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Environmental Study of the Rehabilitation Of the Monze-Zimba Road in Zambia

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Environmental Study of the Rehabilitation of the Monze-Zimba Road In Zambia

By

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DECLARATION

I Silupumbwe Justine Samu, Student Number 200000001, hereby do declare that the dissertation entitled "Environmental Study Of The Rehabilitation Of The Monze-Zimba Road in Zambia" is the result of my own investigation and research, supervised by Dr. Paul Joslin and that it has not been submitted in part or in full for any other degree or to any other University

Signature

6/08/01

Date

Confirmed By Supervisor

Signature

7th August 2001

Date

DEDICATIONS

This dissertation is dedicated with boundless love and gratitude to
my five personal angels without whom I could never have
survived the darkest times of my life as a student;

my wife, Musonda Prisca,
who is my inspirational and constant source of strength;

my sons, Mpazi, Wizya and Chilanzi
my continual sources of humour and optimism.
You have always given me the temptations to live longer to watch
you grow responsibly,

and

my daughter, Tukiwe Suwilanji,
the source of my admiration

To all of you I declare my love and promise always
to be a good husband and father.

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ABSTRACT

It is very unfortunate that despite laws that require adequate incorporation and integration of environmental concerns at all phases of the economic developmental projects in Zambia, the research findings of this dissertation show that they are not applied well.

The dissertation consists of six chapters. The Introduction (Chapter One) gives a general overview of Zambia, its geographical position in relation to other African countries, its macro and micro economic policies and its economic needs for a sound transport infrastructure. It also gives a rationale for the Monze-Zimba road rehabilitation project. Chapter Two reviews and states existing policies, legal, strategies and the institutional framework for environmental management and protection in Zambia. It also states and identifies key institutions involved in administering the various environmental laws/regulations and briefly refers to applicable International Conventions. Chapter Three gives a descriptive overview of baseline information - particularly within the catchment area of the road - regarding the biophysical, socioeconomic and cultural environments. The baseline studies provide insights into the normal background environmental variability such that appropriate monitoring programmes can be designed. It is now abundantly and evidently clear that the despoiling of the environment has negative repercussions on the health and wellbeing, culture and economic opportunities of humans. Chapter Four, therefore, provides in-depth discussions of each of the major impacts identified, their nature and scale and appropriate practical measures for their mitigation. The measures are incorporated into an Environmental Management Plan. Chapter Five addresses the environmental monitoring of the impacts resulting from the activities of the road. The Conclusion (Chapter Six) gives substantiated opinions on the overall findings of the research. Recommendations are given to the government of Zambia and all stakeholders on the best ways that environmental issues should be handled at all levels of society.

EXECUTIVE SUMMARY

The Monze-Zimba road in Zambia, which was constructed in 1968, is currently being rehabilitated with funds from the European Union (EU) under the European Development Fund (EDF). The road project involves a section of the international Great North Road (GNR), which connects the Republic of South Africa, through Zimbabwe and Zambia, to the Republic of Tanzania in Dar Es Salaam on coast of the Indian Ocean. It starts in Monze and ends approximately 210 km to the southwest in Zimba. Economically, the road is an important route for the development and promotion of intra and inter-regional trade, especially among member states of the Southern Africa Development Community (SADC) and the Common Market for East and Southern Africa (COMESA).

Assessing development projects for the impacts they will have on the environment, is now standard practice in project development planning around the world. Environmental impact assessments (EIA) are now required for projects funded by most multilateral and bilateral funding agencies.

Road infrastructure development is generally intended to improve the economic and social welfare of the people. Increased road capacity and improved road standards reduce travel times, provide greater safety and lower the operation costs of vehicles. Access to markets, employment opportunities, education and health services, and reduction of transport costs for both freight and passengers, are further benefits. For all significant economic and social benefits that road developments bring, the study has shown that such developments may also have significant negative impacts on the environment.

Historically, there have been no contractual requirements for developers to submit an EIA for road works in Zambia, despite the existence of adequate legislation. The few EIAs that have been done on roads have resulted from the requirements of donor funding agencies.

The Environmental Protection and Pollution Control Act of 1990 is the principal law that provides for the protection of the environment and the control of pollution. This

Act, which includes the production of EIAs, and the establishment of the Environmental Council of Zambia are a few of the many Government measures put in place to address deficiencies in the implementation of measures related to environmental protection and management. Furthermore, this report provides information and recommendations to road authorities for the effective management and protection of the environment. The recommendations, if adopted, will ensure that environmental concerns associated with road construction, operation and maintenance are integrated into the planning phase.

The effects of the road construction industry on the environment are manifold. Some effects are long-term and often irreversible, while some are short-term and reversible but nevertheless have high negative impacts.

This dissertation raises serious concerns regarding the negative environmental impacts of road rehabilitation, operation and maintenance in Zambia. For example, the destruction of vegetation cover has secondary impacts, such as the loss of wildlife habitat, reduction of bio-diversity, soil erosion, modification of drainage and water quality. Consequently, the capacity for the environment to continue sustaining life and provide ecosystem services can be drastically compromised.

Roads are agents of change that can bring about a diversity of developments, which can have either negative or positive impacts on local communities. An example is the disruption of the tradition lifestyles, culture and social structure of communities caused by the presence of a large workforce in a rural area. The incidences of promiscuity in the area, for example, results in increased prevalence of sexually transmitted disease such as HIV/ AIDS amongst both local communities and the immigrant project work force. It has also been revealed that the increase in the amount of money in circulation in a rural area increases the cost of living irreversibly. This is illustrated and confirmed by the findings of the study regarding the cost of living in Choma and Monze District Capitals comparing the situation before and after the commencement of the project. The study selected, monitored and evaluated the cost of essential commodities, food, electricity, house rents and cost of residential, agricultural and industrial lands. The value of land and the cost of living evaluated

after six months from the time of commencement of the project, increased exponentially with time.

The high influx of immigrants from other parts of the country into the project area to find employment, sell goods, and accompany workers on the project etc, places a high demand on local resources such as water, electricity and public services. The study also found that the sudden increase of people coming from diverse cultures with different lifestyles into a small rural area disrupted, though temporarily, the harmony commonly found in rural towns.

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FIGURES

CHAPTER I

GENERAL INTRODUCTION

1.1.0 ZAMBIA

Zambia has an area of 753,000 square kilometres and a total population estimated, in 1995, at about 9.3 million. It is a landlocked country surrounded by eight other nations (Figure 1). To the north it borders with the Republic of Tanzania, to the north-east, Malawi and to the east, Mozambique. In the south-east Zambia borders with Zimbabwe and Botswana. The remaining neighbouring countries are Namibia to the southwest, Angola to the west and the Democratic Republic of Congo to the northwest (Figure 2).

Zambia became a republic in 1964 when it attained its independence from Great Britain. It has a multi-racial population, which includes 73 indigenous tribes. The climate is characterized by three distinct seasons: (i) dry and cool (ii) dry and hot and (iii) wet and warm.

The country is run by a democratically elected government and is divided into nine administrative provinces and 61 districts. There are four cities which include: Lusaka the capital city, Livingstone the tourist capital in Southern Province and, on the Copperbelt, Kitwe, and Ndola.

The present state and future development of its economy is supported by a multi-modal transportation system operated through various infrastructures including roads, railways, airways, inland waterways and oil pipelines. Among these, the road infrastructure is the most significant in terms of the extent of the network.

The Zambian economy has depended heavily on the mining industry and copper, in particular. About a third of Gross Domestic Product (GDP), and over 70% of the annual foreign exchange earnings in the mid-1970s to early 1980s originated from the copper sector. During this period, the National Development Plans focused on the construction of road links to neighbouring countries and from the provinces to

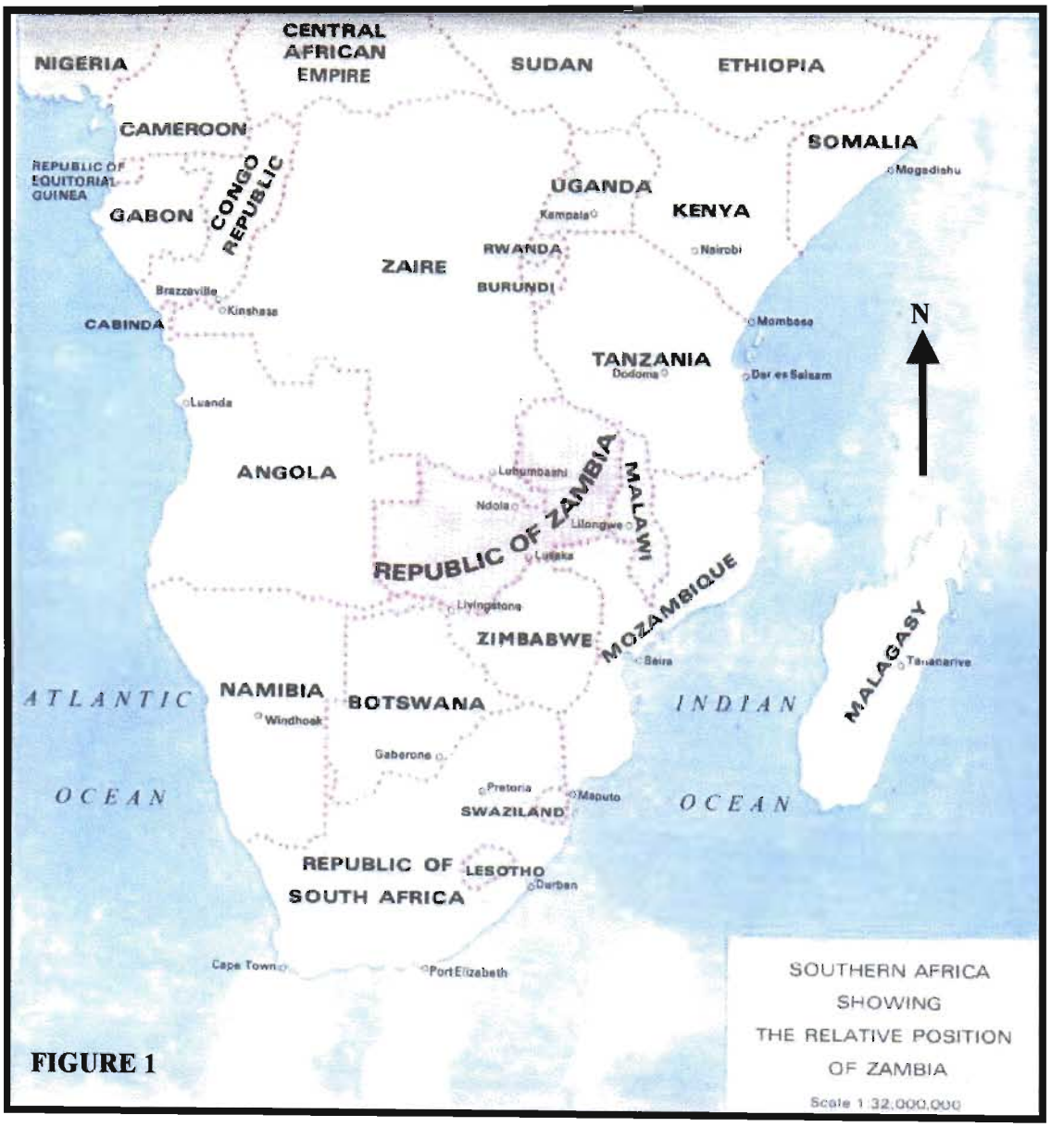

NIGERIA
CENTRAL AFRICAN EMPIRE
SUDAN
ETHIOPIA
CAMEROON
SOMALIA
Mogadishu
REPUBLIC OF EQUITORIAL GUINEA
GABON
CONGO REPUBLIC
UGANDA
Kampala
KENYA
Nairobi
RWANDA
ZAIRE
BURUNDI
Brazzaville
Kinshasa
CABINDA
Mombasa
N
TANZANIA
Dodoma
Dar es Salaam
Luanda
ANGOLA
Lubumbashi
Ndola
MALAWI
Lilongwe
REPUBLIC OF ZAMBIA
Lusaka
Livingstone
MOZAMBIQUE
ZIMBABWE
Beira
Tananarive
MALAGASY
ATLANTIC
NAMIBIA
BOTSWANA
INDIAN
Windhoek
Gaberone
OCEAN
Pretoria
Maputo
SWAZILAND
OCEAN
REPUBLIC OF SOUTH AFRICA
LESOTHO
Durban
Cape Town
Port Elizabeth
SOUTHERN AFRICA
SHOWING
THE RELATIVE POSITION
OF ZAMBIA
Scale 1:32,000,000

FIGURE 1

Lusaka. The length of the road network increased but little funding was allocated for road maintenance. With the gradual decline in the production, due to nationalization of the mining industry, and the falling prices of copper, cobalt, lead, gold and other mineral products such as diamonds and emeralds at the London Metal Exchange, the economy started a downward slide. Over the 25-year period since 1970, Zambia's per capita GDP dropped from one of a middle-income country to one of the lowest in the region. The current account in balance of payments continued to deteriorate because of the shortfalls in export revenue, delays in the adjustment of imports, and mounting debt service requirements.

Between 1975 and 1990 the stock of Zambia's debt mounted fourfold to US$7.04 billion before it subsided to US$6.4 billion in 1994 and US$6.2 billion in 1995. As a result the debt service ratio climbed to over 60% of the value of exports during most part of the period 1990-1995. By the time the copper surplus started to dry-up, Zambia had neither the alternative foreign exchange-generating activities nor sufficient foreign exchange to import the raw materials and the spare parts to keep its import and capital-intensive mining sectors running at efficient levels of capacity use. The effective economic decline translated into further deterioration in social and physical infrastructure - especially in the transport infrastructure sector.

Zambia recognized the precarious macro-economic situation and made several efforts at reforming policies and formulating programmes to address the deteriorating physical infrastructure. For example, the Fourth National Development Plan (1989 - 1993) recognized the deterioration of the existing road network as a major constraint to economic recovery. But until recently, either the implementation of these policies and programmes were weak, or they were completely abandoned for lack of funds.

Since 1992, however, the government has made a more consistent and serious effort towards economic recovery. Under the Structural Adjustment Programme (SAP) – World Bank initiative - the transport sector, like the rest of the Zambian economy, has had to operate within the context of economic liberalization founded on three key inter-related economic policy thrusts, which are deregulation, commercialization and privatization.

The policy measures taken have created a stable macro-economic environment and registered tangible positive economic results. Interest rates and product prices are now market-determined and foreign exchange, including funds for capital transactions, is freely traded. SAP introduced the cash-budget concept, which deliberately introduced policies of financial discipline. Because of the cash budget and the strict monetary policy put in place, inflation, which rose to 191% in 1992, dropped to an average of 53% in 1994, and to an annualized rate of 23% in the last half of 1999.

The civil service has been undergoing major changes that involve re-defining their scope of work, downsizing staffing levels and introducing more effective incentives for those staff remaining. The legal, institutional and tax framework has been restructured to support the development of the private sector. The tax reform program, which began in 1992, requires further fine-tuning, but it has introduced a tax system, which is fairer, simpler and more efficient. As a result, the revenue performance since the second quarter of 1994, has greatly improved.

In 1995, the total length of the road network was estimated at 66,000 km and comprised 36,761 km of gazette (e.g. national) roads and about 29,239 km of ungazetted (e.g. farm access) roads.
Presently, there are about 129,000 motor vehicles of various types on the road in Zambia.

Road management is now under the Road Investment Programme (ROADSIP). The Management Committee is chaired by the Minister of Communication and Transport. Other members are the Ministers of Works and Supply; Energy and Water Development; Agriculture, Food and Fisheries; Local Government and Housing; and Tourism.

The 1994 Economic Report for Zambia indicated that contribution of the transport communication sector to Gross Domestic Product (GDP) has fluctuated around 5 per cent in recent years. The report also showed that during 1990 the road transport sector contributed more to GDP than the railways (36% and 24% of the transport

communications sector respectively). By 1994, despite the poor state of railway tracks and lack of locomotive power, the trend was reversed to 23% and 27% respectively.

Prior to 1992, transport policy in Zambia was based on the belief that the transport sector should be viewed as a public utility, basic, essential and necessary to meeting essential needs and must therefore generate social benefits rather than profits. Ownership and funding of the transport sector was in Government hands - or at least subject to Government controls.

The major thrust of the current transport policy is to promote and facilitate the development of a more efficient transport network and transport services based on the principles of privatisation and deregulation. The liquidation of Zambia Airways and the collapse of the parastatal transport sector such as United Buses of Zambia (UBZ) and Contract Haulage (CH) reflected a radical change in Government policy from a monopoly to one of competition. The overriding Government policy objective for the Communications and Transport sector is therefore to improve the operating efficiency and performance of the sector. This is supported by the modified requirements and as spelt out in the transport policy White Paper of 1995.

The primary objectives of the policy are to:

- ensure availability of sufficient resources from the private and public sectors to create capacity in the sector commensurate with the requirements of the economy;
- allocate available resources among transport modes to meet requirements at minimum cost to society; and
- establish a system of pricing that will ensure a reasonable return on transport investment.

The Government therefore continues to give high priority to rehabilitation and maintenance of road infrastructure in order to stimulate and optimise the existing productive capacities in the sub-sectors of Communications and Transport.

