TOWARDS THE ESTABLISHMENT OF WATER MARKET INSTITUTIONS FOR EFFECTIVE AND EFFICIENT WATER ALLOCATION IN SOUTH AFRICA

Report to the

WATER RESEARCH COMMISSION

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EXECUTIVE SUMMARY

This study was commissioned by the Water Research Commission of South Africa to contribute to the establishment of institutions through which water markets can operate efficiently and help to ensure the effective allocation of water-use rights. In this context, institutions refer to the rules that govern economic actions. These rules are provided by, amongst others, laws, norms and regulations and administrative structures. Depending on their design, they can facilitate or constrain the activities of economic actors. The National Water Act (1998) discerns between eleven types of water-use rights. This document focuses mainly on the transfer, via a regulated market, of abstraction water-use rights, although mention is also made of transfers, via a market, of discharge water-use rights.

Since conditions can vary significantly between the different catchments, it was decided to study three different catchments. Each catchment was selected because it provides a different set of issues that could be relevant to a water market. The three catchments chosen include the Crocodile River (East) Catchment, the Olifants River (East) Catchment and the Berg River Catchment. In each of the case study areas, an assessment was made of the possible constraints to a water market. Ways to address these constraints, which include recommended institutional adjustments, are suggested in each case.

In the case of water management, all the actors (such as water users, water management agencies and government entities) are influenced by incentives. These incentives are provided by the institutional arrangements applicable, such as the conditions attached to water-use rights. The different parts of the institutional framework interact to achieve the stated objective, such as the efficient use of water that can be achieved by the transfer of water-use rights to higher value uses through a regulated water market. For such transfers to take place, the appropriate institutional arrangements need to be in place. On the technical side, water use (i.e. abstraction or diversion) and/or discharge needs to be measured and monitored, and water users must be informed of water saving techniques and have the financial means to implement them. Water-use rights need to be well defined and transfer mechanisms need to be in place to allow water-use rights to move within and between sectors at acceptable costs of transacting. In addition, water-use rights need to be appropriately priced to incentivise more efficient use.

A regulated water market enables the transfer of water-use rights between water users in a manner that ensures that the transactions do not bear with them undesired third party effects. The transfer takes place on a voluntary basis between buyers and sellers for their mutual benefit. Implicit in the discussions on water markets is that the laws, rules and regulations are in place to permit it to happen. The National Water Policy sets the scene and the National Water Act (NWA) of 1998 provides the conditions for water management to move from the previous legislative framework, largely based on "command and control" methods, to a new system which is more decentralised and market driven (while being regulated to minimise undesired third-party effects).

The transformation process is not instantaneous and the National Water Resources Strategy (NWRS) provides a guideline for the implementation of the provisions contained in the NWA. The process of establishing Catchment Management Agencies

(CMAs) and Water User Associations (WUAs) is progressing, but at a slow pace. Similarly, compulsory licensing will take a long time to complete in all catchments. As a water-use right (also termed a water-use license) is a necessary prerequisite for a market- based transfer to take place, ad-hoc licensing is being used in the interim in catchments that have not yet undergone the compulsory licensing process.

CROCODILE CATCHMENT

Water transfers observed in the past were from above the Gorge to below the Gorge. The Gorge is a relatively short stretch of river below Nelspruit and above Malelane characterised by very steep rocky hills. There is quite a large altitude difference from above the gorge to below the gorge, and the climate below the gorge is drier and hotter than above the gorge. At present the transfer of water has almost come to a standstill.

Impediments

The most important impediment to transfers of water has been land claims in the area as water cannot be transferred if a claim is lodged against a farm. As much as 95% of the irrigation land may be under land claims (as at 2007) while 80% of the farms under irrigation (Van Veyeren, 2008) have already been transferred (including registered existing lawful water use where applicable). According to previous studies in the Crocodile River, most of the transfers of water-userights involved non-exercised entitlements. In general, farmers bought these water-use rights (which happened to be non-exercised by the sellers) to improve their assurance of water supply. The Crocodile River Catchment is in a position of water stress, as there is currently too much use (even considering that some water-use rights are non-exercised). The transfer of non-exercised water-use rights to users who intend to use the water exacerbates the observed deficit in the river. The Chairman of the Main Crocodile Irrigation Board stated that he would not support the transfer of non-exercised water-use rights, as this bears with it negative consequences for all other water users. The legality of this decision will need to be tested, as holders of non-exercised water-use rights may be prejudiced by this decision.

The catchment water availability situation – a deficit exists

The water deficit, in conjunction with other issues (e.g. non-exercised user rights) can become a problem. According to DWAF (2004a), official estimates of the deficit can be as much as 50% of the available supply. More recent information (Mallory, 2008) estimates the deficit between 37% and 28%. These estimates are based on levels of supply and demand that differ from those used by DWAF. However, if the mid-point of Mallory's (2008) data is used then a deficit of 146.72 million m^3 is estimated, which is similar to DWAF's original estimate of 149 million m^3. The latter estimate is used in calculations due to the variation in estimates. Other experts expressed doubts about the high estimates of the deficit and consider the over allocation exists only on paper.

Considerable attention was given to ways in which the deficit can be addressed since the effect on the local economy could be catastrophic. If a fund is used to buy out water-use rights to alleviate the deficit of 149 million cubic meters, an estimated R516

million may be needed if irrigation water is bought out. The indirect benefits from irrigation are estimated to be high and it is questioned whether only irrigation users should contribute to such a fund.

The rights of existing lawful water users may be curtailed to satisfy the deficit. If the entire deficit is to be met by reductions in agriculture, then it implies that water to this sector must be reduced by between 28% and 37%. The indirect impacts of a reduction in irrigation water will be the same whether the same volume of water is bought out, or through a mandatory reduction. Indirect costs from the reduction in water-use rights are estimated at between 2 and 20-fold larger than direct cost. Such a curtailment will have a devastating effect on commercial agriculture as well as Previously Disadvantaged Individuals (PDIs) who have been settled on claimed and redistributed land.

Due to the high cost (including opportunity cost) of other measures to reduce the deficit, it is recommended that eradicating alien invasive vegetation through the Government's Working for Water (WfW) programme should be actively pursued.

Non-exercised rights are included in the water reconciliation statements. It is, however, questionable whether trading of non-exercised entitlements should be allowed. If non-exercised water-use rights are activated via trade, it will worsen the effect of the deficit on other users as it affects their level of assurance. It is partly a legal issue. How to resolve legal issues is not certain as the opinions of experts (engineers, lawyers and others) differ.

The option of building a dam should be considered to reduce the deficit due to the high cost of withdrawing land from irrigation as well as the significant indirect effects from such an action. The direct cost of curtailing irrigation to meet the deficit was estimated at about R516 million while the indirect costs will raise this figure substantially. There are different opinions on how much impact a dam will have on the deficit in this catchment and this option should be further studied. A major advantage of a dam is that it will improve the water assurance on the current area under irrigation. As a dam will increase water assurance, farmers may be prepared to contribute to its cost.

The option of using a water market to deal with deficits was considered. The market has limited potential to reduce the current deficit as the present demand and supply are incorporated in the market but it will prevent the deficit from increasing in future years. Water scarcity caused by drought and possibly the expanding of acreage with the saved water increased water efficiency in the catchment. It appears at current use levels that the demand for water may be highly price inelastic which reduces the ability of price as a rationing device. However, it still seems possible to improve efficiency by changing from overhead sprinklers on some lands below the Gorge and to reduce the leakage of some canals. A water market will promote the latter technological changes.

Hydrological issues

The Department of Water Affairs and Forestry has developed techniques over the past 20 years to determine the extent to which surplus water exists in catchments, or

conversely to quantify the magnitude of over-allocation. Use is made of time-series of observed hydrological flows (adjusted to reflect flows that would have occurred under natural conditions). In addition to observed flows, use is also made of stochastically generated flows, which are required to increase the record lengths, as observed flows are generally relatively short in South Africa. Long flow records are required to assess probabilities of assurance of water supply. Water resource planners can then evaluate how many licenses of different assurance of supply can be issued, given the hydrology of the system. In order to determine if a catchment is over-allocated, consideration is given to existing lawful use (and the assurance of supply required by the existing lawful users). Consideration is given to return flows as well. A catchment is considered to be over-allocated if the system is unable to provide the water users with the assurance-of-water supply they require.

Existing lawful use currently takes two forms. Firstly, the water-use licenses are being used. Secondly, there are cases where the entitlements are not being used (i.e. they are dormant, also referred to as non-exercised). In theory, water resource planners should include both exercised and non-exercised existing lawful use in their water availability assessment studies. There are cases where the non-exercised existing lawful use is significant, and if the water availability studies suggest the catchment to be over-allocated, these catchments are often referred to as being "over-allocated on paper". If the dormant water-use rights become used, the over-allocation will be observed physically by all the water users in the system.

In the Crocodile Catchment the deficit is real, but there are also some non-exercised existing lawful use rights. There are two debates arising. The first relates to the non-exercised existing lawful use rights, and the second relates to the land surface area that allocated water can be applied to, with a trend being observed where irrigators stretch their allocation of increasing land surface areas, which impacts on return flows, and hence water availability to downstream users.

Debate 1 – Should non-exercised rights be removed: The argument is that non-exercised water-use rights should not be recognised (i.e. should be removed from the pool of allocated water-use rights), and hence should not be allowed to be traded, especially if the traded use entitlements will be exercised, which will increase the observed deficit to other users.

Debate 2 – Should stretching of water be allowed for water allocations associated with the previous water act, and the new National Water Act? The stretching of irrigation water over larger land surface areas bears with it some positive and some negative consequences. The negative consequence is that return flows will probably be reduced which can negatively impact on the flows to downstream water users. The positive consequence is that irrigators incentivised to continually explore and adopt more efficient irrigation systems and schedules, resulting in greater levels of production, more economically, which helps bring down the cost of food prices. Neither the previous water act nor the current National Water Act make mention of diverted versus consumptive use. Diverted use is the volume of water abstracted or diverted for a use. Consumptive use relates to how much water can be consumed by a user. In theory, the 1998 National Water Act is based on diverted use, and hence water users could in theory consume all the water. The implication is that irrigators

will not be bound to meeting some return flow requirement, and could stretch their water use, and become so efficient that there are in fact no return flows.

Water resource planners will need to be cognisant of this, and will need to ensure that their models assume very low return flows (in anticipation of irrigators becoming increasingly efficient). The real debate centres on stretched water use in the previous water act, where allocations included a volume of water that could be applied to a specified land surface area. Many of the irrigation allocations in the past may have been generous. With many catchments currently being deemed to be over-allocated, an argument put forward is that as the previous water act included a land surface area that could be irrigated with the allocations being generous, it should be possible to curtail existing lawful users (i.e. persons holding water rights in the previous water act) without having a large impact on the well-being of the irrigators. However, as many irrigators have stretched their irrigation (i.e. increasing their irrigated land surface area beyond the land surface area prescribed in their water allocations), curtailments will probably bear with them financial losses to the curtailed irrigators. The water managers, who would like to liberate water in over-allocated catchments, may argue that the irrigators were never legally allowed to stretch their water, and hence any losses experienced due to curtailments are due to the illegal actions of the irrigation farmers. It is probable that these arguments will be held in a court of law, and that a precedent will be established in this regard.

The most important hydrological issue is the high priority that must be given to the installation of water meters and appropriate associated information management systems. The speed at which meters are introduced will be affected by the establishment of an appropriate administrative infrastructure in DWAF and agreement on the best way to implement and finance the installation and upkeep of meters. Satellite imaging of the area planted is of little help during droughts when available water is far less than entitlements while farmers are also permitted to spread water.

Regarding consumptive versus diverted use and the consequent impact on return flow, it is proposed that the entitlement should be in terms of a measurable quantity of water (i.e. a diverted use). Return flow can then be taken into account in different ways, e.g. by water resource planners accounting for reducing return flows over time. A concern in this catchment was that no control measures exist on water abstraction from tributaries.

In situations where water is transferred between sectors or between sources, the existing models can be cumbersome. In such cases, a lack of models aided by suitable decision support systems available to the water resource managers to process trade applications (i.e. being able to confidently understand what the probable impact of any given trade application will be on other water users and the Reserve) is an impediment.

Price of water-use rights

Water prices in a fully developed water market are expected to increase from the current R15 000 per ha, or R1.15 per cubic meter, (1 ha=13 000 cubic meter) to a maximum of about R45 000 per ha (for 13 000 cubic meter of water (i.e. R3.46 per cubic meter). The reason for this expected increase is the complete separation of water

and land rents in a water market. It is also assumed that the area irrigated will be reduced (in spite of irrigators stretching their irrigation water), possibly as irrigation water moves to urban use, or if there is a reduction of water for agriculture. Water prices have already increased threefold since 2005 due to (a) drought, (b) increased international sugar prices and (c) farmers frantically want to buy water to increase assurance. If water is not available from non-exercised users the price of water will be bid up.

Land claims and redistribution

The catchment was investigated in 2005/2006 and some of the following comments relate to the situation at that time. Since then considerable progress has been made regarding restitution.

Major empowerment initiatives in the Crocodile River are being undertaken through restitution as well as the small grower scheme. Restitution claims were handled on an individual basis during 2006 and some of the large commercial farmers have made significant progress in transferring ownership during that time. According to recent information (Van Veyeren, 2008) the land of TSB Sugar (largest land holding) has been transferred to PDIs. TSB Sugar also operates a small grower scheme which is seen as a success as farmers are given technical and financial assistance. There are also small growers with land but no water-use rights. It is recommended in such a case that land and water reform should be linked and PDIs should be assisted to acquire commercial land under irrigation as it is costs about R30 000 per ha to bring undeveloped land into production. Under the communal tenure arrangement of some small growers, land and water-use rights cannot be sold. It is recommended that small growers be encouraged to promote a rental water market as it will expose them to the opportunity cost of water. As an interim measure it is recommended that water (and land) should not be allowed to move out of the small grower sector as these growers may be enticed to sell their water right to more wealthy commercial farmers.

OLIFANTS RIVER CATCHMENT

Major impediments to a water market are land claims and the lack of metering and monitoring.

Land Claims

Land claims in the catchment are a common occurrence. The extent of claims is not known and estimates of the percentage of land under claims vary across the catchment. The process needs to be completed by 2008 but farmers think that the deadline will not be met. If a claim is lodged against a farm, it may not be sold which means that the sale of water is not possible. Banks are reluctant to finance the purchase of land, even if there is no specific claim because of the uncertainty about future possible claims. Since the purchase of farms is dependent on external financing, land and water sales will not occur in such an environment.

Lack of metering and monitoring

Water is metered and monitored in the Loskop and Blyde River irrigation schemes and there is little room for illegal use. It is alleged that in areas outside the schemes the absence of water metering and monitoring is a problem. Mines and farmers are blamed for illegal abstraction of water.

Characteristics of water market in area

Few sales of water have been observed in the study area. Several reasons for this have been proposed. It may be attributed to the prevalence of land claims but also because the climate and crops within each sub-area appear more homogeneous. Other reasons include the fact that irrigation plots in the area are relatively small (25.7 ha in Loskop and 20 ha in the Blyde River Irrigation Scheme) meaning that farming cannot be continued if the water-use right is sold. It makes more sense to sell the farm than only the water-use right. Another reason may be that there are no unexercised water-use rights in areas visited (Loskop and Blyde River) as is the case in the Orange and Crocodile rivers where water markets were active. Water prices need to increase substantially before it becomes worthwhile for an irrigation farmer to sell his water use. It is expected that water will be transferred in future from agriculture to urban and residential use as urban use is expected to double by 2010 while significant future mining development is expected.

In the Loskop area the present water sales price is about R1.52 per cubic meter. As development cost is sunk and may have a zero opportunity cost in future as water is transferred to urban use, water prices are estimated to increase to R2.50 per cubic meter (2006 values) in the Loskop area and to R2.02 per cubic meter in the Blyde River irrigation scheme.

Rent of water is not affected by land claims. Rents are important in a water market as it exposes both parties in the transaction to the opportunity cost of water. It is also expected that producers of horticultural crops (long term crops) will prefer not to rent as these producers would want more certainty of future water availability. The Loskop Irrigation Board Waterbank Facility creates a mechanism for farmers to rent out surplus water during the year for 10 cents per cubic meter (which is the cost of providing water to users). Apart from the Waterbank, person to person rent of water is not common. Farmers do occasionally rent out water privately. The price is negotiated individually but the average price is estimated at about 18 cents per cubic meter although prices as high as 50 cents per cubic meter have been recorded. The requirement that water renting can only be for one year and renewable for an additional year discourages renting as farmers want more certainty for future use. This restriction can be overcome when both water and land are rented, as there is no such restriction on renting irrigation land if the water is used for irrigation. In the Blyde River Irrigation Scheme farmers rent out surplus water at the price they have to pay to service the debt on the pipeline (R210/ha/month or 25.4 cents per cubic meter). It appears as if the rental market is reasonably active in both areas.

Based on evidence obtained in the catchment it appears as if the water market and higher water prices will increase water use efficiency and that for irrigation the demand for water is price elastic.

Water assurance is a problem as droughts often occur in cycles in the Olifants River Catchment for as long as five years. Many farmers in Loskop have changed to permanent crops but local Department of Water Affairs and Forestry (DWAF) officials have advised against perennial crops in the event of cutbacks in allocations. Some farmers have significant investments in table grapes but others plant maize and wheat so it appears as if incentives are present for water to move to higher income crops by renting if cutbacks occur.

Hydrological issues

The catchment consists of the following sub-areas; Upper Olifants, Middle Olifants, Steelpoort area and Lower Olifants. The deficit for the total Catchment is estimated at 192 million cubic meters based on data for the year 2000.

A preliminary Reserve determination has been undertaken. The validation process has been completed, showing that there are over and under registrations. This process indicated 450 illegal dams in the catchment. The hydrology of the catchment is being revisited to recalculate the water balance. The result is as yet unknown but the resulting stress level may be less serious than the 20% originally thought. The verification in terms of section 35 of the NWA must still be done.

The building of the De Hoop Dam in the Steelpoort Catchment has been approved subject to a final environmental audit. Of the dam's capacity, 40 % of the water will go to the mines in the Steelpoort valley and will be financed by the Lebalelo Water Users Association. Until the De Hoop Dam becomes productive, the raised Flag Boshielo Dam will provide water to the Steelpoort mines.

It is estimated that there are close to 10 000 operating boreholes in the catchment contributing 16% of local yield. The mines are increasingly utilising groundwater while in some areas it is used for irrigation. It is difficult to control or monitor water use from boreholes and it is not clear whether effective control measures exist in the Springbok Flats where irrigation from boreholes is significant. At present farmers pay little or no user charges. Water from different boreholes often comes from the same source and the common ownership problem arises. It is proposed that this water use be metered and monitored and that economic measures be taken to promote conservation such as regulation, user charges or possible transferable permits in some instances.

Approaches to improve water efficiency

Water trade may be possible between surface water, smaller dams and boreholes as well as between farmers and the Kruger National Park. Some boreholes appear to be linked to surface irrigation. Linking up smaller dams and boreholes in the total market will depend on expert opinion but, given the extent of this source, it is an aspect that must be investigated further. The Regional DWAF Office, based in Nelspruit, does not support the transfer (sale) of water between sub catchments for irrigation purposes but supports transfers for industrial and for human needs. The price of water will be different between sub-catchments and the feasibility of trade between sub-catchments must be considered in future.

Environmental issues and market approaches

The catchment surface is fractured by mining activities, runoff decreases and water is drained into underground aquifers, which then seeps into streams. Pollution in the river and in Loskop Dam is high and one of the main problems is the effluent leakage from old disused mines. Mines have been permitted to release nutrients in the streams during periods of high flow, which is called the "controlled release scheme". During the past few years river flow was low and sufficient dilution of nutrients was not possible. Mines and power stations had to invest in desalination plants at considerable cost to dispose of nutrients.

A Waste Discharge Charge System is proposed by DWAF but at present discharges in the catchment are not taxed. It is recommended that polluters should pay a discharge tax in the same way as water abstraction users pay water rates. As in the case of a water market, it is proposed that a market be established for the discharge of nutrients and that this market be used to discover the optimum price for pollutant disposal. All markets operate within certain rules. In a pollution permit trading market rules that may be considered are that discharges in the river are only allowed when flow is sufficiently high and that trades may only occur within certain parameters.

Apart from a pollution-trading program, it is suggested that bio-diversity offsets be created to provide incentives for cooperation amongst stakeholders which may be mines, developers, environmental groups, farmers and public land agencies. Several examples of the use of such offsets are discussed in the report.

BERG RIVER CATCHMENT

Transfers have taken place regularly and largely within the Government Water Control Area (GWCA). About 50% of the Berg Water Management Area (WMA) falls under a GWCA. The approval process for transfers took on average about four months from date of receiving the required documentation to final approval. Of the 18 transfers since September 2002, the two largest were for the same property. If these two are excluded then the largest transfer was 270 000 m^3 of water, the smallest 7 450 m^3 with the mode of 60 000 m^3.

Based on information that transfers have stopped and that non-exercised rights will not be supported for transfer, it appears that most of the proposed transactions involved non-exercised user entitlements.

Issues that can potentially reduce effectiveness of a water market

A number of issues have been identified. Among them is the fact that riparian owners do not have water meters. Abstraction by pump irrigation schemes is accurately measured while there is no metering of individual riparian owners. Illegal use of water by members is limited because water applications on crops are carefully monitored and over use will lead to diseases such as amongst others root rot. There are, however, allegations of illegal use of water by some irrigators.

Transaction costs are high if the farmers use legal firms to process applications. If an application is made directly to DWAF the costs are low. Most farmers are using legal firms to process their applications in which case costs are high.

The Upper Berg River Irrigation Board opposes water transfers in the following instances: i) from agriculture to residential use, ii) from Upper Berg River to the Lower Berg River, iii) from near the river to further from the river and iv) from riparian irrigators to pump station users. Although reasons are valid these restrictions reduce the flexibility of a water market in promoting efficiency of water use.

There are no restrictions, imposed by the irrigation boards, for riparian irrigators to transfer water from downstream to upstream. There are salinity problems ("verbrakking") down-stream in the Berg River and selling water up-stream may have advantages for the users. Transfers may occur within pump schemes (six schemes) but for cost reasons not with outside entities. Water from farm dams can be transferred to a nearby farmer if it is practically possible. Only one transfer occurred between agriculture and non-agriculture.

Three irrigation boards have converted to Water User Associations (WUAs) and sixteen still remain currently as irrigation boards. The legal obstacle in interpreting the National Water Act and pricing strategy such that the obligation of debt rests with the buyer of water has been resolved and no further difficulty is foreseen in establishing WUAs. WUAs may be in a better position to deal with total water use control as well as the pollution problems in the Berg River.

Characteristic of the water market in the Berg River Catchment area

In general, irrigation practices in the Berg WMA are highly sophisticated and water use by the irrigation sector is relatively efficient. Farmers use drip irrigation on wine grapes and table grapes and micro on citrus. The irrigation demand for water may thus be fairly inelastic and high water prices may not squeeze much water from production.

The average price for summer use entitlements varies between R15 000 and R20 000 per ha in the Upper Berg River (average application of 5000 m^3 per ha/annum – range between 4000, 5000 and 6000 m^3 per ha/annum), i.e. R3 to R4 per cubic meter. Land under wine grapes sells for about R110 000 to R130 000 per ha. Some of the costs to establish a vineyard are fixed (sunk) in the long run such as the investment in drainage systems. The costs now attributed to the sunk components may move to water and water prices may increase accordingly in future. It is estimated that water prices may increase to about R45 000 per ha or more than double the present price (i.e. R9 per cubic meter). In a water market, prices will increase (in real terms) which will provide incentives for conservation. Winter water entitlements are more common in the Lower Berg River. The price of winter use entitlements is lower (about R10 000 per ha) as farmers need to build dams to capture this water for use in summer.

Hydrological issues

In this catchment, DWAF works on guidelines of 100% assurance for 7 years and 70% assurance for 3 years giving a long-term average assurance level of 91% for

agriculture. Cut-backs have occurred in the past. Cut backs are normally debated with water sectors and tables and models are operated to determine when and why restrictions should be made depending on factors such as growth prospects. Farmers prefer to be able to retain additional water-use rights in order to improve supply assurance for high value crops.

Pollution is a problem in the Berg River and fruit and vegetable exports to the European Union (EU) and United States of America (USA) are at risk. Pollution sources are informal settlements, municipalities, wineries, intensive farms and industry. Part of the reason for this situation is that insufficient funds are being made available to local governments to upgrade waste treatment facilities of municipalities. A program is underway to mobilise stakeholders to improve the water quality of the Berg River.

About 6% of the total requirements for water in the Berg WMA is estimated to be supplied by groundwater. Close inter-dependence exists between groundwater and surface water in certain areas where further exploitation of groundwater may cause reduced surface water flow.

As this is a winter rainfall area with peak consumption in the summer months, the supply situation and water availability through storage is critical.

There was a small deficit in the catchment of about 4% in 2000. About 57% of the available water goes to urban and rural water use and 43% to agriculture. The projected shortfall for 2025 is about 8%. Recent developments at improving the water balance include the completion of the Berg River Dam near Franschhoek as well as significant efforts to conserve water by the Greater Cape Town area. According to the latest data, the Regional DWAF Office in Bellville estimates a balance of supply and demand for water up to 2010 or up to 2017 in a best case scenario with implementation of further water demand management projects. A significant proportion of the water used in the Berg River Catchment comes from the Theewaterskloof Dam.

Unlike many other catchments in South Africa, irrigation use is smaller than residential use. The allocation of water to farmers in the Upper Berg River varies from 4000 m^3 per ha in the upper reaches of the river to 5000 m^3 per ha in the middle and 6000 m^3 per ha in the lower area. The quota for the Lower Berg is 7000 m^3 per ha. It was stated that the allocation of 4000 m^3 that applies to the upper reaches is based on the requirements of wine grapes but since there is a switch towards fruit farming this allocation may be too low. Irrigation areas must then be adjusted to cater for higher crop demands. Riparian users are permitted to pump water in the winter months to fill farm dams for use in the dry summer months but this will be part of their total allocation per ha. Water from natural inflow into a farmer's dam is not deducted from his allocation. A limited number of irrigators have winter rights. They are members of irrigation boards away from the river.

At present only 6% of the return-flows are used in Cape Town compared to 15% in Durban. In Johannesburg 100% of the return-flows is used due to the fact that return-flows are discharged in the river and used by lower-down users. Recycling is a future source of water in Cape Town. The Palmiet River sub-basin has, at present, a surplus

of 10 million m^3 due to a switch from apple farming to wine grapes. Higher dam walls at Voëlvlei, the Theewaterskloof, and Steenbras Dams are possible future supply sources. Water saving in the Greater Cape Town area is a major source of supply augmentation which will postpone likely shortages. Demand management measures already resulted in a saving of up to 20% and further savings can be achieved. An estimated 137 536 ha is infested in the Berg WMA with invasive alien vegetation which consumes an estimated 87 million m^3 of water. Some success has been achieved with eradication (cutting down eucalyptus and other alien invasive plants) but much still needs to be done. A condition of the licence for the Berg River Dam is that alien invasive plants must be cleared in the catchment above the dam.

Equity issues

Some policy options will be discussed that may be considered to promote a more equitable ownership and use of land and water. These strategies may be used in a combination with one another or in support of other strategies.

Most of the arable land in the Upper Berg River area is under cultivation while most of this land is also owned by white farmers. Projects to empower historically disadvantaged individuals are taking place.

Strategies to empower PDIs with access to water include (a) using the current subsidy on water-use rights that is available to PDIs. PDIs can apply for a subsidy of R7 500 per ha to buy water. This is less than what water sells for (about R15 000 to R20 000 per ha). The Regional DWAF Office can motivate to the Minister to secure the full amount under special circumstances; (b) A fund can be established to buy out water-use rights.

If irrigation water is provided to PDIs, then they will still have to be provided with suitable irrigable land which is a problem as most of the land in the Upper Berg is already under cultivation. One way that PDIs could be assisted to attain 30% ownership of the land and water is for PDIs to be provided financial assistance by Government under the Land Redistribution Program to buy land under irrigation or join white commercial farmers in trusts as equity schemes (joint ventures). Other subsidies include financial assistance of R15 000 per ha for bulk water infrastructure and phased assistance for WUA charges over 5 years. Lessons from failures and successes elsewhere must be applied.

LESSONS LEARNT FROM THE THREE CASE STUDIES

Certain conclusions are common to all areas while there are also differences. The common conclusions will be discussed first. Water markets in the three areas studied (Crocodile, Olifants and Berg rivers) have come to a standstill either because of land claims (Crocodile and Olifants rivers) or because of a reluctance to transfer non-exercised (dormant) use rights of water (Berg and Crocodile rivers). It is suggested that water (refer to the Water Allocation Reform document) and land empowerment must be coordinated as PDIs need both water and irrigable land. Water will be transferred to PDIs in the Crocodile and Olifants River catchments through restitution (land claims) while in the Berg River Catchment (no land claims) it can be achieved through the redistribution of land. The Department of Land Affairs have a target that

30% of the land must be redistributed which means in irrigation areas that the target that 30% of the water should be redistributed can be met by land redistribution. As the rules of the game have changed with the implementation of the New Water Act, the achieving of political objectives is a precondition to water markets.

Renting of water is not subjected to the same political constraints as sales. Farmers prefer buying water to renting as it provides more certainty for long term crops. The renting market is, however, important as it is a vehicle through which the opportunity cost price of water is discovered. As all parties face this opportunity cost they have the incentive to conserve water.

In a water market, rents attributed to water are separated from land. As transfers are on volume of water, the market separates rents attributed to water and land. These incentives are thus achieved even in the absence of water licenses (licenses reinforce these incentives). In the areas studied, it was concluded that water prices (in real terms) will substantially increase in the future as water is moved from agriculture to urban use. This will provide increased incentives for water conservation.

Illegal use is a problem in all areas especially where water is scarce. Metering is needed to enforce water-use rights.

Other conditions in the three areas differ which will impact on a water market. The most important impediment to water sales in the Crocodile River in recent years has been land claims. About 95% of the land was claimed which meant that water sales were not possible. As about 80% of irrigation land in this river is now in black ownership, this constraint is falling away. Non-exercised rights still remain a problem in the Crocodile River. There have been no trades in the Crocodile River since about 2002, but before this time trades (sales and rents) were common. The most common type of trades that did occur was non-exercised users selling their water. One of the reasons for selling is that sellers were afraid that they may lose their unused entitlements. The situation has now changed and according to the reconciliation statement for this river it has a serious deficit as allowance had to be made for the Reserve. While both buyer and seller benefit from a sale, the Chairman of the Crocodile Irrigation Board indicated that he will oppose the sale of non-exercised rights as the assurance of all third parties (other farmers) will become visible if these rights are activated in such a stressed situation. This is a legal issue, the outcome of which is uncertain. If non-exercised rights may not be transferred then water prices will have to increase substantially before transfers will take place. The positive side of such an increase is that it will provide more incentive to conserve water. How the deficit will be reduced creates uncertainty in this market but with 80% of water in PDI ownership it is unlikely that irrigation use will be cut.

In the past it took only four months to process a transfer in the Berg River which shows that it was a relatively uncomplicated process. The suspicion is that most of these transfers were from unexercised users. A senior local DWAF official in the Berg River said that he will not support the transfer of unexercised rights. He has taken this position although this river is not in a deficit according to reconciliation statements. The implication is that water prices will have to increase sufficiently before exercised users will sell and it may take some time before water transfers reach its previous level. In any transfer application the impacts on PDIs and other socio-economic

effects will be considered by authorities who will make transfers less flexible. Changes in crops over time have increased the demand for water in some areas. In the past the municipalities were part of irrigation boards which shows that stakeholders work well together (probably because there was sufficient water).

Of the areas studied, water markets may have the greatest impact in improving water conservation in the Olifants River. The reason is that water efficiency in this catchment can be improved as:

(a) Better scheduling can reduce consumption,

(b) About 35% of irrigated area is under maize, wheat and pasture which are generally seen as low income crops,

(c) Overhead irrigation is common while,

(d) Water distribution losses attributable to faulty infrastructure are estimated at around 30%. Land claims are a problem in this area.

Few sales have been recorded in the past in this area and it is estimated that water prices will have to increase before sales from exercised users will take place. Pollution is a problem in this river and some low cost strategies have been suggested.

STATE OF INSTITUTIONAL STRUCTURES

The purpose of the discussion is to identify possible institutional bottlenecks that impact on the operation of water markets and recommend ways of dealing with them. These factors can be listed as:

- The installation of water abstraction meters and river-flow monitoring devices, in combination with appropriate information management systems, is required for the enforcement of the conditions of entitlements
- As far as possible to reduce uncertainty that is related to the interim period before compulsory licensing is implemented. Special mention is made about clearing up uncertainty of non-exercised rights. The legal issue regarding this category of water use should perhaps be clarified by court action since a variety of opinions exist at present. When compulsory licensing is completed, regulations on the transferability of water use need to be formalised.
- Emphasis on developing models that will be directed towards the administration of water-use rights. This includes investigations on different apportionment rules and the possible merit of a fractional water allocation and capacity sharing (FWA-CS) system.
- Progress on the decentralisation of administration will bring the management of water transfers closer to the users and thus more responsive to local needs. Eventually the WUAs and the CMAs will deal with the applications to trade water use applications. The CMAs will have access to the models to evaluate the implications of applications to trade and have the administrative capacity to manage the re-allocation of water use flowing from these transfers.
- The use of media including electronic media to provide market information is underdeveloped.
- Approval procedures can be streamlined and rules for transferability can become more explicit even in the pre compulsory licensing phase.

- Rental market can play a larger role and it is foreseen that once WUAs are fully functional, their role in this regard can be expanded. The one year limitation is too strict given the fact that droughts can last up to five years. Leasing is only allowed within the irrigation sector but a case can be made for inter-sector leasing.
- A water market addresses the efficient use of water and is not specifically capable catering for equity conditions. Equity is a very important objective of the NWA and the redistribution of water-use rights and land should be implemented in a complementary way. In so far as outstanding restitution claims inhibit transfer of water use, completion will allow land and water markets to function. The section 27 conditions that, amongst others, include equity, need to be applied with sensitivity for unique circumstances that may regard a transfer desirable. Guidelines in this regard by DWAF will remove this source of uncertainty.
- Human resource needs for the implementation of the new water management system are critical. Programs to retain expertise, recruit, educate and train people in this field of expertise are critical.

As can be seen, the only regulatory bottleneck that needs revisiting is that pertaining to the length of rental periods. Most of the other bottlenecks are of an operational nature. As far as could be ascertained, there are no legal institutional limitations that prohibit the functioning of the market. Most of the operational issues that affect the water market are of an evolutionary nature that will take time to implement and will be shaped as events unfold.

RECOMMENDATIONS

A considerable number of recommendations for improving institutions that will assist the functioning of the water market are made in Chapter 8. General and catchment specific issues are discussed.

The general recommendations can be summarised as:

The necessity of installing meters and monitoring devices and based on these more precise technology for the enforcement of the conditions of an entitlement.

As far as possible to reduce uncertainty that is related to the interim period before compulsory licensing is implemented. Special mention is made about clearing up uncertainty of non-exercised rights. The legal issue regarding this category of water use should perhaps be clarified by court action. High priority should be given to clarify this issue since a variety of opinions exist at present. When compulsory licensing is completed, regulations on the transferability of water use need to be formalised.

Emphasis on developing models that will be directed towards the administration of water-use rights. This includes investigations on different apportionment rules and the possible merit of capacity sharing and a fractional water allocation system.

Progress on the decentralisation of administration will bring the management of water transfer closer to the users and thus more responsive to local needs.

The use of media, including electronic media, to provide market information is underdeveloped.

Approval procedures can be streamlined and rules for transferability can become more explicit even in the pre-compulsory licensing phase.

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A water market addresses the efficient use of water and is not specifically capable catering for equity conditions. Equity is a very important objective of the NWA and the redistribution of water-use rights and land should be implemented in a complementary way. In so far as outstanding restitution claims inhibit transfer of water use, completion will allow land and water markets to function. The section 27 conditions that, amongst others, include equity, need to be applied with sensitivity for unique circumstances that may regard a transfer desirable. Guidelines in this regard by DWAF will remove this source of uncertainty.

Human resource needs for the implementation of the new water management system is critical. Programs to retain expertise, recruit, educate and train people in this field of expertise are critical.

Catchments specific recommendations that are common to all case study areas include:

It appears that empowerment of people through secure water-use rights will take place through land transfers as evidence indicates that about 80% of land under irrigation in the Crocodile River has already been transferred to PDIs. This has changed the political landscape in terms of the feasibility of reducing irrigation water to reduce deficits. Water markets in the three areas studied have come to a standstill either because of land claims (Crocodile and Olifants rivers) or because of a reluctance to transfer non-exercised use rights of water (Berg and Crocodile rivers). There are good reasons for these policies (not permitting transfers if claims exist or not supporting the transfer of non-exercised rights) and the market will again function once this has worked through the system. In both the Berg and Crocodile rivers opposition has been voiced against transfers of non-exercised rights although many want to sell/buy. It is, however, noticeable that the DWAF office in the Berg River has taken a harder line on such transfers in spite of the fact that deficits are not an issue in the Berg River while in the Crocodile the deficit is substantial. One would expect that the interpretation of the law should be more uniform in different areas. It is recommended that these rights not be transferred in areas with deficits or potential deficits.

It is proposed if risk management strategies fall within the provisions of the NWA, then they must be pursued. Farmers prefer to be able to retain additional water-use rights in order to improve supply assurance for high value crops. According to Human (2005), farmers may retain additional rights after compulsory licensing. This will only be retained if reasonable – say 10% to 15% additional to average use to avoid risks of large restrictions. According to the NWA, water must be used efficiently. It is contended that risk management is not in conflict with the NWA as the reduction of risk improves the efficiency of water-use as risk is a cost. In a water market the return

per cubic meter of water is maximized which includes risk as a cost. The Reference Group Meeting of this study was unsure about the legality of retaining additional rights after compulsory licensing. Courts may rely on expert opinion on issues in a specialized field and in this spirit it is recommended that consideration be given to farmers retaining some addition rights to protect them against cutbacks where capital losses or income are at stake.

Better information must be obtained about the deficits in the Crocodile and Olifants Rivers before action is taken regarding possible cut-backs. There is concern regarding the large variation in estimates of deficits in the Crocodile River.

Lack of metering was an issue on all catchments in particular in the Crocodile and Olifants and metering and enforcement must be seen as a priority. It is further proposed that the entitlement should be in terms of a measurable volumetric quantity of water. Return flows need only be considered if it is significant. Return flow was not significant in the Crocodile and Berg Rivers and can thus be ignored in transfers.

Underground water is important in the Olifants and Berg Rivers and in some instances this water is connected to surface water. Licenses must be used with penalties to discourage overuse.

LIST OF ACRONYMS

BHN	:	Basic Human Needs
CMA	:	Catchment Management Agency
CMS	:	Catchment Management Strategy
DFID	:	Department for International Development
DWAF	:	Department of Water Affairs and Forestry
FWA-CS	:	Fractional Water Allocation and Capacity Sharing
GWCA	:	Government Water Control Area
HRSTS	:	Hunter River Salinity Trading Scheme
IFR	:	In-stream Flow Requirement (Ecological Water Requirement)
IWRM	:	Integrated Water Resource Management
NEMA	:	National Environmental Management Act
NWRCS	:	National Water Resource Classification System
NWRS	:	National Water Resources Strategy
PDI	:	Previously Disadvantaged Individual
PRROR	:	Priority-based River and Reservoir Operating System
WAR	:	Water Allocation Reform
WDCS	:	Waste Discharge Charge System
WfW	:	Working for Water
WMA	:	Water Management Agency
WRYM	:	Water Resources Yield Model
WUA	:	Water User Association

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CHAPTER 1. INTRODUCTION

1.1 Background

South Africa is a part of a world-wide trend to critically re-evaluate the way in which water use is managed (Saleth & Dinar, 1999). A new National Water Policy (1997) was developed and followed by the National Water Act (1998). The overall aim of this new approach to water management is to achieve the efficient, equitable and sustainable use of water. The implementation of the new policy and legal framework is described in the National Water Resource Strategy (NWRS, 2004).

The fact that water is scarce and over-allocated in more than 50 percent of the catchments (NWRS, 2004) necessitates that efficiency measures are in place. Such measures include the most efficient distribution systems and also the most efficient methods of water use. This aim can best be achieved once the realisation has taken place that water is not a free good and that users must pay for the cost of sound water management required to provide water users with the assurance of water supply (from quantity and quality perspective) that licensed water users require. To this end, water user charges previously levied on non-agricultural users are also extended to agriculture. In the case of agriculture the scarcity of water is exacerbated by regular periods of drought and the payment of user charges provided incentives for farmers to introduce water saving mechanisms such as sprinkler systems and drip irrigation instead of the relatively less efficient surface irrigation methods. These incentives were further encouraged by the permission granted by DWAF that water saved by increased efficiency from the allocated quotas can be applied to additional land (van Rooyen, 2005).

Another powerful approach was added that encourages efficiency namely, water markets. A water market enables the transfer of water-use rights between water users. The transfer takes place on a voluntary basis between buyers and sellers for their mutual benefit. The necessary institutions are needed to facilitate such transfers. In this context institutions refer to the rules that govern economic actions that are provided by, amongst others, laws, norms and regulations and administrative structures. Depending on their design they can facilitate or constrain the activities of economic actors. The legislative basis for the institutions necessary for trade in water-use rights has been provided for in principle by the NWA (Conningarth, 2004). In fact, trade is taking place in many catchments, notably the Lower Orange while it is not taking place in others (Armitrage, 1999 and Gillit, 2004).

Since the right to use water is separated from the ownership of land the entitlement to use water of the owner, as specified in a license, can be bought and sold as a separate entity just as land can be bought and sold. The proposed trades are, however, subject to administrative control to ensure that third party effects are taken into account. This simple concept is indeed a very powerful mechanism to enforce efficiency of water use (Easter, 1995). It is the major aim of the rest of this study to investigate the detail necessary for this market to function effectively.

The point of departure in any water allocation system, whether an administrative or a market system, is the definition, description and conditions applicable to a water-use

right. This will be contained in a water use license. All water uses, except for schedule 1 and general authorisations, will eventually be authorised by a license.

The licensing of water-use rights is a complicated and administratively time consuming process and therefore the licensing of all water uses will take a considerable time to complete. In the meantime the NWA permits existing lawful water use to continue until such time as it is formally licensed. Where changing needs of water use occur, prior to compulsory licensing, it can be accommodated by a license application. Such individual applications will generally be for new water users, existing water users who want to increase, change their water use or who wish to continue their use in terms of an existing limited duration authorisation.

