PID Document

listed under

690-0209

690-0209.01

AGENCY FOR INTERNATIONAL DEVELOPMENT

# PROJECT DATA SHEET

Amendment Number

DOCUMENT CODE 3

2. COUNTRY/ENTITY: Southern Africa Regional

PROJECT NUMBER: 690-0209

3. BUREAU/OFFICE: AFRICA

PROJECT TITLE (maximum 40 characters): Regional Transport and Storage Makuti-Chirundu

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 05 DD 1 YY 84

7. ESTIMATED DATE OF OBLIGATION (Under "B" below, enter 1, 2, 3, or 4): A. FY 82 B. Quarter 3 C. Final FY 82

8. COST (000) (Dollars)

| A. FUNDING SOURCE | B. FX | C. L/C | D. Total | E. FX | F. L/C | G. Total |
|---|---|---|---|---|---|---|
| | | | | LIFE OF PROJECT | | |
| AID Appropriated Total | | 4,200 | | | 4,200 | 4,200 |
| (Grant) | ( ) | ( ) | ( ) | ( ) | ( ) | ( ) |
| (Loan) | ( ) | (4,200) | ( ) | ( ) | (4,200) | (4,200) |
| Other U.S. 1. | | | | | | |
| Other U.S. 2. | | | | | | |
| Host Country | | 1,250 | | | 1,250 | 1,250 |
| Other Donor(s) | | | | | | |
| TOTALS | | 5,450 | | | 5,450 | 5,450 |

SCHEDULE OF AID FUNDING (000)

| A. APPROPRIATION | B. PRIMARY PURPOSE CODE | C. PRIMARY TECH. COD. 1. Grant | C. 2. Loan | D. OBLIGATIONS TO DATE 1. Grant | D. 2. Loan | E. AMOUNT APPROVED THIS ACTION 1. Grant | E. 2. Loan | F. LIFE OF PROJECT 1. Grant | F. 2. Loan |
|---|---|---|---|---|---|---|---|---|---|
| (1) ESF | 210TS | | 321 | | | | 4,200 | | 4,200 |
| (2) | | | | | | | | | |
| (3) | | | | | | | | | |
| (4) | | | | | | | | | |
| TOTALS | | | | | | | 4,200 | | 4,200 |

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 4 characters each)

11. SECONDARY PURPOSE CODE

12. SPECIAL CONCERNS CODES (maximum 6 codes of 4 characters)
A. Code
B. Amount

13. PROJECT PURPOSE (maximum 480 characters)

To facilitate trade and communications between Zimbabwe and Zambia and among other countries in the region by rehabilitating the Makuti-Chirundu portion of the Salisbury-Lusaka (Zim-Zam) road.

14. ESTIMATED DATE OF A.I.D. OBLIGATION: MM [illegible] YY [illegible]

15. SOURCE/ORIGIN OF GOODS AND SERVICES: ☐ 000 ☒ 941 ☐ Local ☐ Other (Specify)

16. AMENDED DATE (N/A): MM [illegible] YY [illegible] CHANGE PROPOSED (N/A for PP Amendment): Time: MM 8 YY 13

17. APPROVED BY
Signature: [illegible]
Title: Director USAID/Zimbabwe
Date Signed: MM 06 DD 01 YY 82

18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION: MM DD YY

AID 1330-1 (6-72)

# REGIONAL TRANSPORT AND STORAGE

# ZIM-ZAM ROAD (690-0209)

# REHABILITATION OF THE MAKUTI-CHIRUNDU ROAD

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## Acronyms - Abbreviations

| | |
|---|---|
| AFR/DR/SAP | Africa Bureau/Office of Development Resources/Southern Africa Projects |
| AID/W | Agency for International Development, Washington D.C. Office |
| AID/Z | AID Zimbabwe |
| B/C | Benefit Cost |
| CDSS | Country Development Strategy Statemen |
| CP | Conditions Precedent |
| FAR | Fixed Amount Reimbursement (Contract) |
| GOZ | Government of Zimbabwe |
| IBRD | International Bank for Reconstruction and Development |
| IFB | Invitation for Bids |
| IRR | Internal Rate of Return |
| Km | Kilometre |
| PID | Project Identification Document |
| PP | Project Paper |
| REDSO/EA | Regional Economic Development Services Office/East Africa |
| RFMC | Regional Financial Management Center |
| RLA | Regional Legal Advisor |
| SADCC | Southern Africa Development Coordination Conference |
| SATCC | Southern Africa Transportation Coordination Committee |
| UDI | Unilateral Declaration of Independence |
| Z$ | Zimbabwean Dollar (=$1.40 US) |
| Zim-Zam | Zimbabwe-Zambia (Salisbury-Lusaka) Road |

## Project Design Team

| | |
|---|---|
| Timm A. Harris | Project Design Officer, REDSO/EA |
| F. Denis Light | Civil Engineer, REDSO/EA |
| Dale B. Pfeiffer | Regional Development Officer, AID/Zimbabwe |

# I. SUMMARY AND RECOMMENDATIONS

## A. Summary

Title: Regional Transport and Storage, Makuti-Chirundu Road 690-0209

Amount: AID $4.2 million; GOZ $1.25 million

Type of Funding: ESF, FAR contract

Timeframe: FY 82-FY 83

Executing Agency: Ministry of Roads

The proposed project is a response to the requests for assistance from the Government of Zimbabwe and the high priority in project identification by the Transport Committee of the Southern Africa Development Coordination Conferences (SADCC) for the rehabilitation of the Salisbury-Lusaka (Zim-Zam) Road.

With the cessation of hostilities in the "Rhodesian" war, trade and communications between Zimbabwe, Zambia and other neighboring states has grown tremendously. Movements of grains, industrial goods, consumer goods and raw materials has been greatly expanded. A large amount of this trade has seen movements of goods via the Salisbury-Lusaka Road. For Zambia this road is closely tied to the nation's extreme concern about its access to external international trade. The road is the shortest route to a major sea port (Beira in Mozambique) and connects the population centers of Lusaka and the Copperbelt with Salisbury, Zimbabwe's major maize production area and the rail head at Zawi.