To encourage private operation in the rural and urban passenger and freight markets, Government has undertaken the following policy measures:

- Allowed initial free entry to the road industry subject to quality control.
- Had suspended duty and sales tax on the importation of all commercial buses with a 14 plus seating capacity for an interim period of 24 months (1994 – 1996). This was in order to encourage the provision of public transport
- Abolished exchange controls thereby making it easier for operators to source spare parts and replace the fleet within a minimum bureaucratic process.
- The abolition of foreign currency exchange controls and liberalisation of the market so that spare parts for vehicles are now readily available.
- Decontrol of government-promulgated passenger fares and freight tariffs i.e. letting the market decide.

Also important is the opening up of the insurance industry from a Zambia State Insurance Corporation monopoly to other investors wishing and able to enter into the insurance industry. The increase in the number of insurance companies (currently at four) has led to increased competition and reduced premiums being offered to operators and the prompt settlement of motor claims.

In terms of the institutional arrangements, The Ministry of Communications and Transport (MCT) is responsible for the overall transport policy and for the supervision of transport enterprises. The Roads Department (RD) within the Ministry of Works and Supply (MWS) is responsible for the operation and maintenance of main and trunk roads. All other roads are under the jurisdiction of four cities, nine municipal councils and 61 district councils (DCs), which are currently under the Ministry of Local Government and Housing (MLGH), the Ministry of Agriculture Food and Fisheries and the Zambia Wildlife Authority (ZAWA).

1.2.0 The Monze-Zimba Road Project.

As part of its efforts to achieve sustainable economic growth, the Government of the Republic of Zambia, through the Ministry of Works and Supply (MWS), Roads Department (RD) has put emphasis on the rehabilitation of the country's infrastructure, in particular the road network.

The rehabilitation of the Trunk road – designated as T1 between Monze and Zimba in the southern part of the country, constitutes part of the Great North Road (GNR). The GNR is a major linking route between the southern and northern countries bordering with Zambia. In the south the road links Zambia with Zimbabwe via the Victoria Falls bridge, Namibia at Katima Mulilo, and via Kazungula crossing to Botswana and South Africa. In the north it links Zambia with the Republic of Tanzania, Rwanda and Malawi and forms a section of the Cape to Cairo route.

The rehabilitation of the road is financed with assistance from the European Development Fund (EDF) of the European Commission (EC).

1.2.1 Project synopsis

Refer to the project location maps figures 2 and 3.

Contract Details Of The Monze – Zimba Road Project

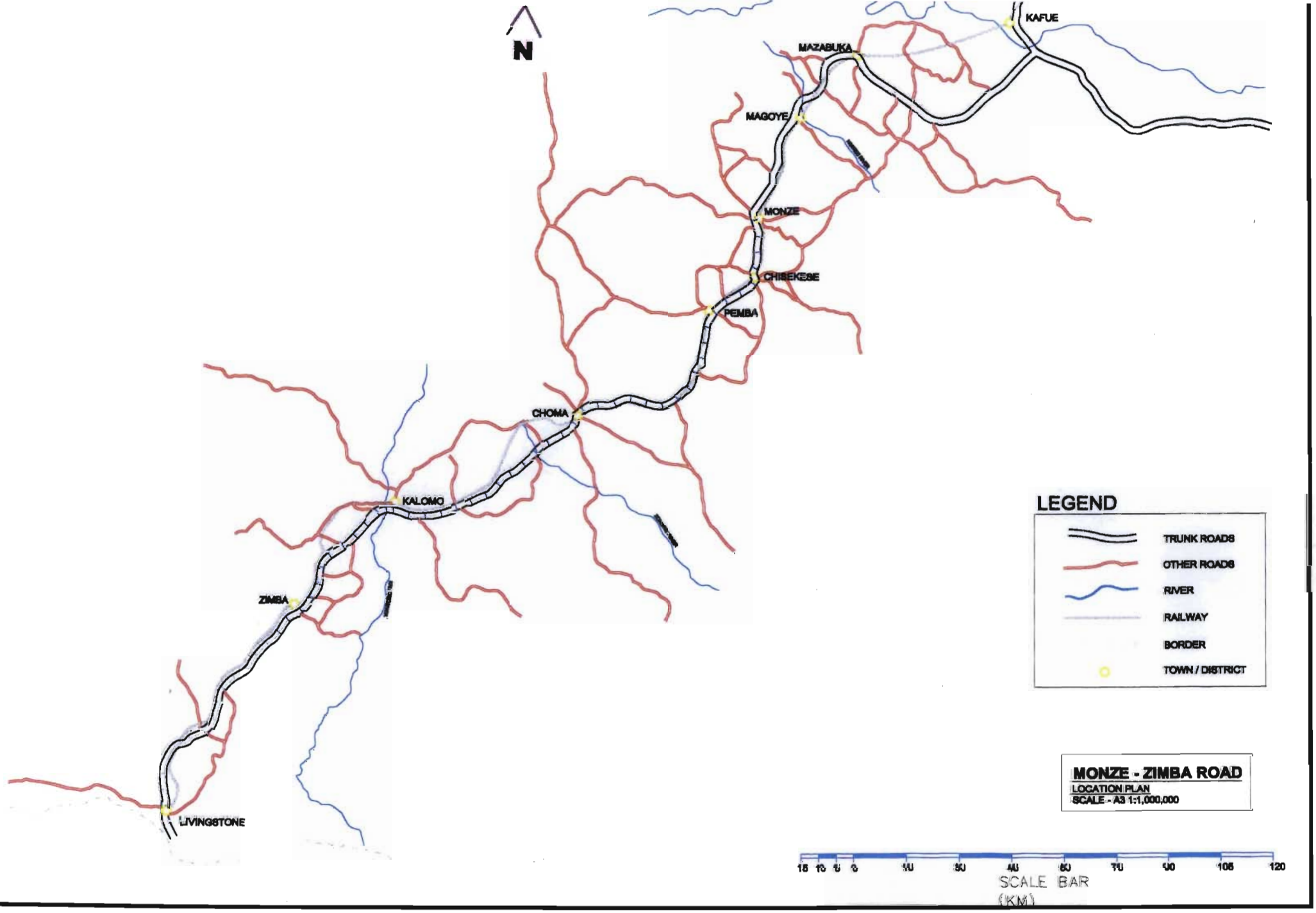
Contracting Authority	National Authorizing Officer (NAO) of the European Development Fund, Office of the President.
Funding Institution	European Development Fund of the EC
Supervisor	Ministry of Works and Supply, Roads Department,
Supervisor's Representative	Roughton International of U.K
Contractor	Grinaker Construction Ltd of RSA
Date of commencement	15th February 2000
Contract period	735 days
Completion date	18th February 2002
Contract value	K45 billion (Contract exchange rate US$1.00 to ZK2 282.40)
Project length	210 km

Project Purpose

The project purpose was to carry out civil works so as to arrest the deteriorating structural integrity of the road substructures and to improve both the vertical and horizontal alignments in order to:

- improve the riding qualities in terms of comfort and road safety;
- reduce the vehicle operating and cost;
- reduce on the travel time by improving on traveling speed;
- to support and promote both the National and Regional Economic growth and developments; and
- promote the expansion of forecasted Inter-Regional Trade for the Southern Africa Development Community (SADC), the Common Market for East and

FIGURE 2
PROJECT LOCATION


N
KAFUE
MAZABUKA
MAGOYE
MONZE
CHISEKESE
PEMBA
CHOMA
KALOMO
ZIMBA
LIVINGSTONE
LEGEND
TRUNK ROADS
OTHER ROADS
RIVER
RAILWAY
BORDER
TOWN / DISTRICT
MONZE - ZIMBA ROAD
LOCATION PLAN
SCALE - A3 1:1,000,000
SCALE BAR
(KM)

Southern Africa (COMESA) and for other Bilateral Economic Agreements and Treaties entered into with neighbouring countries.

A Project of these design scopes, with bituminous wearing courses, utilizes the usual components of road construction materials. The works included in the contract consist of mainly:

Pavement designs

- Asphalt Concrete Overlay sections;
- Reconstruction sections; and
- Composite of crushed stone base and asphalt overlay sections.

Activities of Rehabilitation

The understanding of this section is aided by a dozen of photographs appearing in the Appendices section which show pictures of the rehabilitation activities at various sections and sites of the road. However, the scope of works in the Contract consist mainly of:

- All works associated with site establishment such as construction and maintenance of the site camp, comprising; site office, laboratory, mechanical workshop and a residential camp accommodating the construction team;
- Provision of services for the work force e.g. sewage systems, solid waste disposal, and domestic water supply;
- Establishment and operation of quarries;
- Establishment and operation of gravel borrow pits;
- Mining river and building sand for construction;
- Site clearance, removal and stock pilling of top soil;
- Earthworks to widen the existing carriageway;
- Drainage activities - re-excavation of side drains, mitre drains, cut-off drains, inlet/outfall drains (including excavation of new ones), replacing or repairing existing cross drainage structures under the road and construction of new pipe culverts;
- Construction and maintenance of deviations and other works, as necessary, to provide safe, uninterrupted and convenient traffic flow through the works.

- Other activities are traffic guides and control devices including the construction of bus-bays, the replacement and provision of new traffic signs, road markings, guide posts, culvert markers, mileage posts and guardrails; and
- Upgrading of the road through towns - including pedestrian walk paths and storm drains.

Applicable Road Designs

Depending on the degree of sectional deterioration of the road structure, the project is applying three types of road rehabilitation designs. Severely structurally failed sections are being reconstructed with 150mm Crush-Stone-Base and overlaid with a 60 mm Asphalt Concrete (AC) wearing course; a 35 mm Asphalt Concrete Overlay (ACO) is applied to sections on which investigations revealed as having longer residual life. Rehabilitation activities on these sections comprise of repair of potholes, reinstatement of shoulders with stabilized imported gravel and finished with an Asphalt Concrete wearing course while a Composite Design of Crush - Stone - Base and Overlay is being applied on moderately deteriorated sections.

The study revealed that all designs require great amount of construction materials, apply construction methods whose activities adequately impact negatively on the immediately environment and have effect on the receiving environment ranging from ephemeral to long term, severe to moderate and localized to regional and global affecting.

Mobilization

The contractor has 40 expatriate professional staff, 141 operators, 152 skilled labourers, 192 unskilled labourers and 11 junior staff - including 3 students on industrial attachment.

The consultant has 4 expatriate staff on site and 14 local staff all specialized in different fields

The MWS is represented by the Project Engineer, who is the project administrator.

Equipment

The contractor has the following plant and equipment: bulldozers, tractors, loaders, graders, cranes, excavators, rollers, tipper trucks, pavers, welders, generators, water

tankers, fuel tankers, water pumps, trucks, compressors, explosives van and utility vehicles. Fixed plant includes crushers, premix chip spreader etc.

Materials

Construction materials on site includes selected laterite gravel, stone aggregates ranging in size from 0 to 35 mm, river and building sand, bitumen, cement, lime, water and different types of paint.

Petroleum products include petrol, diesel, oil lubricants, detergents and thinners.

From an economic point of view, the haul distance of gravel is restricted to a 1 km from the borrow pit to the point of application. This results in an increased number of borrow pits along road corridor, which will increase the amount of environmental degradation. Furthermore, while the existing gravel sources can be reworked, there is often a need to open up new ones in order to meet the quality standard criteria set for borrow materials.

The quarry sites supply crushed stone for the road base course, aggregates for the asphalt concrete and quarry dust for buildings, construction and riding surfacing. These are located in Kalomo, Choma and Monze. The cost–effective haul distance for stone material is in the order of 10 Kilometres, whilst haul distances of up to 60 km is accepted in certain cases.

The road project is implementing three engineering designs:

a) Reconstruction with crushed run road-base and an asphalt concrete riding surface.
b) Asphalt concrete overlay of existing riding surface.
c) A composite of crushed run and asphalt concrete overlay riding surface.

1.3.0 Aim of the Dissertation

The aim of this dissertation is to provide specific information on how to integrate environmental concerns associated with road improvement into the overall

The fifth reason was to identify, analyze and review environmental impacts resulting from the rehabilitation, maintenance and operation activities of the Monze-Zimba road on the biophysical, socioeconomic and archaeological/cultural environments.

The sixth reason was that the study provided an opportunity to review the impacts and objectively provided good environmental management practices which include recommendations for avoidance, modification, mitigation and amelioration measures for the adverse effects of road works.

Lastly, to use knowledge gained from the study to modify approaches to suit and meet environmental requirements and to educate decision makers in order for them to make informed decisions in similar future road projects.

Aspects of Environment for Study

Three aspects of the environment have been considered in this document, which are affected by the activities of rehabilitation, maintenance and operation of the road. These are the bio-physical, socioeconomic and archaeological/cultural environments.

The biophysical environment includes the consequences of the rehabilitation, maintenance and operation of the road on elements of the natural environment. The socioeconomic environment addresses issues related to the affected community's welfare and how the project will affect their present social and economic lives and daily activities. Archaeology and culture deals with their history, relics and how communities are culturally identified with each other, their customs and traditional values.

1.4.0 Methodology

A number of techniques were used in this research, which included:

Literature review

A review of literature, which included that related to the study area, was undertaken.

Interviews

A number of interviews were conducted with government officials from appropriate Ministries, the University of Zambia, the private sector, non-governmental organizations (NGOs) and interested and affected parties (I&APs) in the zone of potential impact of the project.

The interviews were necessary to gain insight regarding:

- The important activities and baseline conditions in the study area;
- Major users of renewable and non-renewable resources;
- Potentially conflicting activities between economic development and environmental management activities - especially regarding the use of natural resources;
- The main environmental issues that need to be addressed as the project rehabilitation works proceed.
- The number and type of the I&APs.

Field investigations

Field investigations involved direct observation of various phenomena in the study area. These included the biophysical environment (e.g. Miombo woodlands, the dambos (wetlands), the National Forestry Reserves and National Parks), socio-economic and archaeological/cultural issues.

Impact presentation and evaluation

A tabular approach (page 64) was used to compare the impacts arising from the three designs being implemented. The aim of this method was to highlight the impacts of each design on the environment and to provide information that could be of benefit to similar road designs in future.

1.5.0 Limitations To The Study

A number of factors acted as constraints in carrying out this study:

- Limited time available for undertaking the study.

- Lack of financial assistance to cover, for example, field study costs.
- Lack of expert knowledge on the many issues involved in an environmental study of this nature.

1.6.0 Structure of the Dissertation

This dissertation is presented in six chapters:

Chapter I gives an overview of Zambia, its geographical position in relation to other African countries, the economic situation and policy regarding the transport sector. It also gives background information and the approach to the study.

Chapter II outlines the legal, policy and Institutional framework regarding environmental management in Zambia.

Chapter III details the environmental baseline of the study area and Zambia as a whole.

Chapter IV identifies and discusses the impacts arising from the activities of the road rehabilitation project and provides environmental management procedures and mitigation measures for the adverse environmental impacts and to enhance positive environmental benefits resulting from the road rehabilitation activities.

Chapter V deals with the environmental monitoring of road projects in Zambia.

Chapter VI is the Conclusion of the dissertation.

References and Appendices are included at the end of the report.

CHAPTER II

LEGAL, POLICY AND INSTITUTIONAL ARRANGEMENTS FOR ENVIRONMENTAL MANAGEMENT IN ZAMBIA

2.1.0 Institutions

The following Institutions deal in one way or another with matters related to the environment:

- The Ministry of Environment and Natural Resources,
- The Environmental Council of Zambia,
- The Ministry of Transport and Communication,
- The Roads Department (Environmental Management Unit)

2.2.0 Policies and Strategies

In order to protect the environment, the government introduced policies and strategies as guiding principles for the public and the people intending to carry out any developmental projects of specified magnitude and which are perceived to have activities that would potentially affect the environment.

This chapter provides a brief description of policies, laws and strategies aimed at supporting the Environmental Technical Guidelines of the Road Sector. They are useful for referencing by those legally empowered to enforce the laws, in monitoring compliance and for identifying the relevant stakeholders during the processes of consultation in the EIA process.

National Conservation Strategy (Policy document)

The National Conservation Strategy (NCS) was adopted by the government in 1985 and is the main policy document on the environment. It has led to the establishment of environmental legislation and institutions. The NCS provides guidance for the sustainable development of Zambia through the use and conservation of natural

2.3.0 Environmental guidelines for Road Rehabilitation and Maintenance Work (EGRRMW)

In August 1997, the Ministry of Transport and Communications (MOTC) published guidelines to be used by those involved in the planning, designing, implementation and monitoring of road works, to ensure that environmental concerns are addressed or activities that are perceived to contribute towards the unhealthy environment are avoided or modified. In addition to providing guidelines, the manual also reviews environmental policy and management framework for the country pointing to the national legal and policy framework relevant to road works and management of natural resources.

Review of Guidelines

The manual contains guidelines which are designed primarily for three types of users: those concerned with preparation and supervision of contracts vis-à-vis the relevant Highway Authorities and private sector Consulting Engineers; those directly involved in execution of road maintenance and rehabilitation works such as the highway authorities and private sector contractors and those concerned with monitoring and evaluation of environmental mitigation plans of road works – the Environmental Council of Zambia and also the relevant Highway Authorities.

The purpose, aims and objectives of the guidelines document are comprehensively well articulated making the document very easy to understand, interpret and follow by all the concerned people. The document is neither a legal document nor a book of recipes to be followed mechanically. It is rather a set of ideas and opinions from which road authorities, consulting engineers and contractors can choose activities appropriate to their specific conditions. Though a very useful tool in dealing with environment matters, the manual has very serious deficiencies in its lack of extensive dissemination, enforceability and none availability to the people. The majority of the people who are direct beneficiaries of utilization of natural resource are ignorant of its existence. A vigorous campaign to make people conscious of the issues addressed in the manual is required. Means of policing and enforcing the recommendation as contained in the manual are further recommended as a matter of urgency.

