THE ENVIRONMENTAL IMPACTS OF UPGRADING THE OLUSHANDJA DAM NORTHERN NAMIBIA

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SYNOPSIS

INTRODUCTION

The purpose of this dissertation is to assess and evaluate various water level management options for the upgrading of Olushandja Dam in northern Namibia (Figure 1.1) within the framework of the environmental impact assessment carried out for the project. This will enable the Namibian Department of Water Affairs (DWA) to improve their management of the dam for the benefit of the local communities and consumers in the Oshana Water Region (Figure 5.1).

The dam has been in existence since 1975 and is part of the Calueque-Olushandja inter-basin water transfer scheme. A pipeline and a series of canals links Calueque Dam, on the Cunene River in Angola, with Olushandja Dam in Namibia and the urban areas to the east and south. In order to provide for the expected increase in water requirements from agricultural and rural development the scheme is presently being upgraded.

An environmental impact assessment (EIA) was initiated in 1994 by the DWA as a requirement of the Dutch Government who are funding the project. Biophysical studies were undertaken by staff from the DWA and private consultants from Windhoek.

The socio-economic study was carried out by a study team from the Department of Environmental and Geographical Science, University of Cape Town, in association with a consultant from the University's Environmental Evaluation Unit (EEU). The EEU was appointed to compile a full EIA based on the findings of the specialist reports. This report is expected to be completed by October 1995.

THEORETICAL APPROACH

The Olushandja EIA planning process is based on the South African Integrated Environmental Procedure (IEM) and Namibia's Environmental Assessment Policy. To date, the success of conducting social impact assessments (SIA) similar to the Olushandja study for development projects in Africa, has been limited. In most cases this is due to a lack of commitment by the authorities to involve the public in the EIA process from the start. The communities are often consulted once the objectives and alternatives of the EIA have been decided and there is little scope for the interested and affected parties to modify them.

Researchers believe that in order for EIA's to work in developing countries new methods appropriate to local conditions need to be developed. Work has been done in the fields of rapid rural appraisal and participatory rural appraisal to improve the SIA planning process. Components of these two methods were used in the Olushandja SIA which formed part of the full EIA.

During the last three years the Directorate of Environmental Affairs in Namibia has developed an environmental assessment policy. This policy outlines the approach proponents should take in carrying out an impact assessment. In support of this policy document the South African Integrated Environmental Procedure was used to provide a framework on which to undertake the Olushandja SIA.

Unfortunately the communities in the study area had not been involved in the EIA planning cycle prior to the first site visit by the University of Cape Town (UCT) study team. This emphasises the need for early participation in the project planning by the affected parties. The upgrading of the infrastructure at Calueque and Olushandja Dams was already in progress by December 1994 when the specialist consultants were employed. This was a major limiting factor. However, the UCT study team were allowed to modify their terms of reference to take into account limiting factors such as this. This flexibility enabled the SIA methodology to be refined and altered during the course of the study.

WATER RESOURCES

The management of water resources in northern Namibia is critical to the development of the region. At present the only source of permanent bulk surface water is that obtained from the perennial Cunene River and transferred to Olushandja Dam (Figure 2.1). In the rural areas water pipelines branch from the bulk feeder canals to the smaller growth points and rural water distribution points.

The presence of drinkable groundwater is limited to the area west of Olushandja Dam where boreholes have been drilled for livestock use. Communities that do not have access to potable water in the dry season use hand dug wells.

The distribution of bulk and rural water supply is the responsibility of the DWA. In order to improve the management of bulk water supplies in Namibia the government is establishing the Namibia Water Corporation (NWC) to take over the bulk water supply function. The distribution of water to the rural areas will remain the responsibility of the Directorate of Rural Water Supply.

The creation of the NWC is likely to have an impact on the operation of Olushandja Dam as the new pricing system will mean that the NWC will have to charge the present water users of the dam and canals or receive income from the government in the form of consumer subsidies.

One of the major problems presently facing the Namibian Government is that of land degradation in the environmentally sensitive regions of northern Namibia. The high population pressure and shortage of suitable grazing land are issues that need to be addressed as part of the development planning for the Oshana Water Region. The environmental aspects of the water supply network are closely linked to the problems of human settlement planning and grazing management. Facilities such as Olushandja Dam and livestock watering points on pipelines need to be incorporated into an integrated development plan for the region.

METHODOLOGY

The main part of the EIA was the socio-economic study undertaken by the UCT study team. A site visit was made in January 1995 to familiarise the team members with the study area and to consult with various organisations working in the region. Their terms of reference were refined based on the first site visit.

A literature review; consultations with interested and affected parties and site interviews were undertaken during the second field trip during March. In addition to household interviews key informants such as headmen and school teachers were asked for their views on various aspects of Olushandja Dam. A community meeting was held towards the end of the second site visit to inform the community of the study team's progress and to find out what the community perceived to be major issues.

The significant findings were that the dam was mainly used by the people living within 2,5 km from the shore to obtain water for domestic and livestock use. During the dry season people on the eastern side of the dam relied on the dam water mainly for livestock use. Health was an important issue with a high incidence of malaria and bilharzia in the communities. Other issues included the lack of a suitable bridge across the centre of the dam, water supply to schools and clinics and the request for a new clinic to the west of the dam.

Five biophysical studies were conducted by government departments and private consultants during the period January to May 1995. These covered limnology; freshwater fish; freshwater snails; aquatic and terrestrial plants and groundwater. The findings from these reports indicated that the major impacts of the scheme would be: the high abstraction rate from the Cunene River; the migration of fish from the Cuvelai System to the Cunene River via the canals; the inundation of plant communities with a rise in water level in Olushandja Dam; an increase in waterborne diseases and the long term deterioration in water quality.

Five water level management alternatives were assessed and evaluated to meet the requirements of the terms of reference for the socio-economic study. These were: full supply level; present level; dead storage level; fluctuating level and no dam. The five scenarios were chosen to cover all the options currently available to the DWA. Based on the findings of the biophysical and socio-economic studies a set of environmental components were chosen against which the alternatives were assessed. Management requirements of the DWA were included.

A series of evaluation summary frameworks were drawn up to provide a means of assessing the magnitude and significance of each resulting impact on the various interest groups. From these tables two alternatives were selected by evaluating the highly significant impacts of each alternative. In the evaluation decision framework the two alternatives, full supply level and present level, were compared and the scenario with the least significant impacts was selected.

PREFERRED ALTERNATIVE

In the final evaluation the significant impacts considered were: health; water abstraction from the Cunene River; security of supply and storage; quantity of water lost through evaporation and pumping cost; flooding of land and water quality. The adoption of the full supply scenario would mean the flooding of buildings, pasture and land utilised for crops. This would result in the resettlement of people and the issue of compensation. A small number of protected terrestrial plant species would be affected and need to be relocated. The issues of evaporation, health, fish, water quality and new habitats for aquatic flora would also need to be addressed.

The preferred alternative is: **scenario 2, present level**. In this case only the five impacts of health; water abstraction from the Cunene River; storage; evaporation and water quality would need to be mitigated (Tables 8.1 & 8.2). This alternative is seen to be in the best interests of both the present water authority, the DWA and the communities living within the study area.

ENVIRONMENTAL MANAGEMENT PLAN

In order to manage Olushandja Dam successfully an environmental management plan (EMP) is proposed. This plan would cover the three programmes of mitigation, monitoring and auditing.

The mitigation measures include the installation of additional water pipelines around the perimeter of the dam to reduce the dependence of the community on the dam. This would help in reducing human and livestock contact with the water thus decreasing the incidence of waterborne diseases. An investigation should be carried out to determine the cost effectiveness of providing alternate covered storage facilities along the canal network. The water level in Olushandja Dam could then be reduced with a corresponding saving in the quantity of water lost through evaporation. By completing Calueque Dam the storage and security of supply problems would be reduced. This would allow the option of releasing water down the Cunene River during the dry season to avoid adverse impacts on the aquatic flora and fauna below Calueque Dam.

As part of the monitoring programme regular water quality studies should be conducted to identify an increase in salinity or bacteria levels. Periodic tests should be carried out to determine the number of people infected with bilharzia. Target dates should be set for obtaining funds to implement the EIA for Calueque Dam and to complete the construction. As with the mitigation programme the local communities should be invited to take part in the monitoring programme.

The environmental impact audit programme should assess how effective the mitigation measures are and whether the frequency and level of monitoring is sufficient. The audit will provide feedback to the NWC on the success of the EIA and what improvements can be made to similar studies in the future. The Directorate of Environmental Affairs should be involved in advising on the structure and timing of the first and subsequent audits.

As part of the EMP a Olushandja Dam user group should be set up comprising representatives of the local communities, the NWC and the DWA. This committee would be involved in the setting up of the monitoring and auditing programmes that follow the mitigation programme. It is important that the management of the NWC is committed to the EMP and the various programmes. These should be carried out in consultation with the Directorate of Environmental Affairs.

CONCLUSIONS

This dissertation assessed and evaluated the impacts of five proposed water management strategies for Olushandja Dam. The magnitude and significance of each impact were determined based on the baseline information provided by the five biophysical studies and the socio-economic study.

TABLE 8.1	EVALUATION DECISION FRAMEWORK - INTEREST GROUPS 1, 3 & 4			
INTEREST GROUP	ENVIRONMENTAL COMPONENT	ASPECT	WATER LEVEL MANAGEMENT SCENARIOS	
			FULL SUPPLY LEVEL	PRESENT LEVEL
GROUPS 1,3 & 4: People living in ZONES A, B & C	SURFACE WATER	HEALTH Malaria Bilharzia	Impact: negative Increased contact Signifance: high	Impact: negative Contact taking place Signifance: high ●
	LAND	BUILDINGS	Impact: negative Buildings may be flooded Signifance: high	Impact: none No change Signifance: N/A
		CROPS	Impact: negative 28 fields flooded Signifance: high	Impact: none No change Signifance: N/A
	TREES	FIREWOOD	Impact: negative Woodland flooded Signifance: high	Impact: none No change Signifance: N/A
		BUILDING MATERIAL	Impact: negative Woodland flooded Signifance: high	Impact: none No change Signifance: N/A
	TERRESTRIAL PLANTS	HABITAT	Impact: negative Loss of protective plant species Signifance: high	Impact: none No change Signifance: N/A
	FRESH WATER FISH	CUNENE WATER ABSTRACTION	Impact: negative Reduced flow in Cunene below Calueque Signifance: high	Impact: negative Reduced flow in Cunene below Calueque Signifance: high ●
	LIMNOLOGY	NUTRIENT LOAD	Impact: negative Increase in the short term Signifance: high	Impact: negative Increase in the long term Signifance: moderate

KEY

Preferred alternative

● Impacts requiring mitigation

TABLE 8.2	EVALUATION DECISION FRAMEWORK - INTEREST GROUP 2			
INTEREST GROUP	ENVIRONMENTAL COMPONENT	ASPECT	WATER LEVEL MANAGEMENT SCENARIOS	
			FULL SUPPLY LEVEL	PRESENT LEVEL
GROUP 2: DWA and consumers in the Oshana Water Region	STORAGE	SECURITY	Impact: positive 2,7 months supply Signifance: high	Impact: negative 0,7 months supply Signifance: high ●
		PEAK DEMAND	Impact: positive Can meet long term demand Signifance: high	Impact: negative Can meet short term demand Signifance: high ●
	EVAPORATION	QUANTITY	Impact: negative 3,8 Mm^3 per month Signifance: high	Impact: negative 2,0 Mm^3 per month Signifance: high ●
		COST	Impact: negative High pumping cost at Calueque Signifance: high	Impact: negative Moderate pumping cost Signifance: high ●
	RESERVOIR MANAGEMENT	WATER QUALITY	Impact: positive Short term improvement Signifance: high	Impact: negative Long term deterioration Signifance: high ●
		ALTERNATE RESOURCES TO BE PROVIDED	Impact: negative Land and compensation Signifance: high	Impact: none No change Signifance: N/A

The evaluation of the five alternatives concluded that scenario 2, present level, is the preferred alternative in terms of minimising impacts on the people living along the perimeter of the dam. This scenario would provide sufficient security of supply for the consumers in the Oshana Water Region until a more cost effective solution can be provided.

The impacts resulting from the adoption of scenario 2 need to be mitigated. Mitigation measures are included in a proposed environmental management plan for the dam. Monitoring and audit programmes are recommended with the Namibia Water Corporation forming a partnership with the local community and the Directorate of Environmental Affairs to implement the three programmes.

RECOMMENDATIONS

In order to minimise the water level fluctuations and reduce the dependence of the community on the dam the following actions should be taken:

1. The NWC should continue to manage the water level in Olushandja Dam at the present level.

2. The environmental management plan should be accepted and implemented by the NWC.

3. The NWC should encourage the development of new water supply distribution networks within the study area to reduce the dependence of the communities on the dam.

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ABBREVIATIONS

DEA	Department of Environmental Affairs - South Africa
DDGIC	Dutch Directorate General for International Co-operation
DSL	Dead storage level
DWA	Department of Water Affairs - Namibia
EA	Environmental assessment
EEU	Environmental Evaluation Unit
EIA	Environmental impact assessment
EMP	Environmental management plan
ENGEO	Department of Environmental and Geographical Science, UCT
FSL	Full supply level
ha	Hectare
IEM	Integrated Environment Management
km	Kilometre
km^2	Square kilometre
NDEA	Directorate of Environmental Affairs - Namibia
NWC	Namibia Water Corporation
m	Metre
mm	Millimetre
m^3/s	Cubic metres per second
Mm^3	Million cubic meters
m.a.s.l	Metres above sea level
SIA	Social impact assessment
SWAWEK	South West African Water and Electricity Commission
UCT	University of Cape Town

1 INTRODUCTION

1.1 MASTER OF PHILOSOPHY DEGREE IN ENVIRONMENTAL SCIENCE, UCT.

This dissertation forms part of the academic requirements of the master of philosophy degree in environmental science which involves seventeen months of theoretical and practical work.

The academic portion of the programme consists of nine months of course work covering a broad range of social and biophysical disciplines relevant to environmental concerns. The programme is split into discipline specific and inter-disciplinary courses with the emphasis being placed on the theory and practice of environmental impact assessment and the relevance of the discipline to the development of southern Africa.

From November to June a research project is undertaken to provide practical experience in the application of environmental impact assessment methodologies to real life issues in environmental planning and management. The project is supervised by members of staff from the Department of Environmental and Geographical Science (ENGEO) and the Environmental Evaluation Unit (EEU), the Department's consulting group. During the first five months, six masters students forming the Namibian Masters project team worked together to produce a socio-economic baseline report for the EEU's client, the Namibian Department of Water Affairs (DWA). The remaining three months were spent writing individual dissertations based on the baseline and other specialist reports.

1.2 TERMS OF REFERENCE FOR THE DISSERTATION

The terms of reference for the dissertation were provided by the Department of Environmental and Geographical Science. Unlike a consultants report, the individual dissertation should:

- Review the relevant literature
- Develop the theoretical basis for the study
- Critically assess the study plan in terms of the requirements of EIA/IEM
- Demonstrate an adequate grasp of principles and techniques for analysing, evaluating and presenting information appropriate to the project in question
- Consist of a logical and coherent account of the project.

1.3 APPROACH AND AIM OF THE DISSERTATION

This dissertation looks at the environmental impact assessment (EIA) planning process undertaken by the DWA in parallel with their engineering upgrading programme for Olushandja Dam. This dam is an existing pumped storage reservoir situated in the Omusati Region, east of Ruacana in northern Namibia (Figures 1.1 & 1.2).

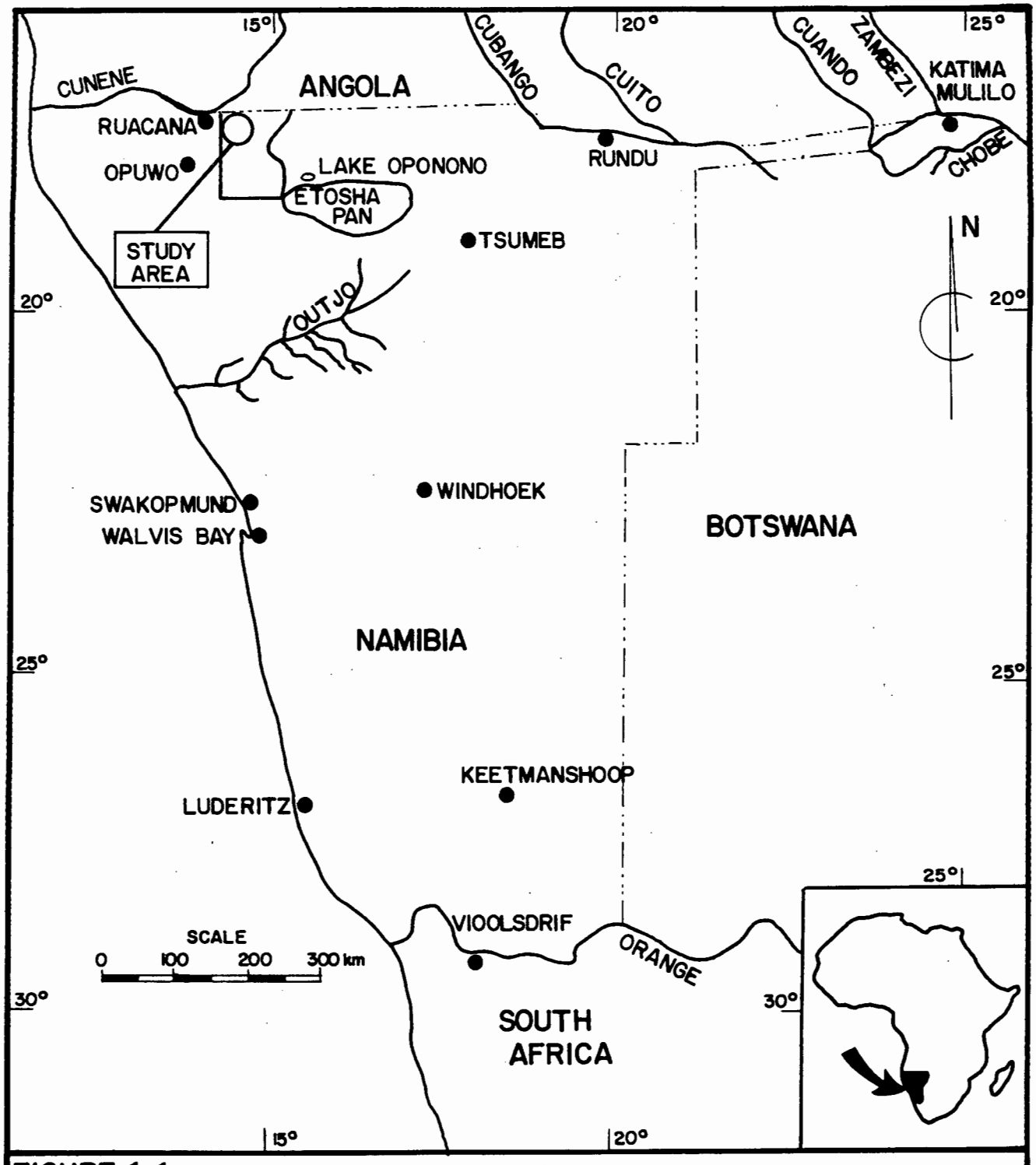


FIGURE 1.1

LOCALITY MAP

The implementation of the project's EIA is assessed in terms of the requirements of Namibian and South African environmental assessment policies. In addition to the social impact assessment (SIA), five biophysical studies were carried out as part of the EIA. They include studies on: limnology; fresh water fish; fresh water snails; aquatic plants and groundwater. These five reports plus the SIA are used as a base from which an environmental management plan is developed.

The development of a project such as Olushandja Dam cannot be seen in isolation to the use and sustainability of the other natural resources found within the Omusati Region (Figure 1.3). **The primary aim of this dissertation is to examine five scenarios for the management of Olushandja Dam in the light of the importance of water resources in the development of an arid country such as Namibia.**

1.4 SCOPE AND LIMITATIONS

The background information for this dissertation was obtained from a literature review of recent trends in the development of environmental impact assessment and a review of case studies involving the assessment of water development projects in Africa. The social impact assessment baseline report and the five biophysical reports were used to identify significant environmental components related to the present operation of Olushandja Dam and possible impacts of the various scenarios on these components. Although the SIA forms the main part of the overall EIA, the recommendations given are based on the findings of all the specialist reports and the results of the various interviews conducted.

The main limitation was the lack of information from the Department of Water Affairs on the structure of their EIA for the project and the future operation policy on water supply to northern Namibia. Secondly, the timing of the project was such that the final specialist reports were not available by the end of May. As a result there may be recommendations made by the specialists in the final EIA that were not available at the time that this dissertation was written.

1.5 STRUCTURE OF THE DISSERTATION

This dissertation consists of five sections. In the first section a background to the project, describing the various infrastructure components and the reasons for the upgrading of the inter-basin transfer scheme, will be provided. A review is undertaken, in the second section, of the theoretical background to the EIA planning process and the various methodologies currently available to EIA practitioners. In the third section the present situation regarding water resources in northern Namibia (Figure 1.2) with the associated environmental impacts that inadequate planning can have are discussed. The existing and future administrative structures of the water supply authorities are given.

Summaries of the specialist reports are provided in the fourth part with their key findings highlighted. Based on these findings five water management scenarios are evaluated for Olushandja Dam and a preferred option chosen. The last section develops an environmental management plan that includes recommendations for the three programmes of mitigation, monitoring and auditing.

