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E-211

Environmental Assessment of the Mozambique National Water Development Project

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for

The World Bank
Washington, DC, USA

and

Direcção Nacional de Águas
Maputo, Moçambique

July 1996
(Second Edition August 1997)

AGRICULTURAL UNIVERSITY OF NORWAY

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ABBREVIATIONS AND ACRONYMS

AdM	Águas de Maputo
AdN	Águas de Nampula
AdP	Águas de Pemba
AdQ	Águas de Quelimane
ARA	Regional Water Administration (Administração Regional de Águas)
BA	Beneficiary Assessment
CAB	Companhia de Águas de Beira
DAS	Department of Water and Sanitation (Departamento da Água e Saneamiento)
DNA	National Directorate of Water (Direcção Nacional de Águas)
EA	Environmental Assessment
EDM Moçambique)	Electricity Company of Mozambique (Electricidade de
EIA	Environmental Impact Analysis
FINNIDA	Finnish International Development Agency
GoM	Government of Mozambique
HC	House connection
MICOA	Ministry for Coordination of Environmental Actions (Ministério Para a Coordenação da Acção Ambiental)
MISAU	Ministry of Health (Ministério do Saúde)
MOPH	Ministry of Public Works and Housing (Ministério das Obras Públicas e Habitação)
Mt	Metical (local currency)
NGO	Non-governmental organization
NWDP	National Water Development Project (new project title)
NWRMDP	National Water Resources Management and Development Project
O&M	Operation and maintenance
PRONAR	National Program for Rural Water Supply (Programa Nacional dos Águas Rurais)
PT	Public tap (standpost)
SUPRA	Regional water construction unit
TOR	Terms of reference
WB	The World Bank
WHO	The World Health Organization of the United Nations
YC	Yard connection

EXECUTIVE SUMMARY

The USD 125 million Mozambique National Water Development Project (NWDP) (previously named: Mozambique National Water Resources Management and Development Project) will be funded by the World Bank and executed by the Government of Mozambique, in support of the implementation of the Mozambique National Water Policy. It will commence in 1997 or early 1998 and have three main components, plus support to capacity-building within Mozambique to successfully implement them:

1. **Urban and Peri-Urban Water Supply** which will rehabilitate and extend the water supply systems with some complementary investments in sanitary systems in five cities -- Maputo, Beira, Quelimane, Nampula and Pemba -- incorporating an investment program for each city, allocations to support management contracts, and management development for seven other cities;
2. **Rural Water and Sanitation** consisting of improvement and rehabilitation of small piped water and sanitation systems on a pilot basis in rural towns; and
3. **Water Resources Management** incorporating four sub-projects:
    - Management Development Plan for ARA-Sul
    - Corumana Dam Completion Works
    - Strengthening of Management of Shared Water Resources
    - Joint Incomati Study -- Supplementary Work in Mozambique

In addition, allocations are proposed for capacity development and technical assistance (project implementation unit), planning and strategy development studies in urban and rural water supply and sanitation, and project implementation.

The NWDP was classified by the Bank as a Category B project. This EA report was prepared in accordance with Bank EA practices, relevant guidance from the Bank's OD 4.01, and terms of reference (TOR) provided by the Bank. As an initial step, a scoping exercise was carried out and resulted in an Inception Report which modified the TOR somewhat. The Inception Report was approved in principle by the Bank with substantial comments on the key issues of public consultation, and pollution and environmental health problems related to sanitation. These issues were clarified and the EA proceeded on the basis of the Inception Report.

After the draft final EA report was presented, and during the Staff Appraisal process, the Bank expanded the scope of the project to include investments in complementary sanitary systems and development of sewerage rehabilitation plans for implementation under an upcoming Urban Environmental Management Project. The Team did not have access to any documentation on these issues during the work on the EA study. The final EA report therefor reflects this new positive development of the project only to the degree specific Bank comments (Shepherd 1996b) refer to the new components of the project. The EA report is basically prepared in reference to the project description as outlined in the Aide Memoire of 1 March 1996 (WB 1996b).

Concerning public consultation during the EA study, it was found that project components likely to be of direct concern to the public were not sufficiently defined to make consultation productive at the time of the field work. It was therefore determined to leave such consultation to the Beneficiary Assessment (BA) and to detailed project design. Comments to the TOR for the BA were offered by the EA team at the commencement of that study both in writing to the Bank and in meetings with the BA team. These and recommendations on further consultation are contained in this report.

However, in consultation with DNA, the Bank later decided that the main findings and recommendations of the EA report should be presented at public displays. The Team Leader was engaged to assist DNA, and displays with posters and public consultations/debates were arranged in the five cities during March - April 1997. A book for written comments was made available to the public during the displays.

The general public in Mozambique is not yet used to this kind of participatory approaches and the display was generally found to be too technically oriented to attract the interest of the general public. The initiative was welcomed, however, and received wide coverage on national television, radio and in the press. A summary report on the exercise is contained in Appendix E of this 2nd edition of the EA report. *It is recommended that an appraisal is made of the experiences from the public display and consultation.* This may provide valuable information for planning of later, similar exercises.

As initially planned, the NWDP would substantially increase water supplies to urban and peri-urban areas of Mozambique without, at the same time, improving currently inadequate sewage and waste water collection, treatment and disposal. As mentioned above, some complementary sanitary solutions are now incorporated, and another Bank project expected to begin in 1999, the Urban Environmental Management Project (UEMP) will address these sanitation and other urban environmental management needs. The situation however, still raises justifiable concerns for exacerbating pollution and environmental health problems until the second project is implemented, or if it is delayed. At the commencement of the study it was determined that this EA would not address sanitation, pollution and environmental health issues in the detail required if the NWDP were considered in isolation. However, it does offer substantial recommendations on how they can be dealt with.

Water resources management, development and supply is a priority policy issue for Mozambique and in 1995 the Council of Ministers passed a resolution on a comprehensive National Water Policy. The key water policies, together with central legislation of relevance to water -- the Water, Land and Municipality Acts and the proposed Environmental Act with EIA regulations -- and the evolving institutional framework constitute a basic reference framework for this EA study. For example, the environmental monitoring and management plan recommended in this report relates to the legal and institutional framework.

This executive summary concentrates on recommendations to address significant environmental issues for each component or sub-project of the NWDP. With a possible exception for the policy issue with regard to the project's apparent priority on the

provision of house connections, the EA study did not come up with issues of the NWDP of such potential environmental significance that they would lead to redefinition or rethinking of major components of the project.

Issues Common to the Five Cities

Issues common to the five cities relate to the water distribution system, potential resettlement, and the design of future sewage and waste water collection and treatment systems. *It is recommended as a guiding principle that house connections should not be provided unless and until appropriate and adequate facilities are available to handle water- and excreta-related waste. Consequently, the NWDP should switch from providing house connections to providing, as a first priority, public taps and, as a second priority yard connections.* The key arguments for this revised strategy are that house connections generate substantial waste water and without, as yet, a proper functioning sanitation system, the already problematic urban sanitation situation in all cities will be exacerbated and lead to significant increases in water pollution and environmental health problems. Giving priority to public taps will also represent a better fit between supply and demand, improve prospects for cost recovery; and provide access to safe water for a larger share of the population at the same level of total cost or total water consumption.

A strong participatory involvement of the beneficiaries during planning and establishment of the water distribution systems is recommended. This is important to respond to large variations among neighborhoods and towns, and the differences in expectation and demand from various segments of the population involved in the NWDP, and to building community support for the new water distribution and sanitation arrangements. Consequently, the Beneficiary Assessment should be carried out in *all* five cities and provide a set of design criteria tailored to each community to guide the planning, design and implementation of the refurbished and/or expanded distribution system, with the necessary flexibility needed to accommodate planning assumptions, technical and economical concerns.

An incentive system should be established such that it does not pay to damage water meters. Provisions for compensation and resettlement should be included in the project plan and budget, and not be dependent on Government funding.

Regarding the future refurbishment and/or extension of sewage and waste water collection and treatment systems in the five cities, preference should be given to the use of waste stabilization ponds (oxidation ponds) providing sedimentation and biological treatment. The waste stabilization ponds can for example be designed for reuse of effluents in irrigation.

From a socio-economic point of view, there is no question that improvement and expansion of water supply and distribution systems in urban and peri-urban areas meets a real and urgent need, and will provide significant benefits. To enhance these benefits, local companies and workers should be contracted to carry out project works in cities outside Maputo instead of importing them from other parts of the country.

Maputo

Significant environmental issues for the Maputo water supply concern potential conflicts over use of Umbeluzi River water, minimum flow requirements downstream of the Maputo raw water intake, proposed future transfers of water from the Incomati River, and monitoring and management of minimum cross-border flows from Swaziland. It is recommended that hydrological monitoring at the intake and thorough analysis of required minimum flows be carried out. The issue of minimum flows in the Umbeluzi below the intake, and alternative use of water for irrigation, should be key factors in the design of NWDP hydrological analyses. These analyses should include analyses of the requirements for firm minimum flows from Swaziland and/or transfers from the Incomati basin. These issues should also be addressed by the Incomati River studies proposed under the Water Resources Management component of the NWDP. It is vital that competing water demands, nationally and internationally, be reconciled based upon both human and ecological requirements, and that feasibility studies into alternative water sources include environmental assessments to evaluate the environmental costs and benefits of each alternative.

Water quality downstream of the Maputo water treatment plant should be monitored for contamination from the plant and, if required, safe disposal of plant wastes should be provided into a lagoon or landfill.

Beira

Provided that appropriate restrictions are established and enforced on irrigation withdrawals, and that minimum cross-border flows from Zimbabwe are established and maintained, increased extraction of water for Beira will not cause any significant environmental impact. DNA and/or the new ARA for the region should monitor water demands on the Púnguè River and, should these demands plus water supply to Beira indicate potential problems with maintaining minimum flows in the lower river, more detailed hydrological analysis should be carried out to assist in resolving competing water demands.

A final solution to solving the saline intrusion problem associated with Beira's raw water intake has not as yet been determined. We believe that the best option is to move the intake further upstream and provide a pipeline to the water treatment plant. However, there are several options available and a thorough feasibility study should be undertaken, considering all options, before settling on the final solution. Options involving a weir in the Púnguè River will require a separate environmental assessment.

The existing treatment plants, particularly the newer one, should be rehabilitated, and provide for safe disposal/discharge of sludge and backwash water.

Quelimane

Increased water abstraction from the Licuare River, without a regulating reservoir, will further reduce flows with the risk of the downstream river bed remaining dry or with a very low flow over prolonged periods during the dry season. This may cause adverse

ecological impacts. Estimation of the storage volume of a proposed new reservoir (not included in the NWDP) should in case include the eventual requirement for a minimum flow downstream of the town intake. An environmental assessment should be carried out for the proposed dam if further planning is initiated.

The proposed weir across the Licuare River should be omitted if possible. Planning for increased treatment capacity must include provisions for safe disposal/ discharge of sludge and backwash water. The proposed new transmission main from the treatment plant to town will, in conjunction with expansion and upgrading of the road (a World Bank project), cause significant environmental effects, in particular to farming families living along the road. Planning and construction of the new pipeline should be closely coordinated with road planning and a detailed study should be conducted to set the final pipeline alignment and identify resettlement requirements. The old transmission main should be abandoned and the new pipeline equipped with branches to supply adjacent settlements.

Nampula

Environmental impacts from increased water abstraction from the Monapo River will probably be minor. However, further investigations will be required to confirm current flows, to determine the feasibility of greater abstractions, both with the current supply arrangements and with the proposed second dam, and to assess the need for maintaining a minimum flow downstream of the dam. The second dam (not included in the NWDP) should in case planning is initiated, be subject to an environmental assessment.

Concerning the treatment plants and intakes at the Monapo reservoir, a pipeline should be built from the treatment plants and along the mountain side track to carry sludge and backwash water to the downstream side of the dam. The new reservoir intake should be located as close as possible to the dam and as far as possible from the existing leisure area. Chlorination should be shifted from the intermediate reservoirs along the transmission main to the treatment plant.

Pemba

Significant environmental impacts are anticipated from the proposed extension of the Metuge well field. The impacts relate to lowering of the ground water table, the possibilities of salinity and effects on and from agriculture. The extension must be based on thorough hydrogeological investigations and extensive monitoring of the water table and draw-downs during test-pumping. The area immediately around the Metuge well field should be declared a partially protected zone and new settlements close to the wells should be prohibited. Resettlement of people presently living close to the wells may be necessary.

The water supply situation in Pemba is becoming critical. Rehabilitation of the Metuge well field, and reduction of demand through metering and leakage reduction is extremely important.

Rural Water and Sanitation

This component of the NWDP, allocated a lump sum of USD 5 million, is still being developed and only an outline design document has been prepared which specifies small piped water systems (SPS) on a pilot basis with complementary sanitation systems. Specific villages/towns have not yet been identified for the SPS. None of the SPS projects are expected to require a formal environmental assessment (category A) but, depending on size, some may require environmental analysis.

This EA report lists a number of general environmental issues which could be of concern and which should be included in TORs for further investigation and assessment by feasibility study teams for individual rural towns. Development of design criteria based on inter alia what people can afford to pay for water should be included in the feasibility studies, as should identification of external factors which may impede sound development of individual schemes, such as lack of roads and electricity supplies.

Water Resources Management

This component of the NWDP is comprised of four sub-projects. A set of four draft TOR was prepared by the Bank and DNA in March 1996. For each sub-project, the issues which should be addressed to obtain environmentally sustainable development of the water systems with which each is concerned were assessed, including some raised by the city-based assessments. The issues which can and should be addressed by the NWDP are:

1. The minimum flows required downstream of the Maputo water intakes to control salinity intrusion and protect other ecological functions;
2. Proposed future transfers of water from the Incomati to the Umbeluzi River to augment Maputo raw water supplies; and
3. Monitoring and management of the minimum cross-border flows being delivered from Swaziland and Zimbabwe.

Specific comments were provided on each TOR as to how it should be modified to strengthen NWDP response to these issues and, more generally, to incorporate environmental management perspectives into the many elements of the sub-projects.

Resettlement

Implementation of the Urban Water component of the NWDP will, in some places, require limited amounts of resettlement. There are established procedures for expropriations and forced resettlements in the Land Act of 1979. The City of Maputo has reportedly developed and implemented a functional system for resettlements. As well, the Bank's Operational Directive 4.30 provides specific guidance on resettlement. In Mozambican practice, the Municipality/City Council is responsible for conducting negotiations and for providing new sites for settlements as well as necessary logistics for moving people and movables. Resettled families are to be issued titles for the new dwellings or homesteads. The respective implementing agency must bear all costs involved. It is recommended that the implementing agencies conduct separate studies

on the resettlement requirements for each project and prepare detailed plans for carrying them out. Outline procedures for doing so are included in this report.

It is strongly recommended that funds to cover resettlement and compensation costs be included in the NWDP project loan.

Environmental Monitoring and Management

General requirements for environmental monitoring and management of the Urban Water Supply component of the NWDP are specified during the location, planning, design, construction and operation of project facilities. All should be implemented by the private operators who will take over the city water companies, under the monitoring and direction of the DNA Project Unit (and the provincial MOPH/ SUPRA). The construction requirements should be incorporated into the construction contracts and the operation requirements should be incorporated into O&M manuals and staff training programs.

Monitoring requirements are specified to be carried out as an integral part of the regular monitoring and reporting procedures for the various components of the project. Identified institutions are the Bank supervisory missions, the DNA Project Unit with its provincial administrations and/or SUPRAs, the water company managements, the Ministry of Health and its laboratories, and MICOA. Monitoring of water use is an integral part of the mandate of ARA-Sul and the other ARAs to be established in the future. Municipal councils will also play a role in environmental monitoring in the future when their responsibilities are defined and their new administrations are functioning.

Environmental Awareness-Building and Training

Few training needs will be required beyond those embodied in the capacity-building elements of the NWDP. Training will be required for personnel of DNA (and provincial MOPH/ SUPRA), MICOA, private-sector water company management and operational staff, and later municipal council staff, to monitor and supervise environmental performance during construction of new and refurbished works being funded by the project. The DNA Project Unit should conduct a workshop for key personnel of these institutions on the recommendations of the EA report and how they should be implemented.

The water companies should make their management, supervisory and field staff aware of environmental provisions of construction contracts. Field staff should be trained alternative practices for dealing with environmental concerns on-site.

1. INTRODUCTION

1.1 Overview of the Project

To support the implementation of the Government of Mozambique's (GoM) National Water Policy, the National Water Development Project (NWDP) to be funded by the World Bank (WB or the Bank) will assist government efforts to improve the management of water resources and increase the quality, reliability and coverage of urban and rural water supply services. The immediate goals (World Bank 1996a) are:

i) To improve the policy and institutional framework for the management of water resources and the provision of water services;
ii) To restore deteriorating infrastructure and increase coverage to progressively provide access to safe water for an increasing proportion of the population; and
iii) To strengthen the ability of government institutions to plan, coordinate and monitor the delivery of water supply services.

The project will have three components, plus support to capacity-building within Mozambique to successfully implement them:

i) Urban Water

The project will rehabilitate and extend the water supply systems with some initial sanitation works in five cities (Figure 1.1) -- Maputo, Beira, Quelimane, Nampula and Pemba. In the initial years, priority will be given to rehabilitating existing headworks and distribution systems, and to bringing operations, maintenance and administration under control. Later years will bring the planning and extension of service delivery and preparatory activities for coping with the increased volumes of wastewater that will ensue.

ii) Rural Water and Sanitation

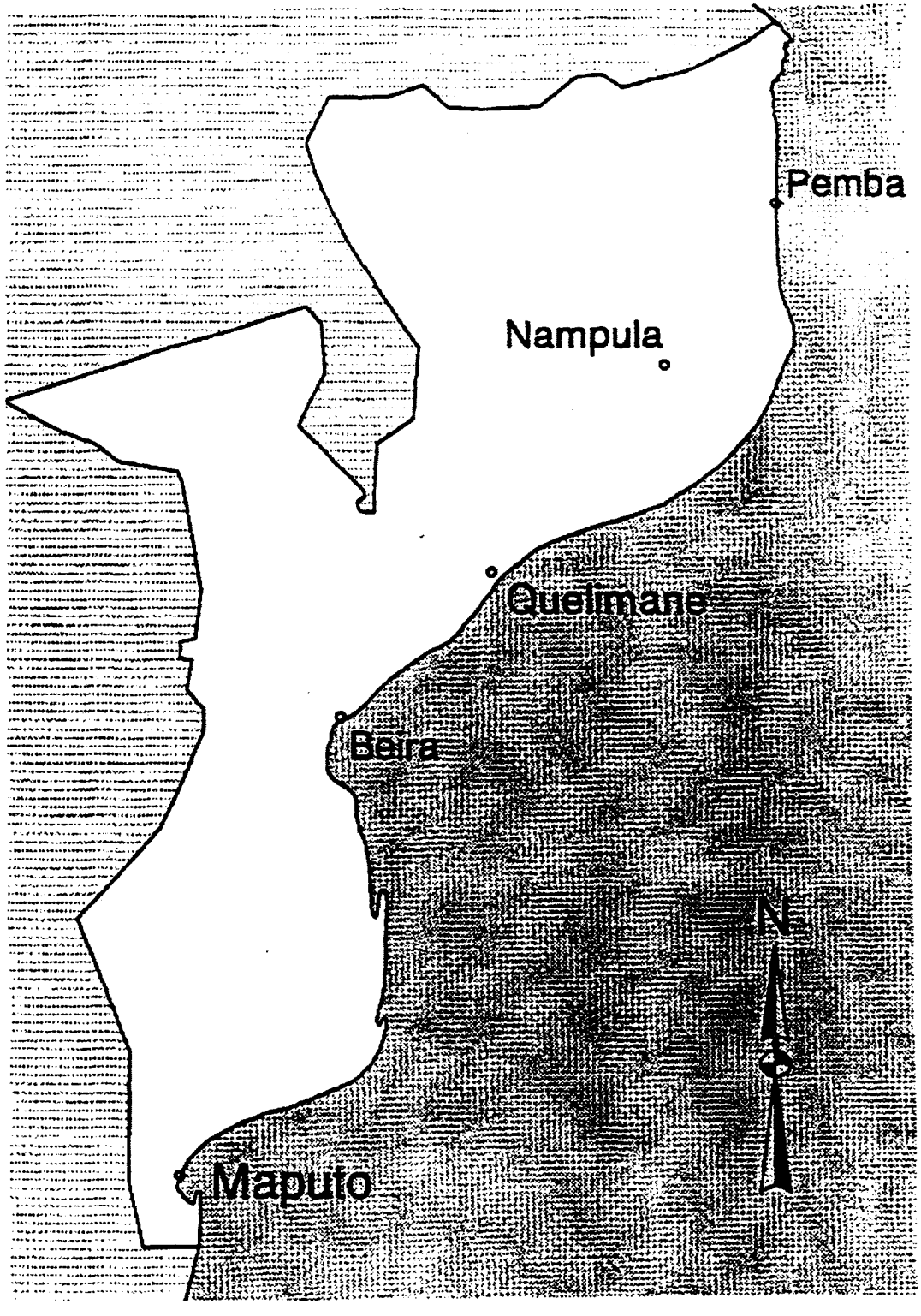
Funds will be made available for the improvement and rehabilitation of rural and small town water supply, treatment and distribution systems, with complementary sanitation solutions.

iii) Water Resources Management

The project will support the strengthening of water resources management both within Mozambique and with respect to international waters. Funding will be directed toward institutional development, river basin studies (local and international) and priority investment in bulk water supply (i.e. the Corumana Dam).

The project will be implemented under the oversight of the Ministry of Public Works and Housing (Ministério das Obras Públicas e Habitação, MOPH) with associated water companies also playing major roles. The actual design, construction, operation and maintenance of all existing, upgraded and new

Figure 1.1: Mozambique



facilities will be carried out by private operators who will act autonomously but be accountable to the Government for the cost-effective provision of services. As the responsible government authority, the National Water Directorate (Direcção Nacional de Águas, DNA) will develop a new role in regulating and monitoring the performance of the private sector operator(s). Local communities will be consulted in the early stages of the project to promote local involvement in the design and execution of project sub-components. The project may also involve non-governmental organizations in the implementation of the peri-urban, rural and small town schemes.

The project is expected to begin in 1997 or early 1998 and extend for five years.

The NWDP was originally designed *not* to involve any capital investments in drainage, sanitation, sewerage and waste water treatment in the five cities. However, it is part of a much larger country assistance strategy being implemented in Mozambique by the Bank (WB 1995). Specifically, the project is expected to overlap with the Urban Environmental Management Project (UEMP) which will address drainage, sanitation and other urban needs and begin in 1999 (Shepherd 1996a). The Bank has also later incorporated the following components in NWDP: (i) finance of cleaning and inspection of the cities' existing sewerage networks and development of sewerage rehabilitation plans for implementation under the UEMP; (ii) a fund for complementary, low-cost sanitation in areas where the water distribution network is to be rehabilitated/extended but where such facilities are lacking; and (iii) adequate draining facilities for all rehabilitated and new connections to the water distribution network (Shepherd 1996b).

Moreover, GoM is considering to prepare a four-year program (DHV 1995) which may comprise institutional strengthening for environmental management within GoM; the development of a master plan for sanitation, drainage and environment in 13 cities, including the five incorporated in this project; and the development of a coastal zone environmental management plan. Because of the close relationship between the water supply aspects of this Bank project, the sanitation aspects of the second Bank project and the proposed new four-year GoM program, this Bank project will include, at the request of the GoM, provisions for coordination of the three initiatives to ensure that a holistic, integrated result is obtained in the management of urban water services in the five cities (Shepherd 1996a).

Project details relevant to carrying out the environmental assessment are presented in Sections 4, 5 and 6 along with the assessment of associated environmental issues. Project details for each of the five cities were drawn from the "Provincial Towns Water Sector Study" prepared by DHV Consultants BV (DHV 1994) and from information from the Bank on their proposed investments (e.g. WB 1996b). DHV's water demand projections were based on population growth rates drawn from government data, targets for the volume and type of supply and distribution set by the GoM, and anticipated reductions over time in the amounts of unaccounted-for water in each municipal system. Possible changes in the water tariff structure were *not* considered by DHV. This is a task for the ongoing Beneficiary Assessment study.

1.2 Scope of the Environmental Assessment

The NWDP is classified as Category B by the World Bank for the purposes of environmental assessment (EA), and this EA report was prepared in accordance with World Bank practices for such projects. Specifically, comprehensive terms of reference for the study were prepared by the Bank (Appendix A) and then refined by the EA consultant in-country. The results of this "scoping" work were embodied in an Inception Report (Appendix A) to the Bank and DNA, and the EA proceeded on the basis of the information and analyses in that report, after substantial comments offered by the Bank on issues of public consultation, and pollution and environmental health problems related to sanitation were discussed and the issues clarified.

1.2.1 Construction Activities

By far the largest component of the project will be rehabilitation or upgrading of existing water supply facilities involving no disturbances of new sites. Existing project sites were examined for environmentally sensitive aspects but it is expected that most environmental protection requirements during construction can be adequately managed using standard, general construction contract requirements (e.g. for trench openings, erosion control, dust suppression) coupled with supervision and monitoring. These general environmental requirements were developed during the EA and form part of the environmental management plan (Section 7). Thus, most activities for the rehabilitation or upgrading of existing facilities were not analyzed in detail in the EA. Sensitive aspects of particular existing sites/routes (e.g. resettlement) were addressed with site-specific recommendations and construction contract requirements. Known new sites/routes were examined and specific siting and construction management recommendations made.

1.2.2 Resettlement

The project will involve relatively little resettlement. It might occur, for example, in:

- the siting of new works (e.g. new storage tanks, expanded distribution systems);
- the upgrading of existing works where people have settled in working areas (e.g. main transmission lines);
- the construction of new transmission mains (e.g. Quelimane); and
- the construction of new dams in Nampula, Quelimane (not part of NWDP) and establishment of partially protected zones (e.g. Pemba).

Known locations of new project works and possible restricted areas were surveyed and resettlement estimates and strategies were prepared based, in part, on consultations with officials and individuals or groups which may be affected. Where locations were not known, the potential need for resettlement was identified for future study. In either case, resettlement policy, principles and guidelines were recommended to guide the preparation of separate resettlement plans.

1.2.3 Public Consultation

The World Bank's OD 4.01 (paragraph 19) specifies that EA studies include consultation with affected groups and local NGOs "to understand both the nature and extent of any social or environmental impact and the acceptability of proposed mitigatory measures, particularly to affected groups". On this project, the major project components likely to be of concern to the public are the introduction of new tariffs for water, the extension of distribution networks and, perhaps, the linkages between increased water supply and improved drainage, sanitation and waste water collection and treatment works. None of these components were sufficiently defined to be adequately considered in the EA at the time the EA was carried out. Moreover, the first two are the focus of the major Beneficiary Assessment (BA) being undertaken as part of project preparation by the Bank. *Thus, the EA did not consult the public on these issues, but recommends means for the BA to address them.* The EA team did provide advice to the Bank on the TOR for the BA study.

The final draft report was presented to the DNA and World Bank in June 1996. The Team Leader was later engaged by the Bank to assist DNA in preparing public displays and consultations on the EA Report's main findings and recommendations. Public displays were arranged in the five cities during March - April 1997. A report on the exercise, approved by DNA, was prepared in June the same year. A summary of this report is attached as Appendix E of this 2nd edition of the Report.

It is envisaged that the BA and subsequent community consultation will identify priority areas for extension of the distribution networks and that levels of service, the location of facilities and the need for complementary sanitary initiatives will be agreed in consultation with the communities (Shepherd 1996b). The consultative work on the BA should incorporate public education on the costs public taps, yard connections and house connections, the number of people they can serve and the health consequences of improving water supply without parallel improvements in sanitation, so that potential beneficiaries are able to make informed comments and choices. It is important that all sectors of the peri-urban societies are being adequately heard.

Consultation about potential drainage and sanitation concerns are also discussed below. Another issue which may concern the public is the potential need to resettle people from project work areas and eventual partially protected areas. This issue was discussed above.

The planned introduction by the NWDP of foreign management of the water companies may also be of public concern. It is recommended that the issue is subjected to public consultations before contracts are signed. Proposed management arrangements should be advertised in the media (radio/newspapers) and exhibited for public review and written comments, and public meetings should be conducted in each city. The issue should also be incorporated in the BA work, to ensure that the poorer, uneducated segments of the population are also heard.

1.2.4 Urban Sanitation

As discussed earlier (see section 1.1), this water supply project originally contained *no* investments in urban drainage, sanitation or waste water treatment. It is, however, part of a much larger country assistance strategy being implemented in Mozambique by the Bank which will include such investments in a project which will overlap with this one. Clearly, increasing urban water supply without making complementary improvements to drainage, sewerage and waste water treatment is a prescription for substantial negative effects on pollution levels and human health. An EA of such a project would have to assess these effects very thoroughly.

However, because this water supply project will be closely linked to a second program of investment in drainage, sewerage and waste water treatment works, *this EA has omitted detailed assessment of urban pollution and environmental health effects. The EA does consider what monitoring of pollution and health indicators will be required both to identify impacts and design mitigation measures should the second project not proceed, and to provide information for the planning of that project. The EA of the second sanitation project should include an assessment of health and pollution effects.*

This is a significant scoping feature which assumes a firm commitment by both the Bank and the Government of Mozambique to the timely implementation of the second project. Proceeding with this water supply project, as proposed in the feasibility studies, in the absence of such commitment could result in substantial negative impacts on pollution and urban environmental health.

1.2.5 Water Quantity Management

The project is intended to bring new water supplies to urban, peri-urban and rural town areas and it is thus expected that demands on both surface and ground water resources will be increased. In addition to the supply of potable water, other demands and values associated with water resources may be affected if urban water withdrawals are significant enough. These include:

Irrigation: Reductions to the availability of irrigation water can have consequent effects on agricultural production, land use and socio-economic factors.

Waste dispersion: Flow reductions in rivers can leave less flow to carry away and disperse, for example, agricultural chemicals, urban waste water and silt with consequent downstream effects on water quality and dependent water uses such as domestic water supply, tourism and fisheries.

Salt intrusion: Reduced river flows can result in more extensive upstream intrusion of salt water and consequent effects on aquatic life and water suitability for irrigation and urban water supply. Ground water withdrawals can similarly cause saline intrusion and

consequent reductions in water quality for human use and agriculture.

Ecological functions: Reduced flows in rivers, along with consequent water quality changes, can affect aquatic environments. Ground water abstraction can lower water tables and have consequent ecological effects.

It was important during this EA to try to forecast and quantify the downstream and ground water effects of increased water withdrawals precipitated by the project. At the same time, hydrological and hydrogeological data are sparse in Mozambique, and it was not possible to estimate these effects to the degree desired. The project includes substantial components of monitoring and research on specific water systems and of development of water resources management capacity. Where the EA could not realistically forecast the effects of water withdrawals, recommendations were made for focusing these research and management efforts, in part, on (1) quantifying available water, (2) analyzing the socio-economic and environmental trade-offs between competing water uses, and (3) developing measures for managing the environmental effects of water abstraction for human use (e.g. setting minimum river flows to keep downstream effects within acceptable limits).

More generally, the TOR specify that the EA "assess the mechanisms proposed by which Mozambique is to seek to increase its security of supply from international river basins" (Page 1, Section 2). This is a very "big" question relating to the capacity of Mozambique to both understand and manage its water resources (which the project is intended to strengthen), and to its ability to negotiate and ensure compliance with international water basin management agreements. NORAGRIC feels that a thorough assessment of this matter is possible only within the broader mandate of an eventual sectoral EA of the entire water sector in the country. Nonetheless, the issues which need to be addressed in such a sectoral EA, and in securing water supplies from these basins, were identified during this project EA. These results should be used in conducting such a sectoral EA and/or as suggestions for detailing the capacity building elements of this project for water resources management in international river basins (Section 6).

1.3 Study Area

The geographic areas for the EA are those specified in the TOR and as modified according to the inception report (Appendix A). The areas were:

i) the five cities -- Maputo, Beira, Quelimane, Nampula and Pemba -- that will be the focus of the urban water supply investments, their water intake areas and the main catchment and/or ground water systems (including their recharge areas) which supply them;

ii) the Corumana Dam; and

iii) the limited number of rural towns, to be identified later, for which piped water supply systems will be upgraded and/or rehabilitated.

1.4 Structure of the Report

Following this introduction is a review of the policy, legal and administrative framework in Mozambique which governs the management of water resources and environmental assessment (Section 2). In Section 3 is a brief overview of the national environmental setting for the NWDP.

Section 4 presents the environmental assessment of the water supply proposals for the five cities included in the NWDP -- Maputo, Beira, Quelimane, Nampula and Pemba. It begins with a discussion of issues common to the five cities. Each city program is then considered in turn; the assessment recommendations summarized at the end of each city sub-section.

Sections 5 and 6 present the assessments of the Rural Water and Sanitation, and the Water Resources Management components of the NWDP.

An environmental management plan for the NWDP is then presented in Section 7.

Relevant references used are listed at the end of the main report.

Four appendices complete the report. The first is comprised of the Inception Report and terms of reference which established the scope of the assessment. An economic analysis of aspects of the NWDP is presented in the second appendix. The third appendix identifies the EA team members and outlines the EA work schedule and division of tasks among the team members. The people and organizations consulted during the study are listed in the final appendix.

2. POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

2.1 National Water Policy

In 1995 the GoM approved a new National Water Policy (resolution of the Council of Ministers 7/95, 8 August). The resolution established the following principal policies with regard to water:

- Satisfaction of basic needs with regard to water supply and sanitation is a high priority, in particular to rural, low income groups.
- Demand driven provision of services with active participation of beneficiaries at relevant stages of planning, implementation, management of operation and maintenance.
- Price of water should reflect its economic value, and eventually cover the cost of supply.
- Water resources management shall be decentralized to autonomous catchment (basin) authorities. Provision of water supply and sanitation services shall likewise be decentralized to local autonomous agencies which should become financially self-sufficient.
- The role of the Government will be changed to one of setting priorities, directions, definition of minimum levels of service, information dissemination and stimulation, and regulation of service activities.
- The sector policy on water resources management will be integrated with policies for local administration, health, agriculture, industry and finances.
- Investment policies shall balance economic development with poverty alleviation and public health improvement.
- Institutional capacity of the sector shall be strengthened and expanded to involve beneficiaries, NGOs and private organizations, i.e. decentralized management and training. The new role of the Government, as outlined above, will be strengthened through capacity building and human resources development.
- Private sector participation in water resources development, supply and sanitation services will be promoted by the GoM.

The water policy document states that urban water supplies shall be provided by autonomous entities, and that a tariff reform shall allow for recovery of operational and maintenance costs and later on contribute to future investments. However, infrastructure development and investments will in the foreseeable future remain the responsibility of the State.

Provision of basic water supply to low income groups in peri-urban areas is one of the main objectives of the water policy. Public participation through standpost committees is envisaged and cross subsidies in the tariff structure shall ensure that poorer groups can afford water.

