SOCIAL IMPACT ASSESSMENT OF CHANGING THE WATER LEVEL IN THE OLUSHANDJA DAM

BY

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EXECUTIVE SUMMARY

1. INTRODUCTION

This dissertation is the individual analysis and evaluation of the information contained in the report titled "*Social impact assessment of the Olushandja dam: Baseline report*". The baseline report (BLR) was compiled by a project team from the 1994-1995 Masters of Philosophy (MPhil) class of the Department of Environmental and Geographical Science at the University of Cape Town (UCT). The purpose of this dissertation is two fold. Firstly it is submitted as a partial requirement for the Mphil degree in Environmental Science and secondly it is intended to act as a social specialist report which will be used by the Environmental Evaluation Unit (EEU) to conduct a full EIA on the management of the Olushandja dam.

2. BACKGROUND TO THE STUDY

The Olushandja dam is located in the northern part of Namibia, in the Omusati region - one of the four regions into which the former Ovamboland was divided after independence. The Olushandja dam is part of a two-dam supply system comprising the Calueque dam, on the Cunene river in Angola and the Olushandja dam in Namibia. Construction on Olushandja dam was completed in 1975. It acts as a storage and balancing dam for water supplied from Calueque. Olushandja dam is 17,7kms long and about 300m wide. For the last 20 years it has been managed at 30% as this is the capacity at which evaporation balances injection of water into the dam and seepage.

As part of a plan to upgrade the pumping facilities at Calueque and Olushandja dams, upgrading at Olushandja was initiated early in 1995, and involved repairing the north wall pump station and pumps, and the repair of the sluice gates at the south wall. Upgrading of the Calueque facilities is envisaged for 1996. With upgrading virtually complete at Olushandja, the UCT team were commissioned to conduct a SIA on the effect of changing the water level in the dam on the rural communities living in the vicinity of the dam. The SIA forms part of a full EIA looking at the overall environmental effect of changing the water level at which the dam is currently managed. The impact of the SIA will therefore be in terms of management rather than construction.

3. AIMS OF THIS DISSERTATION

This dissertation has two primary aims, namely to:

- communicate the findings of the social impact assessment to the client, i.e. the DWA so as to assist them in making sound decisions for the overall management of Olushandja dam.

- produce an academic account which exhibits analytical rigour and a sound understanding of the course work completed in the first year of the 18 months, Master of Philosophy in Environmental Science degree.

4. APPROACH TO THE STUDY

Both a practical and a conceptual approach are adopted in this dissertation, in order to meet the practical and academic requirements. Both SIA and IEM theory are considered, and emphasis is placed on adopting an holistic, and political approach, to assessment.

5. METHODOLOGY

A multi-methodological approach to this study is adopted, as different techniques are appropriate at different stages throughout the SIA procedure. The procedure and methodology utilised in this dissertation is summarised below:

5.1. Scoping

- Secondary data collection
- Preliminary site visit
- Interviews with client and organizations within the study area

5.2. Profiling

- Secondary data collection
- Primary data collection
  - Household interviews
  - Key informant interviews

- Participatory rural appraisal (PRA) community meeting
- Consultation with specialists, I&APs and various organizations within the study area

5.3. Formulation of alternatives

- Definition of a set of "reasonable" alternative management scenarios for the Olushandja dam from discussions with I&APs, forecasting and trend extrapolation.

- Characterisation and description of the identified scenarios.

5.4. Projection and estimation of effects - analysis of social impacts.

- Identification of social impacts.

- Analysis of the social impacts.
  - Provision of an impact statement
  - Identification of Interested and affected parties
  - Discussion of the nature of the impacts and determination of whether the impact is negative or positive.
  - Allocation of a significance rating with and without mitigation is assigned to each impact.
  - Provision of mitigation for each impact.

- Summary of significance ratings

5.5. Evaluation

- Preparation of a decision-making framework.

- Evaluation of management alternatives in terms of the criteria of equity, efficiency and sustainability.

- Identification of the preferred management scenario.

5.6. Mitigation, management and monitoring

- Provision of recommendations for a water management plan for the dam and its environs, which mitigate against negative social impacts and enhance positive impacts.

- Provide feedback to the community via the headmen and regional councillor in the form of a pamphlet. This will be done after the dissertation has been completed.

5.7. Audit

- Discussion of the success of the SIA/IEM process in this particular study.

6. RESULTS

6.1. Water utilisation patterns in the study area

There are a number of permanent water points found in the study area. These include the canals, pipeline, hand dug wells, boreholes, and the Olushandja dam. The degree to which people rely on the dam is related to the availability and proximity of other water sources. The investigation on water utilisation revealed that the Olushandja dam is not the "water centre" of the area and that less than 25% of the households in the study area are probably reliant on the dam for their daily water requirements. In fact for people living in close proximity to both the Olushandja dam and the Olushandja-Tsandi pipeline, the later is preferred as the water in the pipeline is purified.

Patterns of water use were also found to be seasonal as during the wet season, oshana, pans *omifimas,* and dams fill with rain water. If an *efundja* comes down virtually the whole study area can become flooded. During these times people utilise these temporal water sources extensively, particularly if they are located closer to the homesteads than the permanent water sources. People utilising the Olushandja-Tsandi pipeline are an exception as the water in the pipeline is purified and therefore utilised throughout the year.

Patterns of water use in the study area were found to be consistent with patterns used in other parts of northern Namibia (Marsh and Seely, 1992, Irving *et al,* 1993, Naeera and Solomon, 1994). Provision of water to schools and clinics in small villages is limited or non-existent. The schools and clinics at the bigger centres, namely Onesi and Eunda are connected to the pipeline

and therefore do not suffer as badly as the schools and clinics located in the small villages.

6.2. Results of the SIA

Four alternative management scenarios are identified for the Olushandja dam. They are:

- Management Scenario One: Keeping the dam at 30% capacity
- Management Scenario Two: Keeping the dam full
- Management Scenario Three: Fluctuating the level of the dam
- Management Scenario Four: No dam option.

The impacts of these management scenario on twenty social factors are analysed, and evaluated in order to determine the optimum water level at which the dam should be managed.

Results from the SIA indicate that Olushandja dam should continue to be managed at 30% capacity. The major factors influencing this decision were those of inundation and water surety. By managing the dam at 30%, between 24 and 94 homesteads would be saved from the upset of relocation, whereas filling the dam or fluctuating it between full and dead storage level would result in compulsory relocation of people as a result of inundation. While scenario one is not as beneficial as scenario two with regards to water surety, scenario one does provide a measure of water surety. Therefore Olushandja dam should is managed at 30% capacity as it provides more benefits to more people in the short and long term than the other scenarios.

7. FULFILMENT OF ACADEMIC REQUIREMENTS.

The academic aim of this dissertation is to produce an academic account which exhibits analytical rigour and a sound understanding of the course work completed in the first year of the 18 months, Master of Philosophy in Environmental Science degree. This aim is considered to have been achieved, as the SIA espouses the principles of both SIA and IEM theory. Information on SIA and IEM reveals that the ideals and aims of both fields are very similar. This can probably be attributed to the fact that both have evolved out of the United State's National Environmental Policy (NEPA) of 1969. SIA evolved in first world countries as a result of social considerations not being adequately addressed in EIAs, while IEM evolved in a third world country, and emphasises the need to incorporate social impacts, and public participation into all EIAs.

Over the years, SIA has evolved as a distinct discipline, yet practical involvement in a SIA has led the author to believe that in reality, SIAs cannot be conducted in isolation, and that the

approach adopted in IEM, i.e. of emphasising the importance of the social component in full EIAs, is the only way to ensure that the long term needs of society are addressed. This is based on the premise that all environmental (biophysical and socio-economic) and developmental factors (technical, and economic), impact in some way on the social environment. If an holistic approach to assessment is not adopted, cumulative and secondary impacts are in danger of being ignored.

In terms of the procedure followed in the full EIA, of which the social study team were a part, many of the short fallings identified have been recognised repeatedly, since the conception of IEM in South Africa three years ago (Preston, 1995). Weaknesses include not incorporating IEM into the project planning phase, a lack of scoping, not identifying alternatives early on in the project cycle, and the subjectivity involved with analysing impacts and evaluating alternatives.

8. RECOMMENDATIONS

Recommendations for the management of Olushandja dam are based on the findings of the SIA and on the principles embodied in the fields of SIA and IEM. The recommendations have been divided into two categories, namely high and medium priority recommendations. High priority recommendations should be implemented within the next two years and deal directly with the dam. Medium priority recommendations are not necessarily less important. They incorporate mitigatory measures which are unlikely to be addressed in the short term because they involve improving basic facilities - a problem associated with the all of rural northern Namibia, or require funding or expertise, which is usually unavailable. The author suggests however, that if the benefits from the dam are to be maximised, that these recommendations be implemented within the next five to ten years. Recommendations are provided the Table 1.

Since the SIA is only a component of the full EIA, the recommendations presented in this dissertation should not be considered the only recommendations associated with managing Olushandja dam at 30%. While some of the recommendations given were suggested by the other specialists it is important that the recommendations of all the specialists bee included in the EIA.

It must be emphasised that if a different water level is chosen as the preferred management option for Olushandja dam in the full EIA, that the mitigatory measures associated with that water level (presented in chapter seven) be implemented. If this is not done, there will be no guarantee that the social impacts incurred by changing the water level in the dam will be addressed.

Table 1. Recommendations

Social factor in consideration	Recommendations
	High priority recommendations
Economic environment	♦ The feasibility of increasing the number of fishermen, and or increasing the size of catches per fisherman operating in Olushandja dam should be investigated. New markets for the sale of fish should also be identified and means of transporting the produce to these markets investigated. ♦ A long term management strategy for the sustainable utilisation and protection of the resources in the dam, should be developed in consultation with all I&APs. The strategy should also ensure that locals wishing to utilise these resources derive the primary benefits accrued from these resources. Non-locals should be permitted to utilise the resources in the dam, but not to the detriment of locals. ♦ Implementation of the management policy, enforcement of regulations and patrolling of the dam should not be the sole function of nature conservation. The headmen should be actively involved, and locals who are democratically elected should become involved in conservation of the dam and its resources. ♦ An education programme should be set up to inform both the fishermen and locals of the need to protect the resource and ways that this can be achieved. The importance of conserving all components of the ecosystem must be emphasised. ♦ Drag nets should be disallowed as it is will increase turbidity in the dam. This will be detrimental to fish survival and will impact on long term sustainability of the resource.
Infrastructure	♦ Construct a foot bridge across the dam in the vicinity of Elao. The site of the bridge should be chosen in consultation with the locals living in the vicinity of the dam.
Health	♦ Health education programmes similar to the one developed for malaria should be produced for bilharzia, diarrhoea and gastritis. The responsibility of health education should not lie only with the clinics, but should be taught at schools. The importance of boiling water should be continually reinforced, and people should be discouraged from bathing or washing their clothes in the dam. ♦ People should be encouraged not to collect water from the diseased and polluted, section of the dam, near the north wall. ♦ Provide drums to people dependant on the dam or canals for water. These drums could be used for boiling water, or for purifying dam water with chlorine pills. These pills should be made available at clinics and schools. Water collected from the dam should then be treated with the pills and allowed to stand for 48 hours. ♦ Manual control of bilharzia should be implemented in the dam. This includes eliminating vegetation along the margins of the dam in the area near the north wall, applying molluscicide to eliminate any remaining intermediate bilharzia hosts from the dam, and keeping the canals free of rooted vegetation. ♦ Fishermen should be tested and treated regularly. Waterproof gumboots should be made available for those people who spend a lot of time wading around in the dam. ♦ Inexpensive mosquito nets should be made readily available to the community.
General	♦ Access to the section of dam around the inlet pipe at the north wall should be prevented, to facilitate the introduction of fish into the dam. ♦ This same area should be cleared of all vegetation to prevent snail hosts for water-borne diseases from settling. ♦ The exact size of this area and how it should be managed should be determined in consultation with all I&APs. ♦ Locals should be informed of the reasons behind prohibiting access to the area around the inlet pipe.

Medium priority recommendations	
Economic environment	♦ The economic potential of the two edible molluscs (*Pila occidentalis* and *Etheria elliptica*) in the Olushandja dam should be investigated, with the specific intent of providing locals with jobs, and expanding the economic base of the area. ♦ The viability of initiating fish farms adjacent to the dam should be explored. The emphasis should be on ascertaining the attitudes of the locals and trying to get them involved in the initiative. ♦ The potential of developing more market gardens or getting locals involved in small scale vegetable growing in their own homesteads should be investigated. Cheap irrigation methods should also be researched. ♦ Identify and approach development agencies such as the Rural Development Centre (RDC) and the Northern Namibia Rural Development Programme (NNRDP), which might be interested in the economic development initiatives mentioned above.
Health	♦ More pipelines should be provided to the region as this would ensure that more people had access to purified water. Extensive work has been done on the problems associated water points in sensitive environments. It is imperative therefore that pipelines are not installed without referring to the findings of these studies. ♦ Health workers should also be sent to private homestead to educate adults, particularly the women. ♦ Inexpensive water filtering devices should be made available to the people living adjacent to the dam, and to Epalela residents, as these are the people most affected by the dam water. ♦ Investigate the potential for using impregnated mosquito nets to help combat malaria.
Location of properties	♦ To ensure that the properties situated next to Olushandja dam are never flooded, an active management plan must be adopted.
Legal rights	♦ Modify the expropriation policy to ensure that people situated on communal land are not forced off the land if the water utility company proclaims that people are forbidden to live below the 1007.5m settlement limit. ♦ Develop a water strategy to ensure that those people currently utilising the dam do not loose their rights to the water in the Olushandja dam if the land around it is expropriated. The needs of people currently utilising the dam on a regular basis as well as those who only utilise the dam in times of drought should be considered. ♦ When the water utility company is initiated, a local representative should be included on committee in charge of the management of Olushandja dam, to ensure that the land and water rights of the locals are not neglected.
Livestock	♦ Continue monitoring cattle to ensure that if liverfluke or livestock bilharzia start becoming problematic, it will be recognised early.
Cumulative impacts	♦ Investigate the effect that the dam has on the local ground water. ♦ Investigate the effect that sedimentation and salinisation will have on the dam. ♦ Generate a resource management policy that protects the aquatic habitats existing in the dam.

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CHAPTER ONE: INTRODUCTION

1.1. BACKGROUND TO THE STUDY

In 1994, the Bulk Water Directorate of the Department of Water Affairs, Namibia (DWA) were commissioned by a The Dutch Directorate General of International Cooperation (DDGIC) to carry out an environmental impact assessment (EIA) of an existing bulk water transfer scheme before securing their grant. The water supply scheme supplies northern Namibia with water from the Cunene river, before securing their grant. The upgrading project is divided into two phases and will take a number of years to complete. Only the second phase of the project i.e. the upgrading of the Calueque-Olushandja component of the Calueque water supply scheme, was investigated in this study. The EIA was initialised early in 1995 and will be completed by the end of the year. As a component of the full EIA, a project team from the Environmental and Geographical Science (ENGEO) Master of Philosophy (MPhil) class, under the guidance of a consultant from the Environmental Evaluation Unit (EEU) (Appendix C), were appointed to conduct a social impact assessment (SIA), to determine the optimum capacity at which the Olushandja dam should be managed.

This dissertation is the individual analysis of the baseline information on the social impacts of upgrading of the Olushandja dam. The baseline information was collected by the masters project team. This dissertation is submitted to the examiners for evaluation as a partial requirement for the MPhil degree in Environmental Science.

The baseline report (BLR) is titled "Social Impact Assessment (SIA) of the upgrading of the Olushandja dam" (ENGEO Master's project team, 1995). The report contains a comprehensive account of the social environmental criteria that are important in the evaluation of the upgrading project on the rural communities living in the vicinity of the dam. It also contains a detailed description of the biophysical and socio-economic environments of the region. The BLR and individual dissertation will comprise the social component of a full environmental impact assessment of the upgrading of the Olushandja dam, commissioned by (DWA). This individual dissertation provides the DWA with recommendations and management alternatives for the Olushandja dam, in light of the social impacts caused by the project. As the BLR constitutes the basis of this dissertation, they should be read in conjunction with one another.

1.1.1. Project description

A brief overview of the project is given in this dissertation, as a detailed account is documented in the BLR.

The Olushandja dam is located in the northern part of Namibia, in the Omusati region (Appendix E, Figure 1). Omusati is one of the four regions into which the former Ovamboland was divided after independence (Appendix E, Figure 2).

Prior to 1969, communities living in these regions were totally dependent on the ephemeral, shallow rivers, known as *oshanas*, which dissect the region, for their water requirements. The water from the *oshanas* replenishes groundwater as well as filling pans and providing surface water during the wet season. The only source of permanent water is the Cunene river, which forms the border between Angola and northern Namibia. In terms of a 1969 agreement between the Portuguese administration in Angola and the South African administration of what was then South West Africa, Namibia was granted rights to extract $6m^3/s$ from the Cunene river.

The construction of a two dam supply system began in 1970, to take advantage of this permanent water source. The first dam, the Calueque dam was sited on the Cunene river in Angola, about 12kms north of the Angola-Namibian border. Due to the outbreak of hostilities in 1976, construction of the Angolan component of the water scheme was never completed, and portions of the completed infrastructure were damaged. Consequently, water abstraction from the dam has always been well below maximum. At present, there are two $2m^3/s$ pumps operational at Calueque. These pumps operate for 24 hours a day. The current demand is less than $2m^3/s$ so it is very rare for the two pumps to operate simultaneously. The pump may even be operated below optimum pumping rate if there is not a demand for water in Namibia.

The second dam, the Olushandja dam, was built between 1971 and 1974 in Namibia, about 4kms south of the border. The Olushandja dam was designed to act as a balancing reservoir for water pumped from the Calueque dam.

As a result of both drought and increased urbanisation in northern Namibia, there is currently a demand for water and this is expected to increase in the future. In 1994, it was estimated that 70% of the population in northern Namibia relied on water from the Cunene, while the remaining 30% relied on underground water (Ward, 1994). The number of people becoming dependent on the water supply scheme in the future is expected to increase above 70%. Therefore, to prepare for the long term water needs of the region, the DWA decided to upgrade the two dam supply system to allow maximum abstraction of water from the Cunene.

Upgrading of Olushandja dam has been initiated, prior to upgrading of Calueque, as the climate in Angola is still unstable.

1.1.2. The Olushandja dam

Because the Olushandja dam has been built in the bed of an *oshana*, i.e the Oshana Etaka, walls exist at both its northern and southern ends. The dam is 17,7kms long (aerial photographs, 1995), approximately 300m wide, with a maximum depth of 3.5m. The large surface area to volume ratio of the dam makes it susceptible to high evaporation rates - up to 1,7m per year (Lund, 1992). The dam is currently maintained at 30% capacity, as this is the level at which evaporation balances, injection of water into the dam and seepage (Haussler, pers comms, 1995). The water level extends to the 1004m contour when 30% full and to the 1006m contour when totally full. In the original dam design, the 1007.5m contour was classified as the settlement limit for the dam, and marks the limit of the wave action zone (Appendix E, Figure 3).

1.1.3. The water supply system

Historically, the people of northern Namibia relied on water from the seasonally flowing *oshanas* which dissect the region for their water requirements. However there is an increasing dependence on water supplied from the Cunene river. DWA operates both bulk and rural water supply distribution networks, so that people throughout the regions of northern Namibia can benefit from a permanent water supply.

Water is pumped from the Calueque dam in Angola into a 2.4km steel pumping main, 1.6m in diameter (Lund, 1992). This feeds a 21km lined canal, (the Calueque-Olushandja canal) which extends to the Olushandja dam. The 2km section of this canal on the Angolan side of the dam has a maximum capacity of $10m^3/s$, while the remaining section in Namibia, has a design capacity of $6m^3/s$ - the maximum volume of water which Namibia is permitted to extract from the Cunene river. At present only one $2m^3/s$ pump is operational at any one time at Calueque, as the demand is such that 1m3/s is sufficient to supply all of the bulk and rural networks with water (Haussler, pers comms, 1995).

On the north-western bank of the Olushandja dam is a purification works. A tiny percentage of the water ($0.028m^3/s$) is abstracted for purification and then pumped into a pipeline which extends via the towns of Eunda, Onesi and Tsandi to Okahao in the south. This pipeline is supplied and maintained by the rural water division on DWA, and is one of three pipelines in the greater area. The second pipeline extends south west from Ogongo to Okahao and the third form Ogongo, north east towards Okalongo (Appendix E, Figure 4). Regularly distributed along

the pipelines are water points which have both taps for human water requirements and troughs for livestock needs.

Prior to construction of the dam, communities living to the south of the study area were dependent on the water which flowed down the Oshana Etaka during *efundjas*. To ensure that communities to the south of the Olushandja dam still have access to water, an unlined, earth canal (the Etaka canal) extends from the south wall of the dam to Tsandi. Water flows naturally into the canal, and pumping is only necessary if the water level in the dam drops below about 35% (Haussler, pers comms, 1995). The pumping capacity of each of the two pumps at the south wall is only 0.35 to 0.40m^3/s. Currently, 0.12m^3/s is let into the Etaka canal and appears to meeting the demands of the communities to the south of the dam (Haussler, pers comms, 1995). Fascilities also exist for flushing the Oshana Etaka, south of the dam with water from the Olushandja dam, but this has never actually happened in the 20 years of the dams existence.

The remaining, unpurified water is channelled via an inverted siphon under the Olushandja dam, parallel to the northern wall, into a lined canal (the Olushandja-Ogongo canal). The Olushandja-Ogongo canal which has a maximum capacity of 3.2m^3/s, runs eastward, to Ogongo, after which water is pumped into the Ogongo-Okahao and Ogongo-Okalongo pipelines (Appendix E, Figure 4.). Presently less than 1m^3/s actually passes down the canal (after water has been extracted for the Olushandja-Tsandi pipeline, for the Etaka canal, and by locals extracting water directly from the Calueque-Olushandja canal). Demands on the Olushandja-Ogongo canal by bulk water consumers include a plant at Ombalantu, which extracts 0.056m^3/s for ten hours per day (Haussler, pers comms, 1995). The demand for the pipelines at Ogongo is currently 0.27m^3/s. An old earth canal extends from Ogongo to Oshakati. Excess water which is not let into the Olushandja-Tsandi pipeline or into the Olushandja -Ogongo canal is pumped into the Olushandja dam.

Since the completion of the social field studies in Namibia, the masters study team have heard that there are now talks about siting a number of new dams (about ten) to the south of Olushandja dam, in the Oshana Etaka. According to Haussler (1995), these Etaka dams will have minimal effect on the Olushandja dam, as they will depend primarily on rain water to fill them, and will only need to draw on water from the Olushandja dam occasionally.

There is one pipeline which falls under the control of the Bulk Water Directorate. It extends from the Ruacana diversion weir on the Cunene River, to the Calueque-Olushandja canal. This pipeline is currently used to supply a large scale irrigation project called Etunda, which is located at the north western corner of our study area (Appendix E, Figure 4). Etunda currently extracts 0.33m^3/s from the pipeline which has a maximum capacity of 0.6m^3/s (Department of

Water Affairs, 1990). The pipeline is very costly to operate as water must be pumped up the escarpment on to the Cuvelai plain (Brand, pers comms, 1995). A study is presently under way to determine feasibility of extracting water for Etunda from the Calueque-Olushandja canal. It involves constructing another canal which will branch off the Calueque-Olushandja canal and extend to Etunda. It will draw $2m^3/s$ from the system when fully operational (Haussler, 1995).

1.1.4. Upgrading of the Olushandja dam

The upgrading of the Olushandja dam is a component of a large project to upgrade the entire Calueque-Olushandja water supply scheme. The upgrading is aimed at addressing the long term demand for water in northern Namibia. Upgrading of the pumps at Calueque is scheduled for 1996. The two $2m^3/s$ pumps will be replaced with two $3m^3/s$ pumps, which will enable maximum extraction. An additional standby pump of $3m^3/s$ pump will also be installed (Haussler, pers comms, 1995). Other improvements and reconstruction of the Calueque dam are envisaged for some stage in the future. Once the Calueque pumpstation has been upgraded, $3m^3/s$ will be released into the supply system. Two thirds of it will be channelled to Etunda, and the remaining third channelled to Olushandja.

The aim of upgrading the Olushandja dam is to work towards providing the consumer with maximum security of supply of up to $6m^3/s$. This includes being able to utilise both the Olushandja-Ogongo and Etaka canals at their maximum, once full upgrading has occurred at Calueque. Upgrading of the existing infrastructure at the Olushandja dam is almost complete. It included rebuilding the pump station on the north wall, as it was damaged during the war, installing a pair of $0.75m^3/s$ pumps within the pump station and servicing the *oshana* outlet gates at the south wall. Larger pumps will be needed at the north wall in the future to provide the maximum volume into the Olushandja-Ogongo canal (i.e $3.2m^3/s$). However the two smaller pumps installed should meet water demands in the short and medium term.

1.2. SCOPE OF THIS DISSERTATION

The study of the social environment around the Olushandja dam took place after upgrading of the dam itself had been initiated. The report is therefore intended to provide recommendations for the management of the Olushandja dam in terms of social criteria. In order to achieve this aim, the study shall include the evaluation of alternative management scenarios for the Olushandja dam, each of which may require different management plans. One of the alternative scenarios will be a no dam option. The no-go option is probably not a realistic alternative in this study as DWA seem determined to keep the dam and have already incurred large expenses on upgrading the infrastructure at the dam. It has been included therefore to provide more scope for the academic component of the study. Evaluation of the alternatives will include the view points of all interested and affected parties (I&APs), namely the communities living around the dam, the communities supplied with bulk water and the DWA. A preferred alternative will be identified and recommendations for a management plan will be based on the chosen alternative. The analysis, evaluation and recommendations will be based solely on socio-economic criteria, and the final report will be used as a socio-economic specialist report in the full EIA, to be complied by Ms Barker of the EEU.

1.3. AIMS AND OBJECTIVES

1.3.1. Aims

This dissertation has two primary aims. The first is to communicate the findings of the social impact assessment to the client, i.e. the DWA to assist them in making sound decisions for the overall management of the Olushandja dam. The second is to produce an academic account which exhibits analytical rigour and a sound understanding of the course work completed in the first year of the 18 months, Master of Philosophy in Environmental Science degree.

1.3.2. Objectives

More specifically, the objectives of this dissertation are:

i) To provide an account of the water use patterns of the communities living in the vicinity of the Olushandja dam by analysing the data contained in the BLR.

ii) To identify alternative dam management scenarios by determining the needs of the I&APs and assessing the key social criteria.

iii) To identify, the key social criteria which will influence the decision made towards a particular management option for the dam.

iv) To evaluate these chosen alternatives using accepted evaluation methodology, based on academic theory.

v) To identify a preferred alternative for management of the Olushandja dam in terms of socio-economic impacts, based on the evaluation and academic theory.

vi) To provide recommendations for a management programme, based on the findings of the SIA and on the principals embodied in the fields of SIA and Integrated Environmental Management (IEM).

vii) To provide a brief evaluation of the EIA process adopted for the upgrading of the Olushandja dam, and use the project as a case study to identify weaknesses and strong points in the process.

viii) To demonstrate an understanding of the principles, methods and techniques used in the analysis, evaluation and presentation of social and environmental impact assessments.

The first objective has been documented extensively in the BLR. Consequently an account of water usage patterns will be relatively brief and this dissertation will focus on fulfilling the requirements specified in points ii) to viii).

1.4. ASSUMPTIONS AND LIMITATIONS

1.4.1. Assumptions

- The information in the BLR is assumed to be correct.
- The views of the people interviewed are assumed to be representative of the community and/or of the organizations they represent.
- The findings of this social impact assessment will be used in conjunction with other environmental specialist reports to produce an integrated environmental management plan for the Olushandja dam.

1.4.2. Limitations

- The dissertation is limited in its analysis and evaluation as it should ideally be performed by a multi-disciplinary team.
- The BLR does not contain all of the data ideally required for analysis. Time constraints, lack of existing data, and inability to contact some interest groups, are some factors contributing to this problem. Consequently, sections of the analysis and evaluation may lack depth.
- The dissertation is limited by the fact that the actual upgrading of the dam was initiated prior to the start of the SIA. In reality therefore, the SIA is not required to identify the best upgrading alternative in terms of the social impacts, but to determine the best management scenario for the upgraded dam.
- The extent to which the author can contribute to socio-economic problems within the Omusati region of northern Namibia is limited by the fact that she has had no formal training in sociology.
- The dissertation has to amalgamate the requirements of a SIA report with those of an academic dissertation. Thus, although the academic requirements are emphasised, it cannot be considered to be a purely academic work.

1.5. APPROACH TO THE STUDY

To attain the aims and objectives set out in this dissertation, it is necessary to adopt both a conceptual and practical approach to the study.

1.5.1. The conceptual approach

The "conceptual approach" ensures that the theoretical base on which the study is founded is addressed. This dissertation draws on SIA and IEM theory. Consequently analysis, evaluation and recommendations will not be based solely on the information documented in the BLR but will draw on the methodology and techniques of assessment and evaluation prevalent in contemporary SIA and IEM literature.

According to Leistritz and Murdock (1981), SIA focuses analysis on four broadly accepted areas of social phenomena. These are:

i) the process by which people interact to form groups
ii) social organization and social structures
iii) social institutions
iv) social perceptions and attitudes.

In the study of the Olushandja dam, an emphasis is placed on social perceptions and attitudes, as this area of analysis affects and is affected by each of the others (Leistritz and Murdock, 1981). It is this aspect of analysis which attempts to measure community and service satisfaction, perceptions, of the environment and community growth and development preferences (Selby, 1978, Lopreato and Blisset, 1978, and Freudenberg, 1979, in Leistritz and Murdoch, 1981).

From the theoretical perspective, it is important to acknowledge that the choice of methodology and interpretation of assessment data is often influenced by the conceptual approach which underlies the research effort (Leistritz and Murdock, 1981). There are a number of theoretical bases , but the one adopted in this dissertation, adheres to the human ecological perspective. This perspective presumes that the primary problem humans face is the need to continually adapt to an ever changing environment (Leistritz and Murdock, 1981). It adopts an holistic approach to social analysis and emphasises the need to consider both the social and non social determinants of human behaviour. The author finds this approach useful as it incorporates many of the principles of IEM discussed on page 18.

1.5.2. The practical approach

The "practical approach" has to satisfy the terms of reference laid out by the client. This involves two distinct phases. Initially the masters study team collected the necessary social information and compiled a baseline report, which was given to the client. The second phase involves the analysis and evaluation of the BLR to provide recommendations for the management of the Olushandja dam. This dissertation will then be used as a socio-economic specialist report in the analysis of a full EIA on the upgrading of the Olushandja dam. The EIA Report will be compiled by the Environmental Evaluation Unit (EEU) of the University of Cape Town (UCT) and presented to the client before the end of the year.

There are a variety of practical approaches to SIA, which can generally be divided into two camps;

i) the technically orientated, technocratic approach and

ii) the participatory, political approach.

(Freudenberg, 1986, Craig, 1990).

These two models have different approaches to methodology. The first focuses on research and a top down approach, while the latter advocates public participation and a bottom up approach (Freudenberg, 1986). As Burdge (1990), points out, there is no "right" approach, they depend upon the particular development situation at hand. Additionally amalgamation of these two models is often the most desirable option. The rural nature of this study made it necessary to adopt a more politically orientated approach and methodology.

