# AN ANALYSIS OF WATER PRICING INSTRUMENTS GOVERNED BY THE DWA WATER PRICING STRATEGY, AND ITS POTENTIAL FOR GENERATING REVENUE FOR CMAs

Report to the
**Water Research Commission**

by

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# EXECUTIVE SUMMARY

In any organization, the organizational mandate guides the organizational functions, while the organizational functions determine the cost structure. Successful organizations manage to acquire the funding required to address the cost structure.

The key purpose of this project is to investigate the mechanisms, conditions and viability of revenue selected streams required to address the cost structure of Catchment Management Agencies (CMAs) in South Africa.

The investigation assumes a resource economics based point of departure. Common pool resources such as air, water and certain types of land are public property, and hence the ecosystem services provided by this resource are implicitly public resources. Public resources, being non-excludable, are subject to overuse and degradation. In order to limit negative externalities and improve allocative efficiency, market intervention is required, enacted through a management authority. Catchment Management Agencies, enabling the devolution water resource management to the local level facilitate broad based user participation and are intended to manage the resource towards this end.

CMAs are statutory bodies with jurisdiction in defined water management areas. The mandate of the CMA has been clearly defined. The various functions required of the CMA have been spelled out in the National Water Act and various publications of the Department of Water Affairs. The foundational strategies, as defined in this report, address the core business of managing water resources and of complying with the business requirements, and with the other functions vested in the Minister. As the CMA becomes established, the Minister will progressively delegate further powers to the CMA to broaden its functioning.

In the initial phase the CMA is required to develop policy and strategy and organisational and administrative support for itself. Following this the Minister may delegate certain financial functions such as the registration of water users and the setting of water use charges. The physical implementation and information management of the WMA are then to be delegated before the CMA will become the responsible authority in the WMA. Recognising that some of the CMAs will serve areas with a relatively small water use management component, while others will serve WMAs with a large and diverse economy, the size and powers of the CMA would differ accordingly.

The CMA is empowered to raise funds through the various activities associated with the management and protection of the water resource. In this report, we focus on the following potential sources of CMA revenue:

- Water use charges
- Waste Discharge Charge System (WDCS)
- Ecosystem services transfers between CMAs
- Economic charges
- In-kind contributions (Narrative, non-quantitative)

This report starts by examining the funding requirements of the CMAs and the revenue streams available to them in order to determine whether the available funding will enable the CMA to become self-sufficient. The findings are based on the costs of two existing CMAs, the Inkomati and the Breede-Overberg, and benchmarked against international examples. In these two CMAs, staff costs will normally represent the greatest proportion of CMA operating costs (46-55%), Capex varies between 3% and 6% and the remainder is divided between professional and general services, with Board expenses making up 4% of the total. The revenue from water use charges (at current rates) for the Inkomati and Breede-Overberg CMAs is R7.8 million and R9.4 million respectively while the actual budget requirements for the Inkomati and the Breede-Overberg CMAs is R34.99 million and R18 million respectively. Funding for the operation these CMAs is allocated from the DWA budget. The shortfall is a product of under-recovery of water use charges, a matter which is highlighted for attention as CMAs will, subsequent to being established, be charged with the responsibility of collecting their own revenue.

CMAs are new organisations in the water institution environment and are expected to evolve in phased manner from an initial set of mandated functions to a fully functional organisation. Inn this report, we envisage that CMAs will mature through 6 phases. The budget requirement for CMA operations will therefore progressively increase from Phase 1 to Phase 6.

Water use charges, the main source of income from water users for catchment management and the NWA specifies that the revenue earned from these may be used for activities such as monitoring (including information gathering) and resource protection (including the discharge of waste and the protection of the reserve) and water conservation.

There are, however, other potential revenue streams available. These revenue streams are envisaged in DWA's Raw Water Pricing Strategy (2007).

In this report we focus on four revenue streams available to CMAs:

- Raw water use charges
- Waste Discharge Charge System (WDCS)
- Economic charges, and
- Ecosystem services transfers between CMAs.

The current raw water use charge structure in South Africa does not reflect the full anticipated cost of water resource management activities as detailed by the National Water Act (1998), the Water Services Act (1997) and the Raw Water Pricing Strategy (2007).

In the 2010/11 financial year, expenditure on water resource management activities was R250 million with the DWA having budgeted R350 million for that financial year. The budget allocated by the DWA for water resource management in the 2011/12 financial year was R450 million.

A budget of R214 million per annum would be required to fully account for the cost of establishing the CMAs (Phase 1 and 2 of CMA development). At this tariff level, assuming zero grant funding from DWA, average charge would be 1.51 cents/$m^3$. However, by phase 6, which is the fully matured stage of CMA development, these water resource charges would have to be increased by an average of 270% across all WMAs to generate sufficient revenue to fully account for the cost of operating the CMAs. At this tariff level, the average charge would be 5.84 cents/$m^3$ and would generate revenue of approximately R828 million.

CMAs may qualify for various grants from DWA. DWA currently envisages two types of grants: Public benefit grants, and Agriculture grants. Public benefit grants would cover CMA mandated activities that are in the national benefit such as responsibilities attached to inter-basin transfer schemes, or water allocation reform initiatives. Agriculture grants would cover the budget shortfall accruing from Agriculture water price subsidies.

The other three revenue producing activities evaluated in this study (WDCS, payments for ecosystem services and economic charges) all require CMAs to take responsibility for additional functions associated with the respective activities. We therefore propose that additional income from these activities only be raised to a sufficient level to cover the additional costs incurred by the CMAs.

The Waste Discharge Charge System (WDCS), once fully implemented, offers the opportunity for the CMA to more effectively manage the quality of the water resource through incentive-based control of pollutant discharge into the resource as well as the levying of a charge to mitigate adverse effects of discharges. We recommend that the WCDS be implemented and the charges set at levels which will realistically enable the management of the resource quality.

The estimation of potential revenue from the WDCS is a complex matter, as expenditure to improve water resource quality might not be realised as a direct revenue stream but may in fact be internalised by would-be polluters. The estimation of the treatment costs is thus an estimation of total industry expenditure on reducing pollutant loads in water resources, and not necessarily of a revenue stream that will flow from one party to another (user/polluters – resource management authority).

In reality a fully functional WDCS would be a highly dynamic system, needing to adapt to variations in both environmental an economic activity. The estimations presented here are ultimately a simplification, an ideal, yet it is by far the most insightful model available for generating the possible revenue implications of the WDCS system.

We anticipate that a CMA would levy an administrative charge on the Tier 1 WDCS charge. This levy could typically range between 12-18% of the Tier 1 charge. In the Olifants WMA case study used in this report, this would amount to an additional revenue of between R67 million to R100 million per year. This revenue would likely be spent on personnel and equipment costs incurred to manage the WDCS.

DWA, during its National Water Policy Review in 2013, indicated an intention to strongly regulate water transfers. Although the NWA makes provision for transfer of water use authorizations (Section 25), since 1998, instances of water trading have emerged that have undesirable unintended consequences such as, for example, that the water allocation may take place without Ministerial consent; and that water, because it is a scarce good, becomes commoditized, and water traders use it as a means to make profit, to the cost of users. Thus, although DWA has signaled policy intent to prohibit water trading, economic charges still remain a valuable policy instrument in water transfer mechanisms. The framework provided by the current Pricing Strategy gives insufficient policy direction for economic charges. We propose an alternative framework for understanding and designing economic charges for water.

With respect to economic charges, the Pricing Strategy gives effect to the NWA's intention to achieve 'equitable and efficient allocation of water', but its implementation is dependent on compulsory licensing. More recently DWA have identified other ways of reducing water consumption, but the pre-condition of compulsory licensing constrains the implementation of economic charges.

Two matters arise from the implementation of economic charges: the financial cost and the fiscal impact. The pricing strategy does not differentiate between these, but sees accrual of all charges to the National Treasury. However, implementing economic charges will incur costs to the CMA which would be set off by revenue earned through the economic charges.

The full supply cost of water is already captured in the raw water tariff. Thus, the full (economic) cost of water would also recover the opportunity costs, economic and environmental externalities and resource rents. This report demonstrates the concept of economic charges through three case studies.

The first case study deals with water trading. It discusses how Australia used water trading to shift water use from rice to higher value agriculture, urban centers and the environment, while at the same time taking the opportunity to cap water use. This showed that water trading can reduce opportunity costs with the benefits accruing through increased GDP and higher tax revenues. The Australia case is appropriate because of the contextual circumstances which include:

- Comparative scarcity of water
- A functional shift towards localized water resource management

Water trading has taken place in the lower Orange River where table grape growers have traded water to expand their operations.

The second set of case studies deals with a compulsory levy and purchasing of water entitlements as has been proposed in the Olifants Reconciliation Strategy. This involves an economic charge on all users, and the revenue would be ring-fenced for the purchase of water entitlements from those willing to sell. The water balance would be achieved when the opportunity cost approached zero. This could offer a more cost effective approach in some cases than building more infrastructures. This case deals with the Water Administration System (funded by the WRC). While not an economic charge, WAS has increased the efficiency of water use on irrigation schemes substantially by both reducing wastage and by increasing production per unit of water used. Another way of realizing indirect benefits from the water resource would be through reducing the assurance of supply.

The third case study demonstrates that the waste discharge charge system is a form of economic charge. The WDCS provides a way for internalizing the externalities of economic activities that negatively affect water quality. The WDCS is based on the polluter pays principle, the principle of reducing pollution at source and the precautionary principle. Tradable pollution permits (TP) may be an alternative economic instrument for environmental control. This system offers the option of fixing the number of permits, thereby capping the environmental damage caused by the discharge of saline effluent.

The key benefits of economic charges are that they can allocate water more efficiently and they can assist in curtailing pollution.

We recommend that a revised water pricing strategy should take account of the most recent thinking on this subject. Instruments that encourage the use of water to move from the production of lower to higher value commodities could be introduced. Economic charges can allocate water more efficiently but their implementation is constrained by their being linked to compulsory licensing. Thus a revised pricing strategy should de-link the implementation of economic charges from compulsory licensing. Furthermore, water is underpriced, particularly in river basins where it is in short supply. This means that the income stream from the resource rent which could accrue to the CMAs is being distributed as an implicit subsidy. We thus recommend that the pricing structure for water should be revised to take the full cost of water into account.

The suite of ecosystem services (ES) delivered by the aquatic ecosystem underpins the social ecological system upon which livelihoods and the economy depend. They also provide resilience in the face of the climate variability experienced in South Africa. They may be exported to the benefit of neighbouring catchments or redistributed through the development of infrastructure. These ES are vulnerable to mismanagement. We recommend that the stream of ES delivered by the aquatic ecosystem be recognised and their contribution be included in the planning and implementation of resource management.

The transfer of ES between WMAs also offers an opportunity for the donor WMA to receive funds from the recipient WMA, as the transferred water carries with it the opportunity for the receiving WMA. In the same way, degradation of water quality by an upstream WMA which imposes additional water quality management cost on the downstream WMA should be funded through WRM charges levied from the upstream WMA. This principle should apply to other ES as well.

Payments for ES (PES) offers a potential source of sustainable financing for conservation and sustaining ecosystem health. It ensures the realistic valuation and sustainable management of ES and aligns investments in natural and human well-being. However, PES is input-driven and so the payments are not necessarily related to the change in quantity or quality of the ES. (Although PES has the potential to be environmentally effective, it is complicated by the possibility of market failure associated with natural resources and the environment. Efforts to control deforestation in Costa Rica through outright prohibition proved ineffective, but the introduction of a PES programme is reversing the severe deforestation. Costa Rica is currently broadening its funding base to address specific cases such as the loss of the economy of scale and property tenure faced by the small scale user-financed programmes.

The case studies on the Maloti-Drakensberg and the Baviaanskloof-Tsitsikamma both show that the restoration of natural capital through PES schemes will improve the flow of ES from an area. The Working for Water Project has a dual focus of poverty relief and clearing invasive vegetation, the latter benefitting water availability downstream. This very successful project is estimated to have increased stream flow by nearly 46 million $m^3\ yr^{-1}$.

A review of the conditions for success of a PES programme recognises that that sustainable funding must be available, there must be willing sellers and willing buyers and there needs to be monitoring of the programmes. Subsidies may be necessary, but important for success is a situation where legal, institutional, social and economic conditions provide an appropriate framework. Such a framework would need to address property rights, capacity and community involvement.

Reasons leading to failure of PES programmes include political and economic factors beyond the control of the project as well as the development of a 'rent mentality'.

CMAs are mandated to support PES as they are to finance water resource management through the sale of water rights. When improved hydrological functioning is the main benefit, PES will increase the potential water sales in the catchment. There will be an incentive to invest in water-related PES. It is envisaged that CMAs can play various roles in the support of PES such as direct policy or institutional support, the regulation of water use, implementing interventions, managing information and providing an audit function for existing schemes.

CMAs are in a position to play a pivotal role in the successful implementation of PES. They form the hub of a network of water managers and users in the catchment. However, as in the case of the economic charges and the WDCS, we anticipate that a CMA would levy an administrative charge on for managing the progressive responsibilities emanating from the implementation of the respective initiatives (e.g. compulsory licensing, PES).

This study produced several key recommendations, listed as follows:

- CMAs should progressively endeavor towards increasing raw water use charges and to improve cost recovery.
- Water resource management activities currently assigned to the DWA regional offices need to be itemized in detail and ring-fenced to make it possible to determine the current expenditure on water resources management.
- A handover schedule needs to be developed to determine an order of priority for water resource management activities to be transferred to the CMAs.
- A cost benefit analysis of the various CMA functions needs to be undertaken to identify which specific functions will yield the greatest benefit for the given level of expenditure.
- CMA budgets should be set relative to expected revenue
- Establish a contractual obligation between water resource users and their corresponding CMA, detailing services offered and the corresponding charges

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# ACRONYMS

| | |
|---|---|
| AUD | Australian Dollars [World Currency Symbols] |
| CBNRM | Community Based Natural Resource Management |
| CMA | Catchment Management Agency |
| CMS | Catchment Management Strategy |
| DBSA | Development Bank of Southern Africa |
| DPSA | Department of Public Service Administration |
| DWA | Department of Water Affairs |
| DWEA | Department of Water and Environmental Affairs |
| ES | Ecosystem Services |
| MARDV | Maximum Allowable Resource Directed Values |
| MEA | Millennium Ecosystems Assessment |
| NGO | Non-Governmental Organization |
| NMBM | Nelson Mandela bay Municipality |
| NWA | National Water Act of 1998 |
| NWRS | National Water Resources Strategy |
| PES | Payment for Ecosystem Services |
| RDM | Resource Directed Measures |
| REDD | Reducing Emissions from Deforestation and Degradation |
| RO | Regional Office |
| RQO | Resource Quality Objectives |
| RRVD | Recommended Resource Directed Values |
| SA | South Africa |
| SFRA | Stream Flow Reduction Activity |
| SWR | Significant Water Resource |
| WDCS | Waste Discharge Charge System |
| WFW | Working for Water |
| WMA | Water Management Area |
| WMI | Water Management Institute |
| WQG | Water Quality Guidelines |
| WRC | Water Research Commission |
| WRCS | Water Resource Classification System |

| | |
|---|---|
| WUA | Water User Association |
| WUR | Water Use Requirements |
| ZAR | South African Rands [World Currency Symbol] |

# 1 INTRODUCTION

## 1.1 BACKGROUND TO THE PROJECT

In any organization, the organizational mandate guides the organizational functions, while the organizational functions determine the cost structure. Successful organizations manage to acquire the funding required to address the cost structure.

The key purpose of this project is to investigate the mechanisms, conditions and viability of funding streams required to address the cost structure of Catchment Management Agencies (CMAs) in South Africa.

This report focuses on the CMA mandate, the CMA functions that follow from this and estimates a generic cost structure for CMA functions. In addition, it also defines a range of CMA funding opportunities, which will be the subject of later investigations.

The point of departure of the study is primarily resource economics based. Water resources, as defined in the NWA, comprise aquatic ecosystems which are natural assets which are public property. Water resources deliver a set of aquatic ecosystem services. These ecosystem services are by extension also public services. These services include:

- Water provisioning;
- Pollution absorption; and
- A range of other aquatic ecosystem services as envisaged in the Millennium Ecosystems Assessment (MEA) framework of ecosystem services.

The mandate and functions of CMAs require of them to protect and manage the water resources in order to maintain a sustainable production of aquatic ecosystem services.

The cost of conducting all these functions is to be covered by the resource rent of water resources. The resource rent accruing from water resources forms a portion of the value of aquatic ecosystem services.

South Africa comprises 19 Water Management Areas (WMAs), all of which are ultimately to be managed by 9 Catchment Management Agencies (CMAs).

The Inkomati CMA and the Breede-Overberg CMA were established in 2005 and 2007 respectively. DWA is currently working on establishing the remaining CMAs. In the interim, water management is performed by DWA regional offices, also called the proto-CMAs (Pietersen et al. 2011).

A catchment management agency may raise any funds required by it for the purpose of exercising any of its powers and carrying out any of its duties in terms of the National Water Act (1998). The Act states that a CMA must be funded by:

a. money appropriated by Parliament;
b. water use charges; and
c. money obtained from any other lawful source for the purpose of exercising its powers and carrying out its duties in terms of the NWA (1998).

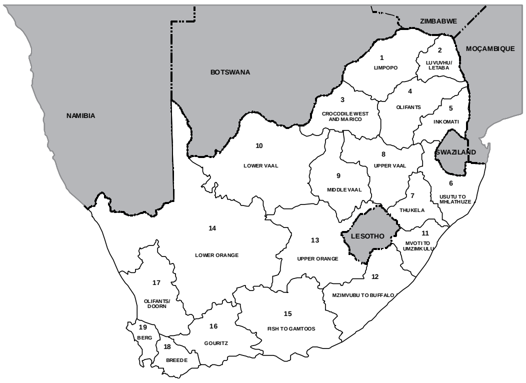



FIGURE 1-1. THE WATER MANAGEMENT AREAS OF SOUTH AFRICA

## 1.2 Report Structure

This report conducts an analysis of water pricing instruments governed by the DWA water pricing strategy, and its potential for generating revenue for CMAs.

Chapters 4-6 investigates a typical cost budget for a CMA based upon the operating functional obligations and operating requirements established in previous studies which include Mazibuko and Pegram (2006), Pegram and Palmer (2001), DWAF (2000) and DWA (2001a). The financial reports of the currently operating Inkomati and Breede Overberg Catchment Management Agencies (INCMA and BOCMA) are analyzed in the context of these operating parameters. These estimates establish a benchmark/target for costs that would need to be recovered by potential revenue streams.

Chapter 8 analyzes the potential of water resource charges as a fixed income to CMAs. The primary point of departure in this phase of the report is the historical income from catchment management charges (CMC's) paid to DWA. Anecdotal evidence suggests however that CMCs have historically been set based on very coarse estimates which do not reflect the actual cost of catchment management. This study thus conducts and in-depth investigation of reasonable cost-recovery charges related to water resource charges. This is to be done through budget analysis of DWA regional office activities, making use of available budgets. This phase also investigates international best practice.

Chapter 9 considers the implementation of the WDCS and analyzes its potential for generating revenue for CMAs. This simulation makes use of a water pollution marginal cost of abatement curve developed for the Olifants Catchment which is then extrapolated to the other WMAs.

The assessment of the revenue potential of the WDCS builds upon the water use estimates (per water management are, per economic sector) discussed in chapters 4 through 6. Estimation of the Total Revenue Potential for a WDCS is South Africa is achieved by extrapolating costing figures obtained from the Olifants Catchment Case into the other 18 catchments according to the scale and composition of water use in the various economic sectors. The estimations made in this report build off of the current work being done in the Olifants Catchment, utilised but not intricately detailed in this project, as it falls outside of the scope.

Chapter 10 investigates the economic charges. These charges relate closely to a number of initiatives that affect water supply and demand behavior.

Chapter 11 investigates, in a narrative form, the potential for Economic Instruments and Payment for Ecosystem Services (PES) programs to act as potential revenue streams for CMAs. These economic instruments relate to a variable pricing mechanism for water use, with the policy objectives of saving water (i.e. conservation) and improving efficiency of use (i.e. demand management). The discussion around Payment for Ecosystem Services Programs makes use of several case studies to illustrate functional aspects of and the necessary requirements for such initiatives.

# 2 FUNCTIONS OF THE CMA AND ITS BOARD

## 2.1 CMA MANDATE

The National Water Act (Act No 36 of 1998) (NWA) provides for the establishment of catchment management agencies (CMAs) and specifies their mandate. The CMA is governed by a Board of Directors.

CMAs are primarily responsible for water resources management in their WMA. Thus the purpose of CMAs is the delegation of water resource management to a catchment level, within the framework of the national water resource strategy (DWA 2004) of the Department of Water Affairs (DWA).

The CMA achieves this through developing and implementing a catchment management strategy (CMS). The CMS provides the framework for management of water resources in a WMA.

The sections below discuss the functions of the CMA and the Board.

## 2.2 FUNCTIONS OF THE CMA

### *2.2.1 INITIAL CMA FUNCTIONS*

The NWA envisages CMA to perform five initial functions; other functions that may be designated by the Department of Water Affairs (DWA) and yet other functions incidental to any of its functions, which fall outside its water management area, and may also be performed by the CMA. These five functions are listed in the table below. They are of a strategic nature and include the investigative and advisory services to interested persons, development of policy and strategy, co-ordination and promotion of community participation.

TABLE 2-1. INITIAL FUNCTIONS OF CATCHMENT MANAGEMENT AGENCIES AS DEFINED IN THE NWA

| Functional area | Initial functions |
|---|---|
| **Investigate and advise interested persons** | 1. On water resource protection, use, development, conservation, management and control |
| **Develop policy and strategy** | 2. Develop a catchment management strategy (CMS) |
| **Co-ordination** | 3. Of the related activities of water users and of the water management institutions within its water management area<br>4. Of CMS implementation with the implementation of any applicable development plan established in terms of the Water Services Act, 1997 (Act No. 108 of 1997) |
| **Promote community participation** | 5. In the protection, use, development, conservation, management and control of the water resources in its water management area |

### *2.2.2 FUNCTIONS ARISING FROM THE CMS*

The catchment management strategy (CMS) is of particular importance as it directs the activities of the CMA. The NWA requires every catchment management agency to develop a catchment management strategy (CMS) for guiding water resources planning within its water management area (WMA). Catchment management strategy must align with the national water resource strategy (NWRS). The process of CMS development is co-operative and consensus driven.

The generic framework for a CMS (DWA 2001) proposes that a CMS consist of (1) an assessment of the current water resource situation and (2) several foundation strategies and supporting strategies which would enable the CMA to achieve a desired future water resource situation as guided by the NWRS.

The foundation and supporting strategies, together, are viewed as the minimum requirements for covering as many aspects as possible of water resource management of the WMA.

The foundation strategies intend to create the framework for human and financial resources and the institutional development necessary to involve and deal with stakeholders as well as to implement the strategies. The supporting strategies intend to protect, use, develop, conserve, manage and control water resources.

The foundation strategies are envisaged to include:

- An RDM strategy, for management classes and resource quality objectives;
- An NWRS strategy, to meet the requirements of the NWRS;
- A stressed catchments strategy, to identify stressed catchments in WMA and develop catchment management plans for them;
- An institutional development strategy, to deal with existing and develop new institutional frameworks;
- A spatial/land use planning strategy, to influence water related aspects of land use planning;
- A Human Resource strategy, to establish policy on human resource requirements and development;
- A co-operative governance strategy, to strategize for effective co-operative governance;
- A public involvement/interaction strategy, to facilitate effective public participation;
- A data collection and information management strategy, to develop centralized, relevant, and updated database for planning and strategy formulation;
- A capacity building/education strategy, to improve the level of participation through appropriate capacity building;
- An auditing and review strategy for internal and external auditing of CMS activities;
- A conflict management strategy, for conflict anticipation and resolution;
- A financial strategy to ensure financial viability and growth.

The supporting strategies are deemed to be essential for effective water resources management. These include:

- A water resource protection strategy, for maintaining desired Resource Quality Objectives; designing, implementing, reviewing Source Directed Controls; dealing with point and non-point sources of pollution; economic incentives for reduction in pollution; dealing with hazardous spills, import & disposal of toxic waste; dealing with ecosystem components under stress or threat; co-operative governance strategy for land use planning, impact assessment.
- A water use strategy, which deals with over-allocated catchments; under-utilized catchments; water allocation; water pricing; general authorizations; license

applications (individual and compulsory); trading water rights; upliftment programs; future demands.

- A water resource development strategy, which addresses the efficiency and financial viability of existing water supply schemes; evaluation of new development proposals; future and potential transfers; integration of land development initiatives.
- A water resource conservation strategy, which deals with demand management strategies.
- A water resource management strategy for water quantity and quality management and which also addresses ecological sustainability and reliability, financial viability and the integration of protection, use, development, conservation and control of water resources.
- A water resource control strategy which addresses the water quantity and quality monitoring in WMA; flood, drought and pollution disaster management; dam safety and disaster risk management.
- Cooperative governance arrangements enhance the institutional viability of CMA and results in improved participation of all stakeholders. This might result in cost savings from operational agreements where there is overlap in mandates.
- In-kind contributions, in terms of reducing the expense burden for CMAs. This area of contribution is increasingly recognized as having potential, given the increasingly prominent role of ”visible” social responsibility efforts in the private sector.

Thus, other possible functions of CMAs may include general management of water resources in the WMA, the powers and duties of a responsible authority[1] and other powers and duties vested with the Minister (of DWA) that can be delegated. Depending on the size and capacity of the CMA, some of these functions may be delegated or outsourced to the other WMIs established within a WMA. Table 2-2 below list examples of such anticipated functions.

TABLE 2-2. OTHER CMA FUNCTIONS AS ADAPTED FROM WRC REPORT 1433/1/06 (MAZIBUKO AND PEGRAM 2006)

| Functional area | Sub-functions and activities |
|---|---|
| **Develop policy and strategy** | Long-term strategic planning for the CMA (including climate change)<br>Determination of resource directed measures<br>Reconciliation of water availability and requirements<br>Financial and business planning for the CMA |
| **Support institutions** | Creation of non-statutory consultative and participative bodies or forums<br>Coordination of the activities and relationships of WMIs in the WMA<br>Fostering cooperative governance and creating partnerships<br>Building capacity in WMIs and forums<br>Resolution of conflicts<br>Supportive or emergency organisational interventions<br>Ensuring appropriate stakeholder participation in these bodies |
| **Regulate water use** | Registration of water use<br>Authorisation of water use (licensing)<br>Setting, billing and collecting water use charges<br>Ensuring dam safety and dam zoning<br>Monitoring authorisation requirements |

[1] “responsible authority'' in the NWA is defined to be catchment management agency in relation to a specific power or duty assigned to the CMA by the Minister of DWA.

| Functional area | Sub-functions and activities |
|---|---|
| | Ensuring compliance (including enforcement)<br>Negotiation of co-regulation and cooperative agreements |
| **Implement physical interventions** | Implementation of the Working For Water programme<br>Implementation of water demand management (WDM) interventions<br>Rehabilitation of water resources (such as wetland or riparian zones)<br>Emergency response interventions (including disaster mitigation)<br>Operation and maintenance of water resource systems (water works)<br>Development (design and construction) of water resources infrastructure (waterworks) |
| **Manage information** | Monitoring water resources (collect, source and capture data)<br>Development and maintenance of databases (including quality control)<br>Development and maintenance of information management/evaluation systems<br>Conducting research on water resources<br>Performance of needs assessments and water resource problem identifications<br>Communication with stakeholders and collection of anecdotal information |
| **Audit WRM** | Development and maintenance of indicators for auditing<br>Performance of financial and organisational audits of WMIs<br>Performance of functional performance audits<br>Performance of water resources audits against specified objectives<br>Proposition and facilitation of corrective action |

### *2.2.3 Infrastructure*

As part of the catchment management strategy, a CMA is required to identify possible water resource infrastructure that may be needed to supply current or future water use. In many cases, other organizations in the WMA (such as Water Boards, WUAs or local authorities) may have adequate capacity to develop this infrastructure. However, in some cases it may be necessary for the CMA to facilitate this development by raising capital and project management. The CMA policy (DWA 2002a) however indicates that this situation should be avoided where possible, due to the potential organizational conflicts arising from being involved in management and development.

## 2.3 Description of CMA functions

### *2.3.1 Water resources planning*

The NWA envisages key roles for CMAs in relation to the CMS, and the planning framework that arises from it. The headline details of these have been discussed in section 2.2.2 above.

### *2.3.2 Water use management, Water resource protection and Water allocation reform*

Water use is defined by the NWA to include taking water from a water resource; storing water; impeding or diverting the flow of water in a watercourse; engaging in a stream flow reduction activity (SFRA); engaging in a controlled activity (such as irrigation); discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit; disposing of waste in a manner which may detrimentally impact on a water resource; disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process; altering the bed, banks, course or characteristics of a watercourse; removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and using water for recreational purposes.

All water use activities are regulated through the NWA. Such regulation is achieved mainly through water use licencing, although there exist certain water uses which are excluded from licencing[2]. The regulation includes the issuance of licences and the monitoring of water use (both licenced and non-licenced). An additional activity is the control of allocation by a responsible authority, as the granting of a license does not imply any guarantee regarding the availability or quality of water which it covers. The issuance, review and renewal of licences, and amendment and substitution of conditions of licences, are to be done by the responsible authority.

Contravention of or failure to comply with authorisations, requires a responsible authority to force the licensee to take remedial action, failing which it may take the necessary action and recover reasonable costs from that juristic person, to the suspension or withdrawal of a licence.

The NWA also requires CMAs to deal with pollution prevention and pollution incidents. The organisation that owns, controls, occupies or uses land or processes that leads to water pollution is responsible for taking measures to prevent pollution of water resources. If these measures are not taken, the CMA may do whatever is necessary to prevent the pollution or to remedy its effects, and to recover all reasonable costs from the persons responsible for the pollution.

The NWA further defines water conservation as important and requires water resource management measures that enable the efficient use and saving of water, through measures such as water saving devices, water-efficient processes and various water demand management instruments.

Most of the supporting strategies, envisaged by the generic framework for a CMS (DWA 2001) fall within this function.

NOTHING ON ALLOCATION REFORM AS PER TITLE

### *2.3.3 INFORMATION SYSTEMS*

CMAs have important roles to play in setting up and maintaining information systems.

The planning, water resource management and protection functions all require monitoring, recording, assessing and disseminating information on water resources to be performed, backed up by adequate information systems.

The systems are to provide for the collection of appropriate data and information necessary to assess, including the quantity of water in the various water resources; the quality of water resources; the use of water resources; the rehabilitation of water resources; compliance with resource quality objectives; the health of aquatic ecosystems; and atmospheric conditions which may influence water resources.

Not all of these activities are necessarily the responsibility of the CMA, however the NWA does indicate that the Minister must, consult with relevant organs of state; water management institutions; and existing and potential users of water, establish mechanisms and procedures to

[2] A water use must be licenced unless it is listed as a "permissible use" (Schedule 1 of the NWA lists several low impact uses as "permissible uses"), is an existing lawful use, is permissible under a general authorisation, or if a responsible authority waives the need for a licence.

co-ordinate the monitoring of water resources. The monitoring is to be based on information systems which may include, among others a hydrological information system; a water resource quality information system; a groundwater information system; and a register of water use authorisations.

The generic framework for a CMS (DWA 2001) requires the CMA to have (a) data collection and information management strategy and (b) a water resource control strategy which addresses (amongst other things) the water quantity and quality monitoring in WMA.

### 2.3.4 *Institutional engagement*

Co-operation, public participation and coordination are key initial functions of CMAs. The generic framework for a CMS (DWA 2001) requires the CMA to develop strategies for institutional development strategy, to deal with existing and develop new institutional frameworks; co-operative governance; public involvement/interaction, and capacity building and education.

***Water Sector Institutions****:* Catchment management forums are voluntary associations of stakeholders, with an interest in water resource-related concern or a particular sub-catchment area. They provide an important mechanism for stakeholder communication, participation and consultation with DWAF and/or a CMA.

Water user associations (WUAs) are statutory bodies established by the Minister. They are cooperative single or multiple sector associations of individual water users who wish to undertake water-related activities on a local scale for their mutual benefit.

International water management bodies are statutory water management institutions that may be established by the Minister. Their primary role is to implement international agreements entered into by the South African government in relation to water management.

The Minister may also establish advisory committees for different purposes and functions.

***Water services institutions****:* Water boards are responsible for the supply of bulk water, including the development and operation of bulk water and sanitation infrastructure. Water boards are therefore an important stakeholder in catchment management, representing the interests of a number of domestic and industrial water users. As many water boards are also involved in water resources infrastructure development and operation, including water resource monitoring, they are organizations with existing capacity for certain catchment management functions. Under these circumstances, the CMA may contract or even delegate certain functions to the water board, to prevent duplication of effort.

Water service authorities (WSAs) and water service providers (WSPs) are responsible for the supply of water and sanitation services within their area of jurisdiction. As with water boards, these organizations are important stakeholders representing the interests of municipal domestic and industrial users. Where they have capacity to operate infrastructure or monitor water resources, the CMA should consider contracting them to perform these functions.

***Other Catchment Management Agencies:*** Cross boundary matters between Water Management Areas such as water quality and quantity would require coordination between other CMAs. CMAs may also wish to contract out work to each other or to share resources, such as staff, plant or equipment, to reduce costs.

***Organs of state:*** Effective catchment management requires proactive planning and management of spatial and infrastructure development. Other government departments and their statutory agents in all three spheres of government are responsible for environmental management, infrastructure development and service provision, spatial, land use and economic planning. National and Provincial Government are therefore key stakeholders in terms of catchment management, as well as performing functions that require alignment with the CMA.

***Local government:*** Implementation of development and land use planning is primarily the responsibility of local government. Many local governments are also required to prepare a range of other plans including water services development plans under the Water Services Act. The relationship between CMAs and local government is therefore a very important one. (Mazibuko and Pegram 2001)

***Interest groups:*** A number of organized sectoral and non-governmental interest groups have a role in catchment management. (Many of these may be represented on the catchment forums or catchment management committees.) In specific WMAs, particular agricultural, commercial, industrial, labour, civic, community or environmental interests may require active involvement on the CMA governing board (DWA 2002).

### *2.3.5 Dispute Resolution and Legal Support*

Although the NWA establishes the Water Tribunal as a dispute resolution organisation, the responsibility of evidence required in Water Tribunal matter probably resides mainly with the CMA. The generic framework for a CMS (DWA 2001) requires the CMA to have a conflict management strategy, for conflict anticipation and resolution.

In addition, the NWA further stipulates that a catchment management agency must provide the Director-General with copies of all pleadings, affidavits and other documents in the possession of the catchment management agency relating to any proceedings instituted against that catchment management agency.

### *2.3.6 Functional Support*

The NWA requires that the provisions of Schedule 4 of the NWA, which relates to best practise institutional and management planning, apply to a catchment management agency. This requires CMAs to provide functional support related to human resource and financial matters.

In addition, the generic framework for a CMS (DWA 2001) requires the CMA to have a Human Resource strategy, an auditing and review strategy and a financial strategy to ensure financial viability and growth.

## 2.4 Functions of the CMA Board

Each CMA is governed by a Board of Directors.

The Board and the Chief Executive Officer of the CMA is responsible for the good governance of the CMA which includes safeguarding that all money payable to the institution is properly collected; that all money spent by the institution is properly spent and properly authorised; that there is adequate control over all assets acquired for the purposes of the institution, or managed or controlled by it; that all liabilities incurred on behalf of the institution are properly authorised; efficiency and economy of operations and avoidance of waste and extravagance; develop and maintain an adequate budgeting and accounting system; and develop and maintain an adequate financial control system. These requirements require certain functions of the Board (such as regular meetings, appointment of committees, auditing and publications of annual reports), the costs of which have to be carried by the CMA.

One of the functions of the Board is to prepare business plans. Business plans are required to include (amongst other things) a statement of the functions which the institution expects to provide.

It must also include an outline of the overall financial strategies for the institution including the setting of charges, borrowing, investment and purchasing and disposal strategies; a forecast of the revenue and expenditure of the institution, including a forecast of capital expenditure and borrowings.

Key requirements are the maintenance of the CMA's financial viability, the need to maintain a reasonable level of reserves, especially to provide for corrective action to redress the results of past racial and gender discrimination in the use of water resources; any estimated future demand for the services of the institution; and any need to improve the accessibility of, and performance standards for, the services provided by the institution. The business plans must also provide for capacity building amongst its board members and officials.

## 2.5 PROGRESSIVE DELEGATION OF FUNCTIONS

Not all of the above discussed functions become the responsibility of the CMA immediately. The NWA envisages that the water resources management functions may progressively be delegated to the CMA.

The document entitled "Implementation of Catchment Management in SA **(**The National Policy)" (DWA 2000) advises that this process of delegation should begin with *financial and administrative functions* such as the registration of water users and making and collecting water user charges.

Once financial and administrative capacity has been created, *water resource management functions* may follow, based on the particular priorities outlined in the catchment management strategy.

Finally, once the CMA has demonstrated capacity to fund and exercise these water management functions, powers and duties of a *responsible authority* may be delegated to the CMA, which relate to the ability to authorize, license and regulate water use.

### *2.5.1 PROBABLE PHASES OF CMA PROGRESSION*

In literature, two different types of progression phases for CMAs are identified. Pegram and Palmer (2001) proposed four generic phases in the progression of CMAs. DWA (2001) thereafter supersedes the Pegram and Palmer four phases.

Pegram and Palmer envisaged an "Initial phase" where-in a CMA develops the CMS, conducts institutional coordination, engages stakeholders and conducts general administrative activities.

This is followed by the "Financial phase" where it recovers water use charges. Thereafter follows a "Management phase", where functions associated with water resource management activities described above is fulfilled. Ultimately, a "Responsible authority" phase is reached where the authorisation and control of water use is implemented. The table below summarizes these functions.

TABLE 2-3. PHASES OF CMA EVOLUTION AND ASSOCIATED FUNCTIONS (PEGRAM AND PALMER 2001)

| Phase | Delegated or Assigned Functions | Key Functional Areas |
|---|---|---|
| Initial | Initial functions | *Policy & Strategy*<br>*Organisational development*<br>*Administrative support* |
| Financial | Registration of water users<br>Setting and recovering water use charges<br>Fostering cooperative governance and partnerships | *Financial regulatory* |
| Management | Making input to DWAF:RO regarding licences<br>Development and operation of waterworks<br>Auditing of catchment management activities<br>Routine monitoring (and information management)<br>Implement physical interventions<br>Outstanding functions in Schedule 3 of the NWA | *Physical implementation*<br>*Information management*<br>*WRM Audit* |
| Responsible authority | Function as responsible authority<br>Monitoring of water use<br>Enforcement of licence conditions | *Regulatory* |

DWA 2001 describes three progressive phases for CMA development, following on the progressive delegation of functions discussed in section 2.5 above.

In the "Initial phase" *the CMA* establishes and positions itself as a legitimate and central institution for water resources management in the WMA. An effective CMA management team (and some support staff) actively coordinates and develops relationships with existing organizations and stakeholders (including catchment forums, local government, and water user associations). The focus is thus on enabling WRM functions to be performed without having to build significant capacity within the CMA.

In the "Consolidation Phase" the CMA develops from a relatively small coordinating team into an organization that is responsible for managing, coordinating and implementing significant WRM activities. The CMA now develops in-house capacity and conducts some outsourcing in order to deliver the delegated CMA functions. This results in an increase (probably doubling) in the size and resources of the organization, possibly including the transfer of some DWAF staff with delegated functions, which will raise a number of transitional and organizational challenges. An important change during this stage is that the CMA becomes primarily responsible for delegated functions, while DWA would become more responsible for regulatory oversight. However, DWA still maintains capacity for the authorization and management of water use.

In the "Full functionality phase" the CMA becomes fully functional and the responsible authority as envisaged by the NWA. The DWA Regional Office (RO) now plays the role of institutional coordination, support and oversight (auditing). However, depending upon the WRM priorities in the WMA and the likely resources available to the CMA, the CMA may depend upon DWAF (or external specialist consultants) to provide technical support.

## 2.6 TYPES OF CMAS

It is further anticipated that different types of CMAs may evolve, depending on the unique water resource situations in each WMA. Pegram and Palmer (2001) identify three different types of CMAs.

*Rural agricultural – community dominated (small) CMA which has* a relatively small water use management component which would largely be oriented towards the authorisation and control of irrigation and municipal water use, with some of the water use control responsibilities being delegated to WUAs (and possibly local government depending on the capacity). Water resources planning and water use authorisation would require DWA (and possibly consultant) technical support, while the monitoring component would need to be supported by laboratory services and possibly monitoring done by WUAs and local government. An example of this type of CMA would be in the Olifants-Doorn WMA.

*Rural agricultural-industrial municipality (medium) CMA* – This is a medium sized CMA with approximately 60 staff members. It mostly has capacity for institutional development, water resources planning, water use management and monitoring within a WMA with significant industrial, power or mining activities. Monitoring would be supported by outsourced laboratory services and other institutions' (including industry) programmes, while technical planning and water use authorisation support would be brought in from DWAF or consultants. Examples of this type of CMA would be in the Olifants and Middle Vaal WMAs. However, some of the larger rural agricultural WMAs (with total water use in the order of 1000 million $m^3$) may also require medium size CMAs, such as the Inkomati and Breede WMAs.

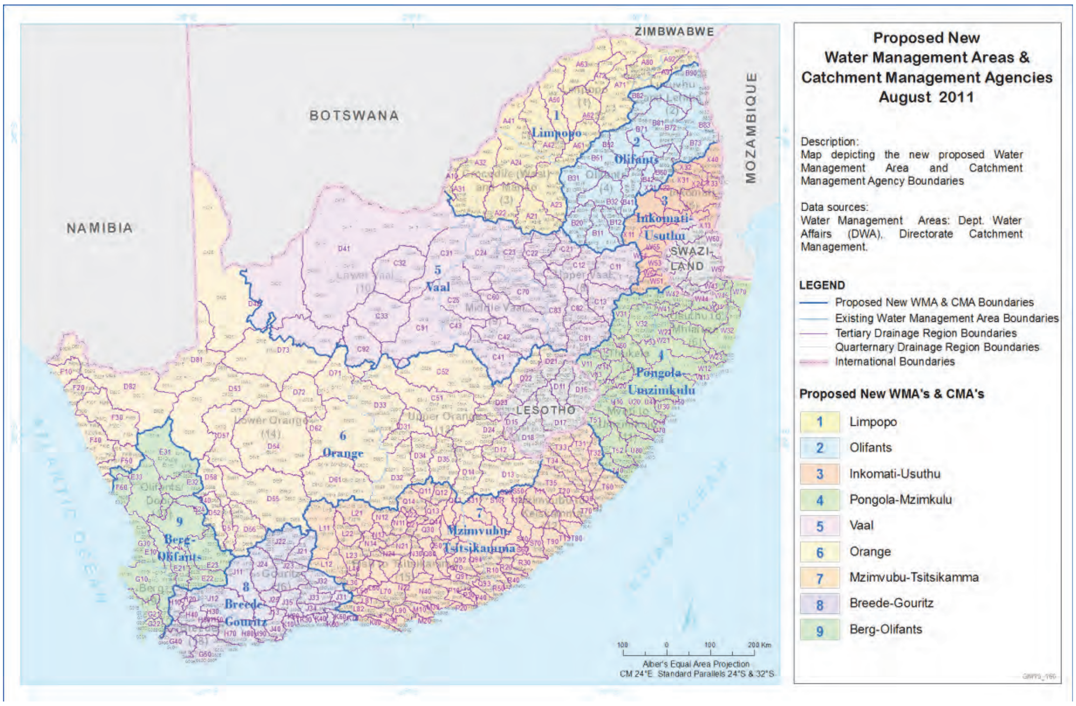



FIGURE 2-1. MAP OF PROPOSED NEW WMAS AND CMAS

*Urban dominated (large) CMA* – This is a large CMA establishment with a staff complement of approximately 85 people, which assumes that most functions are performed in-house by the CMA. However some of the functions may be outsourced, thus decreasing the number of staff.

