SAVE THE SAND

PHASE I: FEASIBILITY STUDY

THE DEVELOPMENT OF A PROPOSAL FOR A CATCHMENT PLAN FOR THE SAND RIVER CATCHMENT (Mpumalanga / Northern Province)

June 1998

" The economic growth, quality of life and environmental health are three interdependent elements which determine the prosperity and well-being of individuals and nations. In countries where rapid economic growth has occurred at the expense of the environment, the ensuing long term environmental and socio-economic problems have been much more costly to repair than the benefits obtained in the short-term" (Huntley *et al.* 1989).

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Report submitted by AWARD to the Department of Water Affairs and Forestry

EXECUTIVE SUMMARY

CHAPTER 1: TERMS OF REFERENCE, OBJECTIVES AND CONCEPTUAL FRAMEWORK

This chapter introduces the study, lists the objectives and Terms of Reference as outlined by the Department of Water Affairs and Forestry (DWAF), and provides a broad review of the conceptual framework for the report and an overview of the approach taken.

1. BACKGROUND TO THIS REPORT

Southern Africa lies within the drought belt of the Southern Hemisphere and, with an average rainfall of 497 mm, falls well below the global average of 860 mm (Department of Water Affairs (DWAF 1986)). As such, this defines South Africa as a relatively arid country, albeit with localised exceptions (Alexander 1985), and with high potential evaporation rates, many parts of the country are often in water deficit (Alexander 1985).

A combination of socio-economic and political factors superimposed on these major physical constraints has compounded the effects of resource scarcity. These factors historically included large disparities in access to water within, and between, sectoral groups and a tariffing system that did not reflect the resource limitations. Political interests were evident in the previous water policy. The recent political changes in South Africa have provided a climate conducive to redressing past disparities, and opened the arena for the consideration and implementation of scientific recommendations pertaining to the maintenance of the resource base.

The Sand River Catchment (henceforth referred to as the SRSC) is a sub-catchment of the Sabie Catchment which currently falls within Mpumalanga and Northern Province. The SRSC has been selected by the DWAF, in collaboration with the Department of Agriculture (DA), as a pilot project for the design and implementation of an Integrated Catchment Management Plan. This project has been named the **Save the Sand Project**. This catchment was chosen because it was recognised that the ecological integrity, productivity and water resources of the catchment have been severely depleted and in turn have precipitated a suite of socio-economic and environmental consequences.

Currently, the project has two phases:

> **Phase 1.** A feasibility report and formulation of specific strategies for the implementation of a catchment plan (this report)
> **Phase 2.** Implementation

Phase 1 was funded from a grant of R200 000 from the Sabie Sand Game Reserve (SSGR). It is envisaged that the implementation of the project (Phase II) will be a joint initiative between a number of bodies.

2. TERMS OF REFERENCE

The TOR for the Save the Sand project (draft of August 1997) specified ten tasks that would lead to fulfilment of the objectives listed below. These were:

- A re-assessment of current land-use practices in the catchment, taking steps to alter those that are not compatible with the long term health of the system;
- An appraisal of the water reserve required for the Sand River (consistent with the proposed National Water Bill) taking steps necessary to ensure that this is met;
- An appraisal of the beneficial use of water in the catchment, taking steps necessary to encourage the most advantageous use thereof;
- The introduction of incentives and disincentives to encourage appropriate land-use and water-

use practices;
- The adoption of water conservation packages in the various communities, private game lodges and the Kruger National Park, based on the success of similar projects run by the *National Water Conservation Campaign*;
- The escalation of the clearing of invasive alien plants, already underway through the *Working for Water* programme in the catchment, but to be substantially increased through funding from the Finnish Government (RM 2 per year for three years) and the *Working for Water* programme;
- The escalation of community water supply and sanitation initiatives in the catchment, in conjunction with DWAF;
- The formation of a catchment management authority to monitor and regulate water management in the catchment.
- A proposal for a public awareness campaign
- A proposal for an education and training project.

3. OBJECTIVES OF THE SAVE THE SAND PROJECT

The principle objective of the Save the Sand initiative is:

- **to address the rehabilitation of the Sand River and its sub-catchments, employing the principles of *Landcare* and *Integrated Catchment Management*.**

The principle objectives of this feasibility report are to embrace the conceptualisation, consultation and planning of the proposed project. This process is guided by a number of key objectives, namely:

- Rehabilitation and sustainability
- Equity
- Economic growth

Figure 1.1 provides an overview of the approach to Phase 1 used to meet this objective. As an over-arching comment, it must be borne in mind that the assessments and recommendations must be **consistent with the new policies** that are being developed for South Africa.

4. GUIDING PHILOSOPHIES AND CONCEPTUAL FRAMEWORK

Two key concepts underpin the development of a catchment plan for the Sand River Catchment. These are the principles of Landcare and of Integrated Catchment Management (ICM). With partnerships and integration as the cornerstone concepts, many of the philosophies of Landcare are paralleled within the framework of Integrated Catchment Management. Both approaches seek to address the sustainable and equitable use of the natural capital of an area. The essence of Landcare is that it is adopted as an ethic and culture in itself, becoming part of peoples daily lives, whereas ICM still falls largely within the remit of management structures and has yet to become a "culture" *per sé*.

Both concepts are important to this document in that the development of a catchment plan is seen as a joint venture, expressing the needs and commitment of all stakeholders and numerous government departments . This in itself is an ambitious objective in that the challenges posed by the historical ethos and disparate realities of our country are enormous, expectations are high and needs will vary, making any efforts at consensus vulnerable to the hurdles that these factors are bound to raise. Nonetheless, this project presents a unique opportunity to tackle such challenges based on a sensitivity to each others realities in such a way as to achieve negotiation by consensus, rather than compromise.

5. LANDCARE

Landcare, which is both a philosophy and a practice, was initiated in Australia some 10 years ago and has subsequently received growing support from all sectors of government, farmers, unions and conservation bodies. It is a community-based programme which reflects societal values and which has

brought rural and urban Australians together to address the restoration of land and water resources. Landcare demonstrates that the attitudes of the community can be changed, and its support secured, for the socio-economic and environmental benefit of the country.

In essence, Landcare is about managing land, water, plants and animals on a sustainable basis. As such, the aim of Landcare is to assess the potential land-use, to plan management on a catchment or regional basis, to involve all land users in the community and to encourage the adoption of a land ethic by the community nationwide.

6. INTEGRATED CATCHMENT MANAGEMENT (ICM)

Any activity within the catchment area (be it use or abuse) will ultimately be expressed in the quality and quantity of water resources, in an intimate cause and effect feedback. This fact has led to the philosophy that the efficient management of water resources can only be done at the catchment scale, irrespective of political boundaries, so that all factors and events that impact on the water resources are taken into consideration. The relationship between land-use and water resources requires that, for the development of either to be sustainable, their management needs to be integrated. This needs to be guided by the socio-economic realities and thus such integration needs to occur principally at a local scale. Furthermore, for people to really be involved in such a process, mechanisms need to be put in place to ensure their participation. The growing body of literature on ICM bears testimony to the recognition that new and innovative approaches to resource management are needed as we move into the next century.

The key elements that distinguish this approach to management from those of previous water resource management plans are the terms **"integration"** and "**catchment"**. Clearly, any form of development or land use practice will have social, economic, political and/or ecological impacts. If a policy of ICM is accepted as the terms of reference, then all activities, their positive and negative effects and inter-relationships within the catchment must be considered. In considering mitigatory measures or future scenarios, the question that must be asked is whether or not a particular development scheme or land-use practice is the most appropriate given the broader operative issues.

Following from an definition of ICM, Chapter 1 discusses the history of ICM in South Africa. It also raises potential constraints to achieving coherency in the integration of water, land and environmental management in South Africa, which are:

- fragmentation,
- feasibility and
- institutional uncertainty.

The Hermanus Water Conservation model, which is one of the first attempts to reduce water use in South Africa through water demand management, is then discussed. The backbone to this project is a 12-point plan, which is useful in that each point can be assessed in terms of its applicability to other areas that may also be embarking on water conservation projects but which may have different physical and/or socio-economic realities.

7. OVERALL APPROACH FOR THE FEASIBILITY REPORT

The limited time frame and budget available necessitated a fairly consolidated approach to this phase and initially, a core specialist group re-worked the extensive list of outputs as stated in the initial TOR draft into appropriate sections (objectives, outputs, strategies). Although the TOR were drafted in August 1997, the final go-ahead for the project was only given in November 1997 and the date of submission for the final report to the steering committee on the 30th March 1998 (subsequently extended to early June 1998). Nonetheless, every effort was made to include as much information on the *status quo* as possible so as to undertake a comprehensive assessment of current land- and water-use, and practices.The key steps of this project were outlined under the objectives and in Figure 1.1.

It was envisaged that this phase would be largely a desk-top study, limited to collating available information into as comprehensive an account of the ***status quo*** of the SRSC. This information was then used for an ***assessment*** based on technical, social, economic and environmental (and where available, hydrological) criteria in order to develop a picture of the factors that have led to the deterioration of conditions in the catchment. However, in areas where informational gaps seriously compromised providing a reasonable assessment, some limited field work was undertaken. These assessments formed the framework for a process of developing a set of alternative scenarios for the SRSC. These scenarios then had to be assessed in terms of their *hydrological consequences*, from which a suite of detailed ***recommendations*** and some key recommendations in terms of land-use, water-use and related practices for the catchment, emanated. These were considered to underpin any future land/ water-use scenario for the SRSC.

In conclusion, the chapter lists the team members and their respective inputs.

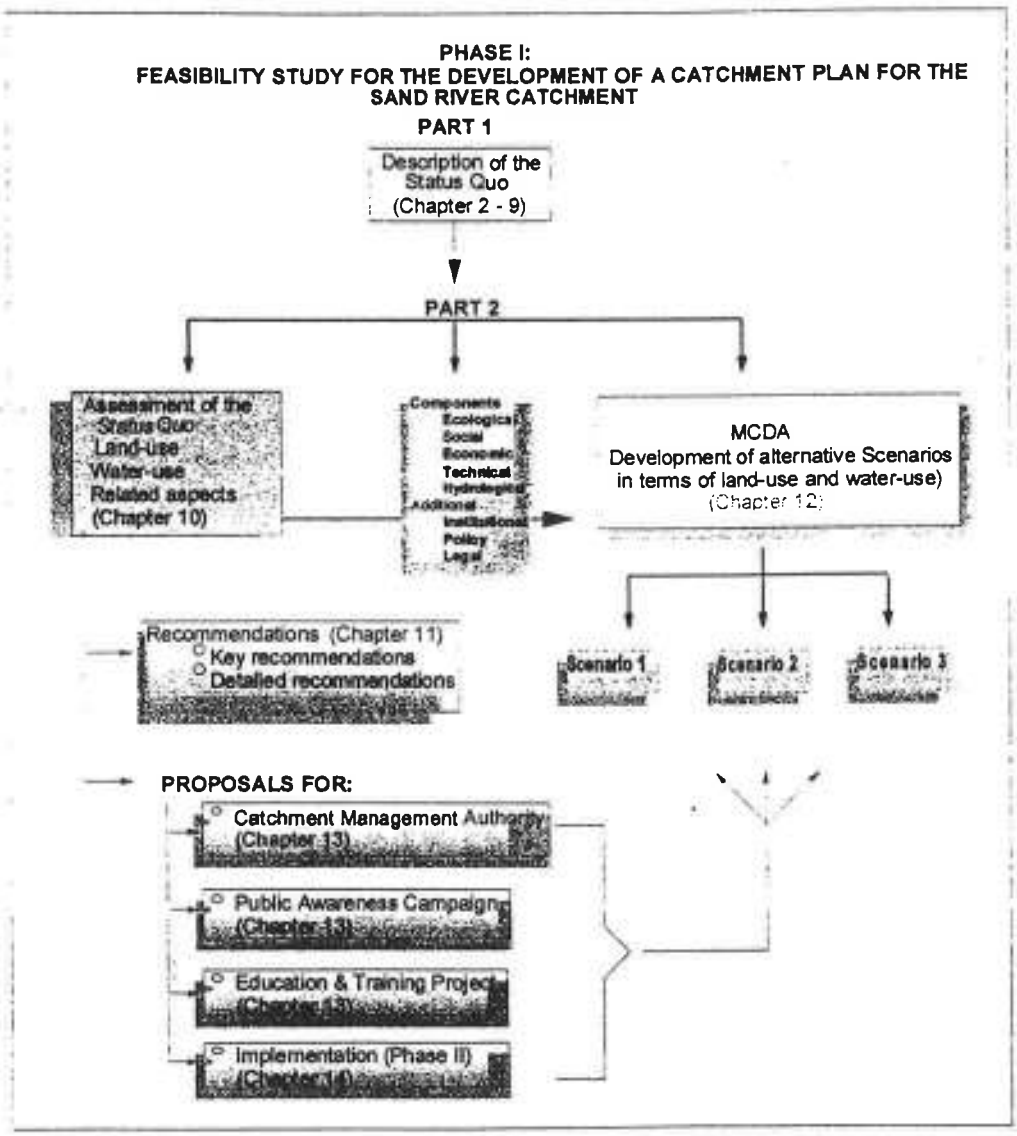

Figure 1.1 Overview of the approach to Phase I- the feasibility study

CHAPTER 2: BIOPHYSICAL CHARACTERISTICS OF THE SRSC

1. LOCATION AND CLIMATE

The Sand River sub-catchment falls within the Sabie River Catchment, comprising part of the Incomati system. The Sabie River Catchment covers some 7096 km², of which the Sand River sub-catchment (SRSC) as the major tributary, constitutes 1910 km² (27%). The Sabie River Catchment now forms part of the new Mpumalanga and Northern Provinces, although the provincial boundaries are currently under dispute. The entire Sabie River Catchment is bounded by the Orpen road in the north, conservation areas in the east, and the Drakensberg escarpment in the west (Figure 2.2). The SRSC lies in the northern portion of the Sabie River Catchment, with the southern border roughly defined by the Mankeli Hills, a gabbro dyke running in an east-west direction. The SRSC falls within the Eastern Transvaal Middleveld and Lowveld climatic region with a warm to hot sub-tropical climate. The area falls within the summer-rainfall region, with summer broadly classified as October to March. A major portion of the catchment, with the exception of the middleveld and highveld, forms part of the *semi-arid savanna* region of the central Transvaal Lowveld. Arid and semi-arid zones are characterised by:

- low erratic rainfall of up to 700 mm per annum,
- periodic droughts and,
- different associations of vegetative cover and soils.

2. RAINFALL, TEMPERATURE, EVAPORATION AND WINDS

The mean annual precipitation (MAP) varies widely over a very short distance of 80 km, from about 2000 mm a^{-1} in the west, to about 550 mm a^{-1} in the east. Intra-seasonal drought is common. Major drought occurs as often as every 3.5 years in the northern portion of the catchment The aridity of the area and frequency of drought combined with high population densities and water demands means that there is insufficient water to meet current sectoral needs at the appropriate levels of assurance. The mean annual temperature is approximately 22°C. Average daily maxima are approximately 30°C in January and 23°C in July. Absolute maximums in excess of 40°C have been recorded. High summer temperatures result in high evaporation rates, considerably in excess of rainfall, varying from 2200 mm in the east to 1850 mm in the west. Winds are fairly light with average wind speeds of less than 12 km per hour for 80% of the time.

3. CHANGES IN CLIMATE

There is evidence of major long-term changes in climate with various long-term cyclical rainfall fluctuations superimposed on the normal rainfall variability typical of the region. In addition to a **quasi 18 year rainfall oscillation** of alternating wet and dry periods of approximately nine years each there is a **longer 100 year cycle** of high and low rainfall periods. The last dry period extended from 1860-1970. There has also been an increase in **inter-annual rainfall variability** in the region over the last half century, the implications of which are that drought and flood events may become more frequent over the lowveld. There does not appear to be any strong evidence to indicate that the desiccation in the lowveld is progressive and irreversible. However, evidence from a study conducted in the mid-region of the catchment indicated that, in terms of people's livelihoods their experience has been of a drier and more variable climate over the last 20 years and this has had significant impact on small scale farming activities and the natural resource base.

4. GEOLOGY

The major lithostratigraphic unit underlying the SRSC is the Basement Complex of the Bandelierskop Complex (Figure 2.7). This consists mainly of potassic granites, granodiorite and minor intrusions of diabase and gabbro, as well as a major central intrusion of diorite (tonalite).

5. SOILS

The granitically derived soils and associated undulating topography has produced the characteristic

catenal sequence of soils and vegetation found in many semi-arid savanna systems. A gradient of soil types exists across the catchment, such that deep, well-drained soils with apedal (structureless) sub-soil horizons occur in the west, replaced by shallower, more dystrophic (nutrient poor) soils on weathered granite, and eutrophic (nutrient-rich), black turf soils of varying depth in the east.