2.2 Water Legislation

A number of acts and resolutions regulates various aspects of water resources management and water use in Mozambique. The following presentation concentrates on key legislative issues.

2.2.1 The Water Act

The Water Act (Law 16/91) establishes in its first two articles that the right to use water resources shall be subject to a guarantee of preservation and management in accordance with national interests. Water resources are defined as inland waters and their basins, and ground water with or without surface springs. This constitutes what is designated as the public water domain. National interests are not further defined.

The main objectives of the Act are to define a general framework for management of the water resources, define users rights and ultimately the institutional control and monitoring of water use. Water is the property of the State according to the Act, and the public may be granted rights to the use of water. The Act has, however, not been supplemented with appropriate regulatory statutes, neither has the Act yet been amended to comply with the new national water policy.

The Water Act envisages a Water Master Plan to be prepared for water resources management. This plan is supposed to guarantee sustainable use, environmental protection and water quality, but the planning work has not yet started.

Water for human consumption has priority over other uses of water. Monitoring and control of water quality is vested with the Ministry of Health (MISAU). The Ministry should:

- Establish control systems and procedures;
- Set bacteriological, physical and chemical standards for drinking water;
- Establish appropriate treatment procedures;
- Apply special protection measures; and
- Carry out sanitary control of water system workers.

No standards for drinking water or environmental standards have, however, been established in reference to the Water Act. In practice MISAU applies a somewhat liberalized set of standards in reference to the standards issued by WHO. Water samples are tested in provincial laboratories and the test results regularly sent to the water companies and MISAU's Directorate of Hygiene. Only microbiological testing is carried out; the samples are not screened for chemical contents. Apart from preparing the test reports, it is not known what kind of actions the Ministry or the water companies take on the reports.

The Act stipulates that standards for installations and equipment should also be established by statutory regulation. This regulation is still not in place, and in practice it

is up to the donors and their expatriate consultants to set standards on a project to project basis. *Both the Bank and GoM should be concerned about the standards issue, and ensure that necessary regulation is in place before contracts are negotiated with private water company operators.*

There is also no effective regulation in place with regard to sanitation, waste water or solid waste. This mean in practical terms that there is no legal instrument under the Water Act that may be applied and enforced to prevent water pollution. The Act stipulates, however, that MOPH is responsible for the authorization of any disposal systems. The provincial administration, apart from the Department of Health, has no responsibility or authority with regard to sanitation and prevention of pollution.

The Act establishes as well the polluter shall pay principle. No cases are known where this principle has been enforced.

The Act stipulates that water projects shall be subjected to social, economic and environmental analysis at the expense of the project owner. However, no regulations are yet in force with regard to the necessary analyses stipulated by the Act and, as far as the EA team could determine, no water supply or sanitation project in Mozambique has been subjected to specific environmental analysis prior to implementation and construction. The present project appears to be the first one, with the possible exception of internal EAs carried out by donors during project preparations.

2.2.2 The Land Act

In relation to water, the Land Act defines as partially protected areas those areas needed for protection and conservation of water resources for the safety of the public (Law 6/79 3 July, with decree 16/87 15 July). Rivers and catchment areas for intake installations for urban water supply, areas surrounding boreholes and natural springs may thus be considered as partially protected zones. The same applies to ground water and areas which might be subjected to flooding. The water policy resolution states that ground water areas shall be declared as protected zones if they become endangered by overuse.

However, enforcement of the legislation is dependent on specific decrees defining borders and restrictions to be applied for partially protected areas, conditions for their use and clarification of responsible management bodies and mechanisms for protection and conservation. Decrees to this effect shall be published and the area demarcated. The entity responsible for establishing a protected area shall bear the costs involved regarding publication and enforcement of the legislation. The entity shall also bear the costs of compensations and necessary resettlements.

The Water Act defines some of the conditions and restrictions applicable to partially protected areas, i.e. with regard to animal husbandry, irrigation and modern agriculture (use of fertilizers and pesticides), and settlements.

With regard to compensation, the Land Act recognizes such rights only in the case where the incumbent has title to the land and if he has made investments that

cannot be moved. There are few smallholders who have any registered rights under the Act. The practice is, however, to recognize land rights regardless of titles. Titles will normally be issued for new land given in exchange to smallholders in cases of forced resettlements. The municipality councils are responsible for the administration of resettlement and compensation cases.

A new Land Act is presently being discussed by the legislative, and the question of recognizing traditional rights in the law and other issues have stirred controversy. The donors have engaged themselves in the debate and the outcome was not clear at the time of this report. There is, however, no specific and commonly accepted concepts of what are traditional land rights. In certain areas rights may be linked to the use of trees, not the land or soil the trees grow in. If traditional land rights are to be recognized by the new law, appropriate definitions must be incorporated.

2.2.3 The Municipality Act

A recently approved Municipality Act (Law 3/94) decentralizes the responsibility of, *inter alia*, water supply and environmental protection to the municipality councils. The Act further stipulates that water companies should be subordinated the respective municipality councils, but no further statutory regulations have been issued. The Act has not yet been implemented. City and municipality councils are still regarded as the extended arms of the central state administration, and a political controversy over organization and implementation of local elections has led to postponement of direct elections to municipality councils.

In the case of this project, the Bank and GoM have agreed that DNA shall supervise directly the introduction of private management contracts for the five relevant water companies.

2.2.4 The Proposed Environmental Act and EIA Regulations

Traditional Mozambican culture has certain perceptions related to the preservation of natural resources but Portuguese culture, which has influenced the administrative establishment of the Mozambican state for centuries, contains very few references to conservation and protection. This is contrary to, for instance, the British culture which for decades has influenced environmental strategies and policies in the previous British colonies in Africa. Policy issues like sustainable environmental development, conservation and natural resources management, were recently brought on the development assistance agenda by international organizations and certain donor countries. As a result, most developing countries already have, or are in the process of preparing national environmental action plans and environmental legislation.

And thus, despite the lack of an environmental conservation culture in Mozambique, a new Environmental Act is presently being debated by the legislative. It is a general law and does not define any analysis criteria or offer any environmental standards. It does, however, establish an universal principle of EIA studies. It is

envisaged that the Ministry for Co-ordination of Environmental Affairs (MICOA) will co-ordinate the work of the various ministries on statutory regulation. Draft EIA regulations are presently being prepared by a working group. If approved, the statutory regulation will establish procedures for the preparation and review of EIAs, as well as criteria for definitions and degree of detail, public participation mechanisms and standards to be used.

The probable procedures to be established for EIA on projects defined under the regulation are:

- Pre-screening of projects by MICOA (4 alternative categories).
- Project specific TORs for EIA to be issued by MICOA in co-operation with the relevant line ministry as a directive to the applicant.
- The EIA will be carried out by the applicant.
- MICOA will do an EA review, with participation of other involved ministries and institutions.
- MICOA will eventually issue the environmental license on four levels, with monitoring procedural guidelines attached.
- The EIA and the MICOA EA will be published, not the technical reviews.
- The project owner shall carry out environmental monitoring and report to MICOA and the relevant sector ministry in accordance with the guidelines.
- MICOA will carry out ad hoc inspections and provide feedback to the project owner on the inspection and monitoring reports.

Introduction and follow up on the Environmental Act and the EIAs will need support from the donor community. A number of donors are already, or want to, support MICOA and its activities. MICOA will thus, probably with Dutch support, develop a Center for Environmental Monitoring.

2.3 Institutional Framework

The field report from the Bank project preparatory mission 5-22 June 1995 (WB 1995) offers an overview of the legal and institutional framework for water resources management and water supply, and this will not be repeated in detail here.

In brief, the institutional framework consists of the following institutions:

- The National Water Council,
- National Directorate of Water (DNA) of Ministry of Public Works and Housing (MOPH),
- International River Basin Committees,
- Regional Water Administrations (ARA) with Basin Committees and Basin Management Units,
- Water Companies, and
- The Irrigation Institute, irrigators, EDM, other users.

2.3.1 National Water Council

The National Water Council was created under the Water Act. It consists of the Ministers of Agriculture, Industry and Energy, and Mineral Resources, the President of the Institute for Rural Development and the National Director of Water. The new Ministry for Co-ordination of Environmental Affairs is not yet formally represented on the Council.

The Council shall ensure co-ordinated management of issues under the Act, and shall also ensure participation of the public and compatibility of the enforcement of the Act with national development priorities and the need for sustainable environmental development.

2.3.2 National Directorate of Water

The National Directorate of Water (DNA) is under the MOPH, responsible for administration of the national water policy, regulating and supervising water operations, maintaining a national database, and carrying out national planning.

DNA is divided into five departments:

- Administration and Finance (DAF)
- Water Resources (DRH)
- Water and Sanitation (DAS)
- Studies, Planning and Investments(DEP)
- National Rural Water Programme (PRONAR)

A separate unit for international rivers (Gabinete dos Rios Internacionais) is being created within DNA. The organization and status of the unit are not yet finalized.

On the provincial level, DNA is represented by the Provincial MOPH with a Water Department. Although the municipality councils, according to the Municipality Act, have a role to play with regard to water supply and environmental management, it is assumed that the provincial administration, as a representative of the central state, still for some time will have a leading role in these issues, related to water supply.

2.3.3 Regional Water Administrations

The main managing bodies for water resources management are the Regional Water Administrations (ARAs). ARA-Sul for the South (up to Save River basin) has been created and is functioning. The other ARAs for the Centre, Zambeze, Centre/North and North are still only paper creations (decree 26/91 14 November).

The ARA-Sul competence encompasses:

- Participate in the preparation, implementation and revision of river basin's hydrological monitoring activities.
- Administer and control water allocations.
- Establish and maintain records of water resources and water users, as well as introduce and charge water user fees.
- License and grant concessions for the use of waters in the public sector, authorize effluents, impose administrative obligations, inspect and monitor that the respective conditions are fulfilled.
- Approve and inspect hydraulic works.
- Permit and cancel licenses and concessions.
- Design, construct, operate and maintain works.
- Provide technical and advisory services to State institutions and public and private entities and individuals.
- Collect and maintain hydrological data for effective river basin management.
- Resolve water use conflicts.
- Act as a water control authority by enforcing corrective measures in cases of unauthorized works, non-licensed water abstraction, or polluting operations.
- Propose partially protected areas in reference to the Water and Land Acts.
- Recognize traditional water use rights by registration of such rights.

For each river basin, Basin Committees are formed, with all stakeholders represented. The Basin Committees relate to Basin Management Units under the ARA administration. It is intended to also establish International River Basin Committees.

2.3.4 · Water Companies

Entities responsible for providing water supply services in the cities are called water companies. Except for Águas de Maputo (AdM), the legal status of the other companies, and their administrative and supervisory linkages, are unclear and vary from one city to another.

Águas de Maputo is a registered State enterprise, and is according to legislation subordinated to the Maputo City Council. However, AdM operates with a high degree of autonomy. New construction works, distribution networks etc. have to be approved by the City Council, which is responsible for physical planning. Relations appear to be functioning well.

In the other cities where the water companies are operating without proper legislative connections, they are supervised by the provincial director of MOPH on behalf of DNA. (Companhia de Água de Beira is still legally a private company). The companies report on water production, performance and billing. No system for environmental reporting and monitoring is in place.

Water company management maintain they have no formal links with the respective city councils, and relations are strained between water companies and city

councils in some of the cities. In Beira the two parties hardly talk to each other. In Quelimane and Nampula there are also co-operation problems, while Água de Pemba and Pemba City Council seem to cooperate fairly well.

In the present situation with unclear legal and institutional relationships between the centre, province and city/district, it is not likely that management contracts for water companies would attract serious private companies without donor funding through the central government. However, the proposed arrangement should be regarded as a transitory one. Direct supervision could be transferred to the city councils in the future when they are properly elected and the new administrations are functioning.

3. NATIONAL ENVIRONMENTAL SETTING

Biophysically, socially and economically, Mozambique has been strongly influenced by many years of war which only ended in 1992, recent droughts and the consequent migration of about one-third of the rural population from the countryside to urban centres, peri-urban areas and transportation corridors. These factors have also meant that the information base for environmental and natural resources management is fragmented and unreliable. Thus, the discussion in this chapter, drawn from World Bank (1993) and DNA (1994), should be considered indicative only.

Because of the war and depopulation of the countryside, rural areas are thought to be in relatively good condition as agricultural land was left fallow and forestry and mining activity declined sharply. At the same time, areas receiving war-induced migration are suffering from deteriorating or lack of infrastructure, water pollution and lack of sanitation, coastal erosion and localized deforestation where the carrying capacity of the environment has been overwhelmed.

The following brief description of the national environmental setting is focused on those aspects which are necessary to appreciate the effects of the proposed project.

3.1 Biophysical Resource Base

Mozambique's total area of almost 80 million ha is comprised of i) a coastal area and 90% of the region south of the Save River which averages 200 m above sea level (a.s.l.); ii) a middle plateau north of the Save and westward into the Zambezi valley, 200-500 m a.s.l.; iii) an upland plateau, mostly in the north, at 500-1000 m a.s.l.; and iv) a highland and upland area along the Malawi and Zimbabwe borders. North of the Save, a well-defined rainy season from November/December to March/April brings annual rainfall averaging 1000-1400 mm and increasing to more than 2000 mm in mountainous areas. South of the Save, the rainy season is irregular and unpredictable, often with long dry periods. Average rainfall here is 600-800 mm, dropping to 400-600 mm inland and reaching 800-1000 mm at the coast. Soils in the northeast and at higher altitudes are largely fertile light clay and clay loams while, in the south and coastal plains, soils are sandy except for the rich alluvial deposits of the major rivers and streams. Southern areas are particularly subject to floods and salinization. The country's five agro-ecological zones range from "specialized and diversified", mostly in the north with favourable conditions for diversification of crops, to "extensive" in the south where agriculture is limited to drought-resistant or irrigated crops. About 36 million ha, 45% of the land area, are considered cultivable.

Mozambique's woodlands cover some 70% of the land area and are comprised of broadleaf forests (about 48%), grassland with trees (21%) and mangroves (1%). Their productivity is not known. There are also about 42,000 ha of plantation forest established to provide fuelwood for urban and peri-urban areas but, reportedly, are considered unattractive for that purpose and contribute little to alleviating pressure on

natural vegetation. Natural forests are estimated to provide 85% of the country's total energy consumption as firewood and charcoal.

Nearly half of Mozambique's surface water comes from rainfall within the country. The balance comes from rivers draining the western mountains to the Indian Ocean and mostly rising in neighbouring countries. The largest portion of surface water is in the Zambezi River. Two of the international rivers provide water for the largest two of the five cities adressed by the proposed project -- the Umbeluzi (Maputo) and the Púnguè (Beira). An agreement with Swaziland from 1976 regarding the Umbeluzi states that Mozambique shall receive, at the border, a daily minimum inflow of 40% of the measured inflow at two key hydrometric stations. No similar agreement exists with Zimbabwe regarding the Púnguè River. Though only a minor part of the Púnguè catchment area lies within Zimbabwe, it is estimated that 25% of the mean annual runoff originates from that area.

The majority of rivers have a torrential regime with high flows during the rainy season (November to March/April) and low flows during the dry season. Some are completely dry during prolonged droughts. In the flatter areas of the coastal zone, salt water intrusion is commonplace, especially in the dry season.

Useful and reliable hydrological data is scarce in Mozambique. The 260 hydrometric and 340 rainfall stations which existed in 1975 were severely depleted during the war to 60 and 75, respectively, in 1990 (DNA 1994). Rebuilding of the network increased those numbers to 73 and 83 by 1993 but is hampered by financial and organizational constraints, lack of skilled personnel, low level of interest from donors, and inaccessibility of rainfal stations and stream guages due to mines. As of 1984, about 38% of the hydrometric stations and 10% of the rainfall stations had less than 10 years of records.

There are 13,000 km^2 of inland water including the Cahora Bassa reservoir on the Zambezi River, part of Lake Malawi (Lago Niassa) and 1,300 lakes. About 70% of the rural population and some of the major urban centres rely solely on groundwater supplies.

There are more than 2,500 km of coastline and about 68,300 km^2 of continental shelf. The shore, primarily soft dunes and sand, is subject to heavy sediment deposition. A diversity of coastal ecosystems, including estuaries, wetlands, mangroves, coral reefs and coastal lakes, play a crucial role in maintaining coastal and marine species, particularly fish, in protecting the coast from wave action and erosion, and in reducing flooding and erosion of river banks.

Mozambique's waters support a wide variety of marine and aquatic fauna -- about 50 fish species were reported as endemic in 1950 and some coral reefs are reported to be high in biodiversity. The country has five protected marine and coastal areas but enforcement of protective legislation has been largely neglected.

3.2 Environmental Quality

Data on air and water quality in Mozambique are scarce. A study on the environmental aspects of the Pequenos Limbombos dam (1995) indicated water-borne chemicals probably originating from pesticides and fertilizers used in agriculture and foresty plantations in Swaziland. However, the key issues of monitoring and enforcement of any agreements with riparian states will remain to be solved without the proper institutional mechanisms in place.

Air pollution is not considered to be an environmental problem in Mozambique, except from vehicle emissions in the main cities.

3.3 Biophysical Resource Use

Most of Mozambique north of the Save River has traditionally been under shifting slash and burn cultivation; this should be sustainable for many years if current land use patterns and low population density continue. South of the Save, however, farmers in some densely populated areas have access to little or no fallow land. More than 3.3 million ha of cultivable land has irrigation potential but only about 3% is currently irrigated.

Coastal and deep sea fishing play a central role in the Mozambican economy, are a major source of foreign exchange and domestic nutrition, and provide a significant source of coastal employment. Prawn and lobster contributed about 42% of fisheries export earnings in 1990. With the exception of shrimp, current exploitation of fisheries resources appears to be well below conservative estimates of sustainable yields. Most animal protein consumed in the country, and more than 65% of the total fishery production (including inland fisheries), are provided by small-scale and artisanal fishermen.

Fuelwood supplies some 85% of the country's domestic energy demand. Other energy sources are underdeveloped due to economic stagnation and transport obstacles during the war. In 1987, hydropower potential was estimated at 11,000 MW of which 20% had been exploited, primarily by the Cahora Bassa dam on the Zambezi River (2,075 MW installed capacity). However, Mozambique consumes little power from this dam (South Africa is the largest beneficiary) and imports nearly half of its electricity from neighbouring countries.

3.4 Socio-Economic Environment

The present and near-future condition of Mozambique's environmental quality and natural resource base are defined by the poverty and geographical distribution of the population after 16 years of armed conflict. About 60% of the population is absolutely poor; at 137, the IMR is among the highest in the world; and life expectancy at birth is 48 years for women and 45 years for men, both four years less than the average for Sub-Saharan Africa. The war caused the destruction or abandonment of 31% of the

country's health centres and 45% of its schools. There are now an estimated 200,000 orphans in the country.

The current population is estimated to be 17-18 million, including refugees returned from neighbouring countries, and growth is expected at about 2.7% per annum. Most significantly, between 1980 and 1993 the combined effects of war and drought resulted in a substantial increase in the proportion living in urban and peri-urban areas -- from 13% to 18% in the north, from 11% to 17% in the centre, and from 27% to 40% in the south -- without a parallel increase in non-agricultural employment opportunities. At the same time, urban infrastructure was designed for much smaller populations and urban government capacity to meet the burgeoning service requirements of a fast increasing population is seriously inadequate. Thus, in most urban areas, water supply infrastructure, storm sewers and sanitation facilities are deteriorating, seriously deficient and/or lacking. This, combined with widespread poverty, is having substantial environmental and health impacts. Nearby fuelwood resources are disappearing and, in many cities, cholera, hepatitis, typhoid, diarrhea and malaria are widespread with consequent effects on morbidity and mortality.

4. ASSESSMENT OF URBAN AND PERI-URBAN WATER SUPPLY

4.1 INTRODUCTION

The assessment of urban and peri-urban water supply is divided into several sections. First of all, issues common to all city programs are discussed (Section 4.2), and recommendations made which pertain to *all* the city programs. Next, the five city programs are analyzed separately (Section 4.3 through 4.7). Recommendations are made as they are needed and then summarized for ease of reference. As appropriate, each of the city assessments refers *back* to the common issues presented earlier and *forward* to the recommended Environmental Management Plan presented in Section 7.

The Environmental Management Plan is a vital component of this assessment, and of efforts to achieve an environmentally-sensitive completion of the NWDP. It presents common approaches necessary to the location, planning and design of project facilities; to their construction and operation; to compensating and resettling people displaced by the project; and to training project participants in environmentally-appropriate behaviour.

Thus, readers concerned with only one city will refer to the common issues material (Section 4.2), the material concerning that city (Section 4.3, 4.4, 4.5, 4.6 or 4.7), and the environmental management material (Section 7).

4.2 ISSUES COMMON TO ALL CITIES/TOWNS

4.2.1 Public Taps, House and Yard Connections, and Sanitation

Concerning the choices to be made among providing house connections, yard connections and/or public taps while refurbishing and extending the distribution networks, we strongly recommended as guiding principles that:

1. *House connections should not be provided unless and until appropriate and adequate facilities are available to handle water- and excreta-related waste; and*

2. *The NWDP switch from providing house connections to providing, as a first priority, public taps and, as a second priority, yard connections.*

There are three key arguments for these strategic recommendations:

1. People with house connections tend to use considerably more water than people with access to only yard connections or public taps. Without adequate solutions to waste water disposal in place, such high levels of water consumption will exacerbate current sanitary problems in the communities. As is well known, not only are water supply systems in the five cities in poor condition but so are the sewerage, drainage and waste water treatment systems. The NWDP would as originally planned, increase water supply without parallel sanitary improvements, though the latter now is

planned to be attended to in a closely-following project. Nonetheless, the potential for increased risks to human health from water and excreta-related diseases due to inadequate sanitation must not be ignored.

2. Urban household surveys have shown that as much as 90% of the urban population are poor or ultra-poor. Thus, they have very limited purchasing power and will most likely be unable to pay for the costs of house and, perhaps, yard connections. Emphasizing public taps over yard and house connections will represent a better fit between supply and demand, and will probably improve the prospects for cost recovery. The Beneficiary Assessment study will intentionally clarify whether the cost of sustainable standpost management will match the communities ability and willingness to pay.

3. A larger share of the urban population will get access to safe water if the number of public taps is increased and the plans for house and yard connections are reduced. This implies fulfilment of basic needs for more people at the same level of total cost or the same level of total water usage, and is in line with the national water policy.

4.2.2 Beneficiary Involvement in the Location, Planning and Design of New Distribution Systems

We recommend strong participatory involvement of the beneficiaries during planning and establishment of the distribution system. This is important because:

1. There is large variation among neighbourhoods and towns in terms of purchasing power, current access to water, alternate sources of water, physical conditions, community structure and organization, etc. The density and location of public taps should thus be determined with inputs from the beneficiaries. This will result in a better fit between demand and supply.

2. Involvement of the beneficiaries in this way will provide a higher degree of identification and responsibility when it comes to establishing and implementing a system for the physical and financial management of the water supply system. This is likely to result in a more secure water supply and reduced operation and maintenance costs.

3. Health and sanitation education may be provided at the same time by the relevant health authorities and projects in collaboration with the present project.

We recommend that the Beneficiary Assessment (BA) to be carried out as part of the Bank's NWDP preparatory work include such participatory involvement, and be carried out in all five urban/peri-urban areas involved in the project. Furthermore, the BA should produce a set of design criteria, tailored to each community, to guide the planning, design and implementation of the refurbished/expanded distribution system. These criteria should specify, for example, the maximum number of people/families served by each connection; the maximum distance anyone would need to travel to a public tap,

how physical and financial management of the public taps should be conducted, the hours of service, etc.

In this connection, we also recommend that an incentive system be established such that it does not pay to damage water meters. The beneficiary assessment should also investigate this issue.

4.2.3 Routing of Distribution Systems

Routing of the expanded distribution and reticulation system in urban and peri-urban areas will probably lead to conflicts with existing houses and gardens, even if the pipelines should mainly follow roads and foot-paths. Destruction of crops, depending on the season, and some resettlement of families will likely be necessary. *We recommend that provisions for compensation and resettlement be included in the project plan and budget, as discussed in more detail in Section 7, the Environmental Management Plan.*

4.2.4 Sewage and Waste Water Collection and Treatment

Refurbishment and/or extension of the sewage and waste water systems for the five cities have yet to be planned. It can only be assumed that they will be combined systems for sewage and storm water, with overflow to storm water canals/pipelines discharging to water courses or the sea during heavy rains. *Where sewers already exists or where their rehabilitation/extension proves preferable to alternative on-site solutions, we recommend as a general guide that:*

1. *During the dry season, wastewater from sewered areas should be transported away from the city and to appropriate treatment facilities where available and affordable, either through the reticulation system or through the regular emptying of septic tanks.*
2. *Siting of the watercourse/sea outlets from treatment plants be based on hydrologic/ oceanographic investigations into their capacity to receive, disperse and naturally purify the waste water.*
3. *Treatment, outlet requirements and eventual reuse of effluents be evaluated together since the choice of sewage treatment methods will influence the outlet and reuse requirements and vice versa.*
4. *Provided suitable land areas are available, preference should be given to the use of waste stabilization ponds (oxidation ponds) providing sedimentation and biological treatment, and with additional treatment required in case effluents will be reused.*
5. *Coarse grates, manually cleaned, be used to screen sewage and wastewater prior to its entering the first pond. Overflow arrangements to stormwater channels should be designed in such a way as not to allow passage of suspended and floating objects.*

The above recommendations are based on existing situations as observed by the Team in the five cities. They should become part of a phased strategy to be designed

with the long-term objective of eventually having full treatment of all sewered wastewater and adequate reuse or disposal of the effluents.

4.2.5 Impacts on Aquatic Life

Little is presently known about the fish species and aquatic biodiversity in the rivers affected by the NWDP, except that there are relatively few species living there. Species may vary from one river to the other. From 20 to 33 species have been identified in some rivers. One of the most knowledgeable people in Mozambique on freshwater fisheries is of the view that there would be minimal effects on fish populations from the type of water supply projects comprising the NWDP (Custodio Boane, UEM, pers. comm.).

4.2.6 Socio-Economic Dimensions

There is no question that improvement and expansion of water supply and distribution systems in urban and peri-urban areas meets a real and urgent need. Availability of clean water contributes to people's health by reducing the risks of catching waterborne diseases and to improving hygienic standards. On the other hand, increasing water supply without at the same time improving sanitation facilities will, as mentioned earlier, lead to increased health risks.

Water supply also has important economic impacts. Unreliable water supplies from the water companies have led to illegal, secondary water markets where poorer groups of the population pay much higher prices for water (up to 50,000 Mt/m^3) than the more well off with house connections and water tanks (up to 4,500 Mt/m^3). This project is intended to result in increased quantities of safe water reaching an increasing number of families in more reliable supply systems and will probably lead to a reduction, if not elimination, of secondary water markets with lower prices. This is unquestionably a significant benefit which will be enhanced if the project emphasis is shifted to public taps from house and yard connections, as recommended above.

Moreover, many industries and other enterprises depend on a reliable water supply. The availability of water is an important factor in investment decisions. In the case of Quelimane, Nampula and Pemba in particular, the unreliable water supply has already discouraged new investors and reduced the profitability and number of employees at existing enterprises. Thus, investments in these towns should be substantially encouraged as a result of the project.

Project investments will require the involvement of a number of contractors and various skilled and unskilled workers in Mozambique. Surveys of labour markets in the cities indicate exceptionally high rates of unemployment and underemployment (DNE 1994). In all cities, companies exist which are capable of executing most of the construction work for the rehabilitation and expansion of water systems. Moreover, with the location of the capital and major centre of political and economic power in the south of the country, people from the north feel certain resentments towards people from

the south. *We strongly recommend that local companies and workers be contracted to carry out project works instead of importing them from other parts of the country (i.e. Maputo).* This will have several positive socio-economic impacts.

One of the main justifications for the project is the rapid growth of the urban (i.e. peri-urban) population. One third of the rural population has moved into the cities in recent years. Until 1992, this migration was primarily caused by the war. Today this bias away from rural habitation seems to have become more permanent mainly due to lack of infrastructure and the difficult economic conditions in rural areas, and to the vicious cycle many urban peasants find themselves in. Although formal employment opportunities in towns are hard to come by, the informal sector (petty trade and crime) offers better income opportunities in urban than in rural areas. Migration and settlement is costly, and people may thus be trapped in places from where they would otherwise like to move.

The GoM's stated policy is to reverse the migration pattern and promote resettlement in rural areas. The donor community is following suit with rural investment programs, although presently on a limited scale. To give priority to investments in urban and peri-urban areas, as the NWDP does, may seem to contradict this policy. The picture is, however, more complicated, as there exist a complexity of reasons for rural-urban migration, and for the difficulties in establishing a new urban-rural migration pattern. Appendix B discusses some of these issues further.

The NWDP will have significant benefits in the urban and peri-urban areas of Mozambique. This is undeniable. At the same time, *investments in urban and peri-urban areas should be complemented with investments in water supply systems and other infrastructure in near-city areas having agricultural and other investment potential for rural-based production (with market outlet potential).* Such investments will assist in encouraging people to relocate out of the major cities/towns. Through its Rural Water and Sanitation component, the NWDP makes an important contribution to this effort. Other initiatives should follow.

4.3 MAPUTO

4.3.1 Existing Water Systems

Institutional Framework and Other Projects. Maputo is the largest urban area and the capital of the Republic of Mozambique. It is located on the south coast at Baía de Maputo at the joint mouth of the Matola and the Umbeluzi Rivers (Figure 4.1). Water is supplied by Águas de Maputo (AdM), the only formally registered state water company in Mozambique. By law, AdM is subject to supervision by the City Council but in practice it is supervised by DNA since most new investments and other support is donor-funded and channelled through DNA, and water tariffs are set by the central Government.

Sewerage and storm and waste water systems are the responsibility of the Council. However, the institutional entity designed to operate and maintain the sewerage system, *Sangest*, has never been formed and the responsibility for sanitation still rests with the Council's Works Department. There is no formal co-operation between AdM and the Works Department but AdM is discussing extensions and principles for water supply with the department, and the two institutions seem to be on good terms.

Through the years AdM has been supported by a number of projects. A Bank-funded project to rehabilitate and extend the water distribution system is nearing completion. As well, a number of projects supported by the Caisse Francaise de Developpement have been completed, are on-going or are being negotiated (World Bank 1996b). These include rehabilitating the intake and treatment facilities, upgrading the clear water transmission mains, extending the distribution network, updating the water master plan for Maputo, and institutional strengthening and technical support.

Water Source, Treatment, Transmission and Distribution. Raw water for Maputo is pumped from above a weir on the Umbeluzi River near Boane about 30 km from the city (Figure 4.2). Flows above the weir are regulated by the Pequenos Libombos Dam about 10 km upstream, commissioned in 1988. The dam was designed to provide a minimum regulated flow of approximately 9 m^3/s in the river, to secure sufficient flow at the intake, but the minimum discharge from the dam is currently set at 4 m^3/s. The dam and its operation, including sufficient flow in the river at the water intake, is the responsibility of the newly-formed regional water administration of ARA-Sul. AdM takes over responsibility for the water supply at the intake to the treatment plants. A hydrological study of the Umbeluzi River basin is being undertaken by a French consulting company under the French project mentioned above.

The raw water is treated in two plants, an old one just refurbished and a newer one commissioned in 1991, having a combined capacity of 144,000 m^3/d. Both plants are functioning well but due to clear water transmission inadequacies, total production is restricted to about 100,000 m^3/d. However, the dosing systems are said not to be suited for the low quality chemicals available in Mozambique, and batch dosing with HTH has been required during frequent breakdowns. Sludge, back-wash water and sediments from the treatment plants are discharged back to the river downstream of the weir.