This type of CMA has a significant water use management and monitoring component required to manage the complex water quality problems associated with urban areas, although outsourcing of the laboratory components is assumed. Examples of this type of CMA would be in the Upper Vaal, Crocodile-Marico and Mvoti-Mzimkulu.

## 2.7 Current functions of existing CMAs

The Inkomati and Breede-Overberg CMAs, in their June 2011 submissions to the Parliamentary Monitoring Group, reported on the functions they performed to date. These functions are summarized in the tables below.

These functions indicate that both CMAs are at least in their consolidation phase and are progressing to full functionality.

TABLE 2-4. FUNCTIONS PERFORMED TO DATE BY THE INKOMATI CMA

| Functional area | Sub-functions and Outputs |
|---|---|
| **Institutions and Participation** | • Establishment of Water Users Associations<br>• Co-operative governance<br>• Stakeholder centered implementation of the Reserve |
| **Regulate water use** | Resource protection and waste (Water quality management; River System Health)<br>• Discharge and water resource quality effectively monitored<br>• Water resource pollution remedied<br>Water Utilisation (Water allocation; Compliance monitoring and enforcement)<br>• Validation and Verification of water use |
| **Water resources planning and programmes** | Information management and systems<br>• Authorized and Metered Water Use<br>• Compliance monitoring effectively implement<br>• Operationalize Learning Reflection and Review System<br>• Reviewed Annual Tariff and billing of Users<br>Systems planning and operations (Planning coordination; River System Operation)<br>• Catchment Management Strategy<br>• Water Allocation Plan<br>• Systems for integrated planning and operations of river systems<br>• Provision of informed advice to DWA on international agreements |
| **Strategic support** | Finance<br>Human resources<br>Administration |
| **Management and governance** | Management<br>Governance |

TABLE 2-5. FUNCTIONS PERFORMED TO DATE BY THE BREEDE-OVERBERG CMA

| Functional area | Sub-functions and Outputs |
|---|---|
| **Water resources planning** | Catchment Management Strategy<br>Engage water resources planning processes<br>• Engage processes (meetings and comments)<br>• Propose relevant WR planning studies<br>• Audit Catchment management plans<br>• Engage and monitor Local Authorities (regarding Water Use for growth and development) |
| **Water use management** | Registration<br>• Complete the waste discharge registration<br>• Identify registration problem areas<br>• Register authorized applications<br>•<br>• Update WARMS with data flowing from Validation and Verification of identified registered water users<br>Water use licensing |

| Functional area | Sub-functions and Outputs |
|---|---|
| | Control & compliance<br>• Compliance audit of point discharge<br>• Monitoring abstraction and discharge water use compliance<br>• Engaging non-compliant water users<br>• Cooperate with DWA and other government institutions on legal enforcement.<br>• Validation & Verification of Water Use in selected Catchments.<br>• Ensure compliance of rezoning applications to the NWA |
| **Institutional engagement** | Marketing and communication<br>• Develop a marketing and communication strategy<br>• Targeted marketing and communication<br>Stakeholder engagement<br>• Develop public participation policy and strategy<br>• Facilitate catchment forums<br>• Establish and maintain new Water Forums and partnerships<br>• Engage and support WUAs<br>• Transform Irrigation Boards into WUAs<br>Institutional cooperation<br>• Participate in inter-governmental processes and forums<br>• Twinning arrangements identified and maintained |
| **Water allocation reform** | Support and facilitation for resource-poor farmers<br>• Assess water use by RPF in the Breede WMA<br>• Promote and assist water allocation (licensing and finance) to resource-poor farmers |
| **Resource protection** | Resource Protection<br>• Assess (ongoing) compliance through WR monitoring and compliance to conditions of authorisations<br>• Ensure relevant water use authorisation conditions<br>• Water quality status reports (for significant water resources)<br>• Align alien vegetation clearing plans with planning priorities<br>• Identify priority riparian habitats<br>• Capacitate land owners on the protection of riparian habitat |
| **Information systems** | Water resources information systems<br>• Make Water Use registration system operational in the BOCMA<br>• Establish a WR information system linked to DWA<br>• Establish a GIS office<br>• Develop ICT strategy<br>Corporate information systems<br>• Maintain the BOCMA website<br>• Maintain relevant corporate systems<br>• Investigate revenue collection system<br>• Develop and implement a disaster recovery plan<br>Information database system<br>• Transfer all relevant information from DWA |
| **Strategic support** | Finance<br>• Transfer revenue collection from DWA<br>• Management of accounts<br>• Financial planning, budgeting, control & reporting<br>• Submit Financial Statements to the National Treasury and Auditor-General<br>• Audited Financial Statement<br>• Facilitate external audit<br>Human resources<br>• Review organisational design<br>• Recruitment of new staff<br>• Development and training of staff<br>• Development and review of HR policies and procedures<br>Administration<br>• Develop and implement records management plan<br>• Fleet management<br>• Development of processes and support procedures to enhance office support services<br>• Review of office support related policies |

| Functional area | Sub-functions and Outputs |
|---|---|
| **Management and governance** | Management<br>• Growth and consolidation of the (CMA) to perform its functions<br>• On-going strategic direction and management of the organisation by the CEO and senior managers<br>• Present draft business plan to the Department<br>• Submit revised business plan to the Department<br>Governance<br>• Training of Board members<br>• MOU with DWA signed, implemented and reviewed<br>• Review and implement risk management system<br>• Develop Board and committee procedures<br>• Internal audit, external audit and legal compliance |

# 3 ORGANIZATIONAL STRUCTURE REQUIRED TO CARRY OUT A CMA'S INITIAL FUNCTIONS

The CMA functions described above require an organizational structure comprising several key skills. Each of these is discussed under the headings below.

## 3.1 STRATEGY DEVELOPMENT, PLANNING AND COOPERATIVE GOVERNANCE SKILLS

Both planning and cooperative governance require a CMA to have staff who are skilled water resource planners, at both strategic and operational levels, and who can interact with peers at various levels of government.

## 3.2 WATER RESOURCE MANAGEMENT TECHNICAL SKILLS

Water resource management requires staff with technical skills and experience in a variety of fields. Even where some of the water resource management functions are out-sourced, the CMA will need in-house project supervision by experienced water resource managers.

## 3.3 INFORMATION MANAGEMENT

The monitoring and information systems functions require specialist information management skills.

## 3.4 INSTITUTIONAL COORDINATION AND PUBLIC PARTICIPATION

Institutional engagement, public participation and associated capacity building are specialist skills for which the CMA has to plan.

## 3.5 MANAGEMENT AND SUPPORT FUNCTIONS

All general management, administration, financial and human resource skills required in any organization are also required by a CMA.

## 3.6 SPECIALIST SKILLS

The CMA may also, from time to time, require several specialist skills, including engineering, financial, resource economics, legal and other skills. Some of these skills may be appointed in-house, while others may be outsourced.

## 3.7 CURRENT STRUCTURE OF EXISTING CMAS

The current organizational structures of both the Inkomati and Breede-Overberg CMAs make provision for these functions and skills.

FIGURE 3-1. CURRENT ORGANISATIONAL STRUCTURE OF THE INKOMATI CMA (WWW.PMG.CO.ZA)

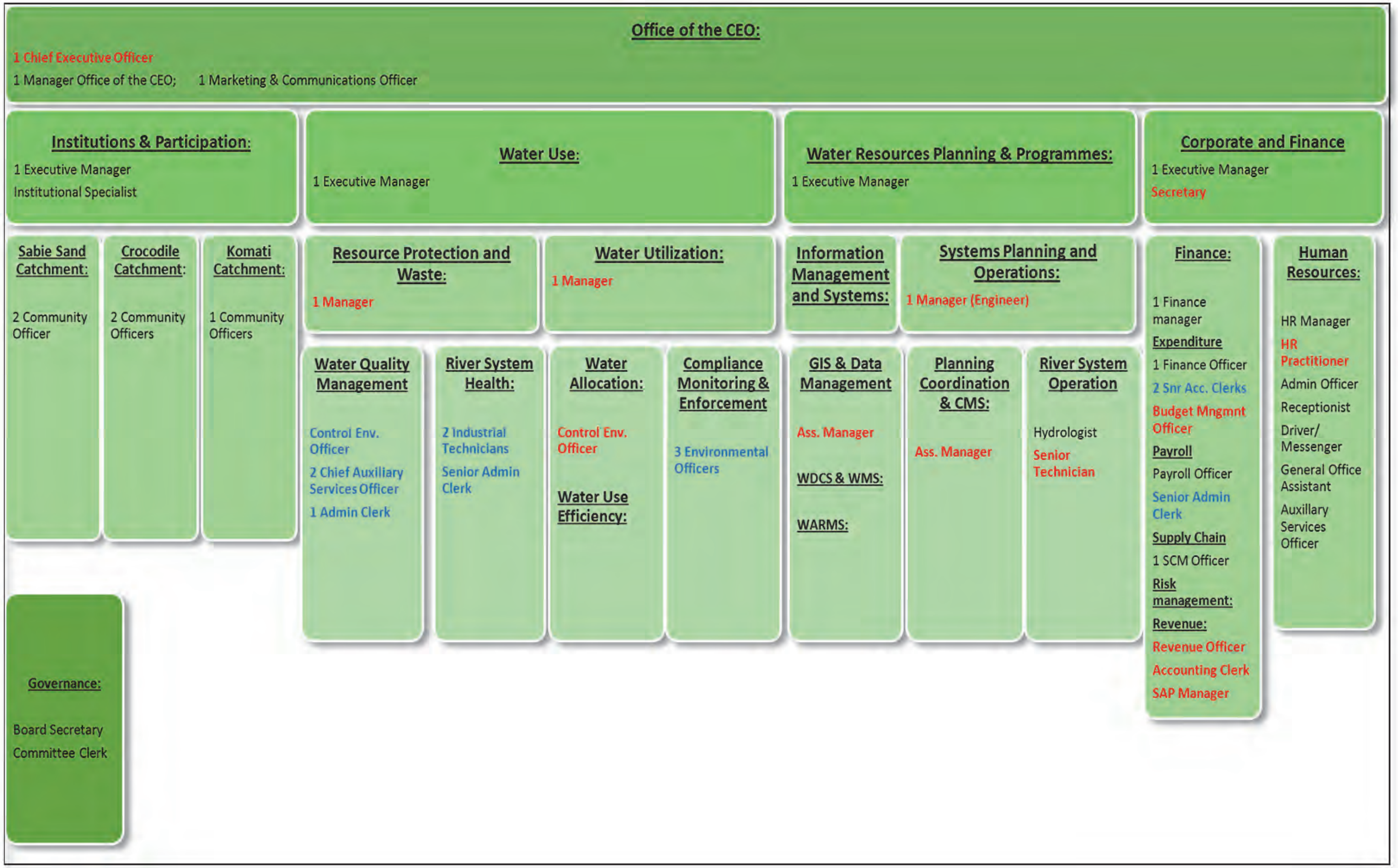
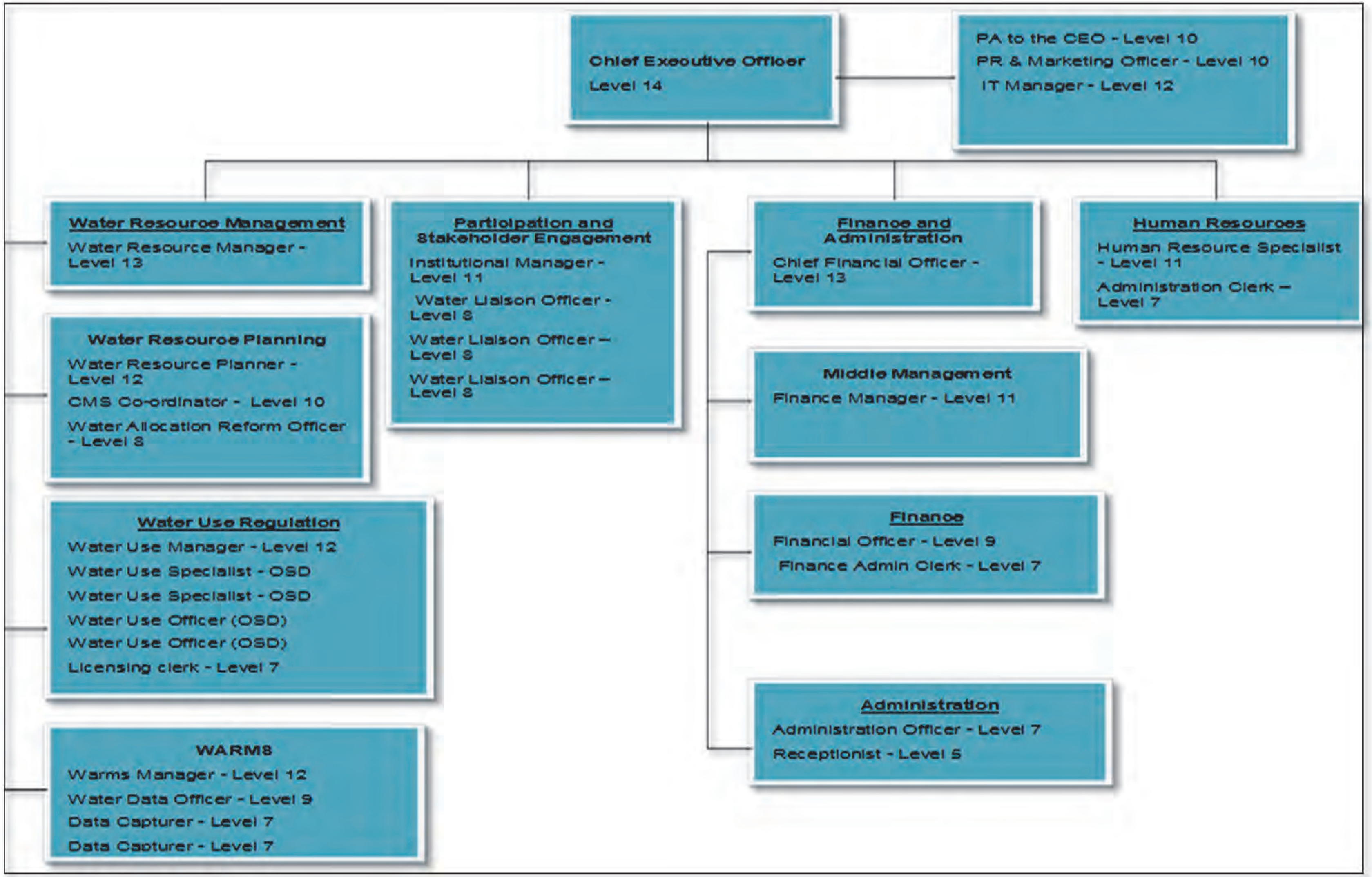


FIGURE 3-2. CURRENT ORGANISATIONAL STRUCTURE OF THE BREEDE-OVERBERG CMA (WWW.PMG.CO.ZA)



# 4 FINANCIAL REQUIREMENTS FOR OPERATING A CMA

The Guidelines for financing catchment management agencies in South Africa (DWA 2000) identifies various cost types. Capital costs represent occasional expenditure by the CMA on buildings, equipment and machinery. Operating costs are the on-going expenses required to support the CMA functioning. Establishment costs are once-off costs associated with establishing the CMA. Fixed costs are those that are constant every year, independent of the amount of water used, while variable costs relate to the amount of water used.

For the purpose of this discussion, we will categorise all costs incurred by CMAs to comprise of operating expenditure (OPEX) and capital expenditure (CAPEX).

## 4.1 OPERATING EXPENDITURE

### *4.1.1 SALARIES*

A CMAs costs are largely associated with staff salaries. The table below provides an indication of staffing requirements at different phases in the CMA progression, assuming the development of in-house capacity supported by outsourcing of certain functions (such as monitoring) or contracting specialist skills for strategy development. This table (DWA 2001a) is only intended to be an indication and more a detailed assessment should be made for the particular situation in the proposed CMA, linked to the proposed functional evolution.

TABLE 4-1. RANGE IN STAFF COMPLEMENT DURING CMA EVOLUTION (ADAPTED FROM DWA 2001A)

| | | **Initial** | **Consolidation** | **Full functionality** |
|---|---|---|---|---|
| By Functional Area | Strategy development and planning | 2-4 | 3-5 | 3-5 |
| | Water resource management* | 1-7 | 6-16 | 9-35 |
| | Information management** | 1-5 | 2-9 | 5-20 |
| | Institutional coordination | 2-8 | 5- 8 | 6-10 |
| | Management and support staff | 1-6 | 6-15 | 11-15 |
| By Staff level | CEO | 1 | 1 | 1 |
| | Manager | 1-3 | 2-5 | 3-8 |
| | Senior | 1-7 | 6-12 | 10-22 |
| | Junior | 2-12 | 8-18 | 10-30 |
| | Administration | 2-7 | 5-10 | 10-14 |
| **TOTAL** | | **7-30** | **23-50** | **34-75** |

* Water use management includes the control, authorization, auditing and implementation of all water uses.

** Information management includes water resource monitoring and information systems.

Staff costs will usually represent the greatest portion of CMA operating costs. Table 4-2 estimates (including salary, pension and medical aid) are derived from the DPSA salary levels for 2011.

TABLE 4-2. ANNUAL REMUNERATION FOR DIFFERENT GENERIC STAFF LEVELS BY CMA DEVELOPMENT PHASE (2011 RANDS)

| DPSA salary scale | DPSA level | | Initial Phase | | Consolidation Phase | | Full Functionality Phase | |
|---|---|---|---|---|---|---|---|---|
| **799,028** | CEO | 14 | 799,028 | 799,028 | 799,028 | 799,028 | 799,028 | 799,028 |
| **584,482** | Manager | 13 | 584,482 | 1,753,446 | 1,168,964 | 2,922,410 | 1,753,446 | 4,675,856 |
| **482,160** | Manager | 12 | 482,160 | 482,160 | 482,160 | 482,160 | 482,160 | 482,160 |
| **584,482** | Senior | 13 | 584,482 | 4,091,374 | 3,506,892 | 7,013,784 | 5,844,820 | 12,858,604 |
| **206,982** | Junior | 9 | 413,964 | 2,483,784 | 1,655,856 | 3,725,676 | 2,069,820 | 6,209,460 |
| **165,159** | Admin | 9 | 0 | 825,795 | 495,477 | 1,321,272 | 1,321,272 | 1,981,908 |
| **TOTAL** | | | 3,448,598 | 11,020,069 | 8,692,859 | 16,848,812 | 12,855,028 | 27,591,498 |

### 4.1.2 *OTHER OPERATING EXPENDITURE*

Other operating expenditure includes a variety of costs:

- Professional services;
- Board costs;
- leases, municipal rates,
- stationary, travel and subsistence, communications and;
- outsourced services (such as monitoring and laboratory);
- monitoring, including collection and analysis of hydrological, water quality and bio-monitoring data,
- advertising and marketing;
- training and conference fees;
- insurance; and
- Ad hoc office costs. (adapted from DWA 2002b)

## 4.2 CAPITAL EXPENDITURE

In addition to the operating costs, the CMA will require capital expenditure for the following types of items:

- Information/communications equipment, such as computers, faxes, copiers, printers; software; PABX;
- Vehicles, for the monitoring, organisational development and regulatory functions;
- Library;
- Laboratory equipment, where monitoring is performed in-house.

These capital costs do not include the costs of water resource infrastructure development and operation. (Adapted from DWA 2002b)

## 4.3 ACTUAL COSTS OF EXISTING CMAS

The actual costs of operating the current two CMAs, Breede-Overberg CMA and the Inkomati CMA, as reported to the Parliamentary Monitoring Group, are summarised below.

TABLE 4-3. TOTAL OPEX AND CAPEX ESTIMATE FOR THE BREEDE-OVERBERG CMA (2011 RANDS)

| Cost item | 2011 Estimate |
|---|---|
| Salaries | 46% |
| Board | 4% |
| Professional Services | 33% |
| Expenses | 14% |
| Capex | 3% |
| Total | R 18,000,000 |

TABLE 4-4. TOTAL OPEX AND CAPEX ESTIMATE FOR THE INKOMATI CMA (2011 RANDS)

| Cost item | 2011 Estimate |
|---|---|
| Salaries | 55% |
| Board | 4% |
| General Expenses | 35% |
| Capex | 6% |
| Total | R34,988,818 |

## 4.4 THE COST OF WATER RESOURCE MANAGEMENT

Table 4-5 estimates the range of expected Water Resource Management costs for CMA in different development phases. These estimates combine the expected staff requirements with the Other OPEX and CAPEX requirements as required by the Breede-Overberg CMA and the Inkomati CMA. The Table seems to indicate that both the Inkomati and Breede CMAs are now entering the full functionality phase. This, by implication, means that additional costs may still be incurred as CMAs perform more functions.

Table 11 compares the costs of CMA management (Table 4-6) to the revenue earned from current water resource management charges. The current charges are inadequate for the current sets of CMA functions performed and needs to be further increased as the CMAs progress to full functionality.

TABLE 4-5. POSSIBLE RANGES IN CMA EXPENDITURE DURING ITS PROGRESSION (2011 RANDS)

| | Initial Phase | | Consolidation Phase | | Full Functionality Phase | | Variance | |
|---|---|---|---|---|---|---|---|---|
| **Salaries** | 3,448,598 | 11,020,069 | 8,692,859 | 16,848,812 | 12,855,028 | 27,591,498 | 43% | 53% |
| **Professional Services** | 2,500,000 | 8,000,000 | 2,500,000 | 8,000,000 | 2,500,000 | 8,000,000 | 31% | 15% |
| **Board costs** | 700,000 | 700,000 | 1,100,000 | 1,100,000 | 1,500,000 | 1,500,000 | 9% | 3% |
| **Other Opex** | 1,100,000 | 3,500,000 | 3,500,000 | 6,000,000 | 6,000,000 | 12,000,000 | 14% | 23% |
| **Capex** | 250,000 | 750,000 | 750,000 | 1,500,000 | 1,500,000 | 3,000,000 | 3% | 6% |
| **Total** | **7,998,598** | **23,970,069** | **16,542,859** | **33,448,812** | **24,355,028** | **52,091,498** | | |

TABLE 4-6. SUFFICIENCY OF RAW WATER USE CHARGES TO COVER COSTS OF CMA FUNCTIONS

| | | Water requirements for the year 2000 (million $m^3$/a) | | | | Raw Water Use Charges 2011/12 (c/m3) | | | Revenue from Raw Water Use Charges 2011/12 | | Budget requirement (Actual) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | D&I | Irrigation | Afforestation | Total | D&I | IRR | Forestry | Rand / year | c/m3 | Rand / year | c/m3 |
| 1 | Limpopo | 83 | 238 | 1 | 322 | 1.9 | 1.9 | 0.92 | 6,108,200 | 1.9 | | |
| 2 | Luvuvhu/Letaba | 42 | 248 | 43 | 333 | 3.15 | 1.84 | 1.09 | 6,354,900 | 1.91 | | |
| 3 | Crocodile West and Marico | 739 | 445 | 0 | 1184 | 1.8 | 1.56 | 0.76 | 20,244,000 | 1.71 | | |
| 4 | Olifants | 407 | 557 | 3 | 967 | 2.29 | 1.25 | 0.85 | 16,308,300 | 1.69 | | |
| 5 | Inkomati | 113 | 593 | 138 | 844 | 1.58 | 0.82 | 0.82 | 7,779,600 | 0.92 | 34,988,818 | 4.15 |
| 6 | Usutu to Mhlathuze | 181 | 432 | 104 | 717 | 1.01 | 0.8 | 0.46 | 5,762,500 | 0.8 | | |
| 7 | Thukela | 130 | 204 | 0 | 334 | 0.8 | 1.39 | 0.48 | 3,875,600 | 1.16 | | |
| 8 | Upper Vaal | 931 | 114 | 0 | 1045 | 2.1 | 1.94 | 1 | 21,762,600 | 2.08 | | |
| 9 | Middle Vaal | 210 | 159 | 0 | 369 | 2.5 | 1.02 | 0 | 6,871,800 | 1.86 | | |
| 10 | Lower Vaal | 118 | 525 | 0 | 643 | 1.39 | 2.06 | 0 | 12,455,200 | 1.94 | | |
| 11 | Mvoti to Umzimkulu | 526 | 207 | 65 | 798 | 2.14 | 2.02 | 1.22 | 16,230,800 | 2.03 | | |
| 12 | Mzimvubu to Keiskamma | 138 | 190 | 46 | 374 | 2.34 | 0.43 | 1.17 | 4,584,400 | 1.23 | | |
| 13 | Upper Orange | 188 | 780 | 0 | 968 | 0.76 | 0.87 | 0 | 8,214,800 | 0.85 | | |
| 14 | Lower Orange | 51 | 977 | 0 | 1028 | 1.36 | 1.11 | 0 | 11,538,300 | 1.12 | | |
| 15 | Fish to Tsitsikamma | 128 | 763 | 7 | 898 | 2.28 | 1.35 | 0.66 | 13,265,100 | 1.48 | | |
| 16 | Gouritz | 69 | 254 | 14 | 337 | 3.12 | 1.25 | 0.74 | 5,431,400 | 1.61 | | |
| 17 | Olifants/Doring | 16 | 356 | 1 | 373 | 2.27 | 1.14 | 0.74 | 4,429,000 | 1.19 | | |
| 18 | Breede | 50 | 577 | 6 | 633 | 3.29 | 1.35 | 0.45 | 9,461,500 | 1.49 | 18,000,000 | 2.84 |
| 19 | Berg | 403 | 301 | 0 | 704 | 4.05 | 0.94 | 0.96 | 19,150,900 | 2.72 | | |
| | **Total** | | | | **12,871** | | | | **199,828,900** | | | |

# 5 REVENUE POTENTIAL OF KEY CMA FUNDING STREAMS

## 5.1 OVERVIEW

This section outlines potential CMA funding streams as envisaged by the *NWA* (1998), the *Pricing Strategy for Raw Water Use Charges* (DWA 2005) and the *Implementation of Catchment Management in South Africa -The National Policy (*DWA 2002). The section further contains extracts from Mazibuko and Pegram (2001).

The purpose of this section is to define potential funding streams for CMA, each of which will be discussed and investigated in more detail in the proceeding phases of this project.

## 5.2 WATER RESOURCES, AQUATIC ECOSYSTEM SERVICES, PUBLIC PROPERTY AND SERVICES, AND RESOURCE RENT

Water resources, as defined in the NWA, are natural assets which are public property. This is because the water resources of South Africa belong to all the people of South Africa, and the National Government exercises overall responsibility for the nation's water resources and their use (NWA 1998).

Water resources also comprise aquatic ecosystems, which in turn deliver a set of aquatic ecosystem services. These ecosystem services are by extension also public services. These services include:

- Water provisioning;
- Pollution absorption; and
- A range of other aquatic ecosystem services as envisaged in the Millennium Ecosystems Assessment (MEA) framework of ecosystem services.

The mandate and functions of CMAs require of them to protect and manage the water resources in order to maintain a sustainable production of aquatic ecosystem services.

The cost of conducting all these functions is to be covered by the resource rent of water resources. The resource rent accruing from water resources forms a portion of the value of aquatic ecosystem services.

Much has been written on the nature and characteristics of public resources and public services (see for instance Mazibuko and Pegram 2001), however insufficient work has been done to disaggregate the roles of public resources (i.e. water resources) and public services (i.e. aquatic ecosystem services), and to further:

- analyse the functions required of CMAs to manage these;
- develop business models through which to convert resource rents into viable funding streams for managing these.

It is recognised fundamentally however in NWA and the NWRS 2004 that the costs of water resource management may be funded through a combination of parliamentary appropriations (taxation) and revenue collected from consumers of aquatic ecosystem services. Examples of these are defined in the following section.

## 5.3 FUNDING OF CMA FUNCTIONS

### *5.3.1 WATER USE CHARGES*

The *Pricing Strategy for Raw Water Use Charges* (DWA 2005) provides a statutory framework for financing catchment management. The pricing strategy expands on the three water use charges specified in the Act, namely the charges for funding water resources management, for funding water resources development and for achieving equitable and efficient allocation of water.

The water use charges for funding water resource management represent the main source of income from water users for catchment management Section 56(2)(a) of the NWA specifies that the pricing strategy for setting 'water use charges for funding water resource management, (may) include the related costs of gathering information; monitoring water resources and their use; controlling water resources; water resource protection, including the discharge of waste and the protection of the Reserve: and water conservation'.

The water pricing strategy expands this into functions including planning and implementation of catchment management strategies, monitoring and assessment of water resource availability, quality and use; water quantity management, including flood and drought management, water distribution, control over water abstraction, storage and steam flow reduction, and to promote the beneficial use of water; the evaluation and processing of water use licensing and registration applications; water resource protection, water quality management and water pollution control and water conservation and demand management.

Water use charges are collected from water users, according to their registered water use.

In support of collecting water use charges, DWA has developed a Catchment Management Trading Account, for the allocation of costs and collection of charges associated with activities such as functional support (indirect costs and regional office overheads); catchment management strategies (planning and implementation); dam safety control; water quality management; water utilisation (authorisation and monitoring); and water conservation (including Working for Water).

### *5.3.2 GRANTS, LOANS OR SUBSIDIES*

The NWA further allows for "the Minister" to give financial assistance to a CMA in the form of grants, loans or subsidies. The financial assistance must be from funds appropriated by Parliament; or otherwise lawfully be used for the purposes water resource management.

This means that a subsidy for water resources management in a WMA may be provided to the CMA. However, CMAs may require additional financial support, either to assist the establishment process, or to support operations, due to, for instance, insufficient water use or inadequate registration of users in the WMA. Another example is where a CMA may be the most appropriate institution through which to channel subsidies aimed at redress, such as support for emerging farmers. (DWA 2002)

### *5.3.3 WASTE DISCHARGE CHARGE SYSTEM (WDCS)*

The NWA sets clear guidelines on prevention and remedying effects of water pollution, and the instrument of policy that reacts to these guidelines is the Waste Discharge Charge System (WDCS). The purpose of this system is the internalization of environmental costs by waste dischargers through use of water charges to ensure compliance with prescribed standards and water management practices according to user pays and polluter pays principles. Thus water use charges are to be used as a means of encouraging reduction in waste, and provision is made for incentives for effective and efficient water use (DWA 2002).

The DWA water pricing strategy (2005) separates the WDCS from the WRM charges on waste discharge (defined in Chapter 6.4 of the Pricing Strategy). It rather views the WDCS as an economic instrument to support the management of water quality, where problems have been identified through the processes of classifying the water resource.

The WDCS consists of two distinct water use charges: an incentive charge that provides a disincentive to the discharge of waste; and a mitigation charge that covers the quantifiable costs of administratively implemented measures for the mitigation of waste discharge related impacts.

Although the DWA water pricing strategy (2005) views the primary aim of the incentive charges to be achieving the resource quality objective, it anticipates that surplus funds will be generated. These funds will be earmarked for waste discharge related purposes through the Money Bill and will be disbursed in accordance with a multi-year National Disbursement Plan reviewed each year by DWA in consultation with National Treasury, reflecting national and catchment level priorities. This plan will be aligned with the Medium Term Expenditure Framework, National Water Resource Strategy and the relevant catchment management strategies. DWA would manage these funds nationally in accordance with the plan, while CMAs will be the implementing agents through which funds are disbursed. Funds would be used for four main purposes. Firstly, compensation measures for impacted users downstream, in terms of providing alternatives or remediation of the impacts. Secondly, incentives (seed funding) for registered dischargers to reduce loads, where this is cost effective but there are institutional constraints. Thirdly, initiatives to reduce the load from non-authorised non-point sources through non-regulatory or regulatory means. And finally, covering the portion of the possible mitigation charges in a catchment associated with non-authorised non-point sources. Monitoring and reporting on the use of these funds will be in line with the Public Finance Management Act, with DWA and the CMA being primarily accountable for disbursement and expenditure.

The primary aim of the mitigation charge is to recover the costs of mitigating the impacts of waste discharge on the resource. It is intended for application where a mitigation measure provides an economically efficient option to support the achievement of resource quality objective in a catchment, in comparison to the costs of waste discharge reduction at source. The water pricing strategy envisages that the collaborative and potentially long-term implications of implementing a mitigation charge requires clear institutional roles and responsibilities, both in terms of financing and operations.

Setting, collection and disbursement of mitigation charges are the responsibility of the

CMA, and must comply with the requirements of the Public Finance Management Act and this Pricing Strategy. *However, t*he CMA may not be the implementing agent for the measure. This may rather be done by service providers, infrastructure operators or an independent implementing agent established by the dischargers.

### 5.3.4 *ECOSYSTEM SERVICES TRANSFERS BETWEEN CMAS*

Water to be exported via inter-basin transfer schemes will create an income opportunity for the donor CMA, as the receiving CMA should reimburse a fixed portion of the WRM budget of the donor CMA. The water pricing strategy advises that this be based on the yield transferred calculated as a fraction of the total available yield at 98% assurance of supply, and in accordance with the NWRS.

Similarly, where the quality of stream flow from an upstream WMA to a downstream WMA imposes an additional water quality management cost on the downstream WMA, this additional cost needs to be funded by WRM charges on waste discharges in the upstream WMA. The water pricing strategy advises that the upstream CMA must reimburse a fixed portion of the WRM budget of the downstream CMA (related to the additional water quality management cost), based on the discharge load in the upstream WMA as a ratio of the total discharge load in the downstream WMA.

Similar situations may hold for the transfer of other aquatic ecosystem services.

### 5.3.5 *DONOR SUPPORT, SPONSORSHIP AND IN-KIND CONTRIBUTIONS*

The water pricing strategy (DWA 2005) further envisages that a CMA may fund its activities through any lawful source in addition to water user charges and parliamentary appropriations, which may include donor support or sponsorship. In-kind contributions are not explicitly income, but they would reduce the expenditure and required income of the CMA.

### 5.3.6 *CONTRACTUAL PAYMENTS*

The CMA may also perform ancillary functions outside of its WMA, as well as non-water resource management activities that are related or incidental to its functions or mandate, as long as this does not jeopardise its functions or detrimentally affect another water management institution. For these it may receive contractual payments.

### 5.3.7 *EXPANDED PUBLIC WORKS PROGRAMMES*

The CMA could also receive government income related to water resources management activities that they perform, such as working for water program.

### 5.3.8 *ECONOMIC CHARGES*

The water pricing strategy (DWA 2005) makes provision for an economic charge through either administratively determining a proxy for the economic value of water, or by selling water by public tender or auction to the highest bidder.

The administratively determined charge is to be used to promote beneficial use through the reallocation of water to higher value users. This can be accomplished by allowing the transfer of authorisations to use water by trading.

Where amounts of water are still available for allocation after compulsory licenses have been issued and there is competition for using this water, the public tender procedure may be followed.

## 5.4 Focus of the rest of this report

In the rest of this report, we focus on the following potential sources of CMA revenue:

- Water use charges
- Waste Discharge Charge System (WDCS)
- Ecosystem services transfers between CMAs
- Economic charges.

# 6 REVENUE POTENTIAL OF WATER USE CHARGES

## 6.1 METHOD FOR DETERMINING AN APPROPRIATE WATER RESOURCE CHARGE

**The following section elaborates upon some of the fundamental principles underlying the determination of raw water use charges.**

### *6.1.1 PRECEDENT FOR RAW WATER RESOURCE CHARGES*

Although there are several pieces of legislation detailing to the types of activities for which it might be possible to charge for, it is the Raw Water Pricing Strategy (2007) that spells out the specifics how to establish the appropriate pricing.

The National Water Act (1998) lists the chargeable water uses under section 21 of which there are eleven in total; (a) through (k). The chargeable water uses as listed in the NWA (1998) are classified into three distinct categories; abstraction related uses, waste discharge related uses and non-consumptive uses. This report deals specifically with first of these three, abstraction related uses, which corresponds to items (a), (b) and (d).

Listed here:

- (a) Taking water from a water resource
- (b) Storing water
- (d) Engaging in a stream flow reduction activity

### *6.1.2 SETTING WATER CONSUMPTION CHARGES*

The setting of water use charges as pertaining to abstraction related uses is determined through a proportional allocation of the costs incurred though the associated activities required to manage the resource.

Chapter 6.3.4 of the Raw Water Pricing Strategy (2007) states specifically that "Abstraction related water resource management activity costs must be allocated to sectors in proportion to volumetric mean annual sectoral use…".

In layman's terms this means that the cost of managing water use within a particular sector should be divided by the annual mean volume of water consumed within that sector. The charges may then be apportioned to a particular consumer according to the volume that they are registered to consume.

It is to be noted that CMAs may qualify for various grants from DWA. DWA currently envisages two types of grants: Public benefit grants, and Agriculture grants. Public benefit grants would cover CMA mandated activities that are in the national benefit such as responsibilities attached to inter-basin transfer schemes, or water allocation reform initiatives. These types of activities are not attributable to any specific water resource user, but rather are highlighted as being part of the greater good, in that they contribute to on-going reforms within the water sector. Agriculture grants would cover the budget shortfall accruing from the cap on the water resource management charges that may be levied on water used in the agricultural sector.

### 6.1.3 *Water Use Charge Differentiation According to Sector*

Water management requirements differ between sectors which by extension imply that the costs of water management will differ between sectors.

To illustrate, the prerequisites for the issuance of a water use license to a mining company will most likely be far more extensive and costly than those required by a farmer for irrigation purposes.

Thus the water resource management charges for each sector need to be reflective of the resources invested in the management of each sectors water resources.

### 6.1.4 *Water Use Charge Differentiation According to Region*

The Raw Water Pricing Strategy states implicitly in chapter 6.3.6 that charges are to be calculated separately for each WMA and in chapter 6.3.5, with regards to monitoring networks, it explicitly states that charges for monitoring will only be applied to users if the monitoring is specific to a particular water management area or a specific water scheme.

This may raise a minor issue of contention as the original roll-out plan for the CMAs allocated one CMA per WMA. With the plan being altered to allow for only 9 CMAs, it raises the question of whether costs will be apportioned according to the area managed by a specific CMA, or according to the WMA.

The following table is a direct extract from the RWPS (2007). It contains four key considerations pertaining to the allocation of water resource management charges:

| |
|---|
| Sectoral water resource management charges for each WMA will be calculated as follows:<br><br>• Total budget cost of each activity will be divided by the registered volumes to arrive at a unit charge per activity.<br>• In WMAs where the allocable yield (water available for use) is more than the registered volumes, a discount will apply, which will be determined by using the allocable yield to determine the per unit charge instead of the registered volumes.<br>• The budgeted activity cost will be applied only to those sectors attracting such cost (e.g. the forestry sector will be excluded from charges relating to dam safety inspection).<br>• The unit charge for all WRM activities will then be applied to each user's registered volumes to arrive at a WRM charge per user. |

Chapter 1 established the fundamental functions of a CMA and brought to light a great deal of information and data regarding the specific costs of operating such an organization.

This report attempts to build upon this established foundation by expanding into the subject of revenue generation, with a primary focus on water use charges. In addition, potential revenue is analyzed relative to the CMA costs and CMA capacity in an attempt to gauge organizational efficiency.

### 6.1.5 *CMA Revenue Function*

Appendix A sets out the current water usage requirements as well as average charges for each of the three broad water use categories, Domestic and Industrial (D&I), Irrigation (Irr) and Afforestation for each of the 19 WMAs .

These figures have been projected 25 years into the future based on the WMA water usage projections outlined in the National Water Resource Strategy (NWRS 2004). This is done for both the "Base" and the "High" projections provided in appendix D of the NWRS. The projected potential revenue is then estimated utilizing constant year-on-year prices so that direct comparisons may be made. The final version of this model, to be included along with the final report will contain figures modified to account for the time value of money.

### 6.1.6 *Generating the Revenue Projections*

The NWRS contains the itemized water usage figures for each of the CMAs as well as 2 sets of projected water usage amounts for the year 2025, a "BASE" projection based on a conservative estimate and a "HIGH" projection based upon a steeper growth estimate.

The revenue projections presented in this report are founded upon these water usage projections presented in the NWRS and utilize the current, 2011 fee structure to determine the projected revenue streams in terms of current prices.

The figures contained within appendix A provide a breakdown of the current and projected raw water requirements and the corresponding revenue to be generated therefrom under the current pricing regime.

A set of curves were constructed based upon the projected water use figures. A linear approach was used to construct the curves such that:

$$WaterUsage_{2025} = WaterUsage_{2000} \times AnnualIncrease(25)$$

These raw water requirement projected trend curves are useful in that they provide insight into approximate raw water requirements at various points in the future. The curves are illustrated in Figure 6-1.

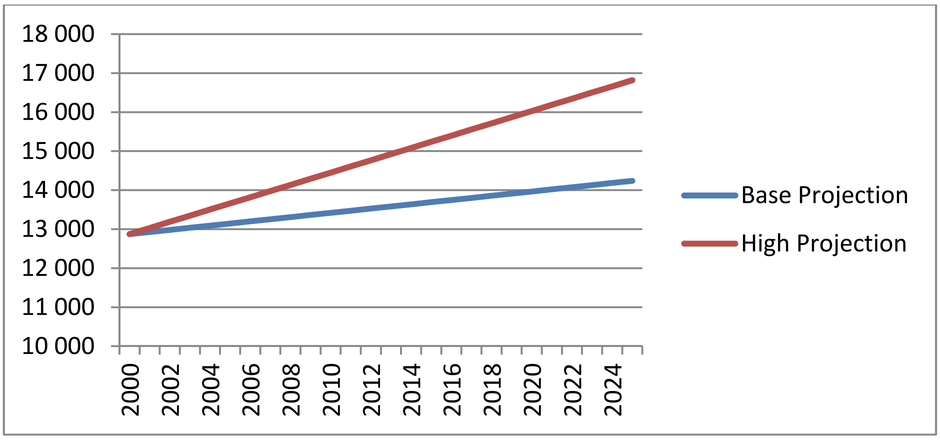



FIGURE 6-1. PROJECTED RAW WATER REQUIREMENTS (MILLION M3/A)

### 6.1.7 CMA Cost Function

The Original master plan for the rollout of CMAs, stipulated, or more accurately, assumed that there would be 19 CMAs; one for each of the WMAs. This number has recently been curtailed to 9 CMAs for the expanse that is South Africa's territory.

This chapter compiles a total cost estimate for a 9 CMA water management organization. The cost estimation is based on the ranges in CMA expenditure presented in C and on a set of assumptions that are further elaborated upon in the upcoming subchapters.

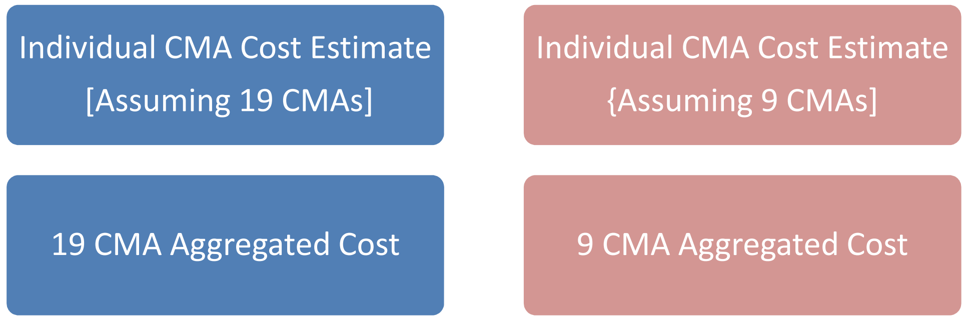
### 6.1.8 Compilation of CMA Cost Estimates

The CMA cost estimate, displayed in Appendix C, was based on a number of estimated staffing and running costs laid out several documents including DWA (2001a), DWA (2002b) and others. Salaries were updated to reflect DPSA 2011 salary levels.

This initial estimate for the costs of running a CMA was based upon the assumption that there would be a total of 19 CMAs in South Africa, one for each of the WMAs. However, it has come to light through the course of this project that the CMAs are being redrawn such that a total of 9 CMAs will be responsible for water management in the 19 WMAs. This report draws up cost estimates for each of these formats, for both individual CMAs, and an aggregated value for the collective.

It was also hypothesized that the average CMA would pass through 3 generis phases of development, "Initial", "Consolidated" and "Fully Functional", with each of these phases consists of a range of plausible values based upon the CMA structural guidelines set out in DWA (2001a). Based upon these guidelines the initial CMA cost estimate was redesigned into a six phase CMA cost progression with each phase corresponding to a step in the CMA's evolution.