The Zim-Zam Road was closed to traffic for seven years (1973-1980) and during that time very little maintenance was done. Once traffic was allowed to resume, deterioration became more apparent and was accelerated by the movement of heavy trucks. This movement, combined with the lack of maintenance, has left several sections of the Makuti-Chirundu Road in poor condition.

The U.S. was approached by SADCC and the Governments of Zambia and Zimbabwe to help in financing repair work. A PID was prepared in February, 1981, which recommended rehabilitation of

road sections in both Zimbabwe and Zambia. Since then, major rehabilitation has been initiated in Zambia, under Phases I and II, and U.S.$14.1 million is being obligated. (March 1982 obligation 990,000 + 10,510,000) Phase I is nearing completion and bids are being accepted for Phase II. Since the PID approval in April, 1981, discussions in AID/W and AID/Zimbabwe have been held to determine procedures for assistance. It has been agreed that the FAR (Fixed Amount Reimbursable) contract approach will be utilized through a concessionary loan to the GOZ. Engineering surveys were performed and preparations were made for the PP design.

The Project Paper design team has found that the rehabilitation of the Makuti-Chirundu Road is economically feasible. The GOZ implementing agency (Ministry of Roads) was found to be quite capable of supporting the project. The project itself should be completed within eighteen months and showed favorable economic benefits and social returns. No significant social or technical issues were identified. No waivers were requested and certain recommended covenants are shown in Section V.D.

B. Recommendations

It is recommended that USAID approve a loan to the Government of Zimbabwe in the amount of U.S.$4.2 million from ESF sources out of regional funds, to be used for the purpose of rehabilitating sections of the Makuti-Chirundu Road (Zim-Zam Road). Contractual terms for the loan should be made in the Fixed Amount Reimbursable (FAR) format, the loan itself to be repaid at AID concessionary terms, over a period of 40 years with 10 years grace on principal, with interest charges at 2 percent during the first ten years and 3 percent thereafter.

II. Background Discussion:

(A) Southern Africa Development Strategy - Transportation

The underlying theme of the Southern Africa Development Coordination Conference (formed by the nine majority ruled countries of the region) is to pursue policies aimed at accelerated economic development and regional self-reliance. A major area of concern in realizing these objectives is that of regional transportation capacities. The ability to move goods efficiently in order to promote greater trade among the countries of the region and with the rest of the world is constrained by the lack of adequate transportation infrastructure. The problem is particularly acute for the six landlocked countries (Botswana, Lesotho, Malawi, Swaziland,

Zambia and Zimbabwe). Much of the existing infrastructure in Zimbabwe has suffered from war damage and deterioration from lack of use during period of sanctions and guerilla war related to the independence struggle. Also, most of the infrastructure was built during a period requiring lesser standards in terms of carrying capacity than now required by the region's expanding economies and import/export trade. Recognizing that the need to develop and maintain the transportation infrastructure transcends national considerations, the countries within SADCC selected transportation as their first priority for regional cooperation. SADCC assigned responsibility to Mozambique for overseeing the planning and cordination in this sector and created the Southern Africa Transportation and Communications Commission (SATCC) which has been functioning in Maputo with Nordic assistance for the past two years. The selection of Mozambique for this sectoral coordination reflects its key position in relation to the region's transportation system. Its ports of Maputo, Beira and Nacala and the rail and road links are extremely important to the SADCC countries (except Lesotho) and represent considerable potential economic savings due to the shorter distances involved (compared to shipping through Dar es Salaam or Durban). Even South Africa, despite political differences with Mozambique, finds it economical to use the port of Maputo for part of its trade.

At a SADCC meeting held in Maputo in November 1980 attended by donors, a presentation was made of priority projects in the transporation and communications area requiring donor support. The emphasis in this listing was for rehabilitation of key parts of the existing infrastructure. First priority among road projects was given to the road link between Salisbury (Harare), Zimbabwe and Lusaka, Zambia. This road had fallen into serious disrepair due to disuse during the eight years of sanctions against the Smith regime in Rhodesia. It is now an important conduit for goods between the two countries, particularly food for Zambia whose industrial/mining sector relies upon grain imports from surplus producing Zimbabwe. Subsequent to the Maputo meeting the United States received a request to support this activity. Funding in the amount of $13.1 million was committed in FY 1981 for reconstruction and resealing of 80 kilometers of the road in Zambia between Kafue and the border town of Chirundu. Construction is now proceeding satisfactorily on this stretch. This project would include the Zimbabwean portion of the road as well.

(B) U.S. Regional Strategy

Support for regional projects such as this road demonstrates the high priority the U.S. places on encouraging and assisting economic growth and stability in Southern Africa. In particular the U.S. endorses the emergence of regional cooperation as embodied in SADCC as a promising means by which the Southern Africa states can more effectively address their common development problems through regular consultation and coordination of their planning and investments in a number of areas amenable to economies of scale and joint efforts.

Southern Africa is economically and politically important to the U.S. Its mineral wealth and projected economic growth offer considerable potential for much expanded trade and investment relationships above current levels with the U.S. and other developed economies. It is, however, a highly volatile area. The existence of South Africa's apartheid policies threaten the stability of the surrounding countries. The movement toward Namibian independence has involved fighting between South African forces and guerillas in both Namibia and neighboring Angola. Within Angola itself conflict has existed between opposing forces. Of longer term concern to the U.S. (particulary in relation to the region's prospects for achieving stability) is the need to overcome the pervasive poverty which affects every country. Until these countries are able to provide their populations with the necessary opportunities for improving their standards of living and make them productive contributors to their nation's economy, there is little hope that the region will be free from political instability and conflict. While the U.S. will work through international political channels to overcome the shorter term areas of tension and conflict such as Namibian independence, it has committed itself to working with various governments of the region in assisting their economic systems to make them capable of eliminating widespread poverty and to internally generate the resources needed to sustain their growth. Success in achieving these objectives will eliminate their dependence on other economies and lead to peaceful resolution of problems.