The first Water Management Area (WMA) scheduled for compulsory licensing is the Usutu to Mhlathuze, which is at present in the preliminary stages of the compulsory licensing process. The duration of the process is not yet known. Preparations are also made for the compulsory licensing process in the Inkomati, the Olifants and the Berg River Catchment Management Agencies (CMAs). The time it will take before all the catchments have completed the compulsory licensing process may be considerable. Some of the lower priority Water Management Areas (WMAs) are scheduled to be completed by 2025 (NWRS:107-118) according to the anticipated programme of DWAF. Judged on available evidence this indicative programme of implementation may be very optimistic.

Other institutional arrangements as they relate to water trade are also not fully developed such as for instance the decentralised administrative structures provided for in the NWA.

Equity in water use distribution is another major aim of the new system. Previously disadvantaged individuals (PDIs) are individuals who have been excluded from access to productive water use under previous racially discriminatory legislation. They were not entitled to own land and thus water-use rights that, according to the riparian principle, were attached to land did not accrue to them. Under the new system where water-use rights have been separated from land rights, ways have been developed to redistribute entitlements to water use. Such redistribution is challenging. Access to water-use rights to PDIs must result in viable and efficient new users of the reallocated water and must happen without violating the property rights of existing owners (Conningarth, 2004:119-121). General principles that can guide such a programme have been circulated for comment (WAR, 2005). Redistribution of water use can occur in cases where PDIs already own the land and where water must be made available for irrigation purposes. In a different scenario ways will have to be developed to transfer existing land with its entitlements to water use to new black farmers. In some areas there are claims for restitution on existing irrigation farms. If such claims are upheld a mechanism will have to be created to transfer the land and water-use rights to the previous owner(s). This is a complex issue and the ability of the market mechanism to contribute to its solution will be part of further discussions.

The sustainability of water use refers to the acknowledgement of the interdependence of water use between the consumptive sectors of the economy and the protection of the environment. Water use must be such that sufficient water is released to maintain the ecosystems. This poses a considerable challenge in the sense that water for the

environment is a water use not specifically catered for previously. Water must now be put aside to fulfil the so-called Reserve requirements. Water put aside for the Reserve must be sufficient to maintain the environment at a specified level as well as provide for normal domestic use.

The challenge faced by the new water management system is to achieve the three basic objectives of efficiency, equity and sustainability. Two of, which, namely the need to allocate water for redistribution and the environment, are uses not previously catered for. In a catchment with excess water available additional water needed for equity and the environment will be less problematic than in cases where catchments are under stress. In this case not even the claims for existing lawful use can be honoured.

The balancing of the supply and demand for water given the need to provide for the new use categories requires a total reassessment of water use in a catchment. This challenge will be faced squarely in the compulsory licensing process. Apart from the balancing of supply and demand the completion of the compulsory licensing process in a catchment will provide a clear description of all the water-use rights. It will include the unit of measurement (volume or rate of flow for a set period), reliability and priority of use for all license holders in the catchment. The primary requirement for a well functioning water market will then be in place.

In the meantime, before the process of compulsory licensing, the objectives of efficiency, equity and sustainability will have to be pursued. This pre-compulsory period has its own challenges since all the structures and institutions required for, amongst others, trade are not yet in place. Re-allocation, via the market mechanism or otherwise, may therefore result in a more cautious approach by the authorities when an application to trade is considered than would be the case in the post-compulsory period.

The project will therefore not be able to evaluate the overall efficacy of the new approach to water management as envisaged in the NWA since all the provisions will not yet be implemented. The study will however include an assessment of the present situation in each of the case studies, identify shortcomings and improvements and envisage the likely outcome when all provisions of the NWA are implemented.

1.2 Objectives of the study

An outline of objectives of the project and key deliverables spelled out in the contract document is:

In general the objective of this project is to contribute to the establishment of institutions through which water markets can operate efficiently and help to ensure effective water allocation.

The specific objectives are as follow:

1. *Evaluate case studies on actual or potential inter- and intra-sectoral water transfer schemes to determine the institutional arrangements that would be*

required to facilitate an efficient water market and ensure equitable and effective water re-allocation.

2. *Propose the design of an institutional structure(s) that would promote establishing and regulating a water market that operate efficiently and ensure equitable and effective water allocation.*
3. *Assess if and how water trading arrangements could be facilitated and implemented in the compulsory licensing process as a means of ameliorating over-allocation.*

1.3 Selection of case study areas

The point of departure of this study is that circumstances differ between catchments regarding the possible functioning of water markets and the kind of transactions that are likely to take place. In an effort to cover most of the issues and challenges faced by the establishment of a water market three case studies are proposed.

The selection of case studies is critical to the success of the project.

Criteria used to guide the selection of case studies include:

Extent to which trade is already taking place;
Degree of stress in the catchment;
Extent to which entitlements are secure in their fundamental attributes. Government Water Schemes are the most secure and cases where water users abstract water with water works belonging to themselves being the least secure;
Whether trade takes place mainly within a sector or between sectors. In the latter case differences in the assurance of supply becomes a factor;
The extent to which progress has been made with verifying existing lawful use and compulsory licensing and regional and local administrative structures;
Hydrological conditions in the catchment or sub-catchment due to amongst others variable supply, quality and importance of return flow use.

Given the criteria above and further deliberations by the project team the following three case study areas have been selected.

1.3.1 Crocodile River Catchment

This catchment is at present under water stress. According to information obtained, trade in sales and rent of unused water-use rights was active until recently. Trade in water-use rights since then has virtually stopped.

The bulk of the water is used for irrigation and forestry but water use in the industrial and domestic sectors may increase in future. Shifts in the demand for water use between the sectors may in future lead to trade between sectors. The quantity of water available for local use is affected by international agreements that require a specified flow to neighbouring states.

Of additional interest is the fact that the catchment is part of the Inkomati Catchment Management Area (CMA) which is the first such structure established and it would be of interest to assess its potential impact on water use trade.

1.3.2 The Olifants River Catchment

The Olifants River Catchment was chosen because it consists of a fairly large mining sector as well as large electricity generating plants, a number of government water schemes and large domestic water users. Apart from the abstractive use of water the quality of water is critically affected by industrial, urban and agricultural activities. The control of water quality thus adds a new perspective to the use of water resources in the catchment.

1.3.3 The Berg River Catchment

The Berg River was chosen as the third case study based on information received from Pretorius (2007) and Barkhuizen (2007). According to records made available by Barkhuizen (2007), 161 water transfers have been processed by DWAF for all catchments since September 2002. Most transfers are in the Orange River (81), with 18 for the Berg River which are marginally more than the 13 for the Riet River. As it is important to visit trading partners as stakeholders, the Berg River was chosen as the third case study. The Orange River was not chosen as several economic studies have already been undertaken on this river in the past.

1.4 Structure of the report

The report starts with a discussion of the role of a water market in the management of water use. The development of a new paradigm for the water sector as it unfolds with the publication of the White paper on water policy, the NWA and its implementation as discussed in the NWRS is reviewed.

The report then proceeds with the analysis of the water market institutions in the three case study areas. The discussion of the case studies follows a similar pattern and is discussed in chapters 3, 4 and 5. In each case the impediments to water markets, state of water trade, development of administrative structures, characteristics of the water market, hydrological and equity issues are discussed. Under each of these headings the unique features in each catchment is discussed and concluded with an assessment of where and how water markets fits in the water management situation in each catchment.

The results of the three case studies are summarised in chapter 6 in a format that spells out the lessons learnt regarding water markets in each catchment.

In a review of the new water management structure in chapter 7 the emphasis is placed on the state of the institutions and how they promote a water market and how they can be adjusted to support a water market.

The study is concluded in the final chapter with a number of recommendations. The recommendations related to the overall state of water markets and also specifically to each catchment included in the study.

CHAPTER 2. THE ROLE OF THE MARKET AND THE FRAMEWORK PROVIDED BY THE NWA FOR THE MANAGEMENT OF WATER USE

2.1 Introduction

This chapter aims to provide the institutional framework against which the functioning of water markets in the three case studies can be evaluated. It defines the role of the water market in water use allocation and clearly indicates its advantages and shortcomings. This is followed by a brief description of the institutions that are needed to facilitate the allocation of water and specifically for the operation of a water market.

The role of a water market is made possible by a number of changes in the way water is managed in South Africa. This has been initiated by a long debate that leads to a National Water Policy published in 1997 (DWAF, 1997) followed by the National Water Act, Act No 36 of 1998 (NWA). The features of these two documents that pertain to the operation of a water market are discussed. After a process of consultation the National Water Resource Strategy (DWAF, 2004d) was formulated. A brief description of this strategy is provided and followed by a review of some of the research studies on water markets in South Africa.

2.2 A general framework for the management of water use

The primary focus of the management of water use in a catchment involves the decision of who can use water from a source and how to control such use. This process is guided by a set of rules as encompassed in a water allocation process.

There are a number of alternative systems of allocation that can be used either separately or in various combinations namely:

- Automatic entitlement, such as the minimum entitlement for human needs and the environment as is specified in the Reserve
- Administrative allocation, the right to use water is given and managed by some authority
- Market allocation, water use is allocated on the basis of trade rather than an administrative process
- Attached to land, water-use rights may be attached to land and transfer of land implies transfer of water-use rights as well.

The allocation process generates a series of water-use rights. These have a number of basic attributes that describe the extent and control of water use.

Extensive research regarding the role of property rights on the optimal use of natural resources exists (Bromley, 1989, Ostrom, 1990). In the present context two kinds of rights are discussed, namely (i) full property rights and (ii) user rights.

2.2.1 Full property rights

The first is a private or common property right that gives the holder (individual or group) a full set of property rights. In the present context it is the closest approximation to the private ownership of water. Accordingly the ownership is absolute in terms of quantity with no conditionality and granted in perpetuity. Such a system has some advantages from an economic perspective. One being that water-based infrastructure is of a long-term nature and private property rights give significant security to and incentive for such investments.

There are a number of disadvantages to this kind of property right in the present case. It does not allow for direct government control over the allocation or re-allocation to be exercised, except for placing limitations on property rights. An allocation can only be changed through an expropriation process with full compensation or purchasing the water rights on the open market. Expropriation is not always an attractive option and can involve divisive political problems. This is an important consideration in a catchment that is over-allocated. It may be necessary to change water management and allocation due to changing demand patterns, new scientific understanding of water use, new legislative framework, pollution related problems, environmental concerns and equity considerations. An adaptive management approach that is needed in such a situation is difficult to achieve with private property rights. Capacity sharing is such an innovative property rights-based approach to enable re-allocation of water rights through market processes (Dudley and Musgrave, 1988; Paterson, 1989; Dudley, 1990; Backeberg, 1994).

2.2.2 Water-use rights

An alternative, given the drawbacks associated with a full property rights system is to have a system whereby there is no property right to the resource itself, and the property right is limited only to the right to use water (i.e. a use right). The right to use water are referred under various terms, such as, licenses, concessions, permits and access entitlements. In South Africa a water-use right is referred to as a license (NWA, 1998). Accordingly water is publicly owned and as such control remains with the state or water users association. The right to use a certain volume of water is granted through an allocation process. Owing to the nature of use rights they are relative in terms of quantity, quality, time-of-use and in addition is conditional and of limited duration.

The strength of user rights is that it enables the adaptive management of water and control of the resource should conditions warrant it. Such controls however cannot be arbitrary and the rules governing their use must be agreed on and legislated. Notwithstanding this safeguard, it does introduce a disadvantage in the sense that it allows for a degree of uncertainty to the user right. The user right can only be defined in relative terms that will depend on the conditions that prevail such as for instance water supply considerations. Uncertainty and insecurity can lead to distortions in water-based investments. There is therefore a need to balance the need for adaptive management and security when considering the conditionality and duration of a water-use right.

The administrative approach to water allocation is in use in many countries. An alternative is to allocate/re-allocate water use on the basis of a market mechanism particularly in the case of re-allocation. There is a paradigm shift away from the "command-and control" methods as embodied in the administrative approach to a more decentralised and market driven process. Full cost recovery, water markets and the devolution of water management to local levels are key components of such an approach (Saleth & Dinar, 1999).

Globally there are very few water management systems where no water trading of any kind takes place (Conningarth, 2004). It is therefore more appropriate to determine what form trade should take on to accomplish the desired social and environmental objectives.

There are several types of water markets:

- An open water market, where water-use rights can be traded on a free market that is subject to an agreed upon set of rules that govern such a market. An open market operates largely without further administrative control or interference. Such an approach approximates the sale of private goods and services in a market economy such as for instance land. Such an open water market can possibly be more easily introduced where the ownership to water is privately held which implies that there is a property right to be traded.
- Temporary markets; this is also known as spot markets or rental markets where water use is traded on a temporary basis. This possibility introduces an element of flexibility in periods of short supply such as during droughts. It is however not conducive to long-term planning and investment.
- Administrative water trading; where the ownership of water is not privately held and only the right to the use of water (i.e. water-use right) is acknowledged. In this situation water markets are subject to regulation. In this case the regulation of water markets often exerts some control over, amongst others:

- Spatial considerations, where water trading is proposed between catchments, or between two distant points along a river. The authorities must evaluate the implications of such a proposed trade before it is approved or declined.
- Social/equity implications of trading, where political and social prerogatives require redress or access to a resource by marginalised groups, water transactions are evaluated by the authorities to determine if such objectives are met.
- Price, where social/redress objectives are relevant, the sales price may be subsidised or even regulated to encourage redress.

Trading of water-use rights can thus be constrained to local transfers or only within sectors or it can be allowed between sectors and catchments depending on the assessment of the authorities as to its impact. Such constraints placed on the transferability of a water-use right will have some effect on its value in the eyes of the owner and potential acquirers and other interested parties.

There are a number of advantages of water-use right markets notably:

- Net benefit from water used is increased by allowing water to be transferred from less productive economic activities to more productive ones.
- Incentives are provided for water conservation. If water is to be purchased or water that is saved can be sold, strong reasons exist to maximise the efficiency with which water is used.
- Allocation and re-allocation can be achieved without political involvement. Where water is allocated by administrative authorities control can be exercised by social and or political influence whereas markets provide a transparent means of allocation.

Water-use right markets however face significant challenges such as:

- Where differences in income levels and access to capital markets are experienced there will be differences in transaction costs and access to information. This may lead to adverse effects on the poor. Poor communities may be attracted by the short-term benefits of water trading which may jeopardise their means of production and long-term livelihood.
- While transactions on temporary markets may occur frequently, permanent transactions are infrequent. It is sometimes stated that if the water market is thin (i.e. few trades take place), that the price realised may not reflect its true opportunity cost. This can only be true if market participants are not fully informed which is not sustainable since the price realised in the market is available to all water users within a given catchment. The reservation demand argument strengthens the argument by claiming that non-buyers and non-sellers also participate by agreeing with prices that are realised otherwise they would trade. The turnover in other asset markets may also be small as in the case of farmland it estimated that only four percent of farmland in South Africa is sold every year. The land market (urban and non urban) has an additional complication in the sense that each property is unique and will be reflected in its realised market price while in the case of water, which is a less heterogeneous product for a particular use and makes the price determination process relatively simpler.
- Third party effects experienced by parties not involved in the transaction may be significant. For instance, downstream to upstream transfers may influence other water users along the river, transfers may affect the seasonal availability of water, trading between sectors may influence return flows or may have socio-economic implications for the area from where the transfer originates. Measures to contain third party effects may have a significant effect on the ease of a transfer or in extreme situations may render a transfer impossible.

2.3 Institutional framework

The discussion about the advantages of the market in the water management system is based on the premises that the market will lead to water use efficiency. Conventional economic theory describes the conditions that result in efficient markets without referring to the institutions needed for such transactions to take place. New institutional economics fill the gap in traditional economic theory by examining the

effect of institutional arrangements as they affect markets (North, 1992). The rules of the game for economic actions are provided by institutions such as laws, norms and regulations. Depending on their design they can facilitate or constrain the activities of economic actors.

In the case of water management all the actors (such as water users, water management agencies and, government entities) are influenced by incentives. These incentives are provided by the institutional arrangements applicable and include;

- Water-use rights
- The price of water
- The existence of laws mandating the way water must be used (such as minimum river flow and minimum quality standards)
- The enforcement of such laws and regulations (monitoring) by a sanctioning system (such as fines, pressure by others users)
- Access to information

The institutional arrangements and the actors provide the institutional framework. The different parts of the institutional framework interact. For instance, regulations prescribing more efficient use of water will not be effective if it is not enforced. They will not be effectively enforced if the different actors do not have adequate information about them. Regulations/laws mandating certain actions such as, for instance, the use of the latest water saving technology will be of little effect if not supported by incentives.

Since water resources are getting scarcer it is necessary to use water more efficiently. The transfer of water to higher value uses will achieve this objective.

For such transfers to take place the appropriate institutional arrangements need to be in place. On the technical side, water abstraction and/or diversion needs to be measured and monitored. Irrigators must be informed about water saving techniques and have the financial means to implement them. Water-use rights need to be defined and transfer mechanisms need to be in place to allow water-use rights to move within and between sectors. In addition water-use rights need to be adequately priced to provide an incentive for more efficient use.

Water-use rights are seen as the central point in the institutional framework to achieve the effective management of water resource and include more efficient water use and allocative efficiency (Kemper & Simpson, 1998). Water-use rights (also termed water-use rights) define the volume of water available to an individual or user group at a certain point in time or during a specific time range. Without a clear definition of who the users are and how much water they are entitled to the users have no incentive to use water efficiently because they have no guarantee that if they save water today they will receive more tomorrow. In addition, if water-use right allocations are to be shifted to a different set of users, without clearly defined entitlements there is no information about how much can be reallocated, who will win and who will lose.

The existence of water-use rights has an essential effect on enforcement, sanctioning systems, application of pricing systems, water re-allocation mechanisms and the need for generating information.

Water-use rights are thus essential to provide incentives for better water management. Such user rights can however be designed in a flexible way to cater for local needs and circumstances by, amongst others, placing conditions on its length of validity and transferability.

So far the role of water-use rights and the market have been briefly outlined. In the next paragraphs water use policy, the relevant sections of the NWA and the implementation of its provisions are presented.

2.4 National Water Policy

According to the White Paper on a National Water Policy for South Africa, all water in the water cycle whether on land, underground or in surface channels, falling on, flowing through or infiltrating between such systems, will be treated as part of the common resource. As such it is required to meet the broad objectives of water resource management (DWAF, 1997: 3 & 14).

A legal framework for allocating water must be set up to achieve the "best possible use" of water. This concept involves more than the productive use of water since it explicitly provides for the weighing up of social, economic and environmental objectives by regulators to achieve equity, efficiency and sustainability (DWAF, 1997: 12-13).

Water use allocations claimed under the Water Act of 1956 may be recognised if these are beneficially used in the public interest.

Preference will be given to basic human needs and to the protection of eco-systems, which are called the Reserve, and to international obligations. This will be done in a way which will ensure that no avoidable or unnecessary damage is done to regional economies or groups such as irrigation farmers (DWAF, 1997:15, 16 & 17).

The riparian system of allocation, in which the right to use water is tied to the ownership of land along rivers will be abolished. Transitional arrangements will over time ensure an orderly, efficient and gradual shift in water use allocations as and when necessary (DWAF, 1997:4)

Water allocations will no longer be permanent, but will be granted for a five-year cycle with a maximum length of forty years. Applications will be subject to a number of conditions. Where new applications compete with existing ones, the guideline for government authorities will be the above mentioned criteria of "best possible use".

All water users will eventually have to apply for the registration of their water use and these uses will, where possible and justified be converted into licenses. This will be done in sequence of priority areas. Areas under water stress will generally be considered first (DWAF, 1997:4 &17-18).

The policies of water resource protection, conservation and allocation have all identified that there is a possible role for economic measures such as water resource charges to support the policies proposed. While the approach to price setting has some limitations, the trading in water use allocations as a price setting mechanism also has its limitations and is by no means free from administrative burdens (DWAF, 1997:21&22).

Provision is made to allow trading in water use allocations in limited areas. If introduced these will be subject to varying degrees of control depending on whether it is within a single user sector or between different sectors or between water management areas. Particular attention will be given to evaluating whether equity objectives and fair resource allocations are achieved (DWAF, 1997:18 & 3).

2.5 Water use and transfers as outlined in the NWA

As stated above, water-use rights are of primary importance in any water allocation system. The relevant sections of the Act related to this aspect is contained mainly in chapter 4 (NWA, 1998) that deals with the use of water and the processes that will eventually lead to the authorising of water uses by way of a licence.

2.5.1 Definition of the use of water

Section 21 provides the detail of what constitutes the use of water. Uses that are included in the list are; taking water from water resource, storing water, engaging in stream flow reduction activities such as forestry and discharging waste or water containing waste.

2.5.2 Authorising the use of water

The Minister of Water Affairs and Forestry is responsible for authorising and regulating the use of water, except if the Minister has assigned the power to a specific catchment management agency in which case this agency has the power for the specific area.

The Minister may in terms of section 23 determine the quantity of water for which a responsible authority may issue general authorisations and licences from the water resource in the area concerned.

A person may in terms of section 22(1) only use water if that water use is;

- Permissible under Schedule 1 of the Act; It sets out the uses that a person may engage in without any authorisation and represents minimum use that are allowed without being regulated by a formal authorisation.
- Permissible as a continuation of an existing lawful water use in terms of section 32. Section 32 states that an existing lawful use must comply with the following criteria:

Use must have taken place during the period of the two years before the Act commenced

The use must have been authorised by or under any law that was in force when the Act commenced.

In the case where these criteria do not apply a person may apply for a use to be declared an existing lawful use. Section 33 contains the conditions applicable.

In terms of section 34 a person or that person's successor may continue with the existing lawful use subject to the conditions and obligations attached to it. A responsible authority may require a person in terms of section 35 to apply for the verification of a water use to determine the extent and lawfulness of the water use.

- Permissible in terms of a general authorisation. General authorisations are specified in section 39. And allows the limited but conditional use of water without a license. It sets out cut-off points above those mentioned in schedule 1. Water use below the cut-off points and above schedule 1 use can take place without obtaining any authorisation. Water uses above the cut-off points must be licensed except if it is an existing lawful use.
- Authorised by an individual licence or authorised by licence due to a process to issue compulsory licences. A person who wants to use water that does not fall under the 3 types of authorisations described above must apply for a license to use that water. The application can be for an individual license or as part of a compulsory licensing process. Application for an individual license takes place in terms of section 40. A general invitation to apply for a license is followed in terms of section 43 as part of a compulsory licensing process.
- A compulsory license process is followed in cases where, amongst others, the water resources are under stress due to severe competition between users and potential users while water resource capabilities are limited or the aim is to achieve equity in allocation. After providing for the Reserve and international obligations the compulsory licensing process will be granting of a license to achieve fair allocation of water, promoting its beneficial use in the public interest and facilitating efficient management of water resources.
- Licenses will be granted for a period of time appropriate to a particular use. Long-term crops and industrial uses that involve substantial infrastructure investments with long time horizons will be given longer-term licenses than cash crops. To facilitate the process of allocation and review, licenses will be granted on a five-year cycle for a maximum length of 40 years. A license remains in force in terms of section 28(3) until the end of the license period when it expires. The license could in terms of section 54 be suspended or withdrawn if there is non-compliance with the conditions of the license.

2.5.3 Conditions attached to an authorised water use

In terms of section 29 conditions could be attached to the license or general authorisation. It states amongst others the specific quantity of water or percentage of flow that can be used and times when it may or may not be used.

2.5.4 Factors to be taken into account before issuing general authorisations or a license

Before issuing a license or general authorisation the authority must in terms of section 27(1) take into account the following factors:

Existing lawful water uses,
The need to redress the results of past racial and gender discrimination,
Efficient and beneficial use of water in the public interest,
The socio-economic impact of the water use or uses if authorised and the failure to authorise the water use(s),
The likely effect of the water use to be authorised on the water resource and on other water users,
Investments already made and to be made by the water user in respect of the water use in question,
Strategic importance of the water use to be authorised, and
The probable duration of any undertaking for which the water use is authorised.

These same factors must be taken into account when an application is made to license a water-use right for the purpose of trade.

2.5.5 Compensation due to severe prejudice when individual or compulsory licensing takes place

In terms of section 22(6) a person may claim compensation from the water tribunal for financial loss suffered:

A person who has applied for a license as part of a compulsory license procedure in respect of an existing lawful use. and;

Whose application has been refused resulting in severe prejudice to economic viability of an undertaking in respect of which water was beneficially used; or,

Who has been granted a license of lesser use than the existing lawful use resulting in severe prejudice to economic viability of the undertaking where the water was beneficially used;

A person to whom a license was issued where the conditions of the license were so amended to severely prejudice the economic viability of the undertaking to which the license was issued

Compensation payable is determined in accordance to the Constitution. Backeberg (2007) discusses situations where compensation is appropriate. Compensation is not applicable in cases where water use is curtailed in order to;

Provide for the Reserve,
Rectify an over-allocation of water use from the resource in question or,
Rectify an unfair or disproportionate use of water.

2.5.6 Regulations regarding transactions in water use

The Act provides for the creation of a market in water use. This will be subject to various degrees of control. Such controls should ensure that water use is managed in a sustainable manner over the long-term. For this reason section 26(1)(*l*) allows the Minister of Water Affairs and Forestry to issue regulations related to transactions in respect of authorisations to use water which include:

The circumstances under which a transaction may be permitted,
The conditions subject to which a transaction may take place, and
The procedure to deal with the transaction.

These regulations may differentiate between different water resources, classes of water resources and geographical areas.

No such regulations have been issued so far.

2.5.7 The surrender of water-use rights to facilitate transfers

Even in the absence of the regulations referred to above trade can still take place. Provisions for these transfers are made in section 25 of the Act. A person holding an entitlement to use water may in terms of section 25(2) surrender that entitlement, or part of it, to facilitate a particular license application for the use of the water from the same source in respect of other land. Section 25(1) provides for the temporary transfer of a water-use right for one year, which can be extended for one further year.

2.6 The National Water Resource Strategy

The NWRS provides information about the ways in which the framework provided by the NWA will be implemented.

The starting point of the report is an assessment of the quantity of water available and the demand for water in each of the 19 CMAs for the year 2000 and the projected availability and use for 2025. Use categories considered are, amongst others, irrigation, urban, rural industrial use as well as requirements for the Reserve and international obligations. It would appear as if more than 50% of the catchments are under stress. Ways in which availability and use can be reconciled are outlined. This balancing can include water demand management, managing groundwater resources, re-use of water, re-allocation of water, development of surface water resources and inter-basin transfers.

It is interesting to note that in the case where the re-allocation of water is required the following instruments are listed namely the compulsory licensing process, demand management and the trading of water use authorisations.

The statistics on availability and use are at present not very refined and will have to be adjusted as more information becomes available from, amongst others, the accurate Reserve determination, verification of lawful use, etc.

The strategies, objectives, plans, guidelines for the management of the South Africa's resources are outlined in Chapter 3 of the NWRS. A short summary will be presented here with an emphasis on the aspects more directly related to water trading.

Regarding the protection of water resources, a National Water Resource Classification System (NWRCS) was still under development at the time of the publishing of the report (DWAF, 2006b). Procedures to determine the different classes of water resources must be developed. A comprehensive Reserve determination is subject to the development of guidelines and procedures to determine the different classes of water resources. The determination of the Reserve is therefore preliminary until the classification system is completed. Source directed controls related to, amongst others, the protection quality of water have been implemented under 1956 Act and will be continued.

Water use has already been dealt with in the discussion of the NWA. This aspect described in chapter 4 of the NWA is very important for it prescribes the provisions according to which water use may be progressively adjusted to achieve the Acts principal objectives of equity, sustainability and efficiency of water use.

General authorisations were established by a government notice in 1999 and revised and extended in 2003. The validity of such authorisations is for 5 years with review at 3-year intervals. It is foreseen that eventually all water uses will be licensed. The NWRS outlines the interim stages. Procedures are outlined for applications for licenses, compulsory licensing and conditions pertaining to such licenses. The NWRS acknowledges that the authorisation of all water uses that require a license will take time. As an essential preliminary step towards licensing and to enable water user charges to be levied all existing water uses must be registered. The deadline for registrations was June 2001. Before compulsory licensing the lawfulness of existing water uses will have to be verified. Verification will be prioritised in areas where information indicates that existing use exceeds the capacity of the resource. Ad hoc verifications can be undertaken if it is necessary to license an existing use to for instance facilitate a transfer.

Procedures have been developed to deal with transfers as provided for under section 25. Section 26 regulations may in future be written to provide a nationally consistent basis for such transfers.

Since the Act only specifies the broad legal framework for water resource management details on water use are provided in government notices various such regulations are listed (DWAF, 2004d:70). An overview and approaches to deal with water quality aspects are provided as well as remediation strategies for degraded and impaired water resources are provided.

Water conservation and demand management also get attention. A strategy and subsidiary strategies for three use sectors namely, water services, agriculture and industry, mining and power generation are envisaged. Such strategies will provide incentives to support measures and interventions aimed at encouraging and supporting water institutions and water users to increase their efficiency of water use.

Considerable attention is devoted to water pricing which should be more correctly referred to as a system of user charges. It seems as if the pricing strategy has a number of objectives. One objective is to ensure that the cost of managing water resources including capital cost is recovered from the respective users. Provision is made for measures to promote equitable access to historically disadvantaged groups. Further objectives are to achieve equity, sustainability and efficiency. How such a pricing strategy will provide the incentives is not spelled out. User charges for abstracting, storing and stream-flow reduction activities is accepted and implemented. Provision is made for the payment for various services that will be encompassed in the user charge. The role of trading in water-use rights to achieve water use efficiency is provided for. Interim provisions are applicable but the conditions under which water can be traded after compulsory licensing will be developed at that time.

The principle of full cost recovery may be reduced for some users. Charges for water from government water schemes to emerging farmers will be subsidised on a reducing scale over 5 years and depreciation charges will be phased in over time.

The establishment of the various bodies that are provided for in the Act has as its main objective to progressively decentralise the responsibility and authority for water management. At present DWAF is responsible for managing all aspects of the Act. The role of DWAF will change as regional and local structures are established and responsibility for water management delegated and assigned to them. In such an event the DWAF will take the responsibility for national policy and the regulatory framework under which decentralised bodies will operate.

After consultation, 19 water management areas have been established the demarcation is presented in the NWRS (DWAF, 2004d:88). A Catchment Management Agency will manage water resources in each such area. The functions and responsibilities and operational modus of these administrative bodies are described. At the local level water users associations will be established under the authority of the CMAs. Existing irrigation boards and other local bodies must be transformed to water users associations. Provision is made for Advisory committees that are instituted by the Minister to provide advice on specific matters. Although not specified in the Act various forums existed in the past. These informal forums have made valuable contributions to water management and DWAF will support existing forums and new ones.

A Water Tribunal replaces the Water Court. It is an independent body with a mandate to hear and adjudicate appeals on a variety of water related issues-mainly against administrative decisions made by the responsible authority. Procedural rules for have been provided. The first members of the Tribunal were appointed in May 2001.

Monitoring and information systems, DWAF already operates a number of monitoring systems but coverage is not always complete and its reliability is also suspect. These shortcomings are addressed by the department. New information systems have been developed to provide data on surface water hydrology, water quality and groundwater. A comprehensive water use authorisation and registration management system (WARMS) has been put in place to manage various aspects involved in the management of water resources.

A strategy for disaster management is outlined in the NWRS and although very important is not related to the issue of water trade.

The schedule for the implementation of the strategies is comprehensive and some of the tasks will take considerable time. The routine operational activities required by the Act will continue. These include the reconciliation of supply and demand for water, planning and designing capital works, operating and maintenance of bulk supply, control over water use, water conservation and demand management, setting tariffs, dam safety control and control of alien invasion plant species.

A number of new once-off activities are required by the Act. These activities are in some cases of a long duration and require substantial human and financial resources. All these projects cannot be carried out simultaneously in all 19 water management areas and priorities will have to be set. Included in these activities are compulsory licensing, establishing CMAs, delegation of operation and physical infrastructure to the appropriate bodies, creating new WUAs, expanding monitoring and information systems. In addition the introduction of revenue collections for the management charges, transforming irrigation boards to WUAs and streamlining individual license applications needs attention.

An indicative programme for compulsory licensing is presented. The first one the Usutu to Mhlathuze management area and was scheduled to start in 2004. Preliminary activities are still in process underscoring the time consuming nature of this project. Similarly an indicative programme for establishing CMAs have been drawn up. The first one, namely the Inkomati CMA, was established in 2005 but it is not fully operational at present. Other CMAs are preparing to follow suit but the experience and teething problems with the first one must provide guidelines for the ones to follow. Some irrigation board has been transformed to WUAs but the complexity and speed at which it happens have been underestimated. The delegation of functions and transfer of infrastructure to water management institutions will develop as these institutions becomes viable. Substantial attention is still needed on the development of information systems and monitoring networks. An indicative programme for international water sharing agreements has been drawn up but progress on this front has been uneven. The last set of implementation activities relate to the development of physical infrastructure (NWRS, 116-118). Some of the projects are in the conceptual and or planning or implementation stages. Projects such as for instance the Berg River project and the raising of the Flag Boshielo dam have been completed.

2.7 Research on water markets in South Africa

A recent paper (Dinar & Saleth, 2005) measured the health index of water market institutions in 43 countries based on three main dimensions, law, policy and organisation or administration. They conclude that water institutions in many countries are weak and dated although South Africa was given a favourable index. This finding is a direct result of the water policy review process that preceded the NWA and the progress made so far to implement it. A recent study (Conningarth, 2004) concluded that the NWA contains the necessary provisions to allow for a water market to function. An evaluation of the South African experience in designing

institutions to facilitate the market process in irrigated agriculture was published recently (Backeberg, 2007).

Studies undertaken in several rivers in South Africa showed that water market trading promotes the more efficient use of water. A study by Armitage (1999) on water market transfers in the Lower Orange River showed that water-use rights were transferred to farmers with the highest return per unit of water applied, those producing table grapes, and with a high potential arable 'outer land' without water entitlements. It is concluded that the market promoted the more efficient use of water. Only unused water was transferred, while water saved (through adoption of conservation practices) was retained possibly for security purposes.

A second study by Armitage (1999) in the Nkwaleni Valley in northern KwaZulu-Natal found that no water market had emerged despite the scarcity of water in the area. No willing sellers of water-use rights existed. Transaction costs appear larger than benefits from trading. Farmers generally retain surplus use rights as security against drought because of unreliable river flow while crop profitability in this area is similar for buyers and sellers (they grow the same crops).

Gillitt (2004) firstly studied water markets in the Lower Orange River. Data showed that farmers held more water entitlements than their actual irrigated area. Sellers had, on average, about 22% more hectares of water entitlements than actual area planted, whereas buyers had 41% more water-use rights. Few temporary transactions took place because farmers need long-term security of water for perennial crops. Excess water entitlements are held usually for future development and not necessarily for insurance against drought. This study confirms results of Armitage (1999) study that the water market performs well and that efficiency is promoted.

The importance of risk was further researched. Policy risk and risk aversion appear to be important in explaining future investment in irrigation farming in the Lower Orange River. Results show that farmers who view their water entitlement as less secure, expect to invest less. Important policy implications are that farmers should be better informed about the practical implications of the New Water Act and specifically water licenses.

A second study in the Crocodile River where water supply is irregular, water is transferred from farmers where risk is high to farmers where lower risk crops can be produced especially sugar cane. These conclusions confirm results of a study by Bate et al. (1999). In the Lower Crocodile crops in the purchasing area have lower production risk (sugar cane) and lower financial risk and better cash flow (bananas and sugar cane). Other attributes of buyers are that they irrigate larger areas and that they probably have a deficit allocation (use more water than their quota). A motivation for buyers is to legitimise their current use.

Bate et al. (1999) found a wide range of trade prices that was attributed to asymmetric information between few large buyers (four accounted for 90% of trade by volume) and many small sellers, with a large buyer paying smaller sellers different prices. Water renting is common in this area and in their study was more important than temporary trades. In their study 23 permanent trades (563 ha) and 46 temporary trades (2140 ha) were recorded. Short-term leases are likely to be used on sugar cane as it is

a shorter-term crop and production can be changed more quickly. Sugar cane production expanded in spite of lower relative returns per ha of land. The lower risk in the sugar industry appears to outweigh the greater profitability of other products up the Gorge. A negative externality from trade is that river flow is reduced, causing increased concentration of industrial sewage and farming effluent. However, several farmers sought extra water as assurance against drought, so not all the supplies will have been used.

2.8 Conclusion

The ownership of water is publicly held and private ownership to water is restricted to a right to use water. This kind of ownership allows for a degree of state control over water use. It is a preferable kind of property right in situations where there is a need for state driven adaptive management. This principle is stated as part of the National Water Policy and subsequently legislated in the NWA. Water use and water use licenses is therefore the central focus of the NWA.

The right to use a certain volume of water is granted through an allocation process. Owing to the nature of use rights they are relative in terms of quantity, quality, time of use and in addition is conditional and of limited duration. In this case the regulation of water markets often exerts some control over transfers due to, amongst others, spatial considerations and third party effects. In the case of water-use rights it is therefore more appropriate to refer to an administered water market.

The strength of user rights is that it enables the adaptive management of water and control of the resource should conditions warrant it. The key disadvantage though is the degree of uncertainty that the relative nature and the conditionality that the user rights introduce. Uncertainty and insecurity can lead to distortions in water-based investments. There is therefore a need to balance the need for adaptive management and security when considering the conditionality and duration of a water-use right.

In the case of water management all the actors (such as water users, water management agencies and, government entities) are influenced by incentives. These incentives are provided by the institutional arrangements applicable such as water-use rights. The institutional arrangements and the actors provide the institutional framework. The different parts of the institutional framework interact to achieve stated objective such as the efficient use of water that can be achieved by the transfer of water to higher value uses. For such transfers to take place the appropriate institutional arrangements need to be in place. On the technical side, water use needs to be measured and monitored, irrigators must be informed about water saving techniques and have the financial means to implement it. Water-use rights needs to be defined and transfer mechanisms need to be in place to allow water to move within and between sectors. In addition water use needs to be adequately priced to provide an incentive for more efficient use.

Implicit in the discussions on water markets is that the laws, rules and regulations are in place to permit it to happen. The National Water Policy set the scene and the NWA provides the conditions for water management to move from the previous legislative framework to a new system where a tendency for “command and control” methods

are replaced by a more decentralised and market driven process. The transformation process is not instantaneous and the NWRS provides a guideline for the implementation of the provisions contained in the NWA. The process of establishing CMAs and WUAs are progressing but at a slow pace. Similarly compulsory licensing will take a long time to complete in all catchments. Arrangements have been made in the meantime in the absence of compulsory licensing for ad hoc licensing that is a necessary prerequisite to consider an application to transfer a water use.

The last aspect discussed is the research into the operation of the water market in South Africa. Studies indicate that the water market is active in some catchments and that it does lead to the transfer of water from lower to higher value use and thus increasing the efficiency of water use.

CHAPTER 3. WATER MARKET INSTITUTIONS IN THE CROCODILE RIVER CATCHMENT

3.1 Introduction

The first case study selected is the Crocodile sub-basin in Mpumalanga. It is an area under water stress and one that presents a variety of water use issues that are relevant to the functioning of a water market.

An exhaustive discussion of all the water management issues in the catchment will not be presented. Instead the discussions will concentrate on institutions considered relevant to a water market.

A detailed mapping and description of the present water use in the catchment area will provide the background against which the issues confronting a water market on the Crocodile will be discussed.

The catchment specific issues will dominate the discussion but where appropriate important issues common to all areas will be included. The discussion of transaction costs and administrative structures and measures to delegate administrative decision making are examples of aspects common to all areas but will also be related to the Crocodile Catchment.

The threats and preconditions for a water market in the area are the next topics. Attention will also be given to alternative ways to deal with the water deficit problem in the area and different approaches to deal with the associated hydrological problems. This will be followed by an analysis of the specific attributes of water markets in the catchment. The last issue discussed is that of the small growers and empowerment. The chapter is concluded by a discussion of the particular impediments to a water market encountered in the Crocodile.

3.2 Mapping the water use in the catchment

Figure 1 provides and overview of the location of the Crocodile Catchment in South Africa. The map also shows irrigated areas, areas planted to commercial forestry and the boundary of the Kruger national Park.

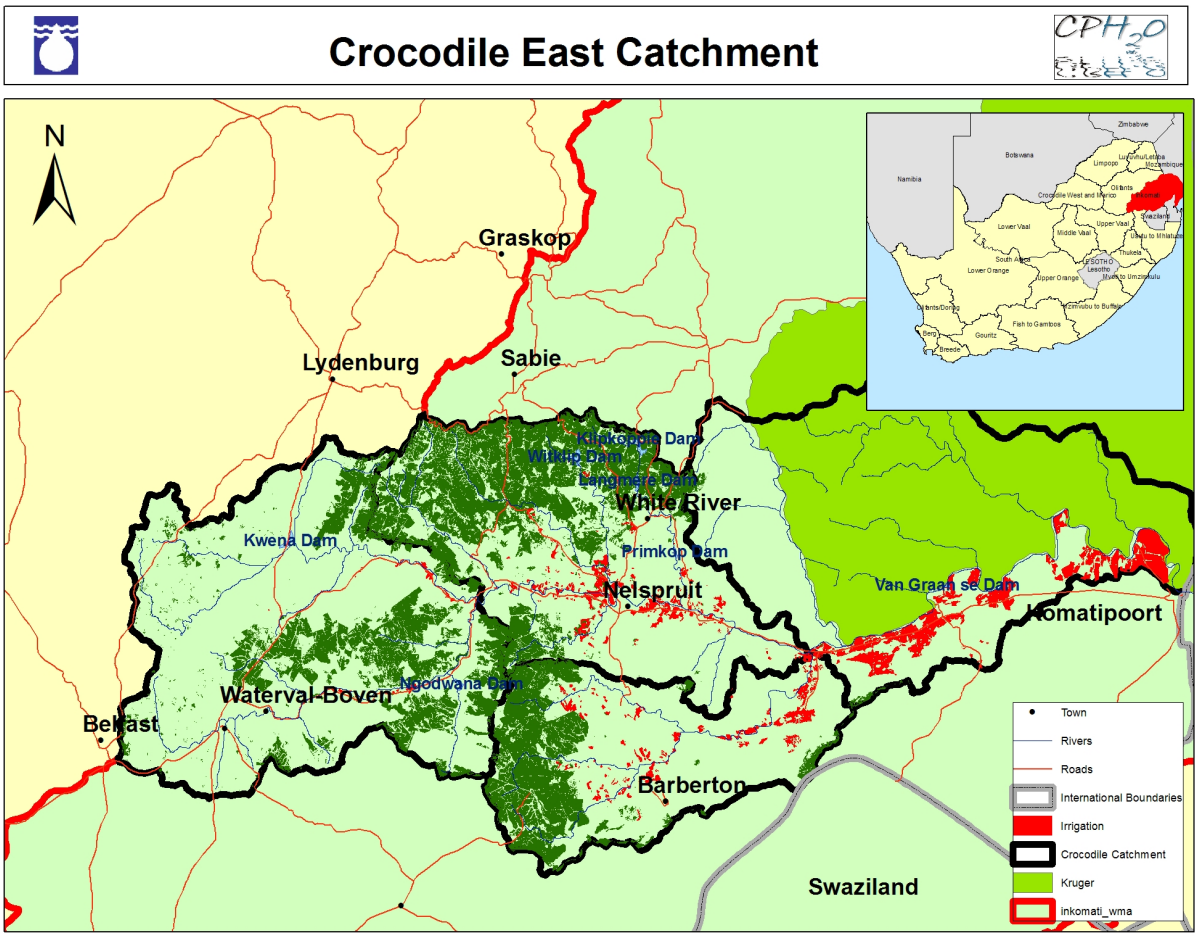

Figure 1. A map of the Crocodile River Catchment (East) showing irrigated areas, conservation areas and commercially afforested areas

3.3 Experience with applications to trade in the Crocodile Catchment

In the present South African situation a proposed trade requires the existing lawful use to be licensed before a trade can be considered. This process imposes an additional cost element on trade. After compulsory licensing all uses will be licensed and this element will fall away.