Figure 4.1: The Maputo Region

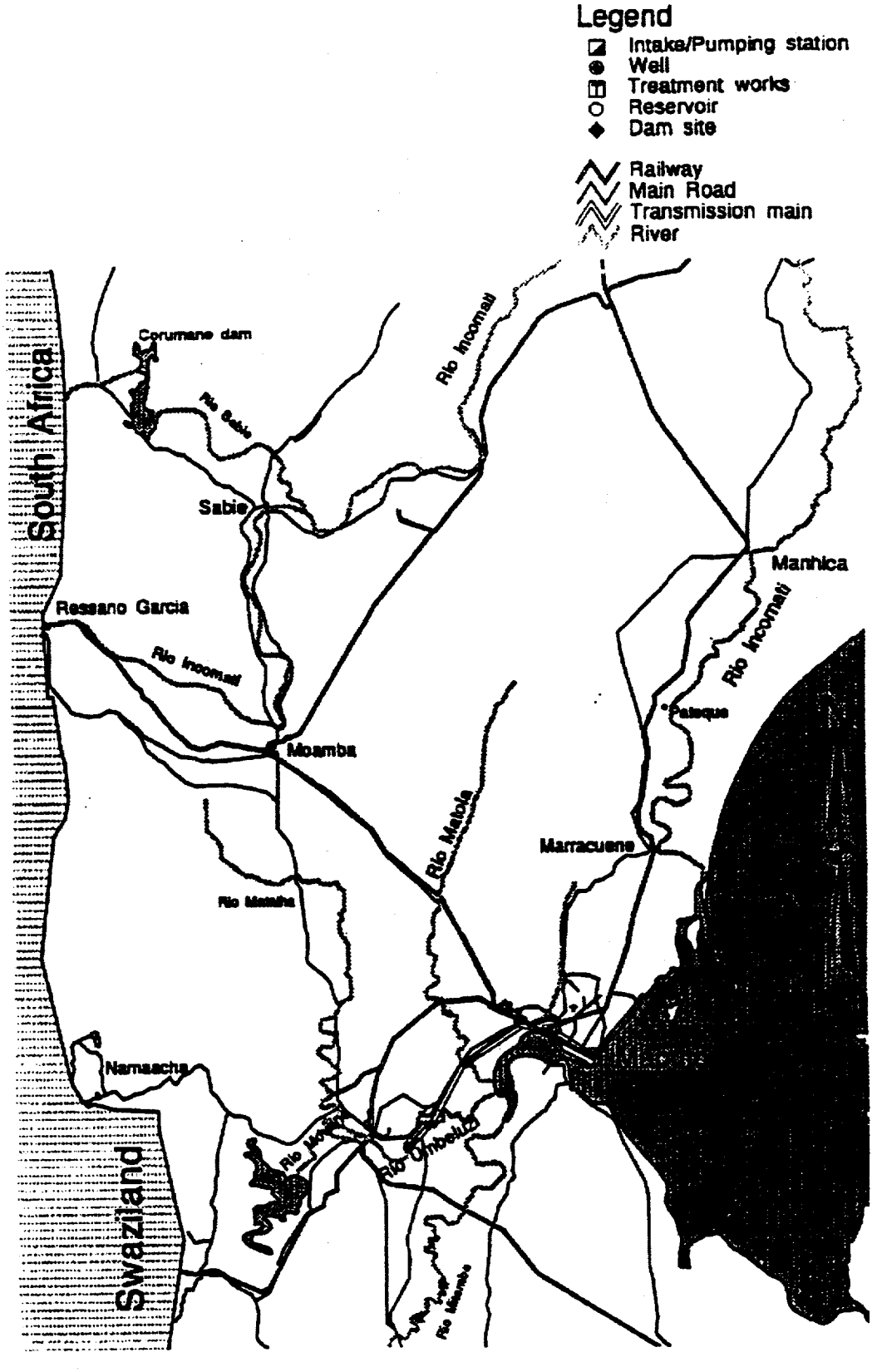
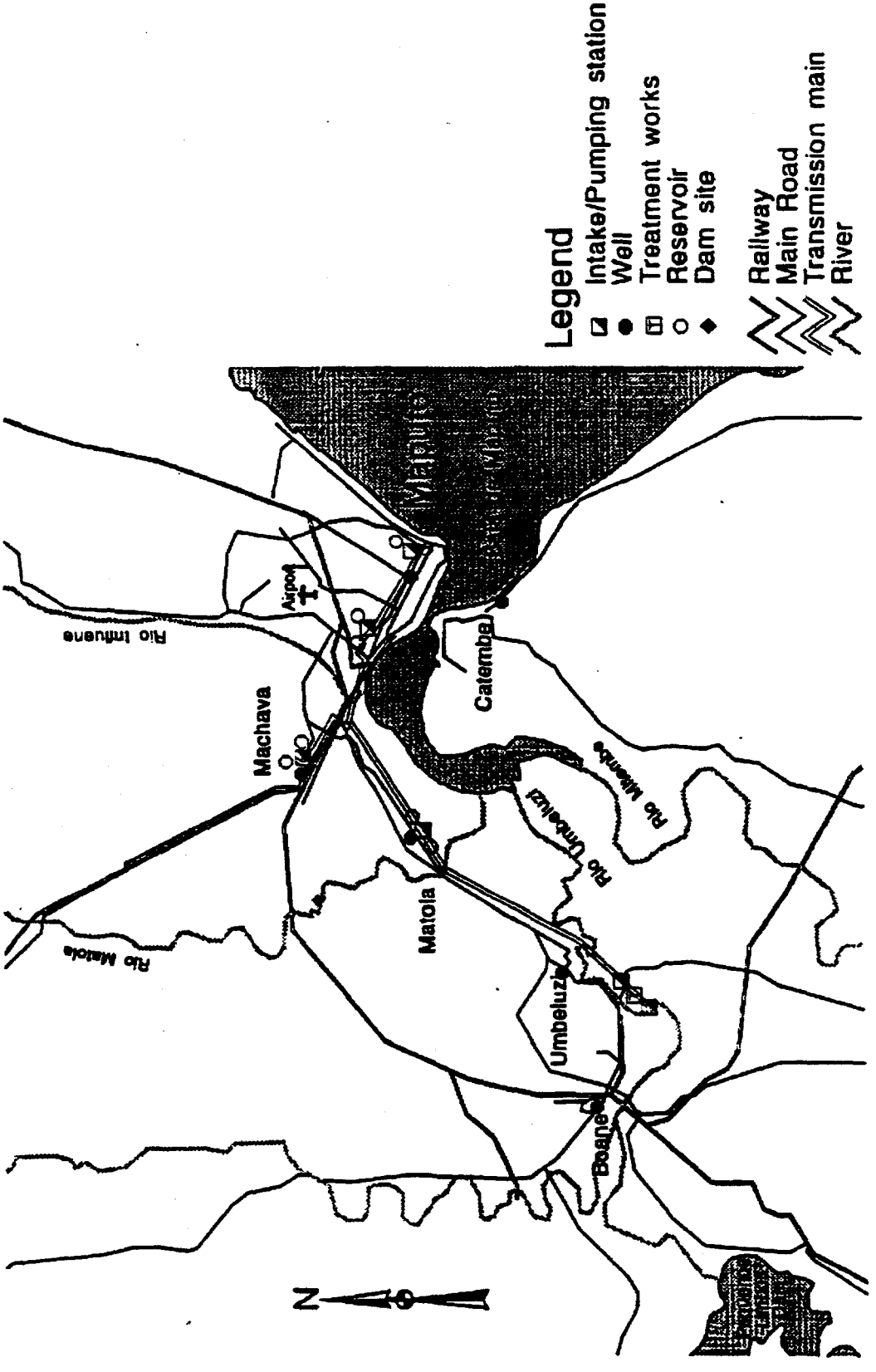


Figure 4.2: The Maputo Water System



A third treatment plant, with a capacity of 72.000 m^3/d, is presently in preliminary design by a French consulting company under French funding. The consultancy also includes a feasibility study for a possible raw water pipeline directly from the Pequenos Libombos Dam to improve raw water quality. AdM indicated that this would probably not be cost effective.

After treatment, water is pumped through twin transmission mains about 14 km to the Matola distribution centre. From there, water is gravitated and/or boosted to distribution centres at Machava, Chamanculo, Maxaquene and Alto Maé. The current bottleneck in the transmission system is a broken down booster station at the Matola distribution centre which limits transmission capacity to the 100,000 m^3/d mentioned above. Rehabilitation, or more probably the construction, of a new booster station and upgrading of the transmission mains to the city are reported to be included in the ongoing French-funded rehabilitation program.

The piped water supply system serves the city and peri-urban areas directly bordering the city, as well as the suburbs of Matola and Machava between the water treatment plant and Maputo city. More periphery areas on the outskirts of the city and suburbs are not supplied by the system but rely on wells fitted with hand pumps. The total number of domestic connections is some 58,000, assumed by DHV (1994) to be 3/4 house connections and 1/4 yard connections. The number of public taps is relatively small, about 500 in the Greater Maputo area, almost all of them located in peri-urban areas. The special *Programa de Abastecimento de Água aos Bairros Periféricos* (PAABP) was set up in 1984 to improve the water supply in the bairros. PAABP is now a part of a nation-wide program, and PAABP (Maputo) is operated by AdM.

The Water Market. The local authority in the bairros has set the price of water at 100 Mt/20 litre bucket. The price charged at the standpost is thus eight times the official AdM tariff for small consumers (5,000 Mt/m^3 as against 600 Mt/m^3). The higher prices are paid by the poorest groups of the urban population. In bairros with more pronounced water shortages, prices at the standposts are even higher (200 Mt/bucket). In these bairros the pressure is low and water supply is often interrupted. Women fill 200 litre bins and sell water to their neighbours. Residents of the bairros should, however, be able to register for obtaining water at a fixed rate of 3,000 Mt/month, regardless of the quantity actually consumed. Residents also complain about the profits made by the managers of the standposts and question where the profits end up. The City Council, local authorities and AdM are meeting regularly to resolve current problems and intend to formalize their cooperation with a contract.

In suburban areas such as Polana Canico a secondary water market has evolved. Water is only supplied between 4:00 and 9:30 am. People will buy water from neighbours who have a private connection at lower cost than that at standposts. Typically a household of five will pay 5,000 Mt/month.

Sewerage Systems. A combined sewerage system for discharge of wastewater and stormwater from Maputo city centre was constructed between 1948 and 1973, resulting in a system totalling 100 km in length This combined storm water and sewerage system discharges to the sea and the Infulene River. Another system separating sewage and

storm water was planned and implemented with Dutch assistance in the 1980s which conveys most of the sewage parallel to the storm water system to lagoons in the Infulene valley, west of the city Centre, and then to the river, which discharges into the shallow Bay of Maputo. Sewage from the eastern part of town is pumped to this system, only overflowing to the drainage system during heavy rains.

The lower part of town, the Baixa, has a combined system which discharges to the harbour without treatment. The last investments in sewerage were made in 1990. Many buildings in the city centre are not connected to the system because the internal plumbing ends up below the sewer level. A large number of septic tanks with soakaways are still in operation. Emptying of septic tanks is undertaken by the City Council or by private contractors against payment. Contractors are expedient but expensive. The Council has old equipment and little capacity, and it is thus difficult to obtain their services.

4.3.2 Current Environmental Situation

Water Source, Treatment, Transmission and Distribution

The field report from the Bank's 1995 project preparation mission (WB 1995) has an outline of hydrological characteristics and potential conflicts with regard to the use of water, and this will not be repeated here. A discussion of the environmental aspects of water resources management is given in Section 4.3.4 below, and again in Section 6.

Since the construction of the Pequenos Libombos dam, the water source has been reliable, allowing a minimum flow of 0.6 to 0.7 m^3/s downstream of the intake for the Maputo water supply. As mentioned earlier, an investigation is going on to establish the real minimum flow which can be secured from the dam and below the intakes. The minimum ecological water demand to control saline intrusion has been estimated at 16 Mm^3/y or 0.5 m^3/s.

Traces of chemical pollution have been found in the Umbeluzi waters, and a 1993 study (Chonguica 1995) indicated that fertilizers used upstream are inducing eutrofication. Pesticides were also found. Traces of lead and cadmium were detected in water from the Calchane river discharging into the Pequenos Libombos reservoir.

At the treatment plant, the tidal range in the river downstream of the weir is at times up to 1 metre. Sludge and backwash water are discharged to the river below the weir along with undissolved sediments from the lime saturators. This arrangement results in large quantities of aluminium and calcium being mixed into highly turbid water which is used for irrigation and supports fish caught for consumption. This could result in negative impacts on the aquatic environment and human health.

Water Quality, Consumers and Health

The distribution system is said to supply clean water complying with WHO requirements 80% of the time. However, water is supplied only a few hours a day, thus leaving the system empty and non-pressurized most of the time. The prevailing sanitary situation (sewerage, drainage) in the supply area is not good, and very bad in some areas

with flooding septic tanks which are not emptied and clogged soakaways. The situation is particularly bad during heavy rains. Since water supply, particularly house connections, creates waste water, the sanitary situation is such that there are high risks of leakage of contaminants into the pipes through cracks, bad joints and during repairs. This situation is probably the cause for the polluted water supplied 20% of the time, and must be considered as a significant adverse effect of the present water supply system.

Accumulation of rain water occurs naturally in depressions that alternate with the dunes in the peri-urban areas. These depression pools of residential waste and rain water lead to the increase of the incidence of malaria in the rainy seasons. Previous surveys indicate that also the ground water of some bairros is contaminated by nitrates and is unsuitable for human consumption. The occurrence of waterborne diseases has become more frequent in the Maputo area, such as an increase in the index of conterminous diarrhoea, epidemics of cholera, and incidences of malaria.

Receiving Waters

Although a large part of the sewage produced in Maputo is piped and treated before discharge to the bay, much is also not being treated, particularly during the wet season. At times of heavy rain, the sewerage system overflows to the storm water system, streets are flooded, and the sewage treatment facilities are overloaded. The bay and harbour of Maputo are considered heavily polluted, a situation which must partly be considered an adverse effect of water supply in combination with an inadequate sewerage system.

4.3.3 Project Description

Supply and Demand Projections

The Provincial Towns Water Sector Study (DHV 1994) projected a population increase for Greater Maputo to about 1.4 million in 1997, 1.7 million in 2002, and 2.7 million at the end of the planning period, 2017. The entire population is expected to be supplied from the main piped water supply as it is extended through the planning period, with about 50% coverage in 1992 and 75 % in 2002. The percentage of house and yard connections is projected to increase from about 30% today to 75% in 2017, and non-domestic water consumption is expected to decrease from about 55% of domestic use to about 30% during the planning period. Unaccounted-for water (UfW) would be reduced from today's approximate 40% to a modest 20% early in the planning period. Based on these assumptions, DHV (1994) projected that the average daily water demand in the supply area will increase to about 132,000 m^3/d in 1997, and to 439,000 m^3/d in 2017, all to be supplied by AdM.

Further, DHV (1994) estimated that a maximum of 240,000 m^3/d can be extracted from the Umbeluzi River. DHV concluded that supply from the Umbeluzi River will become inadequate around 2006 and should then be augmented by diverting water from the Incomati River near Moamba northwest of Maputo to the Umbeluzi via the Matalha and Movene Rivers for 4 to 6 months a year. During the other 6 to 8 months, water should be drawn from the Pequenos Libombos reservoir. Alternatively or additionally, new ground water sources could be developed north of Maputo between Pateque and Manhica. Both options for additional water would require detailed hydrological studies to determine their feasibility.

NWDP Investments

Project investments proposed by the Bank for Maputo (WB 1996b) are shown in Figure 4.3. In addition to hydrological studies to determine the feasibility of developing new water sources from the Incomati River and/or ground water resources north of the city, the project would repair, upgrade and/or extend the existing supply, treatment and distribution system based entirely on raw water withdrawals from the Umbeluzi River.

Project activities on which this EA focuses, with a distinction between those which may cause significant and minor effects, are:

Significant environmental effects:

- increase surface water abstraction from Umbeluzi River

Minor environmental effects:

- new intake and treatment plant
- extension of distribution network

4.3.4 Environmental Assessment of the NWDP

Location, Planning and Design: Water Source

DHV carried out an investigation of the existing and the long term potential water resources for urban use and irrigation for the Greater Maputo area and the Umbeluzi-Incomati River basins (DHV 1994, Maputo: Annex IV). Potential ground water resources were also assessed and an economic evaluation of the potential use of (part of) the resources for irrigation purposes was undertaken, outlining a number of possible scenarios.

As mentioned in section 4.3.3, DHV estimated the maximum amount of water which may be extracted from the Umbeluzi River by AdM to be 10,000 m^3/h (88 Mm^3/year), which corresponds to the projected demand in the year 2006. This assumes a maximum consumption for irrigation purposes of 44 Mm^3/year which corresponds to a limit of slightly less than 4,000 ha of irrigated land. At present, the irrigated area is reported to be in the range of 1,400 ha (of which only half is operational) whereas soil surveys have indicated an irrigation potential of 10,600 ha in the upper Umbeluzi, 2,600 ha in the lower Umbeluzi (near Boane) and 11,000 ha along the Movene River (DHV 1994). When the use of the water resources for irrigation purposes in Swaziland (presently 10,000 ha) are also included, it is very clear that there are competing demands for water from the Umbeluzi River for irrigation and urban use in Maputo, and that alternative sources must be developed to meet at least part of the future demand from AdM.

The principal environmental concerns with regard to the use of water and the water balance in the Umbeluzi basin relate to:

1. The minimum flow required downstream of the Maputo water intake to control salinity intrusion and protect other ecological functions;
2. Proposed future transfers of water from the Incomati to the Umbeluzi River to augment Maputo raw water supplies; and

3. Monitoring and management of the minimum flow being delivered across the border from Swaziland.

Figure 4.3:
Project Investments in Maputo

Sub-Project	Scope	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
Hydrological investigations (1.01)	Set up monitoring program for Calichane and Movene Rivers. Study joint use of Umbeluzi and Incomati river basins. Additional hydrogeological investigations for the Pateque-Manhica area.	XXX	XXX			
Leak reduction program (1.06)	Repair/replace bulk meters. Establish district metering. Rehabilitate/replace 7,500 service connections and replace 15,000 faulty meters. Repair/replace 100 km of distribution pipes. Upgrade 20 km of primary distribution network. Recover 10,000 illegal connections.		XXX	XXX	XXX	
New service connections (1.07)	Connect 13,500 HC, 11,000 YC and 900 PT	XXX	XXX	XXX	XXX	XXX
New intake and treatment (2.01/2)	Construct new intake. Install 3 pumps of 2,500 m^3/h each. Construct new treatment plant 96,000 m^3/d capacity.			XXX	XXX	XXX
Distribution (2.07)	Extend distribution network: Mahotas and other areas			XXX	XXX	XXX

From an environmental viewpoint, there are several dimensions to the question of transferring water from the Incomati via the Movene to the Umbeluzi River. As with the Umbeluzi, competing water demands on the Incomati River for irrigation and human consumption, and maintaining a variety of downstream ecological functions, must be considered. As well, the environmental consequences of increasing flows in the Movene River, beyond what it and its riparian water dwellers and users have evolved to handle, must be assessed.

Regarding minimum flows below the Maputo intake, the EA team was unable to determine on what basis the minimum ecological flow of 16 Mm^3/y or 0.5 m^3/s was estimated. Moreover, this "ecological water demand" appears to be only for the control of saline intrusion. The preservation of other ecological functions (e.g. dispersion and natural purification of waste waters, including those from the Maputo water treatment

plants (see below); preservation of riparian habitats; flushing of suspended sediments through the harbour) does not appear to have been included. *It is vital that good hydrological monitoring at the intake, and thorough analysis of minimum flows required to meet domestic, industrial, irrigation and a variety of downstream ecological demands, be carried out before maximum withdrawals available from the river to supply Maputo are settled. Only with this information in hand will analysis of the requirements for firm minimum flows from Swaziland and/or transfers from the Incomati River be possible.*

Together with the outstanding need to negotiate shared water arrangements with Swaziland and South Africa, the above concerns highlight the need to develop co-ordinated regulating regimes for the various river basins and major water users involved. This will be a task for ARA-Sul in collaboration with the new unit for international river basins in DNA.

The issue of minimum flows in the Umbeluzi below the Maputo intakes should be a key factor in the design of hydrological investigations planned under the Maputo sub-project of the NWDP. Moreover, this and the Incomati and international rivers issues should be addressed by the relevant Water Resources Management components of the NWDP discussed in more detail in Section 6 of this report:

- *Section 6.2: Management Development Plan for ARA-Sul*
- *Section 6.4: Strengthening of Management of Shared Water Resources, and*
- *Section 6.5: Joint Incomati Study -- Supplementary Work in Mozambique.*

Location, Planning and Design: Treatment

Disposal of sludge, backwash water and undissolved sediments from the treatment plant into the river is probably causing negative impacts on the aquatic environment and human health downstream, though the reduced water quality and its impacts have not been studied. *Water quality downstream of the treatment plant should be monitored, particularly during low flows, to determine if contaminants from the treatment process are creating significant problems. If they are, planning for increased treatment capacity at the present site should include provisions for the safe disposal of these wastes into a lagoon or landfill.*

Location, Planning and Design: Transmission, Storage and Distribution

Along the clear water transmission mains between Boane and Maputo, some informal settlements have developed on top of and along the pipelines, and some resettlement will be necessary. Some of the most likely locations are:

- About 100 refugee houses remain along the transmission main between Matola and Maputo, adjacent to the highway and in from the Cement Factory. The area is relatively low and wet and the houses are built on an artificial elevation created for the pipeline. Because of the high pressure in the line, any ruptures would represent serious risks to the safety and lives of these people.

- The area next to Mahotas, where a new distribution centre is planned, is densely populated. Construction of a distribution tower will necessitate the removal of an unidentified number of families.

Upgrading of the transmission main and the new distribution centre are proposed components of French funded projects, and not parts of the NWDP. Environmental and resettlement issues in this regard are thus outside the scope of this EA study. The Team would however, make the following recommendations to the Maputo City Council and AdM:

Families living on the transmission main and in the area of the new Mahotas distribution centre should be resettled in accordance with existing regulation and practice. This matter will be particularly important if the planned upgrading of the whole transmission main goes ahead under French funding.

Construction

No construction impacts were identified which cannot be satisfactorily managed through measures incorporated in the environmental monitoring and management plan (Section 7.3).

Operation

Apart from increased water abstractions from the Umbeluzi River, no operation impacts were identified which cannot be satisfactorily managed through measures incorporated in the environmental monitoring and management plan (Section 7.4). Increased withdrawals of water from the river will result in lower flows downstream of the treatment plant, exacerbation of what impacts may be caused by waste discharges from that plant, and other as yet unidentified water quality, quantity and related ecological and human use effects. These concerns are discussed further in Section 6, Assessment of Water Resources Management Proposals.

The Water Market

With an expanded network, improved quality and regularity of the supply, prices for water should come down in the bairros as compared to today's prices. It is, however, necessary to review and improve the organization of distribution. The collapse of the Grupos Dinamizadores (previous local authority) in the bairros has caused an administrative vacuum at the grass roots organizational level. The local authority substituting for these groups lacks the financial, administrative, political and legal authority and autonomy necessary to set priorities, make decisions and exercise administrative control.

For the organization of public participation in connection with the extension of the distribution system, new partner organizations should be found, such as associations of inhabitants and women's organizations.

4.3.5 Analysis of Alternatives

The principal alternatives which pertain to the NWDP, concern sources of future raw water supply for Maputo. As discussed above, the two alternative sources under consideration are the Incomati River and groundwater in the Pateque-Manhica area north of Maputo. DHV (1994) indicated that further investigations are required to determine the practical and economic feasibility of these alternatives.

Hydro(geo)logical investigations in support of these feasibility studies are planned as part of the NWDP.

It will be essential that these feasibility studies include environmental assessment to evaluate the environmental costs and benefits of each alternative, and to include these factors in any comparison of and selection between the alternatives.

4.3.6 Summary of Recommendations

1. *It is vital that good hydrological monitoring at the intake, and thorough analysis of minimum flows required to meet domestic, irrigation, industrial and a variety of downstream ecological demands, be carried out before maximum withdrawals available from the Umbeluzi river to supply Maputo are settled. Only with this information in hand will analysis of the requirements for firm minimum flows from Swaziland and/or transfers from the Incomati River be possible.*

2. *The issue of minimum flows in the Umbeluzi below the Maputo intakes should be a key factor in the design of hydrological investigations planned under the Maputo sub-project of the NWDP. Moreover, this and the Incomati and international rivers issues should be addressed by the relevant Water Resources Management components of the NWDP discussed in more detail in Section 6 of this report:*
   - *Section 6.2: Management Development Plan for ARA-Sul*
   - *Section 6.4: Strengthening of Management of Shared Water Resources, and*
   - *Section 6.5: Joint Incomati Study -- Supplementary Work in Mozambique.*

3. *Water quality downstream of the treatment plant should be monitored, particularly during low flows, to determine if contaminants from the treatment process are creating significant problems. If they are, planning for increased treatment capacity at the present site should include provisions for the safe disposal of these wastes into a lagoon or landfill.*

4. *For the organization of public participation in connection with the extension of the Maputo distribution system, new partner organizations should be found, such as associations of inhabitants and women's organizations.*

5. *It will be essential that the feasibility studies into future alternate water sources for Maputo include environmental assessment to evaluate the environmental costs and benefits of each alternative, and to include these factors in any comparison of and selection between the alternatives.*

4.4 BEIRA

4.4.1 Existing Water Systems

Institutional Framework and Other Projects

Beira is the second largest town in Mozambique and the capital of Sofala Province. The water system supplies Dondo, Manga and Inhamizua as well as Beira and is run by the Companhia de Águas de Beira (CAB), originally a shareholder company owned by the City Council and anonymous (Portuguese) individuals. At independence, the Portuguese left and the company was nationalised and turned into a state enterprise. This status, however, has never been formalised and CAB has maintained its legal company structure.

CAB operates independently from the City Council (although the City Council is the majority shareholder). In practice DNA supervises CAB through the Sofala Provincial MOPH office by channelling donor investment assistance and the setting of water tariffs. Relations between the City Council and CAB are very strained due to problems with managing the Beira sewage system and to serious management problems within CAB. CAB was previously responsible for sanitation, but the responsibility was transferred to the Council. Despite prolonged investment support from a Dutch-financed project, the Council has been unable to execute proper maintenance of the sewerage and storm water systems. The Council attributes the lack of maintenance partly to CAB which has for more than a year refused to transfer receipts of an agreed 15 % share of the water fee to the Council to cover maintenance costs of the sewerage system.

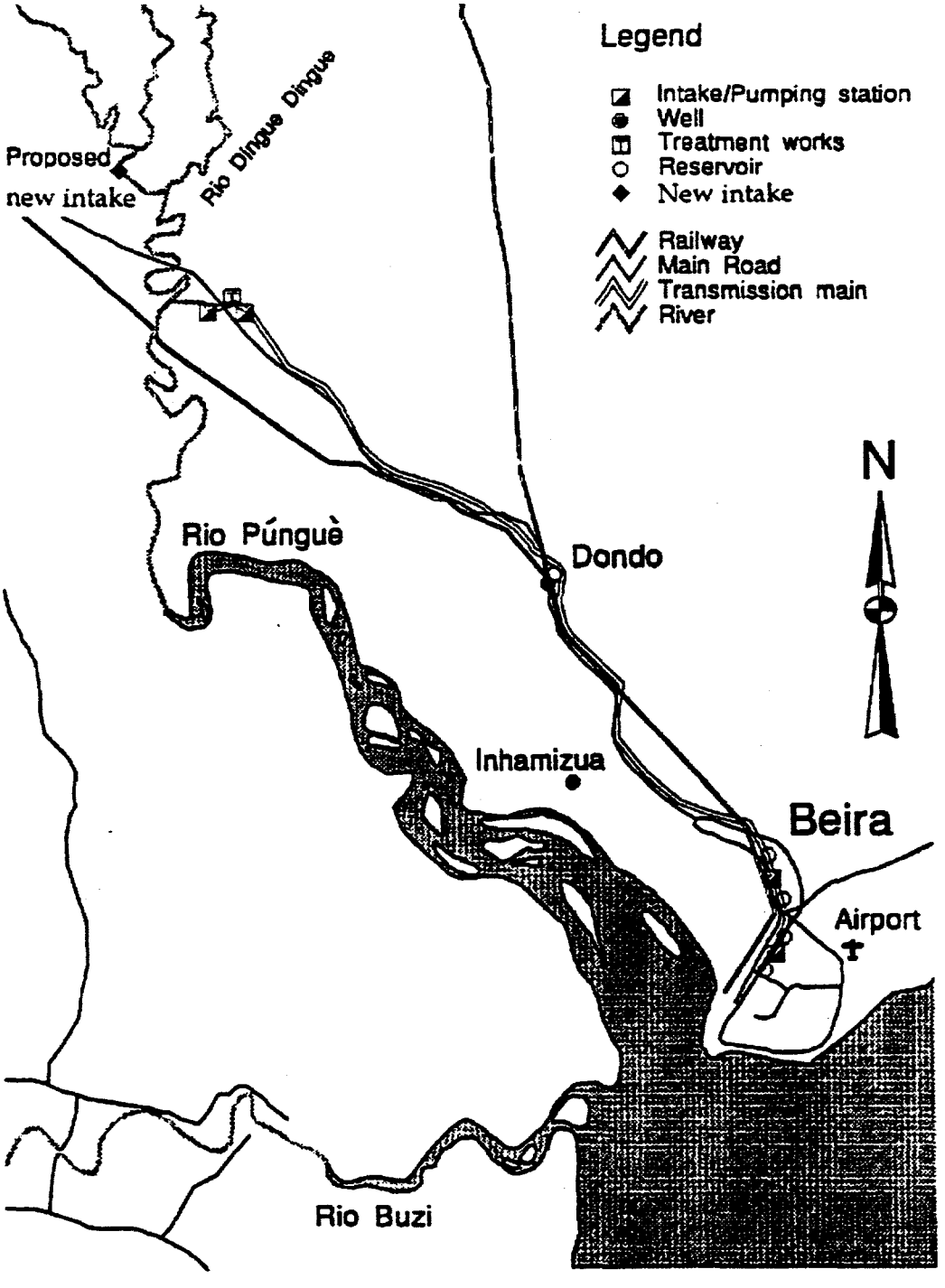
The Finnish Embassy in Maputo has concluded that a recently completed FINNIDA project for institutional support to CAB was a failure due to misappropriation of funds; lack of policies, strategies and tariff structure; and unqualified management which did not follow established regulations. FINNIDA will, however, consider some bridging support to CAB until commencement of the Bank-funded NWDP.

The third institution involved in the Beira water supply is the Mozambique Sugar Estate (*Açucareira de Moçambique*). In the early 1970s a flood destroyed the original CAB water intake in the Púnguè River and CAB has since been dependent on the sugar estate intake pumps and irrigation canal for its raw water supply. The estate is compensated in an agreement between the parties with free potable water. Relations between CAB and the estate are also strained due to salt intrusion in the river and the intake, and consequent interruptions to water supplies (see below).

Water Source, Treatment, Transmission and Distribution

Beira obtains its raw water from the Púnguè River about 75 km from the river mouth (Figure 4.4). Minimum flow on the Púnguè is estimated to be 3.9 m^3/s (337,000 m^3/d) (100 year return period). At the intake works, the river is still tidal and, during the May to October period of drier years, saline intrusion can affect water quality and limit pumping. Salt intrusion during low flows may reach 95 km from the river mouth.

Figure 4.4: The Beira Water System



Water is pumped from the river by the Mozambique Sugar Estate into its 6 km irrigation channel. A 1.5 km branch channel supplies the CAB intake pumping station which feeds two treatment plants with combined capacity of 30,000 m^3/d. A new intake pumping station on the same branch channel, and a new treatment plant (cap. 30,000 m^3/d), both Italian-funded, are almost complete and are said will be finished by the NWDP. Average water production from the existing plants is about 19,000 m^3/d. Waste flows from the treatment process are discharged back into the branch channel beyond the CAB intake.

The estate's river intake is presently undergoing a complete rehabilitation with new intake and outlet pipes and eight new pump-sets to increase capacity from 5.6 to 7.2 m^3/s. The main irrigation channel is subject to siltation and is regularly dredged by the estate.

Treated water is pumped 14.2 km to reservoirs at Mezimbite then gravity-fed 30 km (via Dondo and Inhamizua) to the Manga distribution centre. Here it is pumped into a tower for local distribution and further transmission to the Munhava then Beira distribution centres. Almost complete are a new pumping station at the treatment site and a 52 km transmission main to Munhava. These too are also said will be completed by the NWDP.

The people of Beira and its bairros get their water from wells, private house or yard connections, standposts, through water vendors and from neighbours (Ojanperä 1993). About 45% of the population is served primarily by CAB, 2/3 of which have a house/yard connection and 1/3 depends on standposts (DNE 1994). In 1992 there were 74 standposts in the bairros. By 1995, the number had increased to 112 but only 63 are now in service, each serving an average of about 800 individuals. CAB has created a special Board for organising payment at the standposts. The Board operates a net of local managers made responsible for collecting water fees. They are selected after consulting people in the area and their local leaders. Users pay a fixed fee per family at the end of each month.

The Water Market

An important source of water in Beira is the secondary market developed to cope with the inability of CAB to secure a timely supply of water. It covers about 20 % of the population (Ojanperä 1993). Prices in 1993 were found to vary between 5,000 to 10,000 Mt/m^3. It was not possible to identify current secondary market prices but they are a multiple of the official CAB tariffs and vary considerably depending on the services included -- e.g. whether water is brought by the vendor to elevated floors of high rise buildings, or if the buyer goes to the vendor. Another variable is the relationship (kinship) between buyer and seller. Anecdotal information indicates that they may reach 50,000 Mt/m^3.

Sewerage Systems

The only piped sewerage system in the supply areas of CAB is in the city centre and serves about 30% of the population. Operation and maintenance of the system is the responsibility of City Council, but neither the customers nor the water company are paying any contribution for the services. The system is comprised of about 50 km of

reticulation, 9 km of main collector pipelines, 11 lift stations to deliver sewage to the mains, and four mains pumping stations to discharge the sewage to the Púnguè River estuary without any kind of treatment. Outside the city centre, septic tanks with soakaways and pit latrines constitute the main sanitary facilities.

The Urban Infrastructure Programme, financed by the World Bank, and a program funded by the Dutch government, have rehabilitated parts of the piping system and all pumping stations in recent years. According to information obtained during the visit, many pumps have broken down after rehabilitation but at least one pump is working in each station.

4.4.2 Current Environmental Situation

Water Source, Treatment, Transmission and Distribution

Beira's raw water supply is totally dependent upon the continuous operation of the river intake owned and operated by the sugar estate, an undesirable dependency. The main problem is the salt water intrusion at low flows which causes salt contents far above the limit which is acceptable for the irrigation of sugar cane (140 mg/litre). When this occurs, normally during the early August to mid-December period, the estate stops pumping river water to protect its land and crops from salination. Although the water is still suitable for human consumption (WHO recommended maximum 250 mg/litre), CAB is consequently forced to shut down the city water supply.

This interruption causes serious adverse impacts in Beira. Only last year the intake was closed for 10 days in succession. By strict rationing of the water in the channel and the reservoirs, some supply was possible for three days, leaving people without water for one week. Under the circumstances, the population uses whatever water can be found and since the sewerage system also stops functioning in these situations, the effects are potentially disastrous. It is strange that the new Italian-funded raw water pumping station was located on the existing raw water channel, thus maintaining the salt intrusion problem and the dependency on the sugar estate. This was, apparently, against advice of both CAB and the City Council who wanted to restore the original river intake upstream which was washed out in the early 1970s.

At the treatment plant, sludge and backwash water are discharged back to the intake branch of the channel, downstream of the intake. The channel continues far into the marshy flatland and the idea is that solids should settle while water should seep back to the river. As it is, the channel has silted up and, during floods or when raw water intake to the channel is less than the pumping rate of the raw water station, heavily polluted water flows backwards to the intake. During the site visit, two clearly distinctive flows, one from each direction, were feeding the intake pumping station, the one from downstream being completely black. This situation clearly adds to treatment costs.

The transmission system capacity is adequate for the water production at the treatment plant in operation, but not more. The leaking ground reservoir in Manga, causing loss of precious water, is aggravating the difficult supply situation. The Italian-

funded transmission line could have eased the supply situation, along with the other components under the same program. Moreover, the 40 year old distribution system is in a poor state with frequent bursts in spite of extremely low pressures in the city centre and some rehabilitation and replacement works recently carried out with FINNIDA support.

Water Quality, Consumers and Health

With water being distributed only about 7 hours per day, and sometimes not at all, the distribution system is often empty and non-pressurised. This, coupled with an inadequate and only partly developed sewerage system, means that the water reticulation is susceptible to contamination from pit latrines and drained or flooding septic tanks. As the sewerage system to a great deal is dependent on sewage pumping stations, break-down of these causes leakage and high risk of contamination of water pipelines, with adverse impacts to human health. The EA team was not able to obtain any official statistics on the health and hygiene situation in the city and the bairros. However, anecdotal information indicate that the health situation is no better in Beira than in other cities, and that incidents of cholera had been recently reported.

Receiving Waters

Anecdotal information indicate that sewage and waste water being discharged to the Púnguè River mouth without treatment is causing severe pollution of the waters and the shores along the water front. This results in health risks to everybody taking part in the harbour activities and is adversely affecting the general impression of the town and surroundings. The pollution is possibly also having other adverse ecological effects.

4.4.3 Project Description

Supply and Demand Projections

DHV (1994) projected the population in the supply area to increase to about 490,000 in 1997 and to about 980,000 by the end of the planning period, year 2017. Only the urban and peri-urban areas will be covered by the water supply system which means that Beira and Manga will have full coverage in 2017 whereas the coverage in Inhamizua and Dondo are estimated to be 85% and 75% respectively in the same year. Unaccounted-for water (UfW) was taken to be reduced from 40 - 50% of present production to a modest 20% early in the planning period. The present level of service, with 68% of the population not covered and only 25% covered by house and yard connections, is expected to improve until full coverage is reached in 2017 with 75% being supplied by house/yard connections.