While the U.S. has been providing assistance bilaterally to the countries of the region, it also accepts the rationale and potential for resolving some of the constraints to development through regional cooperation. Regional cooperation through an entity such as SADCC offers possibilities both for cost savings in development investment and for improved relations among countries as a result of a continuous dialogue. The U.S. has

supported the concept of SADCC from its inception and its approach to identifying and prioritizing common problems compatible with its own perceptions. The ranking of regional transportation by SADCC as its first priority has been endorsed by the U.S. in its own regional development strategy analysis. Business investment and commerce depend on the existence of reliable, cost effective means of moving goods and materials. The Zim-Zam road project is seen as a prime example of the constraints poor transport can place upon trade within the region. The condition of the road has added to the cost of Zambia and Zimbabwe trading, costs which ultimately are passed on to consumers in terms of higher prices for goods purchased and to the governments in terms of increased foreign exchange outlays for imports, dampered export expansion potential and increased maintenance costs. By aiding in its rehabilitation, the U.S. contributes to the improvement of economic conditions in the region and encourages the southern Africans in their efforts to coordinate their development for mutual benefit.

(C) Regional Transport - The Zimbabwean Perspective

Zimbabwe's central geographic position within the southern Africa region makes it a crossroad or transit point for much of the trade for surrounding countries. It's economy and trade structure are conducive to expansion and competition with the Republic of South Africa. Zimbabwe has one of the best developed transportation infrastructures in Africa with a well developed rail system and an extensive international standard trunk road network. Its economy has been constrained since independence by difficulties in the transportation field.

Patterns of transport had been established during the period of sanctions which tied Zimbabwe's import/export trade to South Africa's transport system. Road and rail links with the closer (and theoretically more economical) rail/port system of Mozambique had been cut off and the facilities there had fallen into a serious state of disrepair and ineffectiveness due to the Portuguese withdrawal which left equipment in poor condition and a shortage of trained indigenous manpower. Transport links with other countries (except South Africa) had generally fallen into disarray and were limited.

The importance of efficient transport was made clear to Zimbabwe when shortly after independence South Africa withdrew twenty-four locomotives it had loaned to the previous government. This precipitous action added to an already

critical situation caused by old equipment and the demands of the rapidly expanding economy, particularly the need to move maize and mineral shipments. This dependence on the RSA has proved costly for Zimbabwe (at one point the GOZ estimated a weekly loss of $5 million in foreign exchange) and efforts are therefore being made to lessen this dependence and expand interactions with neighboring states.

The Salisbury/Lusaka road, as one of the major routes for trade with Zambia, (and southern Zaire) was identified early on as Zimbabwe's and SADCC's first priority for road rehabilitation. Other routes, including those through Umtali and Plumtree in the east and southwest respectively were also given high priority as 'regional' roads and will be receiving assistance from other donors. It is intended that rehabilitation of all these routes and the improvements in the rail system will make Zimbabwe's transportation infrastructure capable of handling intra-regional trade and its own international trade in an effective, efficient manner. The benefits thus will be shared by all users. These benefits will be both social and economic in nature.

(D) Relationship to AID's Bilateral Country Program

Assistance to Zimbabwe since its independence in early 1980 has been directed largely towards activities intended to stimulate its economy and to aid government efforts in the reconstruction of facilities damaged or having suffered deterioration during the years of the independence conflict. One of the first efforts to stimulate the economy was a government offering of price incentives to improve agricultural production. Maize production which had been depressed from lack of price incentives and two years of drought conditions, totaled approximately 3 million metric tons in 1980. This was considerably higher than domestic needs (estimated at 1 million metric tons per annum) and Zimbabwe was anxious to find markets for export, preferably within the region. Zambia was a natural customer since it had been experiencing food deficits and needed the maize for its large urban population. Zambia subsequently contracted for a quarter of a million tons of Zimbabwean maize. The lifting of sanctions had also reopened trade in a large number of other commodities, largely produced in the Salisbury industrial complex or purchased from South Africa and transited through Zimbabwe. The Salisbury/Lusaka road was a prime conduit for this trade.

The road was one of the many elements of Zimbabwe's (and Zambia's) infrastructure which had received "war damage" or had

deteriorated from misuse. The closure of the border for the eight years of sanctions resulted in the road being used for only very limited local traffic. The lack of use and the absence of any substantial maintenance during this period allowed the road to deteriorate. The road thus qualified as a legitimate project for reconstruction of war damage. Its rehabilitation was supportable both on these grounds and on the need to provide efficient transport for Zimbabwe's growing trade with Zambia. It thus complements and conforms to the country assistance program as expressed in the CDSS and program thrust.

## III. PROJECT DESCRIPTION

### A. Project Goal and Purpose

The over-riding goal of the rehabilitation of the Makuti-Chirundu Road is to assist in the economic development and general welfare of the people of both Zimbabwe and Zambia. Essential elements in such an effort are trade and communication between the countries, brought about by improved transport and linkages, efforts which will be improved by the road rehabilitation. The project purpose is to facilitate the exchange of goods (food, manufactured goods for industry and consumption and raw materials) between the two nations and with other countries throughout the world. To achieve these objectives in a meaningful manner, an all-weather, heavy load capacity road linking the countries is required. This road is the most economically efficient means now available to link Salisbury to Lusaka.

A secondary purpose also to be met by the project is the support of a pragmatic solution to regional economic problems as seen by Southern Africa Development Coordination Conferences (SADCC) member nations and the general U.S. policy to assist in such efforts.

### B. Project Components

The proposed project will help finance the rehabilitation of the Makuti-Chirundu portion of the Zimbabwe-Zambia Road project. This is in coordination with the efforts currently being made in Zambia on the extensive repairs of the Kafue-Chirundu Road under Project 690-0209 (as mentioned in Section IIIC). These two regional projects, best known as the Zim-Zam Road, are inseparable as they are both necessary to meet the stated objectives. Project 690-0209 in Zambia is

reaching completion of Phase I and Phase II should be initiated shortly.