6. SOIL EROSION AND DEGRADATION

In general, soil degradation in the study area **does not appear to be widespread** and occurs mostly at a localised level around roads and settlements, along drainage lines and in sodic areas. The highest sediment yield potential occurs in that portion of the catchment that is predominantly occupied by the former homelands of Gazankulu and Lebowa. This observation is supported by the fact that sediment yields in the Sabie River catchment are relatively low and sedimentation poses no real threat to large storage dams in the catchment except perhaps in the Edinburgh and Acornhoek dams.

7. SOIL POTENTIAL

The irrigation suitability of the Sabie catchment had previously been assessed by Chunnett *et al.* (1990) as:-

- Class I: good irrigable land with a high to moderate irrigation potential — 20 325 ha (11%)
- Class II: marginal irrigation potential: — 45 700 ha (25%)
- Class III: unsuitable irrigation potential: — 114 075 (63%)

Additionally, they delineated *tentative* potential irrigation zones, combining Classes I and II and considering the proximity to water. They noted that the irrigation water demand of this area far exceeds the quantities of water that would be available for irrigation, and concluded that water availability, rather than lack of arable soils, is the major limiting factor for irrigated agriculture in the catchment. For the purposes of this feasibility study it was felt that the inclusion of Class II was inappropriate due to the constraints associated with this class noted by Chunnett *et al.* (1990). Hence, for use in the development of land-use scenarios (Chapter 12), the tentative potential irrigation zone was classified on the basis of Class I soil types only.

8. GEOHYDROLOGY

Chunnett *et al.* (1990) stated that the only good primary aquifer and significant potential source of groundwater is an area of dolomite limestone on the west side of the catchment around Sabie. According to them, ground water is a suitable source only for isolated communities and stock and game watering. They estimated that the total available ground water for the Sand sub-catchment as 8.8 Mm^3a^{-1}. Recently, yield testing of existing infrastructure conducted by VSA in 1997-98, indicated that existing borehole installations within the SRSC currently provide an estimated 3.66 Mm^3a^{-1}. Of these, only a small area around Acornhoek and Buffelshoek is regarded as fully exploited.

9. SURFACE WATER

Surface water comprises the greatest portion of the water resources of the Sabie River Catchment, of which the Sand River is the major tributary. The Sand River source is situated in a humid, mountainous region of high precipitation where much of the runoff is generated, but thereafter the river rapidly descends into a semi-arid region of low rainfall that subsequently generates little runoff. The dominant characteristic is that nearly half of the runoff is generated in about 25% of the catchment; that is, the mountainous portion. Consequently, the entire catchment relies on this headwater portion to furnish much of the water supplies.

10. MEAN ANNUAL RUNOFF

Calculations of the mean annual runoff (MAR) vary between three data sources (Table 2.1): (i) Chunnett *et al.* (1990), (ii) Hughes *et al.* (in DWAF 1996)and (iii) the ACRU agrohydrological model used by the

Department of Agricultural Engineering at the University of Natal, for this report. Initial estimates from the ACRU model are much higher than the previous studies. The MAR estimations from these different studies are as follows:

DEVELOPMENT CONDITION	MAR ($M m^3 a^{-1}$) PER CATCHMENT						
	Sabie	Sand	Total	Sabie (IFR 4)	Sand (IFR 8)	Total	Sand (catchment 17)
Virgin	606	158	762	594	122	708	/
Under afforestation	488	145	633	412	96	498	215
Contribution to Sabie	77%	23%			19%		
% decrease from virgin	↓ 20%	↓ 8.2%	↓ 17%		↓ 21.4%		
DATA SOURCE	Chunnett *et al.* (1990)			Hughes *et al.* (DWAF 1996)			ACRU

11. DISCHARGE PATTERNS

The hydrology of the Sand River indicates a distinct seasonality with frequent no-flow conditions in the lowveld portion. Most of the middle - and lowveld tributaries of the Sand River are seasonal. A comparison of historic conditions (simulated) to present runoff conditions indicates vast differences. The mid-Sand summer peak flows have been reduced by about 20%, whilst more importantly, the dry season base-flows have been reduced by 75%. This reduction of base flows is attributed principally to abstractions for agriculture.

12. WATER QUALITY

Water chemistry samples have been analysed from 13 sites in the SRC since the mid 1970's, one of which is on the Sand River at Exeter. These samples indicate that surface waters in the catchment are suitable for irrigation, livestock watering, and, after conventional treatment, for domestic supply. This, and other, studies indicated that the water quality conditions of the Sand River are good, with the exception of some elevated turbidities and nutrient conditions. In general, the water quality of the Sabie and Sand Rivers is better than the other rivers of the KNP. However, there are a number of constraints to the current data:- large periodicity in sampling, large distances between sample sites, and the synergistic effects between water quality constituents. Further, population increases are expected which will place extra loads on the wastewater treatment systems such that it cannot be assumed that water quality conditions will remain acceptable in the future without appropriate management measures. Recent information points to poor water quality conditions below treatment works in the SRSC.

13. VEGETATION

The area is broadly classified as moist forest and semi-arid savanna and is characterised by a mixture of trees, shrubs and grasses. The SRSC comprises four Veld types: Northeastern Mountain Sourveld (Veldtype 9), Lowveld Sour Bushveld, Lowveld (Veldtype 10) and the Arid Lowveld (Veldtype 11). In common with other semi-arid savanna systems, vegetation production and recruitment is highly variable from year to year in response to variation in rainfall, the major ecosystem driving variable. Little information exists with respect to the characteristics and status of the riparian vegetation fringing the Sand River and tributaries. At the scale of the river channel, the most apparent characteristic on the Sand River is that there are two distinct areas within the wider river channel, namely the more stable macro-channel bank, and the highly dynamic macro-channel floor. These two systems support very different vegetation types. The Sand River is known as a mixed bedrock-alluvial system. The proportions of sand and bedrock are determined by the degree of sediment deposition and erosion, and this in turn is a major determinant of the extent and composition of vegetation growing on the Sand River.

14. EVIDENCE OF CHANGES IN VEGETATION

Since one of the objectives of the Save the Sand project is that of rehabilitation, this raises questions with regard to baseline conditions or "the desired state" of a system. In terms of the terrestrial system, it is implicitly assumed that the conservation areas represent this baseline condition. This assumption has been challenged since many of the conservation areas are currently stocked at densities far higher than documented previously and the frequency of fire is probably lower than that historically experienced.

As part of this feasibility study, a number of criteria were identified as important in evaluating the *status quo* of the terrestrial environment. Much of the land under individual or state tenure has experienced some degree of bush encroachment, a form of degradation. Communal areas have not experienced encroachment, but they have undergone some changes relative to other forms of land-use due to selectivity by local residents for particular species and sizes of vegetation. The herbaceous layer generally has a good basal cover, and is generally better in the communal areas than the adjacent game areas. Basal cover decreases with increasing distance from human settlement. Some communal areas are typified by a reduction in both woody biomass and numbers of species. A survey undertaken during the course of the SSP indicated that species richness was statistically significantly higher in communal areas than adjacent conservation areas.

A preliminary assessment of the habitat integrity of the riparian zones classified the Sand River as 3 (moderately modified) until the boundary of the SSGR. Some portions however rated as 4 (largely modified), and included (i) a 5 km long reach below and including Zoeknog Dam site and, (ii) the confluence of the Mutlumuvi and Sand River. Changes in the riparian zone were ascribed to bank erosion, channel modification and vegetation removal. Within the conservation areas, the habitat integrity was rated as 3 (moderately modified) on the left bank and 2 (largely natural with few modifications) on the right bank. There is also some evidence to indicate that the incidence of alien vegetation has increased over the past decade down the entire length of the river. The highest levels of infestations occur in the forestry areas.

15. AQUATIC BIOTA

The pre-impoundment study for the Sabie-Sand system is the only data set available and has limitations in that no species-level data on invertebrate fauna exist for the SRSC exclusively. This makes drawing any conclusions that are specific to the Sand River impossible at this stage. With 44 indigenous fish species, the Sabie-Sand system is the most diverse river system known in the country, followed by the Pongola River in Kwa-Zulu Natal (there are an additional five alien fish species in the Sabie system). Of this total number, 34 species (75%) were recorded in the Sand River during the pre-impoundment survey. The zonation pattern of fish distribution within the Sabie-Sand rivers is generally best explained by water temperature, and not altitude, and two zones (foothill and lowveld) are identified. The foothill zone supports between 6 and 11 species, and the lowveld zone 28 species. In general, diversity in the lowveld zone is high with more than 20 species per site, with the exception of one site near Dingleydale on the Sand River. It is suggested that anthropogenic disturbance (abstraction and vegetation removal) is responsible for this lower species complement at this site as a consequence of a reduction in habitat types and availability.

16. EVIDENCE OF CHANGE

Two species of fish sensitive to river flow for their survival are absent from the lowveld zone of the Sand River. This stands in contrast to their distribution in the Sabie River, where both species are found in the lowveld and below the Sabie-Sand confluence. This points to a deterioration in conditions necessary for their survival. Both species are intolerant of low-oxygen concentrations that are associated with low or no-flow conditions and this probably explains their absence from the lower Sand River.

On 25th January 1993 the central section of the Zoeknog dam wall collapsed, sending a pulse of sediment-laden water down the Sand River and into the Sabie. Interpreting the effects of this is confounded by the fact that it coincided with the worst drought on record. The combined effects of both of these events were to decrease fish abundance and effect changes in the species assemblage, with

a marked loss of lotic species. No marked recovery from these events was noted after 5 months in the Mutlumuvi River at Zoeknog, or at New Forest. Much further downstream at Londolozi, on the Sand River, there was evidence of a species assemblage equivalent to that of antecedent conditions. It appears that invertebrate species are able to recover (at least numerically) more rapidly than fish after cataclysmic events.

17. INVASIVE ALIEN VEGETATION

Studies have demonstrated that invader plants can significantly reduce water delivery from catchments, negatively affect natural habitats and biodiversity and change the natural fire regime. The alien species population in a catchment can double in 20 years, and so can the costs to control the problem. It is estimated it would cost the country R20 Billion over the next 20 years to eradicate all alien invader species.

The distribution of alien invader plant species within the SRSC varies between three areas: forestry, communal and the conservation zones. The forestry area is situated in the high rainfall area, which is also the major water producing area. Alien plant infestation is relatively high due to the favourable (warm and moist) growing conditions. Weed species here include pine, gum, jacaranda, *Lantana*, bugweed, Mauritius thorn, *Sesbania*, guava, and bramble. It is estimated that between 20 – 30% of the plantations should be removed from the riparian zones, and this in turn would increase the streamflow in the catchment. The communal area where the majority of the population lives, does not have a serious alien plant problem as the lands are utilised for natural resource harvesting, grazing, farming and residential purposes. The major weeds in this area are *Lantana, Sesbania* and guava and are mainly found along the rivers and on fallow farm lands. Likewise, the conservation area which includes all the game reserves, does not have a serious invader plant problem and the majority of the problem occurs along the rivers. Species include *Sesbania punicea, Lantana camara, Ricinis communis* (castor oil bush), *Opuntia ficus-indica* (prickly pear) and *Argemone mexicana* (Mexican poppy). Over 70% of the landowners are making an effort to control the spread of alien plants.

CHAPTER 3: HISTORY, SOCIO-ECONOMICS AND POLITICS

1. HISTORICAL TRENDS

Chapter 3 provides an historical, demographic and socio-political description of the SRSC.

Originally populated by Sotho speaking peoples, Tsonga speakers emigrated into the area in the 1850's following wars in Portugese East Africa. Colonial penetration also occurred at around this time. With the advent of colonial rule, and subsequently apartheid in 1948, different forms of social engineering occurred, such as "betterment", "villagisation" and the "homeland" system. Under homeland rule the area was divided into Mhala district of the former Gazankulu and Mapulaneng district of the former Lebowa. Colonial and apartheid policies led to further population influxes and losses of arable land.

2. DEMOGRAPHICS

Population statistics are very difficult to determine and a complex methodology was required to make calculations. Figures from the 1990 Central Statistical Services 1990 census was utilised and adjusted by data from the 'The Agincourt Demographic and Health Study: Phase 1', (Tollman *et al* 1995). On this basis it estimated that in **1998 the population of the SRSC is 336 638 people**, increasing at a 2.4% growth rate, to 447 469 in 2010. The current average **density is 176 people / km^2** (refer to Appendix 3.2 for details). In addition, there are currently (1998) 46 226 people that reside outside the SRSC but who are dependent on water supply from within the SRSC. The average household size is 6.2 persons and estimates of average monthly income varies between R178 and R1131. Unemployment estimates are between 40% and 80% with the dependency ratio of 93%. With a lack of employment opportunities 50% of adult males and 14% of adult females engage in migratory labour. This impacts on the sex ratio where in the 20 to 59 age bracket the ratio becomes 0.48:1.

The literacy rate is calculated at 66%, and only 3% of students reach tertiary education. Preliminary indications are that the birth rate is declining, although women still tend to have their first child before the age of 21. There is a significant proportion of single headed households. Women are marginalised from political life and formal economic activities. Domestic violence is common.

3. SOCIAL SITUATION

The area has a range of social problems and conflict is not unusual, with the 1984 "border war" between Gazankulu and Lebowa, the 1997 provincial border dispute, and an ongoing taxi conflict having attracted national attention. Although crime is a serious problem, it is low relative to some other parts of South Africa.

There is a plethora of community-based organisations active on a wide range of issues. The dominant political organisation is the African National Congress, although recently the Pan African Congress and the United Democratic Movement have made inroads. Five tribal authorities fulfill traditional and customary responsibilities. In 1995 two local governments were elected for the first time, although todate they lack capacity and financial resources. There are a number of non-government organisations based mostly in the north of the SRSC.

4. KNOWLEDGE, ATTITUDES AND PRACTICES

Chapter 3 provides a listing of stakeholders at national, provincial and local level who were informed of the feasibility study for the Save the Sand project. It concludes with a summary of a Knowledge, Attitudes and Practices survey that was conducted amongst some of the local stakeholders (Table 3.2).

CHAPTER 4: LAND USE AND PRACTICE

1. APPROACH

This chapter describes present land-use and associated practices within the SRSC. The approach was to develop a revised description of land-cover and land-use based on a single high resolution LANDSAT Thematic Mapper satellite image (the 1996 TM image). The TM image was digitally classified into 12 land-cover/use categories and was used for 1: 50 000 scale GIS-based resource modelling applications. Most of the land-use practices described for forestry, agriculture and conservation areas have been gathered from fieldwork undertaken during this project. The satellite image data indicated that the entire area of the SRSC is 1910 km^2, some 55 km^2 less than the 1965 km^2 quoted by Chunnett *et al.* (1990). In order to facilitate the description and appraisal of current land- and water-use, land-cover was reclassified to reflect land-use. Certain reclassified land-use areas represent a mix of some of the initial categories, and were redefined to incorporate this mix, as follows:

1. Forestry	The additional land incorporated under this category reflects the temporarily unplanted land as well as the indigenous vegetated areas
2. Rangelands	"Rangelands" is a generic category referring to vegetated land under communal tenure. The main activities in this land-type are livestock grazing and the harvesting of natural resources. Rangelands is a combination of woodland and bushland
3. Conservation	"Conservation areas" refer specifically to state or privately-owned game reserves. Like rangelands, these are comprised of a combination of the woodland and bushland

On this basis, the 1996 TM land-cover was reclassified into 12 land-use categories, as follows:-

TM CATEGORY	LAND-USE	TOTAL(ha)
1	WATER BODIES	926.6
2	FORESTRY: planted	5339.6
5, 7	FORESTRY: unplanted	656.0
3, 4, 5, 6, 7	FORESTRY: indigenous unplanted	5931.7
8	RESIDENTIAL: sparse & garden plots	15391.6
9	RESIDENTIAL: dense	2750.3
10	DRYLAND ANNUAL	7600.4
10	DRYLAND PERMANENT	142.6
1, 2	IRRIGATED PERMANENT CROPS	438.1
1, 3	IRRIGATED ANNUAL CROPS	2145.0
3, 4, 5, 7	RANGELANDS	80193.8
3, 4, 5, 7	CONSERVATION BUSHLAND	69486.6
	TOTAL	191002.40

2. FORESTRY

Afforestation refers to concentrated plantings of a single tree species for timber and timber products. In most cases this involves the planting of exotic trees. In order to provide a source of timber, alien trees were introduced to SA in about 1883 and now cover about 1.3 million ha. Afforestation started within the Sabie River Catchment in 1906 and expanded to the 1990 estimate of 74 221 ha, primarily in the Mac Mac and Marite sub-catchments. Since 1972, permits from the Department of Environment Affairs were required for new afforestation. Limits were determined on the basis of not more than 10% of the mean annual runoff (MAR, 1972 conditions) being consumed by new plantations. The same system operated independently in the former homelands. The significant reduction in runoff as a result of afforestation makes the determination of historical, as well as future impacts of afforestation essential when assessing the water resources.