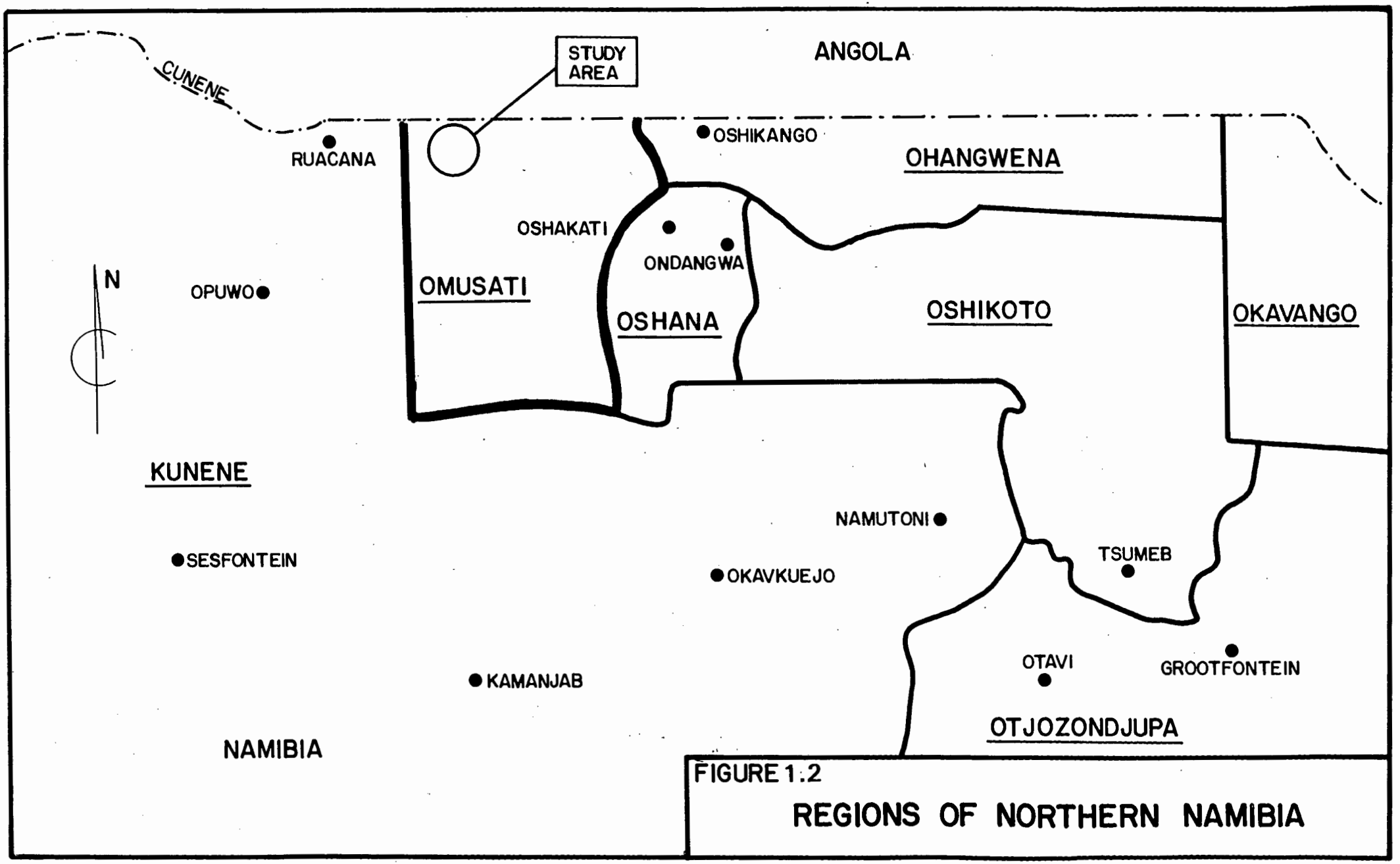


FIGURE 1.2

REGIONS OF NORTHERN NAMIBIA

ANGOLA

RUACANA

OKALONGO

OMBALANTU

OLUSHANDJA DAM

OHANGWENA

92

1/11

67

OGONGO

STUDY AREA

TSANDI

OSHAKATI

92

OKAHAO

ONDANGWA

OSHIKOTO

1/11

KAMANJAB

TSUMEB

OPUWO

N

KUNENE

OMUSATI

OSHANA

LEGEND

INTERNATIONAL BORDER

67 MAIN ROADS

0 SCALE 50km

NAMIBIA

FIGURE 1.3

OMUSATI REGION

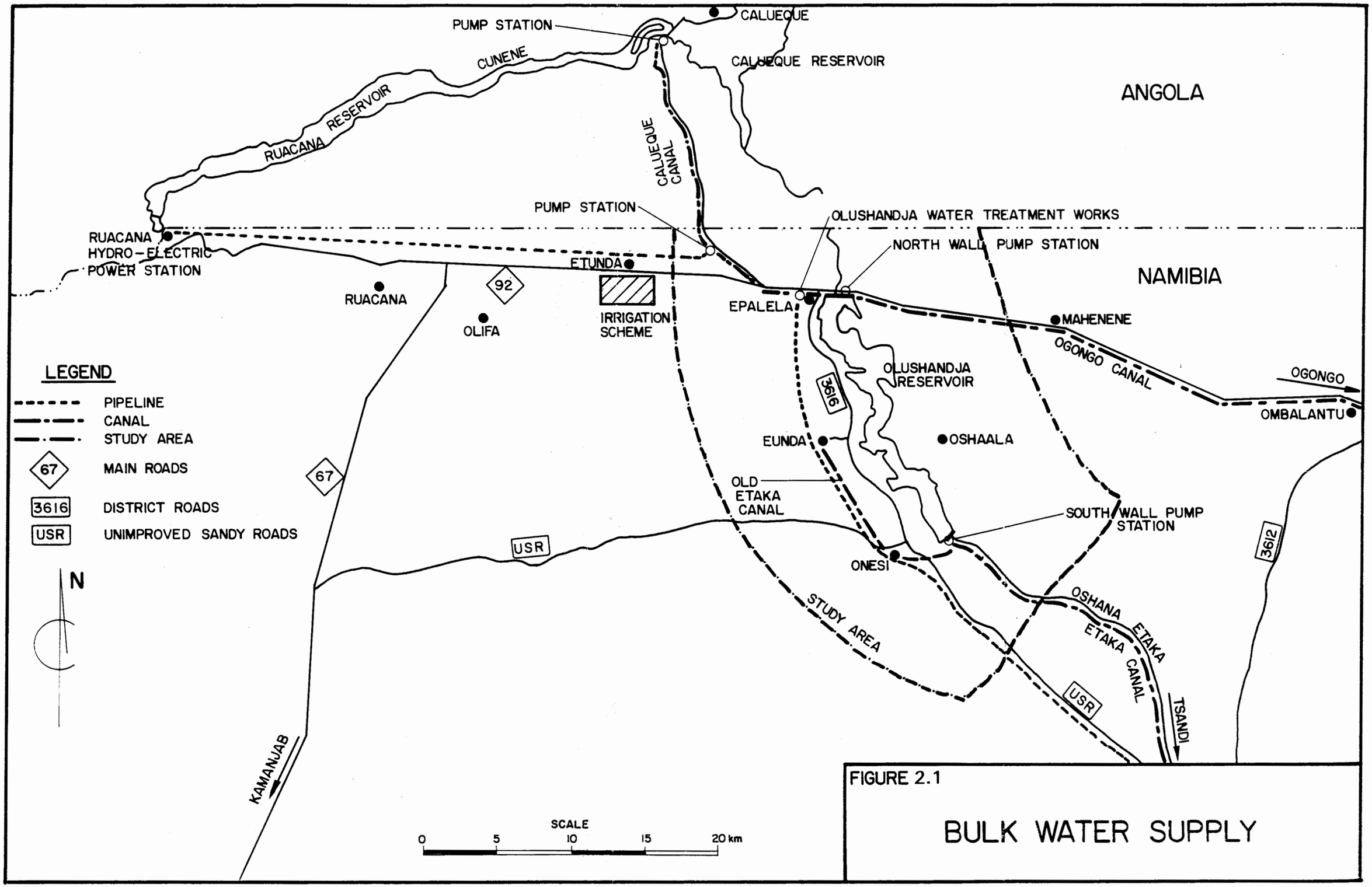


FIGURE 2.1

BULK WATER SUPPLY

This chapter describes the present infrastructure and operation strategy for the Calueque Phase II project as at March 1995; the proposed upgrading of the Calueque and Olushandja Dams; the necessity for an EIA and the administrative, legal and policy requirements for the Olushandja Dam EIA.

2.2 PRESENT INFRASTRUCTURE AND OPERATION STRATEGY

The present infrastructure of the Calueque-Olushandja water transfer scheme consists of a number of components. Some of these components have been upgraded since independence in 1990 while the remainder will be upgraded as water demand increases during the next few years. The various components are described below along with the present operation strategy (Figures 2.1 & 2.2).

2.2.1 Calueque Dam

Calueque Dam consists of three sections. A southern earth embankment, a central concrete spillway incorporating the pump station, and a partially completed northern earth embankment. Owing to bombing during the war, prior to independence, the central concrete section is damaged and the vertical steel gates and radial gates are not operational. There is presently no storage behind the dam. The pumps rely on water supplied via a skimming weir and approach channel on the left bank of the river, constructed as stage 1 in 1970 (Figure 7.1).

The pump station at Calueque Dam consists of two pump sets each with a capacity of 2,0 m^3/s. However, the availability of an adequate quantity of water to the pumps during periods of low river flow is governed by the height of the skimming weir and the condition of the approach channel (LUND, 1992).

2.2.2 Calueque Dam to Olushandja Dam

A 2,4 km, 1600 mm diameter steel pipeline links the Calueque pump station with the concrete lined canal which starts 12 km north of the Angolan-Namibian border. The canal capacity of the first section, to a point just south of the border where there is provision for a bifurcation, is 10 m^3/s. A couple of hundred metres further downstream is a new pump station with an abstraction capacity of 1,2 m^3/s. This supplies the Etunda irrigation scheme to the west of the canal. The remaining canal to Olushandja Dam is designed to carry 6 m^3/s.

From the border to Olushandja Dam (9,5 km) the canal lining consists of precast concrete slabs. In response to problems with the lining over this second section a new 6 m^3/s canal is being constructed parallel to the original canal from the Etunda pump station to the main Ruacana-Mahanene road.

2.2.3 Olushandja Dam

Olushandja Dam consists of two earth embankments situated 18 km apart forming a reservoir in the natural Oshana Etaka which runs from the border south towards the Etosha Basin. The maximum water level at a full supply level (FSL) of 1106 m is 3,5 m, with a capacity of 42,3 x 10^6 m^3. The corresponding surface area is 26,6 km^2.

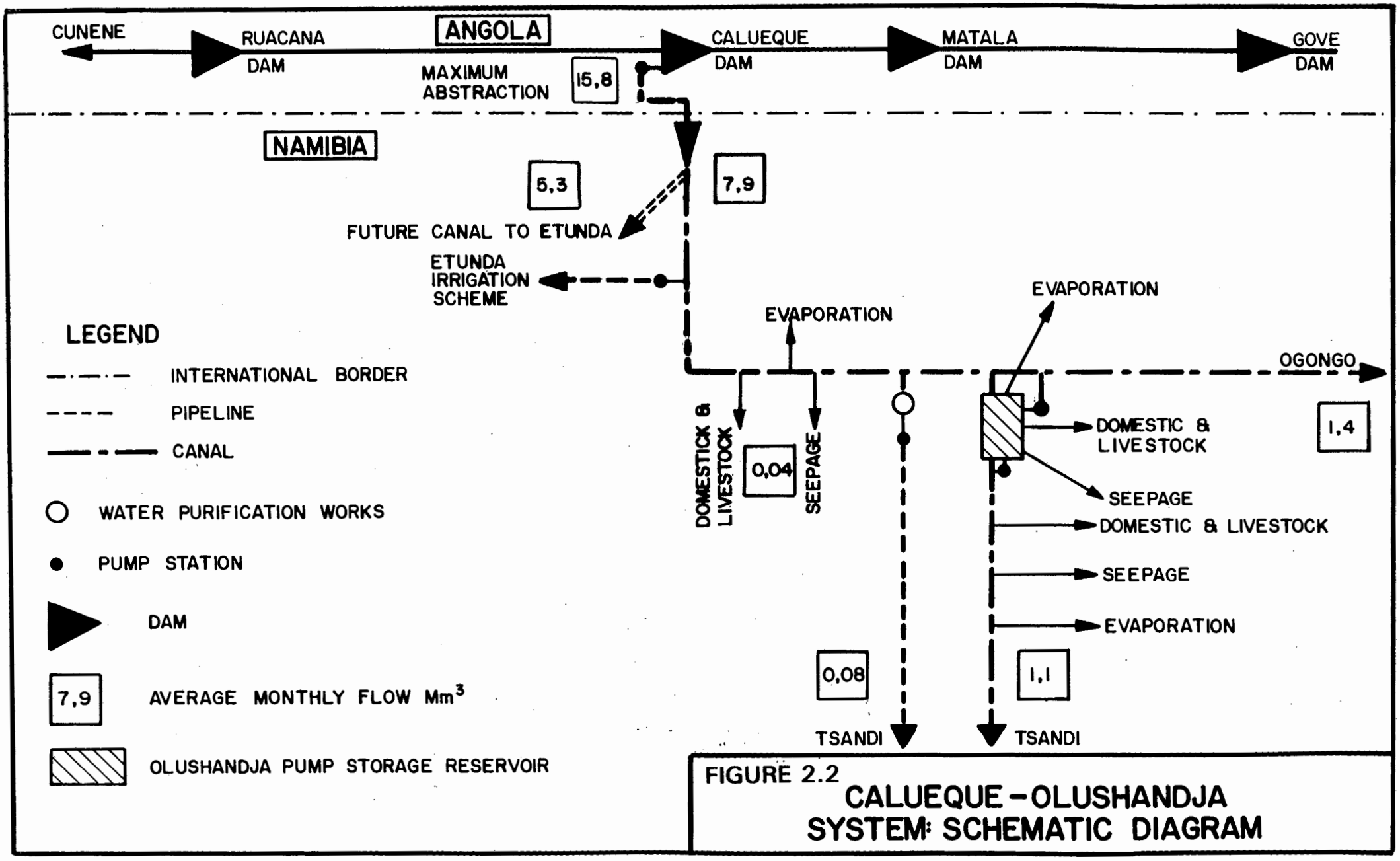


FIGURE 2.2

CALUEQUE-OLUSHANDJA SYSTEM: SCHEMATIC DIAGRAM

On the eastern side of the northern embankment lies the concrete lined Ogongo canal with a capacity of 3,2 m^3/s. A 2200 mm diameter concrete inverted syphon connects the Calueque-Olushandja canal with the Olushandja-Ogongo canal. During 1994 the pump station located on the northern embankment was repaired, having suffered damage during the war.

Two pump sets were installed, each pump having a capacity of 0,75 m^3/s. The Ogongo canal can thus be supplied directly from the Calueque-Olushandja canal or from the dam via the pump station. A gate on the inverted syphon allows for the full 6 m^3/s to be fed into Olushandja Dam if required.

The southern earth embankment consists of two concrete structures containing steel gates. In the centre is a set of radial gates from which water can be released directly into the Oshana Etaka or diverted into the unlined Etaka canal to Tsandi. At the western end of the embankment is a pump station with two submersible pumps each with a capacity of 0,4 m^3/s. Two steel gates allow water to be released into the Etaka canal provided the level of the dam is higher than the invert level of the canal. The Etaka canal has a capacity of 1 m^3/s.

2.2.4 Olushandja water purification works

The Olushandja water purification works is situated next to the Calueque-Olushandja canal just west of the Olushandja Dam. The current abstraction rate of the plant is 0,03 m^3/s. The purification works is linked via Eunda and Tsandi to Okahau with a 74 km pipeline ranging in diameter from 250 to 300 mm.

In the event that the Calueque-Olushandja canal has to be closed for repairs or there is a problem with supplying water from the Calueque pump station, water is pumped from Olushandja Dam to the purification works. This scheme consists of a temporary pump set at the northern embankment and a temporary pipeline to the purification works.

2.2.5 Present operation strategy

During the period February 1991 to February 1995 the volume of Olushandja Dam has been kept at between 20 and 35% of full capacity (DWA, 1995). This decision is based on the current demand of the Etaka canal (1 m^3/s), the Ogongo canal (3,2 m^3/s) and the evaporation rate for the dam which is estimated to be 1,7 metres per year (LUND, 1992).

At present there is no management plan for the operation of Olushandja Dam besides the requirement to keep the southern and eastern canals supplied with water. The dam is not fenced and the Department of Water Affairs is not involved in any programme to educate the communities living around the dam on the best way to use the water resource.

2.3 The upgrading of Calueque and Olushandja Dams

In order to improve the surety of water supply to northern Namibia (95% at 5,5 m^3/s) at the maximum extraction rate of 6 m^3/s from the Cunene River, certain components of the scheme need to be completed (Figure 2.2).

2.3.1 Calueque Dam wall

In their planning report presented to the Department of Water Affairs in 1992 LUND Consulting Engineers (LUND, 1992) identified the following (Figure 2.1) as the main components of Calueque Dam still outstanding:

- Completion of the northern embankment
- Completion of all the hydraulic steelworks including electrical installations and standby diesel generator
- Completion of the north upstream flank wall
- Repairs to the various components that have been damaged on the concrete section
- Enclosure to the new pump station and outlet works.

These measures will allow the impoundment of up to 35 million m^3 of water in the dam.

2.3.2 Calueque pump station

In early 1996 the existing motors will be removed at the pump station and larger units installed. This will increase the capacity of each pump set from 2,0 m^3/s to 3,0 m^3/s. Once both pump sets have been tested they may be removed and replaced with the existing sets until such time as the water demand in Namibia rises. (Haussler, pers. comm., 1995). The anticipated demands on the Calueque-Olushandja system are shown in Figure 2.2. This scenario is based on a nominal pumping rate of 3,0 m^3/s or 7,9 Mm^3 per month from Calueque Dam. A feasibility study to supply Etunda irrigation scheme with ultimately 2 m^3/s is presently being carried out. This leaves 1 m^3/s for distribution to Ogongo and Tsandi.

2.3.3 Calueque to Olushandja canal

The repairs and the construction of the new section of canal between the border and Olushandja Dam are expected to be completed during 1995. These repairs will allow the full 6 m^3/s to be carried by the canal.

2.3.4 Olushandja Dam

The installation of the new pump sets, electrical components and building repairs are due for completion during 1995.

2.4 THE NECESSITY FOR AN EIA

The environmental impact assessment for Olushandja Dam was initiated by the DWA in 1994 in response to a request by the Netherlands, the country funding the project (Figure 7.1). It is important to note that the original Olushandja Dam project was executed at a time when there was generally very little awareness about the impact of water resources development projects on the social and biophysical environments of northern Namibia. As part of their EIA planning a number of aims were identified by the DWA:

- To describe the existing environment which will be affected by the various water management scenarios
- To investigate, identify, evaluate and report on the impacts which the upgrading of Olushandja Dam will have on the surrounding environment
- To propose reservoir management alternatives to mitigate the negative effects and optimise the positive benefits
- To propose a cost effective monitoring programme to facilitate effective implementation of mitigatory actions.

In 1990, soon after Namibia became independent, the Netherlands entered into a co-operation agreement with the Namibian government. Under this agreement the Netherlands would provide development aid for the upgrading of rural water supply and the improvement of education facilities.

In 1991 two projects were allocated funds by the Netherlands. Phase I of the rehabilitation of Calueque-Olushandja Water Supply Scheme and the upgrading of the Ogongo Purification Plant (DDGIC, 1992).

During 1993 the Directorate-General for International Co-operation, Dutch Ministry of Foreign Affairs, published the document: "Environmental Impact Assessment in Development Co-operation" (DDGIC, 1993). The document: "provides information on the way in which the Netherlands Ministry for Development Co-operation has integrated environment impact assessment into the governing procedures for development co-operation activities" (DDGIC, 1993, p.1).

In 1990 sustainable development was defined as the main policy objective in the policy document: "A World of Difference" (DDGIC, 1993). At the time the Netherlands believed that environmental impact assessment of projects and programmes was one way of achieving sustainable development.

The Dutch reformulation document (DDGIC, 1992) refers to a: "screening development form (O-toets) (p.10)". This initial environmental screening or "D-screening" was introduced in 1991 by the ministry as a policy instrument (DDGIC, 1993). The principle behind the inclusion of the D-screening requirement is that EIA must be integrated into the project cycle. The initial assessment is designed to identify the possible implications of the project ideas and proposals for the environment, women and poverty. Detailed checklists are used for different project categories. The calueque-Olushandja study falls into the exploitation of hydrological resources category (DDGIC, 1993).

2.5 ADMINISTRATIVE, LEGAL AND POLICY REQUIREMENTS

The EIA procedure for Olushandja Dam needs to be considered in the context of the full Calueque-Olushandja project (Figure 7.1). Each country in southern Africa has developed its own legal requirements with regard to EIA procedure. In the case of Namibia, the Directorate of Environmental Affairs recently completed the document: "Namibia's Environmental Assessment Policy" (NDEA, 1994). The Olushandja environmental study should thus be carried out in accordance with this national environmental policy (Figure 3.3).

As part of their aid agreements, the Dutch Directorate-General for International Co-operation would like to see EIA as a statutory requirement in the recipient country. However, if no requirement exists then the DDGIC believes it is necessary to include an EIA as a prior condition for the funding of certain projects.

The Namibian environmental assessment policy is described in more detail under section 3.5.3 of chapter 3 which deals with the theoretical background and current practice of EIA.

3 THEORETICAL BACKGROUND AND CURRENT PRACTICE

3.1 INTRODUCTION

The upgrading of the Calueque - Olushandja bulk water supply scheme is presently being financed by the Dutch bilateral aid agency, the Directorate General for International Cooperation (DDGIC). An EIA was considered necessary by the DDGIC as the project was situated in the environmentally sensitive area of northern Namibia. The natural resources of the area are limited with a low annual rainfall; soils, that have a low agricultural potential; saline groundwater conditions and increasing pressure on the land from cattle and human settlement.

Since the passing of the National Environmental Policy Act (NEPA) in 1969 by the United States Government, countries concerned with environmental degradation have followed a policy of incorporating environment assessment (EA) into their decision making process (World Bank, 1994). Donor agencies, such as the DDGIC, have followed this trend.

In order to provide a theoretical basis for the Olushandja Dam EIA this chapter reviews the EIA literature, provides a description of the stages of an EIA, demonstrates how EIA can fit into a typical project cycle and outlines the history of the development of environmental assessment in the United States, South Africa and Namibia.

3.2 LITERATURE REVIEW OF EIA THEORY

"Is environmental impact assessment a science or a tool to facilitate the application of existing scientific knowledge ?".

Stromquist and Tatham (1992) believe that environmental impact assessment is definitely a tool. Lawrence (1994) agrees with this view. He stresses, however, that although EIA draws its theory from related disciplines and professions, environmental professionals must not lose sight of the fact that the EIA planning process: "encompasses the value-full realms of interpretation, evaluation and synthesis" (Lawrence, 1994, p.15). The problems with which EIA practitioners deal may be defined and investigated using scientific terms and methodologies but the ways in which these problems are resolved are often non scientific.

3.2.1 Early EIA methods

During the 1970s methods to assess the environmental impacts of projects were devised. Most of these, originated in the United States of America subsequent to the passing of the National Policy Act of 1969 (NEPA). Methods used include: overlays (McHarg, 1968); filtered overlays (Beaumont et al., 1975); panel evaluation techniques such as those produced by Battelle-Columbus Laboratories (Dee et al., 1973); checklists; matrices (Leopold et al., 1971); rating schemes using co-ordinating bodies and panels (Sondheim, 1978); frameworks (SACTRA, 1979) and networks (Sorensen, 1971).

From the end of the 1970s there is evidence of an expansion in the EIA planning process to take into account firstly, the social impacts of projects and secondly, the needs of communities in developing countries. From experience gained in working on projects in developing countries, environmental practitioners, have also found that methods used to assess biophysical impacts in industrialised countries are not always suitable. New approaches to the early methods such as matrices, overlays and networks were required.

3.2.2 Social impact assessment

During the last twenty years there has been a growing awareness amongst planners and decision makers involved in environmental impact assessment planning that there is a need to involve the public in decision making. The social consequences of projects, programmes and policies need to be better understood with more emphasis required on developing social impact assessment (SIA) as a sub-discipline of environmental impact assessment (IAIA, 1994).

The Interorganizational Committee on Guidelines and Principles (IAIA, 1994) defines SIA as a planning process used:

"To assess or estimate, in advance, the social consequences that are likely to follow from specific policy actions and specific government actions..." (IAIA, 1994, p.108).

The realisation amongst EIA practitioners, that the socio-economic environment is as important as the biophysical environment, is a result of numerous problems that have been highlighted during the carrying out of EIAs. Researchers have found that the following were the major problems associated with not carrying out in depth SIAs:

- The results of investigations into the social consequences of major projects were fragmented and lacking in focus
- People were not given the opportunity to participate in designing their future
- The development of river basin projects resulted in the impoverishment of the affected communities
- A through scoping to determine the various population groups liable to be affected by the development was not carried out
- The communities were not left with a feeling of project ownership.

(CATAD, 1993; IAIA, 1994; Peters, 1994; Scudder, 1994).

CATAD (1993), Sowman (1994) and the World Bank (1993) believe that the practice of social impact assessment can be improved by improving the level of public participation. They highlight a number of advantages that such a process will bring to the overall EIA:

- The process allows for a better implementation of plans
- An SIA provides valuable information and insights into local conditions, community needs, values and preferences
- SIA's develop a sense of self-worth, responsibility and empowerment within the community
- The SIA creates an awareness within the communities about the environment and develops capacity so that the people can become involved in their own development
- They provide valuable feedback to improve future EA legislation.

3.2.3 EIA in developing countries

Bowonder (1985) proposed a set of strategies for managing environmental problems in developing countries. These strategies were followed by basic procedures for implementing EIA by the United Nations Environmental Programme in 1988 (UNEP, 1988). More recently other researchers (Biswas, 1992; Tatham, 1992 and Ebisemiju, 1993) have suggested techniques to successfully carry out EIAs in developing countries.

In his review of the literature Bowonder (1985) identified four major environmental problems that face developing countries:

- Land degradation
- Deforestation
- Air, water and insecticide pollution
- Environment and health.

Bowonder (1985) recommended various strategies needed to deal with these problems which are often unique to the developing countries concerned. Fuggle (1989) argues that the values and traditions that went into the formulation of NEPA and environmental legislation in the industrialised world are lacking in developing countries. In these countries the important issues are not aesthetic, scientific, educational or future needs but the basic human needs of food, water and shelter.

In order for developing countries to benefit from the experience gained by the developed nations in researching new techniques and undertaking EIAs, emphasis needs to be placed on developing techniques for local conditions. Wrammer (1992) recommends that more emphasis needs to be put on ecological and socio-economic conditions in developing countries. Biswas (1992) believes that risk analysis and social impact analysis should be studied further while Ebisemiju (1993) favours the solution that Third World countries focus more on the creation of an enabling environment for the introduction of EIAs.

Woube (1994), proposes that the long term sustainability of water resources in Ethiopia, Sudan and Egypt can be achieved through proper planning of conservation based development programmes. This proposal can be extended to cover other national resources found in developing countries. Sustainability was highlighted during the drafting of AGENDA 21 at the Earth Summit held in Rio during 1992. One of the recommendations of Agenda 21 is that:

"National action plans for sustainable development need to be created in all countries...They should be backed up by specific programmes to deal with human needs and the sustainable use and conservation of the environment" (Keating, 1993, p.68).

EIAs adapted for developing countries can provide an important management tool to ensure that development projects are sustainable. By taking into account basic human needs and local conditions EIAs are more likely to be accepted by developing countries thus encouraging their success.

3.2.4 EIA in Africa

There is a growing trend towards the increased use of environmental impact assessment techniques in Africa. However the success during the last twenty four years has been disappointing. Fuggle (1989), Biswas (1992), Collinson (1992), Wrammer (1992) and Kakonge and Imeubore (1993) found that the major problems in implementing environmental management planning in Africa can be attributed to:

- Too little feedback on projects for which detailed EIAs have been completed
- Lack of scientific data and information
- Secrecy by authorities in the release of project information to the public
- EIA's being conducted by personnel from first world countries with little experience of local conditions
- Public participation not forming part of the implementation of EIAs in developing countries.

In 1992, as a result of the Earth Conference in Brazil, the African Environmental Protection and Assistance Centre (AEC, 1994) was established. This organisation is now referred to as The African Environmental Centre (AEC). The aims of the AEC are similar to those of the Committee for the National Institute for the Envirinment (CNIE, 1994) in the USA, providing possible solutions to the problems stated above. As part of their approach to improving environmental management in Africa the AEC lobbies local governments to carry out environmental studies before external funding for aid programmes are approved.