Thus in total, four CMA cost estimates were compiled as follows:




### 6.1.9 *Proxy for an Equivalent CMA Organization*

In an effort to benchmark the performance of the hypothetical CMA figures outlined in this report, the team developed a proxy for an equivalent water management system based upon the approach utilized in Western Australia. This data used to build the proxy for an equivalent water management agency was obtained online through the Government of Western Australia's Department of Water website, and is realized in the form of their Department of Water.

The resulting output, seen in appendix G, provides a 4 year itemized water management cost breakdown for the Western Australia water management program from its inception in 2007/2008 up until 2010/2011 when it reached full operating capacity.

This cost data has also been expanded into a 6 year/6 phase cost evolution to allow for direct comparisons with the CMA cost estimates found in appendix C.

### 6.1.10 *Modeling CMA Efficiency*

Modeling the efficiency of water management requires two things. Firstly, it is necessary to have an effective benchmark against which one can make comparisons. The second thing that is required is a set of common measurements that can be directly compared between the benchmark and the individual cases being modeled.

Australia was selected as the country against which our South African CMAs' figures could be benchmarked. (Please see Appendix H for more information). The choice of Australia was made for a number of reasons.

First and foremost, Australia is a highly developed economy with well-functioning government structures. It is likely that their operations would be far more efficient and less susceptible to distortions created by market imbalances, corruption, lack of knowledge, etc.

In addition to being a highly developed economy, Australia is also pushing to the forefront of water resources management. This motivation is due in no uncertainty to affect that climate change is projected to have on Australia's available water supply, keeping in mind that Australia is one of the driest nations on the planet.

In 2006, the Government of Western Australia launched their "Water Resource Management and Planning" initiative, an initiative not entirely distinct from the operations of the Western Australia Department of Water. Investigations into the efficiency of this operation have recently been conducted by the Western Australia Economic Regulation Authority and the reports (DoW

2010 and Dow 2011) have been made available to the public. This availability of data is the final reason why Australia was chosen as the proxy for water management efficiency.

In order to develop an effective set of measurement tools to compare relative efficiencies, it was necessary to glean as much as possible from the available data. This however proved insufficient and it was necessary to develop certain theoretical indices.

These "theoretical" indices, although not representative of actual data are still immensely useful in their implementation as they complement the existing data and represent measurements that would take place under a fully functional CMA regime.

*Percentage of Consumption Managed [Theoretical]*

Under a well-functioning water management institution is should be possible to determine the proportion of the available raw water that is being managed by the efforts of a given CMA, which is fundamental to assessing the management capacity of such an organization.

This factor is incorporated into the CMA cost model in the form of a decreasing marginal value curve (blue curve) illustrated here in 6-2.

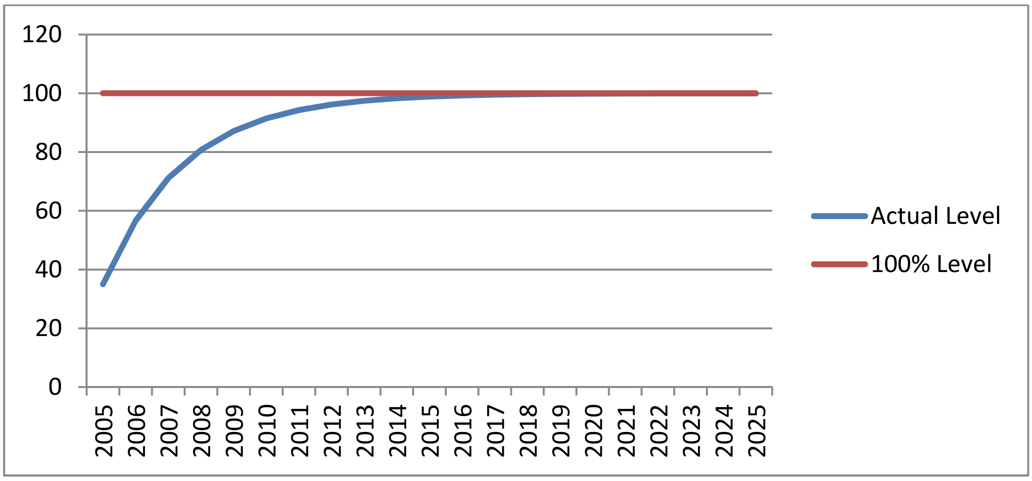



FIGURE 6-2. PERCENTAGE OF RAW WATER THAT IS MANAGED OVER TIME

*Cost per Hour of Labor [Actual]*

Determining the cost per hour of labor of an organization is determined, quite simply, by dividing the total operational budget/cost of an organization by the total number of labor hours the organization is capable of providing.

This measurement is useful because it can provide direct insight into the cost efficiency of an organization. In addition, one would expect to see a decreasing average cost of labor over the 6 phases of development in a CMA caused by economies of scale.

*Cost per $m^3$ of Raw Water [Actual]*

It is important to know how much money is being invested relative to the quantity of raw water that needs to be managed. This index is somewhat more useful if you can account for the proportion of the raw water that is being managed.

*Cost per Managed $m^3$of Raw Water [Hybrid Actual/Theoretical]*

This index assesses the level of investment relative to the quantity of raw water that is being actively and effectively managed. This index is particularly useful in assessing the productive efficiency of a CMA.

### *6.1.11 Efficiency as Defined by the Model*

The indices discussed in the previous sub-chapter (3.4.2) make up a basket of tools that may be used to assess, at a glance, the relative effectiveness and efficiencies of a CMA.

Since the issue of revenue generation with regards to raw water management is fundamentally tied to the cost of raw water management it is essential that CMA operations be appropriate as well as cost effective. This is necessary if a CMA is to achieve its mandate of being "economically efficient".

However, the model being described in these chapters, which is yet in its infancy, serves to provide more than just point measurements of efficacy and efficiency. The model aims to be able to provide guidance over the entire life cycle of a CMA and to be able to assist with key decisions regarding the operational direction of a CMA as it evolves and expands to fulfill its purpose.

Thus the indices discussed in the previous chapter are modeled over time and show the evolution of each relative to the others. Interpretation and understanding of these relationships will be discussed in greater detail in the "Findings" section of this report.

## 6.2 Raw Water Requirements

**The raw water requirements, per annum, over the period 2000 until 2025 are presented in appendix B. The curves for the base and high projections act as boundary lines and stipulate a range of values for the required amount of raw water for each year.**

### *6.2.1 Current Raw Water Requirements*

Based upon the projections for raw water requirements it can be expected that South Africa will requires between 13 473 and 14 608 million $m^3$ of raw water in 2012. The projected range is highlighted by a red rectangle in Figure 6-3 below.

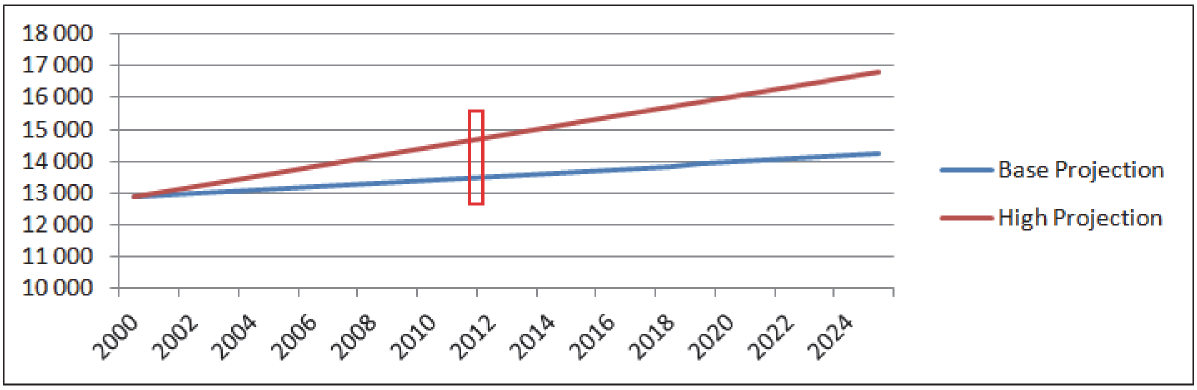



FIGURE 6-3. WATER USE REQUIREMENTS FOR SOUTH AFRICA 2012

The breakdown of water requirements according to each sector are presented in Table 6-1 below. The sector with the biggest consumption is irrigation which is set to use approximately 59% of raw water in 2012. "Domestic and Industrial" will account for 38% of raw water consumption with afforestation accounting for the remaining 3%.

TABLE 6-1. 2012 RAW WATER USE REQUIREMENTS

| | Base | High | Mean |
|---|---|---|---|
| **Total** | 13 528 | 14 766 | 14 147 |
| **Irrigation** | 8 221 | 8 445 | 8 333 |
| **Domestic & Industrial** | 4 860 | 5 855 | 5 358 |
| **Afforestation** | 447 | 466 | 456 |

The complete breakdown of 2012 raw water use requirements according to each of the 19 WMAs may be viewed in appendix A.1.

The WMAs with the highest raw water requirements are "Crocodile West and Marico" which requires 1 417 million $m^3$, "Upper Vaal" with a requirement of 1266 million $m^3$ and "Lower Orange" with a requirement of 1058 million $m^3$.

The biggest revenue generators, as the numbers currently stand, are the "Upper Vaal", "Crocodile West and Marico", and the "Berg" CMAs which at current pricing levels generate R26.3 million, R24.2 million and R23.9 million respectively. A higher than average charge of 2.72c/$m^3$ in the Berg catchment see it make the top 3 for revenue generation despite being 9th in terms of raw water requirements.

Certain CMAs dominate particular economic sectors. More than 50%of the water requirements for power generation may be attributed to the Oliphant's CMA. The "Crocodile West and Marico", "Olifants" and "Upper Vaal" CMAs account for more than 50% of the water requirements for mining. The Upper Orange", Lower Orange" and "Fish to Tsitsikamma" CMAs account for more than 30% of the water requirements for Irrigation.

Afforestation is a relatively minor sector in terms of water use requirements. It is dominated mostly by the "Inkomati" and "Usutu to Mhlathuze" CMAs which account for 55% of the water use requirements in this sector.

*See Appendix A.1*

### *6.2.2 Projected Raw Water Requirements*

The base projection for raw water requirements in South Africa stipulates that on average raw water requirements will increase by 55 million $m^3$ each year. In non-linear terms that amounts an average per annum increase of 0.4%.

The high projection poses a steeper per annum increase of about 158 million $m^3$ each year which amounts to an annual growth rate of 1.08%.

Based on these projected figures we can deduce that South Africa will require between 14 239 and 16 818 million $m^3$ of raw water by 2025

TABLE 6-2. COMPARISON OF WATER USE REQUIREMENTS PER SECTOR BETWEEN 2012 AND 2025. MEAN PROJECTED VALUES.

| | 2012 % of WUR | 2025 % of WUR |
|---|---|---|
| **Total** | 100.00 | 100.00 |
| **Irrigation** | 58.91 | 58.50 |
| **Domestic & Industrial** | 37.87 | 38.30 |
| **Afforestation** | 3.23 | 3.21 |

The projections do not show any major shift in the proportions that the three primary economic sectors require water. The percentage attributable to irrigation is projected to decrease by 0.41% while the percentage attributable to D&I is projected to increase by 0.43%. Afforestation is set to decrease by 0.02%.

## 6.3 Estimating CMA Costs

**The development of an estimate for the revenue generating potential of CMAs is fundamentally tied to the cost of operating them. WUA (Water User Association) be considered to be a part of the water management system but for all intents and purpose their range of possible permutations is far too great and does not merit discussion at this point.**

**What is considered here are the CMA phases of development and their corresponding costs,  a comparison of the costs between 19 CMA and a 9 CMA formats and a comparison of the attributes and associated of water management between South Africa and Western Australia.**

### *6.3.1 Developing CMA versus Fully Functional CMA*

Previously compiled studies expounding strategies for the development of CMAs posed 3 phases of development from conception through to fully functional capacity. Each of the three phases, “Initial”, “Consolidation” and “Full functionality” consisted of a range of possible costs (max and min values) for the various expenses that would be incurred by a CMA.

Thus the CMA costing model elaborated upon here comprises of 6 phases leading from inception to fully functioning capacity. For the sake of simplicity, the models employed for the purpose of this study assume that CMA costs remain constant once full functionality has been attained.

The costs for each phase of an individual CMA’s development may be viewed in appendix B and as may be observed the cost evolution has been modeled for both the 19 CMA and 9 CMA scenarios.

Both of the cost estimates start on an identical footing with their corresponding 1st and 2nd phases of development being identical. The cost estimates begin to differ once the CMA hit phase 3. This is due to the fact the CMA in the “9 CMA Scenario” has to assume a greater workload and thus needs to expand far more rapidly over the six phases.

### *6.3.2 NINE CMAS VERSUS NINETEEN CMAS*

With the shift in overarching design from 19 to 9 CMAs to manage the raw water resources of South Africa, it is necessary to assess the likely cost implications of running 9 relatively larger CMAs as opposed to 19 relatively smaller ones.

One of primary arguments towards having fewer CMAs was that the system would most likely achieve cost savings through economies of scale and through a reduction in the replication of services. The locality of water management would still be achievable through WUAs and on the whole the system could be more efficient.

The findings of this report support these arguments. Estimates for the cost of 19 fully functional CMAs were in the region of R1,008 billion. On the whole, by having only 19 CMAs as opposed to 9, a saving of R175 million is achievable each year for a fully functioning CMA.

If we factor in the cost difference over the developmental phases of CMAs, illustrated in Table 6-3 below, then the over this six phase period, assuming each phase last for a period of one year, it is possible to achieve savings of approximately R522 884 965 over the six phases of CMA development assuming that each phase corresponds with a single year of operation.

TABLE 6-3. COST DIFFERENCES BETWEEN THE 9 CMA AND 19 CMA FORMAT

| | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Phase 5 | Full-Op |
|---|---|---|---|---|---|---|
| **RSA 19 CMA Cost** | 151 973 362 | 306 714 321 | 415 531 311 | 483 645 475 | 685 064 000 | 1 008 738 462 |
| **RSA 9 CMA Cost** | 71 987 382 | 145 285 731 | 329 011 911 | 474 223 482 | 679 502 295 | 828 771 165 |
| **Cost Difference** | 79 985 980 | 161 428 590 | 86 519 400 | 9 421 993 | 5 561 705 | 179 967 297 |
| | **Total Saving =** | **522 884 965** | | | | |

It is clear then that the 9 CMA format is cheaper on the whole than the 19 CMA format. However, as is visible in Figure 6-4, the costs for the two formats are quite similar through phases 4 and 5. This anomaly is the result of the capital investment pattern of the 9 CMA format, which starting at phase 4 begins to invest heavily in equipment and facilities. At this stage of development the

CMA format ration of capital to other expenses is rather higher, but as staff numbers expand in phase six the (CMA format return to a more cost effective capital to labor ratio.

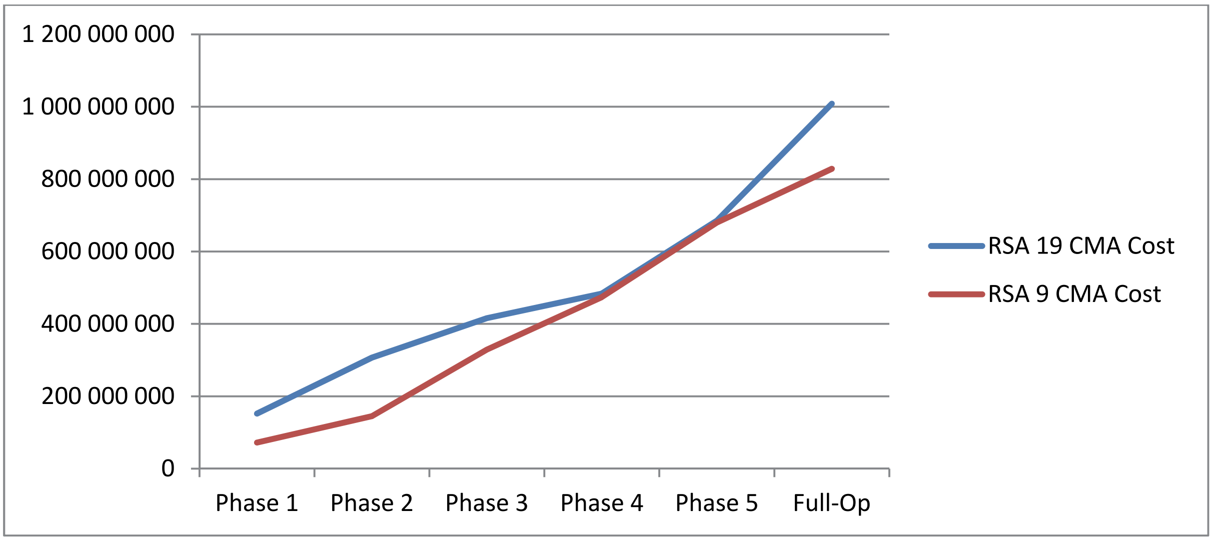



FIGURE 6-4. COST TRENDS FOR THE 9 AND THE 19 CMA FORMATS

In terms of the amount of money invested relative to the quantity of water being managed, Table 6-4 shown below displays the cents/m$^3$ rate for each of the 3 scenarios through 6 phases of development.

As can be seen, in phase 6 which is the fully operational phase, the rate is slightly lower for the 9 CMA format by 1.27cents/m$^3$. The rate of 5.86 cents/m$^3$ is equivalent to the average rate in Table 6-4 which displays the necessary rates for the full cost recovery for the 9 CMA format.

TABLE 6-4. COST PER QUANTITY OF WATER MANAGED. CENTS/M$^3$

| | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Phase 5 | Phase 6 |
|---|---|---|---|---|---|---|
| **cents/m$^3$ RSA [19 CMA]** | **1.07** | **2.17** | **2.94** | **3.42** | **4.84** | **7.13** |
| **cents/m$^3$ RSA [9 CMA]** | **0.51** | **1.03** | **2.33** | **3.35** | **4.80** | **5.86** |

## 6.4 Current Expenditure on Water Resource Management

At present the responsibility of water resources management is assigned to the DWA regional offices. Over the short to medium term the intention is to shift that responsibility from the regional offices to the CMAs as they come online and mature towards full functionality.

National Treasury (2012) provides a comprehensive breakdown of estimated national expenditure by DWA in their document titled "Vote 38".

In the 2012/13 financial year the department spent a total of R8.8 billion over a six departmental programs which include:

- Administration
- Water Sector Management

- Water Infrastructure Management
- Regional Implementation and Support
- Water Sector Regulation
- International Water Cooperation

A budgetary summary is provided below:

NATIONAL TREASURY BUDGETARY SUMMARY OF VOTE.38, DWA PROGRAM EXPENDITURE

**Budget summary**

| | 2012/13 | | | | 2013/14 | 2014/15 |
|---|---|---|---|---|---|---|
| R thousand | Total to be appropriated | Current payments | Transfers and subsidies | Payments for capital assets | Total | Total |
| **MTEF allocation** | | | | | | |
| Administration | 883,128 | 828,974 | 14,575 | 39,579 | 975,738 | 1,075,837 |
| Water Sector Management | 618,859 | 532,761 | 49,371 | 36,727 | 521,582 | 610,007 |
| Water Infrastructure Management | 2,273,496 | – | 2,273,496 | – | 2,967,102 | 3,145,448 |
| Regional Implementation and Support | 4,896,682 | 1,135,896 | 575,353 | 3,185,433 | 5,135,697 | 5,709,726 |
| Water Sector Regulation | 114,683 | 113,208 | – | 1,475 | 119,890 | 123,993 |
| International Water Cooperation | 25,813 | 25,188 | 625 | – | 25,670 | 27,506 |
| **Total expenditure estimates** | **8,812,661** | **2,636,027** | **2,913,420** | **3,263,214** | **9,745,679** | **10,692,517** |
| **(National Treasury. 2012)** | | | | | | |

Each of these programs is comprised of a number of sub-program, each with its own budgetary allocation. The inclination would be to assume that the responsibilities of the "Water Sector Management" program would be transferable to the CMAs however closer inspection for the sub-programs reveals that this is not the case.

Several subprograms, scattered throughout the 6 programs have mandates that could be attributed, to various degrees, to the CMA range of responsibilities. Indeed, clear determination of the extent to which degrees of responsibility should be attributed to CMA function would be a matter for more in depth consideration and should certainly be highlighted for further investigation and research.

The Sub Programs that comprise the Water Sector Management (Program 3) portfolio include:

- Policy and Planning Management and Support
- Integrated Planning
- Policy and Strategy
- Water Ecosystem
- Water Information Management
- Institutional Oversight

Other sub-programs within the various other portfolios' that have a bearing on CMA functionality include:

- Administration (Program 1)
    - CMAs will require their own in-house capacity in this regard
- Regional Implementation and Support (Program 2)
    - Institutional Establishment
    - Support Services
    - Integrated Catchment Management
- Water Sector Regulation (Program 5)
    - Water Use Authorization
    - Compliance Monitoring
    - Enforcement

## 6.5 A Comparison of Water Management and Planning Cost

The Government of Western's Australia's Department of Water (DoW) is the organizing body responsible for the management of Australia's water resources. Unlike South Africa's Department of Water Affairs the Australian DoW serves a function that is more akin to the CMAs of South Africa.

Appendix G displays the cost breakdown of the DoW over a four year period ending with the 2010/2011 financial year. In order to facilitate a direct comparison between South Africa and Australia the costs for the Australian DoW have been stretched over 6 phases as opposed to the original four. The results are displayed in Figure 6-5 below.

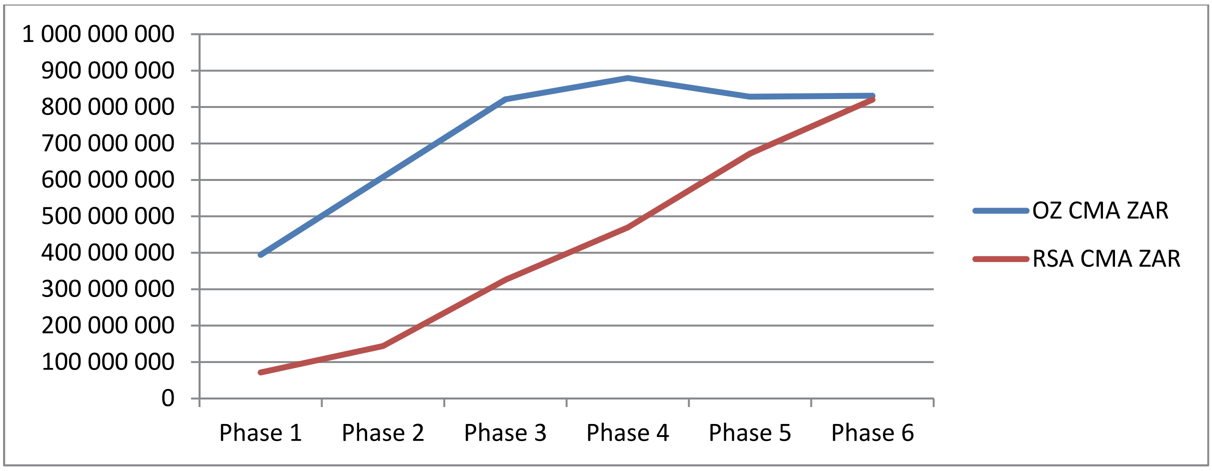



FIGURE 6-5. COMPARISONS OF THE COSTS OF WATER MANAGEMENT AND PLANNING BETWEEN SOUTH AFRICA AND AUSTRALIA.

It is clear from the graph that the water management cost in Australia started off from a higher point, though over the course of the curve it eventually begins to approximate the cost of water management in South Africa.

This is a decidedly interesting finding given that that size quantity of raw water being managed in Australia is not too different from the South African quantity; 13,474 million $m^3$ for Australian and 14,146 million $m^3$ for South Africa.

TABLE 6-5. COMPARISON OF THE COSTS OF WATER MANAGEMENT BETWEEN SOUTH AFRICA AND AUSTRALIA IN CENTS/M3

| | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Phase 5 | Phase 6 |
|---|---|---|---|---|---|---|
| cents/m$^3$ AUS | 2.93 | 4.51 | 6.09 | 6.53 | 6.15 | 6.17 |
| cents/m$^3$ RSA | 0.51 | 1.03 | 2.33 | 3.35 | 4.80 | 5.86 |

In phase 6, which is the fully developed phase for South Africa, the rate per m$^3$ is only slightly higher for Australia by 0.31 cent/m$^3$.

## 6.6 Comparison of BOCMA and INCMA CMA Costs with CMA Cost Estimates.

Presented here is are the financial figures for the BOCMA and ICMA CMAs, which are then compared with the cost estimates put forth in the preceding chapters.

The ICMA is clearly at a more advanced stage of development relative to the BOCMA if costs incurred are indicative of CMA developmental progress. For the ICMA, they have a state allocation of R28.193 million, retained income of R4.232 million and some additional income which gives them a total budget of R32.542 million for the 2011 financial year. There total costs for that year amount to less than 50% of this available budget at R14.423 million.

TABLE 6-6. ICMA INCOME STATEMENT FOR 2010 AND 2011

| ICMA Income Statement | 2011 | 2010 |
|---|---|---|
| INFLOWS | | |
| Budget | 28,193,000 | 20,958,313 |
| Other Income | 117,449 | -55608 |
| Retained Surplus | 4,232,296 | 132,067 |
| OUTFLOWS | | |
| Opex (Including Salaries) | 13,078,990 | 16,696,105 |
| Other Expenses | 28,121 | 56,420 |
| Capex | 1,316,648 | 49,951 |
| **Balance (Year end surplus)** | 18,118,986 | 4,232,296 |
| **Actual Costs for Year** | 14,423,759 | 16,746,868 |

The BOCMA had a total budget of R21.379 million for the 2011 financial year with their actual costs of R13.441 million taking up only 63% of their budget.

TABLE 6-7. BOCMA INCOME STATEMENT FOR 2010 AND 2011

| BOCMA Income Statement | 2011 | 2010 |
|---|---|---|
| INFLOWS | | |
| Budget | 17,435,000 | 11,000,000 |
| Other Income | 416,783 | 424,741 |
| Retained Surplus | 3,528,212 | 818,230 |
| OUTFLOWS | | |
| Opex (Including Salaries) | 12,474,330 | 7,253,028 |
| Capex | 937,479 | 1,461,731 |
| **Balance (Year end surplus)** | 7,968,186 | 3,528,212 |
| **Actual Costs for Year** | 13,411,809 | 8,714,759 |

Relative to one another it seems apparent that the ICMA is further along its developmental pathway but consideration of these figures relative to the costs estimate presented in the previous chapter (5.2) suggests that both are still relatively young in comparison to their projected potential.

By factoring in the financial figures from these two CMAs into a graph alongside the CMA cost curve we can assess their relative level of development. This is presented below.

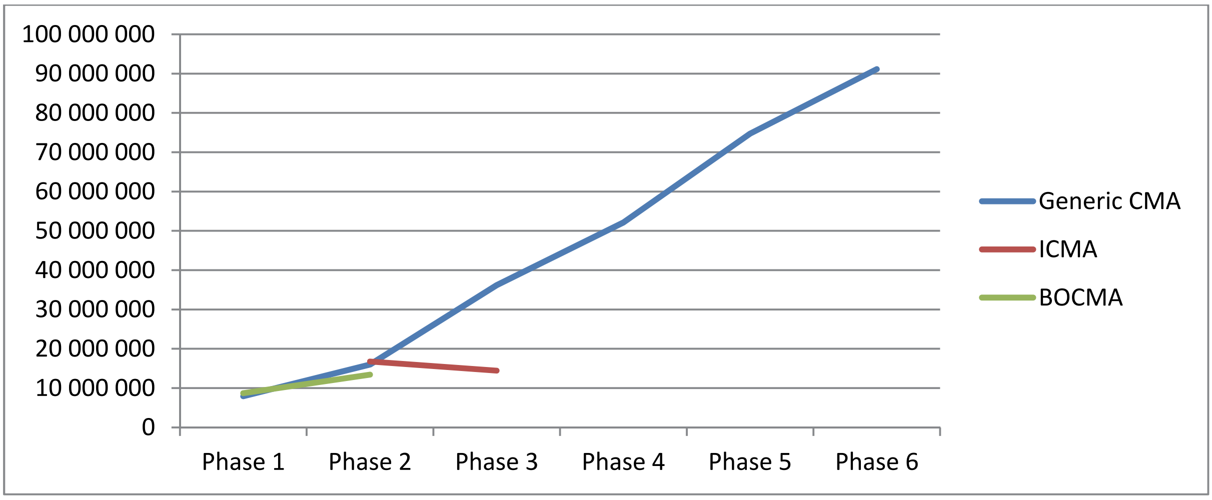



FIGURE 6-6. COMPARISON OF CURRENT ICMA AND BOCMA COSTS TO THE GENERIC CMA COSTS

Based upon this graphical assessment it is clear that BOCMA and ICMA are still relatively young in their stages of development.

## 6.7 Cost of Hypothetical CMA Rollout

Appendix E contains cost estimates of the total cost curve in a hypothetical CMA rollout scenario. The estimates contained in these appendices assume that the CMA rollout is starting from scratch with no BOCMA or ICMA CMA present yet.

The hypothetical scenario models a cost function for the rollout of nine CMAs, by starting one new CMA each year over a period of nine years starting in 2012.

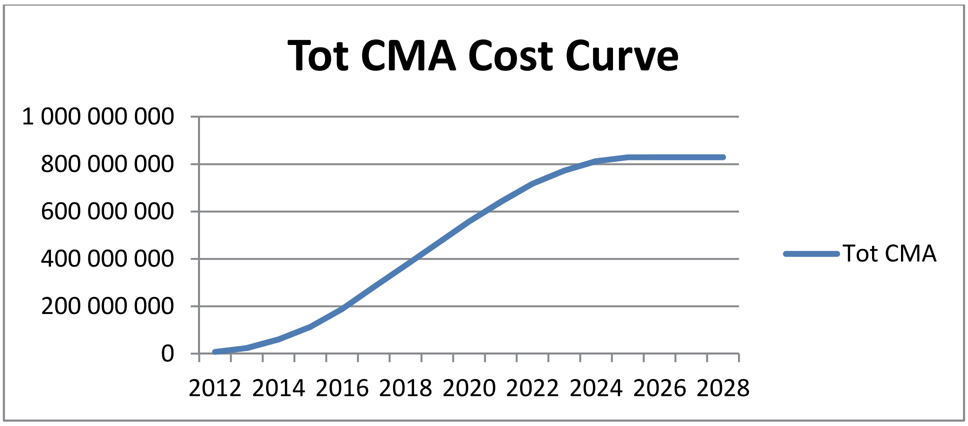



FIGURE 6-7. TOTAL COST CURVE FOR CMA ROLLOUT HYPOTHETICAL SCENARIO

The costs for year one stand at R7.9 million for year one and increase year on year by 43% until it reaches full cost 13 years later in the year 2025 for a total cost of R828 million.

## 6.8 Water Use Charges: Revenue Potential

**Estimations of revenue potential have been constructed according to weighted average of the charges currently being administered. Prices are kept at a constant 2011/2012 level in order to simplify comparisons between amounts in different years.**

Based upon the mean projected water usage amounts for the year 2012, and with the current pricing levels for raw water usage, the estimated potential revenue stands at approximately R223 million.

Factoring in the base and projections for 2012 provides and upper and lower boundary for current revenue potential from water use charges of between R213 million and R233 million.

With the mean per annum growth rate 106.3 million $m^3$ per year, maintaining the current pricing level, potential revenue from water use charges should increase at R1 679 540 per year.

See Appendix A.1

## 6.9 Projected Revenue Potential

Raw water use requirements are estimated to be between 14 239 million $m^3$ and 16 818 $m^3$ in the year 2025.

At current charge levels this will yield a total potential yield of between R223 million and R273 million by the year 2025.

See Appendix A.2 and A.3

## 6.10 Breakeven Prices

Based on the CMA cost projections presented in chapter 5 we can calculate the increase in general prices that would be required to cover the cost of running the 9 CMAs.

An across the board increase of 271% would be required in order to raise revenue to the level where the cost of the CMAs could be 100% accounted for.

At this pricing level the average charge per m³ will be 5.86 cents/m³ and will generate revenue of approximately R828 million, which will cover 100% of the estimated cost of running 9 fully functional CMAs

See appendix A.5

## 6.11 Extent to which Water Resource Charges subsidizes Sectors

**There are a wide range of reasons why it might be prudent or necessary to subsidize particular sectors with regards to being charged for raw water usage. This chapter discusses the more pertinent of those issues and provides a sector by sector comparison of the effect of subsidy levels in certain sectors.**

**In this chapter, it is assumed that prices are at break-even level and it is from this point that the analyses of subsidies proceeds.**

### *6.11.1 Motivation for a Sector "Subsidy"*

Subsidization is a useful financial/economic tool that may be used to reduce to the cost burden to a particular group of consumers. Most subsidies are made by the government to producers/consumers in order to decrease the cost of production/consumption.

Subsidies are, however, not a free lunch and the cost of subsidizing sectors needs to be carried somehow. However, this chapter seeks only to observe the financial implications of a possible subsidy an even to that extent the detail of the analysis is limited.

A fuller discussion of subsidies and their usefulness will be reserved for later in this project.

### *6.11.2 Comparison of Effect of "Subsidies" in Various Sectors*

The effect that a given subsidy, in a particular sector can have on the overall revenue potential is directly proportional to the amount of water that the particular sector consumes relative to the whole.

The agricultural sector, labeled here as Irrigation is by far the largest consumer of raw water. And will account for approximately 60% of raw water consumption in 2012 (See appendix A.1). Any reduction in raw water consumption charges in this sector is going to have a relatively larger effect than a comparable reduction in charges in an alternate sector

TABLE 6-8. COMPARISON OF SUBSIDY EFFECT IN VARIOUS SECTORS. [PRICING FOR FULL CMA COST RECOVERY]

| | Required Revenue | Actual Revenue | Shortfall |
|---|---|---|---|
| **50% Irr Subsidy** | 828 771 165 | 515 964 727 | 312 806 438 |
| **25% Irr Subsidy** | 828 771 165 | 646 300 743 | 182 470 422 |
| **50% D&I Subsidy** | 828 771 165 | 630 299 362 | 198 471 803 |
| **25% D&I Subsidy** | 828 771 165 | 729 535 263 | 99 235 902 |
| **50% Aff Subsidy** | 828 771 165 | 821 395 011 | 7 376 154 |
| **25% Aff Subsidy** | 828 771 165 | 825 083 088 | 3 688 077 |

Irr = Irrigation
D&I = Domestic and Industrial
Aff = Afforestation

Table 6-8 above contrasts the net effect of two subsidy levels through each of the three sectors, irrigation, domestic and industrial and afforestation. As can be observed, a 50% subsidy for irrigation will result in a R313 million (rounded up) shortfall in revenue, assuming pricing level are set for 100% recovery of CMA costs. In contrast, a comparable 50% subsidy for the afforestation sector will result in a mere R 7.37 million reduction is potential revenue.

### *6.11.3 Cross Subsidization versus Government Subsidization*

Government subsidization may be defined, in this instance, as the state assuming financial responsibility for any difference between the cost of running the 9 CMAs and the revenue collected from water users. In short, since government raises its revenue from tax, it is essentially still the general public that assumes the cost. The primary difference being that the cost will be apportioned to the nation's tax base as opposed to a specific group of water users.

Cross-subsidization on the other hand, is when certain water use sector/s compensates for the revenue shortfall in alternate sector/s through an increase in their water use charges.

Appendix A.6 displays the figures for a cross subsidy between the Irrigation and the Domestic and Industrial Sectors. The figures indicate that a 20% subsidy in the Irrigation sector may be compensated for by a 9% increase in water use charges in the Domestic and Industrial sector.

Although the irrigation sector uses 63% more water that the Domestic and Industrial sector, the average charges in the latter are considerably higher, hence only a 9% increase in charges in this sector will make up for the revenue shortfall due to the subsidy.

## 6.12 Recommendations for setting water use charges

DWA budget allocated water resource management across the total budget of the 19 water management areas during the 2010/11 financial year totaled R350 million, of which R250 million was spent. The larger portion of the unspent budget may be accounted for by staff shortages/unfilled posts and the subsequent reduction in operational capacity resulting therefrom. In the 2011/12 financial year the allocated budget was increased to R450 million.

The rollout of the remaining 7 CMAs has been given the highest priority by the DWA. Table 6-9 on the proceeding page lists estimated budgets required to fund the establishment of all 9 CMAs. The budgets presented in the table represent a cost estimate for a generic CMA (as presented in Table 16-3), adjusted for the varied composition of CMAs in terms of the water resources uses that fall within their area of jurisdiction.

The estimates indicate that the funding required to establish and develop CMAs through to phase 2, lies within the allocated budget for water resource management. However, due to low rates of revenue recovery, these amounts are effectively being drawn from the national fiscus, in what is an unintended subsidy for water resource management.

This will have significant implications for the CMAs down the line, given that the responsibility for collecting water resource management charges will lie with the CMAs. As the CMA develop towards full maturity, the required budgets for operating the CMAs will exceed what is currently being allocated for water resource management. The implication being that CMAs will have to address the following two issues:

- Increasing the recovery of water resource management charges from water resource users.
- Increasing the charges levied on water resource users for water resource management such that sufficient revenue can be generated to operate the CMAs

By phase 6, which is the fully matured stage of CMA development, these water resource charges would have to be increased by an average of 270% across all WMAs to generate sufficient revenue to fully account for the cost of operating the CMAs. At this tariff level, the average charge would be 5.84 cents/$m^3$ and would generate revenue of approximately R828 million.

TABLE 6-9. ESTIMATED REVENUE REQUIREMENTS, WATER VOLUMES AND RECOVERY LEVEL WATER RESOURCE CHARGES FOR THE 9 CMAS

| WMA | Budget (Phase 1) | Budget (Phase 6) | Water volume | Full cost recovery price (Phase 1) – cents/$m^3$ | Full cost recovery price (Phase 6) – cents/$m^3$ |
|---|---|---|---|---|---|
| Limpopo | 29,306,549 | 113,411,308 | 1,758 | 1.67 | 6.45 |
| Olifants | 24,707,264 | 95,612,866 | 1,376 | 1.8 | 6.95 |
| Inkomati Usuthu | 11,740,261 | 45,432,792 | 888 | 1.32 | 5.12 |
| Pongola-Umzimkulu | 25,404,211 | 98,309,931 | 2,103 | 1.21 | 4.67 |
| Vaal | 40,218,588 | 155,639,027 | 2,306 | 1.74 | 6.75 |
| Orange | 29,002,349 | 112,234,107 | 2,086 | 1.39 | 5.38 |
| Mzimvubu-Tsitsikamma | 16,485,537 | 63,796,197 | 1,358 | 1.21 | 4.7 |
| Breede-Gouritz | 14,384,754 | 55,666,527 | 1,018 | 1.41 | 5.47 |
| Berg-Olifants | 22,314,522 | 86,353,368 | 1,253 | 1.78 | 6.89 |
| **Total** | 213,564,035 | 826,456,123 | 14,146 | 1.51 | 5.84 |

# 7 REVENUE POTENTIAL OF THE WASTE DISCHARGE CHARGE SYSTEM (WDCS)

## 7.1 OVERVIEW

The mandate and functions of Catchment Management Agencies (CMAs) require of them to protect and manage the water resources in order to maintain a sustainable production of aquatic ecosystem services. The cost of conducting all these functions is to be covered by the resource rent of water resources. The resource rent accruing from water resources forms a portion of the value of aquatic ecosystem services. The aquatic ecosystem services delivered by the water resources, as defined in the National Water Act (NWA) (1998), are by extension also public services, which include:

- Water provisioning;
- Pollution absorption; and
- A range of other aquatic ecosystem services as envisaged in the Millennium Ecosystems Assessment (MEA) framework of ecosystem services.

The key purpose of this project is to investigate the mechanisms, conditions and viability of funding streams required to address the cost structure of Catchment Management Agencies (CMAs) in South Africa. For this purpose, the revenue potential from an implemented Waste Discharge Charge System (WDCS), throughout each of the Water Management Areas (WMAs) in South Africa, were assessed. The assessment of the revenue potential of the WDCS builds upon the water use estimates (per water management are, per economic sector) discussed in Section 2. Estimation of the Total Revenue Potential for a WDCS is South Africa is achieved by extrapolating costing figures obtained the Olifants Catchment Case into the other 18 catchments according to the scale of water use in the various economic sectors. The classification of the water resources within South Africa is at a relative early stage. The estimations made in this report build off of the current work being done in the Olifants Catchment, utilised but not intricately detailed in this project, as it falls outside of the scope.

There are several key principles underlying the rationale for the WDCS, which include the internalisation of the cost of pollution and pollution prevention.

*Internalisation of the Costs of Pollution:* The costs of pollution that arises from different forms of economic activity are often born by society at large, instead of the producer. Thus producers obtain the profits of their activities without realising the costs. This imbalance leads to a misallocation of economic activities and distortions in the distribution of utility within society. This is also known as the polluter pays principle, whereby the body responsible for generating the pollution also assumes the cost.

*Prevention is better than Cure*: Whilst it is possible to remove pollutants from a water resource, it is often not possible to reverse the damage done by the pollutants. Through the incorporation of deterrent charges, the WDCS seeks to prevent excessive pollution instead of simply cleaning up afterwards. Treatment of pollutants is always necessary, but damage to the environment is to some extent avoidable.

The literature overview covers four areas of relevance:

1. Background information to WDCS and some of the rationale justifying the need for the WDCS;
2. The fundamental components of the WDCS including water quality indicators and setting of resource quality objectives (RQO's); and
3. Calculation of the various charges that comprise the WDCS.

The assessment of the revenue potential of the WDCS, in this study, is based the resource economic analysis of three primary water polluters: (1) the discharge of wastewater effluents from municipal wastewater treatment works (WWTW), (2) pollution from agricultural activities and (3) the discharge of effluents originating from mining operations. The associated cost of water pollution, from these activities, is determined with a load based waste treatment-costing model, developed by Prime Africa Consultants.

The report subsequently demonstrates the calculation of waste discharge charges accounting for effluent treatment at wastewater treatment works (WWTWs), diffuse pollution arising from agricultural activities and the effluents resulting from mining activities. The report demonstrates these as they pertain to the Olifants Water Management Area (WMA).

The treatment costs for this case may be summarised as follows:

| TOTAL TREATMENT COST (Rand/Year) | |
|---|---|
| WWTW | 344 394 521,17 |
| Agriculture | 7 774 857,23 |
| Mining | 1 333 545 659,97 |
| TOTAL | 1 685 715 038,36 |

Based upon these costs an average treatment cost was calculated per million m$^3$ of water that is utilised by each of the sectors. These costs are summarised as follows:

| **Treatment Costs per million m$^3$** | **(Rands)** |
|---|---|
| **WWTW** | 2 451 161 |
| **Agriculture** | 12 945 |
| **Mining** | 5 736 151 |

These figures were then utilised to compile an estimate of waste treatment costs for each of the 19 water management areas based upon the quantity of water that is utilised in each of the economic sectors of the WMAs.

The aggregate values for these estimates are summarised here:

| Treatment Costs | (R' Billions / Year) |
|---|---|
| **WWTW** | 9 844 |
| **Agriculture** | 116 |
| **Mining** | 8 309 |
| **Total** | **18 269** |

## 7.2 INTRODUCTION

### *7.2.1 WATER AS A SANITATION RESOURCE*

Since ancient times, water was, and is still, considered to be the most suitable medium to clean, disperse, transport and dispose of wastes (including domestic, industrial, mine drainage and irrigation return waters). With industrialization and increased populations the range of water requirements have increased further to now include, for example, the cooling in fossil fuel power plants and hydropower generation. Wastes generated by water users have therefore become a part of the high standard of living that people have become accustomed to in the industrialized society. Ironically, in parallel to the greater range of water requirements, the demand for water of a greater quality has also increased (Chapman 1996).