The political model

- Emphasis is placed on community development and the decision-making process rather than the product.
- It is influenced the development theories of democracy.
- The decision-making process is portrayed as being value laden and political in character.
- Experts and scientific evidence are perceived to have some importance, but the ultimate determinant of policy is seen as value choice.
- It adopts a critical view of industrial market society with its growth imperatives and focuses on alternative economic and social strategies that may evolve less exploitative values toward the environment.
- There is an emphasise on socially useful and socially directed technology.
- Issues in the decision-making process tend to be identified as higher-level planning issues such as project need and alternatives as well as broad social strategies.
- Conflict over social values is perceived as the reality in environmental controversies and demands are made for the them to be debated and determined in a democratic manner.
- Attention is given to the historical and cultural context of SIA.

(Craig 1990).

1.6. ADMINISTRATIVE, LEGAL AND POLICY REQUIREMENTS

1.6.1. Administrative aspects

Within the Department of Water Affairs, the administration of water is divided into two directorates, the Directorate of Bulk Water Supply (DWA) and the Directorate of Rural Water Supply (DRWS). The management of water in the Olushandja dam is a function of Bulk Water while the provision of water to the people living in the vicinity of the dam belongs to Rural Water. Many of the social issues which have been identified in the project are related to improving peoples' standard of living and accessability of people to water. These are rural water functions.

Rural water supply

If the SIA is to be of any value, it is imperative that the two directorates are involved in the upgrading project. Therefore mitigation will have to be carried out in the context of the Rural Water Supply Strategy which was released in the September of 1994. This strategy outlines a new approach towards rural water provision and is based on the principle that "communities in

the rural areas should be encouraged to participate fully in the planning, management and operation of their water supply" (Department of Water Affairs, 1994b).

The objectives of the DRWS are to:

- contribute towards improving public health
- reduce the burden of collecting water
- promote community based social development especially taking into account the role of women
- support basic needs
- stimulate economic development.

Included in their functions are the:

- evaluation and planning of new water supply schemes and improvements to existing schemes in conjunction with the local community.
- technical and financial assistance to communities for the operation , maintenance and management of their water supply, as well as for the implementation of new water supply schemes and improvements to existing schemes.

It is important that the recommendations and mitigatory measures suggested in this assessment are implemented within the context of the aims laid out in the strategy, i.e. to promote the sense of ownership of the water and to involve the community in the planning, design, construction phases and formal handling of the water facilities (Department of Water Affairs, 1994b).

In November a rural water supply and sanitation sector coordinating body, namely the National Water and Sanitation forum, was established. The forum brings together government and non-government organisations who are actively involved in rural water supply and rural sanitation. The main aim of this forum is to ensure that all organisations are aware of what is happening in the rural water sector (Department of Water Affairs, 1994b).

Despite the fact that the SIA project has been commissioned by the Bulk Water Directorate, it cannot be viewed strictly as a bulk water project. Therefore, the report should be presented to the forum to ensure that the people involved in rural water development are aware of this SIA and allowed to comment on it.

Bulk water supply

The bulk supply, including the Calueque-Olushandja supply system is currently controlled and administered by the directorate of Bulk Water Supply. However a draft bill to commercialise the

Directorate and establish a Namibian Water Corporation Limited is presently before the cabinet. According to a feasibility study carried out in April, 1993 (Department of Water Affairs 1994a), commercialisation of DWA is both desirable and financially viable.

Essentially, if the bill is passed, the bulk water function of the DWA will be commercialised, by establishing a limited liability water utility company. The company would be formed by the ministry of Agriculture, Water and Rural development, incorporated under the provisions of the Companies Act, 1973, and be wholly owned by the Government (Namibian Government, 1994a). Rural water services and the management and control of the countries water resources are to remain with the state, and DWA will be restructured as its scope of activities will be reduced.

Within the bill there are mentions of the environment. In S4, it is stated that one of the main objectives of the corporation is to supply bulk water in an environmentally sound manner and S12, indicates that the corporation will "have regard" for preserving the country's heritage and for protecting the environment and also states that it will "take into account" the effect which proposals might have on the country's heritage and the environment. While these inclusions are welcomed, it is felt that it provides inadequate environmental protection and that a clause should be included which advocates EIAs for certain projects or policies, in accordance with the Namibian Environmental Policy (Glazewski, 1995).

In terms of social issues, the bill does not contain any dispute resolution procedure and this is seen as a weak point as conflict situations are bound to develop and should be provide for.

S8 of the bill also proposes that the Expropriation Ordinance (Ordinance 13, 1978), be extended to the Water Corporation, providing it with the powers to expropriate moveable and immoveable property in the public interest subject to payment of reasonable and fair compensation. There is however no discussion of how compensation might be addressed and dealt with, and who decides what is "fair" and "reasonable". There is in fact no compensation policy in Namibia and the author feels that inclusion of a procedure should be outlined in this bill, to act as a precedent.

As far as this study is concerned, it must be noted that the proponents of the SIA are the DWA and that if the Water Corporation takes control of bulk water, there can be no guarantees that they will take into account or adhere to the recommendations provided in this report. However because the company will be owned wholly by the government, it is likely that the policies and management plans adopted by the DWA will in turn be adopted by the company. Additionally, the Company will be accountable to the DWA as far as water resource management is concerned (Department of Water Affairs, 1994a). If this is the case then the long term

management plans for Olushandja dam need not be jeopardised by a change in ownership and management thereof.

1.6.2. Legal aspects

In many respects, the legal framework in Namibia is inappropriate. Most of the policies and acts currently used in Namibia were passed when the country was still under German or South African Rule. This is particularly evident with regards to the Water Act. The South African Water act No 54 of 1956 is currently in use in Namibia. The act focuses on regulating water relationships between the private and public sector. The problem is that in Namibia, a large percentage of the population live on communal lands. This is particularly true for the northern regions of Namibia (previously known as Owamboland). The law does not regulate relationships between the state (who own the land and water resources) and the public (who live on the land and have free access to the water.) Where the act does not apply, it is substituted by common law. According to Roman-Dutch Law, all running water is common property. Such an approach to water utilisation, in a country seriously bereft of water, can lead to a situation referred to in law as "the Tragedy of the Commons". In Namibia, the state should have the power, in the public interest to exercise control over any running water. Until the act is amended to deal with the issue of water rights on communal land, conservation and management of the country's water resources will be very difficult.

Laws protecting land rights are also seriously lacking in Namibia. There has been no revised policy on communal lands since the South African Lands Act of 1936. This act is no longer applicable and although it is theoretically still enforceable, it has never really been used in Namibia. The main reason is that the act deals with homelands. The legal situation regarding expropriation, relocation and compensation in communal lands have never been tested. When land has had to be compensated for, it has been done on an *ad hoc* basis, the situation being resolved by negotiation between the developers and public involved. According to Mr Werner (pers comms, 1995), the DWA are entitled to claim areas around the Olushandja dam and expropriate people. This has happened before in communal land, at Omdel dam. Policies dealing with these issues need to be developed, to ensure that the rights of people living on communal lands are recognised and not abused.

Closely linked to the issue of land rights in communal areas is the rights of traditional leaders, as traditional leaders are responsible for allocating land to people. A Traditional Authorities Bill of 1995, outlining the roles of traditional leaders and regional councillors has recently been passed by cabinet (Namibian Government, 1994b). As far as the environment is concerned, there is a clause in the bill, clause 10 (2)(c), states that it is the traditional authorities duty to ensure that the members of their traditional community use the natural resources at their

disposal on a sustainable basis and in a manner that conserves the environment and maintains the ecosystems for the benefit of all persons in Namibia. However, the bill provides few enforcement mechanisms, so to enforce this function, thus traditional authorities would need to be guided by supporting legislation (Corbett, Jan 1995, comments). Unfortunately at present that legislative backing is lacking.

Regional councillors also currently have no meaningful powers, and although this is not altered in the act, there is a move to elevate their position by subordinating tribal leaders. This has been achieved by emphasising the customary roles of traditional leaders in most policy documents. According to Mr Werner (pers comms, 1995), there should be a formalised framework to bring the traditional leaders and political authorities together. It is unlikely however that the national government would wish to accept jointly negotiated decisions as this would involve the diffusion of power between political and traditional figures.

1.7. STRUCTURE OF THE REPORT

An executive summary of the dissertation is included before chapter one.

The dissertation itself consists of the following:

CHAPTER ONE contains the introduction, which includes the scope, aims and objectives, assumptions and limitations, theoretical context and approach.

In **CHAPTER TWO** the theoretical context in which this dissertation is set is discussed

CHAPTER THREE contains the methodology adopted during the different stages of the SIA procedure.

In **CHAPTER FOUR** a background to the study is given as well as a brief description of the biophysical and social environments within the study area .

CHAPTER FIVE provides a brief description of the patterns of water use, and dependence of the people living in the study area on Olushandja dam.

In **CHAPTER SIX** the interested and affected parties are identified and their concerns documented. The three alternative management scenarios are also identified and described.

CHAPTER SEVEN contains the description of the social criteria which might be affected by the upgrading of Olushandja dam, and the analysis of those social criteria. Each impact is ascribed

a significance rating with and without mitigation, and reason are given for the decisions. Mitigatory or optimisation measures are given for each impact.

In **CHAPTER EIGHT** an evaluation of the three alternatives is conducted using a decision making framework, and a preferred alternative is identified.

CHAPTER NINE contains the recommendations and mitigation for the management of the Olushandja dam based on the chosen management scenario.

CHAPTER TEN presents a discussion of the SIA/IEM process using the upgrading of Olushandja dam as a case study. Strong points and weaknesses inherent in application of the process are identified.

In **CHAPTER ELEVEN** the conclusion to the dissertation is presented, as well as the recommendations for the decision maker.

CHAPTER TWO: THEORETICAL CONTEXT OF THE DISSERTATION

This dissertation is set within the theoretical disciplines of social impact assessment and environmental evaluation. This section discusses in general, the nature and principles of SIA and IEM.

2.1. SOCIAL IMPACT ASSESSMENTS

SIAs originated in the USA with the conception of the National Environmental Policy (NEPA) of 1969. The act required federal agencies to adopt an interdisciplinary approach to ensure that both natural and social environmental criteria were considered in environmental design and project planning (Taylor *et al*, 1990). However in the late seventies, it was realized that social aspects were not being adequately addressed in EIAs. In fact " integrated use of the natural and social sciences was virtually impossible to find in some of the earliest environmental impact statements (EISs) (Freudenberg, 1986). Consequently, an independent field of research referred to as SIA emerged. Because SIAs are essentially a product of the nature of the environmental impact assessment effort and of the role of the social assessment product within the overall assessment effort (Leistritz and Murdock, 1981), many of the fundamental concepts and principles of EIA and SIA are similar. However the conceptual dichotomies evident between the natural and social sciences result in a number of theoretical differences between SIAs and EIAs and justify their existence as separate academic disciplines.

2.1.1. Definition of SIA

No single definition of SIA is accepted universally (Burdge *et al*, 1990). According to Bowles (1981, in Craig, 1990), SIA is "*an application of social science methodology to assist in social planning*", while Freudenberg, (1986) defines it as "*an hybrid, a field of social science and a component of the policy making process*". The most appropriate definition in terms of this dissertation is provided by D'Amore (1978 in Craig, 1990);

> "*SIA is an attempt to predict the future affects of policy decisions (including the initiation of specific projects) upon people, their physical and psychological health, their traditions, lifestyles, institutions and interpersonal relationships.*"

2.1.2. Purpose of SIAs

Despite the variety of definitions and a variety of conceptual approaches to SIA (Craig 1990), there are a number of aims and objectives which are characteristic of the process.
The aims of SIA are to:

- be action focused
- anticipate and describe social effects of change caused as a result of development projects, planning or policy before they happen
- involve all interested and affected social groups in the planning process
- maximize co-operation, coordination and communication between all of the affected parties, including the developer
- to provide recommendations and mitigation to minimize negative social impacts
- manage social impacts as early on in planning as possible
- monitor prospective social problems
- give more concrete and democratic meaning to social planning
- increase knowledge before, during and after the planning and active stages of the development project.

(Burdge, 1990, Craig, 1990, Derman and Whiteford, 1985, Taylor *et al*, 1990 and Wolf, 1983 in Derman and Whiteford, 1985).

2.1.3. The SIA Process

In any type of impact assessment, it is critical to adopt a procedure which is designed to achieve the theoretical and practical aims of the process. Within the literature there is variety on the structure of the SIA procedure and concepts such as "evaluation" are often used in different contexts (Wolf, 1983 in Taylor *et al,* 1990 and Taylor *et al*, 1990). For this dissertation, the author has chosen to modify Wolf's general methodology for impact assessments (Wolf, 1983 in Taylor *et al*, 1990) as it has been used in a number of countries and to also include some of the modifications made to this procedure by Taylor *et al* (1990) (Table 1). This procedure is also very similar to the Integrated Environmental Management (IEM) procedure which has been adopted by South Africa for implementing EIAs.

The problem with the SIA procedure is that it does not emphasise the importance of public participation within the SIA procedure - particularly the need to feed back to the I&APs by means other than an SIA report.

According to Kahn (1994), it is essential to ensure that the following considerations are not omitted from the SIA procedure:

- SIA should be initiated in the earliest phases of the decision making process and the

potential social impacts identified early in the project cycle.

- The SIA must be set within a relevant historico-political context and those factors still prevailing should be identified.
- Identification of all Interested and affected parties (I&APs) is essential.
- Public participation must form a fundamental component of the process.

Whereas the procedure looks straightforward in theory, the practical reality of SIAs is that it is very difficult to provide recommendations and mitigation on social impacts which are interlinked with economic, natural and other social impacts in a complex web. Analysis of these impacts can rarely be accomplished quantitatively and evaluations are then based on qualitative descriptions of impacts which are very difficult to rate. It is also difficult to isolate impacts and events from the cumulative picture (Craig, 1990). Consequently there is often a tendency to compartmentalise issues or to produce broad generalisations which distort the socio-economic reality of the particular setting (Quinlan, 1993).

It is important therefore to shift the emphasis of SIAs away from establishing the concrete effects of a project proposal to the dynamics of how the effects occur (Quinlan, 1993). In other words the emphasis of any SIA should be on the process, not on the report.

One way of looking at a development project is that is an intervention which results in the establishment of new relationships between the project proponent and the other I&APs and creates new environmental conditions which will be modified in time by the interactions of the people concerned (Quinlan, 1993). Therefore in this study, it is important not to base the decisions on the specific, fixed effects of the upgrading project only, but to focus on what relationships should be fostered in order to sustain the project and its socio-economic context to the benefit of all involved. In other words consideration of long term effects is fundamental.

TABLE 1. The Social Impact Assessment (SIA) procedure, taken from Wolf, 1983, in Taylor *et al*, 1990 and Taylor *et al*, 1990.

ASSESSMENT STEPS	FUNCTIONS
Scoping	1. Formulate the terms of reference. 2. Identify and determine the impact categories. 3. Develop study design. 4. Perform a mini assessment.
Profiling *(baseline study)*	1. Overview and analyse the current socio-economic context. 2. Overview and analyse the historico-political context and identify historical trends. 3. Characterise the potentially impacted system(s). 4. Interpret data on social issues and trends. 5. Compile an overview or baseline study report which will act as a source of information for the process of decision making prior to the estimation and comparison of effects.
Formulation of alternatives	1. Define a set of "reasonable" alternatives. 2. Characterise and describe the technical system(s).
Projection and estimation of effects *- Analysis of social impacts*	1. Identify social impacts. 2. Determine decision criteria for analysis of social impacts. 3. Determine the scale, intensity, duration and probability of the effects. 4. Compare effects and implied social, economic and resource trade-offs. 5. Detailed examination of impacts of one or more options against decision criteria. 7. Display the information in a document as is appropriate and required by consent procedures.
Evaluation	1. Rank and weight preferences for alternatives. 2. Preform trade-off analysis. 3. Identify preferred alternative.
Mitigation, management and monitoring	1. Identify possible mitigation measures. 2. Provide recommendations and specify the terms and conditions for the application of the possible preventative measures. 3. Devise a management plan. 4. Adjust the planning objectives, operating procedures and design specifications. 5. Devise a monitoring plan 6. Measure the actual versus the predicted impacts. 7. Feed back the results to the policy makers and public.
Auditing	1. A systematic retrospective review of the social effects of the change being assessed including the social assessment process that was employed.

2.2. SIA AND IEM

SIA and IEM are very similar in nature, consequently, this dissertation embraces the aims and priciples of IEM. The concept of IEM was proposed by the Council for the Environment as a procedure to deal with the juxtapositions evident in environmental management in South Africa, i.e. the existence of both technological, first world and underdeveloped, third world environmental issues.

IEM is defined in document six of the IEM Guideline Series (Department of Environmental Affairs, 1992), as

> *A philosophy which prescribes a code of practise for ensuring that environmental considerations are fully integrates into all stages of the development process in order to achieve a desirable balance between conservation and development.*

The IEM procedure attempts to overcome the social short fallings identified in EIAs in the USA by including a comprehensive social component to the IEM procedure. Two of the principles of IEM are:

- consultation with I&APs
- the opportunity for public and specialist input in the decision making process.

Both are also important components of SIAs.

As with SIAs, IEM identifies the value of active public participation and advocates that the public be included in the earliest stages of the project proposal and that consultation be maintained throughout the project cycle.

The IEM document includes an extensive list of social environments, activities and variables which should be considered in the light of any development project, management plan or policy. Whereas this dissertation is essentially a SIA, it must be understood that the study has been carried out as part of an overall EIA. The compilation of this report is the task of the EEU. They are the champions of IEM. IEM also constitutes the foundation of our training in environmental management. Consequently it is inevitable that the principles, process, and attitudes of IEM will flow through this dissertation. This should not be problematic as the SIA and IEM procedures are complimentary.

2.3. IEM IN NAMIBIA

Another reason for becoming familiar with IEM is that Namibia has recently drawn up its own

environmental assessment policy, a policy which aims to achieve IEM. This policy was only approved by cabinet in January 1995. It stresses the need for environmental assessment in projects as well as policy to ensure that the environmental consequences of these activities are considered. The policy aims to promote sustainable development and economic growth while protecting the environment in the long term. As in IEM, the term "environment" is broadly defined to include both the biophysical and socio-economic components of the environment. Institutional structures and procedures still need to be put in place for its effective implementation, and appropriate legislation must still be drawn up.

The main aims of the policy are to:

- better inform decision makers and promote accountability for decisions taken,
- consider alternatives for specific projects, programmes or policies,
- include public participation of all I&APs as an important component of the process,
- take environmental costs and benefits of the proposed activity into account
- incorporate internationally accepted norms and standards where appropriate in Namibia,
- consider secondary and cumulative effects,
- be flexible and dynamic.

All of these aims are contained within the South African IEM document. The Namibian policy adds one additional objective;

- to ensure that the EA procedure is paid for by the proponent. If the EA is initiated by the state, the government will meet the costs of an independent assessment.

Two valuable additions which are not incorporated in the IEM documents are include in the Namibian Environmental Evaluation Policy.

Firstly they state that "the proponent shall enter into a binding agreement based on the procedures and recommendations contained in the EA report". The aim of this is to help ensure that recommendations and mitigatory measures are accepted by all I&APs and complied with. In South Africa, EAs are compulsory for certain activities and environments, but proponents are not obliged to adopt the recommendations given in the EA, they simply have to take them into account. In a recent paper discussing problems with IEM since its conception three years ago (Preston 1995), indicates that one of the serious problems in the implementation of IEM to date has been the lack of effort to ensure that mitigatory measures for negative impacts and optimisation of positive benefits are implemented.

Secondly the Namibian policy advocates the establishment of an Environmental Commission, appointed by the Ministry of Environment and Tourism and housed in the office of the National Planning Commission. This commissioner would be responsible for administering the EA procedure. The combination of the environmental and planning divisions within the National planning Commission is a very valuable inclusion, as it acknowledges the need for IEM and planning to be complimentary (Preston, 1995). In South Africa, IEM duplicates planning legislation rather than complimenting it.

The major advantages of Namibia's environmental policy over the South African policy is that it has broad support from government departments and the business community and is backed by the full force of the law (Preston, 1995).

In order to achieve IEM, the following procedure has been adopted (Table 2.). Except for the first two stages of the process, which involves the submission of the project or policy and registration of the project, and the omission of initial impact assessments, the rest of the procedure mirrors the procedure outlined in the IEM Guideline Documents. A list of activities, identifying those types of projects, programmes or policies which would require an EA is also provided in the policy.

CHAPTER THREE: METHODOLOGY

A multi-methodological approach to this study is adopted, as different techniques are appropriate at different stages throughout the SIA procedure. The methods which were used in the BLR and which are used in this dissertation are presented below:

3.1. SCOPING

- Secondary data collection
- Preliminary site visit
- Interviews with client and organizations within the study area

3.2. PROFILING

- Secondary data collection
- Primary data collection
  - Household interviews
  - Key informant interviews
  - Participatory rural appraisal (PRA) community meeting
  - Consultation with specialists, I&APs and various organizations within the study area

A detailed account of the methodologies used in the scoping and profiling stages of the procedure are documented in chapter four of the BLR.

3.3. Formulation of alternatives

- Define a set of "reasonable" alternative management scenarios for the Olushandja dam from:
  - Discussions with I&APs.
  - Scenario Forecasting, which involves formulating a set of logical assumptions about future patterns in various social dimensions and tracing their likely interactions and trends over time. This technique can be difficult to apply because the data is lacking for accurate scenario formulation, but is valuable in a

more general sense as it recognises restraints on dynamic interactions between identified impacts and its tendency to examine multiple possible futures (Leistritz and Murdock, 1981).

- Trend Extrapolation, where past trends are extended into the future. The advantage of using this technique is that it is relatively easy to apply and is based on existing data. The precaution is to not forget that social patterns change over time even if development does not impact on an area (Leistritz and Murdock, 1981).

◆ Characterise and describe the identified scenarios.

3.4. PROJECTION AND ESTIMATION OF EFFECTS - ANALYSIS OF SOCIAL IMPACTS

3.4.1. Identification of social impacts

Identify the important issues by carrying out an initial screening of social issues which were investigated during the profiling stage and documented in the BLR.

3.4.2. Analysis of the social impacts.

The following approach is adopted for the presentation of social impacts:

Impact: Provide an unquantified statement of the what the impact is expected to be.

Interested and affected parties: Identify the groups of people who may be directly or indirectly affected by the identified impact.

Discussion of impacts: Elaborate on the nature of the impact. Identify the impact as negative or positive.

Significance without mitigation or optimisation: Assign a significance rating to the described impact if mitigation is not implemented.

Reasons: Give a statement of reasons for assigning a particular significance rating, based on the criteria set out in the IEM Guidelines (DEA - South Africa, 1992). The following should be considered:

- Context
  - the spatial dimension i.e. local versus national level
  - the time dimension i.e. short versus long term.
- Intensity

  i.e. the degree to which the proposed action:
  - affects public health and security
  - is highly uncertain or unknown
  - is irreversible
  - affects the functioning of life support systems, natural amenities and cultural resources
  - establishes a precedent for future actions
  - may interact with other impacts to cause cumulative or synergistic impacts.

In this dissertation, impact significance will be identified as minor, moderate of major. They are defined as follows :

MINOR - impacts are temporary and reversible. They do not have a detrimental effect on affected groups.

MODERATE - impacts are likely to have a greater effect and could be of medium or long term in duration.

MAJOR - impacts are permanent and may be irreversible. There are likely to be significant secondary impacts.

Optimisation and Mitigation: Suggest recommendations which try to minimise negative impacts and maximise positive impacts.

Significance with mitigation or optimisation: Reassess the gravity of the impact in the light of mitigation options and re-assign a significance rating. Give reasons for the decision made.

3.4.3. Summary of significance ratings

Compile a summary framework which contains all of the information about all decision factors, for all alternatives considered (Hill, 1994).

3.5. EVALUATION

- Prepare a decision-making framework. The framework will not include those social factors which have the same significance ratings for all alternatives, as well as those

impacts which have been rated as minor or moderate for all four alternatives.

- Highlight impacts with high negative and positive significance ratings (either with or without mitigation) to facilitate the comparison of alternatives.
- Take respective I&AP views into account.
- Where possible, evaluate the alternatives in terms of the criteria of equity, efficiency and sustainability (Strauth 1983).
- Identify the preferred management scenario.

3.6. MITIGATION, MANAGEMENT AND MONITORING

- Provide recommendations for the mitigation of negative social impacts and enhancement of positive impacts in a social management plan for the dam and its surroundings.
- Provide feedback to the community via the headmen and regional councillor in the form of a pamphlet. This will be done after the dissertation has been completed.

3.7. AUDIT

- Discuss the success of the SIA/IEM process in this particular study.

CHAPTER FOUR: DESCRIPTION OF THE STUDY AREA

A brief description of the study area is given here, as a detailed account of both the region in which the study area is located and of the study area itself is contained in the BLR.

4.1. BIOPHYSICAL ENVIRONMENT

The Olushandja dam is a man made reservoir situated in the north western corner of the Omusati region in northern Namibia (Appendix E, Figure 1). The study area comprises the Olushandja dam and the environs immediately surrounding it. It is bounded by the Omusati border ten kilometres to the west of the dam, by the Angolan border, about four kilometres to the north of the dam, and extends ten kilometres to the east and south of the dam (Appendix E, Figure 3).

The climate is classified as semi-arid, the average rainfall in the Omusati region being approximately 450mm annually. Most of the rainfall occurs in summer in the form of thunderstorms and is very erratic. Summers are hot and winters mild, with cold nights.

The topography of the study area is extremely flat, with a gradient of approximately 1: 2 500 (Department of Water Affairs, 1990). Sandy, solonetz soils predominate, with bands of aeolian derived soils also occurring (A.O.C. technical services, 1967). The vegetation is dominated by mopane woodland which grows on the solonetz soils and small pockets of mixed woodlands which occur on the aeolian sands (A.O.C. technical services, 1967).

The plain is dissected by a poorly developed drainage system of ephemeral rivers known as *oshanas*. The Oshana Etaka is the most well defined oshana in the study area, and it is in this shallow bed that the Olushandja dam is situated. In the Omusati region, most of the underground water is contained in a deep regional aquifer which is extremely saline (Department of Water Affairs, 1995a). Fresh water is found in two forms, discontinuous perched aquifers (DPAs) and main shallow aquifers (MSAs) (Department of Water Affairs, 1995). DPAs are found at shallow depths, and do not have hydraulic connections to deeper aquifers. They only provide limited amounts of water, usually of good quality. DPAs are recharged by local rainfall only, (Department of Water Affairs, 1995a). MSAs are much deeper, and are recharged by both local rainfall and runoff from the *oshanas* (Department of Water Affairs, 1995a). Water quality in MSAs varies from fresh to saline.

4.2. SOCIO-ECONOMIC ENVIRONMENT

4.2.1 Population statistics

Of the entire Namibian population, over 615 000 people (approximately 43,8%) live in the four northern regions of the country (National Population Census, 1991, in Quan *et al,* 1994). A total of 2614 homesteads situated within the study area were identified (Department of Water Affairs, 1995b). Results from the BLR indicate that an average number of people per household is 8,1 (n = 80, BLR). In other words, approximately 20 912 people live in the 10km^2 study area. The population growth rate is estimated at 3.8 - 4.2% (Quan *et al,* 1994).

4.2.2. Settlement patterns

The people living in the study area are Owambos, the majority of whom live in a rural environment and practise subsistence farming. Individual settlements are in general scattered throughout the Cuvelai plain and operate independently of each other. Villages are loosely defined, consisting of a number of settlements in fairly close proximity to each other. A settlement is made up of a dwelling area (*egumbo*), which is surrounded by the cultivated fields (*epya*) (Irving, 1993). The *egumbo* is separated from the *epya* by wood fences made from mopane, as is the whole homestead from *eputa* (surrounding communal grazing land). Land is not privately owned but allocated on the basis of a lifetime lease to the people by the headman of the area. Households may be either female or male-headed and differ in composition. Of the eighty households interviewed, 52 were male-headed and 28 female-headed (BLR). Female-headed households tend to have more children and old women (Naeraa and Solomon, 1994) as the men have usually migrated to urban centres for work, have moved to their own property or have died.

4.2.3. Livelihood

The majority of people in the study area are transhumant pastoralists. A subsistence crop called *mahangu* (pearl millet) forms their staple diet and is cultivated in the *epya* during the wet season. Tilling of the *epya* is usually achieved by the use of hand held hoes. Less than half the respondents use ox or donkey drawn ploughs. An even smaller percentage utilise tractors hired from the Department of Agriculture or private contractors as it is costly.

Vegetables, such as beans, peanuts, watermelons and pumpkins which are not dependant on irrigation are grown in amongst the *mahangu*. Tomatoes, chilies, cucumbers, potatoes and onions are grown in some of the households.

Most households own livestock of some kind. Fifty nine of 73 households canvassed indicated that they owned goats. The average number of goats owned per household is 20.64 ± 24.073 (n= 73, BLR). In other words there is a large range in herd size. Some households also own donkeys, chickens and pigs. Only 42 out of 71 household respondents indicated that they owned cattle. In general those people owning cattle send them on *ohambo* for most of the year. That is, the cattle are taken to areas in the far west of Omusati or Kunene (Appendix E, Figure 2) in the dry season, as grazing is better and boreholes exist in these areas. It was very difficult to ascertain exactly how many cattle households owned, but numbers varied from two to 135. Many respondents indicated that they had lost cattle in 1980s as a result of drought and have been unable to purchase more cattle as they are so expensive. The principle factor limiting cattle numbers in northern Namibia at present is degradation of rangelands and pastures by overgrazing rather than seasonal water scarcity. In particular, this makes small herds vulnerable to drought as access to dry season and emergency grazing is now restricted due to the growing dominance of large cattle owners (Quan *et al*, 1994). This is the reason for the observed socio-economic differentiation in livestock ownership in northern Namibia (Tapscott, 1990 and FAO/ IFAD, 1993, in Quan *et al*, 1993).

Cuca shops form strong social foci for the community. These are tiny little stores, where members of a village commonly meet to talk and drink. They are usually established on communal land amongst the homesteads. They also provide valuable sources of income for a number of people in the study area.

Other important sources of income for members in the community include hiring out oxen, donkeys or donkey carts during the ploughing season or selling wood, fish, bread or meat. In general however adults are unemployed and households are extremely poor. Twenty four of the 80 households interviewed rely on the pension money of elderly relatives. The amount varies from N$ 140 - N$270 bimonthly. This money will support an entire household, which has on average 8 people living in it (n=80, BLR).

A small number of people in the study area fish. Approximately thirty percent of the people interviewed are involved in fishing activities, for private consumption. Only five of the households interviewed reported selling fish if they have a surplus. There is however a small contingent of fishermen who sell their catches.

4.2.4. Schools

From the household interviews it appeared that parents generally send their children to school, although some keep the children behind to mind livestock or to help prepare the fields and plant the crops in the wet season. Whereas most villages have a primary school only some have combined (preparatory and secondary) schools. the only high school in the study area is located in Onesi. All the schools are understaffed, underequipped, and overcrowded. The combined school in Onesi is the oldest school in the area, having been built in 1936 by missionaries. The original buildings are still being used and are in serious need of attention.