The Zim-Zam Project Identification Document (PID), which incorporated both the Zimbabwean and Zambian portions of the road rehabilitation (it was originally intended that the road rehabilitation be considered one project, but this has proved impossible). The road between Makuti and Chirundu is 62 kilometers long, eleven kilometers of which have been identified, at this time, as needing reconstruction. Funding for the reconstruction of one additional kilometer has been made to compensate for further deterioration in the next year. Since that time, various surveys and tests have shown that an additional twenty eight kilometers of road are in need of resealing and resbouldering. This is dealt with extensively in Section IVA and the Appendices on Engineering.

As a result of the civil war in 'Rhodesia', the road from Makuti to Chirundu was subject to little traffic and very minor maintenance. For strategic and military tactical purposes, the road was maintained as serviceable, but no resealing was performed and maintenance consisted of grass-cutting and occassional pot-hole repairs. Upon cessation of the war, the road was opened once more to through traffic with Zambia, and has become a most important route for the movement of grain, fertilizer, mining equipment, spare parts and other general cargo.

This greatly increased traffic has made more apparent the general weaknesses of the section of road to be repaired. Erosion of the shoulders, un-evenness of the surface, cracking, and pot-holes have appeared. The traffic has increased four-fold since 1980 and is liable to continue to grow, but at a lesser rate. Given the current state of the road and the increased traffic, it is imperative that repair efforts be initiated in the near term.

Necessary rehabilitation has been determined through soil tests, field visits, Benkelman beam testing and surveying work. After these tests and surveys were performed, a series of cost estimates were derived. The total rehabilitation cost of the Makuti-Chirundu road is estimated at U.S.$5,450,000. It is proposed that the U.S. support cover 77% of this amount and the GOZ cover 23% of the requirements. In monetary terms this represents U.S. $4,200,000 in a USAID loan and the GOZ portion would be approximately U.S. $1,250,000. Under the Fixed Amount Reimbursable (FAR) contract approach, a set amount would be disbursed to the GOZ for each kilometre (up to a maximum of

twelve kilometers) reconstructed and each kilometre resealed/reshouldered. The amounts disbursed would be U.S.$282,800 per kilometre of road reconstructed and U.S.$23,800 per kilometre of road resealed and reshouldered. The total U.S. loan would therefore not exceed the following disbursements:

| | |
|---|---|
| Reconstruction (U.S.$282,800 x 12) | $3,393,600 |
| Reseal and Reshoulder (U.S.$23,800 x 28) | $ 666,400 |
| Contingency | $ 140,000 |
| Total U.S. Loan | $4,200,000 |

It is anticipated that funds will be disbursed on a monthly basis upon certification by the Ministry of Roads and a USAID engineer that a given number of units of resealing, reshouldering and/or reconstruction have been completed satisfactorily.

C. Project Beneficiaries

Project beneficiaries are both directly and indirectly served by the road. Those directly served are people who need the road for access to their property and those working on the road rehabilitation effort itself. The direct beneficiaries are of much fewer numbers and economic importance than the indirect beneficiaries and benefits that will accrue. This is because the section of the rehabilitatied road is found, for most of its length, running through the Zambezi River Basin/Nyakasanga Controlled Hunting Area (public lands).

The major beneficiaries (in numbers and levels of benefits) are those people served through the transport of various kinds of goods, and therefore the benefits are both economic and social in nature. The benefits can be grouped as: road user savings (reduced vehicle operating expenses), time savings (more rapid movement), stimulation of trade and related business activities and the potential for new agricultural, manufacturing and service industries to develop.

Certain activities are easily identifiable and quantifiable as benefiting from the road rehabilitation. Zambian consumers have been and probably will be dependent on Zimbwean maize to meet local production shortfalls. In 1981 some 250,000 tonnes were transported from Zimbabwe to Zambia, a total which represents (at 40 tonnes per truck) 6,125 loads or 12,250 trips

in either direction and some 35 heavy vehicles per day over the road. Reported figures (from the MOR) are that some 180,000 tonnes of maize will be transported in 1982, representing 9000 trips (4500 round trips) or some 25 heavy lorries per day for maize only. Zambia, through the mines in the Copperbelt, produces bitumen. A fairly large portion is exported to Zimbabwe. It is possible that empty maize lorries will be utilized to carry this (and other) Zambian products. The benefits in costs are discussed in Section IVC.

D. Project Issues

The highly qualified staff and professional operations of the Ministry of Roads are most impressive. The maintenance programs, testing operations and overall state of the vehicular infrastucture in Zimbabwe are excellent and the country is in (comparatively) good condition. In Zimbabwe no major project issues are seen at this time. The MOR has recently been given the responsibility of maintaining an additional 6,000 kilometres of rural access roads previously maintained by County Councils. The impact of this additional work is not yet known. Yet the quality of workmanship and the road infrastructure in Zambia has many problems. These difficulties directly relate to the effectiveness of the Makuti-Chirundu Road. The Zimbabwe portion of the Zim-Zam Road serves as a link between the countries (as an entity in of itself the road has very little purpose). If the Zambian portion of the Zim-Zam Road is in a state of disrepair or its not serviceable, the benefit of the Makuti-Chirundu Road is greatly lessened. Therefore, those elements which were "project issues" for the Zambia Kafue-Chirundu Road are also issues for the Zimbabwean Makuti-Chirundu leg.

In the PP for the Zambia Zim-Zam Phase II (pp. 36-37), two major issues are discussed. They are; continued maintenance of the road and enforcement of the vehicle standards for weights (control of overloading). These issues are addressed in the Zambia Project Agreement and hopefully will be dealt with.

E. Other Donor Interest

Wichin Zimbabwe, there are no donors assisting the Ministry of Roads at this time, although many organizations have expressed a strong interest in providing assistance. The MOR is currently undergoing discussions with two donors about possible assistance to roads in the eastern part of the country. The IBRD, has expressed an interest in assisting Zimbabwe in the rehabilitation of certain segments of the Fort Victoria -

Birchenough Bridge Road and are considering assistance through a transport sector analysis and construction/rehabilitation of certain District Council Roads. The Australian High Commission has been discussing assistance to Zimbabwe with the construction of an Umtali by-pass and also rehabilitation of certain railway crossings and bridges between Salisbury and Umtali. Both of these roads are important for internal transport and linkages with Mozambique.