Associated with each water use, including the abstraction of water and the discharge of wastes are rather predictable and specific impacts on water quality. Water quality can be defined in terms of the composition and state of aquatic biota in the water body where a set of organic and inorganic substances (water quality indicators) are present at specific concentrations. Changes in the concentrations of water quality indicators, without any harm to aquatic biota or restriction to water use, due to human activities is considered to be the first phase of water quality degradation. The second phase of water quality degradation, before the water body is classified as polluted, results in harm to aquatic biota, restricted water use and exceeding of water quality guidelines (WQG). Water is polluted when maximum allowable resource directed values (MARDV) of indicators have been reached. Polluted water has markedly modified aquatic biota and habitat with further restricted water uses (Chapman 1996).

Human activities impacting on water as a resource, especially the activities resulting in a decrease in water quality, are of great concern in water management areas (WMAs). The activities of major environmental concern will differ between WMAs, but will usually include the discharge of partially treated or untreated wastewater by municipalities, the discharge of industrial effluents, mining operations and agricultural activities. These activities function as point or non-point (diffuse) sources of pollution. Seeing as diffuse sources may result from a large number of point sources, no clear distinction exists between point and non-point sources. However, an important difference is that point sources care related to a single outlet and can be collected, treated and controlled. As an example, the discharge of wastewater effluents from WWTW is a point source. Runoff and leaching from agricultural fields are considered to be a diffuse source of pollution (Chapman 1996).

### *7.2.2 Pollution Management/Water Quality Improvement – The Rhine River; the Netherlands*

Pollution of the water system needs to be managed not only from a human need thereof but also from an ecological perspective. Pollution management includes pollution prevention and pollution mitigation. An example of the application of pollution management and the successful outcome thereof would be the ecological rehabilitation of the Rhine River.

The Rhine River system changed from a historically viable ecosystem to an acutely degraded ecosystem by 1986. The ecosystem degradation was linked to human activities that altered river flow and morphology and activities, which impacted on water quality. Ecosystem degradation presented water users with the challenge of rehabilitating the Rhine River to a certain quality to enable them to continue with their activities. The focus was therefore on the minimisation of pollution from the major sources. The most damaging human activities associated with the degradation of the Rhine were agricultural, industrial and municipal uses. Two rehabilitation programmes, aimed at the improvement of water quality, were implemented in order to address the pollution associated with the main activities. The first programme aimed at reducing water pollution from point sources while the second programme considered the reduction of non-point source pollution as well as other hazardous compounds. Central to the success of these programmes was the setting of clear water quality objectives.

In 1986 the Rhine Action Programme (1986-2000) was implemented. This ecological rehabilitation plan mainly focussed on the improvement of water quality by reducing the point source inputs from industries and municipalities. This was accomplished by connecting industries and municipalities to waste water treatment works (WWTW) thereby reducing the discharge of partially treated or untreated effluents. However, the challenges associated with the pollution from diffuse sources, as well as pollution as a result of other hazardous substances, were not considered. The Rhine 2020 Programme (2000-2020) was implemented in order to continue with ecosystem rehabilitation by included the improvement of water quality by addressing pollution from non-point sources and by considering priority pollutants (Nickel, Soks, Frijters, and Raith).

## 7.3 The Waste Discharge Charge System (WDCS)

### *7.3.1 Background to WDCS*

The waste discharge charge system (WDCS) aims to reduce the impacts that water users have on water resources in order to address the problem of excessive pollution on water systems. The objectives of the WDCS include efficient resource utilization, sustainable water use and development, discouraged pollution, internalization of environmental costs and cost recovery from activities polluting water sources. The principles on which the WDCS is based are the polluter pays principle (PPP), reduction of pollution at source principle and precautionary principle. These guiding principles also form the basis for ecosystem legislation. According to the WDCS, pollution minimization is accomplished by holding the waste dischargers financially accountable for water pollution caused by their activities (DWAF 2000, DWA 2003, DWA 2007).

The WDCS charge is based on the pollutant load introduced into the water body by waste dischargers and follows the identification of the following four requirements. The requirements are listed below followed by a theoretical example if implemented. It is important to note that the system is based on a clear understanding of resource quality objectives (RQO). The requirements to be identified are:

1. most damaging human activities in the catchment,
2. most important water quality indicators representing the pollution associated with these activities,
3. methods for the reduction of these identified pollutants (water quality indicators); and
4. target water quality objectives for the identified pollutants.

### *7.3.2 Role of CMA in WDCS*

The CMAs have an integral role top place in the implementation and maintenance of a viable WDCS. The table below illustrates the functions of the CMA, whilst those that pertain to the WDCS have been highlighted.

TABLE 7-1. OTHER CMA FUNCTIONS AS ADAPTED FROM WRC REPORT 1433/1/06 (MAZIBUKO AND PEGRAM 2006)

| Functional area | Sub-functions and activities |
|---|---|
| **Develop policy and strategy** | Long-term strategic planning for the CMA (including climate change)<br>Determination of resource directed measures<br>Reconciliation of water availability and requirements<br>Financial and business planning for the CMA |
| **Support institutions** | Creation of non-statutory consultative and participative bodies or forums<br>Coordination of the activities and relationships of WMIs in the WMA<br>Fostering cooperative governance and creating partnerships<br>Building capacity in WMIs and forums<br>Resolution of conflicts<br>Supportive or emergency organisational interventions<br>Ensuring appropriate stakeholder participation in these bodies |
| **Regulate water use** | Registration of water use<br>Authorisation of water use (licensing)<br>Setting, billing and collecting water use charges<br>Ensuring dam safety and dam zoning<br>Monitoring authorisation requirements<br>Ensuring compliance (including enforcement)<br>Negotiation of co-regulation and cooperative agreements |
| **Implement physical interventions** | Implementation of the Working For Water programme<br>Implementation of water demand management (WDM) interventions<br>Rehabilitation of water resources (such as wetland or riparian zones)<br>Emergency response interventions (including disaster mitigation)<br>Operation and maintenance of water resource systems (water works)<br>Development (design and construction) of water resources infrastructure (waterworks) |
| **Manage information** | Monitoring water resources (collect, source and capture data)<br>Development and maintenance of databases (including quality control)<br>Development and maintenance of information management/evaluation systems<br>Conducting research on water resources<br>Performance of needs assessments and water resource problem identifications<br>Communication with stakeholders and collection of anecdotal information |

## 7.4 FUNDAMENTAL COMPONENTS OF THE WDCS

### *7.4.1 WATER QUALITY INDICATORS*

In order to assess the extent of the pollution by the identified waste dischargers, the following water quality indicators were identified (DWA 2003) and will be discussed in more detail below:

I. total inorganic nitrogen (TIN) representing nutrient pollution from partially treated or untreated sewerage discharge and from agricultural practices
II. soluble reactive phosphorous (SRP), representing ortho-phosphates ($PO_4^{3-}$), used to assess nutrient pollution from sewerage discharge and agricultural activities
III. and sulphate ($SO_4^{2-}$) to represent the salinity changes due to mining operations, specifically used due to the impacts of acid mine drainage (AMD).

These pollutant indicators correspond to the indicators suggested for use by the WDCS as indicated in Table 7-2 below (DWAF 2000; DWA 2003; DWA 2007).

TABLE 7-2. WATER POLLUTANTS AND ASSOCIATED INDICATORS (WDCS 2007)

| Pollutant | Indicator |
|---|---|
| Salinity | Electrical conductivity (EC), Chloride ($C\ell^-$), Sodium (Na) and Sulphate ($SO_4^{2-}$) |
| Nutrients | Soluble phosphorous ($PO_4^{3-}$), Nitrate ($NO_3^-$), Ammonium ($NH_4^+$) |
| Heavy Metals | Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Mercury (Hg), Lead (Pb), Nickel (Ni) and Zinc (Zn) |
| Organics | Chemical oxygen demand (COD) |

### *7.4.2 NUTRIENTS*

Nitrogen and phosphorous are essential nutrients for primary production in the environment with phosphorous often being the limiting nutrient. When these nutrients exceed the allowable levels in water bodies, as stipulated by the water quality guidelines (WQG) adverse effects on the environment and human health are expected.

#### *NITROGEN*

Total inorganic nitrogen (TIN) represents the sum total of ammonia ($NH_3$), ammonium ($NH_4^+$), nitrate ($NO_3^-$) and nitrite ($NO_2^-$). The presence of inorganic nitrogen in water is indicative of agricultural and sewerage related impacts. The application of fertilisers to agricultural fields may result in nitrogen contamination of groundwater. Fertilisers are commonly applied as ammonium salts which upon oxidation (nitrification) form nitrite and nitrate which are very mobile. Leaching of nitrite and nitrate from agricultural fields will result in groundwater pollution. Nitrogen is also introduced into water bodies from the discharge of partially treated or untreated sewerage effluents. Nitrogen is removed from sewerage during the nitrification-denitrification two-step treatment process. When WWTW do not operate effectively, TIN may be discharged directly into receiving water bodies as. Major environmental concerns associated with TIN including (1) dissolved oxygen concentration decrease due to increased biological oxygen demand, (2) fish toxicity from the effect of ammonia on receiving water bodies, (3) eutrophication and (4) negative implications to water reuse applications including groundwater recharge and irrigation. The impacts associated with TIN in water bodies as a result of agriculture and WWTW are outlined below. For a full discussion refer to the Water Quality Guidelines, Volumes 1-6.

1 Ammonia:

- highly toxic to aquatic organisms resulting in fish kills (see WQG: Volume 6). At pH<8, Ammonia concentrations may not exceed 0,025 mg $NH_3$/L.
- impact on human health due to the accumulation in fish flesh (WQG: Volume 6).
- results in taste and odour problems in drinking water (WQG: Volume 1). No health or aesthetic effects expected at <1,0 mg $NH_3$/L.

2 Nitrite and nitrate:

- Nitrite is highly toxic. Nitrite reacting chemically with amino compounds form nitrosamines, which are highly carcinogenic (WQG: Volume 1).
- Nitrate in itself is not highly toxic, but when ingested it reduces to nitrite in the gastrointestinal tract. The normal stomach acidity in adult humans reduces/prevents nitrate reduction, but infants with lower stomach acidities are highly susceptible. The nitrites combine with hemoglobin in the blood system of infants causing respiratory distress known as *methaemoglobinaemia*, blue baby syndrome. Nitrate reduction also impacts on livestock and fish (WQG: Volume 1, 5 and 6).
- Increased nitrate concentrations may lead to eutrophication.

For the purposes of this study TIN concentrations in WWTW and agricultural effluents were not allowed to exceed 0,5 mg/L as stipulated by the WQG document Volume 7 for irrigational use.

### *Phosphorous*

Phosphates in water mainly indicate agricultural activities but can also signify sewerage related impacts. SRP was used as phosphate indicator due to its availability and reactivity. SRP comprises the inorganic fraction of total phosphorous and is mainly represented by ortho-phosphates due to its bio-availability. The major environmental concern associated with phosphorous is eutrophication. Eutrophication results from over stimulated algal growth (high biomass production) as a result of the presence of nutrient limiting phosphorous. The impacts of eutrophication are increased biological oxygen demand, decreased dissolved oxygen, increased water temperatures, decreased light penetrability, increased fish deaths and anaesthetic conditions with noxious odours. Phosphate concentrations of less than 0,1 mg/L were used as the maximum allowable level to be discharged as for aquaculture (WQG: Volume 7).

### *Sulphates*

Acid mine drainage (AMD) generation and the discharge there of into the Olifants WMA is considered to be the direct result of coal mining in the upper Olifants catchment. The major environmental concerns associated with AMD are aquatic habitat destruction, chronic and acute toxicity, bio-accumulation and environmental persistence. The production of AMD is a naturally occurring process but is greatly accelerated when metal sulphide minerals contained in geological strata become exposed to air and water during deep excavation operations such as mining activities. AMD production usually, but not exclusively, occurs in iron sulphide bearing rocks of which pyrite, $FeS_2$, is the most. Pyrite is found in association with gold, other metals and coal deposits. AMD with its persistent dark reddish-brown colour is characterized by low pH (values as low as 2.5), high specific conductivity, elevated concentrations of sulphate, iron, manganese and aluminium and increased levels of toxic heavy metals and possible radio-nuclides.

Sulphate was chosen as water quality indicator to represent the polluting effects associated with mining activities seeing as (i) sulphate removal has become a priority and (ii) treatment technologies for sulphate removal will also result in the removal of acidity and metals.

### *7.4.3 Understanding and Setting Resource Quality Objectives*

Damaging human activities are considered to be the discharge of wastes with pollutant concentrations that exceed the RQO of the identified pollutant. Therefore, central to the system is the setting of (1) target concentrations (referring to recommended resource-directed value (RRDV) or effluent concentration) as to achieve in-stream resource quality objectives applicable to the resource class and (2) maximum allowable resource-directed values (MARDV) in order to achieve the upper limit of the in-stream quality associated with the resource class for each water pollutant.

Target water quality objectives need to be set, corresponding to the environmental management class (EMC) assigned to the Olifants WMA. The upper boundary concentrations of identified pollutants corresponding to EMCs (DWA 2008) may be used to represent MARDVs. RRDV can be set as to correspond to the water quality guidelines' (WQG) strictest user (DWA 1996), depending on the water uses downstream, or more accurately the RQO (DWA 2009) of the site. The strictest water user for the concentration of nitrogen is aquaculture, requiring a concentration of less than 0,05 mg/L TIN. On the other hand, the concentration of phosphorous, to ensure the protection of all aquatic organisms is 0,1 mg/L ortho-phosphate. However, the RRDV identified for SRP is the concentration corresponding to a category A, 0,005 mg/L, representing ideal conditions. The WQG stipulates sulphate levels not to exceed 200 mg/L $SO4^{2-}$ for human consumption and 30 mg/L $SO_4^{2-}$ for use by category 1 industries. Table 7-3 below summarises RQO, WGQ and international standards of water quality indicators.

TABLE 7-3. SUMMARY OF RQO, WGQ AND INTERNATIONAL STANDARDS OF WATER QUALITY INDICATORS.

| | WATER QUALITY INDICATORS | | | | | | |
|---|---|---|---|---|---|---|---|
| **STANDARDS** | **$NO_3^-$** | **TIN** | **$PO_4^{3-}$/ SRP** | **$SO_4^{2-}$** | | **TDS** | **EC** |
| **WQG Domestic Use – Formal** | 6 | | | 200 | | 450 | |
| **WQG Domestic Use – Informal** | 10 | | | 400 | | 1000 | |
| **WQG Industrial Use** | 6 | | 0,02 | 200 | | 500 | |
| **WQG Agricultural Use** | | 0,5 | | | | 450 | |

| | WATER QUALITY INDICATORS | | | | | | |
|---|---|---|---|---|---|---|---|
| **WQG Aquaculture** | | | 0,077 | | | | |
| **WQG Livestock Watering** | 100 | | | 1000 | | 1000 | |
| **EU Drinking Water Use** | < 50 | | | 250 | | | |
| **Canadian Drinking Water** | 45 | | | 500 (Aesthetic) | | | |
| **Australian Drinking Water** | 50 | | | 500 | | | |
| **Australia Recreational** | 10 | | | 400 | | | |
| **A** | | 0,25 | 0,005 | 130 | 122 | | |
| **B** | | 0,75 | 0,02 | 200 | 142 | | |
| **C** | | 2 | 0,058 | 350 | 176 | | |
| **D** | | 4 | 0,125 | 530 | 203 | | |
| **Recommended/Ideal** | 6 | | 0,005 | | | 200 | 31 |
| **Acceptable** | 10 | | 0,015 | | | 350 | 54 |
| **Not Recommended/ Tolerable** | 20 | | 0,025 | | | 800 | 123 |

## 7.5 Waste Discharge Charge System (WDCS) Revenue Estimation: Olifants WMA Case

### *7.5.1 Background*

It was suggested that the WDCS charge be calculated by considering both a mitigation charge and an incentive charge. Furthermore the WDCS charge will depend on the level of pollution and can therefore be calculated by considering four tiers of pollution. Both the incentive charge and the mitigation charge are calculated from the relationship between the concentrations of the pollutant abstracted and discharged. The concentration of the water quality indicator abstracted corresponds with the RRDV related to the management class. The abstracted concentration can also be referred to as the background concentration (DWA 2003, DWA 2007).

The WDCS incentive charge incentivizes waste dischargers that use the resource as waste receiving entity, to reduce effluent loads. The charge is not intended as cost recovery but to change discharge behaviour. In order to deter waste discharges from discharging loads in excess of RQO, the incentive charge (cost of impact) increases exponentially with an increase in the pollution load from dischargers. Equation 1 was proposed for the calculation of the incentive charge. When waste dischargers concentrate the effluent, the incentive charge can be calculated as set in Equation 2. The WDCS therefore allows the calculation of an incentive charge based on the extent of pollution (DWA 2007). For this reason the incentive charge may also be calculated in terms of four tiers.

**Equation 1:** $C_{ik} = FR_i[Cd_{ik}Vd_k - Ca_{ik}Va_k]$

**Equation 2:** $C_{ik} = FR_i[\,(Cd_{ik} - Ca_{ik})Vd_k]$

Tier 1 (Equation 3) is a basic administrative charge to all water users that discharge into the water management area (WMA). In addition to a basic charge is the load-based charge (Tier 2) introduced when the discharger exceeds the target concentration (Equation 4). The target concentration refers to the recommended resource-directed value (RRDV) or effluent concentration required to reach the in-stream quality. A deterrent charge (Tier 3) is introduced when the discharger exceeds the MARDV (Equation 5). Tier 4 charges deter discharges from introducing toxic and priority pollutants into the environment. Tier 2 charges are paid in addition to tier 1 charges, and both tier 3 and tier 4 charges are paid in addition to tier 2 charges (DWA 2003).

**Equation 3** $C = C_dV_d$

**Equation 4** $C_1 = FPR[Q_d(C_d - C_t) - L_a - L_0]$

**Equation 5** $C_2 = FPR[Q_d(C_d - C_s)^E - L_b]$

On the other hand, the mitigation charge is the charge levied to waste dischargers in order to recover the cost of mitigation measures in the resource (Equation 6, Equation 7) (DWA 2007). Here, the mitigation charge (cost of reducing impact) will decrease with the greater quantity of pollutant load removed before discharge, i.e. the cost of mitigation will decrease exponentially with a decrease in pollution load discharged by users, as illustrated in the figure below:

**Equation 6** $CM_{xik} = RM_{xi}[Cd_{ik}Vd_k - Ca_{ik}Va_k]$

**Equation 7** $CM_{xik} = RM_{xi}[(Cd_{ik} - Ca_{ik})Vd_k]$

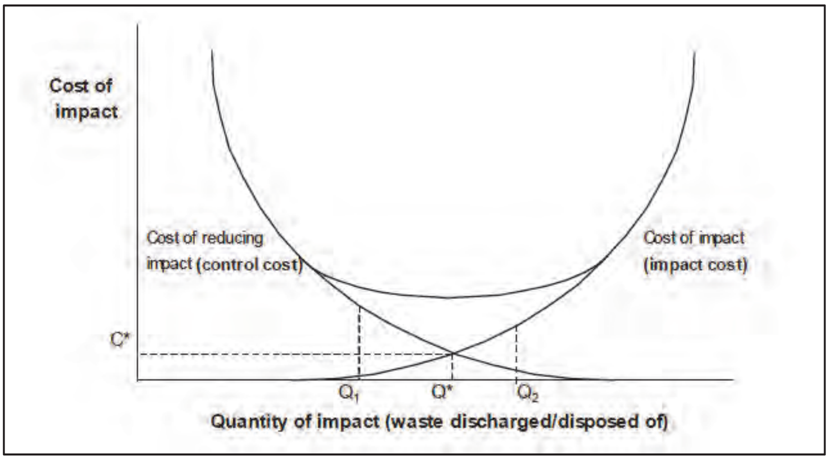



FIGURE 7-1. DETERMINING THE EQUILIBRIUM POINT BETWEEN THE COST OF REDUCING POLLUTION AND THE COST OF THE IMPACT OF POLLUTION (DWA2000).

### 7.5.2 Treatment Cost Calculation

For each identified EWR site within the catchment a present ecological state (PES) and a recommended ecological category (REC) were assigned during the reserve assessment study ("Classification of Significant Water Resources in the Olifants Water Management Ares: (WMA 4) – WP 10383", DWA 2011). The current pollutant load (PES) and the desired load (REC) at each EWR site was calculated by using the upper boundaries of the water quality indicators. The upper boundaries for TIN and SRP, as presented by Scherman Consulting 2008, were used. The upper boundaries for sulphate were taken from "Olifants River Ecological Water Requirements Assessment, Water Quality Modelling".

The pollution load within the Olifants WMA is modelled with the load model. The load model calculates the pollution load at each EWR site by using the present ecological state (PES) and the virgin runoff at each site (Equation 8). From the pollution load at each EWR site and by considering the main stem Olifants River and tributaries, the cumulative load is calculated. From the cumulative load, sites where pollution load reduction is required can be identified. This is achieved by converting the cumulative load at each EWR site to a concentration (Equation 9) which can be compared to the recommended ecological category (REC). When the calculated concentration exceeds the REC, water treatment for load reduction may be required. The load reduction is calculated by decreasing the load at identified EWR sites to meet the REC. However, the load model can only be used to calculate the loads of conservative pollutants, and can therefore only be applied to the modelling of sulphates. The model, however, does provide valuable insight into nutrient pollution loading. A shortfall of the model is that it considers all pollution loads from downstream users to the EWR sites. Individual waste discharges can therefore not be linked to specific pollution loads. However, by considering the main water users downstream of EWR sites, required load reductions can be linked to specific sectors of water users, in this study either municipalities, agriculture or mining.

**Equation 8** Load (kg/yr) = PES Concentration (kg/kL) x VMAR (kL/yr)

**Equation 9** REC Concentration (kg/kL) = Load (kg/kL) / VMAR (kL/yr)

Table 7-4 summarizes the results of the treatment costs for the Olifants WMA.

TABLE 7-4. SUMMARY OF THE TREATMENT COSTS FOR THE OLIPHANTS WMA.

| **TOTAL TREATMENT COST (R/yr)** | |
|---|---|
| WWTW | 344 394 521,17 |
| Agriculture | 7 774 857,23 |
| Mining | 1 333 545 659,97 |
| TOTAL | 1 685 715 038,36 |

### 7.5.3 WWTW Costs

The positive effect on the ecosystem by connecting municipalities and industries to WWTW, in order to reduce pollution from partially treated or untreated effluents, is clearly evident from the Rhine rehabilitation program. When considering the WWTW in the Olifants WMA, none are

Greendrop compliant (Greendrop Report 2011). It can therefore be directly concluded that by treating wastewater effectively at WWTW, pollution from municipalities and the associated negative environmental effects can be reduced. The major municipalities within the catchment were identified to have the greatest impact on pollution load. Tabulated (Table 7-5) are the WWTW identified with associated daily flows and loads reduced. Table 7-5 also gives the calculated cost of wastewater treatment.

TABLE 7-5. DAILY FLOWS, LOAD REDUCTIONS AND TREATMENT COSTS FOR THE MAJOR MUNICIPALITIES WITHIN THE OLIPHANTS WMA.

| Municipality | Flow (kL/yr) | Downstream of EWR | TIN Load Reduced (kg/yr) | SRP Load Reduced (kg/yr) | Treatment Cost (R/yr) |
|---|---|---|---|---|---|
| Emalahleni | 40 296 000 | 1 | 1 571 544 | 443 256 | 143 476 057,12 |
| Steve Tshwete | 25 915 000 | 3 | 1 010 685 | 285 065 | 92 271 739,63 |
| Kungwini | 4 745 000 | 4 | 185 055 | 52 195 | 16 894 825,57 |
| | | 2 | | | |
| | | 5 | | | |
| | | 6 | | | |
| Mookgopong | 2 190 000 | 7 | 85 410 | 24 090 | 7 797 611,80 |
| | | 8 | | | |
| | | 9 | | | |
| Thaba Chweu | 11 680 000 | 10 | 455 520 | 128 480 | 41 587 262,93 |
| | | 11 | | | |
| Tubatse | 1 314 000 | 12 | 51 246 | 14 454 | 4 678 567,08 |
| | | 13 | | | |
| | | 14a | | | |
| | | 14b | | | |
| Ba-Phalaborwa | 10 585 000 | 16 | 412 815 | 116 435 | 37 688 457,03 |

The cost associated with wastewater treatment (Table 7-5) can be calculated from a costing model developed for this purpose. The costing model is based on the principles of the sanitation tariff for wastewater as stipulated in the Tshwane by laws. The principles behind the WWTW costing model are outlined below.

The Tshwane sanitation tariff for the treatment of industrial effluents with a typical biological nutrient removal (BNR) process is based on two treatment costs; a normal conveyance and treatment cost (Equation 10) and an extraordinary treatment cost (Equation 11). The extraordinary treatment cost, payable when wastewaters exceed the pollution loads of normal wastewater, is charged in addition to the normal treatment cost (based on wastewater with a quality equal to domestic wastewater). Table 7-6 summarizes the concentrations of the water quality indicators used in the cost calculation.

**Equation 10** $$C_{WW} = R_{WW} \times VMAR$$

**Equation 11** $$C_{TIN,SRP} = R_{WW} \times \left[\left(f_{TIN} \times \frac{\Delta L_{TIN}}{Conc_{TIN}}\right) + \left(f_{SRP} \times \frac{\Delta L_{SRP}}{conc_{SRP}}\right)\right]$$

TABLE 7-6. SUMMARY OF THE CONCENTRATION OF WATER QUALITY INDICATORS USED IN THE COST CALCULATION.

| Level of Treatment | Feed Water Characteristics (mg/L) | | Treated Water Characteristics (mg/L) | | Calculation |
|---|---|---|---|---|---|
| | TIN | SRP | TIN | SRP | |
| Basic WW treatment from high strength to normal domestic water | | | | | Extraordinary |
| | 45 | 12 | 25 | 10 | |
| Basic WW treatment as for normal domestic wastewater | | | | | Normal |
| | 25 | 10 | 6 | 1 | |

### 7.5.4 *AGRICULTURAL COSTS*

As with the Rhine rehabilitation program, agriculture is seen as a diffuse source of nutrient pollution in the Olifants WMA making the management thereof quite difficult. The introduction of priority pollutants into the environment from agricultural practices, such as pesticides and herbicides, was, as for the Rhine, not considered. Literature mainly refers to nutrient pollution prevention practices for the reduction of agricultural pollution. However, for the purpose of calculating a WDCS charge payable by the agricultural sector, the following options were considered. Firstly, typical nutrient loads (kg/ha/yr) released from cultivated fields can be used to calculate a charge (R/yr) when typical load reduction costs (R/kg) are known. Cullins et al. (2005) estimated nutrient losses for various crops under irrigation and dry land cultivation within different rainfall regions. Using the estimated loads and extrapolating it to loads from crop types within the Olifants WMA a WDCS charge can be calculated. Alternatively, wastewater from other dischargers can be treated as to compensate for the load from agriculture. The additional treatment cost can then be levied to the agricultural sector. The WDCS charge for agricultural dischargers in the Olifants WMA was calculated from the additional treatment of wastewater by WWTW (Table 7-7). Assuming wastewater effluents of good quality being produced after wastewater treatment, additional treatment can be done as to achieve RQO as specified for the class.

TABLE 7-7. CONCENTRATION, REQUIRED LOAD REDUCTION AND ASSOCIATED COST ATTRIBUTABLE TO AGRICULTURE AT EACH EWR.

| EWR | Concentration after WWTW (mg/L) | | Concentration as per Class (mg/L) | | TIN Load Reduced (kg/yr) | SRP Load Reduced (kg/yr) | TOTAL COST (R/yr) | Cost (R/yr) |
|---|---|---|---|---|---|---|---|---|
| | TIN | SRP | TIN | SRP | | | | |
| 1 | 6 | 1 | 2 | 0,058 | 161 184 | 37 959 | 3 271 445,69 | 1 788 263,58 |
| 3 | 6 | 1 | 2 | 0,058 | 103 660 | 24 412 | 2 103 918,87 | 1 150 060,82 |
| 4 | 6 | 1 | 0,75 | 0,02 | 24 911 | 4 650 | 448 297,24 | 219 069,03 |
| 7 | 6 | 1 | 4 | 0,125 | 4 380 | 1 916 | 130 579,56 | 90 275,70 |
| 10 | 6 | 1 | 4 | 0,124 | 23 360 | 10 220 | 696 424,32 | 481 470,39 |
| 12 | 6 | 1 | 0,75 | 0,02 | 6 899 | 1 288 | 124 143,85 | 60 665,27 |
| 16 | 6 | 1 | 0,75 | 0,02 | 55 571 | 10 373 | 1 000 047,69 | 488 692,45 |

### *7.5.5 Mine Effluent Treatment Costs*

The cost associated with the treatment of mine effluents was based on typical treatment costs as for reverse osmosis technologies (Equations 12 and 13). The calculation of the treatment cost was based on the costs (R/kL) associated with different plant sizes (ML/day). It is evident that per unit treatment costs will decrease as the volume of effluent to be treated increases (Figure 7-2). For the application to the Olifants WMA, RO treatment plants of 10 ML/day were identified for AMD treatment at specific sites at 10,72 R/kL. The cost calculations are based on the assumption that 2 500 mg/L sulphate will be removed during treatment.

**Equation 12** Charge (R/kL) / Concentration Removed (kg/kL) = Charge (R/kg)

**Equation 13** Charge (R/kg) x Load to be Removed (kg/yr) = Treatment Cost (R/yr)

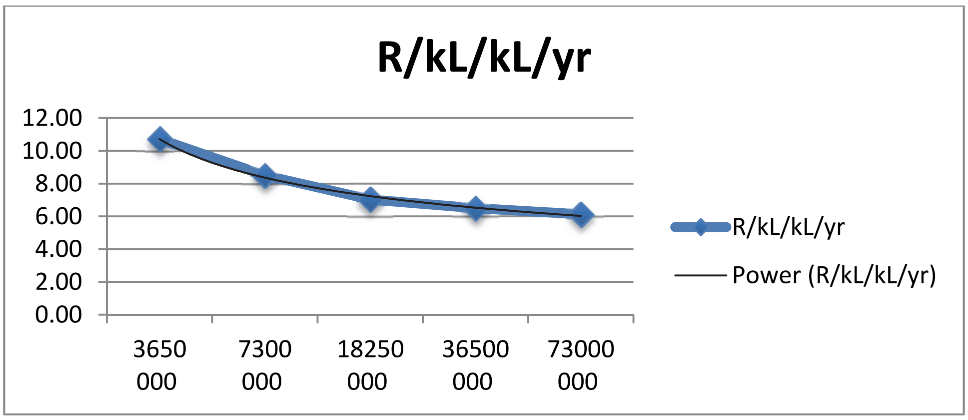



FIGURE 7-2. MARGINAL COST OF ABATEMENT CURVE FOR THE TREATMENT OF MINE EFFLUENT.

TABLE 7-8. DESCRIPTION OF THE VARIABLES COMPRISING EQUATION 1 THROUGH 13 IN CHAPTER 5.

| Variable | Description | Measurement Units |
|---|---|---|
| $C_{ik}$ | Incentive charge in terms of indicator *i* and discharger *k* | R/yr |
| $F$ | Phasing factor | |
| $R_i$ | Constant incentive charge rate | |
| $Cd_{ik}Ca_{ik}$ | Concentration discharged or abstracted of indicator *i* and discharger *k* | mg/L |
| $V$ | Volume | |
| $d$ | Discharged | |
| $a$ | Abstracted | |
| $C$ | Tier 1 charge | |
| $C_1$ | Tier 2 Charge | |
| $C_2$ | Tier 3 Charge | |
| $P$ | Phasing factor | |
| $R$ | Waste treatment cost | R/kg |
| $Q$ | Volume | kL |
| $L$ | Load | kg |
| $E$ | Exponent for deterrence | |
| $t$ | Target concentration (RRDV) | mg/L |
| $b$ | Pollutant extracted exceeding MARDV | kg |
| 0 | Minimum load or concentration corresponding with class A | |
| $CM$ | Mitigation charge | |
| $RM$ | Constant mitigation charge rate | |
| $C_{WW}$ | Treatment cost for wastewater with pollution loading within the normal loading range of wastewaters | R/year |
| $C_{TIN,SRP}$ | Treatment cost for wastewater with pollution loading exceeding normal wastewater pollution load – using $NO_3$-N and SRP as representative indicators for nutrients, organic loading (COD) and suspended solids (TSS) | R/year |
| $R_{WW}$ | Unit treatment cost for wastewater – 0.94R/kL as used by the City of Tshwane WWTW | R/kL |
| $VMAR$ | Virgin Mean Annual Runoff | kL/year |
| $f_i$ | Proportion of treatment cost for indicators TIN and SRP during wastewater treatment | |
| $\Delta L_i$ | Change in load of variable TIN and SRP during treatment | kg/year |
| $Conc_i$ | Concentration of indicators TIN or SRP calculated from cumulative load after treatment load reduction | kg/kL |

## 7.6 Estimating Revenue Potential of WDCS

The scope of this report does not allow for an in-depth explanation of the details of this model but the core constructs of the model are detailed here and a fairly thorough explanation of the costing methods are contained within those sub-chapters.

### *7.6.1 Methodology for WDCS Revenue Estimation*

The methodology used to estimate the values for the other 18 catchments were based on a direct linear conversion of the costs determined in the Olifants CMA case. The list of assumptions that underlie the determination of the WDCS revenue for a given catchment are such that more complex forms of estimation, non-linear or otherwise, would not necessarily result in the estimation being any more accurate, and if the estimation were more accurate this would not be verifiable.

The direct conversions of the costs are based upon the water use estimation for each of the catchments as developed in this project; they are illustrated in Appendix B of this report. The six water use sectors presented there were then subsequently grouped together to form the three sectors namely; “WWTW”, “Agriculture” and “Mining”.

The “WWTW” component is comprised of the “Rural” and “Urban” water use sectors. The “Agriculture” component is comprised of the “Agriculture” and “Afforestation” water use segments and the “Mining” component is comprised of the “mining and industrial” and the “power” sectors.

A treatment cost per million $m^3$ of water was determined based on the treatment costs and water uses for the Olifants Catchment. The treatment cost per million $m^3$ of water was determined to be as follows:

TABLE 7-9. TREATMENT COST PER MILLION $M^3$. (RANDS)

| Treatment Costs per million $m^3$ | |
|---|---|
| **WWTW** | 2 451 161 |
| **Agriculture** | 12 945 |
| **Mining** | 5 736 151 |

These treatment costs were subsequently multiplied by the water use amounts for each of the sectors in each of the catchments. The detailed estimates may be viewed in Appendix C.

### 7.6.2 *RESULTS OF THE WDCS REVENUE ESTIMATION*

The aggregated revenue estimation due to the WDCS is R 18.269 billion, with waste water treatment accounting for just over half (53.88%) of this revenue. The costs attributable to the agricultural sector make up just less than a percentage of the total spent.

TABLE 7-10. ESTIMATED REVENUE FOR THE WDCS ACCORDING TO SECTOR. (R' MILLIONS)

| Treatment Costs | |
|---|---|
| **WWTW** | 9 844 |
| **Agriculture** | 116 |
| **Mining** | 8 309 |
| **Total** | **18 269** |

The mining sectors contribution accounts for 45.48% of the total spent despite being responsible for only 8.39% of total water use within South Africa.

TABLE 7-11. PERCENTAGE OF TOTAL WATER USAGE PER SECTOR.

| % Water Use per Sector | |
|---|---|
| **WWTW** | 28.39 |
| **Agriculture** | 63.22 |
| **Mining** | 8.39 |
| **Total** | **100.00** |

### 7.6.3 *REVENUE ACCRUING TO CMAS*

We anticipate that a CMA would levy an administrative charge on the Tier 1 WDCS charge. This levy could typically range between 12-18% of the Tier 1 charge. In the Olifants WMA case study used here, this would amount to an additional revenue of between R67 million to R100 million per year. This revenue would likely be spent on personnel and equipment costs incurred to manage the WDCS.

### 7.6.4 *KEY ASSUMPTIONS OF THE WDCS REVENUE ESTIMATION*

**Exclusion of Deterrent Charge (Tier 3 and 4):** The deterrent charge is described earlier in this report does not factor into the revenue estimation for the WDCS. This is due to the simple fact that under optimal circumstances, where the deterrent charge is effective, there should be no incurrence of this charge.

The revenue estimation presented in this report is thus based purely on the cost of treatment, and it is assumed that water users are not emitting effluent to the extent of exceeding the MARDV's, and thus are not incurring deterrent charges.

**Revenue Equivalent to Treatment Costs:** The estimation of WDCS revenue has been set as equivalent to treatment cost. Thus, in fact what this document estimates is the amount of money that will inevitably be spent on removing pollutants from water, not necessarily the revenue that will be obtained by the "management authorities" for the treatment of the water.

In a real world setting it is certain that a hefty percentage of the estimated spend will be contained within the private sector, for treatment that is done "in house".

**Power Sector and Mining Sector Combined:** It was decided to combine the "Power" sector with the "Mining" sector when compiling the water use sectors for the WDCS revenue estimation in Appendix C. This is due to the close affiliation between these sectors, and due to the fact that power generation is listed as a heavy industry.

# 8 Revenue potential of Economic Charges

This section focuses in particular on the economic charges envisaged in the Pricing Strategy.

DWA, during its National Water Policy Review in 2013, indicated an intention to strongly regulate water transfers. Although the NWA makes provision for transfer of water use authorizations (Section 25), since 1998, instances of water trading have emerged that have undesirable unintended consequences such as, for example, that the water allocation may take place without Ministerial consent; and that water, because it is a scarce good, becomes commoditised, and water traders use it as a means to make profit, to the cost of users. Thus, although DWA has signaled policy intent to prohibit water trading, economic charges still remain a valuable policy instrument in water transfer mechanisms.

The framework provided by the current Pricing Strategy gives insufficient policy direction for economic charges. We propose an alternative framework for understanding and designing economic charges for water. To this end, we adapt the FOA definition of the full cost of water consumption. We thus define the economic charge as an additional charge that could capture the opportunity costs, economic externalities, environmental externalities and resource rents associated with water consumption.

This document discusses various examples of economic charges, within an adapted framework of the full cost of water consumption of Rogers et al. (1998).

The key benefits of economic charges are that they can allocate water more efficiently and that they can assist in curtailing pollution. This can be achieved without jeopardizing social imperatives.

The benefits of these charges accrue indirectly to the economy through increased Gross Domestic Product (GDP) and to the fiscus through higher tax revenues associated with increased production. The costs of implementing water trading schemes would most likely accrue to CMAs, and thus need to be recovered either through the raw water tariff, or through a mechanism ring-fenced within the particular economic charge scheme. In addition it may also be possible to capture the resource rent associated with these transactions – these rents would likely accrue to National Treasury.

## 8.1 Background

### *8.1.1 The Pricing Strategy for Raw Water (2007)*

The National Water Act (1998) in paragraph 56(2)(c), envisages a pricing strategy for water use charges that may set these charges "for achieving the equitable and efficient allocation of water." The Pricing Strategy for Raw Water (2007) interprets this paragraph in section 8, which deals with Economic Charges.

Economic charges are primarily viewed as a mechanism through which to shift water from lower to higher value water uses.

The economic charge is to be set by DWA, either:

- Administratively, by determining a proxy for the economic value of water, or
- By selling water on public tender or auction.

### 8.1.2 Administrative mechanisms

The administratively determined charge is envisaged to be implemented only after compulsory licensing has been introduced.

It is to be used in water stressed catchments to promote beneficial use through the reallocation of water to higher value users. This is to be accomplished by allowing the transfer of authorizations to use water by trading.

The administratively determined charge is intended to incorporate the return on assets charge for government water schemes as well as the opportunity cost of water as determined by prevailing transactions.

### 8.1.3 Market-oriented mechanisms

Market-oriented mechanisms are also envisaged to be implemented only after compulsory licensing had been introduced. The pricing strategy envisages that this would be especially applicable in areas where large competition for water use exists. In such cases, mechanisms such as a public tender procedure may be followed.

The Pricing Strategy further refers to voluntary trading of water use entitlements within and between sectors.

### 8.1.4 Compulsory licensing – a constraint to economic water charges in the Pricing Strategy

The Pricing Strategy sets compulsory licensing as a pre-condition for implementing economic charges. The NWA establishes a procedure for a CMA to undertake compulsory licensing of any aspect of water use in respect of one or more water resources within a WMA. It includes requirements for a CMA to prepare schedules for allocating quantities of water to existing and new users. The procedure is intended to be used in areas which are under 'water stress'. This may occur where water demand is approaching or exceeding the available supply. It may also occur where water quality problems exist, and/or where the water resource quality is under threat (NWA 1998).

The full compulsory licensing process could, however, be long and tedious (DWA 2011). Moreover, a number of economic charge mechanisms exist through which to relieve such supply constraints. DWA in its Water Allocation Reform Programme (2005) and its recent reconciliation strategies (2011) identifies a number of "alternatives" to compulsory licensing with a view to reducing water requirements. These include:

- Water Conservation and Water Demand Management (WC/WDM) in the irrigation, domestic water use, and mining sectors
- Lowering the assurance of supply
- Compulsory Levy and Purchasing Water Entitlements, and
- Promoting water trading.

The alternatives in fact present DWA with economic charge mechanisms. Thus, by making compulsory licensing a pre-condition for economic charges, the Pricing Strategy in effect constrains the implementation of economic charges.

For economic charges to be effective, this constraint needs to be addressed.

### 8.1.5 *A POTENTIAL CONFLICT BETWEEN SOCIAL AND ECONOMIC IMPERATIVES*

It is not only the above constraints that have to be addressed. A potential conflict between the application of economic charges for water, and the social value of water, also has to be managed.

This conflict was described to some extent by Adam Smith in An Inquiry into the Nature and Causes of the Wealth of Nations: A Selected Edition (Smith, 1776, Book 1, Chapter 4), where he describes the paradox of value between water and a diamond:

*"The word Value … has two different meanings, and sometimes expresses the utility of some particular object, and sometimes the power of purchasing other goods which the possession of that object conveys. The one may be called 'value in use'; the other 'value in exchange'. The things which have the greatest value in use have frequently little or no value in exchange; and, on the contrary, those which have the greatest value in exchange have frequently little or no value in use. Nothing is more useful than water; but it will purchase scarce anything; scarce anything can be had in exchange for it. A diamond, on contrary, has scarce any value in use; but a very great quantity of other goods may frequently be had in exchange for it."*

Although water in modern times have become a much scarcer commodity than in Adam Smith's time, it is still true that water is a relatively inexpensive commodity. However, it is also a social good, and the rights to free basic water and to an ecological water reserve are recognized in South African water law. Thus there arises an apparent conflict between the application of economic charges for water, and the social value of water.

It is likely for this reason that the Pricing Strategy takes a cautious approach and links economic charges implicitly to water use licenses, whilst using compulsory licensing as pre-condition.

However, the Pricing Strategy does not express an explicit opinion on this apparent conflict.

### 8.1.6 *FINANCIAL COSTS, FISCAL IMPACTS AND POLICY IMPERATIVES*

Different objectives are usually followed with implementation of economic charges as a policy instrument (Backeberg 2009). These are mainly to (1) balance the budget and (2) influence water user behaviour.

In order to balance the budget, two matters are of concern: the financial cost and the fiscal impact.

The financial cost concerns the capital and recurrent expenditure required to implement the economic charge. The fiscal impact concerns the accrual of tax revenue to the Treasury.

Influencing behavior relates to achieving policy objectives, which may include, promoting water savings, promoting water equity and/or achieving ecological sustainability. The key argument in influencing water user behaviours to these ends is to provide behaviour-changing price signals.

The Pricing Strategy does not discriminate between these matters and envisages accrual of all economic charges to National Treasury.

It is however to be expected that efforts made by CMAs to implement economic charges would incur costs, and these would have to be set off against the revenue earned through the economic charges. In addition, economic charges should not only be seen as a revenue generation instrument, but they also have an important role to play as a policy instrument. This may require the economic charges at times to be used as incentives for changing water use behaviour. A very important component of economic charges is what economists define as the resource rent, this rent is theoretically what should accrue to National Treasury.

### 8.1.7 CHARGE TYPES

Various charging systems are available to design specific water user charges. These include for instance average and marginal costs; area and volumetric based cost; unitary or tiered/block-rate charges; and two-part charges, consisting of a fixed, area based component and a variable, volumetric component (Backeberg 2009). The Pricing Strategy is silent on these matters.