4.2.5. Clinics

There are four clinics within the study area, one at Mahanene, about 12kms to the east of the dam north wall, two on the west side of the dam, at Eunda and Onesi, and one on the east side of the dam at Oshaala (Appendix E, Figure 3). All of the clinics were visited by the study team, who found that three of the four clinics are under staffed, under equipped and over crowded. The Onesi clinic was in the process of being upgraded to a health centre. This centre will then be the only health facility in the study area, equipped to care for overnight patients. At present all serious illnesses or disease cases are sent to the hospitals at Ombalantu, Tsandi or Oshakati. There is a serious need for more clinics in the area. The sister at the mahanene clinic (BLR) indicated that she treats over 2000 people per month and has a catchment area of 19 680 people.

4.2.6. Leadership structures

Since independence, there has been a dual system of authority, namely the traditional and political governance. Traditionally, districts are controlled by headmen and their sub-headmen. The study area fell under the control of two headmen, Mr Daniel Shoiya and Mr Shilongo Sakaria (Kananas) Itembu. The main roles of these leaders include the allocation of land as well as adjudication in traditional court where they reserve the right to impose fines for minor offenses. The Traditional Authorities Bill, recently passed in parliament, provides that the role of the traditional leaders will not change drastically, but is nonetheless subordinate to the powers of the political administration at all levels of government (Namibian Government, 1994b). The authority of traditional leaders is not as strong as it was in the past, as many headmen collaborated with colonial administration during the war years and lost respect from

many people subordinate to them (NNRDP, 1993). The recent democratic election of councillors is also likely to have an impact on their authority. Political authorities were elected in November 1992. The Omusati region comprises nine constituencies, each represented by a councillor. Councillor Jonny Ipinge is the councillor in our study area. Like the headmen, his role is ill defined in the Traditional Authorities Bill.

4.2.7. Semi-urban centres

Within the study areas there are three semi-urban centres.

Epalela

Epalela is an informal settlement, situated at the north-western corner of the Olushandja dam (Appendix E, Figure 3). It has grown in size as a result of its proximity to a perennial source of water (Olushandja dam and Calueque-Olushandja canal) and the border. Epalela has become an important market centre in the region for the sale of Angolan cattle, fish caught in the Olushandja dam and vegetables grown at the two market gardens in the study area. Most of the people who own shops in Epalela or sell their wares there, live in nearby homesteads.

Eunda and Onesi

Eunda and the larger Onesi are both old settlement nodes, situated on the west side of the dam (Appendix E, Figure 3). They are both supplied with water from the Olushandja-Okahao pipeline, have a clinic, school (Onesi has two), and a number of cuca shops. Onesi also boasts a garage, supermarket and the church which is frequented by most of the people in the study area.

CHAPTER FIVE: PATTERNS OF WATER USE IN THE STUDY AREA

5.1. INTRODUCTION

During the field work component of this study, one of the major tasks was to determine the extent of Olushandja dam's influence on communities living in north western Omusati and to determine the water utilisation patterns with increasing distance from the dam. The study area was divided into three concentric bands. Both Zone A (the band immediately adjacent to the dam) and Zone B were 2.5kms in width, while the outer Zone C was five kilometres in width (Appendix E, Figure 3). By interviewing people in the three bands, the study team aimed to determine whether gradients of water utilisation existed as one radiated out from the dam.

5.2. WATER SOURCES WITHIN THE STUDY AREA

5.2.1. Permanent water points

The findings of the study revealed that the Olushandja dam is not the water locus of the study area. There are other reliable water sources in the study area, and people tend to travel to the water point closest to their homes (Appendix E, Figure 5).

The Calueque-Olushandja and Olushandja-Ogongo canals run through the northern section of the study area, and the Etaka canal extends south from the south wall of the dam. These canals are used by people living in close proximity to them. When the canals are dry, eg during periods of maintenance, people have to travel to either the Olushandja dam, wells or pipelines.

On the western side of the dam, only those households located very close to the dam (less than 2kms from the dams edge) utilise the dam regularly. The reason for this is that the Olushandja-Tsandi pipelines is located about three kilometres to the west of the dam. Interviews indicated that the pipeline is the favoured water source in the area as the water is purified. Consequently, some people living less than two kilometres from the dam choose to travel to the pipeline for water. Contrastingly, the absence of a pipeline and limited numbers of functional, hand dug wells on the eastern side of the dam, results in people living approxiimately 3kms from the dam having to depend on it for their daily water requirements

(BLR).

A number of reliable hand dug wells are located on the western perimeter of the study area and provide people with water throughout the year (Appendix E, Figure 5). Wells are also utilised by people on the eastern side of the dam, but appear to be less reliable, in terms of both volume and quality of water.

5.2.2. Temporal water sources

There is a strong seasonal difference in water utilization. Regardless of the permanent source of water used, everyone utilises *oshanas*, *omifimas* (shallow , hand dug pits designed to trap water from an oshana), earth dams and pans during the wet season. Pans are a common source of water for human needs and if they are closer to the homestead they will be used in preference to canals or the dam in the wet season. Those people in close proximity to pipelines tend to use them throughout the year. Livestock generally utilise the *oshanas* as the water is considered to dirty for human consumption. However people will utilise this water resource if there is nothing else.

Therefore in terms of everyday utilisation, the Olushandja dam has a very limited sphere of influence which is skewed by the availability of other reliable water points.

5.3. WATER ROUTINES

Similar daily, water routines are practised by all people in the study area, regardless of the type of water source from which they obtain their water.

Water collection is manual, and is undertaken by women and children. In most households, water is fetched twice daily, in the early morning and again in the evening, although in some cases the distance to reach water is so great that people can only afford to fetch water once a day or even less. For example a respondent interviewed to the north of the dam in Zone C indicated that they only collect water once a day as they have to walk for 1-2 hours to reach the canal on which they depend for water. An old woman interviewed on the east side of the dam in Zone B also indicated that she only fetches water once a day as she has to travel to the dam to fetch water, a round trip of over 5kms. On the other hand, some one respondent in zone C indicated that she could fetch water from the dam up to four times in the dam as she lives less than ½km from the Olushandja- Ogongo canal. Donkey carts, bicycles and motor vehicles are sometimes used for water collection if water points are far from the household and

if people have access to such vehicles. This is the only time that men become involved in the chore. For example one respondent living on the east side of the dam indicated that once a week, her husband travelled on his motorbike to a well to collect water as there was are no permanent water points close to her homestead. Another respondent living in Zone C Collects 200l of water every 3-4 days with a donkey cart (BLR).

The most common vessels of collection are 10l -25l containers which are either carried by hand or on the women's head. On average a person utilises 2-5l per day (BLR). This water is used for drinking, cooking and washing of clothes. Only a couple of households indicated that they used it for bathing, one woman said that she used the water for her goat kids and another for her chickens.

5.4. WATERING OF LIVESTOCK

During the wet season, goats, donkeys and cattle wander freely throughout the *eputa*, utilising the free standing water, but in the dry season they are taken daily, or every second day (depending on the distance from a water source) to a permanent water source to drink. In general, cattle are taken on *ohambo* during the dry season, where they depend on boreholes for water. *Ohambo* is necessary mainly because of local grazing shortages rather than water shortages.

5.5. WATER AVAILABILITY AT SCHOOLS

Of the six schools visited, only the combined school in Onesi has access to a reliable water point. This school has a connection to the Olushandja-Tsandi pipeline, but the extension pipe is very narrow and cannot provide sufficient water for the 750 children attending the school (BLR). The five other schools have been provided with cement water tanks which collect rainfall runoff from the school roof. Water in a tank usually last less than a month, is totally inadequate in the dry season. Sporadic deliveries of water with mobile tankers from the Department of Education, relieve water shortages for a short period of time, but for most of the year, rural schools are forced to operate without water. One teacher indicated that children have to bring water or *mahangu* beer (non-alcoholic) with them to school. Despite being situated on the other side of the Olushandja dam, the Oshaala school has applied repeatedly for a pipeline connection from Onesi, but has never had any response. A pipeline is desperately needed on the eastern side of the dam, to meet the water needs of the people living there and to provide the schools with a regular supply of water[1].

5.6. WATER AVAILABILITY AT CLINICS

There are four clinics within the study area (Appendix E, Figure 3). The Mahanene, Eunda, and Onesi clinics all have access to purified water. The Mahanene clinic uses water which is extracted from the Olushandja-Ogongo canal and purified at the Mahanene Agricultural Research Station. The clinics at Eunda and Onesi both are both connected to the Olushandja-Tsandi pipeline, and unless the connection or pipeline is damaged, both have sufficient water to meet their needs. When we were at Onesi clinic, the pipeline was in fact broken so Water Affairs in Onesi were filling a large water tank at the clinic on a daily basis. When the Onesi health centre is complete there will be taps both in and outside the building, so water should not be a factor limiting operation of the clinic.

Contrastingly, the small clinic situated at the village of Oshaala, has only one water tank to provide for all of its water requirements. A tanker comes from Oshakati every few weeks to fill the tank, but this is inadequate, and the sister sometimes has to borrow a bakkie from the Oshaala school principal so that she can fetch water from Onesi or the dam. The water brought from Oshakati or Onesi is purified, but if water is collected from the dam, the sister has no means by which to boil the water, and is therefore forced to use dirty water in the clinic. It is vital that a pipeline is installed to the east of the dam so that the Oshaala clinic can have access to a regular supply of clean water.

5.7. IMPACT OF CHANGING THE WATER LEVEL IN OLUSHANDJA DAM ON WATER UTILISATION PATTERNS IN THE STUDY AREA

The results of the two field visits to the study area revealed that only a small proportion of households in the study area are dependent on the dam for their daily water requirements. It is these households which are likely to be impacted on the most by the changing the level of the water in the Olushandja dam.

In terms of analysing the effect that a new water level might have on the rural communities in the study area, emphasis will therefore be placed on those people that depend on the dam for their daily existence.

CHAPTER SIX: IDENTIFICATION OF INTERESTED AND AFFECTED PARTIES AND ALTERNATIVE MANAGEMENT SCENARIOS FOR THE DAM

6.1. IDENTIFICATION OF INTERESTED AND AFFECTED PARTIES

Seven different interest groups, which might be affected in some way if the water level in the Olushandja dam is changed, have been identified. Their issues or concerns and the context in which their concerns should be viewed are presented in Table 3.

6.2. IDENTIFICATION OF ALTERNATIVE MANAGEMENT SCENARIOS FOR THE DAM

Four management scenarios are considered for the management of Olushandja dam. The first considers the feasibility of maintaining the present *status quo* i.e. maintaining the dam at approximately 30% capacity i.e. keeping the water level at the 1004m contour. The second involves maintaining the dam at 100% capacity, i.e the 1006m contour throughout the year. The third looks at the impacts of fluctuating dam level between the 1006m (full level) and 1003m (dead storage level), and the fourth scenario looks at a no-dam situation.

According to DWA, the main reason for upgrading the Olushandja dam is to ensure 100% surety water supply for the region should supply of water from upstream of the Olushandja dam be discontinued. When talking about 100% surety, it is most likely that they are referring to the ability of the pumps to pump the maximum capacity of water into the canals. The current upgrading at Olushandja dam, which involved the installation of two 0.75m^3/s pumps at the north wall, is a move to attain this goal. However the water level in Olushandja dam also affects water surety ,as it determines the duration that a reserve water supply will be able to be provided to the networks. If the dam was filled and then water extracted from the dam at maximum pumping capacity, there would be sufficient water in Olushandja dam to supply the northern regions with water for about two months (Haussler, 1995). In operational terms therefore, the level at which Olushandja dam is managed, will only affect the period that this reserve could last in the light of discontinued water supply from upstream of Olushandja dam.

Water supply from upstream of the Olushandja dam can, in reality only be jeopardised by three situations. Hostilities in Angola, temporary shut down of either part of the Calueque pump station or the Calueque-Olushandja canal as a result of maintenance and repairs, and the water

level in the Cunene dropping to a level where pumping can no longer continue would result in water needing to be extracted from Olushandja dam.

6.2.1. Management scenario one: Keeping the water level of Olushandja dam at 1004m (30% capacity)

Since the Olushandja dam was filled in 1975, there has been a management policy to keep the dam at approximately 30% capacity. According to Haussler (pers comms, 1995) this is the level at which a balance between inflow, evaporation and seepage occurs. Despite adopting this management stance, the dam does not currently appear to be controlled vigorously. This could be a consequence of the pumping facilities at the north wall being damaged in the border war. Excess water from Calueque is pumped into Olushandja dam, but if the level rises well above 30% as a result of heavy rainfall or *efundjas* coming down from Angola, active pumping of water out of the dam and into the canals, appears to have been nonexistent.

When the dam was designed in the seventies, a contour line of 1107.5m was identified as the recommended limit of settlement. No control of rural development around the dam has been enforced, in the last twenty years, with the result that 94 homesteads are located between the 1004m contour (level,of the dam at 30% capacity) and the 1007.5m contour (recommended limit of settlement). The reason for identifying a water level of 1004m as a management scenario is because increased water levels might have a negative impact on the people living below the 1007.5m contour.

6.2.2. Management Scenario Two: Keeping the water level of the dam at 1006m (100% capacity)

If the DWA decides that it is imperative to have enough water in Olushandja dam, to last as long as possible in the advent of an unpredictable water supply cut from Calueque, then it would be necessary to keep Olushandja dam full throughout the year. Because the gradient of the Cuvelai plain is so slight, increasing the capacity from 30% to 100% would result in an increase in the extent of the dam. The dam currently covers 1380ha, and would increase to 2660ha if filled (Lund, 1992). This alternative looks at the social implications should a full dam scenario be adopted.

Table 3. Interested and affected parties which may be affected if the water level in Olushandja dam is changed.

INTERESTED AND AFFECTED PARTIES	DESCRIPTION	ISSUES OR CONCERNS	CONTEXT
Rural Community -			
Living close to the dam (less than 3kms).	Those people who depend on the Olushandja dam for water on a regular basis. This refers particularly to those people living below the 1007.5m settlement limit contour of the dam, which was established by the DWA in 1970.	• Flooding • Increased disease • vegetable gardens • poor quality water in the dam • Restriction of fishing by nature conservation • The need for a bridge to facilitate access between wester and eastern banks of the dam	Local
Living far from dam (more than 3kms).	People living within the study area not dependant on the dam for their daily water requirements	• Bridge issue • Back up in times of drought	Local
DWA - Bulk Water Directorate	The proponent of the upgrading project, and a division in the Agriculture, water and Rural Development Ministry	• 100% surety of water supply for the pipeline and canal networks	Regional
Water network users	All of those people in the four northern regions of Namibia, who depend on the water transported in the pipelines or canals from Olushandja dam.	• The dam will improve the surety of water supply to them for a longer period of time,even if water supply from Calueque is discontinued	Regional
SWAWEK (South West African Water and Electricity Commission	This private company is legally responsible for the operation of Calueque dam, and has a vested interest in Cunene water for hydroelectric power.	• Mainly concerned about the high evaporation in Olushandja dam. They feel that it is a waste of Cunene water which can be used more efficiently in generation of power.	National
Department of Nature Conservation - of the Ministry of Environmental Affairs and Tourism	Unknown	Unknown, as the study team were unable to get in contact with this interest group. The following issues are speculative, based on the information obtained from locals living in the vicinity of the dam. • Over exploitation of fishing resource • Poaching of pelicans and flamingoes • Wish to create a bird sanctuary at Olushandja dam	Local and regional
Etunda	This is a government funded irrigation project which is situated 10kms west of Olushandja dam. Once fully operational it will draw $2m^3/s$ of the $6m^3/s$ being pumped from Calueque to Olushandja dam.	• The project farms crops which are water dependant. It will draw water from the Calueque-Olushandja canal. However in the advent of water not being pumped into this canal, it would need to have access to water from the Olushandja dam.	Regional

6.2.3. Management scenario three: Fluctuating the level of the dam between 1003m (dead storage level) and 1006m

According to DWA, the reason for upgrading Olushandja dam is to ensure that water can be provided to bulk water consumers, should the need arise. It therefore goes without saying that the water level in the dam would fluctuate, depending on whether water was being extracted from it, or pumped into it. It is therefore important to consider the effects which a fluctuating water level could have on the social environment. The problem with this alternative is that the type of fluctuation strategy which might be adopted by the DWA is presently unknown. The reason for this is that DWA has absolutely no idea of how often they might need to draw on the water resource in the dam, or for how long they might need to pump water from the dam at any one time. There are basically three situations which would result in water having to be pumped out of the dam.

In the first case, maintenance of the Calueque-Olushandja canal, or Calueque pump station, would result in the flow of water from the Cunene being discontinued. Situations such as these are predictable and relatively short in duration. The water level of the dam should, in general, not fluctuate excessively, under these conditions. The DWA would also be able to replenish the depleted volume, within a relatively short period of time, as soon as the job was complete, and would be able to choose when the best times were to carry out the maintenance work (eg in the wet season when people are less dependant on the bulk water supply). So the dam might be kept at a particular level for most of the year, then fluctuate a certain amount depending on the amount of time needed for maintenance, and then be restored to its preferential capacity and kept at that level until maintenance work was again needed between Calueque and Olushandja.

In the second case, DWA would need to extract water from the Olushandja dam as a result of the water in the Cunene river becoming too low. Upstream of the Calueque dam is another dam called Gove dam. Construction of the dam was completed in 1973 (Department of Water Affairs, 1990), and one of its main functions is to regulate the release of water into the Cunene so that there is always sufficient water to operate the pump station at Calueque. Gove dam is however situated deep in Angola so DWA cannot at present depend on a regular release of water from this dam. Consequently, if rains do not fall between Gove dam and Calueque, and the river level drops to such an extent that the pumps can no longer operate, provision of water to Namibia will cease. Certain predictions can be made as to the frequency of this situation arising, and when it might happen. Therefore a limited amount of warning and forward planning could occur to ensure that once the pumps at Calueque ceased, the Olushandja dam

was filled to capacity. However the dam can only provide water for a maximum of two months (if pumping water at maximum rate into the Olushandja-Ogongo canal) and if rains do not fall and water is not release from Gove dam, the water flow might be discontinued for many months, perhaps until the next rainy season. In this case once the water in the Olushandja dam has been extracted to dead storage level (5% capacity), not only would there be no more water for the water supply network, but no water available to replenish the dam. The remaining water would soon evaporate. A situation like this might happen very infrequently, but the impact it would have on the social environment in the vicinity of the dam would clearly be different from the those of the fluctuations anticipated in the first case.

The third case deals with the most unpredictable situation, i.e. if the reserved water supply is needed because increased instability in Angola, jeopardises the operation of Calueque. In this circumstance, a similar situation as outlined in case two would exist, except that Namibia might not have any forewarning of when the water flow might be discontinued. The DWA would therefore have no time to ensure that the dam was filled to capacity prior the event occurring. They would also have no idea how long the situation might last and therefore would be unable to determine at what rate water should be pumped from the dam.

Therefore in reality it might be impossible for the DWA to ever adopt a particular fluctuating plan for the Olushandja dam. This makes it difficult to analyse the potential social impacts it might have, as it will probably have a range of impacts, depending how often and to what extent the dam will fluctuate. Nevertheless, this scenario looks at the effect that Olushandja dam might have on the surrounding social environment if the dam is fluctuated between 1003m (5% capacity) and 1006m (100% capacity).

6.2.4. Management scenario four: Decommissioning of the Olushandja dam

One of the major voices against the existence of the Olushandja dam is the South West african Water and Electricity commission (SWAWEK). They have a vested interest in Cunene's water - for hydroelectric power. They argue that an unjustifiable amount of Cunene water evaporates from Olushandja dam (Brand, pers comms, 1995). A sister at the Mahanene clinic indicated that the Olushandja dam is a principle source of disease in the area, and that in term of both water borne disease such as bilharzia, malaria and diarrhoea, and hygiene, the presence of a pipeline in place of the dam would be far more beneficial to the community (BLR). With cases such as these arguing against the existence of the Olushandja dam, the author has decided to discuss a no dam scenario, where the Olushandja dam is removed and the Oshana Etaka

restored to its functional capacity. It is also important to discuss the no dam option, as the impacts of the dam on society, in the past twenty years of its existence is unknown. This scenario therefore illuminates what life might have been like prior to dam construction as well as indicating what the impact on communities will be if the dam is now removed.

The no dam scenario simply looks at social implications of Olushandja dam being removed. In reality, removing the dam could in be achieved in a few ways and involves a number of issues:

- The two embankments could be broken down and the Oshana Ektaka rehabilitated.
- The embankments might be left in place and the sluice gates simply opened.
- The Etaka canal could be extended to meet up with the Olushandja -Ogongo canal, could become residual, or could be done away with totally.
- The dam could be substituted with a pipeline, located in a variety of sites.

There is a lack of time and information to deal with these issues in this dissertation, but it is important to mention that if this scenario is identified as the preferred option, an assessment of different, no-dam alternatives must be carried out. Financial, technical, social and biophysical concerns must be addressed before a decision is taken.

CHAPTER SEVEN: ANALYSIS OF SOCIAL IMPACTS

7.1. INTRODUCTION

The methodology used to analyse the social impacts which are created as a result of the upgrading project are described in chapter three. In this chapter, the impacts are identified and given a significance rating. Evaluation of the four management scenarios identified in chapter eight is addressed in the following chapter. The social impacts have been broadly divided into 15 groups, but it is important to remember that impacts are interrelated and should not be considered isolation. Table 4. summarises all of the impacts discussed in section 7.2.

7.2. ANALYSIS OF SOCIAL IMPACTS

7.2.1. Impacts related to demographic aspects

The level at which the water in Olushandja dam is managed could have an effect on the location of families living around the edge of the dam, as in two of the four scenarios, inundation of properties will occur, as a result of flooding. If people presently living next to the dam have to relocate, as a consequence of flooding, this could alter the distribution pattern settlements in the surrounding area.

Interested and affected parties: People living in the study area.

Management Scenario One: Keeping the dam at 30% capacity

Discussion of impacts: If the current level of the dam is maintained, all of those properties that are presently located below the 1007.5m settlement (Appendix E, Figure 3) limit will not be inundated by water in the Olushandja dam in the future unless, as has been the case this year, heavy rains and the occurrence of an *efundja* causes the dam level to rise and water is not pumped out of the dam. In situations such as this, the *epya* of many of these homesteads flood. While flooding of *mahangu* fields affects productivity, people do not consider relocating because of this (personal observations, 1995). Consequently, if the dam is managed at 30% capacity, then there should be no threat of inundation in either the short or long term, and those properties currently located below the 1007.5m settlement limit of the dam would not

population expands and the demand for land increases.

Significance without mitigation: **MINOR** negative

Reasons: Current water level does not affect settlements adjacent to the Olushandja dam.

Mitigation: If an active management plan to maintain the dam at 30% is implemented, flooding of homesteads adjacent to the dam need not occur during the wet season.

Significance with mitigation: **MAJOR** positive

Management Scenario Two: Keeping the dam full

Discussion of impacts: It was established from aerial photos taken in April, 1995, that twenty four properties are currently situated below the 1006m contour and will be totally inundated if the dam is filled. Twenty two properties will be partially inundated (Appendix E, Figure 7). Families, whose homes are totally flooded will have to be relocated. Whether families, whose properties are only partially inundated will have to relocate will depend on the policy adopted by the DWA and by the attitude of the property owners. People living in Omusati are accustomed to flooding, as *oshanas* often flood properties during *efundjas.* Locals might not be prepared to move because a small portion of their land is flooded.

DWA could also decide to expropriate land below the settlement limit (1007.5m contour). People living below this contour would then have to be relocated regardless of whether their properties were inundated or not . If this happened, a total of 94 homes would be affected (aerial photographs, 1995). Forty three homesteads are located below the contour while 51 of the homesteads have some of their land located below the contour (Appendix E, Figure 7). Whether people living below or on the 1007.5m contour, but above the full dam level will be prepared to move in such an event is unlikely.

Relocation will have a severe impact on people in the short term, the reason being that they depend on subsistence farming for survival. The loss of arable land and the time taken to prepare a new *epya* represents a reduction in food security and exacerbates the household poverty cycle. It also has a long term effect as the headman will need to be paid for the new land acquired. Prices of up to N$ 500 can be demanded (BLR). Those who cannot pay might be forced to move from the area. In addition the headman, Sacharias Kananas, expressed that

there might be insufficient space within his area to relocate families inundated by flooding. This would force residents to move out of the area. The study team found that the main criteria considered in choosing the location of a property is proximity to family (BLR). If people are forced to move out of the area, this could have a serious impact on family dynamics.

Relocation of families to new sites within the study area will have a long term effect on the people already living there, for it will result in a reduction of communal land. This will result in a loss of localized grazing for their livestock and the reduction of localized wood resources as the mopanes will be used to construct new fences. The increased density of the populations in these areas will place a further demand on already limited resources in the long term. Each property is approximately 7,8ha (n = 37) in size (Department of Water Affairs, 1995b). Therefore if the 94 homes located on or below the 1007.5m contour were forced to relocate, 733.2ha of communal land will need to be converted into cultivated land. If only the 24 homesteads which would be totally inundated needed to be relocated, 187.2 ha of new land will have to be found.

Significance without mitigation: **MAJOR** negative.

Reasons:

- Between 24 and 94 homesteads would need to be relocated as a result of inundation.
- There would be an increase in settlement density in surrounding areas.
- A reduction in food security would be experienced by those people being relocated.
- Inundation and relocation will result in short and long term effects on the natural resources on which the community depends.

Mitigation:

- DWA must establish the limit of settlement around the newly filled dam before determining who must be relocated. This limit should be defined in consultation with the communities currently living in the affected area.
- Policies on expropriation of communal land by the state, and on relocation procedures do not exist. The negotiations and procedure followed in this case should be documented so that it can act as a precedent in the future, or can be used in the drawing up of appropriate policies.
- Families being relocated should be given the opportunity to choose the location of their new home.
- DWA / Water utility company should pay for relocation. This should include down payment on the new land and full compensation for losses incurred as a result of

relocation.

- DWA / Water Utility company should also assist with the move, in terms of helping the people to dismantle their homes and transport their belongings to their newly chosen site.
- Existing wood from fences should be transported to the new sites for construction of the new *egumbo*. This should reduce the time taken to establish new huts and will reduce the number of mopanes that will have to be felled at the new site.
- Relocation should take place after the harvesting season to ensure that families have sufficient food to tide them over to the next season.

Significance with mitigation: **MODERATE** negative.

Reasons:

- Pressures, such as the reduction of grazing land and increased density of settlements in the surrounding areas of the dam still remain.
- Emotional stresses exist for those people being uprooted.
- Some people might be forced to move from the area due to a lack of available land. This could disrupt social structures and family dynamics.

Management Scenario Three: Fluctuating the level of the dam

As for *Management Scenario Two.*

Management Scenario Four: No dam option

No impact.

7.2.2. Impacts related to economic factors

- **Impact on local job opportunities**

The management of the water level in Olushandja dam could impact on the existence and creation of job opportunities for people living in close proximity to the dam.

Interested and affected parties: Local people living in close proximity (less than 2kms) to the dam

Management Scenario One: Keeping the dam at 30% capacity

Discussion of impacts: There are currently two kinds of small scale businesses (fishing and market gardening) in operation at Olushandja dam.

Fishing:

The total number of people that currently derive income from fishing is unknown, but six fishermen were interviewed, who indicated that they fish everyday. When asked whether many people fish in the dam, one fisherman answered positively, indicating that this was the only place where people could use boats. Another indicated that many people fish in the dam when they are not tilling their fields. This was supported by observations made by Mr Roberts (1995) while conducting his studies on the dam. He indicated that he saw more women fishing with mosquito gauze nets and baskets in the dry season (January) than in the wet season (March). In January, he also counted twenty men fishing, using a variety of methods including long lines with multiple hooks, nets, throw nets, bow and arrow, and rods.

Fishermen utilizing the permanent fish resource are able to sell their catches to the *cuca* shops in Epalela and directly to interested customers. The interviewees indicated that between five and ten fish are caught in a day. The sale price of these fish varies considerably from between N$5 - N$10 per fish to N$2 per bunch (if the fish are small there can be up to 10 fish in a bunch). People who bought the fish generally quoted higher prices than this.

While only a small proportion of the community are currently economically dependant on fishing, it is nevertheless an important component of people's subsistence. 30% of the households interviewed, most of which live within zone A (Appendix E, Figure 3), are involved in fishing activities. The majority of those people interviewed in zone B, indicated that they did purchase fish or would like to, if they had the money.

Fish farms:

In the past there was an attempt to initiate a fish farm on the western bank of the dam. The holding dams (simple earth dams) were built and the fingerlings provided, but the project did not work. Mr Ingram of the Rural Development Centre (pers comms, 1995) feels that the project failed because the people involved were non-locals who did not like being so far from their homes and families. The potential for fish farming on the banks of the Olushandja dam still exists, and would provide long term employment opportunities for a number of people.

Market gardens:

Two market gardens have been established on the western bank of Olushandja dam. The first, Epalela market garden is located approximately five kilometers from the north wall and is a small scheme - only about 1ha in extent. The project was initiated in 1993 by Mr Mishael Shiningayamwe who is now the project manager. He is assisted by the Northern Namibian Rural Development Programme (NNRDP) and the french ministry for Co-operation (BLR). The second, The Elao Agriculture Self Help Project for Disabled People, is considerably larger, approxiamtely 4ha, and is situated on the western edge of the dam 10.8kms from the north wall (Department of Water Affairs, 1995). It was started by the Ministry of Lands, Resettlement and Rehabilitation and the European Economic Commission, in 1991 (BLR). Twenty people, some of whom are handicapped are involved in the project, and each has been provided with a house.

The sponsors for the respective projects provided each garden with a solar panel, a solar operated pump, and an elevated water tank. Water pumped from the dam irrigates the vegetable gardens and the produce is taken to Epalela, Ombalantu, Ruacana, Oshakati, and Tsandi, where it is sold.

The smaller of the two establishments generate about N$ 300 per week whereas the larger can secure between N$ 5000 to 600- per month.

Other potential job opportunities:

In her investigation of the freshwater snails associated with the Calueque-Olushandja water supply network, Ms Curtis (1995) found that two edible species of mollusc, which might have potential economic value, were found in the dam. The first, an edible snail (*Pila occidentalis*) was found in Olushandja dam and the second, a fresh water oyster (*Etheria elliptica*) was located in the Calueque-Olushandja canal.

Significance without mitigation: **MAJOR** positive

Reasons:

- Current jobs created by dam have boosted the local economy and improved the living standards for those involved.
- The biodiversity in the dam offers potential employment opportunities for more people in the future.
- Employment boosts local morale and promotes a sense of well being.

Optimisation:

Fishing:

- A long term management plan for sustainable utilisation of the fish resource in Olushandja dam should be developed in consultation with the locals and the Department of Nature Conservation.
- An education programme should be set up to inform the fishermen and locals of the need to protect the resource and ways that this can be achieved.
- Investigate the potential for expanding fish sales to other markets such as Tsandi and Ombalantu.
- Investigate how and by whom the fish might be transported to these centres.

Fish farms:

- Investigate the feasibility of initiating fish farms, with emphasis on the attitude of locals to the idea.