3.2.5 Development agencies and EIA

Development and international financial institutions such as the United Nations and the World Bank have developed various environmental guidelines aimed at improving the implementation of projects in developing countries. In the early 1980s there was a concerted effort by non governmental organisations to pressurise institutions such as the World Bank to incorporate environmental concerns into their lending policies (Haeuber, 1992).

Donor agencies involved in the development of Africa have tended to follow the example of the United Nations and the World Bank. They require EIA's to be undertaken as one of the conditions for funding development projects.

The British Overseas Development Administration (ODA), in recognition of the importance of global environmental problems, has set up the Global Environmental Assistance Programme (GEA) with a budget that is separate from other aid programmes. In support of the GEP the ODA has published a number of supporting documents such as the "ODA manual of Environmental Appraisal" (ODA, 1992). In South Africa the ODA is presently providing assistance to the Independent Development Trust to develop an environmental management system (EMS) (Harvey pers. comm., 1994).

In Namibia there has been a strong presence of donor countries since independence in 1990. Countries such as the Netherlands, United States, Finland, France and the Federal Republic of Germany have been involved in development programmes that have a strong environmental management component. The Netherlands in particular is concentrating on the rural development of water supply projects. In each case owing to the environmental aspects of the water supply activities, the Netherlands government has requested that environmental impact assessments be carried out.

With the increased attention being paid to the importance of environmental management in the project cycle by international funding organisations, development agencies and donor countries EIAs in the 1990s will have to take into account the particular demands of local conditions and the requirements of the implementing agents.

3.3 PRINCIPLES AND STAGES OF EIA

The United Nations Conference on Environment and Development (UNCED) took place in Rio de Janeiro during June 1992. By the end of the conference the nations meeting at the Earth Summit had adopted a set of principles to guide future development. These principles are contained in the "The Declaration of Rio". One of these principles states that:

"Environmental issues are best handled with the participation of all concerned citizens. Nations shall facilitate and encourage public awareness and participation by making environmental information widely available". (Keating, 1993, p.x).

The EIA planning process is one management tool which can help in encouraging such public awareness and participation. The definition of EIA is varied as can be seen from the following three quotes:

- "...an activity designed to identify and predict the impact on man's health and well being, of legislative proposals, policies, programmes and operational procedures, and to interpret and communicate information about the impacts" (Munn, 1975).

- "... an assessment of all relevant environmental and resulting social effects which would result from a project" (Battelle Institute, 1978).

- "...EIA is not a scientific survey for academic purposes but a development tool involving the application of current scientific knowledge to specific planning contexts" (Stromquist & Tatham, 1992, p.15).

3.3.1 Principles

In a review of the work carried out on the development of EIA, to 1984, Clark (1984) outlines the following as the key principles on which the EIA planning process is based:

- Potential adverse impacts should be reduced
- Likely benefits should be increased
- Identification and assessment of alternative sites and processes is required
- A no-go option should be one of the alternatives
- The public should be involved
- Implement the EIA at an early stage of the project planning
- The EIA should be an integral component of project design
- Attention should be given to immediate, indirect, secondary and long term impacts.

In order to provide a management tool for decision makers the EIA should cover: "the identification, measurement, interpretation and communication of environmental impacts of the proposed action" (Clark, 1984). The UNEP (1988) and the South African Council for the Environment (SACE, 1989) discuss similar principles to those given by Clark.

3.3.2 Stages

The United Nations Environment Programme (UNEP, 1988) breaks the EIA process into two sections. The first deals with screening and preliminary assessment. Once this section has been completed the agency or decision making authority can decide whether or not the project can proceed without further environmental investigation. If further work is required then the EIA process moves to the second section which involves a full assessment.

The UNEP's (1988) full assessment process involves four main stages:

1. Organisation of the EIA study
2. Scoping
3. The EIA study
4. Decision by relevant authority

Stage three is concerned with the impacts of the proposed development on the environment. It is further broken down into the following five parts:

- Identification
- Prediction
- Evaluation
- Mitigation
- Documentation

A recent review of the EIA planning process by Lawrence (1994) discusses the elements and scope of this planning process at the regulatory level in Canada. Lawrence examines the stages, components and activities of the EIA process at the applied level.
By the nature of the wide range of projects covered by the EIA planning process the framework, such as the UNEP's, cannot be rigid. The process needs to be constantly adjusted to suit each particular project and environment. However, Lawrence (1994) believes that there are four key stages that any EIA should progress through. These are the:

- Conceptual stage
- Generation and evaluation of alternatives stage
- Impact assessment stage
- Implementation stage

Under each stage are various components which deal with such items as alternatives, baseline reports, documentation and impact management. The number and form of the components included at each stage will depend on how involved the EIA needs to be.

From his review of the literature Lawrence (1994) sees the need for greater emphasis to be placed on:

- Cumulative impact analysis
- Regional assessment
- Ultimate environmental consequences of EIA must not be neglected
- The social and political side of EIA
- Consideration of risks
- Social and cultural differences

One of the recommendations made in the review is that EIA theory should involve the refining of social and natural science principles, theories and models. Such modelling combined with monitoring of social and natural systems should then become the focal point of EIAs.

The environmental assessment policies developed in South Africa and Namibia contain similar stages to those described in the above two examples. These will be discussed to sections 3.5.2 and 3.5.3.

3.4 INCORPORATING EIA INTO THE PROJECT CYCLE

Haeuber (1992) and Ebisemiju (1993) discuss typical project cycles and how the environmental impact assessment process can be integrated into such cycles. Haeuber (1992) describes the six stages used by the World Bank in the management of their projects. Table 3.1 shows these six stages along with the environmental assessment events, the non governmental organisation (NGO) participation opportunities and the degree of NGO participation. Ebisemiju (1993) shows similar EA events linked to the six phases of the project cycle. (Figure 3.1). This is a modified version of that produced by the Asian Development Bank (ADB, 1988).

In their respective papers both authors stress the importance of incorporating the EIA process into the project cycle starting at the project inception stage. From this point the EIA should run in parallel with the planning process providing valuable input right up to the evaluation stage. Although this combination of the project cycle and EIA works in theory it has not always been applied to projects in developing countries (Ebisemiju, 1993). In chapter 7 five alternatives for the management of the water level in Olushandja Dam are developed. The EIA planning process used by the DWA is described and compared to the ideal project-EIA combination as shown in Figure 3.1.

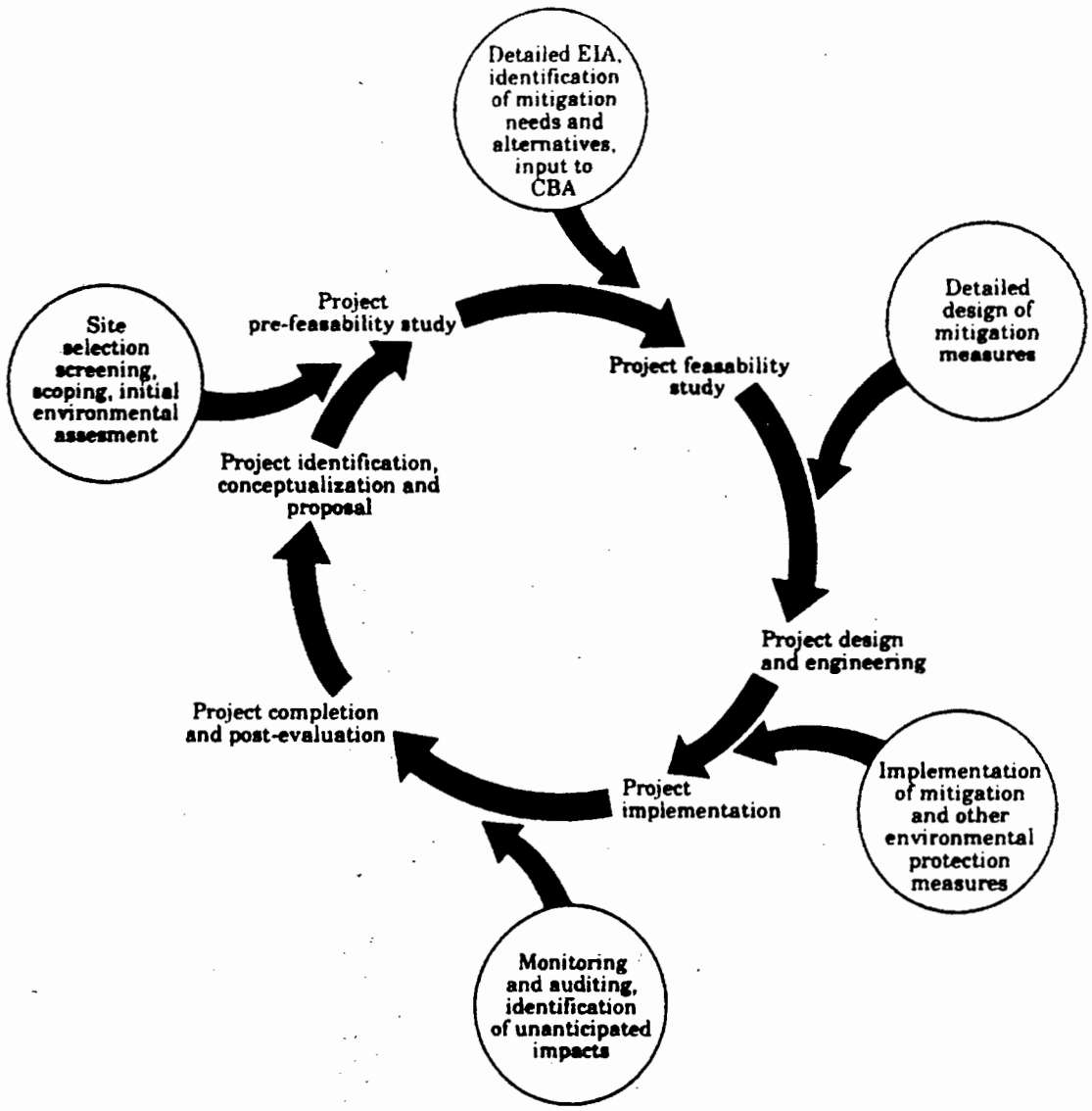


FIGURE 3.1

INTEGRATING EIA INTO THE PROJECT CYCLE

(EBISEMIJU, 1993)

PROJECT CYCLE STAGE	EA EVENTS	NGO PARTICIPATION OPPORTUNITIES	DEGREE OF NGO PARTICIPATION
Identification	screening; inter-agency meeting	reconnaissance mission; post-inter-agency meeting consultation; requests for basic EA and project information	moderate to high
Preparation	selection of EA team; EA background studies; EA drafts; sharing EA drafts with TM, borrower government agencies, and feasibility study team; mid-term review; submission of final EA report	scoping sessions; requests for EA documents, including background studies and drafts; environmental advisory panel; NGOs as consultants	high
Appraisal	review of EA by appraisal mission; completion of SAR, including sections on environment and public participation environmental loan conditions	meetings with appraisal mission; raising environmental, EA, and public participation issues with Eds	moderate
Negotiation	environmental loan conditions	suggesting environmental mitigation measures and loan conditions to Eds	low
Implementation & supervision	Bank supervision missions; borrower reports detailing implementation of EA recommendations; environmental advisory panel meetings; contractual remedies if borrower fails to comply with EA	meetings with supervision mission; membership on environmental advisory panel	low
Evaluation	Project Completion Report	NGO Projection Completion Report	low

KEY

EA	Environmental assessment
TM	Task manager
RED	Regional environmental division
ENV	Environment department

TABLE 3.1

ENVIRONMENTAL ASSESSMENT AND NGO PARTICIPATION (Haeuber, 1992).

3.5 EIA IN PRACTICE

The development of the environmental impact assessment planning process in Namibia is relatively new when compared to the developments that have taken place in North America and Western Europe during the last twenty five years. In order to trace the establishment of an EIA policy in Namibia the history and practice of EIA in the USA and South Africa will be examined.

3.5.1 United States of America

Real concern for the environment in the United States of America started with the introduction of the U.S. Senate Bill No. 2549 in 1959:

"to declare a national policy on conservation, development and utilisation of natural resources..." (Fuggle, 1989).

From this base environmentalism grew in the United States during the 1960's. In 1969 this concern for the environment was translated into law by the promulgation of the National Environmental Policy of 1969 (NEPA), on the 1 January 1970.

NEPA became the foundation for modern American environmental law, being the first statute to allow for mandatory evaluations and impact assessments as part of the development process and policy (Ridl, 1994). Although under NEPA only federal agencies are obliged to conform with the requirements of the act a number of the states have adopted the EIA requirements of NEPA. As a result of the legislation a rapid development of EIA methods and techniques has taken place in the United States and much of the industrialised Western world where countries have used NEPA as a basis for their own environmental legislation.

The component of the EIA planning process in the United States is the environmental impact statement (EIS). Federal agencies are required to prepare an EIS for any action or proposal for legislation which is likely to have a significant impact on the environment. In 1978 the Council for Environmental Quality (CEQ) was established to receive and evaluate environmental impact statements and to provide guidance for their preparation. A watchdog function is undertaken by the Environmental Protection Agency (EPA) which was founded in 1971. This controlling authority has the ability to stop and review the process at various critical points.

Prior to issuing an EIS the responsible Federal agency is obliged to conduct a scoping exercise involving other government departments and the general public. A preliminary environmental impact report is produced for review by the Council on Environmental Quality and other interested and affected parties. From this point a full environmental impact statement may need to be produced if it is found that significant impacts are likely to take place.

With the passing of successive administrations in the United States have come various government policies to improve environment legislation. In 1994 the Clinton Administration introduced two new initiatives: the EPA's Common Sense Initiative and that of Ecosystem Management.

The EPA's Common Sense Initiative replaces the old pollutant-by-pollutant regulatory approach with one that involves all stakeholders from the start and looks at whole facilities and whole industries. This will result in the EPA looking at the full range of environmental impacts of an industry in an holistic manner.

In the case of the ecosystem management initiative federal agencies will be able to work more closely than in the past so that the nation's natural resources can be managed as a whole. In many cases different rules have been applied by different agencies often with significant impacts on the environment (McGinty, 1994).

3.5.2 South Africa

Fundamental to environmental management in South Africa is the concept of:

"Integrated Environmental Management" proposed by the Council for the Environment in the late 1980s.

(SACE, 1989)

This concept is now documented as the Integrated Environmental Management (IEM) procedure (Figure 3.2). To date, IEM has been mainly used for large, multimillion rand projects which are usually privately funded such as the Lesotho Highlands Water project, the Alusaf Aluminium smelter and the proposed Richards Bay Minerals mining venture at St Lucia.

Often the environmental impact assessment stage has been a lengthy and costly one. However, in order to meet the growing aspirations of South Africans, the new government is under pressure to implement reconstruction and development projects as quickly as funding allows. This pressure is likely to result in the application of IEM to low cost government or foreign donor funded projects.

The history of IEM and the environmental impact assessment planning process in South Africa can be traced back to 1972 when South Africa attended the United Nations Conference on the environment held in Stockholm, Sweden. In the same year a permanent Cabinet Committee on Environmental Conservation was established followed by a non-statutory South African Committee on Environmental Conservation which served to advise the cabinet committee. This non-statutory body was renamed the Council for the Environment in 1975.

In the early 1980s the government, in an attempt to recognize and resolve environmental issues, published the White Paper on a national policy regarding environmental conservation. In 1982 the Environmental Conservation Act (Act 100 of 1982) was promulgated and the Council for the Environment became a statutory body with the stated aim of advising the Minister of Environmental Affairs on environmental matters (Hoogervorst, 1993).

In 1989, the same year that the Environmental Conservation Act (Act 73 of 1989) came into force, the Council for the Environment published the document: "Integrated environmental management in South Africa" (SACE, 1989). The aim of the document was to provide recommendations to the Minister of Environmental Affairs for advancing integrated environmental management in South Africa.

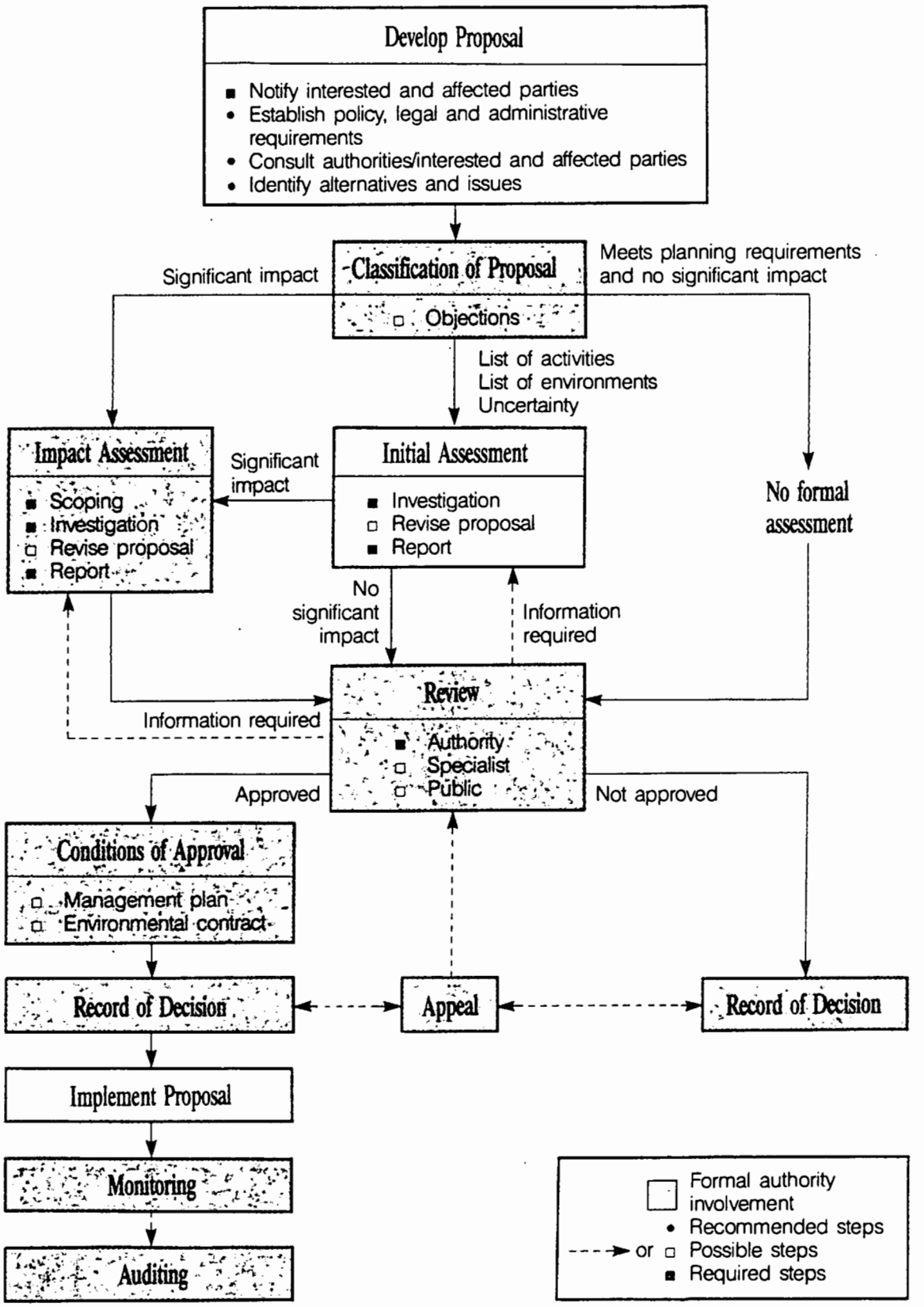


FIGURE 3.2

THE IEM PROCEDURE SOUTH AFRICA

(DEA , 1992)

This document was followed in 1992 by a set of six guideline documents produced by the Department of Environmental Affairs, "The Integrated Environmental Management Procedure" (DEA, 1992). In these documents the term environmental is used in its broad sense, encompassing biophysical and social, economic, historical, cultural and political components.

Integrated Environmental Management (IEM), as developed in South Africa, seeks to ensure that public participation is an integral part of the planning, assessment and decision making process. IEM differs from some of the environmental impact assessment techniques, developed for use in industrialised countries, in the following ways:

- The purpose of IEM is to mitigate or resolve negative impacts and to enhance positive aspects of proposals. EIAs have tended to concentrate on negative impacts
- Alternatives must be identified early on in the development process
- Public participation is an integral part of the IEM procedure
- IEM is a cradle to the grave approach ensuring that environmental considerations are taken into account throughout the life of the project.

However, the application of IEM in South Africa is still in its infancy with many proponents of development projects stating that they practice "integrated environmental management" without adhering to the underlying principles (Ridl, 1994). This problem is compounded by the fact that there is presently no legal compulsion to use the procedure.

The IEM procedure (Figure 3.2), suggests that interested and affected parties are "notified" and "consulted" during the proposal development stage. Arnstein (1969) suggests that notification and consultation are merely degrees of tokenism. She believes that partnerships are a much more successful way of engaging in community participation.

The proponents of bulk water supply projects in South Africa have in some cases been accused of not involving local communities or social scientists at the start of the IEM procedure. However this problem is not unique to South Africa. Perhaps this is because the role of the community in decision making has been underplayed thus far and because the value of partnerships has not been appreciated. This shortcoming in the IEM procedure needs to be addressed.

3.5.3 Namibia

"The Namibian government wants to dam one of Africa's last wild rivers. You'll have to shoot us first say the people who live there, reports Phillip van Niekerk"

(Van Niekerk, 1995).

In 1995 the Namibian Government awarded a contract to a Norwegian-Swedish engineering consortium to undertake a detailed feasibility study for the Epupa Falls hydro-electric project on the Cunene River. As part of this study the consultants are required to conduct environmental and social studies. This section of the two year study will be split into three parts: ecology, environment and social (Hjort-af-Ornes, pers. comm., 1995).

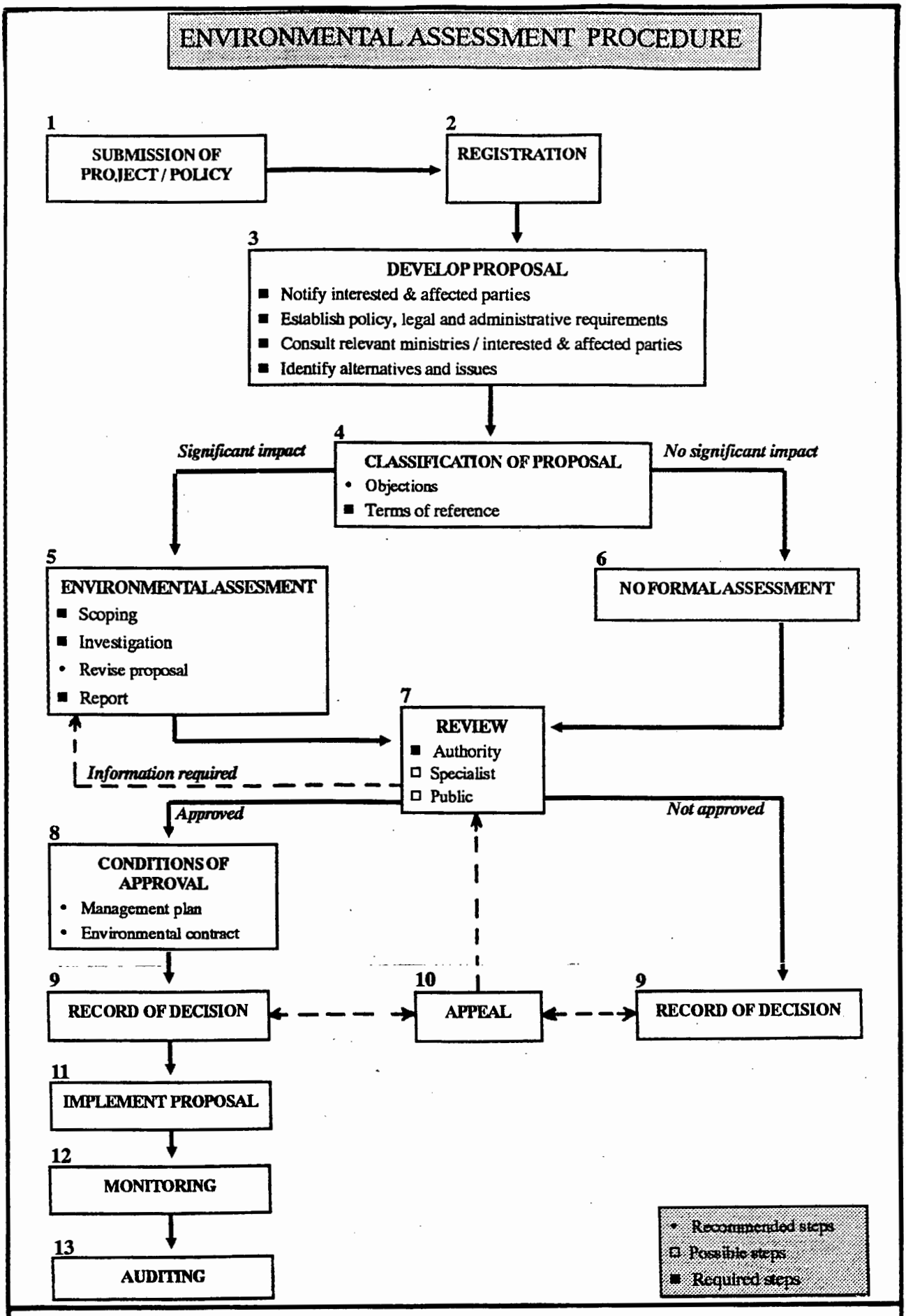


FIGURE 3.3

ENVIRONMENTAL ASSESSMENT PROCEDURE
NAMIBIA

(NDEA, 1994)

With independence in March 1990 the Republic of Namibia's new constituent assembly adopted a draft constitution. The change in government in 1990 brought about the repeal and amendment of various South African laws in operation at the time. This resulted in Acts such as the South African Water Act (Act 54 of 1956) being kept while others like the South African Environment Conservation Act (Act 73 of 1989) being repealed (Glazewski, pers. comm., 1995).