### 8.1.8 PROBLEM STATEMENT

The framework provided by the current Pricing Strategy gives insufficient policy direction for economic charges. We require a different framework for understanding and designing economic charges for water.

## 8.2 A DEFINITION FOR THE FULL COST OF WATER CONSUMPTION

The FOA (2004) proposes a framework for analyzing economic charges. It does this through defining the full cost of water consumption.

According to this definition, the full cost of water consumption comprises three cost components: the Full Supply Cost; the Full Economic Cost; and the Full Cost. This is according to a definition by Rogers et al. (1998), as adopted by the FAO (2004). Each of these concepts is composed of separate elements that need further explanation. The sections below were adapted from Rogers et al. (1998).

### 8.2.1 FULL SUPPLY COST

The Full Supply Cost is defined to include the costs associated with the supply of water to a consumer excluding the externalities imposed upon others, and excluding the alternate uses of the water (i.e. opportunity costs).

Full Supply Costs comprises two items: Operation and Maintenance (O&M) Cost, and Capital Charges, both of which are defined to include the full economic cost of inputs.

O&M costs are associated with the running of the supply system. Typical cost items include purchased water (e.g. TCTA fees), electricity for pumping, labour, repair materials, and input costs for managing and operating storage, distribution, and treatment plants where relevant.

Capital Charges include capital consumption (or depreciation charges) and interest costs associated with reservoirs, treatment plants, conveyance and distribution systems.

### 8.2.2 FULL ECONOMIC COST

The Full Economic Cost of water is the sum of the Full Supply Cost, the Opportunity Cost associated with the alternate use of the same water resource, and the Economic Externalities imposed upon others due to the consumption of water by a specific actor.

The Opportunity Cost addresses the fact that by consuming water, the user is depriving another user of the water. If that other user has a higher output production value associated with water use, then there are some opportunity costs experienced by society. The Opportunity Cost of water is zero only when there is no alternative use (or where there is no shortage of water). The consequence of ignoring the Opportunity Cost undervalues water, and results in a failure to invest optimally and, thus, causes serious misallocations of the resource between users.

The most common Economic Externalities are those associated with the impact of an upstream diversion of water, or pollution discharge, on downstream users. There are also externalities due to over-extraction from common pool resources such as underground water.

### *8.2.3 Full Cost*

The Full Cost of consumption of water is the Full Economic Cost, as defined above, plus the Environmental Externalities. These costs have to be determined based upon the damages caused, or as additional costs of treatment to return the water to its original quality.

Environmental Externalities are those associated with public health and ecosystem maintenance. Thus, if pollution causes increased production or consumption costs to downstream users, it is an Economic Externality, but if it causes public health or ecosystem impacts, then it is defined as an Environmental Externality.

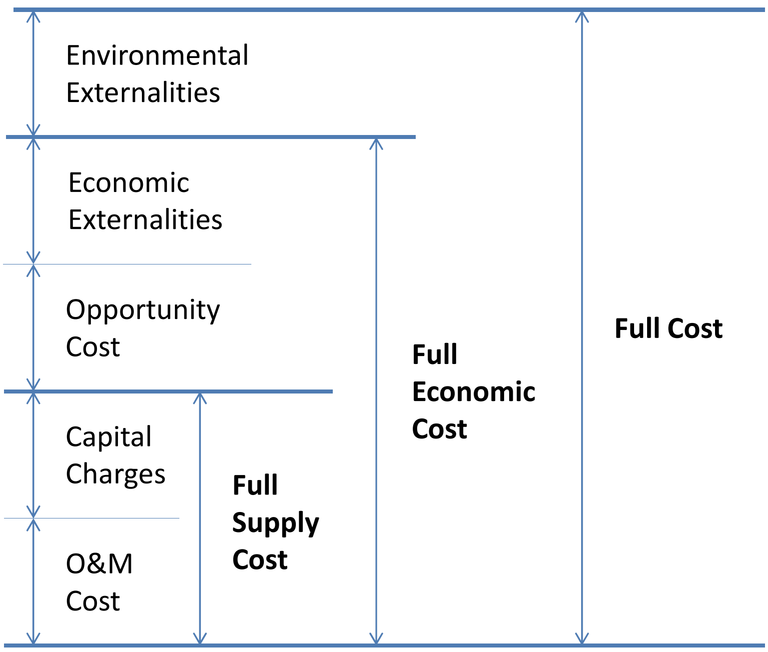



FIGURE 8-1. THE FULL COST OF WATER CONSUMPTION COMPRISES O&M COST, CAPITAL CHARGES, OPPORTUNITY COST, ECONOMIC EXTERNALITIES AND ENVIRONMENTAL EXTERNALITIES. RECOVERY OF OPPORTUNITY COST, ECONOMIC EXTERNALITIES AND ENVIRONMENTAL EXTERNALITIES THROUGH WATER PRICING MECHANISMS FALLS WITHIN THE DOMAIN OF ECONOMIC CHARGES.

### 8.2.4 *Resource rent*

In economics the rent is the surplus value achieved over and above the expected costs and required returns (normal profits) that need to be accounted for. Resource rent is thus akin to a supernormal profit and that arises from the use of a natural resource. In mining, a mining royalty tax often reflects the resource rent accruing from the mineral resource asset. The Rogers et al. (1998) definition does not explicitly include a resource rent accruing to water resources. This is an omission.

### 8.2.5 *A definition for economic charges*

The above definition is however especially helpful for analyzing economic charges for water.

In the South African setting, the Full Supply Cost is already captured in the raw water tariff.

Thus the economic charge would be an additional charge that could capture the opportunity costs, economic externalities, environmental externalities and resource rents associated with water consumption. Or, alternatively, the recovery of Opportunity Cost, Economic Externalities, Environmental Externalities and Resource Rents through water pricing mechanisms falls within the domain of economic charges.

In the section below we test various economic charge cases against this definition.

### 8.2.6 *Social imperatives*

The potential conflict between economic charges and social imperatives can be managed within the above definition by securing social imperatives (e.g. basic human and environmental needs) within the Full Supply Cost component. This would "ring-fence" the provision of water for social imperatives within the Full Supply cost and leave it unaffected by economic charges.

## 8.3 Discussion: Economic charges

This section provides a discussion of economic charges at the hand of case studies. The section is structured according to the definition for economic charges set out above. The purpose of this section is to demonstrate various aspects of economic charges for water.

### 8.3.1 *Economic opportunity costs – Water trading*

Australia has been using water trading as a mechanism for reducing the economic opportunity costs of water. The policy imperative was to move water use away from rice production to higher value output water uses.

In Australia in the 1980s there was a fundamental shift in focus with regards to water management. Government was less willing to fund large scale water infrastructure projects, the agricultural sector was becoming increasingly exposed to international competition and there was an increasing awareness of the impact of large scale water storage and use on the environment (NWC 2012).

Water resources in certain catchments were becoming fully or even over allocated leaving agriculture and other economic sectors vulnerable to shocks in the available water supply. This resulted in a shift away from the augmentation of existing water supply schemes towards making better use of the existing water entitlements. This led to the introduction of a water trading system in 1983 whereby water entitlements could be traded between water users.

One of the primary advantages of the system of tradable water entitlements was that it allowed for the overall extractions of water to be capped, meaning that the only way to obtain additional water rights was to purchase them from someone else.

The underlying motive was to increase efficiency as well as equity in water allocation whilst simultaneously preserving the environment for coming generations. Fundamentally, this enables water allocations to move to relatively higher valued uses which reduces the opportunity costs associated with the use of water and results in a benefit for the overall economy (NWC 2011).

The price signal that resulted from the trade of water entitlements encouraged irrigators to use water and other inputs in a productively efficient manner. Water prices signals during the droughts of the early 90s encouraged irrigators to determine exactly how much water their crops required during particular phases of their growth cycles and to invest in technologies that improved the efficiency of their water use

The result of these new approaches saw shifts on a regional scale with large volumes of water moving away from flexible production systems such as the rice growing areas of New South Wales towards long lived perennial horticultural investments in South Australia (NWC 2012).

The trade of water entitlements also saw water move from the agricultural sector to urban centers as well as the environment.

The system has encouraged the development of high value irrigation enterprises whilst allowing for adjustments to production to be made more easily. This allows market exit and retirement decisions to be made by producers as the sale of water entitlements allows individuals to finance their exit from the industry, or simply to negotiate a period of change.

This case provides evidence that water trading can reduce economic opportunity costs. The benefits thereof accrue indirectly through increased Gross Domestic Product (GDP) and to the fiscus through higher tax revenues associated with increased production. The costs of implementing water trading schemes would most likely accrue to CMAs, and need to be recovered either through the raw water tariff, or through a mechanism ring-fenced within the water trading scheme. In addition it may also be possible to capture the resource rent associated with these transactions – these rents would likely accrue to National Treasury.

Water trading has been taking place in South Africa for many years (Armitage et al. 1999).

Armitage and co-workers (1999) conducted research in two irrigation districts, and investigated how water markets could lead to more efficient allocation and use of water in irrigation. In the first study area, the Lower Orange River, where water is a scarce resource and production is entirely dependent on irrigation water, one of the highest incidences of market trading of water rights in South Africa had occurred. In the second study area, the Nkwaleni Valley, water is similarly a scarce resource with production wholly dependent on irrigation, but no trading of water rights had occurred.

Along the Lower Orange River water transactions were driven by the demand of large-scale table grape producers, with large holdings of arable "outer land" without water rights, to expand their operations. The sale price (1996 value) for "outer land" water rights ranged from R800 to R5 000/15 000 $m^3$·ha, with an average price of R3 380/15 000 $m^3$·ha. No water-market activity had occurred in the Nkwaleni Valley. However, more than 40% of the sample farmers indicated that they needed additional water and that they would like to purchase water rights or rent in water rights.

Evidence of water transfers exist across the country (personal communication: Ms A Petersen, DWA). However, these water trading transactions take place at an administration fee of R114 per transaction. This fee is an outdated fee that fails to capture either the O&M cost of transaction administration or the resource rent associated with the transaction.

### *8.3.2 Economic opportunity costs – Compulsory Levy and Purchasing Water Entitlements*

An interesting approach to reduce water use proposed by DWA in the Olifants Reconciliation Strategy is for DWA to levy an additional water use charge (i.e. and economic charge) on all users of water in terms of Section 57 of the NWA.

The financial contributions of all the water users would be ring-fenced and used to buy out water entitlements from those water users who are willing to sell. This process would then be continued until the necessary water balance is achieved. This would include buying water to meet the needs of the Ecological Reserve. In some places this could provide a more cost effective option than building, for instance, a dam (DWA 2011).

The water balance would theoretically be achieved when the Opportunity Cost approaches zero. This levy provides a good example of how an economic charge primarily becomes a policy instrument. If the CMA is to administer this levy, it needs to internalize the administration cost thereof within the levy.

### *8.3.3 Economic opportunity costs – Case Study: The Water Administration System*

The WRC, DWA and some WUAs developed the Water Administration System (WAS) project over the last 25 years. The system is a management tool for Water User Associations (WUAs), Catchment Management Agencies (CMAs) and water management offices to effectively measure and manage agricultural water resources. The main objective of the system is to minimize water losses for irrigation schemes (Agri 2010).

The system is an integrated database-driven system with many water management capabilities that include handling any number of farmers, abstraction points and measuring stations on canal networks, pipelines and rivers. The system involves simplified and controlled ways of managing water allocations, use, distribution and billing (Winter 2009).

The WAS program has been implemented at major irrigation schemes throughout South Africa and manages an irrigated area of more than 142,000ha including 9,500 farmers. Through improving accuracy of water quota allocations based on water orders from farmers and crop water use data, the WAS has reduced spillages due to excessive water release. This has resulted in 21.2% or 85,165,900 $m^3$/yr of water being saved (Winter 2009).

This water saving, in combination with other benefits including reduced operating costs, improved planning, better water utilization, accurate release of water and improved crop water use data have resulted in increased crop yields for farmers. In the Eastern Cape, irrigation under the old manual water distribution system would yield an output of between 1.5-2.5 tons of wheat on a 100 hectare farm. Irrigation under the WAS however has increased the output of wheat to about 6.5-7.5 tons (Winter 2009).

Utilization of the WAS in the Free State improved records of debtors that in some cases were unknown to the water administrators. Full utilization of the system in the Free State has also ensured that farmers were unable to abstract water without the full knowledge of the water distribution administrators. This was because the WAS reports and monitors all increases and decreases in water levels in the various dams and canals. Farmers that overdraw water can easily be identified and billed using the WAS (Winter 2009).

More importantly, these water savings enable farmers to horizontally expand their irrigation areas.

Although the WAS is not a pricing mechanism, it is an interesting mechanism for reducing opportunity costs. At the same time it can increase either area under irrigation, or water availability to other non-irrigation use. In the both these cases it may present an opportunity for increased revenue generation for CMAs.

### *8.3.4 Economic opportunity costs – Reducing assurance of supply*

As in the case of the WAS, further water allocations may be possible if existing water users agree to accept lower assurances of supply. The assurance of supply is explained as follows in the Pricing Strategy:

- If (for example) a scheme has 100 million $m^3$ of available water per annum, of which 30% is allocated to domestic and industry, (30 million $m^3$) and the balance of 70% is allocated to agriculture, then the long term average use of allocations are calculated as follows:
  - Domestic & Industry assurance of supply = 97% implies 30 million $m^3$ x 0,97 = 29.1 million $m^3$
  - Irrigation assurance of supply = 91% implies 70 million $m^3$ x 0,91 = 63,7 million $m^3$
  - Total assured water supply is thus 92,8 million $m^3$

Various incentives for lowering assurance of water supply exist. This could include for instance, higher water availability during shorter assurance periods, lowering of water charges resulting from lower assurances, or compensating for losses as a result of increased water shortages.

As in the case of the WAS, reducing the assurance of water supply would likely produce indirect benefits through increasing production in the long run with commensurate increases in GDP and fiscal revenues. It may also present an opportunity for increased revenue generation for CMAs.

### 8.3.5 *ECONOMIC EXTERNALITIES – CASE STUDY: RESOURCE RENT IN THE STEELPOORT RIVER*

A paper by Hassan and Farolfi (2005) outlines the case of the Steelpoort sub-basin (SPSB) in the Olifants catchment where a partial equilibrium estimation model was used to estimate the resource rent achieved through the supply of water and to determine to whom this resource rent was accruing.

As defined above, resource rent is the surplus value achieved over and above the expected costs and required returns (normal profits) that need to be accounted for. Rent is thus termed as a supernormal profit and may arise due to various reasons. In the case of the CMAs the cost of the management of water is what is to be considered primarily, since that is the functional role that CMAs play. The cost of managing a catchment is thus what needs to be recovered by a CMA, and the resource rent generated by this market could be further exploited to generate revenue for to the fiscus.

The case of the SPSB illustrates a case of resource rent that is achieved due to the scarcity of the water resource relative to the demand for it. The equilibrium price for the resource is driven up by the high demand for the resource resulting in an equilibrium market price that exceeds the cost of supplying the resource (including the normal profits required by those who supply it).

**Scarcity Rent Illustration:**

*Consider for a moment the case of long stemmed roses, where the cost to produce one long stemmed rose (i.e. paying for the labour, soil products, logistics packaging) including the normal profit expected by the producer adds up to R5. If we assume that a single long stemmed rose sells for R10 on the market then we can calculate the resource rent as being R5 (the difference between the sale revenue and the cost of production).*

*However, let's say that the demand for roses increases before Valentine's Day, and the price of roses on the market increases to equilibrium price R15. The resource rent achieved on the sale of the rose thus increases to R10.*

*However, if the equilibrium price is R15 and the cost of production is R5, but the actual selling price of a rose is R3, the resource rent remains the difference between the equilibrium price and the cost of production (R10). The difference between the equilibrium price of the rose (R15) and the selling price of the rose (R3) is thus recognised as a subsidy of R12 to the entity purchasing the rose (Griffiths and Wall 2008).*

However, the case also illustrates how through the underpricing of the water being supplied, that the resource rent was not captured, and was instead was dissipated to the various users of the water, in what is an indirect subsidy. A compounding factor illustrated in the case is the over abstraction of water from the sub-basin which erodes the ecological reserve. The effect of this over abstraction on the net welfare experienced by the users is however not expounded.

The paper details that the Steelpoort sub-basin region comprises some 13% of the Olifants WMA (Water management Area) and has a land area of over 7,139km$^2$. The primary water use sector is agriculture which accounted for around 70% of water use in the area in 2002 (Hassan and Farolfi 2005). The mining sector accounted for 12.6% whilst industry and rural communities accounted for 5% of water use. Total demand was estimated at 95 million $m^3$.

The total quantity of water within the system which includes water available for abstraction (61 million $m^3$) as well as the basic human needs reserve (2.61 million $m^3$) and the ecological reserve (94 million $m^3$) amount to 157.61 million $m^3$. However with demand exceeding the available allocation for abstraction the deficit of 34 million $m^3$ is taken at the expense of ecological reserve.

The conservative estimates produced by the study indicate that of the resource rent generated by that market only a fraction, less than 2% was captured by the levy for water research (the mechanism by which the WRC generates its research funds) whilst the remaining resource rent was dissipated to the various users of the resource through what amounts to an indirect subsidy of R0.42/$m^3$. This amounts to a subsidy of almost R40 million to this market.

With commercial irrigation being the largest water user it goes to reason that they also enjoy the largest slice of this subsidy followed by mining and the remaining. The commercial irrigation sector will thus be the most affected by any policy changes with regards to water charges. More importantly, the case illustrates the potential to generate additional revenue through the capturing of the resource rents that are dissipated into the market.

### *8.3.6 Economic externalities – Case Study: Subsidy to Irrigation*

Analysis of the revenue potential of water resource charges to fund the operations of CMAs, as analyzed and expounded in this project revealed that increases in water resource charges will be necessary in order to fund the potential costs that will arise from the fully capacitated catchment management institutions.

At the present level, water resource charges will account for roughly 27% of the costs of water management, implying that 73% of water management costs will be subsidized if the current tariffs are maintained.

As in the case of the Steelpoort sub-basin illustrated below, this shortfall in the water resources charges amounts to an indirect subsidy to the water use sectors. Agriculture, being the biggest water user, accounting for an estimated 60% of water use in South Africa in 2012, enjoys the largest portion of the indirect subsidy to water management costs, which amounts to R289 million (assuming 2012 water use requirements and fully capacitated catchment management institutions).

The combination of subpar water resource charges and the resulting limitations in water resource management are likely to result in market distortions, generating negative externalities, which in turn will lead to a less efficient agricultural sector.

In addition, the observably low price elasticity of water observed in the agricultural sector (Pearce et al. 2011) lends support to the notion that it would be possible to increase water management charges with the consequential effect on overall agricultural production being negligible. This argument is supported by the fact that water resource charges form a relatively small portion of the overall cost of water.

### 8.3.7 *ENVIRONMENTAL EXTERNALITIES – CASE STUDY: WDCS*

Externalities arise when a cost or benefit arises from a particular type of economic production and that cost or benefit does not accrue to the buyer or seller of that particular good/service.

Human activities impacting on water as a resource, especially the activities resulting in a decrease in water quality are of particular concern in water management areas (WMAs). The activities of major environmental concern will differ between WMAs, but will usually include the discharge of partially treated or untreated wastewater by municipalities, the discharge of industrial effluents, mining operations and agricultural activities.

The Waste Discharge Charge System is a particular system of internalizing the externalities that arise from economic activities that negatively affect the quality of water of water resources. The WDCS is in essence a set of institutional constructs operating in unison to accrue the negative effects of a specific economic activity to the parties responsible, effectively reducing/eliminating the externality.

The waste discharge charge system (WDCS) aims to reduce the impacts that water users have on water resources in order to address the problem of excessive pollution on water systems. The objectives of the WDCS include efficient resource utilization, sustainable water use and development, discouraged pollution, internalization of environmental costs and cost recovery from activities polluting water sources. The principles on which the WDCS is based are the polluter pays principle (PPP), reduction of pollution at source principle and precautionary principle (DWA 2007).

### 8.3.8 *ENVIRONMENTAL EXTERNALITIES – CASE STUDY: TRADABLE POLLUTION PERMITS*

The Loskop Dam catchment of the Olifants River in Mpumalanga is the center of the coal mining and power generation industries in South Africa. These industries generate saline effluent, part of which is discharged into the river system.

Lodewijks (2002) investigated transferable permits as an alternative economic instrument to the WDCS, for environmental control. TPs involve having a fixed number of permits, effectively capping the environmental damage caused by emissions of saline effluent. These TPs can be freely transferred between emitters, improving the economic efficiency of the pollution control system. A precedent exists in the form of the Hunter River Salinity Trading scheme, a TP system in operation in a catchment in Australia that is very similar to the Olifants River catchment.

The study concluded that some of the conditions in the Loskop Dam are favorable for the effective implementation of TPs, notably a sizeable market for permits and an existing rudimentary scheme that could be easily adapted to a TP scheme.

An important consequence of the scheme was that TPs could likely address the negative environmental impacts of abandoned mines by including these in the scheme.

The study regarded TPs as an alternative to the WDCS based on the principle that market forces would be more efficient and accurate at determining the true value of the damage caused by pollution (as well as the cost of abatement of pollution), than a centralized control authority such as the DWA.

In the scheme, the total number of permits in circulation is to be capped. This means that the total effluent load is capped.  TP value would adjust to inflationary pressures, thereby maintaining the income for the control authority from the sale of permits.

The income for the CMA would be generated by the sale of permits by the control authority.

## 8.4 Opportunities for CMAs in Economic Charges

This document provides various examples of economic charges, within the adapted framework of the full cost of water consumption of Rogers et al. (1998).

The key benefits of economic charges are that they can allocate water more efficiently and that they can assist in curtailing pollution.  This can be achieved without jeopardizing social imperatives.

The benefits of these charges accrue indirectly to the economy through increased Gross Domestic Product (GDP) and to the fiscus through higher tax revenues associated with increased production.  The costs of implementing water trading schemes would most likely accrue to CMAs, and thus need to be recovered either through the raw water tariff, or through a mechanism ring-fenced within the particular economic charge scheme.  In addition it may also be possible to capture the resource rent associated with these transactions – these rents would likely accrue to National Treasury.

# 9 REVENUE POTENTIAL OF PAYMENTS FOR ECOSYSTEM SERVICES SCHEMES

## 9.1 OVERVIEW

Good institutional support is essential to the on-going viability of PES programs. Very few transactions take place in the absence of supporting institutions. Even the simplest contracts between buyers and sellers rely on institutions (formal or informal) to adjudicate disputes when they arise and on enforcement to ensure the judgments are carried out.

A well-functioning and established CMA should be optimally placed to provide the necessary institutional support for PES Programmes, specifically those that would promote the mandate the CMA, and contribute to more effective management of the catchment.

A range of specialized institutions, both public and private, can promote PES transactions. CMAs occupy the unique social space of being able to home in to localized areas through Water User Associations or to facilitate national level cooperation through the national CMA network. The adaptability of scale would allow CMAs to act as facilitator at various levels, as is appropriate for the given PES program. The network would also allow for expansion of pilot programs that have proved successful at a small scale.

Assessment of the suitability of a suggested PES program could feasibly be the responsibility of the CMA, which would ensure the availability of the necessary drivers to motivate such a program. Such drivers would include the availability of funding to launch the program, the scientific viability of the benefits proposed by a PES program, ensuring the existence of a willing market of buyers for the ecosystem services and ensuring the existence of a willing market of sellers who would contribute the actions necessary to produce the added ecosystem services. In addition, the monitoring capacities of the CMA would track the efficacy of the program as well as sanctioning the non-compliance of any stakeholders participating in a PES agreement.

CMAs would also function as facilitators for exchange, allowing for the existence of trading markets for ecosystem services, as in the example of carbon credit exchange, to facilitate exchange of carbon sequestration credits. In order to facilitate exchange, a marketplace for buyers and sellers of carbon credits to exchange with one another should be provided. This has proven viable as a number of countries have created the equivalent of national carbon offices that keep track of carbon emissions and reduction projects.

There are many different types of institutions that can support PES and, importantly, these need not be formal government bodies as the private sector should play an active role as well. The private sector could include commercially motivated organizations as well as local institutions based on customary practices.

Indeed, in many parts of the world formal institutions are ineffective, and parties cannot assume that laws will be complied with or enforced. In such cases, informal local institutions, based on customary practices, can provide the support needed for PES schemes to operate.

Thus for PES programmes to succeed there should be well formed regulatory drivers that provide a legal framework for PES programs. An ecosystem services approach is more likely to succeed in a situation where the legal, institutional, social and economic conditions provide a supportive and appropriate framework. These requirements would include well defined property rights, strong institutions, sufficient technical and field capacity, stakeholder involvement between higher level stakeholders right down to community level participation.

Supporting institutions are particularly important in the context of property rights. Take for example the need for a land registry where owners can record their titles and where buyers can search titles. There also must be adequate contract law and legal institutions to adjudicate disputes as well as adequate authorities to enforce judgments.

There is no textbook model of a successful PES program in South Africa. The Working for Water (WfW) and Working for Wetlands Programmes are an approximation to this. The WfW case is thus not typical for PES, and resembles more the generic family of environmental food-for-work programs (Holden et al. 2006). It is actively funding poverty relief with a government-supported program. WfW effectively acts as a conduit for the provision of ecosystem services, predominately water supply, through the control of invasive alien plants and the provision of unskilled job opportunities, using predominantly taxpayers' money. Though this form of transfer payment does not constitute the creation of a market for the provision of ecosystem services in the strict sense, it does constitute a payment for the service delivery.

The cases of the Baviaanskloof-Tsitsikamma PES Program and the Maloti-Drakensberg Transfontier Project are still in the exploratory phases. Initial investigations have provided sufficient scientific evidence to delineate the ecosystem linkages necessary to enact a PES initiative. However, the supporting institutions are still insufficiently developed to undertake the full scale initiative in an effective and efficient manner.

CMAs could potentially play a central role in facilitating the development of PES programmes to promote the mandate of effective and efficient catchment management. This will include the progressive privatization of PES programs where deemed feasible, as this would ensure greater efficiency with regards to expenditure and productivity. CMAs would in such a case continue to play a regulatory role.

The central tenet underlying the development of PES programs is the creation of markets of ecosystem services, such that the trade in ecosystem services will allow for a more efficient transfer of benefits derived from natural resources, which in turn allows for a more complete recognition of the benefits derived from those resources.

## 9.2 WHAT ARE PAYMENTS FOR ECOSYSTEM SERVICES?

**The definition of Payment for Ecosystem Services (PES) is** 'A voluntary transaction in which a well-defined environmental service (or land-use likely to secure that service) is being 'bought' by a (minimum of one) ES buyer from a (minimum of one) ES provider if and only if the provider continues to supply that service (conditionality)' (Wunder 2005).

The definition provided by Wunder is conceptually based on the Coase theorem (Engel et al. 2008; Muradian et al. 2010) by seeking to internalize the positive externalities that ES provide through bargaining solutions between those who provide the services and those who gain from it and is theoretically rooted in the field of environmental economics (Gómez-Baggethun et al. 2010).The basic idea behind these mechanisms is that the beneficiaries of service provision compensate the providers.

Payments for Ecosystem Services (PES) have gained ever-increasing attention among a wide public of scholars as well as conservation and development practitioners. The main premises of this innovative conservation approach are appealing:

- Private landowners, which in normal circumstances – i.e. in absence of any direct incentives – are poorly or not motivated to protect nature on their land, will do so if they receive direct payments from environmental service (ES) buyers, which at least cover part of the landowners' opportunity costs of developing the land.
- Key Points:
  - Private land owner, in absence of any incentive;
  - who are poorly motivated to protect their land;
  - will so do if they receive direct payments from ecosystem services buyers;
  - which at least partially cover the cost of developing the land

This is an innovative approach to nature conservation and includes a variety of arrangements through which the beneficiaries of environmental services reward those whose lands provide these services with subsidies or market payments. Arranging payments for the benefits provided by forests, fertile soils and other natural ecosystems is a way to recognize their value and ensure that these benefits continue well into the future.

PES is a new approach to internalizing the positive environmental externalities associated with ecosystem services. It involves financial transfers from the beneficiaries of these services (i.e. those who are demanding them) to others who are conducting activities which generate these environmental services (i.e. are supplying them). PES schemes reward people, either with cash or in-kind benefits, to manage their land in ways that will secure environmental services. PES is one type of economic incentive for those that manage ecosystems to improve the flow of ecosystem services that they provide. Generally these incentives are provided by all those who benefit from ecosystem services, which include local, regional and global beneficiaries. PES is an environmental policy tool that is becoming increasingly important in developing and developed countries. These payment schemes can be designed and introduced in a context where there are already well-defined and measurable links between a certain activity (or conservation practice) and the quantity and quality of ecosystem services. They can also be introduced in a context where there is a change in conservation practice (e.g. land use) which will lead to a change cum improvement of ecosystem services.

Most PES are based on inputs (i.e. land management practices) rather than outputs (i.e. a measurable change in service provision), whether this increases the service provision or not. PES has an advantage over many other conservation tools in that it is both an incentive and a financing mechanism, and is potentially very efficient (Pagiola et al. 2002; Pagiola and Platais 2007). Thus, targeted conservation areas may benefit from PES as long as conservation action results in a measurable increase in the provision of ecosystem services that can be 'commoditized' and traded. They differ from more conventional integrated conservation and development approaches by making payments directly and conditional on the level of environmental service achieved. PES schemes are therefore generally more cost-effective and have less complex institutional arrangements than other approaches.

PES will likely be a blueprint for the payment systems to be used within a REDD mechanism. The concept is often cited as an appropriate model upon which to base a REDD system whereby financial reward is made towards efforts to avoid deforestation and conserve carbon. Previous or existing PES schemes or projects have extended beyond the area of forest conservation, recognizing the environmental contribution delivered through certain practices carried out by small land-owners and resource users. These include, for example:

- promotion of water sanitation practices
- sustainable agricultural activities
- wildlife conservation.

PES encourages them to continue to operate sustainably. This can be important when government policy and economic climate favours large producers (Hall 2008).

## 9.3 WHAT ARE ECOSYSTEM SERVICES?

The Millennium Ecosystem Assessment (MEA) framework, released in 2005, is a synthesized framework for the assessment of ecosystems and the services that they generate. The MEA framework assesses the relationship between ecosystem functionality and human benefits.

The MEA defines ecosystems services as the benefits humans derive from ecosystems. The MEA provides a sound and well established framework for the assessment of ecosystem services and the benefits to human well-being.

The four types of ecosystem service benefits, as defined by the Millennium Ecosystem Assessment Framework, are the units that should be counted to determine the beneficial products of nature. Economic principles are used to define these services (Boyd 2006).

In the MEA system, water resources comprise aggregate assets that yield a flow of aquatic ecosystem services, all of which benefit households and firms. These include four types of services:

1. Provisioning services (including the production of fresh water, foods, fuels, fibres and biochemical and pharmaceutical products);
2. Cultural services (including non-consumptive uses of the ecosystem for recreation, amenity, spiritual Renewal, aesthetic value and education);

3. Regulating services (including the absorption of pollutants, storm buffering, erosion control and the like); and
4. Supporting services (a fourth category of ecosystem services which includes services such as photosynthesis).

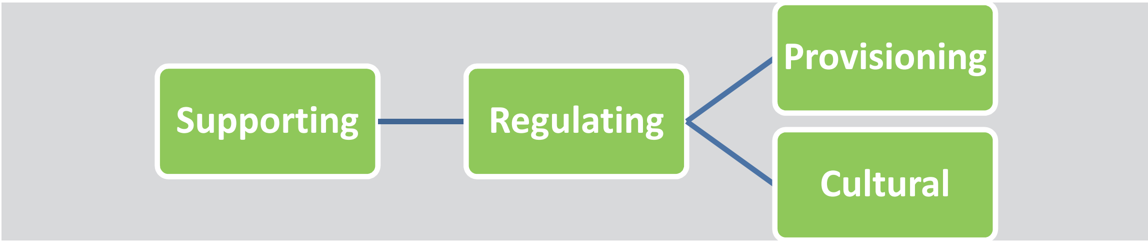



**FIGURE 9-1. DIAGRAM ILLUSTRATING THE FOUR FUNCTIONAL ECOSYSTEM SERVICES CATEGORIES**

Literature distinguishes between four different kinds of services which are included most in market schemes: hydrological or watershed services, carbon sequestration, biodiversity protection, and landscape beauty (Wunder 2005). These services are currently receiving the most money and interest worldwide and demand for these services in particular is predicted to continue to grow as time goes on. PES for hydrological services primarily operates at the local or regional scale whereas buyers for biodiversity, landscape beauty and carbon sequestration are often located abroad, with PES schemes spanning international boundaries. Certification of products is also sometimes included as a form of PES (FAO 2007, Carroll and Jenkins 2008) although others do not consider it to be a PES because certification requirements do not entail guaranteed price premiums for certified products (Sommerville et al. 2009).

## 9.4 WHAT IS THE MOTIVATION FOR PES?

Across the world, environmental conservation is critical to secure the flow of ecosystem services that are essential for people and nature. A variety of PES schemes have emerged as potential sources of sustainable financing for conservation. PES programs use market and institutional incentives in order to meet both environmental and poverty alleviation objectives. PES turns attention towards the role of environmental services in agricultural landscapes as they provide a living for many poor in developing countries thus providing policy insights and stimulating debate on linkages between poverty alleviation and environmental protection. In addition to preserving natural resources, these schemes improve rural areas and rural lifestyles resulting in increasing support for their use. Although PES schemes can be linked to poverty alleviation strategies, their major objective is to achieve a given environmental goal at a feasible cost, using the market price mechanism. Development policy has responded to an increasing concern about natural resource degradation by setting up innovative PES programs in developing countries.

The payment schemes are a mechanism that could play a key role in achieving conservation goals and sustaining ecosystem health more generally. Payment schemes for ecosystem services are emerging worldwide as a valuable tool to ensure their proper valuation and sustainable management and are important mechanisms to align investments in human and natural well-being. Today's technology and knowledge can contribute to minimizing the human impact on ecosystems, but their potential will be fully realised once ES cease to be perceived as free and limitless and their full value is taken into account. The concept of PES seeks to create positive economic incentives to change human behaviour in ways that increase or maintain environmental services such as watershed protection, the sequestration of carbon and the provision of habitat for endangered species. PES encourages the maintenance of natural ecosystems through environmentally friendly practices that avoid damage for other users of the natural resources. PES schemes complement other approaches, such as command-and-control and structural measures and are widely recognized as novel and innovative mechanisms that seek to promote the conservation of biodiversity while simultaneously improving human livelihoods.

## 9.5 DEFINING ECOSYSTEM SERVICES FOR PES PROGRAMS

Ecosystem valuation can be a difficult and controversial task, and economists have often been criticized for trying to put a "price tag" on nature. However, agencies in charge of protecting and managing natural resources must often make difficult funding decisions that involve trade-offs in allocating resources. These types of decisions are economic decisions, and thus are based on society's values. Therefore, economic valuation provides a way to justify and set priorities for programs, policies, or actions that protect or restore ecosystems and their services. Ecosystem valuation can help resource managers' deal with the effects of market failures, by measuring their costs to society, in terms of lost economic benefits.

Decisions about ecosystem management are complicated by the fact that various types of market failure are associated with natural resources and the environment. Market failures occur when markets do not reflect the full social costs or benefits of a good (e.g. the price of petrol does not fully reflect the costs imposed on society in terms of pollution). Most market failures related to ecosystems are due to the fact that:

- Many ecosystem services are public goods;
  - Public goods may be enjoyed by any number of people without affecting other peoples' enjoyment. The problem with public goods is that, although people value them, no one person has an incentive to pay to maintain the good. Thus, collective action is required in order to produce the most beneficial quantity. ES may be affected by externalities, or uncompensated side effects of human actions.
- they are affected by externalities and property rights related to ecosystems;
  - The problem with negative externalities is that the people (or ecosystems) they are imposed upon are generally not compensated for the damages they suffer.
- and their services are often not clearly defined
  - Finally, if property rights for natural resources are not clearly defined, they may be overused, because there is no incentive to conserve them.

PES has the potential to be an environmentally effective, economically efficient and socially equitable tool for implementing integrated water resources management (IWRM).

## 9.6 History of PES

### 9.6.1 *Evolution of the Concept of PES*

The concept of PES itself is relatively young since the first PES schemes in developing countries having been initiated during the 1990s (Pagiola 2008; Pattanayak et al. 2010). The origins of the modern history of ecosystem services are to be found in the late 1970s with the utilitarian framing of beneficial ecosystem functions as services in order to increase public interest in biodiversity conservation (Westman 1977; de Groot 1987). It then continues in the 1990s with the mainstreaming of ecosystem services in the literature (Perrings et al. 1992; Daily 1997), and with increased interest on methods to estimate their economic value (Costanza et al. 1997).

Much of the literature on PES has focused on the effectiveness of the instrument and success and limiting factors when putting it into practice (e.g. Engel et al. 2008) as well as its potential role in poverty reduction (e.g. Bulte et al. 2008). With growing experience in the implementation of PES, it has become increasingly clear that only a limited number of projects meet all the requirements of the definition (Wunder et al. 2008).

As such, revised conceptual frameworks have recently emerged that relax some of Wunder's criteria and put a greater emphasis on PES as an incentive mechanism (Sommerville et al. 2009, Muradian et al. 2010). Since the release of the Millennium Ecosystem Assessment (MEA 2003), literature on ecosystem services has grown exponentially and the concept has been firmly put to the policy agenda. (Fisher et al. 2009).The widespread promotion of Market Based Instruments (MBI) for conservation such so-called PES schemes are increasingly reaching economic decision-making ( Engel et al. 2008; Pagiola 2008).

Costa Rica pioneered the use of formal PES mechanisms in developed countries by establishing a country-wide program called Pago por Servicios Ambientales (PSA) in 1997, which aimed to reverse the severe deforestation rates existing at that time (Pagiola 2008). In the early 2000s a growing number of PES like mechanisms have spread throughout Latin America (Kosoy et al. 2007; Asquith et al. 2008; Pagiola_Date). The prevalence of PES programs in Latin America results due to several reasons:

- First, established conservation organizations have been seeking innovative financing for their projects.
- Second, there has been a critical mass of leaders in key positions interested in economic instruments that can effectively influence decision-making processes at different levels of government.
- Third, environmental organizations and overseas development organizations have been active in disseminating experiences and networking among practitioners, making PES instruments accessible and applicable from one country to another.

At the same time, although boasting a long history of institutional and legal framework for environmental protection, governments across the region have limited and weak enforcement capacity. Given this weakness, the conservation movement throughout the region has been driven to innovate and find alternatives to command and control measures and views economic incentives (such as PES programs) as a viable alternative to protecting catchment services. Efforts to control deforestation with outright prohibition have been ineffective. In the 1990s, conservationists and other stakeholders interested in protecting forests and the catchment services they provide instituted voluntary payments to landowners for maintaining forest stands.

## 9.7 Pioneer Work of PES in Costa Rica

Costa Rica, in particular, pioneered the emerging market of PWS in the late 1990s. Since forest areas were being transformed for cattle-raising, water users—particularly for hydroelectric generation—were concerned about the effects on their water sources. Thus, the idea arose of creating an economic incentive to landowners for protecting their forest lands. The Costa Rican experience catalysed the growth of other private and government driven programs throughout the region. The Costa Rican government implemented legislation to ensure that the concept of market incentives to protect the inherent value of natural resources would become part of the market place.  The Law 7575 took into account the value of carbon fixation, hydrological services, biodiversity protection, and provision of scenic beauty. People were able to receive tax breaks for protecting services through the new laws. The Private Forestry Project was created, forming Costa Rica's first project to reward carbon sequestration on private land. The Protected Areas project created the ability to transfer private land into parkland and to set up an institution that could manage small and medium-sized forests.

### *9.7.1 Funding Structures, Economies of scale, Transaction Costs*

Costa Rica's PSA program, for example, is financed primarily from government funds, but also includes payments from service users and international agencies and NGOs. In practically every case, payments are based implicitly or explicitly on the cost of ES provision, rather than on the value of the ES. Thus, programs that are nominally paying for multiple ES, such as Costa Rica's PSA, do not pay more for similar activities than programs paying for a single ES. Many payments by individual water users in Costa Rica, for example, are explicitly based on this logic.

It is interesting to note that some government-financed programs are attempting to evolve in ways that bring them closer to user-financed programs.  Costa Rica's PSA is attempting to develop additional financing sources from individual ES users to complement their public financing, and are trying to move away from their current one-size-fits all approach to payments addressing a much more differentiated and targeted approach in which the amount of payment and the specific land uses being paid are much more closely targeted to local conditions. At the opposite end of the spectrum, the challenge is to find ways to help create and operate small-scale user-financed programs in ways that preserves their benefits while also enjoying some of the economies of scale that larger programs receive.

Meanwhile the costs to enter into contracts are also higher relative to expected returns for smallholders than they are for large landholders. Such costs may include titling papers and the need to follow complex procedures, which are the same regardless of the size of the land area held. In Costa Rica's PSA program, applicants were previously required to fulfil 11 separate requirements, including the submission of a management plan prepared by a certified forest engineer (Pagiola et al. 2004). PES programs can try to minimize transaction costs by taking measures such as creating systems for collective bargaining and contracting.

Here, a system of collective bargaining has enabled groups of small farmers to join the program collectively, so that transaction costs are spread over a large group (Pagiola et al. 2004). PES schemes may make participation requirements more flexible and/or strengthen property rights of the poor, possibly as a reward itself. Costa Rica's PSA program, where land users receive payments for various specified land uses originally required land titles in order for landholders to participate. This prevented many poor farmers from participating and this requirement was later eliminated (WRI 2005). In Costa Rica, PES contracts were found to help increase tenure security.

Some of the main goals are to create programs for the smaller farmers through advanced payment for woods, sustainable forest harvesting, reforestation projects, getting farmers the best prices for their wood, performing environmental education, and helping to develop property rights of forest workers by registering their properties on the National Property Register (fundecor.org). Since in this case the PES project sets up systems for those with little money to get land titles and use natural resources to join the economy in a sustainable manner, it has proved successful in creating a pathway out of poverty for many individuals (by giving them property rights). The recipients of the payments are predominantly upstream landowners, which in 2008, totalled close to 3,799 beneficiaries. These represent payments to individuals, indigenous groups, rural communities, and in a few cases, protected areas such as national parks or private reserves. In 2008, the national programmes had 1,103 contracts signed in Costa Rica.

PES can also create benign incentives. For example, if cutting down forest is an irreversible decision that extinguishes the option of receiving payments in the future, even non-participants may retain forests. The existence of the PES program could thus be said to be creating an option value for the forest. Tattenbach et al. (2006) argue that this effect has been significant in Costa Rica. It should be noted that not all PES programs require additionally of their participants. Costa Rica's PSA, for example, explicitly does not and would in principle pay every landholder with forest cover if funds were sufficient. It does require that the country has a stable government to implement these types of plans, but it is an effective way to include natural resources into the price of markets, giving people incentives to protect their environment.

## 9.8 PES Case Studies

### *9.8.1 Maloti-Drakensburg Transfontier Project*

The Maloti-Drakensberg mountains are one the most significant catchments in South Africa and with the increasing scarcity of water the effective management of such resources is of increasing importance (DBSA 2008).

The Maloti Drakensberg Transfontier Conservation and Development Project (MDTP) was a collaboration between South Africa and Lesotho. The goals of the project were to conserve biodiversity in Maloti and the Drakensberg Mountains. The project sought to promote several principles in order to achieve this goal. These included:

- Sustainable resource use
- Sustainable land use
- Development planning

The natural vegetation in this mountainous region is essential to regulating the flow of water coming out of the areas as well as maintaining the quality of that water (DBSA 2008). The results of degradation of the vegetation in the region is reduction of flows in the dry season, exaggerated flows in the wet season, increased incidence of flooding and erosion and a reduction in water quality.

The mountainous areas that comprise the Drakensberg and Maloti mountain ranges form the basis of South Africa's most significant water catchment area, with over 25% of South Africa's water supply originating in that area (Mander 2010).