Apart from this element the fact that we are dealing with a new situation where all the processes are not yet streamlined and there are uncertainties regarding certain parameters (such as land claims) means that the time it takes to approve a trade is longer. This will be become more streamlined once the approval process is decentralised.

Some of the aspects related to applications to trade such as the verification of lawful use, Reserve requirements, the possibility of delegation of certain types of applications and the time involved for a trade to be process were investigated in this catchment.

3.3.1 Verification of lawful use

Ad hoc licensing is needed before trade can be considered. One of the requirements is that the lawfulness and accuracy of registered water use by a given water user need to be verified before a license will be issued. Jackson (2005) noted that the process of verification is relatively easy in a GWCA (Government Water Control Area), but more complicated in non-GWCAs.

In a GWCA, a water user needs to obtain a letter from the irrigation board which confirms that the water user is lawfully entitled to the license being applied for.

In a non-GWCA, a water user needs to prove that his water use registration (and application of a license) is lawful and accurate. Use can be made of consultants to assist in this regard. Generally the SAPWAT computer model is used in this process. The cost of this process ranges from R7000 to as much as R15 000, depending on the level of complication of the process and the size of the application (Conningarth, 2004).

3.3.2 The Reserve

The Regional Office (Jackson, 2005) noted that if applications for trade are received in the same geographic area (Quaternary Catchment), calculations to assess the impact on the Reserve are not done.

A preliminary Reserve is available for the Crocodile River.

A comprehensive Reserve determination is currently being undertaken for the Olifants and Komati catchments.

3.3.3 Delegating certain categories of trade applications to Regional Offices

The Regional Office can issue new licenses for up to 780,000 m^3 per annum. The Regional Office however, cannot process trades for the equivalent volume of water.

This anomaly can be addressed if the regional office can process trade applications in such cases that are currently sent to the national office for further processing. The reluctance of the Head Office to delegate approval can perhaps be ascribed to uncertainties that at present surround trade.

As a reference point however, the Regional Office estimates that if the approval process is decentralised it will take 3 months. This presupposes that the relevant information required is available. This includes the verification of existing lawful use, proof of land titleholder, approval from Land Claims office, appropriate power of attorney from DWAF. In addition a recommendation by Dept of Agriculture is required if the trade goes from irrigation to another use and information on whether the seller was a recipient of land reform grants or DWAF subsidy.

3.3.4 Time taken to assess a trade application

The time taken between application and approval of a proposed trade receives a lot of attention in the literature since it represents an opportunity cost of time foregone in

the process and add to the uncertainty. International evidence cites average times of over 2 years at the upper end to 4 to 5 months at the lower end. From the limited local experience so far the average time taken in South Africa falls in the lower end of this time span. It takes up to a year to approve an application to trade from the agricultural sector and for the forestry sector it takes up to two years (Genesis Analytics, 2005). Approval times do however vary according to the complexity of the specific case and examples of individual cases taking more than two years have occurred.

Armitage and Gillitt refer to this aspect (2004:59) and reports the time span of most sales between one week and three months in the Orange River. This experience must be considered as exceptional.

It would appear that under ideal circumstances such as the possible delegation to the Regional Office of small trade applications it would take up to 3 months to approve routine applications. At this stage it would appear to be the shortest possible time it can take to approve a trade application.

3.3.5 Overall assessment of the elements of transaction cost

During the pre-compulsory period the verification of lawful use and the uncertainties about the reserve and other water balance issues will affect transaction costs because it requires longer administrative procedures. It is foreseen that as regional and local institutions become operational that the approval procedures will be streamlined. In the meantime the possibility of delegating the approval of trade of some categories of trade can be investigated.

It would appear as if the transaction cost would be minimal in the case of trade applications within the agricultural sector in a GWCA. It becomes more costly and time consuming in non-GWCAs because of the more complicated procedures to verify lawful use.

In the post compulsory stage transaction cost will in all probability be lower because the relevant institutions will be in place.

3.4 Strengthening administrative structures and delegation of authority

3.4.1 Introduction

It is one of the major aims of the NWA to increase local participation in water use management. The eventual function at the national level will be to provide the national policy and regulatory framework within which other regional and local institutions will directly manage water resources. DWAF will accordingly progressively withdraw from the direct involvement of water management and delegate these functions to the CMAs and the WUAs.

In the absence of the CMA' s or until they are fully functional DWAF will perform these functions.

3.4.2 Inkomati CMA

The first CMA established in 2004 is the Inkomati CMA encompassing the Crocodile, Inkomati and Sabie- Sand basins. The Chairperson of the Board, Ms Nyakane as well as the 14 Board members was appointed in 2005. At that time the CMA was in the process of making executive appointments (Nyakane, 2005). At present the CMA has a staff component of 20 (Jackson, 2008).

Precisely how the present centralised functions will be divided between Head Office, the CMA and WUA remains open (Faysse, 2004, p668). For instance the WUA may be linked to the CMA as an implementing arm of the catchment management strategy and can also be contracted by the CMA to undertake broader integrated water resource management (IWRM) functions.

The process of decentralisation is however not an easy one. It calls for the delegation and deregulation of involvement but DWAF still appears to steer the process (Faysse, 2004). The CMA is at present still in a process of negotiation with Head Office as to what functions will be delegated to the CMA. It is foreseen that the negotiation process may be completed by the 2nd quarter of 2008. In all probability applications to trade will be processed by the CMA but it is foreseen that final approval will still be retained by Head Office (Jackson, 2008).

It is interesting that there are different perceptions regarding the CMA. Some local role players (van Veyeren, 2005) believed that the establishment of a fully functional CMA would promote the implementation of the NWA. Other local views are more critical (Conningarth, 2004 & Waalewijn, 2004).

3.4.3 Water User Associations (WUAs)

Over time WUAs will replace all the existing irrigation boards. The transformation process has not been going equally smooth in all cases. There were initially about 290 Irrigation Boards of varying sizes. A total of 45 large scale WUAs have been accepted in 2003 (Karar, 2003). The core functions of the local institution remain unchanged namely to operate and maintain the waterworks the WUA owns as well as to monitor water abstraction. In addition WUA should have some ancillary functions which will be undertaken if it does not threaten their financial stability. Among these integrated water resource management (IWRM) functions can be listed the monitoring of water quality, groundwater use or sustainable use of the riparian eco-system. The role of WUA vis-à-vis the quality of water is however not clear. Obviously WUA can perform these functions if they have the capacity to do so.

If the WUA undertakes more IWRM functions the cost will have to be carried by the non-farming sectors through the CMA budget. The demarcation of functions between CMAs and WUAs is however an ongoing process which will depend on local conditions such as the size of the WUA and the financial arrangements and naturally the, to be established, CMA.

The role of the WUAs and the relationship with the CMA is part of the negotiations that are at present taking place between Head Office and the CMA. It is however clear that the local management of water use will have to be a more inclusive process

and that the focus will shift towards the integrated management of local water use (IWRM) that will recognise the interdependencies amongst local water users.

The transformation of IBs to WUA will therefore extend their responsibilities and will of necessity involve representation of all stakeholders. Traditionally IBs have been rather autonomous bodies in local water use management. They dealt only with irrigation issues such as to issue use permits, construct and operate weirs, restrict abstraction rates during droughts and decide on the expansion of the irrigated area. Membership consisted of commercial farmers. Integrating small-scale farmers and non-farming users that often have different needs in terms of service is a difficult process.

The experience of the Inkomati sub-basin (Waalewijn, 2004, p154) reflects some of the common transformation challenges. In this case the initial incorporation of small farmers in the existing irrigation board was problematic. Small farmers are mainly situated in communal irrigation schemes where the water issues are quite different from that of commercial farmers who are more experienced have more resources at their disposal to manage risks resulting from the irregular supply of water. In addition the small farmers find it difficult to play a meaningful role in the governance process of established irrigation boards. The differences between small farmers and commercial farmers are reflected in the comment of one commercial farmer (Waalewijn p160) that stated; "water management is not fun anymore, we want quick decisions on what to do, and they want to discuss all day about a broken pump". Such problems can however be overcome by establishing committees to deal with such issues.

The transformation proposals made by the three boards in the Inkomati region were rejected by DWAF because not enough attention has been given to public participation and the authorities wanted more active inclusion of farm workers and local communities. Many commercial farmers are of the opinion that it is sufficient to only change the name of the organisation and continue with business as usual. DWAF however, wants to include issues such as redress and integrated water resource management. The concern of the IBs can be understood in the perspective of its previous autonomy and the reluctance of opening up the management to non-users who will not contribute financially.

In the case of eight large WUAs studied (Faysse, 2004) it was found that non-farming users are not always interested in joining the WUA while others face internal problems that prevents meaningful participation. The non-compulsory nature of membership of a WUA is another contributing factor (DWAF, 2001). It states that a person with an existing entitlement to use water (lawful use under previous legislation) cannot be forced to become a member of a WUA unless the entitlement is replaced by a license containing such a condition. Membership of a WUA can therefore be mandated in an indirect way.

Membership is a relevant issue in the case of the forestry sector that is now considered to be a water user. For instance the Umlaas IB would like forestry companies to come on board as their activities affect downstream water users. Forestry is reluctant to join if it means paying extra fees. Not all municipalities have fully incorporated the implementation of the Water Services Act of 1997 and this

hampers their ability to meaningfully interact with other water users. In the Great Letaba, Komati and Lomati areas drinking water networks draw water directly from dams not managed by IB or the WUA, (which are managed by DWAF and an international organisation in the latter two cases). The municipalities already pay a water management fee and do not see a need to pay additional WUA fees.

A way out of this dilemma could be to review the organisation in which the integrated water management should take place. For instance, the Great Letaba WUA comprises only farmers and there is not much need for interaction between drinking water users and farmers. The secretary of this organisation says that if a forum for all users is needed it should be at a basin level through the CMA or a designated committee of the CMA rather than the WUA (Faysse, 2004). This is not a new concept since in 2003 there were about 200 local catchment forums that aimed at initiating discussions around shared water use problems.

In the case of the Malelane Irrigation Board a WUA has not yet been established. The draft constitution was not acceptable to DWAF. On two occasions documentation was submitted for the formation of a WUA, and DWAF has turned this down on both occasions (van Veyeren, 2005). Apparently the setback lies in the lack of public participation involved in developing the to-be established WUA.

In order to promote public participation in the formation of the WUA, DWAF appointed a consultant to assist with the public participation process. The first public participation meeting was held in the beginning of November 2005. A total of 27 public participation workshops are scheduled which implies that the process may take quite a while to complete. Stakeholders participating in the public participation workshops include amongst others, irrigators, tourism industries, municipalities and community representatives.

It is anticipated (Jackson, 2005) that the process will take up to one and a half years to complete. Paradoxically, the NWA seemed to anticipate that the transformation from irrigation boards to WUAs would be relatively simple, and would take in the region of six months. Clearly this is not the case. This is borne out by the fact that WUA have still not been established in the Crocodile Catchment (Jackson, 2008). Apparently one of the remaining stumbling blocks is the way that the assets of the irrigation boards will be handled under the WUAs.

3.5 Issues, threats and preconditions to a water market

The most important impediment to transfers of water has been land claims as water cannot be transferred if a claim is lodged against a farm. According to information 95% of the irrigation land is under land claims (2007).The situation has changed dramatically since first visits (2005/2006/2007) and recent information (Van Veyeren, 2008) indicates that about 80% of the farms under irrigation have already been transferred.

According to previous studies in the Crocodile River, most of the transfers of water use involved non-exercised entitlements (sales and rentals). Farmers bought these user rights to improve their assurance but because of the deficit and the lack of water in the

river the assurance of all the other farmers deteriorates if non-exercised rights are activated. The Chairman of the Main Crocodile Irrigation Board said that he would not support such applications for transfers because of this reason. There is legal uncertainty regarding the status of non-exercised entitlements as far as trading is concerned. The interaction of legal issues, deficit and the perception that third parties would be harmed by transfers of non-exercised rights resulted in opposition to applications to trade that would activate non-exercised entitlements.

3.5.1 The deficit between water use requirements and water availability

Uncertainty about reducing the deficit to allow for the Reserve is not a limiting factor on the market in the Crocodile River as a preliminary Reserve has been determined. Reductions to provide for the Reserve will be addressed in future when compulsory licensing takes place (DWAF: Water abstraction and in-stream use, 2004). Deficits are a problem as provision must be made for the Reserve and this provision cannot be compromised (Seetal, 2005). How the deficit is going to be reduced, introduces uncertainty in a water market as buyers/sellers are uncertain as to the quantity of water use that is being traded.

In future a reconciliation of water use to allow for the Reserve and the deficit must be determined at different points on the river and for each tributary (van Rooyen, 2005) which means that the task will be time consuming. This reconciliation has not been undertaken for the Lower Crocodile. Estimates about the size of the deficit vary. Based on 1:50 year assurance DWAF (2004a) estimates the deficit as 149 million m^3 of water (availability estimated as 264 million m^3 and requirement as 413 million m^3). Using these data, irrigation and forestry must be reduced by 50% in order to eliminate the deficit. Mallory (2008) estimates the deficit for two scenarios. Scenario 1 includes high flows (floods) for the Reserve. Under this scenario current demand is estimated as 446 million m^3 and supply as 232 million m^3. The difference between demand and supply is still high (48%) but the data were interpreted differently from the reconciliation statement of DWAF. If demand is reduced to 282 million m^3 (37% or 163.28 million m^3) then the reduced demand is still more than available supply but they view this as sufficient assurance. Under scenario 2, high flows are excluded. Under this scenario demand is 446 million m^3 while supply is 259 million m^3. Reduced demand is estimated at 319 million m^3 which is more than supply but again assurance was seen to be sufficient. This implies a cutback of 28% or 126 million m^3. The average deficit estimated by Mallory (2008) is 146.72 million m^3, calculated as 0.5*(163.28 million + 126.86 million m^3) which is similar to DWAF's estimate of 149 million m^3. Van Niekerk (2007) who is familiar with this area questions high deficit estimates, in his opinion the Crocodile River is over-allocated on paper.

According to DWAF (2004a), water use requirements for 2003 are estimated (in million m^3) to be; 257 for irrigation, 42 for forestry, 35 for urban, 23 for industry and mining, 7 for rural and 49 for transfers out of the basin respectively. The supply of the surface water resource is estimated at 364 million m^3. Allowance has to be made for the following (in million m^3); 105 for the ecological reserve (ER), 57 for invasive alien plants while the following sources add to the supply; groundwater 8, return flow 42 and transfers into the catchment 12 cubic meters respectively. As the use by agriculture and forestry is relatively large Comrie (2006) is of the opinion that the deficit can only be reduced if attention is given to the demand by these sectors.

According to DWAF (2004a) the deficit is due to the allowance for the ER as the catchment was in balance before taking the ER into account. It is contended that alien plant use is less than originally estimated (DWAF, 2004a). It is contended that as ER is a new use category a comprehensive determination of the ER should be made in future.

3.5.2 Restitution and redistribution of land and other equity considerations

The strong equity concerns about water markets in South Africa cannot be ignored. A market cannot operate if property rights are not secure, and the latter is not possible if many feel deprived. Handling this issue in a compassionate way is a precondition to effective markets. Major empowerment initiatives in the Crocodile River are approached through restitution claims as well as private assistance such as the Small Growers Scheme. According to information 95% of commercial farms were under restitution claims (2007) while when the document was in the editing stage (Van Veyeren, 2008) information was obtained that about 80% of the land were transferred to PDIs. The information is that the previous commercial farmers are still on the land to assist the management transfer process.

The situation changed rapidly in the area. When the area was first visited in 2005/6 of the about 45 000 ha, claims gazetted totalled about 10 000 ha. One of the most important impediments to water trade in the Inkomati Catchment is the uncertainty that arises from these land claims (Putter, 2005). If a claim against a particular parcel of land succeeds, after the water was transferred, then the PDI may be entitled to compensation for the water transferred. Once restitution claims have been dealt with this uncertainty will be removed from the market.

In the irrigation area, land and water are seen as joint resources and restitution of land also implies that PDIs have access to water allocated to that land. A target has been set for redistribution of 30% of land and water-use rights to PDIs (Comrie, 2005). Claims for restitution are included in the 30% target. As claims under restitution exceed 30% of irrigated land, the water distribution target of 30% will be met by restitution alone which appears to be the case now as PDIs will now own about 80% of the irrigation water.

Farmers along the Crocodile River appeared proactive and expedited the land claims process. Commercial farmland had been offered for sale to PDIs for some time but none had been purchased initially (Van Rooy, 2005). The observation that commercial farmers are willing to sell land was encouraging, as it appears that the farming community wants the process to be concluded and certainty on this issue restored.

The initial delay in transfer of land was partly attributed to the magnitude and complexity of the claims which cannot be processed in one transaction (Van Rooy, 2005). The strategy of processing claims has then changed since the 2005 interview and claims were then dealt with on an individual commercial farm basis (van Rooy, 2006). Some of the large farmers then made significant progress in transferring land under claims. The idea was to first process claims for the large farms and then for the medium sized farms and so on (van Rooy, 2006). Another reason for the delay

appears to be that the Land Claims Commission did not have the capacity to facilitate transfers more expeditiously.

Commercial farmers contend that PDIs be given access to commercial land under irrigation (owners receiving compensation) rather than further water being withdrawn from the system to initiate new small grower production. If more water is withdrawn then the water stress will be aggravated. It makes more sense to settle PDIs on commercial land already developed than to provide water to PDIs that needs further development. A case can be made for land and water reform to be linked.

The majority of claims were filed on behalf of a specific group and not individuals. If the claims are successful the ownership arrangement of the restituted land is not clear. Should the possibility be considered of dividing such land into parcels for individual ownership the result could be small parcels that will not be economically viable (Slabbert, 2005). The commercial sustainability of agriculture in such a scenario will be impossible. Different modules of land and water transfers have been adopted as the objective is not only to transfer ownership but also to promote a viable business unit (van Rooy, 2005).

3.5.3 Legal issues related to non-exercised water-use rights

One of the pillars of a water market is the protection of water-use rights by the law. One of the areas of contention in the Crocodile River is the difference of opinion on the legality of unexercised water-use rights. A previous study in the area (Gillitt, 2004), concluded that all sales that took place were from farmers who did not use their water-use rights. The activation of non-exercised lawful rights does not affect the deficit, as these rights are included in the reconciliation statement as an irrigation use. These rights are, however, "water on paper" only (not backed up by water in the system) which means that if they are sold and activated the area under irrigation further increases and the stress in the system worsens. Not all such purchases go to the extension of the area irrigated. Some farmers want to purchase rights for increased assurance rather than to expand (van Veyeren, 2005). If unexercised rights are purchased then the assurance of the buyers will increase and when used in emergencies the assurance of other irrigators will deteriorate, as the total water supply is the same. Van Rooy (2006) concurs with the latter conclusion. In his opinion unexercised rights must be lost and not transferred.

The legal and other opinions on the status of unexercised rights in terms of existing lawful use provisions differ and are briefly given:

Thompson (2005) alleges that unused rights are already been taken away. Only water use during the two-year period before 1998 came into operation (1 October 1996 to 30 September 1998), are existing lawful use. There are three extensions and exemptions to this ruling:

(a) A person who used water before the Act came into operation and use discontinued for a good reason may apply to the responsible authority to declare use as existing lawful use.

(b) He had taken steps in good faith to use water before the Act came into operation and that use would have been lawful then the person may apply to the responsible authority to declare the use existing lawful.

(c) If use is next to a river then he can apply for a license and license may be issued (it appears even if he has never paid rates).

According to Human (2005), if the area is scheduled in terms of section 33 of Act, and if rates are paid up, then the entitlement is accepted as an existing lawful use. During the compulsory licensing process the Minister will look at exercised lawful use. If use is not exercised then there is a strong possibility that use will be lost. Human (2005) contends that there will be no compensation for unused entitlements if it is confiscated or scheduled for re-allocation, as the farmer has never used it. Seetal (2005) was more adamant than Human (2005) that unexercised rights will be lost.

Pretorius (2005) and van Rooyen (2005) contend that if farmers have paid their rates then these entitlements cannot be taken away without compensation. Van Rooyen (2006) also states that these rights may be traded. Jackson (2005) states that non-exercised lawful water use in a Government Water Control Area (GWCA) can be traded (even now) while unexercised lawful use in a non-GWCA cannot be traded. Jackson (2006) was concerned about the influence of trading "paper water" entitlements on the assurance of water use in the catchment. This difference of opinion between engineers and others must create uncertainty in the water market.

3.5.4 Hydrological issues in the catchment

A major hydrological problem arises from the fact that water is not effectively metered and that rights can therefore not be effectively enforced. The establishment and enforcement of rights is a central pillar of a market economy and thus a water market. The lack of metering is a problem as Deacon (2004) asserts that some farmers below the Gorge have exceeded their entitlements and expanded their acreage. As farmers were allowed to spread their water over a larger area if they use drip or other water conservation measures it is difficult to enforce entitlements in the absence of metering. Related to the water spreading is the issue of return flow. Stretch (spreading) water by using drip is seen as a water efficient strategy, but the return flow from the latter measures is small. The reduced return flow has exacerbated the shortage of water in the system.

Another hydrological issue that has had an impact on water availability in the system is surplus water (flood water) permits. The idea with floodwater permits is to allow farmers to capture surplus water during flooding. Farmers have, however, built dams and so there is less flooding. These permits are now entrenched and included in the current quota allocation that expanded the quota allocation.

3.6 Alternative approaches to deal with deficit problem

In stressed catchments where the Reserve is not being met, reductions for purposes of meeting the Reserve will be addressed in future when compulsory licensing is called for (DWAF, 2004c). Various studies are under way researching options dealing with

the deficit in the Crocodile River. Due to the uncertainty that the deficit creates in a water market and its implication for the Reserve some of the approaches will be discussed. The decision as to which approach to use is a political decision and the purpose is to provide some information on the costs and benefits of approaches to policy makers.

DWAF (2005) suggests that the following processes can be progressively followed to identify allocable water before curtailing existing lawful water uses:

(a) Ending unlawful use,

(b) Removal of alien invasive vegetation,

(c) Promoting the use of groundwater resource, where possible,

(d) Actively promoting water conservation and demand management,

(e) Phased and progressive curtailment of existing lawful water use,

(f) Lowering the assurance of supply,

(g) Developing the resource (for example construction of new impoundment) and

(h) Promoting water trading.

3.6.1 Ending unlawful water use

According to some (Deacon, 2004; Jackson, 2006) unlawful water use in the Crocodile below the Gorge is common. Gillitt (2004) confirms this showing that buyers of water-use rights below the Gorge significantly exceeded their water entitlements. Gillitt (2004, p70) reported that six buyers of water-use rights farming on 12156 ha exceeded their water entitlements by 1584 ha before transactions and by 592 ha afterwards. A major reason for buying or renting water was to legitimize entitlements. It appears as if farmers have expanded irrigation (some illegally) to the extent that little water is left in the river during dry periods and that droughts occur more frequently. Illegal use is not included in DWAF's calculations and not shown in the reconciliation statement. According to Human (2005), if farmers have exceeded their water quota, then they would be required to reduce consumption to the original quota. They believe that the Irrigation Board should manage this process. Penalties are that the Department can suspend use and if the farmer does not comply then his/her water can be cut off completely.

Van Veyeren (2005) admitted that a possibility exists of some users exceeding their quotas. According to him the issue of individuals exceeding their quotas is not relevant at present because of the drought cycle as everyone's quota is cut in accordance with available water. He contends that officials appointed by the IB ("waterfiskaal") and self-policing procedure keep users in check. However, if farmers have expanded their area (Deacon, 2004; Gillitt, 2004) and if water is not metered then it appears likely that the water allocated to users in a stressed situation is not directly proportional to original entitlements.

3.6.2 Eradicating alien invasive vegetation

It is estimated (DWAF, 2004a) that alien invasive vegetation consumes 57 million cubic meters of water which is considerable given that the deficit is estimated

(DWAF, 2004a) at 149 million cubic meters. Hallowes (2006) questions the figure of 57 million cubic meters and thinks it may be much less, even as low as 10 million cubic meters. If the forestry sector that covers an area of 172 000 ha consume 42 million cubic meters then the figure of 57 million cubic meters for alien vegetation is suspect. Jackson (2006) contends that alien vegetation has a big impact at low flood times but on an annual use basis it is much less. The impact of invasive alien plants should be determined more accurately and if significant be removed (DWAF, 2004a). Alien invasive vegetation is currently been eradicated under the Government's Working for Water (WfW) Programme and currently R50 million is spend per year for the Province which includes the Crocodile River (Comrie, 2006). There is a strong motivation to consider the catchment for the Programme given the high value of water and the high poverty rate of 57% (Crafford, 2004). Mallory (2008) did not provide a breakdown for alien use.

3.6.3 Fund to buy out water-use rights

Strategies specifically aimed at water redistribution may be to create a fund that facilitates water transfers to PDIs through the market (van Niekerk, 2005). As restitution has transferred water to PDIs the fund may not be necessary to achieve equity objectives. This fund can still be used to facilitate transfers to the environment and to reduce the deficit.

3.6.3.1 Size of a fund needed to address re-allocation of water use

This fund could assist in reducing the deficit but on it own it will require significant funding. If the deficit of 149 million cubic meters (DWAF, 2004a) is to be met by reducing agricultural land under irrigation from existing irrigators then 11 461 ha needs to be removed from irrigation. In this calculation the entitlement of 1 ha = 13 000 cubic meters is used. Farmers have already stretched their water which means that a larger area (could be 30% larger) will have to be removed from irrigation. The current market value of this land (11 461 ha at R58 000 per ha) is R665 million. The alternative use value of the land is R3 000 per ha while the value of a sugar cane crop is about R10 000 per ha (Van Rooy, 2006). This implies that if a fund is to be established to buy out water for the deficit then about (R58 000-R10 000-R3 000)(11461)= R516 million is needed.

The impact on the rural economy in terms of reduced output and loss of employment and other indirect effects is similar to that of a volumetric reduction in water through regulatory (administrative) means. These indirect impacts are discussed in 3.6.4.2 "Impacts of volumetric reduction".

3.6.3.2 Source of funds for re-allocation of water-use rights

All water users may be levied and money may also be obtained from groups friendly to the environment. It is common in the USA for environmental groups to be able to buy water. A tax could also be imposed on transfers of water but this may not generate much income, as in the past there have not been that many transfers. Further transfers of water will promote efficiency and such a tax will remove some of the economic incentive to transfer.

3.6.4 Curtailment of existing lawful water use (Cut entitlements)

Water-use rights of each lawful water user may be reduced by a percentage in a water-stressed area in order to make allowance for the Reserve. Reducing water entitlements is one of the more contentious issues among the instruments proposed.

3.6.4.1 Efficient existing lawful users

It is suggested that other approaches should be considered first and the curtailment of existing lawful use of the most efficient users of water will be considered "least and last" (DWAF, 2005, p17). Beneficial use considerations will therefore be foremost in the authorities' plans if and when curtailment of existing lawful use is concerned. The impression gained from visits to the area is that water scarcity has forced farmers to use water as efficiently as is economically possible. There is still some overhead irrigation in sugar cane (below Gorge) but according to van Veyeren (2005) these farmers will convert to more water conservation measures once the cane is replanted. The impression is that farmers of horticultural crops up the Gorge use precision irrigation due to problems associated with over- and under-irrigation of fruit trees (Hough, 2005).

3.6.4.2 Impacts of volumetric reduction

Some reduction in volumetric entitlements can be rationalized on the basis that initial allocations were generous and that farmers have since then adopted water conservation measures such as drip irrigation that reduced return flow. The return flow from flood irrigation is about 30% (Comrie, 2005; Mackenzie and Craig, 1999) while from drip it may be 5% (Comrie, 2005). Given these figures then it may be argued that entitlements may be reduced by about 25% without affecting the farmer's original consumptive use.

If the data from Mallory (2008) are used then agriculture needs to reduce consumption by between 37% and 28%. This may not be political feasible as about 80% of the land under irrigation belongs to PDIs. It does appear that other options should be considered. Since it is concluded that water is efficiently used due to its scarcity, a given reduction in water to farmers will cause an almost similar reduction in agricultural production and an almost similar reduction in employment. The investments that farmers have made in developing their lands such as levelling will be wasted if there is no water. Van Rooy (2005) estimates this cost at about R30 000 per ha.

International sugar prices (a crop also grown by small farmers below Gorge) are now 4.4 times as high as 24 months ago. This is due to the increase in oil prices (Brazil is again diverting sugar into ethanol) and the successful lobbying strategy of developing countries which forced the EU to stop subsidising sugar exports (Sunday Times, Business Times section, February 5, 2006). Cutting water use to farmers will thus come at a cost to the country and these costs will have to be considered from an individual as well as a social aspect. Reducing irrigation has implications on employment (high unemployment in area), profitability of sugar mills (milling cost is higher if mills operate at low capacity), and multipliers on the rural economy in general. Crafford et al. (2004) estimates the indirect benefits from agriculture and

forestry in the Crocodile River Catchment to be significantly larger than direct benefits. Total economic benefits measured as total value added and employment (full-time jobs equivalent) per unit of water were between 2 and 20-fold larger than direct benefits. Poverty is high in Mpumalanga as 57% is classified as poor. Volumetric reduction of water will therefore have high direct and indirect impacts.

3.6.4.3 Legal opinions of reduction in volumetric allocations

According to Human (2005) if farms are not viable after the volumetric reduction then the farmers will be compensated. Compensation will be by buying out land. Large farms, however, may not be compensated. At present the process is still far from this point but he expects that the issue will end up in court. A problem with this approach is how viability is defined.

Pretorius (2005) states that the deficit may be partially overcome by cutting all water allocations by a fixed percentage that may not imply compensation. Van Rooyen (2005) also supports the cutting back of water on a proportional basis. Seetal (2005) contends that different people can be cut back in a different way as long it is not in an arbitrary way but there will be no compensation in most cases.

According to Thompson (2005) if existing lawful use is cut back during the compulsory licensing process then compensation is payable under certain conditions. It would not be paid to provide for the Reserve, rectify over-allocation, and rectify unfair or misappropriated water use. Compensation is only payable if it results in severe prejudice to the economic viability of concern. This also applies if a license is reviewed.

3.6.4.4 Water use by the forestry sector

Forestry comprises the largest intensively managed land use in the Crocodile River Catchment, Mpumalanga Province and is concentrated in the escarpment region, to the west of Nelspruit. These plantations cover some 172 00 ha (16.5%) of the catchment (Crafford et al., 2004). Forestry uses 42 million cubic meters of water according to the reconciliation statement and if agriculture is to be cut back then it may be expected that forestry should also be cut back. At present virtually no further afforestation is allowed because of the predicted reduction in stream flow (Olbrich and Hassan, 1999).

3.6.5 How can a water market deal with the deficit problem?

A water market may be used to balance supply and demand for water use in stressed and compulsory licensing areas. It gives support to the notion that water markets are seen as part of the solution to solving the country's water allocation problems.

3.6.5.1 Inelastic demand reduces the ability of price as a rationing device

Water scarcity caused by drought and the expanding of acreage (some possibly illegal) have increased water efficiency in the Catchment. Farmers below the Gorge use deficit irrigation due to water shortage while those above appear to be using precision irrigation due the problems from under and over irrigation in fruit trees. It

still, however, seems possible to improve efficiency by changing from over-head sprinklers on some lands down from the Gorge and to lining some channels. Lining channels may, however, reduce return flow. Once the water market institutions are put in place users will have further incentives to adopt conservation measures. It appears as if water prices have already increased due to the drought and scarcity of water and possibly higher sugar prices since the Team's first visit.

With a fairly high level of efficiency it appears as if there is not that much inefficiently used water in the system that can be squeezed out by higher water prices or other measures. It appears at current use levels that the demand for water may be highly price inelastic which reduces the ability of price as a rationing device. This is different from what is observed in other catchments and what is normally expected in agriculture.

3.6.5.2 A water market can accommodate future growth in water demand

A water market will prevent the deficit from increasing as initial demand and supply is being given legal protection. Current projections of DWAF show that current deficits are projected to increase because of projected increase in demand. For instance the deficit in the Lower Crocodile is projected to increase from 149 million m^3 to 169 million m^3 largely because of an increase in local requirements (DWAF, 2004a).

Such an estimated increase in current deficits is based on the assumption of fixed coefficients of water use such as, for instance, a fixed number of litres per unit of output. If industrial output grows by 10 percent so does the quantity of water use. Water use is however sensitive to price. If the price of water increases the quantity demanded will decrease. If the demand for water grows in a catchment then deficits should not increase as the price of water will increase. This increase in the deficit should not happen in a water-trading situation, as non-agriculture will buy water from agriculture in future. The total supply of water is fixed in the short-run while the demand shifts along this inelastic supply.

The price of water will increase as the demand and scarcity increase but the deficit should remain more or less the same. Meeting the requirement for an increased deficit is therefore not an argument to cut water to agriculture in future years. The market will allocate the fixed supply of water to the activities where its opportunity cost is the highest. The market thus accommodates future changes in demand and supply as the opportunity cost price of water is expected to increase (as demand increases) which would provide further incentives for conservation. The same argument has been used for pollution permits namely that the market price of the permits will increase over time as the demand for these permits increases, which raises the opportunity cost of pollution to the polluter.

In addition as the opportunity cost of existing water supply increases it provides a basis for determining whether the development of new sources of supply will be economically viable.

3.6.5.3 Other market approaches

Other market approaches discussed are:

(a) A fund to buy out water and

(b) Trading of unexercised rights (assuming trading is permitted).

3.6.6 Consider legality of non-exercised rights

There may be different reasons why farmers did not exercise their rights. Some farmers keep additional rights for supply assurance while for others irrigation may not be profitable because of high development cost of their land. The opinion of some is that farmers in both categories should be treated the same (van Rooy, 2006; Comrie, 2006). It does, however, appear more difficult to prove that irrigators who keep water for supply assurance did not actually use it, as there may be no surplus water in the river. Van Rooy (2006) questions this argument as he says that satellite photos can be used to verify acreage.

The Nelspruit regional DWAF office (Comrie, 2005) acknowledges a difference between exercised (i.e. currently used) existing lawful water users, and non-exercised existing lawful water users (i.e. where the rights are not used). It is estimated that 10% to 15% of water-use rights fall in the latter category (Comrie, 2005). The difference has a bearing on trade. Given the current over-allocation of water-use rights in the catchment, and the current real level of stress, any trades from a non-exercised existing lawful user to another user who will indeed use the water will cause further stress in the system. The activation of non-use rights is a problem also in Australia. This caused hardship and resentment from irrigation communities in the Murray-Darling Basin in Australia (Bjornlund, 2004).

The process of compulsory licensing will be required to understand how non-exercised existing lawful use entitlements are to be dealt with as this will require various legal opinions being tested in the water tribunal for a final ruling on the matter. In the interim, (i.e. pre-compulsory licensing period), there is uncertainty how to deal with these rights as there is difference in opinion between engineers and other parties (including legal) in DWAF.

The greater the stress in a river the greater the problem. This may not only be an issue in the Crocodile River and more general solutions need to be found in South Africa. Legal solutions need to be found that do not endanger peoples' rights but at the same time promote the use of water for overall social benefit.

3.6.6.1 Trading of non-exercised lawful rights (assume rights are not lost) if rights of all users are reduced

If non-exercised rights are not lost and if entitlements of all users (exercised and not exercised lawful users) have been reduced then trading can be used to transfer rights to users. This trading will not increase the deficit, as unexercised lawful rights are included in the reconciliation statement.

Trading unexercised lawful rights has welfare implications for users and non-users. Farmers who have not used their water because expected development cost exceeded expected benefits will get a windfall if these rights can be traded. The water price will be bid up as exercised lawful users now have developed land but no water. The value of water to potential sellers who have not developed their land is almost nothing otherwise they would have developed it. In a trading situation water takes on the value in its new use. It is estimated in this study that the price of water-use rights may increase significantly once water is the only limiting resource. It means that these non-users will reap substantial profits from the water market. The above reasoning implies that the value of water to sellers (who have not developed their land) may increase from zero (VMP on seller's farm) to about R45 000 per ha. The R45 000 is the difference between the price of land (and water) and the opportunity cost of land without water (refer 3.8.1). Given these welfare implications the question is then asked whether non-exercised lawful users who have never developed their lands and irrigated it should be permitted to transfer entitlements in the Crocodile River catchment. These transfers have no efficiency benefits.

3.6.6.2 Retain non-exercised lawful rights but not be permitted to transfer them

It is proposed that not allowing the transfer of non-exercised lawful rights be considered in the Crocodile River due to the stressed nature of the area. That is the only rights that may be transferred are when rights have been used for irrigation. Thompson (2005) was asked in the case of a non-exercised lawful user of water what is the likelihood of attaching a requirement that the water may not be transferred (sold or rented) while the right may be retained. He replied that it could be done as "it is possible to issue a license and that it may be used for a specific purpose and that transfer may not be approved". Conditions can be attached to licenses once they are awarded. Human (2005) was unsure and believes that section 33 of Act does not allow for conditions. Pretorius (2005) supports the suggestion that a non-exercised lawful user of water retains these entitlements but not be allowed to trade. Van Rooy (2006) stated that these rights should not be retained but lost as the individual will have the incentive to use it in future. This potentially sensitive issue has legal implications and needs further study. The uncertainty about who owns what will be removed once the compulsory licensing process is completed.

If non-exercised rights are transferred then farmers who acquire them attain more assurance but it comes at a cost of less assurance for others as the quantity of water is the same.

3.6.7 Supply augmentation by the building of a dam

The positives of building a dam are that it may cater for communities that do not receive water at present and it may also increase supply assurance. Supply assurance is important as the cost of the recent drought in the Crocodile is estimated at R50 million or roughly at about R1800 per ha (van Rooy, 2006). Another advantage is that no new land under irrigation needs to be developed in this situation as is the case when new dams are contemplated.

There still appears to be sufficient water during the raining season that can be captured for storage. The feasibility of building a dam is currently been studied but it

will only make a dent in the deficit (Comrie, 2006). The cost of such a dam could be in the region of R800 million to R1.5 billion (Comrie, 2006). Van Rooy (2006) is more positive about building a dam and mentioned that different options with lower cost are being considered. Jackson (2006) is of the opinion that a problem for water shortage is unlawful use and over-production and these issues must be attended to before a dam is built. A site or sites have been suggested. One site is the proposed Mountain View Dam or Montrose Dam on the Kaap River, a tributary to the Crocodile River.

The advantage of building a dam is that some of the current production is maintained. The cost of this dam could then be compared to the cost of buying out water-use rights for the corresponding production. The latter cost is the same as the reduction in the capital value of farm assets if water allocation is cut to reduce the deficit. It is estimated that the direct cost of reducing water for irrigation in order to meet the deficit could be R516 million. The indirect benefits from agriculture and forestry are estimated (Crafford et al., 2004) to be significantly larger than direct benefits. Benefits measured as value added and employment (full-time jobs equivalent) per unit of water were between 2 and 20-fold larger than direct benefits.

3.6.8 Other approaches

Lowering assurance level of supply of new applications has been suggested but it is not sure how this will apply in this area as assurance is already low. Where feasible, and this is very carefully formulated, the lowering of reserve requirements can be considered as a short-term measure to accommodate equity.

3.7 Approaches to deal with hydrological problems

3.7.1 Metering of water and enforcement of entitlements

A water management plan exists in the Crocodile River whereby the quantity of water is assessed on a weekly basis to determine how much water is available and periodically it is determined how this quantity is to be distributed amongst farmers (van Veyeren, 2005).

The water available in the river at the moment is far less than entitlements and the management plan had to be adjusted to ration the available supply.

Meters are being installed in the Komati and Lomati while Eskom is negotiating with farmers to use water during off-peak electricity-consumption periods (Comrie, 2005). The speed at which meters are being installed is affected by the fact that metering technology has not yet stabilized. Water is dirty which complicates measuring. If metering can be done accurately the Irrigation Board can be involved in installing and monitoring meters (van Veyeren, 2005). Van Rooy (2006) is of the opinion that satellite imaging can be used to verify use. The use of this technology is somewhat doubtful as farmers can spread their water. There are penalties for over-use but these are not enforced (Van Veyeren, 2005). He was adamant that water use in tributaries must also be measured and rationed.

A recent study (Van der Stoep et al., 2005) concluded that irrigation water measurement technologies are definitely available. In the report it is stated that each WUA' situation is different and no two WUAs can blindly apply the same devices. The technology must be managed which also includes procedures for handling disputes and tampering, data retrieval and management, support by users, maintenance policies etc. (Van der Stoep et al., 2005). Improving monitoring networks and water auditing to reconcile actual use with entitlements is a high priority due to allege illegal use and high potential value of water in this scarcity situation.

If water is not metered then there is little verification of use with no binding constraints. For property market institutions to function it is important that rights (user rights) be secure and be enforced. Both these criteria are important. More specific: (a) licensing of water-use rights (legal protection) will play an important role in providing security of the user right and (b) water-use rights are properly enforced. This is a weakness in the Lower Crocodile as water is not metered. Enforcement of rights implies that penalties are in place and implemented for exceeding licensed use.

3.7.2 Return flow problems

Comrie (2005) estimates the return flow from flood irrigation to be 30% while Mackenzie and Craig (1999) estimates it at 33% near Vioolsdrift and 30% near Louisvale. A tracer study was conducted near Vioolsdrift with the assistance of the Atomic Energy Corporation. This site is seen as representative of most flood irrigation along the lower Orange River. A DWAF (2004a) report estimates return flow from agriculture as about 10% in the Crocodile River.

The more stressed water is in a catchment the more important is the return flow. The issues involved with return flow considerations can get very entangled (Mcann & Easter, 2004). These issues will not be revisited in this report. A private meeting was held between the Team and Dr G Backeberg of the WRC and it was decided to suggest a more practical approach given the realities in South Africa.