Section "g" of the terms of reference for the Epupa feasibility study states:

"The environmental study should be carried out in accordance with existing and emerging national environmental policies of Angola and Namibia." (NDEA, 1994).

With no legislation in place to guide and regulate the Epupa environmental impact assessment, authorities and environmental consultants working in Namibia have to rely on the constitution and recently published policy documents to provide guidance.

The Namibian constitution contains important environmental provisions which provide a base from which future environmental legislation could evolve.

One of these deals with: "Promotion of the Welfare of the People":

"The state shall actively promote and maintain the welfare of the people by adopting, inter alia, policies aimed at the following:

(1) that the ecosystems, essential ecological processes and biological diversity of Namibia are maintained and living natural resources are utilized on a sustainable basis for the benefit of all Namibians, both present and future; in particular the Government shall provide measures against the dumping or recycling of foreign nuclear and toxic waste on Namibian territory."

The enforcement of the first provision is covered by the position of an Ombudsman, established in Chapter 10 of the constitution:

"shall have the duty to investigate complaints concerning the over-utilization of living natural resources, the irrational exploitation of non-renewable resources, the degradation and destruction of ecosystems and failure to protect the beauty and character of Namibia."

(Glazewski, 1994).

In order to ensure that the environmental consequences of development projects such as Epupa Falls are considered, understood and incorporated into the planning process the Directorate of Environmental Affairs produced a draft environmental assessment policy in 1993. This document is the result of a workshop held in September 1992 to draw up environmental guidelines similar to the South African Integrated Environmental Management guidelines.

In February 1995 the policy document: "Namibia's environmental assessment policy for sustainable development and environmental conservation" was published (NDEA, 1995). The Namibian environmental procedure is similar in structure to that of the South African IEM. It consists of thirteen stages which take the project or policy from the "submission of project/policy" stage to that of "auditing" (Figure 3.3).

The NDEA is presently drafting a new Environmental Conservation Act which is likely to incorporate many of the recommendations found in the policy document. It is expected that this drafting process will take two years and will be available for public comment in the second half of 1996. (Glazewski, pers. comm., 1995).

For the successful completion of an environmental impact assessment it is important that the management team incorporates methods into the EIA that are suitable for the type of project being considered and are applicable to local conditions. Chapter 4 reviews various methods currently being used by EIA practitioners to evaluate environmental impacts. Some of these methods have been developed specially for North American, or Western European conditions while some have been modified to suit conditions in developing countries such as Namibia.

4 EIA METHODOLOGY

4.1 INTRODUCTION

In chapter 3 the concept of integrating the environmental impact assessment planning process into the project cycle was introduced and discussed. If during the pre-feasibility study or after an initial assessment has been carried out, it is shown that the proposal will result in significant impacts, then an impact assessment must be undertaken (DEA, 1992).

EIAs frequently involve a number of alternatives, different interest groups and multiple environmental characteristics. Under such problematic decision-making conditions it is difficult for the authorities to arrive at a decision that will meet the approval of both the proponent and the public. To make the decision-making process easier various methods have been developed to assess and evaluate the impacts.

EIA methodology can be split into two distinct evaluation procedures: Qualitative and quantitative. The World Health Organisation (WHO, 1992) puts forward the argument that in choosing a method the assessor should ensure that the methods chosen are flexible, fairly simple, objective, include all the key environmental issues and be able to identify project generated impacts.

The type and ultimate use of the EIA are also important in deciding on which methods to use. Should the EIA be dealing with predominately social issues then a more qualitative approach is required. If biophysical characteristics play an important part in the planning process then quantitative methods are appropriate.

This chapter looks at six methods that have been developed since the early 1970s to help with impact prediction, assessment and evaluation. Three of these methods have been used in this dissertation and their application is dealt with in chapters 6 and 8.

4.2 CHECKLISTS

In 1992 the South African Department of Environmental Affairs published a set of six documents forming: "The Integrated Environmental Management Guideline Series" (DEA, 1992). Guideline document 5 provides a detailed checklist of environmental characteristics.

The checklist, such as that published by the DEA, is probably the most common and most widely used of the available EIA methods of evaluation (WHO, 1992). A number of checklist techniques are available which vary in characteristics and degree of complexity.

The DEA checklist, as an example, provides an aid to the identification of environmental characteristics which may be sensitive to development options, or which could place significant constraints on a proposed development. A series of questions are presented to which the reader responds.

Preston et al. (1992) lists positive and negative points associated with this method. On the positive side checklists provide the following functions:

- They help to order thinking
- They aid data collection and presentation
- They alert against the omission of possible impacts
- They provide a base for constructing matrices and providing input into other methods of evaluation.

In using checklists practitioners need to recognise the following constraints:

- No guidance is given for the interpretation of impacts
- They are a poor means of communication
- The lists tend to lead investigators through an analysis in a set manner
- No environmental description is included
- Impacts considered important by the public or interested parties are not necessarily identified.

In order to improve on some of the deficiencies found in checklists a matrix format is often used to compare a list of development actions with a list of environmental components.

4.3 MATRICES

In 1971 Leopold headed a team from the United States Geological Survey that produced the matrix technique consisting of two data sets arranged at right angles to form a cross-tabulation (Preston et al., 1992). Impacts are described in terms of magnitude and importance on a common scale of 1-10 with 1 being the least magnitude or importance.

Each cell of the table is split with a diagonal line. The score for magnitude is placed in the top left hand corner while the score for importance is placed in the bottom right hand corner. A plus sign can be included to indicate whether an impact is beneficial (WHO, 1992).

One of the major drawbacks in using the matrix method is that the scores are subjective and thus cannot be manipulated arithmetically. Other disadvantages include:

- They are often complex and produced in an unfamiliar format
- They focus on first order interactions and on the numerical scoring system
- The public cannot be involved
- Separate matrices must be prepared for each alternative project
- It is difficult to compare the matrices.

On the positive side the Leopold Matrix highlights areas of particular concern and of high risk. It is highly adaptable to various projects and environments while the timing, duration and probability of particular actions on specific environmental elements can be readily displayed.

4.4 OVERLAYS

The growth of geographical information systems (GIS), based on computer based technology, has greatly improved the method of overlays, since its introduction by McHarg in 1968. Although McHarg designed the method to select highway routes in the United States, overlays can be applied to any project which involves putting social values to both social and natural processes. The McHarg method (McHarg, 1968), often referred to as the "additive overlay technique", consists of a series of maps which each represent a critical factor affecting the project. The physiographic factors are ranked using colours. The darker the tone the greater the cost. Social values are ranked from high to low also using colours with the value increasing with a darkening of the tone. The social and physiographic maps are then superimposed. The lowest cost to society are those areas which have the lightest tone.

A second technique involving filtered overlays was devised by Beaumont et al. (1975). This technique involves the use of maps and aerial photographs to produce overlay maps on which a code rates the suitability of land for a particular activity. A "1" or A depicts highly unsuitable while "4" or "D" is highly suitable. As each new overlay map is added the number or letter is added (1342 or ACDB) to form a code. The composite map is then coloured using the most unsuitable rating in the code for a particular area.

The overlay method of evaluation provides a visual impression of the suitability of an area for a particular type of development. The main strengths of the method are that:

- Summarised data is easily presented
- Project proposals can be considered whenever spatial relationships are important
- They are effective in communicating the number, types and location of affective parties.

The main weaknesses (Preston et al., 1992; Glasson et al., 1992) include:

- The lack of comprehensiveness and precision
- The inability to consider non-spatial variables or second or third order interactions
- The inability to accommodate uncertainties in data or impact predictions
- The problem that value judgements used to rank factors are hidden.

4.5 NETWORKS

In 1971 Sorensen (Sorensen, 1971) developed an EIA network to aid planners with land use problems in California. The network method is based on a number of linked impacts known to have occurred from past experience in similar conditions (Stromquist & Tatham, 1992). This method is then used to consider the secondary, tertiary and higher order impacts that may arise from an initial impact. A number of impacts can be considered together. The combined effect will have a further impact on other environmental components. The original networks based on Sorensen's ideas were visually displayed using a single large chart or a number of smaller charts. Networks are ideal methods for computerisation and there is now the possibility of combining network and overlay methods using GIS.

Problems associated with the network method are that:

- It is time consuming to construct and use
- It does not show the magnitude or significance of the interaction between environmental characteristics
- It requires a considerable knowledge of the environment under consideration.

4.6 FRAMEWORKS

One of the principles forming the base to the South African Integrated Environmental Management (IEM) procedure is that of: "due consideration of alternative options" (DEA, 1992). During a full environmental impact assessment a number of alternatives are considered and evaluated based on the positive and negative impacts for each alternative. The number of alternatives may be reduced depending on the information, time and finance available. Each alternative will in turn have a number of impacts. These need to be evaluated by the professional team to determine to what degree each affects the environment. A summary of the evaluation of impacts for each alternative will allow the impact assessor to determine where the scenario in question lies in relation to the other alternatives.

In both cases a systematic evaluation procedure is required (Lawrence, 1993) if the public are to understand the basis for the evaluation and a sound decision is to be produced. Evaluation can be undertaken using either qualitative or quantitative procedures. An example of a qualitative evaluation method is that of the framework. This method of evaluation involves using a matrix format.

The framework consists of a set of environmental characteristics which are likely to be affected by the proposed development. These are considered for each of the alternatives taking into account who the interest groups are and the views of the public.

The British Advisory Committee on Trunk Road Assessment (SACTRA) published a document in 1979 (SACTRA,1979) which gave four principles for the development of a framework:

- A need for the project must be identified
- A number of possible solutions must be identified
- The merits of each solution must be analysed so as to maximise the benefits and minimise the adverse impacts
- Decisions have to be made during the planning process. Alternatives have to be chosen, impacts identified and finally the decision making authority has to decide on the preferred option.

The SACTRA document gives various characteristics which should be included to make the framework meaningful:

- No effects which are relevant, or might reasonably be thought to be relevant, should be excluded
- During the early stage of design the framework will provide a convenient check list
- Although it is useful to quantify impacts where this comes naturally, quantification is not an end in itself. In many cases a verbal description is more appropriate
- There must be a reliable methodology for determining the quantity measured, and the measure must be appropriate to the impact it is desired to represent
- In order to minimise the risk of double counting the framework should avoid double counting
- The framework should record effects at the most direct level of incidence possible
- The framework should not contain entries which have been obtained by taking account of factors which occur elsewhere in the framework.

Work undertaken by the "Ministerie van volksgezondheid en Milieuhygiene" (MVM) during 1981 in the Netherlands took the framework concept further by splitting the process into two stages (MVM, 1981).

The first stage consists of a "first level" or summary framework. Here information on impacts associated with each alternative is displayed. This framework is compiled prior to the first screening process of alternatives. It acts as a summary of relevant information.

Once the information on impact has been presented in the first framework a "second level" or decision framework is developed. It is at this stage that any alternatives, where impacts fail to meet environmental quality standards, are excluded. Alternatives which are for some other reason considered to be unacceptable are also screened. The result is a simplified second level matrix indicating remaining alternatives and significant impacts. This framework is used by the decision making authority to help reach a decision on whether the project should go ahead and in what form. The framework approach is used in this dissertation to determine the preferred alternative for the Olushandja Dam EIA.

4.7 PARTICIPATORY RURAL APPRAISAL

The concept of participatory rural appraisal (PRA) evolved out of the technique developed in the 1970s called rapid rural appraisal (RRA). This technique was developed as one solution to problems experienced during the 1960s, with the collection of information in developing countries. More cost effective methods were devised to learn about rural conditions and people (Chambers, 1993).

Chambers (1993) identifies the main strengths of RRA as:

- Allowing for progressive learning which is flexible, exploratory, interactive and inventive
- Allowing for the necessary two way flow of ideas between the rural people and researches
- A more efficient method of information gathering which confines itself to relevant information
- Allowing for different information collecting methods, sources and disciplines
- Allowing for direct contact between investigations and local people in the field.

In the late 1980s there existed a growing awareness that the RRA approach was very much one sided. Knowledge of the local community conditions was extracted by outsiders so that the developers could decide on the best way to process and act on the data. With the PRA approach outsiders go into a community to learn and act as facilitators in the development process (MIDNET, 1993). The people interviewed become part of the problem solving process.

PRA comprises approaches and methods which enable people in the community to share, enhance and analyse their knowledge of life and living conditions. The process results in ownership of the project, with the community providing management, monitoring and evaluation functions. (IIED, 1995).

With the range of applications growing and the request by donor agencies, governments and NGOs' to use a more participatory approach in the EIA planning process, the PRA method is well suited to qualitative evaluations.

4.8 RECENT DEVELOPMENTS IN EIA

The application of SIA as a subsection of the EIA planning process is particularly relevant to the development of African countries in the 1990's. Some of the advantages for undertaking SIA's are given in section 3.2.2. Recent developments may prove useful in improving the planning of EIA's in general and SIA's in particular. All the approaches discussed below were developed for African conditions by people who have extensive experience undertaking projects in southern Africa.

Owing to the lack of background data and qualified staff in developing countries, EIA methods used in industrialised countries are inappropriate. Stromquist and Tatham (1992) suggests the use of "*a stepwise approach*" or "*an extended screening procedure*". This approach is based on work that was carried out in east Africa. In South Africa, the South African Council for the Environment (SACE, 1994) has published guidelines for: "*Streamlined environmental impact assessment*"; the Department of Water Affairs and Forestry, *REIP* (Louw, 1994) while ESKOM uses *CORSEL* (Clara, pers. comm., 1994).

In 1994 the South African Council for the Environment published a document dealing with:

"Streamlined environmental impact assessment (SEIA)" (SACE, 1994).

The SEIA evolved as a result of the implementation of the South African Reconstruction and Development Programme (RDP) which commenced shortly after the national elections in 1994. In order to adapt the EIA planning process to the requirements of the RDP the Council for the Environment saw the need for a streamlined EIA process that could identify major environmental impacts using limited resources. Emphasis in the implementation phase is placed on public communication, transparency, education and awareness. Although the method is based on the checklist approach, SEIA has been designed for conditions in developing countries and thus takes into account those constraints that affected the implementation of methods used by the industrialised countries.

In the field of water resources management the South African Department of Water Affairs and Forestry (DWAF) has developed various procedures and methodologies to deal with environmental impacts of water resource projects (Louw, 1994). One of the techniques presently being used is the "*Relevant Environmental Impact Prognosis* (REIP)". The DWAF uses this technique for project planning with a standardised IEM procedure as a base. With the Namibian Government presently compiling new environmental legislation there is scope for using a planning tool such as REIP for inter-basin transfer schemes such as the Calueque - Olushandja scheme currently under review.

ESKOM, the South African parastatal electricity supply organisation, uses a rapid environmental assessment technique in its planning of transmission line routes. The "*corridor selection programme*" (CORSEL) was developed for the identification and assessment of corridor alternatives for transmission lines. The purpose of the programme is to find a balance between environmental impacts, cost and technical feasibility (Van der Merwe, 1994; Clara, pers. comm., 1994).

The availability and management of water resources in Africa is vital to the development of the continent and long term economic progress. To increase the supply and thus improve access to unpolluted water, governments throughout the world have tended to follow a policy of building dams. In Africa fourty dams were under construction at the start of 1994 (IWPDMC, 1994). However, long term progress needs to be linked to environmental protection if such progress is to be sustained.

The EIA planning process, using the methods discussed above, is one tool that can be used to successfully mitigate the negative consequences of building dams such as Calueque and Olushandja. There is a growing realisation that water resource development impacts on other key resources such as people, land, flora and fauna. Chapter 5 reviews the present water resource management in Namibia and the associated environmental problems.

5 WATER RESOURCES MANAGEMENT IN NAMIBIA

5.1 INTRODUCTION

During her address in March 1994 to the Ministerial Conference on Drinking Water Supply and Sanitation, held in the Netherlands, Elizabeth Dowdeswell (Under-Secretary-General for the UNEP) highlighted seven priority areas which needed urgent attention. One of these was directly related to the understanding of water problems:

"We need to understand far better the consequences of water problems, the extent to which we cause them and the effects of our traditional practices. Damming and diverting water has caused major upset to the world's deltas, wetlands, lakes and aquatic habitats, imperiling countless species." (Dowdeswell, 1994, p.3). In the same address Dowdeswell highlights the fact that most water scarce countries are in Africa.

Water is one of the key natural resources which developing countries such as Namibia need in order to improve the quality of life for the majority of the population. The environmental impact assessment of water resources projects such as Olushandja Dam will ensure that the resource is properly managed so as to benefit both the local and regional communities.

This chapter describes the available water resources in Namibia and in particular those of the region within which the Olushandja Dam is located (Figure 1.3). The existing water infrastructure is described along with the environmental aspects of developing water supply schemes in the region. The existing and planned water management structures are discussed emphasising those areas that will affect the management of Olushandja Dam.

5.2 EXISTING NATIONAL WATER RESOURCES

In his 1994 State of the nation Address, President Nujoma discussed developments that had taken place within Namibia since independence in 1990. One of the main developments centered around the provision of water to the Namibian people. Water supply infrastructure had been upgraded in the highly populated regions of Ohangwena, Omusati, Oshana and Oshikoto (Figure 1.2) in northern Namibia, to improve the availability of water for use by urban and rural communities. However Nujoma expressed his concern about the continued availability of water to the communities living on the west coast.

Namibia has a total land area of 823 000 km^2 with an estimated population of 1,4 m (NPC, 1994a) giving an average population density of 1,7 persons per km^2. The highest rural population density is found in the better watered central northern area, formerly known as Owamboland (Figure 1.2). The population for this area in 1991 was 615 057, or 43,8% of the national population.

Namibia's mean annual rainfall is 250 mm. This is a result of the country's geographical position in the southern tropics (Figure 1.1) and the cold Benguela current along the west coast. Precipitation decreases from 700 mm in the north east Caprivi Region to less than 50 mm on the west coast.

The average daily temperature is 25° C while the average annual evaporation varies from 3 700 mm in the central southern area to 2 600 mm in the northern regions. The combination of the evaporation and rainfall conditions in the highly populated northern regions leads to high evaporation and above average rainfall. However it should be noted that over 70% of rainfall occurs between January and March (DWA, 1990).

Namibia's arid climatic conditions has resulted in a unique hydrological cycle (Heyns, 1993). Of the 17% of rainfall that is available after evaporation, 14% is lost through evapotranspiration, 1% recharges groundwater aquifers leaving 2% available for possible storage in reservoirs.

Namibia is presently divided into eight water regions. The focus of this chapter will be on the Oshana Water Region (Figure 5.1). The water resources available in the eight regions can be grouped as follows:

1. The perennial water of the Cunene, the Cubango, Cuito, Cuando and Zambezi rivers in the north and the Orange River in the south (Figure 1.1). Agreements signed with neighbouring states allows Namibia access to 180 Mm^3 per year from the Cunene River and 500 Mm^3 from the Orange River. Although no formal agreement has been reached on the utilization of water from the Cubango, Cuito, Cuando or Zambezi rivers it is estimated that once the Eastern National Water Carrier has become fully operational, 60 Mm^3 per annum will be abstracted from the eastern system (Heyns, 1993).

2. Groundwater forms the second category, with 57% of Namibia's requirements (Ward, 1992) being supplied from this source. Owing to the varied composition of the underlying geology the occurrence of groundwater depends on a combination of sufficient rainfall and favourable geological conditions. Out of an estimated 130 000 boreholes that have been drilled in Namibia only 32 000 (Heyns, 1993) were producing acceptable yields in 1993.

3. The ephemeral rivers such as the Outjo which flow west to the Atlantic Ocean form the third source of water. A combination of farm and major government developed dams trap the runoff from these rivers for domestic, livestock, mining, tourism and irrigation use.

5.3 OSHANA WATER REGION

The Oshana Water Region is situated in the north of the country (Figure 5.1). Its boundaries extend from the headwaters of the Outjo river in the south to the Namibian-Angolan border in the north. The eastern and western limits are the towns of Tsumeb and Opuwo (Figure 1.1). The Kunene Region is situated on the western boundary while the Okavango Region forms the eastern border (Figure 1.2).

The region is characterised by the Cuvelai drainage system which originates from the Serra Encoco mountains in southern Angola (Figure 5.2). The Cuvelai system extends from the Cunene river eastwards to the Cubango River in the north east of Namibia. The drainage channels or oshanas are more defined south of the Namibian - Angolan border, acting as distributaries for local precipitation.

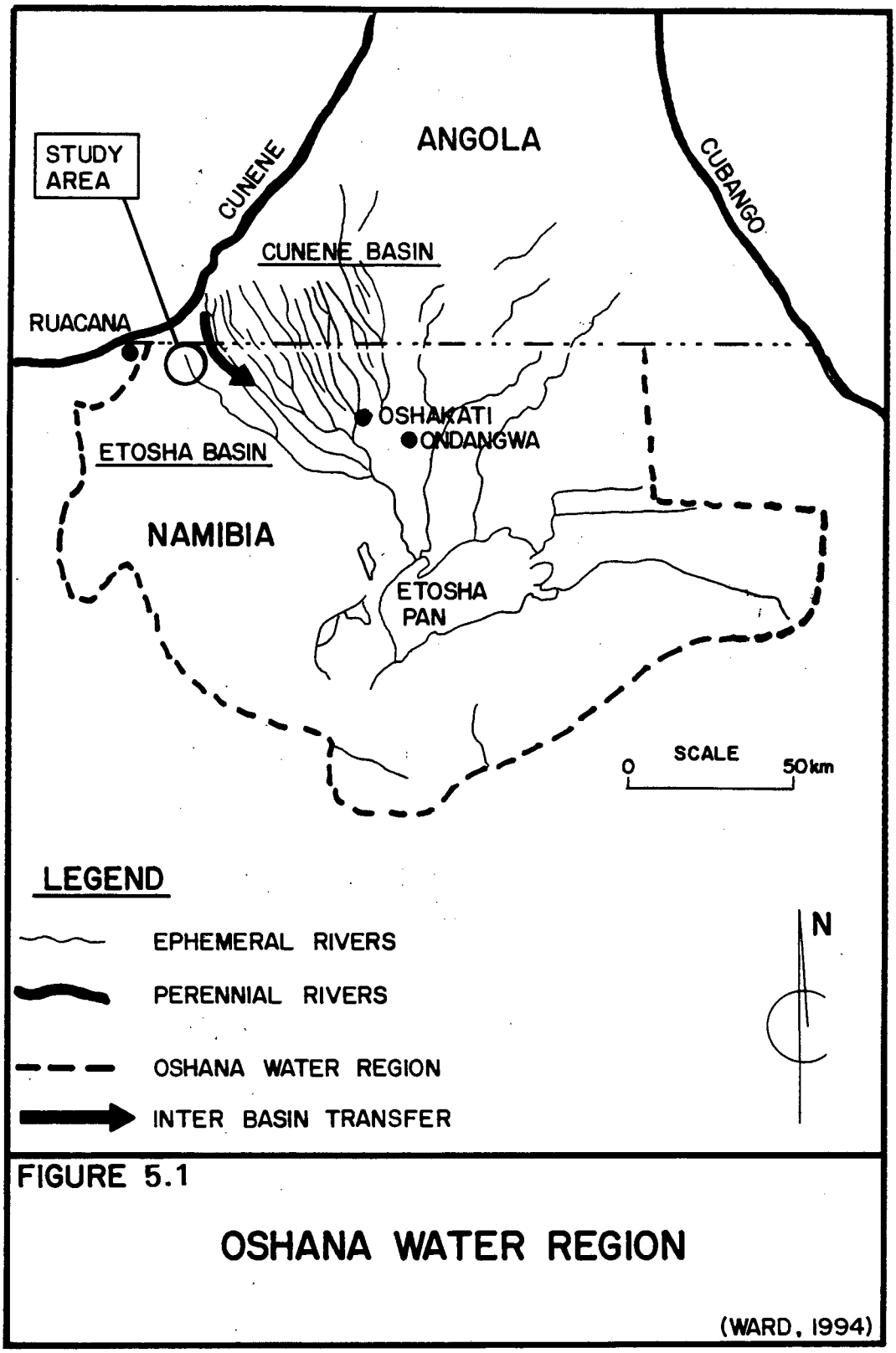


FIGURE 5.1

OSHANA WATER REGION

(WARD, 1994)

Should the catchment receive above average rainfall, floods (efundja) occur, with the result that the water flows down the oshanas in a southerly direction as far as Lake Oponono and Etosha Pan. (Moon & Dardis, 1988).