2.4.0 National Environmental Legislation

Key environmental legislation are included in Table 2.4-1 below.

Table 2.4-1

Key Environmental Legislation

Legislation	Environmental and Natural Resources Aspects	Institution Responsible for Enforcement
Environmental Pollution Prevention and Control Act, Cap. 204 of 1990	Protection of environment through pollution control	Environmental Council of Zambia
The Mines and Minerals Act, Cap 213 of 1995	Minerals and quarry resources	Ministry of Mines and Minerals
The National Heritage Conservation Commission Act, Cap 173 of 1989	Historical and cultural heritage	Ministry of Tourism
Forest Act, Cap. 199 of 1973	Forest resources	Department of Forestry
Water Act, Cap. 198 of 1949	Water resources	Department of Water Affairs
National Parks and Wildlife Act, Chap. 202 of 1991	Wildlife resources	Zambia Wildlife Authority
Fisheries Act, Cap. 314 of 1974	Fish and marine resources	Department of Fisheries
Natural resources Conservation Act, Cap 315 of 1970	Soil, Water, flora and fauna	Ministry of Environment and Natural Resources
Lands Act, Cap 29 of 1995	Land	Ministry of Lands
Lands acquisition Act, Cap 296 of 1970	Land	Ministry of Lands
Local Government Act, Cap 281, of 1991	Natural Resources within local area	Ministry of Local Government and Housing
Public Health Act, Cap 295	Human population	Ministry of Local Government and Housing
Petroleum Act, Cap 424	Conveyance and storage of petroleum products	Ministry of Energy and Water Development
Energy Regulation Act, Cap. 16 of 1995	Petroleum. Firewood, charcoal etc	Ministry of Energy and Water Development
Plants and Pests Act, Cap 346 of 1959	Crops, natural vegetation	Ministry of Agriculture Food and Fisheries

Source : Environmental guidelines for roads and works 1997

Laws and Regulations Specific to the Road Sector

This provides a brief table of parliamentary Acts and Regulations, which support the Environmental Technical Guidelines of the Road Sector. The section is useful for providing reference by those empowered to enforce them, for monitoring compliance and for identifying the relevant stakeholders during the processes of consultation. A complete list of laws and regulations with relevance to general environmental and natural resource management aspects and in whom they are enshrined is provided in table 2.4-1.

Environmental Pollution Prevention and Control Act (EPPCA)

Out of twenty-eight pieces of legislation on the environment, the Environmental Pollution Prevention and Control Act (EPPCA) is the principal environmental law. It resulted in the establishment of the Environmental Council of Zambia (ECZ), which has the responsibility of enforcing the EPPCA. The EPPCA primarily focuses on environmental quality standards for water, air, waste, pesticides and toxic substances, noise, ionizing radiation and natural resources conservation. In 1997, EPPCA established regulations for conducting and reviewing EIA as well as detailing the types of projects that require EIA.

The Forest Act provides for the management, conservation and protection of forest and trees. It prohibits excavation, construction, and the operation of machinery within the protected forest reserves.

The Act also provides for the protection of the following six tree species - whether they are found in a protected area or not:

Scientific name	**English name**
Entandrophragma caudatum	Mountain Mahogany
Khaya nyasica	Red Mahogany
Pterocarpus angolensis	African Teak
Afzelia quanzensis	Pod Mahogany
Faurea saligna	Beechwood
Baikiaea plurijuga	Teak

Forest reserves currently cover approximately 10% of the country and are intended for the conservation and development of forest resources, as well as providing protection to watersheds.

The Act is being amended to bring it in line with current government policies of devolving political and economic power to local people through the promotion of community based natural resources management systems. Other Acts include:

The Mines and Mineral Act, Cap 213 regulates mining activities and operations in Zambia. The Act requires that license be obtained before any prospecting of mining activities which in this case include quarry, borrow pits and river and building sand for construction purposes. While the regulations requires that the disturbed area should be afforested before abandoning the site. The National Heritage Conservation Commission Act Cap. 173 provides for the conservation of ancient, cultural and natural heritage, relics and objects of aesthetic, historical, pre-historical archaeological or scientific interest by preservation, restoration, rehabilitation, reconstruction, adaptive use and good management. The Commission provides for the regulation of archaeological excavation and export of relics. This cause for careful operations at excavations sites of quarry and borrow pit during road construction. The water Act, Cap 198's main objective is to regulate the ownership, control and use of public and private water. It regulates the use, diversion and apportionment of all water in Zambia. The National Parks and Wildlife Act Cap. 201 provides for the establishment, control and management of National Parks, game management areas, licensing of hunting, control of possession of trophies and control of bushfires. It also provides for the protection of the biodiversity and ecosystems and objects of aesthetic, prehistoric, historical and scientific interest and value. While the Road and Road Traffic Act, Cap 464 provides for the control of traffic and regulation for the storm water disposal structures by developers. The Town and Country Planning Act, Cap.283 is the principal Act regulating the preparation and implementation of the physical and land use plans for the cities, towns and other major settlements. It establishes planning authorities for various areas, a planning tribunal for settling land disputes and compensation for the affected. The local Government Act Cap 281 empowers the Council to discharge environmental protection and natural resources

management functions. Public Health Act, Cap 295 's main objective is to provide for the prevention and suppression of disease in the country. It empowers the council to implement bye-laws that will prevent disease and pollution dangerous to human health and to any supply of water used for domestic purpose. The Factory Act, Cap 441 provides the framework for the regulation of the conditions of employment in factories regarding the safety and occupation hazards.

2.5.0 International and Regional Legislation and Conventions

Zambia is a signatory to a number of international and regional conventions, which are related to the environment. Those of relevance to road projects are: the Ramsar Convention on Wetlands of International Importance and the Convention on the Protection of World Cultural and Natural Heritage.

Other international and regional conventions signed by Zambia relevant to the road project are:

- The Convention on Plant Protection of 1951 (revised in 1979)
- The Regional Convention on the Conservation of Nature and Natural Resources of 1968
- A convention concerning the protection of workers against occupational hazards in the working environment such as air pollution, noise and vibration.
- The African Convention on the Conservation of Nature and Natural Resources.

The main purpose of these is to supplement the national laws and regulation for such aspects of environment that transcend the boundaries and need to be jointly managed. The immediate examples, are the consequences of polluting the atmosphere and the water bodies in rivers and lakes.

CHAPTER III

ENVIRONMENTAL BASELINE DATA

3.1.0 Baseline Studies in EIA

There does not appear to be a universally accepted definition of environmental baseline studies. In general, it is taken to refer to a description of some aspects of the physical, biological and social environments, which could be affected by the development project under consideration.

An operational definition is given by Hirsch (1980) who defines a baseline study as "*description of conditions existing at a point in time against which subsequent changes can be detected through monitoring*". Baseline studies should be designed "*to provide insight into the normal variability of phenomena such that appropriate monitoring programmes can be designed*"".

It can be seen that baseline studies are closely linked to environmental monitoring. If the practical objective of EIA is to predict changes in the environment resulting from a proposed project, baseline studies provide the pre-project record, while monitoring provides the construction period and post-project measurements from which changes over space and time can be assessed.

It is critically important that baseline information is considered as early as possible in project planning and design.

3.2.0 Baseline Data for the Monze-Zimba Road Project

This study addresses three aspects of the environment affected by the rehabilitation activities:

- Biophysical;
- Socioeconomic; and
- Archaeological/Cultural

The 'no project' or 'do nothing' scenario is often used as a yardstick against which to measure the relative environmental performance of interventions. In this case, the relative impacts of the 'do something' project options were compared to the 'no project' option. It was decided that the 'no project' option should be discarded and, as a result, three engineering designs were selected (section 1.2) and this study is concerned with these.

3.2.1 Biophysical Environment

The Monze-Zimba road is part of the T1 trunk road linking Lusaka, the capital city of Zambia, to Livingstone, an important destination for tourists. It is also a very important segment of the road network for the Southern Africa Development Community (SADC) and the Common Market for East and Southern Africa (COMESA) economic regional groupings. Strategically, it is of significant economic importance.

As the road corridor has very good soils and is served by a good transport infrastructure, the region is well developed agriculturally.

The road project starts in Monze at the junction of the Great North Road (T1) and the Lochinvar Game Park road (Figures 2 and 3) and is situated entirely within the Southern Province. It runs through the district capitals of Choma and Kalomo to reach Zimba, which is 210km to the southwest of Monze.

The road runs along the Tonga Plateau, which forms the ridge between the Kafue and the Zambezi River drainage systems. It runs across a generally flat and gently rolling topography at approximately 1250m to 1350m above sea level and follows a watershed.

Geology

The geology of the country as a whole is shown on the Zambia Geological Map (1974/5). This can be obtained from the Geological Department of the Ministry of Lands in Lusaka.

Disregarding superficial and swamp deposits, about two thirds of Zambia is underlain by Precambrian rocks. Extensive tracts of Karoo rocks occupy the Luangwa, Luano-Lukusashi and the Zambezi rift valleys, and the smaller Rufunsa depression. Though it is now covered by superficial deposits, the lower Kafue valley seems to be underlain by Karoo sediments and probably represents an ancient rift valley, which, unlike the other troughs, has been modified by recent faulting to produce features such as the Victoria Falls.

Soils

In general, soil development depends mainly on differences in parent material (the material on which the soils have developed), climatological conditions such as temperature and precipitation, and difference in topography. In the study area, there is a close relationship between the development of the soil and its underlying rock or parent material, particularly with regard to soil texture, colour, structure and other morphological features.

The road traverses a soil group known as the ferralsols, which cover a large portion of Zambia, and tend to occur on gently sloping uplands. They are derived from granitic parent material and in the southern part of Zambia tend to have lower clay content than in the north. The ferralsols are well drained and therefore, fairly resistant to erosion.

The soils in the study area are fairly fertile, making the region suitable for arable farming (Courtney and Trudgill, 1984) especially with the application of moderate quantities of fertilizer. The soils may be used for local crops such as cassava and finger millet, for timber production, pasture grasses or simply left to support natural vegetation cover utilizable by wildlife (Mackel 1972a). A portion of the region is characterized by fluvisols of the Zambezi Valley. These are formed from alluvium

(river deposits) and are Grey to dark-brown with a variable texture. The pH values of fluvisols vary between 6.0 and 8.0.

Climate

Rainfall is the most important factor causing seasonal differentiation in Zambia. The climate is typically distinguished by three seasons namely: the cool, dry season that occurs from April to August; the hot dry season from August to November; and the warm wet season that occurs from November to April. The latter period accounts for 93% of the average annual rainfall in Zambia. Average annual rainfall decreases from the north to south of the country. In the Southern Province, the rainy season falls between November and March with an average annual rainfall of 500 to 1000mm. The mean annual rainfall (1994-99) recorded for Choma, for example, was 839mm. The main winds that bring rains to Zambia are the wet Congo winds from the northwest, and the prevailing easterly winds.

Rainfall data for the study area are presented in Table 3.2.1-2 below.

Table 3.2.1-2

Monthly Mean, Maximum and Minimum Rainfall for Monze and Choma district Capitals.

Month	Monze (1994-1999)			Choma (1994- 1999)		
	Mean (mm)	Maximum (mm)	Minimum (mm)	Mean (mm)	Maximum (mm)	Minimum (mm)
January	280	436.6	76.8	237.2	367.7	109
February	232	394	118.9	224.7	455.9	67.1
March	150	340.1	14.2	171	406.6	31.8
April	45.4	140.4	0.7	41.3	253.1	4.8
May	5.0	41.5	0	5.9	45.8	0
June	0	9	0	0	1.0	0
July	0.2	2.7	0	0.4	10.0	0
August	0	0.4	0	0.2	2.5	0
September	0.8	5.6	0	3.3	35.5	0
October	17.7	103.6	0	10.9	48.9	0
November	91.1	181.9	29	89	207.8	19.8
December	245.5	387.5	102.3	229.8	393.4	68.1

Courtesy of Ministry of Environment and Natural Resources 2000

The coldest months are June and July, which are characterized by cloudy skies and zero rainfall. Temperatures increase markedly by the beginning of September with he hottest months coming immediately before the annual rains in October and November. Temperatures decrease with the arrival of rains between November and April because solar radiation is reduced by increased cloud cover.

Climatic information obtained from Choma Research Station shows mean monthly temperatures varying from 13.3 degrees Celsius for the coldest month (July) to 22.7 degrees Celsius in the hottest month (October). The absolute maximum and minimum temperatures recorded were 37.3 degrees Celsius and -6.6 degrees Celsius, respectively.

The main influences on temperature are altitude, latitude and the time of the year. Temperature data are given in Table 3.2.1-3 below.

Table 3.2.1-3

Mean Monthly Maximum and Minimum Temperatures for the Monze and Choma Districts

MONTH	Monze (1995-1999)		Choma (1995-1999)	
	Mean Max. Temp.	Mean Min. Temp.	Mean Max. Temp.	Mean Min. Temp
January	26.0	15.9	26.2	16.3
February	26.2	15.8	26.8	16.0
March	26.9	15.5	26.6	16.0
April	26.4	14.0	25.7	15.0
May	25.2	11.6	24.6	12.7
June	23.2	8.7	23.2	9.7
July	23.1	7.9	23.0	9.0
August	25.1	9.5	24.7	10.8
September	28.8	12.1	28.4	13.8
October	30.2	14.5	29.9	16.1
November	29.3	15.6	29.4	16.5
December	26.9	16.0	26.9	16.3
Average	**26.5**	**13.1**	**26.3**	**14.0**

Courtesy of the Ministry of Environment and Natural Resources (2000).

Vegetation

Much of the road alignment runs through the region that is geographically classified as "moist savannah" and is characterized by long grass with scattered woodlands. There are two types of woodland in the study area depending on the dominant tree species: Miombo (*Brachystegia spp.*) and Musuku (*Uapaca kirkiana).*

The Musuku tree produces edible fruit and its wood - which is reddish in colour and fine grained - works easily, polishes well and resists termite attack. This makes it useful for general building purposes (Williamson 1975).

The road mostly passes through Miombo woodlands until it reaches the valleys of the Zambezi River where the Musuku tree dominates. The Miombo woodlands are generally dominated by *Brachystegia boehmii, B. stipulata* and *B. spiciformis.* Also within the Miombo woodlands *Julbernardia globiflora,*
J. paniculata, Isoberlinia tomantosa and *Lulbernardia* tree species are found along with *Marquesia macroura, Erythrophleum africanum* and *Parinari curatellifolia.*

The diversity of trees ranges from 37 species per hectare in dry Miombo to 75 per hectare in wet Miombo (Chidumayo1993).

The major tree genera in the Miombo woodlands include the six protected tree species in Zambia Table 3.2.1-4.

Table 3.2.1-4

Protected Tree Species In Zambia

Scientific Name	English Name
Entandrophragma caudatum	Mountain Mahogany
Khaya nyasica	Red Mahogany
Pterocarpus angolensis	African Teak
Afzelia quanzensis	Pod Mahogany
Faurea saligna	Beechwood
Baikiaea plurijuga	Teak

Most of these trees can tolerate a wide range of soils conditions as seen by their thriving on relatively infertile ferralsols and lithosols which are found in the study area. Their adaptive success rests in their ability to develop deep roots to tap nutrients that have leached into the subsoil. Nutrients are produced when leafy and woody materials fall from the trees. The subsequent decaying process unlocks and releases the nutrients to the upper-soil layers. These nutrients with time leach downwards into the sub-soils with the help of high input of rain water (Courtney and Trudgill 1984). Through uptake from sub-soils, standing biomass (e.g. in leaf foliage) in the Miombo woodlands become nutrient reservoirs.

Notable threats to the forest arise from the local people living in scattered village settlements along the road. The major impacts were generated and initiated by the construction of the road in 1967-1968. This promoted linear settlements of communities and services along the new road corridor due to the improved transportation system. Deforestation occurred primarily from the increased chopping down of trees for firewood, charcoal production, building materials, clearing areas to give way for farms, felling of trees in the process of harvesting edible caterpillars. Further damage to trees occur during the process of harvesting bee's honey from trees and digging plant roots of medical importance such as *Pterocarpus angolensis* and *Cassia abbeviata (*Chidumayo 1993).

Other plant resources which are harvested from Miombo woodlands - with unknown consequences on the ecosystem integrity - include the lateral roots, and sometimes tap roots, of the leguminous herb *Rhynchosia insignis*, which is used in brewing sweet beer locally known as Munkoyo.

The harvesting of edible, wild mushrooms is also practiced extensively. The most abundant and popular species of mushroom are the termite mushroom (*Termitomyces letestui*), the Christmas mushroom (*Amanita zambiana)* and *Chanterelles cantharellus* sp. These species are harvested at different times of the rainy season.

Fauna and Wildlife

Species accounts in this part of the country include small mammals of rodent family such as Four-toed elephant shrew, Woodland dormouse, House mouse, Bush mouse, Bush squirrel, Black rat, Common slit-faced bat and Peters' epauletted fruit bat, Giant rat, Cane rat, Bush baby and Night -ape. In the less peopled areas but within the area of influence of the road are found the Chacma Baboon, Vervet monkey, Porcupine and Bush pigs which are all labeled as nuisance to the farmer and this could have led to the endangered ness of the species. Larger mammals in the road corridor that have been sighted regularly crossing the region include: buffalo, bush buck, kudu, impala, black lechwe, Kafue Flats lechwe and migratory elands and elephants at certain times of the year.