3.7.3 Possible solution to return flow problem in the Crocodile River

It is proposed that the entitlement should be in terms of a measurable quantity of water. Return flow can be taken into account, in different ways:

(a) If return flow at present is very low due to water saving technology then it may be assumed that current use is the consumptive use. It is not clear if this is the case as DWAF (2004a) uses a return flow of 10% in its water balance statement.

(b) The water allocation to the farmer is reduced to allow for the loss in return flow. For instance the water allocation to a farmer below the Gorge of 13 000 cubic meters per ha can be reduced by up to 25% being the estimated difference in return flow loss between flood and drip irrigation. In this calculation it is assumed that original entitlements are for flood irrigation. All original allocations are thus converted to a consumptive use entitlement assuming best technologies (drip) and almost no return flow. The original (diverted use) entitlement has a legal standing and it is proposed that all farmers be treated the same if such a cut back is accepted whether he/she now uses flood, sprinkler or drip.

(c) The percentage reduction to convert diverted use in consumptive use only applies when water is transferred.

The legal opinion on return flow in South Africa according to Human (2005) is that it is not credited or debited but civil action is possible if water is moved and a farmer suffers a loss as a result. The legal problems from the loss in return flow which stymied water markets in the western USA are not an issue in South Africa.

3.7.4 The Reserve

Water available to the Reserve will depend on the location of existing extraction points of lawful users of water. Transfers from down to up-stream should thus not be permitted as it negatively affects the Reserve. South African water authorities are wary of the environmental impact and impact on down-stream users of such transfers. In the Western USA it is unlikely that these transfers will be approved. If farmers stop irrigating up-stream and sell their rights to down-stream users then stream-flow is improved. A case in point is the transfers in the Lower Orange and the Crocodile Rivers which have all been from up to down-stream (Gillitt, 2004). In these specific cases the up-stream users did not irrigate (non-users) so that there were no positive effects in terms of in-stream flow.

Jackson (2005) noted that if applications for trade are received in the same geographic area (Quaternary Catchment), the impact on the Reserve is not determined. A preliminary Reserve is available for the Crocodile River.

3.7.5 Water Quality

Jackson (2005) stated that water quality in the Crocodile was particularly bad during the time of the visit of the Team (November 2005) due to drought conditions that exist. The dilution potential of the system is compromised by the water scarcity. Hough (2005) also commented on the poor water quality in the River. He said that water quality was so bad that he had to relocate his nursery. If it is a dilution problem then protecting water for the Reserve will assist in improving water quality. Further research is needed to identify possible polluters and consideration should be given to pollution taxes based on the principle that the polluter pays for his damage. Van Veyeren (2005) also states that pollution is a problem. Examples are high salt and acidity levels partly caused by Sappi and settlements. Comrie (2006) on the other hand is of the opinion that water quality is acceptable.

3.7.6 Tributaries

The Vice-Chairman of the Crocodile Main Irrigation Board (van Veyeren, 2005) complains that no control measures exist on the tributaries of the Crocodile River. This is a legitimate concern that should be addressed by the to-be established WUA.

3.7.7 Conversion factors of forestry and agriculture

Van Rooy (2006) is not aware of any transfers of water between forestry and agriculture. According to Warren (2005) land under forestry can be converted to dry land sugar using the conversion of 1 ha sugar cane = 0.5 to 0.6 ha forestry. Trade

between irrigated agriculture and forestry is also possible and one case was noted where 1 ha irrigated sugar cane =10 ha forestry (the 10 ha was seen as extreme) (Warren, 2005). It is important that conversions be based on a scientific study of Stream Flow Reduction Activity (SFRA) and water use in agriculture. Stating that the above figure is extreme implies that such a study was not undertaken. If trades with the forestry sector are permitted then this sector will have increased incentives to promote conservation while water will move to more efficient uses.

Forestry, being a dry land user of water, is a SFRA. The NWA declared only Forestry as a SFRA. The Forestry Industry was regulated in terms of the Afforestation Permit System (APS) from 1972 to 1995 (Forest Act). The APS was replaced by a new SFRA Water Use Licensing System by the then Minister of Water Affairs and Forestry (Prof K Asmal).

The value of water in forestry and agriculture differs and trade is expected to take place if permitted. Olbrich and Hassan (1999) estimate net terminal values per cubic meter in this catchment as follows under current practice: eucalypts for saw log (R3.0), mangos (R10.9) and sugar cane (R1.0). Eucalypts for saw log and pulp dominated sugar cane in terms of economic efficiency. Under best management practice the terminal value per cubic meter of water is: mangos (R19), grapefruit (R15), oranges (R8), bananas (R6) and avocados (R4). Subtropical fruit crops are more efficient water users than forest plantations (Olbrich and Hassan, 1999).

There are about 200 000 ha unlawfully used (not authorized) in South Africa in the forestry sector out of an industry total of 1.4 million ha. The unauthorized area was planted post 1972, and permits were not applied for. The Forestry sector would like to get these farmers into the fold but legal experts disagree. It is not known whether some of the forest land in the catchment falls in the unlawful category and the legal implications are not known.

3.7.8 Information and models

Good information is the fuel of markets including a water market. According to Comrie (2006) the information used in the calculation of the deficit and Reserve will be updated. This is welcomed as some of the data can be refined, for instance, it is highly unlikely that alien vegetation consumes 57 million cubic meters of water while the estimate of the more significant forestry sector is only 42 million cubic meters of water.

Hydrological models are needed assess various water user scenarios in a catchment and its impact on individual users. Planning models exist at present but whether they can provide all the information required must be evaluated on a continuous basis.

At present information can be improved if adequately configured systems models (with accurately detailed information about water users and how they are linked to water supply options) and its implications for the Reserve were available. This is especially problematic where the applications are for water use in a different area from where the water is used currently, or where water is to be transferred to a different sector and assurance of supply considerations are involved.

In such cases it is understandable that there can be a hesitancy to process trade applications. Some hydrologists expressed the opinion that the necessary accurate information that can be provided by improved models (or alternatives) is urgent. Such models aided by suitable decision support systems available to the water resource managers to process trade applications (i.e. being able to confidently understand what the probable impact of any given trade application will be on other water users and the Reserve) is a major impediment to processing trade applications.

If this view is supported a major effort will be required evaluate present models, to adjust them and where appropriate replace present ones.

3.8 Some attributes of a water market in the area

Water transfers observed in the past were from above the Gorge to below the Gorge. The water allocation above the Gorge is 8000 cubic meters per ha and below the Gorge it is 13000 cubic meters per ha. According to Human (2005), all scheduled entitlements in terms of the 1956 Act were for an area with a volume coupled to it. If these entitlements are transferred then only the volume is transferred. This has happened in the past in this area as 1 ha above the Gorge yielded 8/13 ha below.

3.8.1 The price water-use rights may reach on the market

The net profit earned by a natural resource such as land and water, called rent, is capitalized in land in the absence of a separate water market. If water can be sold separately then these rents are separated. It is shown that a study of these rents (or capitalized value) may provide some information on future water prices. The value of land under irrigation down from the Gorge in the Lower Crocodile River is about R58000 (Slabbert, 2005, Van Rooy, 2006). Van Rooy (2006) provides the following per ha breakdown of the market price of water and land:

Water	R15 000
Bare land	R3 000
Development	R10 000
Cane	R10 000
Irrigation	R20 000
Total	R58 000

Source: Van Rooy (2006)

Some of these investments such as development and irrigation are sunk (fixed). It is expected that water in future will be transferred to non-agriculture which means that sunk investments will have a zero opportunity cost unless some of the irrigation equipment can be sold. If the opportunity cost of the sunk investments is zero then the price of water may increase from R15 000 per ha for 13 000 cubic meters of water to R45000 for 13000 cubic meters or to R3.46 per cubic meter. The transfer of rents from land to water should not affect the value of farms. The expected significant increase in water prices will provide incentives for its conservation.

The estimated water price is a maximum price as no site rents for land are assumed. Land closer to the river will always command site rent as it costs less to move water

over a shorter distance than further away. In such a scenario the price of land closer to the river will be more than its grazing value. It is also assumed that water is given as much legal protection in terms of security and enforcement as land. However, given the uncertainty of site rents, the best estimate is that the price of water is expected to exceed the price of land (land excluding water) in future, which means that water prices may still double.

A farmer will not be prepared to sell his water-use rights from land under irrigation (if rights are fully appropriated). The reason is that land without water will have little value (R3000 per ha which is the value of bare land). If non-exercised users cannot sell water then a farmer who wants water can only purchase it from a user who irrigates. The conclusion is that no user who irrigates (exercised user) will sell his water and no sales in this category will take place until the price of water increases sufficiently. Van Rooy (2005) concurs with this conclusion and logic. It is predicted that no sales from exercised users to other exercised irrigators will take place for some time. Where farmers can also sell to non-agriculture the price of water in agriculture will be determined by what non-agriculture is prepared to pay. As cities can afford to pay more for water, transfers to them will take place. It is also predicted that the price of water will increase as the rules (legal requirements) protecting irrigation rights are more effectively enforced.

Water prices have increased significantly (at least threefold) since 2005 when the area was first visited. During the visit in 2005 Putter (2005) estimated the market price of water at about R2 500 per ha although van Rooy (2005) mentioned that the price could vary between R2500 and R5 000 per ha. It appears as if the market price of water is sensitive to market forces. The following three reasons may have contributed to the recent increase in water prices:

(a) The drought. According to Jackson (2005) prices have gone up to R15 000 per ha due to the drought.

(b) Increased prices of sugar. Water prices may also have increased in response to the significant increase in international sugar prices from about 4.5 US cents per pound 24 months ago to 20 US cents per pound on 3 February 2006 (Sunday Times, Business Times section, February 5, 2006).

(c) Separation of water and land rents. It is concluded above that water prices will keep increasing as farmers who irrigate now refuse to sell at current market prices as land without water has little value. It has become difficult if not impossible to buy water from unexercised users. The past drought also provides the same market information namely that water is the limiting resource and not land. The drought was broken in 2006 but water prices appear high which could mean that more long term structural forces as have been explained (separation of water and land rents) are driving water prices.

Water prices may have been depressed in the past because of the following policies (a) non-exercised users were able to sell, (b) no adequate metering is undertaken while (c) past policies attributed a scarcity value to land and not water. Under riparian law ownership of riparian land provides access to water. Farmers have been given fairly generous water quotas per ha with the implication that land was the scarce resource and not water. The markets priced land and water in accordance with this.

Land (land without water) prices will move downward as rents move from land to the scarce resource water.

Given the scenario outlined above it can be expected that water prices will increase significantly in future. Higher prices in turn will provide incentives for its conservation.

3.8.2 Assurance (inter- sectoral and farm level)

Van Rooy (2006) says that assurance (security) is the main issue and not so much scarcity. The cost of the recent drought is estimated at R50 million or R1800 per ha which is very high. Farmers may be prepared to pay in order to attain more assurance during adverse times. The main reason for trade in the Crocodile is to achieve a greater assurance of supply (Van Veyeren, 2005). Additional water-use rights are therefore acquired to use on existing land rather than to extend the acreage under irrigation. This is not surprising given the uncertain supply in the river and the fact that the Kwena dam during the past year (2005) was reserved for urban use (Comrie, 2005). This dam, however, is an important source of water for farmers in most years (Van Rooy, 2006).

3.8.2.1 Assurance categories

Categories of assurance users are low, medium and high. Typically water used for irrigation purposes fall in the lower assurance category. Different charges are levied on irrigators, domestic water use, industrial water use and water use by forestry. Higher assurance users pay higher water use charges than lower assurance users. A water market will also attach a premium to assurance in a trading situation over and above the different charges attached to given assurance categories. The charges may be seen as a method by which cost can be recovered but not so much as a pricing mechanism of the value of assurance.

Effect is given to the assurance levels via system operating rules. The operating rules relate to restrictions during periods of relative water scarcity. The rules will discern:

- Who is to be restricted,
- By how much, and
- When exactly the restrictions must “kick in”.

3.8.2.2 Assurance in agriculture for individual farmers

According to prior appropriation rights in the Western USA, senior rights must first be fulfilled before junior rights, which provide more certainty of supply to senior right holders. Under riparian rights, rights are expressed as a percentage of water available for irrigation, which is an equal misery scenario. Although the NWA has moved away from the riparian water law the percentage use principle is still a feature of SA water practice. The practice of retaining additional user rights as supply insurance in the latter situation is supported by Thompson (Conningarth Economists, 2004, p109). One of the strategies for farmers to assure that sufficient water is available during periods of droughts is to buy additional entitlements that can serve as an assurance

buffer. This is particularly important where water supply is irregular, no dams exist and high value crops are grown (such as bananas in the Lower Crocodile below the Gorge). Holding water or non use rights have been seen in the past as bad policy and is not supported by current water legislation in South Africa. However, the "use it or lose it rule" also embedded in water laws of the Western USA may promote over-use of water (Matthews, 2004).

The individual producer who wants more assurance in situations where water supply risks are high (no or inadequate dams upstream) while high value crops are grown may thus be vulnerable. For instance Mr. R Plath, manager of Umbhaba Estates in the Crocodile River said that they have 450 ha under bananas (which is large) and only 40 ha under lay (legume) crops. Water supply is highly irregular and low assurance water users were cut back by 50% during one month in 2004 (they irrigate from the Crocodile River). They are very concerned about droughts and need to ensure that they have enough water for the high assurance crops during dry periods to ensure that minimally the health integrity of the plant is not compromised. In order to ensure that ample water is available during dry periods (being periods in which water restrictions are imposed), additional entitlements need to be gathered. This strategy ensures that even after restrictions have been imposed, there is enough water for the survival and possibly productive needs of high value crops in particular (such as bananas). Note that the assurance category is not changed (as this has water use charge implications). Rather, the user secures extra water entitlements of a given category (e.g. low assurance rights) in order to increase his personal assurance level.

Farmers will thus be able to decide for themselves how much insurance they want. A farmer who is highly risk averse may want more insurance than one who is not. This will improve the investment climate as an irrigator may have a greater incentive to invest if he can manage his risk better. In a water market a farmer is faced with the opportunity cost of water (insurance premium) and he thus has little incentive to "hoard".

The view of Jackson (2005) is that surplus rights are not part of the new dispensation while van Rooy (2006) states that non-exercised rights must be lost. Human's (2005) legal opinion is, however, that the farmer may have additional rights once licenses have been issued. After compulsory licensing the "use it or lose it" will have less validity as explained previously.

If additional rights are lost if not used then the best option for a farmer who wants to protect a high value crop is also to irrigate a low income annual crop such as grazing. That water can then be transferred to the high value crop in times of scarcity. The low assurance of supply in the river is one of the reasons why buyers of water-use rights in the past were in most cases sugar cane farmers. Sugar cane is better able to recover from drought. The water market institution in terms of how assurance is handled has an impact on the choice of enterprises.

3.8.2.3 Assurance of residential and other urban uses and conversion factors.

Residential use and industries generally have a low price elasticity of demand for water indicating a high level of assurance. DWAF (2004c) proposes the determination of a conversion factor between agriculture and urban/industrial as a ratio of the water

available for irrigation at 98% assurance and the total irrigation allocation. In the example given water available for irrigation at a 98% assurance was 10 million m^3 while the total irrigation allocation was 16 million m^3 giving a conversion factor of irrigation to urban/industrial of 0.625 or 62.5%. It appears as if the above method is applied as Van Rooy (2006) says that a conversion factor is used when water is transferred between irrigation and urban.

A more market driven approach is used by some cities in the USA. It is common in the Western USA that cities acquire more water-use rights than they need at present to satisfy their level of assurance. These surplus water-use rights are then rented back to farmers. The advantage is that a city can decide what level of assurance is required based on very region specific data. Cities may want more assurance in terms of availability during the year and also assurance for future supplies. If this is applied to the previous case a city may purchase 100 units of water if it needs 62.5 units at an assurance of 98%. The city is not going to need all 100 units every year so the best use for the 37.5 units will probably be irrigation. In this case the level of assurance is decided by market forces which relieve the authority of making ratio calculations for different situations. It is common in South Africa that cities purchase land near the city for future possible expansion while this land is used by agriculture in the interim period.

In the Western USA, prior appropriation rights apply meaning that cities have a high percentage of assurance. It is also common under the riparian system that urban users receive a higher priority use right for water for instance in the eastern part of the USA. This is also the case in the Crocodile River as the water from the Kwena dam in 2005 was reserved for urban use. It may be necessary to retain the latter principle in spite of the above conversion ratios giving urban centres more assurance.

3.8.2.4 Municipalities

Municipalities are important users of water and their needs must also figure strongly in the water management strategy of the catchment. The biggest municipality in the area is the Mbombela local municipality (Nelspruit area). In discussions with municipal officials (City Engineers Office, 2006) it would appear as if supply and demand for the Nelspruit area is at present finely balanced. New areas specifically the former Kangwani area that was for a time managed directly by DWAF and now falls under the Mbombela municipality are already exceeding their allocation.

Faced with uncertainties about water availability to service new developments the municipality approached DWAF as far back as 2000 for a larger allocation. Given the stress in the catchment as well as water needed for the Reserve such requests could not be granted.

The municipality is not inclined to stop new developments just because of possible water shortages. Developers must transfer any entitlements they had on water on the, to be developed areas, to the municipality. If water cannot be obtained in this way developers must pay a charge that would enable the municipality to obtain water for the new development.

The municipality is at present working on a strategy to address future water shortages. If the proposed Montrose dam is built some time in the future water from there will be a possibility. Another option is to buy water-use rights. The market approach is still new to the municipality and doubts are expressed as to whether entitlements will be for sale.

The municipality of Mbombela is positive about cooperation with other water management agencies. In the past good cooperation existed between IBs and the municipality. For instance in the case of the town White River water is provided amongst others from the Witklip Dam where the municipality and the Sand River Irrigation Board have a good working relationship. A number of IBs are busy with the transformation process in the catchment and it places a heavy administrative burden on local government officials. It is not clear what the role and financial commitments of the municipality will be in new WUAs.

No contact has taken place between the City Engineers Department and the CMA, the perception is however that the CMA will not be fully functional within the next 5 years.

3.8.3 Sales and rent of water

Van Veyeren (2005) stated that farmers in the Crocodile River prefer sales to renting as it provides more security. Transaction cost and other cost probably explain why in the lower Crocodile more rental transactions (in number as well as area) than permanent transactions are observed (Bate et al., 1999). It has been suggested that the rental market is more active in the case of annual crops where long term security of water use is not as important as in the case of long term crops (Gillitt, 2004). Renting is important as it provides an opportunity cost price to the resource.

The Regional Director can allow leases for one year (Jackson, 2005). Contracting parties obtain information of rental possibilities amongst themselves or via the secretary of the Irrigation Board (van Veyeren, 2005). The transaction is referred to the Board for approval and the quantity of water to be transferred, as agreed by the parties, is implemented by the Irrigation Board. The rental price is not recorded. It would appear as if the Regional Office is not involved in this process.

3.8.4 Length of the period of a water use license

Producers of long term crops or who have significant investments can obtain water-use rights for a longer term (NWA, section 27 (1) k). The length of a water use authorisation for these producers will be reviewed after a five year cycle with a maximum duration of 40 years while for other producers the periods will be shorter. According to Human (2005), the authorisation regarding the length is dependent on the nature of the crop involved. Long-term leases are not allowed as leases are for one year only. The Government wants to find their feet first and needs flexibility in the interim period regarding the length of authorisations (Human, 2005). The shorter period increases insecurity in use and has an impact on future long run investments. Property rights are an essential component of a market. However, according to van Rooyen (2005) allocations may not be revisited every five years due to manpower problems. The crops grown in the area have long time horizons for instance (years of

life or rotation): Sugar cane (6), orange (20), grapefruit (12), mango (16), banana (10), and avocado (25) (Olbrich and Hassan, 1999).

3.8.5 Water charges

Water use charges are introduced to cover the cost of providing water. Jackson (2005) mentioned four types of charges levied on water users, including a water research charge, a CMA charge, a scheme charge and a WUA charge. The CMA charge is a flat charge, and differs from one WMA to another.

3.9 Small growers and empowerment

In order to redress the inequity in land ownership, the National Department of Agriculture (NDA) assist PDIs to purchase land using varies models and finance strategies. PDIs for instance can obtain grant financing from the NDA which can be coupled with loans from the Development Bank of South Africa. Small growers will in future be more represented in the structures of the WUA than is currently the case with the irrigation board.

3.9.1 Right of first refusal

It is often claimed that properties are mostly transacted between white farmers and that PDIs have difficulty entering the market. In residential property it is common that a prospective buyer can state his intention in writing that he wishes to acquire a right of first refusal for a specific property. If this is agreed to by all parties in writing then the property will first be offered to this prospective buyer. The seller may, however, sell to anybody else and this right does not affect the market price but it alerts the buyer (who has the right) about the sale. In order to promote transfers, PDIs may be given the right of first refusal to purchase a property. Van Rooyen (2005) stated that he is not against such rights. This approach presupposes that PDIs will have sufficient resources to buy the property.

3.9.2 TSB Sugar small cane grower scheme

There are a number of projects to assist small farmers in the area such as, amongst others, a vegetable grower's project and a flower grower's project. TSB Sugar's initiative involving small sugarcane growers is one of the more successful initiatives.

3.9.2.1 Background to TSB Sugar's small cane grower scheme

The success of this scheme is attributed to the technical expertise that is provided by TSB and the marketing of the small farmer's sugarcane crop that is handled by the TSB mill in Malelane. Short term financing can also be obtained against the security provided by the annual harvest. TSB is involved in two initiatives to establish successful black farmers. One for small growers in the Komati and Lomati river catchments and a number of medium scale projects designed to establish commercial farmers. In the Komati and Lomati area 1330 farmers are assisted by TSB. The size of each farm varies between 2 and 20 ha with the average size of 7 ha. The farms are on communal land that falls under the direct control of tribal authorities.

Yields realized by the small growers are good. The top third of the farmers obtained similar yields to commercial farmers. The middle third realized yields somewhat below that of commercial farms. The bottom third is performing poorly because of a lack of interest and motivation in farming.

TSB is also involved in a partnership arrangement with ABSA, Khula and the Dept of Land Affairs in a number of projects to establish black commercial farmers. Land is purchased and developed, potential farmers selected and the farms offered to them for sale at market prices. The average price of land under sugarcane is estimated to be in the range of R58 000. A 15-year loan is provided at an interest rate that is determined annually based on the price of sugar that is in turn influenced by the exchange rate. At present 580 ha is under development on which the establishment of 13 farms is considered. The investment of the newly established farmers is therefore substantial. Since the establishment of farmers is based on commercial principles no restrictions on the buying or selling of such farms are foreseen.

3.9.2.2 Water use and tenure issues

Although farms are not individually owned, tenure of individual farmers is fairly secure. Land and water-use rights cannot, however, be sold. It is suggested that a renting market for land and water be promoted in the smaller grower areas which will expose these farmers with market incentives. This needs to be discussed with small growers. In order to fully understand the impact of market forces, rules may be developed that prohibits water from moving out of the small grower area. Promising initiatives have started in KwaZulu-Natal regarding the promoting of renting of land in communal areas. There are also PDIs that own arable land with no water-use rights (Slabbert, 2005). DWAF (2004a) also states that there is a huge demand of water from emerging farmers, yet no allocable water available. If these lands are not developed then it may make more sense to assist these farmers to acquire developed land which has water-use rights.

3.10 Final comments

The functioning of a water market in the Crocodile River, is at present, hampered by a degree of uncertainty on a number of issues. Ways of how the deficit will be resolved has not been addressed. Land claims appear to have been resolved but the new owners need to take charge of their properties. Other issues of importance are legal issues such as the position of non-exercised rights. If cutbacks are not political feasible other avenues as discussed will be considered. Hydrological issues such as for instance lack of metering need attention while a. decentralised administrative structure is in the process of being implemented. For any market to function properly such uncertainties must be removed.

3.10.1 Pre- and post compulsory licensing phases

The functioning of a water market should be discussed in the pre- and post compulsory phases. This is because the compulsory licensing phase will address some of the major impediments to trade. The relevant conditions that compulsory licensing will address are the clear definition of all entitlements in a catchment so that the

volumes or rate of flow reliability and priority of right are known and free from dispute. The major elements of uncertainty caused by the balancing of supply and demand, the verification of lawful water use, Reserve requirements and assurance levels will also receive attention. Political considerations due to redistribution and restitution claims would most probably also be closer to completion.

Technical information to be provided by improved hydrological models, market information, decentralisation and delegation of approval procedures, the metering and efficacy of enforcing licensing condition requires constant diligence.

The larger part of this document where catchment specific issues are discussed refers to the present pre-compulsory licensing period.

3.10.2 Transaction cost, administrative structures and the delegation of authority

The application of an ad hoc license requires amongst others the verification of lawful use. It is uncomplicated in the case of GCWS. In the non-GCWS situation this procedure is more complicated and verification cost can be as high as R15 000.

A large element of transaction cost is tied up in the time it takes to approve a trade. Time delays can also be a discouraging factor that can inhibit a market. The present approval procedure is centralised and has the disadvantage that local conditions cannot be taken into account.

Hydrological models and the data needed to assess the implications of a proposed trade can be very demanding. Both the models and information needs continuing attention to eliminate delays caused by complicated trades. This is especially relevant in the case of inter-area and inter-industry trade.

The decentralisation of approval procedures is dependent on the functioning of CMAs. The ability of these organisations to have the necessary technical expertise and the technical information as provided by user friendly hydrological models to assess the influence of a proposed trade on the rest of the catchment water system are also needed. Impediments in both these elements limit the full blossoming of a market.

The local level structure is also very important for the orderly functioning of a water market. They must protect the rights of their members and monitor and enforce the conditions of the entitlements. In the case of temporary trade they have a major responsibility for the functioning of this market. The transformation of IB to WUA is taking longer to complete than as was initially anticipated.

3.10.3 The deficit issue

The choice as to how to deal with the deficit is a political decision. In this contribution the deficit is studied from a water market perspective. Different approaches to the solution of this issue have been discussed. The position of non-exercised rights and whether to allow it to be traded is a problem. It is partly a legal issue. How to resolve legal issues is not certain as the opinions of experts (engineers,

lawyers and others) differ. The activation of non-exercised lawful rights does not affect the deficit as these rights are included in the reconciliation statement as irrigation use. The buyers of these rights will increase their assurance level while the assurance of the other farmers deteriorates as the available water is the same. Assurance is major problem to farmers as the loss from drought during the past year is estimated at about R50 million which could amount to a rough estimate of as much as R1800 per ha.

CHAPTER 4. WATER MARKET INSTITUTIONS IN THE OLIFANTS RIVER CATCHMENT

4.1 Introduction

The Olifants River Catchment consists of a fairly large mining sector as well as large electricity generating plants, a number of government water schemes and large domestic water users. Apart from the abstractive use of water the quality of water is critically affected by industrial, urban and agricultural activities. The control of water quality thus adds a new perspective to the use of water resources in the catchment.

A brief description of the catchment is followed by an outline of factors that impact on water markets. The factors that were identified are discussed in detail in the chapter. These include the impediments and preconditions to water markets, the stage of the development of administrative institutions and the extent and characteristics of a water market in the catchment at present. Important hydrological aspects include the stage of the determination of the Reserve that is dependent on the Water Resource Classification System. Various supply management issues such as the building of a new dam, the linking of the various supply sources such as surface and under-ground water sources are highlighted.

The environmental impact of sources of pollution in the catchment and approaches to control it get considerable attention. In the upper Olifants a number of mines co-operates voluntarily in a controlled release scheme. The quantity and time of the release of polluted water from the mines are monitored and administered so that quality of water in rivers and dams, in this case the Witbank Dam, are within the specified limits. Other approaches to the control of water pollution such as a discharge tax, tradable discharge permits and offsets are discussed.

The extent of successful small irrigation farmers in the catchment at present is not clear. It would appear as if small farmers are mainly operating on a subsistence level. A brief discussion of small farmers in the catchment is presented.

4.2 A description and mapping of water use in the catchment

Approximately 3.4 million people live in the Olifants River Catchment and a considerable proportion of South Africa's mining, power generation and agricultural activities are concentrated here (McCartney et al., 2004). The catchment also encompasses important tourist destinations (such as the Kruger National Park). It is estimated that activities within the Olifants Water Management Area (referred hereafter to as the Olifants Catchment) generate 6% of the GDP of South Africa. The Olifants River CMA will be responsible for managing water resources to the point where the river flows into Mozambique. The Catchment is divided into the Upper Olifants, Middle Olifants, Steelpoort and Lower Olifants. The climate varies from cool in the south (Upper Olifants) to temperate in the central part (Middle Olifants) and sub tropical east of the escarpment (Lower Olifants).

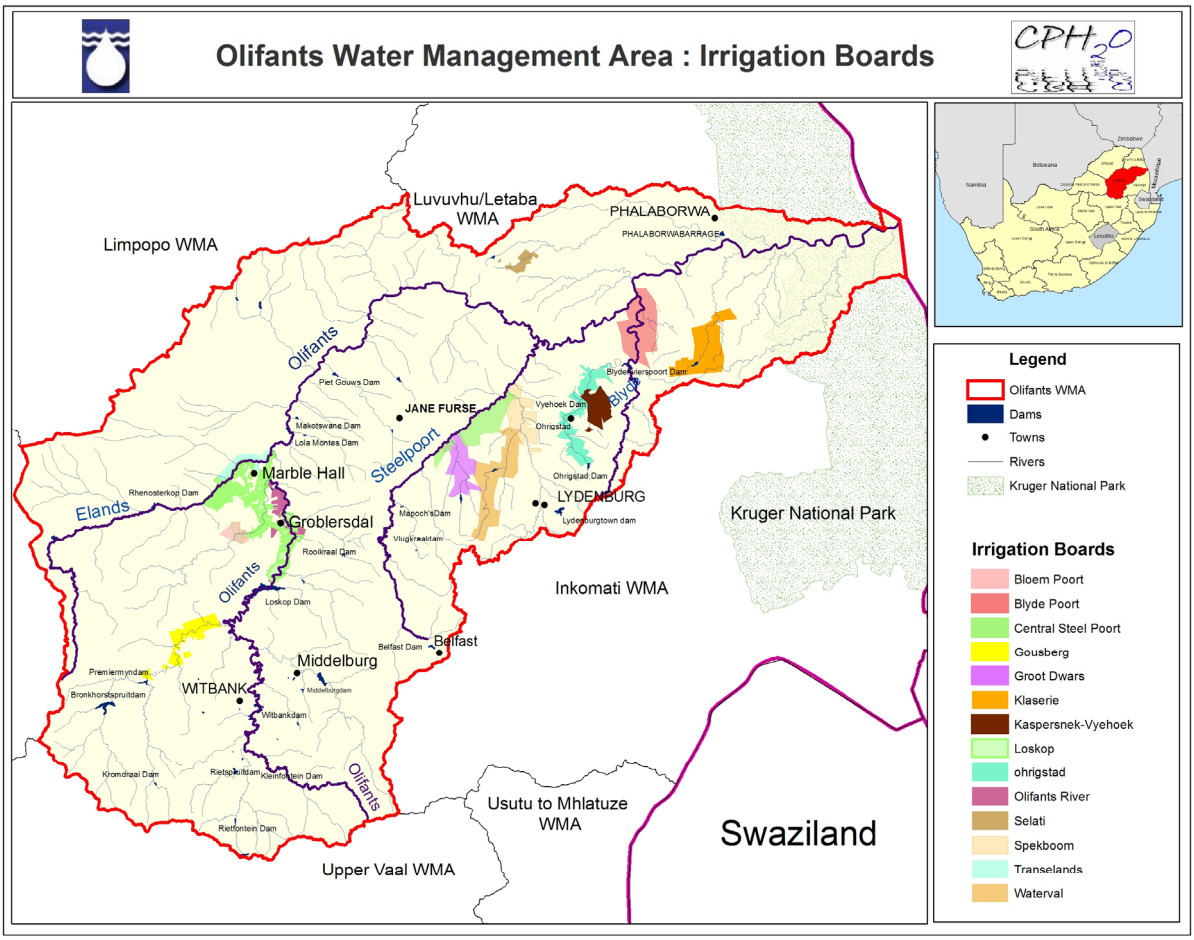

Figure 2. A Map of the Olifants River Catchment showing the major tributaries and irrigation boards

About 20% of net availability of water originates from underground water sources (NWRS, 2004 p168). Substantial under-ground water sources are available in especially the Middle Olifants where 40 percent of the available water comes from under-ground sources. The reconciliation of water availability and requirements for 2000 indicated a shortfall in the Catchment of about 20 percent. The distribution of the shortfall is about 24 percent in the Middle, 36 percent in the Steelpoort, 38 percent in the Lower and balance in the Upper Olifants respectively. The water balance statistics for the catchment are at present being updated and it is not known whether the estimated shortfall will change as a result of this more accurate reassessment.

4.3 Impediments and preconditions to a water market in the catchment

The two major impediments to a market in the catchment are the existence of land claims and the lack of proper metering of water use. The occurrence of these factors in the catchment is subsequently discussed.

4.3.1 Land claims

Land claims under the Governments programme of restitution are important in the Olifants Catchment. These claims have two major consequences. On the positive side it is a vehicle by which water-use rights will be redistributed and it will promote the equity objectives as stated in the WAR document (DWAF, 2005). As the value of water is capitalised into the value of a farm the restitution of agricultural land under irrigation will also redistribute the associated water-use rights. On the negative side it has a negative impact on new investment in irrigation farming until the process is completed. Sales of water and land are not possible if claims are lodged against the properties. It is shown below that almost all the irrigated areas visited are affected (directly or indirectly) by restitution claims. Both these issues will be further discussed in relation to the Loskop Scheme and the Blyde River Irrigation Scheme.

Loskop Scheme: According to Van Stryp (2006) land claims have been lodged on 50% of the land in the Loskop Scheme. Pretorius (2006) seems to think that there is a blanked claim on the Loskop Scheme that falls in the former Lebowa area while Prinsloo (2006) is of the opinion that the entire surrounding area is under land claims. There are many claims in Loskop North (7300 ha). Postma (2006) estimates that so far 10% to 20% of claims have been processed. According to Postma (2006) and Prinsloo (2006) the land market has come to a standstill because of claims. No land (and thus water) may be sold if a claim is lodged against the farm. Many farmers are contesting claims and a committee has been established to oppose the claims (Van Stryp, 2006).

Due to the uncertainty that a claim may be lodged against a farm, even if there is at present no such claim, results in banks being reluctant to accept the collateral of a farm as security against a loan (Prinsloo, 2006). It thus appears as if the uncertainty created by restitution is affecting all the farmers and not only those who have claims against their properties. Prinsloo (2006) states that the uncertainty of unsettled land claims renders sound planning impossible. New investment projects on land under claim cannot be undertaken without approval of the Land Claims Commissioner. The Land Claims Commissioner also discourages improvements such as the replanting of orchards and building of packinghouses (Prinsloo, 2006). In addition should a claim be successful, improvements such as capital invested in new farm projects are not taken into account in determining the value of land or at least are not fully taken into account. This stifles investment as well as the land market (Prinsloo, 2006).

Land for sale with unsettled claims are advertised as such but since there is a risk attached to such a transaction it will lead to a lower price (Prinsloo, 2006). Capital investment for grape production can be as high as R160 000 to R200 000 per ha. Such investments will not be undertaken in case of land under claims.

Government is not forthcoming with information on land claims, which adds to the uncertainty. Communication channels are slow or non-existent, so that a stalemate situation has arisen.

Blyde River Irrigation Board: All the land in the Hoedspruit area is subject to land claims (Van der Merwe, 2006). The process needs to be completed by 2008 but he does not think that they will meet the deadline, as the land claim process is slow. It is

estimated that about 30 to 40 percent of the land involved in claims will be successful. About 10% of the land is claimed in the first phase (PDIs have received land), 10% of the land is in the process of moving to PDIs while another 10 % of the land is anticipated to be processed. Many farmers (139) are opposing the claims in court. At present the market for irrigation land is flat as a result of claims. It is also not clear how the new owners will manage the transferred land. No new investment is undertaken because of claims and no water will be purchased in such an uncertain environment.

The following restitution process is followed when a claim is lodged against a farm. If the farmer agrees, an assessor is sent to the farm and an offer is made. If the offer is accepted the farmer is paid and transfer occurs. If the offer is not accepted then currently the threat is that the land will be expropriated.

A problem with the valuations is that goodwill is not considered, the full value of the house is often not included in the price of the land while in addition the land market is depressed. For instance, land claims are currently put a value of about R1800/per square meter on a house (which is way below the market price). In some cases the farmer stays on the land in a joint venture to ease the changeover process.

4.3.2 Lack of metering and monitoring

The Loskop Irrigation Board monitors water use and because it is a closed system there is no room for illegal use (Van Stryp, 2006). Water in the Blyde River Scheme is also metered (payment is based on metered water) and assurance of supply is high. The absence of water metering and monitoring is a problem in other areas according to different sources. DWAF (2004b) states that over commitment is a problem. According to Havenga (2006) illegal use is a major problem. Pretorius (2006) alleges that mines abstract water illegally in the catchment near Witbank. Where water is abstracted from rivers various problems may complicate measurement as the meters may be blocked by for instance fishing lines. Pretorius (2006) suggests that because of problems encountered with metering that other proxies for water consumption such as electricity consumption should complement it.

A statement from Gyedu-Ababio (2006) that should the Kruger National Park buy or rent water then the water may not reach the Park highlights the fact that the lack of water meters and insufficient monitoring in areas outside the Government Water Schemes is problematic. He was also unhappy about the fact that at present the dams are full but the Park does not even get its low flow allocation. The latter problem may be attributed to a lack in metering and monitoring because if water is released from dams then it may disappear in the system and never reach the Park.

Van Stryp (2006) is concerned that DWAF does not exercise control and enforcement to deal with illegal water abstraction especially with regard to stretches of the river above the Loskop Dam, i.e. upper Olifants Catchment. For example a farmer sunk a borehole in close proximity to the riverbank without authorization and thereby effectively using water from the river illegally. He is also concerned about pollution control and poor water quality in the upper Olifants. Raw sewerage seeps into the river near Witbank with no remedial action (Van Stryp, 2006). This water is not fit for human consumption. Clearly, improvement of DWAF's monitoring and enforcement

capabilities is needed. In a similar vein Rossouw (2006) and Van Stryp (2006) favour the conversion from IBs to the establishment of WUAs throughout the catchment as they may have a better chance to curb illegal water abstraction through self-regulation.

4.3.3 Other restrictions

It would appear as if a dominant factor in an irrigation scheme is to keep the cost of its operation as low as possible. Van Stryp (2006) has no objection to water trading as long as it does not negatively affect administrative cost of the other water users. In addition water trade will not be opposed if the trade is from the lower reaches of a canal to the upper reaches of the same canal. This is because the canals may not be able to carry the volume of water that may go downstream in case of a sizable trade.

4.4 The development of administrative structures

The development of administrative structures to support the implementation of the provisions of the NWA is an ongoing process. The discussion presented relates directly to the specific case study area.

4.4.1 The Department of Water Affairs and Forestry

In discussion with DWAF the importance of reaching the compulsory licensing stage was re-emphasised (Havenga, 2006). It will result in a clear picture of water-use rights and the resulting administration of water use. It is however difficult to establish a timeframe for the compulsory licensing process since public participation forms a significant part of the process and it is always difficult to determine how long that will take.

4.4.2 Existing lawful use

In order to evaluate the actual use of water against the lawful use, validation and verification of water use must be undertaken in the catchment. The validation is now completed. During this process that took about 12 months (considerably longer than the 6 months originally envisaged) it became clear that there were over as well as under registrations of water use. It was also established that about 450 dams existed that were not registered. It was indicated that in this respect the Department will be as accommodating as possible. Rather than dismantling an illegal dam an opportunity will be provided so that the impounded water can be lawfully declared.

The next step in this process is the verification. This is to be carried out in terms of section 35 of the Act, which is largely an administrative exercise.

4.4.3 The Water Resource Classification System (WRCS)

Progress has been made with respect to the Reserve determination process in the Olifants Catchment. The present Reserve is preliminary in the sense that the formal classification system is not yet complete. A comprehensive Reserve determination is subject to the development of guidelines and procedures to determine the different

classes of water resources. DWAF (2006b) is at present developing a Water Resource Classification System (WRCS). This process is a consultative process that will lead to the classification of all meaningful water resources into a specific Management Class (MC). Provision is made for four classes that range from class 1 being natural, class 2 moderately used, class 3 heavily used and lastly class 4 being an unacceptable degraded resource.

The economic, social and ecological implications of a specific MC will be established and communicated, discussed and agreed upon with Interested and Affected Parties (I&AP) during the classification process.

It would appear as if the WRCS would be gazetted early in 2007. A period of 60 days is allowed for comment on the gazetted RWCS. Thereafter the classification process can commence with the announcement of the:

- Class (MC)
- Resource Quality Objectives (RQO)

These specifications will be gazetted by the Minister and after this is in place the Reserve determination can be finalised.

4.4.4 Models to support the implementation of the NWA

Up to now the models available to DWAF were mostly planning models. In order to determine and evaluate various water availability scenarios these models have to be updated and improved. Model development by DWAF has progressed to such an extent that the improved models will be available for use from August 2007.

At this stage it is not known what the capability of the models will be. It needs to be stressed that as the implementation of the NWA and especially licensing unfolds there will be a need for planning models and also for operational models.

The administration of water use licenses can be said to consist of two related stages namely:

Planning stage consisting of;

- The definition of the water-use rights (i.e. the privileges and responsibilities associated with the different entitlements) and
- The initial allocation of the entitlements.

Operational stage consisting of;

- The management of the allocated entitlements.

It would appear as if the models available at present would deal with the planning phase satisfactorily.

Once the initial round of water-use right allocations has taken place upon completion of the compulsory licensing process, the challenge will be to manage the water-use rights in circulation.

4.4.5 Stage of development of CMA and WUA' in the Olifants River Catchment

The establishment of a CMA for the Olifants Catchment has been postponed and it is not foreseen that it will be established within the next two to three years. The reason for the delay is partly due to the fact that the Inkomati CMA is not yet fully operational. The experience gained with this first CMA will be valuable in the establishment of the new CMA. Considerable progress has been made with the Inkomati CMA but the organisational and policy design phases are a cumbersome task. Similarly the incorporation of the staff from the Regional DWAF Office into the CMA can be a time consuming operation. Until the Olifants River CMA is established and operational DWAF head Office will continue to fulfil the functions that will eventually be assigned to the Olifants CMA.

The Lower Blyde River Water User Association is the only such local body established under the provisions of the NWA. Since our visit in 2006 a further three WUAs have been instituted in the catchment (Jackson, 2008). Weston (2006) acknowledges it that the NWA lacked clarity on the role and scope and policy regarding WUAs. The result is the slow process of instituting WUAs. It is a matter that is at present receiving urgent attention from DWAF. A new director dealing with water use governance issues has been appointed. In addition amendments to the NWA have been formulated that will resolve the lack of clarity surrounding WUAs.