These water provisioning ecosystems are extremely sensitive and inappropriate development in the area (excessive livestock grazing, invasive alien species, development for human settlement, etc.) was having significant adverse effects on the quality and quantity of those services.

The goal of the project was to restore and ensure the on-going functionality of key ecosystems that provision fresh water, with the goals being to improve both the quality and quantity of the water provisioned. The project would achieve this through a number of interventions, specifically (CAPE 2009):

- Fire Management
- Stock Management
- Grasslands Restoration
- Donga Restoration

The intention of these interventions was to restore basal vegetation cover which would ensure (CAPE 2009):

- Enhanced biodiversity
- Enhanced water flows and quality
- Enhanced carbon sequestration

The benefits that would be realized due to these interventions would be in the form of 16.805 $m^3$ in additional base-flow to the Thukela and Umzimvubu Rivers, and a sediment reduction of 6,176 $m^3$ which would improve storage within water storage (rivers, dams, weirs) within the system (CAPE 2009).

## 9.9 Baviaanskloof-Tsitsikamma PES Project

The exploration of the feasibility of a PES program in the Baviaanskloof Reserve was in response to the recognition of unsustainable land practices on extensively farmed land in the Baviaanskloof and Tsitsikamma catchment have an adverse effect on the sustainable supply of ecosystem services.

The extensively farmed land in the upper reaches of these watersheds produce relatively little returns, and the effects of the degradation of the landscape have serious negative effects on the veldt itself, the downstream farmers and the water stressed urban areas at the edge of the catchment on the coast which include Port Elizabeth, Jeffrey's Bay and Cape St. Francis (Mander et al. 2010).

The Baviaanskloof, Kouga and Kromme watersheds have a total surface area of 5,600 $km^2$ and collectively supply some 138 million $m^3$ of water to user. In addition to the provision of fresh water the spekboom thicket that that is prevalent in large areas of the landscape store significant amounts of carbon with high quality thicket storing approximately 100 tons of carbon more per hectare that degraded areas (Mander et al. 2010).

The current livestock based farming practices currently employed in the region produce relatively poor returns and the effect on the local veldt is detrimental to the ecosystem services of freshwater provisioning and carbon sequestration.

The hydrological impacts are of particular concern as the Nelson Mandela Bay Municipality (NMBM) downstream of the farming areas has a long history of water supply problems and relies on this catchment as well as several other inter-basin transfers to meet local water needs.

**TABLE 9-1. COSTS AND BENEFITS OF THE BAVIAANSKLOOF-TSITSIKAMMA ECOSYSTEM RESTORATION (ANDREW 2010)**

| Returns to ecosystem services | Baseflow Maximisation | | Revegetation | |
|---|---|---|---|---|
| | Amount | % | Amount | % |
| Above ground carbon / ha | R 71.10 | 50 | R 72.95 | 52 |
| Avoided loss :soil carbon/ ha | R 1.72 | 1 | R 1.72 | 1 |
| Water: Value of sales / ha | R 22.93 | 16 | R 22.48 | 16 |
| Land use change : (Agric., biodiv & tourism)/ ha | R 44.18 | 31 | R 42.80 | 30 |
| Sediment reduction / ha | R 1.39 | 1 | R 1.39 | 1 |
| Total benefits: R/ha/yr | R 141.32 | 100 | R 141.35 | 100 |
| Total management cost: R/ha/yr | R 43.20 | 31 | R 35.89 | 25 |
| Net returns: R/ha/yr | R 98.12 | 69 | R 105.46 | 75 |

Given the rate of land degradation the farmers are aware that current practices are not sustainable and are willing to shift to alternative uses for the land.

The combination of water requirements for the NMBM and the desire of local farmers to shift to more sustainable and profitable land uses provide the motivation for the development of a PES programme. The farmers are willing sellers and the NMBM represent a willing buyer of ecosystem services.

The suggested framework for the Baviaanskloof-Tsitsikamma is illustrated below. The primary intervention in the project revolves around improved veldt management and restoration. This pertains primarily to restoration of indigenous plant cover and the removal of invasive alien species of plants.

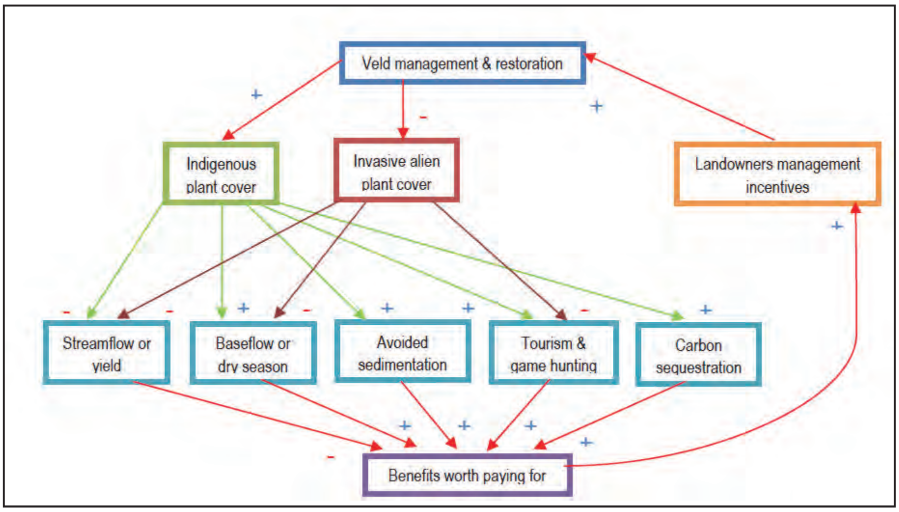



**FIGURE 9-2. THE SUGGESTED PES FRAMEWORK FOR THE BAVIAANSKLOOF-TSITSIKAMMA WATERSHEDS (MANDER ET AL. 2010)**

The benefits for provisioning of freshwater are increased stream flow yield and an increase in base flow. An assessment of different scenario options indicates that a realistic expectation of the interventions would result in an 11 million $m^3$ increase in water yield and a 14 million $m^3$ increase in base flow per annum.

## 9.10 Working for Water Project (WfW)

The government-financed Working for Water (WfW) program in South Africa was initiated in 1995 with the dual purpose of clearing invasive vegetation and facilitating poverty alleviation through creating employment. Milton et al. (2003) estimated that the program employed 24 000 people in 2000. Here, unemployed workers are hired to clear exotic invasive species, especially of highly water-consuming trees – primarily on public lands, but also on some private lands. This improves water availability downstream and protects native biodiversity – two clear externalities.

The WfW case is a typical example of PES, and resembles more the generic family of environmental food-for-work programs (Holden et al. 2006), it is actively funding poverty relief through a government-supported program. WfW effectively acts as a conduit for the provision of ecosystem services, predominately water supply, through the control of invasive alien plants and the provision of unskilled job opportunities, using predominantly taxpayers' money. Whether this is justifiable in terms of the spread of the taxpayers versus the beneficiaries of clearing is uncertain, although it should be noted that water savings in one area have geographically widespread ramifications, and biodiversity benefits are also likely to have more than localized benefits. Though this form of transfer payment does not constitute the creation of a market for the provision of ecosystem goods and services in the strict sense, it does constitute a payment for the service delivery.

The WfW program has been hailed as highly successful in terms of its objective of restoring water supply in alien infested catchments (Macdonald 2004). Hobbs (2004) calls it one of the most successful integrated land management programmes in the world, referring to the programme's impacts on biodiversity, water and socio-economic development. Mooney and Neville (2000) described the program as an outstanding example of dealing with invasive alien plants in a holistic manner. Woodworth (2006) calls it inspirational in terms of the restoration of natural capital. Since its inception, the program has cleared more than one million ha of invasive alien plants.

Marais and Wannenburgh (2007) estimate that the clearing of invasive alien plants from riparian areas between 1997 and 2006 increased stream flow by nearly 46 million $m^3$ per annum. Whereas costs have been very well monitored, progress in terms of restoration of infested lands has not been tracked in detail until the establishment of GIS-linked monitoring in 2000/01. Based on available data, it has been established that good progress has been made with certain species, but that some will not be under control within the next 50 years (Marais et al. 2004).

While many PES programs include the objective of poverty alleviation as a secondary objective, it is the one of the primary objectives of WfW. Indeed, the continued political support of the program has hinged on its being primarily a poverty-relief program. The program has created thousands of jobs, with a strong emphasis on gender equity, and provides considerable benefits such as skills training and health and HIV/ AIDS awareness programs. It also generates further income through the development of value adding industries, such as furniture, fuel wood, and charcoal that use alien vegetation as inputs.

Although the social aspects of WfW tend to be valued more highly than water provision, it is likely that increasing water scarcity will lead to the water provision aspects being increasingly demanded by the private sector and water utilities. Indeed, if the program continues to rely heavily on poverty relief funding, it might find itself having to compete with other poverty relief programs in the future. It is important to increase payments from service users to secure the continuation of service delivery. But while WfW usually undertakes periodic follow-up clearings, it seemingly does not exercise the same continuous control over land access and ES provision as in all our remaining cases where contracts are with land stewards.

This may especially be a problem on privately owned lands. ES buyers will normally require that "the seller has legal or *de facto* control over the habitat's [or land area's] fate for the duration of the contract"(Ferraro 2008). Nevertheless, given the scale of the invasive alien species problem facing South Africa, and the increasing scientific proof of the benefits (water delivery and biodiversity protection) provided by clearing action, the WfW-model is likely to be sustainable and productive over the long term.

## 9.11 Conditions for Success of PES

PES schemes succeed only if payments can be sustained over the long-term. Their success depends on:

- **Funding Availability:** funding availability – from implementation and operation to the cost of program maintenance, including continued payments to service providers
- **Funding Sustainability:** Sufficient and sustainable funding is essential
- **Sufficient benefits:** Benefits must be sufficiently high to cover the costs of service provision.
- **Willing Buyer:** Some entity must be willing and able to pay for the service (e.g. through private payments or government funding)

- **Willing Seller:** Tightly connected to benefit sufficiency and funding availability, for those receiving the payments, the benefits needs to be sufficiently high to ensure their on-going participation
- **Monitoring and sanctions for non-compliance:** To ensure that the on-going viability of PES agreements

Strengthening of social organizations may be an important component of a successful PES program. If private costs (including opportunity costs) are greater than private benefits, a subsidy may be required to create incentives for providing the service. Various economic factors can influence the success of an ecosystem services approach over time through secondary impacts that undermine incentives for ecosystem service provision and conservation. Relevant economic factors include:

- existing or new subsidies or taxes;
- changes in commodity prices, and;
- changes in prices for ecosystem services

An ecosystem services approach is more likely to succeed in a situation where the legal, institutional, social and economic conditions provide a supportive and appropriate framework.

An ecosystem services approach is more likely to succeed when there are regulatory drivers that provide a legal framework for ecosystem services. A successful approach relies on:

- **Well Defined Property Rights:** A system of clear property rights to create incentives for service provision and make service providers accountable and reduce their risk
- **Strong Institutions:** Strong institutions are critical for building stakeholder confidence in an ecosystem services approach and ensuring its long-term viability.
- **Field and technical Capacity:** Implementing an ecosystem services approach also requires significant field and technical capacity.
- **Community Involvement:** Involvement and participation of the community is vital to the success of a PES scheme. Granting influence in the organizational process is much more effective than a top-down approach, with failed programs in Bolivia and Brazil citing 'inadequate stakeholder participation' as a barrier to success (Griffiths 2007)

Shifting the approach of PES from a sole focus on providing benefits, and towards the sharing of power and decisions, has demonstrated far better participatory results than a model in which the authorities maintain the dominant position of power and dictate the decision making process (Contreras-Hermosilla & Fay 2005). There should be effective facilitating structures

- contracting, administration
- buying and selling services
- enforcement & monitoring
- harmony with other regional and/or local institutions,

In terms of the contextual considerations that contribute towards a successful PES program the following must be considered:

**Sufficient/sustained Demand:** There must be high, sustained demand for the service to generate on-going private and/or public support for the project actions

**Sufficient supply of Ecosystem Service Providers:** There must also be a potential source of supply from service provider(s) that are willing and able to ensure uninterrupted service provision through feasible changes to land use or management

For a PES program to succeed over the long term, the buyers must be confident of:

- **Well defined connection between actions and benefits:** The landscape management they pay for will, in fact, lead to either improved or continued service provision. This is fundamentally a scientific question, requiring a clear understanding of the biophysical pathway between landscape activity, service provision, and service delivery
- **Sufficient assessment and monitoring of benefits:** The success of a PES scheme depends critically on the accuracy and cost of such assessments and, by extension, the creation of assessment methodologies for use in the field. This underscores the importance of modelling and monitoring.
- **Stakeholder support / Local coordinator:** The support of stakeholders who are affected by, and directly involved in, an ecosystem services project is a critical factor influencing the likelihood of success . It is also extremely valuable to have someone locally who will champion the approach.
- **Equitable distribution of benefits:** The distributional implications of an ecosystem services approach may affect its political feasibility. For example, a situation where there are clear winners, particularly among the poor, and where any potential losers can be compensated, may be more likely to gain public support. Equal power relations should be enhanced to promote trust and legitimacy among stakeholders. PES schemes should be complementary to the community's livelihood.
- **Assurance to PES Buyers:** While an obvious assumption in PES schemes, it is worth emphasizing that the buyers need assurances that the payments they have made will, in fact, lead to the service provision they desire.

To gain this assurance (the 5 points above – or which one?) requires both adequate modelling and monitoring. Effective modelling shows the biophysical pathway of a service provision, identifying metrics that should be monitored in order to assess service provision such as a farm's proximity to a watercourse.

Effective monitoring serves three purposes:

- First, it creates a baseline. One cannot determine if there has been a change in service provision unless a baseline exists. This is a fundamental issue in the "additionality" debate over the role of forests in carbon markets
- Second, monitoring provides the data to assess compliance and service provision once performance has begun. Monitoring is easier in certain cases than others. PES schemes based on inputs are easier to monitor than those based on outputs
- Thirdly, PES works best when the rules are simple and compliance monitoring mechanisms remain inexpensive. Yet this may result in less information than buyers want.

In general, the more accurate the modelling and monitoring, the better buyers understand whether land use changes will improve service provision but, equally, the more expensive the transaction. The net result is that it will be easier to develop markets for some services than for others for the simple reason that those buying services will be more confident that they are receiving value for their money. How difficult, for example, is linking the contributions of individual land management decisions to water quality in a water supplier's sub catchment? The success of an ecosystem services approach for water quality depends on the accuracy and cost of such assessments and, by extension, the creation of assessment methodologies for use in the field.

## 9.12 Reasons for the failure of PES programs

Debate about the desirability and conceptual clarity of the PES conservation tool is necessary since the concept of PES could distract the attention for environmental problems away from the more complex underlying causes, which generally require broader locally embedded political action for their solution and not merely market creation.

- **Political and Economic Factors:** Political or economic factors outside the control of the project frequently contribute to their failure. It would be extremely foolish to neglect the influence of external forces, global markets, corruption and governance on the ability of ecosystem service projects to enhance human well-being.
- "**Rent Mentality":** Criticism has emerged of the PES concept that it engenders within communities of the developing poor a counter-productive 'rent mentality', where they lose the drive and initiative to work towards economic development and meaningful engagement with contemporary society.

  Countering this argument is the fact, firstly, that 'conservation concessions' are comparatively modest and involve relatively long time-frames, being less likely to promote a lethargic mentality by creating quick and easy money. Secondly, concern about rent-seeking behaviour is probably misdirected at PES schemes, and should rather focus on circumstances where communities are granted much higher revenues from oil and mineral operations (Wunder 2006: 29).

Here, we describe two examples of projects that have failed on both environmental and poverty alleviation fronts.

### *9.12.1 Case 1: West Africa Pilot Community based Natural Resources and Wildlife Management Project*

The West Africa Pilot Community based Natural Resources and Wildlife Management Project sought "a common solution to both development and conservation concerns by involving local communities in the sustainable, profitable exploitation of wild resources and assisting them to manage their wild land areas for their own economic benefit and for the benefit of biodiversity." This, however, is an example of an effort that failed to achieve both its biodiversity and development goals. Supported by the World Bank and initiated in 1995, the project faced many difficulties including an initially very low level of training among villagers, a deeply rooted mistrust of central government within local governing bodies, and the resumption in 2004 of civil conflict in one of the participating nations, Cote D'Ivoire. The project's anti-poaching program failed because of the lack of a legal basis for villagers to apprehend poachers; insufficient investment in high-quality weapons, which put village teams at a major disadvantage in conflicts with poachers; and insufficient investment in a communications infrastructure, which caused slow response times. Moreover, weak and incomplete implementation of ecological and sociological monitoring made it impossible to assess what was working or not working. In the end, there was no compelling evidence that the wildlife or the local villages had benefited from the project, and there was anecdotal evidence that poaching and livestock encroachment had resumed in wildlife zones.

### *9.12.2 CASE 2: ECUADOR HIGH ALTITUDE TREE PLANTATIONS PROJECT*

While some experiences were positive, there are several examples of projects that were unsuccessful or generated negative impacts on local communities. One initiative aimed at indigenous and peasant communities in high-altitude country in Ecuador was reported to effectively hold the 'beneficiaries' hostage to the project: the payment received was insufficient to cover the expenses incurred by the communities establishing tree plantations for carbon sequestration, let alone to reward them for their services. In some cases they did not have the capacity, nor any training, to independently carry out certain activities and were forced to rely upon hiring external actors (Granda 2005). The *Proambiente* program in Brazil's Amazon rainforest has had 'mixed results' after four years, and highlighted the importance of:

- Monitoring
- Quantification
- Certification of services

…to guarantee financial reward – the concept of PES becomes very weak if it relies upon:

- trust,
- goodwill and;
- an opaque benevolent sense of appreciation for a community's activities (Hall 2008).

## 9.13 IMPLICATIONS FOR CATCHMENT MANAGEMENT AGENCIES

Where hydrological functioning can be sold as the 'umbrella service', the future potential for successful implementation of PES has been significantly enhanced by the institutional arrangements that have been established under the National Water Act (Act 36 of 1998, DWAF, 1998).

According to the Act, the CMAs that will be established will effectively 'own' the water and finance catchment management through the sale of water rights. The CMAs will have the incentive to invest in catchment conservation by means of payments to landowners and managers, as well as through management agents such as WfW, as this will yield benefits in terms of more water available to sell. Thus, in addition to the creation of WfW, the legislated requirement to establish CMAs has effectively also paved the way for a very effective institutional arrangement to facilitate water-related PES in South Africa. As the role of Catchment Management Agencies (CMAs) increases, the incentives to enter into such voluntary arrangements with WfW and similar service providers are likely to increase. CMA will in future manage the expenditure with respect to water resources management. These agencies will each have a governing board, which will take the decisions and an executive structure, which will do the work.

The CMAs have the necessary mandate and functional structure to undertake specialized water resources management programs. PES programs fall under the umbrella of services that CMA could potentially enable and carry out. Essentially CMAs are positioned as stakeholder management and resource use coordinators, that are envisioned to have necessary capacity to manage, monitor and enforce the financial transactions and stakeholder agreements that will comprise these programs.

CMA embodies the principle of decentralized management and co-operative governance. Proper functioning of the CMAs is dependent on its ability to forge co-operative governance relationships with all relevant stakeholders, and particularly around environmental management, spatial (land-use) planning and management, infrastructure development and service provision. This necessitates good relationships particularly with:

- local authorities / local government
- water sector institutions
- water services institutions
- user groups represented by Water User Associations; and
- Provincial government departments involved in implementing these functions.

The development of the Catchment Management Strategies and their implementation will indicate who needs to be involved. The focus of these co-operative relations should be primarily on the alignment of policies, programs, and procedures, with the aim to improving the efficiency and consistency of implementation and optimizing the use of resources.

### *9.13.1 What role do CMAs play in managing PES systems*

CMAs have an institutional framework composed of key stakeholders who prioritize the use of payments that, at least in part, go towards conservation management of the watershed and biodiversity protection. They allow downstream water users (service buyers) to finance upstream provision of a clean, regular supply of water. In all these cases the services originate within natural ecosystems (e.g. public protected areas) but it is the land management and land use by the human communities living on private, public and communal lands in the watershed that determine service delivery; these communities are the key service providers. Water users (e.g. utilities, municipalities and industries) contribute to the fund. Each CMA has its own location dependent objectives and goals but in general they invest in conserving watersheds to improve or maintain water quality for downstream users, maintain regular flows of water throughout the year and maintain or enhance natural ecosystems. CMAs can be utilized at various stages, from facilitating stakeholder dialogue to program administration support. At the dialogue stage, they can identify which environmental services buyers expect and then negotiate the prices for trading these services. At the program design stage they can conduct feasibility studies, design mechanisms for payments, develop management plans, establish monitoring systems and ensure the delivery of services. At the support stage, intermediaries can design technical, social and institutional land-management instruments for both providers and buyers. Finally, at the administration stage, they can draw up contracts, manage funds, coordinate monitoring and oversee technical issues that arise (Porras et al. 2008).

Invasions by introduced alien plant species alter ecosystems often reduce supplies of valuable ecosystem goods and services and imposing substantial costs on South Africa's economy. Reversing these losses by removing alien plants imposes further costs because clearing and control operations are expensive. However, the high costs can be offset by the benefits of creating employment opportunities through such operations and the livelihood benefits that can be derived from the cleared land. Based on these existing structures, a future model for water-related PES in which the CMAs are the direct buyers of hydrological services, via a type of

PES facilitation agency that brokers deals, and monitors service delivery. The service providers might be predominantly nature-oriented poverty-relief programmes such as WfW, but could also include landowners and conservation agencies directly. Under this type of set-up, there is no need to impose specifically labelled levies to be paid by water consumers for catchment conservation, although the costs borne by the CMAs would be passed on to these consumers. A further advantage of such a system is the fact that water price increases could be designed in such a way as to achieve water demand management in addition to the conservation of catchment areas. Although well-funded through the tax base and compulsory charges, voluntary private initiatives have also been undertaken to boost the funding to WfW. This is not only testament to the fact that the resultant restoration of water services makes financing WfW worthwhile, but also that there is a potentially large voluntary market for these services. The fact that delivery of these services is labour intensive and provides opportunities for poverty relief makes it even more attractive.

### *9.13.2 Specific CMA Functions pertaining to PES Programs*

The specific function of the CMA that would pertain to undertaking a PES program is outlined in the table below. The table highlights the essential functions that would be required to effectively managing a PES program.

**TABLE 9-2. CMA FUCNTIONS THAT PERTAIN TO THE IMPLEMENTATION AND MANAGEMENT OF PES PROGRAMS, MODIFIED FROM WRC REPORT 1433/1/06 (MAZIBUKO AND PEGRAM 2006)**

| Functional area | Sub-functions and activities |
|---|---|
| **Develop policy and strategy** | Determination of resource directed measures<br>Reconciliation of water availability and requirements<br>Financial and business planning for the CMA |
| **Support institutions** | Coordination of the activities and relationships of stakeholder in a PES Program<br>Acting to facilitate participation and cooperation between stakeholders<br>Assisting in creating capacity in WUAs and WMIs<br>Assisting in monitoring of PES program participants and enforcing agreement where in instances of defaulting<br>Working to resolve stakeholder conflicts<br>Support of organisations that could foreseeably assume a management role of a PES program (i.e. privatisation of the program)<br>Ensuring appropriate stakeholder participation in these bodies |
| **Regulate water use** | Maintaining a registry of stakeholders for a PES program<br>Set criteria for participation in a given PES program<br>Collection of payments for ecosystem service buyers<br>Monitoring ecosystem promoting inputs of ecosystem service sellers<br>Ensuring compliance of stakeholders involved (including enforcement)<br>Negotiation of co-regulation and cooperative agreements |
| **Implement physical interventions** | Implementation of the PES Programs<br>Development of the specific inputs required for participation of ecosystems services sellers |
| **Manage information** | Monitoring water resources (collect, source and capture data) affected by PES programs<br>Development and maintenance of databases to track stakeholder contributions<br>Development and maintenance of information management/evaluation systems<br>Conducting research on water resources<br>Performance of needs assessments and water resource problem identifications<br>Communication with stakeholders and collection of anecdotal information |
| **Audit WRM** | Development and maintenance of indicators for auditing PES programs<br>Performance of financial and organisational audits of PES programs<br>Performance of functional performance audits<br>Performance of water resources audits against specified objectives<br>Proposition and facilitation of corrective action |

# 10 In-kind contributions

The water pricing strategy (DWA 2005) envisages that a CMA may fund its activities through any lawful source in addition to water user charges and parliamentary appropriations, which may include donor support or sponsorship.

In-kind contributions are not explicitly income; rather, it includes goods or services donated to the CMA instead of money.  Thus in-kind contributions would reduce the expenditure and therefore the required income of the CMA.  It is likely that in-kind contributions could be made in the form of services that replaces salary costs and goods that replaces CMA expenses to some extent.

The prioritization of CMA establishment and development, and the corresponding efforts to establish primary sources of revenue have meant that in-kind contributions have as yet not been considered in earnest. However, as a proactive measure to identify additional sources of CMA revenue move forward, in-kind contributions have been brought to light as an option augment current capacity.

Various economic sectors, public and private, have some form of water related responsibility built into their organizational mandates. Their efforts are not borne out of curiosity or benevolence but rather out of the realization that related matters are an integral part of the endeavors of all their organizations.

These originations stand to benefit from one another, through collaboration and common interest. Their efforts relate to

- sharing of capacity,
- development of critical mass,
- creation of economies of scale,

Examples of organizations that could potentially contribute, and the motivating factors for their contributions include:

Banking Sector: Loan sureties are tied to the value of the land. Water entitlement can play a key role in this regard.

Organized Agriculture: Climatic information systems improvements; drought responses; flood responses

Other Industries: Organizations may view contributions to the CMAs finances and its workings as part of their contributions towards their social responsibility. Wise environmental stewardship is an international marketing imperative for many industries.

Integrated Development Plans (IDPs): Local governments need water resources components to be detailed in their IDP's. Local governments have a critical responsibility and will form a useful core for these integrated activities.

Health Sector: Water related health issues are of key concern to this sector.

Mining sector: Water remains a significant constrain to the development and on-going performance of this sector.

*Argument for Leveraging Sector Support*

The water resources of South Africa, its rivers, streams, lakes and springs run the risk of being subject to pollution due to the fact that these resources are held in common by society. No single private individual or institution holds a financial incentive to maintain the quality and condition of these water resources.

The rhetoric holds that users maintain the property they own. Users will maintain property they control and for which they are able to control access to the benefits derived from the maintenance of said property.

Commonly held goods such as air, water and certain land resources are freely available. A specific sub-category of these “freely available” goods are termed “common-pool resources”. Common pool resources are comparable to public goods, but differ in that they are subtractable, and are vulnerable to overuse. Ostrom and Elinor (1990) state that common-pool resources are typically defined by stock and flow components. They consist of a core resource (e.g. water), which defines the stock variable, while providing a limited quantity of extractable fringe units which define the flow variable. It is necessary to protect the core resource in order to allow for its on-going exploitation whilst the fringe units may be consumed.

If users invest in the maintenance of such a resource then the benefits are enjoyed by the larger group of consumers who have access to the resources. The primary argument relies on the notion of incentives.

The traditional economic argument states that there is no incentive for any individual consumers to incur the internal cost associated with reducing or eliminating pollution/resource degradation when those costs can be transferred externally to society (McConnel and Brue 2005). However the argument falls short on two avenues:

- Firstly, in the sense that organizations benefit indirectly from the protection of the resource, through the “moral” position that it affords them. In a social age where consumers are increasingly aware of the impact of industry on the environment, preference is given to those companies/organization demonstrate a degree of social/environmental responsibility. These efforts can be leverages as a significant marketing/PR resource.
- Secondly, many of these organizations possess significant influence which is enabled through their critical economic mass, and their “trickle down” dependence of various sub-sectors on these big players. The mining sector, for instance, is critically dependent on water resources, and faces enormous risks in complying with environmental regulations and requirements. The sector however, is in a position to influence the behavior of the many sub-sectors of the economy that form part of the mining value chain. They are in a position to influence the behavior of a large sub-sector of users.

*What constitutes an in-kind contribution?*

In economics and finance, in kind refers to goods, services, and transactions not involving money or not measured in monetary terms. For example:

- Payment in kind, or barter: exchange of goods or services for other goods or services with no medium of exchange

In this context, an in-kind contribution must also meet the requirement of reducing the expenditure and therefore required income of the CMA. To state specifically, for the contribution to qualify as an in-kind contribution in the context of this discussion, it must directly reduce the expenditure of the CMA and support the CMA in fulfilling its mandated functions. Such a contribution must directly reduce CMA expenses.

Table 10-3 on the proceeding page provides illustrations of contributions in-kind as received by the Inkomati Catchment Management (INCMA).

TABLE 10-3. CONTRIBUTIONS IN KIND, AS RECEIVED BY INCMA.

| In-kind Contributions | | | |
|---|---|---|---|
| **Contributing Organization:** | **Description of the Contribution:** | **Estimated Monetary Value of the Contribution:** | **Financial Year:** |
| VNG ( De Vereniging van Naderlandse Gemeenten) | 2013 a workshop on the billing of water resource management charges and setting of tarrifs was held at Mercure Hotel, Nelspruit which was arranged by the Dutch Delegation in respect of the Kingfisher Operational Governance Project funded by VNG.The workshop was attended by representatives from the ICMA, DWA Head Office, DWA Mpumalanga, DWA Limpopo, two Regional Water Authorities from the Netherlands Waterschap Roer en Overmaas and Waterschap Groot Salland) and the Dutch Association of Water Authorities | 50 000 Incl. venue hire, presenters and meals | 2013/14 |
| Water Reaserch Commission | Use of professional services by a university professor to conduct a workshop and assist in strategic Adaptive management (kevin Roggers services) | 20 000 rand value of hours of time for the professor which could have otherwise been a consultinbg fee | 2009 -2013 |
| Waterschap Groot Salland, WineJob and ITC- University of Twente,represented by Hydrologic (80% contributor) and ICMA (20% ) | Realtime connections between the HydroNET framework and GeoNetCast,WATPLAN(fromeLEAF)and PostGreSQL. Demonstration of a HydroNET Water Control Room for the ICMAwith a policy control dashboardand an operational control dashboard-Implementation,demonstrationand validation ofthe most interesting HydroNET applications (This project is for development of river and rainfall data Software that would have otherwise been bought at a much higher cost) | 500 000 | 2013 -2014 |
| Dutch king fisher project | Training initiatives for the ICMA board and staff capacity building; training of Institutions and participations staff | 100 000 - cost of consultants | 2008 -2012 |
| REMCO ( Dutch delegation and Uni van Waterskapen) | Annual conference between Swaziland, mozambique and South africa CMA (Stakeholder engagement) | 50 000 Incl. venue hire, presenters and meals | 2009 - annual event |
| Rhodes University project co funding reaserch work | Co-ownership of the reaserch material , therefore the full cost of the project is partly borne by the CMA and the other by the university | | |

# 11 Policy Brief and Study Recommendations

## 11.1 Raw Water Use Charges

The current raw water use charge structure in South Africa does not reflect the full anticipated cost of water resource management as detailed by the National Water Act (1998), the Water Services Act (1997) and the Raw Water Pricing Strategy (2007).

In the 2010/11 financial year, expenditure on water resource management activities was R250 million with the DWA having budgeted R350 million for that financial year. The budget allocated by the DWA for water resource management in the 2011/12 financial year was R450 million.

A budget of R214 million per annum would be required to fully account for the cost of establishing the CMAs (Phase 1 and 2 of CMA development). At this tariff level, assuming zero grant funding from DWA, average charge would be 1.51 cents/$m^3$. However, by phase 6, which is the fully matured stage of CMA development, these water resource charges would have to be increased by an average of 270% across all WMAs to generate sufficient revenue to fully account for the cost of operating the CMAs. At this tariff level, the average charge would be 5.84 cents/$m^3$ and would generate revenue of approximately R828 million.

**Recommendation**

Current budget allocations by DWA for water resource management re adequate to establish the initial development phases of the 9 CMA. However, CMAs should progressively endeavor toward increasing raw water use charges to meet the increasing budgetary requirements as the CMA matures toward full capacity.

## 11.2 Ring-Fencing Expenditure on Water Resources Management

**Statement of the problem**

It is difficult to ring-fence expenditure by DWA regional offices on water management activities in WMAs where no CMA currently exists. As a result it is difficult to estimate the portion of the current DWA budget which would and should be reassigned to the future CMAs

One of the six DWA program is “Water Sector Management” which currently has an allocated budget of R618 million. However, there are additional water resources management activities which fall under the other five DWA programs which will also need to be transferred to the new CMAs. The cost of current management activities could then be contrasted with the cost estimates for operating CMAs.

**Recommendation**

Water resource management activities currently assigned to the DWA regional offices need to be itemized in detail and ring-fenced to make it possible to determine the current expenditure on water resources management, and to ascertain which specific areas of functionality and budget will be handed over to the CMAs

## 11.3 Develop a Handover Schedule

**Statement of the problem**

The slow delegation of functions, with the associated authority, responsibility and delays in the transfer of funds, has impeded the effective establishment and functioning of Catchment Management Agencies (CMAs).

At present the responsibility of water resources management is assigned to the DWA regional offices. Over the short to medium term the intention is to shift that responsibility from the regional offices to the CMAs as they come online and mature towards full functionality.

The CMAs will first need to be established before responsibility for water resources management activities can be assumed from the DWA regional offices.

**Recommendation**

A handover schedule needs to be developed to determine an order of priority for water resource management activities to be transferred to the CMAs. The handover schedule will act as a guideline to assist in the developmental pathway for CMAs.

## 11.4 Asses priority CMA functions through cost benefit analysis

**Statement of the problem**

South Africa is a developing state with a long list of high priority development objectives. State departments compete for a limited pool of available revenue with which they fund their development initiatives. The demand for this revenue greatly exceeds the available supply.

South Africa, in its current and foreseeable medium term economic position does not have sufficient revenue available to fund all of its development objectives concurrently. This position holds true for water resource management and the current quantity of funds available to establish and develop CMAs.

The capacity of CMAs will have to be incrementally developed, with essential, higher order functions taking priority. Functionality can be augmented as additional funding sources are secured by the CMA.

**Recommendation**

A cost benefit analysis of the various CMA functions needs to be undertaken to identify which specific functions will yield the greatest benefit for the given level of expenditure. Development of these “high benefit” functions should be given priority as CMAs are established and developed.

## 11.5 CMA BUDGETS SHOULD BE SET RELATIVE TO EXPECTED REVENUE

**Statement of the problem**

A relatively modest percentage of the water resource management charges due to water management authorities are currently being collected. The setting of budgets for water resource management does not currently take this level of revenue recovery into account.

The disconnect between the setting of water resource management budgets and the recovery of water resource management charges disables the motive for increased recovery of revenue.

The CMAs will be responsible for collecting their own water resource management charges. Setting operating budgets relative to the expected recovery of charges will incentivize CMAs to increase their levels of recovery whilst simultaneously forcing them to prioritize those activities which will support the generation/recovery of this revenue. Budgets may then be augmented as recovery increases.

**Recommendation**

CMAs should set their budgets according the level of revenue that they can reasonably expect to collect from their users. Budgets for water resource management by CMAs can then be augmented as the amount of revenue collected if improves.

## 11.6 CMAS SHOULD HAVE ACCESS TO A WARMS TERMINAL AND HAVE THE AUTHORITY TO UPDATE THE DATABASE

**Statement of the problem**

Access to, and management of, the WARMS database if currently managed at a national level, whilst the management of water resource users, charges, and revenue collection is in the process of being delegated to a catchment level through the CMAs.

The activity of water resource user data is fundamentally related to efforts to improve the recovery of water resource management charges and to the management of water resource allocations to those users.

Having access to accurate data would be supportive of efforts related to the collection/recovery of water resource management charges. Thus CMAs would be intrinsically motivated maintain accurate and up-to-date data in the WARMS database.

**Recommendation**

The agencies responsible for water resource management and the management of registered water resource users should also be empowered to manage and maintain the database being used to the database that is being used to track this information.

CMAs should thus have access to a WARMS terminal and should be granted access to the database for the purpose of managing data related to water resource users and the corresponding allocations.

## 11.7 ESTABLISH A CONTRACTUAL OBLIGATION BETWEEN WATER RESOURCE USERS AND THEIR CORRESPONDING CMA

**Statement of the problem**

At present, water resource users are charged for water resource management, with the pool water resource management activities being broadly defined by the mandated functions for CMAs and other active water resource management authorities. The nature of this arrangement generates uncertainty in water resource users, in terms of what specific water resource management

The nature of this relationship between users and management authorities allows for a great deal of uncertainty in terms of the services water resource users may expect to receive and in terms of the services the management authority in question is expected to deliver.

By establishing a contractual, charge to service specific agreement, between the management authority (CMAs in this instance) and the user, the following can be achieved:

1. The water resource users will have clarity regarding the services they are being charged for and whether or not those services are being delivered.
2. Water management authorities will have clarity around which services water resource users are specifically paying for, allowing them to prioritize the services that they are providing.

**Recommendation**

A contractual obligation should be established between water resource users and the CMA. The contract should clearly define services offered/rendered and the corresponding charges related thereto.

# 12 GUIDELINES FOR SETTING TARIFFS FOR CMAS

## 12.1 WHO ARE THE GUIDELINES INTENDED FOR?

These guidelines are intended for specifically for Catchment Management Agencies (CMAs) with the purpose of setting appropriate water resource management tariffs.

Water resource management tariffs are intended to cover the costs of water resource management activities. These are activities that protect, allocate, conserve, manage and control the water resources and manage water quality located within Water Management Areas (WMAs) (DWA 2007).

## 12.2 THE PROBLEM

South Africa comprises 19 Water Management Areas (WMAs), all of which are ultimately to be managed by 9 Catchment Management Agencies (CMAs).

The Catchment Management Agency (CMA) is directed, through the National Water Act (Act No 36 of 1998) to collaboratively protect, allocate, conserve, manage and control water resources distributed across the specific Water Management Area (WMA). However, in order to finance these activities, the CMA needs a strategy for generating income, which will be used to cover various costs including the functioning of the CMA.

A catchment management agency may be funded by the state from water use charges made in its water management area or from other funding sources. The NWA envisages the funding sources of catchment management agencies to include money appropriated by Parliament; water use charges; and money obtained from any other lawful source for the purpose of exercising its powers and carrying out its duties in terms of this Act.

To date DWA have developed water resource management (WRM) tariffs guidelines, as set out in the DWA Water Pricing Strategy 2007, in the absence of knowledge of the actual costs of CMA operations. Since 2007, two CMAs have been established. Analysis of the actual operations of these CMAs, conducted and reported on in Deliverable 6 (Draft Final Report), showed a 270% under-recovery in water resource management costs. By implication this means that catchment management activities are under-funded or subsidized.

In addition, analyses by National Treasury (Eberhard 2003) have highlighted several weaknesses w.r.t. setting of WRM tariffs:

- Where CMAs are in place, DWA holds regulatory responsibility in this case regulating charges set by the CMAs. The regulatory approach is an informal one and it follows that the incentives for efficient pricing are likely to be weak. However, the water resource management activity typically represents a small component of the full water cost chain and the associated charge is a correspondingly small proportion of the end-price.
- Individual water charges vary widely across South Africa. Due to the large number of links in the water supply chain that are regulated in different ways and by different entities, final charges are unlikely to be cost reflective.

- Regulatory incentives for cost reductions and for efficient prices are weak at all levels of the activity chain. The absence of an independent regulator is problematic with highly opaque regulatory relationships currently in place.
- Efficient regulation and any reliable assessment of pricing efficiency likely to depend above all on ring-fencing of water operations at local authority level from other local authority activities so that better information can be made available

This report reviews the Raw Water Pricing Strategy (2007) and proposes potential enhancements to the existing guideline.

## 12.3 Principles, attributes of and best practices for setting effective water tariffs

### *12.3.1 Principles of effective water tariffs*

The DWA Water Pricing Strategy is based on several four key principles, which broadly guides the setting of WRM Tariffs.

**Social Equity**, which is focused on redressing the imbalances of the past with respect to:

- Inequitable access to basic water services at affordable tariffs within municipal areas, by facilitating a conditional subsidy on raw water cost where stepped tariffs are introduced; and
- Inequitable access to water for productive use purposes by subsidising tariffs for emerging farmers for a limited time period.

**Ecological Sustainability**, which requires:

- Safeguarding the ecological reserve;
- The ecological management of the catchment;
- Water quality protection; and
- Water conservation and demand management;

**Financial Sustainability** aimed at generating adequate revenue for funding the cost related to:

- The management of water resources; and
- The operation, maintenance and refurbishment of existing schemes.

**Economic Efficiency**, which aims to:

- Promote the efficient allocation and beneficial use of water: water should be priced at its opportunity cost; and
- Provide for administrative as well as market-related measures to achieve this goal.

### *12.3.2 Attributes of effective water tariffs*

What constitutes effective water tariffs?

The United Nations Development Programme (UNDP) proposes 8 attributes for setting of effective water tariffs. These attributes include that the tariffs should:

- Be simple and easy for customers to understand
- Produce a revenue stream sufficient to covers the cost of providing service
- Provide a steady revenue stream that can be relied upon to cover cash flow requirements
- Where applicable, discourage inefficient use of resources, including water resources
- Support investments and operations that provide high quality service to its customers
- Support investments and operations that protect the environment
- Be affordable to customers
- Where applicable, reflect the different costs of providing service to different customers.

These attributes are also relevant for tariff setting for CMAs. It has to be noted however that the relative importance and priority of the attributes may vary from CMA to CMA.

### 12.3.3 *BEST PRACTICES FOR SETTING* EFFECTIVE WATER TARIFFS

The UNDP also proposes eight sets of best practices for setting effective water tariffs. These are summarized in Table 12-1 below.

TABLE 12-1. BEST PRACTICES FOR SETTING WATER TARIFFS (ADAPTED FROM UNDP 2006, EBERHARD 2003, WPP 2010, WRC 2000)

| **Best practice** | **Notes** |
|---|---|
| Develop and maintain accurate and extensive accounts and records | Acquire and maintain good customer records.<br>Cost or expenditure records should be linked to tasks and activities.<br>Establish and keep good capital accounts<br>Develop and maintain performance indices |
| Meter and measure water flows and quality | Measure water network flows<br>Meter/measure final users<br>Monitor water quality |
| Establish cost-based tariffs | Establish full cost tariffs including proper account of depreciation<br>Establish cost-reflective tariffs |
| Set tariffs with both variable and fixed charge components | These provides management options for CMAs to reduce, where possible, the complexity of WRM tariffs |
| Beware of, and limit, the tariff burden on customers | Develop suitable subsidy policies (there is no “best practice” level of affordable tariff)<br>Develop long term service agreements with key customers<br>Implement ring-fenced budgets |
| Provide incentives for good management | Award contracts for system management on a competitive basis.<br>Provide pay bonuses CMA staff when performance targets are met.<br>Provide incentives from the central government to the CMA for taking the lead in improving water quality and/or reducing pollution or other externalities. |
| Develop and annual tariff review mechanism | Assess the achievement of performance indices<br>Adjust annual tariffs as required |
| Public Information Programs | Publish and regularly remind customers of the water and wastewater tariff schedule.<br>Describe to customers policies that govern calculation of tariffs and Commission an external, performance audit. |

## 12.4 Assessment of the current state of setting water tariffs against best practices

The section below analyses the current state of setting water tariffs against the best practices defined in section 3 above.  This analysis was informed by:

- The outputs of Deliverable 6 of this study
- The DWA Water Pricing Strategy 2007
- The DWA 2011/12 Annual Report
- A National Treasury report on water administered tariffs (Eberhard 2003).

Each best practice is supported by an importance rating which serves to prioritise the best practices.  The importance score varies between 1-5, with a score of 1 denoting "Higher Importance", and 5 denoting "Lower Importance".