Other sighted small mammals included honey badger, yellow-spotted dassie, scrub hare and slender mongoose.

It is quite likely that due to initial road construction in 1968 and the relocation of the people onto the road corridor to take advantage of the easy of transport system provided, there was an ensuing increase in illegal and professional game hunting. The increased anthropogenic activities further encroached in the wildlife habitat ultimately loosing it due to the clearing of large areas of vegetation.

In the course of site visits of the entire 210 km of the road for this study, which were conducted from August to November, 2000, only a few larger mammals were sighted: a side-striped jackal *(Canis adustus*), common duiker (*Sylvicapra grimmia*), bush pigs (*Potamochoerus porcus*). Small mammals such as scrub hare (*Lepus saxatilis*), squirrels, rats and mongoose were also sighted from the car. The marked paucity of mammalian wildlife in the settled and cultivated areas adjacent to the road gives an indication that the animals have been hunted off or have migrated further into the remote hinterlands where human activities are less pronounced.

Innumerable birds were sighted, however. Among the most frequent were the Fork-tailed Drongo *(Disrurus adsimilis*), the Blue Waxbill (*Uraeginthus angolensis)*, the Massive Giant Eagle Owl (*Bubo lacteus),* and the Spectacular Broad-tailed Paradise Whydar (*Vidua obtuse).* Table 3.2.1-5 (page 31) shows the endemic birds of Zambia.

A complete wildlife lists for mammals and reptiles commonly found in the study area and other parts of Zambia is available in the books "Guide to Common Wild Mammals of Zambia (1991) and Guide to Reptiles, Amphibians and Fishes of Zambia(1993)" and stocked by the Wildlife Society Conservation Society of Zambia based in Lusaka and the Zambia Wildlife Authority which is based in Chilanga. Further information on mammals and birds of Zambia is also contained in Skinner and Smithers (1990) and MaClean (1985).

Some of the larger mammals found in this part of Zambia - the African Elephant and Black and White Rhinoceros, for example – now rarely occur outside protected areas such as game parks, which do not occur in the immediate vicinity of the study area. Occasionally, however, such animals have been sighted crossing the road during migration seasons.

Table 3.2.1-5

Endemic Birds of Zambia,

English Name	Latin Name or Scientific Name
Pale-Billed Hornbill	*Tockus pallidirostris*
Miombo Pied Barbet	*Trichoema frontata*
Anchieta Barbet	*Stactolaema anchietae*
Bohm's Flycatcher	*Muscicapa boehmi*
Central Bearded Scrub Robin	*Cercotrichas barbata*
Miombo Barred Warbler	*Camaroptera undosa*
Red Capped Crombec	*Sylvietta ruficapilla*
Black Capped Eremomela	*Eremomela atricollis*
Slender Tailed Cisticola	*Cisticola melanura*
Sousa's Shrike	*Lanius souzai*
Miombo Grey Tit	*Parus griseiventris*
White Winged Starling	*Neocichla gutturalis*
Sharptailed Staring	*Lamprotomis acuticaudus*
Shelley's Sunbird	*Nectarinia shelley*
Oustalet' White-Bellied Sunbird	*Nectarinia oustaleti*
Red and Blue Sunbird	*Anthreptes archietai*
Chestnut-Mantled Sparrow Weaver	*Plocepasser rufoscapulatus*
Bar-Winged Weaver	*Ploceus angolensis*
Black Eared Seed-Eater	*Serinus mennelli*

Courtesy of ULG Consultants, 1995

Wetlands and Rivers

Two major perennial rivers cross the study area - the Kalomo and Zongwe (Figure 3).

There are a few important wetlands (known locally as 'dambos') in the zone of potential impact in the study area. Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support animals and plants, which are adapted for life in wet conditions. Wetlands generally include swamps, bogs and similar areas. With the exception of scanty patches of the wetlands adjacent to the Kalomo River and a few streams, wetlands are none existent in the road corridor because it runs along a watershed.

When the road was constructed in 1967/8 mitigation measures to protect wetlands were included in road design:

- The road route was designed to avoid wetlands as far as possible.

- Certain preventative and protective measures were incorporated into road design and the execution of the construction works such as:

    - Soil erosion control practices e.g. planting of vegetation;
    - Careful selection of borrow-pit areas and their subsequent rehabilitation;
    - Construction of sediment trap ponds; and
    - Use of culverts and other devices to maintain hydrological conditions.

3.2.2 Socio-Ecomomic Environment

Population

Population statistics were obtained Central Statistics Office of Zambia.

Zambia is sparsely populated with an average of 10 persons per square kilometre. The population figures from the past three censuses were approximately 4 million in 1969, 5.7 million in 1980 and 7.4 million in 1990 (the most recent published census). Zambia is believed to be one of the most urbanized countries in the sub-Sahara region with an estimated urban population of 51 percent in 1990. The highest population is

concentrated in the mining and industrialized Copperbelt, Northern, Southern and Lusaka Provinces.

Table 3.2.2-6 shows the Population and Labour Force in Zambia (1980-1990).

Table 3.2.2-6

Population and Labour Force in Zambia 1980-1990

Parameters	1980	1985	1989	1990
Total population (millions)	5.68	6.72	7.57	7.79
Rate of growth (%)	-	3.30	2.90	2.90
Urban population (millions)	2.26	3.00	3.80	4.00
Urban population as % of total population	40.00	44.60	50.20	51.30
Labour force (millions)	1.65	1.99	3.82	3.86
Formal Sector employment (millions)	0.38	0.36	0.37	0.38
Formal sector (e.g. government) employment as % of labour	23.20	18.10	9.70	9.80

Source: Central Statistic Office of Zambia

In the district capital town the population density is as high as 500 per square kilometres, while in rural areas it is as low as 5 per square kilometre.

The majority of inhabitants along the road project are Tonga people who belong to the group of people called the Bantu Botatwe, which also comprises the Lenjes and Ilas.

Table 3.2.2-7 shows the population numbers and densities in Monze, Choma and Kalomo districts as compared to the rest of the country.

Table 3.3.2-7

Population and Densities in Monze, Choma and Kalomo districts compared to Zambia (1969, 1980 and 1990 Censuses).

Year Of Census	Monze		Choma		Kalomo		Zambia	
	Total Pop.	Dens. per Km^2	Total Pop.	Dens. Per Km^2	Total Pop.	Dens. per Km^2	Total Population	Density per Km^2
1969	52 981	2.3	59 378	1.4	57 330	2.3	4 056 995	5.4
1980	73 480	3.2	81 291	2.0	63 550	2.5	5 661 801	7.5
1990	103 472	4.4	115 125	2.8	83 097	3.1	7 383 097	9.8

Courtesy of Central Statistic Office, Lusaka, Zambia

Economic Activities

The Great North Road, of which the Monze-Zimba segment is a part, provides a very important transport link to economically important regions in Zambia and neighbouring countries.

The road serves important economic areas to the south e.g. the Maamba coal mine in Sinazongwe and tourist destination in the Siavonga district. It also serves the Namwala District to the north of it, which is another important tourist destination as it includes the South Kafue, Lochinvar and Blue Lagoon National Parks.

In Southern Province, agriculture dominates the economy of the inhabitants especially in the study area. A fifth of the national agricultural produce comes from this part of the country. Maize, sugar cane and cotton are the main cash crops produced, in addition to livestock.

The region is also endowed with precious and semi-precious stones, and coal at Maamba in Gwembe District. The proportion of the coal is hauled by road along the northern-most section of the road project, between Batoka and Monze.

Other areas of importance for tourism, which are served by the road, include the mighty Victoria Falls, which is one of the seven natural wonders of the world. The Zambezi River is popular for river cruises and rafting in the Batoka Gorge. Abundant

game viewing and safaris are available in the Mosi-oa-Tunya National and Zoological Park.

Agriculture

The Southern Province's economic activities are mainly related to agriculture – the area produces around 20% of the country's annual maize grain. It is an important livestock area, with one third of the national cattle herd found in the Province. The Tonga people are traditionally livestock subsistence farmers and cattle are a symbol of wealth to them. Families with a large herd of cattle are considered wealthy and hence occupy high status among the people. Animals are used for many purposes including paying Lobola in marriage unions and are also used as draught power to cultivate agricultural fields.

Table 3.2.2-8 gives a summary of cash crop data for the Southern Province. Fluctuations in crop production are related largely to variation in climatic conditions. Another factor which is influencing the high crop production in the Province is the influx of commercial farmers in the region - mostly from South Africa who have come to settle in Zambia in the past five years.

Table 3.2.2-8

The Production of Major Crops in the Southern Province

Figures shown (multiplied by 1000) give the number of 90kg bags produced of maize, soya beans, sorghum and millet; 80kg bags of ground nuts; 50kg bags of sunflower seeds and 100kg bails of cotton.

Crop Type	Years/ Farming Seasons									
	1985/6	1986/7	1987/8	1989/9	1989/0	1990/1	1991/2	1992/3	1993/4	1994/5
Maize	4.300	2 508	5 980	5 088	3 194	2 063	280	5 140	2 151	1 385
Soya Beans	41	29	29	271	53	55	29	87	63	135
Sorg-hum	145	16	109	69	28	60	24	68	72	38
Millet	3	10	54	40	21	7	6	10	23	10
Groun dnut	47	31	41	102	55	50	36	42	32	53
Sunf-lower	238	139	163	163	159	89	7	175	95	150
Cott-on	221	87	439	212	135	150	30	60	48	51

Courtesy of Provincial Agricultural Office, Choma , Zambia

Livestock numbers regarding cattle, goats, sheep and pigs are given in Table 3.2.2-9.

Table 3.2.2-9

Number of Livestock in Southern Province (1990) in Kalomo, Choma, Monze and Mazabuka

District	Cattle x 1000	Goats x 1000	Sheep x 1000	Pigs x 1000
Kalomo	564.6	59.7	1.6	19.1
Choma	154.2	54.6	1.9	24.5
Monze	195.1	22.2	1.7	8.5
Mazabuka	398.5	35.2	2.3	16.4
Total for other Southern Province Districts	**485.4**	**117.3**	**5.5**	**13.5**
Total Southern Province	**1 797.7**	**289.0**	**13.0**	**82.0**
Total Zambia	**5 181.0**	**1 013.2**	**83.1**	**507.1**

Courtesy of National Census of Agriculture 1990/92.

Social services and facilities

Social services are necessary to ensure the well-being and healthy development of the people living in the project area. These are generally inadequate or inappropriate in both urban and rural areas.

In the urban areas domestic water is provided by the newly formed Southern Province Water Company (SPWC), which provides semi-treated (e.g. filtering only) piped water. Domestic water supply in both rural areas and towns are inconvenient and, in many instances, unsafe to drink. In rural areas average distances to and from any water source, be it a natural stream or communal bore-hole, clean or contaminated, is approximately four kilometers. Needless to say, the incidence of water-borne diseases is very high in the road catchments area. The water is obtained from the following sources: 55% directly from rivers, 28% from unprotected shallow wells, 4% from protected deep wells, 4% from reticulation and 9% from other unspecified sources.

The health care in the study area is inadequate - especially in the rural areas, which are only catered for by health clinics. Rural health centres are located far apart and require patients to travel long distances. This study found that the Southern Province, unlike other provinces, has one of the worse levels of access to health care. It is estimated that 44% of the population live within 5 km of a clinic or hospital, 32%

within 5-15 km and 24% further than 16 km from the nearest specialized referral hospital.

Government District hospitals (supplemented by privately owned medical surgeries) are only available in district capitals, which are generally located far from the villages. The majority of these facilities are ill-equipped in terms of available medicine, trained personnel and equipment. Medical reforms requires that the patients pay for all their medical attention, a situation that has left most people unable to afford medical services. As a result, 63% of rural and urban people in Southern Province visit formal health centres and 37% consult traditional healers. Similar percentages apply to other provinces in Zambia.

The majority of the people (82%) of people living along the road project - mostly in the rural areas - use pit latrines as a form of human waste disposal system. Only 6% have access to water-borne sewage reticulation systems, mostly septic tanks, while 12% use other ways (e.g. in the bush) of disposing human excrement.

Domestic solid waste collection and disposal services are largely none existent even in District Capitals. Residents are forced to find their own means and ways of disposing of such waste. This study revealed that 66% of the residents in district capitals use back yard dug-out open pits, 32% undesignated waste-dump sites within townships and 2% - mostly made up of commercial shop owners and other business entrepreneurs - have some form of hired private solid waste collection systems. None of the four district capitals has a legally licensed solid waste dump site.

Apart from the district capitals and a few settlements along the road project where the residents live in buildings with modern cement walls and asbestos or iron sheets roofs, the majority of the people live in mud-walled thatched grass huts.

Education statistics for Southern Province do not differ significantly from other provinces. The greatest proportion (39.3%) of the population have attained a level between grades 5 and 7, while 22% have not had any formal education. Table 3.2.2-10 gives the illiteracy level in Southern Province for people older than 14 years.

Table 3.2.2-10

Education Standard Attained By The Population of Southern Province Older Than 14 Years (Priority Survey, 1998)

Education Grade	% Of Population Older than 14 Years
No formal education	22
Attained grade 1 to 4	17.5
Attained grade 5 to 7	39.3
Attained grade 8 to 9	11.1
Attained grade 10 to 12	5.1
College level	3.0
University level	2.0

Road Traffic

Both the horizontal and vertical alignment designs of the road throughout the entire length were found to be good and adequate to guarantee a sense of safety to motorist. The only geometric improvement that was considered was the realignment of the road to rectify the tight "S" bend in Choma. The road crosses the main rail line in three locations and at all three crossings the alignment was found to be good and conforming to the Roads Department's design standards. Both approaches are designed to reduce the vehicle driving speeds supplemented by the warning signs of Rail Crossing.

Traffic levels are low for the entire length of the road with Annual Average Daily Traffic (AADT) values between Monze and Choma of 509 and between Kalomo and Zimba of 253. Comparison with the traffic AADT flows values in 1985 indicated traffic growths only of 1.9 percent between Monze and Choma and 4.4 percent between Kalomo and Zimba.

An axle-load survey by Burrow Binnie International Ltd, indicated that the northbound traffic lane is far more heavily trafficked in terms of heavy commercial vehicles than the southbound lane.

Traffic counts were carried out manually at four locations and were used to give average flow estimates for the road. These were classified into six groups. Table 3.2.2-11 gives traffic on the four defined sections of the project road.

Table 3.2.2-11

Traffic flow on Four Defined Sections of the Project Road

CLASSIFIED GROUPS*	MONZE-BATOKA	BATOKA-CHOMA	CHOMA-KALOMO	KALOMO-ZIMBA
Group 1	129	105	88	66
Group 2	345	277	228	166
Group 3	52	46	42	37
Group 4	47	32	26	18
Group 5	30	20	20	19
Group 6	34	29	25	21
Group Totals	**637**	**509**	**429**	**327**

*** Group 1 - motorcycles; Group 2 - cars; Group 3 - passenger vehicle up to 30 persons; Group 4 – light trucks and buses; Group 5 – single and double axle trucks; Group 6 – articulated heavy goods vehicles.**

From: Burrow Binnie Consultants Engineering Report (1995)

In the past, traffic flows have tended to reduce along the project route but appear to have risen again since 1990 due to a more diversified economy and increased vehicle ownership.

Following many economic policies that were put in place and the liberalization of the regions trade, the introduction of Free Trade Area by COMESA and the implementation of the World Bank supported Structural Adjustment Programme (SAP) since 1989, there has been and increase in the Zambian economy. It is estimated to grow at between 2.5 and 3.0% per annum over the 20 year Benefit Evaluation Period from 1999 to 2018. A similar growth rate could apply to economic activities of the Southern Province, which has good agricultural potential subject to good feeder road rehabilitation and maintenance.

Experience in a number of countries in the region suggests that the traffic growth rate may often be somewhat higher than that of Gross Domestic Product (GDP). Hence, as an estimate, it is assumed that traffic on Monze– Zimba road should be expected to

grow at around 3% for a low forecast growth rate and 5% per annum for a high forecast. This is presented in Table 3.2.2-12 - assuming the high forecast for the purpose of design and considering several parameters.

Table 3.2.2.12

Annual Average Daily Traffic Forecast From 1995 to 2020

SECTIONS	ANNUAL AVERAGE DAILY TRAFFIC			
	1995	2000	2010	2020
Monze- Batoka	637	813	1 324	2 157
Batoka- Choma	509	650	1 058	1 724
Choma-Kalomo	429	548	892	1 453
Kalomo- Zimba	327	417	680	1 107

Ministry of Works and Supply (Roads Department Traffic Section 1999)

Accident statistics from January 1985 to December 1995 were gathered from the relevant districts traffic police for the various sections of the Monze-Zimba road project by Burrow Binnie Zambia LTD and are indicated in Table 3.3.2-13

Table 3.2.2-13

Vehicle Accidents From January 1991 to December 1995 on Three Road Sections

PERIOD	DISTRICTS								
	MONZE			CHOMA			KALOMO		
	No. accidents	No. fatalities	No. accidents due to road condition	No. accidents	No. fatalities	No. accidents due to road condition	No. accidents	No. of fatalities	No. of accidents due to road condition
Jan-Dec. 1991	29	2	6	124	27	24	17	17	17
Jan-Dec. 1992	59	5	3	135	19	26	17	14	14
Jan- Dec. 1993	57	8	5	117	9	19	5	12	12
Jan–Dec. 1994	48	5	2	106	16	17	36	9	9
Jan–Dec. 1995	25	1	3	24	2	4	8	5	5

Source; Police Service in respective districts namely Monze, Choma, and Kalomo

3.2.3 Archaeological and Cultural Environment

The 1992 map of the National Heritage of Zambia, depicts the distribution of archaeological, national monuments and other tourist sites in Zambia. Further information was obtained from the Annual Reports of Archaeological Sites in Zambia (National Heritage and Conservation Commission, 1998).