Market Gardens:

- Investigate the potential of developing more market gardens adjacent to the dam
- Investigate new markets at which vegetable growers might sell their produce.

Molluscs:

- The economic potential of the two edible molluscs found in Olushandja dam and the Calueque-Olushandja canal should be investigated, with the specific intent of providing job opportunities to locals.
- The edible snail (*Pila occidentalis*) would need to be cultured in protected areas in the dam, while culturing the freshwater oyster (*Etheria elliptica*) would only be successful if water flowed continuously in the canal as oysters require clean, flowing water (Curtis, 1995).

Significance with optimisation: **MAJOR** positive

Reasons: The positive economic benefits currently derived from the dam are optimised.

Management Scenario Two: Keeping the dam full

Discussion of impacts: The majority of people in the study area are unemployed, consequently most households do not receive a regular income, the few that do depend almost exclusively on pensions (BLR). A few receive remittances.

Fishing:

A full dam has the potential to be beneficial in terms of job creation as the possibility will exist for developing fishing as a major source of income. This is because the full dam will occupy a larger surface area which will be able to support larger fish stocks. According to Hay and van Zyl (1995), and Roberts (1995), if the dam is filled, there will be an initial increase in fish populations, which will last about two years. After that the fish numbers will decrease and the maintenance of fish stock in the long term, will depend on fishing regulations and dam management.

Market gardens:

The situation with respect to market gardening, is complex. Filling the dam would result in the flooding of the existing gardens. This would represent a loss in existing sources of income. However if we consider inundation of existing structures as a separate issue and address the potential for a full dam to provide market garden type opportunities in the long term, the potential is high. When the dam is full, the circumference of the dam will be increased. Consequently there will be more land available directly adjacent to the dam with the potential to be irrigated and developed into income generating market gardens.

Other potential job opportunities:

According to the vegetation specialist report compiled by Burke (1995), a species of aquatic grass (*Oryza staminata*) was identified in the dam, albeit only once. It is a relative of cultivated rice and has potential economic importance. If this species expands its population as a result of filling the dam, it could be worth investigating as a possible employment opportunity for locals living neat the dam.

The possibility of developing the economic potential of the edible molluscs found in the dam, also exists in a full dam scenario.

Significance without mitigation: **MAJOR** positive

Reasons: Long term job creation, benefits the local economy and increases well being of the people.

Optimisation:

- As in *Management Scenario One*.
- Additionally, an investigation into the breeding potential of the aquatic grass (*Oryza staminata*) should be commissioned.

- NGOs and other organisations who might be interested in pursuing one or more of the above mentioned employment opportunities as part of their economic development programmes should be identified and contacted.

Significance with optimisation: **MAJOR** positive
As in *Management Scenario One.*

Management Scenario Three: Fluctuating the level of the dam

Discussion of impacts: If a fluctuating management plan is adopted the success of both small scale fishing and market gardening industries will depend on how often the dam level fluctuates, how extensive those fluctuations are and for how long the dam will be maintained at a particular level.

Fishing:
The potential carrying capacity of the dam for fish will vary depending on its percentage fullness. In addition, if the dam is pumped down to dead storage level (5%) and maintained at this level for an extended period of time or even allowed to dry up from evaporation, most of the fish will die. The reason is that except for one cichlid species which has managed to invade the oshanas (Hay *et al*, 1994), all of the 41 fish species (Hay and van Zyl, 1995) in the dam need perennial habitats to survive. Additionally, if the dam level fluctuates between full and dead storage on a regular basis, the ecology of the dam on which the fish depend could be negatively affected. Aquatic vegetation will be exposed and could die, as will the algae, zooplankton and invertebrates which make up the food chain of which the fish are a part. Mismanagement of the dam could therefore result in mismanagement of the dam ecosystem which could reduce the economic potential of the dam.

Market Gardens:
The success of the market gardens depends on crops being regularly irrigated by water which is pumped from the dam. In this management scenario, market gardens would have to be situated above the full dam contour (1006m) to avoid inundation when the dam was filled. In fact DWA / Water Utility Company could specify that the market gardens be located above the 1007.5m contour limit. This being the case, pipes would have to be installed so that water being pumped from the dam could reach the gardens. If however the dam level then decreased the pipes would be to short and pumping would have to cease. The gardeners could compensate for this by installing longer pipes. The problem is it would be difficult to ascertain how long the pipe should be because the extent to which water levels might vary is unknown.

Piping is expensive to install and besides the initial costs, maintenance costs could be high if the pies were subjected to continuous wetting and drying. A bigger and more expensive pump would also be needed to pump water through a longer pipe. Because the pumps are solar generated, more solar panels would be needed. Both pumps and solar panels are costly. The implementation of a changing dam level could therefore jeopardise the feasibility of establishing market gardens at Olushandja dam.

Other employment opportunities:

It is unlikely that the aquatic grass (*Oryza staminata*) or the edible snail (*Pila occidentalis*) would be able to survive regular exposure, as a result of varying water levels in Olushandja dam as they are both perennial water species. However the degree of exposure that these species can withstand was not identified in either Burke and Curtis's reports and further investigations into the effect of changing water levels on these species should be conducted as this will affect the viability investigating these resources as potential economic opportunities.

Significance without mitigation: **MAJOR** negative to **MODERATE** positive

Reasons: Because of the uncertainty associated with this scenario, it is impossible to determine the extent of its affect of the potential employment generating opportunities of the dam. Dramatic fluctuations could have a high negative impact on job opportunities, whereas infrequent fluctuations which only alter the volume of the dam minimally could have little to no effect on access to the water or on the natural resources on which these economic opportunities depend.

Mitigation: As in *Management Scenario One.*

In addition:-

General:

- Develop a management plan which maintains the dam at maximum capacity and only draw from the dam when it is really necessary.
- Do not keep the dam at the dead storage level for long periods of time.
- As far as possible, inform people of when the dam level is going to fluctuate. Give them time to prepare for such events.
- Investigate the effect of a fluctuating dam on the potential fish farming, mollusc harvesting and aquatic grass breeding opportunities.

Fishing:

- Conduct an investigation on the effect of fluctuating water levels on the survival of fish species.

Market Gardens:

- Extend the pipes used for the market gardens further out into the dam to provide for a certain degree of fluctuation.
- Provide stronger pumps to facilitate the pumping of water through these longer pipes.
- Provide more drums to the gardeners so that water can be stored in the advent of water level in the dam having to drop.

Significance with mitigation: **MODERATE** positive

Reasons: Even with mitigation, fluctuations will occur. Uncertainty amongst fishermen, gardeners and other potential entrepreneurs as to when the level of the dam will change and affect their livelihood will exist.

Management Scenario Four: No dam option

Discussion of impacts: If the dam is removed then all of the perennial fish species on which the fishermen depend for their livelihood will die. Then the only fishing opportunities to the people living near to the Oshana Etaka will be during *efundjas*, when fish are brought down from Angola in the flood waters. Such fishing does not provide a long term source of income.

The re-establishment of the Oshana Etaka will also signify the removal of a permanent body of water. Market gardens will not be able to operate in the absence of a reliable and large water source.

The potential employment opportunities associated with the edible molluscs (*Pila occidentalis and eteria elliptica*) and aquatic grass (*Oryza staminata*) will be lost.

The fate of Epalela is also questionable. At the moment, despite the fact that the pipeline runs past this informal settlement, water points have not been provided. People working in Epalela rely primarily on the dam for their water requirements, although some people fetch water from a hand pump located at the purification works adjacent to the town. Epalela has become a prominent market place for the sale of livestock, and fish. Small businesses such as *cuca* shops, photography studios and second hand clothes shops have developed as a result of this regular trade. If Epalela had to disintegrate as a result of removing the permanent water source on which their inhabitants depend, it would represent a large loss to those people with small businesses in the town, to those families who boost their subsistence existence by selling bread, *mahangu*, or livestock at Epalela, and to the local and regional economy as a whole.

bread, *mahangu*, or livestock at Epalela, and to the local and regional economy as a whole.

Significance without mitigation: **MAJOR** negative

Reasons:

- Removal of the dam will result in the loss of current sources of income derived from fishing and market garden activities.
- Removal of the dam will result in the loss of potential economic opportunities.
- Loss of current and future job opportunities will result in a reduction of money injected into the local economy. This will have a detrimental effect on the sense of well being of locals previously established in long term jobs. Threatens the existence of Epalela.
- The long term survival of Epalela could be threatened.

Mitigation:

- Rural Water must supply Epalela with a water point on the pipeline so as to sever its dependency on the dam.[1]
- With regard to boosting other non dam related job opportunities not no mitigation can be foreseen. Construction of the Olushandja dam twenty years ago provided the Omusati region with an unique resource in an area that was totally subsistence orientated. Even the establishment of Epalela during the war years was a result of the dams presence. Removal of the dam will thrust the people, living around the dam back into the same situation that prevailed before the dam and indeed still prevails in the rural areas of northern Namibia.

Significance with mitigation: **MAJOR** negative.

Reasons: Despite securing a reliable and clean source of water for people at Epalela, removal of the dam represents a loss in valuable local employment opportunities in both the short and long term.

- **Increased competition from non-locals**

The level at which the water in Olushandja dam is managed could result in increased competition for employment opportunities through non-locals moving into the area.

Interested and affected parties: Locals reliant on the dam's resources as a source of income.

Management Scenario One: Keeping the dam at 30% capacity

Discussion of impacts: Building the dam has resulted in Angolans crossing the border to fish. Roberts (1995) recorded four boats on the Olushandja dam in January. He indicated that these were angolans as the local fishermen do not have a boating tradition. The senior headmen and regional councillor expressed concern over this. They feel that as water and fish stocks are abundant in Angola, Angolans should not be utilizing their limited resource. The angolans bring their nets with them. These are much larger and more sophisticated than, the home-made nets, kavango baskets or lines which the locals generally use. As a result the angolans secure larger catches (BLR). Other than Angolans, the dam does not seem to attract many people. Within the study area, the number of people that fish at the dam decreases with distance from the dam.

Significance without mitigation: **MINOR** negative

Reasons:

- The is a limited influx of non-locals.
- In general the community have not expressed animosity toward the angolans. At present the presence of non-local fishermen has not affected the potential for locals to fish.

Mitigation: Develop a management strategy for the dam to ensure that utilisation of resources are maximised and that local communities derive the primary benefits accrued from these resources.

Significance with mitigation: **MINOR** positive

Reasons: A sound management plan will ensure that even if some non-locals utilise the dam, it will not be to the exclusion of the locals. In fact the presence of Angolans could then be beneficial as exchange of expertise could occur. In addition the non-locals could inject money into the local economy by purchasing other goods.

Management Scenario Two: Keeping the dam full

As in *Management Scenario One*.

Management Scenario Three: Fluctuating the level of the dam

As in *Management Scenario One*.

Management Scenario Four: No dam option

No impact.

- **Enhancement of regional self sufficiency**

The level at which the Olushandja dam is managed could contribute towards potential economic development and provision of long term job opportunities in the vicinity of the dam. This in turn could contribute towards the enhancement of regional self sufficiency.

Interested and affected parties: People living in the Omusati region.

Management Scenario One: Keeping the dam at 30% capacity

Discussion of impacts: There are very few economic development projects in the Omusati region. The Elao and Epalela market garden projects are two important success stories in terms of both the money generated and fresh produce made available for market. Centres such as Onesi, Tsandi and Ombalantu benefit from the market gardens, and the potential exists to expand the sale of vegetables to other centres within Omusati. Besides boosting the regional economy (albeit only marginally) and centres within Omusati not having to import all their fresh produce from other regions, such projects play an important role in making people aware of economic options available to them. It is very important that capacity building occurs in northern Namibia, as the Owambos were provided with limited opportunities when the northern regions were collectively administered as the homeland, Owamboland. Projects such as the market gardens help build not only local but regional capacity. This is very important in the achieving regional self sufficiency.

The Omusati region has traditionally been referred to as the fishing area of northern Namibia (Pomuti, 1995), because of the abundance of fish which come down the Oshana Etaka and other regional *oshanas* during *efundjas*. This association has been accentuated since the dam has been built, as Omusati is the only region which now has a permanent fish resource. While fish are not yet marketed in the greater Omusati region, the potential to do so exists. Therefore, fishing has the potential to enhace regional self sufficiency in economic, nutritional and capacity building terms.

Significance without mitigation: **MAJOR** Positive

Reasons:

- The potential exists to market produce grown in market gardens, or caught in Olushandja dam to centres in Omusati.

Optimisation:

- Investigate the viability of establishing more markets and look at avenues for transporting produce (eg fish and vegetables) to other centres within the Omusati region.
- Investigate the potential for economic spin-offs which could develop as result of the small businesses initiated at the dam.

Significance with optimisation: **MAJOR** positive

Reasons: Optimisation enhances the positive economic benefits derived regionally from the presence of the Olushandja dam.

Management Scenario Two: Keeping the dam full

As in *Management Scenario One*.

Management Scenario Three: Fluctuating the level of the dam

Discussion of impacts: As has been mentioned in the discussion of other economic impacts influenced by a changing water level - management scenario, the effect of varying water levels on natural aquatic resources is unknown.

If a management regime is adopted which aims to keep the dam at a constant level for most of the time, then not only local communities, but the Omusati region could benefit from the economic opportunities associated with Olushandja dam. The regional economy will then experience the same beneficial impacts as identified in *Management Scenario One*.

If however the water level varies regularly such that it threatens the biotic resources in the dam and jeopardises peoples ability access and utilise the dam water, then the economic opportunities available will be threatened. This will be felt by the region as the potential to provide fresh produce within the region will be lost and will have to-be imported from other regions. Current sources of regional income will also be lost.

Significance without mitigation: **MAJOR** negative to **MAJOR** positive

Reasons: Unknown effect of a fluctuating dam level on economic resources.

Mitigation: The dam should be maintained at a level which maximises the economic potential associated with the dam and should fluctuate as infrequently as possible. If is done, then the same mitigatory measures outlined in *Management Scenario One* should be applicable for this scenario.

Significance with mitigation: **MAJOR** positive

Reasons: Mitigation would ensure that the economic potential associated with the dam is not compromised. This would impact positively on the regional as benefits derived from the dam would not be forfeited.

Management Scenario Four: No dam option

Discussion of impacts: With the dam removed, all of the local and regional economic benefits derived from the dam would be lost. There are very few economic development projects which could be initiated in the Omusati region, which would provide the same potential regional benefits as the market gardens and fishing do. Additionally, if the dam was eliminated, potential satellite businesses such as small transport enterprises, which are dependant on the economic potential associated with the dam, will die. This will impact negatively on regional self sufficiency.

Significance without mitigation: **MAJOR** negative

Reasons: Removing the dam will result in the region being more dependant on other regions for fresh produce. The loss of job opportunities in the region will exacerbate regional poverty and increase reliance on national funding.

Mitigation: Although the potential for economic development in Omusati is limited, potential opportunities should be investigated. For example, the Department of Agriculture are currently working in Omusati on a dryland farming project. The project is based at Mahanene, about 12kms east of Olushandja dam north wall and involves locals in producing a drought resistant variety of *mahangu* known as Okashana 1 (Mr Lechner, pers comms, 1995). This type of project should be encouraged as it is based on traditional farming methods and utilises a crop appropriate to the climate of Omusati. It has the potential to develop and would certainly

contribute to regional self sufficiency in terms money and capacity building.

In reality, this project has the potential to contribute to regional self sufficiency whether the dam exists or not. It therefore compliments the benefits accrued from economic activities occurring at the dam and could not compensate for them should they be lost. There is unfortunately no mitigation which could be implemented to avoid the irretrievable loss of both regional and local economic opportunities associated with the dam if it was decommissioned.

Significance with mitigation: **MAJOR** negative

7.2.3. Impacts related to health issues

The incidence of water related diseases such as bilharzia, malaria and diarrhoea will continue or increase with varying water levels in Olushandja dam. This will impact negatively on public health.

Interested and affected parties: People utilising the dam for their water requirements, fishermen, and others living in close proximity to the dam (Zone A).

Management Scenario One: Keeping the dam at 30% capacity

Discussion of impacts: Ms Curtis was commissioned by the DWA to investigate whether any snail-borne diseases occurred in the dam. She found that *Bulinus globosus*, an intermediate host for urinary bilharzia was abundant in marginal vegetation along the north wall of the dam, particularly around the water inlet from the Calueque-Olushandja canal. Although she found that the number of snails infected with the bilharzia parasite was low (7.5%), clinic records indicate that cases of bilharzia have been steadily increasing in the last ten years (Curtis, 1995). Information obtained from interviews with people utilising the dam for their daily water requirements or for fishing also indicate that bilharzia is quite common. Of the 24 respondents interviewed, who are reliant on the dam, 10 indicated that at least one member of their household passed blood in their urine (BLR). One of the fishermen interviewed indicated that he too suffered from this symptom. Two nurses (from different clinics) who have been working in the area for a long time feel that since the dam was built, there has been an increased incidence of sickness in the area (BLR).

Clinic interviews also identified malaria as a major problem in the area. Most incidence of malaria are recorded in April/May and is directly related to the breeding time of mosquitoes

(intermediate host). However in the Olushandja dam area, a second peak occurs in September (BLR). This is because the presence of the dam allows the mosquitoes to breed again.

One of the nurses and some of the people interviewed in zone A indicated that "Skin-burrowing" worms are also contracted from wading in the dam (BLR). Exactly what type of worm or worms these are is unknown.

Diarrhoea and gastritis have also been recorded, the former being a particularly common malady, of people drinking dirty, unboiled water from either the Olushandja dam or the canals. The water is dirty because the people do not only drink the dam water, but wash their clothes and bathe in it. Both livestock and fishermen wading in the dam make the water muddy and even more unsuitable for drinking. Nearly all of the people interviewed in the study area had been informed by the sisters at the clinics and/or health workers of the need to boil their water. Fifty of the 80 respondents answered that despite this they never boiled their water (BLR). One respondent who collects water from the dam said that when the dam water makes her ill, she walks to the pipeline and then mixes the purified and dirty water together, but she never boils her water. Only three of the households interviewed (all in zone A) boiled their water (BLR). People identified a number of practical reasons which stopped them from boiling their water. These were factors such as limited containers in which to store and collect water, limited access to firewood especially dry wood in the rainy season, and time constraints. According to a sister at one of the clinics, children under the age of five are the most susceptible to diarrhoea.

During a bacteriology study, Roberts (1995), found that two of his samples from sites at the edge of the dam contained coliform bacteria. These sites were used by people for washing their clothes, bathing and for drinking. High concentrations were also recorded in the vicinity of the north wall. High *E. coli* concentrations can contaminate the water and make it unsuitable for drinking. According to the standards set out for microbiological quality of human drinking water, there should be no *E. coli* counts found per 100ml of tested water (Roberts, 1995). In the two in question, counts of 22 and "large" per 100ml were observed (Roberts, 1995).

Significance without mitigation: **MAJOR** negative

Reasons:

- The presence of a permanent water body allows water borne diseases to proliferate.
- Many people utilise and contaminate the dam. This exacerbates the incidence of diarrhoea in the area.

Mitigation:

Prevention of bilharzia:

- People should not have to depend on the dam for their water requirements but should be provided with purified pipeline water[1]. Alternatively draw off points along the dam should be designated. Large drums with chlorinated dam water should be provided at these points and local people democratically elected to look after the drums in conjunction with a health worker. The water in the drums should be left to stand for at least 48 hours before being used. For this reason it is important that at least two large drums are provided - where one drum can provide enough water to last for two days.
- An active education programme should be initiated to discourage people from using the dam. This can only be done successfully if the first issue is addressed.

According to Curtis (1995) the following mitigation should be implemented:

- Vegetation along the margins of the dam up to 500m from the north wall should be eliminated so as to remove attachments for the snail host.
- Molluscicide should be used to kill any remaining snails that are not removed when the vegetation is cleared.
- Water should be pumped from the swift flowing area of the Cunene to avoid the uptake of snails.
- All canals should be kept free of rooted material, onto which the snail could attach themselves.
- Fishermen should be tested and treated regularly.

Malaria prevention:

- A malaria education programme has been running in the area for the last 2½ years (BLR). This is the main reason, according to one of the clinic sisters that the number of malaria cases she has treated have decreased from 12 500 in 1992 to 3 500 in 1994. This programme should be continued and more manpower should be provided to the clinics to help with these health education programmes.
- Inexpensive mosquito nets should be made readily available to the community, and people should be encouraged to purchase and use them.
- Throughout the world, mosquito nets, impregnated with insecticides has been tested, with a fairly high degree of success (Appleton, pers comms, 1995). A major problem identified with using nets is that they are very hot to sleep under, however they are inexpensive, and the potential of using them should be considered.

Infection from "Skin-burrowing worms":

- People should be discouraged from wading or from washing their clothes in the dam.

To achieve this it is imperative that the people who are dependant on the dam for water, are provided with an alternative, accessible water source - preferably a pipeline water point[1].

Diarrhoea prevention:

- Purified water must be made available to the people living close to the dam. They should not have to rely on the dam for their water requirements[1].
- If pipelines cannot be extended to provide clean water, either rural or bulk water should supply all households reliant on dam water with drums in which they can chlorinate dam water. This would solve the practical problem of having too few containers in which to collect and boil water. A system such as this would also decrease the need to boil water and would eliminate the need to spend large amounts of time looking for extra firewood.
- Chlorination pills should be made available at all the schools and clinics in the study area and should be inexpensive.
- Alternatively, DWA or DRWS should provide large drums which contain chlorinated water at designated points along the dam (see first point in bilharzia prevention section, page 65).
- People should be discouraged from washing their clothes and bathing in the dam to prevent further pollution of the water. Most of the respondents interviewed in the study area transported water to their homesteads for washing. This should be encouraged.
- Most importantly, the importance of boiling unpurified water should be continually reinforced. Drums in which the people could boil their water could be provided.

Prevention of contamination by *E. coli*:

- According to Roberts (1995), water quality monitoring, areas of the dam regularly used for clothes washing, bathing, or water collection, should be done on a regular basis, so as to confirm the findings of his study and to monitor changes in the future.
- Efforts should be made to educate people about sanitation.
- Simple filtering devices are another alternative for people dependent on the dam water for their daily water requirements. This should be inexpensive and made readily available.
- People should be discouraged from collecting water near the north wall, as high faecal concentrations are evident there.

Significance with mitigation: **MODERATE** negative

Reasons:

- Implementation of mitigatory measures would reduce peoples dependency on the dam for water requirements.
- There would be a reduction in the number of bilharzia cases as a result of active eradication. There will however be a continual threat from all the diseases as long as the dam exists.
- Mitigation will be expensive and will need to be administered on a long term basis.
- Education is slow and can only improve the situation marginally if it is not conducted in conjunction with improvements in regional water infrastructure.

Management Scenario Two: Keeping the dam full

Discussion of impacts: There is a possibility of the incidence of water borne diseases increasing if the dam is filled, because the volume of Cunene water carrying water-borne diseases and being pumped into the Olushandja dam will increase. Once the dam is full, areas covered with marginal vegetation will increase. It is in this marginal vegetation that the bilharzia snail hosts live, as do most of the other water-borne diseases. Mosquitoes also breed in the still waters associated with marginal vegetation. A larger number of mollusc hosts and parasites can also be expected to be introduced into the water supply system when pumping at Calueque is maximised to $6m^3/s$.

There is an additional threat of increased water pollution from faecal matter if the dam is filled to capacity. People in the study area use the bush as their latrines. It is not known what levels of raw faecal matter would be needed to increase water pollution levels to dangerous levels, however inundation of land presently being lived on will result in faecal matter entering the dam. This potential threat should not be overlooked. Roberts (1995) found that parts of the dam (areas near north wall, and next to homesteads) are contaminated with faecal matter. Livestock also defecate in the dam.

If after investigation, it is found that present "terrestrially " located faeces is not a threat to water pollution, filling the dam will have a positive impact on faecal concentrations currently in the dam, as it will be diluted (Roberts 1995).

Significance without mitigation: MAJOR negative

Mitigation: The effect of raw faecal matter on water pollution should be investigated in addition to the mitigation measures suggested in *Management Scenario One.*

Significance with mitigation: **MODERATE** negative

Reasons: As in *Management Scenario One.*

Management Scenario Three: Fluctuating the level of the dam

Discussion of impacts: Bulinus globus can only survive in perennial water systems. Therefore if the volume of the dam had to change on a regular basis, such that the vegetation on which the snails are attached was exposed, the snails in the dam would die. Adopting a fluctuating management policy for Olushandja dam would then have a positive impact on public health as it would prevent bilharzia from becoming well established. If however, the volume of the dam was rarely varied and changes in water levels were gradual, the snails and the vegetation on which they attach themselves might be able to adapt. If this was the case, then the varying water regime would have the same negative effect on health as the 30% capacity and full dam scenarios.

Neither malaria nor diarrhoea are likely to be affected by a fluctuating dam level, unless the dam becomes very low and is kept at this level for an extended period of time. In this case diarrhoea could escalate, as the utilisation of the decreasing water resource would cause the water to become badly polluted.

Significance without mitigation: **MODERATE** negative to **MAJOR** positive

Reasons: Fluctuating dam levels could affect the survival rate of the bilharzia snail hosts, but the other major disease will probably not be affected dramatically. Therefore high incidence of water related sickness will probably still be recorded in the area.

Mitigation: As in *Management Scenario One.*

Significance with mitigation: **MODERATE** negative.

Reasons: Mitigation would help to curb the incidence of water related diseases in the area. Nevertheless the presence of the permanent water body as well as a continual introduction of disease and disease hosts from the Cunene into Olushandja dam means that the potential for contracting water-borne diseases will always exist.

Management Scenario Four: No dam option

Discussion of impacts: Prior to 1987 neither *Bulinus globosus* nor the bilharzia parasite had been recorded in the northern and north western regions of Namibia (Curtis 1995). This could be attributed to a number of factors such as limited data collection in this area prior to 1987 or to the lack of suitable, permanent water bodies in the area in which the snails could live. If the Olushandja dam were removed, a similar situation would be reinstated and bilharzia would die. Snail hosts bearing the parasite would still be transported down the canals, but would be unable to survive if they could not find rooted vegetation on which to anchor.

Malaria would still be an issue, but only during the wet season, when the *oshanas* were filled, and the area was covered in standing water. Diarrhoea would also persist as most people rely on pans and *oshanas* for their water requirements in the wet season. These can become very dirty they are often utilised by both livestock and people.

Significance without mitigation: MODERATE positive

Reasons: Removal of the dam will reduce the occurrence of bilharzia in the area substantially, if not totally. It might result in a slight reduction of malaria cases, but will probably have a minimal effect on the incidence of diarrhoea.

Mitigation:

- Canals should be kept free of rooted vegetation to ensure that bilharzia carrying snails cannot settle in the open canals.
- Purified water in the form of pipelines[1] must be made available to people who were previously dependant on the dam, so as to ensure that they do not utilize pans or the canals for their water requirements.
- Malaria and diarrhoea education programmes should be continued. The importance of boiling water and not bathing or washing clothes in the same place from which drinking water is collected is essential.

Significance with optimisation: **MODERATE** positive.

7.2.4. Impact on water and land rights

If the DWA or Water Utility Company decided to expropriate land around the Olushandja dam, rural people who are accustomed to free access to natural resources such as water and land might find that they have no legal rights to the water in the Olushandja dam or to the communal land surrounding the dam, albeit their properties are located on this land.

Interested and affected parties: Locals living below the settlement limit contour (1007.5m) and DWA.

Management Scenario One: Keeping the dam at 30% capacity

Discussion of impacts: At present, there are 94 households situated below or on the settlement limit originally demarcated by the DWA. The average number of people per household is 8.1 (n = 80, BLR), i.e. there are about 752 people living within the dam limits. It is uncertain what rights these people will have to the land on which they are currently living and what rights they will have to the water in the dam once the water utility company takes control of Olushandja dam or if DWA decide to expropriate land around the dam. According to the Water Act No 54 of 1956, these people should not be denied access to the dam as it has been built on communal land, but if the land is expropriated by the DWA, they may be denied access to the water.

People living below the 1007.5m contour were given permission to occupy the land on which they live by the headman. Yet if the land is expropriated by the state, relocation might be enforced, even if inundation is not a threat. The expropriation policy has never been tested in communal situations, so it is uncertain how issues of compensation and relocation might be addressed.

Because the strategy for both rural and bulk water in the future is to charge consumers for water (Department of Water affairs, 1994b), it is likely that there will at some stage in the future be a move to charge the people for the dam water which they consume, if indeed they are allowed to use the dam at al. This would be relatively easy in the case of the market gardens, as the volume of water used could be easily measured. It would be virtually impossible to monitor water collection from the dam and impose a cost on locals collecting water in containers. At present DWA have no idea how the government will subsidise local consumers when the Namibian Water Company starts selling water to the government

(Haussler, pers comms, 1995). It is also uncertain whether people would be denied access to the dam because of the difficulty involved in charging people for the water.

In interviews 14 out of 27 respondents indicated that the dam belonged to the government, but that the water belonged to the community (BLR). Six people believed that it belonged to the people because they use the water and fish there. In reality it would be very difficult for the DWA or the new utility company to prevent access of locals to Olushandja dam because of these perceptions and the fact that there are insufficient rural water points in the area to service everyone.

Significance without mitigation: **MAJOR** negative

Reasons: Uncertainty as to the actual rights of rural people if communal land or a water body located in communal land is expropriated by the state.

Mitigation:

- Investigation into the rights of the rural people living below the 1007.5m settlement limit, if they are faced with expropriation demands or denied access to water in Olushandja dam.
- Because the expropriation ordinance (Namibian Government, 1994a) does not deal with compensation of communal land, DWA should include a policy on how to deal with these issues in the operation guidelines for the Water Utility Company in order to ensure that the rights of locals living in the vicinity of the dam are not neglected. This policy must be drawn up in consultation with the affected locals, councillor and headmen. The policy should address expropriation, compensation, relocation. Access to the dam by people dependant on dam water for their daily requirements as well as people who only utilise the dam in times of drought should be addressed.
- A local representative should be included in the Water Company, Olushandja dam management team to ensure that policies taken in the future will always take local concerns into account.

Significance with mitigation: **MODERATE** negative

Reasons: The outcome of the investigation is unknown, but if mitigation is imposed, the situation will improve for the locals as it will ensure that their interests are considered in any issues affecting the dam in the future. It should also ensure that they are adequately compensated if expropriation by the state occurs. Nevertheless the social disruption associated

with relocation remains a negative issue, as is the potential that people might be denied access to the dam.

Management Scenario Two: Keeping the dam full

The same situation as outlined in *Management Scenario One* with regard to the legal rights of rural people to water and land applies if the dam is managed at full capacity.

Management Scenario Three: Fluctuating the level of the dam

As in *Management Scenario One.*

Management Scenario Four: No dam option

No impact.

7.2.5. Impact on groundwater

Changing the water level of the Olushandja dam could impact the local ground water, by altering the rate of recharge of underground aquifers, changing the salinity of the ground water or contaminating the ground water.