Based on the above assumptions, DHV (1994) projected an average day water demand increase to about 21,000 m^3/d in 1997 and 137,000 m^3/d in 2017, all to be supplied by CAB.

NWDP Investments

Project investments proposed by the Bank for the Beira system are shown in Figure 4.5. They involve:

- New intake pumping station, first phase

- Local storage and pumping at Inhamizua and Dondo
- Water loss reduction and metering
- New service connections

In addition, it is understood that the new intake pumping station and treatment plant almost completed with Italian funding will be finished by the NWDP (Shepherd 1996a).

Figure 4.5:
Project Investments in Beira

Sub-Projects	Scope	Yr1	Yr2	Yr3	Yr4	Yr5
New intake (1.03)	Construct first phase of new intake pumping station of 2,000 m^3/h capacity (ultimate cap. 7,200 m^3/h).	XXX	XXX	XXX		
Storage (1.07)	Construct 2,500 m^3 ground level reservoir with pumping unit in Inhamizua (south).			XXX	XXX	
Storage (1.08)	Construct 2,000 m^3 ground level reservoir with pumping unit in Dondo.			XXX	XXX	
Distribution (1.10)	Loss reduction and consumer meter program.	XXX	XXX	XXX	XXX	XXX
Distribution (new connections) (1.11)	Construct 2,492 HC and 4,740 YC			XXX	XXX	XXX

Project activities on which the EA focuses, with a distinction between those which may cause significant effects and those for which effects are likely to be minor, are:

Significant environmental effects

- increase surface water abstraction from Pungue River

Minor environmental effects

- new ground level reservoirs at Inhamizua and Dondo

4.4.4 Environmental Assessment of the NWDP

Location, Planning and Design: Water Source and Treatment

The DHV report (1994) for Beira states that there is sufficient water for the supply of Beira if this is given priority over any other uses, and if the saline intrusion problem can be solved. However, it will be necessary to limit other uses in the future as the demand for Beira water supply increases. (Minimum annual recorded flow was 766 Mm^3/y in 1967-8 against projected demand of 50 Mm^3/y in 2017). The National Irrigation Development Master Plan (quoted in DHV 1994) recommended that the total irrigated

area should be limited to about 8,500 ha (present area of the sugar estate). Although no minimum flow requirement was specified, the estimated irrigation area limit was taking into account the need to use available flow to push the freshwater/saline water interface downstream. It is not known whether possible reduction in flows across the border from Zimbabwe was considered. A new supply line from the river destinated for the town of Mutare in Zimbabwe, is under construction. Planned extraction is 0.7 m3/s, but the capacity is actually higher.

Provided that restrictions on water use for irrigation are enforced to maintain a minimum downstream flow, the increased abstraction of water for Beira from the Púnguè River would probably not cause any significant environmental impact. This statement, however, also presupposes that a satisfactory agreement is reached with Zimbabwe with regard to the shared water resources of the Púnguè River. *DNA and/or the new ARA for the region should monitor water demands on the Púnguè River from irrigation and other uses in Mozambique and from Zimbabwe. Should these demands plus water supply to Beira indicate potential problems with maintaining minimum flows in the lower river, more detailed hydrological analysis should be carried out to assist in resolving competing water demands.*

Monitoring of salt content, evaluation of the weir option and hydrological studies, as recommended by DHV (1994), have been omitted from the NWDP investments outlined in Figure 4.5. The recommended new intake pumping station is included, but its location is not specified and no raw water transmission main to the treatment plant is included. The Bank is currently studying the downstream weir option (Shepherd 1996a). Although not specified in the investment plan of NWDP, there is evidently still some analysis to be completed before a final solution to Beira's raw water supply, and investments under the NWDP, are settled. At this point, there appear to be five options:

1. A new river intake at the current location, no weir, and discharge of raw water into the existing channel for delivery to the treatment plant intake. This appears to be what the Bank is currently proposing.
2. Option 1 but with a weir in the river.
3. Option 1 but with a pipeline from the river intake to the treatment plant directly. This would eliminate the need for intake pumps on the channel into the treatment plant.
4. Option 1 but with a weir and a pipeline from the river intake to the treatment plant directly. This would eliminate the need for intake pumps on the channel into the treatment plant.
5. Location of a new river intake 14 km upstream, to avoid the salt water intrusion problem altogether, and a pipeline to the treatment plant directly.

Options 1 and 3 do not solve the salt water intrusion problem. Options 2 and 4 will solve the problem both for CAB and the sugar estate if the weir can be reliably built and operated, and if it is affordable considering both capital and O&M costs. Both these assumptions need to be seriously examined. Option 5, the one most desirable to both CAB and the City Council, will very likely solve the salt water intrusion problem for CAP, but not for the sugar estate, and includes no new technology which CAB must

adapt to. Options 3, 4 and 5 all release Beira from dependency on the sugar estate's own pumping criteria and schedule.

It is our opinion that Option 5 should be seriously considered since it offers the simplest technical solution to the salinity problem and releases Beira from dependency on the sugar estate. Options involving a weir are likely to have significant environmental impacts, especially to fisheries and river navigation, which would have to be assessed. The other options will have minimal and manageable environmental effects. However,

> *We recommend that a thorough feasibility study be undertaken, considering all five supply options, before settling the final solution for Beira's raw water supply and the final proposed investments under the NWDP. Any options involving a weir in the Púnguè River will if selected, require a separate environmental assessment.*

Completion of the Italian-funded treatment plant must include provisions for safe disposal/discharge of sludge and backwash water. The present self-polluting situation must be discontinued.

Rehabilitation of the existing treatment plants is not included in the NWDP. The reason could be that the new, Italian-funded treatment plant will have sufficient capacity alone until approximately 2000. *However, the existing treatment plants, particularly the newer one, should be rehabilitated to prevent further deterioration with adverse effects and extra costs when the capacity is needed in a relatively near future.*

Location, Planning and Design: Transmission, Storage and Distribution

The route for a possible new raw water transmission main has not been studied, and no specific comments on environmental impacts are possible. However, the area is sparsely populated, and significant environmental impacts from one, later two, pipelines in parallel are not expected.

The distribution system recommended for Inhamizua by DHV (1994) has been left out of the NWDP. However, a local reservoir, drawing water from the transmission line, has been constructed under Finnish funding, including also a pumping station and a small, elevated reservoir. A distribution system would be a natural part of this program, but the extent is not known.

Construction

No construction impacts were identified which cannot be satisfactorily managed through measures incorporated in the environmental monitoring and management plan (Section 7.3).

With regard to employment, Beira is not much different from other major cities of the country. Unemployment and underemployment rates are extremely high with more than half of the population between the age of 15 and 59 being unemployed (DNE 1994). The area also counts a large number of demobilised soldiers (100,000 in the Sofala Province, 14,000 in Beira itself). At the same time, there are at least three local

companies capable of executing construction works under the NWDP: CETA, Teixeira Duarte and COTAM.

Operation
Apart from the potential for increased sewage treatment and sanitary problems addressed in Section 4.2.1, no operation impacts were identified which cannot be satisfactorily managed through measures incorporated in the environmental monitoring and management plan (Section 7.4).

Receiving Waters
The increased water supply and number of connections will cause increased sewage and waste water production, especially if recommendations in Section 4.2.1 are not followed. Unless extension and improvement of the water supply is accompanied by parallel improvements in the sewerage system and/or introduction of other appropriate sanitation solutions, the present untreated discharge of solids and human wastes will increase, polluting the harbour and nearby ocean and beaches, and creating the potential for impacts to both the aquatic environment and human health.

Recommendations for the planning of waste water treatment facilities are discussed in Section 7.2 of the Environmental Management Plan. See also Section 4.2.4.

4.4.5 Analysis of Alternatives

DHV (1994) offered two alternatives for improving raw water quality, the Púnguè River being the source in both cases:

- Construction of a weir downstream of the intake to prevent salt intrusion;
- Construction of a new intake where salt intrusion does not occur, 14 km up the river just above the tributary Dingue-Dingue River.

These alternatives were discussed above in Section 4.4.4.

DHV (1994) also mentioned developing ground water supply but this would only complement the present source and is not discussed here. Also mentioned was, for the long term, constructing a storage dam on the Púnguè River at Bué-Maria. A design has already been prepared for a large dam at this location. It is not likely that the project will be considered viable in the forseeable future and is not discussed further in this report.

4.4.6 Summary of Recommendations

1. *DNA and/or the new ARA for the region should monitor water demands on the Púnguè River from irrigation and other uses in Mozambique and from Zimbabwe. Should these demands plus water supply to Beira indicate potential problems with maintaining minimum flows in the lower river, more detailed*

hydrological analysis should be carried out to assist in resolving competing water demands.

2. *We recommend that a thorough feasibility study be undertaken, considering all five supply options discussed in this report, before settling the final solution for Beira's raw water supply and the final proposed investments under the NWDP. Any options involving a weir in the Púnguè River will if selected, require a separate environmental assessment.*

3. *Completion of the Italian-funded treatment plant must include provisions for safe disposal/discharge of sludge and backwash water. The present self-polluting situation must be discontinued.*

4. *The existing treatment plants, particularly the newer one, should be rehabilitated to prevent further deterioration with adverse effects and extra costs when the capacity is needed in a relatively near future.*

5. *Recommendations for the planning of waste water treatment facilities are discussed in Section 7.2 of the Environmental Management Plan.See also Section 4.2.4.*

4.5 QUELIMANE

4.5.1 Existing Water Systems

Institutional Framework and Other Projects

Quelimane is the capital of the Zambezia Province, situated on the northern bank of Rio Cuacua as it reaches the Indian Ocean. The water supply mainly covers the town of Quelimane, but some standposts and other, single connections along the transmission main to the town distribution centre are also supplied by Empresa de Água de Quelimane (AdQ). AdQ is a state enterprise "in creation"; it functions as an independent company but is supervised by DNA through the Zambezia Provincial MOPH office. There are no formal connections between AdQ and the Quelimane City Council. Co-operation with the city health service is limited to exchange of biological test results from water taps and there are no dialogue on health problems.

Other projects in the area include a German-funded manpower development initiative within AdQ as an emergency measure. Fundação Eduardo Mondlane is sponsoring a sanitation project in the peri-urban areas. PRONAR, the Rural Water Program, is constructing wells in the Quelimane area. In the near future, the National Roads Directorate will begin to rehabilitate and extend the main road along the transmission main from Quelimane via Nicadala, and passing Licuare, with financing from the Bank through the GoM National Roads Program.

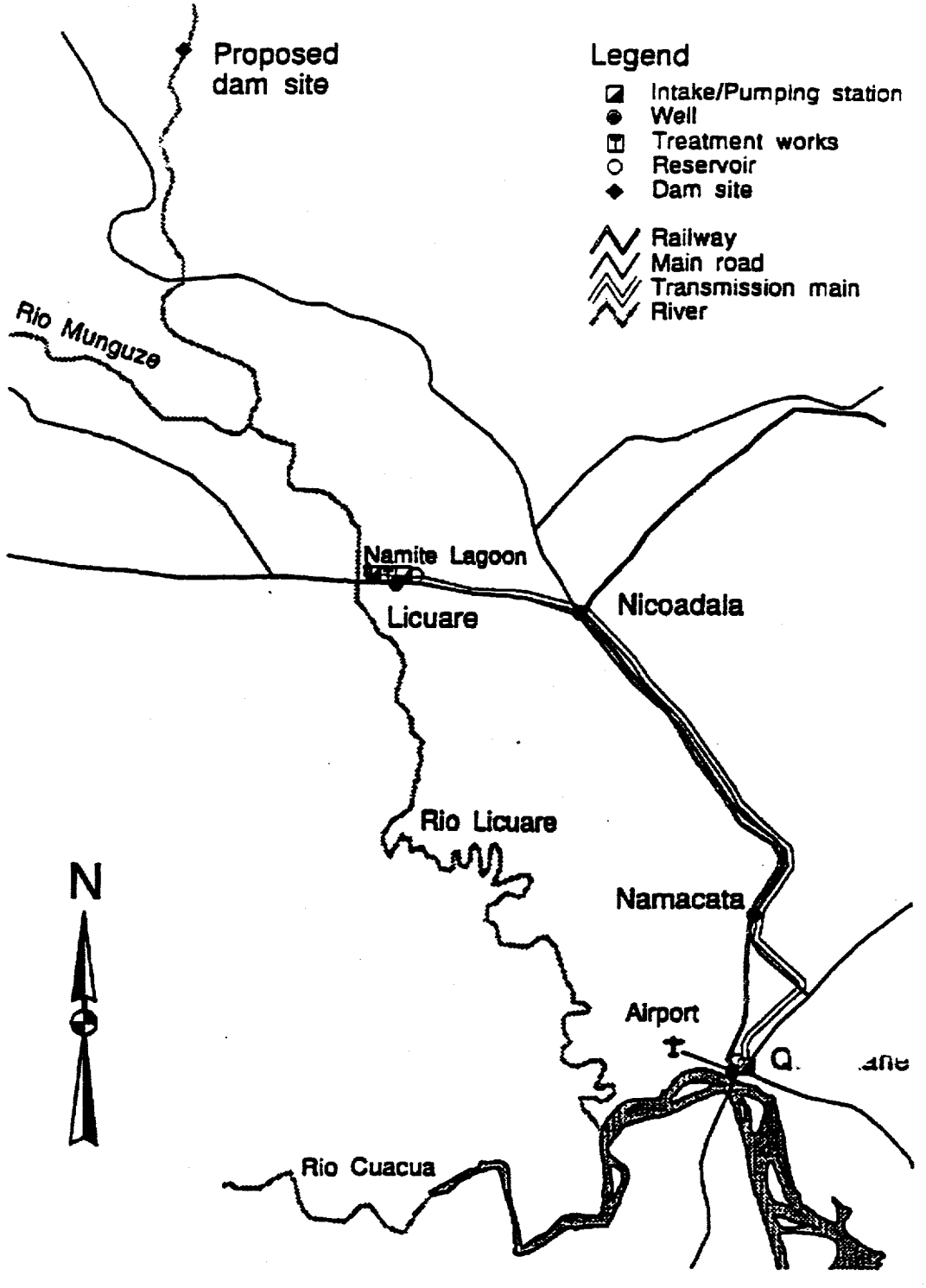
Water Source, Treatment, Transmission and Distribution

The original and main water source for Quelimane is the artificial Namite Lagoon close to the Licuare River about 50 km northeast of town (Figure 4.6). The lagoon is fed by groundwater and by pump and 950 m open canal from the river during dry periods when groundwater flows decrease. The lagoon is severely overgrown by hyacinths and weeds. An intake tower with three pumps (one operational) in the lagoon feeds the treatment plant on the shore. Another, bigger pump has been installed in a shed on the shore with an intake pipe into the lagoon and outlet pipe to the plant. The German government has funded the drilling of five boreholes near the treatment plant yielding 150 to 220 m^3/h though the driller suspects that the long-term recharge will not allow all boreholes to be in operation simultaneously. One borehole has been completed, with a smaller pump than planned, and provides about 70 m^3/h to the plant.

The conventional treatment plant is in a state of complete deterioration except for one rapid sand filter. Due to lack of money, no chlorination is carried out and no equipment for this is present. Thus, water treatment for Quelimane is virtually non-existent.

From the treatment plant, water is pumped into an elevated reservoir, and further gravity-fed by a 51 km main to ground level reservoirs in town. These systems are also in poor condition with pumps working intermittently or not at all, dangerously deteriorated support structures, and leaky tramsmission main. Direct pumping, omitting the water tower, is considered impossible as several pipe-bursts occur every month with just gravity, leaving the town without piped water supply.

Figure 4.6: The Quelimane Water System



The pipeline supplies a few standposts and some private connections on its way to town. The distribution centre at AdQ headquarters comprises two ground tanks, a pumping station and a water tower from which water is supplied to the distribution system a few hours per day. No bulk water meters are functioning anywhere in the production or transmission system.

There are only 2,100 private connections (house/yard) in the city which serve 7 % of the population (DHV 1994). About 1/3 of the population depend primarily on standposts for their water (DNE 1994). However, only 12 of the 27 standposts installed are functioning. The rest of the population, approximately 60% depend on wells as their main source of water. The wells are apparently more reliable than piped water from AdQ. Water use is not metered but average total use is estimated to be about 1,800 m^3/d (DHV 1994).

The Water Market

In Quelimane, standpost caretakers are apparently free to set their own prices for water. In response to the general raise in tariffs from February 1996, the EA team observed that at one particular standpost the price was 50,000 Mt/m^3. This is more that 70 times the official tariff at standposts set by the Government. The caretaker is allegedly charged 319,000 Mt/month by AdQ for the operation of the standpost but there appears to be no control from the enterprise on his financial operations. The price on the secondary market is also around 50,000 Mt/m^3.

Sewerage Systems

In the city centre, a rudimentary drainage system is also functioning as sewerage system, with several septic tanks connected. Apart from the septic tanks, which are never emptied, no wastewater treatment exists, and the combined drainage and sewage is discharged directly into the Cuacua River. Flooding septic tanks are common during rains and blocked drainage canals and pipelines are causing health risks. Operation and maintenance of the sanitation and sewerage systems are the responsibility of the City Council, but no charges are being claimed or paid, and there is no formal cooperation between AdQ and the Council on the issue. Outside the town centre, sanitation facilities comprise pit latrines and a few septic tanks with soakaways.

4.5.2 Current Environmental Situation

Water Source, Treatment, Transmission and Distribution

The Namite Lagoon is subject to siltation due to sedimentation of turbid river water at high flow, and to overgrowing due to stagnant water. Nonetheless, the lagoon is improving raw water quality by filtration in the ground at high flows and functions as a settling basin for turbid water when this is pumped from the river. The plant operator is pleased with the intake arrangement as a whole and wants no changes. The ongoing ground water development is important as it is believed to achieve a yield sufficient to close down the treatment plant for desperately needed refurbishment. The treatment plant is virtually non-functioning and the population of Quelimane is consuming untreated river water, except from the processes in the lagoon, mixed with ground water reportedly of good quality. The situation undoubtedly has the potential for adverse impacts on health.

Water Quality, Consumers and Health

Water supplied to the public of Quelimane is of bad quality (e.g. washing machines cannot be used due to high contents of sand and silt), and house connections create waste water. With the prevailing sanitary situation in Quelimane, with septic tanks flooding and never emptied and drained, or connected to a poor sewerage system, the house connections constitute a health hazard to the public, particularly during rains. Also, since water is provided only for a few hours a day, the distribution system is empty and non-pressurised most of the time. These conditions represent a high risk of leakage of contaminants through cracks and open joints into the water-pipes.

Water supplied by AdQ is tested once a month by the Quelimane Hospital laboratory. The water is normally regarded as unsuitable for human consumption. Diseases such as diarrhoea, cholera, hepatitis and typhoid fever occur in the city on a regular basis. Other water-related diseases such as malaria and filaria occur as well as problems caused by improper hygiene practices (scabies and trachoma). Statistics could however, not be obtained.

Although some health workers qualified the population's knowledge of hygiene and waterborne diseases as sufficient, it was admitted that there are many problems. Extension workers recommend that people boil drinking water before consumption, but most people fail to do so. The reason is probably a complex of poverty, lack of sufficient firewood and ignorance as to the health dangers of impure water.

The sanitation situation of public areas, such as markets is very poor. Only the Central Market has a water connection. The markets in the peri-urban areas are not served by AdQ.

Receiving Waters

Waste and storm water, carrying human and solid wastes, eventually discharges into the harbour and estuary of the Cuacua river totally uncontrolled and without treatment. The pollution constitutes a health risk to fishermen, washing and other activities in and around the harbour and shores bordering the seaward side of town, and has potential negative effects on the ecological systems of the estuary.

4.5.3 Project Description

Supply and Demand Projections

DHV (1994) projected the population in the supply area to increase to about 149,000 in 1997 and to 326,000 at the end of the planning period, year 2017. Approximately 40% of the population in 1994 were refugees, and it has been assumed that some 60% of these will return to their home villages. Only the urban and peri-urban population will be covered by the supply system, and this part of the population is estimated to increase from today's 48% to 58% in 2017. Unaccounted-for water (UfW) is taken to be reduced from today's 50 to 60% of production to a modest 20% early in the planning period. The present level of service, with 52% not covered, with 22% of those covered having house or yard connections, is expected to improve until full coverage of the urban and peri-urban population is reached in 2017 with 75% covered by house/yard connections.

Based on the above assumptions, DHV (1994) projected an average daily water demand increase to about 3,600 m^3/d in 1997 and 26,000 m^3/d in 2017, all to be supplied by AdQ.

NWDP Investments

Project investments by the NMDP for the Quelimane system are shown in Figure 4.7. They include hydrological and hydrogeological studies in the Licauri basin to improve water supply data and examine the feasibility of a dam. New intake works at the river and water main to the treatment plant (bypassing Namite Lagoon), refurbishment of the treatment plant, a new transmission main, and new ground level storage in the town are planned. Metering, leak detection and repair, and expansion/improvement of the distribution system, including connection of settlements along the transmission main, are also part of the program.

Project activities on which the EA focuses, with a distinction between those which may cause significant effects and those for which effects are likely to be minor, are:

Significant environmental effects:

- increased surface water abstractions from Licuare River
- new transmission main from treatment plant to town (mainly due to the expansion and upgrading of the road)

Minor environmental effects:

- small weir and new intake on the Licaure River
- transmission main from river to treatment plant
- new ground level storage reservoir in town
- extension of distribution system

4.5.4 Environmental Assessment of the NWDP

Location, Planning and Design

The DHV (1994) report on Quelimane offered an analysis of the discharge pattern of the Licuare River based on data from a total of 14 years during the period 1967-84. The discharge has very irregular intra-annual distribution (only 6% from June to November on average). The analysis also revealed that there is an important variability on an inter-annual basis. The mean flows in the river, in particular during October, will therefore not be sufficient for the future demand from AdQ. Increased water abstraction from the river, without a regulating reservoir, will further reduce the flow with the risk of the river bed downstream remaining dry or with a very low flow over prolonged periods during the dry season. This may cause adverse ecological impacts downstream to where the river discharges into a marshy flatland and a network of historical riverbeds of the Cuacua river. The time allocated did not permit the EA team to conduct further investigations. No settlements were, however, observed along the stretch of the river which may be affected.

Figure 4.7:
Project Investments in Quelimane

Sub-Project	Scope	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
Hydrological investigations (1.01)	Licuare alluvial aquifer hydrogeological study. Start hydro and meteorological program in Licuare basin and detailed investigations of dam site on the Licuare River.	XXX				
Leakage reduction (1.06)	Prepare reliable maps of distribution system. Install/repair bulk and connection water meters. Leak detection and repair.	XXX	XXX	XXX	XXX	
Service connections (1.08)	Install 1,500 HC, 1,500 YC and 30 PT.		XXX	XXX	XXX	XXX
New intake (2.02)	Build small weir in Licuari River. Construct new intake tower. Install 2 pumps 375 m^3/h each.		XXX	XXX		
Increase transmission capacity (1.07)	Lay 51 km of 500 mm main. Install 2 pumps 450 m^3/h each. Install water hammer facilities.		XXX	XXX	XXX	
Increase storage capacity (2.03)	Construct 3,000 m^3 ground level reservoir in town.		XXX			
Upgrade/expand distribution system (2.04)	Expand/improve distribution system. Increase capacity of primary distribution system.				XXX	XXX
Service connections (2.05)	Install HCs, YCs and PTs.				XXX	XXX
Bypass Namite Lagoon (1.03)	Lay 1 km of 400 mm main from river to treatment plant.		XXX			
Treatment (1.04)	Rehabilitate treatment plant.		XXX			

Plans to construct a new intake at the river, and to bypass Namite Lagoon will omit use of the lagoon as pre-treatment of the river water, which must be considered negative. On the other hand, waste of water and energy by seepage from the canal and lagoon will be avoided and, with a fully operational treatment plant, the solution will have a net positive effect on the quality of water supplied.

The construction of a weir in the river, believed to be necessary to acquire sufficient intake depth, could have negative environmental effects as it will hinder the passing of boats and possible fish migration during the dry season. Apparently, this is

not considered a problem locally, and no professional opinions were acquired during the team's visit. *The weir should be omitted if possible.*

Both with regard to securing the water supply for Quelimane over the year and for mitigating any negative environmental impacts from reduced flows during the dry season resulting from increased water extraction, the DHV proposal of constructing a storage reservoir upstream is supported. *It is recommended that estimation of the storage volume of the new reservoir should include the eventual requirement of a minimum ecological flow downstream of the water intake. Although a new reservoir is not included in the NWDP, this should be assessed during the proposed hydrological investigations.*

The planning of increased treatment capacity at the present site must include provisions for the safe disposal/discharge of sludge and backwash water, possibly to the lagoon which will be abandoned as water source, or to the river downstream of the new intake if considered safe. Care should be taken in the design of the refurbished facilities to choose processes and equipment the same as or similar to the existing ones as far as possible (see Section 7.2.1 for more details).

The NWDP includes the construction of a new, separate pumping station at the treatment site pumping directly to town through a new transmission main with no connections on the way. The old pumping station, water tower and AC transmission line is supposed to be kept for supply of the villages along the route after repairs to the pipeline and valves. However, there is good reason to believe that the old pipeline is approaching the end of its lifespan. *It is recommended that the old pipe be abandoned and the new pipeline be equipped with branches along the route, including pressure reduction valves or local elevated reservoirs as required, to supply adjacent settlements.*

The main road next to the pipeline is partly non-existent and a World Bank project is upcoming for its rehabilitation and widening. With shoulders and ditches, the new road will require a width of 30 m. It is expected that the road works will affect agricultural areas (rice fields) and require the resettlement of an as yet undetermined number of families. The new transmission main, parallel to and replacing the present one, would probably also require the resettlement of some families along the route.

Planning and construction of the new transmission main should be closely co-ordinated with these road plans to minimize construction disturbance to local people and, where possible, make use of joint rights-of-way to minimize any required resettlements. In any case, detailed study is required to set the final transmission main alignment and identify resettlement requirements.

Construction

No construction impacts were identified which cannot be satisfactorily managed through measures incorporated in the environmental management plan (Section 7.3).

Statistics indicate an unemployment rate of 45 % of the population in age groups between 15 and 59 (DNE 1994). Construction works from project investments will create at least temporary employment opportunities for local skilled and unskilled

workers, provided that local companies are considered for engagement on the various components of the project. It is likely that qualified companies exist in Quelimane and should be investigated further during project preparation.

Operation

Apart from the potential for increased sewage treatment and sanitary problems addressed in Section 4.2.1, no operation impacts were identified which cannot be satisfactorily managed through measures incorporated in the environmental management plan (Section 7.4).

Receiving Waters

The increased water supply and number of connections will cause increased sewage and waste water production, especially if recommendations in Section 4.2.1 are not followed. Unless extension and improvement of the water supply is accompanied by parallel development of adequate sanitary solutions, the present untreated discharge of solids and human wastes will increase, polluting the harbour, the river estuary and nearby ocean and beaches, and creating the potential for impacts to both the aquatic environment and human health.

Recommendations for the planning of sewage and waste water treatment facilities were discussed in Section 4.2.5.

The Water Market

Qualitative, quantitative and regularity improvement of the AdQ water supply will most likely contribute to a significant reduction in the cost of water for the poorer groups of the population in Quelimane. However, the impact of the improved water supply on the local economy will be contingent on the competitiveness of the AdQ water with water from wells where these represent real alternative sources for people. Water from the wells is by its nature free, and well owners will only be interested in piped water if it is of sufficiently high quality and if supply is sufficiently reliable. *The Beneficiary Assessment study should take this issue into account.*

The city of Quelimane hosts a number of industries that depend on regular water supplies. These include a soap plant, a textile industry, fisheries, the railways and the shipping activities. Quelimane is a renown export port for, among other things, copra and tea (Grupo Madal) on the Mozambican coast. A producer of soft drinks had to close down, probably from the lack of a reliable water supply. Continuing failure to supply water on a sustainable basis may led to further closures of industrial plants, thus further endangering the city's economy. The NWDP will thus have substantial economic benefits for the town.

4.5.5 Analysis of Alternatives

A future dam site, required for flow regulation in the Licuare River when water demand increases, has been preliminary located by DHV (1994) to about 30 km upstream of the present intake. Although the NWDP does not include this new reservoir, the possible development of a reservoir in this area is commented upon in general terms in this report regarding environmental impacts. The reservoir area was overflown by the Team

and scattered farms were noted on shallow soils penetrated by rock within rather sparse primary and secondary forest. The development of a reservoir will apparently not require major resettlement. *The area to be flooded should be investigated for environmental resources, e.g. minerals, before a final decision about location of the dam and reservoir is made. Possible conflicts with historical or cultural areas are unlikely in the area in question, but this should always be investigated early in the planning stage for reservoir developments.*

The raw water quality from the new reservoir can be expected to be much the same as from the present lagoon, providing the area to be flooded has no particular adverse characteristics and that activities in the area have not created pollution or contamination. The reliability of water supply created by a reservoir may rapidly decrease due to heavy siltation from the upstream river catchment area or from adjoining terrain. *The state of the catchment area should be investigated, the potential for water quality and erosion problems assessed, and their effects mitigated as necessary by, for example, regulating land use, road construction and deforestation.*

Clearing of the reservoir area should be planned to avoid impacts from decaying vegetation and to create the impression of a natural lake without the adverse impression of a dead, flooded landscape.

Notwithstanding the above comments, an environmental assessment should be carried out if planning for a dam proceeds into pre-feasibility studies.

The DHV report on Quelimane (1994) assessed the ground water potential in the alluvial valley of Licuare for water supply to Quelimane. DHV considered the discharges from a well opened by Geomoc in 1981 to be in the high range when pumped for 6 months in 1985-6 (the well stopped operating probably due to inadequate construction and/or filters). A well field would probably provide additional water and be less sensitive to dry years than the present Namite Lagoon. As mentioned in Section 4.5.1, five boreholes have been drilled recently with German support near the treatment plant. More tests and hydrogeological studies (included in the NWDP) will, however, be needed to determine how the well field might be contributing to the future water supply for Quelimane. *It is recommended that the hydrogeological study should include an environmental assessment, in particular with regard to effects from drawdowns of the ground water table.*

4.5.6 Summary of Recommendations

1. *Estimation of the storage volume of the proposed new reservoir on the Licuare River should include the eventual requirement of a minimum ecological flow downstream of the intake. This should be assessed during the proposed hydrological investigations, although the reservoir is not part of the NWDP.*

2. *The proposed weir across the Licuare River should be omitted if possible.*

3. *The planning of increased treatment capacity at the present site must include provisions for the safe disposal/discharge of sludge and backwash water,*

possibly to the lagoon which will be abandoned as water source, or to the river downstream of the new intake if considered safe. Care should be taken in the design of the refurbished facilities to choose processes and equipment the same as or similar to the existing ones as far as possible (see Section 7.2.1 for more details).

4. *It is recommended that the old transmission main be abandoned and the new pipeline be equipped with branches along the route, including pressure reduction valves or local elevated reservoirs as required, to supply adjacent settlements.*

5. *Planning and construction of the new transmission main should be closely co-ordinated with plans for rebuilding the road from Quelimane via Nicadala, and passed Licuare to minimize construction disturbance to local people and, where possible, make use of joint rights-of-way to minimize any required resettlements. In any case, detailed study is required to set the final transmission main alignment and identify resettlement requirements.*

6. *Recommendations for the planning of sewage and waste water treatment facilities were discussed in Section 4.2.5 above.*

7. *The Beneficiary Assessment study should take into account the relative competitiveness of AdQ and well water.*

8. *Concerning the proposed dam on the Licaure River (if being considered):*

   - *The state of the catchment area should be investigated, the potential for water quality and erosion problems assessed, and their effects mitigated as necessary by, for example, regulating land use, road construction and deforestation.*

   - *The area to be flooded should be investigated for environmental resources, e.g. minerals, before a final decision about location of the dam and reservoir is made. Possible conflicts with historical or cultural areas are unlikely in the area in question, but this should always be investigated early in the planning stage for reservoir developments.*

   - *Clearing of the reservoir area should be planned to avoid impacts from decaying vegetation and to create the impression of a natural lake without the adverse impression of a dead, flooded landscape.*

   - *Notwithstanding the above comments, an environmental assessment should be carried out if planning for a dam proceeds into pre-feasibility studies.*

4.6 NAMPULA

4.6.1 Existing Water Systems

Institutional Framework and Other Projects

The town of Nampula is the capital of the Province of Nampula, situated on the main south-north and east west roads and the railway line, about 130 km from the coast (Figure 4.8). The water system supplies mainly the central parts of town. The Texmoque textile factory, with 3,000 workers, used to be supplied from an intermediate reservoir along the transmission line but has been closed down. Nampula town and peri-urban areas is supplied by Companhia de Água de Nampula E.E. (AdN). AdN is not yet a registered state company and is supervised by the DNA through the Nampula Provincial MOPH office.

The financial situation of AdN is particularly bad. Water fee arrears amount at present to 2.3 million Mt or 11 months billed fees. Less than 1/4 of the billed fees are collected each month, and the main defaulters are Government institutions. The rapid depreciation of the Metical makes the financial situation for the company even worse than the figures indicate. A fine system was introduced in 1994 in which 50 % of the outstanding amount is added to the bill for each month of non-payment. The fine system is not applied at the standposts and there were no reports as to the success of the system. AdN has made arrangements with EDM with regard to payment for electricity and this may help the company stay afloat for some time. However, the situation is very serious.