In the road project corridor, a number of archaeological sites occur along its entire length. These are predominantly depositions from the Stone Age period - especially in Kalomo District where there are several sites of the Early Stone Age (2.5 to 1.75 million years ago), Middle Stone Age (60, 000 to 15, 000 years ago), and Late Stone Age (15 000 years ago to the third century BC). Tools become progressively smaller, more refined and show greater variety and specialisation. Late Stone Age (LSA) sites are usually found in caves or in open sites, in river valleys and around lakes and are usually indicated by the presence of scatters of stone tools. Rock art became more commonplace in the LSA and is typified by naturalistic paintings of animals with little artistic value.

Inhabitants of the Stone Age typically lived by hunting and collection of wild fruits.

In contrast, the Iron Age (IA) is associated with a more permanent settled lifestyle, typified by food production, animal domestication, metallurgy and pottery, and the construction of pole and mud houses. The Iron Age period includes the Early Iron Age (EIA), Middle Iron Age (MIA) and the Late Iron Age (LIA) periods.

The archaeological sites in the road corridor are designated as National Monuments - three of these are in Kalomo along with the old British settlement and the monument depicting Kalomo as the first Capital of Northern Rhodesia. Most of these sites and other fossil locations, were discovered during the first programme of road construction and therefore, it is not envisaged that discoveries of new sites during the rehabilitation activities is likely, because there will be no road realignment. However, care has to be taken during the excavation of borrow pits and quarry mines.

In Choma, there is a National Museum run by the National Museum Board, which houses collections of artifacts, tools and other antiques. The improvement of the road will have a positive impact on the museum as it will help attract tourists and archaeologist to Choma.

CHAPTER IV

ENVIRONMENTAL IMPACTS AND MANAGEMENT OF THE REHABILITATION OF THE MONZE-ZIMBA ROAD.

4.1.0 Introduction

This chapter identifies, analyses and suggests mitigation and optimization of the environmental consequences of application of the three rehabilitation methodologies. All environmental impacts associated with the project i.e. site-preparation, rehabilitation, operation and maintenance are assessed and evaluated.

Impact have been included in Table 4.6-20 of this chapter, which also incorporates mitigation measures.

Certain assumptions have been made in identifying and assessing the impacts associated with the road improvement project:

- The road in its current deteriorating structural condition and configuration would continue to reduce opportunities for economic development in the area of influence of the road and the nation as a whole. Efforts to expand international trade would be hampered, especially among those countries in regional economic alliances such as SADC and COMESA.

- The volume of passenger vehicles and freight trucks will increase along the entire Great North Road - from Nakonde (bordering Tanzania) in the north to Livingstone (bordering Zimbabwe) in the south. Improved road conditions would result in lower vehicle maintenance and transport cost and reduce travel times due to improved traveling speeds.

- The emphasis of the transport modal split will continue favouring the use of roads as opposed to rail and air for both passenger and freight services and for national and international journeys.

- Population growth and development will continue and accelerate along the road corridor.

- It is assumed that the effects of the road rehabilitation activities in sections already completed, or being presently undertaken, will be approximately the same in all other remaining sections yet to be rehabilitated. This assumption has been made considering the fact that the road passes through areas of similar character along its length.

4.2.0 Project Activities

Road reconstruction generally involves actions grouped under site preparation; road construction; operation and maintenance.

Site Preparation

Site preparation involved the following activities:

- The location and excavation of existing and new borrow pits and stone quarries;
- the construction of access roads to borrow pits, quarries, construction camps, installation of drainage facilities such as culverts and reconstruction of embankments; and
- the siting and erection of construction camps.

Road construction.

Road construction for this particular project involves: scarifying (breaking up) the existing riding surface, addition of selected gravel, compaction of sub- base layers, placement of crush run road-base, sealing of the main carriageway and single surface dressing of shoulders. Further addition to existing embankments will be required where the road traverses dambos, particularly in the last 100km near Kalomo.

Culverts may have to be replaced and others installed where the road crosses dambos or perennial streams, or where the lie of the land may cause water to dam adjacent to the road. The entire road reserve of 60m (i.e. 30 either side of road centre line) may be cleared of vegetation to maintain sight distances for road safety reasons. No major realignments are envisaged although a climbing lane (for slow vehicles) may be constructed along one section.

Road operation.

Road operation covers that period of time when the reconstructed road is complete and in use by passenger vehicles and freight trucks. Most of the impacts in this category have been extrapolated from earlier completed sections such as the Monze-Mazabuka, which was rehabilitated three years ago.

Road Maintenance.

Road maintenance activities will include the periodic and routine activities such as patching of potholes, clearing of vegetation from road reserve, rehabilitating drainage channels, repairing road signage, replacement of road markings and maintaining road shoulders.

4.3.0 Biophysical Impacts

Impacts on the biophysical environment, which are likely to arise from road reconstruction, are discussed under the four categories given above (Section 4.2).

Under each project activity, the impacts of specific project actions on the biophysical environment as a whole are discussed. Because features of the biophysical environment are strongly interrelated it was decided not to attempt to separate the impacts of borrow pits.

4.3.1 Site Preparation.

The stripping of topsoil by earth moving equipment during construction of access roads and camps and the excavation of borrow pits and quarries for road-building

materials impacts on vegetation, soil and surface water resources (erosion, compaction, contamination etc) and creates visual scarring of the landscape. Unfortunately, not all the future locations of borrow pits, quarries, construction camps and access roads in the project are known, thereby precluding detailed comment on the anticipated overall impacts for specific areas. For this reason, and time restrictions, impacts associated with site preparation activities are necessarily discussed in very general terms.

4.3.2 Borrow Pits and Quarries.

Where possible, road-building materials have been excavated from several unexhausted existing borrow pits which occur along side the road project. Many of these were opened when the road was initially built and several have been re-used during routine and periodic maintenance. Unfortunately, none of the existing borrow pits have been rehabilitated but some have developed ecological value naturally e.g. though in-filling with water, which has encouraged the establishment of aquatic life. Reconstruction and composite overlay designs, however, requires the location and excavation of several new borrow pits and three stone quarries along the project length due to the large quantities of materials required for construction works.

The excavation of borrow pits and quarries destroys vegetation on and around the sites resulting in soil erosion which leaves unsightly scars in the landscape. Soil erosion also contributes towards silting and later sedimentation of watercourses. By reworking existing borrow pits and quarries, the extent of land destroyed by excavation and the occurrence of associated impacts can be minimized. In some instances, however the borrow pits may have become important habitat and their reworking could have negative impacts. On the other hand, the in-filling of abandoned pits with water can create breeding grounds for disease (e.g. malaria) vectors. Reclamation of these borrow pits following completion of excavation can help to repair the damage of associated impacts. The fact that overburden and topsoil were not stockpiled when the older borrow pits were first opened, means that reclamation of these would require the sourcing of topsoil from elsewhere, which could have environmental repercussions.

4.3.3 Access Roads.

New roads are required to provide access to new borrow pits or quarries and construction camps, or where embankments need to be built or culverts installed. Furthermore, detour roads are also required during road reconstruction for rerouting and maintaining undisrupted traffic flow.

Construction of access roads involves the stripping of topsoil and vegetation cover (e.g. Miombo woodland), compaction of the soil surface etc.

Detour roads for the Monze-Zimba project are 10m wide and 201km in total length. This results in a land-take, which includes Miombo forest and agricultural land, of 2.01 square kilometres. This loss of land has immediate seasonal impact on agriculture and will have a socio-economic impact on the people no matter how temporary the disturbance might be.

In areas where embankments need to be built-up or culverts installed, access roads traverse dambo grassland alongside the road. Dambos are seasonally wet grassy areas, which are important hydrologically and ecologically. Loss of dambo grassland therefore reduces the capacity of dambos to retain water and contributes towards an increased rate of runoff.

4.3.4 Construction Camps.

Temporary construction camps are required for housing construction workers, and storing construction vehicles, equipment, fuel and road construction materials. Establishing new construction camps may involve use of earth moving equipment such as bulldozers, stripping of topsoil, leveling of ground, the erection of temporary or permanent buildings and the establishment of sanitation facilities. These activities destroy substantial areas of woodlands, leading to soil erosion and deteriorating water quality - especially where camps are poorly sited or constructed. Pit latrines may also lead to the contamination of natural water resources. Indiscriminate dumping of engine oils, fuel, lubricants or other solvents can contaminate soil and leach into subsurface water.

4.3.5 Road Construction.

The majority of impacts arising from road construction already occurred following initial construction of the road in 1968 and subsequent periodic and routine maintenance activities.

Given the minimal requirements for road widening realignment for the present road rehabilitation, fewer significant direct impacts on the biophysical environment are expected. Impacts related to individual activities, which could occur are outlined in the paragraphs that follow.

Scarification, Road-base Construction and Asphalt Placement

As long as these activities are confined to the present road carriageway and immediate un-vegetated areas and do not infringe upon the vegetated road reserve, the only significant impacts that may occur relate to water and soil. Contamination of watercourses, water bodies and soil may occur as a result of runoff from detours and newly surfaced road, spillage of oils and fuels, bitumen etc.

Drainage-Culverts

Activities at the culvert construction sites can contaminate soil and water with petroleum products and produce silting, which are detrimental to terrestrial and aquatic ecosystems.

Road Cuttings

The cut sections have steeply sloping banks, which are often sparsely vegetated, depending on ground conditions. Cutting may also impact on geology, soil (e.g. by causing erosion), hydrology and may cause significant visual impacts.

Road Embankments

Embankments are often necessary for the road to cross low-lying areas where dambos may occur. Detour roads are often required at embankment sections. Biophysical impacts associated with embankments construction relate to loss of dambo grassland,

modification of the hydrological regime, soil and water contamination and visual impacts.

Clearance of Road Reserve

The natural vegetation is removed in some areas from the road reserve to improve road safety, especially on curves. Impacts could include the destruction of valuable vegetation, which is important for providing habitat for wildlife. Vegetation is also important for maintaining soil integrity, protecting water quality and reducing runoff rates.

4.3.6 Road Operation

The use of the road by vehicles and pedestrians causes impacts regarding air quality and noise. In addition pollutants are deposited on the road surface due to wear of tyres, fuel and lubricant leakages. Greater use of the road and marginally faster travel speeds may increase pollution risks as a result of an increased risk of accidents and spillage of oil and other contaminant chemicals. This risk is minimized, however, by the fact that most petroleum products and other potentially toxic chemicals are transported by rail.

Poaching in National Parks and in Game Management Areas (GMAs) constitutes one of the greatest problems facing officials of the Zambia Wildlife Authority (ZAWA). Poaching of endangered species, particularly elephants and rhinos, is rife in Kafue and Blue Lagoon National Parks.

Rehabilitation works would improve road links with neighbouring countries for international trade but such trade could include the illegal transport of poached game. If ancillary roads were also improved this might facilitate greater access for poachers to remote areas. On the other hand, it could be argued that developing these new road links would allow improved patrolling by anti-poaching staff. Given the present problems of under-staffing and under-funding of ZAWA, however, improved patrolling is unrealistic.

There might also be a significant increase in road-kills regarding game and livestock animals due to increased vehicle speeds.

Increased population levels due to the road improvement would place additional pressure on a number of natural resources such as:

- Firewood;
- wood for making charcoal;
- emperor moth caterpillars for food; and
- harvesting of wild honey and construction of bee hives.

All these result in widespread deforestation.

Increase road use would increase the risk of accidental bush fires being started by, for example, discarded cigarette butts.

The farming of dambos and river margins for vegetables could increase significantly with greater settlement in the road corridor. Such practices are detrimental to the hydrological and ecological functioning of the dambos and rivers.

4.3.7 Road Maintenance.

Biophysical impacts arising from maintenance activities are likely to be insignificant because most of the impacts would have already occurred during road rehabilitation. Provided that proper measures are taken to limit unnecessary vegetation clearing, restrict maintenance vehicles and equipment to the road carriageway and avoid indiscriminate disposal of road building materials, bitumen and other wastes.

4.4.0 Socio-economic Impacts

Rehabilitation of the Monze-Zimba road section is unlikely to have highly significant direct negative or positive impacts on the socio-economic environment. This is largely attributed to the fact that many of the benefits and adverse effects of the upgrading the road will already have been felt following the construction of the road

in 1968. Reconstruction of the road will, however, ensure potential impacts, particularly positive ones, are sustained throughout the envisaged 20-year life span. Potentially significant socio-economic impacts could arise due to future traffic growth. Some potential impacts arising from rehabilitation are discussed in the proceeding sections.

In contrast to the section on biophysical impacts, discussion of socio-economic impacts have not been separated into different project actions. This is because the majority of project actions will have similar socio-economic impacts.

4.4.1 Economic and Employment Opportunities

It is possible that the condition of the road prior to the current rehabilitation may have played a marginal role in restraining the implementation of economic developmental projects. If this is the case, its rehabilitation will remove this obstacle that impeded development and implementation of other economically beneficial projects, which depend on good road conditions. In the case of the study road, rehabilitation will lend a sense of security to such economic ventures, which depend on good transport links. It is unlikely to stimulate a spate of economic development initiatives immediately.

In the short-term, recruitment of labour from roadside villages will contribute towards raised employment rates, increased income and development of life-long skills to the local people and their families. Newly skilled workers would have enhanced prospects for future employment.

In the long-term, an increase in traffic volume may stimulate business opportunities along the road through the sale of goods such as food and drinks, handcrafts, wood products and charcoal and promote other services. Since the economic activities of the settlements along the road is largely based on agriculture, road reconstruction may increase transport opportunities and potentially decrease the costs of distributing agricultural products and thereby increase peoples' earning potential and welfare.

The study of the similar completed road sections showed an increase in the establishment of small-scale entrepreneurs selling essential commodities on the

roadside. It is envisaged this will also be the trend on the Monze–Zimba road upon completion, although this positive impact for the local economy will only be realized if there is a significant increase in traffic. The trend of increased road side business is also unlikely to be optimized, in the absence of other supportive investments such as provision of agricultural incentives to small-scale farming communities and improvement of tourism infrastructure coupled with a rigorous marketing strategy by respective Ministries.

4.4.2 Access to Services and Facilities

Although construction activities in the short-term are an inconvenience to the traveling public due to dust and other nuisance, in the long-term the benefits are significant as the road provides access to services and facilities through increased reliability and availability of public transport.

It is envisaged that public and private transport opportunities would improve because of improved travel speeds, reduced travel time and lowered vehicle maintenance and operation costs, which may encourage an increase in private haulage, freight and bus services.

One negative result may be that the settlement's demands on social services may over-stretch the capacity of the existing facilities, such as schools and health services.

4.4.3 Water Sources

Many of the populations along the road obtain water from natural sources such rivers, streams, springs and unprotected dug-out open shallow wells. The quality of freshwater resources in the study area was sampled and tested and the results tabulated below:

Physical-chemical quality

Parameters were measured in September 2000 with the help of the Mount Makulu Agricultural Research Station and the results given in Table 4.4.3-14

Table 4.4.3-14

The results of the analysis- Physical Chemical Quality

PARAMETER	SAMPLE STATIONS / RIVERS				
	Kalomo River	Choma dam	Magoye River	Muzuma dam	Stream 58.5km from Monze
Conductivity uS/cm	66	72	59	67	1500
TDS (mg/l)	32	84	28	26	1000
TSS (mg/l)	8	9	5	26	Less than 0.1
BOD(O_2 mg/l)	10	12	20	17	-
COD(O_2 mg/l)	24	16	24	24	-

Note: Tests carried out in conformity with "Standard methods for examination of water and wastewater" (ALPHA 1998) and University of Zambia (UNZA-2000). TDS - Total Dissolved Solids; TSS - Total Suspended Solids; BOD – Biochemical Oxygen Demand; COD – Chemical Oxygen Demand.

The results - when compared with World Health Organization (WHO) and national water quality standards for human consumption - show that there was no danger in terms of physical-chemical parameters in the water.

It was also noted that there was often a lot of litter in the water at most sample sites. This could be attributed to local communities, road users and the road rehabilitation team. The presence of oil and grease on top of the water surfaces was also observed, which was observed to be coming from construction plant and equipment.

It must be stressed that the water quality is likely to be worse at other times of the year, when, for example, the rivers are in full flow and contain a lot of suspended sediments due to construction plant activities and natural soil erosion.

Bacteriological Quality

The bacteriological quality of the water was also assessed owing to the fact that some drinking water for residents along the road project comes from rivers or shallow wells. Laboratory tests and visits to the local health centres were carried out as a way

of analyzing the bacteriological status of the water - both qualitatively and quantitatively. The results of the laboratory tests are presented in table 4.4.3 -15

Table 4.4.3-15

Bacteriological Quality

PARAM-ETER	SAMPLE STATIONS / RIVERS					WHO LIMITS
	Kalomo river	Choma Dam	Muzuma dam	Magoye River	Stream 58.5 km from Monze	
Total coliforms (units/ 100 ml)	5100	10900	5100	22000	5100	0
Faecal coliforms (units/ 100ml)	200	200	2300	200	1578	0

Note: tests were carried out in conformity with the "Standard methods for examination of water and wastewater" (ALPHA 1998; UNZA-2000)

The results revealed a high number of coliforms in the samples, which far exceeded the WHO limit. There are numerous possible sources of contamination, which would include construction workers who were not provided with sanitary facilities.