### 12.4.1 Develop and maintain accurate and extensive accounts and records

Record keeping should meet accounting standards, but in addition should be designed to support financial and management systems and decision making. Accurate and extensive accounts and records would allow CMAs to:

- Have data to accurately set tariffs for full cost recovery
- Be transparent in its tariff setting policy and therefore gain customer trust.

| Objectives | Notes | Actions | Importance |
|---|---|---|---|
| A comprehensive and active customer database is in place | A comprehensive and active customer database is the most basic requirement of any tariff-earning organisation.  Acquiring and maintaining good customer records are likely one of the largest challenges facing DWA and the CMAs.  These records should include information on consumption, charges, and payments that are up to date and in a form suitable for supporting management of the CMA. Such a database, kept in a manner that is easily accessed and analysed, have would be invaluable for tariff studies, payment recovery initiatives, demand forecasting, and demand management studies. Such studies and analyses are important in first developing better tariff policies and refinement of those policies over time. | DWA has commenced with several validation and verification projects.  Comprehensive completion of these projects, across all WMAs, is fundamental to a successful WRM tariff system. CMAs should implement appropriate systems to maintain these databases on a daily basis. | 1 |
| Cost records linked are linked to tasks and | Activity-based cost knowledge is required to ensure efficient management and control.  Best practice includes cataloguing these data to particular | CMAs have to implement sound control, accounting, auditing and | 1 |

| Objectives | Notes | Actions | Importance |
|---|---|---|---|
| activities | activities, projects, or tasks that can, in turn, be linked to the output of particular water resource management activities. Such data can be used to support development of “full cost” and/or “reflective-cost” tariffs (see below); maintenance, repair, and investment cost estimates; estimates of cost-savings from special operations; preventive maintenance and other interventions; capital accounts, including estimates of replacement costs with new technologies and materials. All these applications are critical to improvement or refinement of analyses that support management planning and design of tariffs that support investment and operating decisions. | performance management measures in all its operations. | |
| Good capital accounts are established and kept | Good capital accounting will allow for effective charging of the depreciation component. Depreciation is a key variable in designing of tariffs that will financially sustain relevant water management systems or other assets. | CMAs have to implement sound control, accounting, auditing and performance management measures to all its capital assets. | 1 |
| Tariff performance indices are in place | Tariff performance indices would provide CMAs with management information to monitor the effectiveness of water tariffs. The purpose of these would be to assist CMAs to detect possible problems and take early corrective actions. Social, ecological, financial and economic indices may be used, following from the principles set out in section 3 above and the norms and standards set out in the Appendix to this report. | DWA (or the Water Regulator) or CMAs to develop appropriate, measurable performance indices, and ensure that these are updated on a monthly basis. | 1 |

### *12.4.2 Meter and Measure Water Flows and Quality*

Best practice includes not only development of better systems of accounts but sound measurement systems in support of those accounts. Metering and measuring water flows and quality would allow CMAs to:

- To do precise billing per customer.

| Objectives | Notes | Actions | Importance |
|---|---|---|---|
| Measure water network flows | Measuring flows within the water network includes monitoring dam water levels, aquifer levels, water transfers and flows through other structures. This information is obviously of general management | CAMs to implement a flow monitoring system | 3 |

| Objectives | Notes | Actions | Importance |
|---|---|---|---|
| | importance to CMAs. With respect to water tariffs measurement of these flows would provide CMAs with strategic water budgets which may be used for risk management, i.e. dealing with droughts, unlawful water use, possible compulsory licensing. | | |
| Meter/measure final users | Accurate metering / measurement of customers allows for correct billing to be done. Various measurement systems exist including metering and estimation algorithms for agriculture and plantation forestry. In addition, when final users are metered/measured the tariff selected provides a direct incentive to conserve water resources. Metering also helps assure the customer that they are paying only for the water they use and this greatly aids acceptance of tariffs levels. | CAMs to implement a metering/measurement system for final users | 1 |
| Monitor water quality | The measurement of water quality requirements will be specified by relevant Waste Discharge Charge Systems (WDCS) requirements and Water Use Licence (WUL) requirements. This is especially important in the case of the WDCS to ensure accurate billing. | CAMs to implement a water quality monitor system for pending the requirements of any WDCSs. | 1 |

### *12.4.3 Establish cost-based tariffs*

Accurate and extensive accounts and records would allow CMAs to:

- Have data to accurately set tariffs for full cost recovery
- Be transparent in its tariff setting policy and therefore gain customer trust.

| Objectives | Notes | Actions | Importance |
|---|---|---|---|
| Establish full cost tariffs including proper account of depreciation | Although DWA currently has a tariff structure in place, it does not cover the full cost of water resource management. Efficient resource allocation requires that service users pay the cost of providing that service. | CMA to develop a full cost tariff. This starts with a comprehensive analysis of the full costs of water resource management and then correctly allocating these costs to the different water user categories. | 1 |

| Objectives | Notes | Actions | Importance |
|---|---|---|---|
| | Thus customers pay tariffs that are sufficient to cover the operating costs of the system. The need to set tariffs that also cover system depreciation is also widely acknowledged in principle, but the practice is often imperfect and, in some cases, results in divergence from the principles of efficient resource allocation. | | |
| Establish cost-reflective tariffs | Cost-reflective tariffs not only reflect the full costs of providing service but also differences in the cost of servicing different customers. The DWA 2007 pricing strategy adopts a cost-reflective tariff system in that it delineates between domestic/industrial, agriculture and afforestation. However, it is important to ensure that the allocation is done accurately. | CMAs to implement a cost-reflective strategy | 1 |

### 12.4.4 *Consider setting tariffs with both variable and fixed charge components*

It is worth noting the existence of both variable and fixed tariff approaches. These guidelines have been designed with the key purpose of implementing variable tariffs, i.e. tariffs denominated in monetary units per volume of water (cents/$m^3$).

Fixed tariffs, on the other hand, are denominated in monetary units per unit time (e.g. R/month). In some instances, for some user groups, it may make economic and business sense to recover fixed water resource management costs through use of fixed tariffs and to recover operating costs that vary with the amount of water used with the variable tariff. Fixed fees would be attractive to CMAs because they stabilize revenue streams.

### 12.4.5 *Beware of, and limit, the tariff burden on customers*

The risk of tariffs that are set too high is that water users may not be able to afford the water bill and this can threaten the CMAs revenue stream. Thus CMAs need to anticipate the financial burden imposed on their customers. Typical customers responses to such a situation may include reducing water use; delaying or refusing payment; or petitioning public officials or directly or through industry or other associations. Such responses resulting from tariffs that are set erroneously high are undesirable.

Thus tariffs need to be designed to help reduce financial burdens on the neediest customers. The DWA 2007 water pricing strategy do make provision for various subsidies for various water users, including resource poor farmers, afforestation and commercial agriculture. It is unclear however what the basis for these subsidies was and in addition, there are no subsidy review mechanisms. The risks of ineffective subsidies include:

- Undermining the water resource management revenue stream
- Cross subsidies
- Inefficiency.

| Objectives | Notes | Actions | Importance |
|---|---|---|---|
| Develop suitable subsidy policies | These subsidies should be designed bases on evidence-based on the principles of the NWA and the analysis of the micro- and macro-economic consequences of tariffs to water user groups. | DWA to commission studies on the affordability of water tariffs to various use sectors. These studies should then be used to revise water tariff subsidies as well as regular subsidy review mechanisms. | 1 |
| Implement ring-fenced budgets | Both the DWA 2007 water pricing strategy and National Treasury (Eberhard 2003) envisages ring-fencing of WRM costs and tariffs. Effective ring-fencing is not only limited to WRM as an activity, but may also be applied to cost-centres and customer-segments within the CMA operations. A ring-fencing policy should thus complement a subsidy policy. | CMA to develop ring-fending policies that complement their subsidy policy. | 1 |

### 12.4.6 *Provide incentives for good management*

An emerging international best practice in water management is to provide incentives for a management that encourage reductions in the cost of service or improve the quality of service without increasing costs. The rationale for this is that if management is effective, and tariffs reflect the cost of service, these incentives will pay for themselves. Precedents for such practices exist elsewhere in government departments and public entities in South Africa. Such practices may be a useful future consideration for CMAs but is not an immediate priority.

| Objectives | Notes | Actions | Importance |
|---|---|---|---|
| Provide pay bonuses to CMA staff when | Bonuses may be awarded when costs are reduced below recent levels. The performance targets can be | To be considered by CMAs. | 5 |

| Objectives | Notes | Actions | Importance |
|---|---|---|---|
| performance targets are met | based on the performance indices discussed above and costs-savings. | | |

### *12.4.7 Develop an annual tariff review mechanism*

A key requirement for setting and maintaining effective tariffs is to develop an annual tariff review mechanism. This would serve to maintain a relevant and dynamic tariff system that adjusts to changes in the policy, social environmental and economic environments. It would therefore serve to:

- Maintain effective subsidy policies
- Maintain cost-effective tariffs
- Maintain affordable tariffs
- Maintain policy-relevant tariffs.

| Objectives | Notes | Actions | Importance |
|---|---|---|---|
| Adjust WRM tariffs annually | Thus mechanism would the form of a tariff review and adjustment exercise. Performance the data and performance indices generated during the course of the preceding periods would serve as a basis review. Operational requirements and policy imperatives would provide review guidelines. | DWA / CMAs to develop an annual WRM review and adjustment mechanism | 1 |
| Commission an external performance audit of the effectiveness of the WRM tariffs | Such an audit would provide an independent view of the effectiveness of the tariff system. This would provide valuable management insight into improvement of operations and reduction of costs. An audit that certifies that the system is well and efficiently run would also engender customer trust and support. | CMAs to commission an external performance audit of the effectiveness of the WRM tariffs | 1 |

### *12.4.8 Publish and regularly remind customers of the water and wastewater tariff schedule.*

CMAs would rely on a loyal and trusting customer base and for this; transparency and trust wrt tariff systems are prerequisites.

| Objectives | Notes | Actions | Importance |
| --- | --- | --- | --- |
| Implement customer information programmes | The CMA should alert customers in advance to upcoming investments, regulatory requirements, or other cost increases that will impact tariffs and compute the corresponding impact on typical customer bills. | Describe to customers policies that govern calculation of tariffs and keep them informed of changes. Share audit reports. | 1 |

## 12.5 Norm and Standards for Setting Water Tariffs

**10.** (1) The Minister may, with the concurrence of the Minister of Finance, from time to time prescribe norms and standards in respect of tariffs for water services.

(2) These norms and standards may-

(a) differentiate on an equitable basis between-

(i) different users of water services;

(ii) different types of water services; and

(iii) different geographic areas, taking into account, among other factors, the socio-economic and physical attributes of each area;

(b) place limitations on surplus or profit;

(c) place limitations on the use of income generated by the recovery of charges; and

(d) provide for tariffs to be used to promote or achieve water conservation.

(3) In prescribing the norms and standards, the Minister must consider, among other factors

(a) any national standards prescribed by him or her;

(b) social equity;

(c) the financial sustainability of the water services in the geographic area in question;

(d) the recovery of costs reasonably associated with providing the water services;

(e) the redemption period of any loans for the provision of water services;

(f) the need for a return on capital invested for the provision of water services; and

(g) the need to provide for drought and excess water availability.

(4) No water services institution may use a tariff which is substantially different from any prescribed norms and standards.

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# APPENDICES

# 14 Appendix A: Raw Water Requirements and Revenue Generation

## 14.1 Appendix A.1 Current Water Use Requirements

TABLE 14-1. CURRENT WATER USE REQUIREMENTS. 2012 MEAN PROJECTED VALUE.

| | Water requirements for the year 2012 (million m³/a) | | | | | | | | Raw Water Use Charges 2011/12 (c/m3) | | | Revenue from Raw Water Use Charges 2011/12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D&I | Irrigation | *Urban* | *Rural* | *Mining* | *Power* | Afforestation | Total | D&I | IRR | Forestry | Rand / year | c/m3 |
| Limpopo | 88 | 252 | *36* | *30* | *15* | *7* | 1 | 341 | 1.9 | 1.9 | 0.92 | 6 473 226 | 1.90 |
| Luvuvhu/Letaba | 43 | 254 | *10* | *32* | *1* | *0* | 44 | 341 | 3.15 | 1.84 | 1.09 | 6 501 317 | 1.91 |
| Crocodile West and Marico | 884 | 532 | *655* | *44* | *152* | *34* | 0 | 1 417 | 1.8 | 1.56 | 0.76 | 24 223 161 | 1.71 |
| Olifants | 436 | 596 | *94* | *47* | *101* | *194* | 3 | 1 035 | 2.29 | 1.25 | 0.85 | 17 462 928 | 1.69 |
| Inkomati | 119 | 624 | *66* | *27* | *25* | *0* | 145 | 888 | 1.58 | 0.82 | 0.82 | 8 181 027 | 0.92 |
| Usutu to Mhlathuze | 187 | 447 | *52* | *41* | *94* | *0* | 108 | 742 | 1.01 | 0.8 | 0.46 | 5 965 801 | 0.80 |
| Thukela | 139 | 218 | *56* | *33* | *49* | *1* | 0 | 358 | 0.8 | 1.39 | 0.48 | 4 150 923 | 1.16 |
| Upper Vaal | 1 128 | 138 | *769* | *52* | *210* | *97* | 0 | 1 266 | 2.1 | 1.94 | 1 | 26 358 861 | 2.08 |
| Middle Vaal | 218 | 165 | *97* | *33* | *88* | *0* | 0 | 383 | 2.5 | 1.02 | 0 | 7 134 028 | 1.86 |
| Lower Vaal | 121 | 536 | *69* | *45* | *6* | *0* | 0 | 657 | 1.39 | 2.06 | 0 | 12 727 222 | 1.94 |
| Mvoti to Umzimkulu | 661 | 260 | *513* | *55* | *93* | *0* | 82 | 1 003 | 2.14 | 2.02 | 1.22 | 20 406 660 | 2.03 |
| Mzimvubu to Keiskamma | 148 | 204 | *106* | *42* | *0* | *0* | 49 | 401 | 2.34 | 0.43 | 1.17 | 4 919 978 | 1.23 |
| Upper Orange | 200 | 828 | *134* | *64* | *2* | *0* | 0 | 1 028 | 0.76 | 0.87 | 0 | 8 723 460 | 0.85 |
| Lower Orange | 52 | 1 006 | *26* | *17* | *9* | *0* | 0 | 1 058 | 1.36 | 1.11 | 0 | 11 876 141 | 1.12 |
| Fish to Tsitsikamma | 136 | 813 | *119* | *17* | *0* | *0* | 7 | 957 | 2.28 | 1.35 | 0.66 | 14 137 413 | 1.48 |
| Gouritz | 75 | 277 | *57* | *12* | *7* | *0* | 15 | 367 | 3.12 | 1.25 | 0.74 | 5 917 619 | 1.61 |
| Olifants/Doring | 16 | 358 | *7* | *6* | *3* | *0* | 1 | 375 | 2.27 | 1.14 | 0.74 | 4 449 196 | 1.19 |
| Breede | 51 | 593 | *40* | *11* | *0* | *0* | 6 | 651 | 3.29 | 1.35 | 0.45 | 9 729 450 | 1.49 |
| Berg | 503 | 376 | *486* | *17* | *0* | *0* | 0 | 879 | 4.05 | 0.94 | 0.96 | 23 903 387 | 2.72 |
| Total | 5 206 | 8 478 | | | | | 462 | 14 147 | | | | 223 241 798 | 1.58 |

[MEAN PROJECTED VALUES UTILIZED]

## 14.2 Appendix A.2 Water Use Requirements 2025 – Base Projection

TABLE 14-2. WATER USE REQUIREMENTS. 2025 BASE PROJECTION.

| | | Water requirements for the year 2025 (million m³/a) BASE Projection | | | | | | | | Raw Water Use Charges (2011/12 Prices) (c/m3) | | | Revenue from Raw Water Use Charges (2011/12 Prices) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | D&I | Irrigation | *Urban* | *Rural* | *Mining* | *Power* | Afforestation | Total | D&I | IRR | Forestry | Rand / year | c/m3 |
| 1 | Limpopo | 89 | 256 | *37* | *30* | *15* | *8* | 1 | 346 | 1.9 | 1.9 | 0.92 | 6 566 315 | 1.90 |
| 2 | Luvuvhu/Letaba | 44 | 259 | *10* | *32* | *1* | *0* | 45 | 348 | 3.15 | 1.84 | 1.09 | 6 640 871 | 1.91 |
| 3 | Crocodile West and Marico | 898 | 541 | *665* | *45* | *154* | *34* | 0 | 1 439 | 1.8 | 1.56 | 0.76 | 24 596 460 | 1.71 |
| 4 | Olifants | 453 | 620 | *98* | *49* | *105* | *201* | 3 | 1 076 | 2.29 | 1.25 | 0.85 | 18 151 138 | 1.69 |
| 5 | Inkomati | 122 | 642 | *68* | *28* | *26* | *0* | 149 | 913 | 1.58 | 0.82 | 0.82 | 8 417 527 | 0.92 |
| 6 | Usutu to Mhlathuze | 184 | 438 | *51* | *41* | *92* | *0* | 106 | 728 | 1.01 | 0.8 | 0.46 | 5 848 938 | 0.80 |
| 7 | Thukela | 135 | 212 | *54* | *32* | *48* | *1* | 0 | 347 | 0.8 | 1.39 | 0.48 | 4 026 748 | 1.16 |
| 8 | Upper Vaal | 1 130 | 138 | *771* | *52* | *210* | *97* | 0 | 1 269 | 2.1 | 1.94 | 1 | 26 419 796 | 2.08 |
| 9 | Middle Vaal | 217 | 164 | *96* | *33* | *88* | *0* | 0 | 381 | 2.5 | 1.02 | 0 | 7 091 698 | 1.86 |
| 10 | Lower Vaal | 118 | 524 | *68* | *44* | *6* | *0* | 0 | 642 | 1.39 | 2.06 | 0 | 12 430 290 | 1.94 |
| 11 | Mvoti to Umzimkulu | 667 | 263 | *518* | *56* | *94* | *0* | 82 | 1 013 | 2.14 | 2.02 | 1.22 | 20 596 885 | 2.03 |
| 12 | Mzimvubu to Keiskamma | 152 | 210 | *109* | *43* | *0* | *0* | 51 | 413 | 2.34 | 0.43 | 1.17 | 5 061 178 | 1.23 |
| 13 | Upper Orange | 206 | 856 | *138* | *66* | *2* | *0* | 0 | 1 062 | 0.76 | 0.87 | 0 | 9 011 636 | 0.85 |
| 14 | Lower Orange | 54 | 1 026 | *26* | *18* | *9* | *0* | 0 | 1 079 | 1.36 | 1.11 | 0 | 12 115 215 | 1.12 |
| 15 | Fish to Tsitsikamma | 141 | 840 | *123* | *18* | *0* | *0* | 8 | 989 | 2.28 | 1.35 | 0.66 | 14 604 875 | 1.48 |
| 16 | Gouritz | 73 | 268 | *55* | *12* | *6* | *0* | 15 | 356 | 3.12 | 1.25 | 0.74 | 5 735 558 | 1.61 |
| 17 | Olifants/Doring | 16 | 356 | *7* | *6* | *3* | *0* | 1 | 373 | 2.27 | 1.14 | 0.74 | 4 429 000 | 1.19 |
| 18 | Breede | 50 | 580 | *39* | *11* | *0* | *0* | 6 | 637 | 3.29 | 1.35 | 0.45 | 9 518 269 | 1.49 |
| 19 | Berg | 475 | 355 | *459* | *17* | *0* | *0* | 0 | 830 | 4.05 | 0.94 | 0.96 | 22 578 911 | 2.72 |
| | Total | 5 225 | 8 548 | | | | | 467 | 14 239 | | | | 223 841 307 | 1.57 |

## 14.3 Appendix A.3 Water Use Requirements 2025 – High Projection

TABLE 14-3. WATER USE REQUIREMENTS: 2025 HIGH PROJECTIONS.

| | | Water requirements for the year 2025 (million m³/a) HIGH Projection | | | | | | | | Raw Water Use Charges (2011/12 Prices) (c/m3) | | | Revenue from Raw Water Use Charges (2011/12 Prices) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | D&I | Irrigation | *Urban* | *Rural* | *Mining* | *Power* | Afforestation | Total | D&I | IRR | Forestry | Rand / year | c/m3 |
| 1 | Limpopo | 97 | 279 | *40* | *33* | *16* | *8* | 1 | 378 | 1.9 | 1.9 | 0.92 | 7 171 027 | 1.90 |
| 2 | Luvuvhu/Letaba | 44 | 261 | *11* | *33* | *1* | *0* | 45 | 350 | 3.15 | 1.84 | 1.09 | 6 679 000 | 1.91 |
| 3 | Crocodile West and Marico | 1185 | 714 | *877* | *59* | *204* | *45* | 0 | 1899 | 1.8 | 1.56 | 0.76 | 32 471 376 | 1.71 |
| 4 | Olifants | 481 | 658 | *104* | *52* | *111* | *214* | 4 | 1143 | 2.29 | 1.25 | 0.85 | 19 276 411 | 1.69 |
| 5 | Inkomati | 128 | 672 | *71* | *29* | *27* | *0* | 156 | 956 | 1.58 | 0.82 | 0.82 | 8 814 287 | 0.92 |
| 6 | Usutu to Mhlathuze | 205 | 489 | *57* | *45* | *103* | *0* | 118 | 812 | 1.01 | 0.8 | 0.46 | 6 523 150 | 0.80 |
| 7 | Thukela | 163 | 256 | *65* | *39* | *58* | *1* | 0 | 420 | 0.8 | 1.39 | 0.48 | 4 871 629 | 1.16 |
| 8 | Upper Vaal | 1551 | 190 | *1058* | *72* | *288* | *133* | 0 | 1741 | 2.1 | 1.94 | 1 | 36 256 492 | 2.08 |
| 9 | Middle Vaal | 237 | 179 | *105* | *36* | *96* | *0* | 0 | 416 | 2.5 | 1.02 | 0 | 7 744 519 | 1.86 |
| 10 | Lower Vaal | 129 | 574 | *74* | *48* | *7* | *0* | 0 | 703 | 1.39 | 2.06 | 0 | 13 613 534 | 1.94 |
| 11 | Mvoti to Umzimkulu | 948 | 373 | *736* | *79* | *133* | *0* | 117 | 1439 | 2.14 | 2.02 | 1.22 | 29 264 132 | 2.03 |
| 12 | Mzimvubu to Keiskamma | 166 | 228 | *119* | *47* | *0* | *0* | 55 | 449 | 2.34 | 0.43 | 1.17 | 5 505 864 | 1.23 |
| 13 | Upper Orange | 218 | 906 | *146* | *70* | *2* | *0* | 0 | 1124 | 0.76 | 0.87 | 0 | 9 537 383 | 0.85 |
| 14 | Lower Orange | 55 | 1047 | *27* | *18* | *10* | *0* | 0 | 1102 | 1.36 | 1.11 | 0 | 12 369 058 | 1.12 |
| 15 | Fish to Tsitsikamma | 150 | 895 | *131* | *19* | *0* | *0* | 8 | 1053 | 2.28 | 1.35 | 0.66 | 15 559 962 | 1.48 |
| 16 | Gouritz | 91 | 335 | *68* | *14* | *8* | *0* | 18 | 444 | 3.12 | 1.25 | 0.74 | 7 153 154 | 1.61 |
| 17 | Olifants/Doring | 16 | 363 | *7* | *6* | *3* | *0* | 1 | 380 | 2.27 | 1.14 | 0.74 | 4 513 151 | 1.19 |
| 18 | Breede | 56 | 642 | *43* | *12* | *0* | *0* | 7 | 704 | 3.29 | 1.35 | 0.45 | 10 521 188 | 1.49 |
| 19 | Berg | 748 | 558 | *722* | *26* | *0* | *0* | 0 | 1306 | 4.05 | 0.94 | 0.96 | 35 524 920 | 2.72 |
| | Total | 6668.577 | 9619.072 | | | | | 530.776 | 16 818 | | | | 273 370 235 | 1.63 |

## Appendix A.4 Current Water Use Requirements: Prices Adjusted for Full Cost Recovery

TABLE 14-4. CURRENT WATER USE REQUIREMENTS. PRICES ADJUSTED FOR FULL COST RECOVERY.

| | Water requirements for the year 2012 (million m³/a) Prices Adjusted for Full Cost Recovery | | | | | | | | | Raw Water Use Charges (2011/12 Prices) (c/m3) | | | Revenue from Raw Water Use Charges (2011/12 Prices) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | D&I | Irrigation | *Urban* | *Rural* | *Mining* | *Power* | Afforestation | Total | D&I | IRR | Forestry | Rand / year | c/m3 |
| 1 | Limpopo | 88 | 252 | *36* | *30* | *15* | *7* | 1 | 341 | 7.05 | 7.05 | 3.42 | 24,031,445 | 7.04 |
| 2 | Luvuvhu/Letaba | 43 | 254 | *10* | *32* | *1* | *0* | 44 | 341 | 11.69 | 6.83 | 4.05 | 24,135,731 | 7.08 |
| 3 | Crocodile West and Marico | 884 | 532 | *655* | *44* | *152* | *34* | 0 | 1417 | 6.68 | 5.79 | 2.82 | 89,926,964 | 6.35 |
| 4 | Olifants | 436 | 596 | *94* | *47* | *101* | *194* | 3 | 1035 | 8.50 | 4.64 | 3.16 | 64,830,023 | 6.26 |
| 5 | Inkomati | 119 | 624 | *66* | *27* | *25* | *0* | 145 | 888 | 5.87 | 3.04 | 3.04 | 30,371,551 | 3.42 |
| 6 | Usutu to Mhlathuze | 187 | 447 | *52* | *41* | *94* | *0* | 108 | 742 | 3.75 | 2.97 | 1.71 | 22,147,662 | 2.98 |
| 7 | Thukela | 139 | 218 | *56* | *33* | *49* | *1* | 0 | 358 | 2.97 | 5.16 | 1.78 | 15,410,040 | 4.31 |
| 8 | Upper Vaal | 1128 | 138 | *769* | *52* | *210* | *97* | 0 | 1266 | 7.80 | 7.20 | 3.71 | 97,855,618 | 7.73 |
| 9 | Middle Vaal | 218 | 165 | *97* | *33* | *88* | *0* | 0 | 383 | 9.28 | 3.79 | 0.00 | 26,484,631 | 6.91 |
| 10 | Lower Vaal | 121 | 536 | *69* | *45* | *6* | *0* | 0 | 657 | 5.16 | 7.65 | 0.00 | 47,249,011 | 7.19 |
| 11 | Mvoti to Umzimkulu | 661 | 260 | *513* | *55* | *93* | *0* | 82 | 1003 | 7.94 | 7.50 | 4.53 | 75,758,445 | 7.55 |
| 12 | Mzimvubu to Keiskamma | 148 | 204 | *106* | *42* | *0* | *0* | 49 | 401 | 8.69 | 1.60 | 4.34 | 18,265,110 | 4.55 |
| 13 | Upper Orange | 200 | 828 | *134* | *64* | *2* | *0* | 0 | 1028 | 2.82 | 3.23 | 0.00 | 32,385,299 | 3.15 |
| 14 | Lower Orange | 52 | 1006 | *26* | *17* | *9* | *0* | 0 | 1058 | 5.05 | 4.12 | 0.00 | 44,089,430 | 4.17 |
| 15 | Fish to Tsitsikamma | 136 | 813 | *119* | *17* | *0* | *0* | 7 | 957 | 8.46 | 5.01 | 2.45 | 52,484,258 | 5.48 |
| 16 | Gouritz | 75 | 277 | *57* | *12* | *7* | *0* | 15 | 367 | 11.58 | 4.64 | 2.75 | 21,968,789 | 5.98 |
| 17 | Olifants/Doring | 16 | 358 | *7* | *6* | *3* | *0* | 1 | 375 | 8.43 | 4.23 | 2.75 | 16,517,362 | 4.41 |
| 18 | Breede | 51 | 593 | *40* | *11* | *0* | *0* | 6 | 651 | 12.21 | 5.01 | 1.67 | 36,119,971 | 5.55 |
| 19 | Berg | 503 | 376 | *486* | *17* | *0* | *0* | 0 | 879 | 15.04 | 3.49 | 3.56 | 88,739,825 | 10.10 |
| | Total | 5206 | 8478 | | | | | 462 | 14147 | | | | 828,771,165 | 5.86 |

**[Charge increase of 271% to achieve full cost recovery]**

## 14.4 Appendix A.5 Current Water Use Requirements: Prices adjusted for full cost recovery + 50% Agricultural Subsidy

TABLE 14-5. CURRENT WATER USE REQUIREMENTS. PRICES ADJUSTED FOR FULL COST RECOVERY + 50% AGRICULTURAL SUBSIDY

| | Water requirements for the year 2012 (million m³/a) Prices Adjusted for Full Cost Recovery + 50% Agricultural Subsidy | | | | | | | | | Raw Water Use Charges (2011/12 Prices) (c/m3) | | | Revenue from Raw Water Use Charges (2011/12 Prices) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | D&I | Irrigation | *Urban* | *Rural* | *Mining* | *Power* | Afforestation | Total | D&I | IRR | Forestry | Rand / year | c/m3 |
| 1 | Limpopo | 88 | 252 | *36* | *30* | *15* | *7* | 1 | 341 | 1.76 | 7.05 | 3.42 | 19 378 161 | 5.68 |
| 2 | Luvuvhu/Letaba | 43 | 254 | *10* | *32* | *1* | *0* | 44 | 341 | 2.92 | 6.83 | 4.05 | 20 367 193 | 5.98 |
| 3 | Crocodile West and Marico | 884 | 532 | *655* | *44* | *152* | *34* | 0 | 1 417 | 1.67 | 5.79 | 2.82 | 45 609 815 | 3.22 |
| 4 | Olifants | 436 | 596 | *94* | *47* | *101* | *194* | 3 | 1 035 | 2.13 | 4.64 | 3.16 | 37 041 937 | 3.58 |
| 5 | Inkomati | 119 | 624 | *66* | *27* | *25* | *0* | 145 | 888 | 1.47 | 3.04 | 3.04 | 25 143 901 | 2.83 |
| 6 | Usutu to Mhlathuze | 187 | 447 | *52* | *41* | *94* | *0* | 108 | 742 | 0.94 | 2.97 | 1.71 | 16 878 056 | 2.27 |
| 7 | Thukela | 139 | 218 | *56* | *33* | *49* | *1* | 0 | 358 | 0.74 | 5.16 | 1.78 | 12 308 628 | 3.44 |
| 8 | Upper Vaal | 1 128 | 138 | *769* | *52* | *210* | *97* | 0 | 1 266 | 1.95 | 7.20 | 3.71 | 31 922 256 | 2.52 |
| 9 | Middle Vaal | 218 | 165 | *97* | *33* | *88* | *0* | 0 | 383 | 2.32 | 3.79 | 0.00 | 11 309 097 | 2.95 |
| 10 | Lower Vaal | 121 | 536 | *69* | *45* | *6* | *0* | 0 | 657 | 1.29 | 7.65 | 0.00 | 42 582 417 | 6.48 |
| 11 | Mvoti to Umzimkulu | 661 | 260 | *513* | *55* | *93* | *0* | 82 | 1 003 | 1.99 | 7.50 | 4.53 | 36 353 393 | 3.62 |
| 12 | Mzimvubu to Keiskamma | 148 | 204 | *106* | *42* | *0* | *0* | 49 | 401 | 2.17 | 1.60 | 4.34 | 8 615 806 | 2.15 |
| 13 | Upper Orange | 200 | 828 | *134* | *64* | *2* | *0* | 0 | 1 028 | 0.71 | 3.23 | 0.00 | 28 160 718 | 2.74 |
| 14 | Lower Orange | 52 | 1 006 | *26* | *17* | *9* | *0* | 0 | 1 058 | 1.26 | 4.12 | 0.00 | 42 101 674 | 3.98 |
| 15 | Fish to Tsitsikamma | 136 | 813 | *119* | *17* | *0* | *0* | 7 | 957 | 2.12 | 5.01 | 2.45 | 43 824 124 | 4.58 |
| 16 | Gouritz | 75 | 277 | *57* | *12* | *7* | *0* | 15 | 367 | 2.90 | 4.64 | 2.75 | 15 438 096 | 4.20 |
| 17 | Olifants/Doring | 16 | 358 | *7* | *6* | *3* | *0* | 1 | 375 | 2.11 | 4.23 | 2.75 | 15 501 483 | 4.14 |
| 18 | Breede | 51 | 593 | *40* | *11* | *0* | *0* | 6 | 651 | 3.05 | 5.01 | 1.67 | 31 410 040 | 4.83 |
| 19 | Berg | 503 | 376 | *486* | *17* | *0* | *0* | 0 | 879 | 3.76 | 3.49 | 3.56 | 32 017 933 | 3.64 |
| | Total | 5 206 | 8 478 | | | | | 462 | 14 147 | | | | 515 964 727 | 3.65 |

## 14.5 Appendix A.6 Current Water Use Requirements: Prices adjusted for full cost recovery + 20% Agricultural Subsidy Cross Subsidized by D&I Sector

TABLE 14-6. CURRENT WATER USE REQUIREMENTS. PRICES ADJUSTED FOR FULL COST RECOVERY + 20% AGRICULTURAL SUBSIDY CROSS SUBSIDISED BY THE D&I SECTOR.

| | Water requirements for the year 2012 (million m³/a) Prices Adjusted for Full Cost Recovery + 20% Agricultural Subsidy Cross Subsidised by D&I Sector | | | | | | | | | Raw Water Use Charges (2011/12 Prices) (c/m3) | | | Revenue from Raw Water Use Charges (2011/12 Prices) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | D&I | Irrigation | *Urban* | *Rural* | *Mining* | *Power* | Afforestation | Total | D&I | IRR | Forestry | Rand / year | c/m3 |
| 1 | Limpopo | 88 | 252 | *36* | *30* | *15* | *7* | 1 | 341 | 8.40 | 5.64 | 3.42 | 21 654 252 | 6.35 |
| 2 | Luvuvhu/Letaba | 43 | 254 | *10* | *32* | *1* | *0* | 44 | 341 | 13.92 | 5.46 | 4.05 | 21 625 986 | 6.35 |
| 3 | Crocodile West and Marico | 884 | 532 | *655* | *44* | *152* | *34* | 0 | 1 417 | 7.95 | 4.63 | 2.82 | 95 006 949 | 6.71 |
| 4 | Olifants | 436 | 596 | *94* | *47* | *101* | *194* | 3 | 1 035 | 10.12 | 3.71 | 3.16 | 66 346 927 | 6.41 |
| 5 | Inkomati | 119 | 624 | *66* | *27* | *25* | *0* | 145 | 888 | 6.98 | 2.44 | 3.04 | 27 901 585 | 3.14 |
| 6 | Usutu to Mhlathuze | 187 | 447 | *52* | *41* | *94* | *0* | 108 | 742 | 4.46 | 2.38 | 1.71 | 20 828 495 | 2.81 |
| 7 | Thukela | 139 | 218 | *56* | *33* | *49* | *1* | 0 | 358 | 3.54 | 4.13 | 1.78 | 13 942 198 | 3.90 |
| 8 | Upper Vaal | 1 128 | 138 | *769* | *52* | *210* | *97* | 0 | 1 266 | 9.28 | 5.76 | 3.71 | 112 600 284 | 8.90 |
| 9 | Middle Vaal | 218 | 165 | *97* | *33* | *88* | *0* | 0 | 383 | 11.05 | 3.03 | 0.00 | 29 085 989 | 7.59 |
| 10 | Lower Vaal | 121 | 536 | *69* | *45* | *6* | *0* | 0 | 657 | 6.14 | 6.12 | 0.00 | 40 227 993 | 6.12 |
| 11 | Mvoti to Umzimkulu | 661 | 260 | *513* | *55* | *93* | *0* | 82 | 1 003 | 9.46 | 6.00 | 4.53 | 81 855 854 | 8.16 |
| 12 | Mzimvubu to Keiskamma | 148 | 204 | *106* | *42* | *0* | *0* | 49 | 401 | 10.34 | 1.28 | 4.34 | 20 063 039 | 5.00 |
| 13 | Upper Orange | 200 | 828 | *134* | *64* | *2* | *0* | 0 | 1 028 | 3.36 | 2.58 | 0.00 | 28 106 972 | 2.73 |
| 14 | Lower Orange | 52 | 1 006 | *26* | *17* | *9* | *0* | 0 | 1 058 | 6.01 | 3.30 | 0.00 | 36 306 094 | 3.43 |
| 15 | Fish to Tsitsikamma | 136 | 813 | *119* | *17* | *0* | *0* | 7 | 957 | 10.08 | 4.01 | 2.45 | 46 531 234 | 4.86 |
| 16 | Gouritz | 75 | 277 | *57* | *12* | *7* | *0* | 15 | 367 | 13.79 | 3.71 | 2.75 | 21 057 814 | 5.74 |
| 17 | Olifants/Doring | 16 | 358 | *7* | *6* | *3* | *0* | 1 | 375 | 10.03 | 3.39 | 2.75 | 13 748 135 | 3.67 |
| 18 | Breede | 51 | 593 | *40* | *11* | *0* | *0* | 6 | 651 | 14.54 | 4.01 | 1.67 | 31 367 931 | 4.82 |
| 19 | Berg | 503 | 376 | *486* | *17* | *0* | *0* | 0 | 879 | 17.90 | 2.79 | 3.56 | 100 513 433 | 11.44 |
| | Total | 5 206 | 8 478 | | | | | 462 | 14 147 | ** | * | | 828 771 165 | 5.86 |

* 20% Subsidy for Irrigation

** Full cost pricing + 19% to compensate for revenue lost in irrigation subsidy.

# 15 APPENDIX B: PROJECTED RAW WATER REQUIREMENTS FOR THE PERIOD 2000 UNTIL 2025.

TABLE 15-1. PROJECTED RAW WATER REQUIREMENTS FOR THE PERIOD 2000 UNTIL 2025

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|
| Base | 12 871 | 12 926 | 12 980 | 13 035 | 13 090 | 13 145 | 13 199 | 13 254 | 13 309 | 13 363 |
| High | 12 871 | 13 029 | 13 187 | 13 345 | 13 503 | 13 660 | 13 818 | 13 976 | 14 134 | 14 292 |

| Year | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|
| Base | 13 418 | 13 473 | 13 528 | 13 582 | 13 637 | 13 692 | 13 747 | 13 801 | 13 856 | 13 911 |
| High | 14 450 | 14 608 | 14 766 | 14 923 | 15 081 | 15 239 | 15 397 | 15 555 | 15 713 | 15 871 |

| Year | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|
| Base | 13 965 | 14 020 | 14 075 | 14 130 | 14 184 | 14 239 |
| High | 16 029 | 16 186 | 16 344 | 16 502 | 16 660 | 16 818 |

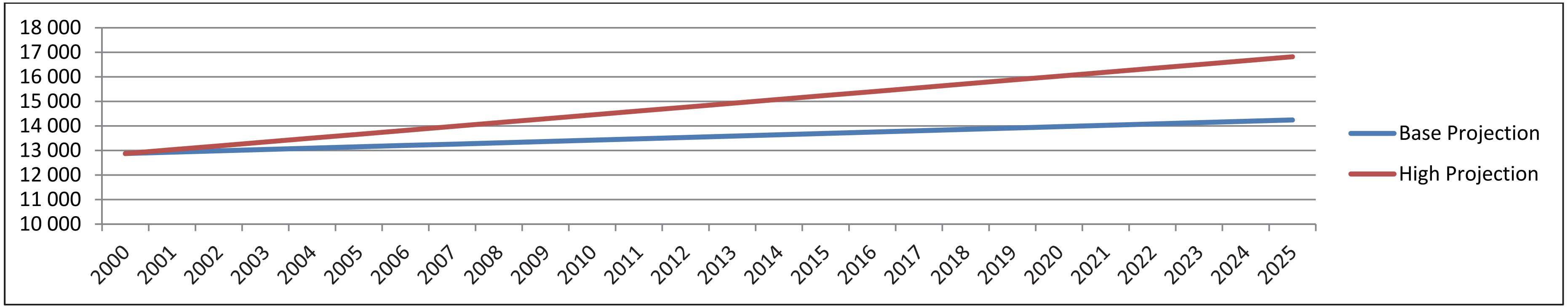



FIGURE 15-1: PROJECTED RAW WATER REQUIREMENT CURVES

# 16 APPENDIX C: CMA COSTS

## 16.1 APPENDIX C.1

TABLE 16-1. INDIVIDUAL CMA COST [ASSUMING 19 CMAS IN RSA]

| Individual CMA Costs [Assuming 19 CMAs in RSA] | | | | | | |
|---|---|---|---|---|---|---|
| **Costs** | **Phase 1** | **Phase 2** | **Phase 3** | **Phase 4** | **Phase 5** | **Phase 6** |
| Salaries | 3 448 598.00 | 8 692 859.00 | 11 020 069.00 | 12 855 025.00 | 17 556 000.00 | 27 591 498.00 |
| Professional Services | 2 500 000.00 | 2 500 000.00 | 5 500 000.00 | 5 500 000.00 | 8 000 000.00 | 8 000 000.00 |
| Board Costs | 700 000.00 | 700 000.00 | 1 100 000.00 | 1 100 000.00 | 1 500 000.00 | 1 500 000.00 |
| Other Opex | 1 100 000.00 | 3 500 000.00 | 3 500 000.00 | 4 500 000.00 | 6 000 000.00 | 12 000 000.00 |
| Capex | 250 000.00 | 750 000.00 | 750 000.00 | 1 500 000.00 | 3 000 000.00 | 4 000 000.00 |
| **Total** | **7 998 598.00** | **16 142 859.00** | **21 870 069.00** | **25 455 025.00** | **36 056 000.00** | **53 091 498.00** |
| **Labour Details** | | | | | | |
| Staff Compliment | 7.00 | 20.00 | 28.00 | 35.00 | 50.00 | 80.00 |
| Hours in an RSA Work Year | 1 864.00 | 1 864.00 | 1 864.00 | 1 864.00 | 1 864.00 | 1 864.00 |
| Total CMA Hours | 13 048.00 | 37 280.00 | 52 192.00 | 65 240.00 | 93 200.00 | 149 120.00 |
| Cost per Hour of Labour | 613.01 | 433.02 | 419.03 | 390.18 | 386.87 | 356.03 |

## 16.2 Appendix C.2

TABLE 16-2. AGGREGATED CMA COST [ASSUMING 19 CMAS]

| 19 CMA Aggregated Cost | | | | | | |
|---|---|---|---|---|---|---|
| **Costs** | **Phase 1** | **Phase 2** | **Phase 3** | **Phase 4** | **Phase 5** | **Phase 6** |
| Salaries | 65 523 362.00 | 165 164 321.00 | 209 381 311.00 | 244 245 475.00 | 333 564 000.00 | 524 238 462.00 |
| Professional Services | 47 500 000.00 | 47 500 000.00 | 104 500 000.00 | 104 500 000.00 | 152 000 000.00 | 152 000 000.00 |
| Board Costs | 13 300 000.00 | 13 300 000.00 | 20 900 000.00 | 20 900 000.00 | 28 500 000.00 | 28 500 000.00 |
| Other Opex | 20 900 000.00 | 66 500 000.00 | 66 500 000.00 | 85 500 000.00 | 114 000 000.00 | 228 000 000.00 |
| Capex | 4 750 000.00 | 14 250 000.00 | 14 250 000.00 | 28 500 000.00 | 57 000 000.00 | 76 000 000.00 |
| **Total** | **151 973 362.00** | **306 714 321.00** | **415 531 311.00** | **483 645 475.00** | **685 064 000.00** | **1 008 738 462.00** |
| **Labour Details** | | | | | | |
| Staff Compliment | 133.00 | 380.00 | 532.00 | 665.00 | 950.00 | 1 520.00 |
| Hours in an RSA Work Year | 1 864.00 | 1 864.00 | 1 864.00 | 1 864.00 | 1 864.00 | 1 864.00 |
| Total CMA Hours | 247 912.00 | 708 320.00 | 991 648.00 | 1 239 560.00 | 1 770 800.00 | 2 833 280.00 |
| Cost per Hour of labour | 613.01 | 433.02 | 419.03 | 390.18 | 386.87 | 356.03 |