The IBRD is also assisting in Zambia and is providing technical support and funding in order to upgrade the road maintenance capabilities of the Ministry of Works and Supply. There has been no other donor with a direct interest in assisting with the rehabilitation of the Zim-Zam Road, as far as is known.

## IV. PROJECT ANALYSIS

### A. ENGINEERING ANALYSIS

#### 1. Makuti to Chirundu Section (Zim-Zam Road) Current Status

The section of the Zim-Zam Road from Makuti to Chirundu under the project is 40 kilometers in length (kilometer 312 to kilometer 352 from Salisbury). It extends from the lower slope of the Zambezi escarpment to the Zambezi River at Chirundu. The road was constructed during the years 1959 through 1961 but was not in use for the seven year period of the Rhodesian war (1973 to early 1980).

As a result of a lack of periodic maintenance during the hostilities, together with the effects of the Zambia maize haul traffic which commenced immediately after cessation of hostilities, the road is now in varying stages of distress. Major emergency repairs have been made in a number of places but pavement depressions and cracking continue to occur. High grass shoulders prevent the flow of water away from the road. The absence of traffic and maintenance during the war years caused brittleness and cracking of the surface, permitting water to penetrate the protective surface membrane and affect the base and subgrade. From the results of field inspections, it is evident that road collapse has occurred in areas of "sodic" material (where this material was used for earth embankment). Sodic material is soil which, though relatively impervious in its natural state, when remolded and used in fill has the property of retaining moisture that seeps through the surfacing and pavement, retains the moisture of seepage to a level above optimum moisture content and reduces the subgrade

strength to zero when related to the CBR classification. This saturated condition appears to continue throughout the dry season and becomes progressively worse during the following rains. The drastic reduction in strength has resulted in large deformations in the road and emergency patching has had to be done. A further aggravating property of these "sodic" materials is that a chemical reaction occurs in the presence of moisture whereby sodium compounds are dissolved and transported or dispersed out of the material whenever a moisture gradient exists (no matter how slight) resulting in voids and a pipe effect through the material. In the road structure under present pavement and traffic conditions, the pipes appear to collapse when reaching a diameter of about 100 mm.

The Ministry of Roads performed Benkelmann Beam tests in 1980, visual inspections and sampling in 1981 and has recommended that certain sections of the road be removed and replaced with a stable fill and subgrade (Letter dated September 22, 1981). This is in accordance with a laboratory report MSW/901/HKG/563 dated August 19, 1981. See Annex D. Exhibit 1. It is also clear that due to continuous road deterioration these sections will increase in extent until replaced. A length of 12 kilometers is therefore planned for reconstruction purposes instead of the 11 kilometers as shown in the September letter. The repairs program will be done according to Zimbabwe standard designs which are shown in Annex D. Exhibit 2. Design is based on a 20 year pavement life for 1 million equivalent axle loads (8.2 metric tons per load) and an expansive soil subgrade. Subbase will be 150 mm natural gravel; base 150mm crushed gravel, fill CBR 9 materials. Surfacing will be double bituminous surface treatment over the 7 meter pavement and single surface over the shoulders. This repair program has been reviewed by the PP engineer based on traffic data, weight and numbers of axle loads and is found to be based on sound engineering principles. In addition the PP engineer has received typical drawings and contractor documents and found them to be satisfactory for AID FAR contracts.

Sections to be reconstructed first will be removed according to Annex D Exhibit 2, Symbol T5 in which the expansive soil is removed to a depth of 600 mm together with the surface and base and then stock-piled. The excavation is then filled with a plastic non-expansive soil of SG 9 quality (CBR 9) and compacted to a density of 90% modified AASHTO all in 150 mm lifts. Sub-base and base courses then complete the pavement. Surfacing is double surface bituminized treatment for the pavement, and shoulders.

The above work is to be done for some 12 km of pavement with the remaining 28 km to be treated in a different manner. Vegetation is to be removed from the shoulders and the shoulders levelled and compacted to 90% modified AASHTO. The road will then be sealed with single bituminous stone treatment on the pavement and shoulders.

## REHABILITATION PROGRAM

| Distance from Salisbury Kms + meters | | KMS | | KMS |
|---|---|---|---|---|
| | RESEAL | 4.2 | | |
| 347 + 800<br>347 + 300 | | | RECONSTRUCT | 0.5 |
| 341 + 200<br>340 + 000 | RESEAL | 6.1 | RECONSTRUCT | 1.2 |
| 339 + 500<br>338 + 300 | RESEAL | 0.5 | RECONSTRUCT | 1.2 |
| 334 + 100 | RESEAL | 4.2 | | |
| 332 + 400 | | | RECONSTRUCT | 1.7 |
| 331 + 400 | RESEAL | 1.0 | | |
| 327 + 100 | | | RECONSTRUCT | 4.3 |
| 326 + 300<br>326 + 000 | RESEAL | 0.8 | RECONSTRUCT | 0.3 |
| 324 + 100<br>323 + 400 | RESEAL | 1.9 | RECONSTRUCT | 0.7 |
| 321 + 800<br>320 + 700 | RESEAL | 1.0 | RECONSTRUCT | 1.1 |
| | RESEAL | 8.7 | | |
| TOTAL | | 29.0* | | 11.0 |

* Note allowance is made in the project for 12.0 kms. of reconstruction and 28 kilometers of reseal.