5.3.1 Natural water sources

Owing to the high population density in the Oshana Water Region (25% more than the average national population per unit area) (Ward, 1994), the ephemeral oshana system is not sufficient to supply the annual water demand for the region.

Water obtained from the Calueque Dam on the Cunene River in southern Angola now supplements groundwater and surface water resources in the region (Figure 2.1). The Cunene River is the nearest source of perennial water for the region. In 1994 it was estimated that 70% of the population in northern Namibia relied on water from the Cunene, while the remaining 30% used groundwater supplies (Ward, 1994).

The natural water sources in the region consist of rain water that collects in the oshanas and groundwater accessed by hand dug wells. The groundwater supplies in the Oshana Water Region consists of perched aquifers which lie on deeper saline aquifers. The fresh water is obtained by sinking wells into the perched aquifers.

The fresh water lenses are found in two forms - discontinuous perched aquifers (DPAs) and main shallow aquifers (MSAs) (Bittner, 1995). DPAs do not have hydraulic connections to deeper aquifers. They are found at shallow depths and only provide limited amounts of water, usually of a good quality. DPAs are recharged by local rainfall only (Bittner, 1995). By contrast, MSAs are much deeper, varying between 5 m and 50 m in depth. They are located within semi-consolidated sand and silt of the upper Kalahari Sequence, and are recharged by both local rainfall and runoff from the oshanas (Bittner, 1995). The quality of the water in the MSAs varies from fresh to saline.

The population rely on the hand dug wells during the dry season for domestic water and sometimes for the watering of small livestock. Normally livestock obtain water from man made dams, pipelines or canals. The wells are constructed by local people, take one to two months to build and range from 15 to 30 m in depth. A bucket with chain is used to draw water. These wells are sometimes extended during times of drought with the result that they tap the lower saline aquifers.

Oshanas are used during the wet season to supply water for domestic and livestock use. Although the rains tend to end during April, water often remains in the oshanas until June. Wellington (1938) describes oshanas as long, vlei like water courses, generally discontinuous except during times of heavy rainfall.

As the oshana channels dry up pans are left providing water for the communities well into the dry season. In some cases the Owambo people favour the water found in the pans as they feel that it is cleaner than the water in the oshanas. A second feature associated with the oshana drainage system are the omifimas. While pans are entirely natural depressions characterised by a relatively impermeable clay surface layer the omifimas are shallow, hand dug, conical depressions sometimes found next to oshanas (Marsh & Seely, 1992).

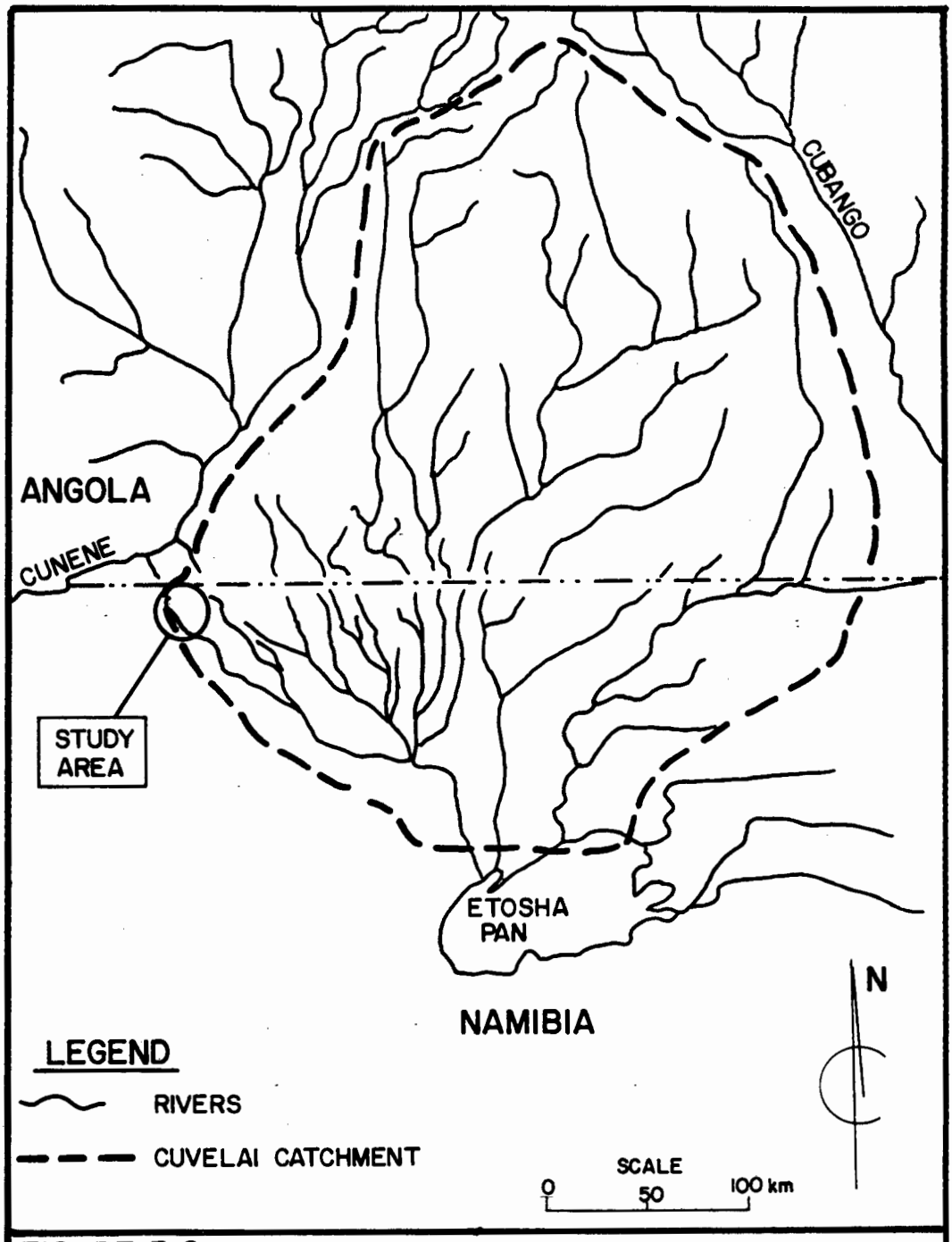


FIGURE 5.2

THE CUVELAI SYSTEM

(SANDLUND, 1992)

The collection of rain water from house roofs is not common in the rural areas. This method for obtaining water is usually found at schools where development agencies have installed rain water collection tanks. As the traditional thatch roof is replaced by corrugated iron or asbestos the use of rainwater collection tanks is likely to increase.

In order to supply water to both urban and rural consumers, the Department of Water Affairs operates bulk and rural water supply distribution networks. In the Oshana Region the bulk water supply is obtained from the Cunene River in Angola.

5.3.2 Bulk water supply

The DWA bulk water supply system in the Oshana Water Region consists of seven main distributors. The first four are responsible for bulk water supply to the Omusati Region in which the Olushandja Dam study area is situated (Figures 1.3 & 2.1):

- The Ruacana pipeline from the Ruacana diversion weir on the Cunene River to the Calueque-Olushandja canal
- The pipeline and concrete-lined canal from Calueque Dam to the border, Calueque-Olushandja canal and the Olushandja-Ogongo canal
- The unlined Etaka canal from Olushandja Dam to Okahau and Ngandjera
- The new concrete canal and the existing pipeline from Ogongo to Oshakati
- The pipeline from Oshakati to Omupale in the south
- The pipeline from Oshakati via Ondangwa to Omutsegwanime in the south east
- The pipelines from Oshakati and Ondangwa north to Oshikango.

The Ruacana-Olushandja pipeline is presently used to supply the Etunda irrigation scheme with water from a pump station on the Calueque-Olushandja canal. With the re-installation of pumps at Calueque there is no need to pump water from Ruacana. The Ruacana supply was used during the war years when the Calueque pump station was shut down for security reasons.

5.3.3 Rural water supply

Although the canals are still used by people for domestic and livestock water supply, a network of pipelines provides purified water to some of the rural residents in the Omusati Region. The rural piped water supply network (Figures 1.3 & 2.1) extends:

- South east from Olushandja Dam via Eunda and Tsandi to Okahao
- South west from Ogongo to Onaanda and Okahao
- North east from Ogongo to Okalongo near the Angolan border.

The rural pipelines serve small administrative centres such as Tsandi and provide rural communities with regularly distributed water points between the centres. In addition the rural population also use boreholes. During the wet season, water is collected mainly from pans and oshanas (Spruitj, 1990; BICON, 1991; BICON/LCE, 1992; Ward, 1994).

A series of earth embankment dams, designed by Stengel in the early 1950's, are also used for additional storage capacity. These have become known as "stengel dams" (Lempp, 1961). Some of these dams are still being used by the local community in the study area (pers. obs). A stengel dam consists of an earth embankment situated next to an oshana or unlined canal. Floodwater is allowed to flow into a sump from where it is pumped into the main off-channel storage dam. Water is collected directly from the dam by the community or pumped through a water purification plant. However, in many cases the pumping plant is not working or has been removed.

In order to increase the supply of water to the communities living along side the Oshana Etaka the DWA is constructing a series of small "off storage" earth dams linked to the water course. In contrast to the Stengel dams these dams will be at a lower elevation to the bed of the Oshana Etaka and will be fed by gravity. (Haussler, pers. comm., 1995).

Boreholes with hand pumps are to be found to the west of Olushandja Dam. These boreholes are drilled into the upper Kalahari sequence at varying depths of between 70 to 90 m (DWA, 1990). They tap the main shallow aquifer. In the far west i.e. beyond the western border of the study area, boreholes are mainly used for livestock watering.

In the Omusati Region, ground water is hosted in the geological formation of the Kalahari sequence. Most of the underground water is contained in a deep regional aquifer (Bittner, 1995). This water is extremely saline. Discontinuous perched aquifers of fresh water are however also found, overlying less permeable alluvial horizons or layers of saline water. These are an important source of water in the region (DWA, 1990).

5.4 ENVIRONMENTAL ASPECTS

In Namibia, a country with scarce water resources, the availability of water is a key element in determining the scale and location of long term development. Water planning and management is thus an integral part of a comprehensive development planning process. Any management plan, such as that proposed in chapter 9 for Olushandja Dam, should form one component of this process.

During interviews, conducted by the National Planning Commission (NPC, 1994b) in the Omusati Region, one of the key findings was that the lack of water was one of the principal obstacles to development in the region. In response to the question: "who was responsible for socio economic development in the different sectors" during the same study, the majority of people replied that central government was.

In reviewing the health and environmental aspects of water management in Namibia, Heyns (1993, p. 29) states that:

"The Department (DWA) is committed to ensuring that environmental management is carefully considered in the planning, design and operation of water supply schemes so as to avoid unnecessary conflict between development and conservation objects as well as to ensure well-balanced water infrastructure development in Namibia".

This statement is an indication that the DWA is committed to some degree of environmental resource planning in northern Namibia and needs to work closely with the Directorate of Environmental Affairs to ensure that the DWA's policies are compatible to those of Namibia's Environmental Assessment Policy discussed in chapter 3.

The environmental priority in Namibia at present is to reduce the effects of desertification (Brown, 1994). This can be attributed to:

- Overgrazing
- Deforestation
- Over cultivation of land
- Poor choice of crops
- Population pressure.

If the spread of desertification is to be controlled, especially in the communal lands in northern Namibia, then a more effective land management plan is required.

The Ministry of Agriculture, Water and Rural Development is presently setting up a scheme to be known as the Northern Region Livestock Development Project. The scheme involves the introduction of semi-commercial ranches in communal northern Namibia over the next seven years. It is designed to improve livestock production and marketing while at the same time attempting to reduce the deterioration of grazing land in the communal areas (Nawa, 1995). Such a scheme is likely to affect the movement of cattle from the Olushandja Dam study area to the communal grazing areas to the west and south west. The planning of the proposed ranches should take into account these movement patterns.

During her research work at the Desert research Foundation of Namibia, Seely found that desertification has occurred mainly where the provision of artificial waterholes has caused the concentration of animals (Cupido, 1994). In order to avoid further desertification taking place in those areas where the semi-commercial ranches are to be implemented, a combined water and land use management plan is required. Water use and land use are interrelated, especially in the semi-arid areas of northern Namibia. Government departments such as the DWA need to acknowledge this when undertaking the " planning, design and operation of water supply schemes" (Heyns, 1993, p.29) .

The position of the Olushandja Dam in an old water course, the Oshana Etaka, may have had an influence on the natural flow of water which existed prior to the dam being constructed. The quality of the dam water is in question owing to the high density of people living along the north western shore, the presence of livestock and the shallow nature of the dam (maximum depth of 3,5 m).

Staff at the Directorate of Environmental Affairs in Windhoek are concerned that, as a result of a lack of institutional structures, the environmental impacts of installing too many boreholes in the western area of the Omusati Region have not been investigated (Tarr, pers. comm., 1994). If excessive groundwater depletion is to be controlled so that future rural water supply projects will be sustainable, then recommendations such as those given by the World Bank need to be incorporated into a water resources management strategy for Namibia.

5.5 MANAGEMENT STRUCTURES

5.5.1 Existing management structure

The conservation and utilization of the natural water resources in Namibia is presently the responsibility of the Department of Water Affairs. The department is one of two departments which fall under the Ministry of Agriculture, Water Affairs and Rural Development. The second department is that of Agriculture and Rural Development.

The Department of Water Affairs (DWA) is split into five directorates: administration; investigations/research; water infrastructure; water supply and rural water supply. The last directorate was transferred from the Department of Agriculture and Rural Development in 1993.

The Directorate of rural water supply is responsible for the supply of water to rural communities and focuses on community involvement to promote the transfer of certain water supply responsibilities to the consumer. Regional water supply offices have been set up to help local and regional authorities with the distribution of water. As the majority of rural consumers are not economically active relying more on subsistence agriculture, the state has a social responsibility to subsidise the supply of water to these consumers.

In contrast the Directorate of water supply operates approximately 130 state water schemes as well as supplying municipalities, commercial enterprises and private consumers. As these comprise the economically active sector of the country cost recovery is implemented in whole or in part. Some of the state irrigation schemes are still subsidized while full cost recovery is obtained from the mining sector (DWA, 1994).

At a public workshop held during 1994 in Windhoek to discuss the Central Areas Master Plan, including the existing Water and Sanitation Policy, the participants agreed that the bulk water pricing system should be reviewed and that the full cost of water provision should be recovered from end users.

In order to facilitate the restructuring of the water sector in Namibia the Ministry of Agriculture, Water and Rural Development was given a mandate in 1993 to investigate the possibility of the commercialisation of the bulk water supply function. Problems such as the pricing and sale of water could then be effectively dealt with.

The first phase of the Water Commercialisation (WATCOM) Project, determination of an appropriate model for commercialization, was completed in May 1994. The second phase, which includes the preparation of plans, policies and procedure, is presently in operation.

5.5.2 Water law

The current legislation dealing with the control, conservation and use of water in Namibia is the South African Water Act (Act 54 of 1956) (RSA, 1956). The Act incorporates several mechanisms of state control:

- Subterranean government control areas
- Government water control areas
- Government drainage control areas
- Catchment control areas
- Dam basin control areas
- Water sport control areas.

Section 59(4)(a), which deals with the reservation of areas for dams (Dam basin control areas) is relevant to the management of Olushandja Dam. Control over such areas is exercised by the Minister by means of issuing permits for certain activities and for water utilization.

One of the constraints identified by WATCOM is that of water legislation. The existing Water Act has become outdated due to changes which have taken place since Namibian independence in 1990, the Act has never been fully appropriate to the particular water environment of Namibia and the legislation needs to be updated to take into account the provisions of the new constitution. The working committee recommend that: "It is proposed that the drafting and promulgation of a new Water Act should be pursued as a matter of urgency" (DWA, 1994, p.ES-14).

5.5.3 Planned management structure

The commercialisation of a directly controlled state activity is not a new concept in Namibia. Namibia Post and Telecom Holdings Limited, Namibia Development Corporation and the SWA Water and Electricity Company Pty Limited are examples of commercialised activities.

The commercialisation of the bulk water supply function is intended to remove a number of key constraints that presently face the water sector in Namibia. These include:

- Budgetary constraints
- Tariff constraints
- Public sector constraints
- Legislative constraints
- Sector coordination constraints.

In May 1995 the Namibian government requested applications for the post of chief executive officer to head the newly created Namibia Water Corporation. Once the management posts are filled the following structural changes are envisaged:

- The DWA will continue to be responsible for the administration of law enforcement with regard to quality standards for potable water and the management of water resources. The DWA will consist of two directorates; rural water services and regulation, planning and control. The divisions of regulation and scientific services. There will also be an administration division
- Bulk water services will be separated from the DWA and transferred to the Water Corporation
- The Directorate Rural Water Supply will remain in the DWA
- The Department of Agriculture and Rural Development will take over the responsibility for the reticulation of irrigation water.

The proposed structure of the Water Corporation consists of five divisions: finance and administration; human resources; water services; engineering services and scientific services.

The problem of which state water schemes fit into the category of bulk water schemes needs to be addressed. Some of these schemes supply rural consumers while others supply government departments such as health and education. Such schemes should remain the responsibility of the DWA. The WATCOM Project committee proposed that: "in Phase 2 of the project the status of all bulk and rural water supply schemes be evaluated and an appropriate classification be made prior to the transfer of bulk water supply schemes to the company" (DWA, 1994, p.ES-19).

The proposal that all state water supply schemes be evaluated will affect the setting up of a management plan for Olushandja Dam. If the dam is seen as primarily a part of the bulk water supply for the Oshana Water Region then its management will fall under the control of the Namibian Water Corporation. However, if the dam provides a rural water supply function then control will remain with the DWA. The situation is further complicated in that the dam occupies land within a communal area. The local communities presently have unrestricted access to the water. The future management of this reservoir should take this situation into account. Recommendations are given in chapter 9.

This chapter reviewed the general water resource situation in the Oshana Water Region and the present structure of the department responsible for the distribution of water. Chapter 6 describes in more detail the socio-economic problems of obtaining water in the study area with particular reference to Olushandja Dam. The environmental impacts of the biophysical components are given for each of the specialist studies undertaken as part of the Olushandja EIA.

6 SIA BASELINE AND OTHER SPECIALIST REPORTS

6.1 INTRODUCTION TO THE SPECIALIST REPORTS

In December 1994 a project team from the Mphil Programme of the Department of Environmental and Geographical Science and the Environmental Evaluation Unit, University of Cape Town, was appointed to the consulting team for the Calueque Phase II project in northern Namibia (Roberts, pers. comms., 1994).

The environmental evaluation for the Calueque Phase II project is split into two parts. Part 1 covers the environmental investigation of the bulk water upgrading scheme in Namibia. Part 2 deals with the upgrading scheme at Calueque Dam in southern Angola. For the reasons given in section 2.1 the consulting team will not be involved with Part 2.

The overall management of the project is being undertaken by the Directorate Investigations and Research, Department of Water Affairs, Windhoek. The environmental evaluation follows "Namibia's Environmental Assessment Policy" (NDEA, 1994). Specialists from the private and government sectors provided reports on particular aspects of the project as identified in the terms of reference.

6.2 TERMS OF REFERENCE

The first steering committee meeting with the client, the Namibian Department of Water Affairs (DWA), was held in Windhoek during the second half of December 1994. At the meeting the terms of reference for the EIA and the role of each specialist were discussed.

Prior to the meeting preliminary meeting terms of reference were sent to external consultants. During the period December 1994 to March 1995 the objectives and scope of the work for the social impact assessment were revised to take into account the limitations of time and access. The final terms of reference used to compile the social impact assessment baseline report (ENGEO, 1995) and the socio-economic section of the full EIA are given in Section 6.5.1

At the second steering committee meeting held in January 1995 a number of changes were made to the structure of the study team (Appendix 1). Staff from the Ministry of Wildlife, Conservation and Tourism were not in a position to provide a specialist report for the EIA. However the Directorate of Environmental Affairs was prepared to coordinate and review various aspects of the EIA as required. The Department of Agriculture, Ministry of Health and Social Services and the National Planning Commission were not able to take part in the EIA. Owing to time constraints the Department of Geography and Environmental Studies at the University of Namibia was not able to allow students to take part in the socio-economic study.

After the first field trip, undertaken in January 1995, it became apparent that two new specialist reports were required. The first would be carried out by the hydrology division of the DWA. It would describe the hydrology of the system and suggest different operating procedures for Olushandja Dam.

The second report would cover a desktop study of the effect of the dam water levels on the groundwater situation within the study area. This would be produced by the DWA's groundwater division in association with Parkman Namibia. By June 1995, owing to time constraints, the hydrology report was not yet available.

6.3 STUDY APPROACH AND METHODOLOGY

The approach and methodology used in undertaking the SIA and other specialist reports was based on the procedures given in: "Namibia's Environmental Assessment Policy" (NDEA, 1994). Where necessary the South African Integrated Environmental Management Guideline Series, produced by the Department of Environmental Affairs (DEA, 1992), were used to support the Namibian document.

Two of the nine objectives stated in the Namibian EIA policy document (NDEA, 1994), which are relevant to the EIA are to:

- (ii) consider a broad range of options and alternatives when addressing specific policies, programmes and projects

- (iii) strive for a high degree of public participation and involvement by all sectors of the Namibian community in the EIA process.

Because the impacts of the project on the socio-economic environment are seen to be greater than those on the biophysical environment the background to the SIA will be dealt with in greater detail. The other five studies are an integral part of any management plan and are thus important in determining both the impact of the various scenarios on the communities and the impact of the people on the dam.

From the work undertaken during the socio-economic study it is clear that in order to provide a complete environmental impact assessment the following studies should be included:

- A review of the current and potential land use with specific reference to conservation and livestock management

- A study of the current health services available in the study area along with the incidence of water borne diseases

- A need and availability study of the boreholes to the west of Olushandja Dam.

- A study of the importance of the Etunda irrigation scheme to the west of the dam to the local and regional economy

- An investigation into the present use of indigenous vegetation to supply timber for. fuel and building

At this stage of the EIA (June 1995), constraints on time and finances mean that unless other ministries provide assistance these studies will not be undertaken. In the introduction to this chapter mention was made of the fact that certain key ministries had been invited to take part in the EIA by the client. Unfortunately this help did not materialise and no money is available to employ consultants to undertake the work.

The incomplete nature of the EIA could have implications for the decision making process depending on the parties involved in the process and the significance they attach to the importance of the environmental characteristics not included in this study.

6.4 SOCIAL IMPACT ASSESSMENT

6.4.1 Introduction

The socio-economic study was carried out by the UCT study team. Prior to the first field trip in January 1995 the team conducted a review of the literature covering the social and biophysical aspects of the region and the study area.

Two field trips were undertaken in order to become familiar with the site and to investigate, identify, evaluate and report on the social effects which the proposed water supply upgrading scheme might have on the communities living within the study area. In addition to the two site visits, staff from various governmental and private organisations were interviewed to canvass their views on the Calueque-Olushandja upgrading scheme.

The UCT study team was provided with the following terms of reference (ENGEO, 1995). The main objectives of the study were to:

- Undertake a comparison of the existing social groups or communities that have gradients of availability or access to water from the Olushandja Dam and other water supply infrastructure
- Evaluate how water provision has influenced the social environment
- Predict the positive and negative socio-economic effects of the proposed water supply upgrading project in both the short and long term
- Develop various scenarios for the management of the dam and identify opportunities, impact and resource replacements for the communities affected by these scenarios
- Identify and evaluate any remedial measures which may be required and provide recommendations for a simple and cost-effective monitoring programme.

It is important to note that although the UCT study team were given initial terms of reference they were allowed to revise them to suit the particular conditions of the study area and the people being interviewed. This was done once the first site visit was completed. The benefits of this approach were that the methodology could be developed around the EIA's limitations and allow scope for future studies to be carried out if required.

6.4.2 Methodology

The methodology for the SIA drew on a combination of rapid rural appraisal (RRA) and participatory rural appraisal (PRA) methods. Secondary information was reviewed and preliminary questionaires with check lists compiled using the RRA approach. After the first site visit and consultations with people from the government and private sectors, the questionaires were refined.

PRA methods were incorporated into the household interviews, key informant interviews and the running of the community meeting.