## 16.3 Appendix C.3

TABLE 16-3. INDIVIDUAL CMA COST [ASSUMING 9 CMAS]

| Individual CMA Cost [Assuming 9 CMAs in RSA] | | | | | | |
|---|---|---|---|---|---|---|
| **Costs** | **Phase 1** | **Phase 2** | **Phase 3** | **Phase 4** | **Phase 5** | **Phase 6** |
| Salaries | 3 448 598.00 | 8 692 859.00 | 18 456 879.00 | 27 591 498.00 | 40 500 255.00 | 49 585 685.00 |
| Professional Services | 2 500 000.00 | 2 500 000.00 | 8 000 000.00 | 8 000 000.00 | 12 000 000.00 | 15 000 000.00 |
| Board Costs | 700 000.00 | 700 000.00 | 1 100 000.00 | 1 100 000.00 | 1 500 000.00 | 1 500 000.00 |
| Other Opex | 1 100 000.00 | 3 500 000.00 | 6 000 000.00 | 12 000 000.00 | 16 000 000.00 | 19 000 000.00 |
| Capex | 250 000.00 | 750 000.00 | 3 000 000.00 | 4 000 000.00 | 5 500 000.00 | 7 000 000.00 |
| **Total** | **7 998 598.00** | **16 142 859.00** | **36 556 879.00** | **52 691 498.00** | **75 500 255.00** | **92 085 685.00** |
| **Labour Details** | | | | | | |
| Staff Compliment | 7 | 20 | 50 | 80 | 120 | 150 |
| Hours in an RSA Work Year | 1 864 | 1 864 | 1 864 | 1 864 | 1 864 | 1 864 |
| Total CMA Labour Hours | 13 048 | 37 280 | 93 200 | 149 120 | 223 680 | 279 600 |
| Cost per Hour of Labour | 613.01 | 433.02 | 392.24 | 353.35 | 337.54 | 329.35 |

## 16.4 APPENDIX C.4

TABLE 16-4. AGGREGATED CMA COST [ASSUMING 9 CMAS]

| 9 CMA Aggregated Cost | | | | | | |
|---|---|---|---|---|---|---|
| **Costs** | **Phase 1** | **Phase 2** | **Phase 3** | **Phase 4** | **Phase 5** | **Phase 6** |
| Salaries | 31 037 382.00 | 78 235 731.00 | 166 111 911.00 | 248 323 482.00 | 364 502 295.00 | 446 271 165.00 |
| Professional Services | 22 500 000.00 | 22 500 000.00 | 72 000 000.00 | 72 000 000.00 | 108 000 000.00 | 135 000 000.00 |
| Board Costs | 6 300 000.00 | 6 300 000.00 | 9 900 000.00 | 9 900 000.00 | 13 500 000.00 | 13 500 000.00 |
| Other Opex | 9 900 000.00 | 31 500 000.00 | 54 000 000.00 | 108 000 000.00 | 144 000 000.00 | 171 000 000.00 |
| Capex | 2 250 000.00 | 6 750 000.00 | 27 000 000.00 | 36 000 000.00 | 49 500 000.00 | 63 000 000.00 |
| **Total** | **71 987 382.00** | **145 285 731.00** | **329 011 911.00** | **474 223 482.00** | **679 502 295.00** | **828 771 165.00** |
| **Labour Details** | | | | | | |
| Staff Compliment | 63 | 180 | 450 | 720 | 1 080 | 1 350 |
| Hours in an RSA Work Year | 1 864 | 1 864 | 1 864 | 1 864 | 1 864 | 1 864 |
| Total CMA Labour Hours | 117 432 | 335 520 | 838 800 | 1 342 080 | 2 013 120 | 2 516 400 |
| Cost per Hour of Labour | 613.01 | 433.02 | 392.24 | 353.35 | 337.54 | 329.35 |

# 17 Appendix E: 9 CMA Rollout Cost Estimate

## 17.1 Appendix E.1 Per Annum Cost Estimate for 9 CMA Rollout

TABLE 17-1. COST ESTIMATE FOR 9 CMA ROLLOUT

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CMA 1** | 7998598 | 16142859 | 36556879 | 52691498 | 75500255 | 92085685 | 92085685 | 92085685 | 92085685 | 92085685 | 92085685 |
| **CMA 2** | | 7998598 | 16142859 | 36556879 | 52691498 | 75500255 | 92085685 | 92085685 | 92085685 | 92085685 | 92085685 |
| **CMA 3** | | | 7998598 | 16142859 | 36556879 | 52691498 | 75500255 | 92085685 | 92085685 | 92085685 | 92085685 |
| **CMA 4** | | | | 7998598 | 16142859 | 36556879 | 52691498 | 75500255 | 92085685 | 92085685 | 92085685 |
| **CMA 5** | | | | | 7998598 | 16142859 | 36556879 | 52691498 | 75500255 | 92085685 | 92085685 |
| **CMA 6** | | | | | | 7998598 | 16142859 | 36556879 | 52691498 | 75500255 | 92085685 |
| **CMA 7** | | | | | | | 7998598 | 16142859 | 36556879 | 52691498 | 75500255 |
| **CMA 8** | | | | | | | | 7998598 | 16142859 | 36556879 | 52691498 |
| **CMA 9** | | | | | | | | | 7998598 | 16142859 | 36556879 |
| **Tot CMA** | 7998598 | 24141457 | 60698336 | 113389834 | 188890089 | 280975774 | 373061459 | 465147144 | 557232829 | 641319916 | 717262742 |
| | **2023** | **2024** | **2025** | **2026** | **2027** | **2028** | | | | | |
| **CMA 1** | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | | | | | |
| **CMA 2** | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | | | | | |
| **CMA 3** | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | | | | | |
| **CMA 4** | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | | | | | |
| **CMA 5** | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | | | | | |
| **CMA 6** | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | | | | | |
| **CMA 7** | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | | | | | |
| **CMA 8** | 75 500 255 | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | | | | | |
| **CMA 9** | 52 691 498 | 75 500 255 | 92 085 685 | 92 085 685 | 92 085 685 | 92 085 685 | | | | | |
| **Tot CMA** | 772 791 548 | 812 185 735 | 828 771 165 | 828 771 165 | 828 771 165 | 828 771 165 | | | | | |

## 17.2 Appendix E.2: Costing trend for 9 CMA Rollout

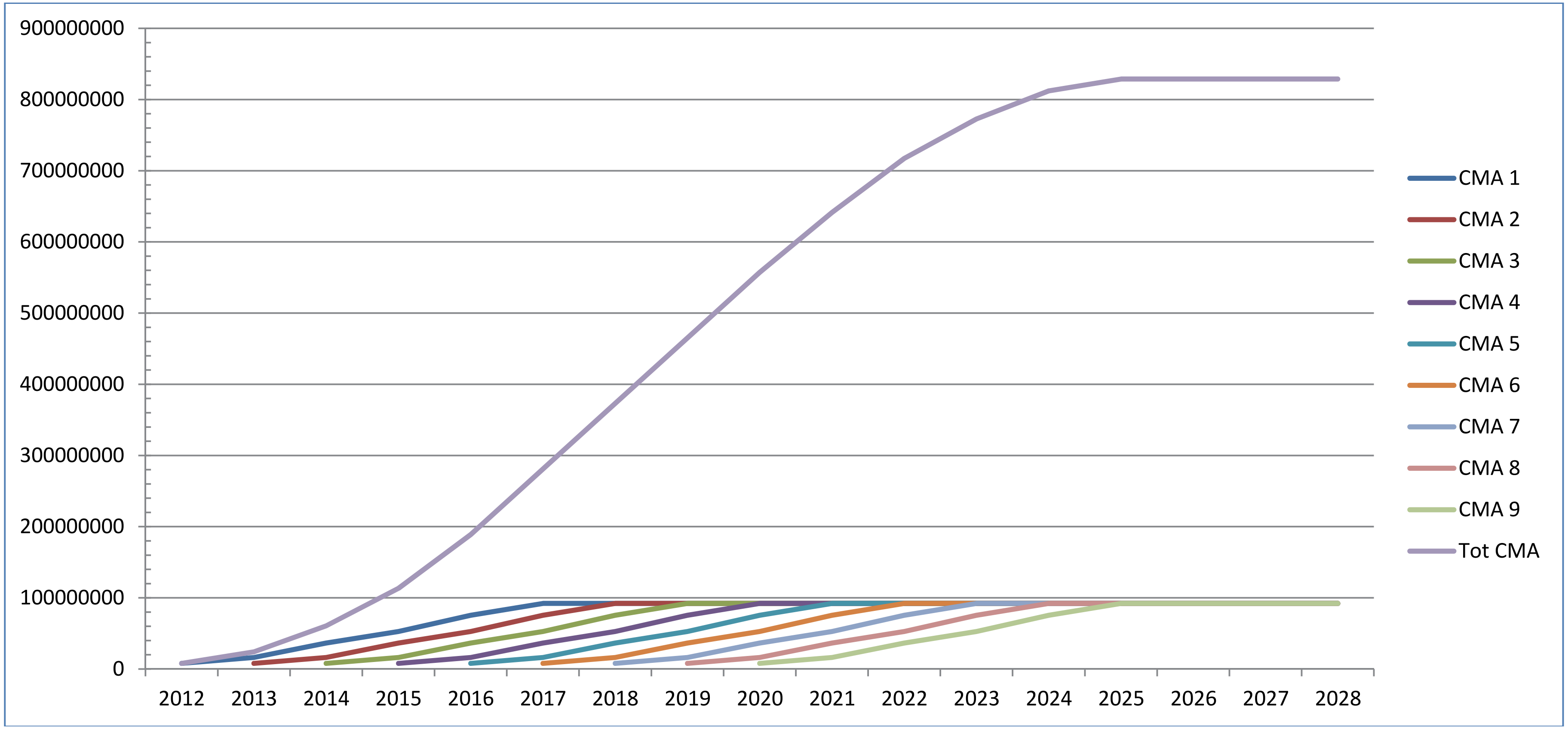



FIGURE 17-1: COSTING CURVES FOR 9 CMA ROLL-OUT

## 17.3 Appendix E.3 CMA Rollout Cost Trend with 10% Margin of Certainty

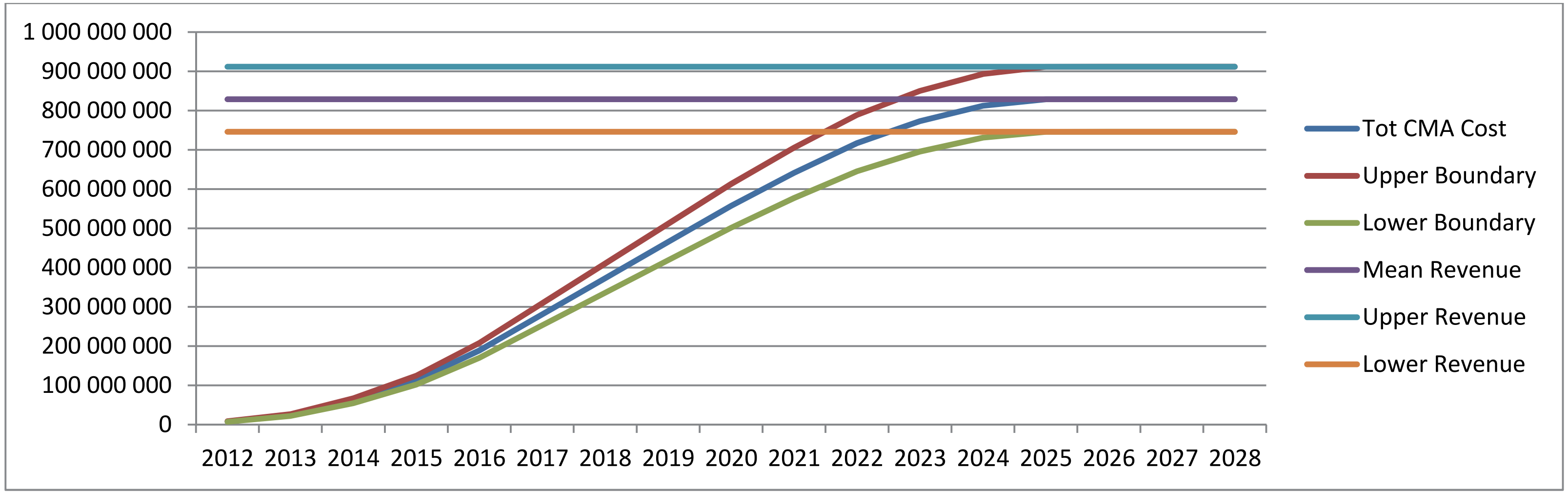



FIGURE 17-2. 9 CMA ROLLOUT COST TREND WITH 10% UPPER AND LOWER BOUNDARY

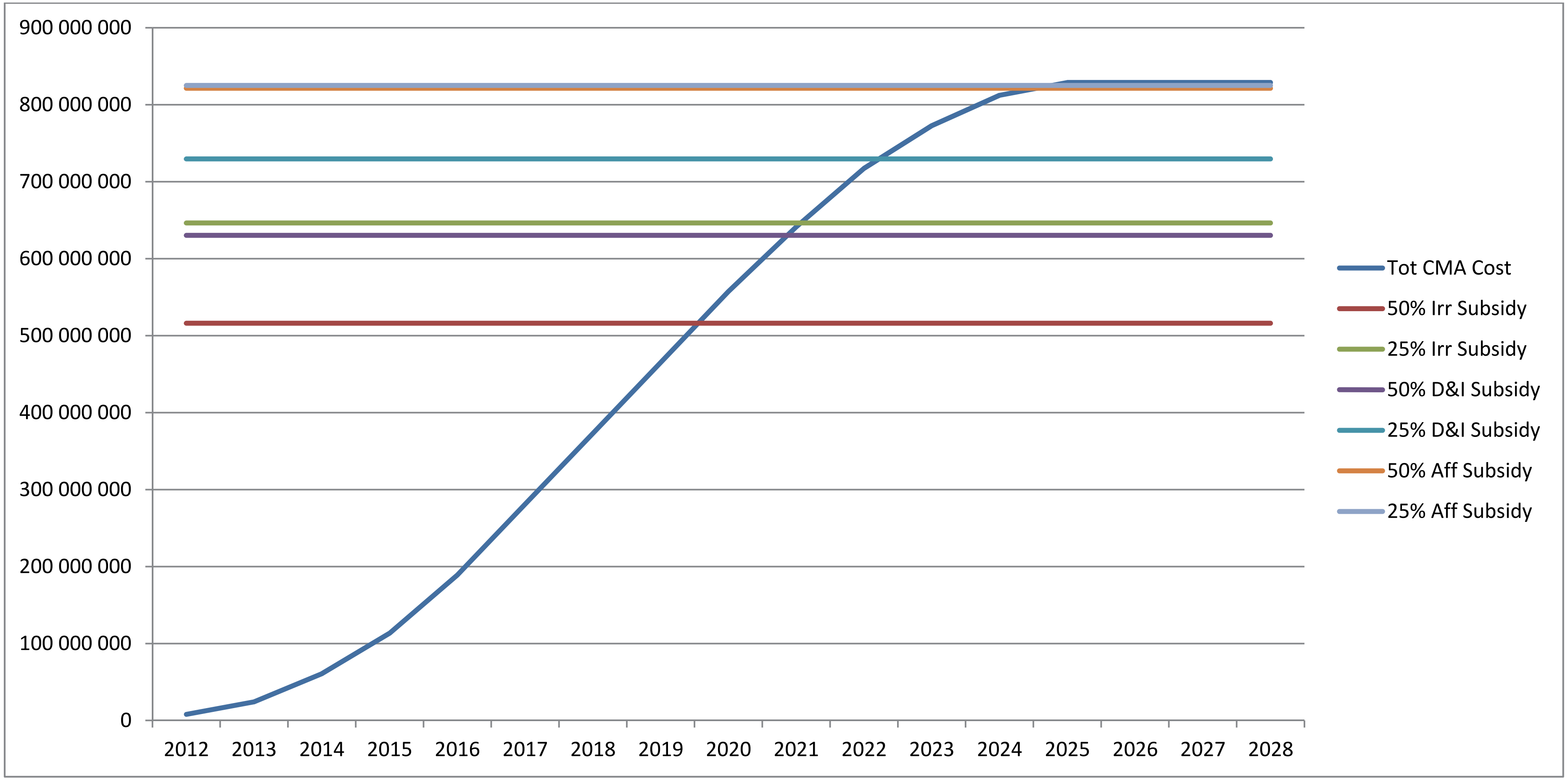
TABLE 17-2. 9 CMA ROLLOUT COST TREND WITH 10% UPPER AND LOWER BOUNDARY

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tot CMA Cost** | 7,998,598 | 24,141,457 | 60,698,336 | 113,389,834 | 188,890,089 | 280,975,774 | 373,061,459 | 465,147,144 | 557,232,829 | 641,319,916 | 717,262,742 |
| **Upper Boundary** | 8,798,458 | 26,555,603 | 66,768,170 | 124,728,817 | 207,779,098 | 309,073,351 | 410,367,605 | 511,661,858 | 612,956,112 | 705,451,908 | 788,989,016 |
| **Lower Boundary** | 7,198,738 | 21,727,311 | 54,628,502 | 102,050,851 | 170,001,080 | 252,878,197 | 335,755,313 | 418,632,430 | 501,509,546 | 577,187,924 | 645,536,468 |
| | **2,023** | **2,024** | **2,025** | **2,026** | **2,027** | **2,028** | | | | | |
| **Tot CMA Cost** | 772,791,548 | 812,185,735 | 828,771,165 | 828,771,165 | 828,771,165 | 828,771,165 | | | | | |
| **Upper Boundary** | 850,070,703 | 893,404,309 | 911,648,282 | 911,648,282 | 911,648,282 | 911,648,282 | | | | | |
| **Lower Boundary** | 695,512,393 | 730,967,162 | 745,894,049 | 745,894,049 | 745,894,049 | 745,894,049 | | | | | |

# 18 Appendix F: Effect of Subsidy on Revenue

## 18.1 Appendix F.1 Subsidy Effect on Revenue

TABLE 18-1. CMA COST CURVE ILLUSTRATING THE EFFECT OF SECTOR SUBSIDIES.



# 19 APPENDIX G: COST OF WATER MANAGEMENT IN WESTERN AUSTRALIA

**In order to assess that scale and proportions of a hypothetical CMA cost estimation it is essential that an equivalent be assessed in terms of its own scale and proportions. The Government of Western Australia's Department of Water is just such an organization that can provide some insight into what a fully functional CMAs network will look like and cost.**

**Australia and South Africa are very different nations in term of per capita income and general economic wellbeing, yet they are remarkably comparable in term of their available water resources, water scarcity and the predominance of certain sectors within the water economy. It is upon these similarities that the comparison is drawn between Australia and South Africa.**

## 19.1 FUNCTIONS OF THE DOW

The Government of Western Australia's Department of Water is the organization charged with the management of Western Australia's water resources. The mandate of the DoW may be described as follows:

- Integrate water planning and land-use planning
- Protect and improve water resources
- Work with industry, government and the community to find solutions for better water use
- Assess and advise on water availability
- Provide easy to find information
- Encourage water conservation
- Promote use of alternative water sources
- Lead policy development

(DoW. 2011)

A fully illustrated diagram of the DoW organizational structure and functional components may be viewed on page 144.

Based off of this description of the DoW mandate, it is clear that the specific functions of the DoW are comparable to the functions of the CMA system. Chapter 3.2 elaborates further.

## 19.2 COMPARISON OF DOW AND CMA FUNCTIONS

Chapter 4 deals with the specific functions of CMAs. The NWA envisages CMA to perform five initial functions; other functions that may be designated by the Department of Water Affairs (DWA) and yet other functions incidental to any of its functions, which fall outside its water management area. These five functions are listed in the Table 19-1 below.

TABLE 19-1. INITIAL FUNCTIONS OF THE CMA AS DEFINED BY THE NWA

| Functional area | Initial functions |
|---|---|
| **Investigate and advise interested persons** | 1. On water resource protection, use, development, conservation, management and control |
| **Develop policy and strategy** | 2. Develop a catchment management strategy (CMS) |
| **Co-ordination** | 3. Of the related activities of water users and of the water management institutions within its water management area<br>4. Of CMS implementation with the implementation of any applicable development plan established in terms of the Water Services Act, 1997 (Act No. 108 of 1997) |
| **Promote community participation** | 5. In the protection, use, development, conservation, management and control of the water resources in its water management area |

Each of the five functions listed in Table 19-1 has a comparable equivalent listed in chapter 3.1. If we discuss the secondary functions of CMAs the similarity becomes even more apparent. The secondary CMA functions are:

- Support institutions
- Regulate water use
- Implement physical interventions
- Manage information
- Audit water resource management

For all intents and purposes it is feasible to compare the DoW in Australia with the CMA system in South Africa and call them equivalents.

## 19.3 COMPARISON OF RAW WATER USAGE SECTORS BETWEEN SOUTH AFRICA AND AUSTRALIA

In the 2010/2010 financial year Australia consumed a total of 13.476 million m$^3$ of raw water. This water was used various sectors according to the proportion illustrated in Figure 19-2 shown below.

TABLE 19-2. WATER CONSULTPTION IN AUSTRALIA, BY SECTOR

| Water Consumption per Sector, Australia 2011/12 | | |
|---|---|---|
| | **ML** | **%** |
| **Agriculture, forestry and fishing** | 7,187,433 | 53.3 |
| **Mining** | 489,313 | 3.6 |
| **Manufacturing** | 658,312 | 4.9 |
| **Electricity, gas, water and waste services** | 2,199,020 | 16.3 |
| **Other industries** | 1,074,695 | 8.0 |
| **Household** | 1,867,621 | 13.9 |
| **Total** | **13,476,395** | **100.0** |

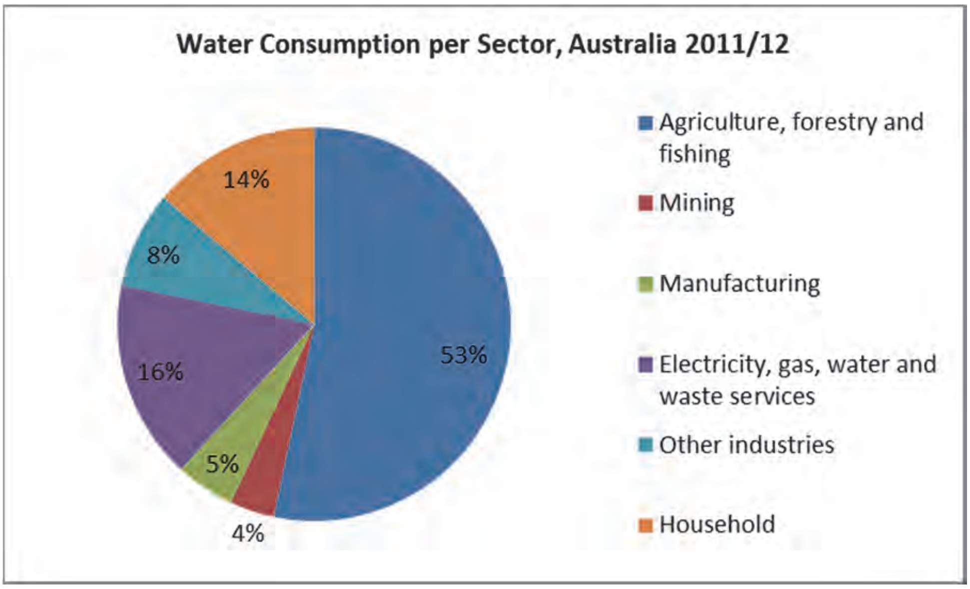



FIGURE 19-1. RAW WATER USAGE SECTORS OF AUSTRALIA

Agriculture and irrigation currently consume 38%. Public water supplies make up 20% of raw water usage. Mining is a significant water consumer accounting for 27% of raw water requirements while commercial, industrial and power generation account for 10% collectively.

South Africa consumed approximately 14.041 million $m^3$ of water in 2011. Figure 19-2 shown below details raw water usage according to sector for South Africa. At 60% of raw water usage, irrigation accounts for a considerably larger portion of raw water consumption than in Australia. Though, on the other hand, Australia allocates a far larger portion of its raw water towards mining related activities; 6% for South Africa compared to 27% in Australia.

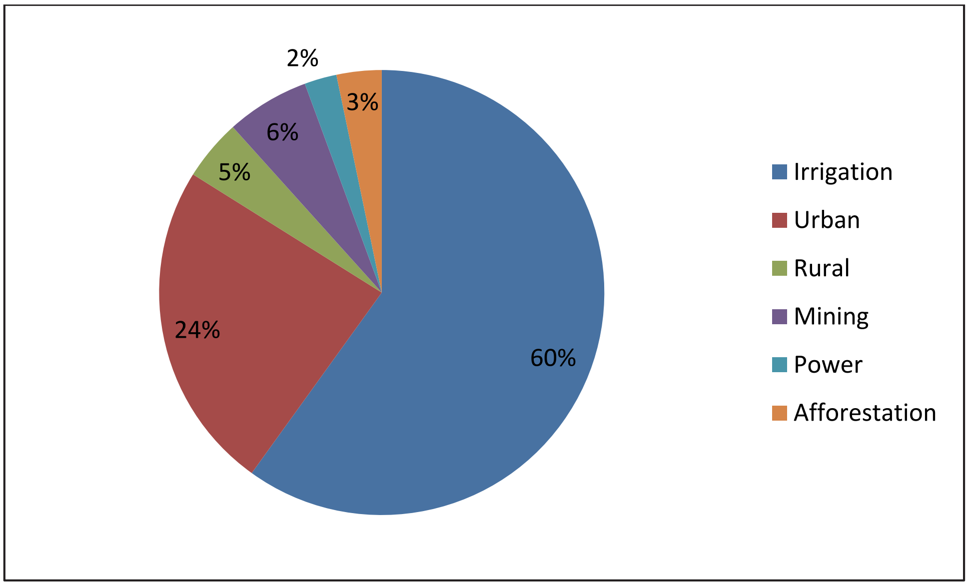



FIGURE 19-2. RAW WATER USAGE SECTORS OF SOUTH AFRICA

South Africa allocates a larger proportion of its raw water towards public consumption (29%; Urban + Rural) than Australia. Though, with a population of 23 million people compared with South Africa's 49 million, Australia still has a relatively higher per capita water allocation.

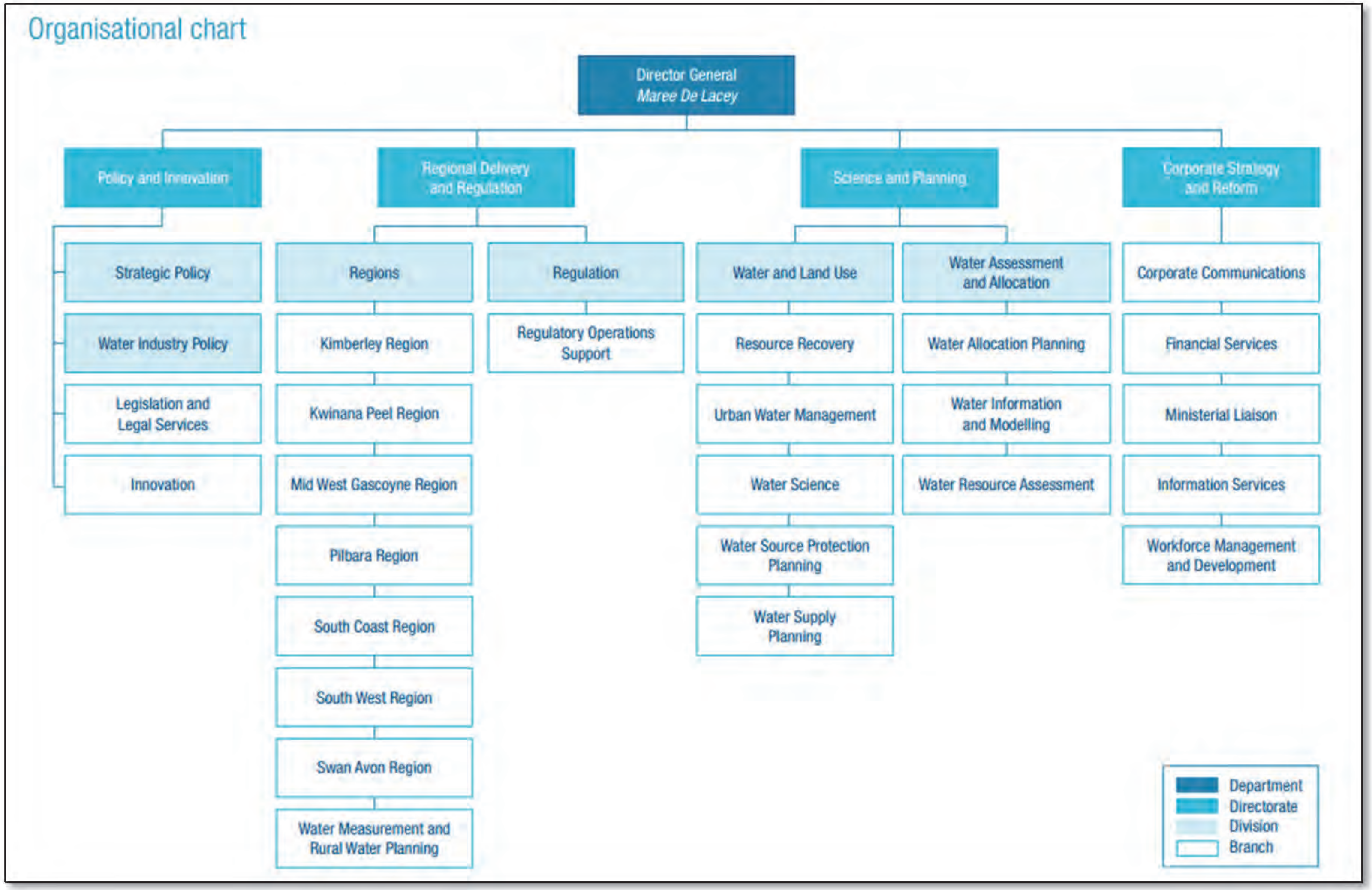



FIGURE 19-3. ORGANOGRAM

TABLE 19-3. WESTERN AUSTRALIA DEPARTMENT OF WATER (DOW). OPERATING COSTS.

| | 2011/2010 | % | 2010/2009 | % | 2009/2008 | % | 2008/2007 | % |
|---|---|---|---|---|---|---|---|---|
| **Total [AUD]** | 101 701 000 | 100 | 107 974 000 | 100 | 100 828 000 | 100 | 48 408 000 | 100 |
| **Salaries** | 51 512 000 | 51 | 52 842 000 | 49 | 47 644 000 | 47 | 19 428 000 | 40 |
| **Capex** | 6 281 000 | 6 | 6 205 000 | 6 | 4 917 000 | 5 | 2 466 000 | 5 |
| **All other Opex** | 43 908 000 | 43 | 48 927 000 | 45 | 48 267 000 | 48 | 26 514 000 | 55 |
| | | | | | | | | |
| **Total [ZAR]** | 833 948 200 | 100 | 885 386 800 | 100 | 826 789 600 | 100 | 396 945 600 | 100 |
| **Salaries** | 422 398 400 | 51 | 433 304 400 | 49 | 390 680 800 | 47 | 159 309 600 | 40 |
| **Capex** | 51 504 200 | 6 | 50 881 000 | 6 | 40 319 400 | 5 | 20 221 200 | 5 |
| **All other Opex** | 360 045 600 | 43 | 401 201 400 | 45 | 395 789 400 | 48 | 217 414 800 | 55 |
| | | | | | | | | |
| **FTE** | 537 | | 561 | | N/A | | N/A | |
| **Total Labor Hours** | 983784 | | 1027752 | | | | | |
| **AUD/Labor Hour** | 103.38 | | 105.06 | | | | | |
| **ZAR/Labor Hour** | 847.69 | | 861.48 | | | | | |
| | | | | | | | | |
| **Hours in AUS working year** | 229 | | | | | | | |
| **Hours in working day** | 8 | | | | | | | |
| **Total Hours/person/year** | 1832 | | | | | | | |

TABLE 19-4. AUSTRALIA DEPARTMENT OF WATER. ITEMIZED COSTS SUITABLE FOR RECOVERY

| **Itemized Costing for Water Management and Planning** | **Cost in AUD** | | | |
|---|---|---|---|---|
| **Urban Water Management and Industry Services** | **2006/2007** | **2007/2008** | **2008/2009** | **2009/2010** |
| Drainage and Water Management Planning | 902 906.00 | 1 452 060.00 | 1 668 265.00 | 1 887 464.00 |
| Arterial Drainage Studies | 815 526.00 | 1 424 123.00 | 1 508 143.00 | 1 284 985.00 |
| Statutory Referrals | 471 527.00 | 1 148 159.00 | 1 424 201.00 | 2 149 989.00 |
| Floodplain Management Advice | 880 991.00 | 1 074 866.00 | 728 300.00 | 859 290.00 |
| Water Source Protection Planning | 1 296 448.00 | 1 242 051.00 | 1 106 436.00 | 1 194 194.00 |
| Implementation of Water Source Protections Plans | 451 311.00 | 661 752.00 | 694 010.00 | 786 589.00 |
| Preparation of Guidance Notes | 852 265.00 | 688 911.00 | 851 476.00 | 875 577.00 |
| **Water Use Allocation and Optimisation** | | | | |
| Water Allocation Planning | 1 979 938.00 | 2 941 273.00 | 3 545 836.00 | 3 581 623.00 |
| Environmental Water Planning | 2 305 196.00 | 3 052 063.00 | 3 122 315.00 | 3 004 782.00 |
| Water Licensing Policy | 825 910.00 | 4 239 466.00 | 1 887 395.00 | 1 334 808.00 |
| Water Licensing and Compliance | 6 031 324.00 | 7 115 121.00 | 7 831 548.00 | 8 055 136.00 |
| Water Licensing Support | 557 361.00 | 685 871.00 | 1 213 442.00 | 967 914.00 |
| IWSS Licensing | 356 216.00 | 352 641.00 | 324 211.00 | 272 495.00 |
| Enforcement | 92 559.00 | 347 024.00 | 621 319.00 | 105 743.00 |
| Metering | 2 084 933.00 | 2 679 289.00 | 2 954 969.00 | 3 147 480.00 |
| **Water Resource Assessment, Investigation and Review** | | | | |
| Groundwater assessment investigation and review | 3 748 981.00 | 6 238 155.00 | 9 703 805.00 | 7 312 638.00 |
| Regional hydrogeological advice | 237 230.00 | 0.00 | 0.00 | 485 276.00 |
| Surface water assessment | 748 071.00 | 1 033 445.00 | 770 643.00 | 811 105.00 |
| Water information collection | 7 298 988.00 | 9 154 574.00 | 10 294 199.00 | 11 955 992.00 |
| Water information management | 1 127 542.00 | 1 346 071.00 | 1 680 493.00 | 1 647 762.00 |
| Water information provision | 551 540.00 | 607 337.00 | 553 154.00 | 600 872.00 |
| Acquisition of Priority 1 land | 0.00 | 27 257.00 | 2 721 700.00 | 4 435 604.00 |
| Land asset management | 361 287.00 | 272 277.00 | 337 824.00 | 247 841.00 |
| **Total Cost (AUD)** | **33 978 050** | **47 783 786** | **55 543 684** | **57 005 159** |
| **Total Cost (ZAR)** | **272 809 763 450** | **383 656 017 794** | **445 960 238 836** | **457 694 421 611** |

# 20 APPENDIX H: PES CASE STUDIES

## 20.1 NAMIBIA CBNRM

Namibia's community-based natural resources management (CBNRM) program effectively operates as one large-scale PES program, making it one of the world's longest-standing schemes. Namibia provides a powerful example of poor people investing in and protecting their environment. The policy that emerged from this process has become known as one of the most innovative approaches to CBNRM in Africa. The result is environmental protection and expanding opportunities for entrepreneurship and economic development. Government policies provide incentives to conserve environmental resources; these policies create a pathway towards economic development and natural resource conservation. There is visible evidence of this beneficial relationship in Namibia. More than 60 communities now participate, supporting 31 conservancies that cover some 70,000 km2, or 17% of Namibia's land area.

The major vehicle through which rights could be delivered was legislation tabled in 1996. This allowed for the formation of communal area conservancies and paved the way for a new era of conservation and natural resource management in Namibia. The Namibian government's policy of devolving wildlife management rights to local communities has created a new class of property rights. These property rights give local people incentives to develop businesses and pursue entrepreneurial opportunities, producing multiple benefits for local communities, such as jobs and training. As the movement grew, more and more communities took advantage of the new opportunities for natural resource management. Several new organizations, including those that had previously worked in sectors other than wildlife towards rural empowerment, joined forces to assist communities to organize themselves into conservancies. Enrollment in the program gives communities rights, for the first time, to recreational hunting and revenues from game products and tourism.

Most of the requirements for a PES program are present in Namibia's CBNRM program. This project has been a success on both social and ecological fronts. Many of the conservancies are on lands that now act as corridors between protected areas. Wildlife populations have increased dramatically on conservancy lands. Namibia now houses the world's largest free-roaming black rhino population and game species such as elephants, zebra, oryx, and springbok have increased 600% in some places. For the first time in 30 years, seasonal migrations have resumed between Botswana and Namibia. The program was a major development success, with local incomes increased by a total of $2.5 million in 2004 and Namibia's net national income up by $9.6 million. Overall, 3,250 part-time and 547 fulltime jobs were created, and the fact that the majority of these jobs were obtained by women meant that gender equity was substantially improved.

Notwithstanding the increases in wildlife populations and financial benefits that have been associated with the program, a major challenge going forward revolves around diversifying the number of services produced. If property owners can personally benefit from the effective use and maintenance of property, they are more likely to expend resources identifying valuable ways to use and conserve property. Broadly speaking, conservancies face issues in the areas of legal and regulatory uncertainty, capacity and governance, and human/wildlife conflict. While it is among the best examples of CBNRM in Africa, the Namibia program has some weaknesses. These include lack of legal right for conservancies to exclude unwanted/harmful outsiders, a confused process for resolving conflicting land use claims and an institutional environment that imposes unnecessary costs on entrepreneurs and small businesses. Political stability gives conservancies the freedom to develop in a less stressful environment. This stability, combined with the willingness of the Namibian government to allow conservancy development to be locally driven, contrasts with what has happened to the CAMPFIRE program in Zimbabwe. Namibia's CBNRM program has much to contribute to the design of large-scale PES schemes. Alternatives to a community-owned enterprise would, therefore, have to clearly demonstrate their means of generating income for the conservancy while involving the community.

## 20.2 Zimbabwe Campfire

In Zimbabwe, the national government devolved the rights to manage wildlife to rural district councils (RDCs), already existing political units. The idea was that RDCs would then devolve their powers to manage natural resources to local communities. RDCs are granted the authority to market wildlife on behalf of the people living in their area. Concessions to hunt or photograph wildlife are sold to safari operators who, in turn, market these to mainly foreign sport hunters or eco-tourists. The RDC passes on to communities 50 percent of the revenues and other benefits received from the sale of concessions. It keeps the balance to fund wildlife management and its own activities. CAMPFIRE is an entrepreneurial approach to development based on wildlife management using market forces to achieve economic, ecological, and social sustainability. Potentially, it can satisfy many of the material needs of rural people without depleting wildlife populations or degrading the natural ecosystem on which their survival depends. On the assumption that markets exist for the goods and services that can be provided under the program. Institutionally, the program's success depends on the flexibility of government agencies and district authorities and their willingness to empower communities in communal areas to participate. CAMPFIRE projects have been implemented in sparsely populated areas where the tsetse threat was removed or in rugged terrain of little agricultural value. The program involves changing people’s perceptions of wildlife, and fostering the notion that wild animals constitute a viable resource base to be protected and utilized.

CAMPFIRE program is labeled PES because it seems to share many features of a PES program. However, the program does not fully satisfy all criteria especially conditionality which is very weak. CAMPFIRE’s problem is qualitatively different, because there is no ‘market failure’ at hand: The two services provided by CAMPFIRE are landscape values and biodiversity conservation. Access to landscape values is sold to safari operators is not an externality, since non-consumptive use of wildlife areas occurs on-site. However, biodiversity conservation being closely monitored and paid for by external donors over a couple of decades clearly constitutes an externality. The RDC can directly apply user fees in return for access to the wildlife sites, and thus internalize the benefits. Payments were also made explicitly to compensate communities’ direct and opportunity costs for more biodiversity-friendly land management. However, donor payments for these services occurred under the logic of integrated conservation and development programs (ICDPs) rather than as conditional PES transfers. Farmers who through their land use decisions affect water flows have no way to prevent downstream water users from enjoying the benefits of their actions. Thus, CAMPFIRE and can provide useful lessons for PES implementation though it is not a PES program in the strictest sense.

Benefits that have been accrued from the program's activities mostly the sale of hunting and fishing permits as well as leases for tourism purposes. Between 1989 and 2001, CAMPFIRE generated over US$ 20 million for the participating communities, 89 percent of it coming from sport hunting. In 1991, 12 districts out of 37 generated US$ 1.1 million. Performance varies with wildlife resources, human population density, local institutional arrangements, and governance. Benefits have been distributed among communities, and used in construction works (e.g. schools, rural clinics, electrical fencing, roads, and establishment of grinding mills) in provision of food and water as well as payment of household dividends and cash compensation. A national CAMPFIRE Association has been formed with the objective of promoting the wildlife interests of the rural district councils in the political arena and serving as an association of producer communities. The association has been very successful in making communal-land wildlife producers an important political voice, but it has been less successful in its role as a producer association, since its membership is restricted to rural district council representatives and does not include representatives from the communal wards.

The intense poaching that took place in Zimbabwe in the 1980s was significantly stopped by the CAMPFIRE program with wildlife populations regaining their numbers by the end of the 1990s. But farmers saw this wildlife growth as a threat to their crops and have been using the Problem Animal Control legislation to encourage the return of poaching. CAMPFIRE has been able to attract strong support from donors. The CAMPFIRE project in Zimbabwe also enhanced the communities' sense of ownership of their natural resources. Dialogue around the project contributed to higher confidence and skills in negotiating and managing conflicts (Frost and Bond 2006). Although CAMPFIRE is not a panacea for communal land development, it represents a bold change in the thinking of ecologists, environmentalists, planners, and policymakers with respect to their perceptions of natural resources and conservation. The CAMPFIRE approach has been actively replicated in several African countries including Zambia, Tanzania Namibia, CAMPFIRE has become a paradigm and a point of departure when discussing CBNRM in Southern and Eastern Africa.

Unfortunately, the recent years of political and economic turmoil in Zimbabwe have delivered a blow to all development programs, including CAMPFIRE, and it is fair to say that 10 years of CAMPFIRE success are in jeopardy. The significance of CAMPFIRE revenues for the local population has decreased as a result of rapid population growth from increased immigration to rural areas. In real terms this has resulted in an average decline in financial benefit per household from US$ 19.40 in 1989 to 4.49 in 1996.Some decline in the wildlife population has been noticed at some CAMPFIRE areas, a situation that is complicated by disagreements between the local communities and the rural district councils regarding each one's responsibility for wildlife management. Another issue has been the reappearance of poaching. In the aforementioned CAMPFIRE program, landowners and land users directly bordering wildlife-priority areas often lost out but could not individually reject the program (Wunder 2008). Land tenure is highly insecure; communities using communal lands have sometimes been unable to prevent settlement and land clearance by migrants (Frost and Bond 2006). Even worse is the possibility that such lack of control over land may lead to more powerful people forcing people with insecure tenure off these lands as PES increases the land value, as has occurred in some out-grower schemes.

This initial external support decreased after a couple of years and increasingly the districts would have to pay for the CAMPFIRE costs out of the program revenues. Most rural district councils had no problems in negotiating this transition since CAMPFIRE revenues were considerably larger than costs incurred. However, over the years some rural district councils have retained an increasing portion of CAMPFIRE revenues and used them for purposes not related with CAMPFIRE costs or wildlife management. Furthermore, RDCs have retained revenues designed for local communities, diluting the CBNRM incentive structure. As RDCs have become short of cash, delays in payment and occasional underpayments have become more frequent. The extreme political instability that now wracks Zimbabwe compounds the problem of the weakened CBNRM's incentive structure. Had the country been more stable politically, CAMPFIRE might well have offered a more viable strategy for rural economic development and natural resource conservation. Conditions are desperate, and the country is no longer a desirable tourist destination, which directly threatens CBNRM efforts.