The permit system applicable to afforestation has been extensively modified by the National Water Bill. This system, previously regulated in terms of the Forest Act, is brought within the ambit of the Bill through the definition of afforestation as a *stream flow reduction activity*. As such, afforestation (albeit a land-based activity) will be brought within the licencing system applicable to all water users in terms of the Bill.

The total area currently planted within the SRSC is estimated as 5340 ha. The formal plantation schemes in the SRSC lie in the western portion, above the 1100 mm rainfall isohyet. Additionally, there are small areas of exotic planted forests scattered throughout the SRSC. The forestry plantations within the SRSC are state-owned (DWAF) and are comprised of three plantations, namely, Welgevonden, Hebron and Onverwacht. Prior to 1994, these plantations fell under the administration of the former homeland of Lebowa. Unlike commercial forestry companies the DWAF plantations have not adopted the ISO 14001 Management System. In essence, this system addresses the operational and social environment of forestry. It would appear that even an annual plan of operation (APO) is not adhered to in the DWAF plantations. It would also appear that the York sawmill has a contract in perpetuity, which holds DWAF responsible for the supply of timber to the company. Last year, the company sued DWAF for R3 M for not supplying the annual quota.

3. AGRICULTURE

The agricultural land-use has been divided into three sections reflecting different irrigation practices and crop-types:- **irrigated permanent, irrigated annual** and **dryland** agriculture.

Irrigated permanent agriculture is permanent tree crops that are presently irrigated. There are three such schemes in SRSC:- **Allandale, Champagne and Zoeknog.** All are commercial government schemes operating on communal land, and managed by the DA (Allandale) or the ARDC (Champagne

and Zoeknog). They were established with the provision of employment as the main objective. A total of 438.1 ha were rated in this class, with coffee (103,58 ha), citrus (288,8 ha), litchis (1,7 ha) and mangoes (44,02 ha). Normal fertilisation, pest and weed control, irrigation, and marketing practices are followed. All schemes employ micro-irrigation but the pipe-basin method and drip-irrigation are also used at Allandale and Zoeknog respectively. The schemes employ 367 permanent staff and some 550 seasonal workers. At Champagne, small-farmer initiatives are planned for the present dryland mangoes and, at Zoeknog the establishment of small farms is also being planned. These would comprise privately-owned 5 to 10 ha plots of coffee on the fringes of the scheme.

Irrigated Annual agriculture is the area under irrigated multi-cropping (twice per year) of seasonal crops. Currently, there are seven formal schemes:- **Dingleydale, New Forest/ Orinoco, New Forest Tobacco Scheme (ARDC), Dumfries, the Allandale small farmers scheme, Tsakani Silk Farm and the Rice Project.** These schemes consist of numerous farms grouped together and which use the same irrigation system. In addition to these formal schemes, smaller "non-formal" areas under irrigated annual cropping exist, mainly patches of irrigation along the riparian zones of streams, totalling an estimated 360 ha. Dingleydale, New Forest/ Orinoco, Dumfries, and Allandale schemes are operated by numerous small farmers, each cultivating 1 to 6 ha. They mostly grow maize, groundnuts, Togo beans, and various vegetables, including tomatoes, cabbage, spinach, onions, green beans. Farm management is undertaken by farmers themselves, with some assistance from provincial government in the form of mechanisation services and technical advice (extension). The two largest schemes, Dingleydale and New Forest/ Orinoco, and the "informal" farmers use furrow irrigation. All the other schemes are under sprinkler irrigation, with the exception of the near-defunct rice scheme, which used to produce rice under a flood-paddy system.

Dryland agriculture within the SRSC involves principally crops such as maize and a combination of maize, pumpkins and beans. These crops are planted by individual farmers (or families) on communal lands, without irrigation. Additionally, this area includes dryland permanent tree crops, mainly mangoes. On average an area of between 0,5 ha and 1 ha are cleared by individual farmers during the summer months. Virgin areas are cleared about once every three years. The number of farmers and the number of plots vary from year to year, depending on climatic conditions and logistical considerations. Some farmers cultivate their own plots or rely on family labour; others employ seasonal labour. Some farmers may apply fertiliser, depending both on their financial situation and the area cultivated. Ploughing is done either by using contractors or oxen whilst planting; weeding and harvesting is done by hand. The harvesting of secondary products, such as *morogo* (a local spinach) is common for this land-use. The products, including secondary resources, are either sold locally or used for personal consumption.

4. RESIDENTIAL AREAS

Two categories of residential area are distinguishable from the 1996 TM image, namely *sparse residential* (low to medium density) comprising 15391.6 ha, and *dense residential* comprising 2750.3 ha (total of 18 142 ha). In most communal areas of the SRSC, the allocation of land is undertaken by the respective tribal authority, but there appears to be no clear criteria for land allocation, which is undertaken subjectively. In the three declared towns of Thulamahashe, Dwarsloop and Shatale, traditional leaders have no influence and land is owned by freehold title. Land allocation is by the town superintendent, under guidance of local government.

In all types of residential areas, but most notably in sparse, land surrounding an individuals' plot is used for food production, particularly maize and vegetables. Householders often also use their plot for some form of low-level economic activity (which fall within the ambit of the "informal economy") such as spaza shops or shebeens, brick-making and beer-brewing. At the larger centres other forms of informal activities are found, such as panel-beating, welding or mechanical services. Street side fresh and cooked food vendors are common. The main residential centres have formal businesses in commercial shopping centres, particularly selling food stuffs, clothing, basic hardware, car parts and furniture.

5. RANGELANDS

The area categorised as 'rangelands' describes the vegetated areas principally of communal lands. It comprises indigenous bushland and woodland, as well as harvested portions of both these types. This area is principally the middle portion of the SRSC, and the foothill zones of the Drakensberg Mountains. The area is bisected by the foot-and-mouth *red line*. It covers about 80 194 ha, or 42% of the total SRSC.

Rangeland is used for **natural resource harvesting** and for **grazing livestock**.

5a. Natural Resource Harvesting

Many SRSC residents use the indigenous resource base for a range of needs;- religious and cultural, food, fuelwood, building materials and medicines. Despite modernisation and a move to more western lifestyles, these resources make a substantial contribution to livelihoods, both directly and indirectly. The resources are harvested as primary resources from communal woodlands, or as secondary products from agricultural fields. Riverine resources (instream and riparian) are also important to SRSC communities. Here people fish, which offers a source of protein, and collect a range of plants, many of which are only found in riverine zones. Under the SSP, a dictionary of utilised species was prepared for these resources.

Some 'illegal' harvesting does take place within the borders of the conservation areas, and some land owners indicated a willingness to open up certain areas to harvesting. All indicated that they needed formal support in terms of mechanisms for management and implementation. **This is an area that requires urgent attention.**

The socio-economic value of such resources has frequently been overlooked in the past. Recent evidence suggests that the harvesting of natural resources from the rangelands have a higher economic, and possibly, social, value than the livestock. **The utilisation and trading of veld products is an important facet of the economy of the catchment, and therefore must be included in any economic analysis and catchment plan. This aspect is considered vitally important in describing the real socio-economic attributes of the catchment.**

Most of the land under natural vegetation is communal rangelands. Thus, all indigenous resources are common property unless they occur in an individual's allocated home plot or field. Access to particular resources in communal areas is theoretically controlled by local government but, in practice, an open access system operates in which local communities have no control over their own resource base. Deforestation of indigenous forests in surrounding areas is being undertaken by entrepreneurs from as far afield as Gauteng. Most local resource-users have welcomed participation in resource management strategies at a local level and have shown interest in being involved in, for example, social forestry/tree planting programmes. **The whole issue of "ownership" of local indigenous resources and credible, participatory co-management regimes for these resources is an area that requires urgent attention.**

5b. Livestock

Livestock play an important role in the livelihoods of many households. The main species are cattle, goats and poultry. Most households own chickens, but only a minority own cattle. The primary reasons for cattle ownership are the provision of draught power, meat, milk, and a source of money in times of crisis. Draught power is particularly important as it influences the amount of ground a household can cultivate. Households without cattle have to hire cattle for ploughing, or cultivate by hand, which usually results in a smaller area being cultivated.

A total of 44 318 cattle or LSU (Large Stock Units) and 29 656 goats utilise this area. This gives an average stocking rate of 1.94 ha/LSU. Adding the areas of irrigated annual and dryland crops (9890 ha), where cattle may use the plant remains, to the potential grazing area the stocking rate increases to 2.16 ha/LSU. There are 5 572 cattle owners; an average of 10.5 LSU per owner, and an area of about 14.4 ha of rangelands per owner.

There are cattle dip facilities in villages and inspectors visit frequently. Dosing and immunization services are provided by cattle officers from the Department of Agriculture. There is very little fencing to contain cattle or to control grazing. Cattle drink from rain pools, streams, rivers and from small earth fill stock dams. There is a **lack of a functioning viable market for livestock**, due to transport problems and the foot and mouth disease regulations. About half of the communal lands lie behind the foot and mouth **"red line"**. This disease is of great economic importance for the area in that cattle and other cloven-hoofed animals (including wildlife such as impala) are extremely susceptible to this highly contagious disease. There are two cattle schemes in the eastern portion of the communal lands, the Uthla and Seville schemes. Both schemes have suffered temporary closure over the years due to lack of management, attacks by lions and the 1991/1992 drought. Both schemes appear to benefit few individuals at the expense of most cattle farmers due to the loss of land to these schemes.

6. CONSERVATION AREAS

There are three conservation areas within the SRSC, totalling 69 486 ha: **Manyeleti Game Reserve**, the **Sabie-Sand Game Reserve (SSGR)** and the **Kruger National Park (KNP)**. Both Manyeleti and the SSGR lie on the sensitive interface between communal lands and the KNP, which itself comprises the boundary with Moçambique.

Manyeleti reserve is state-owned and falls under the jurisdiction of NP Dept. of Agriculture, Land & Environmental Affairs (formerly DEAT). In terms of land-management, a fire management plan is followed based on a measure of the annual fuel load. Then, portions of the reserve are burnt, generally on a 3 to 5 year rotation. There has been no burning for the past two years. Two years ago, a 12 km fence separating Manyeleti and the SSGR was removed but the removal of the fence between Manyeleti and the KNP has still to be negotiated. For the past two years, there has been an annual, informal meeting with the SSGR managers to exchange loose management plans and problems. There is no harvesting of natural resources by communities with the exception of some limited collection of fuelwood and thatch by staff. Models for the management of Manyeleti are currently being explored to incorporate commercialisation plans. Under the proposed model, the NP will retain ownership, and aspects of the tourism will be commercialised. A section 21 company has been set-up within the Mnisi Tribal Authority. They will have a long-term lease on the land and will grant short-term leases to private concerns. The profits accrued by this initiative will be used within the area for community development projects.

The Sabie-Sand Game Reserve (SSGR) which comprises a number of privately-owned farms, covers a total area of 65 000 ha, of which 49 414 ha falls within the SRSC. The reserve shares a common unfenced boundary with the KNP. This reserve falls under the jurisdiction of DEAT Mpumalanga. Although the size of portions of the farms within the Sabie-Sand that are owned, or leased, is relatively small (1100 ha to 3000 ha), the commercially-operated concerns have access to larger areas via agreements between owners and facilitated by an absence of internal fencing. Some of these lodges extract water from the Sand River for domestic and animal use, while others only extract water for animal use, and use borehole water for domestic use. In terms of land management, some farms indicated that bush-clearing had been undertaken in the last five years. Being within a red-line area, the venison from game culling cannot be exported and is hence used for lodge consumption.

Only a small portion, some 16 971 ha of the total 2.3 million ha of the **Kruger National Park (KNP)** falls within the SRSC. This reserve is state-owned and falls under the jurisdiction of South Africa National Parks (SANP). There are no camps within the SRSC portion of the KNP.

7. LAND CLAIMS

The Regional Land Claims Commissioner (Mpumalanga and Northern Province) has indicated that in terms of the Restitution of Land Rights Act (act No. 22 of 1994) restitution claims have been submitted on forty six farms within the SRSC. In some cases more than one claim has been lodged for the same farm. The claims and claimant are indicated in Table 4.4 and farm locations are indicated in Figure 4.6 in the main report. Discussions with the commission have indicated the complexity and potential volatility of land restitution claims, and of planning changes to land use patterns without full negotiation with all stakeholders.

CHAPTER 5: WATER DEMAND AND PRACTICE

1. DATA SOURCES AND CONSTRAINTS

Chapter 5 provides a description of the water demand, water sources and practices in water use for each sector. A knowledge of how water is currently used is important in order to make any recommendations on changes is water use practices. However, a lack of available information and differing methodologies used to determine water requirements and usage by different institutions, has been a serious constraining factor in being able to accurately assess the current situation. For example, specifically with regard to the estimation of water use by commercial forestry, a variety of approaches are used. Each of these methods have advantages and drawbacks that are described in the chapter. Other constraining factors are also described.

At present, four sets of data are available that provide estimates of the sectoral water demand or use. These were: (i) Chunnett *et al.* (1990) based on 1985 data for the entire Sabie River Catchment; (ii) research results on the economics of domestic water undertaken by AWARD; (iii) a limited amount of field work and water demand modelling was undertaken under the auspices of this feasibility study to estimate water demand as input to the estimates of economic returns for irrigated agriculture, conservation and forestry sectors and (iv) the stimulation of the hydrological consequences of some of the land-use scenarios (see Chapter 12).

Another major constraint of comparing data from different sources pertaining to water demand is that of the terminology used. In essence, these differences reflect attempts at describing water that is intercepted from rainfall (and hence cannot really be managed *per sé)* and water that is abstracted for use (over which there is therefore potential for control). For the purposes of this study, and in order to assess the economic returns on water-use, two water demand parameters, which are explained, were introduced, namely the Maximum Water Demand (MWD), and Allocatable Water Demand (AWD). It must be noted that it would have been preferable in this study, and far more relevant, to use the maximum water use. However, no instances of measured and recorded water use could be found in the catchment. Hence, the researchers had to resort to calculated and extrapolated demand data, which is far from ideal, and which emphasises the importance of measurement as a precursor to effective management.

For the purposes of consistency, the water demand and water-use figures as determined by each of the above studies are reported on separately. These are shown in table format with a detailed explanation given in the Appendices.

2. THE "RESERVE": WATER FOR THE ECOLOGICAL RESERVE & FOR BASIC HUMAN NEEDS

DWAF, as the custodian of the country's water resources, has recently reviewed a number of policies pertaining to natural resources. In line with this review, South Africa is still in the early stages of quantifying amounts for ecological reserve and domestic supply for catchments in the country. Quantifying these amounts is essential to any catchment plan and reserving sufficient quantities of water to meet these obligations and their application to the SRSC, on the basis of available data, is discussed.

3. THE ECOLOGICAL RESERVE

Calculations to determine the necessary ecological reserve, and the increase in water availability associated with rehabilitation of the SRSC, are more complex. In this regard the concept of *instream flow requirements* (IFR) for rivers has emerged and a number of approaches have been developed which reside on the assumption that there is a point below which discharge is reduced that results in a progressive or immediate loss of habitat, disruption of ecological processes and loss of species. These changes in turn threaten the integrity and health of the entire system.

Certain patterns characterise a "normal" hydrological cycle within the Sabie-Sand system and the biota life cycles are adapted to these patterns. Maintaining this overall pattern is considered to be the key focus of calculations of IFRs. These include:

- a steady low-flow period between April and October. Although stream flow decreases over this time, conditions are relatively stable.
- the rainy season during which the discharge generally increases, but is characterised by punctuated flood events ("freshets"). These flood events are the "pulse" of the system- they act as cues for breeding, spawning and other biological processes. What has been difficult is determining which of these freshets are important as cues i.e. which flood events can you

Ten factors in terms of river flow/water demand by the environment were identified, the most important of these being: the minimum flow, seasonal variations in flow and the long term flood patterns.

The urgent need for IFRs to accompany current and planned water developments, as well as mitigation of past perturbations, precipitated the development and evolution of a locally-derived approach, the Building Block Methodology (BBM). The result of the BBM application is the provision of an IFR recommendation for the river in question. What is not yet clear is whether or not the recommended IFRs for rivers constitute the Environmental Reserve, although this would appear to be the logical conclusion. Thus, for all intents and purposes the assumption is that the recommended instream flows for the Sand River comprise the Environmental Reserve. The conceptual basis for instream flow requirements and the BBM is discussed in more detail in Appendix 5.2. The IFR for three sites is given in Appendix 5.3. The total volume for the maintenance IFRs are 25.1, 51.7 and 44.0 Mm^3 for Sites 6, 7 and 8 respectively (see Figure 2.13).