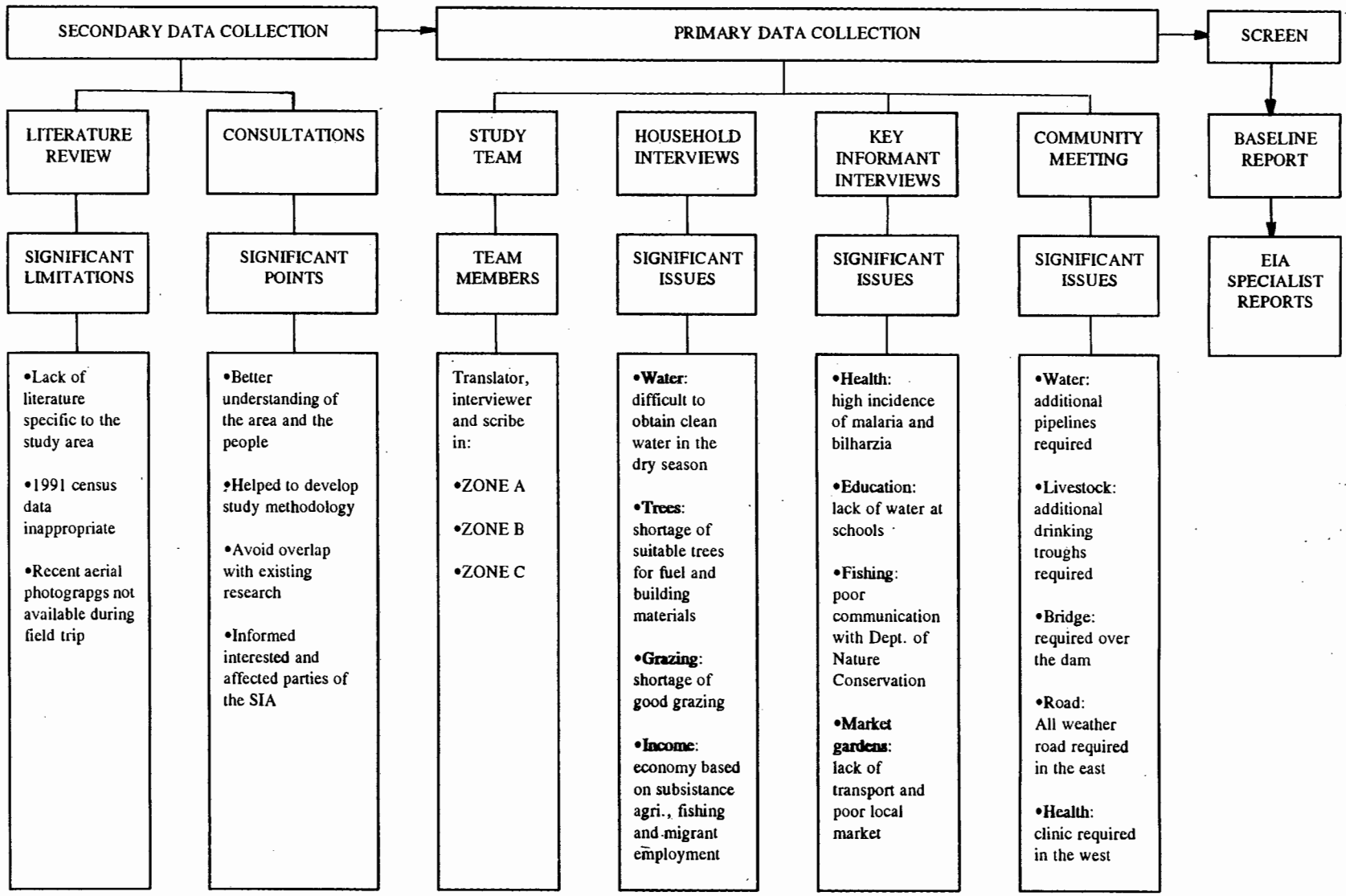
At the first coordination meeting a number of limitations were identified and the client accepted that the SIA baseline report would be written taking these into account:

- The study team had limited time available
- A through scoping exercise had not been carried out prior to the team's first visit to the site. The communities interviewed would not have been part of the EIA planning process from the start
- Some of the recognised SIA research methods are costly in terms of human resources and time
- The communities in northern Namibia have been subjected to repeated studies by research groups since independence in 1990
- Owing to the flat terrain and extensive system of pans and interlinking water courses within the study area access is difficult during the wet season
- The agricultural system in northern Namibia is predominately subsistence. Most of the people interviewed would be either women or the elderly. Men tend to migrate to the urban centres in the south east in search of employment.

6.4.2.1 Secondary data collection

The SIA methodology used for the Olushandja Dam EIA comprised two components. Secondary and primary data collection. The collection of secondary data involved a literature review and consultations with interested and affected parties outside the study area. This component was carried out before and after the field work. Primary data collection involved the interviewing of people within the study area who may be directly affected by upgrading of the dam. The stages of the social impact assessment methodology is shown in Table 6.1.

TABLE 6.1 : STAGES OF THE SOCIAL IMPACT ASSESSMENT METHODOLOGY



Literature review

As a precursor to the SIA a comprehensive literature review was undertaken using the resources available at the University of Cape Town; at various libraries and institutions in Windhoek and from private consultants. The review concentrated on the social structure of the communities of northern Namibia, the biophysical characteristics of the study area and the technical aspects of the upgrading scheme. Sources included: Maps; policy documents; legislative material; census data; reports on various environmental assessments and social studies conducted in northern Namibia.

The main problem encountered in the collection of secondary data was a lack of literature specific to the study area. In addition the aerial photographs from which the 1: 50 000 topographical maps, used during the study, were produced were dated, having been flown in the late 1960s. However at the request of the UCT study team new 1: 20 000 aerial photographs were flown and printed in April.

Consultations

In order to gain an insight to the scope of work being carried out within and adjoining the study area the study team interviewed key people from government departments, parastatals, research institutions, NGOs, international funding agencies, consultants and United Nations representatives.

By the end of the first site visit the team had acquired a base of information from literature, views of people who had worked in the area or very similar areas, and personal observation of site conditions.

6.4.2.2 Primary data collection

The study team

During the second field trip, during which the field surveys were carried out, the UCT study team were joined by three Owambo translators from the Department of Water Affairs. The study area was split into three zones (A, B & C) which extended around Olushandja Dam (Figure 6.1). The study team was divided into three interview-teams, each having a translator, an interviewer and a scribe and each interview-team was assigned a zone.

Household interviews

The household interviews formed the main part of the study. The aim of these interviews was to gain an insight into peoples opinions and perceptions relating to water availability and peoples behaviour in terms of water utilisation. Owing to the nature of the study, the study team decided on a qualitative rather than a quantitative approach in the structuring of the questions. A study of the communities to the south east of Olushandja Dam had been carried out in 1993. Most of the material obtained from that survey had been quantitative.

N

NAMIBIA

ANGOLA

MAHANENE

10,0 km

5,0 km

2,5 km

OMBALANTU

OGONGO CANAL

ESHINGA

OSHANA ETAKA

ZONE C

ZONE B

ETAKA CANAL

OSHAALA

OKAANGA

TSANDI

ZONE A

OMNDAMBA

ELAO MARKET GARDEN

SOUTH WALL

NORTH WALL

EPALELA

EPALELA MARKET GARDEN

ONESI

CANAL FROM CALUEQUE

BORDER POST

CALUEQUE CANAL

EUNDA

30 % FULL SUPPLY LEVEL (1104,5m)

FULL SUPPLY LEVEL (1106m)

RECOMMENDED LIMIT OF SETTLEMENT AT TIME OF DAM DESIGN (1107,5m)

ETUNDA

RUACANA

ETUNDA IRRIGATION SCHEME

LEGEND

CANAL

ZONE BOUNDRIES

SCALE 0 5km

FIGURE 6.1

OLUSHANDJA DAM STUDY ZONES

The questionnaire was split up into various categories ranging from household particulars, through livestock to the use of water. Questions were designed to be open ended so, although the questionnaire was structured there was room for interaction and discussion. In many cases the opinions and issues that came from asking the questions were of more value than a one sentence answer.

In total the three interview-teams interviewed eighty households during the seven days of interviewing. The identification of households to be interviewed was governed by access to the houses and an attempt to get an even spread of interviews around the dam in the time available.

From a study of the April 1995, 1: 20 000 aerial photographs the number of households in each zone was obtained. Based on an average of 9 people per household (ENGEO, 1995) the total estimated population for the study area is 23 500. The percentage of households interviewed is 3 % based on a household count of 2 614.

Key informant interviews

Key informant interviews were held to supplement the data collected from the household interviews as well as discussing specific issues such as fishing and water supply to schools and clinics. Those people interviewed included the two local headmen; school principles and teachers; health workers; fishermen and people involved with the running of the two market gardens, Epalela and Elao, on the western shore of the dam.

As with the household interviews specific interview guidelines were drawn up for each group of key informants. The questions included those relating to the community and the role of the key informant within the community. Most of the key informant interviews were conducted after the majority of the household interviews had been completed so additional questions were added to discuss issues raised during the household interviews.

Community meeting

The third stage of the primary data collection was the holding of a community meeting. This took place towards the end of the field trip at Eunda village (Figure 2.1).

The purpose of the meeting was:

- To provide the opportunity for those people who did not know about the study to meet the team and ask questions
- To provide feedback to the community on the work undertaken during the field trip
- To hold a workshop to find out about the important places in the study area
- To learn from the people what they felt were the important issues.

The meeting consisted of three parts. The first dealt with introductions by the local councillor, headman and the UCT team. The team members were introduced and the reasons for undertaking the Olushandja Dam study given. The workshop process was explained and questions answered.

For the second part, the meeting participants formed three groups. Each group was accompanied by three members of the study team, a facilitator, a scribe and a translator. The PRA technique, "land-use mapping" was used. The technique was useful in obtaining a general overview and a spacial idea of how the community interacts amongst themselves and with their environment. There were no rules or set structure with the process the group meetings being allowed to follow their own course.

The final part of the meeting consisted of a feedback session where the issues identified in each group were summarised and discussed with the participants. The community had the opportunity to add any information that they felt the study team had missed or correct ideas that had been interpreted incorrectly.

Field observations

The fourth component of the collection of primary data was that of field observations during the two site visits. The information collected from the field included:

- A distribution of different vegetation types
- An overview of the differences in the biophysical and social environments during the dry and wet seasons with specific reference to water utilisation
- Observations to gauge the spatial mobility of the local population.

Logistics

The presence of oshanas and fairly extensive flooding in the area posed logistical problems in terms of accessing certain areas within the study area. Hand held global positioning instruments (GPS) were used to fix the position of each household visited or key informant interviewed. The coordinates were plotted on a 1:50 00 map each evening. The resulting pattern of interviews enabled the groups to plan the work for the following day and fill in any gaps towards the end of the study period.

6.4.3 Significant findings

The following key findings emerged from the socio-economic study:

- People want clean water for household use and raw water for their livestock. Schools and clinics require a more permanent source of supply than the present tanker system
- Cattle obtain water from the dam because there are not enough drinking troughs along the Olushandja-Tsandi pipeline
- Cattle have to be taken as far as Opuwo and Ruacana (Figure 1.2) in search of grazing. There is little grazing within the study area
- People want a bridge to connect the west and east sides of the dam at the point where the old Eunda-Oshaala road is flooded by the dam
- The need for a road on the eastern side of the dam was identified.
- A clinic is needed in the west
- There was not a significant influx of people to the study area after the dam was built
- People living around the dam were keen on fishing but owing to a breakdown in communication with the Department of Nature Conservation the full potential of the dam was not being used
- Most of the households rely on subsistence agriculture. This is supplemented with money from pensions and relatives who work in the main centres such as Windhoek and Walvis Bay in the south
- Women are often left to run the households as husbands are employed for all or part of the year in the south
- Water borne diseases such as malaria and schistosomiasis are a problem for the people who come into contact with the dam.

The social impact assessment carried out for the Olushandja Dam provided the study team with key learning points with regard to both the methodology for carrying out such an assessment and the lifestyle of the community members of the study area.

The five biophysical surveys carried out between January and May this year will now be discussed with their respective significant findings highlighted.

6.5 LIMNOLOGY

6.5.1 Introduction

During the period January to May 1995 members of the Research Division, DWA, visited Olushandja Dam on three occasions to conduct a limnology study. The objectives of the study were to determine the likely effects of the upgrading scheme on the water ecology, to make recommendations for mitigatory measures to reduce any environmental costs and to provide a limnological baseline for future monitoring. The study would also contribute to the studies being undertaken by the other specialists involved in the EIA (Roberts, 1995a).

6.5.2 Methodology

The study was divided into three components:

1. An examination of the main aquatic plant communities in the dam was conducted during the March and April field trips. Aerial photographs flown in April provided details of the habitat structures and their distributions.

2. Water samples were taken throughout the reservoir to record changes in water chemistry and nutrient loads. Oxygen concentrations and temperatures were measured; bacteriological samples were taken; plankton were sampled while aquatic plant and aquatic invertebrates were collected. Water samples were taken from Oshanas and other open water sources to which the reservoir water could be compared.

3. During the site visits records were kept of bird sightings and their use of aquatic habitats; the local small mammals were sampled; amphibians were collected and the use of the dam by people and livestock recorded.

6.5.3 Significant findings

Based on the chemical and bacteriological analysis of the water samples combined with the information collected during the three site visits the following conclusions were reached by the research team:

- The turbidity of the water is high as a result of the shallow depth, the old oshana silt deposits, input water from the silt laden Cunene River and the stirring action of the wind
- Owing to the fairly constant water levels in the past, communities of aquatic plants have established themselves along the shore in the northern section of the dam. These conditions provide valuable microhabitats for aquatic fauna. As a result increased biological productivity in the dam has taken place. Such plant growth along the shore provides protection from wave action
- The reservoir was used more by people and livestock during the end of the dry season (January) than after the start of the rains in February. The lower number of people recorded using Olushandja in March can also be attributed to the start of the agricultural season
- The limited range in oxygen levels indicate that the dam is well mixed
- Temperatures varied little between sample sites or with depth. This confirms that the water is mixed
- Nutrient levels were relatively low and the water does not seem to be enriched. However turbidity can affect nutrient readings
- Ammonia levels in the southern part of the dam were fairly high
- Bacterial levels were extremely low except in two areas used by people for washing and collecting water. Water quality monitoring should be undertaken at such sites
- The salinity levels increase from north to south. Although the sample results are acceptable, further monitoring is required
- The occurrence of old tree stumps in the dam will have to be taken into account should a commercial fishing project be considered

(Roberts, pers. comm., 1995c).

6.6 FRESH WATER FISH

6.6.1 Introduction

In March 1995 the Ministry of Fisheries and Marine Resources undertook an assessment of the current and possible future status of the fresh water fish population in the Calueque-Olushandja water transfer scheme.

The objectives of the study, as described in the terms of reference given to the government specialists Hay and van Zyl (Hay & van Zyl, 1995) were:

- To determine the species composition
- To present some biological data on the abundant species
- To calculate production estimates of Olushandja Dam
- To recommend possible aquaculture and or fisheries ventures for the local people.

6.6.2 Methodology

Most of the sampling work was carried out in Olushandja Dam. Samples were taken throughout, covering all the various ecological niches within the dam, using gill nets and drag netting. The physical characteristics of the samples were measured and an internal examination of the fish undertaken.

6.6.3 Significant findings

The study highlighted the following findings:

- Olushandja Dam has a high species diversity compared to the oshanas found in the region.
- The pipeline and canal link between the Cunene River and Olushandja Dam has positively influenced the fish production and species diversity of the Cuvelai system.
- The proposed increased transfer of water into the Olushandja Dam is likely to lead to an invasion of fish species from the Cuvelai system to the Cunene River.
- An increase in the abstraction rate from the Cunene River at Calueque Dam could lower the water level in the river downstream of the dam during dry periods. This situation would be detrimental to the fish in the Cunene River.
- The high turbidity of the water in the dam has resulted in at least one species of fish remaining at a low population level.
- A rise in water level will result in newly inundated areas with a corresponding increase in fish production. It is expected that there will be an initial increase in fish production which will be beneficial in the short term to the local communities.

6.7 FRESH WATER SNAILS

6.7.1 Introduction

This section deals with the distribution of fresh water snails and snail borne diseases associated with the Calueque-Olushandja water supply network . The investigation was conducted during 1995 (Curtis, 1995).

The objective of this study was to provide the client with an assessment of the current and expected future effect that aquatic snails play in the transmission of human and livestock parasitic disease in the study area.

6.7.2 Methodology

The methodology for this report comprised of two stages. The first involved a literature search on snails and snail borne diseases and their distribution in the study area. Secondly field survey was undertaken of the canal from the Angolan border to Olushandja, the Olushandja to Ogongo canal, the Etaka Canal and Olushandja Dam.

Fieldwork was carried out over a one week period in March 1995. At that stage the study area had experience heavy rainfall. Snail samples were taken from sites throughout the dam. Samples were obtained from the Calueque-Olushandja canal; at the start of the Olushandja Dam inverted siphon; the earth lined Etaka Canal; the old earth lined canal from Olushandja to Oshakati; rain water pools and oshanas.

Laboratory work was undertaken on the snail samples to determine the degree of infestation of snail hosts with trematodes and the presence of parasites.

6.7.3 Significant findings

As part of the terms of reference the consultant was required to provide DWA with an assessment of the likely short and long term effects of the upgrading scheme on the distribution of snails. Recommendations on the control of the spread of snails, the associated diseases and monitoring requirements were to be included.

The following findings were highlighted in the report:

- The transfer of water from Cunene River to Olushandja Dam has resulted in the introduction of species of mollusc into the study area
- The creation of a permanent water body has allowed certain species to become well established in the dam and associated canals
- The snail intermediate hosts for both urinary bilharzia (human) and liverfluke (livestock) are present in the Olushandja Dam in such numbers as to pose a threat to the health of both people and livestock
- Although the host for intestinal bilharzia does not pose a problem at present it could do so in future
- Clinical cases of urinary bilharzia have been recorded and circumstantial evidence indicates that the disease is present in the area
- Flukes have been recorded in the livers of slaughtered animals in the Omusati region but clinical cases of liverfluke have not been recorded. Animal schistosomiasis and conical fluke do not appear to be a problem at present

6.8 AQUATIC PLANTS

6.8.1 Introduction

This report covers a survey of aquatic and wetland plants associated with the Olushandja Dam and the canals leading to and from the dam. A list of terrestrial species affected by the possible rise in water level was provided along with an investigation of possible invasive species brought in by the distribution canal from Calueque Dam. A literature survey of aquatic plants and their distribution in the study area was compiled (Burke, 1995).

6.8.2 Methodology

The study was undertaken during April 1995 with 28 sample sites selected over the extent of the dam. The selection of the sample sites was based on the extent of the dominant vegetation and the need to obtain representable samples of all possible aquatic community types. A specimen from each species was taken along with water depth and descriptive notes on the habitats made.

A section of the Calueque-Olushandja canal near Olushandja Dam was sampled to investigate the possible introduction of invasive plants from the Cunene River and Calueque Dam.

Transects were used to survey the terrestrial plant habitats along the western shoreline of Olushandja Dam. These 300 m transects were undertaken at each aquatic plant sampling site and extended into the mopane woodland. A list of plant species and physical characteristics were recorded.

6.8.3 Significant findings

Based on the field work, the subsequent identification of plant material and the literature review the following points should be considered during the evaluation of the impacts of the different management scenarios for the dam:

- Since the dam was built, five major aquatic and wetland community types have colonised the Olushandja Dam.
- The present plant communities in the dam provide a biological diversity which should be maintained.
- A rising water level is not expected to affect the floating mats of vegetation, since their dominant species are adapted to seasonal changes in water level.
- Provided that changes in water level do not occur suddenly, the reedbeds in Olushandja Dam will not be affected by a fluctuating water level.
- Floating-leaved vegetation will not be affected by a rise in water level.
- Fringe vegetation comprises short lived annuals adapted to changing water levels and capable of colonising new margins if the water level rises.
- A rise in water level may improve the terrestrial vegetation pattern by flooding some of the unpalatable grazing species. A rise in water level will not destroy any rare wetland associated communities.
- Several species of a stem-succulent (*Hoodia*) which is a protected species occur in the south eastern corner of the dam. Transplants should be considered as they would be affected by a rise in water level.
- No invasive species were recorded in the dam and the distribution canals.

6.9 GROUNDWATER

6.9.1 Introduction

In March 1995, the Geohydrology Division (DWA), in association with Parkman Namibia, compiled a report, describing the influence of the Olushandja Dam on the groundwater in the Oshana Etaka area. This study was requested by the UCT study team after they had returned from their first field trip to the study area. During the site visit it was apparent from personal observations that the people relied on hand dug wells for domestic and livestock water. Management options for Olushandja Dam could influence the quality and quantity of the groundwater in the vicinity of the dam (Bittner, 1995).

6.9.2 Methodology

The report is based on a major study of the groundwater conditions in northern Namibia, carried out in the past by Parkman Earth Science for the Geohydrology Division of DWA. No recent site investigation was carried out.

The report covers the following items: background; groundwater; groundwater recharge; influence of the Olushandja Dam on the recharge to the DPA (discontinuous perched aquifer) and MSA (main shallow aquifer) and conclusions.

6.9.3 Significant findings

The report concluded with three key findings:

- The runoff in the Oshana Etaka and therefore the recharge to the main shallow aquifer is not significantly affected by the Olushandja Dam, due to the proximity of the water shed between the Cunene and the Etosha Pan catchments

- The recharge to the discontinuous perched aquifer is not affected by the dam, due to the recharge by local rainfall

- The spill of water into the Etaka Canal leads possibly to limited recharge to the main shallow aquifer, resulting in a possible improvement of the groundwater situation. The quality and quantity of the groundwater is likely to improve during the dry season as a result of such a water release

The "heart of the environmental impact statement" is, according to the US Council on Environmental Quality (Glasson, 1994, p.77), the discussion of alternatives. This chapter dealt with the six specialist reports commissioned by the client to provide baseline information on the biophysical and socio-economic environments. Chapter 7 considers five water level management alternatives for Olushandja Dam. By looking at a number of alternatives a framework can be built. This framework forms part of the decision making process.

7 MANAGEMENT SCENARIOS FOR OLUSHANDJA DAM

7.1 INTRODUCTION

The terms of reference received by the UCT study team from the DWA included the development of various scenarios for operating Olushandja Dam (Chapter 6). The dam has been operated at an average water level of 30% of full capacity (42,3 Mm^3) during the period, January 1991 to February 1995. This level allows the DWA to balance inflow with the present demand, evaporation and seepage (DWA, 1995).

The upgrading of the pumping capacity at Calueque Dam, Olushandja Dam north wall pump station and Olushandja Dam south wall pump station is presently taking place. Once completed the DWA will be able to manage Olushandja Dam using various scenarios. The biophysical and socio-economic baseline reports produced for the EIA were described in chapter 6. They form part of the "Impact Assessment" step in the IEM procedure (Figure 3.2). This baseline data will be used to identify the magnitude and evaluate the significance of each proposed alternative, on the affected environment. This chapter examines five management scenarios with their corresponding implications for the DWA's management of this water resource for northern Namibia.

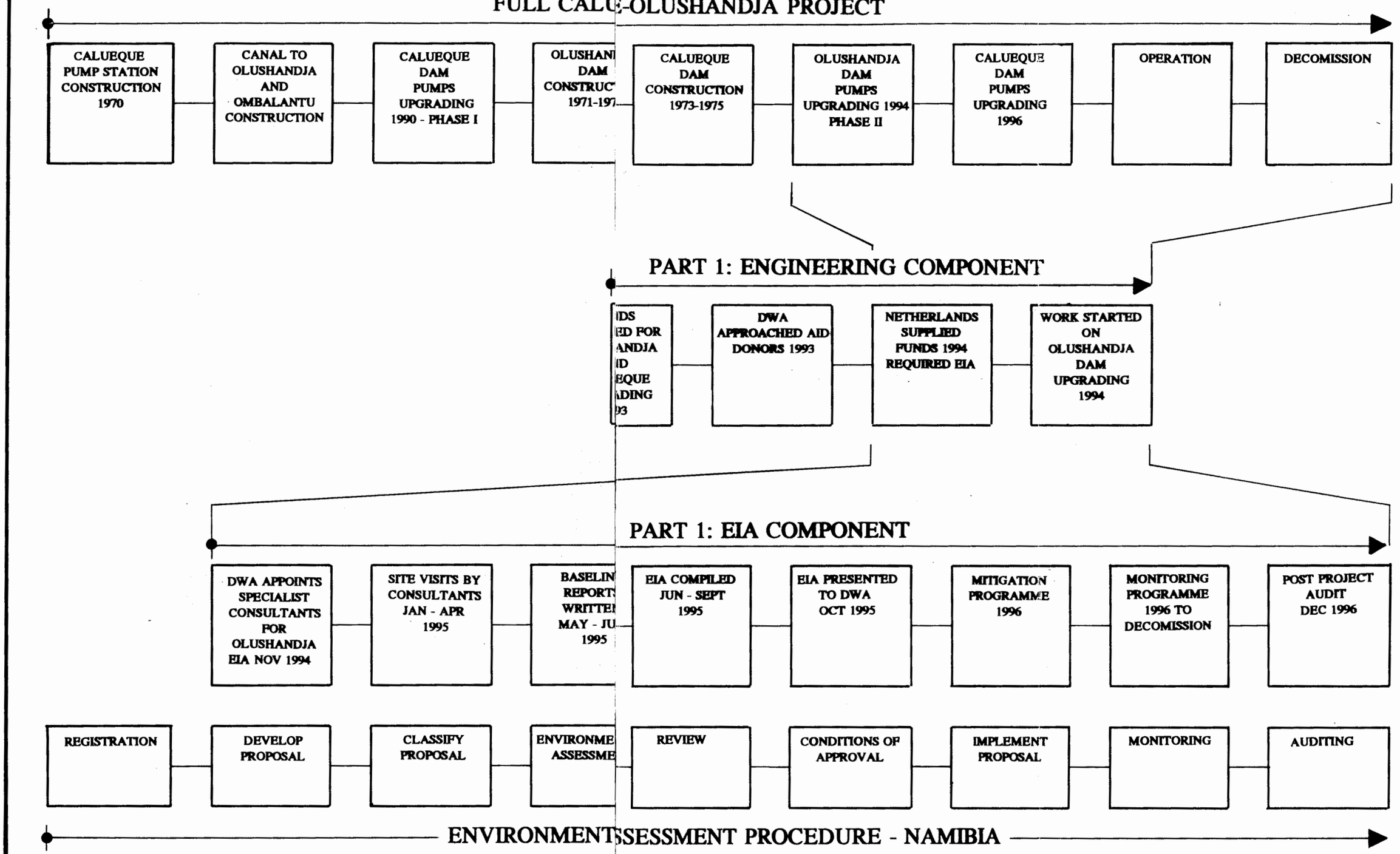
7.2 OLUSHANDJA DAM EIA AND THE PROJECT CYCLE

The upgrading of the Calueque-Olushandja scheme involves two components, engineering and EIA. The engineering component was started in 1994 (Figure 7.1) and is described in chapter 2. By June 1995 most of this work was complete. The EIA component was started during 1994 (Roberts, pers. comm., 1995b) in order to comply with the funding requirements of the Netherlands. The appointment of the environmental assessment team took place in December 1994 by which time the engineering component was well under way. Referring to the project cycle, as described by Ebisemiju (Figure 3.1), the Olushandja EIA was only incorporated into the cycle between the "project design and engineering" and "project implementation" stages.