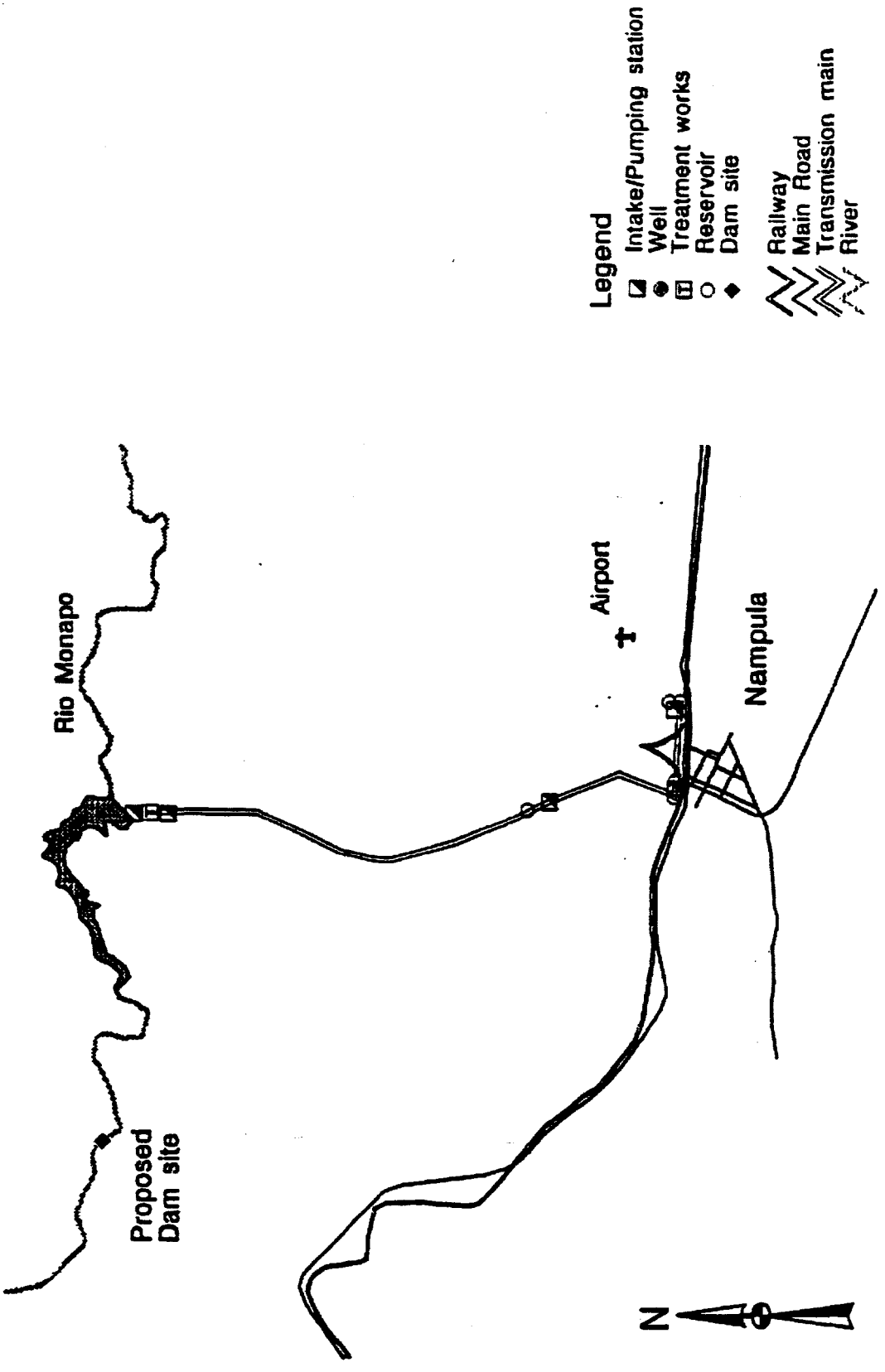
AdN and the City Council are on talking terms, but relations are somewhat strained. As well, there appear to be co-operation problems within the Council itself and among its various departments. This situation will diminish the Council's ability to cope with acute environmental problems in the town area.

Other projects in the area include EU-financed improvements to distribution systems and new taps, but detailed information was not obtained. As well, Dutch-supported projects are laying new transmission mains and rehabilitating the pumping station (commenced June 1995, not yet complete) and working on erosion control education in peri-urban areas. A World Bank-supported Local Government Reform and Engineering project (PROL) is planned to commence in Nampula. An environmental study has been carried out and the project will do an ecological analysis as an input to a structural plan (Kim Hermind, pers. comm.). Nampula will become a testing ground for urban environmental management practices in Mozambique.

Water Source, Treatment, Transmission and Distribution

Nampula pumps its raw water from a dam on the Monapo River about 10 km north of town to a nearby treatment plant commissioned in 1976. No meteorological or hydrological data has been collected for some years. Of the approximate 4 Mm^3 behind the concrete dam, AdN estimates that 1/3 is silted up. Drains to reduce siltation are installed but have not been operated for many years due to fears among the staff of not being able to close the valve after flushing. Generally, the dam gives a good impression and no serious faults, except minor leaks were reported. The intake tower has had four

Figure 4.8: The Nampula Water System



vertical pumps installed, of which three are in working condition and deliver raw water to the treatment plant.

The treatment plant capacity is rated at 800 m^3/h but requires major repairs and is operating at half that figure. The flocculation and filtration components are in particular disrepair. No chlorination takes place at the plant due to former requirements of the Texmoque textile factory which could not use chlorinated water. Sludge from the floccu-clarifier and backwash water from the filters are discharged back to the reservoir close to the intake tower. Another group of filters were never completed beyond the concrete structure, and have never been used. An old treatment plant, adjacent to the one in operation, is severely deteriorated but not beyond repair.

Clear water is pumped through parallel mains for 6.7 km to ground level reservoirs at an intermediate booster station, then 2.5 km to AdN's distribution centre where it is pumped into a tower for gravity distribution. With Dutch funding, the high-lift pump station at the treatment plant is being completely rehabilitated and one of the two AC transmission mains is being replaced with larger PVC pipes.

At the intermediate station, chlorine is being supplied into one of the tanks after the former branch-off to Texmoque but the efficiency is doubtful since the gas is supplied from pressure containers at steady rate with no installation to inform when the container is empty. The pumps are being replaced by new ones with Dutch funding.

The last station and distribution centre was originally a separate waterworks for the railways, drawing water from a nearby stream. The treatment plant is locked and abandoned, whereas the ground reservoir, pumping station and the tower have been included in the town supply. Apparently, the pipeline from AdN headquarters has collapsed, and the distribution centre is not in use. The pumping station was fitted with new pumps by the Dutch last year, and the Dutch government will apparently be funding a new pipeline from the intermediate station to the reservoir.

The peri-urban areas of Nampula are served by 59 standposts of which 52 are actually functioning, according to AdN information. Each standpost serves 900 to 1000 people on average. It is estimated that more than half of the city and peri-urban population draw their water from wells.

Nowhere in the system is water metered but production at the treatment plant is estimated at 9,000 m^3/d.

The Water Market

In the Nampula peri-urban areas, each standpost is operated by two caretakers who collect water fees and keep the standpost area clean. The caretakers sell water tickets of 5,000 Mt each which entitle the holder to collect water for one month without restrictions on quantity. The main problem is the unreliable water supply; tapping is restricted to working hours, i.e. 5:30 to 12:00 and 14:00 to 17:00. The EA team was unable to obtain any information regarding the secondary water market.

AdN is trying to address certain problems of the existing system. There is no connection between the monthly fee and the quantity of water supplied, and in some cases the receipts from the sale of tickets do not cover the costs for water supply to the standposts. Large quantities of water are used by people producing cement blocks, and several households may collect water by using the same ticket.

Sewerage Systems

There is no sewerage system in Nampula. Most of the houses in the city centre have septic tanks followed by soakaways or connected to the drainage system. No proper vehicles or system for emptying the tanks exist, thus blockages and overflows are common. The drainage system, virtually a combined sewer, is being discharged on slopes outside the city centre. As Nampula is located on top of the hill, with bairros surrounding it, the situation is particularly bad since waste and drainage water, as well as dirt and garbage from streets, find their way to the bairros during rains, causing health hazards. According to the City Council, rats are causing problems in the city and neighbouring bairros. Outside the town centre, pit latrines are the common sanitation facility, some also having septic tanks and soakaways. It was reported that the provincial administration has helped to improve sanitation in some schools, a large number of which have no sanitation facilities at all. Operation and maintenance of sanitation and sewerage systems is the responsibility of the Council but no fees are being charged or paid and there is no formal co-operation between AdN and the Council on the issue.

4.6.2 Current Environmental Situation

Water Source, Treatment, Transmission and Distribution

Environmental impacts of the present scheme could be seen in and around the dam and reservoir, along the transmission main, in the supply areas and in connection with wastewater discharge.

Two issues concerning impacts to the water source were noted: (1) the location of the water intake inside a frequently visited leisure spot, next to a restaurant and swimming pool, and (2) the discharge of sludge and backwash water into the reservoir close to the intake.

The location of the intake inside and the treatment plant immediately outside the gates of a leisure area is peculiar. The dam and reservoir have initiated the establishment of the enterprise on the shore of a beautiful lake, and people are bathing next to the intake. The swimming pool, on shore a few metres from the intake, is emptied into the reservoir when water is changed or overflowing due to rain. The same goes for wastewater from the restaurant, whereas the toilets reportedly discharge to tanks which are collected by trucks and emptied elsewhere. The mutual benefits for the establishment owner and the water company seem to please both parties (the owner of the establishment is maintaining the road in good condition). However, the activities next to the water intake are no doubt causing pollution problems and the arrangement is totally unacceptable by any standards.

The discharge of sludge and backwash water close to the intake is obviously silting up the immediate surroundings and causing inferior raw water quality. The positive element of not loosing the 5 to 10% of treated water used for backwashing does not make up for this, and another solution should be sought, e.g. dewatering and depositing of the sludge and backwash water downstream of the dam. The latter would require a pumping station and a pipeline, preferably along the mountainside track between the treatment plant and the dam.

No adverse environmental impacts of the original transmission main were reported, except for local erosion and flooding which used to be caused by frequent bursts on the old pipeline. This line is presently being replaced, and old and new pipes were scattered all along the route from the treatment plant to town. Partly backfilled trenches are causing erosion and silt run-off. It is to be expected that these adverse effects will be dealt with soon as part of the contract as the project is close to completion.

In the distribution system, with the prevailing sanitary situation and septic tanks that are never emptied and soakaways, house connections generating much waste water constitute a health hazard to the public, particularly during rains. AdN provides water in the distribution system only a few hours a day, meaning that the reticulation is empty and without pressure most of the time. The described sanitary situation in town, as well as pit latrines and open defecation in the villages, creates a high risk of seepage into the pipelines. The high degree of leakage and lost water suggests that the occurrence of pollution of the drinking water in this way is very high.

Water Quality, Consumers and Health

The present water treatment plant is in bad condition, the quality of the water produced is far from satisfactory, rendering chlorination ineffective, and is not fit for human consumption. Chlorination of the water is not taking place at the treatment plant but at the intermediate reservoir and 2.5 km from town, a situation which is totally unsatisfactory and provides no security for proper disinfection. This means that the restaurant at the intake and villages supplied between the treatment plant and the intermediate reservoir are getting non-disinfected water, creating a clear health hazard.

The Central Hospital laboratory in Nampula regularly analyzes the quality of the water supplied by AdN. In most cases the tests show that the water is unsuitable for human consumption. The Urban Health Service also provides preventive health training in 11 health centres in the city and treatment of drinking water is one of the issues dealt with. However, people do not normally boil their drinking water. Despite the health service's claims that their staff pay regular visits to the bairros for preventive health education, the locals contacted by the EA team maintained that they never have met an health extension worker in their area.

Although water quality is poor and the preventive health care system deficient, the health situation (according to the same health service's statistics) appears to be not particularly bad. Cholera and dysentery have not been registered, but diarrhoea is relatively widespread, particularly during the rainy season. This points at the unsatisfactory waste water system in the city.

Receiving Waters

There appear to be no proper waters to receive wastewater in Nampula, the combined sewerage and storm-water system simply discharging on slopes and mostly dry streams outside town. The present arrangement, with the city centre on the top of a hill surrounded by peri-urban areas at lower levels, creates serious health hazards. The situation has been worsened by the water supply system, enabling house connections and sewage production which is not taken care of in any way.

4.6.3 Project Description

Supply and Demand Projections

DHV (1994) projected the population of Nampula to increase to approximately 295,000 in 1997 and 610,000 at the end of the planning period, year 2017. Only the urban and peri-urban population is expected to be supplied by the public water supply system, and this part of the population is expected to increase from today's 53% to 73% in 2017. Unaccounted-for water (UfW) is taken to be reduced from today's 40 to 50% of production to a modest 20% early in the planning period. Of the urban and peri-urban population, 43% is today covered by the water supply system, 24% having house or yard connections and the rest serviced by public taps. The aim is to reach full coverage in 2017, with 75% covered by house/yard connections.

Based on the above assumptions, the DHV (1994) projected an average daily water demand increase to about 11,600 m^3/d in 1997 and 64,000 m^3/d in 2017, all to be supplied by AdN.

NWDP Investments

Project investments proposed by the Bank for the Nampula system are shown in Figure 4.9. With the exception of monitoring and assessment studies to confirm and extend surface and ground water availabilities, all involve improvements and extensions to existing infrastructure, and leakage reduction. The elements are:

- Hydro(geo)logical investigations to gather flow data and investigate dam and ground water alternatives
- Detect and repair leaks in existing dam
- Build new intake in the reservoir
- Construct a new treatment plant
- Increased storage at the railway reservoir
- Service connections, including house/yard connections and public taps

Project activities on which the EA focuses, with a distinction between those which may cause significant effects and those for which effects are likely to be minor, are:

Significant environmental effects

- increased water abstraction from Monapo River

Minor environmental effects

- new intake at the reservoir

- new treatment plant
- new railway premises ground level reservoir and pumping station
- extension of distribution network and service connections

Figure 4.9:
Project Investments in Nampula

Sub-Project	Scope	Yr1	Yr2	Yr3	Yr4	Yr5
Hydro(geo)logical studies (1.01)	Survey Monapo Dam and reservoir and prepare O&M rules. Start flow monitoring program. Study dam alternatives. Assess ground water potential.	XXX				
Intake station (2.01)	Construct new intake in Monapo reservoir. Install 2 pumps at 850 m^3/h each.				XXX	XXX
Treatment plant (2.02)	Construct new treatment plant (Phase 1), capacity of 24,000 m^3/d.	XXX	XXX			
Increase capacity to/at railway reservoir (1.09)	Construct new 2,500 m^3 ground level reservoir at PS4. Construct district pumping station.	XXX	XXX	XXX	XXX	
Service connections (1.10)	Install 2,200 HC, 5,500 YC and 160 PT.	XXX	XXX	XXX	XXX	XXX
Existing dam (1.11)	Detect and repair leaks in dam.	XXX				
Distribution system (2.03)	Upgrade/expand/improve distribution system. Increase capacity of primary distribution system.		XXX	XXX	XXX	XXX

4.6.4 Environmental Assessment of the NWDP

Location, Planning and Design

The discharge of the Monapo River measured at the dam shows a very irregular intra-annual distribution with only 6% of the average during the dry season from June to November with a possibility of the river drying up towards the end of the season (DHV 1994: Nampula, Annex II). With the present storage capacity (reduction due to silting probably not considered) of the reservoir, it is, however, estimated that AdN will have supplies with adequate reliability up to the year 2007. The estimated demand of 29,000 m^3/d represents less than 10% of the mean annual discharge at the dam. Only in extreme drought situations is there a possibility of water shortages.

The EA team did not obtain any information regarding the ecology and land use downstream of the dam. Although data are not available (earlier recommendations to collect hydrological and meteorological data had not been followed up), it is likely that the periods of dry riverbed are prolonged by the extraction of water from the reservoir (if the present leaks from the dam do not maintain a minimum flow). This may have negative environmental impacts beyond the normal effects of the dry season, but to what degree is not possible to assess. There are no medium or large scale irrigation schemes in the area of influence and AdN has received no complaints about loss of water which could be attributed to the dam.

It is recommended that, in connection with the new O & M rules (regulation regime) to be prepared, the need for maintaining a minimum flow from the dam for ecological or other reasons, should be considered.

For a discussion of possible impacts from the proposed new dam upstream from the existing one, see Section 4.6.5.

Increasing treatment capacity by construction of a new plant should not cause significant adverse environmental impacts if the existing plant were in satisfactory condition and functioning well. However, for Nampula, the planning of increased water treatment capacity at the present site must first of all include provisions for improved raw water quality, in particular making proper arrangements for the discharge of sludge and backwash water. Failing this, an increasing number of consumers will be subjected to the hazards imposed by the present situation. *Thus, it is recommended that:*

- *The NWDP include in its investments a pipeline from the treatment plants and along the mountain side track to carry sludge and backwash water to the downstream side of the dam; and*

- *The new reservoir intake be located as close as possible to the dam, and as far as possible from the leisure area, to minimize the potential for water-borne wastes from the leisure facility from entering the intake.*

Care should be taken in design of the new treatment facilities so as to choose processes and equipment the same as or similar to the existing plant. Different designs and operational routines will increase the risk of faulty operation and the need for a large number of different spare parts, thus adversely affecting the safety and possibilities for proper maintenance and quick repair of breakdowns.

Furthermore, chlorination must be shifted from the intermediate reservoirs to the treatment plant. If Texmoque is reopened and still have the same requirements regarding chlorine content, other disinfection methods should be evaluated, e.g. UV-transmission at the treatment plant followed by chlorination at the intermediate station.

Most of the sub-projects in the first development block of the DHV (1994) report are under way with funds from the Dutch government. However, it is unclear if they will also undertake the rehabilitation of the existing intake and treatment plant. *If*

this is not being done under Dutch aid, it should be included in the investment program as the plant presently is producing water far below acceptable standards.

No bulk water metering is taking place in Nampula, and few consumer meters are functioning. The amount of water lost through leakage is thus unknown, but of the 40% unaccounted-for water, and based on the situation in other towns, it can be assumed that leakage is an important issue. *If water metering and leakage detection, including construction of reticulation maps, are not part of the Dutch-funded rehabilitation program, they are recommended for World Bank funding.* Excessive loss of clean water, produced and pumped at high cost, is not acceptable and causes adverse effects due to unsatisfactory supply to customers.

Construction

No construction impacts were identified which cannot be satisfactorily managed through measures incorporated in the environmental monitoring and management plan (Section 7.3).

Due to time constraints it was not possible to contact the provincial employment services to obtain information on qualified construction companies and the labour market. However, the situation is probably not very different from the other cities. Compared to Beira and Quelimane, Nampula is a rural town. Many inhabitants maintain agricultural plots outside town which they attend to during the rainy season. About 46 % of the population (above 7 years of age) describe themselves as economically active (DNE 1994), and about 27 % qualify themselves as farmers. The unemployment rate is high, about 54% claiming to be unemployed. Both skilled and unskilled workers would be available through local construction companies.

Operation

Apart from the potential for increased sewage treatment and sanitary problems addressed in Section 4.2.1, no operation impacts were identified which cannot be satisfactorily managed through measures incorporated in the environmental monitoring and management plan (Section 7.4).

However, with dams and reservoirs, there is always a risk of serious adverse impacts from improper operation and maintenance, such as flooding of downstream areas, erosion, loss of precious water, siltation, etc. This can only be avoided through proper planning and provision of operation and maintenance manuals, and training of staff, which must be adhered to. Proper monitoring of dam, reservoir, adjoining areas and downstream effects are important factors.

Receiving Waters

The prevailing situation regarding treatment and discharge of sewage and waste water in Nampula is particularly difficult since there appears to be no proper receiving waters close to town and with a year-round flow adequate for sufficient dilution and natural purification of waste waters. While the general recommendations concerning sewage and waste water collection and treatment (Section 4.2.5) should be considered and prevail, alternative solutions must be evaluated. A separate system for transporting all sewage to treatment at all times may prove to be necessary, with increased costs. If a

combined system is found sufficient, this must be provided with overflow arrangements discharging to artificial or natural streams or ditches during heavy rains.

During the planning and design of a sewage and waste water collection and treatment system for Nampula, we recommend that special attention be paid to the choice of treatment method and especially to the method(s) for disposing of both overflow from the collection system during heavy rains and discharge from the treatment plant.

4.6.5 Analysis of Alternatives

DHV (1994) estimated that natural flows in the Monapo River and the capacity of the existing dam permit abstraction of 30,000 m^3/d (95% reliability). When needed, around 2007, the only realistic alternative to maintain a reliable water supply would be to construct a second storage dam some 8.5 km further upstream. The report also recommends that ground water supply should be investigated for local supplies to peri-rural areas, but expects limited yields. The ground water option will thus not be discussed further here.

Further investigations will be required to confirm current flows in the Monapo River and to determine the feasibility of greater water abstractions, both with the current supply arrangements and with a possible second dam in the future.

The site for the new dam has been preliminary located, based on topographical maps, and no further investigations have been carried out regarding population, geology, flora, fauna etc. The area was overflown by the Team during the visit. Although the proposed new dam is not included in the NWDP, the possible construction of a dam and reservoir is commented upon in general terms regarding environmental impacts.

The reliability of water supply created by a reservoir may rapidly decrease due to heavy siltation from the upstream river catchment area or from adjoining terrain. Raw water quality can be expected to be much the same as from the present reservoir, providing the area to be flooded has no particular adverse characteristics and that activities in the area have not created pollution or contamination. *The state of the catchment area must be investigated, the potential for water quality and erosion problems assessed, and their effects mitigated as necessary by, for example, regulating land use, road construction and deforestation.*

The establishment of a regulating reservoir may create social conflicts as it will introduce a different flow pattern. Small water catchment dams on the slopes to the river between the present and future reservoirs could be seen from the air at the time of the team's visit, indicating that irrigation is or has been in use. *This suggests the need for maintaining a regulated, minimum flow in the river, or the necessity of resettlement of people. Provision of new, acceptable land, and payment of reasonable compensation and resettlement costs must be expected.*

The area to be flooded is used for a large-scale afforestation project. Only 1,700 ha of the planned 20,000 ha were actually planted. Farmers have moved into the area

during wetter years but moved on when the eucalyptus started to constrain the growth of their crops. The afforestation project originally included the borders of the existing reservoir. It was hoped that this would stop erosion and silting of the lake. However, most of the silt probably originates from the river it self. *Design of the new dam should therefore take the silt load into consideration.*

Clearing of the reservoir area should be planned to avoid impacts from decaying vegetation and to create the impression of a natural lake without the adverse impression of a dead, flooded landscape. The area should also be investigated with regard to other environmental resources (e.g. minerals) before a final decision about location of the dam and reservoir is made. Possible conflicts with historical or cultural areas are unlikely in the area in question, but this should always be investigated early in the planning stage for reservoir developments.

Notwithstanding the above comments, an environmental assessment should be carried out if planning for a dam proceeds into pre-feasibility studies.

4.6.6 Summary of Recommendations

1. *In connection with the new O & M rules (regulation regime) to be prepared for the Monapo dam and reservoir, the need for maintaining a minimum flow from the dam for ecological or other reasons, should be considered.*

2. *Concerning the treatment plants and intakes at the Monapo reservoir, it is recommended that:*

   - *The NWDP include in its investments a pipeline from the treatment plants and along the mountain side track to carry sludge and backwash water to the downstream side of the dam; and*

   - *The new reservoir intake be located as close as possible to the dam, and as far as possible from the leisure area, to minimize the potential for water-borne wastes from the leisure facility from entering the intake.*

3. *Chlorination must be shifted from the intermediate reservoirs to the treatment plant.*

4. *If rehabilitation of the existing intake and treatment plant is not being done under Dutch aid, it should be included in the investment program as the plant presently is producing water far below acceptable standards.*

5. *If water metering and leakage detection, including construction of reticulation maps, are not part of the Dutch-funded rehabilitation program, they are recommended for World Bank funding.*

6. *During the planning and design of a sewage and waste water collection and treatment system for Nampula, we recommend that special attention be paid to*

the choice of treatment method and especially to the method(s) for disposing of both overflow from the collection system during heavy rains and discharge from the treatment plant.

7. *Further investigations will be required to confirm current flows in the Monapo River and to determine the feasibility of greater water abstractions, both with the current supply arrangements and with a possible second dam in the future.*

8. *Concerning the possible second dam on the Monapo River (if being considered):*

   - *The state of the catchment area must be investigated, the potential for water quality and erosion problems assessed, and their effects mitigated as necessary by, for example, regulating land use, road construction and deforestation.*

   - *Indications of small-scale irrigation above the existing Monapo reservoir suggest the need for maintaining a regulated, minimum flow in the river, or the necessity of resettlement of people. Provision of new, acceptable land, and payment of reasonable compensation and resettlement costs must be expected.*

   - *Design of the new dam should take the silt load into consideration.*

   - *Notwithstanding the above comments, an environmental assessment should be carried out if planning for a dam proceeds into pre-feasibility studies.*

4.7 PEMBA

4.7.1 Existing Water Systems

Institutional Framework and Other Projects

The town of Pemba is the capital of the Province of Cabo Delgado, situated on the peninsula between the Bay of Pemba and the Indian Ocean. Águas de Pemba (AdP) is still a state enterprise "in creation". It is currently reorganising its internal structure in an effort to make it more effective and efficient. There are no visible positive results of this reorganisation due to the supply problems of the well fields, which have reduced income from water sales. As a reaction to the prolonged crises, about 100 of the 3,500 clients have suspended their contracts with AdP. Among these were many of the larger consumers. AdP management feels that the state enterprise status restrains its development, and is dissatisfied with its present relations with the State. The State sets tariffs that inhibit the company's profitability without providing subsidies for coverage of subsequent income shortages.

The population in the peri-urban areas is mainly served by wells, constructed by Água Rural (EPAR) which is a section of the Provincial Directorate of Water (DPA) and part of the National Programme for Rural Water Supply (PRONAR). 25 of the 1,600 wells maintained by EPAR are located within the city boundaries. EPAR is investigating methods to improve public participation in maintenance and cost recovery through a network of locally elected "caretakers". The caretakers also monitor the condition of the wells and quality of the water. DPA maintain a database where the information is processed.

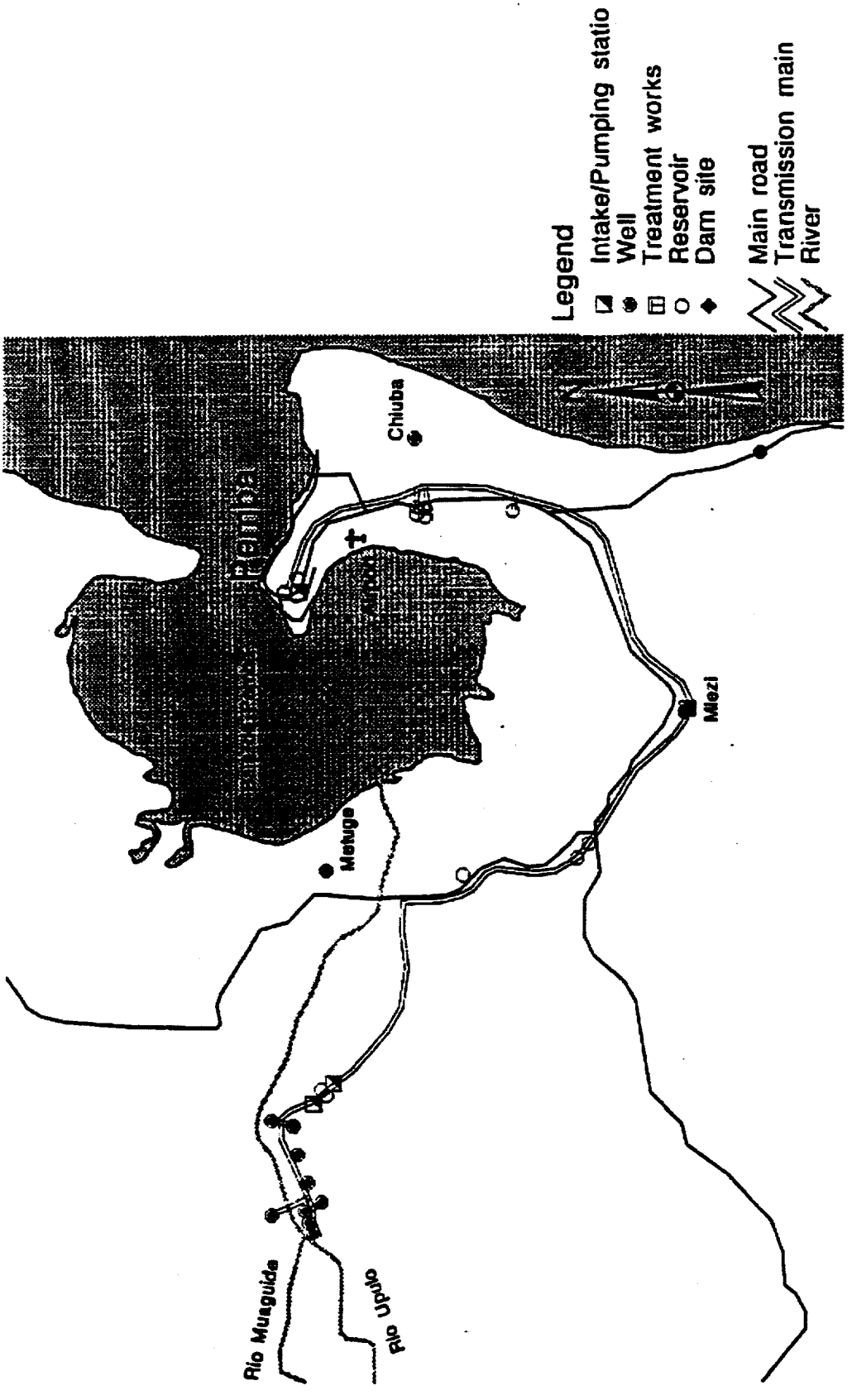
The Swiss Organisation for International Co-operation, Helvetas, is supporting the wells program in Cabo Delgado, and the Dutch government will be financing a Support Unit North (Niassa, Nampula and Cabo Delgado provinces) based in Nampula which will work on institutional development for (peri-) urban water supply systems. The Italian government will be financing new reticulation network and a public tap system.

Water Source, Treatment, Transmission and Distribution

The only water source at present for Pemba water supply is the Metuge ground water well field along the Muaguide River, commissioned in 1993 (Figure 4.10). It has a design capacity of 9,600 m^3/d but delivers only 2,900m^3/d, mainly due to poor borehole construction and corrosive water with high iron content. Water is discharged to a central reservoir, chlorinated and pumped about 40 km via several intermediate reservoirs and booster pumping stations to the main storage capacity near the airport some 4.5 km from the end reservoir/cistern in town. Along the transmission main, the villages of Metuge, Mieze and Morrebue are also being supplied.

The former water source for Pemba, the Chiuba well field, located about 8 km southeast of town has been abandoned due to salt water intrusion. Only the boreholes and the collecting reservoir are left; all headworks, buildings and equipment have been demolished and/or removed by vandals. The pumping station has also been vandalised, only the walls remain.

Figure 4.10: The Pemba Water System



Only eight standposts are installed in the peri-urban areas, supposed to serve as many as 54,000 inhabitants. Due to lack of piped water and the poor supply to the existing standposts, most people of the bairros depend on wells. The 22 wells constructed by EPAR in the bairros (DHV 1994) are relatively shallow (4 to 7 m deep). Three boreholes were also drilled by EPAR. However, the water supply systems are deficient, each standpost, borehole or well serving an average of 1600 persons, three times as many as desired.

The Water Market

AdP has tried several payment systems for public taps through a project of community management of standposts. Existing variants include the appointment of a caretaker by the community of water users and the leasing of the standpost to private contractors. At a standpost visited during this study, the previously elected community member had been replaced by a private contractor. Consumers were charged the average of 5,000 Mt/m^3, while AdP billed the contractor 700 Mt/m^3 for the metered consumption from the standpost. Water meters are, however, often not functioning or have been manipulated to measure less than the real consumption.

The secondary market in Pemba mainly consists of people with house connections and tanks. Prices vary from 10,000 to 50,000 Mt/m^3. AdP suspects that 10 to 20 individuals are selling water on a large scale.

Sewerage Systems

There is no full sewerage system in Pemba. In the city centre, most buildings have septic tanks, whereas latrines and open defecation, also on the beach, are common solutions in other parts of the town and the neighbouring villages. Septic tanks are not emptied since the breakdown of the collecting truck several years ago.

Wastewater is collected partly in separate, partly in combined sewers. A ditch starting in the high zone ends in a close conduit between the cinema and the port, carrying combined wastewater. Broken-down pipes and clogging cause overflow of the pipeline which discharges to the sea without treatment. A separate sewage line from the hospital is connected to the sewerage system along the main street and discharges to the ocean without treatment. In the bairros the situation is very bad -- 80 % of the houses are without latrines. Unicef is currently assisting a project for construction of pit latrines in the Pemba area.

There is no formal connection between AdP and the Municipality Council, which is responsible for sanitation, and no charges are billed or paid for sanitary services. However, the two institutions are discussing water supply and sanitation expansion and problems, and are on good terms.

4.7.2 Current Environmental Situation

Water Source, Treatment, Transmission and Distribution

According to the test-pumping protocols, the static ground water level throughout the Metuge well field was 3 to 5 m below ground level before pumping started. Draw-

downs at design yield for the respective boreholes varied between 10 m and 15 m leaving the water levels in the boreholes at 15 to 20 m below ground level. The current variations in the water levels are not known since the piezometer arrangements for monitoring ground water levels in the area have disappeared.

According to AdP, no vegetative variations have been detected in or around the well field even during dry seasons. The EA team visited the well field at the end of a very wet rainy season and the area gave the impression of being very fertile, with tall grass and maize. The present well yields are small and it must be concluded that physical environmental impacts due to abstraction of ground water at Metuge well field so far have been minor if any. The area around the well fields is inhabited by rain-fed slash and burn shifting farmers. Apparently they moved into the area after the road was opened into the well field. The households use surface or shallow well water. Any significant impact on agriculture from lowering of the ground water levels and impact from agriculture on water quality is not very likely with the present farming practices.

Expansion of the well field in a westward direction may, however, have an indirect impact. There are indications that shallow well water in the area is influenced by salination (EPAR 1996). Contrary to AdP officials, EPAR indicated that minor changes have taken place over the past years in the vegetation west of Metuge water divide and that this indicates salinity influence in the area. The information offered is unclear and more based on intuition than factual observations. Salt in the well water may also indicate the existence of sediments of marine origin in the area.

In or close to the area proposed for new wells, several claims have been made for land concessions for farming. One concession of 20 ha is located within the area, and another 6 concessions of approx. 790 ha have been granted in its vicinity. Two other requests are still being considered.

Water Quality, Consumers and Health

Water quality from the piped system and wells is regularly monitored by the Pemba Hospital laboratory. However, recent test reports were not available. Since AdP provides water in the distribution systems only a few hours a day, it will be empty and without pressure most of the time. The described sanitary situation in town, as well as pit latrines and open defecation in the villages, thus create a high risk of seepage into the pipelines. The high degree of leakage and lost water suggests that the occurrence of pollution of the drinking water in this way is high.

According to the Health Department, the occurrence of water-related diseases are relatively high in Pemba. The relatively densely populated bairros of Cariacò and Ingoname are the worst hit. However, dysentery occurs more frequently in the cement city than in the bairros of Paquite and Cariacò. Waterborne diseases are most likely the result of consumption of water from contaminated wells, tanks and local private reservoirs where piped water has been contaminated from sewage through leakage. The high figures of diseases in Pemba, as compared to country averages, may also be a result of a better functioning registration system in this relatively small town.

The only market served by piped water is the Central Market in the cement city. Most commercial activities are concentrated in markets in the bairros, the most important being located in Natite. These markets are not serviced with piped water and do not have any sanitation systems.

Irregularity of water supply has made people use tanks and other reservoirs for storage of water. The Health Department is preparing a program for the cleaning of tanks at the owners request and cost.

Receiving Waters

Waste and storm water, carrying human and solid wastes, will eventually be discharged to the sea, mostly into the Bay of Pemba, where it pollutes the beaches and shallow waters and creates health hazards to possible swimmers, and to fish and fishermen as the catch is being hauled onto the beaches. During the EA team's visit, the shores and water on the ocean side of the peninsula appeared clean and fresh while the coastline facing the bay was obviously polluted, with floating garbage and oil spills drifting along the shores.