4. THE DOMESTIC DEMAND

Although the situation regarding access to domestic water in the area has improved during last two years, reliable access to safe water of a sufficient quantity continues to be one of the major problems for many people living in the SRSC, particularly in rural settlements. Borehole and bulk supply are the main sources of water for most residential areas in the catchment. In some areas people still have to use water from rivers, unprotected springs, or wells dug in the riverbeds. Although water is generally not paid for through a formal system (there are very few functioning formal institutional arrangements regarding payments for water), this needs to be qualified to some extent since water many households in the SRSC purchase water from private vendors. Taking cognisance of the information constraints, and utilising the population figures presented in Chapter 3, it is calculated that domestic demand requirements are as follows:

	YEAR			
	1998		2010	
Population	382864		508922	
Level of service	25 l/c/d	60 l/c/d	25 l/c/d	60 l/c/d
Domestic Reserve Mm^3/a	3.49	8.38	4.64	11.15

It must be noted that the Domestic Reserve refers to water for basic human consumption (reasonably based on 60 l/c/d). However, numerous activities occur at a domestic level that require water over and above that specified under the Reserve. Their importance to peoples livelihoods is discussed in Chapter 6.

5. FORESTRY

With regards to afforestation, exotic plantations are rain-fed. However, certain practices such as planting in riparian zones and wetlands and at times, right through stream beds, is evident and these practices impact negatively on the water resources of the area. For the purpose of this study, the calculations of annual demand were based on a constant crop factor of 0.75. The MWD of the total plantation area was estimated as 73.7 Mm^3/a.

6. AGRICULTURE

Details of each agricultural irrigation scheme are given in Appendix 5.5. The three permanent irrigation schemes employ micro-irrigation and the drip and pipe-basin methods. There is no evidence that any of these schemes are over-irrigated and, in fact the conditions of some of the trees and the problems of water availability, indicate that these schemes may be using less than the ideal AWD. However there appears to be problems with the timing of irrigation and a need for improved irrigation systems. The average MWD of the schemes is 12 746.4 m^3/ha/a and the total MWD is 5.59 M m^3/a. The average AWD of the schemes is 8133.3 m^3/ha/a and the total AWD is 3.43 M m^3/a. For irrigated annual agriculture systems, 1 919 ha is designed for furrow irrigation systems and 226 ha has dragline sprinkler irrigation systems using a gravity supply. The furrow irrigation systems are not very efficient with high water loss. The average MWD of the schemes is 10 012.1 m^3/ha/a and the total MWD is 16.4 Mm^3/a. The average AWD of the schemes is 7 941.5 m^3/ha/a and the total AWD is 12.91 M m^3/a.

Dryland agriculture is rain fed. The average MWD is for dryland mangoes is 1.61 Mm^3/a and of dryland agriculture is 62.46 Mm^3/a.

7. RANGELANDS

Rangelands are used for a variety of purposes, including cattle grazing, collection of firewood and harvesting of secondary resources. If the land is over-grazed or over-harvested, the runoff will result in erosion, especially on the slopes. The AWD for livestock is estimated as 0.957 Mm^3/a and the MWD for range land as 969.4 Mm^3/a.

8. CONSERVATION AREAS

The conservation areas utilise the Sand River, boreholes and dams to supply game, for human consumption and on gardens. Some of the private lodges practice water conservation systems and recycle water.The annual AWD, which is presently used by humans, gardens and wildlife is 0.279 876 Mm^3/a. The MWD is estimated as 786.23 Mm^3/a.

9. CONCLUSION

Some estimate of water demand and use was made from the available information projected to 1998 as well as a limited amount of fieldwork. However, as noted in the preceding section, this area of research is still contentious and various institutions utilise different approaches to the estimations of water use and demand. Thus, any current figures with regard to water use within the SRSC should be viewed with circumspection and the purposes for which they were developed, must be recognised. It is felt that whilst the figures provided in this report allow for comparisons of relative sectoral use and economic parameters, the values provided should not be viewed as absolute. It is strongly recommended that developing accurate figures (as well as the mechanisms that facilitate this) form a key focus area within Phase II of this project.

CHAPTER 6: ECONOMIC RETURNS TO LAND AND WATER USAGE

Chapter 6 presents the economic analysis in the context of the information requirement of the MCDA process undertaken in this report (Chapter 12). It provides estimates of the returns from land- and water-use for each land use type in the SRSC, and also, by identifying and quantifying some economic criteria such as gross margins, salaries and wages and employment, provides some indication of the contribution of each sector to the economy of the area.

1. DEFINITIONS

The concept of *Operating Margin* (*OM*) is used in the report as a proxy for the profit generated by each land use category. Due to constraints on the amount and quality of data available for each land use category, this concept was considered the most appropriate to be able to compare, with certain degree

of consistency, the returns to land and water production factors for the different land use categories. In the same fashion, the number of direct jobs created by each category and the current wage levels were used as proxies for employment and remuneration respectively.

2. SOURCES OF INFORMATION

Data for the economic analysis was mainly drawn from existing sources, although a limited amount of fieldwork was undertaken by DPR to gather financial information for the agriculture, forestry and conservation land use categories. Data from Conningarth Consultants (1994) provided a macro overview for the entire Sabie River Catchment. Data from research on the economic of domestic water in the Bushbuckridge district (Perez de Mendiguren *et al* in prep.) was used to estimate the returns from water and land in the residential category. SAFCOL forestry standards, South African Commercial Agricultural norms, and data from Venda and Nebo District in the Northern Province were used to calculate gross margins for forestry and agriculture, when efficient use of resources and management is assumed. Finally, data provided by RCRD and DPR was used to analyse the extent and importance of the harvesting and sale of veld products, one of the key informal sector activities in the SRSC.

3. CONSTRAINTS

Section 6.3 (main report) provides a comprehensive discussion around the constrains to the data and henceforth the constraint to the scope of the analysis. A comprehensive macroeconomic analysis could not be done due to the fact that neither the data, nor the level of dis-aggregation required were available, and producing such data was clearly not possible within the time and financial limitations of Phase I. Consequently, it was necessary to prioritise and to focus on those aspects of the analysis which were essential for input to the MCDA used for this report (see Chapter 12).

Without a multiplier analysis, the spinoff effects that changes in land and/or water use patterns in one land-use category would have on the remaining economic activities could not be calculated. Also, major problems with availability and access to data were encountered when trying to access financial information for some of the activities such as forestry and some agricultural concerns.

On the other hand, even had such data been available, the traditional economic tools normally fail to reflect the extent and significance of the informal economic activities. Due to their very nature, informal sector activities are not registered and accounted for. Very little recorded information is available about them and obtaining the required data is a costly exercise. This constraint is particular relevant to the economy of the SRSC, where very high unemployment levels and a high incidence of informal economic activities pertain.

Although the report has gone some way into looking at informal activities (particularly interesting information and analysis is presented with the calculations and discussions around the harvesting and sale of veld products, and the *low level economic activities* that take place in the residential areas), more research is needed around the economic value and significance of these activities. Moreover, creative thinking is required into methods of integrating this sector and traditional economic analysis.

The main results are presented in Section 6.5, whereas the economic features of each land-use and the details on the calculations are presented in Appendixes 6.1 to 6.10. Table 6.2 provides a summary of the economic returns per land-use and water demand. Also, a socioeconomic assessment of current land-use an water practices for each land use category is presented Chapter 10.

Due to the aforementioned constraints, the figures provided in Chapter 6 represent preliminary estimates. They allow for comparisons of relative returns for land and water use for the different land-use categories, but the values provided should not be viewed as absolute.

Despite the limitations of the data there are, however, some interesting points to note:

4. RESULTS

Figure 6.1 (see Chapter 6) illustrates the relative importance of each land use for the economy of the SRSC:

- Conservation is the land use category with highest direct contribution to the economy of the SRSC, followed by residential and range land. The figure for conservation was not unexpected as the sector targets the upper segment of the international tourist market. However the ranking for residential an rangeland is unanticipated. The figures emphasise the importance of rangeland and residential land-use (which is often regarded as involving consumptive activities in terms of water and land as opposed to productive ones).
- The picture changes if the relative hectarage of each land use category is considered. Figure 6.2 illustrates the returns per unit of land when considered this way.
- Under the current situation, irrigated annual agriculture yields the highest returns to land in the SRSC. This is again an interesting feature of the SRSC, and contrasts with the low attention and support given to this sector when compared to irrigated permanent agriculture. However if "efficient use" in terms of operation and management is assumed, irrigated permanent agriculture will give notably the highest returns.
- As far as employment is concerned, residential land use creates the highest number of direct jobs, followed by the agricultural sector (as a whole) and then by dryland agriculture. Once again the picture changes if one looks at the employment per hectare, with agriculture, and especially irrigated permanent and irrigated annual agriculture having the highest number of workers per ha (Figures 6.3 and 6.4).
- The high number of jobs created in the residential land-use category (informal economy), the high number of people per hectare in agricultural concerns, the negative real returns to irrigated permanent agriculture (created with employment objective) and the massive loss-incurring forestry concern (inappropriate management) provide a good snapshot of the economic situation in the SRSC.

Section 6.5.2 also provides an overview of the returns to water as calculated by using the concepts of MWD and AWD, defined for the purpose of this study. However, the figures are not presented in this executive summary due to the conceptual problems encountered in the process of analysing the data. For a full discussion of this problems see Chapters 5 and 6.

CHAPTER 7: INFRASTRUCTURE DEVELOPMENT

1. STATUS QUO: WATER SUPPLY

The towns of Dwarsloop, Thulamahashe, Shatale all have extensive reticulation systems with house connections. These systems provide approximately 175 l/c/d but no payment is made. Of the remaining "villages" in the catchment many had basic public standpipe systems installed by the previous homeland governments of Gazankulu and Lebowa. These systems have all been badly neglected in terms of maintenance and repair of the "public" infrastructure, and most have had numerous informal and unplanned private connections made on them. As a result the vast majority of domestic supply systems in the SRSC provide an inequitable and unreliable service to consumers.

DWAF assessed several alternative water-resource developments for the Sabie River and its tributaries. A storage dam, Injaka Dam, on the confluence of the Maritsane and Marite Rivers, and the associated Bosbokrand Transfer Pipeline, were deemed to be the most economical alternative for the first phase of the Sabie River Government Water Scheme.

The Reconstruction and Development Programme (RDP 2) Bushbuckridge Infrastructure Project (originally budgeted at R25 M, current estimate R30 M) is designed to upgrade bulk water supply to 50 - 60 l/c/d to service reservoirs at the towns of Marite, Dwarsloop/Maviljan, Zoeknog/Orinoco and Acornhoek. Additional bulk water supply infrastructure projects have been proposed with a total estimated capital investment of R370 M.

2. STATUS QUO: SANITATION

The majority of inhabitants of the SRSC have sanitation facilities below the minimum acceptable standard for public health protection as indicated in the Sanitation White Paper of 1995. At an average cost of R1 500 per house the cost of upgrading or installing sanitation facilities to meet minimum RDP criteria could amount to R 75 673 500. Of this, the household capital subsidy of R600 would account for R30 269 400. Assuming all other factors remain equal, to achieve this by the year 2010 will require an annual investment of R6 306 125. Within the SRSC Northern Province DWAF have initiated 10 sanitation projects under RDP 3 funding. The DWAF Mpumalanga PROSCO (Provincial Sanitation Coordinating Committee) have approved 3 Phase-A projects and 1 Phase-B project under RDP 4, and 11 projects under RDP 5.

Dwarsloop and Thulamahashe towns, and Mapulaneng Technical College all have waterborne sanitation systems, with effluent treatment works. The Tintswalo works are located within a community just outside the catchment boundary, but dependent upon water supplies from within. None of the treatment plants are operating at acceptable performance levels. Work is currently (May 1998) underway on the detailed designs and costings of refurbishments to these plants.

3. STATUS QUO: HOUSING AND ASSOCIATED INFRASTRUCTURE

Under the previous dispensation no subsidies for house construction were available. At the initiative of the Northern Province government 5 000 subsidised houses at 11 sites are being constructed in Bushbuckridge, of which 3 334 houses at 5 different sites fall into the SRSC. All these houses have been allocated, and apparently an extra 2 000 houses are at the planning stage. Since 1994 ESKOM has made 26 497 electrical connections in Bushbuckridge North and Midlands. In the SRSC 900 telephone connections have been made since 1994, and the areas of Acornhoek, Shatale, Arthurstone and Bushbuckridge have been automated. In terms of industry there are two sawmills, owned by the York Timber Company.

CHAPTER 8: ADMINISTRATIVE ARRANGEMENTS, POLICY & LEGISLATIVE FRAMEWORK

1. INTRODUCTION

Chapter 8 provides an overview of the administrative arrangements, the emerging policies as described in a number of White Papers, as well as the legal framework. These descriptions have concentrated principally on policies and legislature that pertain specifically to Integrated Catchment Management (ICM) although every effort was made to provide as comprehensive a synopsis as possible.

2. ADMINISTRATIVE ARRANGEMENTS

The past was marked by a number of different 'governments' having responsibility, with poor planning, a lack of record keeping, low skills and ignorance of regulations being the norm. Improvement to services was often determined for political reasons rather than identification of real needs. New institutions are now emerging to meet the needs of a new socio-political environment, of which a Catchment Management Agency (CMA) is just one. Other institutions include local government (also as a Water Services Authority), a Water Board, and Water Service Providers.

2. WHITE PAPERS

Although the White Paper on a National Water Policy for SA (the Policy) is the over-arching national water policy statement of DWAF and therefore underpins all water related legislation, to a large extent the principles and policy embodied in it have been incorporated into the provisions of the National Water Bill and the Water Services Act. Other White Papers that are discussed are

- the Environmental Management Policy,
- the Sustainable Forestry Development,
- the Conservation and Sustainable Use of Biological Diversity, and
- the Integrated Pollution and Waste Management policies.

3. THE NATIONAL CONSTITUTION OF 1996

Constitutionally, the management of water is a national function, while water and sanitation service provision are local government competencies. Pollution control and the environment are concurrent national and provincial competencies. The devolution of environmental powers and functions to the provinces runs counter to the idea that centralisation is central for the formulation and implementation of an efficient and integrated environmental management policy. The Bill of Rights is discussed in terms of the environmental right, the rights to administrative justice and to information, and property rights.

4. THE BILL OF RIGHTS

A number of rights are included in the Bill of Rights that have direct bearing on the formulation of a Catchment Plan and ICM. These, discussed in the main report, include:

- The Environmental Right
- The Administrative Justice and Access to Information Rights
- The Right to Property

5. NATIONAL WATER BILL

The National Water Bill (currently before parliament) defines National Government's role as the public trustee of the nation's water resources ultimately responsible to ensure that water is allocated equitably and used and managed beneficially in the public interest which includes an environmental component. Notwithstanding this, the Bill, in contrast to the 1956 Act, places a significantly reduced number of powers in the hands of the Minister.

The National Water Bill (the Bill) fundamentally repeals a multitude of water laws most notably the Water Act 54 of 1956. It must be borne in mind that the National Water Bill, albeit far reaching in the changes it brings about to water resources management in SA, is a framework act, leaving much of the detail as to how it is to be implemented up to regulations which will be drafted in due course. Of particular importance to the present study are details concerning the determination of the Reserve, resource classification systems and some aspects of how catchment management is to operate in practice. In the absence of guidelines the effect of the Bill on water resource management on a practical level remain rather speculative.

5.1 Catchment Management Agencies

Chapter 13 of the National Water Bill deals with the establishment, the appointment of members of the governing Boards, the powers, functions and operation, the financing and disestablishment of CMAs. CMAs are required to develop catchment management strategies. In the process of developing a strategy, a CMA must seek co-operation and agreement on the content of the strategy from the various stakeholders and interested parties, take into account both the class of water resources and resource quality objectives and international obligations, and contain a water allocation plan.

Arguably one of the most far reaching changes to existing water law brought about by the Bill, is the transition from a private use rights allocation system to a public rights system which treats all water-use uniformly and grants rights to use water in terms of an administrative system. Through the creation of the Reserve, the quantity and quality of water required for basic human needs and for the maintenance of aquatic ecosystems is effectively removed from the total body of water available for allocation to other uses. In issuing any license or general authorisation, the Bill lays down certain guidelines to assist authorities such as CMAs in the exercise of their discretion. Such agencies are required to take into account a number of considerations including the efficient and beneficial use of water in the public interest, the socio-economic impact of the water use to be authorised and the need to redress the results of past racial and gender discrimination. The Bill provides for resource quality measures to be developed

progressively within the contexts of the national water resource strategy and the catchment management strategy, and contains specific pollution prevention provisions aimed at applying the polluter pays principle.

The Bill envisages significant changes to the current water resource pricing regime although the details of this pricing policy are not provided for. Although the basic policy of government is that water services provision should be self-financing at a local and regional level, CMAs are not responsible for such provision and are thus not directly affected by the water services pricing policy detailed in the Water Services Act. Municipalities, at the water service authority level are required to make by-laws containing conditions for the provision of water services, including determined tariff structures.