STANDARD 1 M PAVEMENTS

DESIGN TRAFFIC 0.3 - 1.106E 80

7 METER PAVEMENT ON 10 M. EMBANKMENT

SC 9 SOILS RECONSTRUCTION

SBST DBST SBST

150 MM CLASS 2.6 Crushed gravel (base 1)

150 MM CLASS 3.3 national gravel (Base 2)

SC 9 SOILS 600 MM

SUBGRADE TREATMENT TE

RESEAL

7 METER PAVEMENT ON 10 M EMBANKMENT

SBST SBST SBST

120MM CLASS 2.6 SHOULDERS REPLACED WITH CRUSHED GRAVEL

2. Proposed Work

This project will finance the reconstruction and resealing work of 40 kilometers of the Makuti-Chirundu section of the Zim Zam Road during the 1982 and 1983 dry seasons. This is dependent on the GOZ creating a stockpile of gravel and stone sufficient for construction work. A cost summary and discussion of cost factors including Government contribution is found in the next section (Financial Analysis).

It is intended that construction work will be done by a private contractor with a private consultant supervising construction. Crushing of stone and gravel is the subject of a separate contract awarded in February 1982. There is no lack of construction contractors or consultants in Zimbabwe capable of performing the work.

3. Maintenance: Current Status and Future Requirements

(a) Current Status. Insufficient road maintenance has been caused by the recent hostilities, but with the cessation of the "war" and availability of monies for priority roads, the maintenance problem had become less critical. Recently though, the Ministry has been given an additional 6000 kms to maintain (in the last 18 months) and there maybe overall budget deficits. Planning and coordination is essential. Preventive maintenance is increasing even though much maintenance is done on an emergency basis. Shortage of operating funds, decrease in trained staff, shortage of spare and replacement parts for equipment are increasingly prevalent problems and can be traced to the lack of foreign exchange and staff attrition.

In terms of the Makuti-Chirundu section of the Zim Zam road, the pavement had not been sealed during the war years even though some maintenance was performed.

(b) Project Initiatives. The situation presented above is not encouraging in the long run, but given the implementation of this project and the standard of maintenance done prior to the war years, this road section should be adequately maintained. Both AID and the World Bank stress the overall importance attached to sound maintenance as the best way of protecting capital investment. The Ministry strongly enforces penalties for overloading of vehicles by use of weighbridges and mobile inspections.

(c) Future Maintenance Requirements. The 40 kilometers of road will require periodic maintenance comprised of additional spray and chip treatment at 7 year intervals. This is in addition to annual routine maintenance.

## 4. Cost Estimates

12 Kilometers of the road will be constructed because of sodic soil failure; 28 kilometers will have shoulder work and total reseal performed, due to lack of maintenance and resealing over the past nine years.

Costs are based on national average costs per kilometer of roads constructed and/or maintained over the past 18 months (dated December, 1981). For the project road reconstruction, the standards used are 7 m. pavement on 10 m. embankment, (1 million 8.2 metric ton equivalent axles) and SG 9 pavement structure. Pavement structure is 150 mm Base Course 1 (crushed gravel); 150 mm Base Course 2 (natural gravel) and 600 mm SG 9 (CBR 9) fill. Allowance is also made for a separate contract for crushing gravel and stone and stockpiling along the the road. The conversion factor is taken as 1Z$ = $1.40.

Reconstruction per Kilometer in Z$

| | | |
|---|---|---|
| a) | Earthwork removed | 51,500 |
| b) | Earthwork reinstated | 37,600 |
| c) | Base 2 (class 3.3) 150 mm. | 12,800 |
| d) | Base 1 (class 2.6) 150 mm. | 13,300 |
| e) | Spray and stone DBST pavement, SBST Shoulders | 11,500 |
| | Sub total | 126,700 |
| | Miscellaneous costs from cost statistics 22% | 27,900 |
| | Allowance for remoteness of site 12% | 15,400 |
| | Total | 170,000 |

Reseal and Shoulders per Kilometer in Z$

| | |
|---|---|
| a) Shoulder excavation and replace with base 1 120 mm. (A factor of 1.8 allows for difficulty of compaction) | 6,300 |
| b) Reseal SBST (A factor of 1.2 allows for laying difficulties) | 4,200 |
| Sub total | 10,500 |
| Miscellaneous costs from cost statistics 22% | 2,300 |
| Allowance for remoteness of site 12% | 1,200 |
| | 14,000 |

Contract Costs

| | |
|---|---|
| a) 12 km Reconstruction @ 170,000 | 2,040,000 |
| b) 28 km Reseal + shoulders @ 14,000 | 392,000 |
| Sub Total | 2,432,000 |
| 20% inflation from December 1981 to completion | 468,000 |
| USAID assistance total | Z$ 2,900,000 |
| | US$ 4,060,000 |

Repayment Scheme

Factor individual costs by (1.22 + 1.12) 1.20 and rounded.

| | | | |
|---|---|---|---|
| a) Earthworks removed | 12 x 82000 = | Z$ 984,000 | US$ 1,377,60 |
| b) Earthworks reinstated | 12 x 60000 = | Z$ 720,000 | US$ 1,008,00 |
| c) Base 2 | 12 x 20500 = | Z$ 246,000 | US$ 344,40 |
| d) Base 1 | 12 x 21500 = | Z$ 258,000 | US$ 361,20 |
| e) Surfacing | 12 x 18000 = | Z$ 216,000 | US$ 302,40 |
| f) Reseal + shoulders | 28 x 17000 = | Z$ 476,000 | US$ 666,40 |
| | | 2,900,000 | 4,060,00 |

Zimbabwean Government Costs

| | | |
|---|---|---|
| a) Base Gravel 32000 $m^3$ @ 18 | = Z$ 576,000 | US$ 806,40 |
| b) Surfacing stone 5100 $m^3$ @ 29 | = Z$ 148,000 | US$ 207,20 |
| c) Private consultant supervision 14 months @ 12000 | = Z$ 168,000 | US$ 235,20 |
| | Z$ 892,000 | US$ 1,248,80 |

611(a) Determination

Engineering analysis has concluded that all necessary planning (including design, plans, specifications, contract documents) have been examined and found satisfactory, and that cost estimates are reasonably firm. Given the above it can be determined that the requirements of FAA 611(a) have been met.