4.7.3 Project Description

Supply and Demand Projections

DHV (1994) projected the population of Pemba to increase to approximately 80,000 in 1997 and 135,000 at the end of the planning period, year 2017. Only the urban and peri-urban part of the population, in addition to villages along the transmission main, is expected to be supplied by the water supply system, and this part of the population is expected to increase slightly from today's 44% to 47% in 2017. Unaccounted-for water (UfW) is taken to be reduced from today's 40 - 50% of production to a modest 20% early in the planning period. Of the urban and peri-urban population, 54% was covered by the water supply system in 1992, 48% having house or yard connections. The aim is to reach full coverage in 2017, with 75% covered by house/yard connections.

Based on these assumptions, average demand on the system is expected to grow to about 4,300 m^3/d in 1997 and 14,000 m^3/d in 2017. DHV (1994) recommended that the Chiuba field be refurbished to supply adjacent villages. As the safe yield of the Metuge field aquifer is thought to be only about 6,000 m^3/d, eastward extension of the field to exploit another aquifer was recommended to provide an additional 6,500 m^3/d.

NWDP Investments

Project investments proposed by the Bank for the Pemba system are shown in Figure 4.11. With the exception of hydrogeological studies to determine safe yields from aquifers at Metuge, all involve improvements and extensions to existing infrastructure. In particular, several villages/bairros will be connected and the distribution system expanded.

Project activities on which the EA focuses, with a distinction between those which may cause significant effects and those for which effects are likely to be minor, are:

Significant environmental effects

- increase ground water abstractions from existing Metuge well field

Minor environmental effects

- extension of distribution network

Figure 4.11:
Project Investments in Pemba

Sub-Project	Scope	Yr1	Yr2	Yr3	Yr4	Yr5
Hydrogeological investigation (1.01)	Study safe yields of Metuge aquifers (east and west).	XXX				
Water metering and leak reduction (1.05/6)	Install/repair bulk water meters and connection water meter. Prepare reliable maps of distribution system. Leak detection and repair.	XXX	XXX	XXX		
Rehabilitation of Chiuba wellfield (1.07)	Repair existing facilities. Construct facilities for Chiuba and adjacent villages.		XXX			
Rehabilitation of Metuge wellfield (1.04)	Reconstruct boreholes and electrical lines. New pumps. Construct flood protection and pump housing. Provide spare parts.	XXX	XXX			
Phase 2 of ongoing project to connect villages/bairros (1.03)	Connect Alto Gingone-Wimbe, Morrebue, Mieze and Nangua sub-systems	XXX	XXX			
Service connections (1.08)	Install 315 HC, 1,000 YC and 50 PT.	XXX	XXX			
Upgrade distribution system (2.01)	Increase capacity of primary and secondary distribution systems.		XXX	XXX		
Expand distribution (2.02)	Expand distribution systems.			XXX	XXX	
Service connections (2.03)	Install 250 HC, 1,180 YC and 45 PT		XXX	XXX	XXX	

4.7.4 Environmental Assessment of the NWDP

Location, Planning and Design

The probable impacts of the extension of Metuge well field will relate to the ground water table, possibilities of salination and effects on agriculture. *The extension must be carefully designed, based on thorough hydrogeological investigations and extensive monitoring of the water table and draw-downs during test-pumping. The area should*

be declared a partially protected zone. New settlements in the area should be prohibited, and resettlement of people presently living in the well field may be necessary. Impact on and from agricultural activities in the influence area must be carefully considered with regard to drought and pollution, and possible reduced flow in the Muaguide river must be evaluated. Care must be taken when choosing equipment and materials suitable for the prevailing water quality with corrosive properties and high iron content. The hydrological investigations should treat the issue of salinity with the necessary concern.

Treatment of the water, probably restricted to aeration and iron removal, must be considered on the basis of laboratory testing of water samples from the test-pumping.

The project includes a water metering program for bulk supply and individual connections, and a leakage reduction program including the establishing of reticulation maps. As discussed above, the safe well field yield at Metuge is suspected to be lower than the designed abstraction capacity, and reduction of the demand through leakage reduction is thus of extreme importance. *The metering and leakage reduction programs should be given first priority in Pemba.*

The investment program includes close to 3,000 new connections, of which almost 600 are house connections. The total number of connections in 1992 was estimated at approximately. 2,400 of which 1,150 were house connections. The number of new connections planned is considerable, and will cause serious adverse impacts if the increased sewage production is not taken care of in a safe way. As emphasized in Section 4.2.1, plans for new house connections should be reduced in the NWDP if appropriate sanitary solutions are not introduced along with the water supply development.

Construction

Development, operation and maintenance of both well fields will require extensive access road rehabilitation and construction work and areas for storage of construction materials. *Care must be taken to avoid conflicts with settlements and agricultural areas along the roads. Storage areas for construction materials and equipment must be established on free land, fenced and guarded.*

Although the working market situation is not as bad in Pemba as in most other cities, only 23 % of the potential labour force hold formal employment (DNE 1992). One third considers themselves as totally unemployed, the balance consisting of farmers and the informal sector. Rehabilitation and expansion of the water supply system may offer some new employment opportunities, at least during the construction phase. There are at least three companies in Pemba capable of exercising construction works: EMAC, Construcção Civil e Infrastructuras and Empresa de Reparação de Casas.

Operation

Low yields may be caused by siltation of gravel-pack, corrosion of screens and excessive draw-down, and will cause reduced water supply and may lead to breakdown of pumps. With the high degree of water lost in transmission and distribution, it can be foreseen that the total planned capacity to be installed will be used as from day one after

rehabilitation. As a result, excessive draw-downs and general lowering of the water table may well cause impacts on vegetation, reduce crops and available fire-wood, and reduce flow in streams and rivers in the area. It may also cause land subsidence and harm to borehole headworks and structures. Shallow wells may dry out. Adverse water quality may cause health problems, clogging and corrosion of pipes, and loss of borehole installations. Long term ground water abstraction is different from test-pumping, and developments in the influence area must be closely monitored with regard to yields of each borehole, draw-downs and water table, water quality and impacts on various crops, trees and vegetation in general. *As a consequence, hydrogeological investigations, planning and design are required prior to rehabilitation of the entire well field. As well, intensive monitoring, inspection and management of operations are necessary to avoid adverse environmental impacts.*

Water Market and Employment Situation

A number of industrial enterprises in mining (graphite), logging, plywood and fisheries are or have been operating in Pemba. Major employers are Marmonite, ECMEP, EDM, TDN, Texmanta and the airport. It is known that at least two companies, Texmanta and Marmonite have had to reduce operations due to water supply problems. Securing water supplies will improve operations of existing enterprises and create conditions for rehabilitation, expansion and establishment of new industries.

4.7.5 Analysis of Alternatives

DHV (1994) concluded that the abandoned Chuiba well field should be rehabilitated to provide a safe yield, avoiding salt intrusion, of 1,000 m^3/d and that necessary transmission facilities be installed for supply of Chuiba and other adjacent villages. The redevelopment of Chuiba well field to a yield far below the former capacity will, according to DHV, cause no significant environmental impacts, and salt intrusion will probably not occur at the suggested maximum yield.

Based on aquifer characteristics and numerical models, DHV (1994) concluded that the safe yield of the present Metuge field is approximately 4,600 m^3/d, far below the originally installed capacity of approximately 9,500 m^3/d. However, it is assumed with a high degree of certainty that the well field can be extended eastwards and thus attain a safe yield of approximately 11,200 m^3/d.

The future exploitation of the present well fields in Pemba, if achievable, will secure the projected water supply until the end of the planning period, year 2017. The DHV report makes it quite clear that thorough hydrogeological investigations and long term test-pumping are needed. If the real safe yield of the extended Metuge well field should prove to be less than the theoretical value, the supply will have to be augmented by abstraction of water from the Mieze or the Muaguide Rivers. These solutions will also have to be considered for supply beyond year 2017. Abstraction of water from both rivers will require the construction of dams and reservoirs, and water treatment plants will be required. The future abstraction of water from the rivers, including dams and reservoirs, is regarded only as a possible necessity in Pemba, and the environmental impacts are not considered here.

The water supply situation in Pemba is becoming critical. Due to breakdowns and low yields of the remaining boreholes at Metuge and the abandoning of Chuiba well field, combined with a high degree of leakage and unaccounted-for water, water is supplied to the customers a few hours a day only and new breakdowns and further reduction of yields are highly probable. The rehabilitation of Metuge well field, and later redevelopment of Chuiba, are thus of great importance to prevent further degradation of living and health standards in Pemba.

4.7.6 Summary of Recommendations

1. *Concerning the extension of the Metuge well field:*

   - *It must be carefully designed, based on hydrogeological investigations and extensive monitoring of the water table and draw-downs during test-pumping.*
   - *The area should be declared a partially protected zone.*
   - *New settlements in the area should be prohibited, and resettlement of people presently living in the well field may be necessary.*
   - *Impact on and from agricultural activities in the influence area must be carefully considered with regard to drought and pollution, and possible reduced flow in the Muaguide river must be evaluated.*
   - *Care must be taken when choosing equipment and materials suitable for the prevailing water quality with corrosive properties and high iron content.*
   - *The hydrological investigations should treat the issue of salinity with the necessary concern.*
   - *Treatment of the water, probably restricted to aeration and iron removal, must be considered on the basis of laboratory testing of water samples from the test-pumping.*

2. *Because the safe well field yield at Metuge is suspected to be lower than the designed abstraction capacity, reduction of the demand through leakage reduction is of extreme importance and the metering and leakage reduction programs should be given first priority.*

3. *During construction, care must be taken to avoid conflicts with settlements and agricultural areas along the roads. Storage areas for construction materials and equipment must be established on free land, fenced and guarded.*

4. *During well field operations, thorough hydrogeological investigations, planning and design are required prior to rehabilitation of the entire well field. As well, intensive monitoring, inspection and management of operations are necessary to avoid adverse environmental impacts.*

5. ASSESSMENT OF RURAL WATER AND SANITATION

5.1 Current Condition of Rural Water and Sanitation

According to the National Water Policy (NWP) document (1995), sufficient water resources had been developed to increase the supply to rural communities to cover 6% of the population in 1980 and 30% in 1993. The present level of use and the quality of the services is not known. It is likely that a significant number of small piped systems (SPS) have been abandoned due to destruction, lack of maintenance and migration during the war.

The EA team did not come across any reliable information with regard to the present sanitation situation in rural towns. It would, however, not be too far fetched to assume that sanitation is provided by septic tanks and latrines in the centres of rural towns and by latrines and open defeacation in the surrounding areas.

5.2 Project Description

This component of the project is still being developed but is expected to include the development/strengthening of community-based water users' associations in rural towns and peri-urban districts; community-led design of SPS, and complementary sanitation such as simplified sewerage, septic tanks, pit latrines, drainage and solid waste management; and subsequent project investments in these systems/works. Only an outline design document was prepared at the time of the EA study (21 March 1996), and the EA will therefore simply provide recommendations/guidelines on how these systems/works may best be implemented to be environmentally and socially sustainable.

A lump sum of USD 5 million is allocated for this component in the NWDP investment program (WB 1996b). Specific villages/towns or provinces have not yet been identified for the project.

The total estimated costs have not been broken down, but the following categories are indicated:

i) SPS component management;
ii) Studies on optimal arrangements for public participation and sustainable management and operation of SPS;
iii) Beneficiary assessments for identification of eligible towns;
iv) Capital investments in SPS and complementary urban environmental management initiatives (sanitation, drainage, solid waste management and erosion control);
v) Support to a district/provincial fund management unit; and
vi) Workshops and information dissemination.

The NWP document (1995) indicates that up to 200 SPS shall be rehabilitated and that the number of improved family latrines should be doubled to 200,000 by the

year 2000. The SPS component is proposed as a pilot project, and the number of provinces benefiting and the number of SPS to be targeted will be limited, probably far below the target of NWP. A Low Cost Sanitation Programme is presently being implemented with UNICEF support. The outline design document indicate future coordination between the two programs.

The document further discusses and indicates possible institutional frameworks, development of public participation mechanisms, project management, technical evaluation and monitoring arrangements. Issues in the fields of hydrology, environment and technology are mentioned, but not discussed in the document.

5.3 Recommendations on Environmental Issues

It is expected that none of the SPS will be of a size and magnitude which would require full EA (WB Category A) but some, depending on size, may require environmental analysis (WB Category B). *The feasibility studies of individual SPS projects should, however, be prepared in a way to facilitate proper environmental screening in accordance with the Bank's OD 4.01. The scope of the TORs for feasibility studies of individual projects should therefore include relevant environmental issues for further investigation and assessment if required.*

Issues of physical, biological and social environmental concerns with regard to SPS would normally, among more site specific issues, include the following more general issues:

- Impacts of water extraction from source -- lowering of water table (groundwater), reduction of downstream flows (river) with possible conflicts with other users and/or biological impacts.
- Flooding and hydrological changes in case of dam construction
- Pollution of water source
- Impacts from increase in waste water production -- consequences for sanitation system choices
- Health -- possible change in incidences of water-borne diseases and malaria

Design criteria for the SPS should be developed during the feasibility phase. A starting point is to define the minimum criteria for people's access to water. A basic principle would be that the criteria should be based on what people can afford.

People's real conception around the issue of water therefor needs to be clarified. The document stresses public participation at all stages of the project cycle. This is important, but is not easy to accomplish. One should, however, attempt to develop both the eligibility criteria, and later on the design criteria, through public participatory mechanisms. The design criteria should, for example, specify the maximum number of people/families to be served by each connection (public tap), maximum distance for fetching water from a public tap, operation, management and tariff/payment principles for public taps, hours of service, etc.

The SPS component is a pilot undertaking, and wider application of learned lessons depends on the rate of success of the pilot schemes. *It is therefore imperative that external factors which may impede the sound development of individual SPS schemes (e.g. sanitation systems, roads, electricity supplies) are identified, analysed and if possible incorporated for solution in the development program for a town.*

Finally, *the TORs for the feasibility studies should spell out criteria for appropriate technologies to be applied in the individual schemes*, taking into account the local level of technical knowledge, desired standardization, existing water dealer networks and future supply possibilities for equipment, spareparts and chemicals.

5.4 Summary of Recommendations

1. *The feasibility studies of individual SPS projects should be prepared in a way to facilitate proper environmental screening in accordance with the Bank's OD 4.01. The scope of the TORs for feasibility studies of individual projects should therefore include relevant environmental issues for further investigation and assessment, if required.*

2. *The TORs for the feasibility studies should spell out criteria for appropriate technologies to be applied in the individual schemes.*

3. *Design criteria for the SPS should be developed during the feasibility phase. A starting point is to define the minimum criteria for people's access to water. A basic principle would be that the criteria should be based on what people can afford.*

4. *It is imperative that external factors which may impede the sound development of individual SPS schemes (e.g. sanitation systems, roads, electricity supplies) are identified, analysed and if possible incorporated for solution in the development program for a town.*

6. ASSESSMENT OF WATER RESOURCES MANAGEMENT

6.1 INTRODUCTION

The Water Resources Management component of the NWDP is comprised of individual studies, institutional and capacity-building support and investments with the common objective of supporting the strengthening of water resources management both within Mozambique and with respect to the management of shared international rivers. The objectives of the Water Resources Management component include:

- Support to decentralized river basin management;
- Investments in necessary rehabilitation of hydraulic works;
- Reinforcement of Mozambique's capacity to operate as an equal partner in international negotiations regarding water resources shared with other riparian states; and
- Enhancement of co-operation at the river basin level.

The Water Resources Management component as presented to the EA team was comprised of four sub-projects:

1. Management Development Plan for ARA-Sul (institution building)
2. Corumana Dam Completion Works (feasibility study)
3. Strengthening of Management of Shared Water Resources (preparatory study)
4. Joint Incomati Study -- Supplementary Work in Mozambique (investigation)

These sub-projects are still in the identification/pre-feasibility phase. A set of four draft terms of reference (TORs) for consultancies was prepared by the Bank and DNA on 6 March 1996 which specify the work to be done under the Water Resources Management aspects of the NWDP.

As discussed in Section 4 of this report, the NWDP also involves several activities to study and determine the need for and feasibility of future activities and investments in each of the urban water supply sub-projects. Where these involve abstractions from rivers and associated hydrological investigations, and are appropriate for inclusion in the design of the Water Resources Management sub-project studies listed above, they are incorporated in the discussions below. The relevant aspects of the urban sub-projects are:

<u>Maputo</u>

- Increased surface water abstraction from the Umbeluzi River
- Diversion of water from the Incomati, via the Movene, to the Umbeluzi River
- Construction of a transmission main/canal from the Incomati to the Movene River
- Ground water abstraction in the Pateque-Manhica area

<u>Beira</u>

- Increased surface water abstraction from the Púnguè River

The approach taken to the environmental assessment of the Water Resources Management component of the NWDP was to outline, for each sub-project, the issues which should be addressed to obtain environmentally sustainable development of the water systems with which each is concerned. Each draft TOR was then reviewed and comments were made concerning how they should be revised to better address the identified issues.

6.2 MANAGEMENT DEVELOPMENT PLAN FOR ARA-SUL

6.2.1 Introduction

This sub-project concerns the creation of a development plan, and capacity-building and support, to the Regional Water Administrations (ARAs) which are key institutions of the new, decentralized water resources management structure in Mozambique. The ARAs will function as financially self-sustaining water resources management agencies with responsibilities for bulk water delivery, hydrological services and water allocation concessions. NWDP support will initially be concentrated on ARA-Sul, the Southern Region Water Administration. Based on experience gained in this region, the development of other high priority ARAs can be undertaken.

ARA-Sul's mandate includes all of southern Mozambique north to and including the Save River basin. Of the five cities which are part of the NWDP, this area includes only Maputo and the rivers on which it depends for its water supply -- the Umbeluzi and, probably in the future, the Incomati.

6.2.2 Environmental Concerns Associated with Urban Water Supply

As discussed in detail in Section 4.3.4, the principal environmental concerns with regard to the use of water in Maputo and the water balance in the Umbeluzi basin relate to:

1. The minimum flow required downstream of the Maputo water intake to control salinity intrusion and protect other ecological functions;
2. Proposed future transfers of water from the Incomati to the Umbeluzi River to augment Maputo raw water supplies; and
3. Monitoring and management of the minimum flow being delivered across the border from Swaziland.

To address these concerns, two major recommendations were made:

1. *It is vital that good hydrological monitoring at the intake, and thorough analysis of minimum flows required to meet domestic, industrial and a variety of downstream ecological demands, be carried out before maximum withdrawals available from the river to supply Maputo are settled. Only with this information in hand will analysis of the requirements for firm minimum flows from Swaziland and/or transfers from the Incomati River be possible.*

2. *The issue of minimum flows in the Umbeluzi below the Maputo intakes should be a key factor in the design of hydrological investigations planned under the Maputo sub-project of the NWDP. Moreover, this and the Incomati and international rivers issues should be addressed by the relevant Water Resources Management components of the NWDP.*

All of these concerns fall within the mandate of ARA-Sul. They, and the recommendations which they precipitated, should be reflected in the scope of work for the sub-project TOR.

6.2.3 Comments on the Terms of Reference

All comments refer to Section 3: Scope of Work.

Basic Considerations: Legal and Institutional Framework
In addition to identifying gaps and loopholes in the existing Water Act, the consultant should identify overlaps and inconsistencies with other Acts and statutes regulating water management and use. Particular reference should be made to the Municipality Act.and new Land Act under preparation, in addition to the Water Act.

The role of ARA-Sul in the context of the new Environmental Act should be assessed, that is on environmental management issues with regard to protection and management of water resources and on ARA-Sul's, and later the other ARA's relations with MICOA.

Responsibilities and Functions: Hydrology and Water Quality
Mechanisms for improved collaboration and co-ordination with agriculture, forestry and irrigation authorities should be assessed.

As a separate item, the consultant should be directed to emphasize the implementation of urgently-needed flow and water quality monitoring on the Umbeluzi River system, perhaps as a "pilot" exercise to explore and develop ARA-Sul's capabilities in a practical situation (see section 6.2.2 above).

Responsibilities and Functions: Bulk Water Supply and Water Demand Management
Several studies have pointed at the increasing problem of salt water intrusion in rivers along the coastal plains. Minimum ecological flows have been calculated for some of the rivers (probably on weak data bases) -- that is, minimum flows during the dry season required to keep the salt water at bay. As demand for water increases, both nationally and in upstream riparian states, it will be more difficult and costly to maintain minimum ecological flows during dry seasons and drought periods. As a separate item, the TOR should direct the consultant to prepare a strategy for studying the salt water intrusion problem with the aim of analyzing alternative solutions which are technically, economically and environmentally sound.

Beyond recommending policies and plans for the allocation of water among various users, the TOR should direct the consultant to develop specific strategies and

study requirements to analyze minimum flow requirements and, where appropriate, reservoir operations, and to assess possibilities for improving hydrological regimes to better meet requirements for "environmental allocations and pollution control". These requirements should be specified in the TOR to include not only the management of salt water intrusion but also, for example, the conservation of riparian habitats; the transport, dispersion and natural purification of waste waters; and the transport of suspended sediment through important waterways and harbours. On this matter, the TOR should emphasize urgent requirements on the Umbeluzi River system.

Responsibilities and Functions: Environmental Protection and Pollution Control
The "polluter pay principle", embodied in the National Water Policy, should be highlighted for consideration by the consultant, in particular in descriptions of mechanisms for enforcement and control.

Responsibilities and Functions: International River Basin Issues
The TOR should require that the assessment of ARA-Sul's responsibilities in the management of international river basins be co-ordinated with the team working on the "Strengthening of Management of Shared Water Resources" preparatory study.

Organization and Management: Staff Development and Incentives
The TOR should direct the consultant to include the integration of environmental "awareness-building" wherever appropriate and thus pioneer the development of an environmental culture in water resources management and pollution control. There are elements of environmental protection and natural resources management in traditional rural cultures, but modern Mozambique has little, if any, environmental conservation traditions.

Performance Monitoring
The performance monitoring systems should also incorporate some key environmental monitoring indicators.

6.3 CORUMANA DAM COMPLETION WORKS

6.3.1 Introduction

Corumana Dam in the Sabie river in the Incomati catchment area has not been completed up to standard, and it is necessary to carry out engineering design, costing and construction of the critical remaining works as part of this sub-project. It is also planned to carry out a feasibility study to assess the development opportunities and potential of this dam in order to identify and justify options for maximizing development benefits from the investigations to be made.

The scope of work to complete the Corumana Dam is contingent on the results of the subject feasibility study but could involve:

- Protection of the downstream slope;
- Stabilization of the river channel downstream of the spillway;
- Provision of a security fence;

- Installation of lighting;
- Upgrading of the 1.5 km access road; and
- Installation of spillway gates to increase the storage volume.

The dam is already in place and, in early 1996, the reservoir was full. The feasibility study will probably not raise any new significant environmental issues. On the other hand, impacts from the completion work will by and large result in positive effects on the environment.

6.3.2 Comments on the Terms of Reference

Feasibility of Increasing the Storage Capacity
The TOR do not envisage the need for installation of the spillway gates in the foreseeable future. However, the consultant is asked to assess the feasibility of this option. The study should therefore identify possible environmental impacts in case the spillway gates are to be installed, that is impacts from increasing the storage volume of the reservoir from 830 Mm^3 to 1,230 Mm^3. Raising the water level will result in a larger flooded area, with possible impacts on human settlements, agriculture, forestry, flora, fauna and micro-climate. The TOR should direct the consultant to identify these impacts in brief and indicate necessary restrictions. The viability of the option of installing spillway gates should be analyzed not only in economic and technical terms but also in natural and social environmental terms.

Stabilization of the River Channel Downstream of the Spillway
The TOR should emphasize the need to protect not only the dam from erosion but also the downstream river channel.

Security Fence
The TOR should direct the consultant to investigated whether any traditional footpaths, crossings or housing unrelated to dam operations will be affected. If so, mitigation and compensation measures should be proposed.

Tender Documents
Environmental concerns and mechanisms for maintaining worker safety etc. should be incorporated in the tender documents, indicating control and mitigating measures, and reporting procedures.

6.4 STRENGTHENING OF MANAGEMENT OF SHARED WATER RESOURCES

6.4.1 Introduction

Preliminary study and institutional support will be provided to establishing an international river basin unit (Gabinete dos Rios Internacionais) within DNA which will be the focal institution in Mozambique's negotiations with other riparian states about

water rights and mutual management and utilization of shared water resources. The preliminary study will serve as a basis for the five-year institutional support program.

6.4.2 Environmental Concerns Associated with Urban Water Supply

As discussed in Sections 4.3 and 4.4 of this report on urban water supply, Maputo and Beira depend on rivers shared with other countries -- Swaziland, South Africa and Zimbabwe. The international aspects of the environmental concerns for the water supply to Maputo, first raised in Section 4.3, were reiterated above in Section 6.2 concerning the management development plan for ARA-Sul, and will not be repeated here.

For Beira, the increased abstraction of raw water from the Púnguè River would probably not cause any significant environmental impact. This statement, however, assumes that restrictions on water use for irrigation are enforced to maintain a minimum downstream flow and that a satisfactory agreement is reached with Zimbabwe with regard to the shared water resources of Púnguè River. The recommendation was that DNA and/or the new ARA Central should monitor water demands on the Púnguè River from irrigation in Mozambique and from Zimbabwe. Should these demands plus water supply to Beira indicate potential problems with maintaining minimum flows in the lower river, more detailed hydrological analysis should be carried out to assist in resolving competing water demands.

These city-based factors highlight one dimension of the need for Mozambique to have a much stronger capacity to assess its own water needs, to analyze cross-border flows in its international rivers with a view to determining its requirements in those flows, and to negotiate acceptable arrangements with upstream riparian states for actual receipt of those flows.

6.4.3 Comments on the Terms of Reference

The TOR focus on legal, procedural and institutional capacity issues, whereas the apparent environmental imperatives for improved water resources sharing mechanisms receive little prominence. The TOR should highlight the issue of sound environmental management as a fundamental basis for assessing equitable sharing and use of water.

The TOR should further recognize the fact that securing Mozambique's interests and rights with regard to cross-border water resources management may represent the most significant factor when it comes to the country's ability to sustain environmental and natural resources management in the southern and central regions of the country.

Staffing of the team of consultants should reflect the importance of this issue. In particular, the water resources management and river basin expert must be knowledgeable about both human and ecological values associated with water, and with the complexities of making choices among competing values and uses for water.

6.5 JOINT INCOMATI STUDY – SUPPLEMENTARY WORK IN MOZAMBIQUE

6.5.1 Introduction

This will be the first of five studies to support Mozambique's participation in joint international river basin studies concerning the Incomati, Púnguè, Limpopo, Save and Umbeluzi River basins. These studies are crucial for enhancing a good climate for cooperation, and for establishing a common base for monitoring, management and development of watercourses with other countries.

6.5.2 Environmental Concerns Associated with Urban Water Supply

Of concern here is the prospect of water transfers from the Incomati to the Umbeluzi River to supply Maputo. Analyses of Mozambican water demands on the Incomati must consider the amount and location of potential abstractions for this purpose. Flows downstream of the abstraction point must be left sufficient to accommodate both human, irrigational and ecological requirements for water, especially with respect to minimum flows.

6.5.3 Comments on the Terms of Reference

Water Related Development

Criteria for evaluating potential development alternatives should include environmental criteria in addition to "economic, financial and social". Such criteria should address minimum requirements for ecological flows at different times of the year and at key points in the river. Factors to consider include the management of salt water intrusion; the conservation of riparian habitats; the transport, dispersion and natural purification of waste waters; and the transport of suspended sediment through important waterways and harbours.

Dams and Regulation

Assessment of the hydrological regime and development regime of the Corumana Dam should be done in close collaboration with the team on the Corumana feasibility study. As discussed in Section 6.3.2, an environmental point of view should be taken in addition to technical and economic, especially when considering the effects of raising the flood level of the dam.

Environment

The reference to mitigation measures should give, as examples, the specification of minimum flows at different times of the year and at different locations on the river, and the conservation of important riparian habitats and wetlands.

7. ENVIRONMENTAL MANAGEMENT PLAN

7.1 INTRODUCTION

The final part of this report addresses a number of matters concerning the environmental management of NWDP activities. The first three sections provide guidance on the location, planning, design, construction and operation of project facilities to maximize the opportunities for good environmental performance. They complement discussions on issues common to all project cities/towns presented at the beginning of Section 4. The fourth section addresses the vital and sometimes sensitive issue of resettlement of people from lands required by the project. The fifth and sixth sections concern the monitoring of project activities, and the management of those activities based, in part, on monitoring information. Finally, matters related to environmental awareness-building and training are discussed.

7.2 LOCATION, PLANNING AND DESIGN

7.2.1 Refurbishment/Expansion of Existing Treatment Plants

All new investments should be analyzed in terms of their capital costs, their operating and maintenance requirements, their reliability on foreign equipment and spareparts, etc. If choices are to be made between more or less equal alternatives, processes and equipment of the same type or similar to the existing ones should be chosen. Different designs and operational routines will increase the risk of faulty operation and the need for a large number of different spare parts, thus adversely affecting the safety of and possibilities for proper maintenance and quick repair of breakdowns.

7.2.2 Distribution Systems

Wherever possible, new distribution systems should be located to avoid existing houses and infrastructure, and thus the need to relocate them and, perhaps, people who live in them.

Routing of pipes through areas polluted by industrial and human wastes will probably be unavoidable. Proper design is particularly important in such areas. *Care should be taken to choose the right pipe-material. Pit latrines and garbage dumps should be cleaned and closed and new locations sited if necessary.*

If water and wastewater pipelines are to be located in the same trench, care should be taken to have the water pipeline at a higher level than the sewer. This will help to avoid direct leakage of polluted water into leaky, non-pressurized water pipes during hours of no supply, or while repair works are carried out. *Where possible, water and wastewater pipelines should be routed in separate trenches or on different sides of a road.* This is safer but generally more expensive.

7.3 CONSTRUCTION

Wherever possible, water companies should use local contractors, skilled and unskilled workers from each of the cities in which NWDP construction will take place. Before DNA approves any construction contracts, it should assure itself that water company operators, and any general contractors involved, have thoroughly investigated the availability of local companies and workers for the contract, and have maximized the opportunities for them to be involved in the construction work.

Standard environmental construction requirements for the project are detailed below. It is vital that these requirements are incorporated into general and specific construction contract specifications for all works being funded by the NWDP.

7.3.1 Water Sources and Treatment Plants

- Soil erosion and silt run-off from construction sites should be carefully prevented, since this could easily find its way into drainage and water courses.
- Noise, dust and air emissions should be minimized by use of modern equipment, awareness and attentive construction practices, especially in populated areas.
- The use of toxic and polluting substances during construction should be avoided or minimised remembering that such substances will have direct impact on soils and water quality.
- Proper housing and sanitary facilities for workers must be provided, and storage areas kept fenced and guarded.
- Oils and chemicals must be prevented from seeping into the ground or into drainage and water courses. Oil spills from construction machines must be avoided, and used oils and lubricants should be collected and disposed safely out of the working area.
- Construction sites must be left clean and tidy. After completion of the construction work, all temporary installations must be removed.
- Construction hazards will not be significant providing safety precautions and control are imposed on the labour force.

7.3.2 Transmission and Storage

- Pipeline trenches should be backfilled as soon as possible after laying of pipes and pressure testing, thus reducing the risk constituted by open trenches.
- Trenches should be carefully backfilled, using proper materials, and compacted to avoid later subsidence, uneven surfaces and erosion. Paved areas should be carefully restored. Top soil with vegetation should be replaced where applicable to avoid erosion.
- Noise, dust and air emissions should be minimized by use of modern equipment, awareness and attentive construction practices, especially in populated areas.
- Proper housing and sanitary installations for workers, and fenced and equipped stores and storage areas must be arranged. Spilling of oil must be avoided.
- All temporary structures, fences and leftovers must be removed after completion of works.

7.3.3 Distribution Systems

- Pipeline construction in populated areas creates problems for traffic and access to houses. Care should be taken, during design if necessary, to section the work in such a manner that these problems are minimized.
- Trenches should be backfilled as soon as possible after laying of pipes, thus reducing the risk, particularly to children, constituted by open trenches.
- Trenches should be carefully backfilled, using proper materials, and compacted as necessary to avoid later subsidence, uneven surfaces and erosion. Paved grounds should be carefully restored. Top soil with vegetation should be replaced where applicable to avoid erosion. Contracts should require that the contractor return to disturbed sites to repair later-occurring damages caused by the excavations.
- Proper housing and sanitary installations for workers, and fenced and equipped stores and storage areas must be arranged.
- All temporary houses, fences and leftovers must be removed after completion.

7.4 OPERATION

7.4.1 Water Sources and Treatment Plants

- Operation and maintenance (O & M) manuals, and suitable staff training, must be supplied and adhered to, particularly regarding the handling of chemicals.
- Intake water quality should be monitored regularly to establish whether unknown substances or minerals are adversely affecting the quality of drinking water.

7.4.2 Transmission and Storage

- Pipeline routes should be inspected regularly against leakage and valve chamber vandalism, and to avoid illegal connections.
- Significant leakage will cause erosion and flooding, and should be prevented by automatic monitoring of pressure or flow, thus stopping the pumps on such occasions. All leakage must be attended to immediately to avoid damages.
- Valves should be checked and manoeuvred regularly to secure their functioning when required for proper operation of the transmission system.

7.4.3 Distribution Systems

- The pipeline routes should be inspected regularly to make sure that all manhole lids are in place, and that no illegal connections are being attempted.
- Significant leakage will be reported by the public, but inspection should include awareness of unexpected growth of grass and weeds during the dry season. Flow measurements should be carried out according to a pre-set schedule or whenever leakage is suspected. Leakage must be repaired immediately to prevent erosion and flooding.

- Water samples from taps on the reticulation system should be analyzed regularly as safety against pollution.
- Valves should be inspected and manoeuvred at regular intervals to secure their functioning whenever required.

7.5 RESETTLEMENT

As indicated in Section 4, some of the investments of the NWDP will influence existing housing and settlements, in particular farmers along transmission mains and makeshift housing in peri-urban areas. Where possible, specific resettlement needs were identified. In most cases, such as in the location of distribution systems, project planning has not progressed far enough to identify specific resettlement requirements, time tables and budgets. What this study provides is guidance and the basis for future, more detailed resettlement planning.

There are established procedures for expropriation and forced resettlements in the Land Act of 1979 (see Section 2.2.2). Although the Act presupposes that the settler have legal title to the land, recent practice has been to offer compensation and title to new settlements regardless of whether incumbents held titles previously. The entity causing the need for resettlement must bear all the costs involved. With particular reference to Maputo, the City Council developed in 1988/9 a resettlement model which reportedly has been used with success on a number of occasions.