6. WATER SERVICES ACT

The Water Services Act (WSA), which deals with the supply of water and sanitation, also impacts on the institutional management of water. The institutional structure (municipalities) for water service provision under the WSA is largely determined by the provisions of the Constitution in terms of which local government, both in urban and rural areas. One of the functions of municipalities is to provide basic water and sanitation services, under the supervision of and subject to monitoring by both national and provincial government.

Where the National Water Bill deals with water resource management and CMAs, the Water Services Act (WSA) deals with the supply of water and sanitation. This includes Water Boards and the role of local government as Water Services Authorities. The chapter details the key functions and responsibilities of these institutions, and discusses a three-tier tariffing system.

7. LAND RIGHTS

The Restitution of Land Rights Act (No. 22 of 1994) provides for the lodging, registration and adjudication of land claims. A person or community is entitled to restitution if they satisfy the requirements of s 25(7) of the 1996 Constitution, read with s2 of the Restitution Act. In essence, land claimants have to prove that they were dispossessed of property after 19 June 1913 in terms of a racially based law or practice without receiving just and equitable compensation.

In the event of a claim succeeding, the claimant is entitled to restoration of the actual land claimed or to 'equitable redress'. Even an order for 'equitable redress' may have land use implications. For example, should the land claimed fall within the area of a game reserve, the Land Claims Court could, as an alternative to actual restoration, direct that members of the community be employed as wardens in the reserve, and/or be allowed to harvest traditional medicinal plants.

The catchment plan will have to take these changing land use patterns into account. On the one hand, over-regulation of land use may reduce the Land Claims Court's scope to devise creative solutions to conflicting land claims. On the other, negotiated solutions with existing land users may be upset by the entry of new right-holders into the SRSC.

Other relevant land legislation discussed includes the Land Reform (Labour Tenants) Act 3 of 1996, and the Extension of Security Tenure Act 62 of 1997.

8. ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS

In September 1997, the Department of Environmental Affairs and Tourism, acting in terms of the Environment Conservation Act of 1989, published regulations identifying certain activities which may have a 'substantial detrimental effect' on the environment. The regulations, which have become known as the 'impact assessment regulations' further prescribed certain procedures that must be complied with before any of the identified activities are embarked on.

CHAPTER 9: OTHER INITIATIVES UNDERWAY IN THE SAND RIVER CATCHMENT OR THAT AFFECT THE CATCHMENT

The purpose of this chapter is to give a brief overview of initiatives in or near the SRSC which could have an impact on the long term sustainability of the catchment. It does not claim to be exhaustive in its scope but it could inform the discussion on the basis by which membership of the CMA might be invited. These initiatives are listed here and detailed in Chapter 9.

1. GOVERNMENT INITIATIVES

- Bushbuckridge Water Board
- Water Services Authority
- Working for Water
- DANCED Community Forestry Project
- Mpumalanga Medicinal Plant Programme (MMPP)
- Maputo Sub Corridor

2. NON GOVERNMENTAL ORGANISATIONS (NGOs)

- Association for Water And Rural Development (AWARD)
- Health Systems Development Unit (HSDU)
- Refugee Research Programme (RRP).
- Mvula Trust
- Nethworc Education Project
- Wits Tintswalo Community Rehabilitation Worker Training Programme (CRWTP)

3. RESEARCH AND DEVELOPMENT

- The Resource Conservation & Rural Development Programme
- Kruger National Park Rivers Research Programme
- The Kruger National Park Traditional Healers Programme
- National Aquatic Ecosystem Biomonitoring Programme (NAEBP)
- Pfunanani Project

4. GENERAL

- Pipeline From Phalaborwa to Maputo
- Sabie River Working Group
- Lowveld Coordinated Research Forum (LOCORES)
- Bushbuckridge Nature Conservation Project
- Biosphere Initiative

CHAPTERS 10 & 11: A DESCRIPTION & ASSESSMENT OF LAND- AND WATER-USE AND PRACTICES

1. INTRODUCTION

Having described the current land- and water- use and practices within the SRSC, as well as detailing the bio-physical, historical, socio-economic, ecological, technical, political and institutional characteristics of the area, an assessment of the *status quo* is presented. In keeping with Landcare principles, there are a suite of practices in the use of water and land that can be improved or introduced that jointly, will address the overall objectives of this phase of the project. Some practices, on the other hand, are appropriately confronting socio-economic and/or ecological concerns within the catchment and should be encouraged. Each land-use/ water-use sector is addressed individually (Section 10.3), and evaluated from socio-

economic, ecological and hydrological perspectives, where appropriate. Additional assessments included (i) the terrestrial and aquatic resources of the SRSC (Section 10.4), (ii) the infrastructure and development plans (Section 10.6), and (iii) the knowledge, attitudes and practices of the different sectors, so as to inform the Public Awareness Campaign (Section 10.7).

Therefore, the assessments are followed by recommendations for water- and land -use practices that should be included in any scenario for the catchment, irrespective of the final scenarios chosen. These assessments and their respective recommendations are summarised in Boxes 1 to 9, below.

Box 1 represents a number of key recommendations that have emanated from the assessments and that are considered to be of vital importance for immediate attention by the steering committee or CMA. In essence, these embody the objectives of most of the extensive recommendations. Thereafter, extensive recommendations, covered in subsequent boxes are those that would need to be implemented in order to return the Sand River to a healthy condition, meet growing domestic demand, and ensure that the principles of integrated catchment management are adhered to. These detailed recommendations represent medium and long term targets that are the responsibility of various bodies that are represented on the CMA.

2. KEY RECOMMENDATIONS

The following points (not in order of priority) represent key recommendations that embody most of the detailed recommendations that follow. Addressing these are considered to be the backbone of Phase II of the SSP and the development of the Catchment Plan.

BOX 1
KEY RECOMMENDATIONS FOR THE SRSC

- Establish an appropriate and sustainable management institution and Landcare groups
- Develop and implement a Water Management and Information System for the SRSC
- Provide an equitable and reliable domestic supply (ensure the "Reserve")
- Implement and monitor the Instream Flow Requirements (the Reserve)
- Ensure an equitable allocation water between sectors and implement an appropriate tariffing system
- Rehabilitate and maintain tributaries of the Sand River
- Reduce and control the extent of forestry and invasive aliens plants and develop appropriate management plans for both
- Develop and implement a comprehensive plan for the use of natural resources
- Maintain current conservation areas but re-appraise management models to ensure equity
- Ensure that the vital role of informal employment is recognised in future plans
- Implement the Public Awareness Campaign and Education & Training Programme

3. ASSESSMENT OF AND RECOMMENDED PRACTICES FOR THE SECTORS

BOX 2 SUMMARY OF THE ASSESSMENT OF & RECOMMENDED PRACTICES FOR THE FORESTRY SECTOR
11.4.1.1 Poor practice and management within the forestry sector resulting in socio-economic and environmental problems (Sect. 10.3.1.2.1)
• Recommendation: Implement the ISO 14001 Plan and an audited annual plan of operation • Recommendation (alternative): If DWAF does not want to manage the plantations to implement ISO 140001, then the ownership or land-use needs to be changed • Recommendation: Given that the plantations make a loss, management must explore the financial gains to be made by felling immature plantations to maximise current returns. This should be especially the case on sensitive areas that should not have been planted in the first place
11.4.1.2 Unfulfilled contractual obligations to York Timbers (Sect. 10.3.1.2.1.)
• Recommendation: Institute the process to terminate such a contract or switch contractual obligations to other plantations
11.4.1.3 Over-staffing of this sector (Sect. 10.3.1.2.2.)
• Recommendation: Explore possibilities for skills-training or alternative employment options for workers in a socially sensitive manner
11.4.1.4 Negative perception toward this land-use by other sectors (Sect. 10.7.5)
• Recommendation: Address socio-economic and environmental problems and participate in catchment management structures/ Landcare initiatives
11.4.1.5 No control of alien plants (Sect. 10.3.1.2.2)
• Recommendation: As for 11.4.1.1, to include the current WFW eradication programme

BOX 3 SUMMARY OF THE ASSESSMENT OF & RECOMMENDED PRACTICES FOR THE AGRICULTURAL SECTOR
11.4.2.1 There is no accurate data of water use due to the lack of measurement systems. (Sect. 10.3.2.2.2)
• Recommendation: Undertake a water audit of each irrigation scheme and implement formal monitoring systems for water use
11.4.2.2 Abstraction from the rivers and other water sources is uncontrolled (Sect. 10.3.2.2.2)
• Recommendation: With the establishment of a CMA, needs to be effective control put in place particularly vis-a-vis allocation
11.4.2.3 There is no charge for water abstracted (Sect. 10.3.2.2.4.1)
• Recommendation: The plan to bring each scheme onto a profitable footing should include details of the most cost-efficient and water-efficient irrigation systems (and management systems in general). Appropriate water tariffs can be used to encourage the adoption of best practice
11.4.2.4 Inequitable distribution of water within the sector
• Recommendation: All farmers along particular tributaries or sections of the river should establish Irrigation Boards to manage water allocation and use. This would also allow them to lobby for finance.
11.4.2.5. There are a variety of irrigation systems such as flood-irrigation and overhead sprinklers, many of which are inefficient and wasteful (sect. 10.3.2.2.2)

BOX 3 SUMMARY OF THE ASSESSMENT OF & RECOMMENDED PRACTICES FOR THE AGRICULTURAL SECTOR
• Recommendation: The plan to bring each scheme onto a profitable footing should include details of the most cost-efficient and water-efficient irrigation systems (and management systems in general). Appropriate water tariffs can be used to encourage the adoption of best practice
11.4.2.6 The selection of appropriate crops vis-a-vis the water shortages seems to be non-existent and rather, is determined only on the basis of market forces (Sect. 10.3.2.2.2)
• Recommendation: Tariffing system for water-use will encourage possible conversion to water efficient crops
11.4.2.7 The canal-systems that supply some farms are poorly managed, maintained and leakages are common (Sect 10.3.2.2.2)
• Recommendation: Maintenance audits to be conducted by farm management and departmental extension personnel every six months, and leakages repaired when discovered. The long-term viability of these canals needs to be examined.
11.4.2.8 General farm practices are not undertaken according to a management policy (Sect. 10.3.2.2.2)
• Recommendation: As per 11.4.2.5.
11.4.2.9 High impacts on sensitive areas, such as cultivation of seeplines and riparian zones due to a lack of policy with regard to riparian zones, slopes, wetlands (Sect. 10.3.2.2.3)
• Recommendation: Identify sensitive areas for each landuser, and develop strategies to ensure these areas are not impacted, and enforce the Conservation of Agricultural Resources Act, and as per 11.4.2.5.
11.4.2.10 Most of the irrigations schemes are not economically viable under current practices (Sect. 10.3.2.2.4.1)
• Recommendation: Explore models for a reduction in staffing and incentives for increased production
• Recommendation: Privatise each potentially commercial scheme, or create independent companies for each, with the state as the major shareholder (in the short-term)
• Recommendation: Phase II to assess the potential of each scheme as a possible land redistribution project to local communities

BOX 4 SUMMARY OF THE ASSESSMENT OF & RECOMMENDED PRACTICES FOR THE RESIDENTIAL AREAS
11.4.3.1 Inequitable access to water between this and other sectors (Sect. 10.3.3.1.2)
• Recommendation: Evaluate figures (first estimates) provided in this report for the Domestic Reserve
• Recommendation: Ensure equitable availability and allocations through the CMA
• Recommendation: Identify priority users (e.g. hospitals) for greater assurance in supply
11.4.3.2 Absence of formalised connections at household level (Sect. 10.3.3.1.2)
• Recommendation: Ensure individual connections are properly installed, formally registered and recorded
11.4.3.3 Excessive usage of water when available (Sect. 10.3.3.1.2)
• Recommendation: Introduce measures to reduce individual and village water usage to appropriate levels
11.4.3.4 No formal payment for water except within small scale schemes (Sect. 10.3.3.1.2)
• Recommendation: Establishment of a functional revenue system to cover capital and operations and maintenance costs

BOX 4 SUMMARY OF THE ASSESSMENT OF & RECOMMENDED PRACTICES FOR THE RESIDENTIAL AREAS
11.4.3.5 Lack of adequate spring protection and no rain water harvesting (Sect. 10.3.3.1.2)
• Recommendation: CMA allocation criteria should include framework for spring protection • Recommendation: Education and training programme to promote rainwater harvesting. Tariffing system to provide incentive to those complying
11.4.3.6 Lack of well-communicated criteria for the allocation of land and lack of title deeds (either individual or group) (Sect. 10.3.3.1.2)
• Recommendation: Landuse zonation plans required for each farm/village • Recommendation: Formulate criteria for the allocation of land separately per local government and tribal authority area and consider legal deeds for communities requiring them
11.4.3.7 Housing schemes established without due consultation and following an urban model (Sect. 10.3.3.1.2 & 10.5.6)
• Recommendation: Future housing schemes must be developed through the guidance of community requirements • Recommendation: Phase II to promote research into this sector with results informing economic and water-use development plans for the area
11.4.3.8 Inadequate understanding of the water use and economic potential of small-scale economic activities (Sect 10.3.3.1.2)
• Recommendation: Phase II to promote research into this sector with results informing economic and water-use development plans for the area
11.4.3.9 Lack of credit for small-scale entrepreneurs (Sect. 10.3.3.1.2)
• Recommendation: Awareness campaign to inform communities and NGOs of existing financial packages and lending institutions that support small-scale entrepreneurs

BOX 5 SUMMARY OF THE ASSESSMENT OF & RECOMMENDED PRACTICES FOR THE RANGELANDS
11.4.4.1 Clearing of sensitive area such as riparian zones and seeplines (Sect. 10.3.4.2.2)
• Recommendation: Use zonation plan for each village (see Sect. 11.4.2.9 & 11.4.3.6) as basis for a public awareness campaign to halt the clearing of sensitive areas
11.4.4.2 Inadequate maintenance of stock-watering dams (Sect. 10.3.4.2.2)
• Recommendation: Rehabilitate and implement a programme for the maintenance of stock- watering dams
11.4.4.3 Complete clearing of land for agricultural purposes
• Recommendation: Educate D.A. extension officers in appropriate agro-forestry practices
11.4.4.4 Clearing of woody plants to meet fuelwood needs (Sect. 10.3.4.2.2)
• Recommendation: Phase II to focus on solutions to this issue in both the medium- and long- term • Recommendation: Eskom be lobbied for increased electrification of area, especially where wood stocks are almost exhausted
11.4.4.5 Over-harvesting of selected species (Sect. 10.3.4.2.2)

BOX 5 SUMMARY OF THE ASSESSMENT OF & RECOMMENDED PRACTICES FOR THE RANGELANDS
• Recommendation: Phase II to sponsor appropriate research into sustainable harvesting rates of key flora • Recommendation: Establishment of nursery projects for selected species • Recommendation: Development of a plan for the harvesting of natural resources that ensures long-term sustainability
11.4.4.6 Community-based control of harvesting has become ineffectual (Sect. 10.3.4.2.1)
• Recommendation: Address the capacity of local government to manage / implement community-based management of communal resources
11.4.4.7 Heavy continuous grazing (Sect. 10.3.4.3.1)
• Recommendation: Consult community and cattle owners regarding alternative management options and returns from cattle enterprises, allowing individual communities to opt for management objectives suitable to them • Recommendation: The DA to limit the density of artificial water points • Recommendation: Lobby training institutions regarding the introduction of courses promoting proper valuation of multi-purpose landuse systems, and tolerance of communal management systems
11.4.4.8 Veld burning (variety of causes) (Sect. 10.3.4.2.2)
• Recommendation: No actions to be taken
11.4.4.9 No control of alien plants (Sect. 10.3.4.2.2)
• Recommendation: Educate D.A. extension officers and local government in appropriate control measures of alien invasive plants (see comments under 11.4.1.5)
11.4.4.10 Lack of knowledge with regard to the potential effects of the collection of sand from river beds
• Recommendation: Phase II to implement appropriate research study if deemed necessary
11.4.4.11 Lack of knowledge with regard to the demand and collection rates of wood for construction
• Recommendation: Phase II to implement appropriate research study
11.4.4.12 Trapping of fauna
• Recommendation: Development and implementation of a long-term public awareness programme
11.4.4.13 The existence of the two cattle schemes in the SRSC is largely contingent on subsidies and is reserved for the exclusive use and hence benefit of a small number of people
• Recommendation: Phase II to assess the potential of each scheme as a possible land redistribution project to local communities or models for their sustainability so as to meet their original objectives, must be proposed

BOX 6 SUMMARY OF THE ASSESSMENT OF & RECOMMENDED PRACTICES FOR CONSERVATION AREAS
11.4.5.1 High per capita consumption of water within privately-owned reserves (Sect 10.3.6.1.1)