Quality of water for construction.

Water sources have also been investigated and tested for use in construction such as for:

- Structural concrete production
- Stabilization operations
- Earth works and fills
- Dust control on detours to enhance visibility to motorists.

A number of water quality parameters were measured for a number of potential sources in this regard (Table 4.4.3-16)

Table 4.4.3-16

Construction Water Quality

SOURCE	PH	Suspended Solids (ppm)	Chloride (ppm)	Sulphate (ppm)
Kalomo River	8.3	1.8	5.69	1.8
Choma Dam	7.7	6	7.59	0.2
Magoye River	8.0	4	5.69	-
Muzuma Dam	7.9	4	3.79	-
Km 58+500 Stream	7.4	-	-	-
Km 57+500 stream	7.7	-	-	-
Km 99 +200 stream	7.4	-	-	-

Note: Laboratory tests and analysis courtesy of Mount Makulu Research Station

The following limits are a guide to acceptability in respect of water for structural concrete:

pH	6.0 – 8.0
Chloride	less than 500 ppm
Suspended solids	less than 1000 ppm
Sulphate	less than 1000 ppm

It is possible that construction activities themselves could modify significantly construction water parameters – particularly suspended solids generated by plant activity and pH changes due to the deposition of rock dust in water.

4.4.4 Air quality

Currently, the air quality in the area is within recommended standards (Environmental Pollution Prevention and Control Act) in sections where the rehabilitation activities have not yet taken place. This is not the case for the sections where rehabilitation is active and smoke and fugitive dust from construction plant and traffic activity is evident. Qualitative measurements could not be carried out due to the unavailability of measuring equipment. Visible signs includes the presence of thick layers of dust on

tree leaves and the roof tops of houses situated along the road. This creates a nuisance and is possibly detrimental to the health of local residents, flora etc.

Secondary air quality impact anticipated would be increased smoke production from charcoal production and domestic fires as local population levels increase.

Increase traffic volumes on the rehabilitated road will result in increased vehicle emissions e.g. CO, lead, particulate and NO_X.

4.4.5 Noise and Vibration

High noise and vibration levels were common on the construction site due to construction machinery, rock blasting etc.

Noise is defined as an "undesirable sound" and is most often a highly subjective matter, as different people perceive and respond differently to the same type of noise (Johnston 1994).

The units for noise levels is the decibels (dB) and according to Environmental Council of Zambia (ECZ), any noise levels above the specified 55dB(A) are disturbing.
For the sake of comparison, noise levels at different locations were measured and are shown in table 4.4.5-17

Table 4.4.5-17

Noise Levels at Various Project Sites.

Point Source	Minimum Level dB (A)	Maximum dB (A)	Average dB (A)
Market centre	53.6	68.2	62.4
Bus station	72.7	82.3	72.8
Construction site	79.2	96.8	88.0
Quarry site	102.6	120.0	111.3
Work force camp site	60.0	72.9	66.45
Borrow pit site	73.9	80.1	77.00

Courtesy of Grinaker Construction Company and Roughton Consultants 2000. All measurements were taken during the daytime with activities in progress.

Ambient noise level was found to almost always exceed the recommended maximum level of 55dB(A). The primary source of this noise is the HGV and construction equipment, jack hammers and explosive blasts at the quarry sites.

It was interesting to note that shouting from the drunken workers at the residence camps over weekends contributed significantly to the noise generated at markets and bus stops. Other sources of noise were mostly bus conductors - locally known as "*call boys*" - urging travelers to their buses or vendors advertising and marketing their merchandises.

4.4.6 Visual and Aesthetic Impacts

Construction activities create a visual impact due to plant movement, dust generation, scarring of the landscape etc.

Security lighting for the construction site at night can be disturbing to local residents and nocturnal animals.

4.4.7 Health and Safety

Road construction activities could have an impact on local residents in several ways. An influx of construction workers into an area normally increases the risk of spreading sexually transmitted diseases (STD) and HIV/AIDS to rural inhabitants. Table 4.4.7-18 reveals the prevalence of communicable diseases in the project area using data taken from Monze District Health Office.

Table 4.4.7-18

Survey results for the prevalence of diseases and accidents on the Monze-Zimba Road Rehabilitation Project .

AILMENT	1996	1997	1998	1999	2000	REMARKS
STD	3779	3622	3328	3504	2433	The generally reduced prevalence of cases after 1998 could be attributed to rigorous health and educational campaigns carried out by both None Governmental Organizations and the Zambian Government.
Respiratory infections	23593	29729	33976	29826	19036	
Diarrhea	9702	39562	9979	11448	7811	
Cholera	-	-	5	93	0	
Mental illness	-	-	20	138	92	
Road accidents	4170	4660	2640	6586	4948	
TB cases	1143	900	1002	1045	804	
HIV/AIDS	1705	1799	1465	534	331	

Data from the Monze District Health Office.

Other areas of health concerns regarding the rehabilitation works on vehicular road users and pedestrians are the dangers of the increased risk of vehicle-pedestrian conflicts, which may result into fatal road accidents. Collisions with road building equipment or loss of vehicle control due to unsafe road conditions during the rehabilitation programme, is common. Once the road is improved, it is likely to encourage speeding - resulting in a greater number of road accidents

Once the road is operational, an increase in numbers of long-distance freight truck drivers may encourage an increase in prostitution along the road corridor.

Stagnant water in borrow pits, quarries and pools near the road is a health hazard to nearby residents since they serve as breeding sites for vectors of disease such as mosquitoes and snails which transmit malaria and bilharzia respectively. Positive impact could be that during the dry season it is possible that many people use these pools of water for domestic purposes and watering of livestock, at the same time increasing health risks.

4.4.8 Community Cohesion and Social Disruption

The social fabric of the rural settlements, especially the smaller ones, may be disrupted by an influx of construction workers and the opportunities presented in earning income

Once the social fabric of the people is disrupted it is very difficult to re-establish resulting in vices of prostitution, spread of STD, including HIV/AIDS, and alcohol abuse. In this way, construction camps can severely disrupt the social fabric of settlements by exposing culturally closed residents to alien and different norms and practices.

The increased presence of money in a rural area would also contribute to the escalation of the price of commodities and merchandise as shown by the survey carried out on 27th October 2000 in Choma (Table 4.4.8-19)

Table 4.4.8-19

The Cost of Living in Choma (RSA RAND).

MERCHANDISE	1999	March 2000	October 2000
Vegetables (10 leaves)	1.10	1.50	2.22
Chicken	11.10	12.22	14.44
Meat/kg	8.00	10.00	13.90
Cooking oil(720ml)	5.56	5.77	6.45
Meal mill 25kg	35.10	36.44	38.89
Charcoal (50kg bag)	8.89	10.00	11.11

Exchange rate: 1 RSA Rand to Zambian Kwacha 450.00

It was also noted that accommodation rental costs and property values increased as a result of the road project.

4.5.0 Archaeological and Cultural Impacts

Given the limited road widening which is envisaged during road reconstruction, it is unlikely that there will be significant impacts on cultural or archaeological resources.

Nevertheless, opening of new borrow pits or quarries may destroy or affect unknown archaeological deposits unless surveys are undertaken prior to excavation. The Southern Province National Heritage and Conservation Commission has been involved in the prospecting for the possible sites so that they are not destroyed whilst rehabilitating the road.

An increased through-flow of tourists, which is likely to occur regardless of road rehabilitation, will increase the number of both local and international visitors to the national monuments and museum in Choma. An increased number of visitors is unlikely to have negative impact on the sites themselves if they are properly managed and supervised.

There could also be impacts on sacred sites, shrines etc that are only known about by the local community.

4.5.1 Impact on Tourism

Road rehabilitation may have significant impacts on tourism in the long-term by providing a safe and comfortable riding surface thus increasing the number of tourists traveling by road. Tourism is likely to play an important role in the regional economy of the Southern Province in particular and the Nation in general, particularly the Monze and Choma Districts from which entry is gained to Kafue and Blue Lagoon Nation Parks and the Tourist capital of Zambia, Livingstone.

Tourism potential is likely to be realized, if the necessary infrastructure is developed. The tourist potential of the road and surrounding area will be maximized only once knowledge of its good condition spreads and related tourist facilities, such as appropriate accommodation and services, are provided. Unless these are put in place, rehabilitation of the road alone will not stimulate meaningful tourism. At present the GN road serves merely as a through-route for tourists traveling between Tanzania and Zimbabwe via Namibia and Botswana to South Africa.

4.6.0 Environmental Management

4.6.1 Mitigation and Optimization of Impacts

Most of the mitigation measures regarding adverse effects of road works are contained in the Environmental Guidelines for Road Rehabilitation and Maintenance Works (Ministry of Transport and Communication, August 1997).
The impacts identified in this chapter and associated mitigation and optimization measures are presented in Table 4.6.-20.

The overall significance of impacts for the total project given in the table, refers to the situations which would pertain in the absence of mitigation measures.
The impacts are defined as being 'negative' or 'positive' and the following designations of impact significance used:

HIGH Long-term to permanent and/or affecting a large geographical area e.g. national/ international.

MEDIUM Medium-term and/or affecting the road corridor (approximately 20km on either side of the road).

LOW Short-term (limited to construction period only) and/or confined to the road reserve (30m either side of the centre line of the road).

Environmental Impacts and Appropriate Mitigation Measures

(1) Biophysical Environment

IMPACTS	OVER-ALL SIGNIF-ICANCE	SITE PREPARATION	REHABILITATION	OPERATION/ MAINTENANCE	MITIGATION MEASURES
Loss of natural habitat e.g. forest and grasslands	**HIGH** Negative	Destruction of vegetation cover during construction of camps and access roads	Clearing road reserve to improve sight distance and widen carriageway	Significant impacts will result from continued cutting of trees by people who have come to settle near the road	▪ Locate site camps on already vegetation-degraded sites ▪ Minimize clearing of vegetation cover ▪ Do not clear entire road reserve
Water Quality	MEDIUM Negative	Decrease in water quality through increased siltation during installation of culverts and upgrading of embankments in dambo areas. Fuel and lubricant spillage from construction plant	Decrease in water quality through increased siltation during installation of culverts and upgrading of embankments in dambo areas. Fuel and lubricant spillage from construction plant.	Pollution and contamination of water from chemical spillage at scenes of road accidents. Pollutants produced by vehicles e.g. fuel leaks and rubber compounds from tyre wear washing from road surface	▪ Install culverts and upgrade embankments during the dry season. ▪ Restrict movement of construction machines to designated access tracks and fenced turning areas ▪ Clean-up team to deal with water contamination emergencies due to spillage of chemicals transported by road
Poaching of Wildlife	LOW Negative	Increased poaching of game directly by road rehabilitation workers or local people to sell to workers.	Increased poaching of game directly by road rehabilitation workers or by local people to sell to workers.	Increased poaching of game by locals to sell to travelers. Improved road access would promote 'professional' poaching and trafficking in government trophy.	▪ [illegible] Police Service should increased patrols. ▪ Involve local people in game management. ▪ Education campaigns to teach local people the importance and value of protecting wildlife.

Biophysical Environment continued…..

IMPACTS	OVER-ALL SIGNIF-ICANCE	SITE PREPARATION	REHABILITATION	OPERATION/ MAINTENANCE	MITIGATION MEASURES
Destruction of forest for charcoal production and firewood	MEDIUM Negative	Increased tree cutting for firewood and charcoal to supply road workers.	Increased tree cutting for firewood and charcoal to supply to road workers.	Increased tree cutting for firewood and charcoal to supply to motorists and increased local population.	▪ Avoid locating construction camps near forestry reserves. ▪ Supply construction team with firewood from sustainable sources. ▪ Forestry department to educate the people on forest conservation and sustainable wood harvesting.
Soil	LOW Negative	Loss of disturbed soil by wind and water erosion. Contamination with chemicals, petroleum products and by compaction by construction plant.	Loss of disturbed soil by wind and water erosion. Contamination with chemicals, petroleum products and by compaction by construction plant.	Contamination with chemicals, petroleum products etc as a result of accidental spillage and general vehicle operation.	▪ Designated areas for dispensing fuel, plant maintenance etc. ▪ Irrigate all detours and access road to reduce dust and wind erosion ▪ Encourage roadside vegetation cover to prevent soil erosion.
Loss of Fauna	MEDIUM Negative	Road kills and general disturbance of animals and their habitat.	Road kills and general disturbance of animals and their habitat.	Road kills and general disturbance of animals.	▪ Signage warning the motorist of animals crossing the road. ▪ Environmental awareness campaign.
Harvesting of natural resources for food and medicine	LOW Negative	Increased chopping of trees to collect caterpillars, fruits and for brewing medical concoctions for the treatment of various ailments.	Increased chopping of trees to collect caterpillars, fruits and for brewing medical concoctions for the treatment of various ailments.	Increased chopping of trees to collect caterpillars, fruits and for brewing medical concoction for the treatment of various ailments.	▪ Enforce wood cutting laws. ▪ Forestry Department to educate the people on the sustainable harvesting of natural resources.

(2) Socio-Economic Environment

IMPACTS	OVER-ALL SIGNIF-ICANCE	SITE PREPARATION	REHABILITATION	OPERATION/ MAINTENANCE	MITIGATION MEASURES
Tourism	MEDIUM Positive	Temporary disruption to the travelling public including tourist.	Will cause temporary disruption and affect the travelling public including tourist.	Increased tourism activities has potential positive effects on local as well as the national economy.	▪ Ministry of Tourism to develop tourism related infrastructure and facilities in the region ▪ Upgrade and repair road signage and provide picnic facilities along the road.
Community Severance	MEDIUM Negative	Road acts as artificial barrier separating communities and families living on either side of the road.	Road acts as artificial barrier separating families living on either sides of the road.	Road acts as artificial barrier separating communities and families living on either side of the road.	▪ Provide safe crossing points (e.g. zebra crossing and enhanced signage) for pedestrians at intervals.
Traffic Flow	MEDIUM Positive	Temporary disruption of traffic flow.	Temporal disruption of traffic flow.	Long-term benefit of increased traffic volume with economic benefits.	▪ Keep one lane open to traffic throughout construction or provide detours, wherever necessary ▪ The government should improve roadside facilities and create an enabling environment for economic ventures.
Freight Services	MEDIUM/ **HIGH** Positive	Temporary disruption of traffic is expected to HGV.	Temporary disruption is expected to HGV.	Increased economic opportunities and reduced costs of transporting goods.	▪ Encourage regional trades and remove all impeding cross border trade barriers ▪ Improve border facilities and reduce time losses at borders.

Socio-Economic Environment Continued...

IMPACTS	OVER-ALL SIGNIF-ICANCE	SITE PREPARATION	REHABILITATION	OPERATION/ MAINTENANCE	MITIGATION MEASURES
Public Transport	MEDIUM Positive	Temporary disruption of public transport.	Temporary disruption of public transport	.Local people will have easy access to improved availability of passenger transport services.	▪ Government to provide enabling environment for the establishment and growth of public transport system
Local Business	MEDIUM Positive	Presence of labour force will increase economic opportunities for the local people in the short-term through the provision of a ready market for local goods and services provided.	Presence of labour force will increase economic opportunities for the local people in the short-term through the provision of a ready market for local goods and services provided.	Generally increase traffic and other induced economic activities along the road will provide opportunities for local businesses.	▪ Support and promote the proliferation of local entrepreneurial activities. ▪ Government to provide incentives for local business people
Access to Social Services and Facilities	MEDIUM Positive	Increased number of people in the area such as the rehabilitation work force and their families may over stretch existing services.	Increased number of people in the area such as the rehabilitation work force and their families may over stretch existing services.	The government would provide social services such as schools and health centres.	▪ Relevant Institutions to play their parts in service provisions, especially as the settlements are most likely to increase over the years ▪ Government to construct more schools and health centres

Socio-Economic Environment Continued...

IMPACTS	OVER-ALL SIGNIF-ICANCE	SITE PREPARATION	REHABILITATION	OPERATION/ MAINTENANCE	MITIGATION MEASURES
Skills deve-lopment.	MEDIUM Positive	Involvement of local people in the project will provide and enhance their marketable skills.	Involvement of local people in the project will provide and enhance their marketable skills.	Skilled local people will be able start their own businesses such as carpentry, bricklaying and curios handcrafting for tourists.	▪ Promote and support local entrepreneurs
Employ-ment opportun-ities	MEDIUM positive	Increased opportunities for employment of local labour.	Increased opportunities for employment of local labour.	Increased opportunities for employment of local people who have developed skills as a result of the road project.	▪ Recruit labour from local communities situated along the road project, especially those that are unskilled.
Community Cohesion and Social Fabric.	MEDIUM Negative	Presence of large construction work force amongst culturally closed communities may disrupt community cohesion and alter the social fabric of the people. In the process they may be exposed to social ills such as prostitution and alcoholism.	Presence of large construction work force amongst culturally closed communities may disrupt community cohesion and alter the social fabric of the people. In the process they may be exposed to social ills such as prostitution and alcoholism.	Increased in freight trucks and general traffic volume may increase prevalence of prostitution, crime etc.	▪ Provide education services on the dangers of indulging in immoral conducts. ▪ Establish construction camps away from small local communities. ▪ Consult local authorities before establishing the camps.
Health	**HIGH** Negative	Increased risk of transmission of STD, and HIV/AIDS through increased prostitution.	Increased risk of transmission of STD, and HIV/AIDS through increased prostitution	Increased risk of transmission of STD, and HIV/AIDS through increased prostitution arising from increased number of long distance truck drivers.	▪ Education campaign on the dangers of STD and HIV/AIDS to local communities by both social workers and health personnel. ▪ Increased primary health care and distribution of free condoms.