B. Financial Plan

The financial plan for the rehabilitation of the Makuti-Chirundu Road will require a total estimated expenditure of U.S.$5,308,800 over a two year period. The sources of funds are a loan of U.S. $4,060,000 from AID and a local currency equivalent contribution of U.S.$1,248,800 from the Government of Zimbabwe (GOZ). In view of the economic conditions and recent upheavals in Zimbabwe, the AID loan will be made at concessionary rates: repayment of principal spread over forty years, with an initial grace period of ten years. Interest of two percent per annum will be paid during the grace period and three percent on the principal owed thereafter. The net present value of the interest and principal repayments is about 25% of NPV of the loan itself, using a conservative 10% discount rate. The loan will be made on a Fixed Amount Reimbursable contract agreement basis.

AID funds (U.S.$4,060,000) will be used to finance 77 percent of the estimated project costs. These monies will be utilized to pay for reconstruction of twelve kilometers of road and the resealing and reshouldering of twenty-eight kilometers of road. The GOZ will meet the consulting engineer costs, taxes and duties, the gravel and stone costs and/or any cost over-runs that may occur.

The disbursement of these AID funds will be made solely on the basis of productive output, as is standard in FAR agreements. The payments will be made upon receipt of certification of certain work units completed certified (by MOR and AID engineer). The disbursements, it is proposed, would be made on a monthly basis in payment for each of 100 meters completed. These payments would be made in U.S. dollars paid directly to the Treasury. Payments to the contractors would be the responsibility of the GOZ, although all work would be checked on a regular basis by a USAID Engineer (as stated in Section V A.7). The payment schedule by USAID is similar to that of the GOZ to the contractor and is expected to have the following

appearance. The figures are shown by the number of kilometers done and totals are at the given rate times the number of kilometers.

| Date | Km Road Complete @$282,800 | Km Shoulder Complete @$23,800 | 75% Total Earned | Acc. FAR |
|---|---|---|---|---|
| 10/82 | | | | *1,01 |
| 12 | | 2 | 35,700 | 1,05 |
| 1/83 | 1 | 4 | 71,400 | 1,12 |
| 2 | 2 | 4 | 71,400 | 1,193 |
| 3 | 2 | 2 | 247,800 | 1,441 |
| 4 | 1 | 2 | 459,900 | 1,901 |
| 5 | 1 | 2 | 459,900 | 2,361 |
| 6 | 1 | 2 | 247,800 | 2,60 |
| 7 | 1 | 2 | 247,800 | 2,8 |
| 8 | 1 | 2 | 247,800 | 3,10 |
| 9 | 2 | 2 | 459,900 | 3,56 |
| 10 | 2 | 2 | 459,900 | 4,02 |
| 11 | | 2 | 35,700 | 4,060 |
| | 12 | 28 | | |

* Represents 25% advance minus US$140,000 contingency. Assumes 25% Advance on FAR (Z$1,015,000). GOZ repays advance @ 25% each per periodic invoice.

## C. Economic Analysis

Utilizing conservative growth plans and quantifying vehicle use and maintenance savings only, the project shows a benefit-cost ratio of 1.1 and an internal rate of return of 12%. The B/C ratio is at a discount rate of 10% (See Appendix E). These figures do not reflect many major factors necessary to determine the importance of the road. The strate importance to Zambia's transportation system (as well as Zimbabwe's), access to new markets, time savings, increased and improved communicati and the tremendous cost of alternative routes are all factors of importance which cannot easily be quancified. Yet their importance must not be overlooked, as all are factors which increase the benefits of the road.

The Zim Zam Road or Salisbury-Lusaka Road has substantial value as the shortest link between the capitals and major industrial and agricultural areas, as a bi-modal (road-rail) link to the closest Zimbabwean

railhead (Zawi) and to Mozambique sea ports. It will lessen dependence on RSA routes and ease the traffic loads on other routes as well.

Access to new markets in an economically viable manner will be improved through this reconstruction effort. Over 250,000 tonnes of maize were shipped last year over this road to Lusaka from the maize growing areas north of Salisbury. It is expected that some 160,000 tonnes of maize will be shipped over this route in 1982. The only alternate route for these goods would be via Bulawayo - Victoria Falls - Lusaka. The distance is 1360 kilometers via Bulawayo as opposed to 490 kilometers via Chirundu (between Salisbury and Lusaka).

Road improvements, on both sides of the border at Chirundu, are estimated to provide a time savings of one-two hours per journey. The time and cost savings over the southern "Victoria Falls" route could perhaps roughly be estimated at some Z$5,000 and two days per trip by heavy lorry. The "Malawian" route, as another alternative, is over 2,000 kilometres in length. In terms of alternatives, it is clear, albeit difficult to quantity, that the Salisbury-Chirundu-Lusaka route is far superior in savings and time to the Victoria or Malawi route.

Overall, it is fairly clear that the road is economically, strategically and socially important to the development of the region. Phase I of the Zambian Kafue-Chirundu section of the road has been completed for some 33 kilometers (at a cost of nearly $1 million). Phase II of the Kafue-Chirundu Road is estimated to cost approximately $17.7 million dollars. This effort at road rehabilitation in Zambia cannot be separated from Zimbabwean efforts as the goals and purposes of both are one and the same.

## D. Social Soundness Analysis

### 1. Socio-Cultural Context and Beneficiaries Discussion

The project is located in Tribal Trust Lands and in a controlled hunting and wildlife area. Marangoro at kilometer 306.5 is the controlled area's entrance whereas the project starts at km 312 on the escarpment slope leading down to the plains.

The proposed project is unlikely to have any significant positive or negative impact on the local population, as the only populated area is within 3 kilometers of the border. No change in road alignment is proposed and the project will not

affect existing rights of way. The population adjacent to the border work in service orientated capacities in small rest camps or in the army. There is no commercial farming or industry.

During the road rehabilitation there will be some employment opportunities for laborers. The likelihood is that this labor will be recruited from population living near to the area.

The anticipated traffic using the road will consist largely of heavy and light commercial vehicles transiting the route between Zimbabwe and Zambia. This traffic will have little interaction with people in the area. However, the road will also be used by smaller vehicles (including pickups, passenger vans, buses and government vehicles). In addition the road will be used by tourists to the wild life areas, fishermen, boaters to the Zambezi river and dam areas. Heavy commercial vehicles will, transport maize among other products, from Sinoia and Karoi on the extended trunk road to Salisbury to markets in Kafue and Lusaka. Improving the road will help to facilitate that traffic.