As well, the Bank's Operational Directive 4.30 on involuntary resettlement provides specific policy guidance which should be adhered to during implementation of the NWDP. OD 4.30 states that:

1. Involuntary resettlement should be avoided or minimized where feasible, exploring all viable alternative project designs.
2. Where displacement is unavoidable, resettlement plans should be developed. All involuntary resettlement should be conceived and executed as development programs. Displaced persons should be (i) compensated for their losses at full replacement cost prior to the actual move, (ii) assisted with the move and supported during the transition period in the resettlement site, and (iii) assisted in their efforts to improve their former living standards, income earning capacity, and production levels, or at least restore them.
3. Community participation in planning and implementing resettlement should be encouraged.
4. Resettlers should be integrated socially and economically into host communities.
5. Land, housing, infrastructure and other compensation should be provided to adversely affected [people] ... who may have usufruct or customary rights to land or other resources taken for the project. The absence of legal title to land ... should not be a bar to compensation.

Without in any way commenting on the intentions or practices of the government or institutions in Mozambique, it must be noted that, in far too many cases, involuntary resettlement programs around the world have fallen far short of

expectations. A key reason is that project loans have not included resettlement costs, they are planned to be covered from other government funds and, for one reason or another, these funds have not been forthcoming. Thus, *it is strongly recommended that resettlement plans should be prepared early in the planning process, and their financing and execution should be implemented with the support of the donor (NWDP). The Project Unit should assist the relevant Municipality councils and implementing agencies as required.*

The following procedures are recommended in general for involuntary resettlement necessitated by the NWDP:

1. Areas being influenced by installations and construction works, including flooded areas, protected areas, storage and construction areas, should be marked on maps and/or demarcated during the detailed planning stage. Maps should be at a scale allowing identification of affected houses and settlements in the field. Where possible, project works should be designed or located to avoid the need for resettlement, for example in the location of pipelines, storage tanks and distribution systems.

2. The implementing agency, supported by the Project Unit, should carry out a specific study of resettlement needs when the need is apparent or, if a significant number of families are identified for resettlement, engage a consultant with socio-economic and legal experience for the task. The study should register names, number of family members, standards and approximate values of houses and other immovables, affected areas, land use, crops etc. Particular attention must be paid to special places which may be affected such as graves and spiritual sites, and to local practices required to manage the disruption involved. In collaboration with the Municipality Council, the study should identify suitable resettlement areas and calculate costs for moving people and movables, and constructing new houses, infrastructure and other compensations. The study should also assess indirect effects of ruptures to traditional and social bonds such as ethnic linkages (e.g. the Macua people in the bairro Mafalala in Maputo) and develop appropriate strategies for dealing with these effects. These could include, for example, moving entire groups together and supporting the groups in undertaking traditional practices involved in moving. Finally a detailed plan for resettlement should be developed in collaboration with the Council and the secretary of the bairro/village. The Bank's OD 4.30 provides a useful reference in developing resettlement plans.

3. *Throughout the process of developing and implementing resettlement plans, affected people, families and communities must be consulted concerning the overall process, and their needs and desires for adequate relocation.*

4. A minimum of three months notice prior to moving must be given orally and in writing, in accordance with the expropriation regulations of the Land Act.

5. Negotiations should take place with each individual family or groups of families on one side, and the implementing agency and the respective Municipality council on the other. The secretary of the bairro/village should act as a mediator.

6. The Municipality council will be responsible for coordination and monitoring of the resettlement activities and for necessary logistical arrangements regarding moving and resettlement, with the costs to be covered by the implementing agency. Reports should be prepared by the implementing agency on the execution of the resettlement plan to be presented to the DNA Project Unit and the respective Municipality Council.

7. Compensation should be based on full replacement and moving costs, and be paid without delay before the actual move. If appropriate, the implementing agency or the Council should supervise the building of new houses for resettled families, replanting of fruit trees, etc. In some cases, additional cash compensation should be considered to support displaced families while they restore their livelihoods at the new locations.

7.6 ENVIRONMENTAL MONITORING AND MANAGEMENT

Apart from normal monitoring and management by the Bank and DNA of contracts and other activities under the NWDP, the needs for environmental monitoring and management during project implementation are expected to be largely limited to ensuring compliance with:

1. Environmental specifications contained in construction contracts, as discussed in Section 7.3 above.
2. Resettlement planning and implementation, as discussed in Section 7.5 above.

The project "owner" will be the National Directorate of Water (DNA) which will thus have a major responsibility for monitoring and management of the environmental aspects of planning and implementation of the NWDP. In practice, the Project Unit (with a Project Co-ordinator) to be established under the National Director of DNA should carry out these functions as an integral part of its roles of supervision and monitoring of the various components of the project. A separate chapter of regular project reports to be prepared by the DNA Project Co-ordinator should deal with environmental aspects of the various components as indicated and described in this EA report and any later EA reports.

Reporting procedures should follow lines of command to be established for planning, implementation, operation, supervision and management of the various NWDP components. Thus the Provincial MOPH and/or the SUPRAs (ad hoc construction supervisory units established by DNA at the Provincial MOPH for particular water supply construction projects), and the new management of the water companies may be assigned monitoring and management functions. In principle, the water companies should monitor and manage their contractors and DNA (central or provincial) should monitor the water companies and, occasionally, contractors in the field.

The regular reports will be scrutinized by MOPH and the WB supervisory missions. MICOA (and its future Centre for Environmental Monitoring) should receive

copies of the reports (environmental section) to enable the Ministry to monitor DNA for compliance with provisions of the environmental assessment and issue directives or take any other appropriate action. MICOA may also carry out ad hoc field monitoring surveys.

ARA-Sul (for Maputo Urban Water Supply sub-project, and sub-projects of the Water Resources Management component), and the other ARAs (when established) will in accordance with their mandate monitor water use, flow regimes and other hydrological aspects of water resources management carried out by the water companies. These aspects should also, as appropriate, be incorporated in the regular data collection and reporting procedures of the water companies/implementing agencies. Resettlement planning and implementation (see Section 7.5) should be monitored by the DNA Project Unit.

The Ministry of Health (through the provincial health administrations/ laboratories) should continue monitoring of water quality. The quality of sample collection, laboratory testing and reporting routines needs to be improved, and procedures for follow up actions on the analysis reports should be developed. The NWDP should, in co-operation with other health support projects, assist in improving monitoring of people's health and hygiene situation in the areas of influence of the project. It would be appropriate to include this issue in the WB Staff Appraisal Report.

Currently there are no mechanisms in place for pollution monitoring and control. Relevant for this project would be monitoring of the quality of raw water and of downstream waters receiving sludge and backwash water from the treatment plants. In the absence of relevant institutions, the water companies should be instructed to carry out required testing and monitoring as part of the regular reporting procedures.

The EA report does not envisage any formal role of the relevant municipality/ city councils, since the Municipality Act has not yet been made effective. However, after the establishment of functional administrations in compliance with the Act (e.g. after the dust has settled from the oncoming direct elections), an adequate role for the councils should be designed in the environmental monitoring plan for the project.

7.7 ENVIRONMENTAL AWARENESS-BUILDING AND TRAINING

Few training needs will be required beyond those embodied in the capacity-building elements of the NWDP. Training will be required for personnel of DNA (and provincial MOPH/ SUPRA), MICOA and private-sector water company management and operational staff to monitor and supervise environmental performance during construction of new and refurbished works being funded by the project. The DNA Project Unit should conduct a workshop for key personnel of these institutions on the recommendations of the EA report and how they should be implemented.

The water companies should make field staff aware of environmental provisions of construction contracts, and train them in alternative practices for dealing with environmental concerns on-site. Training of key personnel of the water companies in

supervising these practices could possibly be included in the workshop mentioned above, or other training schedules of the institution-building efforts of the DNA Project Unit.

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APPEDIX A:
INCEPTION REPORT AND TERMS OF REFERENCE

THE WORLD BANK

MOZAMBIQUE NATIONAL WATER RESOURCES MANAGEMENT AND DEVELOPMENT PROJECT

INCEPTION REPORT
on the
ENVIRONMENTAL ASSESSMENT
concerning
SCOPING AND INTERPRETATION OF THE TERMS OF REFERENCE

by

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March 1, 1996

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THE WORLD BANK

MOZAMBIQUE NATIONAL WATER RESOURCES MANAGEMENT AND DEVELOPMENT PROJECT

INCEPTION REPORT on the ENVIRONMENTAL ASSESSMENT concerning SCOPING AND INTERPRETATION OF THE TERMS OF REFERENCE

1. INTRODUCTION

This inception report was based on descriptions of proposed project investments provided by the World Bank, on project details from the "Provincial Towns Water Sector Study" prepared by DHV Consultants BV of the Netherlands (DHV 1994), and on discussions with members of the Bank's project preparation mission to Mozambique over the 20-29 February 1996 period. Guiding documents were primarily the EA terms of reference (TOR) of 30 January 1996 provided by the Bank and annexed to this report, and relevant Bank policies and documents, notably:

- Environmental Assessment Sourcebook;
- OD 4.01, Environmental Assessment;
- OD 4.30, Involuntary Resettlement; and
- AFTES "Environmental Assessment and Review in Sub-Saharan Africa", 1995

Also taken into account were Mozambique's draft environmental management law and draft EIA regulations.

This inception report deals with Noragric's interpretation of some elements of the TOR and with the proposed scope of the EA itself. The TOR are very comprehensive and require interpretation and scoping because of the nature of the project and because this is a Category B project rather than Category A. Category B projects require "environmental analysis" rather than the "full EA" required of Category A projects. *The report makes some specific interpretation and scoping proposals for which Noragric requires Bank approval to ensure that the EA will meet the Bank's project preparation needs.* Because of the urgent time frame on which the EA is to be prepared, *this approval is needed as soon as possible.* Nonetheless, Noragric will proceed with the EA on the basis of the proposals contained in this report so that no time is lost and the EA can be completed in a timely fashion.

2. GENERAL ASSESSMENT APPROACHES

2.1 Urban Sanitation

This five-year water supply project is part of a much larger country assistance strategy being implemented in Mozambique by the Bank (World Bank 1995). Specifically,

this project, expected to begin in 1997, will overlap with a "Water, Sanitation and Local Government Project" which will address sanitation and other urban needs and is expected to begin in 1999 (Shepherd 1996). Moreover, GoM has recently concluded an agreement with DHV Consultants to undertake a four-year program (DHV 1995) which comprises institutional strengthening for environmental management within GoM; the development of a master plan for sanitation, drainage and environment in 13 cities, including the five incorporated in this project; and the development of a coastal zone environmental management plan. Because of the close relationship between the water supply aspects of this Bank project, the sanitation aspects of the second Bank project and the DHV program, this Bank project will include, at the request of the GoM, provisions for coordination of the three initiatives to ensure that a holistic, integrated result is obtained in the management of urban water services in the five cities (Shepherd 1996).

Clearly, increasing urban water supply without making complementary improvements to drainage, sewerage and waste water treatment is a prescription for substantial negative effects on human health and pollution. An EA of such a project would have to assess these effects very thoroughly. The Bank's TOR acknowledges this risk by specifying that the EA "make recommendations for the proper management of the wastewater produced by the various urban water supply sub-components of the project." However, this water supply project will be closely linked to a second program of investment in drainage, sewerage and waste water treatment works. *Thus, it is proposed that this EA omit assessment of the health and pollution effects of this project which would increase water supplies without, at the same time, making parallel improvements to sanitation works. The EA should consider what monitoring of health and pollution indicators will be required both to identify impacts and design mitigation measures should the second project not proceed, and to provide information for the planning of that project. The EA of the second sanitation project should include an assessment of health and pollution effects.*

This is a significant scoping proposal which must be seriously evaluated by the Bank. Accepting the proposal presumes a firm commitment by both the Bank and the Government of Mozambique to the timely implementation of the second project. Proceeding with this water supply project in the absence of such commitment could result in substantial negative impacts on pollution and urban environmental health.

2.2 Construction Activities

By far the largest component of the project is rehabilitation or upgrading of existing facilities involving no disturbances of new sites. All project sites should be examined for environmentally sensitive aspects but it is expected that most environmental protection requirements during construction can be adequately managed using standard, general construction contract requirements (eg. for trench openings, erosion control, dust suppression) coupled with supervision and monitoring. These general environmental requirements should be developed during the EA and form part of the environmental management plan. Thus, most activities for the rehabilitation or upgrading of existing facilities need not be analyzed in the EA. Any sensitive aspects

on particular existing sites/routes (eg. resettlement) should be addressed with site-specific recommendations and construction contract requirements.

Previously undeveloped sites (eg. Inhamizua ground level reservoir near Beira) should be examined and specific siting and construction management recommendations made.

2.3 Water Quantity Management

The project is intended to bring new water supplies to urban areas and it is thus expected that demands on both surface and ground water resources will be increased. In addition to the supply of potable water, other demands and values associated with water resources may be affected if urban water withdrawals are significant enough. These include:

Irrigation:	Reductions to the availability of irrigation water can have consequent effects on agricultural production, land use and socio-economic factors.
Waste dispersion:	Flow reductions in rivers can leave less flow to carry away and disperse, for example, agricultural chemicals, urban waste water and silt with consequent downstream effects on water quality and dependent water uses such as domestic water supply, tourism and fisheries.
Salt intrusion:	Reduced river flows can result in more extensive upstream intrusion of salt water and consequent effects on aquatic life and water suitability for irrigation and urban water supply. Ground water withdrawals can similarly cause saline intrusion, reductions in water availability for human use, and ecological effects.
Ecological functions:	Reduced flows in rivers, along with consequent water quality changes, can affect aquatic environments. Ground water abstraction can lower water tables and have consequent ecological effects.

It will be important in the EA to try to forecast and quantify the downstream and ground water effects of increased water withdrawals precipitated by the project. At the same time, hydrological and hydrogeological data are sparse in Mozambique, it may not be possible to even estimate these effects, and the project includes a substantial component of monitoring and research on specific water systems and of development of water resources management capacity. Where the EA cannot realistically forecast the effects of water withdrawals, recommendations should be made for focusing these research and management efforts, in part, on (1) quantifying available water, (2) analyzing the socio-economic and environmental trade-offs

between competing water uses, and (3) developing measures for managing the environmental effects of water abstraction for human use (eg. setting minimum river flows to keep downstream effects within acceptable limits).

More generally, the TOR specify that the EA "assess the mechanisms proposed by which Mozambique is to seek to increase its security of supply from international river basins" (Page 1, Section 2). This is a very "big" question relating to the capacity of Mozambique to both understand and manage its water resources (which the project is intended to strengthen), and to its ability to negotiate and ensure compliance with international water basin management agreements. Noragric feels that a thorough assessment of this matter is possible only within the broader mandate of a sectoral EA of the entire water sector in the country. Nonetheless, the issues which need to be addressed in such a sectoral EA, and in securing water supplies from these basins, can be identified during this project EA. These results could be used in conducting such a sectoral EA and/or as suggestions for detailing the capacity building elements of this project for water resources management in international river basins.

2.4 Resettlement

The project is expected to involve little, if any, resettlement. It might occur, for example, in:

- the siting of new works (eg. new storage tanks, expanded distribution systems);
- the upgrading of existing works where people have settled in working areas (eg. main transmission lines); and
- the construction of new dams (eg. Nampula, Quelimane)

Where the location of project works is known, these should be surveyed and resettlement estimates and strategies prepared based, in part, on consultations with individuals, families and groups which may be affected. Where they are not known, the potential need for resettlement should be recommended for future study. In either case, resettlement policy, principles and guidelines should be recommended in the EA and contribute to the preparation of a separate resettlement plan as called for in the TOR.

2.5 Public Consultation

OD 4.01 (paragraph 19) specifies that EA studies include consultation with affected groups and local NGOs "to understand both the nature and extent of any social or environmental impact and the acceptability of proposed mitigatory measures, particularly to affected groups". On this project, the major project components likely to be of concern to the public are the introduction of new tariffs for water, the extension of distribution networks and, perhaps, the linkages between increased water supply and improved sanitation works. None of these components are sufficiently defined to be adequately considered in the EA and the first two are the focus of the major beneficiary study being undertaken as part of project preparation. *It is proposed that the EA not consult the public on these issues but recommend means for the beneficiary study to address them.* The only other issue which may concern the

public is the potential need to resettle people from project work areas. This issue was discussed above.

3. PROJECT ACTIVITIES TO BE ASSESSED

Project activities on which the EA should focus are summarized below. First, the five urban sub-projects are discussed, and then the more general water resources management and rural water and sanitation sub-projects. For the towns, a distinction is made between those activities which may cause significant effects and those for which effects are likely to be minor. As discussed above (Section 2.2), routine activities which involve the rehabilitation or upgrading of existing facilities are not listed.

3.1 Maputo

Significant environmental effects
- increase surface water abstraction from Umbeluzi River

Minor environmental effects
- new intake and treatment plant
- extension of distribution network

3.2 Beira

Significant environmental effects
- increase surface water abstraction from Pungue River

Minor environmental effects
- new intake
- new ground level reservoirs at Inhamizua and Dondo

3.3 Nampula

Significant environmental effects
- increase surface water abstraction from Monapo River

Minor environmental effects
- new transmission main
- new ground level reservoir at PS4
- district pumping station
- extension of distribution network

3.4 Pemba

Significant environmental effects
- increase ground water abstractions from existing Metuge well field

Minor environmental effects
- extension of distribution network

3.5 Quelimane

Significant environmental effects
- increased surface water abstractions from Licauri River

Minor environmental effects
- small weir and new intake on the Licauri River
- transmission main from river to treatment plant
- new transmission main from treatment plant to town
- new ground level storage reservoir in town
- extension of distribution system

3.6 Water Resources Management

The only capital works in this sub-project are those associated with completing the Corumana Dam. Undertaking these works is contingent on the results of a feasibility study but could involve:
- protection of the downstream slope;
- stabilization of the river channel downstream of the spillway;
- provision of a security fence;
- installation of lighting;
- upgrading of the 1.5 km access road; and
- installation of spillway gates to increase the storage volume.

The project involves several activities to study and determine the need for and feasibility of future activities and investments which are not part of the current project. Some of these may have significant environmental effects which should be studied in the course of the project. They are:

Maputo
- diversion of water from Incomati, via Movene, to Umbeluzi Rivers
- construction of transmission main/canal from Incomati to Movene River
- ground water abstraction from Pateque-Manhica area

Nampula
- construction of dam and reservoir upstream of present reservoir on Monapo River

Pemba
- ground water abstraction from extended Metuge well field

Quelimane
- construction of a dam and reservoir on the Licauri River

3.7 Rural Water and Sanitation

This part of the project is still being developed but is expected to include the development/
strengthening of community-based water users' associations in rural towns and peri-urban districts; community-led design of small piped water systems and sanitation works; and subsequent project investments in these systems/works. As specific towns have not been identified, the EA will simply provide recommendations/guidelines on how these systems/
works may best be implemented to be environmentally and socially sustainable.

4. DETERMINATION OF POTENTIAL IMPACTS

Based on the above discussion, the potential impacts to be assessed would include:

i) Project Location: possible resettlement of people; loss of forest land; loss of agricultural land (cropping and grazing); impact on flora and fauna; impact on historic and cultural sites; effects on water resources inside the command area.

ii) Project Design: disruption of surface water and ground water resources; drainage problems; design of constructions and other structures; crossings for people and animals.

iii) Construction Works: soil erosion; noise; traffic and other safety issues; management of construction spoils; dust suppression; sanitary conditions and health risks associated with construction camp and workers coming into area; social and cultural conflicts between imported workers and local people.

iv) Project Operation: changes in surface water quantities and qualities within affected drainages; changes in ground water levels within command areas; consequent effects on other water uses and values.

5. STUDY AREA

The geographic areas for the EA should be those specified in the TOR, modified according to the general assessment approaches proposed in Section 2, and the discussion of project activities to be assessed discussed in Section 3. The proposed areas will thus be:

i) the five cities (Maputo, Beira, Nampula, Pemba and Quelimane) that are the focus of the urban water supply investments, their water intake areas and the main catchment and/or ground water systems (including their recharge areas) which supply them; and

ii) the Cornuna Dam.

iii) the limited number of rural towns for which piped water supply systems will be upgraded and/or rehabilitated.

Draft Terms of Reference (TOR) for the Environmental Assessment of the Mozambique Water Resources Management and Development (MWRMDP) Project.

Cyprian Fisiy with Jean-Roger Mercier (AFTES)
Revised version by John Sheperd/Torbjorn Damhaug, January 30, 1996

1. Introduction

Mozambique is under reconstruction and its environmental problems have been identified and solutions proposed from the Bank's perspective in the CESP. The water sector approach taken in this project and in this EA is consistent with the need to plan the use of this natural resource and should also be consistent with the regional water Resources management strategy being designed by the World Bank in a very participatory way.

2. Objectives

The Objectives of the EA will be to identify the possible negative environmental impacts of the project as presently designed and propose the required mitigating measures to be implemented to avoid these negative impacts. The EA will also highlight the positive impacts of the project on the water sector.

At this stage of the screening process, the negative impacts should be coming from the physical investments financed, notably the infrastructure and equipment components, with the possible following impacts:

- general nuisance of the construction works and their health and safety hazards,
- water pollution, both inland and marine,
- water quantity management, e.g. in a transboundary context (the EA will assess the mechanisms proposed by which Mozambique is to seek to increase its security of supply from international river basins.

The EA will also take the water cycle as a whole and make recommendations for the proper management of the wastewater produced by the various urban water supply sub-components of the project.

Although involuntary resettlement is not anticipated at this point in the preparation, should it become an issue subsequently, a separate resettlement plan will be required.

The Project proposes the enhancement of the performance in water resources management and urban water supply and sanitation through projects incorporating institutional reforms and capacity building. The EA will assess likely effects of other proposals under the Project on the enhancement of urban and rural environmental conditions.

These terms of reference have been drafted with the objective that the EA would be over, endorsed by the Government of Mozambique /GoM) and cleared in the Bank (AFTES) before the appraisal mission.

3. Environmental Assessment Requirements

The EA will seek to ensure that the project complies with the relevant guidelines and requirements of the following:

- World Bank Operational Directive 4.01 "Environmental Assessment," and related guidelines such as O.D. 4.30 "Involuntary Resettlement";

- national laws and/or regulations on environmental reviews and impact assessments;

- regional, provincial or communal environmental assessments regulations;

- environmental assessment regulations of any other financing organisations involved in the project

- The National Environmental Action Plan (NEAP)

4. Study Area

The core areas for the study include: (i) the five cities (Maputo, Beira, Quelimane, Pemba and Napula) that are the focus of the urban water supply investments , their water intake areas, wastewater discharge locations, and affected water surface waters, and the main catchment and/or groundwater systems (including their recharge areas) which supply them; (ii) the Corumana Dam and its basin; (iii) a limited number of rural towns for which piped water supply systems will be upgraded and/or rehabilitated. The precise boundaries of the study area for the Assessment (e.g., water catchment) will be decided upon during the initial exercise of the EA.

5. Tasks

5. Scope of Work.

Some of the technical and economic/financial as well as institutional information on the project is till being refined. The consultants will take stock of all relevant existing information at the time of starting EA preparation.

Description of the Proposed Project:

The Project is described in the attached Project Identification Document (PID). Details of the proposed investments will be provided for the Consultants. This task will take stock of the project components as they stand now and will break them down

according to the type of works in order to ease the identification of their likely environmental impacts. A convenient way to do so is to break down each activity into the following phases: construction, maintenance, development of activities permitted by the works (e.g. design of the water supply systems, land clearing and acquisition work, laying out the pipes etc.)

Description of the environment

The consultants will assemble, evaluate and present baseline data on the relevant environmental characteristics of the study area. These will include information on any changes anticipated before the project commences. The first task of the EA will be the scoping phase. This will include a preliminary reconnaissance of the likely environmental impacts of the project. Within the areas likely to be impacted the following environmental impacts will be collated when relevant:

(a) Physical environment: geology; topography; soils; climate and meteorology; ambient air quality; surface and ground-water hydrology; coastal and oceanic parameters; existing sources of air emissions; existing water pollution discharges; and receiving water quality.

(b) Biological environment (especially in rural areas): flora; fauna; rare or endangered species; sensitive habitats, including parks or preserves, significant natural sites, etc.; species of commercial importance, and species with potential to become nuisances, vectors or dangerous.

(c) Socio-economic environment: land use (including current crops and cropping patterns); land tenure and land titling; human settlements, human health indicators, present water supply and water uses (including current distribution of water Resources if irrigation systems already exist in area); control over allocation of resource use rights.

The consultants will make use of the abundant data collected for the preparation of the CESP/NEAP and the Beneficiary Assessment which will be carried out in parallel as part of the project preparations.

Legislative and Regulatory Considerations.

Ascertain and summarise the pertinent regulations and standards governing environmental quality, health and safety, protection of sensitive areas, protection of endangered species, siting, land use control, etc., at international, national, regional and local levels. An Assessment of the present handling of the EA requirements and procedures, as well as of the Government's capacity to handle these in the future should be included in this EA. Make use of the NEAP as part of this exercise.

Determination of the Potential Impacts of and Impacts on the Proposed Project

Potential impacts to be assessed include, but are not limited to:

(a) Project Location: possible resettlement of people; loss of forest land; loss of Agricultural land (cropping and grazing); impact on flora and fauna; impact on history and cultural sites; effects on water Resources outside and inside command area.

(b) Project Design: disruption of hydrology; drainage problems; design of constructions and other structures; crossings for people and animals.

(c) Construction Works: soil erosion; noise; traffic safety issues, construction spoils (disposal of); sanitary conditions and health risks associated with construction camp and workers coming into area; social and cultural conflicts between imported workers and local people.

(d) Project Operation: pollution by agrochemicals; impacts on soils (waterlogging, salinization, etc.); changes in ground water levels and quality inside and outside command area; changes in surface water quality and risks of eutrophication; incidence of excreta and water-related diseases, sanitary risks from the landfill.

The scoping part of the EA will determine the exact list of impacts that should be investigated.

Analysis of Alternatives to the Proposes Project.

Describe alternatives that were examined in the course of developing the proposed project and identify other alternatives which would achieve the same objectives. The concept of alternatives extends to siting, design, technology selection, construction techniques and phasing, and operating and maintenance procedures. Compare alternatives in terms of potential environmental impacts; capital and operating costs; suitability under local conditions; and institutional, training, and monitoring requirements. When describing the impacts, indicate which are irreversible or unavoidable and which can be mitigated. To the extent possible, quantify the costs and benefits of each alternative, incorporating the estimated costs of any associated mitigating measures. Include the alternative of not constructing the project, in order to demonstrate environmental conditions without it.

The Consultants could refer to the DHV report which refers to the feasibility studies for the five cities include Assessment of alternative solutions.

Development of Management Plan to Mitigate Negative Impacts

This task will only be executed if the EA has identified significant harmful impacts of the proposed Project.

Recommend feasible and cost-effective measures to prevent or reduce significant negative impacts to acceptable levels. Estimate the impacts and costs of these

measures, and of the institutional and training requirements to implement them. Consider compensation to affected partied for impacts which cannot be mitigated. Prepare a management plan including proposed work programs, budget estimates, schedules, staffing and training requirements, and other necessary support services to implement the mitigating measures.

Identification of Institutional Needs to Implement Environmental Assessment Recommendations

This duty component is subject to a justified need of more monitoring plans and institutional building than those which will be implemented as part of the proposed Project.

Review the authority and capability of institutions at local, provincial/regional, and national levels and recommend steps to strengthen or expand them so that the management and monitoring plans in the environmental Assessment can be implemented. The recommendations may extend to new laws and regulations, new agencies or agency functions, intersectoral arrangements, management procedures and training, staffing, operation and maintenance training, budgeting and financial support.

Development of a Monitoring Plan.

Prepare a detailed plan to monitor the implementation of mitigating measures and the impacts of the project during construction and operation. The monitoring efforts shouldn't only cover biophysical elements, but also inhabitants and their sanitary conditions. Include in the plan an estimate of capital and operating costs and a description of other inputs (such as training and institutional strengthening) needed to carry it out.

Assist in Inter-Agency Coordination and Public/NGO Participation.

DNA will lead coordination with other governmental agencies, donors, and other affected groups. The Consultant will assist DNA in this, include keeping records of meetings and other activities, communications, and comments and putting these at their disposals.

6. Report

The environmental Assessment report should be concise and limited to significant environmental issues. The main text should focus on findings, conclusions and recommended actions, supported by summaries of the data collected and citations for any reference used in interpreting these data. Detailed or uninterpreted data are not appropriate in the main text and should be presented in appendices or a separate volume. Unpublished documents used in the Assessment may not be readily available and should also be assembled in an appendix. Organise the environmental Assessment report according to the outline below.

Executive Summary, Policy, Legal and Administrative Framework, Description of the Proposed Project, Baseline Data, Significant Environmental Impact, Analysis of

Alternatives, Mitigation Management Plan, Environmental Management and Training, Environmental Monitoring Plan. Appendices: List of Environmental Assessment Preparers References Record of Interagency/Forum/Consultation Meetings

(This is the format suggested in OD 4.01, Annex B; the TOR may specify a different one to satisfy national agency requirements as long as the topics required in the Bank's directive are covered.)

7. Consulting Team and Time Budget

Members of the team should consist of people with the following specialisation's:

- one EA preparation team leader with general expertise in EA
- one environment economist
- one social scientist
- one water Resources specialist with general expertise in water and sanitation projects

The tentative time budget for each team member are as follows:

Team member	Number of days
Team Leader/EA expert	50
Environmental Economist	20
Social Scientist	30
Water Resources and WSS Specialist	30
Total	130

The use of local/Southern African consultants is highly recommended.

8. Schedule

The EA preparation is scheduled to take place as follows:

Tasks/Month (1996)	February	March	April	May	June
Scoping	xxxxxxxxx				
First Progress report	x	x			
Impact & analysis of altern.		xxxxxxxxx	x		
Second Progr. Report			xxxx		
Recommendations			xxx		
Public consultation			xxx	xxx	
Draft Final EA report				xxxxxxx	
Review: GoM/AFTES				x	xxx
Final EA report					xxxxxxx

9. Other Information

It is important that this EA takes into consideration all relevant information on environmental issues in Mozambique, as well as the specific planning and implementation activities dealing with environmental aspects of this Project. Hence, the consultants attention should be directed to i.a. the following data sources, project background reports and studies, relevant publications, and other items:

- Environmental Assessment Sourcebook and all related regulatory texts published by the World Bank group
- AFTES «Environmental Assessment and Review in Sub-Saharan Africa», 1995
- AFTES «Managing the Environment Locally in Sub-Saharan Africa (MELISSA)», 1995
- AFTES «Integrated Coastal Zone Management», 1995
- Mozambique CESP, 1994
- Programa Nactional de Gestâo Nacional do Meio Ambiente, (NEAP) Maio 1994
- Coastal Zone Management Projects

Some relevant project specific plans, descriptions and Terms of Reference are as follows:

- Strengthening of Management of Shared Water Resources, Draft TOR January 9, 1996
- Business Development Plan for ARA-Sul, Draft TOR, January 9, 1996
- Feasibility Study for Corumana Dam Complementary Works, Draft TOR, January 9, 1996
- Joint Incomati Study - Proposals for Revised Study, DNA
- Implementation of Performance Contracts in the Water Sector: Terms of Reference for the Counterpart Team
- Beneficiaries Assessment Study. Terms of Reference, January 1996.

APPENDIX B: ECONOMIC ANALYSIS

With the wide definition of "environment" in the Bank OD 4.01, a wide definition of environmental economics is also chosen in assessing the urban water supply project.

B1. Introduction: A Social Welfare Function for Mozambique?

The political goals and legislative system of the country are supposed to represent the social preference function or what is considered to be the accepted social justice in the country. Ideally, these should represent a complete and consistent basis for formulation of a development strategy. In practice, there are big gaps and inconsistencies in existing institutional frameworks, lack of coordination, incomplete information causing moral hazard problems and inferior and inconsistent strategies. The international society through international and donor organizations is also imposing their goals of efficiency, social justice and sustainability on poorer countries.

In order to carry out an environmental economic analysis of urban water supply in Mozambique, we have to try to apply economic theory to an economy where transactions costs may be high, information problems are tremendous, poverty is an urgent issue, institutional structures are under complete revision, and the people have lost hope in the government's ability to solve its problems. No doubt, this is a thorny and narrow, if at all passable, path. Concepts in economic theory, like market failure, externality, policy failure, etc. are linked to an ideal world without transactions costs (and with perfect information) as a baseline for comparison. In a second-best world the conclusions arrived at in a first-best world do not necessarily hold. In a "third-best" world, like Mozambique, the situation is even worse. Navigation according to rules from the first-best world do not necessarily lead towards improvements because important issues are neglected. Still, this is attempted due to the lack of better principles to follow.

The principles we follow are:

- Water should be provided according to needs. The National Water Policy (1995) states that provision of basic water supply needs to low income groups in peri-urban and rural areas are prime (principal) objectives.
- Water should be paid by the users according to its economic value or the cost of providing it (Ibid.).
- Aim for cost recovery to develop a sustainable water sector.
- Matching of water supply (quantities and qualities) with the demand for water (ability and willingness to pay for water).
- Polluter pays principle (wastewater disposal).

These principles may in some cases contradict each other, in particular the needs may be higher for the poorest segments than their actual ability to pay for water. Cost recovery may thus only be achieved in several stages if a positive economic growth, also benefiting the poor, can be achieved. Grant money will be necessary to facilitate this process.

The objective of the National Water Policy is to increase the coverage in urban and peri-urban areas to 50-80% of the population by the year 2002. The target for Maputo is 60%, for Pemba 80%, while it is 50% for Beira, Quelimane and Nampula. Tariff structures should be revised such that by year 2000 they should cover operation, maintenance and 50% of the depreciation costs. Full cost recovery should be achieved before 2003 (Ibid.).

B2. Pricing of Water

A new tariff system has recently (February 1996) been introduced in Mozambique. This is an important step in the direction of establishing a system to support a commercially viable water sector (WB 1996). We will suggest here some general principles for the pricing of water. These principles could be used in relation to the further development of a tariff system as long as pricing cannot be left to market forces alone.

If water is abundant, the correct pricing of water would be the cost of cleaning and distributing it. If water is scarce, pricing is more tricky. One may have to trade off between the goals of satisfying current basic needs vs. economic growth (including future basic needs). In two of the towns, Maputo and Beira, there were emerging conflicting interests in use of water, either for irrigation or for urban consumption. In the towns there may also be conflicts between using water for commercial purposes and for household consumption.

Raw water from the Pequenos Libombos dam near Maputo is currently priced at only Mt 4/m^3 (USD 0.00033/m^3). This is the price paid both for urban consumption and for irrigation. This price is likely to be increased to Mt 70/m^3 (USD 0.0058/m^3) in the near future. This can be compared to the estimated average net value added per m^3 for irrigation water of USD 0.046/m^3 (DHV 1994). If this estimate is still valid, and we make the simplifying assumption that marginal cost is equal to average cost (linear profit function), the opportunity cost of water is almost nine times as high as the suggested new price for raw water. ARA-Sul is responsible for the overall water resource management and should get an income to cover its costs as sale of water is the principal source of income.