Socio-Economic Environment Continued...

IMPACTS	OVER-ALL SIGNIF-ICANCE	SITE PREPARATION	REHABILITATION	OPERATION/ MAINTENANCE	MITIGATION MEASURES
Safety	LOW Negative	Temporary increased risks of traffic accidents due to increased conflicts among normal traffic vehicles, pedestrians and the construction vehicles.	Temporary increased risks of traffic accidents due to increased conflict among normal traffic vehicles, the pedestrians and the construction vehicles.	Increased risks of road accidents to all road users as a result of greater traffic volume and increased tendency for speeding due to improved road conditions.	▪ Install adequate road signage, ▪ Provide pedestrian crossings ▪ Encourage educational road safety campaigns in schools. ▪ Traffic calming measures.
Dust	MEDIUM Negative	Increased dust nuisance to residents and posing potential respiratory health risks.	Increased dust nuisance to residents and posing potential respiratory health risks.	No significant dust impact during operation.	▪ During dry and windy conditions, spray the access and construction sites with water. ▪ Cover dust producing materials when being transported to construction sites.
Noise	MEDIUM Negative	Disturbance to residents along the road from increased noise levels emanating from construction and camp activities.	Disturbance to residents along the road from increased noise levels emanating from construction and camp activities.	Disturbance to local residents due to increased noise levels emanating from increased traffic volumes and speed. Increased clearing of vegetation barriers along the road by additional people moving into the area.	▪ Limit construction activities to regular daytime hours. ▪ Grow trees along the road to act as noise barriers.
Livestock kills	LOW/ MEDIUM Negative	Increased risk of collision of livestock with construction plant etc.	Increased risk of collision of livestock with construction plant etc.	Increased risk of livestock collisions due to increased traffic volumes and speeds.	▪ Enforce fencing of livestock ▪ Adequate road signage

(3.0) Archaeological and Cultural Environment

IMPACTS	OVER-ALL SIGNIF-ICANCE	SITE PREPARATION	REHABILITATION	OPERATION/ MAINTENANCE	MITIGATION MEASURES
Archaeol-ogical and Cultural Sites	MEDIUM Positive	No significant impacts unless excavation of new sites for borrow pits and construction of access roads destroy unknown archaeological deposits.	No significant impacts unless excavation of new sites for borrow pits and construction of access roads destroy unknown archaeological deposits.	Increased visitation to national monuments is unlikely to have significant negative impacts given the current low number of visitors. Positive impacts through increased tourism activities and hence revenue.	▪ Optimize tourism regarding national monuments by upgrading sign posts, improved site supervision, providing picnicking and sanitation facilities, maintaining access roads etc.

4.6.2 Environmental Management Plan (EMP)

An EMP for the road rehabilitation project has been produced, which incorporates mitigation measures outlined in Section 4.6.1.

The environmental legislation and guidelines of Zambia (Chapter II) stipulate the need to make environmental management measures mandatory. This should be achieved by making sure that contract documents contain environmental management clauses. Unfortunately, this study revealed that such requirements are not being undertaken for the Monze-Zimba road project but are presented here for the benefit of future projects of a similar nature.

Suffice to say the EMP should be incorporated into Works Tender Documents and should serve as a checklist for the construction supervisor to ensure all necessary actions are applied during road rehabilitation/ reconstruction. Whether or not the EMP is being satisfactorily enacted should be evaluated through an environmental audit process

In order to successfully monitor and manage the impacts and to implement the mitigation measures at the appropriate time, the proponent requires a clear plan of action. Depending on the requirements of the EIA system, this plan of action may be included in, or appended to, the EIA report.

In various circles this plan of action is referred to as an Impact Management Plan (IMP), Environmental Action Plan (EAP), Environmental Protection Plan (EPP), Environmental Construction Plan (ECP) or Environmental Management Plan (EMP) as it is commonly known in Zambia.

The EMP is probably the most important output from the EA process. It is the synthesis of all proposed mitigation and monitoring actions. It is set to a timeline with specific assigned responsibilities and defined follow-up actions. It consists of a well-defined set of implementable tasks with specific assignments for the proponents, the contractor and the regulatory agency - all within a specified time period.

An EMP normally contains the following:

- A statement of the proponent's environmental policy including compliance of the project with any legislation or standards.
- A designated person to be responsible for the overall implementation of the plan.
- A schedule of tasks (specific remedial and monitoring measures) to be undertaken during the design, construction and operation of the project to comply with the recommendations of the EIA report.
- Allocates responsibilities and tasks to the proponent, contractor and regulatory agency etc.
- A system of reporting on the progress of the tasks.
- A system for the monitoring and auditing of the achievements in environmental protection/enhancement, and
- A contingency plan of actions to be taken when monitoring results indicate that impacts are not in accordance with predictions or required standards.

An EMP is normally subject to review by the relevant authority, the Ministry of Works and Supply.

The EMP is normally used as the basis for generating the environmental performance standards and requirements that can be included in the contracts of those carrying out the works or providing supplies. It can also be used as the basis of an environmental management system during the operational phase of the proposal.

4.6.3 EMP Guidelines (Environmental Council of Zambia)

4.6.3.1 Construction Camps

- Locate site camps on degraded land and away from the smaller and vulnerable rural villages.
- Provide adequate water, sanitation and solid waste disposal services.
- Provide suitable housing to accommodate married and single workers.

- Establish a health education and awareness programme.
- Maximize the employment of women and local residents in road construction and maintenance, particularly for jobs not requiring skills.
- Locate construction equipment, maintenance and storage areas away from water resources, which may become polluted.
- Store all used solvents and engine oils/lubricants in containers until they can be transported for recycling or appropriate disposal.

4.6.3.2 Borrow Pits and Quarries

- Maximize the use of existing borrow pits and quarries unless they have ecological value.
- Site new borrow pits and quarries away from drainage systems to minimize erosion and sedimentation and site them behind a screen of trees to minimize visual disturbance.
- Prior to excavation of borrow pits, remove and store topsoil in an appropriate place and
- Following excavation of old and new borrow pits, re-shape the excavated area, replace stored topsoil and re-vegetate, prevent establishment of alien species.

4.6.3.3 Access Roads

- Where possible, restrict construction of access roads to already degraded areas or make use of existing tracks and paths.
- Hide construction camps, borrow pits and quarries to minimize aesthetic impacts from the road.
- Minimize unnecessary movement of construction vehicles in ecologically sensitive areas such in dambos and undisturbed forests by educating operators and drivers to restrict construction activities and turning to access tracks and demarcated areas only.

4.6.3.4 Clearing of Vegetation

- Do not clear woodland from the road reserve unless necessary for road safety.
- Minimize tree clearing as far as possible when building construction camps, access roads, borrow pits and quarries.

4.6.3.5 Noise and Dust

- Limit noisy construction activities to regular daytime hours only.
- Spray water on the road during very dry and windy conditions to restrict fugitive dust.
- Cover building sand and other dust producing materials during windy conditions when being transported.

4.6.3.6 Facilities for Local Residents

- Provide surfaced lay-byes and bus stops near villages
- Install appropriate signage at bus stops, crossing points, schools, bends and on the approach to villages,
- Replace and/or construct access steps where access is required over embankments or down cuttings near villages.
- Provide alternative sources of water where construction activities will affect the quality and quantity of existing water sources prior to road rehabilitation.

4.6.3.7 Protection of Archaeological Resources

- Conduct an archaeological survey where new borrow pits or quarries are to be excavated or mined.
- Train construction supervisors to recognize archaeological sites and artifacts.
- Report any archaeological discoveries to relevant authorities.

- Do not disturb any archaeological sites until the area has been surveyed, explored and authorization has been granted by the National Heritage Conservation Commission.

4.6.3.8 Facilities for Tourists and Motorists

- Upgrade, repaint or install signage to sites of tourism importance.
- Provide roadside picnicking facilities (tables, benches and rubbish bins) at appropriate intervals in scenic areas along the road.

CHAPTER V

ENVIRONMENTAL MONITORING

5.1.0 Introduction.

It is by law mandatory in Zambia to include monitoring programmes on extensive development project such as road rehabilitation. Unfortunately, it was not possible to do so on the Monze-Zimba road project because the contract did not include such a programme.

Nevertheless, this chapter highlights the importance of monitoring projects. It reflects the general need, purpose and the requirements of carrying out the programme.

Environmental monitoring is an important aspect of EIA that is receiving more attention worldwide. It is used to reveal the results of developments, it also ensures that the anticipated impacts are maintained within the levels predicted. Unanticipated impacts are identified, managed or mitigated before they become a problem. Monitoring can also be used to provide information for periodic review and alteration of EMPs and the optimization of environmental protection through good practice at all stages of the project.

The monitoring programme should be implemented throughout the construction life span of the project and carried over into the post construction phases in order to monitor the re-establishment of disturbed ecosystems.

It involves the planning of a monitoring programme, the collection and analysis of samples and the interpretation of the data and reporting.

5.2.0 Types of Monitoring

There are a number of different monitoring activities which include baseline, effect and compliance monitoring.

5.2.1 Baseline Monitoring

This refers to the measurement of environmental parameters during a pre-project period for the purpose of determining the nature and range of natural variation and to establish where appropriate, the nature of change. This method was used in this study.

5.2.2 Effects Monitoring

This involves the measurement of environmental parameters during the project implementation. This helps to detect any significant changes in these parameters, which can be attributed to the project activities. This is undertaken in the absence of baseline information.

5.2.3 Compliance Monitoring

Compliance monitoring takes the form of periodic sampling and or continuous measurement of environmental parameters, for example levels of waste discharge into the river or process emissions at a plant, in order to ensure that regulatory requirements are observed and standards met.

5.3.0 Purpose of Environmental Monitoring

Environmental monitoring has a broad goal of demonstrating whether changes have occurred in an environment. In EIA, the investigated changes are linked to the development project or activity being assessed. Monitoring not only provides a time

series of measurements of important variables in a disturbed area following a disturbance, but also includes adequate pre-disturbance measurements.

Consequently, data compiled from monitoring can be used to:

- Document the baseline conditions at the start of the EIA.
- Provide necessary information for periodic review and alteration of the EMP as necessary, ensuring that environmental protection is optimized at all stages of the developmental process.
- Ensure that undesirable environmental impacts are detected early, thus making it possible to implement effective remedial measures immediately.
- Assess performance and monitor compliance with regulatory requirements, contractual obligations specified in construction permits, operating licenses and to ameliorate harmful effects on the environment.
- Identify trends in impacts.
- Verify the accuracy of past impact predictions and the effectiveness of mitigation measures in order to transfer this experience to future activities of the same type.
- Evaluate of the effectiveness of the environmental mitigation measures originally agreed on.

The ECZ requires that responsibility for the following points needs to be agreed upon before the project is given any approval to proceed:

- Undertaking and paying for monitoring.
- Management of the information gained from monitoring.
- Implementation of any action that might be required as a result of the monitoring.

5.4.0 Designing an Environmental Monitoring Programme

The design of an environmental monitoring programme depends on the key environmental issues identified during the EIA process, through specific

investigations, field surveys conducted during the planning and operation stages and finally the monitoring requirements prescribed in the EMP.

Since monitoring is expensive, it needs to be aimed at the level required to successfully manage the project or review the adequacy of the EIA without wasting money on unnecessary monitoring. Monitoring should be focused on the impacts that are either significant or not well understood (requiring further analysis).

The design of a monitoring programme needs to reflect the capacity to implement it. This means that considerable thought should be given to the objectives of a monitoring programme before it is designed. In particular, thought should be given to how the results will be used in practice and how long the monitoring needs to be carried out. The monitoring programme should also include action or emergency plans so that appropriate measures can be taken in the event of adverse monitoring results or trends.

Monitoring should be limited to impact predictions previously made so that there is retrospective information on:

- The nature of impacts.
- The magnitude of the impact.
- The geographical extent of the impact.
- The time scale of the impact.
- The probability of the impact occurring.
- The significance of the impact.
- The confidence level in the prediction of the impact.

Monitoring programmes need to be constantly reviewed to make sure that they are effective at all times and to identify the time at which they can be stopped. Above all, the proposed development's total cost should include a component for environmental management.

5.5.0 Monitoring of Specific Components of the Environment on the Monze-Zimba Road Project.

5.5.1 Water Monitoring

Water is potentially a major transporting media for contaminants and can act as a sink for environmental wastes. Where wastewater will be disposed of to rivers, streams or any other water system or on adjacent environment, more detailed attention to water chemistry, aquatic biology and hydrology is required.

Therefore, in order to monitor water quality it is necessary to know the baseline characteristics of the receiving water and the pollutant that might be introduced to them from road construction, rehabilitation, operation and maintenance activities.

Water-monitoring programme needs to take into account the factors outlined above and formulate water quality standards usually at national level. Thereafter, water quality is monitored by analysis, measurement or observation made of key water quality indicators during field surveys. Consequently, a water monitoring programme needs to address and meet the following requirements:

Determining Water Quality Parameters/Indicators

Indicators must be easy to measure and relevant to the project. Examples of key water quality parameters/indicators for environmental monitoring programmes include pH, electrical conductivity (EC), carbonates ($C0_3$), sulphates (SO_4), temperature, turbidity, total dissolved solids (TDS), total suspended solids (TSS) etc.

Water monitoring should include the following:

- Specify temporal sampling frequency, whether continuous or at intervals depending on hydrological variability.
- Use standard sample collection and preservation techniques.

- Choose appropriate analytical methods in order to achieve maximum sensitivity, reliability and comparability of test results.
- Use appropriate quality control procedures for checking reliability of test results i.e. duplicate sampling, external analysis (including independent reference laboratory), standard reference material, maintenance of equipment etc.
- Evaluate and review test results to adjust the monitoring programme, if necessary.

5.5.2 Land Monitoring

Land monitoring relates directly to the land management components of an EMP i.e. minimization of disturbances, weed control, optimization of the utilization of topsoil/subsoil, fire management, erosion control (earthworks and re-vegetation), protection of specific landscape characteristics, cultural/historical and aesthetic features.

Overall, therefore, a land monitoring programme needs to address and meet the following requirements:

Clearing of topsoil

Although re-vegetation can be achieved on various substrates, topsoil is almost always an essential ingredient in successful environmental rehabilitation programmes. This is because topsoil generally contains seeds, nutrients and microorganisms that are essential to normal plant growth and if they are lost then the system will generally take a longer time to re-establish. The success of re-vegetation largely depends on good management of topsoil. It is therefore important to consider topsoil management options during the
planning, rehabilitation/construction and monitoring stages.

During monitoring of road construction/rehabilitation works it should be ensured that:

- Only areas identified and designated for clearing are actually cleared. Stripping adjacent areas not scheduled for such purposes should be avoided.

- Soils are not stripped when they are wet as this can lead to compaction and loss of structure.
- Topsoil is saved and placed in appropriate locations. Manual placement of topsoil will give the best result because it prevents or reduces the deterioration of the biological components in the soil during storage. How much topsoil to be saved will depend on the site and will be specified in the EMP. It should be ensured, however, that the top 10 - 30 cm of soil depth is recovered.
- If stockpiling of topsoil cannot be avoided then ensure that topsoil is used as soon as possible, is not stored in large heaps, is re-vegetated to protect it from erosion, weeds are discouraged and an active population of beneficial soil microbes is maintained. Stockpiles should be located in areas where they will not be disturbed by future road construction activities.
- Recommended plant species are planted at the right time. Unless irrigation can be provided, seedlings should be planted when the soil is moist and prior to reliable rainfall.
- A recommended number of seeds or seedling per unit weight or area of soil is applied to obtain optimal number of plants and the required vegetation cover.
- Where seedlings are planted, the area adjacent to them is clear of other unwanted vegetation (weeds) to reduce competition. The survival rate of seedlings should be monitored and any problems arising, addressed.

Erosion control

Control of erosion is important both during the execution of road works and after completion of the road rehabilitation. The effects of erosion may require remedial works on sites where soil loss has occurred as well as where the material is deposited as drift, dust or river sediments. Inadequate control of erosion can lead to a reduction in water quality downstream. A major objective of most rehabilitation programmes is to establish an adequate vegetation cover in order to stabilize the site and prevent or control excessive soil erosion. Until a vegetation cover is established, measures to protect against wind and water erosion have to be provided.

Wind Erosion

The major impact of wind erosion is to reduce the productivity of the soil and create a dust nuisance. Dust is usually deposited in drifts across roads and against fences and buildings and eroded material can be moved large distances. Though vegetation cover is the best means of protecting against wind, it is a long-term solution and has to be established to be effective.

It is important during monitoring, in order to reduce dust nuisance and enhance soil productivity, to check and ensure the following:

- Natural, manufactured material or mulch adequately protects the soil surface.
- The soil surface is maintained in an erosion-resistant condition by keeping it damp.
- Establishing windbreaks reduce the wind velocity across the disturbed areas.