It is acknowledged that a WUA must perform a broader more integrated water management role at the local level than the present irrigation boards. A mitigating factor in getting this approach going is the issue of land reform. Full representation on the WUA cannot be achieved without the re-allocation of water associated with land reform.

It is also acknowledged that the size of the WUA may be a problem in the sense that if a jurisdiction becomes larger it may become too heterogeneous to be a meaningful management unit. It would appear as if there is an acknowledgement that there may be a role for an overarching local body that can coordinate the broader functions of local integrated water management. This can be achieved by creating a specific integrating or coordinating body or can be handled by a special committee of the CMA.

These issues are reflected in the experience of the Irrigation Board of the Loskop Dam where the effects of actions of users and polluters in the upper catchment have a detrimental effect on the quantity and quality of water in the Loskop Dam. On the other hand an organisation that includes users not directly using water from the Loskop Dam is not considered to be functional.

At present, however, water boards, especially that of the Loskop Scheme, are getting impatient because the advantages of a WUA from an integrated water resource management perspective are envisaged. The challenges that such an integrated approach presents are however often overlooked.

4.5 Characteristics of a water market in the Olifants Catchment

It is expected that water will be transferred in future from agriculture to urban and residential use. Urban use is expected to double by 2010 (McCartney et al., 2004). Significant future mining development is expected in the area, especially platinum and chrome mining (Van Stryp, 2006). New mines might, however, initially utilize existing groundwater.

4.5.1 Water trades and water prices

While the trading of water is presently not significant, it may well become more established once the whole compulsory licensing process is completed (Havenga, 2006).

Although the climate varies significantly from the Upper Olifants to the Lower Olifants, climate and crops within each sub-area appear more homogeneous. This homogeneity in climate (and crops grown) in a sub-area means that the incentive to trade within agriculture in the same sub-area may be less. This is different from catchments where significant trade within agriculture has been observed in the past. Climatic conditions in the Boegoeberg region along the Orange River are not as suitable for table grape production as Kakamas and transfer occurs from the former. Climatic conditions differ between below and under the Gorge in the Crocodile River.

As the climate varies from the Upper Olifants to the Lower Olifants, land and water prices will vary along the river. These prices will be discussed for the Loskop Dam and down for the Blyde River.

Loskop Dam: The Catchment area of the Loskop Dam was proclaimed a Government Water Control Area in 1973 (McCartney et al., 2004). It is expected that the water in the Loskop Dam will fall under one license. However, it is also expected that each individual plot owner will have an individual license, which can be traded as a user right.

It is more common practice that land together with the water-use right are bought and sold (Prinsloo, 2006). As far as can be ascertained water-use rights were only sold in the case of four plots (Van Stryp, 2006). The plots were accordingly delisted. Permission had to be obtained from the Dept of Agriculture, DWAF as well as declarations that no bond was registered on the land. The reason for selling was poor soil.

Van Stryp (2006) mentioned that the water for a farm (25.7 ha) was sold for R300 000 or R11 673 per ha. The water allocation is 7 700 cubic meters per ha under the Loskop Dam which translates to R1.52 per cubic meter. According to Postma (2006) the price of irrigation land in the Loskop Scheme is about R27 000/ha. Uncultivated bushveld sells at R6 000 to R10 000 per ha while irrigable land without water sells for R7 000 to R8 000 per ha. If the mid-point price of irrigable land of R7 500 per ha is used then the maximum price for water is R19 500 per ha (R27 000-R7 500) or R2.53 per cubic meter. The latter price includes the development cost. As the development cost is a sunken investment it may be seen as zero in future years. The reason is that water is expected to be transferred in future years from agriculture to urban use. If

water to agriculture is reduced to provide for the Reserve then the process will be expedited namely that development cost will have zero opportunity cost. It is concluded that water prices will move towards R2.53 per cubic meter (2006 prices) as rents move from land to water in the future.

Not all the water allocated to a farm is usually traded, as cattle need 40 litres per day while water is still needed for basic human needs. Trades (temporary trade) are usually small amounts and at the end of a season. Temporary trade has taken place along the canal and preference was for trade from downstream to upstream due to canal logistics. This is different from where trade occurs along a river and in stream trade affects flow. The Irrigation Board (IB) will only allow trade to occur if the seller has paid his taxes for the year. The IB would consider selling water to the mines as long as they also pay for the user cost that all members of the board must pay (Van Stryp, 2006).

Lower Blyde River Water User's Association: Van der Merwe (2006) bought water-use rights for R11000 per ha (9900 cubic meters per ha) but has not yet started the required DWAF procedure to get it licensed. The reason for the sale was the high water rates that the seller had to pay. He also referred to a case where water was sold for domestic use (development of chalets on a game farm) at R40 000 /ha. The different prices can be attributed to the product being different (a service is included in the product), locality is different (different market), the market is not transparent or sales are infrequent.

The price of listed land with a water-use right is about R23 000 to R25 000 per ha i.e. land cleared and irrigable. Bushveld without water sells for R3 000 to R5 000 per hectare. Clearing of land and preparation for cultivation such as ripping cost about R5 000 to R10 000 per ha (Van der Merwe, 2006). Land with fruit trees is valued at R40 000 to R48 000 per ha. Of this value, micro irrigation amounts to approximately R15 000 per ha while the trees also have value.

If water is transferred from agriculture to industry or if the allocation to agriculture is reduced then the scarcity value will move entirely to water. Some developed land may have no water and developed cost will have a zero scarcity value (sunk). In such a scenario the maximum price of water will approximate R20 000 per ha. The question then arises is, what will a farmer do without water. The question has relevance as the farmer may prefer to sell his farm (water and land) if selling the water only will leave him with an economical infeasible unit.

If a farmer sells all his water in the Blyde River then the farm will be too small for game farming or extensive livestock. At least 400 ha are needed for game while most irrigation farms are 20 ha. The cattle carrying capacity is one animal per 10 ha which means that only two cattle (Large Livestock Units) can be carried on 20 ha. This is not economically feasible. It is unlikely that a farm that was irrigated (de-bushed) can be converted into a game farm. Properties can be consolidated (which has transaction cost) but the most likely use of the land may be from a tourist point of view. Per ha prices are high for smaller plots especially near such an important tourist destination. Soils in the area vary with respect to quality (Van der Merwe, 2006) which implies that if water becomes scarcer, it will be transferred from poor soils. Soils that are

poor (for instance shallow) from an irrigation point of view may not necessarily be poor from another point of view (tourism) promoting transfers.

4.5.2 Rent of water

Due to land claims the potential water sales market has collapsed as a farmer may not sell his water if a claim is lodged against his property. Banks are reluctant to accept farm properties as collateral and potential claims are expected to have an impact on all properties and sales of land and water. However, rents are not expected to be affected that much by claims or may not be affected at all. Rents are important in a water market as it exposes both parties taking part in the transaction to the opportunity cost of water. It is also expected that producers of horticultural crops (long term crops) will prefer not to rent as these producers would want more certainty of future water availability.

Loskop Dam: The Loskop Irrigation Board (IB) provides a facility that they call a Waterbank. Farmers with surplus water during the year put it up for "sale" at a cost of 10 cents per cubic meter (which is the cost of providing water to users). If a farmer wants to rent out water at a higher price then this must be conducted outside the so-called Waterbank. In private transactions prices of up to 50 cents per cubic meter have been realized but the estimated average price in this "market" is around 18 cents per cubic meter. The Loskop IB does not want to make money on these transactions. Farmers plant more than what they can irrigate if water is restricted so they have to rent (Van Stryp, 2006).

Apart from the Waterbank, person to person rent of water is not common. The reason for the latter is that the Waterbank operates at low transaction cost (search and information cost, legal cost). Prinsloo (2006) mentioned a case near Marble Hall where water for half a farm (25.7 ha) was rented for R50 000 or 50 cents per cubic meter. They thought that this price was high. The price is, however, identical to the top price in private transactions mentioned above. The requirement that water rent can only be for a year discourages renting as farmers want more certainty for future use. It was mentioned to overcome this problem that both water and land are rented as there is no such restriction on renting water with land.

Under the Loskop Dam, land is seen as the limiting factor and not water and farmers who use less than their quota do equally well (Pretorius, 2006). Van Stryp (2006) thinks that water has more value than the land (60%/40% split). This will change if water becomes scarcer as Prinsloo (2006) states that the value of the land is nothing without water.

Lower Blyde River Water User's Association: Water allocated but not used by some farmers is rented out for a number of years (three to four) at R210/ha/month. This covers the cost of servicing the debt on the pipeline that conveys water for agricultural use and financed by Rand Merchant Bank (Van der Merwe, 2006). To avoid servicing the debt on the pipe, farmers rent out rather than sell. The above rent translates to 25.4 cents per cubic meter (allocation 9 900 cubic meter per ha). It is not known if other rents occur.

4.5.3 Contributions by water markets to reduce water use

Pretorius (2006) is of the opinion that irrigation water consumption can be reduced by more effective scheduling for instance waiting say two days before irrigation. There are farmers who adopt this. According to McCartney et al. (2004) about 35% of the irrigated area in the Olifants Catchment is under maize, wheat and pasture which are generally seen as low-income crops. Further, overhead irrigation is common in the Catchment. If water prices increase in future then it is expected that water will move from these rather extensive crops and that more water saving technologies will be adopted.

Some farmers below Loskop use water for export grapes while others use it in the more extensive way described above. The high capital cost of grape production, coupled with the uncertainty of land claims partly explain why farmers are hesitant to invest more and convert to this type of farming.

If the scarcity value is shifted from land to water, as is expected in future, a greater incentive will exist to conserve water and to repair faulty infrastructure. Users will have this incentive to repair their own infrastructure while they may place greater pressure on authorities to repair their infrastructure. Water distribution losses attributable to faulty infrastructure are an important aspect to consider in saving water. Presently, around 30% distribution loss (due to leaking sluices or even incorrect timing of sluice gate releases) is factored into supplying user allocations (Pretorius, 2006). Should allocation cutbacks be a reality following the compulsory licensing process, reducing the distribution loss proportion may offset these, at least in part.

The conclusion is that the demand elasticity of water for irrigation may be high in the Loskop Scheme and that higher water prices will reduce consumption as water is moved towards more water efficient crops, water conserving technologies are used and infrastructure is repaired.

Water appears to be more efficiently used in the Blyde River. Van der Merwe (2006) uses tensiometers to help schedule irrigation. Vegetables are irrigated with drip irrigation systems and trees by drip and/or micro. Some farmers plant sweet corn, and others lucerne using overhead irrigation. Van der Merwe (2006) considers the income from sweet corn as high. He thinks that high water prices have forced water to be used more efficiently.

4.5.4 Why the separation of water-use rights and land rights is ignored in transactions

While the sale of water between farms is not common, it appears as if farm to non-farm trades in water is also not common. Based on discussions with various individuals in the Catchment it would appear as if permanent trade in water-use rights is not readily considered as an option. This could be due to lack of information on the possibility of trade or a lack of trust in the required official processes involved in trade applications or the anticipated length of time for a trade to be approved. In cases of some mines, water-use rights were obtained by buying both the land and the associated water-use rights. In such cases the only official intervention that is required

is approval to change the use of water from agriculture to mining. If a farmer sells his water-use right on an irrigation plot which is about 25.7 ha in Loskop and 20 ha in the Blyde River Irrigation Scheme then the land will be too small to continue a feasible operation and he/she may prefer to sell the farm rather than only the water. The situation will be different if he has a much bigger operation.

Rossouw (2006) expressed the same scepticism. He seems to think that trade in water-use rights has a role to play on the margin or where relatively small quantities of water are involved. In the case of larger needs such as was the case with the water needed for large users by the Lebalelo WUA the supply augmenting option of raising the Flag Boshielo dam and later the De Hoop dam was considered a better option for the WUA. This, notwithstanding the fact that trade could have been a cheaper option.

Irrigation farmers may, however, be reluctant to sell their water as the farm without water will have little value according to Prinsloo (2006). Water prices need to increase substantially before it becomes worthwhile for an irrigation farmer to sell his water according to this study. The land and water markets have changed from a phase where land under irrigation expanded in the Olifants to a stage where a possible contraction may be possible due to requirements of the Reserve. A possible contraction implies that the sunken land development cost may approach zero with a concomitant increase in water prices. This is not an issue where unexercised water-use rights have been sold (Orange and Crocodile rivers). One of the reasons why few water sales have been observed in this study is that there are no unexercised water-use rights in the areas visited (Loskop and Blyde River irrigation).

The emphasis on the supply side is also reflected in the emphasis that has been placed on increased water supply resulting from alien vegetation removal and the willingness of large users to finance such projects to obtain the released water.

Based on these observations it would appear that in the case of high value users the relative ease and security of water sources associated with supply increasing measures outweigh the more long outdrawn process of buying out water-use rights of a number of existing users.

This situation will no doubt change as the possibilities for new supply sources run out.

4.5.5 Security/Assurance

A severe drought occurs in most decades in the Olifants Catchment. During the period 1920 to 1989 the longest drought in this Catchment had a five year duration (1961-1965) while three droughts had a four year duration (McCartney et al., 2004, p21). The duration of the droughts must have an impact on demand for assurance and crop selection.

Loskop: Many farmers have changed to permanent crops. As droughts occur at regular intervals farmers are advised by Pretorius (2006) against a switch to perennial crops in the event of cutbacks in allocations. Farmers with more than one plot are better able to handle water cut backs. Some farmers have significant investment in table grapes but others plant maize and wheat so it appears possible that if a farmer

cannot cope with the security situation by moving water around on his farm that he would be able to rent.

Lower Blyde River Water User's Association: Water provided by the pipeline has a high assurance of supply (Van der Merwe, 2006). It is expected that water will move from annual crops through renting to protect the high value subtropical fruit crops.

4.5.6 Information

The Loskop Irrigation Board office is serving as an important point of contact and information exchange in the Loskop Catchment. Other sources are newspapers and agents (Van Stryp, 2006) or neighbours (Prinsloo, 2006).

4.6 Hydrological issues

The demand for water for non-agricultural uses is expected to increase in the Catchment against a background of present deficits. Key hydrological issues are:

(a) Full utilization and over-commitment of water resources,

(b) Substantial deficits will result from the implementation of the ecological reserve,

(c) Strong mining sector growth expected in the Bushveld Igneous complex,

(d) Continued urban and industrial growth in Witbank, Middelburg and Phalaborwa,

(e) Water quality problems in the Upper Olifants in particular, as well as related to mining activities elsewhere in the WMA,

(f) Ensuring water of appropriate quality with respect to the Kruger National Park,

(g) Problems with measurement and monitoring of irrigation abstraction and return flows while (h)

(h) Honouring international obligations (Olifants River Forum, 2006; DWAF, 2004b).

The deficit for the Olifants Catchment is estimated at 192 million cubic meters based on data for the year 2000 (all reconciliation data refer to this year unless otherwise indicated). The Olifants Catchment is divided into the following sub areas.

(a) Upper Olifants encompasses the area above the Loskop Dam. Water is in balance in this area as only the exact quantity is transferred in for the power stations. The requirement of the power station is estimated at 181 million cubic meters which by comparison dwarfs all other users in this sub-area. Apart from surface water an important source is the return flow from urban users.

(b) Middle Olifants stretches from Loskop Dam to the confluence of the Steelpoort River. There is extensive irrigation near Loskop Dam. This area has a deficit of about 94 million cubic meters. Apart from surface water, important sources are groundwater, and return flow from irrigation.

(c) Steelpoort is the catchment of the Steelpoort River.

(d) Lower Olifants is the catchment between Steelpoort confluence and Mozambique.

4.6.1 Current supply management strategies

The building of the De Hoop Dam, in the Steelpoort Catchment, has been approved subject to a final environmental audit. There were appeals, but these have been sorted out. Of the dam's capacity, 40 % of the water will go to the mines in the Steelpoort Valley and will be financed by the Lebalelo Water Users Association. The State will co-fund the development of the dam. Users of the dam include mainly mines and towns including Polokwane (Havenga, 2006).

Until the De Hoop Dam becomes productive the raised Flag Boshielo Dam will provide water to the Steelpoort mines. At such time the water from the Flag Boshielo Dam will be piped to Mokopane (Havenga, 2006). Some irrigation land was inundated with raising of the dam wall.

The DWAF's registry provides a list of 210 dams in the Catchment with Loskop being the largest (McCartney et al., 2004, pp 43-48). For the Olifants Catchment, 37 dams have a reservoir capacity of in excess of 2 million cubic meters while 134 have capacities between 0.1 and 2 million cubic meters. Most small dams are privately financed and constructed.

4.6.2 Groundwater

It is estimated that there are close to 10 000 operating boreholes in the Catchment (McCartney et al., 2004). Groundwater is estimated at 99 million cubic meters or 16% of the local yield (DWAF, 2004b).

In the Springbok Flats, groundwater is used extensively for irrigation (high yields are obtained) and also domestic supply. The mines are increasingly utilising groundwater. In Mokopane the water table fell 16 meter and use by farmers was restricted (Rossouw, 2006). In Pretorius's (2006) opinion it is difficult to control or verify boreholes and in the Springbok Flats there are no controls. Water from different boreholes often comes from the same source and the common ownership problem arises. Economic solutions are restricting use by permits or a user charge on water while transferable permits may provide the same signals. Transferable permits can be considered if the borehole waters are connected (can be seen as a single market). At present farmers pay little or no user charge. All the proposed measures require that water use must be metered and monitored.

The quality of the groundwater is considered acceptable although high nitrate concentrations are observed in the Springbok Flats while in areas where mining occurs low pH and high sulphate concentrations are observed (McCartney et al., 2004).

Loskop is not a ground water Government Water Control Area (GWCA) (McCartney et al., 2004) which may explain why there is no control of its use. The quantity and quality of groundwater in the Blyde River is not good (Van der Merwe, 2006).

4.6.3 Return flow (quality and quantity)

Return flow is estimated as 14% of the local yield (DWAF, 2004b). Return flow from agriculture and urban is important. An estimated 50% of urban water is returned as return flow. In the previous study by the Team it was recommended that transfers be based on metered water and not consumptive use. Agricultural return flow in the study area is important as many farmers do not use drip or other water conservation measures.

4.6.4 Water Allocations

The water allocations were as follows;

- 6600 cubic meters per ha in Upper Olifants River,
- 7700 cubic meters per ha in Loskop,
- 9900 cubic meters per ha in Lower Olifants (Blyde) river and
- 5500 cubic meters per ha in Roossenekal

Source: Pretorius, 2006.

4.6.5 Loskop Canal

It takes 36 hours for water to travel from the dam through the canal. The canal is cleaned twice a year. There is a drive towards piping the water as much as possible (Van Stryp, 2006).

4.7 Approaches to improve water use efficiency

4.7.1 Link sources of supply in a market

Water trades may be possible between surface water, smaller dams and boreholes as well as between farmers and the Kruger National Park (Havenga, 2006). Borehole water can be traded but not Schedule 1 use (domestic use which needs no license). Water from boreholes used for irrigation could be sold to mines. Due to past long drought cycles in the Olifants Catchment the renting of water during a drought by the Kruger National Park was considered. Although Havenga (2006) supports this, a representative from Sanparks view is that nature must not be changed in harsh times as an artificial situation is created (Gyedu-Ababio, 2006).

Boreholes appear to be linked to surface irrigation. If surface irrigation is cut back during a drought then return flow (also to underground) is reduced and boreholes dry up (Pretorius, 2006). Technical opinion is needed regarding the feasibility of transfers of borehole water and this must probably be decided on a case by case basis.

Havenga (2006) stated that water in small dams can be sold and the stock resource converted to a flow. This is important as there are a vast number of dams. The number of major and minor dams included on DWAF's registry total 171 (McCartney et al., 2004) while during the verification stage 450 illegal dams were found (Havenga, 2006).

Pretorius (2006) does not support the transfer (sale) of water between sub-catchments for irrigation purposes but supports transfers for industry and for human needs. There are probably good reasons why such transfers should not be undertaken for irrigation purposes but the feasibility of this should be further investigated.

4.8 Role players that may initiate trade

4.8.1 Farmers

Irrigation consumes 57% of all the water in the Catchment. If the water transferred in for the power stations is excluded then irrigation consumes 71% of the remainder. Approximately 128 000 ha were irrigated during 1995. This area appears to have increased from 98 915 ha in 1988 (McCartney et al., 2004). Farmers must be warned that a cut back may occur and that they should not develop more land for irrigation for which they may not have water. There is extensive irrigation below the Loskop dam and to a lesser extent in the Steelpoort River and Lower Olifants (DWAF, 2004b).

Loskop Scheme: The total area listed under the scheme is 16 000 hectares. The size of plots in the scheme varies from 27.5 hectares in the Groblersdal area to 50.6 and even 70 hectares down at Marble Hall (Van Stryp, 2006). The reason for the increase is that in early years allocation was in terms of flood irrigation. Farmers can increase the size of their plots by using drip as long as the original water allocation stays the same, one plot was as large as 137 ha. Many farmers have more than one plot and that gives them some flexibility in redistributing water between plots as circumstances warrant.

Tobacco and potatoes are the most profitable annual crops with gross margins of about R60 000/ha. The tobacco season is from September to February, thereafter the land is double cropped with wheat. Prinsloo (2006) indicated that the allocation of 7 700 cubic meter per/ha is insufficient as he double cropped. He uses overhead irrigation with drip irrigation only on the corners not covered by overhead sprinklers. If he uses drip then overhead irrigation is still needed to irrigate lands at the beginning of the season, that means having two irrigation systems. In the case of perennial crops drip irrigation is more feasible.

Farmers are concerned about water quality as well as quantity (Prinsloo, 2006). Prinsloo (2006) mentioned that water quality usually deteriorates if the Loskop Dam level drops significantly. He identified acid mine drainage (mainly due to mining in the Witbank area) and eutrophication (as evidenced by fish kills due to a lack of oxygen in the water) as the two main water quality concerns.

Different crops grown in the area have the following water needs; peas (300 mm per annum or 3000 cubic meters/ha/annum), lucerne (1000 mm/annum or 10 000 cubic

meters/ha/annum) and citrus (500 mm or 5 000 cubic meters/ha/annum). Although permanent crops use less water, during dry periods it is the permanent crop farmers who buy water. It appears as if the return per unit of water differs if lucerne (which is extensive) is compared with the other crops. The potential thus exists for higher water prices to promote more water efficient crops.

Farmers, at least initially, had a somewhat negative view of the NWA. They feel that domestic and mine water use will get priority above them in case of cutbacks due to scarcity. At present the main concern is land claims.

Lower Blyde River Water User's Association: Monthly payments as redemption on a loan from Rand Merchant Bank for installing a pipe currently amount to R210/ha (R2520/ha/annum). Farmers assert that profitability in farming does not justify such a high payment and propose to pay R1600/ha/annum. A court case is pending regarding payment, and ownership of the pipe. The pipe has advantages (i.e. pressure). Trades usually result in the trade-in party covering the costs associated with the pipe (i.e. the trade-out party surrenders his obligation to pay these costs, and does not receive any payment above this). The high price associated with the pipe makes trading risky (as people will only trade if they know they can and will use the water profitably enough) (Van der Merwe, 20060. The high cost for water also means that farmers' cash flow is reduced and they may be reluctant to take on additional cost.

The allocated water /ha can be spread to 1.3 to 1.4 ha with drip irrigation (allocation is 9900 cubic meters per ha). Irrigation technology is, however, dependent on the soil type and crop. In the case of maize and winter grains overhead sprinklers are used, tomatoes require micro irrigation and for trees drip irrigation is used. In the case of sandy soils overhead irrigation is usually more effective. Water should not be wasted and only high value crops with low risk can justify high water prices (Van der Merwe, 2006). It is thus somewhat surprising that farmers use sprinklers on maize and wheat. Van der Merwe, however, mentions that the maize is sweet corn and that income is high. Although actual water prices are high at present, prices in a fully developed water market will even be higher and it is expected that it will promote more water efficient crops.

Van der Merwe (2006) mentioned that water quality in the Hoedspruit area of the Olifants is generally poor. Blyde River water quality is far superior, possibly as a result of the large nature reserve area in that region.

4.8.2 Mines and power generation

The mining sector is an important contributor to employment and exports. This sector has great potential for development in the CMA. Most of the water used in the Upper Olifants is as cooling water for the thermal power station. This water leaves the Catchment as evaporation (McCartney et al., 2004). Mines often use groundwater while they also buy water from DWAF. During the initial phases of their operations coal mines need water but later on this changes, and excess water may be a problem.

Water in a coalmine is a liability as it reduces productivity, and is bad for the environment. The mines, however, are starting to see water as an asset. To get the water to within accepted quality levels Anglo Coal erected a reverse osmosis plant

that desalinates water and sells the purified water to Witbank Municipality. Ingwe Coal belonging to BHP also has a similar plant selling water to Middelburg (Steve Tshwete) Municipality. The cost of desalination is R5-R10 per cubic meter and the potable water is sold for R2-R3 per cubic meter to municipalities (Lodewijks, 2006). The Anglo Coal desalination plant at Witbank can generate 20 ML of water per day but will be able to eventually produce 60 ML of water per day. This is a joint venture between Anglo and BHP Billiton. Brine, however, is still a problem, but they are confident that within 12 years a solution will be found to the problem (as the first holding pond will take 12 years to fill). The pollution relates to Ca and Mg Sulphate (gypsiferous water) which is saline. Eskom power stations also have desalination plants because in the cooling process evaporation of water increases concentration of nutrients.

Some coal mines in the catchment are up to 80-90 years old while some of the platinum mines have lives in excess of 100 years (Lodewijks, 2006). In contrast to coalmines, platinum mines in Steelpoort generally need water.

Eskom obtains water from outside the system mainly for cooling purposes. The reduction in volume from evaporation leaves polluted water that must be treated either on site or in- stream. Water from other catchments such as the Vaal and the Usutu is used by the Eskom power stations of which Duba is the largest. Eskom also has desalination plants because in the cooling process evaporation of water increase concentration of nutrients.

New technologies may be more water efficient and a change in mining operations can have an impact on their water use. The Phalaborwa Mining Company switched from open cast to underground mining resulted in surplus water to the Lepelle Water Board which it now can potentially provide for domestic purposes should the necessary infrastructure be in place (Havenga, 2006). The Platinum Group Metal mines adopted new technologies that use 0.4 tons of water for 1 ton of crush instead of using 0.8 tons water to 1 ton of crush (Lodewijks, 2006).

4.8.3 Municipalities

The largest urban centres are Witbank, Middelburg and Phalaborwa. The high level of urban migration is expected to increase urban demand significantly in the near future. At present the municipalities of Witbank and Middelburg have sufficient water which is mainly supplied by the Witbank and Middelburg Dams respectively. Grobler (2006) identified growth in domestic demand (e.g. from informal settlements) as a factor likely to impact significantly on water scarcity in the future.

4.8.4 Kruger National Park

The In-stream Flow Requirement (IFR) for the Kruger National Park has been determined which will vary according to seasonal rainfall patterns of between 2 cubic meter/second and in a normal year 7 cubic meter/second with the lower limit applicable in a dry period. At present the IFR is only 1.8 cubic meters /second. Kruger National Park (Gyedu-Ababio, 2006) asserts that they do not get the minimum flow they need and measures to ensure the required flow is not forthcoming. This is the situation even with average dam levels of 96%. During the past year the Olifants

River stopped flowing for 78 days. It is the policy of the Park that they will not trade to get more water in dry periods because they do not want to create a situation that is not natural. Nature is adapted to such variations (drought) and this balance must not be disturbed. However should the Park buy or rent water there is no guarantee that the water will reach its destination as it may disappear in the system before reaching the Park as there is no monitoring.

The position of the Park is that they want the water that they are legally entitled to according to the preliminary Reserve provision. There is a very strong sense of legal entitlement to water through the provisions of the NWA. The Park is therefore not keen to pay for water via trade. Should they not receive the flows that they are legally entitled to a Court action against DWAF could be considered?

Trade in water-use rights will be a last resort. A case in point is where Sanparks purchased farms on the Limpopo River to get more water. A quality problem did occur with mine effluent from Phalaborwa but the mine now uses a process with zero effluent. The quality of water is measured at two weekly intervals and DWAF specifies quality guidelines. Quantity is the critical variable to the Park as within limits wildlife tends to be more tolerant (than crop production for example) to water quality fluctuations. The critical variable for the Park is therefore flow in the river and usually not quality.

The Park is keenly aware of international obligations regarding flow into neighbouring Mozambique and actively tries to engage with Mozambican stakeholders where it can, although the process is admittedly slow. No agreements have been negotiated with respect to international flows of the water from the Olifants River.

Regarding ground water the recharge rate is very low while boreholes are used as a backup for camps in the Park during dry periods. Mines are currently polluting ground water. Although there is a good relationship amongst stakeholders in the Catchment the Park will use the National Environmental Management Act (NEMA) to pursue their case against the mines. Regarding land claims the situation in the Park is not known although one part of the Park has been opened to a community where they can hunt.

4.9 Environmental issues and market approaches

4.9.1 Pollution of river

The Loskop Dam is the centre of the coal mining and power generation industries (Eskom) in South Africa. These industries generate saline effluent, part of which is discharged into the river system. According to Van Stryp (2006) pollution is bad (and yet 55% of CMA charge is controlling water quality). Several mining operations are currently technically breaking the law due to DWAF's lack of capacity to enforce quality standards (Lodewijks, 2006). Water quality deteriorates if the level of Loskop Dam falls and with lower flow in the river the dilution capacity of the system is compromised. According to Coetzee (2006) the main problem in the Loskop Dam is the effluent leak from old disused mines.

Mines act as a collector of groundwater. The catchment surface is fractured from mining, runoff decreases and water is drained into underground aquifers which then seeps into streams (Lodewijks, 2006). The Klein Olifants River is an example of pollution by contaminated underground water that originates from mines. Mines pollute water due to the reaction of water with minerals. During the wet period in 1995/6 many mines filled up with water, and started spilling. Coalmines need to get rid of this water which in turn has lead to desalination plants discussed in Section 10.2. The quality of the water originating from coalmines is a critical factor (Lodewijks, 2006) while mines near Witbank are accused of polluting the underground water (Pretorius, 2006).

Water quality affects agricultural crops such as tobacco and citrus negatively in the Loskop area (Pretorius, 2006). This has a negative impact on export of some agricultural products that are chemically tested. Prinsloo (2006) also considers algae a problem in this area as filters are clogged. Water quality in the Blyde River is good but this is not the case in the Lower Olifants.

The Department is busy with developing a waste management process but has not implemented it (Pretorius, 2006).

4.9.2 Controlled release scheme

Pollution levels from mines can be brought to the required level by using the assimilative capacity of streams/rivers. A "controlled release scheme" is currently in place that controls the releases of effluent into rivers and dams. During high flow periods, when the assimilative capacity of the system is high, discharges are possible. Golder Africa Associates monitors the discharge scheme. Although this discharge system is the cheaper method, during low river flow sufficient dilution of nutrients is not possible. If the mines had not put in a desalination plant (see Section 10.2), they would not have been able to continue with operations as no discharge was possible during the recent period of low flow of the Olifants River (Lodewijks, 2006).

This controlled release scheme is dependent on stream flow. During high stream flow the release of nutrients may not exceed required quality levels but during low flows the assimilative capacity will be too low to absorb nutrients. The challenge of this approach would be the low flow periods that can be of a long duration in South Africa. For instance, during the period 2001 to 2006 it was too dry to release any nutrients in the Olifants catchment (Lodewijks, 2006). It is an open question whether buying water-use rights from agriculture and/or transfers from other catchments can be used to increase the assimilative capacity of streams in dry periods. The cost and availability of sufficient water at the required time may cause such an approach non-viable. The way in which a market can be used to optimise discharge levels is discussed in paragraph 4.9.4.

4.9.3 Discharge taxes

DWAF is developing a Waste Discharge Charge System aimed at incentivising polluters to reduce discharge levels. This "polluter pays principle" should become operative in 2008 (Havenga, 2006). This system will distinguish between point and non-point sources. At present, discharges in the catchment are not taxed.

In terms of Chapter 3 of the NWA, the water needs for the effective functioning of aquatic ecosystems must be protected. Ecological sustainability refers to water (quantity and quality) required to protect the aquatic ecosystems of the water resources and ensure their sustainability. Waste is defined in terms of Section 1 (1) (xxiii) of the NWA. The calculation of charges will be based on the registered discharge waste load of salinity and phosphorus, as representing the two most widespread water quality problems in South Africa. The salt load will be estimated using electrical conductivity. Phosphorus (as the limiting nutrient for freshwater eutrophication) will be estimated using soluble phosphorus (phosphate) (DWAF, 2006a).

The optimum discharge tax is conceptually indicated by the intersection of two functions. The first function shows as more is polluted the marginal cost of damage increases (marginal cost of one additional unit of pollution released). The second function shows that as more pollution is eliminated the marginal cost of elimination increases (marginal cost of one additional unit of pollution controlled). Marginal cost functions are opportunity cost functions which are by definition subjective and not observable. It is thus not possible to calculate an optimum discharge tax using econometric tools to a high degree of accuracy. The optimum discharge tax will also vary along the river as is the case with water prices in different water markets along a river.

It is recommended that polluters should pay a discharge tax as they use water from the river in a similar way as abstracting users of water pay water rates. It is further suggested that it may not be necessary to attempt to calculate an optimum discharge tax. In a water market the market discovers the optimum price of water and participants in the market face the opportunity cost of this price. It is recommended that the same principle should be followed in discharges of pollution and that the optimum price be discovered in a pollution trading market (see next section).

4.9.4 Tradable discharge permits

In a permit discharge-trading market the market price of permits will be determined by the intersection of the functions discussed in the previous section. If polluters have to pay a discharge tax then this will reduce the market price. Lodewijk (2002) recommended a discharge permit trading system but the following problems have been raised by DWAF and others (Lodewijk, 2006). Discharges are only possible when river flow is sufficient, while the following must be considered; spatial location of mines relative to one another, and the river network which will drain the effluent into the dams. DWAF had concerns about trading monopolies and that it may affect small stakeholders negatively.

It is important that DWAF's concerns and other concerns be considered and possibly be incorporated as possible recommended rules of such a trading program. Any market has rules, for instance the Stock Exchange has opening and closing hours. A market for discharge permits will also have rules. As nutrients can only be discharged in rivers during high flow times, it is important that this rule be adopted in a permit-trading program.

Another rule in a permit-trading program may be that trade may only take place within well-defined reaches of the river. A water market has similar constraints to minimise externalities. In a water market, trade can only take place from up-stream to down-stream while in a permit trading program, trade should go the other way as down-stream trade increases the concentration of the pollutant at a down-stream point.

The rule that discharge is only possible during high flow is also adopted in the Hunter River Salinity Trading Program in Australia (HRSTS, undated). Reason for the adoption of the Australian program is because of conflict between primary producers (livestock and irrigation farmers) and mining. Credits in the Australian program are initially allocated free to license holders based on environmental performance. Two hundred credits are auctioned every two years to replace those retired. New credits have a lifespan of 10 years and a total of 1000 credits are permitted. Auction proceeds are used to pay scheme operating cost (environmental and compliance monitoring cost). Targets are set at 900 microsiemens/cm but it may vary along reaches. Options for industry are to purchase more credits and/or to implement cleaner technologies.

Gunter (2006) indicated that mines are definitely interested in discharge permits but thought that it may not be possible in future to obtain them from DWAF. The alternative of building desalination plants is expensive. The cost of the plant that the team visited near Witbank is about R300 million (Gunter, 2006). Not all this cost is fixed as the reservoir where the nutrients solidify fill up after 15 years after which time a new site must be established and the old one is thus abandoned.

4.9.5 Offsets

The concept of wetland offsets will be introduced briefly to show that some environmental proposals made by stakeholders in the Catchment have a scientific foundation. The feasibility of some of the offsets considered in the catchment will be discussed.

4.9.5.1 Theory of offsets

Economists have traditionally diagnosed environmental problems as market failures. The markets do not transmit appropriate incentives needed to achieve efficiency. Some have called for government to tax or regulate externalities. Others have argued that incomplete property rights cause allocative inefficiency and therefore privatization is the appropriate policy response. The latter group contends that government failure is more pervasive. The merits of these approaches will not be debated here. The insistence on individual action or none at all can leave every one isolated and ineffective. This class of issues is called isolation paradoxes. Instruments that make coordinated action beneficial may be rewarding. Bio-diversity trading in water or offsets as will be discussed will provide the required cooperation to address the problem.

A market for bio-diversity credits has developed in 20 states in the USA where wetlands have been constructed by some developers who then sell an offset right to others who want to drain wetlands (Randall and Taylor, 2000). The authority can require the developer to make onsite offsets while in some instances it might be more beneficial to require the offset to be implemented offsite. The concept of “no net loss”

in section 404 of the Clean Water Act allows individuals who wish to drain wetlands in one location to mitigate the loss by enhancing wetlands elsewhere within the same hydrological or ecological region. In South Africa De Wit (2006) has proposed a similar trading approach for bio-diversity credit by Dickens (2006) of the Institute of National Resources and in the Western Cape. For more information on these trading schemes the reader is referred to Randall and Taylor (2000), Bjornlund (2003), De Wit (2006) and Dickens (2006).

The creation of bio-diversity offsets for a river creates the incentive for cooperation amongst stakeholders which may be mines, developers, environmental groups, farmers and public land agencies. For many kinds of ecosystems (wetlands and rivers), protection of bio-diversity requires large areas (scale effect) of contiguous habitat. This is the classic isolation paradox. Supporting institutions need to be created to facilitate cooperation. Situations are often unique but it is proposed that opportunities for enhancing the environment be sought through a partnership between government and stakeholders.

4.9.5.2 Abandoned and defunct mines

According to Coetzee (2006) the pollution in the Loskop dam is serious. He further is of the opinion that the main source is the leakage from abandoned old mines (pre-1956) during low flow periods. DWAF has accepted ownership of the abandoned mines. Before the promulgation of Water Act of 1956 an agreement was reached between DWAF and the Chamber of Mines that the liabilities with respect to water pollution of all mines that had ceased production before 1956 would lie with DWAF (Lodewijks, 2002, p36, 37). In an offsetting arrangement incentives can be provided to existing mines to desalinate these defunct mines and in return the existing mines could be provided a concession to discharge a given amount in the Olifants River when the water flow is sufficiently high. The problem with the defunct mines is that they leak nutrients all the time including during the period when river flow is low. The negative environmental impact is reduced with this off-set arrangement as the pollution during low flow periods is reduced and pollutant is discharged when flow is sufficiently high. Lodewijks (2006) supports such an approach. It is recommended that this approach or other offsets be further discussed between DWAF and the mines as other offset arrangements may be decided on. The mines have the technology to desalinate polluted water and have already invested hundreds of millions of Rands in this. DWAF may not have the technology while a major part of the significant investment (desalination plant near Witbank cost about R300 million rand) is of a fixed nature. The above arrangement will cost the taxpayer nothing and will promote a more desirable outcome.

4.9.5.3 Off-sets from building dams

The promotion of water markets will reduce the pressure on the construction of new dams. However, the demand for increased storable water is great in South Africa due to increased urbanization and demand from the mining sector. For instance, it is estimated that urban demand will double in the Lower Olifants during the next decade. South Africa has a fast growing urban population which is entirely different from countries such as the USA and Australia as well as Europe. Environmentalists in these countries are concerned about the environmental impact of dams. In China

where urbanization is high, dams are simply built over riding local opposition. It is suggested if dams are contemplated in South Africa and if impacts are negative in sensitive ecological areas that offsets be considered to mitigate negative environmental impacts. It may be possible to negotiate with the builders of a dam to eradicate alien vegetation over a stretch in the river or to make other offsets in return for waiving opposition to the construction. Several offsets will be discussed.

The De Hoop Dam located on the Steelpoort River: The building of a dam in the Steelpoort River namely the De Hoop Dam has been approved subject to a final environmental audit (Havenga, 2006). While the Kruger National Park may have been opposed to the building of the dam initially, management now seems more supportive of the project given that the minimum river flow is such an important variable to them and that the dam may play a role in augmenting flows particularly in dry periods. Gyedu-Ababio (2006) indicated that the Kruger National Park might waive concerns about the building of the De Hoop Dam in the Steelpoort River if the Park gets an allocation (say 5%) of the dam's capacity. This is not an official offer and it is not known whether it is intended as a serious statement but as a potential off-set such an arrangement should be pursued.

Flag Boshielo: Raising of the wall of the Flag Boshielo Dam increases yield by 18 million cubic meters but eight farms were inundated as a result. As part of an off-set the canal infrastructure of Previous Disadvantage Individual (PDI) farmers downstream of the dam is being upgraded as part of the deal.

Newcastle Dam: The town of Newcastle in KwaZulu-Natal is building a dam for drinking water. It has been established that 18 ha will be damaged by construction of the dam. In exchange for flooding 18 ha of a provincial reserve, the proponent purchased more than 1000 ha of the catchment area and set aside funds to manage the remaining area to control invasive plants. The 1000 ha will be handed over to KZN wildlife for conservation (De Wit, 2006).

4.9.5.4 Wetland mitigation

Mines have bio-diversity action plans. For instance a wetlands mitigation program is used whereby a previously destroyed wetland can be rehabilitated in exchange for a concession elsewhere (Lodewijks, 2006).

4.9.6 Privatising the eradication of alien vegetation

Mines intend to eradicate 2500 ha of alien vegetation that will yield 5 million cubic meters of water at a cost of R24.4 million or R4.9 per cubic meter. This appears to be the cheapest (best value) option for harvesting water (Rossouw, 2006). There are other plans to obtain 13 million cubic meters of water from eradicating alien vegetation at a cost of R117 million (Rossouw, 2006). These private ventures should be encouraged as they have positive social spin-offs.

4.10 Equity issues

4.10.1 Urban-domestic water consumption

There are considerable inequities in urban-domestic water consumption between different areas of the catchment. In former homelands, where many people do not have access to piped water, per capita consumption averages 47 litres per day. This compares to 183 litres per capita per day in areas where the majority of the white population live (McCartney et al., 2004). Urban water consumption is thus expected to increase substantially in future.

4.10.2 Small farmers

Not much is known about small holder irrigation farming in the Catchment. Perret (2002) studied the temporary transfer (for five years) of water from small holder irrigation schemes (SIS) under the Flag Boshielo dam to mines. The idea was that most SIS are not currently using their entire water-use rights, in terms of allocated quantity, while newly established mines that come on stream are in dire need of water. Moreover, mines provide the most job opportunities in the area. Perret (2002) was critical of the arrangement as he alleges that information is not only asymmetric, it is non-existent at community level. Effective community representation and information availability at the local level is only scheduled to become operational at a later stage. He warned that the transfer of water-use rights from small farmers to commercial farmers is likely to increase further and that small holder irrigation development will then be abandoned (Perret, 2002).