• Recommendation: Undertake water audit for each commercial enterprise • Recommendation: Implement technical solutions as far as possible (e.g. low-flow showers) • Recommendation: Increase water-use efficiency (e.g. recycling of water, water conservation gardening, etc.) • Recommendation: Implement education and awareness programmes for staff and guests
11.4.5.2 High density of artificial water points for game (Sect. 10.2.5.1.2)
• Recommendation: Evaluate numbers and locations of water points from an ecological perspective and make recommendations
11.4.5.3 Uncoordinated land management practices between sub-units (Sect. 10.3.5.1.1)
• Recommendation: Institute a forum at which managers can meet and discuss major land management issues- invite guest speakers to address specific topics • Recommendation: Encourage research that will support management objectives
11.4.5.4a Relationship between conservation and neighbouring communities: Inadequate community involvement and poor perceptions towards reserves, particularly the privately-owned reserves (Sect. 10.3.5.1.1 & 10.7)
• Recommendation: Explore different management models to increase community buy-in (see below) and increased employment and training opportunities
11.4.5.4b Relationship between conservation and neighbouring communities: No harvesting of veld resources for consumption or trading (Sect. 10.3.5.1.1)
• Recommendation: Design and implement trial models to address the issue of access to resource-harvesting within conservation areas (also help improve sector image in local communities)
11.4.5.4c Relationship between conservation and neighbouring communities: Proposal for commercialisation of Manyeleti Game Reserve (Sect. 10.3.5.1.3)
• Recommendation: Provide future support for the implementation of this initiative
11.4.5.4d Relationship between conservation and neighbouring communities: Initiatives with neighbouring communities
• Recommendation: Explore conservation models that are inclusive of neighbouring communities
11.4.5.5 Few appropriate training & educational facilities
• Recommendation: Explore options for improving such facilities
11.4.5.6 Low diversity of income-generating initiatives and amenities
• Recommendation: Introduce a range of other eco-tourism opportunities, activities and markets to increase employment (and thereby improve community image)

4. ASSESSMENT OF AND RECOMMENDATIONS PERTAINING TO THE ECOLOGICAL RESOURCE BASE

BOX 7 SUMMARY OF THE ASSESSMENT OF & RECOMMENDATIONS WITH REGARD TO THE OVERALL CONDITION OF THE SAND RIVER
11.5.1.1 Reduction in flow and a loss of perenniality
• Recommendation: Implement the IFR recommendations and set-up a monitoring system to ensure that the IFR objectives are met

11.5.1.2 Degradation of the tributaries of the Sand River
• Recommendation: Phase II of this project needs to explore innovative ways of addressing the rehabilitation of tributaries
11.5.1.3 Current water quality appears to be good but may not remain so. Recent evidence points to problems downstream of treatment works.
• Recommendation: The number of water quality monitoring sites needs to be increased
11.5.1.4 Degradation of the upper-catchment (where most of the water is generated)
• Recommendation: Implement land- and water-use scenarios that hold this factor as the overriding consideration.
11.5.1.5 No rehabilitation of Zoeknog Dam site
• Recommendation: Rehabilitate the Zoeknog Dam site with immediate effect and inform stakeholders of future plans

5. ASSESSMENT OF & RECOMMENDATIONS WITH REGARD TO INFRASTRUCTURE DEVELOPMENT

BOX 6 SUMMARY OF THE ASSESSMENT OF & RECOMMENDATIONS WITH REGARD TO INFRASTRUCTURE DEVELOPMENT
11.6.1 GENERAL
11.6.1.1 Need to ensure coordination in development of related infrastructure (Sect. 10.5.1)
• Recommendation: Infrastructure development be coordinated by a body constituted from all relevant structures (CMA, BWB, Local Governments, DoH). The CMA should initiate this and offer its offices as the secretariat in the first instance
11.6.1.2 Need to institute a water allocation / permitting system to ensure equitable access to water resources
• Recommendation: The CMA should institute and enforce a water allocation and charging system as one of its first actions
11.6.2 DAMS/BULK WATER SUPPLY
11.6.2.1 Need to integrate planning and design of dams and bulk water infrastructure with groundwater resource availability and domestic demand (Sect 10.5.2)
11.6.2.2 Need to review bulk water supply plans in line with improved flows in Sand River when Save the Sand phase 2 is implemented (Sect. 10.5.2)
11.6.2.3 Need to include consideration of past capital investments in future bulk service planning (Sect. 10.5.2)
11.6.2.4 Need to include realistically achievable reductions in UFW in future bulk service planning (Sect. 10.5.2)
11.6.2.5 Need to reduce projected capital expenditure to acceptable levels in line with DWAF criteria for RDP funding (Sect. 10.5.2)
• Recommendation: An integrated water management and information system incorporating Geographical Information System technology and hydraulic design capability be established and maintained, either by the CMA or the Bushbuckridge Water Board.

BOX 8 SUMMARY OF THE ASSESSMENT OF & RECOMMENDATIONS WITH REGARD TO INFRASTRUCTURE DEVELOPMENT
11.6.3 GROUNDWATER 11.6.3.1 Need to fully explore in detail the groundwater accessibility and exploitability to inform short to medium term domestic demand and bulk supply planning (Sect. 10.5.3)
• Recommendation: Hydrogeological specialists be engaged to extend and complete the groundwater investigations recently undertaken. Feed the results of this investigation into the integrated water management and information system • Recommendation: Suitably located high yielding boreholes be developed immediately to provide/assist with basic primary supply in the short term and/or back up supply in the long term.
11.6.4 DOMESTIC SUPPLY/RETICULATION 11.6.4.1 Need to determine extent of existing village level infrastructure in order to inform short to medium term domestic demand and bulk supply planning (Sect 10.5.4)
• Recommendation: Engage suitable agency (eg Mvula Trust) to conduct extensive detailed technical and social investigation in collaboration with local government Water Desks and Community Water Committees. Feed the results of this investigation into the integrated water management and information system
11.6.4.2 Need to access resources for community level water reticulation projects for the whole SRSC. Such funding is currently under threat from cutbacks to DWAF budget (Sect. 10.5.4)
• Recommendation: DWAF review its budget cutbacks and release funds to its Mpumalanga regional office to support Mvula Trust (and other) efforts to deliver services at RDP Minimum levels for all communities.
11.6.4.3 Need to develop and institute widely-accepted tariffs for domestic water supply such that operations and maintenance costs (initially) and capital replacement costs (eventually) can be recovered
• Recommendation: That a domestic reticulation policy, principles and project implementation, supplemented by a catchment wide programme, be devised and negotiated with all parties (primarily the CMA, Bushbuckridge Water Board and the Local Governments) for agreement on responsibilities, funding and implementation
11.6.4.4 Need to upgrade assurance of current supplies (Sect 10.3.3.1.2)
• Recommendation: Access funding to improve infrastructure as required, for staff training and motivation to ensure the current systems, despite its shortfalls operates as efficiently as possible
11.6.5 SANITATION 11.6.5.1 Need to reestablish acceptable levels of performance at all existing sewage treatment works. The existing project to this end is threatened by budget cutbacks from DWAF (Sect 10.5.5) 11.6.5.2 Need to ensure that extensions to existing sewage treatment works and future construction of new works remains low cost, low technology, simple operation and low maintenance
• Recommendation: CMA be empowered to control the standards and design of such works to ensure that only Waste Stabilisation Pond technology be used.
11.6.5.3 Need to ensure that all residents of the catchment have access to at least RDP minimum standard of sanitation at household level. This RDP ideal is under threat from cutbacks to DWAF funding (Sect. 10.5.5)
• Recommendation: Further funding be allocated by DWAF to its Northern Province Regional Office to proceed with phase 2 of its existing phase 1 projects, and to its Mpumalanga Regional Office to fund the implementation of the business plan developed over the last two years.

BOX 8 SUMMARY OF THE ASSESSMENT OF & RECOMMENDATIONS WITH REGARD TO INFRASTRUCTURE DEVELOPMENT
11.6.6. HOUSING
11.6.6.1 Need to ensure that Local Government Structures plan housing developments with full cognisance of the related developments affected (Sect 10.5.6)
• Recommendation: The Northern District Council, or DWAF/Rand Water, or Community Based Public Works Programme, should release funds for the training and development of local Councillors, as has been planned for some time. • Recommendation: Infrastructure development should then be continually coordinated by the body constituted from all relevant structures. The CMA should remain as the secretariat for this body.
11.6.7 ROADS
11.6.7.1 Inadequate and poorly maintained road transport system (Sect 10.5.7)
• Recommendation: Responsibility for upgrading of secondary roads should rest with local government and the district council. • Recommendation: Provide support to local government to plan an integrated secondary road system, and to capacitate local government to run and manage a tender and implementation process • Recommendation: Dept of Public Works and Transport to coordinate rehabilitation of eroded areas due to poor road construction and maintenance

6. RECOMMENDATIONS WITH REGARD TO THE APPLICABILITY OF THE HERMANUS WATER CONSERVATION PROJECT AND THE PRINCIPLES OF LANDCARE

The Terms of Reference for the Save the Sand Project requires that the Catchment Plan be contextualised with another water-conservation initiative underway in South Africa, the Hermanus Water Conservation Project (see Section 1.6.3).

Although the context of the Save the Sand Project is a much broader than that of the Hermanus Water Conservation Project, the guiding principle, which is to institute water demand management and thereby reduce water-use, is shared by the SSP. The mainstay of the HWCP which is a 12-point plan, offers a series of implementable initiatives that can be considered within this catchment plan and the applicability of these steps is assessed. These steps reflect the local realities in the Greater Hermanus Region and are briefly assessed within our local context.

Box 9 The applicability of the 12-point plan of the Hermanus Water Conservation Programme to the SRSC (see Box 1.2 for details of each step)	
1	**Assurance of Supply tariff** The need for Water tariffs is recognised as imperative. However, there are a number of constraints, the most apparent of which relate to the lack of any metering systems and resistance to payment. Further assessments and recommendations are made in Sections 10.3.3; 10.6.1 (potential for conflict); 11**; 13.4 (role and responsibility of the CMA) and 13.5.1 (importance of education). Details of levies must be considered in Phase 11.
2	**Block-rate tariff** The principle of a block-rate tariff is supported, particularly with regard to in view of the "life-line" tariff. Details of levies must be considered in Phase 11.

3	**Working for Water- Invasive Aliens Clearing** Currently, the Mpumalanga WFW project has been a leader in initiating clearing operations throughout the SRSC. However, details of the roles and responsibilities for follow-up operations, as well as monitoring and evaluation have to be addressed to ensure the longterm sustainability of this project.
4	**Education and water audits at schools to assess daily use** Whilst this initiative is supported, it is felt that within the local realities broader educational issues with a far wider audience need to be tackled first. This forms the backbone of the PACAM and the Ed&tr Programme (Chapter 13).
5	**Water Loss Management** In reality, UFW is 100% in the formal towns since no costs are recovered. In practices, leakages and illegal connections are widespread. Community-based control over small-scale supply systems has gone some way to addressing this and has been discussed in previous sections (Chapter 8). The long-term solution lies in the establishment of a functional and integrated Water Management System
6	**7. Retrofit Programme- Water Saving in the home** At this stage, retrofitting in accommodation in the game reserves should certainly be implemented and needs attention in Phase II. However, due to local realities, this is not viable for the wider community in the catchment with the exception of designated towns.
7	**Water-wise gardening** Again, this step needs attention within the game reserves and within the designated town, where people do have ornamental gardens.
8	**Water- wise food production** This step of the use of gardens for food production and the use of "grey-water", has already been implemented by many households in the SRSC. In fact, water conservation measures form part of peoples lives. Recycling of water is undertaken by some farms in the conservation areas but should be instituted in the remaining farms.
9	**Security Meter** This step could be applicable in the formal towns as part of a medium- to long-term project but is not applicable to the rural communities.
10	**National Water Regulations** The CMA needs to address the issue of introducing the National Water Regulations as by-laws. This must be undertaken by the inclusion of its constituent members (i.e. the BWB and Local Government)
11	**Communication Programme** Consumer support is pivotal to the success of the entire programme. This aspect therefore, has formed the cornerstone of the PACAM, the Ed&Tr Programme and the steps recommended for Phase II of this project. Long-term communication and the dissemination of information, particularly with regard to progress of the SSP, needs to be carefully planned at the start of Phase II.
12	**Informative billing** This step could be applicable in the formal towns as part of a medium- to long-term project but detailed costing would need to be considered. This is not applicable to the rural communities since individual billing iss unlikely in the foreseeable future. Alternative means of disseminating this information, such as through newspapers.

CHAPTER 12: THE DEVELOPMENT AND ANALYSIS OF LAND-USE SCENARIOS USING MULTI CRITERIA DECISION ANALYSIS

1. THE MCDA PROCESS

As part of the development of an integrated catchment management (ICM) plan, use was made of the techniques of multi-criteria decision aid (MCDA) and scenario based policy planning (SBPP) to develop and to facilitate the choice between different land-use (and implied water-use) scenarios for the SRSC.

Certain criteria were defined which could be used to compare alternative scenarios for the catchment; these criteria are represented in a value tree or framework. The broadly defined goal (ICM) was split into more narrowly defined criteria (economic growth, rehabilitation and sustainability, social upliftment and equity). These were then increasingly defined through the derivation of appropriate criteria. Figure 12.2 (in the main text) shows the value tree of criteria utilised.

2. ZONES AND SCENARIOS

The development and evaluation of various scenarios the SRSC was divided into three separate zones based on current land-use patterns. The attributes (institutional, ecological, biophysical and socio-economic) varied over the catchment in such a way that developing scenarios for the entire area would not permit equitable evaluation. The three zones (Figure 12.3) were identified as Zone A, 40% afforested with exotics; Zone B, where most human activity occurs; and Zone C, which are the game reserves. Eight scenarios were developed for Zone A, three for Zone B, and four for Zone C.

The knowledge of the project team and the available information was used to develop a manageable set of realistic scenarios for which economic and hydrological consequences could be found within the time-frame of this phase of the "Save the Sand" project. The scenarios were then evaluated on the basis of all the criteria as selected by the team. It was agreed that certain aspects would become "constraints" to the scenarios, namely the Instream Flow Requirements and the Domestic Demand (both now protected by law). It was also agreed that there would be various assumptions underlying the scenarios which related to land-care, water conservation, and management.

5. SCORES AND WEIGHTS

The scenarios were given scores on the basis of each of the criteria by the relevant members of the study team. The majority of criteria were evaluated directly on a [0;100] "thermometer scale" by the relevant specialists. In the absence of hydrological modelling for the scenarios, "expert judgement" was used for the criteria relating to aquatic habitats, and the criteria referred to as water equity, which was intended to be a measure of how many people could have access to different levels of water supply. The economic consequences of the scenarios could be evaluated numerically for some criteria (for example: a comparison between formal and informal employment, and associated incomes), and then translated to a [0;100] thermometer scale using a value function. Only economic implications from primary land-uses were assessed in the scenarios, and no multiplier effects are included.

Subsequent to the scoring procedure, weighting (or scaling constants), within the three criteria groups ("rehabilitation and sustainability", "economic growth", "social upliftment and equity") were given using the swing weighting approach. The most important criterion was given a weight of 100, and then a "swing" from worst to best level on the second most important criterion, relative to the swing from worst to best for the first, determined. Weights were then rescaled to the sum to one. Once weights within the criteria groups were found, the weights between the three criteria groups were determined.

Using the within criteria group weights and the between criteria group weights, the scenario scores could then be aggregated using a simple weighted summation of scores. Utilising this process establishes a trade-off between criteria which assumes that a certain level of improvement in one criteria would compensate for a certain level of deterioration in another criteria.

4. RESULTS

Zone A

The initial evaluation of the eight scenarios for Zone A made it clear that from almost any point of view (as represented by changing weights), the upper catchment is more suited to conservation than any more economically profitable use. It was also clear that a conservation option adopting different models to those presently used in the lower catchment (i.e. a more community managed or employment intensive

approach) would even further enhance the preference for adopting conservation in the upper catchment, as the low employment offered by these models was the one area in which conservation performed poorly.

Zone B

For the middle of the catchment some increase in permanent and annual irrigation, as well as an expansion of conservation into this zone from Zone C was recommended. Allowance was also made for an increase in residential areas. The benefits of from the expansion of irrigation were in terms of total operating margin and in expansion of formal employment opportunities (indicators of economic growth). However, expansion to the maximum potential of irrigation was not recommended, due to the negative effects on terrestrial and aquatic ecosystems and the relatively low level of informal employment and earnings resulting.

Zone C

For the lower catchment, or Zone C, it was recommended that the land use would remain as it is currently (conservation), but that controlled harvesting of natural products be allowed in certain areas, and that the Manyeleti Game Reserve be community managed. The preferred scenario had 20% of the commercial conservation area available for harvesting, but whether this is actually an optimal level was not explored (lower or higher percentages may prove optimal). This scenario simply serves to show direction in which future policy should move, while further exploration of more detailed scenarios would be able to accurately pinpoint appropriate levels of harvesting. With the high number of land claims on this area, and change in ownership structure may become necessary in order to retain the commercial conservation orientation.