Interested and affected parties: DWA, locals reliant on the ground water

Management Scenario One: Keeping the dam at 30% capacity

Discussion of impacts: A comprehensive hydrogeological report for the study area, particularly information dealing with the effects of the dam on local ground water is unavailable. A report was provided by DWA on request from the masters group, however it was totally inadequate. There is also very little information available on the state of the hydrogeology prior to dam construction. It is therefore uncertain whether managing the dam at 30% for the last twenty years has affected the rate of recharge or quality of the local ground water. With the construction of the dam and the introduction of water points along the pipeline, the number of people dependent on the local ground water has decreased. Those people interviewed who still use wells did not indicate that the quality of their water had decreased since the arrival of the dam. Prior to construction of the dam, people did have wells in the Oshana Etaka, (BLR) as there is a lens of fresh water directly beneath the Oshana (Department of Water Affairs, 1995a). These were inundated when the dam was filled. Whether this affected the local ground water in any way is unknown. Some respondents indicated that the water from those wells was much better than the water in the dam.

Significance without mitigation: MAJOR negative

Reasons: Actual impact is unknown.

Mitigation: Commission an investigation of the effect that the Olushandja dam and Etaka canal has on the local ground water under the current management regime, and what impacts might be expected if the level of the dam changes or the dam is removed.

Significance with mitigation: Until results from the investigation were published, it would be impossible to assign a degree of significance to the impact.

Management Scenario Two: Keeping the dam full
As in *Management Scenario One.*

Management Scenario Three: Fluctuating the level of the dam
As in *Management Scenario One.*

Management Scenario Four: No dam option
As in *Management Scenario One.*

7.2.6. Impact on transport networks

- **Inundation of roads**

Changing the water level in Olushandja dam could impact negatively on the existing road system in the study area, as sections of the roads running down the east and west sides of the dam might be inundated by water from the dam.

Interested and affected parties: Local and regional users of the roads.

Management Scenario One: Keeping the dam at 30% capacity
No impact

Management Scenario Two: Keeping the dam full

Discussion of impacts: An all weather gravel road with pipe culverts is located on the western side of Olushandja dam. It extends from the north wall of the dam to Onesi in the south. It is

the only road in the area which is not flooded during the wet season. Consequently it is used extensively by people travelling down to Tsandi and other areas south of the dam, as well as those living in villages near the dam. The majority of the road has been built above the 1007.5m contour. There are only three instances when the road runs below the contour, and then only for short distances (Department of Water Affairs, 1995b). The road never crosses the 1006m contour, so filling the dam to capacity will not inundate the road.

A dirt road exists on the eastern side of the dam. Heavy rains or *efundjas* flood this road rendering many tracts impassable during the wet season. This increases peoples dependence on the western road. The dirt road is road also runs above the 1007.5m contour, only crossing below it in four places. It touches the 1006m contour at one point (Depaartment of Water Affairs, 1995b). Unless huge wave action causes water to extend as far as the 1007.5m contour, filling the dam to capacity should not affect either of the roads. The chance of having huge wave action is highly unlikely as the surface area of the dam is relatively small and the dam is situated in an area characterised by having very little wind (DWA, 1990).

There is a need for the road network in the area to be improved, but this is because most of the roads are dirt tracks which are regularly flooded in the wet season, not because of the dam being upgraded or managed at capacity.

Without mitigation: No impact.

Management Scenario Three: Fluctuating the level of the dam
As in *Management Scenario Two.*

Management Scenario Four: No dam option
No impact.

- **Restriction on human movement patterns**

The level of the water in Olushandja dam could affect the movement patterns of people living in the study area, as the dam acts as an obstacle for people travelling from the western side of the dam to the eastern side.

Interested and affected parties: People living in the study area

Management Scenario One: Keeping the dam at 30% capacity

Discussion of impacts: Very few people in the study area own vehicles of any sort, therefore their chief means of transport is by foot. Construction of the dam has created an obstacle between people living on the western and eastern sides of the dam. The only church in the area, is located in Onesi. Consequently if people wish to visit family on the opposite side of the dam or if people from the eastern side of the dam wish to attend church, the only way they can safely cross the dam is to walk around it via the north or south wall roads. The distances involved are in some cases very great, eg someone living on the eastern side, half way down the length of the dam, would have to travel about 11kms to get to the church in Onesi if they went via the south wall. Before the dam existed they would have crossed the Oshana Etaka, and the trip there would have been about 3kms. People do try to cross the dam but are generally afraid to do so as they cannot swim and drownings have occurred. The barrier created by the dam was the major issue raised at the community meeting, and highlights the importance of family relationships in Owambo social structure.

Significance without mitigation: **MAJOR** negative.

Reasons: The dam acts as an obstacle between the areas to the east and west of it. This impacts negatively on the social integration of the community.

Mitigation: At the community meeting held in Eunda, the community indicated that they would like to see a foot bridge built across the dam. They identified a number of locations for the bridge, all more or less in the vicinity of Elao market garden. This location was probably chosen because it provides easy access to both Eunda and Onesi to the west of the dam and Oshaala to the east.

Significance with mitigation: **MAJOR** positive

Reasons: The bridge would provide a safe and direct access route across the dam. It would remove the barrier affecting community communication. Most importantly, it meets the needs of the community.

Management Scenario Two: Keeping the dam full

As in *Management Scenario One,* however the situation can be expected to be exacerbated without mitigation, as the area of the dam will increase substantially.

Management Scenario Three: Fluctuating the level of the dam

As in *Management Scenario One*.

Management Scenario Four: No dam option

Discussion of impacts: If the dam was removed, the road which crosses the south wall might be destroyed. While this is not a problem when the *oshana* bed is dry, when it is full, people would be unable to cross the *oshana*. The loss of the road currently running across the south embankment can therefore be viewed as a negative impact for communities living in the study area, and currently relying on the road to travel from east to west.

Significance without mitigation: **MODERATE** negative.

Reasons: Decommissioning the dam will affect movement patterns of people in the short and long term. It will facilitate access across the Oshana Etaka in the dry season, but will hinder movement in the wet season as the road running across the south embankment will be destroyed if the embankment itself is broken down.

Mitigation: Reconstruct an all weather road if the existing road on the south wall is destroyed. Culverts must run under the road to ensure that it has minimal impact on the functioning of the *oshana*

Significance with mitigation: **MAJOR** positive

Reasons: Mitigation will ensure that removal of the dam in no way hinders movement of people between west and east of the Oshana Etaka. Because the new road would be constructed with culverts, water flowing southwards in the *oshana* would not be restricted. Therefore construction of a road across the *oshana* would not affect people living to the south, who are dependant on seasonal flow of *oshanas* for fish and for grass flushes the *oshana* bed, on which livestock can graze.

7.2.7. Impact on the local infrastructure

The existence of water borne diseases and poor water quality in Olushandja dam and the canals result in a high degree of illness in people dependant on the dam or canals for their water requirements. This results in local health services being heavily utilised by people with water related sicknesses. Changing the water level in Olushandja dam could affect the incidence of disease which in turn could impact on the existing health facilities in the area.

Interested and affected parties: Clinics in the area, locals utilising the health facilities.

Management Scenario One: Keeping the dam at 30% capacity

Discussion of impacts: At present there are four clinics in the study area, at Mahanene, Eunda, Onesi and Oshaala (Appendix E, Figure 3). All of these clinics are understaffed and have inadequate facilities. Only the Onesi clinic is in the process of being upgraded. A large number of the cases treated at all of the clinics are for water related illnesses. Water-borne diseases and water quality therefore do have a negative impact on the health of the local population and therefore on the demands of the health services.

Significance without mitigation: MODERATE negative

Reasons: The existence of a permanent body of water which is not only dirty, but harbours diseases such as bilharzia and malaria exacerbates sickness levels in the study area and places a strain on clinics that are already struggling as a result of infrastructural, provisional and staffing inadequacies.

Mitigation:

- Provide purified water facilities to more rural people in the area so as to reduce the dependency that so many people have on the Olushandja dam and open canals[1].
- Initiate health awareness campaigns to inform people of types of illnesses they can contract from the dam and how to avoid becoming ill.

Significance with mitigation: **MINOR** negative

Reasons: Mitigation will improve the quality of living in the study area, particularly Zone A, as it should reduce the number of people falling ill from water-borne disease. However as long as

the dam exists and fishermen wade in it, or people use it for bathing or drinking, the clinics will continue to deal with water related sicknesses.

Management Scenario Two: Keeping the dam full

As in *Management Scenario one.* However this scenario has the potential to increase pressure on the clinics, as there is a high probability of the incidence of bilharzia and other water related illnesses increasing if the dam is filled.

Management Scenario Three: Fluctuating the level of the dam

As in *Management Scenario One.*

Management Scenario Four: No dam option

Discussion of impacts: With the dam removed, the major source of water related illnesses will be removed. People utilizing the canals and dirty *oshanas* will still suffer from diarrhoea, particularly towards the end of the wet season when *oshanas* and pans are starting to run dry. Free standing water will still provide suitable breeding grounds for malaria, but incidence of malaria should decrease. According to the sister at the Mahanene clinic (BLR), malaria is the biggest health problem in the area, so any reduction in affected patients will reduce pressure on the clinics. Bilharzia should disappear if the dam is removed and this will further reduce the number of people visiting clinics because of water related diseases.

Significance without mitigation: MAJOR positive

Optimisation: No optimisation possible

7.2.8. Impact on water surety

The duration for which water from Olushandja dam can be provided to regional consumers on the water network is directly linked to the volume of water reserved in the dam. The capacity at which the dam is managed will therefore impact directly on the length of time that DWA could provide bulk and rural network consumers with water in the advent of water from Calueque being discontinued.

Interested and affected parties: People living in the vicinity of the dam, and bulk water network users, Etunda and DWA.

Management Scenario One: Keeping the dam at 30% capacity

Discussion of impacts: At present the dam provides water surety for those people living less than three kilometres from the dam, as it is a permanent water source for people who do not have access to other water sources.

Those people living in the study area, further than three kilometres from the dam utilise other water sources which are located closer to their respective households than the dam. These water sources include canals, wells, pipelines, or even in two cases, the Cunene river (BLR). The only surety that the dam provides for rural people living further than 3kms from the dam is as a back up in times in time of extreme drought. It is a permanent water source that can be utilised if all other water sources fail.

At 30% capacity, the dam provides little surety for bulk water users. At 100% capacity there would only be sufficient water in the dam for two months water supply (at the optimum pumping rate), so 30% will provide less than one months supply. At present the demand for water from the Cunene is well below the maximum $6m^3/s$, so in the short and medium term the volume of water contained in the dam if it was managed at 30% capacity would probably last much longer than a month. Of course same applies for the dam managed at capacity.

Significance without mitigation: MODERATE positive.

Reasons: At 30% capacity, the dam provides long term surety at a local level but not at a regional level. It does however provide a measure of short and medium tem surety for regional consumers.

Optimisation: No optimisation possible.

Management Scenario Two: Keeping the dam full

As indicated in *Management Scenario One*, the surety of water supply to regional and local consumers will be maximised if the dam is kept at 100% capacity. This will benefit DWA as they will be providing consumers with the maximum water surety possible. Etunda is an another party which could benefit from the dam being maintained at capacity. This irrigation project will need vast quantities of water when their scheme is fully operational, and if they cannot draw water from the Calueque-Olushandja canal (as planned), they might want to obtain water from the dam. In reality the chances of being allocated their full quota from the entire

northern Namibian water reserve is slim, but even more so if the dam is not full.

Significance without mitigation: MAJOR positive

Reasons: A full dam offers maximum surety for DWA, bulk and rural network consumers, and local rural communities. Etunda might also benefit.

Optimisation: No further optimisation possible

Management Scenario Three: Fluctuating the level of the dam

Discussion of impacts: As in *Management Scenario One*, the only difference being that the degree of surety at any time will be determined by the level of the dam at a particular point in time. If the water level fluctuates regularly and changes in volume of the dam are extreme, short and medium term water surety could be jeopardised.

Significance without mitigation: MODERATE positive.

Reasons: Any level below 100% capacity, is a compromise on maximum surety, but is still providing both regional and local consumers with a water reserve.

Mitigation: To maximise surety in this scenario, it is important to devise a management plan which alters the volume of watering the dam as little as possible, and strives to keep it at maximum capacity for long periods of time (over 12 months). If water is pumped from the dam it should, it should be restored to capacity in the quickest time possible.

Significance with mitigation: **MAJOR** positive.

Reasons: If mitigation is implemented, the dam will be full for most of the time and would therefore be providing a high degree of surety to all I&APs.

Management Scenario Four: No dam option

Discussion of impacts: Removal of the dam would have a large negative impact on water surety in the short and long term for both local and regional consumers, as Olushandja dam is the only reservoir in northern Namibia which could store water pumped from the Cunene. On a local level this would result in increased pressure on pipeline water points and increased use of

the canals or wells. As far DWA is concerned, they would have to hope that unpredictable events which might cause the water supply from north of the Olushandja dam to be discontinued did not occur. If it did, there would be nothing they could do to guarantee water supply to the bulk and rural water networks.

Significance without mitigation: MAJOR negative.

Reasons:

- Decommissioning of the dam will affect the security of water supply to northern regions of Namibia.
- Decommissioning of the dam will result in the removal of a permanent water source on which people living close to the dam (less than 3kms) depend for their daily requirements and for locals within the study area who utilise the dam in times of drought.

Mitigation:

- Wells could be reconstructed in the Oshana Etaka to provide nearby water source for people previously dependant on the dam.
- No mitigation is possible for providing water surety to bulk and rural network consumers.

7.2.9. Impact on daily routines

Changing the water level in Olushandja dam could alter the daily, water routines of people living less than three kilometres from the dam.

Interested and affected parties: People living near to the dam.

Management Scenario One: Keeping the dam at 30% capacity

No impact.

Management Scenario Two: Keeping the dam full

Discussion of impacts: If the dam was filled, between 24 and 94 households would have to be relocated. It can not be guaranteed that these people would be allocated land adjacent to the new dam edge. For these people who are currently accustomed to readily accessible water, relocation might result in them having to walk considerable distances to reach either the dam or

a new water source. Some people who are accustomed to walking up to three kilometres to the dam every day would suddenly find the resource closer, and some households would find themselves bordered by the dam. In other words, filling the dam would result in a reshuffling of who walks to which water source and how far certain people have to walk. Some households would benefit as a result of this, others would suffer. The actual water routine is unlikely to change. Women and children would still be responsible for collecting water in the morning and evening, in large (approximately 10l) containers.

Significance without mitigation: **MINOR** negative

Reasons: Those people who are relocated might find themselves worse off with regard to water accessibility than they are at present. However people are accustomed to spending time collecting water and would adjust easily.

Mitigation: No mitigation possible

Management Scenario Three: Fluctuating the level of the dam

As in *Management Scenario Two.*

Management Scenario Four: No dam option

Discussion of impacts: For all of those households currently dependent on the dam, removal of the permanent water source would result in a change in daily water routine. They would have to find alternate water sources from which to obtain their water. For those living on the western side of the Oshana Etaka, the pipeline would be probably be the favoured water, source as it is only about 3kms away. Those living close to the north wall of the dam would probably utilise the canals. The people on the eastern side of the *oshana* would suffer the most as they do not have pipelines in their area, the closest one being the Olushandja-Tsandi pipeline to the west. They would have to resort back to using local wells or travel even further than they do at present to collect water.

Removal of the dam might result in increased pressure on the alternative water resources in the area.

Significance without mitigation: **MODERATE** negative.

Reasons:

- Removal of the dam will result people currently obtaining water from the dam having to

find new water points.

- Removal of the dam might increase pressure on other water points in the area.

Mitigation:

- New wells could be established in the Oshana Etaka as a lens of fresh water is located at an accessible depth. (Department of Water Affairs, 1995a).
- Pipelines must be provided to the eastern regions of the study area.

Significance with mitigation: **MINOR** negative

7.2.10. Impacts on agriculture

Changing the level at which the Olushandja dam is managed could alter potential for people living adjacent to dam to utilise the water for irrigation.

Interested and affected parties: People living on the banks of the dam

Management Scenario One: Keeping the dam at 30% capacity

Discussion of impacts: Currently both Elao and Epalela market gardens use water from the dam to irrigate their vegetable gardens. One entrepreneur living adjacent to the dam has built his own canals into which he pumps dam water. He is the only respondent of all 80 interviewed who waters his *mahangu* fields in the dry season. The potential exists for all of those people presently living adjacent to the dam to utilise water for irrigation. The fact that so few of these households have irrigation or plan to get it in the future is due to a lack of finances rather than a lack of interest.

Significance without mitigation: MODERATE positive.

Reasons:

- Despite the potential to irrigate very few people will ever be able to do so due to financial constraints.
- There is limited potential for large scale irrigation around the dam as DWA would probably disallow extraction of large volumes of water for farming when the water is actually destined for urban consumption.
- The extent to which irrigation could be used would be limited by the types of crops which grow successfully in the sandy soils of the region.

Optimisation:

- Investigate cheap methods of irrigation. This might make it possible for people living adjacent to the dam to utilise the water for small scale irrigation eg of household vegetable gardens.
- Find funding for more irrigation based projects which could be developed around the dam (The limiting factor hefor the development of market gardens at Olushandja dam is not provision of water for irrigation, but the economic viability of initiating new market gardens or other irrigation based initiatives).
- Determine from DWA the percentage extraction they would permit for small scale irrigation initiatives and the consumption cost they would attach to the water.

Significance with mitigation: **MODERATE** positive

Reasons: Despite optimisation, only a small percentage of the local population residing adjacent to dam will be able to irrigate their fields or vegetable gardens.

Management Scenario Two: Keeping the dam full

As in *Management Scenario One*.

Management Scenario Three: Fluctuating the level of the dam

Discussion of impacts: The success of irrigation could be compromised if the households or projects utilising irrigation could not access the water in the dam. For example, let us assume that when the dam was filled, the existing market gardens were relocated on land above the 1007,5m settlement limit. To reach water, pipes would only have to extend to just below the 1006m contour, when the dam was full. However if the dam level then dropped, the pipes would be to short and the gardens would suffer from water shortages. The cost involved in putting in longer pipes, and bigger pumps might not be economically feasible and because the gardens need regular water supply, periodic shortages resulting from the water level dropping might also render such endeavours impractical. Although the potential to irrigate with dam water would still exist, the cost involved in harnessing that potential would outweigh the benefits derived.

Significance without mitigation: MAJOR negative to **MODERATE** positive

Reasons: Because the frequency with which the dam might fluctuate is unknown, it is very difficult to determine to what extent this management scenario could affect the irrigation

potential of the dam. At its best the dam would have the same impact as *Management Scenario One and Two.* At its worst, a fluctuating dam level could render irrigation to costly compared to the benefits derived from installation and maintenance costs. This could have a cumulative effect on the local and regional economy, if the market gardens were lost.

Mitigation:

- Manage the dam so that it fluctuates as little as possible, and is kept close to full capacity for the majority of the time.
- As in *Management Scenario One.*

Significance with mitigation: **MODERATE** positive

Reasons: As in *Management Scenario One.*

Management Scenario Four: No dam option

Discussion of impacts: The potential for people living adjacent to the dam to irrigate their lands would be lost if the dam was decommissioned. The market gardens currently in operation would have to shut down. The loss of irrigation can therefore be calculated as a direct economic loss, as well as a loss to potential income for the region in the future. The potential to purchase a water connection on the pipeline and irrigate with that water exists, but is very costly because of the piping needed to transport the water from the pipeline to the homestead. This would certainly not be an option for the market gardens as they are situated about 3kms from the pipeline.

Significance without mitigation: MAJOR negative

Reasons: Loss of irrigation would remove the main economic activities currently operating in the study area, as well as decreasing an important avenue for future economic development.

Mitigation: No mitigation possible

7.2.11. Impacts related to livestock issues

- **Increased incidence of livestock disease**

Changing the water level in Olushandja dam could result in an increased incidence of water-borne, livestock diseases in the dam.

Interested and affected parties: Locals utilising the dam to water their cattle, goats and donkeys.

Management Scenario One: Keeping the dam at 30% capacity

Discussion of impacts: In her investigation on the distribution of freshwater snails and snail-borne diseases, Curtis (1995) found that *Lymnaea natalensis*, an intermediate host for liverfluke was associated with the marginal vegetation in the dam. Liverfluke is a parasite which infects cattle. Only 5% of the snails investigated were infected with the liverfluke. The occasional slaughtered cow has been contaminated by the parasite, yet according to Odihao (pers comms, 1995), liverfluke do not at present pose a clinical problem. Nothing is known about livestock bilharzia in the study area.

Significance without mitigation: MINOR negative

Reasons: Managing the dam at 30% capacity is not exacerbating livestock sickness in the area at present.

Mitigation: As with the mitigation of Bilharzia (see pg 65). Additionally there should be an ongoing monitoring programme to ensure that if liverfluke or livestock bilharzia do start becoming problematic, it will be recognised early.

Significance with mitigation: **MINOR** negative

Reasons: Even with mitigation, the occasional case is bound to be recorded, so the area will never be free of these diseases.

Management Scenario Two: Keeping the dam full

As in *Management Scenario One*.

Management Scenario Three: Fluctuating the level of the dam

As in *Management Scenario One*.

Management Scenario Four: The no dam option

No impact.

- **Changes in livestock movement patterns**

Changing the water level in the Olushandja dam might change the movement patterns of livestock, to the dam.

Interested and affected parties: Locals who send their livestock to the dam on a regular basis. Locals who only take their livestock to the dam in times of drought.

Management Scenario One: Keeping the dam at 30% capacity

No impact.

Management Scenario Two: Keeping the dam full

Discussion of impacts: Increasing the size of the dam will probably not cause the number of livestock utilising the dam to increase significantly. The reason for this is that there is insufficient grazing in the area around the dam. In fact filling the dam could further reduce grazing availability around the dam, which could result in the number of livestock using the dam on a regular basis decreasing in number. Findings from our field visits revealed that all of the people owning cattle, send them on *ohambo* regardless of their proximity to the Olushandja dam (BLR). Oxen, which are kept at kept at home for ploughing the fields, and goats are usually taken to water points in close proximity to the homestead. Therefore only those people living close to the dam, or with no other alternative take their livestock to the dam to drink, regardless of how full the dam is.

As far as those people living in Zone B (over 3kms from the dam) and C of the study area are concerned, they will only utilise the Olushandja dam if drought conditions become very severe. There is no point in walking livestock over long distances to water, if there is no grazing at the water point. Consequently filling the dam will not encourage people far from the dam to take their cattle to drink there more regularly than they do at present.

Significance without mitigation: **MINOR** negative to **MINOR** positive.

Reasons: This scenario will not affect movement patterns of livestock to any great extent.

Mitigation: No mitigation possible.

Management Scenario Three: Fluctuating the level of the dam

As in *Management Scenario Two*.

Management Scenario Four: No dam option

Discussion of impacts: If the dam was removed it would not have an impact on the movement patterns of cattle sent on *ohambo* but it would impact negatively on the movement patterns of the small stock which are currently watered at the dam. People would have to take their goats and oxen to alternative watering points. This would not be as detrimental for those people living on the western side of the Oshana Etaka, as for those on the eastern side, as the former are situated fairly close the pipeline (approximately 3kms). People living on the eastern side of the Oshana Etaka would have to utilise local wells or the Olushandja-Ogongo canal to water their livestock. However. pressure on the limited wells in the area might result in small livestock needing to be taken long distances to water in the dry season.

Significance without mitigation: MODERATE negative.

Reasons: Well being of some small livestock threatened. Increased time needed to be spent on watering livestock.

Mitigation: Provide a pipeline on the eastern edge of the Oshana Etaka so that both those people living on the edges of the Oshana Etaka and those without a permanent water source further east of the *oshana* would be provided with a reliable water source for their livestock[1]. Wells in the Oshana Etaka bed should be reconstructed to draw on the local groundwater resource.

Significance with mitigation: **MODERATE** positive

Reasons: Implementation of mitigation should make water more accessible to livestock herds, living close to the dam. However it will not impact on movement patterns of livestock as much as the availability of grazing will.

7.2.12. Impacts on fishing

The fishing potential in Olushandja dam might increase if the water level is changed.

Interested and affected parties: Fishermen, locals who catch fish for personal consumption and nature conservation.

Management Scenario One: Keeping the dam at 30% capacity

Discussion of impacts: Managed at 30% capacity, the dam provides a permanent fish resource for locals living in the vicinity of the dam. Most of the people who utilise this resource live adjacent to the dam, although some respondents living in zones B and C indicated that they travel to the dam to fish. A few fishermen have initiated small informal businesses, selling their catches to *cuca* shops and individuals.

When questioned about fishing, the fishermen and many of the people living next to the dam indicated that they were afraid of the people from the Department of Nature Conservation, as they had been trying to impose fishing regulations as part of a program to reduce poaching of wildlife. During the community meeting (BLR), one of the three groups who identified fishing as an issue, indicated that were reluctant to fish because of warnings issued by nature conservation. One of the other groups were hesitant to answer fishing related questions, until they were assured that the masters group were not from nature conservation. A group of Epalela fishermen and a number of households interview respondents involved in fishing indicated that in 1994 a meeting at Epalela was organised through the headmen (BLR). At this meeting people were asked how they fish, and were told that they would need to obtain permits if they wished to fish with nets. They were also informed that the mesh size of nets as well as the number of people permitted to fish in the dam would be controlled. Permits have not yet been issued and other regulations have not yet been enforced. This is probably due to the fact that the policy regulating fishing has not yet been drawn up by the department of fisheries. Because the study team were unable to get in touch with the Department of Nature Conservation, they were unable to determine whether the meeting at Epalela was organized by themselves or by the Department of Fisheries. The social study team were therefore also unable to find out from Nature conservation why and to what extent they were patrolling the dam, and who is responsible for managing the fish resource in the dam.

The locals are aware that the fish resource needs to be managed, but are currently very anti Nature Conservation. When questioned on the issue of permits, one angolan fisherman thought that a permit would legally allow him to catch and sell fish, while another thought that although the idea was a good one, permits would not work because people would continue to fish at night and "steal" fish (BLR). The Epalela group felt that control of fishing would ensure bigger fishes in the catch and would also ensue a more sustainable supply. Those who already fished with "castenela" nets or homemade "uwanda" nets with big holes were not adverse too the control of mesh size, but those who use mosquito nets to catch small fish were not animate about the idea. The problem is that "castenela" nets are very expensive - up to N$500, and very few people can afford these nets. (This is the maximum price that people can be expected to pay for a property, which gives an indication of how inflated the price of nets are).

When questioned about the issue of control, the angolan fisherman who was interviewed indicated that the regional councillor should be responsible for giving out permits (BLR). The other fisherman and the Epalela group indicated that the headmen should get the together and that they should democratically elect people to be responsible for fishing control. The Epalela group felt that the headman and not nature conservation should be responsible for telling the elected group how the dam should be controlled as the people respected the headman.

According to the Ministry of Fisheries and Marine resources, a management plan for the fish resource in Olushandja dam will be drawn up, but currently there is no existing policy on how the fish resource should be utilised. The study team were unable to contact Nature Conservation to determine what their current and future policies for Olushandja dam are. However according to Hay and van Zyl (1995), the present fish diversity in the dam has a positive impact on the region as it is currently generating economic and nutritional benefits for a many people. It has the potential to continue doing so in the long term if the resource is managed with the needs of both fish conservation and the community in mind.

Significance without mitigation: **MAJOR** positive

Reasons: The occurrence of fish in Olushandja dam, provides long and short term economic and nutritional benefits for the community. If management of the dam is kept at 30%, the potential to fish will continue to benefit people in the long term.

Optimisation:

- The Department of Nature Conservation must draw up a management plan for the conservation of the fish resource *in consultation with* the local I&APs.

- The Department of Nature Conservation should organise educational workshops to inform the people of alternative fishing methods, best times to fish etc. This will teach them to conserve the fish resource while utilising it.
- According to Hay and van Zyl (1995), drag nets should be disallowed as they are very effective fishing tools and could enhance the possibility of over utilising the fish resource. They also increase turbidity levels in the dam, which impacts negatively on the fish, by threatening their food resources. This impacts on the long term sustainability of the fish resource.
- Try and identify new markets where fish could be sold and explore means of getting the produce to these markets. This should encourage more people to become involved in fishing businesses.

Significance with mitigation: **MAJOR** positive

Reasons: Optimisation will result in more efficient utilisation of the fishing resource and will ensure that this impact remains beneficial in both the long and short term.

Management Scenario Two: Keeping the dam full

Discussion of impacts: As in *Management Scenario One.* However the potential to expand on the current utilisation of fish in Olushandja dam is increased when the dam is at maximum capacity, as the potential stocking density is also increased. An increase in fish density is possible because of the large increase in the surface area of this shallow dam. According to Hay and van Zyl (1995) and Roberts (1995), filling the dam will result in an initial increase in the fish population for about two years, after which populations will start to decrease. In the short term therefore, filling the dam would provide a surplus fish resource for people to exploit, but if the resource was to be maintained in the long term it would be very important to explain this phenomenon to the locals and to ensure that fishing practices were adapted once the fish population started to decrease.

Significance without mitigation: **MODERATE** positive to **MAJOR** positive

Reasons: A diverse and exploitable fish resource will exists in Olushandja dam if the dam is filled, but if careful management of the resource is not implemented, it might only have positive short term benefits for people utilising the resource.

Management Scenario Three: Fluctuating the level of the dam

Discussion of impacts: With a fluctuating dam level, the potential for fishing will still exist, but the number of fish which could be supported in the dam might be affected if the volume of water in the dam fluctuated extensively and on a regular basis. According to Roberts (1995), the reason that Olushandja dam has such an array of aquatic habitats is because stable water levels in the past have allowed aquatic plant communities to establish themselves. If the dam fluctuated more than 40cm, in the short term, concentrations of fish, stranding of aquatic fauna and flora and exposure of sediments will occur. This will result in increased fish mortality, reduced productivity, increased turbidity and a decrease in water quality. In the long term, exposed, rooted aquatic plants will die, exposed sediments will dry up and productivity and biodiversity will decrease substantially. This will result in long tem decrease in ecological stability which will impact directly on the survival of the fish resource.

Significance without mitigation: MAJOR negative.

Reasons: Fluctuating water level in the dam would remove the stable conditions which resulted in the aquatic habitats developing. Removal of these habitats will result in decreased biotic productivity, which will decrease the number of fish which can be supported in the dam.

Mitigation: Fluctuations should be small (less than 40cm (Roberts, 1995)) so as to minimise their impact on the environment. According to Hay and van Zyl (1995), fluctuations should not occur during the fish breeding season (August) in order to optimise and increase fish production.

Significance with mitigation: **MINOR** positive

Reasons: There will always be the threat that extensive fluctuations might have to be enforced, and this could affect the aquatic habitats in the dam.

Management Scenario Four: No dam option

Discussion of impacts: If the dam is decommissioned, the permanent fishing resource located in the dam will be lost. Fish will still be able to be caught when the *efundjas* bring them down from Angola, but this resource is limited in comparison to the fishing potential created by Olushandja dam. An advantage for removing the dam is that communities living south of the Olushandja dam will again be able to benefit from the fish carried down the Oshana Etaka

during flooding.

Significance without mitigation: MAJOR negative

Reasons: Removal of a resource which has large economic potential, both locally and regionally in the short and long term.

Mitigation: No mitigation possible.

7.2.13. Impact on intrinsic value

The presence of the dam in north western Omusati has positive intrinsic value for the people living in the study area.

Interested and affected parties: People living in the study area.