Pretorius (2006) provided more information on transfer of water from the small farmers to the mines. Water for mines in the Steelpoort Valley was obtained (through the Lebalelo WUA) by a temporary transfer of water allocated to small farmers under the Flag Boshielo dam. They did not use this water. This temporary situation was reversed when the dam wall of Flag Boshielo was raised in order to provide water for Lebalelo on a more permanent basis. In return for the temporary use of their water the small farmers received R7 million from Lebalelo to upgrade their canal system. There is not much farming activity going on in this area. Some of the farms especially on the left banks of the river are rented out to commercial farmers. There are some small farmers in the Hereford area and a few more on the Moses River (Pretorius, 2006).

According to this information small farmers received compensation for water that they may not have used. The water-use right was also returned to them. Perret's (2002) conclusions that SIS may have to be abandoned are not supported by this information. In the negotiations of small holders with mines or other buyers asymmetric information must be a concern and the institutional help by government must be provided. It is, however, difficult to see that small holders were prejudiced in this case as Perret (2002) alleges as the water was returned to them and it does appear unlikely that anybody else would have used the water in the mean time.

Although permission to occupy (PTO) in traditional areas provides some security these rights cannot be sold, mortgaged or leased. It is suggested that the sale of water and land rights from small farmers not be encouraged but that rent of land and water is permitted. Not much is known about SIS in this Catchment but it appears that small

farmers under Flag Boshielo Dam experience difficulty in operating viable farming operations In the Loskop Scheme PDIs received two farms in a restitution settlement. The new owners were not successful and the land is now abandoned. Some white farmers wanted to buy it but were not allowed to. Prinsloo (2006) referred to farms that were sold near Loskop to approximately 15 small farmers. The farms were successful while under the mentorship of the previous owners. Upon their withdrawal the farms were abandoned and the land is idle and the tractors out of order.

4.11 Final comments

Major impediments to a water market are land claims and the lack of metering and monitoring. On the positive side land restitution is a vehicle through which water will be transferred to PDIs and the objectives as stated in the WAR document (DWAF, 2005) promoted. On the negative side, almost no new investment is undertaken until the process is completed. If a claim is lodged against a farm, it may not be sold which means that the sale of water is not possible. Banks are reluctant to finance the purchase of land, even if there is no specific claim because of the uncertainty about future possible claims. Since the purchase of farms is dependent on external financing land and water sales will not occur in such an environment.

Few sales of water have been observed in the study area. This may be attributed to the prevalence of land claims but also because the climate and crops within each sub-area appear more homogeneous while non-exercised rights were not observed. It is estimated that water prices need to increase substantially before it becomes worthwhile for an irrigation farmer (exercised lawful user) to sell his water. Rent of water is not affected by land claims and is more common.

The expected increase in water prices should have a significant impact on its use in this catchment. It appears as if the water market and higher water prices will increase water use efficiency through (a) better scheduling (b) change to more water efficient crops (about 35% of irrigated area is under maize, wheat and pasture) (c) more efficient irrigation systems (overhead irrigation is common) and (c) repair faulty infrastructure.

CHAPTER 5. THE BERG RIVER CATCHMENT

5.1 Introduction

The general objective of this study is to investigate ways in which institutions can be established and/or improved so that water markets can operate more effectively and in turn result in the efficient use of water in South Africa. In this case study, the focus is on the Berg River Catchment. This study is a follow-up to similar case studies undertaken by the Team in the Crocodile River and in the Olifants River catchments.

The Berg River was chosen as the third case study based on information received from Pretorius (2007) and Barkhuizen (2007). According to records made available by Barkhuizen (2007), 161 water transfers have been processed by DWAF for all catchments since September 2002. Most transfers are in the Orange River (81), with 18 for the Berg River which are marginally more than the 13 for the Riet River. As it is important to visit trading partners as stakeholders, the Berg River was chosen as the third case study. The Orange River was not chosen as several economic studies have already been undertaken in this river in the past.

5.2 Description of the Berg River Catchment

From its source in the high-lying Groot Drakenstein Mountains, the Berg River flows in a northerly direction and joins the Franschhoek Valley. The flow continues toward Paarl, before it is joined by two tributaries. The first, situated to the east, is the Wemmershoek River, impounded by the Wemmershoek Dam. The second is the Dwars River that joins the Berg River from the west approximately halfway between Franschhoek and Paarl. The Berg River flows through Paarl and Wellington, where it is joined by the Krom River from the east.

The Berg Water Management Area comprises three sub-areas namely; the Upper Berg sub-area which includes the Berg River Catchment down to the Sonquasdrift road bridge near Porterville, the Lower Berg sub-area which includes the downstream reaches of the Berg River below Voëlvlei Dam, while the Greater Cape Town area includes catchments of smaller rivers in the southern part of the WMA. The largest consumer of water is urban use in the Greater Cape Town (343 million m^3 per annum), while agriculture is dominant in the Upper Berg sub-area (202 million m^3 per annum).

Data provided by BKS (2003) are estimates for year 2000. The entire Berg WMA lies within the winter rainfall region with the mean annual rainfall ranging from more than 3 000 mm in the high lying mountains in the south-east to less than 300 mm in the North West. Figure 1 and 2 are maps of the Mean Annual Precipitation (MAP), and mean seasonal precipitation of the Berg River Catchment. The catchment receives the bulk of its rain in the winter months, which is different from the previous two case study areas, which received the large rains in the summer months.

The urban population in the WMA is estimated at 3.5 million with 3.1 million residing in the Greater Cape Town area (data for 2000). The rural population is estimated at 170 000 (BKS, 2003) which is relatively small but there is significant migration from the Eastern Cape to the Western Cape. About 12% of the GDP of South Africa originates from the Berg WMA. The largest economic sectors in the WMA in terms of local Gross Geographic Product are; manufacturing (25%), transport (21%), financial service (18%), and Government (15%). Agriculture, although one of the smallest sectors in terms of its contribution to the local Gross Geographic Product (about 2.5%) has strong linkages to other sectors in the region (BKS, 2003). The fruit farming sector in the Western Cape is highly labour intensive and provides livelihoods to many. Out of the total irrigation use of water in the Berg River of 301 million m^3 an estimated 202 million m^3 is used in the Upper Berg River (BKS, 2003). Due to the importance of irrigation in the Upper Berg this study was largely focussed on this area.

The surface water resources of the WMA have been well developed through the construction of several large dams and numerous farm dams, many of which are filled by pumping from the river during periods of high flow in the winter. Storage is essential as rain is in winter but the peak demand is in summer. A unique feature of the Berg WMA is that water is diverted from the upper tributaries of the Berg River via the Riviersonderend-Berg River Scheme during the high flow season, for storage in the Theewaterskloof Dam in the Breede WMA. This water is transferred back to the Berg WMA with additional water volumes from the Theewaterskloof Dam during the low flow season (BKS, 2003). Figure 3 is a map of the inter-basin transfers into and out of the Berg River Catchment.

5.3 Impediments to a water market in the area

Water transfers have been common until recently. DWAF has, however, stopped processing the transfer of non-exercised rights and farmers are requested to explain how transfers can promote redress of past discrimination. The current draft Water Allocation Strategy highlight transfers of water entitlements as a means to stimulate the demand for water use by Historically Disadvantaged Individuals (PDIs). For current trading and transfers of water among non-PDIs on land under claims & stressed catchments the applicant will need to fulfil the redress and equity requirements as stated in Section 27 of the NWA. There is no formal moratorium on trade (Ncapayi, 2007; Letsoalo, 2007). Letsoalo (2007) stressed that it would be important that applications for transfers take the issue of equity into consideration and demonstrate empowerment to the PDI.

5.3.1 Reason for transfer refusals

There are two categories of water users. Those outside water schemes have no unexercised water-use rights, with their existing lawful use being restricted to actual 1998 use. Those inside water schemes have unexercised rights due to a declaration approved by the Minister for all scheduled water entitlements in GWCAs and irrigation boards. Trading in unexercised rights is not easily approved by DWAF (Enright, 2007).

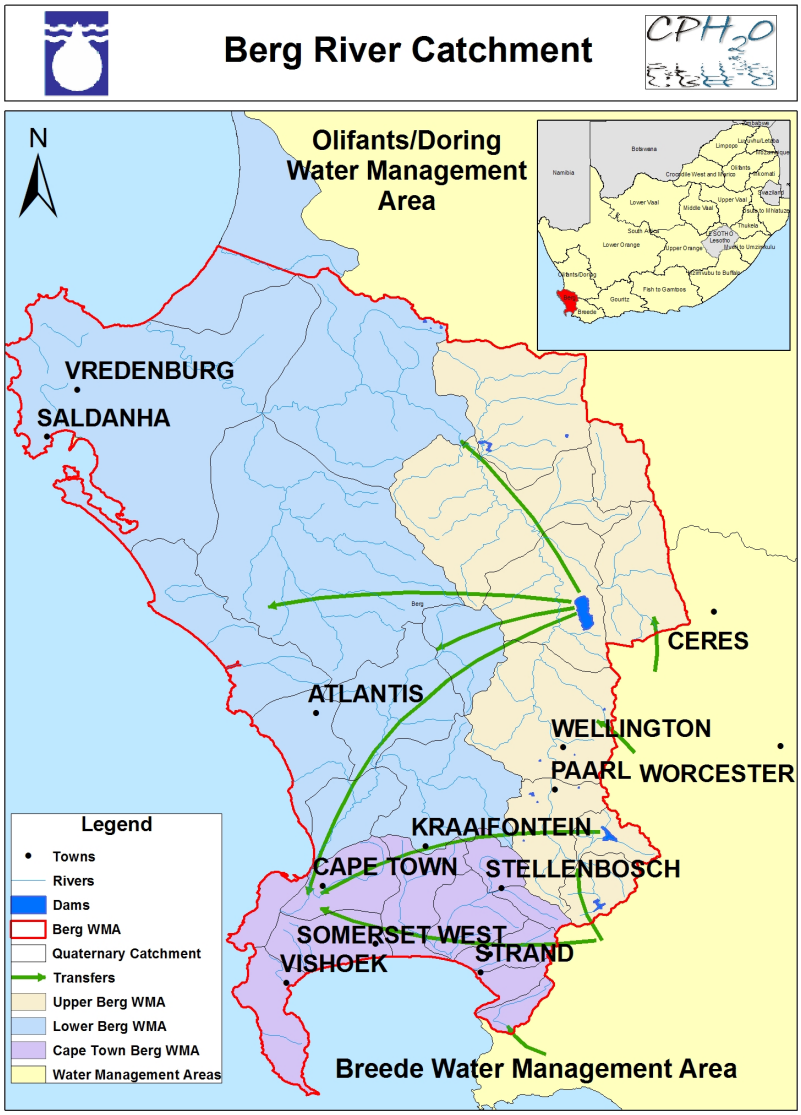

Figure 3. The inter-basin transfers into and out of the Berg River Catchment

Enright (2007) even proposed that unexercised rights might be taken away and used for equity purposes when compulsory licensing is done. Taking away unexercised rights may be challenged in court. However, with compulsory licensing unexercised rights will be forfeited (Enright, 2007). Human (2005) states that the Minister will look at exercised lawful use and if it is not exercised then there is a strong possibility that it will be lost without compensation if needed for the Reserve or to promote re-allocation of water to PDIs. Mochothli (2007) thought that unexercised rights could be sold if lawful provided conditions 32 and 33 are met but she did appear (un)certain. It appears that this issue may have to be decided by court.

The seller is not restricted to sell water if use is an exercised entitlement while buyers must adhere to the section 27 conditions (11 requirements). Head Office must give guidance on what they expect the application to cover in such cases (Ncapayi, 2007). She highlighted the fact that there is no moratorium for trade. Letsoalo (2007) stated that it would be important if applications for transfers take the issue of equity into

consideration and demonstrate empowerment to the PDI. No transfers are currently approved where it does not promote empowerment to the PDI.

Louw (2007) and Van Zyl (2007) are under the impression that the Department of Water Affairs and Forestry does not support transfers from white to white farmers at present as these transfers do not promote the equity objectives of Government. Transfers must address the economic imbalances of the past and promote black empowerment under article 27. A second requirement is that in the application the socio-economic implications of a transfer must be evaluated. Due to the absence of large scale commercial PDIs no transfers are taking place in spite of applications to transfers that have been lodged.

5.3.2 Issues that can potentially reduce effectiveness of a water market

5.3.2.1 Water metering

As water becomes scarcer the need for careful monitoring of water use will become more urgent. Individual metering is not seen as an impediment at present. Water abstraction from the river through pump irrigation schemes (six) is accurately measured (calibrated). There is no individual metering on the Berg River for the approximately 300 riparian owners. The Chairman of the Upper Berg River Main Irrigation Board (Malan, 2007) says it is not necessary to meter individuals since the total volume released from dams into the flow of the river is metered. The total quota of water allocated is not exceeded. Farmers irrigate a maximum of 80% of their land (allocation is for 80% of a farmer's land) and the area irrigated can be calculated (Malan, 2007). Abstraction by pump irrigation schemes is measured. The difference between these bulk meters and the metered pump irrigation schemes is the total abstraction for the riparian users. The lack of individual metering is at present tolerated because total water use is still below the scheduled area multiplied by the relevant quotas. During restrictions the total bulk water releases are monitored and curbed. Illegal use of water by members is limited because water applications on crops are carefully monitored and over use will lead to diseases such as amongst others root rot. In addition, it is said that cost of meters and administrative cost of metering are obstacles (Malan, 2007).

Notwithstanding this positive view, there are allegations of illegal use of water by some irrigators. Some consider it a serious problem (Van Zyl, 2007; Schreuder, 2007; Carstens, 2007). Farmers at the lower end (Riebeek-Kasteel) are more affected by abstraction up the river and have expressed their concerns in the past. Malan (2007) acknowledges that the river has occasionally dried up about 10 km up from Hermon but that they then released water from storage. There, however, appears some enforcement as it was mentioned that an irrigator was requested to remove his pumps from the river.

5.3.2.2 Reluctance to transfer water (trade-off between flexibility and protection of rights)

The Upper Berg River Irrigation Board opposes water transfers from agriculture to residential use and specifically to Cape Town (Malan, 2007; Bourbon-Leftley, 2007). Similarly there is opposition to transfers from Upper Berg River to the Lower Berg

River. The Regional DWAF Office contends that their office can over-rule farmers if it is in national interest or if reasons and arguments are not adequate. Farmers respond that if water is transferred out of the area that it will reduce the original tax base while it will change the character of the region adversely. There is also opposition to transfer water from near the river to further from the river as riparian users share the sorrows and the joys of the river. Malan (2007) also emphasised the importance of irrigated agriculture in its contribution to the region and also to carbon credits (carbon footprint). There are third party considerations that must be taken into account in transfer applications, especially if different sectors are involved.

There is also a reluctance to recommend transfers from riparian irrigators to pump station users. The reason for this attitude of the irrigation boards on transfers out of the area is based on cost considerations. If water is sold to outside areas the obligations of sellers are shifted to the remaining irrigation board members. Restrictions to transfer from riparian irrigators to irrigation board pump schemes are due to practical considerations. A farmer from a pump irrigation scheme said that he would like to buy more water but that it was refused. He further stated that the capacity of the pumping equipment was not fully utilised and thus did not agree with the reasons given for refusal. There have been only a limited number of applications in these categories.

According to the National Water Act, water must be efficiently utilised which means that water should move to its best use, which may mean further away from the river. As water becomes scarcer in future, it is likely that other considerations may override current concerns in certain cases. The supply situation appears favourable until about 2011 (and augmentation possibilities exist) but transferring water out of agriculture must be a future option. Projections by BKS (2003) indicate significant future growth in urban water consumption for the Greater Cape Town area, while agricultural consumption is projected not to change much. It, however, appears as if agriculture has become more intensive in recent years. Urban water demand depends on population growth and economic growth. Urbanization does not appear to be an issue in future water demand as is the case of the Olifants River studied. Migration from other provinces notably the Eastern Cape will have to be taken into account. In the high growth scenario BKS (2003) estimates that urban consumption in the Greater Cape Town area can more than double in 2025 compared to 2000.

5.3.2.3 Transaction costs

DWAF officials dealing with applications to trade think that transaction costs are low. They indicate that the fee for administrative advice from the Regional Office is R114 per application. Such advice plus the guidance on documentation needed from the various statutory bodies should be sufficient. They will also outline what is required to adhere to the section 27 requirements that include an assessment of whether the proposed trade improves the socio-economic conditions as well as its implications for previously disadvantaged individuals.

The legal firm in the Paarl that deals with most of the applications estimates that the average cost has previously been between R3000 to R4000. The cost has gone up, however, and runs up to R8000 for obtaining the necessary documentation. This is excessive if the cost of water is just R40000. Lately the cost incurred by the firm to

obtain an evaluation of the socio-economic implications of a trade adds another R8000. With a total cost of about R20 000 per transaction it is considered high for it compares with attorney cost of a land sale of R8 million. Farmers do not have to use a lawyer but they probably reason that the water is valuable to them, the chance of rejection high and they therefore use a legal firm that specializes in water matters.

From the side of the firm who handles most of the applications there is a need for clarity of rules necessary to obtain approval. The Regional DWAF Office contests these allegations and states that the rules applicable to an application are clear and not too cumbersome. They however admit that the time to get a final decision on an application has recently gone up considerably. Farmers state that they do not know if their motivation will be sufficient and that the target keeps shifting. More emphasis is currently put on the empowerment of PDIs, through water transfers. As the Regional DWAF Office has to prepare supporting documentation for an application to transfer it is suggested that farmers who want to trade, contact this office in order to assist them with their motivation. This is especially recommended for small trades where the transaction cost may be high in comparison to the value of trade.

5.4 State of water trading in the catchment

The total water entitlement includes summer and winter entitlements. So, if a farmer fills his dam in the winter from the river then it comes from his total quota. There are, however, farmers who only have winter water.

5.4.1 Recent transfers

Applications for the transfer of water-use rights between irrigators are taking place regularly since the introduction of the National Water Act of 1998. Transfers are largely within irrigation boards as it is easier to proof existing lawful use. About 50% of the Berg WMA falls under a GWCA. The approval process for transfers within the Berg River GWCA area in the past took on average about four months from date of receiving the required documentation to final approval.

Approvals since 2005 have slowed down while the waiting period increased substantially. A number of applications are waiting for approval. Some applications are still not approved after 2 years. The increased waiting period has allegedly been due to delays of approval at the Head Office.

Barkhuizen (2007) provided information on 18 transfers in the Berg River Catchment since 4 September 2002. The information shows; the name of surrender, surrendering property, name of receiver, receiving property and allocation. The two largest transfers are for the same property. If these two are excluded then the largest transfer was 270 000 m^3 of water (about 54 ha) and the smallest 7450 m^3 (about 1,5 ha) with the mode 60 000 m^3 (about 12 ha). The attorneys dealing with applications say that the majority of applications tend to be small transactions involving water entitlements on less than 10 ha. It appears easier to obtain approval for small transactions.

5.4.2 Reasons for transfer

Various reasons for selling entitlements are advanced such as a change in crops cultivated, a desire to scale down an operation or even occasionally because of financial difficulty. In a previous study, Louw (2002) indicated that unexercised rights are sold but the Regional DWAF Office states that they indicate it as non-use without knowing the specific circumstances. Based on the information that transfers have stopped and Enright (2007) statement that unexercised rights will not be easily supported for transfer it appears that this was a main reason why farmers want to sell. During the workshop in the Paarl during 2007, a team member was approached by an agent who wants to purchase a significant volume of water from a person who did not use it. Carstens (2007) who recently bought water said that he bought water from a wheat farmer who never irrigated. The land remained in dry land wheat production.

Other reasons are that instead of replanting old vineyards of wine grapes, farmers may sell water and use land for something else such as a quest house, golf course etc. Buyers are usually farmers who want to increase their level of security or who have switched to crops with higher water use intensity such as for instance from wine grapes to table grapes or fruit farming. Irrigation land under table grapes increased from 7.4% to 20.6% while citrus increased from 0.6% to 5.3% between 1992 and 1999. During this period wine grapes declined from 67.5% to 57.3% (Louw, 2002). These trends appear to be continuing (Malan, 2007). Some farmers have also changed from small grain production to wine, especially in the south. The shift in production from less intensive to more intensive use increased the individual and overall demand for irrigation water. A reverse type of transfer is farmers who have changed from low production wine grapes to wheat as the price of the latter lately increased (Malan, 2007). Another reason for buying water is to improve assurance during period when cut backs are in place due to low levels in the dams. Water has, in the past, been cut back by 20% of the allocation.

The temporary transfer of water-use rights is not common, mostly due to the fact that long term crops need a permanent secure source of water. Temporary trade of water use do occur between irrigation board members but such transactions are not formally recorded.

5.4.3 Direction of transfer

All the transfers are within irrigation according to data supplied by Barkhuizen (2007). There are no restrictions for riparian irrigators to transfer water from downstream to upstream. This is not approved in the western USA as it reduces in-stream flow below the new diversion point. There are salination problems ("verbrakking") down-stream in the Berg River and selling water up-stream may have advantages for farmers but not necessary for the river.

Transfers may occur within pump schemes (six schemes) but for cost reasons not with outside entities. Water from farm dams can be transferred to a nearby farmer if it is practically possible.

Only one transfer between agriculture and non-agriculture is recorded. This is a farmer who had a fire on his farm and then sold his water to the municipality of

Tulbagh. A transfer of non-agriculture to agriculture happened in the Lower Berg River where water from an industry was transferred to agriculture.

5.5 The development of water user associations

In the Upper Berg River area there are a large number of irrigation boards. Three boards have converted to WUA and 16 remain currently as irrigation boards (Van Zyl, 2007). Apart from one legal obstacle there are no impediments to such a change-over. Presently, under the National Water Act, arrear water user charges fall on the new owner who buys the water. An interpretation of the Act and pricing strategy led to the concern that obligations rest with the seller of water and the buyer does not take over the obligations of arrears. This could lead to a considerable loss of income to the WUAs in the case of arrears. Debt in arrears is, however, small. This obstacle has been addressed and no further difficulty is foreseen in establishing WUAs.

In the past some municipalities were part of irrigation boards so their inclusion is not seen as a problem with WUAs. There may be advantages from the farmer's side in bringing in municipalities in WUAs in dealing with the pollution problems in the Berg River. These problems may be better addressed if all stakeholders are involved. At present it is not foreseen that the present irrigation boards in the Berg River catchment will amalgamate into larger WUAs. Although this may make sense, such an amalgamation is not seen as a factor to rationalize on costs. These individual water user associations will however still be coordinated by the Upper Berg Main Water User Association.

5.6 Characteristics of a water market in the area

5.6.1 Drip and micro irrigation on high value crops

In general irrigation practices in the Berg River WMA are highly sophisticated and water use by the irrigation sector is relatively efficient. According to Louw (2002) irrigation land was used as follows in 1999; wine grapes (57.27%), table grapes (20.61%), citrus (5.28%), plums (3.83%), olives (2.52%), pears (2.4%), peaches and nectarines (1.61%), apples (0.21%), vegetables (2.3%), and other (3.97%). Farmers use drip irrigation on wine grapes and table grapes and micro on citrus. Over-use on these high value crops may cause root rot while insufficient use cause significant financial losses. The irrigation demand for water may thus be fairly inelastic and high water prices may not squeeze much water from production. This is different from the Olifants River where lower income crops such as wheat and maize were irrigated by sprinklers.

5.6.2 Market price of water

Land for wine grapes and citrus sells for about R100 000 to R130 000 per ha while the average water price in summer in the Upper Berg River varies between R15 000 and R20 000 per ha (application of 5000 m^3 per ha) (Malan, 2007). Malan (2007) reports the following per ha costs for land, water and land preparation for a vineyard (Table 1):

Table 1: Estimated costs in Rand per ha for a vineyard in the Berg River Catchment (2007 prices)

Land without water	R15 000
Mechanical development cost	R10 000
Chemical application	R3 000
Plant material	R17 000
Trellising material	R15 000
Drip irrigation	R18 000
Water-use rights	R20 000
Drainage and labour housing	R30 000
Interest on Development cost (could be high)	Not calculated

Source: Malan, 2007

Some of the above costs are variable (recurring) in the long run as vineyards need to be replanted in future. Costs that may be considered as fixed (sunk) in the long run are mechanical development and part of drainage and labour housing costs. If water becomes scarce in future then the point may be reached that it moves from agriculture to urban use and no further expansion in agriculture takes place. The costs now attributed to the sunken components above may move to water and water prices will increase accordingly. If 50% of the drainage and labour housing cost is considered sunk then the sunk component is calculated as development cost (R10 000) plus drainage and labour housing cost (R15 000) amounting to R25 000 per ha. It is thus estimated that water prices may increase to about R45 000 per ha. The purpose of this illustration is not to calculate a precise figure for the future price of water but to show that in a water market, prices will increase (in real terms) which will provide incentives for conservation.

Prices for water-use rights in the Berg River may be somewhat depressed as there is relatively sufficient water in the Berg River system and that water is not seen to be as scarce a resource as in other areas due to the declaration of unexercised water entitlements as existing lawful use. If the demand elasticity for water is low as is suggested, adequate quantities of water will drive down the price. Separation of water and land through licensing of water-use rights will on the other hand increase the price of water in future.

Prices for water of up to R50 000 per ha are reputed to be realised in the Vredendal area while prices of up to R100 000 per ha for table grapes growers in the Hex River Valley are paid. These are however from canal and pipeline schemes where water is available under gravity. Different products are produced in these areas while infrastructure in the areas is different which will affect the contribution of water to profits and thus its price. No firm conclusion can be drawn from this comparison with other areas but it appears as if water prices in the Berg CMA are somewhat low. Winter water prices are lower (about R10 000 per ha) as the farmers need to build dams to store the water captured in winter for usage in summer. The winter water market is thin with few transactions in the Upper Berg River. Malan (2007) estimates that only about 8% of the irrigation in the Upper Berg is from winter water, while in the Lower Berg it could be as high as 40% to 50%.

5.6.3 Seasonal rain and use

As this is a winter rainfall area, rain falls in the winter months but irrigation requirements are in summer. Storage through dams is thus essential to bridge this period. Greater reliance on on-farm dams can increase water availability in this catchment. There are different water markets in summer as in winter. Water prices in summer are about R20 000 per ha and in winter about R10 000 per ha. The lower winter price is because the cost of the dam is factored in.

5.6.4 Information

Information on potential buyers/sellers can be obtained from the attorney in the Paarl who deals with these matters as well as estate agents. Farmers, through irrigation boards, (or WUA) would also want to be more involved.

5.7 Hydrological issues

5.7.1 Assurance

According to Enright (2007) DWAF generally works on guidelines of 100% assurance for 7 years and 70% assurance for 3 years giving a long term average assurance level of 91% for agriculture. Cut-backs have occurred in the past. Strategies in agriculture to cope with cut-backs include irrigation in the evening, the use of straw and additional thinning out. By aggressive thinning out the farmer can retain size and price. Van Niekerk (2007) stated that cut backs are normally debated with water sectors and tables and models are operated to determine when and why restrictions should be made depending on factors such as growth prospects. He stated further that DWAF operates models that provide information on probabilities attached to various users.

Farmers prefer to be able to retain additional water-use rights in order to improve supply assurance for high value crops. Supply assurance is important for high value crops such as grapes (wine and table grapes) as well as for fruit trees. A supply risk management strategy used by farmers in the Crocodile River is to move water away from sugar cane to bananas during cut backs. According to Human (2005) farmers may retain additional rights after compulsory licensing. This will only be retained if reasonable – say 10% to 15% additional to average use to avoid risks of large restrictions. Water-use rights need to be reduced in most catchments for the Ecological Reserve requirements and for re-allocation to PDIs. According to Enright (2007) the declaration of unexercised water entitlements as existing lawful use were not meant to be forever and cutting this back will have less economic prejudice during compulsory licensing. It is not the purpose of this study to revisit the Act while the Steering Committee of this study was unsure about the legality of retaining additional rights after compulsory licensing.

Risk management is important in farming and if strategies are not in conflict with the Act then it should be considered. According to the NWA Act, water must be efficiently used while the term “best use” is also used. Efficiency is an economic concept which means that the return per cubic meter of water must be maximized. In

this return all costs are included including the cost of risk associated with this resource. That is if supply is irregular the rent return to water will be lower. The implication is that reducing some risk is promoting its efficient use and may not be in conflict with the NWA but support the spirit of the Act. The market attaches a cost to risk but to quantify it using econometric tools is problematic due to its complexity. In the study by B Conradie in the Sundays River (for her PhD at CSU) risk and risk aversion were included as costs (using approximation techniques) in the objective function. In fact, a water market promotes the efficient use of water which includes supply risk as a cost.

5.7.2 Quality

Pollution problems in the Berg River are less severe than two years ago, but if it is not brought under control, South Africa's fruit and vegetable exports to the EU and USA would be at risk (Myburgh, September 2007). Myburgh (2007) states that two years ago pollution levels in the Berg River were five to 24 times the EU's permitted maximum for food production. The key is to stop polluted matter from entering the water. This would necessitate cleaning up river banks, providing better sanitation for informal settlements and controlling the discharge of waste water from municipalities, wineries, intensive farms and industry (Myburgh, September 2007). This would require a combined effort from the municipalities, the Province, the Department of Water Affairs and Forestry and industry. Heavy winter rains in 2007 have flushed out the river system giving some breathing space. South Africa's export competitors in the EU and USA have an incentive to cast doubt about the quality of South African fruit exports and it is instructive to bear in mind the massive recalls of Chinese products that failed to meet stringent health standards in their respective export markets. Farmers on the other hand are required to adhere to high quality standards, as rejection is possible for relative minor quality problems.

According to the Regional DWAF Office, part of the reason for this situation is that insufficient funds are made available to local governments to upgrade waste treatment facilities of municipalities. Water quality standards are monitored but DWAF cannot easily institute legal proceedings against another state agency. There is, however, currently a program underway to improve the quality of the Berg River and different role players are involved. There is pressure on municipalities and outcry from politicians. Developers have even promised financial assistance. There are also salinity problems in the Lower Berg. Due to different geological formations, tributary inflows to the lower reaches of the Berg River are of high salinity.

5.7.3 Drought situations

Periodic droughts occur and a cutback of 10% in such cases is not unusual. Cutbacks in periods of scarcity is adhered to by all users except for the municipality of Saldanha where about 60% of their water use goes to industries who find it difficult to cut water use in the short term.

5.7.4 Return flow

Farmers estimate return flow to be in the order of 2% while BKS (2003) uses 5% for the Upper Berg in their calculations. The reason for low return flow is that water is

used in accordance with the latest technology. Drip and micro irrigation is used in about 95% of all water use. The approach used in this study is that return flows are only considered if significant. With such low return flows as in the Berg River it may be ignored.

5.7.5 Reserve

According to BKS (2003) provisional assessments indicate that about 20% of the total river flow is required as Ecological Reserve (ER). Van Zyl (2007) agrees with this and states that the preliminary reserve had to be determined before the construction of the Berg River Dam. BKS (2003) estimates the Ecological Reserve requirement at 217 million m^3 out of a total estimated Natural MAR of 1429 million m^3 for the Berg River.

Total requirement from irrigation, urban and rural is 704 million m^3 while the available water (through storage and abstraction from streams) amounts to be 676 million m^3, which means a shortfall of 28 million m^3. These figures are reported by BKS (2003) and represent year 2000 before the completion of the Berg River Dam. Others users include; alien vegetation (87 million m^3), afforestation (26 million m^3) and river losses.

The total sum of all uses (urban, rural, irrigation, ER, alien vegetation, afforestation) is about 1034 million m^3 which is less than the total MAR of 1429 million m^3. There appears to be enough water for ER in the system on an annual basis. Van Zyl (2007) states that sufficient water must be made available in winter months to meet Reserve requirements. Irrigation in summer increases river flow in excess of the natural state which is undesirable and steps have been taken below the Berg River dam to mitigate this. For instance below the Berg River Dam, water is transported by a pipe in summer bypassing a wetland and a relative pristine section of river.

5.7.6 Groundwater

About 6% of the total requirements for water in the Berg WMA is estimated to be supplied by groundwater. Most of the water abstracted from groundwater is for irrigation, mainly in the Cape Flats area. Groundwater quality follows the same pattern as surface water mineralization (“brak”) is a problem towards the north-west. Close inter-dependence exits between groundwater and surface water in certain areas where further exploitation of groundwater may cause reduced surface water flow. This implies that the total water resource must be considered in its totality in terms of management. As groundwater is also public water the Regional DWAF Office monitor (farmers need licences for new uses) and exercise control over new irrigation uses (a bore hole has been sealed off). It is not known how serious the problem is.

5.8 Water supply situation in the catchment

5.8.1 Water balance

According to DWAF (2004b, p247) there was a small deficit in the catchment of about 4% in 2000. About 57% of the available water goes to urban and rural water use and 43% to agriculture. The projected shortfall for 2025 is about 8%. Recent developments at improving the water balance include the completion of the Berg River Dam near Franschhoek as well as significant efforts to conserve water by the Greater Cape Town area. According to the latest data, the Regional DWAF Office in Bellville estimates a balance of supply and demand for water up to 2010 or up to 2017 in a best case scenario with implementation of further water demand management projects. Reserve requirements are at present based on preliminary calculations.

Based on the Berg River Catchment's own water sources and significant transfers from the Breede River Catchment it would appear as if water supply and requirements are balanced. To maintain this balance some supply augmenting approaches as well as demand management approaches will have to be pursued in future.

A significant proportion of the water used in the Berg River Catchment comes from the Theewaterskloof Dam. In 2002/2003 the yield of this dam was estimated at 241.2 mil m^3 (van Zyl, 2007). Of this total 50.2 million m^3 was allocated to the Riviersonderend River area. The remaining 191 million m^3 goes to the Berg WMA of which 93 million m^3 goes for urban use and 87.6 million m^3 for irrigation use. According to Van Zyl (2007) this leaves a surplus of 10.4 million m^3 that is at present, allocated to Cape Town on a temporary basis. A quantity of approximately 17 million m^3 is currently allocated to agriculture but not used yet. This is also used temporarily by the urban sector. According to Van Zyl (2008), when the Berg River Dam was built this was again confirmed in an addendum to the agreement signed by the Director General of the Department. The approach taken by the Regional DWAF Office is that agriculture can grow into this 17 million m^3 but if it is not taken up, agriculture might lose it during compulsory licensing process (Van Zyl, 2008). The growth in the agricultural sector is, however, small. Van Niekerk (2007), however, states that the 10.4 million m^3 of water (the so called temporary loan) cannot be taken away from Cape Town and be reallocated to the irrigation agriculture sector, even from an equity point of view.

5.8.2 Irrigation requirements

Unlike many other catchments in South Africa, irrigation use is smaller than residential use. According to DWAF's (2004b) data for 2000, the irrigation use for the Greater Cape Town Region is 46 million m^3, the Upper Berg 202 m^3 and the Lower Berg 53 million m^3 respectively.

The allocation of water to farmers in the Upper Berg River varies from 4000 m^3 per ha in the upper reaches of the area to 5000 m^3 per ha in the middle and 6000 m^3 per ha in the lower area of the Upper Berg River (Louw 2002:130). The quota for the Lower Berg is 7000 m^3 per ha. It was stated that the allocation of 4000 m^3 that applied to the upper reaches is based on requirements of wine grapes but since there is a switch

towards fruit farming this allocation may be too low. According to Enright (2007) irrigation areas must then be adjusted to cater for higher crop demands.

Riparian users are permitted to pump water in the winter months to fill farm dams to use in the dry summer months but it is part of their allocation per ha. Water from natural inflow into a farmer's dam is not deducted from his allocation. A limited number of irrigators have winter rights. They are members of irrigation boards away from the river. At present 75 ha in Riebeeck-Wes has an allocation of 6000 m^3 per ha and 220 ha at Riebeeck-Kasteel also for 6000 m^3 per ha. In the Lower Berg River, irrigators have summer and winter water allocations.

5.8.3 Supply augmenting possibilities

At present only 6 % of the return-flows are used in Cape Town compared to 15% in Durban (BKS, 2003). Hundred percent of the return-flows of Johannesburg as well as Paarl and Wellington is used due to the fact that return-flows are discharged to the river and used by lower-down users. Recycling is a future source of water in Cape Town and it is cheaper than desalination of seawater.

Palmiet River sub-basin has, at present, a surplus of 10 million m^3 due to a switch from apple farming to wine grapes. Higher dam walls at Voëlvlei, Theewaterskloof and Steenbras Dams are possible future supply sources.

Water saving in the Greater Cape Town area is a major source of supply augmentation which will postpone likely shortages. Demand management measures already resulted in a saving of up to 20% and further savings can be achieved.

According to BKS (2003), 137 536 ha is infested in the Berg CMA with invasive alien vegetation which consumes an estimated 87 million m^3 of water. This is especially a problem in the Lower Berg River. Some success has been achieved with eradication (cutting down Blue Gums and other alien invasive plants) but much still needs to be done. Use was made of contractors to cut down trees and sold as timber (Malan, 2007). A condition of the licence for the Berg River Dam is that alien invasive plants must be cleared in the catchment above the dam.

5.8.4 Irrigators

In the Upper Berg River there are about 400 riparian farmers with land bordering on the river and about 170 farmers away from the river that pump from the river. The so-called pump station farmers are organised in groups that finance the pump station and infrastructure for their members. Water pumped from the river by these farmers is carefully managed. These irrigation board schemes are the Suid-Agter Paarl, Noord-Agter Paarl, Perdeberg and Riebeeck-Kasteel, Riebeeck-Wes and Simonsberg.

5.9 Equity issues

Some policy options will be discussed that may be considered in empowering disadvantages persons.

5.9.1 Current situation

Most of the arable land in the Upper Berg River area is under cultivation. In the Lower Berg River there is still some possibility for a change of dry land crops to irrigation. The extent to which this will be economically viable is not clear. By and large the area under irrigation is therefore saturated. It must also be stated that most of the land is owned by white farmers. Projects to empower previously disadvantaged individuals are taking place. Several partnership projects are operating. Some of the more prominent are the Bouwland-project in Stellenbosch district and the Wittewater project in the Lower Berg River catchment.

5.9.2 Empowering PDIs with access to water

5.9.2.1 Subsidy to buy water

According to the Regional DWAF Office, PDIs can apply for a subsidy of R7 500 per ha to buy water-use rights. This is less than what water sells for (about R15 000 to R20 000 per ha). The Regional DWAF Office can motivate to the Minister to secure a larger amount in special circumstances but they have not submitted any such applications. Some irrigation boards have volunteered to pay the difference between the market price and the subsidy. This, however, remains an option.

5.9.2.2 Fund to purchase water

Van Niekerk has proposed that a fund be established to buy water for equity or environmental needs (Van Niekerk, 2005). Although farmers may be expected to contribute to this fund, funds may also be obtained from groups, individuals or companies who support the environment and/or transformation.

5.9.2.3 Water on loan to Cape Town Municipality

According to Van Zyl (2007) and Malan (2007) water is loaned by agriculture under previous agreements to the Cape Town Municipality. Van Zyl (2007) mentions a figure of 17 million m^3 but warned that water cannot be kept indefinitely for agriculture. An additional 10.4 million m^3 that was originally earmarked for agriculture but not taken up with purchase of water-use rights, is currently used by the urban sector. Farmers contend that this water was meant for the agriculture sector and may partially diffuse the equity water problem if it is provided to PDIs (Malan, 2007). Van Niekerk (2007) strongly questions the existence of such an agreement as the White Paper for the construction of the scheme cannot be construed as allocations of water-use rights.

5.9.3 Empower PDIs to own land and water-use rights

As there are no claims on agricultural land for restitution no transfer of water is possible through the restitution of land. Other options to transfer irrigation water in the Berg River need to be found in the absence of land claims, as PDIs need both water and suitable land. In the catchments previously visited (Crocodile and Olifants River), it was concluded that water will be transferred to PDIs through restitution claims. As more than 30% of the irrigation land is claimed by PDIs in these

catchments the target that PDIs should have 30% of the water can be met through land restitution. Other options to transfer irrigation water in the Berg River need to be found in the absence of land claims as PDIs need both water and suitable land.

5.9.3.1 Coordinate efforts of Land Affairs, DWAF, The Department of Agriculture, Land and Development Bank and commercial farmers.

If irrigation water is provided to PDIs then they will still have to be provided with suitable irrigable land which is a problem as most of the land in the Upper Berg is already under cultivation. This issue needs more careful study but it appears that one way that PDIs could be assisted to own a targeted 30% of the land and water is for PDIs to be provided financial assistance by Government under the Land Redistribution Program to buy land under irrigation. As the value of water is included in the value of a farm, both land and water will be redistributed in this way. PDIs can also join white commercial farmers in trusts as equity schemes (joint ventures). Other subsidies to PDIs includes financial assistance of R15000 per ha for bulk water infrastructure and phased assistance for WUA charges over 5 years.

If ownership of PDIs is to be promoted towards the national proposed target of 30% of the land and water in this area then a major initiative will have to be launched by the authorities. Water-use rights without access to suitable arable land are not useful. A strategy that only addresses the issue of water-use rights without giving attention to land is not productive. Without support from relevant stakeholders emerging farmers will not succeed.

5.9.3.2 Cost to redistribute land and water

Access to land and water-use rights will be very costly in this area because of the high value of land. Agricultural land with wine grapes sells for about R130 000 per ha. Land under fruit (citrus, prunes etc) sells for up to R200 000. If 30% of the l5 000 ha under irrigation in the upper Berg River is to be transferred to PDIs at R130 000 per ha then about R600 mil (15 000 ha times R130 000 times 0.3) will be needed to settle them on the land. The cost per ha may be high but the farms are small and more intensive and the total cost to Government may not be higher to settle a PDI in the Berg River than is the case in other areas.

5.10 Final comments

It appears that water transfers have stopped as if DWAF does not support the transfer of unexercised water-use rights where it does not promote empowerment of PDIs (Enright, 2007). The transfer of non-exercised water-use rights is also a problem in the highly stressed Crocodile River. Taking away unexercised rights may be challenged in court as it is a controversial issue. However, with compulsory licensing unexercised rights will most likely be forfeited (Enright, 2007). Water-use rights need to be reduced in most catchments for the Ecological Reserve requirements and for re-allocation to PDIs. According to Enright (2007) the declaration of unexercised water entitlements as existing lawful use were not meant to be forever and cutting this back will have less economic prejudice during compulsory licensing. Human (2005) states

that the Minister will look at exercised lawful use and if it is not exercised then there is a strong possibility that it will be lost without compensation.

CHAPTER 6. LESSONS LEARNT AND PROGRESS MADE IN WATER MARKET INSTITUTIONS IN THE THREE CASE STUDY AREAS

6.1 Introduction

The case study approach was chosen to determine if and how a water market functions in each selected area. Factors that may inhibit the functioning of a water market were also investigated. A detailed description and analysis of each case study area has been presented in previous reports. The purpose of this report is to highlight the lessons learnt with respect to aspects that have a direct effect on water markets in each area. Lessons that are common to all areas are discussed in the overview. The case study areas are:

- The Crocodile River Catchment (East),
- The Olifants River Catchment (East) and
- The Berg River Catchment in the Cape.