In Table 3.1 Haeuber shows the degree of non governmental participation at each stage of a typical World Bank project cycle. If the Olushandja EIA had followed the recommendations of the World Bank the communities presently utilizing the dam would have been given the opportunity to participate in the formulation of the alternatives at the "identification" stage. If this had been done there would have been time for the DWA to make changes to the engineering component if required. In terms of the Namibian Environmental Assessment Procedure (Figure 3.3) stage 11 "implement proposal" had been reached before the EIA was started. It is clear from the DWA's handling of the overall project up to the end of 1994 that Namibia's draft Environmental Assessment Procedure, available at the time, or the South African IEM procedure (Figure 3.2) were not utilised By DWA. This is one example of the problems highlighted in the implementation of EIA's in Africa (Section 3.2.4).

Hirji and Ortolano (1991) discuss the effectiveness of the Tana Delta (irrigation development) EIA implementation process. This example is relevant to the Calueque II project for two reasons. Firstly the proponent (The Tana and Athi Rivers Development Authority (TARDA)) secured funding from the Dutch bilateral aid agency (DGIC) to conduct a feasibility study. Secondly the EIA did not "influence project formulation because it was implemented after the feasibility study conducted by Haskonning Royal Dutch had been carried out." (Hirji & Ortolano, 1991, p. 165).

FIGURE 7.1: CALUEQUE PHASE I[illegible]ECT - PART 1: PROJECT AND EIA FLOW DIAGRAM



It is interesting to note that based on the findings of Haskonning Royal Dutch, the DGIC appointed Nairobi firm of consultants to conduct a full EIA. Based on the findings of Ecosystems Ltd, the DGIC discontinued their project funding resulting in TARDA having to approach new donor agencies for funds to complete the project. The main difference between this case study and that of Olushandja Dam EIA is that while TARDA took no part in selecting the consultants or formulating the terms of reference the Namibian Department of Water Affairs was proactive in both these tasks.

By the time the UCT study team visited the site in January 1995 no alternatives had been chosen by the DWA. The development of scenarios for the management of Olushandja Dam was one of the tasks to be undertaken by the EEU in compiling the environmental assessment report. The benefit to the DWA of allowing the consultants to draw up the terms of reference was that the choice of alternatives could be made based on the results of the field work. The five alternatives chosen in this dissertation are thus not necessary those that the DWA would use. However they have been selected to provide a broad range of options that are feasible in terms of engineering, management and economics.

7.3 CONSULTING ENGINEERS PLANNING REPORT

LUND Consulting Engineers were appointed in 1992 (LUND, 1992) to consider various alternatives to upgrade the Calueque-Olushandja component of the Calueque Dam Phase II project. Water balance calculations were undertaken for a number of alternatives with the result that four options were short listed. In their report (alternative 2/1, section 6.3) the consulting engineers recommended that:

- Provision be made at Calueque Dam for 35 Mm^3 of storage
- The capacity of Olushandja Dam be kept at 42,3 Mm^3
- The pumping capacity of the existing pumps at Calueque Dam be increased from 2 x 2 m^3/s to 2 x 3 m^3/s by increasing the motor size
- The Olushandja Dam northern embankment pump station and pumps be rehabilitated and upgraded
- The Olushandja Dam southern embankment outlet works be refurbished along with the construction of a new pump house.

The scenarios discussed in this chapter are based on the assumption that by January 1996 the new motors will have been installed at Calueque Dam (Haussler, pers. comm., 1995) and that all the rehabilitation work at Olushandja Dam will be complete. At this stage (June 1995) there are no plans to complete the Calueque Dam to provide 35 Mm^3 storage. The water transfer scheme will continue to abstract water from the channel that links the old weir on the Cunene River to the pump station inlet.

7.4 SCENARIO 1: WATER LEVEL KEPT AT FULL SUPPLY LEVEL

The full supply level (FSL) for Olushandja Dam is 1106 m.a.s.l. At this level the capacity of the dam is 42,3 Mm^3 and the surface area is 2660 ha. Allowing for 12,5% of the total volume being below dead storage level (DSL) the available storage volume is 37,0 Mm^3. Based on a mean annual evaporation rate of 1,7 m (LUND, 1992), the quantity of water lost through evaporation per month is 3,8 Mm^3.

The combined maximum demand that the Ogongo and Etaka canals are designed for (Figure 2.1) is 4,2 m^3/s. Based on a maximum pumping rate of 21 hours per day, the peak abstraction rate per month from Olushandja Dam is 9,5 Mm^3.

By keeping the water level at FSL the DWA will obtain the following benefits:

- An assured water supply for 2,7 months, should the pumps at Calueque Dam not operate. Security of supply is important to the DWA as their source of water is in a neighbouring country and there is only a single pipeline and canal system. The pipeline from Ruacana to the Calueque-Olushandja canal is not large enough to carry the quantity of water required.

- Water will be available for bulk release through the gates in the south embankment into the Oshana Etaka.

- Adequate storage to allow for peak demands from consumers on the Ogongo and Etaka canals during periods of low flow in the Cunene.

The main negative aspect of scenario 1 involves evaporation. If the DWA continues with a water management strategy, which is based on the principle of water conservation, then the quantity of water lost through evaporation and the energy used to transfer this water from the Cunene River need to be considered. In order to keep the dam at a FSL of 1106 m, 40% of the peak water demand to the east and south of Olushandja Dam is lost through evaporation with a corresponding energy cost.

SWAWEK, the Namibian bulk electricity supplier, believes that the water lost through evaporation would be better utilised by allowing it to flow down the Cunene River to the proposed Epupa Dam. It would provide additional water for electricity generation (ENGEO, 1995).

7.5 SCENARIO 2: WATER LEVEL KEPT AT PRESENT LEVEL

During the past four years the DWA has kept the water level in Olushandja Dam at an average level of 1104,5 m. This level represents 30% of the full capacity with a surface area of 1380 ha. The dam is presently managed within 5% of this four year average. Applying the same evaporation value as used in scenario 1, the monthly quantity of water lost through evaporation is 2,0 Mm^3 or 21% of peak demand.

The positive aspects of this present level scenario are that:

- The evaporation loss is lower than that in **scenario 1**.

- There is still sufficient water in the dam should a bulk release of water be required for the Oshana Etaka

- Peak demands can still be met by Olushandja Dam.

However, the reserve supply drops from 2,7 to 0,7 months at peak demand. Unless management options for Calueque Dam can increase this reserve the DWA are unlikely to consider this scenario.

7.6 SCENARIO 3: WATER LEVEL KEPT AT DEAD STORAGE LEVEL

The DSL in the case of Olushandja Dam is the water level at which the dam separates into northern and southern sections. The gradient of the old Oshana Etaka, in which the dam lies, is such that a high point exists towards the middle of the dam. The level used for DSL is 1103,7 m.

At DSL the main function of the dam would be to allow water to flow from the syphon discharge point, at the northern end of the dam (Figure 2.1), to the Etaka Canal outlet in the south. No storage would be available and the Ogongo Canal would be fed directly from the Calueque-Olushandja canal via the syphon.

The positive aspects of **scenario 3** are that:

- The quantity of water pumped at Calueque Dam and subsequently lost through evaporation would be minimised
- The Olushandja Dam north wall pump station would not be required. This implies a saving in operating costs.

With the water level kept at 1103,7 m, the DWA would have to contend with the following problems:

- No security of supply. Calueque Dam would have to be upgraded so that water could be stored to provide the necessary security during low flow conditions in the Cunene River
- Peak demand would have to be met by either management of the pumping plant at Calueque Dam or by building small reservoirs along the canal to Ogongo and Oshakati at the major abstraction points
- There would be no facility for the flushing of the Oshana Etaka.

7.7 SCENARIO 4: FLUCTUATING WATER LEVEL

Scenario 4 allows for a range of water levels between DSL and FSL. This would mean that the surface area would change during the year from a low of 820 ha to a high of 2660 ha. The corresponding change in volume would be from 5,3 Mm^3 to 42,3 Mm^3. The main advantages of this scenario are that:

- The security of supply can be changed to suit demand and conditions in the Cunene River
- Allowance can be made for peaks in the water demand
- The water level can be increased to meet the requirement of a bulk release down the Oshana Etaka.

The disadvantages consist of those identified under **scenarios 1** and **3**. An additional problem is that the change in water level during the year will result in a wide strip of shoreline which will have a limited vegetation covering made up of plants with an established root structure. This could result in erosion and a maintenance cost for the DWA.

7.8 SCENARIO 5: OLUSHANDJA DAM REMOVED FROM THE SYSTEM

The fifth option that can be considered is that of removing Olushandja Dam from the inter-basin water transfer system. The north and south embankment gates would be left open and the Oshana Etaka would be allowed to return to the flow conditions of the early 1970s, prior to dam construction. The existing channel running down the centre of the dam would be improved so that water could be supplied from the syphon inlet to the Etaka canal. The southern radial gates would allow flood water to be released.

Scenario 5 would be beneficial to the DWA in the following three ways:

- The only water lost through evaporation would be from the canals
- The need to upgrade the capacity of the pumps at Calueque Dam would be delayed until the full 2 m^3/s is required by Etunda irrigation scheme. The "evaporation demand" of Olushandja Dam would not be required
- The north and south wall pump stations would not be needed, provided the syphon can supply the Ogongo canal with sufficient water to meet peak demands.

However on the negative side there would be problems with:

- The security of supply
- The regulation of the peak demands of consumers along the Ogongo and Etaka canals
- The bulk release of water down the Oshana Etaka
- The supply of water to the start of the Etaka canal. A new canal would have to be built down the centre of Olushandja Dam or from the old canal near Eunda to the Calueque-Olushandja canal. Both these options would involve capital expenditure.
- Providing the local communities with an alternate fish source. New off channel storage dams would have to be built and stocked with fish. This could be undertaken in association with the Department of Agriculture.

The five water level management scenarios described above give a wide range of options which have both positive and negative implications for the DWA and the people living within the study area. Chapter 8 looks at the prediction, assessment and evaluation of the impacts that these scenarios have on the social and biophysical environments.

8 PREDICTION AND EVALUATION OF THE SOCIO-ECONOMIC AND BIOPHYSICAL IMPACTS

8.1 INTRODUCTION

In the previous chapter five possible water level management scenarios for Olushandja Dam were outlined. The consequences of each of these scenarios for the DWA was described highlighting both the positive and negative aspects.

This chapter will look at the prediction, assessment and evaluation of the possible impacts that the five management scenarios will have on the socio-economic and biophysical environments. The magnitude of the impacts will be identified by comparing the alternatives to the "4 year average" scenario. This alternative will be referred to in the tables as PRESENT LEVEL. In order to determine which alternative will serve best the interests of the community and the DWA, a method is required to assess the relative significance of each impact and then evaluate the different alternatives.

In this dissertation the method used by the British Standing Advisory Committee on Trunk Road Assessment (SACTRA, 1979; SACTRA, 1992) has been adopted to facilitate the prediction, assessment and evaluation of the impacts and alternatives. Two levels of framework are used (Section 4.6); a summary framework and a decision framework.

8.2 IMPACT PREDICTION

From the results of the field work it was evident that the impacts brought about by a possible change in water level at Olushandja Dam would have a greater affect on the socio-economic environment than the biophysical environment. The dam is a closed system, having embankments at each end, with the water level being regulated by mechanical gates and pumps. Unlike a dam built on an existing river, such as the Cunene, most of the basic ecological processes that occur in riverine systems are not active in Olushandja. This assessment therefore deals with a different set of impacts to those used for normal dam development projects on free flowing rivers (Rooseboom, 1994).

To identify possible impacts, the questionnaires used during the socio-economic study (ENGEO, 1995), were designed to record the level of importance of various resources to the people living within the study area. From the household and key informant interviews the following key resources were identified: surface water; arable and grazing land; cattle; trees and fish. These socio-economic environmental components are presented in Tables A 2.1, A 2.4 and A 2.5 for interest groups 1, 3 and 4 (People living in ZONES A, B and C).

In addition to the issues raised by the people interviewed in the study area, there are those highlighted during discussions with staff from the DWA and SWAWEK. The evaporation issue was a major concern for SWAWEK while the security of supply and the proposed establishment of the NWC were important to the DWA. These three issues are key components of the DWA's present water management policy.

For DOMESTIC USE/FULL SUPPLY LEVEL in the same table, 6885 people in ZONE A rely on the dam for water. The magnitude is large. In most cases the degree of change (eg. area of fields flooded or number of people likely to be infected by bilharzia) relative to the situation without the scenario being implemented gave the magnitude value.

In view of the fact that a major portion of the EIA relied on data collected during the SIA, no quantitative prediction methods have been used in this assessment. There was very little information that can be used from the questionnaires for a quantitative analysis. The nature of the other specialist reports at the time of writing was such that only their draft results could be used in the assessment.

Significance of impacts

Once the impacts had been predicted and their magnitude determined the relative significance of each impact was assessed. While the determination of magnitude should be an objective exercise deciding on how significant an impact is tends to be very subjective. Criteria used for determining significance included: magnitude; geographic extent; duration; frequency; the risk or uncertainty and whether or not similar habitats or resources are available near by. Significance ratings of low, moderate and high were used (Nelson, 1984; Glasson, 1994).

FISH/FULL SUPPLY LEVEL in Table A 2.5 for interest group 4 shows two significance ratings. Results from the household interviews showed that although most people in ZONE C ate fish very few actually fished. The fish population is likely to increase with a rise in water level (Hay & van Zyl, 1995). The supply of fish for all three zones will thus increase. The significance is high as the people's protein source is generally low. However the expected increase in income from fishing for the residents in ZONE C is small (magnitude) so a significance value of low was assigned.

As the objective of an EIA is to present the decision making authority with a summary of significant impacts for the preferred alternatives, emphasis has been placed on those impacts with a high rating in the evaluation summary framework.

Erickson (1994) suggests key inputs which are an important part of the overall impact evaluation process and can help with determining how significant an impact is, namely details of project planning and design; standards, laws, theories and experience; environmental data and information.

All three of these inputs have been used as a basis for assessing the impacts. The Namibian environmental policy was discussed in chapter 3 while the requirements of the Dutch funding agency were highlighted in chapter 2. Environmental data and information was collected during the SIA and other specialist studies.

The rating of magnitude and significance for the evaluation framework is supported further by: field experience in the study area, personal experience gained from the design and implementation of other water supply and sanitation projects in southern Africa, the consultations with organisations working in the region and the specialist reports.

8.4 IMPACT EVALUATION

The South African Department of Environment Affairs refers to evaluation as a process used by planners to:

"Weigh the information available and to determine which alternative is in the best interest of the community at large" (DEA, 1992, document 3, p.14).

In the case of the Olushandja EIA the interests of both the community and the DWA need to be taken into account during the final decision making process. It is in the best interest of the DWA to take a responsible attitude towards supplying water to consumers to the south and east of the study area as well as to the local communities. However, it is in the best interest of the local community that the impacts produced by the chosen alternative are minimised.

In order to evaluate the alternatives the PRESENT SITUATION scenario was used as a baseline. Each of the other four alternatives was compared to this scenario. In compiling the evaluation decision framework (Tables 8.1 & 8.2) those impacts in the evaluation summary framework with a negative rating (shaded) and high significance (■) were used in deciding on the two alternatives to carry forward to the decision framework.

Scenarios 3, 4 and 5 were considered to be unacceptable to both the DWA and the communities living within the study area and were thus not carried through to the evaluation decision framework. The reasons are briefly discussed below:

8.4.1 Scenario 3: Water level kept at dead storage level

The main objectives for building Olushandja Dam were to provide a reservoir of water which could be used to deal with the peak demands of consumers, provide a surety of supply should the link with Calueque be broken and allow water to be released down the Oshana Etaka. If the dam was operated at DSL there would be a saving in the quantity of water lost through evaporation. The risk of people and cattle being affected by bilharzia would be reduced. However at this level the dam would not be able to fulfil the original design objectives.

The DWA would have to upgrade the storage capacity of Calueque Dam earlier than anticipated and look into the provision of further concrete reservoirs along the bulk water supply routes to provide peak demand storage. New potable water pipelines would be required to provide the communities who presently rely on the dam for water with an assured supply of potable water.

8.4.2 Scenario 4: Fluctuating water level

This scenario is likely to be important to the DWA in that the peak demand requirements and the security of supply can both be accommodated by allowing the water level to fluctuate between DSL and FSL. However the adverse effects of flooding and evaporation will arise on FSL being reached. The supply of water to local communities will be a problem during low level conditions.

8.4.3 Scenario 5: Olushandja Dam removed from the system

If the DWA were to remove the dam from the bulk water supply system and install a well planned rural water supply network within the study area, the local people would benefit from: unrestricted access between the eastern and western parts of the study area (an important issue raised during the community meeting); contact with surface water would be reduced thus lowering the risk of contracting bilharzia and malaria and further grazing land for cattle would become available.

However the DWA would have to secure funds to upgrade Calueque and build a series of bulk water reservoirs to meet peak demands. A new canal would be required to link the Calueque - Olushandja canal with the Etaka canal. The capital expended in upgrading the north and south wall pump stations at Olushandja would be lost and the equipment would have to be removed. It is unlikely that the government will provide money to undertake this work at a time when the development emphasis in the region is on supplying rural communities with a safe and reliable supply of water.

The impacts of implementing scenarios 1 (full supply level) and 2 (present level) were evaluated in the decision framework. (Tables 8.1 & 8.2). Those aspects for which there were no differences between alternatives were discarded with the exception of water abstraction from the Cunene River (Table 8.2). It was felt that this is an important issue which should be brought to the attention of the decision making authority. In some cases the impact is positive or negative for scenario 1 but no effect is likely to take place with scenario 2.

8.4.4 Scenario 1: Water level kept at full supply level

The significant positive impacts for this scenario are that:

- the fish population is likely to increase in the short term. This will lead to an improved source of protein and an increase in income generated from fish sales
- the reserve supply of raw water will increase from 0,7 months to 2,5 months. As a result the upgrading of the Calueque Dam wall can be delayed
- the increase in storage will allow for long term fluctuations in consumer demand peaks
- there will be a reduction in salinity and bacterial content resulting in short term improvement in water quality

and the negative impacts are that:

- the quantity of water lost through evaporation would increase from 2,0 Mm^3 per month to 3,8 Mm^3
- some of the existing households and fields in Zone A will be flooded.
- people will have to be resettled, land allocated in ZONES B or C and compensation paid
- there will be a loss in woodland from where the local people can obtain firewood and building materials
- the increase in nutrients will result in algal blooms in the short term and eutrophication in the long term
- there could be a decrease in the quantity of water available downstream of Calueque Dam as a result of increased abstraction. This would be detrimental to the aquatic flora and fauna
- there will be an increase in the length of the shoreline with a likely corresponding increase in waterborne diseases
- there will be a loss in habitat for certain terrestrial plants

8.4.5 Scenario 2: Water level kept at present level

The significant positive impacts of keeping the water level of Olushandja Dam at the present level are that:

- houses, fields, grazing, timber source and market gardens will not be affected by flooding
- there will be no increase in the quantity of water lost through evaporation
- the authority in charge of managing the dam will not be liable for resettlement costs
- there will be no loss in habitat of terrestrial plants

and the negative impacts are that:

- the present incidence of malaria and bilharzia will continue
- the continual growth of the local population and the informal settlement of Epalela will result in a long term increase in nutrient loading faecal contamination of the reservoir as a result of stormwater runoff
- there could be a decrease in the quantity of water available downstream of Calueque Dam as a result of increased abstraction. This would be detrimental to the aquatic flora and fauna
- there will be only 0,7 months of storage
- the dam will be unable to meet long term demand
- the quantity of water lost through evaporation will be 2,0 Mm^3 per month with the associated pumping cost at Calueque Dam.

8.4.6 Preferred alternative

In the evaluation decision framework (Tables 8.1 and 8.2) the shaded blocks indicate the preferred alternative for each environmental component. From this framework **scenario 2, present level**, was identified as being the most suitable for both the community and DWA. This decision was influenced by the two important issues of evaporation and land availability.

The quantity of water lost through evaporation and the cost of pumping this water from Calueque are lower for scenario 2 than 1. In chapter 5 the availability of water was highlighted as a key component in the future development of Namibia. During the consultations with interested and affected parties, SWAWEK expressed their concern that water lost through evaporation could be better used in generating electricity at dams further down the Cunene River.

Land for buildings, crops, trees and grazing will not be affected if the water level is kept at the present level. During the household and key informant interviews the shortage of land was an important issue within the community.

The mitigation of the impacts identified for scenario 2 (marked as ● in Tables 8.1 & 8.2) and the development of a monitoring and auditing programmes for Olushandja Dam are dealt with in chapter 9.

9 ENVIRONMENTAL MANAGEMENT PLAN, CONCLUSIONS AND RECOMMENDATIONS

9.1 INTRODUCTION

One of the key objectives of Namibia's Environmental Assessment Policy states that an EA procedure will, as far as is practicable, set out to:

"promote sustainable development in Namibia, and especially ensure that a reasonable attempt is made to minimize anticipated negative impacts and maximize the benefits of all developments" (NDEA, 1994, p.4).

In order to minimize the negative impacts of implementing the present level scenario selected from the five alternatives discussed in chapter 8, an important step in the EIA planning process is to create a management plan as shown by stages 11, 12 and 13 in the Namibian Environmental Assessment Procedure (Figure 3.3). This will be referred to as the environmental management plan (EMP) and will include the three programmes of: mitigation, monitoring and post project auditing. By carrying out a successful EMP the DWA and ultimately the NWC will meet the objectives of the Namibian Environmental Assessment Policy and the interests of all the interested and affected parties.

The establishment of the Namibian Water Corporation (NWC) was discussed in chapter 5. This organisation will take over the control of the bulk water supply from the DWA which is the present controlling authority. Although no date has been set, the development of the proposed EMP in this dissertation will assume that NWC will be the implementing authority.

9.2 ENVIRONMENTAL MANAGEMENT PLAN

9.2.1 Goals

In setting up the EPM the first step is to define goals. In the case of Olushandja Dam the NWC should draw up an appropriate environmental policy for the Calueque-Olushandja bulk water supply scheme based on the Namibian Environmental Assessment Policy. The improvement of environmental awareness within the northern regions of Namibia with emphasis being placed on the importance of water as a key natural resource should form the second goal. The level of public participation in the making of decisions regarding the management of Olushandja Dam and the associated water supply infrastructure needs to be increased. Finally the NWC should initiate the setting up of an environmental review structure that involves monitoring and auditing programmes.

9.2.2 Actions

Having identified goals the NWC should undertake the following actions:

- Create an Environmental Services Division which will fall under the Chief Executive in the proposed company structure. This will help to improve the existing environmental assessment planning process presently being undertaken by the DWA.

- Report back to all interested and affected parties on the recommendations given in the EIA carried out for Olushandja Dam. Besides involving the directly affected communities such an action will help to show that the NWC is committed to the EMP process.

- Appoint water resource officers whose function will be to implement educational and communication programmes for each of the regions comprising northern Namibia.

- Form an Oshana Water Region bulk water supply development committee. This would be separate to those committees presently dealing with rural water supply issues.

- Form a Olushandja Dam user group to deal with issues directly related to the dam such as health and water quality. Such a partnership with the local community would improve communication and start transferring responsibility for water resource management to the local people.

- Liaise with the DWA's Directorate of Rural Water Supply and the Directorate of Environmental Affairs (NDEA) so as to discuss: the development of the proposed regional environmental profiles presently being compiled by the NDEA; the provision of new stock watering points; cost recovery of water supplied to rural consumers and the continual development of groundwater as a key component of water supply in Namibia.

9.2.3 Key parties and their roles

There are four key parties that will be responsible for the success of the proposed EMP: the Namibian Water Corporation which will be responsible for the supply of bulk water to consumers including governmental departments; the Directorate of Rural Water Supply which will purchase water from the NWC and deliver it to the rural communities; the Directorate of Environmental Affairs which will provide support in the form of environmental policy guidelines and monitor the carrying out of environmental impact assessments and fourthly the communities that rely on the bulk water supply infrastructure rather than the rural water supply reticulation network.