Management Scenario One: Keeping the dam at 30% capacity

Discussion of impacts: When questioned on their perceptions of the dam, all 80 respondents interviewed expressed that they were glad the dam exists (BLR). A variety of reasons were given. Some people indicated that it was good to have a permanent source of water for themselves and their cattle. Others were glad that they were no longer obliged to walk as far as they had to in the past to collect water, while others indicated that the presence of the dam rendered it unnecessary to dig had dug wells and *omifimas*. Some indicated that the dam is a good source of fish as it contains more fish than the Oshana Etaka used to.

More importantly those people living within the study area, but too far away from the dam to utilise it on a regular basis, indicated that they were still pleased that it existed as it was beneficial for the people living close to the dam. They also felt good, knowing that there was a permanent water source for them to utilise in times of drought.

Significance without mitigation: MAJOR positive

Reasons: Managing the current water at 30% capacity increases well being of people in the study area.

Optimisation: Ensure that dam is always available for the community to use if they need it.

Significance with optimisation: **MAJOR** positive

Reasons: Optimisation ensures that the sense of well being created by the dam will prevail.

Management Scenario Two: Keeping the dam full

As in *Management Scenario One.*

Management Scenario Three: Fluctuating the level of the dam

As in *Management Scenario One.*

Management Scenario Four: No dam option

Discussion of impacts: Decommissioning of the dam would remove the sense of security that people associate with the permanent water in the dam.

Significance without mitigation: MAJOR negative

Reasons: Removing the dam would affects public security.

Mitigation:

- Provide a pipeline to compensate for the lost use values which people utilising the dam would have forfeited[1].
- Help the community to rebuild hand dug wells in the Oshana Etaka.
- There is no mitigation possible for people who only depend on the dam in times of drought.

Significance with mitigation: **MODERATE** negative

Reasons: The intrinsic existence value which the dam has could not be compensated for. Removal of the dam represents an irreversible loss to people in the study area.

7.2.14. Impact on current land use

Changing the water level in the dam could result in inundation of land currently used for subsistence farming and grazing.

Interested and affected parties: Locals living adjacent to the dam, DWA.

Management Scenario One: Keeping the dam at 30% capacity

No impact.

Management Scenario Two: Keeping the dam full

Discussion of impacts: Land adjacent to the dam is currently used for two purposes. People cultivate subsistence crops in cleared fields and construct their *egumbos* within their properties. The *eputa* i.e. uncultivated communal land surrounding the homesteads is used by the whole community for grazing of livestock and the exploitation of natural resources such as wood.

When full, the dam will occupy an area of 2660ha (Lund, 1992). Currently, the dam only occupies 1380ha (Lund, 1992), i.e 1280ha of communal and cultivated land would be inundated if the dam was filled. Loss of the communal land not only represents a loss in grazing, but a loss in potentially arable land for future cultivation. Despite the fact that the area which would be inundated is overgrazed and basically denuded of wood, compensation for opportunities lost to future generations would have to be included in the equation. Inundation therefore carries both opportunity and current land use value costs. Unfortunately a compensation policy does not exist in Namibia. The DWA has had to compensate rural communities in the past, when a pipeline or canal has dissected a property, but compensation for resources lost in communal areas has never been addressed.

Significance without mitigation: MAJOR negative

Reasons:

- Opportunity and current land use value costs are associated with the inundation of land currently being used for farming and grazing.
- A compensation policy does not exist in Namibia.

Mitigation: The DWA must compensate for losses associated with altering the current land use. This must be done in consultation with local I&APs. The approach adopted should be

documented to provide guidelines for future compensation situations and hopefully for the compilation of a compensation policy. Compensation must include current land use values, values for opportunities forfeited, for lost resources and values for lost income in the short term.

Significance with mitigation: **MINOR** positive

Reasons:

- How the issue of compensation is addressed in this project could set a precedent for future actions of this nature.
- If compensation is comprehensive, people currently utilising the land around the dam should not be disadvantaged as a result of inundation.
- Long term opportunity costs cannot be mitigated for.
- Filling the dam would not alter the current land use of the greater study area.

Management Scenario Three: Fluctuating the level of the dam

Discussion of impacts: As in *Management Scenario Two.*

Significance without mitigation: As in *Management Scenario Two.*

Management Scenario Four: No dam option

No impact.

7.2.15. Impacts related to biophysical aspects.

If the water level in Olushandja dam is increased the surface to volume ratio of the dam will increase. This will cause the rate of evaporation from the dam to increase. The capacity at which the dam is managed will therefore impact on the rate of evaporation in Olushandja dam .

Interested and affected parties: DWA and SWAWEK.

Management Scenario One: Keeping the dam at 30% capacity.

Discussion of impacts: Because the Olushandja dam is very shallow (maximum depth of 3.5m), it has a large surface to volume ratio, and is consequently susceptible to high evaporation rates.

The evaporation rate for a body of water is about 1.7m per anum (Lund 1992), therefore if the dam is not actively refilled, it would very quickly dry up. Managed at 30%, evaporation is not a major impact for this is the capacity at which evaporation, input and output are balanced (Haussler, 1995). this is the reason that the dam has been managed at this volume for the last 20 years.

Significance without mitigation: **MODERATE** negative

Reasons: Evaporation of water represents an irretrievable loss a scarce resource. However managing the dam at 30% capacity attempts to minimise evaporation.

Mitigation: Mitigation already in place.

Significance with mitigation: **MODERATE** negative

Reasons: Evaporation will be an issue as long as the dam exists.

Management Scenario Two: Keeping the dam full

Discussion of impacts: To manage the dam at capacity DWA, would have to pump water from the Cunene into the dam continually, to compensate for the large volumes evaporated. This would not only be expensive for the DWA, but would result in the continued irretrievable loss of a scarce resource to evaporation. As far as SWAWEK is concerned the volumes of Cunene water lost to evaporation cannot be justified. SWAWEK have a vested interest in the water in the Cunene. Their concern is that the water which is being lost from Olushandja dam could be used for hydroelectric power (Brand, pers comms, 1995). SWAWEK consider a full dam scenario to be the worst of all the alternatives management plans for the dam. DWA acknowledge that allowing such high level of evaporation is unsound management of valuable water, but in their eyes the need to have a storage reservoir on the Namibian side of the border outweighs the economic and environmental costs associated with evaporation.

Significance without mitigation: **MAJOR** negative

Reasons:

- High rates of evaporation associated with a full dam management scenario will result in the irretrievable loss of precious water.

- It is expensive for DWA to maintain the dam at capacity.

Mitigation: No mitigation possible

Significance with mitigation: **MAJOR** negative

Management Scenario Three: Fluctuating the level of the dam

Discussion of impacts: As in *Management Scenario Two.*

Significance without mitigation: MAJOR negative to **MODERATE** negative

Reasons: The volumes of water being lost to evaporation will vary depending on the water level of the dam. The impact of evaporation will therefore vary depending on the fluctuating management plan adopted by the DWA.

Mitigation: Adopt a fluctuating management plan which aims to minimise evaporation, but optimise water surety. For example, water should not be pumped into the dam during those times of the year when evaporation rates are at their highest.

Significance with mitigation: **MODERATE** negative

Reasons: Evaporation will still result in the loss of large volumes of valuable water, yet mitigation will result in the impact being reduced.

Management Scenario Four: No dam option

Discussion of impacts: According to SWAWEK, this is the preferred management alternative as it would stop what is in their eyes unnecessary evaporation of water from the Cunene (Brand, pers comms, 1995). Decommissioning the dam would reduce the costs which incur as a result of high rate of evaporation.

Significance without mitigation: **MAJOR** positive.

Reasons: High water losses to evaporation will cease.

Mitigation: Not needed

7.2.16. Cumulative impacts

- **Impacts relating to sedimentation and sanitisation**

Changing the water level in the Olushandja dam could alter sediment of salinity concentrations in the dam. These changes could result in reduced water quality or compromised the efficiency of the dam to store water. These negative impacts are cumulative, for they could have affect local communities utilising the dam for drinking and fishing purposes.

Interested and affected parties: Locals using the dam, DWA

Discussion of impacts: If changing the water levels in the dam affects salinity in the dam, it could have an effect on the biodiversity in the dam. This could affect the fishing potential of the dam. Increased salinity levels could also affect the quality of the water for drinking (both people and livestock). It might also have an impact on the local ground water. It is unknown what impact salinity will have on these factor. In his limnological study of Olushandja dam, Roberts (1995) mentions salinity briefly. He indicates that the high rates of evaporation associated with the dam causes salinity to increase throughout the length of the dam, while injection of water into the dam dilutes salinity concentrations, particularly in the northern part of the dam.

Changes in sediment levels could alter turbidity levels in the dam. This could affect the ecology of the dam, which in term could affect the survival of certain fish species in the Olushandja dam (Hay and van Zyl, 1995). Sedimentation could also alter the retention capacity of the dam. This could impact on the level of water surety which the dam could effectively provide.

Unfortunately, extensive work has not been done on these issues. It is therefore impossible to gauge what effect the varying water levels might have on these impacts in either the long or short term. It is important that the potential effects of these impacts are investigated for the four alternative management scenarios, before their possible cumulative impacts on social factors are considered.

- **Impacts relating to aquatic ecosystems**

Changing the water level in the Olushandja dam could have a negative effect on aquatic biodiversity, as it could threaten the survival of the aquatic vegetation. Plants form the base of the ecological pyramid, and loss of the lowest trophic levels in the ecosystem directly affects the survival of species occupying higher trophic levels. This could have a cumulative effect on the people utilising the dam as all of the potential job opportunities identified depend on the natural resources in the dam.

Interested and affected parties: Nature conservation, locals reliant on the natural resources in the dam.

Management Scenario One: Keeping the dam at 30% capacity

Discussion of impacts: In the last twenty years, the stable environment created from managing the dam at 30%, has allowed a number of plant species to establish. This has resulted in a variety of aquatic habitats developing in the dam, each with its own floral and faunal make up. Roberts (1995) identified four distinct habitats. The first, "standing tree trunks", is characterised by submerged dead trees, inhabited by algae and invertebrates below water level and by nesting and fish-hunting birds above water level. The second habitat, "Littoral aquatic macrophytes", refers to rooted aquatic plants which have established themselves around the northern half of the dam in water less than 30cm deep. A wide range of microhabitats occur and detritus covered by algae, epiphytes and zooplankton are found. A limited amount of zooplankton was evident and can probably be attributed to the high predation rates from fish fingerlings, insect larvae and snails (Roberts 1995). Numerous birds are associated with this habitat. The third, "reed islands", refers to three different types of islands made up of reeds (*Phragmites mauritianus*), rushes *Typha capensis* or sedges. The islands originated from termite mounds or material which was excavated in the past. These islands are inhabited by birds. The last habitat is found in the southern part of the dam, where in water less than 60cm deep, dense growths of oxygen weed (*Lagarosiphon ilicifolius*) flourish. This is an impoverished habitat in terms of species diversity, as intense photosynthesis by these plants results in depleted concentrations of CO_2 around the leaves, and localised alteration in pH levels.

The variety of habitats with their associated biodiversity helps to maintain the 41 fish species in Olushandja dam. Man is the top predator in the food chain. Whether he realises it or not, his survival depends on the vigour of the whole chain. Consequently if any of the links are threatened so too will he be. The fishing potential of the dam is directly linked therefore to the

health of the dam ecosystem . If the dam is to be managed at 30%, the stable environment should be maintained, and the aquatic habitats should not threatened.

Significance without mitigation: **MAJOR** positive.

Reasons: Aquatic habitats not threatened by inundation, productive ecosystem results in a healthy fish population.

Optimisation:

- Adopt a management policy for the dam to ensure that the aquatic habitats are not destroyed by overtrampling, increased turbidity levels from wading in the dam or from dragging nets, etc.
- The management plan must be developed in consultation with locals.
- Locals should be taught about the interrelationship between a sustained fish resource and the health of the dam ecosystem. They should also be taught how to contribute towards conservation of resources in the dam.

Significance with mitigation: **MAJOR** positive.

Management Scenario Two: Keeping the dam full

Discussion of impacts: Filling the dam has the potential to destroy the aquatic habitats described in *Management Scenario One.* The littoral communities will be swamped, and most of the reed islands will be flooded, as will the single large acacia covered island on the eastern edge of the dam. However according to Roberts (1995), if the dam is filled slowly, i.e. over a year or more, the littoral communities should re-establish easily. Roberts suggests that the reed islands are important habitats for wetland fauna and that mitigation can be implemented to prevent the islands form being lost. He advocates that mounds should be bulldozed to create new islands at the higher water level.

Significance without mitigation: **MODERATE** negative

Reasons:

- Filling the dam will result in short term reduction in species diversity (0-6 months).
- After 1-2 years, the diversity should increase as aquatic vegetation recovers.

Mitigation:

- Fill the dam slowly to minimize loss of littoral habitats.
- Build new mounds on which reed island can be established. In implementing this recommendation however, one would have to be extremely careful that the excavated trench should not penetrate the lens of ground water located below the Oshana Etaka bed. this would ensure that local ground water is not contaminated.
- Design a management plan for Olushandja dam to ensure that once the vegetation starts to recover and the diversity, productivity and ecological stability of the system starts to increase, that it is not threatened by over exploitation and over trampling.

significance with mitigation: **MAJOR** positive

Reasons:

- The integrity of aquatic ecosystems are important to the survival of fish in the dam and will not be jeopardised, in either the long or short term if mitigation is implemented.

Management Scenario Three: Fluctuating the level of the dam

Discussion of impacts: Fluctuating the volume of the dam will have a negative impact on the aquatic habitats in the dam, as these habitats required a stable environment to in which develop. If the water level is changed continually (every year for example), an unstable environment would be created. This would have a long term effect on the survival of aquatic habitats especially the littoral habitat. The reason is that if exposed for extended periods of time i.e. more that six months (Roberts, 1995), the aquatic vegetation will die, would be unable to re-establish populations in the dam because of the unstable nature environment.

Significance without mitigation: **MAJOR** negative

Reasons:

- Fluctuating the water level of the dam will have a long term effect on the survival of aquatic habitats, which will impact directly on the productivity of the food web. This in turn will impact on the fish populations and directly affect local and regional communities dependant on fish for income or protein.

Mitigation: No mitigation possible, except to limit fluctuations as much as possible.

Significance with mitigation: **MAJOR** negative

Management Scenario Four: No dam option

Discussion of impacts: The Olushandja dam is the only permanent water body west of the Okavongo system. The variety of habitats support a large biodiversity ranging from algae to wetland birds. Whether the dam should be considered of conservation value for this reason is debatable. On the one hand construction of a man made reservoir destroyed an *oshana* ecosystem, so even if it is unique, it is artificial and the species occurring in the dam are exotic. On the other hand the dam has been in existence for twenty years, during which time a marvellous array of species have established themselves. If the dam was removed the wetland biodiversity associated with this dam would be lost. Because the study team could not get hold of the Department of Nature Conservation, it was impossible to establish their opinion on the value of the dam for conservation of the dam.

As far as the local communities, dependant on the biodiversity in the dam are concerned, removal of the dam would represent an immediate loss in term of forfeited fishing opportunity. It would also result in long term loss, as the potential to harvest fresh water molluscs and aquatic rice, as well as the potential to derive other benefits from the biodiversity in the dam eg tourism would be lost. Both current economic and nutritional costs, as well as opportunity costs are therefore associated with the no dam scenario.

Significance without mitigation: MAJOR negative

Reasons:

- Immediate and long term loss of biodiversity and loss of exploitable natural resources are associated with the no dam option.
- Removal of the dam will have a cumulative impact on both the local and regional economy.

Mitigation: No mitigation possible.

Table 4. Summary of social impact analysis.

IMPACTS AFFECTING THE SOCIO-ECONOMIC ENVIRONMENT	SCENARIO ONE	SCENARIO TWO	SCENARIO THREE	SCENARIO FOUR
Demographic aspects The level at which the water in Olushandja dam is managed could have an effect on the location of families living around the edge of the dam, as in two of the four scenarios, inundation of properties will occur, as a result of flooding. If people presently living next to the dam have to relocate, as a consequence of flooding, this could alter the distribution pattern settlements in the surrounding area.	*Without mitigation:* **MINOR** negative *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	No impact
Economic aspects ♦ Impact on local job opportunities The management of the water level in Olushandja dam could impact on the existence and creation of job opportunities for people living in close proximity to the dam.	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative to **MODERATE** positive *With mitigation:* **MODERATE** positive	*Without mitigation:* **MAJOR** negative *With mitigation:* **MAJOR** negative
♦ Increased competition from non-locals The level at which the water in Olushandja dam is managed could result in increased competition for employment opportunities through non-locals moving into the area.	*Without mitigation:* **MINOR** negative *With mitigation:* **MINOR** positive	*Without mitigation:* **MINOR** negative *With mitigation:* **MINOR** positive	*Without mitigation:* **MINOR** negative *With mitigation:* **MINOR** positive	No impact
♦ Enhancement of regional self sufficiency The level at which the Olushandja dam is managed could contribute towards potential economic development and provision of long term job opportunities in the vicinity of the dam. This in turn could contribute towards the enhancement of regional self sufficiency.	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative to **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative *With mitigation:* **MAJOR** negative
Impacts related to health issues The incidence of water related diseases such as bilharzia, malaria and diarrhoea will continue or increase with varying water levels in Olushandja dam. This will impact negatively on public health.	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	*Without mitigation:* **MODERATE** negative to **MAJOR** negative *With mitigation:* **MODERATE** negative	*Without mitigation:* **MODERATE** positive *With mitigation:* **MODERATE** positive

IMPACTS AFFECTING THE SOCIO-ECONOMIC ENVIRONMENT	SCENARIO ONE	SCENARIO TWO	SCENARIO THREE	SCENARIO FOUR
Impact on water and land rights If the DWA or Water Utility Company decided to expropriate land around the Olushandja dam, rural people who are accustomed to free access to natural resources such as water and land might find that they have no legal rights to the water in the Olushandja dam or to the communal land surrounding the dam, albeit their properties are located on this land.	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	No impact
Impact on groundwater Changing the water level of the Olushandja dam could impact the local ground water, by altering the rate of recharge of underground aquifers, changing the salinity of the ground water or contaminating the ground water.	*Without mitigation:* **MAJOR** negative *With mitigation:* Unknown	*Without mitigation:* **MAJOR** negative *With mitigation:* Unknown	*Without mitigation:* **MAJOR** negative *With mitigation:* Unknown	*Without mitigation:* **MAJOR** negative *With mitigation:* Unknown
Impact on the transport networks ♦ Inundation of roads Changing the water level in Olushandja dam could impact negatively on the existing road system in the study area, as sections of the roads running down the east and west sides of the dam might be inundated by water from the dam.	No impact	No impact	No impact	No impact
♦ Restriction of human movement patterns The level of the water in Olushandja dam could affect the movement patterns of people living in the study area, as the dam acts as an obstacle for people travelling from the western side of the dam to the eastern side.	*Without mitigation:* **MAJOR** negative *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative *With mitigation:* **MAJOR** positive	*Without mitigation:* **MODERATE** negative *With mitigation:* **MAJOR** positive
Impact on local infrastructure The existence of water borne diseases and poor water quality in Olushandja dam and the canals result in a high degree of illness in people dependant on the dam or canals for their water requirements. This results in local health services being heavily utilised by people with water related sicknesses. Changing the water level in Olushandja dam could affect the incidence of disease which in turn could impact on the existing health facilities in the area.	*Without mitigation:* **MODERATE** negative *With mitigation:* **MINOR** negative	*Without mitigation:* **MODERATE** negative *With mitigation:* **MINOR** negative	*Without mitigation:* **MODERATE** negative *With mitigation:* **MINOR** negative	*Without mitigation:* **MAJOR** positive
Impact on water surety The duration for which water from Olushandja dam can be provided to regional consumers on the water network is directly linked to the volume of water reserved in the dam. The capacity at which the dam is managed will therefore impact directly on the length of time that DWA could provide bulk and rural network consumers with water in the advent of water from Calueque being discontinued.	*Without mitigation:* **MODERATE** positive	*Without mitigation:* **MAJOR** positive	*Without mitigation:* **MODERATE** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative

IMPACTS AFFECTING THE SOCIO-ECONOMIC ENVIRONMENT	SCENARIO ONE	SCENARIO TWO	SCENARIO THREE	SCENARIO FOUR
Impact on the daily routine Changing the water level in Olushandja dam could alter the daily, water routines of people living less than three kilometres from the dam.	No impact	*Without mitigation:* **MINOR** negative	*Without mitigation:* **MINOR** negative	*Without mitigation:* **MODERATE** negative *With mitigation:* **MINOR** negative
Impact on Agriculture Changing the water level at which the Olushandja dam is managed could alter potential for people living adjacent to dam to utilise the water for irrigation.	*Without mitigation:* **MODERATE** positive *With mitigation:* **MODERATE** positive	*Without mitigation:* **MODERATE** positive *With mitigation:* **MODERATE** positive	*Without mitigation:* **MAJOR** negative to **MODERATE** positive *With mitigation:* **MODERATE** positive	*Without mitigation:* **MAJOR** negative
Impacts affecting livestock ♦ Increased incidence of livestock disease Changing the water level in Olushandja dam could result in an increased incidence of water-borne, livestock diseases in the dam.	*Without mitigation:* **MINOR** negative *With mitigation:* **MINOR** negative	*Without mitigation:* **MINOR** negative *With mitigation:* **MINOR** negative	*Without mitigation:* **MINOR** negative *With mitigation:* **MINOR** negative	No impact
♦ Changes in livestock movement patterns Changing the water level in the Olushandja dam might change the movement patterns of livestock, to the dam.	No impact	*Without mitigation:* **MINOR** negative to **MINOR** positive	*Without mitigation:* **MINOR** negative to **MINOR** positive	*Without mitigation:* **MODERATE** negative *With mitigation:* **MODERATE** positive
Impact on fishing The fishing potential in Olushandja dam might increase if the water level is changed.	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MODERATE** positive to **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative *With mitigation:* **MINOR** positive	*Without mitigation:* **MAJOR** negative
Impact on intrinsic value The presence of the dam in north western Omusati has positive intrinsic value for the people living in the study area.	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative
Impact on current land use Changing the water level in the dam could result in inundation of land currently used for subsistence farming and grazing.	No impact	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	No impact

IMPACTS AFFECTING THE SOCIO-ECONOMIC ENVIRONMENT	SCENARIO ONE	SCENARIO TWO	SCENARIO THREE	SCENARIO FOUR
Impacts relating to biophysical aspects. If the water level in Olushandja dam is increased the surface to volume ratio of the dam will increase. This will cause the rate of evaporation from the dam to increase. The capacity at which the dam is managed will therefore impact on the rate of evaporation in Olushandja dam .	*Without mitigation:* **MODERATE** negative	*Without mitigation:* **MAJOR** negative	*Without mitigation:* **MAJOR** negative to **MODERATE** negative *With mitigation:* **MODERATE** negative	*Without mitigation:* **MAJOR** positive
Cumulative impacts ♦ Impacts relating to sedimentation and salinisation Changing the water level in the Olushandja dam could alter sediment of salinity concentrations in the dam. These changes could result in reduced water quality or compromised the efficiency of the dam to store water. These negative impacts are cumulative, for they could have affect local communities utilising the dam for drinking and fishing purposes.	Unknown	Unknown	Unknown	Unknown
♦ Impacts relating to aquatic ecosystems Changing the water level in the Olushandja dam could have a negative effect on aquatic biodiversity, as it could threaten the survival of the aquatic vegetation. Plants form the base of the ecological pyramid, and loss of the lowest trophic levels in the ecosystem directly affects the survival of species occupying higher trophic levels. This could have a cumulative effect on the people utilising the dam as all of the potential job opportunities identified depend on the natural resources in the dam.	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MODERATE** negative *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative *With mitigation:* **MAJOR** negative	*Without mitigation:* **MAJOR** negative.

INTERESTED AND AFFECTED PARTIES	IMPACTS AFFECTING THE SOCIO-ECONOMIC ENVIRONMENT	SCENARIO ONE	SCENARIO TWO	SCENARIO THREE	SCENARIO FOUR
People living in the study area	**Demographic aspects** The level at which the water in Olushandja dam is managed could have an effect on the location of families living around the edge of the dam, as in two of the four scenarios, inundation of properties will occur, as a result of flooding. If people presently living next to the dam have to relocate, as a consequence of flooding, this could alter the distribution pattern settlements in the surrounding area.	*Without mitigation:* **MINOR** negative *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	No impact
People living less than 2kms from the dam	**Economic aspects** ♦ Impact on local job opportunities The management of the water level in Olushandja dam could impact on the existence and creation of job opportunities for people living in close proximity to the dam.	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative to **MODERATE** positive *With mitigation:* **MODERATE** positive	*Without mitigation:* **MAJOR** negative *With mitigation:* **MAJOR** negative
People living in the Omusati region	♦ Enhancement of regional self sufficiency The level at which the Olushandja dam is managed could contribute towards potential economic development and provision of long term job opportunities in the vicinity of the dam. This in turn could contribute towards the enhancement of regional self sufficiency.	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative to **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative *With mitigation:* **MAJOR** negative
People utilising the dam for their water requirements, fishermen, others living less than 2kms from the dam	**Impacts related to health issues** The incidence of water related diseases such as bilharzia, malaria and diarrhoea will continue or increase with varying water levels in Olushandja dam. This will impact negatively on public health.	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	*Without mitigation:* **MODERATE** negative to **MAJOR** negative *With mitigation:* **MODERATE** negative	*Without mitigation:* **MODERATE** positive *With mitigation:* **MODERATE** positive
Locals living below the 1007.5m contour, the DWA	**Impact on water and land rights** If the DWA or Water Utility Company decided to expropriate land around the Olushandja dam, rural people who are accustomed to free access to natural resources such as water and land might find that they have no legal rights to the water in the Olushandja dam or to the communal land surrounding the dam, albeit their properties are located on this land.	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	No impact
People living in the vicinity of the dam, and bulk water network users, Etunda and DWA.	**Impact on water surety** The duration for which water from Olushandja dam can be provided to regional consumers on the water network is directly linked to the volume of water reserved in the dam. The capacity at which the dam is managed will therefore impact directly on the length of time that DWA could provide bulk and rural network consumers with water in the advent of water from Calueque being discontinued.	*Without mitigation:* **MODERATE** positive	*Without mitigation:* **MAJOR** positive	*Without mitigation:* **MODERATE** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative
People living on the banks of the Olushandja dam	**Impact on Agriculture** Changing the water level at which the Olushandja dam is managed could alter potential for people living adjacent to dam to use the water for irrigation.	*Without mitigation:* **MODERATE** positive *With mitigation:* **MODERATE** positive	*Without mitigation:* **MODERATE** positive *With mitigation:* **MODERATE** positive	*Without mitigation:* **MAJOR** negative to **MODERATE** positive *With mitigation:* **MODERATE** positive	*Without mitigation:* **MAJOR** negative
Fishermen, locals fish for personal consumption and nature conservation.	**Impact on fishing** The fishing potential in Olushandja dam might increase if the water level is changed.	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MINOR** positive to **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative
People living in the study area	**Impact on intrinsic value** The presence of the dam in north western Omusati has positive intrinsic value for the people living in the study area.	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative
People living below the 1006m, DWA.	**Impact on current land use** Changing the water level in the dam could result in inundation of land currently used for subsistence farming and grazing.	No impact	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	*Without mitigation:* **MAJOR** negative *With mitigation:* **MODERATE** negative	No impact
DWA and SWAWEK.	**Impacts relating to biophysical aspects.** If the water level in Olushandja dam is increased the surface to volume ratio of the dam will increase. This will cause the rate of evaporation from the dam to increase. The capacity at which the dam is managed will therefore impact on the rate of evaporation in Olushandja dam .	*Without mitigation:* **MODERATE** negative	*Without mitigation:* **MAJOR** negative	*Without mitigation:* **MAJOR** negative to **MODERATE** negative *With mitigation:* **MODERATE** negative	*Without mitigation:* **MAJOR** positive
Nature conservation, locals reliant on natural resources in the dam.	**Cumulative impacts** Changing the water level in the Olushandja dam could have a negative effect on aquatic biodiversity, as it could threaten the survival of the aquatic vegetation. Plants form the base of the ecological pyramid, and loss of the lowest trophic levels in the ecosystem directly affects the survival of species occupying higher trophic levels. This could have a cumulative effect on the people utilising the dam as all of the potential job opportunities identified depend on the natural resources in the dam.	*Without mitigation:* **MAJOR** positive *With mitigation:* **MAJOR** positive	*Without mitigation:* **MODERATE** negative *With mitigation:* **MAJOR** positive	*Without mitigation:* **MAJOR** negative *With mitigation:* **MAJOR** negative	*Without mitigation:* **MAJOR** negative

Table 5. Decision making framework. Red shading refers to major negative impacts and yellow shading to major positive impacts (either with or without mitigation).

CHAPTER EIGHT: EVALUATION OF ALTERNATIVE MANAGEMENT SCENARIOS

8.1. INTRODUCTION

In chapter seven, the impacts of changing the water level in Olushandja dam on social factors were identified and analysed. The effect that each of the four management scenarios, identified in chapter six, might have on the social criteria was discussed. A decision-making framework (Table 5.) has been compiled from the summary of social impacts (Table 4) provided at the end of chapter seven. The decision-making framework does not contain any impacts which have been assigned minor, or moderate significance ratings. It also excludes those impacts which have the same significance rating for all of the management scenarios, even if the impact is major. The reason for this is to highlight the impacts on which the decision maker will have to focus in order to choose a preferred alternative management scenario. The evaluation will be based on this framework.

8.2. POSITIVE IMPACTS

An interesting result emerged with respect to the positive impacts associated with the upgrading project. Six, major, positive impacts are associated with each of the three dam scenarios. Five of these are common to all three scenarios (Table 5.). These results indicate that positive benefits are associated primarily with the presence of the dam, and not with the various management scenarios. This situation makes it possible therefore to evaluate the benefits of having a dam versus not having a dam.

8.2.1. Keeping Olushandja dam versus removing it

The common positive benefits associated with the keeping the dam are:

- Provision of job opportunities
- Enhancement of regional self sufficiency
- Water surety for bulk and rural network consumers
- Irrigation potential
- Intrinsic value.

In comparison, the no dam alternative offers only two benefits. These are:

- Reduced incidence of water related diseases
- Evaporation of Cunene water no longer a problem.

One has to be careful in simply adding up the benefits of the two scenarios and discarding the one with less as one cannot assume that all of the impacts accrue the same amount of benefits to the people affected, or even benefit the same affected groups. Because of this, it is necessary to perform trade-off analysis of benefits. Trade-off recognises that you are in fact comparing "apples and pears", but attempts to determine which impacts will be more beneficial to society by trying to evaluate impacts against a set of philosophies. The concepts of "equity, efficiency and sustainability" originally proposed by Strauth (1983), encapsulate the principles of IEM (Preston, unpublished). Equity addresses the distribution of benefits among people. For a development proposal to be considered equitable, the costs and benefits of the development should be divided equally amongst all affected groups and individuals. Efficiency deals with the extent to which a project minimises costs and maximises benefits, for individuals and society, and sustainability refers to the ability of a development project to meet the needs of the present generation without compromising the needs of future generations. If possible these concepts should be considered when comparing the dam option against the no dam option.