6.2 Crocodile River Catchment

6.2.1 Impediments

Lesson 1: *The most important impediment to transfers of water has been land claims as water cannot be transferred if a claim is lodged against a farm*. According to one expert 95% of the irrigation land is under land claims during 2007. Recent (2008) information is that 80% of the farms under irrigation have already been transferred. The market will again function after the successful completion of the land claims.

Lesson 2: According to previous studies in the Crocodile River, most of the transfers of water-use rights involved non-exercised entitlements that were put up for sale. Farmers bought these rights to improve their assurance. Because of the deficit and the lack of water in the river the assurance of all the other farmers deteriorates if non-exercised rights are activated. The Chairman of the Main Crocodile Irrigation Board said that he would not support such applications for transfers because of this reason. There is also legal uncertainty regarding the status of non-exercised entitlements as far as trading is concerned. *The interaction of the various elements; legal issues, deficit and the perception that third parties would be harmed by transfers of non-exercised rights resulted in opposition to applications to trade that would activate non-exercised entitlements.*

Apart from the issue of land claims there appears to be no obstacles, in principle, to the transfer of exercised water-use rights

6.2.2 Possible strategies to reduce water balance deficits

Lesson 1. *Estimates about the size of the deficit vary*. Based on 1:50 year assurance DWAF (2004a) estimates the deficit as 149 million m^3 of water (availability estimated

as 264 million m^3 and requirement as 413 million m^3). Using these data, irrigation and forestry must be reduced by 50% in order to eliminate the deficit. More recent (2008) estimates have been made by Mallory (2008). Mallory (2008) estimates the deficit for two scenarios. Scenario 1 includes high flows (floods) for the Reserve. Under this scenario current demand is estimated as 446 million m^3 and supply as 232 million m^3. The difference between demand and supply is still high (48%) but the data were interpret differently from the reconciliation statement of DWAF. If demand is reduced to 282 million m^3 (37% or 163.28 million m^3) then the reduced demand is still more than available supply but they view this as sufficient assurance. Under scenario 2, high flows are excluded. Under this scenario demand is 446 million m^3 while supply is 259 million m^3. Reduced demand is estimated at 319 million m^3 which is more than supply but again assurance was seen to be sufficient. This implies a cutback of 28% or 126 million m^3. The average deficit estimated by Mallory (2008) is 146.72 million m^3, calculated as 0.5*(163.28 million + 126.86 million m^3).

An expert (Van Niekerk, 2008) considers the deficit in the Olifants River more of a problem than that in the Crocodile and questions high estimates for the Crocodile River. In his opinion the Crocodile River is over-allocated on paper. Farmers support the view of Van Niekerk (2008) and state that there appears to be a mismatch between the deficit according to DWAF reconciliation statements and water in the Crocodile River. A part of the reason for the latter (over-allocation and mismatch) is that reconciliation statements include non-exercised use which is estimated at between 10% and 15% of total use.

Lesson 2: The deficit can be reduced in different ways each having different cost implications. *A phased approach should probably be used starting with the elimination of illegal water use, eradicating alien vegetation and refining the data on which the reconciliation statement is based.*

Lesson 3: *The market* has limited potential to reduce the current deficit as the present demand and supply volumes are incorporated in the market. It *will however prevent the deficit from increasing in future years*. Water scarcity caused by drought and possibly the expanding of acreage with the saved water has increased water efficiency in the Catchment. It appears at current use levels that the demand for water may be highly price inelastic which reduces the ability of price as a rationing device. Room for improved efficiency is still possible by changing from over-head sprinklers on some lands below the Gorge and to reduce the water leakage in some channels. A water market (reflecting its scarcity value) will hasten the latter technological changes.

Lesson 4: The rights of existing lawful water users may be curtailed to eliminate the deficit. A reduction in volumetric entitlements can be rationalized on the basis that initial allocations were generous and that farmers have since then adopted water conservation measures such as drip irrigation that reduced return flow. The return flow from flood irrigation is about 30% while from drip about 5%. It may thus be argued that entitlements may be reduced by about 25% without affecting the farmer's original consumptive use. If the deficit is to be met by reductions in irrigation entitlements then it implies that water allocation to this sector must be reduced by between 28% and 37% (using Mallory's data). The indirect impacts of a reduction in irrigation water are the same whether the required reduction in water use is bought out

or instituted by a mandatory reduction. Indirect costs from reductions in water-use rights are estimated at between 2 and 20-fold larger than direct cost. Such a *curtailment will have a devastating effect on commercial agriculture as well as PDIs who have been settled on claimed and redistributed land.*

Lesson 5: A fund can be established to finance the required reduction. The advantage of a fund is that it can be used as a phased approach and the cost of the reduction will be visible. In this calculation the deficit was assumed as 149 million m^3 (DWAF's earlier estimate) which is slightly more than the average of Mallory (2008) estimates of 146.7 million m^3. *If a fund is used to buy out a deficit of 149 million m^3 then about R516 million (rough estimate) may be needed if irrigation water is bought out*. The indirect benefits from irrigation are estimated to be high and also impacts on other sectors. It is therefore questionable whether only irrigation users should contribute to such a fund if instituted. If the catchment is over allocated on paper then the cost of buying out will be less. Non-exercised users may lose water rights at the compulsory licensing stage and thus need not be bought out.

Lesson 6: *The option of building a dam to reduce the deficit should be considered due to the high cost of withdrawing land from irrigation as well as the significant indirect effects from such an action*. The direct cost of building a dam can be compared with the cost of curtailing irrigation to meet the deficit (estimated at about R516 million). The indirect cost will raise this figure substantially. As a dam will increase water assurance levels, farmers may be prepared to contribute to its cost. The cost of the drought over the last few years has been estimated to be in the millions (about R50 million per annum).

6.2.3 Hydrological issues

Lesson 1*: High priority should be given to the installation of water meters due to alleged illegal use in this stressed catchment.* The market has operated in the past in the absence of metering but metering is an integral part of a market as it quantifies the entitlement and provides the basis on which rights of the user can be enforced. Hydrological issues and the deficit are connected as the expanded acreage (through water spreading) increased consumptive use of water and thus increased the deficit.

Lesson 2: *Regarding consumptive use and return flow it is proposed that the entitlement should be in terms of a measurable volumetric quantity of water*. Return flow can then be taken into account, in different ways. Return flow is already substantially reduced as farmers have adopted water conservation measures due to the stressed situation.

6.2.4 Characteristics of the water market

Lesson 1: *Water prices in a fully developed water market are expected to increase from the current R15000 per ha (1 ha = 13000 cubic meter) to a maximum of about R45 000 for 13 000 cubic meter of water.* The reason for this expected increase is the complete separation of water and land rents in a water market. The increased water price will provide the proper incentive for its conservation.

Lesson 2: *Water prices in the past were depressed because of the following policies* (a) non-exercised users were able to sell, (b) no adequate metering is undertaken while (c) past policies attributed a scarcity value to land and not water. Under riparian law ownership of riparian land provides access to water. Farmers have been given fairly generous water quotas per ha with the implication that land was the scarce resource and not water. The markets priced land and water in accordance with these past policies.

6.2.5 Equity issues

Lesson 1: It has been estimated that as much as 95% of the land in the Crocodile River Catchment is under restitution claims. During the final editing stage of the document information reach the Team that 80% of the irrigation farms are already in black ownership. *As PDIs acquire both the land and water on an irrigation farm it is concluded that more than the targeted 30% (in fact 80%) of the irrigation water will be redistributed through the land claims process.* It will not make economic sense to take water away from productive farms and initiate new irrigation elsewhere. PDIs should be empowered to gain access to both productive land and water.

Lesson 2: TSB Sugar small grower scheme is seen as a successful programme as farmers are given technical as well as financial assistance. *Land and water reform should be linked and efforts by department of Land Affairs and DWAF should be coordinated*. PDIs should be assisted to acquire commercial land under irrigation as it is costs about R30 000 per ha to bring undeveloped land into production. This in fact has now happened. Under the communal tenure arrangement of some small growers, land and water rights cannot be sold. It is recommended that these small growers be encouraged to promote a rental market in water-use rights as this will expose them to the opportunity cost of water use and if water is no longer a free good it will lead to its more efficient use.

6.3 Olifants River Catchment

6.3.1 Impediments to a water market

Lesson 1: *Land claims are a major impediment to a water market in this catchment*. Claims vary from about 50% of the land in the Loskop Scheme to a blanked claim for the part of the Loskop Scheme that falls in the former Lebowa. All the land in the Hoedspruit area is subject to claims but farmers estimate that about 30 to 40 % of the land involved in claims will eventually be successful. Claims have a negative impact on agricultural investment in this area. On the positive side land restitution is a vehicle through which water will be transferred to PDIs and the objectives as stated in the WAR document promoted. If a claim is lodged against a farm, it may not be sold which means that the sale of water is not possible. Banks are reluctant to finance the purchase of land, even if there is no specific claim because of the uncertainty about future possible claims. Since the purchase of farms is dependent on external financing land and water sales will not occur in such an environment.

Lesson 2: Water is metered and monitored in the Loskop and Blyde River irrigation areas and there is no room for illegal use. *It is alleged that in areas outside the*

Schemes the absence of water metering and monitoring is a problem. Mines and farmers are blamed for illegal abstraction of water. The lack of metering and monitoring is so bad that a representative from the Kruger National Park alleges that if the Park buys or rents water then the water will never reach the Park as it may disappear in the system.

6.3.2 Characteristics of the water market in the Olifants Catchment

Lesson 1: *Few sales of water have been observed in the study area*. This may be attributed to:

1. The climate and crops within each sub-area appear more homogeneous,
2. Irrigation plots in the study area are relatively small (25.7 ha in Loskop and 20 ha in the Blyde River Irrigation Scheme) meaning that farming cannot be continued if the water-use right is partially or fully sold. It therefore makes more sense to sell the farm than only the water-use right and
3. There are no non-exercised water rights in areas visited (Loskop and Blyde River), as is the case in the Orange and Crocodile rivers where water markets were active. Water prices need to increase substantially before it becomes worthwhile for an irrigation farmer to sell his water.

Lesson 2: In the Loskop area the present water sales price is about R1.52 per cubic meter (R11 704 per ha). *Development cost is sunk and may have a zero opportunity cost in future as water is transferred to urban use, water prices are estimated to increase to R2.5 per cubic meter (2006 values) in the Loskop area and to R2.02 per cubic meter (R20 000 per ha) in the Blyde River irrigation scheme*.

Lesson 3: Renting of water is more common and farmers can thus face the opportunity cost price of water. The Loskop Irrigation Board Water-bank Facility creates a mechanism for farmers to rent out surplus water during the year for 10 cents per cubic meter (which is the cost of providing water to users). Apart from the Water-bank, person-to-person rent of water is not common. *Farmers do occasionally rent out water privately*. *The price is negotiated individually but the average price is estimated at about 18 cents per cubic meter* although prices as high as 50 cents per cubic meter have been recorded. The requirement that the duration of water rent can only be for one year, and renewable for an additional year, discourages renting, as farmers want more certainty for future use. This restriction can be overcome when both water and land are rented, as there is no such restriction on renting irrigation land. In the Blyde River Irrigation Scheme farmers rent out surplus water at the price they have to pay to service the debt on the pipeline (R210/ha/month or 25.4 cents per cubic meter). It appears as if the rental market is reasonably active in both areas.

Lesson 4: *Based on evidence obtained in the catchment it appears as if the water market and higher water prices will increase water use efficiency and that the demand for water for irrigation is price elastic*. Greater water use efficiency in the catchment can be attained by:

- Better scheduling that can reduce consumption

- About 35% of irrigated area is under maize, wheat and pasture which are generally seen as low income crops which can be substituted for higher income crops
- Overhead irrigation (high loss to evaporation) is common and can be replaced by more efficient systems
- Water distribution losses attributable to faulty infrastructure are estimated at around 30%.

High water prices will provide an incentive to produce more water efficient crops using water conservation technologies while the opportunity cost of faulty infrastructure and inefficient scheduling increases. It is alleged that the high payment on the cost of the pipeline in the Blyde River has forced efficiency in water use.

6.3.3 Hydrological issues

Lesson 1: The deficit for the total Catchment is estimated at 192 million cubic meters based on data for the year 2000. A preliminary Reserve has been undertaken and the validation process has been completed, indicating that there are over and under registrations of existing water use. This process revealed that 450 illegal dams exist in the catchment. The hydrology of the catchment is being revisited to recalculate the water balance. *The result is as yet unknown but the resulting stress level may be less serious than the 20% originally thought.* The verification in terms of section 35 of the NWA must still be done.

Lesson 2: It is estimated that there are close to 10 000 operating boreholes in the Catchment contributing 16% of local yield. The mines are increasingly utilizing groundwater while in some areas it is used for irrigation. It is difficult to control or monitor water use from boreholes and it is not clear whether effective control measures exist in the Springbok Flats where irrigation from boreholes is significant. At present farmers pay little or no user charges. Water from different boreholes often comes from the same source and the common ownership problem arises. *It is proposed that this water be metered and monitored and that economic measures be taken to promote conservation such as regulation, user charges or possible transferable permits in some instances*.

6.3.4 Approaches to improve water use efficiency

Lesson 1: *Water trade may be possible between surface water, smaller dams and boreholes as well as between farmers and the Kruger National Park.* Some boreholes appear to be linked to surface irrigation. Linking up smaller dams and boreholes in the total market will depend on expert opinion but given the extent of this source it is an aspect that must be investigated further. The Regional DWAF Office does not support the transfer (sale) of water between sub-catchments for irrigation purposes but supports transfers for industrial and for human needs. The price of water will be different between sub catchments and the feasibility of trade between sub-catchments must be considered in future.

6.3.5 Environmental issues and market approaches

Lesson 1: Pollution in the river and in Loskop Dam is high. One of the main problems is the effluent leakage from old disused mines. Mines have been permitted to release effluent in the streams during periods of high flow, which is called the "controlled release scheme". During the past few years, river flow was low and sufficient dilution of nutrients was not possible. Mines and power stations had to invest in desalination plants at considerable cost to dispose of pollutants. A Waste Discharge Charge System is proposed by DWAF but at present, discharges in the catchment are not taxed. *It is recommended that polluters should pay a discharge tax in the same way as water abstraction users pay water rates.*

Lesson 2: *As in the case of a water market it is proposed that a market be established for the discharge of pollutants and that this market be used to discover the optimum price for pollutant disposal.* All markets operate within certain rules. In a pollution permit trading market measures that may be considered are that discharges in the river are only allowed when flow is sufficiently high and that trades may only occur within certain parameters. A permit-trading program will complement desalination plants as some of the costs of these plants are variable (reservoirs where the pollutants solidify fill up).

Lesson 3: *Apart from a pollution trading program it is suggested that bio-diversity offsets be created to provide incentives for cooperation amongst stakeholders which may be mines, developers, environmental groups, farmers and public land agencies*. Examples where the offsets should be considered in the catchment are given. Expert opinion is that the main source of pollution in the Loskop Dam is the leakage from abandoned old mines (pre-1956). The problem with the defunct mines is that they leak pollutants all the time including during the period when river flow is low. DWAF has accepted ownership of these mines but they may not have the technology (which is expensive) to desalinate the effluent. In an offsetting arrangement, incentives can be provided to existing mines to desalinate water from these defunct mines in exchange for the discharge of a given amount in the Olifants when the water flow is sufficiently high. Such an arrangement will have no cost implications for the taxpayer while discharge during low flow periods is reduced.

Lesson 4: *New dams* are often opposed because they have negative environmental impacts in resource sensitive areas. *It is suggested that these impacts be mitigated* with other offsets for instance developers may undertake to eradicate alien vegetation along the river.

6.3.6 Emerging farmers

Lesson 1: Little is known about emerging irrigation farming in the Catchment, apart from a few isolated cases. Perret (2002) studied the temporary transfer (for five years) of water from smallholder irrigation schemes (SIS) under the Flag Boshielo dam to mines. Perret (2002) was critical of the arrangement as he alleges that information is asymmetric and small farmers are thus subject to exploitation. He also expected that emerging irrigation development would be abandoned. Information received indicates that emerging holders may not have been prejudiced as was alleged. Emerging farmers received compensation for water-use rights (R7 million),

which they have not exercised. The water-use rights were returned to them after the five-year rental period. It is unlikely that any other party would have wanted the rights to this water for such a short period so the asymmetric argument appears without foundation. *However, in the negotiations between small holders and mines or other buyers asymmetric information must be a concern and the institutional help by government must be provided.*

6.4 Berg River Catchment

6.4.1 Reason for transfer refusals

Lesson 1. Since September 2002, 18 transfers of water-use rights have taken place in the Berg River. This process has more or less came to a standstill. *The main reason why transfer applications are refused is that DWAF does not support the transfer of non-exercised rights*. There is also a perception that water can only be transferred from white farmers to Previously Disadvantaged Individuals (PDIs) or where it at least promotes empowerment of PDIs.

6.4.2 Issues that can potentially reduce effectiveness of a water market

Lesson 1. Abstraction by pump irrigation schemes is accurately measured while there is no metering of individual riparian owners. Illegal use of water by members is limited because water applications on crops are carefully monitored and over use will lead to diseases such as amongst others root rot. There are, however, allegations of illegal use of water by some irrigators. *The lack of individual metering is at present tolerated because total water use is still below the scheduled area multiplied by the relevant quotas*. During restrictions the total bulk water releases are monitored and curbed.

Lesson 2. *The transaction costs are low (about R114 per application) for direct applications to DWAF, but if an attorney is used then the costs are substantially more*. Farmers do not have to use an attorney but they probably reason that as the water is valuable to them and as the chance of rejection is high, they appear to prefer to use a legal firm that specializes in water matters. From discussions with attorneys dealing with transfers, it is apparent that the attorneys require more clarity related to the rules necessary to obtain approval.

Lesson 3. The *Upper Berg River irrigation board opposes water transfers from agriculture to residential use, from Upper Berg River to the Lower Berg River, from near the river to further from the river and from riparian irrigators to pump station users*. Although reasons are advanced these restrictions reduce the flexibility of a water market in promoting efficiency of water use. There have been only a limited number of applications in these categories.

6.4.3 State of water trading

Lesson 1. *Transfers have taken place regularly and largely within the GWCA*. About 50% of the Berg WMA falls under a GWCA. The approval process for transfers took on average about four months from date of receiving the required documentation to

final approval. Of the 18 transfers since September 2002, the two largest were for the same property. If these two are excluded then the largest transfer was 270 000 m^3 of water, the smallest 7450 m^3 with the mode of 60 000 m^3.

Lesson 2. *Based on the information that transfers have stopped and that non-exercised rights will not be supported for transfer, it appears that this was a main reason why farmers want to sell.* Talking to farmers it appears that this is an important reason for selling. Other reasons for selling entitlements are a change in crops cultivated, a desire to scale down an operation or even occasionally because of financial difficulty. Buyers are usually farmers who want to improve their level of security or who have switched to crops with higher water use intensity such as for instance from wine grapes to table grapes or fruit farming. The temporary transfer of water-use rights is not common, mostly due to the fact that long- term crops need a permanent secure source of water.

Lesson 3. There are no restrictions, imposed by the irrigation boards, for riparian irrigators to transfer water from downstream to upstream. *There are salination problems ("verbrakking") down-stream in the Berg River and selling water up-stream may have advantages for the users.* Transfers may occur within pump schemes (six schemes) but for cost reasons not with outside entities. Water from farm dams can be transferred to a nearby farmer if it is practically possible. Only one transfer occurred between agriculture and non-agriculture.

6.4.4 The development of water users' associations

Lesson 1. Three boards have converted to WUA and 16 still remain currently as irrigation boards. The legal obstacle in interpretation of the National Water Act and pricing strategy that the obligation of debt rests with the buyer of water has been resolved and no further difficulty is foreseen in establishing WUAs. *WUAs may be in a better position to deal with total water use control as well as the pollution problems in the Berg River.*

6.4.5 Characteristic of water market in area

Lesson 1. *In general, irrigation practices in the Berg WMA are highly sophisticated and water use by the irrigation sector is relatively efficient*. Farmers use drip irrigation on wine grapes and table grapes and micro on citrus. The irrigation demand for water may thus be fairly inelastic and high water prices may not squeeze much water from production. This is different from the Olifants River (East) where lower income crops such as wheat and maize were irrigated by sprinklers.

Lesson 2. The average price for summer use entitlements varies between R15 000 and R20 000 per ha in the Upper Berg River (average application of 5000 m^3 per ha/annum). Land under wine grapes sells for about R110 000 to R130 000 per ha. Some of the costs to establish a vineyard are fixed (sunk) in the long run such as development and drainage. *The costs now attributed to the sunk components may move to water and water prices may increase accordingly in future. It is estimated that water prices may increase to about R45 000 per ha or more than double the present price*. In a water market, prices will increase (in real terms) which will provide incentives for conservation. Winter water entitlements are more common in

the Lower Berg River. The price of winter use entitlements is lower (about R10 000 per ha) as farmers need to build dams to capture this water for use in summer.

6.4.6 Hydrological issues

Lesson 1. *DWAF works on guidelines of 100% assurance for 7 years and 70% assurance for 3 years giving a long-term average assurance level of 91% for agriculture*. Cut-backs have occurred in the past. Cut backs are normally debated with water sectors and tables and models are operated to determine when and why restrictions should be made depending on factors such as growth prospects. Farmers prefer to be able to retain additional water rights in order to improve supply assurance for high value crops. According to Human (2005) farmers may retain additional rights after compulsory licensing. This will only be retained if reasonable – say 10% to 15% additional to average use to avoid risks of large restrictions. It is not the purpose of this study to revisit the Act while the Steering Committee of this study was unsure about the legality of retaining additional rights after compulsory licensing. According to the NWA, water must be efficiently used. It is contended that risk management gives implementation to this Act as reduction of risk improves the efficiency of water, as risk is a cost.

Lesson 2. Pollution is a problem in the Berg River and fruit and vegetable exports to the EU and USA are at risk. Pollution sources are informal settlements, municipalities, wineries, intensive farms and industry. Part of the reason for this situation is that insufficient funds are being made available to local governments to upgrade waste treatment facilities of municipalities. *A program is underway to mobilise stakeholders to improve the quality of the Berg River.*

Lesson 3. According to estimates the total sum of all uses (urban, rural, irrigation, ER, alien vegetation, afforestation) is about 1034 million m^3 which is less than the total MAR of 1429 million m^3. *Irrigation in summer increases river flow which is undesirable and innovative methods have been used in ecological sensitive areas*. For instance below the Berg River Dam, water is transported by a pipe in summer bypassing a wetland and a relative pristine section of river. Sufficient water, however, must be made available in the river in winter months to meet Reserve requirements.

6.4.7 Water supply situation

Lesson 1. As this is a winter rainfall area while peak consumption is in summer months, the supply situation and water availability through storage is critical. There was a small deficit in the catchment of about 4% in 2000. About 57% of the available water go to urban and rural water use and 43% to agriculture. The projected shortfall for 2025 is about 8%. Recent developments at improving the water balance include the completion of the Berg River Dam near Franschhoek as well as significant efforts to conserve water by the Greater Cape Town area. *According to the latest data, the Regional DWAF Office in Bellville estimates a balance of supply and demand for water up to 2010 or up to 2017 in a best case scenario with implementation of further water demand management projects.*

Lesson 2. Unlike many other catchments in South Africa, irrigation use is smaller than residential use. *The allocation of water to farmers in the Upper Berg River varies*

from 4000 m^3 per ha in the upper reaches of the area to 5000 m^3 per ha in the middle and 6000 m^3 per ha in the lower area. The quota for the Lower Berg is 7000 m^3 per ha. It was stated that the allocation of 4000 m^3 that applies to the upper reaches is based on the requirements of wine grapes but since there is a switch towards fruit farming this allocation may be too low. Irrigation areas must then be adjusted to cater for higher crop demands. Riparian users are permitted to pump water in the winter months to fill farm dams for use in the dry summer months but this will be part of their total allocation per ha. Water from natural inflow into a farmer's dam is not deducted from his allocation. A limited number of irrigators have winter rights. They are members of irrigation boards away from the river.

Lesson 3. At present only 6 % of the return-flows are used in Cape Town compared to 15% in Durban. In Johannesburg 100% of the return-flows is used due to the fact that return-flows are discharged in the river and used by lower-down users. Recycling is a future source of water in Cape Town. Palmiet River sub-basin has, at present, a surplus of 10 million m^3 due to a switch from apple farming to wine grapes. Higher dam walls at Voëlvlei, Theewaterskloof, and Steenbras Dams are possible future supply sources. Water saving in the Greater Cape Town area is a major source of supply augmentation which will postpone likely shortages. *Demand management measures already resulted in a saving of up to 20% and further savings can be achieved.*

6.4.8 Equity issues

Lesson 1. *Strategies to empower PDIs with access to water include (a) using the current subsidy on water-use rights that is available to PDIs*. PDIs can apply for a subsidy of R7 500 per ha to buy water. This is less than what water sells for (about R15 000 to R20 000 per ha). The Regional DWAF Office can motivate to the Minister to secure the full amount under special circumstances. *(b) A fund can be established to buy out water rights.*

Lesson 2. If irrigation water is provided to PDIs then they will still have to be provided with suitable irrigable land which is a problem as most of the land in the Upper Berg is already under cultivation. *One way that PDIs could be assisted to attain 30% ownership of the land and water is for PDIs to be provided financial assistance by Government under the Land Redistribution Program to buy land under irrigation or join white commercial farmers in trusts as equity schemes (joint ventures)*. PDIs need to be given support from the Department of Water Affairs and Forestry, the Department of Agriculture (extension support), Land and Development Bank (financial support) and assistance from commercial farmers. Other subsidies include financial assistance of R15000 per ha for bulk water infrastructure and phased assistance for WUA charges over 5 years. Lessons from failures and successes elsewhere must be applied.

6.5 Summary

Certain conclusions are common to all areas while there are also differences. The common conclusions will first be discussed. Water markets in the three areas studied (Crocodile, Olifants and Berg rivers) have come to a standstill either because of land

claims (Crocodile and Olifants rivers) or because of a reluctance to transfer non-exercised use rights of water (Berg and Crocodile rivers). It is suggested that water (WAR document) and land empowerment must be coordinated as PDIs need both water and irrigable land. Water will be transferred to PDIs in the Crocodile and Olifants River catchments through restitution (land claims) while in the Berg River Catchment (no land claims) it can be achieved through the redistribution of land. The Department of Land Affairs have a target that 30% of the land must be redistributed which means in irrigation areas that the target that 30% of the water should be redistributed can be met by land redistribution. As the rules of the game have changed (New Water Act) the achieving of political objectives is a precondition to water markets.

Renting of water is not subjected to the same political constraints as sales. Farmers prefer buying water to renting as it provides more certainty for long term crops. The renting market is, however, important as it is a vehicle through which the opportunity cost price of water is discovered. As all parties face this opportunity cost they have the incentive to conserve water.

In a water market, rents attributed to water are separated from land. As transfers are on volume of water, the market separates rents attributed to water and land. These incentives are thus achieved even in the absence of water licenses (licenses reinforce these incentives). In areas studied it was concluded that water prices (in real terms) will substantially increase in the future as water is moved from agriculture to urban use. This will provide increased incentives for water conservation.

Illegal use is a problem in all areas especially where water is scarce. Metering is needed to enforce property rights.

Other conditions in the three areas differ which will impact on a water market. The most important impediment to water sales in the Crocodile river in recent years was land claims. About 95% of the land was claimed which meant that water sales were not possible. As about 80% of irrigation land in this river is now in black ownership this constraint is falling away.

Non-exercised rights still remain a problem in the Crocodile River. There have been no trades in the Crocodile River since about 2002, but before this time trades (sales and rents) were common. The most common type of trades that did occur were non-exercised users selling their water. One of the reasons for selling is that sellers were afraid that they may lose it. The situation has now changed and according to the reconciliation statement for this river it has a serious deficit as allowance had to be made for the Reserve.

While both buyer and seller benefit from a sale, the Chairman of the Crocodile Irrigation Board indicated that he will oppose the sale of non-exercised rights as the assurance of all third parties (other farmers) deteriorates if these rights are activated in such a stressed situation. This is a legal issue, the outcome of which is uncertain. If non-exercised rights may not be transferred then water prices will have to increase substantially before transfers will take place. The positive side of such an increase is that it will provide more incentive to conserve water. How the deficit will be reduced

creates uncertainty in this market but with 80% of water in black ownership it is unlikely that irrigation use will be cut.

In the past it took only four months to process a transfer in the Berg River which shows that it was a relative uncomplicated process. The suspicion is that most of these transfers were from non-exercised users. A senior local DWAF official in the Berg River said that he will not support the transfer of unexercised rights. He has taken this position although this river is not in a deficit according to reconciliation statements.

The implication is that water prices will have to increase sufficiently before exercised users will sell and it may take some time before water transfers reach its previous level. In any transfer application the impacts on PDIs and other socio-economic effects will be considered by authorities which will make transfers less flexible. Changes in crops over time have increased the demand for water in some areas. In the past the municipalities were part of irrigation boards which shows that stakeholders work well together (probably because there was sufficient water).

Of areas studied, water markets may have the greatest impact in improving water conservation in the Olifants River. The reason is that water efficiency in this catchment can be improved as:

(a) Better scheduling can reduce consumption

(b) About 35% of irrigated area is under maize, wheat and pasture which are generally seen as low income crops

(c) Overhead irrigation is common while

(d) Water distribution losses attributable to faulty infrastructure are estimated at around 30%. Land claims are a problem in this area.

Few sales have been recorded in the past in this area and it is estimated that water prices will have to increase before sales from exercised users will take place. Pollution is a problem in this river and some low cost strategies have been suggested.

CHAPTER 7. THE STATE OF INSTITUTIONAL STRUCTURES AND INFORMATION REQUIREMENTS THAT WILL PROMOTE THE ESTABLISHMENT AND REGULATION OF A WATER MARKET

7.1 Introduction

After a process of consultation a new policy framework for water use in South Africa was formulated. The legislative prerequisites for such a system have been provided for in the NWA. This included provisions that will allow a water market to function (Conningarth, 2004). The Act does not provide the detail as to how the legislated principles must be implemented. The NWRS describes the implementation strategies for the new water management structures. It is clear from this document that the implementation of the provisions of the Act in all catchments will take a long time to complete. A progressive programme of implementation, starting with the catchments that are under the greatest stress, will be followed.

The re-allocation of water use in a catchment in accordance with the objectives of the NWA will be done as part of the compulsory licensing process. After the completion of this process certainty will be obtained on how the water use availability will be balanced against the water use requirements in a particular catchment. In discussions with DWAF the importance of reaching the compulsory licensing stage was re-emphasised (Havenga, 2006). It will result in a clear picture of water-use rights and the resulting administration of water use. However, it is difficult to establish a timeframe for the compulsory licensing process since public participation forms a significant part of the process. It is always difficult to determine a reasonable time frame for this process to take place.

In the pre-compulsory licensing period, which can be a period of considerable length, authorities must employ procedures that will not worsen the position of existing water users. These procedures should not influence the Reserve in a negative way, and in general should not worsen the water balance situation.

Provisions are made for the trading of water-use rights in the pre-compulsory licensing phase and at the same time progress has been made with the establishment of institutions and structures that will be needed for a functioning water market.

In the rest of this chapter the water market institutions will be discussed to determine if they are assisting a water market or hindering it and if possible what improvements are necessary.

7.2 Pre-conditions for a water market to function

In order to allocate water use efficiently under any system of allocation it is necessary to:
Appropriately define water-use rights;
Measure (meter) actual use;

Capture the metered use information in appropriate information management systems which enable the use to be monitored in a systematic manner to ensure exclusivity;
Enforce the conditions of the water use license, particularly where users do not comply with their water user entitlements; and
Legally transferable.

7.2.1 Definition of water-use rights

Water-use rights are seen as the central point in the institutional framework to achieve the effective management of water resources and include more efficient water use and efficient allocation. Water-use rights or entitlements define the volume of water available to an individual or user group at a certain point in time or during a specific time period. Without a clear definition of who the users are and how much water they are entitled to, it is difficult for water management authorities to effectively control the use of water. Furthermore, the manner in which the licenses are defined may bear with it incentives or disincentives for water users to use water efficiently (Paterson, 1989). Defining water-use rights is complicated by various factors. There may be numerous sources of water in a given catchment (for example tributaries, dams, groundwater reserves etc) and numerous water users distributed throughout the catchment (with the implication being that not all water users have access to the same water sources) and the water users may require different assurances of water supply. In addition, the variability of flows in South Africa's rivers is one of the highest from an international point of view. There are also various types of water use licenses, such as abstraction licenses, licenses for Streamflow Reduction Activities (SFRAs), amongst others, further complicating the definition of water-use rights.

Given these complicating factors it would be difficult or impossible to define the physical security of a water-use right in absolute terms. Water-use rights are therefore defined in relative terms where conditions such as available water supply and the level of assurance of a specific use are taken into account.

Globally water use is measured at the point of delivery although Paterson (1989) proposes that specifying a water-use right in terms of the origin of the source will have certain advantages above that of a specification at the point of delivery. This is a technical aspect that falls outside the scope of this discussion but will be referred to again when the need for information systems is discussed. Given the relative nature in which water-use rights are defined does not however prohibit the functioning of a water market either globally or in South Africa.

7.2.2 Measuring (metering) use

The actual water diverted (used) needs to be measured, via the use of appropriate abstraction water meters (DWAF, 2006c). However, this is currently not a common occurrence. In the case of irrigation an allocation is usually specified in terms of a certain number of cubic metres per hectare per annum (or other specified time period). The allocation of available water to individual users is at present managed by the user association without the use of meters. Such a system of allocation is not very accurate and illegal use of water can occur. Technology has reached a stage where meters are accurate and affordable. It has been suggested by van Veyeren (2008) that because of these technological advances serious consideration should be given to making

metering mandatory for all users and that non-compliances should be dealt with drastically.

7.2.3 Monitoring water use and quality with appropriate information management systems

Suitable information management systems are needed to capture, store and analyse data from the network of abstraction water meters, in addition to information related to the flowing water and stored water that exists in catchments at any given point in time or time range. The information management systems enable water resource managers to monitor the water use and quality in catchments in a systematic manner, enabling them to become familiar with water use patterns of water users, as well as cases of over-use which need to be acted upon. Water quality has become a serious concern in some catchments (van Veyeren, 2008) and monitoring systems should be developed to deal with this issue (DWAF, 2006c). The information management systems will need to draw on the water apportionment rules (i.e. the way the licenses are defined) in order to determine if over-use is occurring at a given point in time (or time range). The importance of well-defined licenses becomes evident, as water managers need to reconcile water use with the entitlement of water users to use water for a given point in time or time range. If the licenses are poorly defined, it is difficult to undertake this reconciliation at appropriate time and/or space scales, which may be required to ensure that limited water resources that may exist at a given point in time are used optimally.

7.2.4 Enforcing the conditions of the license

Unless the violators of license conditions are prosecuted the market will not function effectively. The ability of water managers to prosecute violators is influenced by the manner in which licenses are defined, as well as the metering and monitoring network in place. In addition information management systems must help to reconcile water use with actual water-use right.

7.2.5 Evaluation of the preconditions for a water use market

Notwithstanding the fact that the definition of a water-use right will by necessity be relative in terms of physical availability the measuring, monitoring and enforcement of the license conditions are at present not ideal. Irrigators defend the lack of meters on cost considerations and even monitoring is considered expensive and superfluous. The validity of this assertion is seriously questioned (see comment of van Veyeren under item 7.2.2). In a system where there are a limited number of interdependent users from a similar source the measuring and monitoring can be based on a self-regulating system. Violation will be addressed quickly by the water user association. Numerous examples where this is not the case have been encountered especially where users are dependent on the same source that may stretch over the jurisdiction of more than one user association. For instance, the Loskop Dam (Van Stryp, 2006) water users complained that users above the dam do not adhere to their conditions of use. Officials from the Kruger National Park (Gyedu-Ababio, 2006) had reservations about the possibility of buying water upstream based on the fact that they thought it will never reach its destination.

Urgent attention needs to be given to systems of measuring, monitoring and enforcing the conditions of entitlement by all users. It is a necessary precaution for any efficient water use allocation system and especially so in the case of a water market.

7.3 Uncertainty and its impact on trade

One of the prerequisites for a market to effectively perform its pricing function is that there must certainty about the parameters related to the market. Uncertainty per se does not necessarily prohibit a market but can have a negative influence on the price of the traded water-use right.

As stated above water-use rights are relative in terms of quantity, quality and time of use. Conditions can be attached to the license that will include the time period that the license will be valid. The strength of the user rights approach is that it enables the adaptive management of water use and the control of the resource should conditions warrant it. Where major structural changes are introduced, as is the case in South Africa at present there is a need for an adaptive management approach. The key disadvantage though is the degree of uncertainty that is introduced.

Policy as well as economic and legal uncertainties can lead to distortions in water-based investments. The balance between the need for adaptive management and security when considering the conditions attached to a license and duration of a water-use right must be managed. However, there are indications that this issue is acknowledged and that the license period is in line with the nature of the specific water use and that the five- yearly reassessment of the license conditions will be approached with necessary sensitivity.

7.3.1 Compulsory licensing

The second element of uncertainty is related to the fact that the compulsory licensing process has not yet taken place. Until such an approach is completed in a catchment there is an inevitable uncertainty as to how a re-allocation of water use will affect users. In catchments where water use requirements exceeds the water availability there is uncertainty about the extent of the deficit and how a possible cutback will affect individual users. The cutback will be affected by the need to accommodate various obligations that include the provision for the environment and basic needs in the form of Reserve requirements and provision for redistribution to accommodate the equity objective of the NWA.

For a water market to function effectively in the pre-compulsory licensing period the authorities need to limit uncertainty with respect to these factors as far as possible. To a large degree uncertainty about the Reserve has been addressed by preliminary Reserve determination and other operational procedures. The uncertainty created by equity considerations does have implications for the functioning of trade, to which we will return in later paragraphs.

7.3.2 Uncertainty related to non-exercised water-use rights

Up to now the majority of transactions that have been approved involve the trade in non-exercised user rights. The major impetus for this trade was the requirement that for a use to be considered lawful it must have taken place during the two-year period before the Act commenced. If not, criteria were issued according to which a person may apply for a use to be declared an existing lawful use. To the extent that there was uncertainty about the possibility of losing such user rights it was traded.

In catchments where the water balance is not at risk, such as the Lower Orange, transactions were approved. This does not appear to be always the case for instance the Berg River Catchment is in balance but the local DWAF office does not support the transfer of lawful unexercised rights. There are still non-exercised user rights in existence in all catchments. As unexercised lawful rights are included in the reconciliation statements of catchments, estimates have been made of these rights. The tradability of these user rights is not always clear. In the sense that when non-exercised user rights are traded and put to productive use by the buyer the water stress in the catchment is increased, leading to a negative impact on all users. Some argue that if the water user charges have been paid and are up to date it is lawful and as such tradable. The contrary view is that it should be considered on a "use- it or lose-it" basis. The possibility of hoarding water-use rights for speculative purposes needs to be discouraged. There may however be a legitimate need for some non-exercised water use to provide for a level of assurance against occasional shortages of water. The legal issues regarding non-exercised water-use rights need to be cleared up. It is possible that the issue will only be resolved by a court decision. It is also not clear what the position of non-exercised water-use rights will be at the time of compulsory licensing. In the case of a catchment under stress a case could be made for this category to be disallowed in the re-allocation process.

7.4 Rules for the permanent transfer of water use licenses

It has been stated that a water market will be subject to certain administrative control measures. The transferability of water use will be affected by such measures. Such controls should ensure that water use is managed in a sustainable manner over the long-term.

Ideally information about the following conditions restricting transferability will simplify trade:

Which geographical restrictions limit transfer,
To which uses can an entitlement be transferred,
How many parties must be consulted prior to transfer, and
Environmental limitations.

Section 26(1)(l) of the NWA makes provision for issuing regulations related to transfers in respect of authorisations to use water.:

These regulations may differentiate between various water resources, classes of water resources and geographical areas. No such regulations have been issued so far. It is understandable that such a specification will have to be delayed until after compulsory

licensing in which case it would streamline the trading process. Such regulations cannot at present be fully anticipated but will most probably be catchment or even sub-catchment specific. It will contain a definition of a source of water within which transfers would be possible in principle, procedures for transfers within say the agricultural sector (where externalities may be small, procedures for trade within sectors where externalities may be bigger and ways of dealing with trade between sectors as well as trade between catchments. At present the transfer of user rights are based on ad hoc procedures.

7.5 Models to support the implementation of the NWA

Up to now the models available to DWAF were mostly planning models (van Rooyen, 1997). In order to determine and evaluate various water availability scenarios these models have to be updated and improved. Model development by DWAF has progressed to such an extent that the improved models will be available for use from August 2007. (Havenga, 2006). At this stage it is not known what the capability of the models will be.

Discussion on models will therefore be restricted to the changing requirements of the models as the implementation of the NWA and especially licensing unfolds. The administration of water use licenses can be said to consist of two related stages; namely a planning stage and an operational stage. The planning stage involves the definition of water-use rights and the initial allocations; whereas the operational stage consists of the management of the allocated entitlements.

It would appear as if the models available up to the present would deal with the planning phase satisfactorily. Once the initial round of water-use right allocations has taken place upon completion of the compulsory licensing process, the challenge will be to manage the water-use rights. Operational tasks will include, amongst other things:

To ensure that water users are complying with their water use license conditions,
To operationalise the Reserve,
To evaluate and give effect to applications to trade water-use rights, and
To collect revenue from water use charges.

To ensure that water users comply with their entitlements, further development of systems or adaptation of existing models may be required. Existing models are at present based on a monthly time-step but in addition provision will have to be made for:

The time step of the water apportionment model will need to operate at a sub-monthly time step;
The apportionment model will need to give more consideration to flow routing considerations, as well as transmission losses.

A system will need to be developed to communicate to water users what their entitlements are. Bear in mind that flows from upstream tributaries may be needed to meet the demands of downstream users. A water user in the upper or middle catchment therefore cannot use water, just because there is a good flow of water past

his abstraction point as the water may be destined for a downstream user. These communication systems are not currently developed.

Water users need to be metered. In order to perform a water audit at a meaningful time step, the water meters should be equipped with loggers, that will log the water use on a daily, or even sub-daily time-step.

A water audit system is needed which reconciles actual water use (at given points in time), with the entitlement to use the water. The system should flag illegal use of water (Pott et al., 2005).

7.5.1 The apportionment rules

Apportionment rules are devised to allocate water amongst competing users when there is water scarcity during a specific time. The apportionment rule that is in use at present is the Priority-based River and Reservoir Operating Rule (PRROR). According to this rule water users are ranked in terms of priority, and water is to be apportioned to high ranking water users before lower ranked users (Pott et al., 2005).

The high ranking water users generally reflect users requiring a high assurance-of-water-supply. Water use charges are higher for water-use rights that bear high assurance-of-water-supply levels than those water-use rights with lower assurance-of-water-supply levels.