5. HYDROLOGICAL MODELLING

Preliminary simulations were done for some of the scenarios discussed above, but could not be completed for all scenarios, nor include all the required assumptions regarding land-use, domestic demand, etc. The hydrological simulations for the scenarios have implications in terms of two of the constraints to the scenarios and two criteria. The constraints were that the IFR and the projected domestic demand for 2010 should be met, and the criteria were: the catchment water yield and "water equity". The latter criterion referred to the number of people who could potentially have access to specified levels of water once the minimum requirement of the domestic demand was satisfied.

Preliminary indications are that there is potentially adequate water to meet both the IFR and domestic demand, but no conclusion should be drawn from these figures at this stage and further investigation is required. Groundwater availability was not incorporated into the modelling.

6. SUMMARY

The overall picture is thus one of a shift in the upper catchment from forestry to conservation (on about 50% of the presently afforested land and particularly towards a form of conservation which would involve more people than that in the lower catchment). Some expansion of irrigated agriculture and conservation in the middle catchment is acceptable. In the lower catchment of Zone C, conservation is preferable to grazing (apparently the only other land-use possible in this zone). The benefits of conservation should be more widely distributed by changing to community ownership of Manyeleti Game Reserve and allowing limited and well-managed harvesting in conservation areas.

CHAPTER 13: PROPOSAL FOR INSTITUTIONAL ARRANGEMENTS

1. APPROPRIATE MODEL

Chapter 13 discusses the institutional framework for the formation of a CMA (CMA) which would be

responsible for the continued development and management a the proposed Catchment Plan. Initially, this chapter questions the appropriateness of forming a management institution just for the Sand River sub-catchment. Rather, it is recommended that a CMA for the entire Sabie River would be more effective and efficient. The suggested process for achieving this involves initially establishing a Catchment Management Committee (CMC) in terms of Chapter 11 of the National water Bill, which would exist until a feasibility study and stakeholder engagement has been undertaken in the Sabie River sub-catchment. Only at that stage, and for a number of identified reasons, would a CMA for the entire SRC be formed.

2. STEERING COMMITTEE

In the interim, the chapter recommends a restructuring of the Save the Sand steering committee to place decision making in the hands of local stakeholders, with expert input from provincial and national advisors. A range of key issues that the steering committee will need to address are raised.

3. REPORT DISSEMINATION

It is recommended that a number of workshops, aimed particularly at local stakeholders, to discuss in detail the feasibility study for the Save the Sand project and the objectives of ICM, would be held. Following on from this, a Stakeholders Consultative Forum (SCF) would be formed which would allow stakeholders to meet and come to a common understanding of each others needs, the roles and functions of a CMA, and of the legal process required to form a CMA. The potential for ongoing Water and Land Care Committees (WALCs) is also identified.

4. FORMING A CATCHMENT MANAGEMENT AGENCY

In order to form either a CMC, or a CMA, a process is presented in accordance with relevant legislation contained in the National Water Bill (5th draft of 1998). Key aspects of the legislation are presented in Appendix 13.1. It is estimated that it would take up twelve months from submission of the feasibility report till a board of a CMC/CMA holds it's inaugural meeting, and a time plan (Figure 13.3) is provided of the necessary steps. Immediate issues that an incoming board would need to address are raised. The chapter also discusses a system for issuing water extraction permits, financing of the CMC/CMA, and a 'home' for the CMC/CMA. The relationship between a CMA and other water management institutions is shown in Figure 13.1, and a possible internal structure for a CMA is given in Figure 13.2.

5. PUBLIC AWARENESS CAMPAIGN

In conclusion, the chapter raises the need for an information and education programme. The Public Awareness Campaign (PACAM) is discussed as a broad information strategy aimed at both the general public and relevant stakeholders. The objective of the PACAM is to disseminate the contents of the feasibility report and raise awareness about the principles of Landcare and ICM. A number of appropriate publicity tools are mentioned. In addition, an Education and Training Strategy (ETS) is proposed which aim at meeting specific training requirements for identified target audiences. A suitable methodology for determining training needs, appropriate audience, training objectives and key performance indicators is provided.

The key tasks for the Steering Committee, the essential responsibilities of the CMA, the issues to be addressed by the Public Awareness Campaign, and the recommendations for the Education and Training Strategy are dealt with in more detail in the following Chapter.

CHAPTER 14: PROPOSAL FOR A CATCHMENT PLAN FOR THE SAND RIVER CATCHMENT & THE WIDER IMPLICATIONS FOR FUTURE INITIATIVES

This chapter summarises a Proposed Catchment Plan. Major constraints and caveats to information and data are also flagged for consideration within Phase II. Additionally we present an overview of the "lessons learnt" from this process.

1. THE CATCHMENT PLAN

Due to the complex and highly detailed nature of the previous discussions, the proposed Catchment Plan is presented in summary visually, at increasing levels of detail in Figures 14.1 to 14.4 (reproduced here) and in Boxes 14.1 to 14.4.

Figure 14.1 provides the overview and directs the reader to the appropriate follow-up description.
Figure 14.2 summarises major concerns for rehabilitating and sustaining the catchment.
Figure 14.3 summarises detailed and key recommendations for implementing phase II.
Figure 14.4 summarises the different scenarios developed for each zone, and the preferred options.

BOX 14.1 Summarises the responsibilities of the CMA.
BOX 14.2 Defines the Key tasks for the steering committee and /or the CMA.
BOX 14.3 Outlines a proposal for the Public Awareness Campaign (PACAM).
BOX 14.4 Outlines the recommendations for an Education and Training Strategy (ETS).

BOX 1 RESPONSIBILITIES OF A CMA
Points 1 - 13 as indicated in Section 13.3.3,
Preparation of a catchment management strategy to meet the requirements of sections 9 & 10 of the National Water Bill (refer to Appendix 13.1 for details),
Fulfill any powers, functions and duties assigned to it under sections 83 & 84 of the National Water Bill (refer to Appendix 13.1 for details),
Fulfill any powers, functions and duties assigned to it under Schedule IV of the National Water Bill (refer to Appendix 13.1 for details),
Take cognisance of relevant land and water legislation, guidelines and policies to ensure a coherent approach to catchment management,
Promote/coordinate an integrated approach between government employees, community committees, and any other organisations active on water and/or land issues,
Coordinate and support the Water and Land Care Committee (WALC), and consider any recommendations coming from the WALC,
Oversee the implementation of the entire catchment plan, with an emphasis on the issues identified in Chapters 11, 12 & 13 of this report,

Prepare a budget and assist in raising finances for activities not directly related to the management of a CMA. This would include costing for many of the recommendations, such as:
- the Public Awareness Campaign and Education and Training Project,
- the costs of installing water saving technologies in the irrigation and tourism conservation sectors,
- eradication of leakages from existing water supply infrastructure,
- operational expenses of the WALC groups,
- costs of implementing an eradication of invasive alien plants campaign throughout the entire SRSC
- costing for various scenarios

BOX 2
KEY TASKS FOR THE STEERING COMMITTEE AND /OR THE CMA

The first immediate tasks for the steering committee are:

1. Analyse the feasibility report;

2. Discuss membership and, where appropriate, offer positions;

3. Establish steering committee Terms of Reference. This would include meeting procedure and decision making powers; determination of running costs, budget and accounting procedures, and raise finances; anticipated life span of the steering committee;

4. Identify and appoint a coordination /implementation body.

After these steps are completed the steering committee then must:

5. Begin the process of appointing necessary consultants;

6. Disseminate the feasibility report to the broader public (Section 13.3.2.2);

7. Initiate the Public Awareness Campaign;

8. Initiate and supervise the selection of scenarios (for each zone) and the implementation thereof. This will include mechanisms to effect the recommendations in the feasibility report, particularly key recommendations pertaining to changes in land and water use patterns, and in relation to the Education and Training Strategy;

9. Launch the Stakeholders Consultative Forum (SCF, see Section 13.3.4);

10. Initiate contacts with stakeholders and launch a similar process in the Sabie River Catchment;

11. Undertake a management audit of government staff in the forestry, agricultural and conservation sectors (such an audit for the water sector has already been performed);

12. The steering committee should begin to investigate, and if possible initiate implementation, of a water abstraction permitting system, with accompanying tariffs at an appropriate level (see Section 13.3.5);

13. Form the CMC/CMA (see Section 13.4).

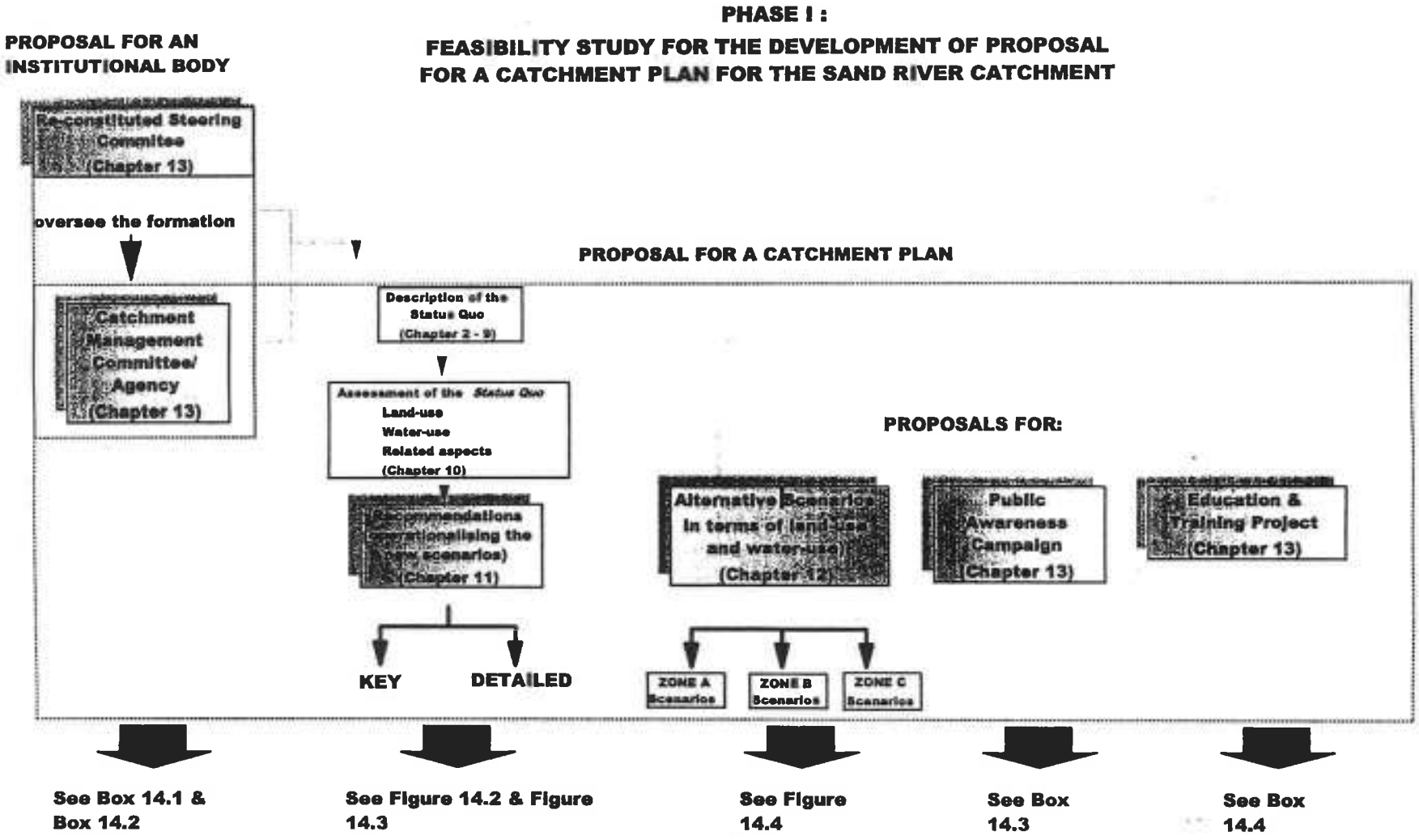

Figure 14.1 Overview of the proposed Catchment Plan: A strategy for the rehabilitation of the Sand River and its sub-catchments employing the principles of *Landcare* and *ICM*

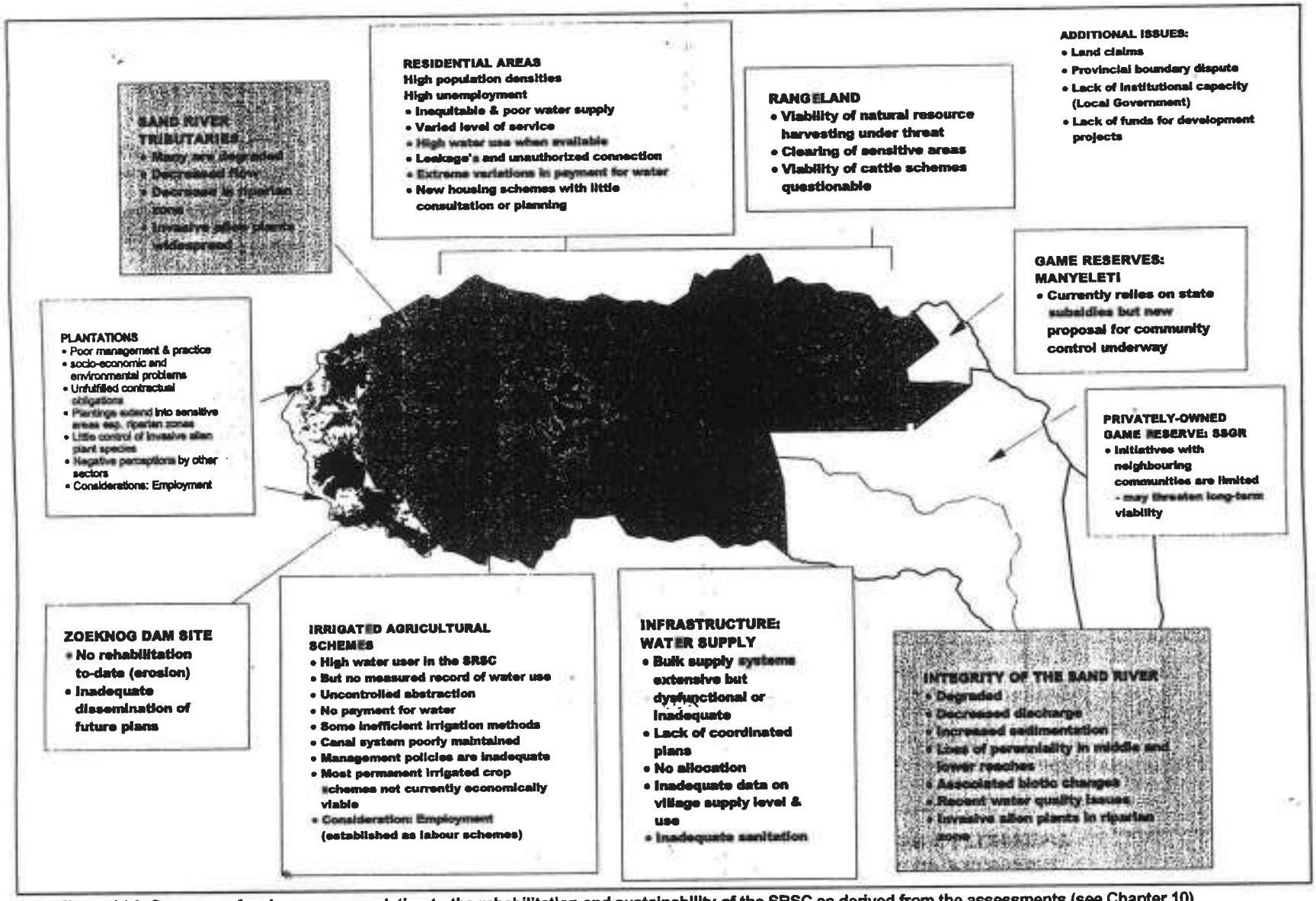

Figure 14.2 Summary of major concerns relating to the rehabilitation and sustainability of the SRSC as derived from the assessments (see Chapter 10)