The dam provides the potential to strengthen the base of both the local and regional economy. When people start to emerge from the poverty cycle, problems such as disease start to decrease, as people have the means to start improving their standard of living. In an area lacking in development opportunities, the existence of Olushandja dam provides potential opportunity for people currently unemployed to become involved in a variety of income generating projects, such as fishing, market gardening and fish farming. This is considered to be extremely important to the socio-economic well being of communities in the Omusati region, particularly to those living close to the dam.

While high levels of evaporation represents a loss of valuable water for hydro-electric generation for SWAWEK and compensation for evaporative losses is costly for DWA, there is a need ensure that development of northern Namibia is not hampered by water shortages. Although limited in the duration that the reserve water in Olushandja dam would be able to physically provide the region with water, the dam does offer piece of mind to people relying on water being pumped from within the borders of another country and to DWA who are responsible for providing water to the people.

As far as equity is concerned, the overall benefits accrued by having a dam will be felt on a

local, regional (Omusati) and greater regional (Northern Namibia) scale, while overall, the benefits of the no dam alternative will only be experienced by SWAWEK. In terms of efficiency, the cost which DWA would incur by decommissioning Olushandja dam are considerably more expensive than the costs of managing the dam with water in it. There a also more benefits for society as a whole associated with keeping the dam. Finally, in social terms, the dam scenario is more sustainable that the no dam option, as the benefits arising from having the dam will meet the needs of local and regional communities in both the short and long term. Therefore, based on the concepts of equity, efficiency and sustainability, the author has identified that keeping the dam accrues more benefits to society than removing it.

8.2.2. Comparing management scenarios one, two and three

With respect to management scenario one, two and three, evaluation of the positive impacts boils down to a trade off between the issue of inundation and water surety.

In terms of equity, managing the dam at 30% will have a major positive impact on local communities and a moderate positive impact on regional communities, while keeping the dam full will have a major negative impact on local communities and a major positive benefit to regional communities. Adopting a fluctuating management plan will have a major negative impact on locals living close to the dam and will only have a moderate positive impact on regional network users. For this reason, it is felt that scenario one, will benefit local and regional water users more than either management scenario two or three. Managing the dam at 30% would also be more beneficial to SWAWEK and DWA as the cost associated with evaporation would be much less than in the other scenarios. It would probably be more beneficial to Nature Conservation too, as aquatic vegetation would not be in danger of becoming inundated. On the other hand a full or fluctuating dam would probably be more beneficial to Etunda than a 30% filled dam, as it would increase the likelihood of them being allocated water from the dam. Overall therefore managing the dam at 30% capacity distributes its benefits to more I&APs than the other two management scenarios.

Because five out of six of the positive impact are shared, there is very little difference amongst the scenarios as far as efficiency and sustainability is concerned. However managing the dam at 30% benefits over the other two with respect to the problem of inundation, as properties situated adjacent to the dam will not be affected if the water level is kept at 1004m. Relocation will then be unnecessary. In comparison, if the water level is raised to the 1006m contour or fluctuated between 1006m and 1003m, homes will be inundated, and people will be forced to move. On the question of water surety, scenario two i.e. keeping the dam at

capacity, meets the needs of I&APs more than the other two scenarios do. This is because a full dam will provide the maximum bulkwater reserve for the regional bulk and rural networks.

By managing the dam at 30%, the threat of relocation for between 24 to 94 homesteads vulnerable to inundation would be removed. Additionally, while scenario one only provides 30% water surety, managing the dam at this level will probably provide sufficient surety for DWA and regional consumers in the short and medium term, as at present water consumption is well below $6m^3/s$ (Haussler, pers comms,1995). Therefore, although scenario one is not as beneficial as scenario two with regards to water surety, it is not detrimental, whereas filling the dam or fluctuating it between full and dead storage level (1003m) will result in compulsory relocation of people as a result of inundation.

In summary then, managing the dam at 30% capacity will provide more benefits to more people in the short and long term than the other two scenarios.

8.3. NEGATIVE IMPACTS

Having rejected the no dam scenario on the grounds of limited positive benefits, and identified that scenario one is the best alternative, in terms of positive impacts, the next step is to identify the preferred management scenario for the dam in terms of the negative impacts.

Scenario one has only two negative decision-making impacts associated with it. These are:

- High incidence of water related diseases
- No legal protection for locals living below the 1007.5m contour and utilising the dam for water, with regards to land and water rights.

Both of these impacts are associated with the full and fluctuating water level scenarios.

Three additional negative impacts are common to scenarios two and three. These are:

- The need to relocate people
- The need to compensate people
- High evaporation rates.

Both relocation and compensation are impacts which will affect the locals living in the vicinity of Olushandja dam. High evaporation rates, affect SWAWEK and DWA. Therefore if scenario two or three is adopted, both local and regional costs can be expected. Because these costs are not associated with scenario one, and the positive impacts of managing the dam at 30%

capacity are considered more beneficial than those associated with a full or fluctuating management plan, it is suggested that the dam continue to be managed at 30% capacity.

CHAPTER NINE: RECOMMENDATIONS

9.1. INTRODUCTION

In this assessment the impacts on the socio-economic environment of the Olushandja dam were analysed according to four management scenarios. These scenarios were chosen in the light of the management plans which DWA might be expected to adopt once upgrading of the dam is complete. Twenty social variables are affected by the upgrading project. Major impacts are associated with eleven of the social variables for at least one of the scenarios. These major impacts, both positive and negative in nature, were identified as the important decision making criteria on which evaluation of the preferred scenario was based. The results of the evaluation indicate that in terms of social criteria, the dam should be managed at 30% capacity.

To ensure that groups affected by the upgrading project derive maximum benefit from keeping the dam level at 1004m (30% capacity), it is essential that optimisation of positive impacts occurs. Similarly mitigation of negative impacts must be implemented. The following recommendations are provided and address the issues associated with managing the dam at 30%. The recommendations have been divided into two categories, namely high priority and medium priority recommendations. High priority recommendations deal directly with the dam and should be implemented within the next two years. Medium priority recommendations are not necessarily less important. They incorporate mitigatory measures which are unlikely to be addressed in the short term because they involve improving basic facilities, a problem associated with the all of rural northern Namibia. Alternatively the recommendations require funding, and this might hinder short term implementation of these recommendations. The author suggests however, that if the benefits from the dam are to be maximised, that these recommendations be implemented within the next five to ten years.

It is important to note that should one of the other management scenarios be identified as the preferred alternative in the full environmental impact assessment, that the mitigation and optimisation measures identified for that management scenario, in the analysis of the social impacts (chapter seven), must be implemented. If this is not done, there will be no guarantee that social issues will be adequately addressed under the chosen management regime.

9.2. RECOMMENDATIONS

9.2.1. High priority recommendations

General

- Access to the section of dam around the inlet pipe at the north wall should be prevented, to improve the survival chances of the fish fingerlings and eggs entering the dam from the Calueque-Olushandja canal. This same area should be cleared of all vegetation to prevent snail hosts for water-borne diseases from settling. Opinions on the recommended size of this restricted area varies. To enhance fish survival Mr Hay recommends a 50m cut off point, while Ms Curtis recommends that vegetation should be cleared up to 500m from the inlet. At present, the area in the region of the north wall is used extensively by locals who might be against prohibiting access. The exact size of this area should therefore be determined in consultation with the Department of Fisheries and Marine resources, Curtis (1995), the Department of Health and the locals utilising the dam. Locals should be informed of the reasons behind prohibiting access to the area around the inlet pipe. Whether the area should be cordoned off (eg with a fence or net), or patrolled (by nature conservation or locals) should be determined in consultation with locals using the dam, DWA, and the Department of Nature Conservation.

Economic environment

- The presence of fish in Olushandja dam currently provide jobs for some locals. There is however the potential to exploit this resource further. The feasibility of increasing the number of fishermen, and or increasing the size of catches should be investigated. New markets for the sale of fish should also be identified and means of transporting the produce to these markets investigated.

- A long term management strategy for the protection of the resources in the dam, particularly the fish resource, should be developed in consultation with all I&APs. The strategy should also ensure that the utilisation of the resources in the dam are maximised and that locals wishing to utilise these resources derive the primary benefits accrued from these resources. Non-locals should be permitted to utilise the resources in the dam, but not to the detriment of locals.

- Implementation of the management policy, enforcement of regulations and patrolling of the dam should not be the sole function of nature conservation. The headmen should be actively involved, and locals who are democratically elected should become involved in conservation of the dam and its resources.

- An education programme should be set up to inform both the fishermen and locals of the need to protect the resource and ways that this can be achieved. The importance of conserving all components of the ecosystem must be emphasised.

- Drag nets should be disallowed as it is will increase turbidity in the dam. This will be detrimental to fish survival and will impact on long term sustainability of the resource.

Health

- Health education programmes similar to the one developed for malaria should be produced for bilharzia, diarrhoea and gastritis. The responsibility of health education should not lie only with the clinics, but should be taught at schools. The importance of boiling water should be continually reinforced, and people should be discouraged from bathing or washing their clothes in the dam.

- People should be encouraged not to collect water from the diseased and polluted, section of the dam, near the north wall.

- If incidence of water related disease is to decrease it is vital that the dependence of people using the dam for their water requirements be reduced. There are a number of ways that this can be done. Large drums could be provided to people dependant on the dam or canals for water. These drums could be used for boiling water. However because the shortage of wood is also a reason for people not boiling water, another suggestion is that the drums store dam water purified using chlorine pills. These pills should be made available at clinics and schools. Water collected from the dam should then be treated with the pills and allowed to stand for 48 hours.

- Manual control of bilharzia should be implemented in the dam. This includes eliminating vegetation along the margins of the dam in the area near the north wall, applying molluscicide to eliminate any remaining intermediate bilharzia hosts from the dam, and keeping the canals free of rooted vegetation.

- Fishermen should be tested and treated regularly. Waterproof gumboots should be made available for those people who spend a lot of time wading around in the dam.

- Inexpensive mosquito nets should be made readily available to the community.

Infrastructure

- Construct a foot bridge across the dam in the vicinity of Elao. The site of the bridge should be chosen in consultation with the locals living in the vicinity of the dam.

9.2.2. Medium priority recommendations

Economic environment

- The economic potential of the two edible molluscs (*Pila occidentalis* and *Etheria elliptica*) in the Olushandja dam should be investigated, with the specific intent of providing locals with jobs, and expanding the economic base of the area.

- The viability of initiating fish farms adjacent to the dam should be explored. The emphasis should be on ascertaining the attitudes of the locals and trying to get them involved in the initiative.

- The potential of developing more market gardens or getting locals involved in small scale vegetable growing in their own homesteads should be investigated. Cheap irrigation methods should also be researched.

- Identify and approach development agencies such as the Rural Development Centre (RDC) and the Northern Namibia Rural Development Programme (NNRDP), which might be interested in the economic development initiatives mentioned above.

Health

- More pipelines should be provided to the region as this would ensure that more people had access to purified water. Extensive work has been done on the problems associated water points in sensitive environments. It is imperative therefore that pipelines are not installed without referring to the findings of these studies.

- Health workers should be sent to private homestead to educate adults, particularly the women.

- Inexpensive water filtering devices should be made available to the people living adjacent to the dam, and to Epalela residents, as these are the people most affected by the dam water.

- Investigate the feasibility of using impregnated mosquito nets.

Location of properties

- To ensure that the properties situated next to Olushandja dam are never flooded, an active management plan must be adopted. If the water level rises above 30% as a result of heavy rainfall, excess filling, etc, then water should be released down the Etaka canal or pumped into the Olushandja-Ogongo canal. This is important for both those settlements growing *mahangu* and for the market gardens, as flooding of fields or vegetable gardens results in the crops rotting.

Legal rights

- Develop an expropriation policy to ensure that people situated around the dam will not be forced off the land if the water utility company proclaims that people are forbidden to live below the 1007.5m settlement limit.

- Develop a water strategy to ensure that those people currently utilising the dam do not loose their rights to the water in the Olushandja dam if the land around it is expropriated. The needs of people currently utilising the dam on a regular basis as well as those who only utilise the dam in times of drought should be considered.

- When the water utility company is initiated, a local representative should be included on committee in charge of the management of Olushandja dam, to ensure that the land and water rights of the locals are not neglected.

Livestock

- Continue monitoring cattle to ensure that if liverfluke or livestock bilharzia start becoming problematic, it will be recognised early.

Cumulative impacts

- Investigate the effect that the dam has on the local ground water.
- Investigate the effect that sedimentation and salinisation will have on the dam.
- Generate a resource management policy that protects the aquatic habitats in the dam.

CHAPTER TEN: ENVIRONMENTAL IMPACT ASSESSMENT OF THE OLUSHANDJA DAM: A CASE STUDY OF IEM IN NAMIBIA

10.1. PAST EFFECTS OF THE DAM ON THE ENVIRONMENT

According to the definition in the IEM Guidelines (Department of Environmental Affairs, 1992), IEM is designed to ensure that the environmental consequences of development proposals are understood and adequately considered in the planning process. When the Olushandja dam was constructed twenty years ago, there was no need to take environmental factors into account. It is therefore very difficult to suddenly have to consider the impacts which changing water levels in the dam are expected to have on the environment, when the impacts which the dam has had on the environment in the past 20 years are totally unknown. To initiate an EIA under these circumstances, one of two assumptions would need to made. Firstly one could work from the base that the dam, as it stands is environmentally sound, and that the only factors needing consideration are those which might occur as a result of the upgrading. The second premise is that before attempting to measure future changes in the environment, an audit of how the development of the dam has impacted on the environment in the past needs to be conducted. The latter is in fact the approach which the author tried to adopt in this dissertation.

Therefore in some respects, this SIA was in part an environmental audit, in part an environmental impact assessment, yet because the terms of reference required us to only look at the effects of changing the water level of the dam, what could be achieved in an audit would be limited. It did become evident in the assessment that many of the social cost and benefits associated with the dam existed as a result of the dam's existence and not as a consequence of changing the water level in the dam. It therefore made it possible to conduct a type of environmental audit, where the costs of keeping the dam or removing it were assessed. The problem however is that comparison of keeping and removing the dam cannot be used as a parallel for comparing pre and post dam situations. The reason is that as the dam has been in existence for 20 years, it has impacted on communities, so removing the dam will carry social costs with it. If the same SIA had been conducted prior to dam construction, the no dam option would have been the no go option, and would only have had forfeited opportunity costs associated with it, and not the additional financial, psychological and biophysical costs associated with removing the dam. Evaluation of the dam versus no dam option did involve some retrospective assessment (as is the case in auditing) but some of the potential impacts associated with the decommissioning the dam had to be predicted (as is the case in IAs).

10.2. A SECTORAL APPROACH TO DEVELOPMENT

The whole water supply system is being upgraded according to the findings of the planning report for reinstatement of the Calueque-Olushandja component of the Calueque Dam water supply scheme prepared by Lund consultants in 1992. Yet instead of commissioning an EIA to establish the environmental impact that the entire water supply scheme has on the environment, a sectoral approach has been adopted. In 1993, proposals were made for the environmental monitoring of the Olushandja-Ogongo canal and in 1995, this project was commissioned, where the impact of altering the water level in the Olushandja dam was the only issue identified by DWA as being potentially harmful to the environment. The result was that our terms of reference required us to determine a management plan for the Olushandja dam based on the most environmentally sound water level.

10.3. INCLUSION OF IEM IN PROJECT PLANNING

One of the principle aims of IEM is that it should be introduced into the planning process at the conception of the project. This did not happen with the upgrading project. In 1992, Lund consulting engineers were commissioned by DWA to investigate the alternatives for upgrading the Calueque-Olushandja water supply scheme with the aim of improving the surety of water surety to northern Namibia. Three alternative development proposals for the Olushandja dam were investigated with the view of reducing evaporation losses. The three alternatives were:

- To maintain the existing configuration of the dam.
- To move the southern embankment northwards - approximately 5,8kms from the north wall and effectively decrease the surface area of the dam from 26Mm^2 to 11.68Mm^3.
- To move the southern embankment northwards - approximately 15.6kms from the north wall and alter the surface to 18.73Mm^2.

(Lund, 1992).

The alternatives were evaluated in terms of technical and financial considerations only. Factors such as evaporation, siltation, the costs of upgrading the facilities, and extending the Etaka canal from is current position to the new south wall sites formed the focus of the investigation. The potential impact that these alternatives might have on either the biophysical or social environment surrounding the dam were never considered. Potential I&APs were not identified, the interests of DWA, being the only ones considered. The results of that assessment indicated that the most cost effective alternative would be to keep the dam at its current size, and

upgrade the existing infrastructure.

Only at this stage were the other specialists brought into the process. The aim of their investigations were exactly the same as that set out for Lund except that they were only expected to to evaluate the alternative chosen by Lund. This is considered to be a major weakness of this assessment as the opportunity to thoroughly address environmental issues was forfeited. Specialists were left instead with the task of crisis management, i.e how best to manage the chosen alternative, so as to minimize its negative impacts and optimise its positive impacts on the environment.

10.4. SCOPING

An integral part of IEM, arguably the most important stage of the EIA process, is scoping. It is defined in the IEM Guidelines (DEA, 1992) as the procedure for determining the extent of and approach to an impact assessment. The main aim is to focus the IA to ensure that only the significant issues and reasonable alternatives are examined. During the scoping stage, the following tasks should be fulfilled:

- I&APs should be identified contacted and asked to become involved
- Alternatives should be identified
- Significant issues should be identified
- Specific guidelines and terms of reference should be drafted.

The proponents of the study, i.e. DWA took it upon themselves to identify the issues they thought would need to be investigated, to contact the relevant specialists and to draft terms of reference with the respective specialists. The only I&AP identified by the DWA, were the local communities living around the dam. They failed to contact other I&APs such as the Department of Nature. The result is that the concerns of an important interest group has had to be left out of the SIA. If scoping had been implemented by the inter-disciplinary team involved in the project, those I&APs not identified by DWA, would have been put forward by others. Similarly issues which were not identified as important by DWA, but of potential significance to one or other aspect of the assessment would have been pinpointed.

The lack of initial scoping affected the degree of interaction between the specialists, and rendered the information of some aspects of the project unsatisfactory. For example, the need for a geohydrology report was only identified by the masters team after the initial visit to the study site. A geohydrologist was never seconded onto the team, and although DWA did get someone to write a report on the geohydrology of the dam, it was totally inadequate.

DWA did however attempt to bring the specialists together during the assessment phase of the project. Steering meetings were set up, but were hampered by the busy schedules of the respective specialists. For example, at no stage throughout the project did the specialists meet the vegetation specialist, Dr Burke. Because of the inter-related nature of all environmental factors, this is identified as a serious weakness in the project. Although specialist groups were working independently, the interaction and exchange of ideas between the social team and Ms Curtis and Mr Roberts was invaluable in terms of developing an understanding of the area.

Lastly, an environmental consultant was commissioned to compile the EIA report, once all the specialist studies had been completed. This consultant, Ms Barker, has had limited input overall project management. If the consultant responsible for tying the project up had been involved in managing the process, instead of the proponent, it would helped to avoid issue biases, as happened with DWA in the driving seat.

Very often the success of an EIA depends on the thoroughness of its scoping phase. That includes both the initial and ongoing aspect of scoping. While this assessment is by no means a failure, it could have been more interactive with respect to both I&APs and specialists.

10.5. IDENTIFICATION OF ALTERNATIVES

The identification of alternatives IEM, refers to identifying realistic development options early on in the project design. As mentioned earlier in this chapter, this was in fact done by Lund Consultants, while the terms of reference for the EIA was to look at the impacts of filling the dam. It is probably unrealistic to have considered the no dam option as a management alternative, especially as upgrading of the facilities is almost complete, however there was a need to look at the effects which the dam has had and currently does have on the communities living in the vicinity of Olushandja dam. To do this a no dam scenario needed to be created. As has been explained in section 10.1., the no dam option is not a no go option. The author feels that if a no dam option and social component had been included in the 1992 Lund report, it would have been unnecessary to include this alternative as a management alternative for the dam.

10.6. ANALYSIS AND EVALUATION

Analysis of impacts and evaluation of alternatives form the crux of any impact assessment, yet ironically in many respects they are the weakest links in the entire procedure. The reason is that despite the variety of evaluation methodologies which have been proposed (Leistritz and

Murdock, 1981; Fuggle and Rabie, 1992), analysis and evaluation are usually very subjective. This was particularly evident in this SIA, as all of the data collected was qualitative, and therefore very difficult to compare. The allocation of significance ratings to impacts does not make them any more comparable, as cause, context and effect of impacts are different. Therefore despite identifying the concerns of all I&APs, and collecting as much information on the potential effect of a project as possible, a degree of subjectivity by the assessor cannot be totally avoided at the analysis and evaluation stages.

10.7. RECOMMENDATIONS

In the terms of reference for the SIA, one of the tasks was to develop a simple management plan for the dam. This has unfortunately been impossible as so many of the recommendations arising from the assessment call for further investigation. Insufficient baseline material with which to work is unfortunately a characteristic of impact assessments in third world countries. Additionally many of the recommendations call for improvement in basic living facilities, such as clean water and better health centres, but such requirements are needed throughout Namibia. Therefore, even if the client iis prepared to implement all the recommendations there may not be funds or expertise available to ensure that the mitigation is implemented. In fact if one was being sceptical, the question could be raised whether the EIA on the upgrading of Olushandja dam would ever have been commissioned had international donors not called for one. The reason is that there recommendations have arisen out of the assessment, which will need to implemented, but for which DWA has probably not budgeted.

Although a management plan has not been compiled the author has distinguished between those recommendations which she believes are of high priority and which should be implemented in the near future (next two years), and those recommendations which are of moderate priority and could be addressed with less urgency.

10.8. IMPLEMENTATION OF IEM IN NAMIBIA

While implementation of the IEM procedure, as outlined in Namibia's environmental policy was sometimes lacking in this project, it must also be noted that this is the first EIA to be commissioned since the policy was passed in parliament in January 1995. It is also the first EIA in which the Bulk Water Directorate have been involved. Although aware of the environmental policy, they are both unfamiliar and inexperienced with the procedure. The procedure sounds logical in theory, and simple to apply, but in reality, it is not that easy. The short fallings experienced by DWA, have in fact been identified as common short fallings of IEM

in South Africa (Preston, 1995). It must be acknowledged that DWA were very willing to listen to the advise of the more experienced EEU consultant, and strived to rectify problems arising from a lack of scoping.

The author believes that it is imperative that the findings of both the SIA, and the EIA, are distributed to all interested and affected organisations and government departments. The short fallings of this project should be highlighted, and this project used as a case study to learn from. If both the government and businesses in Namibia are as committed to the IEM procedure, as they have been made out to be (Preston, 1995), the EIA on changing the water level in Olushandja dam could play an important role in the implementation and success of EIAs in the future.

10.9. SOCIAL IMPACT ASSESSMENTS, A DISTINCT DISCIPLINE

Literature on the topic defines SIA as a field of research distinct from EIA or sociology (Freudenberg, 1986, Leistritz and Murdock, 1981). However the author found it very difficult to conduct this SIA without considering the impacts of the project on other environmental factors being considered in the full EIA. The reason is that just as financial, technical and political decisions impact on the natural environment, so too do they affect the social environment.

For this reason the author believes that even if SIA is developed as an independent field of study in theory, in practice, SIAs should never be conducted alone. The snail distribution, fishing and limnological studies did not only look at the biophysical aspects of the project on their field, but looked at the human component too. In the same vein, it would have been impossible to produce a realistic SIA, if the impact of biophysical aspects on the socio-economic environment were not considered. The author feels that the approach adopted IEM is the most sound not only in theory, but in practise as, it ensconces an extensive social component within the EIA process and emphasises that the term environment encompasses both socio-economic and biophysical components.

CHAPTER ELEVEN: CONCLUSION

The concluding chapter is divided into three sections. Section 11.1. addresses the degree to which the tasks laid out in the terms of reference were fulfilled. In section 11.2. the role of academic theory in this dissertation is discussed and lastly recommendations to ensure sound management of the social environment are presented in section 11.3.

11.1. FULFILMENT OF PRACTICAL REQUIREMENTS

The primary aim of the practical component of this dissertation was to communicate the findings of the of the social impact assessment to the client, i.e. the DWA to assist them in making sound decisions for the overall management of the Olushandja dam. A synthesis of the major findings are presented below.

11.1.1. Water use patterns of the communities living in the study area

Although northern Namibia is classified as semi-arid, a variety of reliable water sources exist in the study area. Permeant water points include the canals, pipeline, hand dug wells, boreholes, and the Olushandja dam. The degree to which people rely on the dam is related to the availability and proximity of other water sources. The investigation on water utilisation revealed that the Olushandja dam is not the "water centre" of the area and that less than 25% of the households in the study area are probably reliant on the dam for their daily water requirements.

Patterns of water use are also seasonal as during the wet season, oshanas pans *omifimas,* and dams fill with rain water. If an *efundja* comes down virtually the whole study area can become flooded. During these times people utilise these temporal water sources extensively, particularly if they are closer to the homesteads than the permeant water sources. People utilising the Olushandja-Tsandi pipeline are an exception, as the water in the pipeline is purified and therefore utilised throughout the year.

Patterns of water use in the study area were found to be consistent with patterns used in other parts of northern Namibia (Marsh and Seely, 1992, Irving *et al,* 1993, Naeera and Solomon, 1994). In general, water is collected twice a day in 10-25l containers, by women and children, and is used for drinking, cooking and washing clothes. An average of 2-5l is used per person on a daily basis. Provision of water to schools and clinics in small villages is limited or non-existent. The schools and clinics at the bigger centres, namely Onesi and Eunda are connected

to the pipeline and therefore do not suffer as badly as the schools and clinics located in the small villages.

11.1.2. Identification of I&APs and alternative management scenarios for Olushandja dam

A number of groups which could be either positively or negatively affected if the water level in the dam changed were identified. I&APs include rural people living less than two kilometres from the dam, rural people living in between 2 and 10kms from the dam, regional bulk and rural water network consumers, DWA, SWAWEK, Etunda and the Department of nature conservation. The study team were unable to contact nature conservation prior to submission of the dissertation. Therefore, although they were identified as an important interest group, their concerns and issues were never determined, and nature related concerns presented within the dissertation were based speculation and on issues raised by other interest groups during the field study.

To determine the best management option, for Olushandja dam, four management scenarios were constructed. The alternative scenarios were based on managing the dam at different capacities and are listed below:

- Management Scenario One: Keeping the dam at 30% capacity i.e at the 1004m contour
- Management Scenario Two: Keeping the dam full i.e. at the 1006m contour
- Management Scenario Three: Fluctuating the level of the dam between the 1006m and 1003m (dead storage level) contours
- Management Scenario Four: No dam option i.e. Decommissioning the dam.

11.1.3. Identification and analysis of social criteria

To determine which factors of the social environment might be impacted on by the alternative management scenarios, a preliminary screening of a broad range of social characteristics was carried out (appendix D). From this, 15 social factors were identified, of which some eg economic aspects had more than one impact. The impact of each of the management scenarios were considered for all of the social factor. Significance ratings with and without mitigation were allocated for every impact assessed, and where possible, optimisation or mitigatory measures were provided. In other words a full analysis of each management scenario was performed.

11.1.4. Evaluation

Of the 21 impacts analysed, only 14 were used in the decision making framework, on which the evaluation of the preferred management scenario was based. To facilitate decision making, all of the impacts that were common to the four alternatives, as well as those impacts which had been ascribed a minor or moderate impact rating were excluded. The major positive and negative impacts of each scenario were evaluated in terms of the concepts of equity, efficiency and sustainability. The results of the evaluation indicated that in terms of the social environment, the best management option for Olushandja dam would be to continue managing it at 30% capacity. The major factors influencing this decision were those of inundation and water surety. By managing the dam at 30%, between 24 and 94 homesteads would be saved from the upset of relocation. whereas filling the dam or fluctuating it between full (1006m) and dead storage level (1003m) would result in compulsory relocation of people as a result of inundation. While scenario one is not as beneficial as scenario two with regards to water surety, scenario one does provide a measure of water surety. Managing the dam at this level will probably provide sufficient surety for DWA and regional consumers in the short and medium term, as at present water consumption is well below $6m^3/s$ (Haussler, pers comms,1995).

In summary then, it is recommended that the Olushandja dam be managed at 30% capacity as this scenario provide more benefits to more people in the short and long term than the other scenarios.

11.2. FULFILMENT OF ACADEMIC REQUIREMENTS

The academic aim of this dissertation was to produce an academic account which exhibits analytical rigour and a sound understanding of the course work completed in the first year of the 18 months, Master of Philosophy in Environmental Science degree. This aim is considered to have been achieved, as the principles of both SIA and IEM theory were espoused while conducting the SIA. The ideals and aims of both fields are very similar. This can probably be attributed to the fact that both have evolved out of the United State's National Environmental Policy (NEPA) of 1969. SIA evolved in first world countries as a result of social considerations not being adequately addressed in EIAs, while IEM evolved in a third world country, and emphasises the need to incorporate social impacts, and public participation into all EIAs.

As the SIA was conducted in a developing country, a political approach, based on public participation was adopted rather than a more autocratic, technical approach.

Over the years, SIA has evolved as a distinct discipline, yet practical involvement an SIA has led the author to believe that in reality, SIAs should not be practised as a separate discipline, and that the approach adopted in IEM, i.e. of emphasising the importance of the social component in full EIAs, is the only way to ensure that the long term needs of society are addressed. This is based on the premise that all environmental (biophysical and socio-economic) and developmental factors (technical, and economic), impact in some way on the social environment. If an holistic approach to assessment is not adopted, cumulative and secondary impacts are in danger of being ignored.

In terms of the procedure followed in the full EIA (of which the social study team were a part), many of the short fallings identified have been recognised repeatedly, since the conception of IEM in South Africa three years ago (Preston, 1995). Weaknesses include not incorporating IEM into the project planning phase, a lack of scoping, not identifying alternatives early on in the project cycle, and the subjectivity involved with analysing impacts and evaluating alternatives.

11.3. RECOMMENDATIONS

Recommendations for the management of Olushandja dam have been formulated in the dissertation during the analysis of social factors, and are based on the findings of the SIA and on the principals embodied in the fields of SIA and IEM. They are intended to guide the decision maker towards maximising the benefits and minimising the costs associated with managing the dam at 30% capacity. The recommendations have been divided into two categories, namely high and medium priority recommendations. High priority recommendations should be implemented within the next two years and deal directly with the dam. Medium priority recommendations are not necessarily less important. They incorporate mitigatory measures which are unlikely to be addressed in the short term because they involve improving basic facilities, a problem associated with the all of rural northern Namibia, or require unavailable funding or expertise. The author suggests however, that if the benefits from the dam are to be maximised, that these recommendations be implemented within the next five to ten years. Recommendations are provided in Table 5.

As the SIA is only a component of the full EIA, the recommendations presented in this dissertation should not be considered the only recommendations associated with managing Olushandja dam at 30%. While some of the recommendations given were suggested by the other specialists it is important that the recommendations of all the specialists are included in the EIA.

Finally, it must be emphasised that if a different water level is chosen as the preferred management option for Olushandja dam in the full EIA, that the mitigatory measures associated with that water level and presented in chapter seven be implemented. If this is not done, there will be no guarantee that the social impacts of changing the water level in the dam will be addressed.