Check whether the following are taken into consideration when selecting and placing windbreaks:

- **Direction of critical winds** - check whether windbreaks are placed at right angles to the direction of wind. Care must be taken to determine which daily or seasonal winds are initiating soil loss.
- **Height and spacing** - check whether windbreaks are of the optimal height and spacing. On level ground protection will extend a distance approximately 20 times the height of windbreak.
- **Permeability** - check whether windbreak materials are permeable i.e. can allow some wind to go through. Windbreak materials should have a permeability of around 40% to reduce turbulence, otherwise their effectiveness will be reduced.
- **Length and continuity** - check whether the windbreak is long enough and has no gaps. Gaps should be avoided and windbreaks should extend sufficiently to protect the disturbed area since turbulence and increased wind speeds occur at the end or at gaps in the windbreak.

Water Erosion

Erosion by water is caused mostly by surface runoff from intense rainfall events. High intensity, low frequency rainfall events can cause rapid runoff and extensive soil erosion.

Factors influencing runoff characteristics include:

- rainfall intensity,
- area of disturbance,
- catchment area,
- slope and profiles of channels (angle, length, cross section etc.),
- soil characteristics (texture, structure, organic matter etc.), which determine the erodibility of particular soil type, and
- land use such as agricultural, forest reserve, open woodland, quarrying, borrowing, etc.

Properly planned with an effective monitoring system in place all these factors are manageable, expect rainfall.

5.5.3 Biological Monitoring

Biological aspects of the environment usually monitored include endangered species of flora and fauna, disease vectors, aquatic ecosystems and soil/plant pathogens. Specific indicator organisms may also be used to measure potential impacts on other biological resources. Due to the complexity and dynamics of biological systems, baseline studies over several seasons/years are necessary to define the key indicators to be used in a monitoring programme. It is necessary to commence monitoring immediately prior to the construction phase and to continue throughout the duration of the project and for some time beyond the project life.

A biological resource monitoring programme needs, therefore, to address and meet the following requirements:

- Define community and species dynamics.
- Select appropriate indicators for direct toxicity or bio-accumulation measurements. If an indicator species is to be chosen then parameters to be monitored need to be selected which may include: species density; breeding timing; juvenile or adult mortality rates; population growth rate; incidence of disease; diet etc. It is important to select indicator species or processes that are ideally highly sensitive to the impacts being monitored.
- Consider variations due to space and time.
- Direct impacts on biological communities.
- Use widely accepted, standardized methods where possible.
- Collect adequate data for appropriate statistical analysis with special attention on short and long-term effects, local and regional effects, individual species and broad community impacts.
- Evaluate and review test results and adjust monitoring programme and/or practices if necessary

5.5.4 Air and Noise Monitoring

Dust, gases, explosives, blasting, vibration and noise are key issues which should be addressed in the EMP and the subsequent monitoring programme. Air and Noise

monitoring programmes need to address and meet the specific threshold requirements stipulated in the *Environmental Guidelines for the Road Rehabilitation and Maintenance Works of August 1997,* and the *Environmental Protection and Pollution Control Act of 1990.*

5.5.5 Waste Monitoring

Waste materials include fuels, chemicals and other potential sources of contamination of water, soil and air. Management of water associated with these sources is key to protecting the environment.

Waste monitoring therefore, needs to address and meet the following requirements:

- Establish water and air quality monitoring in relation to the various wastes.
- Check the placement and management of different wastes.
- Check the engineering quality and stability of erosion control structures.
- Inspect hazardous storage facilities and work practices, operational conditions and maintenance procedures.
- Evaluate and review test results and adjust the monitoring programme and/or practices, if necessary.

5.5.6 People and Community Monitoring

Normally, environmental issues addressed in this monitoring programme include the potential impacts on people and their cultural heritage within close proximity to the project area. Protection of cultural or heritage values (e.g. sacred sites or historical features etc.) and air/water quality as it relates directly to people.

This type of monitoring needs to address and meet the following requirements:

- Identify critical group of people and special areas potentially affected by the project.
- Define the location of monitoring sites for water or air.

- Define access limitations for protection of cultural/heritage sites and check regularly for the employee's observance of restrictions.
- Use standard sample collection and preservation techniques.
- Choose appropriate analytical methods to achieve maximum sensitivity and reliability of test results.
- Use photographic and mapping techniques to monitor the protection of damage to special areas.
- Use appropriate quality control procedures for checking the reliability of test results.
- Define appropriate liaison techniques for consultation with relevant groups of people.
- Evaluate and review test results and observations and adjust monitoring programme and /or practices, if necessary.

5.6.0 Monitoring and Management Practices

Management practices that are applied in impact mitigation include the following:

Compensation In Monetary Terms

Money can be paid to affected parties for land lost or the loss of amenity resulting from a given project implementation.

Replacement, Relocation and Rehabilitation

Examples of these types of mitigation are:

- 'In-kind' compensation such as the replacement of lost wetlands by constructing other wetlands and planting forests to replace those lost.
- Replacing farmland.
- Relocating villages or people displaced by projects.
- Rehabilitating sites after a project is complete, particularly after mining.

Because some of these types of mitigation may take place over a long period it is important to ensure that any new owners of the property have to take on the liability regarding the continuity of the mitigation programme.

Other mitigation measures that might be considered for a project like Monze-Zimba include:

- Training for local people.
- Improved transportation systems for workers.
- Promoting investment in local institutions or developing new ones to undertake long-term development and regional planning and to provide expanded social services for the public.
- Planning adequate health care, drinking water and sanitary facilities for the benefit of the community.
- Providing the necessary social, psychological and counselling services to cope with socio-economic changes.

Often a combination of compensation and replacement, relocation or rehabilitation is needed. For example, people may be relocated and also receive financial compensation for the disruption that has been caused to their lives.

Other factors that need to be kept in mind in the design of mitigation and compensation plans are that:

- Some measures may themselves have negative effects. Relocation and resettlement, for example, sometimes has significant impacts on residents or the natural environment at the new location. Social issues are the most challenging since perceptions of "winners" and "losers" can develop quite readily. The design and implementation of equitable and balanced mitigation measures requires considerable care and broad consultation with affected and interested parties.
- Some may not be exclusive the domain of a single agency. Government departments, local authorities, neighbours, nearby businesses, non-governmental organisations and the legal system may all be involved in the

design and implementation. Clear definition of responsibilities, funding and clearly defined reporting channels can help to ensure the success of such measures.

CHAPTER VI

CONCLUSION

The phenomena and consequences of disturbing the environment has been thoroughly studied and documented in this report.

It is appropriate to now review the concept of the 'environment' in its entirety, its dynamic state of equilibrium, how it is affected by anthropogenic-induced activities or by natural causes and how an unbalanced environment can induce phenomena with potential to severely affect human life.

The word "environment" refers to our surroundings, the context within which we exist. All things, living or non-living, exist surrounded by other things and, therefore, all have an environment. For mankind, the environment has biophysical, socioeconomic and cultural components.

The components of the environment are inextricably linked and no component exists in total isolation and nothing can be changed without affecting something else. Consequently, the environment cannot be assessed simply by examining its component parts in isolation. This concept is crucial in understanding the role which humans play in affecting their environment. The study recommends the use of more encompassing strategic environmental assessment (SEA) as opposed to project specific assessment. The main objective of SEA, which relates to the broad spatial context of the road project, is to assess the perceived cumulative and other potential effects that all proposed projects (present and future) for a geographical area or administrative region might have on the environment.

It should also be understood that people are an integral part of the environment and are active participants in many ecosystems. Indeed, every aspect of human interaction, be it social, economic, or physical, do and can be considered to affect the ecosystems of which we are a part. In other words, we affect the functioning of our environment through our daily actions. As we change the nature or integrity of our activities, the natural equilibrium of our environment must shift to accommodate these

changes. Our actions, therefore, have dynamic consequences, not only for our immediate environment, but for us as well. Anything we do to degrade or promote the health of our environment will generally affect our wellbeing, negatively or positively, sooner or later.

A key characteristic in the intricacy of the functioning of the environment lies in its dynamic equilibrium. As disturbances arise, a system can be thrown off balance temporarily or permanently. It then begins the process of establishing a new balance, which may or may not be the same as existed before. The amount of time required to re-establish a dynamic equilibrium may range from immediate to tens of thousand of years, depending on the scale of disruption and the relative fragility of the ecosystem.

This is why road construction, traffic operations and management, if undertaken without a proper understanding of the relationships inherent in the proper functioning of the environment, can be accompanied by serious imbalances from which it may take a long time for equilibrium to be regained. In human terms, this may mean that generations must live in a debilitated environment and suffer hardships as a result.

The negative effects resulting from anthropogenic activities on the biophysical, socio-economic and archaeological/cultural aspects of the environment can vary significantly in duration, spatial extent and intensity. However, the study has demonstrated that such impacts can be avoided through change of designs or realigning the road on less susceptible land. Other negative impacts that can not be avoided can be ameliorated through implementation of appropriate measures prescribed in an EMP. The effectiveness of the EMP, however, should be evaluated by means of a monitoring programme.

Having learnt that environment and development are not separate challenges and that they are inexorably linked, it has been concluded that development cannot subsist upon a deteriorating environmental resource base. Likewise, the environment cannot be protected when economic growth does not take account of the costs of environmental degradation. Responsible economic planning is required to ensure sustainable environmental management.

Economics and the environment must be completely integrated in decision and law-making processes not just to protect the environment, but to protect and promote development. Economics should not be limited to the production of wealth and ecology limited to the protection of nature but these disciplines should be integrated to improve the overall welfare of people.

Furthermore, environmental problems do not respect national and political boundaries, so it is critical that nations and administrations work in cooperation on such issues e.g. the pollution of rivers such as the Zambezi which flow through a number of countries.

It is critical that we have the far-sighted objective of protecting the environment for future generations to come, in the spirit of sustainable economic development.

This study has revealed that despite the Zambian government's efforts, very little of consequence has been done to implement environmental protection measures in project planning and execution.

For example, in most cases, road construction firms are not contractually obliged to implement environmental management measures. Such firms generally perceive environmental protection as an unnecessary added cost.

A number of reasons that contribute towards the ineffectiveness or lack of performance of government policies, legislation, regulations and guidelines relating to the protection and management of the environment can be identified as follows:

Educational Background

The Zambian education system lacks teaching programmes that promote or incorporate environmental awareness. As a result, the majority of Zambians (including the well educated) are ignorant of the importance of environmental protection. Educational reorientation is the only panacea for responsible environmental protection, management and improvement of capacities for effective project implementation, supervision and monitoring. People with sound environmental education are likely to take individual or collective responsibility for their actions without being forced as they will be conscious of the importance of preserving a healthy environment. Teaching programmes should be introduced at all levels of education including in-service training.

Cultural and Social Perceptions

The Zambian culture - based on historically abundant natural resources – has inculcated carelessness in the utilization and management of such resources. This has lead, in modern times, to over exploitation. This can be solved by re-education to produce a paradigm shift and promote responsible attitudes.

Poverty and Developmental Factors

The satisfaction of human needs and aspirations is the major objective of any development project. A world in which poverty and inequity in the distribution of wealth prevails will always be prone to environmental crises. To the poor majority, the instinct to survive from day to day is of more immediate importance than conserving nature for future generations. The only way to overcome such problems effectively is to alleviate poverty.

Environmental Assessment (EA)

Environmental assessment has been sited as being very weak in Zambia (e.g. World Bank review meeting, November 2000). Hardly any road projects have been subjected to environmental assessment or monitoring due to lack of funds.

Environmental studies should be synchronized with the project development process. The EA document should be completed as part of the feasibility stage of the

engineering work and environmental mitigation measures should be tied in closely with the design, construction and operational phases.

Strategic Environmental Assessment

The most commonly practiced form of EA in Zambia is project-specific and too narrowly focused. It would often be more appropriate and effective to undertake strategic environmental assessment of, for example, national or regional road policies and programmes as a whole, before embarking on project-specific EA.

Establishment of a National Environmental Impact Assessment Strategy (NEIAS).

The approach to environmental management is too fragmented and uncoordinated in Zambia as a number of different institutions, which to not communicate well, are involved. This issue can best be addressed by the establishment of a National Environmental Impact Assessment Strategy (NEIAS).

The country should also improve its baseline data archives by establishing an Environmental Baseline Data Bank. The present archiving of environmental data is inadequate, which makes efficient EA and monitoring of projects very difficult.

Miscellaneous Recommendations

Other recommendations necessary for the protection of the environment include the re-introduction and incorporation of environmental contractual clauses, which should be enforced. The monitoring process should be extended beyond the construction completion dates. The Zambia National Tender Board should include environmental issues as part of the criteria for tender evaluation in addition to the conventional technical and financial criteria. All road projects should carry a financial cost for the implementation of environmental protection programmes. Staff of the relevant environmental authorities should be properly trained and motivated in order to exercise their duties in an effective manner.

It should be recognized that sustainable development is a process encompassing the entire economy in its relationship with the environment.

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Maps

National Heritage and Conservation Commission 1992, 1:1 500 000

Zambia Road Network Metric Map,

Geological Map 1974/5.

Landuse Map

Vegetation of Zambia Map.

National Parks and Game Management Areas 1985. 1:3 000 000

APPENDICES

Appendix 1

Acronyms and Abbreviations

CBO	Community Based Organizations
CSO	Central Statistical Office,
DOE	Department of Energy
DOF	Department of Fisheries,
ECZ	Environmental Council of Zambia
EMP	Environment Management Plan
EA	Environmental Assessment
EMU	Environmental Management Unit
ROADSIP	Road Sector Investment Programme
MWS	Ministry of Works and Supply
HA	Highway Authority
NRB	National Roads Board,
RD	Roads Department

Acronyms and Abbreviations continued...

RRP	Road Rehabilitation Programme
NHCC	National Heritage Conservation Commission
GMA	Game Management Area
EIA	Environmental Impact Assessment
EPPCA	Environmental Protection and Pollution Control Act
EC	European Commission
EDF	European Development Fund
FD	Forestry Department
GRZ	Government of Republic of Zambia
GDP	Gross Domestic Product
IUCN	International Union for Conservation and Nature
LA	Local Authority
MAFF	Ministry of Agriculture, Food and Fisheries,
MCDSS	Ministry of Community Development and Social Services
MCTI	Ministry of Commerce, Trade and Industry,
ME	Ministry of Education,
MENR	Ministry of Environment and Natural Resources
MEWD	Ministry of Energy and Water Development
MLA	Ministry of Legal Affairs
MLGH	Ministry of Local Government and Housing
MMMD	Ministry of Mining and Mineral Development
MOF&ED	Ministry of Finance and Economic Development
MOL	Ministry of Lands
MOT	Ministry of Tourism
MTC	Ministry of Transport and Communication
MOH	Ministry of Health,
NCS	National Conservation Strategy
NEAP	National Environmental Action Plan
NSCU	National Soil Conservation Unit,
PFP	Policy Framework Paper,
RD	Roads Department
TCPD	Country and Town Planning Development,

UNDP	United Nations Development Programme
UNCED	United Nations Conference on Environment and Development
WAD	Water Affairs Department
ZEEP	Zambia Environmental Education Program
ZESCO	Zambia Electricity Supply Corporation Limited
ZFAP	Zambia Forestry Action Plan

Appendix 11

PHOTOGRAPHS

PHOTO 2.1
Surge Pile from primary crusher.

10/10/2000

PHOTO 2.2

Quarry face after blast.

10/10/2000

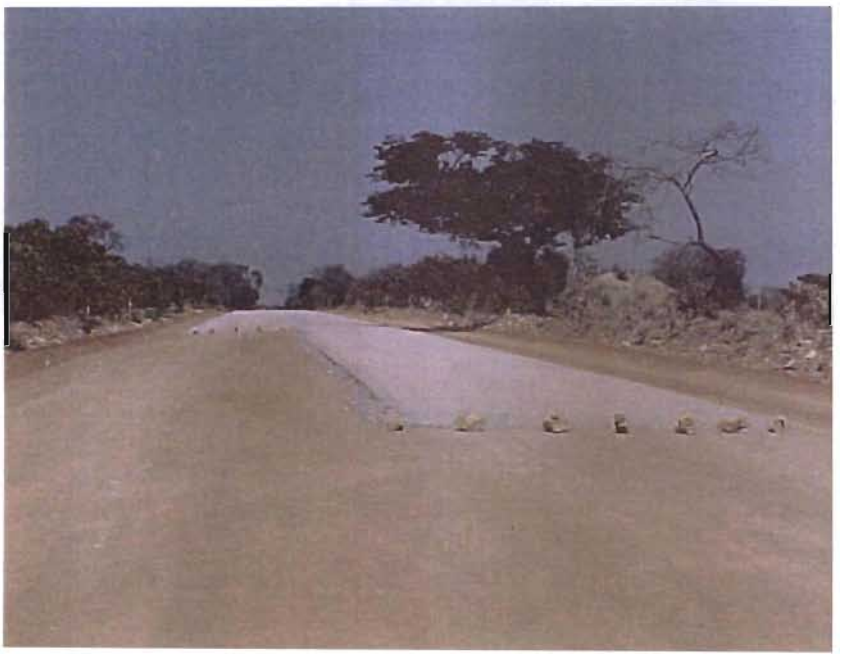

PHOTO 2. 3

Trial section of crusher run base reconstruction design section at chainage Km 71+800m.

10/10/2000

PHOTO 2.4

Pulvimixer reconstruction design section at chainage Km72+320.

10/10/2000

PHOTO 2.5

Construction of detour on reconstruction design section at chainage Km 72+960

10/10/2000

PHOTO 2.6

Construction of drainages box culvert at chainage Km 113+160

10/10/2000

PHOTO 2.7

Culvert construction at chainage km 109+516.

20 /11/2000