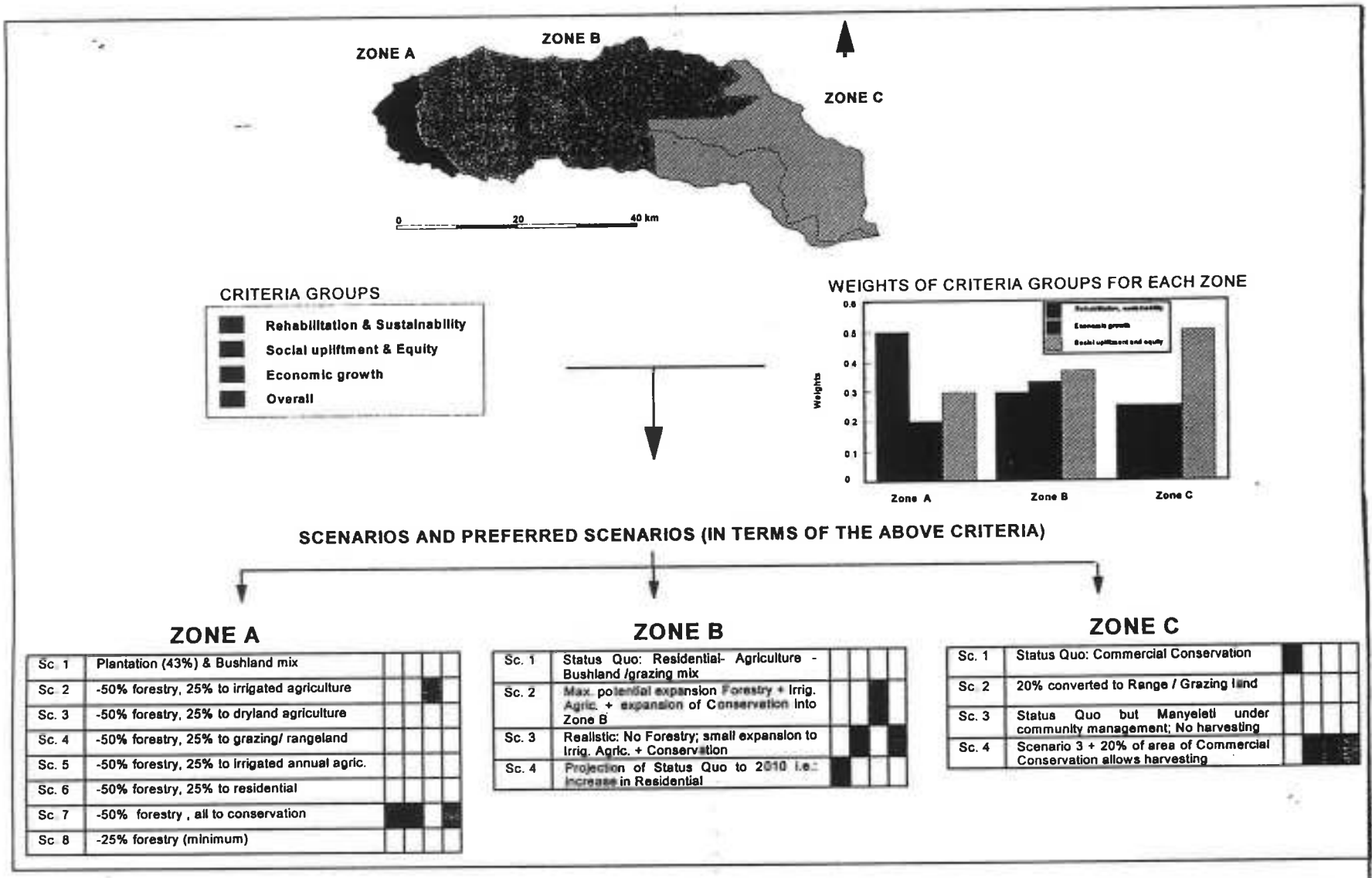

Figure 14.4 Overview of scenarios developed for the three zones of the SRSC and their ratings according to different criteria, as well as the overall preferences

BOX 3
THE PACAM

ISSUES TO ADDRESS	• a lack of knowledge of the recent legislation • a lack of knowledge of the principles of integrated catchment management. • a lack of understanding exists on how each sector uses water, • the roles and functions of the various water management institutions, • how water conservation strategies can lead to equity and reliability of supply. • the need for an allocation system and payment for services.
TOOLS	limited 'leaflet-ing' radio, roadshows, workshops, travelling theatre videos
PHASE 1 Target audience	Oriented at creating a general awareness throughout the broad public Public of the SRSC, including the sectoral users
PHASE TWO Target audience	To provide detailed information on the contents of the feasibility report, and obtain feedback for the report revision. Workshops for key institutional stakeholders and interested and affected parties should be held. Target groups would form the basis of the Stakeholder Consultative Forum (SCF, refer to Section 13.3) and ultimately of a CMC/CMA board.
PHASE THREE Target audience	Same format as outlined in phase one. begins to raise more detail. Campaign to the broader community
PHASE FOUR Target audience	Detailed workshop on the role and functions of a CMA and the legal process to be followed to form one. The Stakeholder Consultative Forum
NATIONAL DISSEMINATION	To promote the concept of catchment management and DWAF's support for it, and to explain experiences and lessons from this national pilot project.
Target audience	DWAF officials, members of other government departments (at all levels), and development activists in the water, land and environment sectors

BOX 4
RECOMMENDATIONS FOR AN ETS

- It is recommended that a detailed ETS should be developed at the start of Phase II (including financing thereof).
- Develop a set of educational issues and training needs identified in the recommendations provided in Chapter 11.
- Forge links with appropriate institutions to implement the ETS.
- As a guideline for the development of a detailed Education and Training Strategy, it is recommended that the following format be adopted. In this regard, a number of topics were addressed as examples within this phase and are presented in Appendix 13.1.
  1. Problem identification;
  2. Description of how the lack of information exacerbates the problem;
  3. Identify the objectives (in relation to the lack of information);
  4. Identify the target audience/s and the means of communication; and
  5. List the objectively verifiable indicators and means of verification.

2. CONSTRAINTS OF THE CATCHMENT PLAN

There were a number of constraints that we faced in providing both the description of the current situation in the SRSC and the assessments. These were:

- Inadequate information on water demand and water use;
- Inconsistencies in hydrological modelling of various scenarios;
- Incomplete analyses of some sectors due to lack of information (particularly financial data);
- Conflicting demographic data;
- Detailed costing to establish the economic value of water for tariffing purposes;
- The lack of institutional capacity, to record and access information, in statutory structures ;
- The development of detailed disincentives and incentives;
- Costs of implementing alternative scenarios.

3. CONSTRAINTS TO IMPLEMENTATION

In addition to the constraints to implementation listed in Chapter 1, a major constraints centres around the statutory support for real integration. Whilst much discussion exists with respect to integration around water resources there is little in terms of guidelines regarding the integration between water and land. Legislation and discussion documents pertaining to ICM relate to water resource management and do not make reference to land-use. Currently, a mechanism for circumventing these limitations and ensuring an integrated approach relies upon due representation of stakeholders on the relevant fora and the goodwill of individuals in decision making positions. Whilst this has been forthcoming for the feasibility study for the Save the Sand project, there is a need to formalise the integration of land and water management as a policy.

3. LESSONS FOR THE DEVELOPMENT OF FUTURE CATCHMENT PLANS

A number of key issues and lessons emanated from this phase. These are discussed particular in terms of similar future initiatives. In summary these are:

- The issue of scale or resolution required must be determined in advance.
- This project benefited enormously from collaborative efforts[1] with other organisations. There was mutual benefit to the participating institutions. However, this is unlikely to be the case in the future implying that the real costs of developing a Catchment Plan are much higher.
- When working Interdisciplinarally sensitivity is needed to make the team functional. The information "trading and dissemination" process required needs to be explicitly stated in the TOR.
- There is no prescriptive or clear-cut method for producing a proposal for a Catchment Plan and the entire process is iterative .Sufficient time needs to be set aside at the start for the development of realistic time frames, so that the team is not put in the unenviable position of producing an incomplete product.
- This project benefited enormously by the involvement of locally-based expertise.
- This achievements of this study were enhanced by the use of a decision-making tool, which instituted objective criteria into a process that can start on fairly subjective grounds.
- Initially, the development of scenarios was confounded by an almost endless list of land-use possibilities. The use of three zones with clearly distinguishable characteristics enabled the relative importance of these determinants to be evaluated consistently.
- Some aspects that were raised during this report reflected the fact that a paradigm shift is needed with regard to their inclusion in management plans. For example traditional economic tools do not deal adequately with the low-level economic activities which are manifest throughout the SRSC. Also the conventional wisdom that informed planning of water supply systems in the past was very urban-biassed, wet-climate appropriate and first world in its approach. The tendency is still

[1]These included the Department of Statistical Sciences at the University of Capetown, the Mpumalanga Working for Water Campaign, the Department of Agricultural Engineering and Computing Centre for Water Research at the University of Natal, the KNP Rivers Research Programme, and the DWAF IFR team.

to rely on "strategies" consisting of massive, capital intensive projects. Ultimately, plans and philosophies applied need to be appropriate in the local context.

- A positive aspect was the support from the private conservation sector which provided funding for this Phase 1 study. Their pro-active initiative can certainly offer a model for future studies of this nature.
- Recommendations regarding changing land-use were facilitated by the fact that much of the land targeted for re-orientation, is state owned. However, in other areas where the land may be under private ownerships, the legal mechanisms for effecting land-use or ownership changes needs to be considered.

4. CONCLUSIONS

This report provides a framework for a Catchment Management model which describes the status quo and makes recommendations on appropriate changes to land- and water-use. Additionally, it flags areas of concern for the implementation phase. As a largely desk-top study and given the time constraints, this study provided as exhaustive an analysis of the topic as possible and identifies areas where more research may be required in the next phase. The success of this phase centres around the importance of input from local expertise, collaborative efforts, interdisciplinarity, the use of decision-making tools and zones for planning purposes, as well as the support of many of the stakeholders. Given that initiatives for ICM are still in their infancy in South Africa, it is hoped that this report will contribute to a willingness to take this process forward locally and both act as a catalyst and assist in the evolution of such endeavours elsewhere.

TABLE OF CONTENTS

14. A PROPOSAL FOR A CATCHMENT PLAN FOR THE SAND RIVER CATCHMENT & THE WIDER IMPLICATIONS FOR FUTURE INITIATIVES 257

SUMMARY LIST OF APPENDICES

ACKNOWLEDGEMENTS

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SUMMARY LIST OF FIGURES

SUMMARY LIST OF TABLES

LIST OF PLATES

tourism market. All these concerns have their own landing strips, supply professional services and charge high rates.

Each reserve is individually managed, although some co-operation and overall strategies exist with regard to conservation. Six farms were interviewed with regard to bush-clearing and alien plant clearing practices. All respondents indicated that bush-clearing had been undertaken in the last five years, with four of the respondents mapping the areas cleared. The common clearing technique was cutting trees (only one respondent indicated poisoning of stumps) although one farm used a slash and burn technique. Reasons for clearing varied included improved game viewing, using brush to pack eroded areas, biodiversity, for internal consumption or sale to neighbouring communities, and to draw in herbivores. Four farms planned to continue with clearing but noted this would be "sporadic", on a "very limited scale", or "if necessary". Only four farms removed alien plants, the other two farms indicating insufficient labour. No farm had a programme for removing alien plants (but see Section 9.1.1.4).

Being within a red-line area, the venison from game culling cannot be exported beyond this line and is hence used for lodge consumption. Some of these lodges extract water from the Sand River for domestic and animal use, while others only extract water for animal use, and use borehole water for domestic use.

Data concerning the operations were obtained from only a few lodges. This was then extrapolated for the total area within the catchment (acknowledging that these are coarse estimations).

4.7.2.3 The Kruger National Park (KNP)

Only a small portion, some 16 971 ha of the total 2.3 million ha of the KNP falls within the SRSC. This reserve is state-owned and falls under the jurisdiction of South Africa National Parks (SANP). There are no camps within this portion of the KNP.

4.8 LAND CLAIMS

The Regional Land Claims Commissioner (Mpumalanga and Northern Province) has indicated that in terms of the Restitution of Land Rights Act (act No. 22 of 1994) restitution claims have been submitted on forty six farms within the SRSC. In some cases more than one claim has been lodged for the same farm. The claims and claimant are indicated in Table 4.4 and farm locations are indicated in Figure 4.6.

Table 4.4
Land claims on farms in the SRSC

Morgenzon 199 KU	Setlhare Community	Phalaborwa, Northern Province
Glenlyden 424 KT	Moletele Community	Pilgrims Rest 2, Mpumalanga
Hebron 461 KT	Mogane Tribe	Pilgrims Rest 2, Mpumalanga
Newington 255 KU	Mhlanganisweni Community	Pilgrims Rest 2, Mpumalanga
Castleton 260 KU	Mhlanganisweni Community	Pilgrims Rest 1, Mpumalanga
Ravenscourt 257 KU	Mhlanganisweni Community	Pilgrims Rest 1, Mpumalanga
Wallingford 256 KU	Mhlanganisweni Community	Pilgrims Rest 1, Mpumalanga
Sparta 259 KU	Mhlanganisweni Community	Pilgrims Rest 1, Mpumalanga
Othawa 242 KU	Mhlanganisweni Community	Pilgrims Rest 1, Mpumalanga
Alicecot 262 KU	Mhlanganisweni Community	Pilgrims Rest 1, Mpumalanga

Malemala 359 KU	Mhlanganisweni Community	Pilgrims Rest 1, Mpumalanga
Marthly 258 KU	Mhlanganisweni Community	Pilgrims Rest 1, Mpumalanga
Exeter 264 KU	Mhlanganisweni Community Setlhare Community	Pilgrims Rest 1, Mpumalanga
Buffelshoek 340 KU	Mnisi Tribal Authority	Pilgrims Rest 1, Mpumalanga
Acornhoek 212 KU	Moletele Community Setlhare Community	Mapulaneng, Northern Province
Buffelshoek 216 KU	Setlhare Community	Mapulaneng, Northern Province
Champagne 230 KU	Mr. J. Nxumalo	Mapulaneng, Northern Province
Maviljan 252 KU	Mr. Busisiwe Shabangu	Mapulaneng, Northern Province
Andover 210 KU	A claim by Meintjies & Jooste has been given in the Government Gazette. Claims have also been received by the the Mnisi Tribal Authority (for the Andover Game Reserve) and the Moletele Community.	Mhala, Northern Province
Leamington 207 KU	A claim by Meintjies & Jooste has been given in the Government Gazette. Claims have also been lodged by the Mnisi Tribal Authority (for the Andover Game Reserve), Moletele Community and the Setlhare Community.	Mhala, Northern Province
Okkerneutboom 211 KU	Moletele Community Setlhare Community	Mhala, Northern Province
Welverdiend 206 KU	Moletele Community Setlhare Community	Mhala, Northern Province
Ludlow 227 KU	Setlhare Community	Mhala, Northern Province
Burlington 217 KU	Setlhare Community	Mhala, Northern Province
New Forest 234 KU	Setlhare Community	Mhala, Northern Province
Rolle 235 KU	Setlhare Community	Mhala, Northern Province
Allandale 237 KU	Setlhare Community	Mhala, Northern Province
Athol 238 KU	Setlhare Community	Mhala, Northern Province
Albatross 201 KU	Mnisi Tribal Authority	Mhala, Northern Province
Middel-In 202 KU	Mnisi Tribal Authority	Mhala, Northern Province
Hermitage 205 KU	Mnisi Tribal Authority	Mhala, Northern Province
Jeukpeulhoek 222 KU	Mnisi Tribal Authority Setlhare Community	Mhala, Northern Province
Islington 219 KU	Setlhare Community	Mhala, Northern Province
Edinburg 228 KU	Setlhare Community	Mhala, Northern Province
Arthurs Stone 247 KU	Setlhare Community	Mhala, Northern Province
Pebble Stream 246 KU	Setlhare Community	Mhala, Northern Province
Dumphries 245 KU	Setlhare Community	Mhala, Northern Province
Sarabank 323 KU	Mnisi Tribal Authority	Mhala, Northern Province
Dixie 240 KU	Mnisi Tribal Authority	Mhala, Northern Province
Thorndale 223 KU	Mnisi Tribal Authority	Mhala, Northern Province

Clare 220 KU	Moletele Community Setlhare Community	Mhala, Northern Province
Eglington 225 KU	Setlhare Community	Mhala, Northern Province
Newington 255 KU	Setlhare Community	Mhala, Northern Province
Agincourt 254 KU	Setlhare Community	Mhala, Northern Province
Xanthia 253 KU	Setlhare Community	Mhala, Northern Province
Utha 239 KU	Setlhare Community	Mhala, Northern Province

It should be noted that claims can continue to be lodged until 31 December 1998. It is also possible that a claim may be accepted for processing and that the legitimate beneficiary may be determined to be different to the initial claimant. It is uncertain which of these claims has been registered. Discussions with the commission have indicated the complexity and potential volatility of land restitution claims, and of planning changes to land use patterns without full negotiation with all stakeholders. The commission has offered assistance with facilitation and negotiation on these issues and can be contacted at:

The Commissioner, Mrs Gilfillan
Regional Land Claims Commission
P. Bag X 02
Arcadia 0007
Tel: 012 325 5261
Fax: 012 321 9694