Table 6. Recommendations

Social factor in consideration	Recommendations
High priority recommendations	
General	♦ Access to the section of dam around the inlet pipe at the north wall should be prevented, to facilitate the introduction of fish into the dam. ♦ This same area should be cleared of all vegetation to prevent snail hosts for water-borne diseases from settling. ♦ The exact size of this area and how it should be managed should be determined in consultation with all I&APs. ♦ Locals should be informed of the reasons behind prohibiting access to the area around the inlet pipe.
Economic environment	♦ The feasibility of increasing the number of fishermen, and or increasing the size of catches per fisherman operating in Olushandja dam should be investigated. New markets for the sale of fish should also be identified and means of transporting the produce to these markets investigated. ♦ A long term management strategy for the sustainable utilisation and protection of the resources in the dam, should be developed in consultation with all I&APs. The strategy should ensure that locals wishing to utilise these resources derive the primary benefits accrued from these resources. Non-locals should be permitted to utilise the resources in the dam, but not to the detriment of locals. ♦ Implementation of the management policy, enforcement of regulations and patrolling of the dam should not be the sole function of nature conservation. The headmen should be actively involved, and locals who are democratically elected should become involved in conservation of the dam and its resources. ♦ An education programme should be set up to inform both the fishermen and locals of the need to protect the resource and ways that this can be achieved. The importance of conserving all components of the ecosystem must be emphasised. ♦ Drag nets should be disallowed as it is will increase turbidity in the dam. This will be detrimental to fish survival and will impact on long term sustainability of the resource.

Health	◆ Health education programmes similar to the one developed for malaria should be produced for bilharzia, diarrhoea and gastritis. The responsibility of health education should not lie only with the clinics, but should be taught at schools. The importance of boiling water should be continually reinforced, and people should be discouraged from bathing or washing their clothes in the dam. ◆ People should be encouraged not to collect water from dam especially the diseased and polluted, section of the dam, near the north wall. ◆ Provide drums to people dependant on the dam or canals for water. These drums could be used for boiling water, or for purifying dam water with chlorine pills. These pills should be made available at clinics and schools. Water collected from the dam should then be treated with the pills and allowed to stand for 48 hours. ◆ Manual control of bilharzia should be implemented in the dam. This includes eliminating vegetation along the margins of the dam in the area near the north wall, applying molluscicide to eliminate any remaining intermediate bilharzia hosts from the dam, and keeping the canals free of rooted vegetation. ◆ Fishermen should be tested and treated regularly. Waterproof gumboots should be made available for those people who spend a lot of time wading around in the dam. ◆ Inexpensive mosquito nets should be made readily available to the community.
Infrastructure	◆ Construct a foot bridge across the dam in the vicinity of Elao. The actual site of the bridge should be chosen in consultation with the locals living in the vicinity of the dam.
Medium priority recommendations	
Economic environment	◆ The economic potential of the two edible molluscs (*Pila occidentalis* and *Etheria elliptica*) in the Olushandja dam should be investigated, with the specific intent of providing locals with jobs, and expanding the economic base of the area. ◆ The viability of initiating fish farms adjacent to the dam should be explored. The emphasis should be on ascertaining the attitudes of the locals and trying to get them involved in the initiative. ◆ The potential of developing more market gardens or getting locals involved in small scale vegetable growing in their own homesteads should be investigated. Cheap irrigation methods should also be researched. ◆ Identify and approach development agencies such as the Rural Development Centre (RDC) and the Northern Namibia Rural Development Programme (NNRDP), which might be interested in the economic development initiatives mentioned above.

Health	♦ More pipelines should be provided to the region as this would ensure that more people had access to purified water. Extensive work has been done on the problems associated water points in sensitive environments. It is imperative therefore that pipelines are not installed without referring to the findings of these studies. ♦ Health workers should also be sent to private homestead to educate adults, particularly the women. ♦ Inexpensive water filtering devices should be made available to the people living adjacent to the dam, and to Epalela residents, as these are the people most affected by the dam water. ♦ Investigate the feasibility of using impregnated mosquito nets to help control malaria.
Location of properties	♦ To ensure that the properties situated next to Olushandja dam are never flooded, an active management plan must be adopted.
Legal rights	♦ Modify the expropriation policy to ensure that people situated on communal land are not forced off the land if the water utility company proclaims that people are forbidden to live below the 1007.5m settlement limit. ♦ Develop a water strategy to ensure that those people currently utilising the dam do not loose their rights to the water in the Olushandja dam if the land around it is expropriated. The needs of people currently utilising the dam on a regular basis as well as those who only utilise the dam in times of drought should be considered. ♦ When the water utility company is initiated, a local representative should be included on committee in charge of the management of Olushandja dam, to ensure that the land and water rights of the locals are not neglected.
Livestock	♦ Continue monitoring cattle to ensure that if liverfluke or livestock bilharzia start becoming problematic, it will be recognised early.
Cumulative impacts	♦ Investigate the effect that the dam has on the local ground water. ♦ Investigate the effect that sedimentation and salinisation will have on the dam. ♦ Generate a resource management policy that protects the aquatic habitats existing in the dam.

1. Contribution of pipelines to environmetal degredation.

The problem with pipelines is that they have the potential to create major negative impacts on the environment if they are installed to close to one another or if there are too many water points placed on a particular pipeline. Overtrampling and overgrazing of vegetation in areas surrounding pipelines not only impacts on the ecology, but on the socio-economic environment. The reason is that overtrampling and overgrazing enhance desertification which not only leads to reduced productivity of the land, but exacerbates the poverty cycle. Extensive work has been done on the problems associated with establishing water points in environments susceptible to desertification (Marsh and Seely, 1992, Irving, *et al*, 1993, Desert Ecological Research Unit of Namibia, 1994). It is imperative therefore that pipelines are not installed without referring to the findings of these studies.

APPENDIX A: GLOSSARY

Castenela nets	very large weighted nets
Cuca shop	a small informal general store
Efundja	a large flood in the oshana system
Egumbo	household dwelling
Eputa	uncultivated communal grazing land
Epya	field (privately owned land)
Hand dug wells	relatively deep shafts with more or less vertical walls that are dug by hand into the earth down to the water table. Water is retrieved from the bottom of the shaft using buckets on ropes and a windlass or other mechanical devices
Mahangu	pearl millet
Ohambo	transhumance practice whereby livestock (principally cattle) are taken to cattle posts for dry season grazing
Oshana	local name for the system of interconnected ephemeral drainage channels that flow through northern Namibia
Omifima	shallow, hand dug, conical pit designed to trap and store water from an oshana
Oshana	local name for the system of interconnected ephemeral drainage channels that flow through northern Namibia
Pan	a small closed basin characteristic of arid and semi-arid areas. Associated with kalahari sand often with an impermeable base made up of fine sediment

Potable water	that which is suitable for drinking
Uwanda nets	home-made weighted nets

APPENDIX B: LIST OF ABBREVIATIONS

BLR	Baseline report
DDGIC	Dutch Directorate-General of International Cooperation
DPA	Discontinuous Perched Aquifer
dsl	Dead storage level
DRWS	Department of Water Affairs - rural water directorate
DWA	Department of Water Affairs - bulk water directorate
EEU	Environmental Evaluation Unit, University of Cape Town
EIA	Environmental Impact Assessment
EIS	Environmental Impact statement
ENGEO	Department of Environmental and Geographic Sciences
ha	Hectares
IEM	Integrated Environmental Management
km	Kilometres
km^2	Kilometres squared
l	Litres
m	Metres
mm	Millimetres
m^3	Metres cubed
m^3/s	Cubic metres per second
Mphil	Masters in philosophy
MSA	Main Shallow Aquifer
NEPA	United States National Environmental Policy Act of 1969
NNRDP	Northern Namibia Rural Development Program
N$	Namibian dollars
NGO	Non-governmental organisation
PRA	Participatory Rural Appraisal
RDC	Rural Development Centre
SIA	Social Impact Assessment
SWAWEK	South West African Water and Electricity Commission
UCT	University of Cape Town

APPENDIX C: THE SIA STUDY TEAM

UCT Masters Students

Kirsten Day	BSc(Hons), Physical Geography
Esme Gauche	B Soc Sc (Hons), Sociology
Philip Haxen	BL LLB (Hons), Law
Richard Hunt	Pr Eng, Professional Engineer
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Michelle Yates	B Sc (Hons), Zoology

EEU Consultant

Janet Barker	MA (Environmental Science)

APPENDIX D: PRELIMINARY SCREENING OF POTENTIAL SOCIAL IMPACTS

SOCIAL FACTORS	FULL DAM	FLUCTUATING DAM LEVEL	CURRENT LEVEL	NO DAM
Current land use	Yes	Yes	No	No
Cultural resources				
Architectural heritage	No	No	No	No
Archaeological sites	No	No	No	No
Sites of religious or spiritual significance	No	No	No	No
Demographic aspects				
Growth rate of the population	No	No	No	No
Location or distribution of the population	Yes	Yes	No	No
Existing age or gender composition	No	No	No	No
Existing biographical composition of the population	No	No	No	No
Proportion of female to male headed households	No	No	No	No
Economic profile				
Sources of income	Yes	Yes	Yes	Yes
Migrant labour	No	No	No	No
Informal businesses	Yes	Yes	Yes	Yes
economic base of the area (subsistence farming)	No	No	No	No
Enhancement of regional self sufficiency	Yes	Yes	Yes	No
Competition through non-local labour moving into the area	Yes	Yes	Yes	Yes
Health				
Incidence of disease	Yes	Yes	Yes	Yes

Threats to health from water	Yes	Yes	Yes	Yes
Water infrastructure				
Water rights	Yes ?	Yes ?	Yes ?	Yes ?
Planned provision of water to the area	?	?	?	?
affect the local ground water	?	?	?	?
Need for new pipelines	?	?	?	?
Transport networks				
existing transport system	Yes ?	Yes ?	No	No
Present movement patterns of people	Yes	Yes	Yes	Yes
need for and desirability for new transport schemes	Yes	Yes	Yes	Yes
Location of houses	Yes	Yes	Yes	No
Health services	Yes	Yes	Yes	Yes
Water pollution	?	?	?	?
Water sources				
people living less than 3kms from dam - current level	Yes	Yes	No	Yes
Water sources 3 to 10kms from dam	No	No	No	No
Regional bulk water users	Yes	Yes	Yes	Yes
Daily water routine	Yes	Yes	No	Yes
Agriculture				
Dryland farming	No	No	No	No
Irrigation potential	Yes	Yes	Yes	Yes
Livestock				
Movement patterns	No	No	No	No
Livestock sickness	Yes	Yes	Yes	Yes
Fishing	Yes	Yes	Yes	Yes
Settlement patterns	No	No	No	No
Acquisition of cattle	No	No	No	No
Intrinsic value	Yes	Yes	Yes	Yes

APPENDIX E: FIGURES

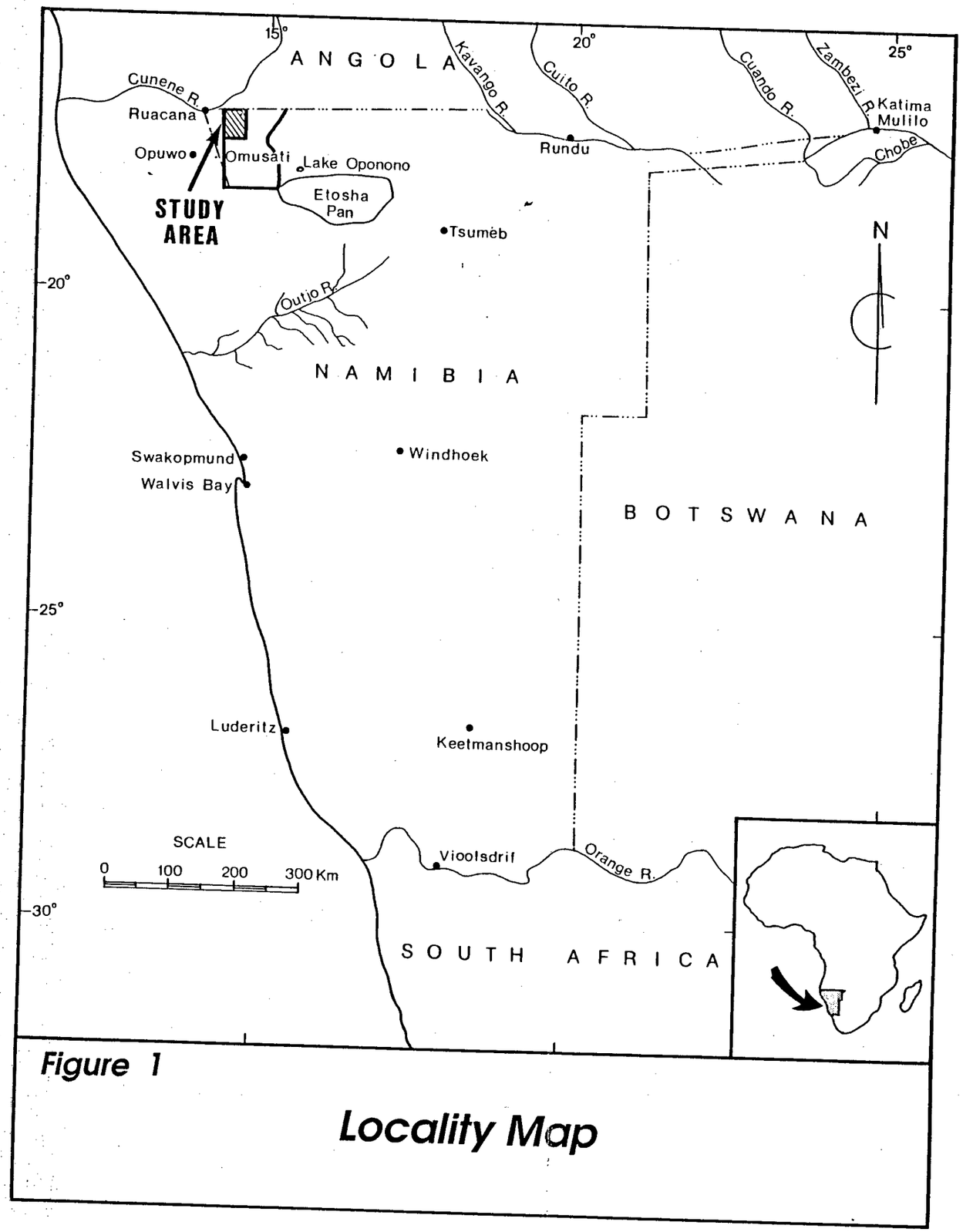

Figure 1

Locality Map

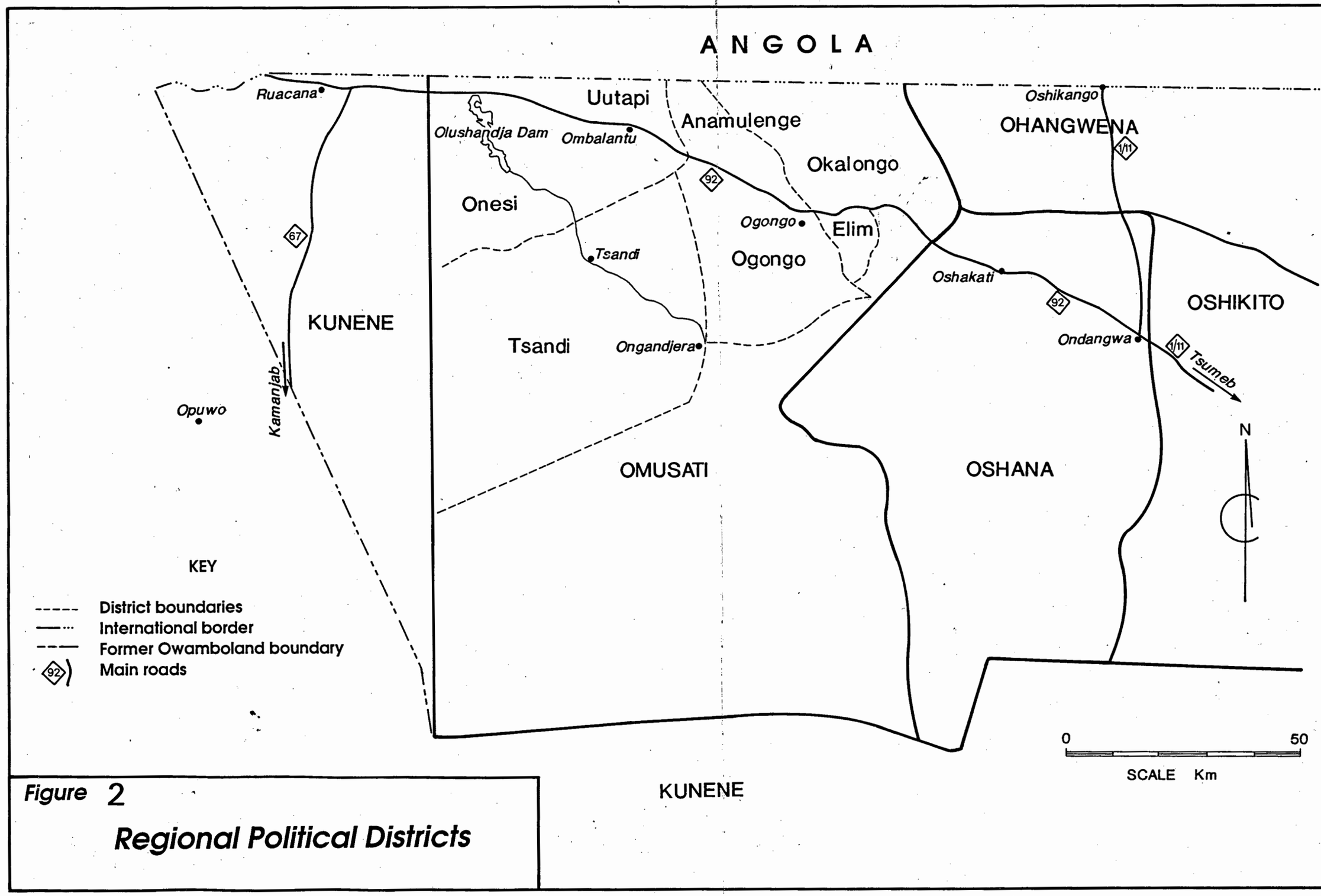

Figure 2

Regional Political Districts

KEY

A,B,C	Household
CW	Well
CC	Cuca shop
AE	Market garden
BS	School
BH	Headman
BC	Clinic

NAMIBIA

ANGOLA

Mahanene BC4

Ombalantu Canal

ZONE C

ZONE B

ZONE A

Eshinga

Oshaala BC3

Okaanga BS3

Etaka Unlined Etaka Canal

Tsandi

Omndamba C20

OLUSHANDJA DAM

Elao market garden

Epalela

Epalela market garden B7

Lined Canal from Calueque

30% Full

Full supply (1106m)

Recommended limit of settlement at time of dam design (1107,5m)

Eunda BC1

Onesi BS1

2,5Km

5,0Km

10,0 Km

Canal

Etunda

Ruacana

SCALE 1: 100 000

0 5

Figure 3 *Household and Key Informant Interviews*

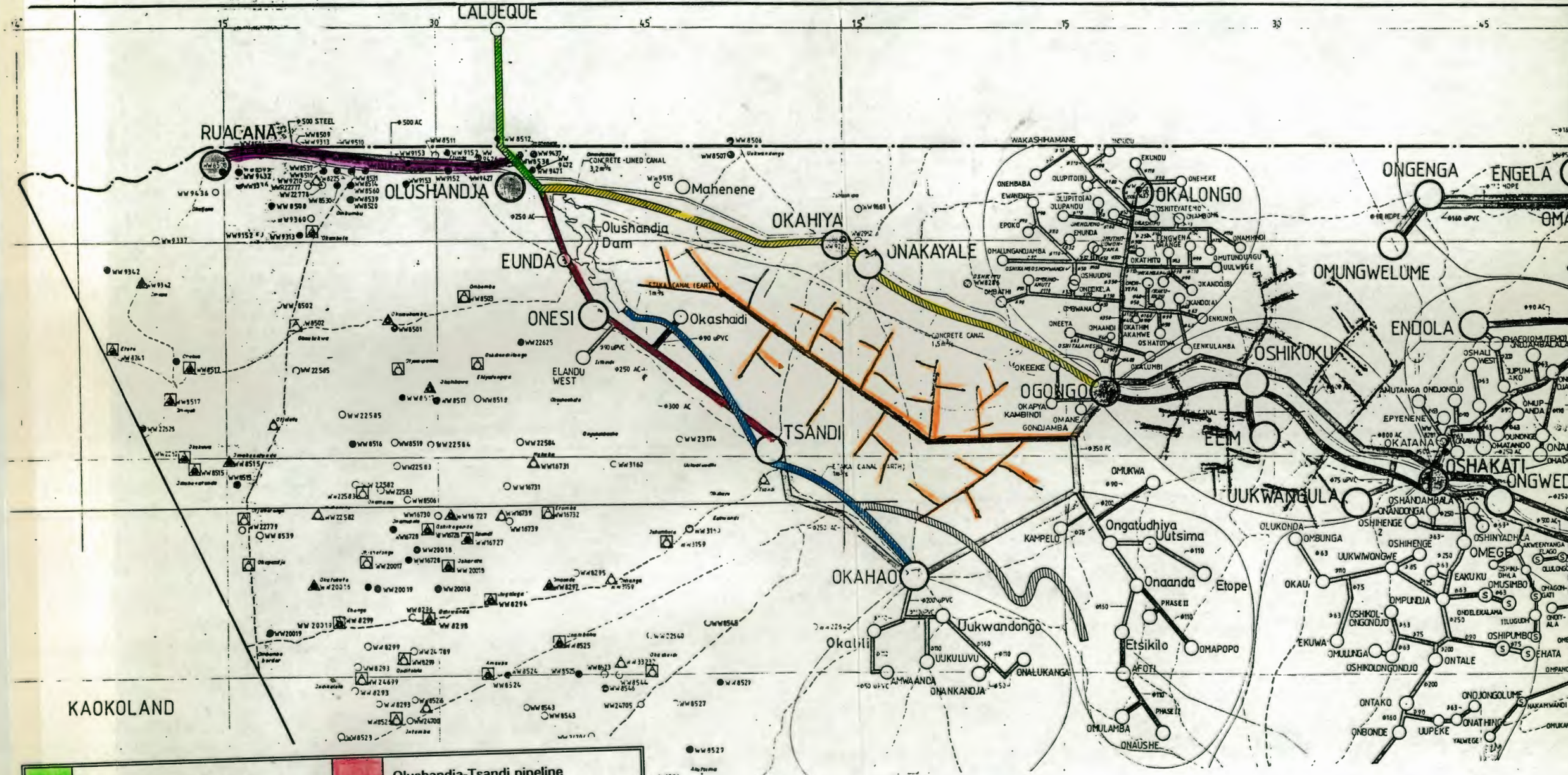

Figure 4. **Diagram of the bulk and rural wat supply network in the Omusati region**

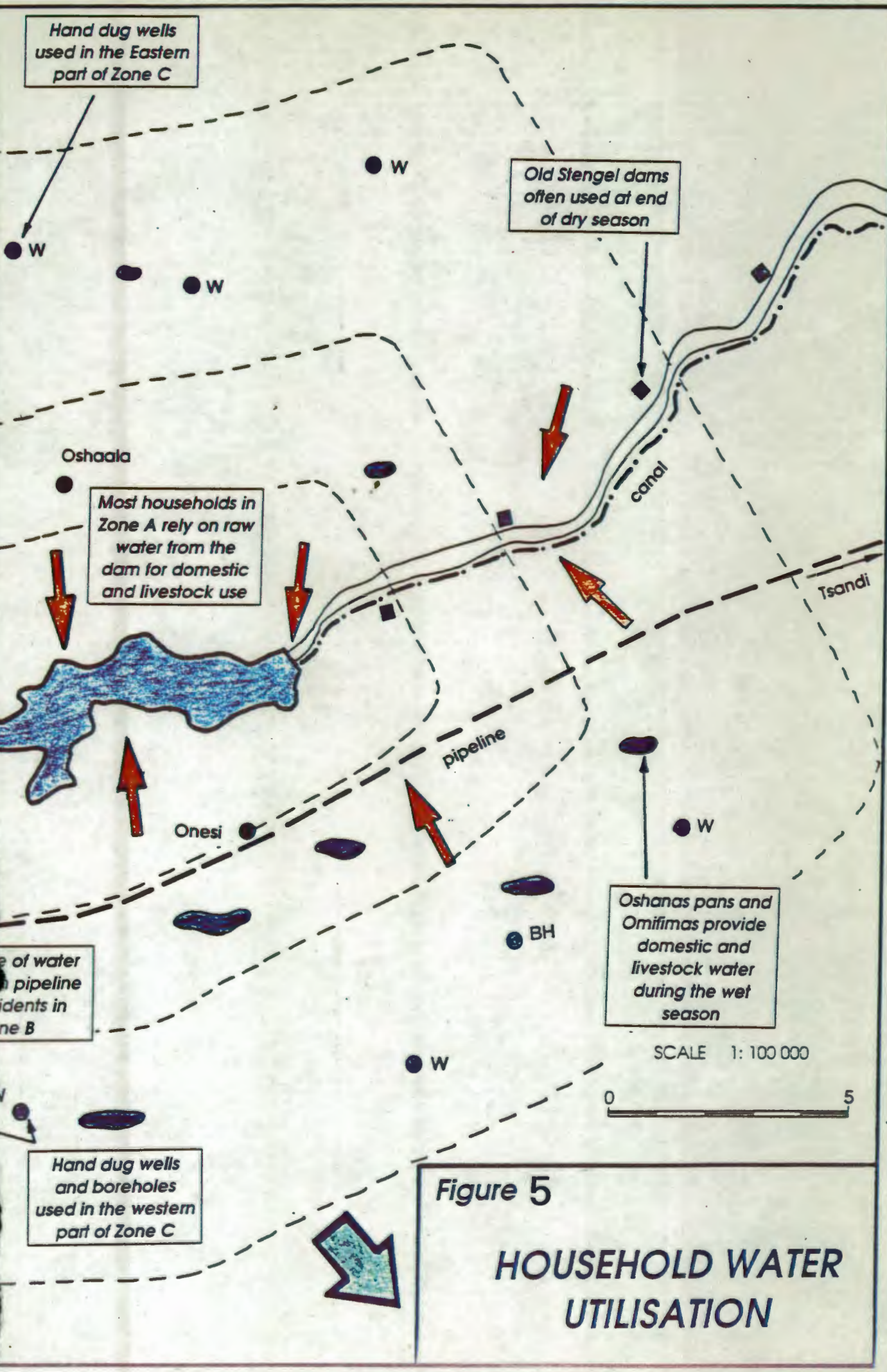

Figure 5

HOUSEHOLD WATER UTILISATION

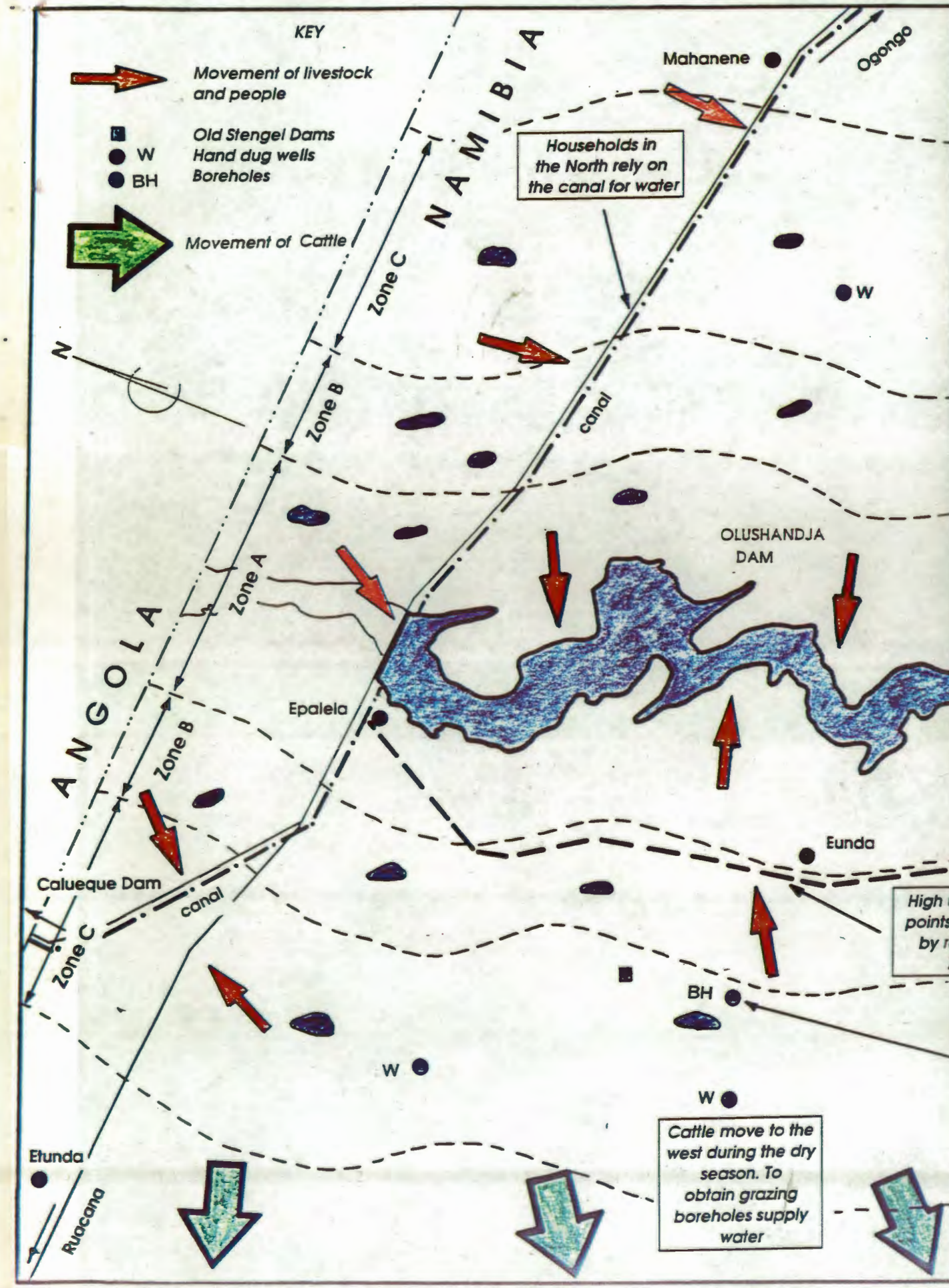
KEY
Movement of livestock and people
Old Stengel Dams
W
Hand dug wells
BH
Boreholes
Movement of Cattle
NAMIBIA
Mahanene
Ogongo
Households in the North rely on the canal for water
W
Zone C
Zone B
Zone A
canal
OLUSHANDJA DAM
ANGOLA
Epalela
Zone B
Eunda
Calueque Dam
canal
Zone C
BH
W
W
Etunda
Ruacana
Cattle move to the west during the dry season. To obtain grazing boreholes supply water

Figure 6. **Diagram of properties susceptible to expropriation if Olushandja dam filled.**

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