The priority-based water apportionment rules are slightly different for undeveloped resources (e.g. run-of-river flows) than for developed resources.

For the undeveloped resources, the rule is that the priority water users will receive the water they need before the lower-priority water users can access the water. Should a water user (even a high assurance-of-water-supply user) not be able to use the water flowing in the river, it can then be used by other water users. Thus, for undeveloped resources, a "use-it-or-lose it" system prevails.

With respect to water apportioned from large dams, restriction rules are used to give effect to the priority with which water is to be apportioned amongst the competing water users. Water restrictions are imposed upon water users, based on a combination of dam level, and priority ranking of the water users. Restrictions are imposed on the lower assurance-of-water-supply users first, upon the level of the dam dropping below some level. As the dam level drops further, the severity of the restrictions faced by low assurance users increases. High assurance users only receive restrictions when the dam level is very low, and even then the restrictions faced by the high assurance users may not be that severe compared to the restrictions faced by the low-assurance-of-water-supply users.

Other apportionment rules, such as the capacity sharing rule for dams and the fractional water allocation rule for water used from flowing rivers, are possible and may result in a more clear definition of water-use rights (Viljoen et al., 2004). The issue of different apportionment rules and the costs and benefits of possible alternatives needs further investigation and evaluation.

7.5.2 Relevance of models and apportionment rules for water trade

Although the brief discussion of models and the use of apportionment rules are technical considerations they do have an influence on water markets. For the water market to function well it is necessary that the entitlements must be defined as best as possible and the users must know in what way their entitlements will be administered under various conditions of water scarcity. Since water sources are interrelated and limited every user must adhere to the conditions of the license and restrictions placed on use under the various supply conditions. If this cannot be assured, the confidence in the system will be undermined and will have implications for the optimal functioning of the water market.

Models that allow for the accurate measurement, monitoring and auditing of water used by users is an absolute necessity for the functioning of water markets. The Department of Water Affairs and Forestry has recently implemented a number of Real Time Systems, which enable water users and water managers to better order and release water (Greaves *et al.*, 2007). The Real Time Systems are currently not able to perform water audits, but the need for this has been identified, and it will be possible to extend the functionality of the Real Time Systems to meet this requirement.

7.6 From centralised to decentralised trade approval procedures

It is one of the objectives of the NWA that the administration of water management systems should be devolved to an appropriate level close to the water users. The CMAs that will eventually handle applications for the transfer of water user entitlements are not yet functional. Similarly not all water user associations are in place. They will deal with the implementation of the allocation system at the local level. Progress has been made in the establishment of these bodies, but progress is slow.

In the meantime applications to transfer water-use rights are administered centrally.

Central administration has its advantages especially in the initial stages of the implementation of a new system in order to establish consistent procedures. Once the initial phases are completed the devolution of procedures for approval of applications to trade can ensure local participation, which can lead to more efficient decision-making.

A decentralised system of water use management is however dependent on the existence of the necessary expertise at the regional and local level. If this is not available or not developed decentralisation may not automatically lead to greater efficiency. As far as the water market is concerned the CMAs will perform a central function. It will be at this level that applications will be processed and eventually approved. It will be crucial that CMAs be empowered with the necessary models to consistently evaluate applications to trade. An administrative system will have to be created consisting of the management and technical skills to implement the water resource allocations in a transparent and efficient manner.

7.7 Market information

Regional newspapers in Colorado carry information on sale and lease opportunities of water use and the set-up is analogous to housing and land markets (Kemper and Simpson, 1998). The NCWCD operates a dispatch centre, which is available on a daily basis to receive and process water orders. In South Africa the DWAF regional office in the lower Orange River provides information, mainly of users who want to buy/sell water in the catchment but it appears not to be the case in the Lower Crocodile River. There is not a lack of communication media in local catchments, since the local newspapers can be used for advertising sales, purchases and rentals, in a similar way as is at present done for residential property. The lack of information provided in the latter area may be seen in the context of the present deficit situation that causes the reluctance the Regional Office of DWAF to encourage trade. The situation would in all probability change when the compulsory license process is completed or when greater clarity is obtained about the parameters required for trade to take place.

A web-site for the sub-catchment operated by the WUA or CMA would be a very cost-effective method of providing all kinds of information about water use; such as renting and trade possibilities as well as the respective water use asking prices in the catchment.

The availability of a registry of all water-use rights in a WMA as well as a registry of transactions that took place would increase information available. If this procedure can be followed the cost about obtaining market information can be minimal. Information networks are at present of the informal variety and thus not sufficiently transparent. It is foreseen that water user associations may develop and extend this function in future. It is also foreseen that in areas where both permanent and temporary trade are more frequent brokers or agents will perform a valuable function in bringing buyers and sellers together.

7.8 Approval procedures

The approval procedures are at present directed by the Head Office, Directorate: Water Abstraction and In-stream Use (DWAF, 2004c). An application to trade a water use goes from the Regional Office signed off by the Cluster Manager via the Manager: Water Abstraction and In-stream Use is sent to the Director General for approval in the case of transactions between different sectors, catchments or WMAs. The Manager: Water Use gives approval in the case of transactions within the same sector in the same catchment, scheme or WMA.

Regional Offices deal with most aspects of an application and can provide assistance to applicants. Some applicants make use of a lawyer and thus will increase the cost of a transaction.

7.8.1 Information requirements:

The detail of the information required for an application is provided by the Directorate; Water Abstraction and In-stream Use (DWAF, 2004c). It involves the

evaluation by the Regional Office of the application. It includes an assessment of the volume of water available to the intending buyer and amended if the quantity surrendered involves a difference in assurance level, limitations in conveyance capacity, transportation/evaporation loss and reduction in allocable water due to Reserve considerations. In addition existing lawful use and section 27 conditions must be assessed and approval from the relevant government offices obtained.

It has become more time consuming, as time has progressed, to get approval of a permanent trade application because of uncertainty about the section 27 conditions. It would appear that trade applications could have been delayed because it did not adequately address the equity objective or that it involved the transfer of non-exercised user rights. To the extent that such rules are not in place it needs urgent attention for trade to take place. Several WUAs expressed concerns about applications not being approved (Bruwer, LH, 2007 and Bruwer, WF 2007). In a letter (DWAF; 2007) the reply to one such application on the Kakamas Irrigation Scheme indicated that the need to redress the results of past racial and gender discrimination have not adequately been addressed by the application. DWAF is on record that the conditions for approval especially with regard to the equity objective are being concretised (WRC Workshop, Nov. 2007).

7.8.2 Time cost

The time taken between an application and approval of a proposed trade receives a lot of attention in the literature since it represents an opportunity cost of time foregone in the process and adds to the uncertainty. International evidence cites average times of over 2 years at the upper end to 4 to 5 months at the lower end (Conningarth, 2004). From the limited local experience so far the average time taken in South Africa falls in the lower end of this time span. It takes up to a year to approve an application to trade from the agricultural sector and for the forestry sector it takes up to two years (Genesis Analytics, 2005). Approval times do, however, vary according to the complexity of the specific case, and examples of individual cases taking more than two years have occurred.

Armitage (1999) and Gillitt (2004, p59) report the time span of most sales between one week and three months in the Orange River while Schreuder (Schreuder, 2007) mention a period of four months in the Berg River. The reason for the short periods is that the transfer process was relatively uncomplicated in the sense that third parties need not to be considered. .It is expected that this situation will change in future as several issues need to be considered such as equity and the environment.

It would appear that under ideal circumstances such as the possible delegation to the Regional Office of small trade applications it would take up to 3 months to approve routine applications (Jackson, 2006). At this stage it would appear to be the shortest possible time it can take to approve a trade application.

7.8.3 Overall assessment of the elements of transaction cost

During the pre-compulsory period the verification of lawful use and the uncertainties about the Reserve, water balance and equity issues will affect transaction costs, as longer administrative procedures are required. It is foreseen, that as regional and local

institutions become operational, that the approval procedures will be streamlined. In the meantime the possibility of delegating the approval of trade of some categories of trade can be investigated.

It would appear as if the transaction cost would be minimal in the case of trade applications within the agricultural sector in a GWCA. It becomes more costly and time consuming in non-GWCAs because of the more complicated procedures to verify lawful use. In the post compulsory stage transaction cost will be lower because the relevant institutions including information sources will be in place. Apart from this element, the fact that we are dealing with a new situation where all the processes are not yet streamlined and there are uncertainties regarding certain parameters (such as land claims) implies a delay in approval times.

7.9 Role of a rental market

Temporary transfer/ trade is limited at present to use of water for irrigation purposes (DWAF, 2004c). The person authorised to use the water must apply in writing to the water management institution. No license is required, but the lawful use must be verified. If the transaction involves the use of the water for a different purpose on the same property then the Regional Director can approve. If the transaction is for the use of water on another property in the vicinity for the same or similar purpose, the Deputy Regional Director can approve or reject or place conditions on the transfer. The transfer is for one year and on application for another year. Longer duration is usually seen as a permanent transfer that must go through a license application procedure. A record of the decision must be kept for user charges purposes and its must be part of the WARMS database. Temporary transfers of water can be processed quickly as opposed to the long and complicated procedures involved in a permanent trade. Temporary transfers are however meant to serve as a bridging mechanism in times of supply scarcity and not as a longer term transfer mechanism. Temporary shortages (drought periods) may exceed the two-year limit put on the duration of such transactions and needs to be revisited. Temporary shortages may affect water users other than agriculture and it would be sensible to also consider temporary trade between sectors.

In Australia the rental market is very active; more so than the permanent market and a water market exchange is established to implement the short term trades. Such trades would be more practical for annual crops rather than permanent crops since water security is more important in such cases. It is foreseen that WUAs will in future play a much more active role in establishing such a temporary market. For instance the present informal transfer that occurs from time to time between irrigators on the Loskop Dam can easily be formalised by the local WUA.

7.10 Is there a role for water banking in water resource management

The term water-banking can refer to the physical storage of water, or can refer to the collection and re-sale of water-use rights by an organisation which in many respects acts as a broker (or bank). There is currently a discussion as to the merits of an

organisational water bank which has powers to facilitate, regulate and administer trade (DWAF, 2008). The argument put forward is that the organisational water bank will be able to reduce transaction costs.

7.11 Accommodating the equity objective of the NWA

A water market promotes the efficient use of water. It has its limitations with regard to the redistribution objective of the NWA. Other more direct ways to effect redistribution must be employed such as the government land redistribution programme and the settlement of restitution claims.

The speed of agricultural land redistribution in South Africa has been slow in spite of its urgency. The machinery for redistribution was agreed on before democratic elections and this has contributed to diffusing tension before the transfer in political power. Government is promoting the welfare of small holder (PDIs) agriculture and it is important in this project to be sensitive to possible equity issues that may arise especially in a water-trading situation. It is important for commercial farmers that agriculture should move towards a non-racial future and it encouraged the South African cane farmers to initiate a small holder scheme in KwaZulu-Natal which currently has about 45 000 farmers. This is probably the most well known small grower scheme in South Africa.

The Water Allocation Reform document (DWAF, 2005) explicitly states that water allocation reform should redress the effects of previous discriminatory legislation. In irrigation areas producers need both water and irrigable land and it may be envisaged that water will be redistributed to PDIs through the land redistribution programme of the National Department of Agriculture (NDA). It is essential that the programmes from the NDA and DWAF are coordinated. Outstanding claims for restitution had a similar disincentive effect on water markets. Large areas of land in the Olifants and Crocodile catchments are subject to restitution claims. On the positive side land restitution is a vehicle through which water will be transferred to PDIs and the objectives as stated in the WAR document promoted. On the negative side, almost no new investment is undertaken until the process is completed. The process needs to be completed by 2008 but farmers think that the deadline will not be met. If a claim is lodged against a farm, it may not be sold, which means that the sale of water is not possible. Banks are reluctant to finance the purchase of land, even if there is no specific claim because of the uncertainty about future possible claims. Since the purchase of farms is dependent on external financing, land and water sales will not occur in such an environment.

The settlement of restitution claims is an ongoing process, but few official statistics are available on the extent of such settlements in local areas. Once this process is completed a major impediment to the functioning of the market will be removed. It would also appear as if there is a view that trade may affect the equity objective negatively. In areas with no claims for restitution such as the Berg River an application the transfer of water use place great emphasis on whether such a transaction promotes the equity objective.

Ways in which redistribution is addressed will affect a water market. This process should be completed as soon as possible and the water market must be allowed to function to achieve efficiency of water use. It would be prudent to consider whether water use allocated to PDIs should be freely transferable. Although restrictions on trade are not favourable for the operation of a water market in this case the equity consideration may override this consideration and call for conditions to be placed on such transfers.

7.12 Management

The implementation of the provisions of the NWA is a major task. The NWA commenced in 1998 and considerable progress has been made over the last 10 years but the full implementation is a long way off. Part of the reason for this is the long consultation procedures that must be used to determine, amongst others, the Reserve and other preliminary phases for the compulsory licensing process. Some impatience with the slow progress may be justified but it is also a fact that the manpower needed to implement these changes as well as the other operational tasks involved in managing the country's water resources is formidable. A situation not assisted by the many vacancies in the DWAF, especially in highly skilled positions. Added to this fact is the additional manpower needed to attain the objective to decentralise many of the management functions to regional and local administrations. It has been suggested (van Veyeren, 2008) that an assessment should be made about the extent to which WUAs has the capacity to assist in managing water use. It is urgent that a programme of recruitment and education and training be launched to address this situation.

7.13 Summary and conclusions

The purpose of the discussion is to identify possible institutional bottlenecks that impact on the operation of water markets and recommend ways of dealing with them.

These factors can be listed as:

The necessity of installing meters and monitoring devices and based on these more precise technology for the enforcement of the conditions of an entitlement;
As far as possible to reduce uncertainty that is related to the interim period before compulsory licensing is implemented. Special mention is made about clearing up uncertainty of non-exercised rights. The legal issue regarding this category of water use should perhaps be clarified by court action since a variety of opinions exist at present. When compulsory licensing is completed regulations on the transferability of water use needs to be formalised;
Emphasis on developing models that will be directed towards the administration of water-use rights. This includes investigations on different apportionment rules and the possible merit of capacity sharing and a fractional water allocation system;
Progress on the decentralisation of administration will bring the management of water transfer closer to the users and thus more responsive to local needs;
The use of media including electronic media to provide market information is underdeveloped;
Approval procedures can be streamlined and rules for transferability can become more explicit even in the pre compulsory licensing phase;

Rental market can play a larger role and it is foreseen that once WUA are fully functional their role in this regard can be expanded;
A water market addresses the efficient use of water and is not specifically capable catering for equity conditions. Equity is a very important objective of the NWA and the redistribution of water-use rights and land should be implemented in a complementary way. In so far as outstanding restitution claims inhibit transfer of water use it completion will allow land and water markets to function. The section 27 conditions that amongst others include equity, needs to be applied with sensitivity for unique circumstances that may regard a transfer desirable. Guidelines in this regard by DWAF will remove this source of uncertainty;
Human resource needs for the implementation of the new water management system are critical. Programs to retain expertise, recruit, educate and train people in this field of expertise are critical.

As can be seen from the identified institutional bottlenecks they are all of an operational nature. As far as could be ascertained, there are no legal institutional limitations that prohibit the functioning of the market. Most of the operational issues that effects the water market are of an evolutionary nature that will take time to implement and will be shaped as events unfold.

CHAPTER 8. RECOMMENDATIONS

8.1 Introduction

The recommendations that are made in this chapter consist of two components. The more general recommendations stem from the evaluation of the state of institutional structures and information requirements that will promote the establishment and regulation of a water market. These aspects have been discussed in chapter 7. Specific recommendations are provided for each case study area. These recommendations flow directly from the investigations in each case study area and the lessons learnt and discussed in chapter 6.

8.2 General recommendations

Recommendation 1. Support for the role of water markets

The positive and important role of water markets in a water management system should be recognised. In the case of administered water markets official regulation is part of the trading process. Unless the administrative procedures are supportive of trade it will not take place as often as it should which can lead to inefficient use of water and finally constrain water users.

Recommendation 2. Provide the pre-conditions for an efficient market

In order to allocate water use efficiently under any system of allocation, it is necessary to:

Appropriately define water-use rights,
Measure (meter) actual use,
Capture the metered use information in appropriate information management systems which enable the use to be monitored in a systematic manner, and
Enforce the conditions of the water use license, particularly where users do not comply with their water user entitlements.

Each of these four identified conditions needs further attention.

Recommendation 2a

In the sense that compulsory licensing is necessary to achieve clear and precise definitions of entitlements and equitable initial apportionment, this process should receive priority.

Recommendation 2b

The measuring (metering) of actual use is fundamental. The installation of meters should be a priority. The administrative structures must be established in DWAF and ways to finance and implement meter installation should be put in place.

Technological developments that rendered metering more effective and affordable should greatly enhance the possibility of making meters mandatory.

Recommendation 2c

Systems should be developed so that the metered use of water can be part of an information management system to monitor use.

Recommendation 2d

Effective definition, measuring and monitoring of a water use simplifies enforcement. No tolerance should be shown to users who do not comply with the conditions contained in their individual license.

Recommendation 3. Limit uncertainty

The limitation of uncertainty is a fundamental requirement for the functioning of a market. Compulsory licensing would remove most of the uncertainties regarding the balancing of supply and demand in a catchment. As such it must be a priority, subject to the restrictions due to data availability, information systems, consultative processes and limitations of sufficiently skilled human resources.

Prior to compulsory licensing, the information requirements and the restrictions that apply to trade in a specific catchment should be freely available. Amongst others the position of non-exercised user rights should be clarified.

Recommendation 3a

Related to the issue of the uncertainty issue is the formulation of the regulations applicable to the transfer of water use in each catchment as envisaged in section 26(l) of the NWA. It would be ideal if this can happen soon after compulsory licensing is completed in a catchment.

Recommendation 4 . Refinement of models

Present models were developed for planning purposes. Models that can monitor the operational aspects of water use should augment them. The development and further refinement of models to support the operation of the new water management system should receive priority.

Recommendation 5. Apportionment rules

Research should be conducted on the alternative apportionment rules and evaluated against the present system to determine whether it can lead to a clearer definition of water use as well as increasing the efficiency of water use.

Recommendation 6. Implementation of the decentralisation process

The decentralisation of administration in the form of CMAs and WUAs and the empowerment of these regional institutions will allow local conditions to be taken

into account when trade applications are processed. There is a need to speed up this process. These structures will have to be provided with the necessary administrative and technical expertise to manage water resources in a transparent and efficient way

Recommendation 7. Market information

Ways in which market information about permanent and temporary trade possibilities and trade procedures can be provided must be investigated. Once the WUAs are fully functional, this is an aspect that will be an integral part of their responsibilities and should enhance trade.

Recommendation 8. Approval time

Clarity about conditions for approval by the relevant officials as well potential market participants will lead to a speedier processing of applications. It should be a specific objective to minimise the time it will take to consider and approve or reject an application.

Recommendation 9. Strengthen the rental market

Short-term fluctuations in the supply of water and the production requirements of some crops are well as its market value makes it viable to buy water from a less valuable crop for the more valuable crop in times of temporary drought. This principle can also be extended to transfer of water between sectors in drought periods. The period of such temporary trades will depend on the length of the drought. It could be longer than the present one year or at most two year length presently allowed for temporary transactions. More discretion should be allowed on this aspect and the restriction of transfer to only within agriculture should be revisited.

Recommendation 10. Equity

Equity is a prerequisite of water management reform. This aspect is not dealt with effectively by the market process. Methods used in facilitating the market process can help to achieve equity. The creation of a fund to purchase water-use rights for PDIs is an example. Programmes specifically designed to transfer water and land to PDIs will attain equity objectives more effectively. The settlement of restitution claims and the redistribution of land programmes administered by NDA should be a priority so that the uncertainty created by redistribution programmes on water markets can minimised.

Recommendation 11. Human resource requirements

The new water management system as envisaged in the NWA is seen as one of the most advanced models. The human resource requirements to manage the transition from the old to the new system and the maintenance of this approach require sufficient numbers of skilled staff. It is possible that the levels of skill and the numbers required will fall short of the need. Urgent ways to address this situation must be employed. An evaluation of the extent to which WUAs can assist in this regard on the local level is needed.

8.3 Crocodile River Catchment

Recommendation 1. PDIs need both water and irrigable land. As 80% of the land under irrigation, according to Van Veyeren (2008), have been transferred to PDIs, the major equity problem in this catchment seems to be resolved. Exploring other options to transfer water use to PDIs may be less important in this catchment because of this development. Other options include the establishment of a fund to finance the transfer of water-use rights for equity purposes.

Recommendation 2. The transfer of unexercised water-use rights in this stressed catchment is not supported. The activation of this water increases water use from the river, has negative spill-over impacts on the assurance of other users while the transfer of such rights has no efficiency gains. It is an important issue as, according to information, most of the transfers (in the Crocodile Catchment) in the past were non-exercised rights.

Recommendation 3. PDIs who have acquired farms should be informed about the workings of water markets. If PDIs were to sell their water-use rights, then it will reduce the productive capacity of their farms in an area where water is very scarce. PDIs should be fully informed about the consequences of sales. DWAF should assist PDIs on these issues.

Recommendation 4. Better information needs to be obtained regarding the extent of the deficit before action is taken to reduce the deficit. There is uncertainty about the extent of the deficit. In Van Niekerk's (2007) opinion the Crocodile River is only over-allocated on paper. Farmers support the view of Van Niekerk (2008) and state that there appears to be a mismatch between the deficit according to DWAF reconciliation statements and water use in the Crocodile River. A part of the reason for the latter (over-allocation and mismatch) is that reconciliation statements include non-exercised use which is estimated as between 10% and 15% of total use. The most recent estimates are contained in a DWAF/DFID document (pages 28 & 31) obtained from Mallory (2008). According to this document the deficit is estimated at 37% (scenario 1) and 28% (scenario 2). The average deficit from the two scenarios is 146.7 million m^3. According to this document a much larger area is under irrigation than the original estimates by DWAF. So, while the percentage deficit in the recent documents is lower than that of DWAF's earlier estimate, the deficit in million m^3 was similar.

Recommendation 5. A phased approach to reduce the deficit should probably be used starting with the elimination of illegal water use, eradicating alien vegetation and refining the data on which the reconciliation statement is based. Reducing the water use from existing users, including PDIs who are the new owners, will not be an attractive political solution.

Recommendation 6. If the deficit is still serious after implementing the above measures then consideration should be given to building a new dam. Since water is already used efficiently in this catchment, reducing water from existing users has a serious negative multiplier impact on a generally poor non-farm community while it will have serious impacts on the new black farmers. Such supply augmentation will also improve water assurance as droughts in the past have been serious.

Recommendation 7. Although the use of a fund to buy out water for equity purposes or for the environment does not appear to be needed in the Crocodile River, this approach has merit and should be considered in other catchments.

Recommendation 8. High priority should be given to the installation of water meters due to alleged illegal use in this stressed catchment. Metering is an integral part of a market as it quantifies the entitlement and provides the basis on which rights of the user can be enforced. There should be sufficiently high penalties to discourage illegal use.

Recommendation 9. It is proposed that the entitlement should be in terms of a measurable volumetric quantity of water. Return flow can then be taken into account in different ways. Return flows need only be considered if it is significant. Return flow is already substantially reduced in this catchment as farmers have adopted water conservation measures due to the stressed situation. A farmer cannot claim his user right from the full diversion right but only from the consumptive use.

Recommendation 10. Small growers should be made aware of the possibilities of a rental market in water-use rights and this will expose them to the opportunity cost of water use. If water is no longer a free good, it will lead to it's more efficient use.

Recommendation 11. Strategies to reduce risk within a water market should be encouraged if they promote the efficiency of water use, are in support of the implementation of the NWA and in accordance with the law. It has been concluded in an earlier study in the Crocodile River that water was mostly purchased by sugar cane farmers. Sugar cane has lower risk (but lower return per ha) than other crops. Farmers who grow bananas, which are vulnerable to drought, have moved water from sugar cane to bananas during times of drought. According to the NWA, water must be efficiently used while the term "best use" is also used. Efficiency is an economic concept that means that the return per cubic meter of water must be maximized. In this return all costs are included including the cost of risk associated with this resource. That is if supply is irregular, the rent return to water will be lower. The implication is that reducing risk is promoting its efficient use and is not in conflict with the NWA. The market attaches a cost to risk but to quantify it using econometric tools is problematic due to its complexity. The argument is that after compulsory licensing, there may be a place for a farmer to hold additional water-use rights as part of a risk management strategy. The economic interpretation is that retaining additional water-use rights after compulsory licensing to protect high value crops may not be in conflict with the NWA and be a sound risk management strategy.

8.4 Olifants River Catchment

Recommendation 1. Land restitution is seen as a vehicle through which water will be transferred to PDIs and the objectives as stated in the WAR document promoted.

Recommendation 2. Water metering and enforcement must be given high priority. Water is metered and monitored in the Loskop and Blyde River irrigation areas and there is no room for illegal use. It is alleged that in areas outside the Schemes the absence of water metering and monitoring is a problem as there is no assurance that

water will reach its destination if sold. Mines and farmers are blamed for illegal abstraction of water.

Recommendation 3. Strategies must be adopted to improve water use efficiency and the water market and higher water prices can play a significant role in this as the demand for water appears price elastic in this catchment. It is estimated that water prices will increase in real terms as water and land rents are further separated. Higher water prices should improve (a) better scheduling that can reduce consumption, (b) reduction in irrigation of low income crops (about 35% of irrigated area is under maize, wheat and pasture) and (c) change towards more efficient irrigation systems (overhead irrigation with high loss to evaporation is common).

Recommendation 4. The state should consider the benefits and cost of investing in the repair of faulty infrastructure. Water distribution losses attributable to faulty infrastructure are estimated at around 30%.

Recommendation 5. The hydrology of the catchment must be revisited to recalculate the water balance. According to the local engineer this will be undertaken. He estimates that the resulting stress level may be less serious than the 20% original estimated. Another expert considers the deficit as serious especially over certain reaches of the river and it is important that more accurate information needs to be obtained before any action is taken to reduce the stress.

Recommendation 6. Steps must be undertaken to ensure that the Kruger National Park receives its natural water flow allowance. A part of the solution is better metering and monitoring but more needs to be done. All stakeholders (farmers, mines and the Kruger National Park) need to be consulted. The Kruger National Park is a natural asset of considerable value in terms of tourism and the creation of jobs in South Africa. If the deficit in the catchment is as low as the revised estimates suggest combined with the water use efficiency improvements, then there is no reason why the Park cannot receive its minimum flow allocation. The In-stream Flow Requirement (IFR) for the Kruger National Park has been determined and will vary according to seasonal rainfall patterns of between 2 and 7 cubic meter/second. The lower limit is applicable in a dry period and the upper limit in a "normal" year. At present the IFR is only 1.8 cubic meters/second. Kruger National Park asserts that they do not get the minimum flow they need and measures to ensure the required flow is not forthcoming. This is the situation even with average dam levels of 96%. During the past year the Olifants River stopped flowing for 78 days. It is the policy of the Park that they will not trade to get more water in dry periods because they do not want to create a situation that is not natural. Nature is adapted to such variations (drought) and this balance must not be disturbed. However, should the Park buy or rent water, there is no guarantee that the water will reach its destination as it may disappear in the system before reaching the Park as there is no metering and limited monitoring of water use.

Recommendation 7. It is proposed that water from boreholes be metered and monitored and that economic measures be taken to promote conservation such as regulation, user charges or possible transferable permits in some instances. It is estimated that there are close to 10 000 operating boreholes in the Catchment, contributing 16% of local yield. It is difficult to control or monitor water use from

boreholes and it is not clear whether effective control measures exist in the Springbok Flats where irrigation from boreholes is significant. At present farmers pay little or no user charges. Water from different boreholes often comes from the same source and the common ownership problem arises.

Recommendation 8. It is proposed to increase the market for water by considering trade between surface water, smaller dams and boreholes as well as between farmers and possibly the Kruger National Park (the Kruger National Park appears not interested in trade). This approach may not be feasible and needs further consultation but it has the advantage that all users will face the same opportunity cost price which means that efficiency is promoted. Some boreholes appear to be linked to surface irrigation. Linking up smaller dams and boreholes in the total market will depend on expert opinion but, given the extent of this source, it is an aspect that must be investigated further. The Regional DWAF Office does not support the transfer (sale) of water between sub-catchments for irrigation purposes but supports transfers for industrial and for human needs. The price of water will be different between sub catchments and the feasibility of trade between sub-catchments must be considered in future.

Recommendation 9. Polluters should pay a discharge tax in the same way as water abstraction users pay user charges. Pollution in the river and in Loskop Dam is high. A Waste Discharge Charge System is proposed by DWAF but at present, discharges in the catchment are not taxed.

Recommendation 10. As in the case of a water market, it is proposed that a market be established for the discharge of nutrients and that this market be used to discover the optimum price for pollutant disposal. All markets operate within certain rules. In a pollution permit trading market measures that may be considered are that discharges in the river are only allowed when flow is sufficiently high and that trades may only occur within certain parameters. A permit-trading program will complement desalination plants as some of the costs of these plants are variable (reservoirs where the nutrients solidify fill up).

Recommendation 11. Apart from a pollution trading program, it is suggested that bio-diversity offsets be created to provide incentives for cooperation amongst stakeholders which may be mines, developers, environmental groups, farmers and public land agencies. Examples where the offsets should be considered in the catchment are given. Expert opinion is that the main source of pollution in the Loskop Dam is the leakage from abandoned old mines (pre-1956). The problem with the defunct mines is that they leak nutrients all the time including during the period when river flow is low. DWAF has accepted ownership of these mines but they may not have the technology (which is expensive) to desalinate the effluent. In an offsetting arrangement, incentives can be provided to existing mines to desalinate water from these defunct mines in exchange for the discharge of a given amount in the Olifants when the water flow is sufficiently high. Such an arrangement will have no cost implications for the taxpayer while discharge during low flow periods is reduced.

Recommendation 12. New dams are often opposed because they have negative environmental impacts in resource sensitive areas. It is suggested that these impacts

be mitigated with other biodiversity offsets for instance developers may undertake to eradicate alien vegetation along the river.

Recommendation 13. When the transfer of water use between small holders and mines or other buyers are involved, the interest of the small holders must be protected. The possibility of asymmetric information must be a concern and could affect small holders detrimentally. Institutional help by government must be provided to eliminate the possibility of the exploitation.

8.5 Berg River Catchment

Recommendation 1. Farmers should be informed by the Regional Office of the reasons why some transfers are not supported and in this regard assist them in preparing applications. There may at times be conflicting information about this aspect. For instance it was said that the reason for not supporting proposed transfers is that it involved non-exercised user rights while others were under the impression that transfers between white farmers will not be supported. The workshop in the Paarl assisted in providing information on this issue. The perception that transfers between white farmers will not be supported was refuted but equity issues need to be addressed in an application. The official view on such matters should be clarified to avoid possible confusion. Based on discussions with attorneys dealing with transfers, it is apparent that they require more clarity about the rules necessary to obtain approval. The application must show how the transfer promotes empowerment but the main issue is that the transfer from unexercised users is not supported.

Recommendation 2. Water use by riparian owners should be metered. There are allegations of illegal use of water by some irrigators. The lack of metering is at present tolerated because water is still relative freely available during most times.

Recommendation 3. Irrigation boards and water user associations should inform members that transaction costs of transfers are low (about R114 per application) if they apply directly through the local DWAF office. The Office will assist them in motivations to support an application. This is especially important for small transactions as the legal cost for these transactions may make the sale not worthwhile.

Recommendation 4. The Upper Berg River Irrigation Board opposes water transfers from the river to non-riparian owners and to others sectors. If such a transfer is in the interest of the community, then the local DWAF office should override such opposition as the New Water Act has moved away from a riparian doctrine.

Recommendation 5. It appears that the main reason why transfers have stopped in the Berg River is that non-exercised rights are not supported for transfer. There is some concern that local DWAF offices do not approach this subject in the same way (Crocodile and Berg River). In the case of the Berg River catchment, the local DWAF Office is taking a harder line on this issue in spite of the fact that the deficit is at present not a problem in this river. There is sympathy for the view not to transfer non-exercised rights in view of the extent of deficits in South African rivers. It is proposed that these rights should not be transferred in rivers of deficits or where deficits may occur in the foreseeable future. This is not a legal opinion and the issue may have to

be clarified by the courts. One opinion is that at compulsory licensing (CL) non-exercised rights will be lost but if these transfers are permitted in the interim period then the damage will have been done by the time when CL commences.

Recommendation 6. There is no opposition to the conversion of the Berg River IB to a WUA. Such a step is proposed since such an association can better deal with the pollution problems in the Berg River. A program is underway to mobilise stakeholders to improve the water quality of the Berg River.

Recommendation 7. It is proposed that farmers should be placed in a position to manage their water supply risk better and not expect Government to bail them out. Risk management strategies are important in water management as droughts may lead to severe capital loss in horticultural crops that are the main crops in the Berg River. Cut-backs have occurred in the past. One risk management strategy that is proposed is to allow farmers to retain additional water-use rights after compulsory licensing. Not all the farmers are in the same risk position as it depends on crops planted, debt/asset ratio while some are more risk averse than others.

Recommendation 8. Government should make available sufficient funds to local governments to upgrade waste treatment facilities of municipalities and enforce regulations on illegal polluters. Pollution is a problem in the Berg River and fruit and vegetable exports to the EU and USA are at risk. Pollution sources are informal settlements, municipalities, wineries, intensive farms and industry.

Recommendation 9. The Regional DWAF Office should continue monitoring groundwater use (farmers need licenses) and exercise control over its irrigation use. Close inter-dependence exists between groundwater and surface water in certain areas where further exploitation of groundwater may cause reduced surface water flow.

Recommendation 10. Consideration should be given, in suitable areas, for farmers to build dams if the water supply situation permits. This is in the spirit of making farmers pay for own storage costs. As this is a winter rainfall area while peak consumption is in summer months, the supply situation and water availability through storage is critical. Riparian users are permitted to pump water in the winter months to fill farm dams for use in the dry summer months but this is part of their total allocation per ha.

Recommendation 11. Recent developments at improving the water balance include the completion of the Berg River Dam near Franschhoek as well as significant efforts to conserve water by the Greater Cape Town area. Several other ways of conserving water were discussed (recycling, higher dam walls and eradicating alien vegetation). As there appears to be a minor shortfall, no additional strategies to reduce consumption such as cutting back on irrigation are foreseen at present.

Recommendation 12. If farmers want more water in a certain area then they must buy more water and it cannot be achieved through a re-allocation. It was stated that the allocation of 4000 m^3 that applies to the upper reaches is based on the requirements of wine grapes but since there is a switch towards fruit farming this allocation may be too low.

Recommendation 13. It is proposed that return-flow be ignored in transfers if the return-flow is as low (2% to 5%) as information suggests.

Recommendation 14. Strategies to empower PDIs with access to water include (a) using the current subsidy on water that is available to PDIs. PDIs can apply for a subsidy of R7 500 per ha to buy water. This is less than what water sells for (about R15 000 to R20 000 per ha). The Regional DWAF Office can motivate to the Minister to secure the full amount. (b) A fund can be established to buy out water-use rights.

Recommendation 15. PDIs should be empowered to own land and water-use rights. If irrigation water is provided to PDIs then they will still have to be provided with suitable irrigable land which is a problem as most of the land in the Upper Berg is already under cultivation. One way that PDIs could be assisted to attain a target ownership of the land and water is for PDIs to be provided financial assistance by Government under the Land Redistribution Program to buy land under irrigation. It is important that farmers receive back-up support through the extension service and on marketing (Department of Agriculture), financing (Land and Development Bank), guidance (commercial farmers), assistance on water use (Department of Water Affairs and Forestry) and other relevant stakeholders. Strategies also include to join white commercial farmers in trusts as equity schemes (joint ventures). Other subsidies include financial assistance of R15000 per ha for bulk water infrastructure and phased assistance for WUA charges over 5 years.

8.6 Some concluding comments

8.6.1 General recommendations

The recommendations address possible bottlenecks that impact on the operation of water markets and recommend ways of dealing with them.

The recommendations emphasize:

The necessity of installing meters and monitoring devices and based on these more precise technology for the enforcement of the conditions of an entitlement;
As far as possible to reduce uncertainty that is related to the interim period before compulsory licensing is implemented. Special mention is made about clearing up uncertainty of non-exercised rights. The legal issue regarding this category of water use should perhaps be clarified by court action. High priority should be given to clarify this issue since a variety of opinions exist at present. When compulsory licensing is completed regulations on the transferability of water use needs to be formalised;
Emphasis on developing models that will be directed towards the administration of water-use rights. This includes investigations on different apportionment rules and the possible merit of capacity sharing and a fractional water allocation system;
Progress on the decentralisation of administration will bring the management of water transfer closer to the users and thus more responsive to local needs;
The use of media including electronic media to provide market information is underdeveloped;

Approval procedures can be streamlined and rules for transferability can become more explicit even in the pre compulsory licensing phase;
Rental market can play a larger role and it is foreseen that once WUAs are fully functional their role in this regard can be expanded;
A water market addresses the efficient use of water and is not specifically capable catering for equity conditions. Equity is a very important objective of the NWA and the redistribution of water-use rights and land should be implemented in a complementary way. In so far as outstanding restitution claims inhibit transfer of water use, it's completion will allow land and water markets to function. The section 27 conditions that, amongst others, include equity, needs to be applied with sensitivity for unique circumstances that may regard a transfer desirable. Guidelines in this regard by DWAF will remove this source of uncertainty;
Human resource needs for the implementation of the new water management system are critical. Programs to retain expertise, recruit, educate and train people in this field of expertise are critical.

As can be seen from the recommendations relating to institutional bottlenecks they are all of an operational nature. As far as could be ascertained, there are no legal institutional limitations that prohibit the functioning of the market. Most of the operational issues that effects the water market are of an evolutionary nature that will take time to implement and will be shaped as events unfold.

8.6.2 Catchments specific recommendations

There are common elements to all case study areas while there are also differences. The common elements will first be discussed.

It is shown in the three case studies that through the water market land and water will be further separated as water moves to non-agriculture with the concomitant increase in water prices and decrease in land prices. The reason is that some of the investments in irrigation are fixed (sunk) with zero opportunity cost. Water prices may increase as follows: in the Crocodile River from R15,000 per hectare for 13,000 m^3/ha to R45,000 (R3.46 per cubic meter); in the Olifants River (Loskop Dam area) from R11,673 per hectare for 7700 m^3/ha to R19,500 per ha (R2.53 per cubic meter); in the Berg River from R20,000 per hectare for 5000 m^3/ha to R45,000 per ha (R9.00 per cubic meter). The purpose is not to calculate a precise figure for future water prices, but to show that in a water market prices will increase (in real terms) providing an incentive for further conservation and more efficient use. The latter is important as the increase in food prices experienced in 2008 may be a long-run phenomenon.

It appears that empowerment of people through secure water-use right will take place through land transfers as evidence indicates that about 80% of land under irrigation in the Crocodile River has already been transferred to PDIs. This has changed the political landscape in terms of the feasibility of reducing irrigation water to reduce deficits. Water markets in the three areas studied (Crocodile, Olifants and Berg rivers) have come to a standstill either because of land claims (Crocodile and Olifants rivers) or because of a reluctance to transfer non-exercised use rights of water (Berg and Crocodile rivers). There are good reasons for these policies (not permitting transfers if claims exist or not supporting the transfer of non-exercised rights) and the market will again function once this has worked through the system. In both the Berg and

Crocodile rivers opposition has been voiced against transfers of non-exercised rights although many want to sell/buy. It is, however, noticeable that the DWAF Office in the Berg River has taken a harder line on such transfers in spite of the fact that deficits are not an issue in the Berg River while in the Crocodile the deficit is substantial. One would expect that the interpretation of the law should be more uniform in different areas. It is recommended that these rights not be transferred in areas with deficits or potential deficits.

It is proposed if risk management strategies fall within the provisions of the NWA, then they must be pursued. Farmers prefer to be able to retain additional water-use rights in order to improve supply assurance for high value crops. According to Human (2005), farmers may retain additional rights after compulsory licensing. This will only be retained if reasonable – say 10% to 15% additional to average use to avoid risks of large restrictions. According to the NWA, water must be efficiently used. It is contended that risk management is not in conflict with the NWA as the reduction of risk improves the efficiency of water use as risk is a cost. In a water market the return per cubic meter of water is maximized which includes risk as a cost. The Reference Group Meeting of this study was unsure about the legality of retaining additional rights after compulsory licensing. Courts may rely on expert opinion on issues in a specialized field and in this spirit it is recommended that consideration be given to farmers retaining some addition rights to protect them against cutbacks where capital losses or income are at stake.

Better information must be obtained about the deficits in the Crocodile and Olifants rivers before action is taken regarding possible cut-backs. There is concern regarding the large variation in estimates of deficits in the Crocodile River.

Lack of metering was an issue on all catchments in particular in the Crocodile and Olifants and metering and enforcement must be seen as a priority. It is further proposed that the entitlement should be in terms of a measurable volumetric quantity of water. Return flows need only be considered if it is significant. Return flow was not significant in the Crocodile and Berg rivers and can thus be ignored in transfers.

Underground water is important in the Olifants and Berg rivers and in some instances this water is connected to surface water. Licenses must be used with penalties to discourage overuse.

Area specific issues: PDI farmers in the Crocodile River who have now acquired farms should be discouraged from selling water-use rights in the interim period as this will seriously affect the capacity to produce in such a water stressed area. These farmers need extension support to assist them in understanding water markets.

There is concern that the Kruger National Park is not getting its minimum flow requirement in spite of the impression that water is not used optimally in the catchment. Stakeholders need to be consulted and more needs to be done than metering water use.

Policies to discourage pollution in the Olifants River by mines include (a) polluters should pay a discharge tax in the same way as water abstraction users pay water rates, (b) it is proposed that a market be established for the discharge of nutrients and that

this market be used to discover the optimum price for pollutant disposal, (c) it is suggested that bio-diversity offsets be created to provide incentives for cooperation amongst stakeholders which may be mines, developers, environmental groups, farmers and public land agencies. This will partly solve the problem of pollution from abandoned old mines (pre-1956).

To the extent that there may be different interpretations among local officials of the reasons why proposed transfers are not supported, it must be clarified and the interested parties should be informed accordingly.

Two of the catchments studied (Crocodile and Berg Rivers) had active water markets that have come to a standstill. Most of these transfers were non-exercised rights. With the protection needed for the Reserve, local water authorities or other stakeholders are concerned with the activation of paper water if the river is in a deficit or potential deficit situation. It was noteworthy that in the case of the Berg River, estimates indicate no serious deficit but the local DWAF Office is not supportive of the transfer of these user rights. If these transfers are not possible, then water prices will keep increasing which will provide greater incentives for conservation. Land claims and the need for motivation that PDIs benefit from transfers place restrictions on transfers. There are sound reasons for these and the water market will again develop once these issues have worked through the system.

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