9.2.4 Party responsible for carrying out management recommendations

The proposed Namibia Water Corporation will be responsible for the development and implementation of the environmental management plan.

9.2.5 Personnel, training and financial implications

The personnel, training and financial aspects of the EMP should be included in the proposed Environmental Services Division of the NWC. Two levels of personnel are required. The first level would comprise managerial staff employed by the NWC to provide environmental management support to other divisions within the corporation and the water consumers. The second level would consist of key community members living within the study area. These people would be chosen by the community and receive a grant from the NWC to provide a communication and educational link between the NWC and the community.

Training of personnel from both levels would be provided by the NWC, the Directorate of Environmental Affairs and possibility the Desert Research Foundation of Namibia.

In order to pay for the Olushandja Dam EMP and the Environmental Services Division a levy could be paid by consumers on each m^3 of water purchased. This method is used to fund the South African Water Research Commission.

9.3 MITIGATION PROGRAMME

Mitigation is defined by the US Council on Environmental Quality (CEQ) as:

"not taking certain actions; limiting the proposed action and its implementation; repairing, rehabilitating, or restoring the affected environment; presentation and maintenance actions during the life of the action; and replacing or providing substitute resources or environments" (Glasson et al., 1994 p. 134).

In order to ensure that the adverse affects, identified for the preferred option during the evaluation phase of this EIA, are minimised, the mitigation measures chosen must be such that they are acceptable to both the authority and the local community. Each mitigation measure will require the expenditure of money. This is usually borne by the project proponent but funds may be available from the Namibian Government if the project is seen to be part of the national policy framework. The carrying out of such measures will also involve some sort of impact on the local environment and it is important that these factors are considered before the mitigation measure is implemented.

Erickson (1994) identified three mitigation measures that are relevant to the operation and maintenance phase of a project:

Minimization: Limiting the degree, extent, magnitude or duration of adverse impacts.

Improvement: Enhancing the capability of an existing resource with respect to its environmental functions.

Diversification: Increasing the mixture or diversity of habitats, species, or other environmental resources in a circumscribed area.

It is important to note that mitigation measures should be incorporated throughout the project cycle and not just during the operation and maintenance phase. Unfortunately this is not the case with the Olushandja Dam EIA. As discussed in chapter 7 the EIA consultants were appointed after the upgrading had started at Olushandja Dam. The decision frameworks (Tables 8.1 & 8.2) show six significant impacts (●) that need to be mitigated if the water level is to be managed at the present four year average level of 30 % full.

9.3.1 Impact 1: Surface water - health

The people living in ZONE A and a limited number of those living in ZONES B and C will continue to visit the dam to collect water, to fish or wash clothes. There is already a high incidence of bilharzia and malaria within the local community. This will continue until human and livestock contact with the water is greatly reduced. Cattle are affected by liver fluke and bilharzia as a result of drinking and grazing at the edge of the reservoir.

Mitigation measures

In order to reduce the health risks to people and livestock there are two mitigation measures that need to be undertaken. The first involves the installation of alternate water supply points for people and livestock around the perimeter of the dam. Unless the community is supplied with an alternate they will continue to use the dam for domestic water use. The second requires the establishment of an education programme (Curtis, 1995). This programme should promote the use of purified water and preventive measures to avoid being infected by malaria and bilharzia. High risk people such as fishermen should be tested and treated for bilharzia on a regular basis. Vegetation along the north wall should be removed to reduce snail habitats and the inlet pipe from the Calueque-Olushandja canal be extended 500 m into the dam.

9.3.2 Impact 2: Fresh water fish - Cunene River water abstraction

Hay and van Zyl (1994) and Burke (1995) expressed their concern that the increased water abstraction rate from the Cunene River is likely to have a significant adverse impact on the natural riverine environment downstream of Calueque Dam. The magnitude of this impact will be large during the dry season when the flow in the river is at its lowest. This would be detrimental to the fish population and aquatic plants in the river. Rooseboom et al. (1994) discuss the environmental needs of rivers and the importance of conserving natural habitats, maintaining the existing conditions of rivers and minimising the impacts on downstream water users. Although the impact of the Calueque Dam on the Cunene River will be part of the EIA for Calueque Phase II Project - Part 2, the increased abstraction should also be considered under Part 1.

Mitigation measures

An investigation should be carried out to determine the minimum acceptable flow of water required for the maintenance of the riverine environment downstream of Calueque Dam. Existing seasonal flows and the effect of Gove and Matala dams (Figure 2.2) will have to be taken into account. The management of the quantity of water abstracted from the Cunene River would be governed by this minimal flow.

9.3.3 Impact 3: Storage - security of supply and peak demand

Olushandja Dam is presently operated as a balancing reservoir to provide a security of supply and to cater for summer peak water demands from consumers along the Ogongo and Etaka canals. In choosing the present level alternate the negative impact of reduced storage needs to be addressed. Although this impact does not affect the people in ZONES A, B or C it does have implications for the NWC's operation strategy for the Calueque-Olushandja scheme and the consumers in the Oshana Water Region.

Mitigation measures

When complete, Calueque Dam will have a storage capacity of 35 Mm^3 which is 2 Mm^3 less than the available storage capacity of Olushandja Dam if the water level was kept at full supply level. It is recommended that funds be sourced to complete Calueque Dam so as to reduce the reliance on Olushandja for storage.

With regard to catering for peak demands the NWC should investigate the viability of constructing purified water storage reservoirs at the main urban centres such as Ombalantu, Ogongo, Oshakati and Ondangwa (Figure 1.3). In 1996 when the first 3 m^3/s pump comes into operation at Calueque Dam, it is envisaged that Etunda irrigation scheme will ultimately consume up to two thirds of the 7,9 Mm^3 average monthly flow (Figure 2.2) leaving one third for distribution to the east (2,6 Mm^3). It is recommended that peak demands be met with adequate balancing storage near the consumers rather than at Olushandja. As the full 2,6 Mm^3 will not be required straight away the storage facilities can be built in stages.

9.3.4 Impact 4: Evaporation - quantity and cost

Olushandja Dam presently loses 2,0 Mm^3 of water per month through evaporation when the water level is at a level of 1104,5 m. This represents 25% of the total average monthly flow that will be pumped from Calueque once the upgrading of the two existing pumps is completed in 1996.

Mitigation measure

The reduction in the quantity of water that evaporates per month needs to be balanced with the need to ensure security of supply and sufficient storage to cover peak demands from consumers in northern Namibia. One of the ways to reduce the evaporation rate is to provide a series of covered reservoirs connected by pipelines. Measures to reduce evaporation, such as floating mats, have been tried in the past at Oshakati (1967) and Ongwediva (1963) (DWA, 1968) with the modern equivalent being floating reservoir roofs made from polyethylene sheeting. At this stage it would be uneconomic and impractical to use this method to cover Olushandja Dam.

It is recommended that the investigation into the rehabilitation of Calueque Dam be completed and the necessary funds be sourced. An investigation into the viability of constructing a series of reservoirs with floating polyethylene roofs at major water demand nodes on the Olushandja - Ogongo - Oshakati canal should be carried out. By combining the 35 Mm^3 storage capacity of Calueque Dam with a series of smaller pump storage reservoirs the problems of security of supply and evaporation could be solved. A further benefit is that the pumping costs at the Calueque pump station will be reduced. These measures would allow Olushandja Dam to be removed from the present inter-basin transfer scheme (Figure 2.2) as described in section 7.8.

9.3.5 Impact 5: Reservoir management - water quality

Olushandja Dam is presently subjected to low levels of nutrient and bacterial loading but the turbidity levels are high and the salinity increases towards the southern part of the dam. The low levels of contamination are due to: human and animal contact with the water; limited storm runoff from the informal settlement of Epalela, situated near the northern embankment; inadequate sanitation facilities at the households in ZONE A; detergents used for washing in or near the dam and the destruction of ground cover due to overgrazing and soil erosion. In the long term a lowering of the quality of the water is expected with the natural increase in population numbers.

Mitigation measures

The NWC should undertake the development of a water quality management plan. Such a plan should involve the local community in the identification of pollution sources. Once the problem areas have been identified the NWC, the Department of Health and the community should look at improving the local household and village sanitation facilities including solid waste disposal. The disposal of sludge and chemicals from the Olushandja purification works should form part of the Epalela waste disposal programme.

Regular bacteriological samples should be taken at sites around the dam where people collect water and wash (Roberts, 1995a). Monitoring of ammonia and salinity levels should be included as one of the tasks. Measures should be taken to reduce the problem of overgrazing and erosion along the shore by establishing a cultivation and grazing free zone (Sundstrom, 1992; Curtis, 1995). The Department of Agriculture should be consulted for advice on improving traditional agricultural practices and the selection of suitable fertilizers and pesticides for use at the two market gardens on the western side of the dam.

9.4 MONITORING PROGRAMME

According to Therivel et al.(1994, p.17):

" the concept of monitoring is universally applauded, but the costs are high and developers have understandably balked at any moves to make monitoring a legal requirement".

The setting up of a monitoring programme is important if the "cradle to grave" responsibility for environmental impacts is to become a key component of the EIA planning process. In order to reduce the cost to the proponent but be beneficial, the programme should only concentrate on recording those physical indicators, decisions and policy changes that have a high significance rating.

In setting up a monitoring programme for Olushandja Dam the following components should be considered:

- Mitigation measures recommended for each significant impact
- Responsible party for mitigation and monitoring
- Frequency of monitoring
- Role of interested and affected parties
- Authority responsible for ensuring compliance with monitoring programme
- Reporting requirements.

(DEA, 1992; Glasson et al., 1994)

The success of the monitoring programme will depend on the commitment of the NWC's Chief Executive and management. The NWC will be responsible for the EMP and thus the monitoring programme.

For each of the impacts discussed in section 9.3, objectives and targets need to be set for the frequency of the monitoring required. The monitoring of water quality may have to be done on a monthly basis, while the testing of people for bilharzia may only have to be carried out every three months. Progress with the sourcing of funds for the completion of Calueque Dam and the construction of storage reservoirs could be monitored by setting target dates by which time certain stages should have been met.

Defining the roles of the local community and other interested and affected parties is extremely important. The Olushandja user group should be given the opportunity to participate in the monitoring programme and provide input into the methods used and frequency. The Directorate of Environmental Affairs should be approached to ensure that the monitoring programme complies with the present environmental assessment policy and eventually with any legal requirements resulting from the proposed environmental legislation.

Finally the results of the monitoring programme need to be compiled into a report that is available for public review. This could be produced initially on a quarterly basis. Later, once the monitoring programme was running smoothly and the NWC can show responsible self regulation this time period could be extended to a year.

9.5 ENVIRONMENTAL IMPACT AUDIT

An important part of the EMP is the environmental impact audit. This involves the comparison of the impacts predicted during the EIA with those that actually occur after the project is implemented. One of the recommendations made in Namibia' Assessment Policy is that the negative and positive impacts of the selected alternative be assessed from time to time. An independent audit will provide important feedback to the NWC and the Directorate of Environmental Affairs, on the effectiveness of the mitigation measures and the monitoring programme. Such an audit could be extended to include the complete EIA from inception to review.

The International Chamber of Commerce (ICC) defines environmental audits as:

"A management tool comprising a systematic, documented, periodic and objective evaluation of how well environmental organisation, management and equipment are performing with the aim of helping to safeguard the environment by:

- facilitating management control of environmental practices
- assessing compliance with company policies, which would include meeting regulatory requirements".

(Soutter & Mohr, 1993,p.23).

In the case of the Olushandja EIA it is recommended that the NWC undertakes the first environmental impact audit six months after the upgrading is complete for Part 1 of the Calueque Phase II scheme. In order to fulfil the aim of the definition given by the ICC and the requirements of the Namibian Environmental Assessment Policy it is recommended that the audit programme:

- be carried out by a auditing team comprising external consultants and NWC staff from the proposed Environmental Services Division
- compares the impacts predicted in the final EIA report with those that actually occur after implementation of the project
- assesses whether the impacts predicted perform satisfactorily
- assesses how effective the mitigation measures are and whether the conditions attached to the upgrading are being honoured
- provides feedback to the NWC on how well the Olushandja EIA was carried out and how the management of future EIAs can be improved
- allows for an action plan to be drawn up by the NWC's management to address the shortcomings identified in the first audit. Management's success in correcting these shortcomings can be assessed in a future audit.

The dates for subsequent audits can be set in consultation with the Directorate of Environmental Affairs after the first environmental impact audit is completed.

9.6 CONCLUSIONS

In reviewing the EIA literature and conducting the social impact assessment for the Olushandja Dam EIA, the importance of the role of public participation in the development of water resources was highlighted. The scope of this dissertation was limited to the future management of Olushandja Dam. This means that consumers throughout the Oshana Water Region were not consulted and the study cannot be seen as part of an integrated resource management strategy for northern Namibia. However it was still possible to reach the following conclusions:

1. There is still scope for the improvement of the environmental planning process in developing countries such as Namibia, with particular emphasis being placed on social impact assessment.

2. New approaches need to be developed for the carrying out of EIA's in Africa, that involve the people but are rapid and cost effective.

3. Namibia is presently developing a legislative framework within which the environmental assessment of policies, programmes and projects will be addressed.

4. Development agencies working in Namibia are aware of the environmental problems that the country faces and encourage the use of EIA's in the planning of development projects.

5. Although water is a scarce resource in Namibia the present methods of distribution and storage result in significant quantities of water being lost through evaporation.

6. The DWA has carried out an EIA for Olushandja Dam which involved an assessment of the socio-economic and biophysical impacts. The study included some of the key elements of the national environmental assessment policy but others were missing.

7. Five management scenarios for the operation of Olushandja Dam were assessed. On the basis of minimising the effects of flooding on the local communities and reducing the quantity and cost of water lost through evaporation, the preferred alternative is that of scenario 2, present level.

8. A environmental management plan was proposed, consisting of mitigation, monitoring and auditing programmes. In order to promote community participation it is essential that the local people are included in the implementation of the EMP.

9.7 RECOMMENDATIONS

In the terms of reference received by the UCT study team, the Department of Water Affairs required that: various scenarios should be developed; opportunities, impact and resource replacements identified; remedial measures be identified and evaluated and recommendations for a simple and cost-effective monitoring programme be made.

Based on the findings and conclusions of this dissertation, the following actions are recommended:

1. The DWA should continue to operate the water level in Olushandja Dam at the four year average of 30% of full storage capacity, as detailed under the present level scenario.

2. The environmental management plan outlined in section 9.3 be accepted by the DWA and in due course by the NWC, on transfer of control of the bulk water supply function.

3. The NWC should enter into a partnership with the Directorate of Rural Water Supply to develop the rural water supply network, for domestic and livestock use, in such a way that rangeland management is improved and the dependence of the local community on Olushandja Dam is reduced.

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APPENDICES

APPENDIX 1

ENVIRONMENTAL IMPACT ASSESSMENT STUDY TEAM

ENVIRONMENTAL IMPACT ASSESSMENT STUDY TEAM

The environmental impact assessment study team at the start of the assessment, in December 1994, consisted of fourteen parties split into three groups:

1. **Client and project managers:**

   Department of Water Affairs.

2. **Organisations supplying specialist advice and environmental impact assessment reports:**

Ministry of Fisheries and Marine Resources:	fresh water fish.
Ministry of Wildlife, Conservation and Tourism:	review of reports.
Department of Agriculture:	agricultural planning.
Ministry of Health and Social Services:	health and social aspects.
National Planning Commission:	project planning.
Department of Water Affairs:	limnological study.
Ms B Curtis (private consultant):	fresh water snails.
Dr A Burke (private consultant):	aquatic and terrestrial plants.
UCT study team:	socio-economic study.
UCT Environmental Evaluation Unit:	compilation of main EIA. report.
University of Namibia (UNAM):	socio-economic study.

3. **Project managers for NGO members:**

   Parkman Namibia (consulting engineers).

TABLE A 2.4	OLUSHANDJA DAM - EVALUATION SUMMARY FRAMEWORK		GROUP 3: SOCIO-ECONOMIC				
INTEREST GROUP	SOCIO-ECONOMIC ENVIRONMENTAL COMPONENT	ASPECT	WATER LEVEL MANAGEMENT SCENARIOS				
			FULL SUPPLY LEVEL	PRESENT LEVEL	DEAD STORAGE LEVEL	FLUCTUATING LEVEL	NO DAM
GROUP 3: People living in ZONE B	SURFACE WATER	DOMESTIC USE	Impact: positive Limited use of dam water Magnitude: medium Significance: moderate	Impact: none Limited use of dam water Magnitude: medium Significance: moderate	Impact: negative Limited use of dam water Magnitude: medium Significance: moderate	Impact: positive Limited use of dam water Magnitude: medium Significance: moderate	Impact: negative Alternate supply required Magnitude: medium Significance: high ■
		LIVESTOCK USE	Impact: positive Limited use of dam water Magnitude: medium Significance: moderate	Impact: positive Limited use of dam water Magnitude: medium Significance: moderate	Impact: negative Reduced quantity Magnitude: medium Significance: high ■	Impact: negative Depends on the level Magnitude: medium Significance: high ■	Impact: negative Alternative supply required Magnitude: medium Significance: high ■
		HEALTH	Impact: negative Increased contact Magnitude: medium Significance: high ■	Impact: negative Continual contact Magnitude: medium Significance: high ■	Impact: positive Contact with water reduced Magnitude: medium Significance: high ■	Impact: negative Depends on the level Magnitude: medium Significance: high ■	Impact: positive Contact with open water reduced Magnitude: medium Significance: high ■
	LAND	BUILDINGS	Impact: negative Influx of people from ZONE A Magnitude: medium Significance: high ■	Impact: none No change Magnitude: N/A Significance: N/A	Impact: none No change Magnitude: N/A Significance: N/A	Impact: negative Influx of people from ZONE A Magnitude: medium Significance: high ■	Impact: none No change Magnitude: N/A Significance: N/A
		CROPS	Impact: negative Influx of people from ZONE A Magnitude: medium Significance: high ■	Impact: none No change Magnitude: N/A Significance: N/A	Impact: none No change Magnitude: N/A Significance: N/A	Impact: negative Influx of people from ZONE A Magnitude: medium Significance: high ■	Impact: none No change Magnitude: N/A Significance: N/A
		PASTURE	Impact: negative Grazing area reduced Magnitude: small Significance: low	Impact: none No change Magnitude: N/A Significance: N/A	Impact: positive Increase in grazing area Magnitude: small Significance: low	Impact: positive Artificial floodplain Magnitude: small Significance: low	Impact: positive Increase in grazing area Magnitude: small Significance: low
	TREES	FIREWOOD	Impact: negative Influx of people from ZONE A Magnitude: medium Significance: high ■	Impact: none No change Magnitude: N/A Significance: N/A	Impact: none No change Magnitude: N/A Significance: N/A	Impact: negative Influx of people from ZONE A Magnitude: medium Significance: high ■	Impact: none No change Magnitude: N/A Significance: N/A
		BUILDING MATERIALS	Impact: negative Influx of people from ZONE A Magnitude: medium Significance: high ■	Impact: none No change Magnitude: N/A Significance: N/A	Impact: none No change Magnitude: N/A Significance: N/A	Impact: negative Influx of people from ZONE A Magnitude: medium Significance: high ■	Impact: none No change Magnitude: N/A Significance: N/A
	FISH	FOOD	Impact: positive Increase in protein source Magnitude: small Significance: high ■	Impact: none No change Magnitude: N/A Significance: N/A	Impact: negative Reduction in protein source Magnitude: small Significance: high ■	Impact: negative Fluctuating supply Magnitude: small Significance: high ■	Impact: negative Alternate protein source required Magnitude: small Significance: high ■
		INCOME	Impact: positive Possible higher income Magnitude: small Significance: moderate	Impact: none No change Magnitude: N/A Significance: N/A	Impact: negative Possible lower income Magnitude: small Significance: moderate	Impact: negative Fluctuating income Magnitude: small Significance: moderate	Impact: negative Possible income lost Magnitude: small Significance: high ■

TABLE A 2.2	OLUSHANDJA DAM - EVALUATION SUMMARY FRAMEWORK		GROUP 1: BIOPHYSICAL				
INTEREST GROUP	BIOPHYSICAL ENVIRONMENTAL COMPONENT	ASPECT	WATER LEVEL MANAGEMENT SCENARIOS				
			FULL SUPPLY LEVEL	PRESENT LEVEL	DEAD STORAGE LEVEL	FLUCTUATING LEVEL	NO DAM
GROUP 1: People living in ZONE A	FRESH WATER SNAILS	PEOPLE Bilharzia	Impact: negative Increase in contact Magnitude: large Significance: high ■	Impact: negative Contact taking place Magnitude: medium Significance: high ■	Impact: positive Reduced contact Magnitude: medium Significance: high ■	Impact: negative Increase in contact Magnitude: medium Significance: high ■	Impact: positive Contact reduced Magnitude: large Significance: high ■
		CATTLE Liver fluke Bilharzia	Impact: negative Increase in contact Magnitude: medium Significance: high ■	Impact: negative Contact taking place Magnitude: medium Significance: high ■	Impact: positive Reduced contact Magnitude: medium Significance: high ■	Impact: negative Increase in contact Magnitude: small Significance: high ■	Impact: positive Contact reduced Magnitude: medium Significance: high ■
	AQUATIC PLANTS	HABITAT	Impact: positive Increase in habitat Magnitude: medium Significance: moderate	Impact: none No change Magnitude: N/A Significance: N/A	Impact: negative Decrease in habitat Magnitude: small Significance: moderate	Impact: negative Plants not likely to adapt Magnitude: small Significance: moderate	Impact: negative Species diversity lost Magnitude: medium Significance: high ■
	TERRESTRIAL PLANTS	HABITAT	Impact: negative Loss of protected plant species Magnitude: small Significance: high ■	Impact: none No change Magnitude: N/A Significance: N/A	Impact: positive Increase in habitat Magnitude: small Significance: moderate	Impact: negative Plants not likely to adapt Magnitude: medium Significance: moderate	Impact: positive Increase in habitat Magnitude: medium Significance: moderate
	FRESH WATER FISH	POPULATION	Impact: positive Increase in range of habitat Magnitude: medium Significance: high ■	Impact: none No change Magnitude: N/A Significance: N/A	Impact: negative Decrease in range of habitat Magnitude: medium Significance: high ■	Impact: negative Unstable population growth Magnitude: medium Significance: moderate	Impact: negative Loss of species to Cuvalei system Magnitude: large Significance: high ■
		CUNENE WATER ABSTRACTION	Impact: negative Reduced flow in Cunene Magnitude: small Significance: high ■	Impact: negative Reduced flow in the Cunene Magnitude: small Significance: high ■	Impact: negative Reduced flow in Cunene Magnitude: medium Significance: high ■	Impact: negative Reduced flow in Cunene Magnitude: small Significance: high ■	Impact: negative Reduced flow in Cunene Magnitude: small Significance: high ■
	GROUNDWATER	AQUIFER	Impact: positive Potential for recharge Magnitude: small Significance: moderate	Impact: positive Recharge stable Magnitude: small Significance: low	Impact: negative Reduced recharge Magnitude: small Significance: moderate	Impact: positive Potential increase for recharge Magnitude: small Significance: moderate	Impact: negative Recharge by Oshana Etaka Magnitude: small Significance: moderate
	LIMNOLOGY	SALINITY	Impact: positive Decrease in the short term Magnitude: medium Significance: moderate	Impact: negative Increase in the long term Magnitude: medium Significance: moderate	Impact: negative Increase in short term Magnitude: medium Significance: high ■	Impact: positive Fluctuating concentration Magnitude: medium Significance: moderate	Impact: none Not applicable Magnitude: N/A Significance: N/A
		TURBIDITY	Impact: positive Decrease in the short term Magnitude: medium Significance: moderate	Impact: negative Increase in the long term Magnitude: medium Significance: moderate	Impact: negative Increase in the short term Magnitude: medium Significance: high ■	Impact: negative Increase owing to shore erosion Magnitude: large Significance: high ■	Impact: none Not applicable Magnitude: N/A Significance: N/A
		NUTRIENT LOAD	Impact: negative Increase in the short term Magnitude: medium Significance: high ■	Impact: negative Increase in the long term Magnitude: medium Significance: moderate	Impact: negative Increase in the short term Magnitude: medium Significance: high ■	Impact: negative Increase in the short term Magnitude: large Significance: high ■	Impact: none Not applicable Magnitude: N/A Significance: N/A

For the reasons given in section 6.2, dealing with the terms of reference, some of the government departments were not able to assist with the writing of specialist reports. As a result the only the following reports were used in this dissertation:

1. **Social-economic**: UCT study team.

2. **Limnology**: Department of Water Affairs, Research Division.

3. **Fresh water fish**: Ministry of Fisheries and Marine Resources.

4. **Fresh water snails**: Ms B Curtis (private consultant).

5. **Aquatic and terrestrial plants**: Dr A Burke (private consultant).

6. **Groundwater**: Department of Water Affairs and Parkman Namibia.

APPENDIX 2

EVALUATION SUMMARY FRAMEWORK TABLES