Water for urban consumption is now given highest priority although the dam was originally designed to provide water for irrigation. Currently there is sufficient water both for urban consumption and irrigation but with the expected increases in urban as well as irrigation demands there may be negative effects on agricultural production from expanding urban consumption. These losses should be valued according to the opportunity cost of scarce water. This requires knowledge about future prices and relevant technologies and management systems. The marginal increase in the

profit in farming due to a marginal increase in the use of water for irrigation would represent this price. As future prices etc. are unknown we can only make a rough estimation of expected scarcity values based on current prices.

A general principle which could be derived from this is that the price of water should be set higher at times of scarcity and this scarcity price should be faced both by urban and irrigation water consumers. This would result in seasonal price variation and higher prices in drought years. Whether this is administratively feasible has to be considered. The relative price variation would be much higher for irrigation water than for urban consumption, however, as much of the price paid by urban consumers is due to the cost of cleaning and distributing water to the urban areas. For comparison with the current (Mt 4/m^3) and future (Mt 70/m^3) prices of raw water, the urban consumers pay Mt700-4,000/m^3, the lowest price being for "basic need" consumption and the highest price for industries. Scarcity pricing of irrigation water would facilitate location of irrigation projects where water is more abundant if conditions otherwise are similar. Irrigation requires high initial investments, however, and careful land use planning is necessary, taking into account future water supply and demand before land is allocated for irrigation.

B3. Cost Recovery Problems

The water companies in each town have severe cost recovery problems. The recovery rates from the consumers were typically low. Particularly state departments often fail to pay their water bills. There were also limited possibilities for reducing the costs as a very large share of the costs were for electricity. For example, in Pemba the costs/m^3 were estimated to be Mt 6,000 (USD 0.50) while the income/m^3 was only Mt 700-900 (USD 0.058-0.075) (Water Deparment in Pemba, 1996). So when with the existing low prices the recovery rates are low, how would they be when prices are raised to try to incorporate coverage of the real costs, and of the additional costs required to upgrade and improve the systems as well? Management problems within the water companies and coordination problems among the various state institutions are only going to add to this problem of creating a sustainable system for water supply.

Poor services were frequently given as reasons for not paying the water bills. The poor services were primarily unreliable supplies of water. Water was often distributed only a few hours a day. In other cases it was distributed only a couple of days per week. This imposed storage problems and costs on the consumers and was an important reason for the development of secondary markets.

Seventy percent of the employees in the Maputo area earn the minimum wage of Mt 228,000 per month. This does not even cover the costs of 40 kg of maize or 50 kg of rice. With the addition of house rent, work travels and other expenses, the minimum wage will not cover the basic costs of living. What would be the willingness and ability to pay for water under such circumstances?

If the aim is cost recovery, there must be a possible match between the willingness or ability to pay and the actual cost of providing the water. If we assume a

water demand for decent living of 15 lites/capita/day and a household size of six persons, the total monthly demand for water would be 2.7m^3. If the cost of water would be USD 0.25/m^3 (Mt 3,000), the monthly expenditure on water would be Mt 8,100 or 3.6% of the minimum monthly wage (assuming only one employed member of the household). If the cost of water is USD 0.5/m^3 (Mt 6,000), the monthly expenditure would be Mt 18,200 or 7.1% of the minimum monthly wage.

If the same household had a yard tap and consumed 70 litres/capita/day, the monthly water consumption would represent 16.6 or 33.2% of the monthly minimum wage, given the same prices as used above. A yard connection may even be too expensive for a technician working in DNA and having a monthly salary of Mt 350,000 as he would have to spend 10.8 or 21.6% of his salary to pay for the water demand of his family. House connections would simply be prohibitive for households on minimum wages, if they were not able to sell water to neighbours and others.

From this perspective it is clear that the DHV consultants who designed the plan have aimed for a too high standard (75% having house or yard connections by the year 2017). They did not have income distribution data at the time they did the study (DHV 1994). It is very unlikely that the large share they proposed will have the ability to pay for such a high standard water supply system. It seems much more realistic to provide public standposts for the large majority of people, which implies lower costs per m^3 of water and considerably lower rates of water consumption per consumer.

Another question is whether an element of cross subsidies incorporated in the tariff system could help to increase the coverage of distribution and recovery of costs. If the relatively rich urban population, who get house connections, have to pay an additional tax on their water supply, this tax could be used to provide subsidized water for the poor. Yet the share of non-poor households is very low on average (less than 10%). However, this points in direction of increasing the price of water for house connections, to a level at least as high as that for commercial users. The current system with progressive water prices is having a similar effect.

The current tariffs are fairly low although they have just been raised. The high inflation rate, if it is going to last, makes it necessary to have frequent index regulation of tariffs using the loan currency (USD) as the base.

B4. Water Quality and Pricing

Poor water quality seemed to be perceived as being less of a problem among consumers than it really was. Lack of knowledge about waterborne diseases was the reason for this. This was therefore not an important reason for non-payment. Distribution of unhealthy water may also be seen as an externality causing human suffering, imposing costs on the health service system, and loss of profits in productive sectors. The price of unhealthy and dirty water should therefore have been lower than the price of clean and safe water. In this case one could view the water company distributing unhealthy water as the polluter imposing damages on others. These damages also represent externalities which ideally should be internalized. Differentiation of water prices according to water

quality would therefore be appropriate from a theoretical point of view. The question is, however, if this leads to improvements in a third best world.

Agrochemical pollution of water has been identified as a possible problem in the Maputo area. Large irrigated areas are found upstream in the Umbeluzi basin, particularly in Swaziland. Water quality considerations from a human consumption perspective should be included in the international agreements and monitoring system to control the use of agrochemicals to keep levels of toxic elements below safe standard levels. It is not known what the effects are on human health and aquatic life from this or whether a monitoring and management system can succeed in reducing the problem.

B5. Free-Riding and Moral Hazard Problems

Illegal connections were common in several of the towns studied and caused unaccounted for water (UFW) losses. Total UFW losses have been estimated from between 30-40% in Maputo to 50-60% in Quelimane. A part of the repair program is to repair leakages and illegal connections. The danger is that these may reappear soon after the repair has been carried out. A permanent monitoring system and a system with fines etc. may be necessary to handle this problem. Establishment of water taps at regular frequent intervals along the transmission mains and other parts of the distribution system may also reduce the problem.

Damage of water meters was common. Often a water meter lasted for only a week before it was put out of function. This was due to the current incentive structure where there were no fines or additional costs imposed on those who used these taps. Rather they could increase their consumption without having to pay for it because billed water consumption tended to be set low at these places. It is part of the rehabilitation and distribution network improvement to repair, replace and introduce new water meters. The costs of doing this may not be recovered and defended unless the incentive system at distribution points is changed. Those in charge of public taps should be held responsible for repair or replacement of damaged water meters and a higher price should have to be paid for water from taps where the meters are out of function.

House connections with broken meters are currently in many cases functioning like illegal connections because large amounts of water may be drawn without paying more than the normal low flat fee. Having a house connection may therefore be a profitable business because unpaid for water may be resold at a very high price to less fortunate neighbours (see also Ojanperä, 1993). This may perhaps also explain that there currently is a high demand for more house connections although the costs may not be justified from a society perspective. It is therefore hard to justify the large planned expansion of house connections in the World Bank investment program. We also return to this in relation to the discussion of sanitation.

B6. The Secondary Markets for Water

We found considerable variation in the extent and functioning of secondary markets for water. In periods of scarcity, the price of water in secondary markets could be as high as up to Mt 50,000/m^3 while the official prices has just been increased to Mt 700-4,500/m^3. One could say that the prices found in the secondary markets represent the true scarcity value of water, however severe poverty could ration poor households out of the market and cause life-threatening suffering. The planned project may result in a larger and more reliable supply of water and lower prices in secondary markets, if they cannot be fully removed.

The planned beneficiary assessment will carry out a detailed study of this market as well. As many types of solutions have been tried in different towns and also within towns, it is likely that this study will result in much clearer recommendations as to how the distribution system should be set up. One option we did not see but which we think should be considered, is that the public standposts rather than ending in a tap, should end in a tank. This would reduce the storage problems which impose high costs on the beneficiaries, particularly the poorer who cannot afford to buy tanks and who have to buy the water at a much higher price from the vendors.

The beneficiary assessment is planned for only two of the towns. We recommend that the beneficiary assessment is developed to a participatory distribution system development project to get a good match between supply and demand.

B7. Impact on Health

Improved supply of clean water will give positive health effects (if sanitary conditions are not worsened). Lack of knowledge about the relationship between water quality and health among the users may cause larger health problems because sufficient precautionary measures are not taken. This may cause people to underestimate the value of clean water or that they believe the water they get is of better (less dangerous) quality than it really is. This points to one of the limitations of willingness to pay studies with regard to water quality. Even with this knowledge people may fail to take the necessary preventive measures, e.g. to boil their drinking water because this is very expensive. It would be helpful to know how common this practice is and how it relates to the income level of people, their knowledge about water quality, educational level, and access to and provision of public information about water quality.

The health effects include the pain suffered by those getting sick and their relatives, additional health services required (drugs, nursing, doctor consultation, and hospitalization), productivity losses in days lost for work, and days worked at lower productivity (Convery 1995). Loss of lives may also occur. In our case we expect a reduction of these costs from improving the water supply and quality of water (if sanitary problems are controlled). It is difficult to relate general health statistics directly to water supply, however. Water quality and quantity are not the single most important elements in direct transmission of e.g. diarrhea and dysentry (Listorti 1990).

Furthermore, there is likely to be considerable underreporting in the health statistics. Ministry of Health (1996) reports 80 deaths caused by diarrhea and dysentry in 1995 in Maputo. With a population of 1.4 million, that is only 0.06 deaths per 1000 inhabitants while a study in Quelimane and Beira in 1985-86 found 15 deaths in Beira and 4.1 in Quelimane per 1000 inhabitants which were caused by diarrhea (Feechem and Jamison 1991). The large difference between Beira and Quelimane may have to do with water quality but we do not know for sure. At this time the water in Quelimane appeared to be of poorer quality than in Beira while water samples taken in 1991 and 1992 show large variation from one year to the other in Quelimane in samples taken from wells (8.6% infected in 1991 against 44.4% infected in 1992). Calculation of costs and benfits on this basis would therefore be pure speculation.

For a proper analysis household data including health records, water supply conditions, behaviour in relation to water use, and other conditions affecting the health of people, are needed. It may then be possible to estimate the effects of water supply on the health of people (frequency of various diseases e.g. in days sickness/year) if other possible causes also can be registered and included in the analysis (including e.g. food/nutritional data). If households also are interviewed about the income and cost effects of being sick, we may put economic value on some of the health effects. It has not been possible to do this with the limited time available for this study. It should be considered whether it is appropriate to include this approach in the beneficiary assessment.

B8. Distribution and Sanitation

Sanitation seems to be the most significant negative issue in relation to increased urban water supply in Mozambique. Sanitation is not part of the current project but implementation of the WB project as planned will result in serious negative environmental effects if a solution to the increased sanitary problems are not found. An alternative plan has thus been sketched. We propose that extensions in the distribution system should not take place for house connections untill the sanitation problem is solved. We thus suggest that funds are reallocated from house connections to public taps/standposts. This will create less sanitary problems and water can be provided to a larger share of the urban population, particularly the poor living in peri-urban areas. This is supported by socio-economic studies of the urban populations which indicate that as much as 70% of the population are ultra-poor, being unable to cover their basic needs, more than 20% had incomes between one and two times the basic needs requirements, and less than 10% were non-poor and had incomes above two times the basic need level (Ministry of Planning and Finance 1994). This may not have changed much since the study was carried out in 1992/93.

The DHV proposed, and current WB project may thus have been planned with a too high standard compared to the purchasing power of the majority of people. If the aim is cost recovery in the long run, the standard of supply should be adjusted down. Detailed analyses are given in Section B.14 for Beira and Quelimane as rough examples. The Beneficiary Assessment will facilitate a more accurate analysis. We have tried to give an idea of the consequences of shifting from house connections to full

coverage by public taps as an extreme alternative and what this implies in terms of total water demand and installation costs (not including all aspects related to distribution network and increased water demand in Quelimane where population data are corrected upwards). An advantage with the alternative plan is that it will more than satisfy the coverage target of the National Water Policy which is 50-80% by 2002. The WB project will fail to meet this target.

Without detailed plans or analyses of the physical situation and health effects from increased water supply on the sanitary situation, it has not been possible to quantify the health costs for the different alternatives.

We may conclude and recommend that further extension of house connections should only take place if those getting these pay the full costs of supplying the water and the increased sanitation costs imposed on their neighbourhoods. Inclusion of house connections in the present project should only be accepted if a solution to the sanitary problem is actually found. We recommend that the program is changed to concentrate on extending distribution through public taps.

B9. Induced Development Effects

There are scarce funds for development investments in Mozambique. Therefore all projects should ideally be judged and compared to the best alternative projects. There are large information gaps preventing proper comparison, however. Projects may have both direct and indirect (induced) effects. Induced effects may be hard to predict. Some of them are short-term, others are long-term. Detailed knowledge of the structure of the economies and data to develop SAM/CGE models are needed to make quantifications of these effects. Without this information it is only possible to make some general assessments based on similar studies carried out elsewhere. There may be short term positive effects from the planned project on urban consumers. Both expenditure on water, if bought at very high prices in the secondary market, and time spent to get the water, may be reduced. There will thus be some clear redistribution effects locally. Others, who have managed to get water at a very low price up to now, may have to pay much more to get water after the rehabilitation.

There may also be some more long-term effects on migration between urban and rural areas. Water supply, however important, is only one of many factors influencing people's decisions about migration and where to settle. The war forced about 1/3 of the rural population to move to the towns. If there are relatively better employment or other income-gaining opportunities in an area, people are likely to go there if they have the knowledge and resources to do so. Migration and resettlement is costly. People may thus be trapped in places from where they would like to escape. Urban-rural migration is particularly dear and difficult as there are few immediate income or employment opportunities in the rural areas. It takes time to reestablish farms.

A gradual expansion of a market oriented and more advanced agriculture from the towns and outwards seems the most appropriate approach in Mozambique. Provision of infrastructure and water supply where needed in peri-urban or near urban

rural areas, together with the development of factor and output markets, extension service, etc. may gradually provide increasing income and employment opportunities which may facilitate the movement of poor unemployed people out of city centres if they have no other options. A modernized agricultural sector has been shown to have strong forward and backward linkages and provides incomes to the majority of poor in most developing countries. Provision of water supply should therefore be seen in this context to stimulate agricultural growth and thus economic development in the country. Investments in different sectors have to be balanced to achieve this.

B10. Urban Water Consumption vs. Water for Irrigation

Agriculture represents the largest sector of the Mozambiquan economy providing 40% of GDP and export value in 1991 after a decline in this sector due to the war (MOPH 1994). In 1994/95 the country produced only 67% of its food requirement causing the need for importing large amounts of food (Ohlsson 1995). In 1990 the total import value was almost six times as large as the total export value and the food import value alone was more than double the total export value. The urgent need to increase food production is therefore evident.

Mozambique has favourable conditions for agricultural development and a huge underutilized irrigation potential, particularly in the Zambezi river basin. Currently irrigated areas are rehabilitated and there is a National Irrigation Development Master Plan indicating expansion of irrigated areas in the years to come. Water demands for irrigation are high, estimated to be more than twenty times the urban water demand in 1992 (MOPH 1992). These demands could therefore easily come in conflict and there is a clear need for integrated water resource management to strike a balance between irrigation and urban demands. As population grows, irrigated areas may have to be reduced in some places. Development of rainfed agriculture and irrigated agriculture in areas with more abundant supply of water, like in the Zambezi river basin, should therefore be prioritized. Poor infrastructure is currently constraining transport of agricultural produce from the north to the south in the country, however. The irrigated areas in Umbeluzi, Incomati and Limpopo river basins therefore have a favourable position in relation to the Maputo area.

Models for integrated resource management should be developed to support the planning process. Currently the irrigation potential developed in this area is far from fully utilized. This is partly due to the war and partly due to the lack of tradition for this type of agriculture among the rural population. PRORURAL, an Italian sponsored agricultural development project, is providing irrigation for 300 ha in Umbeluzi but the farmers have not yet reached break-even yields for full cost recovery. This is for smallholders, however. Commercial farmers with knowledge and access to higher level technology may be able to make high profits. Even export to South Africa could be possible because the season is longer for certain products than in South Africa.

In the Maputo and Beira areas there will be significant competition for water for urban consumption vs for irrigation. Restrictions have already been put on the irrigated

areas in the Umbeluzi basin and in Beira (DHV 1994). The Corumana Dam was established primarily to facilitate irrigation development. However, it is now stated that urban consumption needs have priority over water for irrigation. The DHV consultants carried out an economic evaluation of different water supply scenarios in the Maputo area. They found that irrigation components (Movane area) contributed to increased economic internal rates of return. Detailed analyses have also been made in the National Irrigation Development Master Plan. Further analysis is therefore not pursued here.

B11. Population Growth Projections

The population estimates and projections which served as the basis for planning made by DHV (1994) were very uncertain. There were no reliable statistics on the actual refugee populations or the percentage that would return to their original villages. The consultant thus imposed the assumption that from 3% (Pemba) to 25% (Nampula and Quelimane) of the populations in these towns in 1992 would leave for their areas of origin. Our information obtained during visits to these towns indicated that this outmigration has not taken place. This implies that actual populations in some of the towns are likely to be considerably higher than the projections made by the consultants in 1994. We were told that the population in Nampula was likely to be above 380,000 in 1996 while it was projected to be only 278,000 according the DHV consultants. In Nampula we found that there was some temporary outmigration during the rainy season.

B12. Ability or Willingness to Pay for Water

Demand for water would typically depend on the price of water and the income of the person buying. Rich households would typically demand higher quantities of water but the share of their income used on water may be lower than for poor households as water may be seen a necessity with income elasticity below one. Ojanperä (1993) carried out a study of affordability and willingness to pay for water services in the urban and semi-urban areas of Beira. He found that poor households stated to be willing to pay up to 4% of their income for water supplied from public standposts. Richer households indicated that they were willing to pay 0.1-1% of their income for water. Average WTP for water from public standposts was Mt 1,510/month and approximately Mt 8,000/month for house connections.

Ojanperä also estimated actual quantities of water used by households but the data were presented only as average consumption per household or per capita per day for five different bairros in Beira. The averages per bairro varied from 21 to 31 litres/capita/day with an overall average of 26 litres/capita/day (Ojanperä 1993, Table 6) but these quantities are claimed to be per household in the text (p.13). We assume the figures in the table are correct as they correspond quite well with the quantity estimates used by the DHV consultants for their water demand calculations. They have used 20-30 litres/capita/day for public taps, 60-80 litres/capita/day for yard connections, and 90-130 litres/capita/day for house connections. If we relate these figures to the WTP estimates of Ojanperä, we find the average WTP/m^3 to be Mt 296/m^3 (USD 0.057/m^3) for public taps (assuming use of 170 litres/household/day) and Mt 423/m^3 (USD

0.081/m^3) for house connections (assuming use of 630 litres/household/day). This indicates that the WTP/m^3 may be higher among people with house connections but care should be undertaken when interpreting this. Current WTP/m^3 estimates may reflect the current favourable situation of people with house connections as they often have a favourable position as vendors and having a house connection can be a profitable business. Their WTP may therefore reflect this profitability rather than their WTP for their own consumption needs.

Stated WTP may also reflect what people have been used to paying rather than the maximum they would be willing to pay in a scarcity situation. Prices in the secondary market may thus better reflect real WTP. With prices as high as Mt10,000-50,000/m^3 (USD 0.83-4.20) in these markets, there should be good opportunities for improving the cost recovery of the project. This issue requires careful attention in the Beneficiary Assessment. Attempts should be made at estimating income and price elasticities for water to facilitate the development of a more "optimal" water distribution system. The fact that people with house connections are both sellers and consumers of water needs to be corrected for. Households thus need to be treated both as production and consumption units (sale of water is a production activity). It may be difficult if not impossible to get reliable data from the secondary market as this activity is illegal.

Estimation of demand for water as a function of price and income was not attempted by Ojanperä (1993) and the data set was not included in the report.

B13. Overall Water Supply and Demand Considerations

Table B.1:
Distribution of Connection Types, Service Ratios, Water Demand and Connection Costs for the DHV (1994) Plan, the NWRMDP as proposed and Alternative Plan for Beira (Year 2002)

	Population Served ('000)		
	DHV Plan	**NWRMDP**	**Alternative**
House Connections	94	75	60
Yard Connections	90	42	99
Public Taps	109	66	425
Service Ratio	50	31	100
Water Demand, m^3/d	20,305	12,101	24,759
Connection Costs, USD 1,000	2,950	1,170	2,259

Demand or consumption of water will, besides being determined by the population size, also be influenced by the distribution system (type of connections or taps and coverage). In the plan developed by the DHV consultants the aim was e.g. in Beira to increase the coverage with house connections to 35%, and to 40% for yard connections, while the rest would have access to public taps by the year 2017. We have developed some

alternative scenarios in the following. Our calculations are rough examples for Beira and Quelimane.

In the case of Beira we illustrate the effect of shifting the plan from expanding house connections to only expanding public taps. We use income/expenditure estimates to classify the projected populations in three classes according to their income (poverty) level based on a household survey from 1992. We therefore assume that that income level and distribution of income is constant as we have no better alternative assumption or knowledge. Our analysis indicates that there may be a misfit between the actual income distribution and the planned standard of water supply by the DHV consultants and the Bank project. The income profile data indicate that a small percentage of the urban population has an income level high enough to afford to have house connections. It is possible that the share of non-poor will increase with the new economic policy but we do not have any recent data which confirms that. A summary of the distribution of house connections, yard connections and public taps for the DHV Plan, the Bank project, and our alternative plan, the resulting water demands, service ratios and rough connection cost estimates are given in Table B.1.

Table B.2:
Distribution of Connection Types, Service Ratios, Water Demand and Connection Costs with two population estimates for Quelimane (Year 2002)

	Population Served ('000)			
	DHV Plan	**NWRMDP**	**Alt. 1: Low Pop'n**	**Alt. 2: High Pop'n**
House Connections	14	20	6	6
Yard Connections	23	20	40	62
Public Taps	28	9	134	167
Service Ratio, Low Pop'n	35	31	100	---
Service Ratio, High Pop'n	27	24	77	100
Water Demand, m^3/d	3,696	3,417	6,492	8,599
Connection Costs, USD 1,000	927	1,000	1,830	2,511

For Quelimane we have included alternative population projections to those made by the DHV consultants. They assumed that a large share (24%) of the estimated population in 1992 would migrate out but our information indicated that this has not been taking place. This affects the real service ratios which we have calculated for the urban and semi-urban populations together. Then we have suggested an alternative plan without further development of house connections but with expansion of public taps to increase the service ratio to 100% in year 2002 for the two alternative population projections. These two alternatives result in higher total water demands and investment costs for expansion of connections.

For simplicity we have assumed that the non-poor and poor can be provided with yard connections while the ultra-poor get public taps. The beneficiary assessment will

give better indications. A summary is given in Table B.2. We see from the table that the DHV Plan will provide water for 35% of the population by year 2002 with its own low population estimate but to only 27% with our revised population estimate. The Bank project reaches even fewer households, 31 and 24% for the two population projections, and with an even higher share of house connections than the DHV Plan. Our alternative plans then follow for the two population projections, giving much higher service ratios but also higher water demands and connection costs.

B14. Recommendations

- *Opportunity cost pricing of water. Index regulation of water tariffs.*
- *Relate service standards to purchasing power of people*
- *Improvement of incentive structure at distribution points before installation of new water meters.*
- *Assessment of health effects as part of the beneficiary assessment.*
- *Participatory distribution system development. Involve local people in selecting location points for public taps.*
- *No further expansion of house connections untill the sanitary problems are solved or the use of the "polluter pays principle" is institutionlised in relation to urban water consumption.*

It is estimated that people with house connections use four to five times as much water as people with access to public taps only (Ibid.). One may say that this represents a negative externality if the one causing it is not considering or paying for the costs he is imposing on others. This externality could be internalized by imposing a tax on the polluter. This tax should be high enough to pay for the damages made and/or for the costs of constructing the necessary sanitary facilities to mitigate the damages made.

APPENDIX C:
TEAM MEMBERS, WORK SCHEDULE AND DIVISION OF TASKS

C1. EA Team Members

The World Bank engaged The Centre for International Environment and Development Studies (Noragric) at the University of Agriculture, Ås, Norway to carry out the EA assignment. Noragric assigned the following team to carry out the work:

Arne Dahlen	M.Sc Agric.	AD-Consult A.S.	Team Leader
John A. Boyle	Ph.D., P.Eng.	Private Consultant	EIA Specialist
Hans E. Magnussen	B.Sc. Civ. Eng.	Interconsult	WSS Spec./Hydrol.
Stein T. Holden	Dr. Scient. dev. econ.	Noragric	Environ. Economist
Antonio E.L. Couto	Biologist	Austral SARL	Social Scientist

In agreement with Noragric, Austral SARL assigned another qualified scientist to cover part of the assigned tasks for the social scientist, Mr. Roland Brouwer, Ph.D., Agric./Env. The team also benefited from the expertise of Sra. Cèlia Meneses of Austral SARL regarding legal and institutional aspects of water supply and environmental assessment in Mozambique. In total, 138 persondays of effort were devoted to the study.

C2. Work Schedule

The schedule for carrying out the environmental assessment was outlined in the study TOR and revised in Maputo through discussion with the Bank's task manager. The schedule in 1996 was:

EA scoping and Inception Report	19 February - 1 March
Field work, Mozambique	26 February - 16 March
Draft report preparation, Maputo	18-30 March
Draft report preparation, Norway	15 April - 5 May
Draft report presentation, Maputo	9-10 May
Review, GoM and World Bank	10-31 May
Final report preparation	3-8 June

The EA scoping and preparation of the Inception Report were carried out by A. Dahlen, Team Leader, and J. Boyle, EIA Specialist.

The field work included a one day visit to each of the five cities, water companies, water supply installation sites and meetings with local authorities. A list of the people and organisations consulted is included in Appendix D. The field survey to the central and northern cities of Beira, Quelimane, Nampula and Pemba was undertaken using a chartered aircraft. A. Dahlen, H. Magnussen, S. Holden and R. Brouwer participated in this survey, accompanied by Eng. Bento Mualoja from DAS of DNA. All relevant installations were visited and inspected on the ground. Existing and

proposed water intake and treatment sites were also examined from the air where applicable. The field team also examined the Corumana Dam on the Sabie River from the air.

C3. Division of Tasks

Task allocation among the team members more or less matched the tasks and scope of work outlined in the TOR and Inception Report with the professional background of the various members. The Team Leader, in addition to co-ordinating the work of the other members, was also responsible for financial arrangements and logistics. Contributions of the various team members were used throughout the report. Preparation and editing of the report, based on the various team contributions and comments from GoM and the World Bank, was done by the Team Leader and the EIA Specialist.

C4. Public Display and Consultation

Through Noragric, the Team Leader was engaged by the Bank in the beginning of 1997 to assist DNA in preparing public display and consultation of the report's findings, conclusions and recommendations. Initial discussions were held with DNA in Maputo in February 1997. The Team Leader prepared texts for display posters and a pamphlet based on the executive summary. Austral SARL assisted in translation work, technical production of posters and local logistics. The display and public consultation/debate took place in the five cities during March - April 1997, and Mr. Brouwer prepared the report on the exercise in consultation with DNA (June 1997).

The final report with Appendix E was edited by the Team Leader in August 1997 and issued as 2nd edition.

APPENDIX D: PEOPLE/ORGANIZATIONS CONSULTED

Maputo

Luis Elias	National Director, DNA, MOPH
Manuel Alvarinho	Policy Advisor, DNA
Chandra Pereira	Technical Advisor, DNA
Leonardo S.T. Kranendunk	Hydrology Advisor, DNA
Bento Mualoja	Engineer, DNA
Jaime Matsinhe	Civil Engineerl, DAS, DNA
Vicente Macamo	Sanitary Engineer, DAS, DNA
Francisco T.C. Mabjaia	Senior Advisor to the Minister, MICOA
Rogero Wamusse	National Director, Natural Resources Management, MICOA
Daniel Shier	Legal Advisor, MICOA
Kim Hermind	Advisor to the Minister, MICOA (PROL)
Charlotte Allen	Advisor, MICOA (PROL - INPF)
Issufu Chutumia	Director General, ARA-Sul
Rute Mateus	Head of Administration of Water, Pequenos Libompos Dam, ARA-Sul
Miguel Alves	Director General, Águas de Maputo (AdM)
Joaquim E. Pirej	Director of Operations, AdM
Maria dos Anjos	Department of Environmental Hygiene, MISAU
Anjela Fernandes	Head of Hygiene Laboratory, MISAU
Andreas Garavini	Agricultural Economist, PRORURAL
Custodio Boane	Fish Biologist, Department of Biological Sciences, UEM
Alfredo Santos	LINK, Deputy Co-ordinator, NGO-Donor Working Group

Beira

Gilberto S. Waya	Director, CAB
Simon Comissario	Head of Administration, CAB
Mariano Roia	Head of Technical Division, CAB
Jose Merlandane	Head of Finance Department, CAB
Antonio Velho	Water Commissioner, bairro Chipangara
Isaias Rafael	Co-ordinator, Gabinete da Apoio Comunitario
Luis Caetano	Technical Assistant Water, Acucareira de Mocambique
Jose Dungusa	Director, Construction and Urbanization, City Council
Alberto Massinga	Interim Director, SUTRA
Elias Nyambe	Provincial Director of Workers Department, Sofala Province

Quelimane

Firliz Descanso	Director, AdQ
Serafim J.D. Detrato	Head of Technical Department, AdQ
Retrato	Technician, AdQ

Jose A. Ronda	Technician, GTZ project, AdQ
Antonio	Private standpost manager, bairro Coalane
Americo Muianga	Provincial Director of MOPH, Zambezia Province
Mauricio Duarte	Water Department, MOPH, Zambezia
Leonardo Chaube	Water Department, MOPH, Zambezia
Luis Pedro Chandemba	Head of Department of Urbanisation and Construction, City Council
Raul Branco	Director, Health Department
Joaquim Jori Pedro	Supervisor, Health Department
Rogério Henriques	Head of Administration, Grupo Madal

Nampula

Julius Salim	Deputy Director, Finance, AdN
Rede Manual	Chief, Human Resources, AdN
Eva Fernandes Rafael	Chief, Commercial Section, AdN
Gracinda Trinidade Cadeira	Chief, Finance Department, AdN
Alberto Certo Amado	Chief, O&M Department, AdN
Lopes Mungueleze	Hydromechanical technician, AdN
Mario Luis Artur	Chief of Water Supply Programme, Peri-urban areas
Ichaca Abdul Baraca	Director, Physical Planning, Municipality Council President, Municipality Council
Lanfredo Romao	Director, Urban Health Services
Noacha	Head of Human Resources Department, Urban Health Services
Miguel Massunda Junior	Forestry technician, Provincial Service of Forests & Fauna
Albino Funeli Amanyikanza	Head of the secretariate
Manuel Amos	Head of Provincial Department of Geography and Cadastro
Julio Orlando Mario	District Director of Agriculture & Fishing

Pemba

Vietorino Ferrao	Director, AdP
Rufino	Head, Technical Department, AdP
Alfredo	Standpost manager, bairro Cariaco
Afanso Paquete	Provincial Director of Water, MOPH, Cabo Delgado Province
Montero Jaime Faifa	Provincial Director of Housing, MOPH, CD Province
Jose Julio Andrade	Director of Urban Health
Josina	Community health worker
Paulo Junior	Head of Provincial Rural Water (estaleiro)
Jose Henriques	Head of Rural Water Systems, MOPH, Cabo Delgado
Joao Maria Severiano	Deputy Director of Agriculture, Cabo Delgado
Eusebio João Sitingui	Deputy Director of Works Department, Cabo Delgado

Donors and Embassies

Mette Masst	Assistant Resident Representative, NORAD
Matti Kääriäinen	Resident Representative, FINNIDA
Jarmo Kùuttila	First Secretary, Embassy of Finland
Cor van Honk	First Secretary, Embassy of the Netherlands
Kees Metzlaan	Consultant, Embassy of the Netherlands
Ulla Andrèn	Programme Co-ordinator, Natural Resources and Environment, ASDI, Embassy of Sweeden
Henny Matos	Programme Officer, Environment, UNDP

World Bank Staff/Consultants

John Shepherd	Task Manager, AF1EI
Torbjørn Damhaug	AFTES
Martin Gambrill	Rural Water Supply
Sarah Keener	Beneficiary Assessment
Rod de Vletter	Environment and Natural Resources Operations Officer, Maputo Resident Mission

APPENDIX E: PUBLIC DISPLAY AND CONSULTATIONS - SUMMARY REPORT

Some time after the final draft of the EA Report was presented, the Bank and the National Directorate of Water agreed to arrange public display and consultations on the findings, conclusions and recommendations of the Report. The Team Leader was engaged through Noragric to assist DNA in the exercise. Locally, the company Austral was engaged for translations, technical production of display posters, and logistic support. A book was made available to the public for written comments during the displays, and this received 36 entries.

Public displays and consultations/debates were arranged in the five cities of Maputo, Beira, Quelimane, Nampula and Pemba during March - April 1997. This summary report is based on observations and written comments during the displays and public debates, which are contained in a report of 1st June 1997, prepared by Mr. Roland Brouwer of Austral, in consultation with DNA (DNA 1997).

In all the five cities the public display and hearing was welcomed as a good initiative. However the public debate attracted relatively few people, mostly persons involved with water affairs and public service. The opening display was arranged in Maputo, and here the reasons indicated for the limited interest by the general public were (as an example):

- the location at the Civic Centre which is regarded as the home of administration and bureaucracy, a place earlier not easily accessible to the general public;

- the format of the display and the issues presented, which were found to be too technical and not sufficiently visual. More general issues on access to water would have been preferred to the emphasis on environmental issues; and

- that the still "timid" civil society is not yet used to this form of participatory approaches.

The public meeting in Nampula, scheduled at the end of the display, was cancelled because of no participation from the general public. A possible reason was that the meeting was planned during a weekend. In most of the other cities, however, the debates were lively and reported to have raised a number of important issues related to water sources, supply and sanitation. Main concerns concentrated on i) the privatisation of water companies which may lead to not affordable water tariffs and reduced, instead of increased access to piped water, and ii) the seemingly lack of concern in the project for waste water systems and treatment.

The public display and consultation process received relatively wide national media coverage; television, radio and the press, with focus on NWDP and the findings of the EA.

The mentioned report on the public display and consultation indicates that much can be learned from the process which may be useful for later, similar exercises. It is therefor recommended that an appraisal is made of the experiences from the public display and consultation. It is assumed that DNA and the Bank consider relevant concerns raised by the public in the future planning and implementation of NWDP.