There are no groups that appear likely to be adversely affected nor do there appear to be any practices or policies associated with the project that would disadvantage the target population or interfere with the equitable distribution of benefits.

2. Role of Women

As the foregoing indicates, women are not expected to benefit directly from the project in terms of either employment opportunities, skills enhancement or changes in their family role. Women will, however, benefit indirectly in several ways. To the extent that the work force temporarily employed by the project shares its income with female family members, women will also have increased disposable income. Given the income levels of the target population it is likely that most of those additional resources will be used to improve basic living conditions. Any improvement in access to services will be shared by men and women alike. Additionally, there is some possibility of ancillary employment associated with providing services to the work gangs, e.g., preparation of food. No firm data on this is currently available. In summary, no significant change in the role of women within the target population groups is contemplated.

3. Summary

The proposed project does not lend itself to accelerating either positive or negative social change; its impact on the local population is likely to be minimal, except for the temporary employment opportunities for a small segment of that population. No significant social issues have been identified during the preparatory phases of the project.

E. Institutional Assessment

1. Organizational Structure and Responsibilities

The Ministry of Roads and Road Traffic is responsible for construction and maintenance of the primary system of State Roads comprising international routes and roads linking existing cities and towns plus centers of growth and development. Municipal Authorities control all roads within designated Municipalities: Rural Councils are responsible for the secondary road system servicing commercial farming areas: District Administration is responsible for roads servicing peasant farming areas and minor population centers.

In 1981, State roads, which contain the Makuti-Chirundu (Zim Zam road) consisted of 4,500 kilometers earth, 7,750 kms gravel, 68 km strips, 1,402 kms single lane surfaced, 4,815 kms two lane and multi-lane surfaced and 2 kms dual carriageway totalling 18,636 kilometers of roads. This compares with Rural Council 21,991 kms., Municipal 5,287 kms., District Administration 39,907 kms. for a toal road network of 85,821 kilometers. See Annex D. Exhibit 3.

The Ministry of Roads and Road Traffic is organized around a central headquarters in Salisbury and seven provincial divisions each headed by a Provincial Road Engineer. The central organizations is divided into Coordination, Operations, Development, and Administration. Development is further divided into Planning and Materials; Operations is subdivided into Bridges and Construction; Coordination includes Maintenance. See Annex D. Exhibit 3.

Among the responsibilities of the Ministry is contracting, force account construction and maintenance. Previously the majority of new road construction and rehabilitation of existing roads was done by force account with a minor portion being done on a contract basis and monitored by Ministry of Roads Engineers. With shortages of spare and replacement parts

of equipment, diminishing trained staff, the backlog of projects caused by the war and the additional 6000 km given to the Ministry for maintenance in the last 18 months, a larger percentage of projects is being done on a contractual basis. Presently roads supervision is sometimes let out to consultants. All periodic and routine maintenance work is done by in-house forces except for major earthwork. Provincial Road Engineers are delegated responsibility for both road maintenance and minor design and construction work in their respective regions. The organization chart of the Ministry is shown in Annex D. Exhibit 3.

With regard to the proposed AID project, the Construction Department is already undertaking the design work while the Central Laboratories has completed the sampling and soils testing. The Construction Department has recently awarded a separate contract for crushing gravel and stone for the project road. This will allow gravel and chips to be stockpiled for use by the project contractor in late 1982. The project contract will be sent out for private contractor bids, and supervision will be by private consultant. The Construction Branch has staff available to complete all Project Plans, Specifications and Bid Documents and the Central Laboratory will be able to conduct necessary soils, materials testing and analysis. The PP engineer confirms the capability of these staffs to carry out the assignment in a manner acceptable to AID and without conflicting with the current or projected workload.

2. Staffing

A constraint presently being faced by the Ministry is the departure of some qualified staff both in the field and headquarters, while the workload has increased. The vacancy rate is reportedly a total of 24 engineers out of 69 and mainly affects headquarters rather than the field. Training of new staff is partly offsetting the vacancy rate.

3. Maintenance

The Ministry's Maintenance Branch in the Coordination Department is sound, together with Operations and Development. The quantity and quality of road maintenance is satisfactory but there is difficulty in making headway against the backlog of work caused by the war and transfer of roads to the MOR. Regular programs have been set up for routine and periodic maintenance to prevent road network deterioration.

Maintenance will continue to be a problem area for some time. The shortages of operating funds, trained personnel, spare parts and some capital equipment cannot be overcome quickly. In addition maintenance is not an item that can be readily put out to contract. This project addresses rehabilitation and periodic maintenance of the road and it is anticipated that resources will be applied by the Ministry to give it routine maintenance and future periodic maintenance as required.

F. Environmental Considerations

A negative determination was approved in the Initial Environmental Examination on June 1, 1981 for Phase I of the Zim Zam Project. This approval includes the 40 kms. of the same road (Makuti-Chirundu) in Zimbabwe. The border between Zambia and Zimbabwe is at Chirundu. As the only change in road construction beyond the reconstruction of 12 kilometers is the periodic maintenance of shoulder repair and resealing of the existing road area only. No further environmental analyses are deemed necessary. See Appendix F, Exhibit 2.

V. IMPLEMENTATION PLAN

A. Implementation Responsibilities

1. Ministry of Roads and Road Traffic. Operations Department.

Construction Branch. The Construction Branch of the Ministry's Operation Department will have the prime responsibility for construction work to be done under this project. Certain tasks will be accomplished with in-house personnel; preparation of design plans, specifications and bid documents, analysis of bids and award and soil and material testing. The Construction Department will also have to contract with an engineering consultant to supervise the construction. Although there has been no formal designation, the project co-ordinator will be supervised by the Director of Construction.

The Central Laboratory has already done tests of soils which, when combined with Benkelmann Beam tests taken in 1980, show the road sections which need to be reconstructed. These results and a recommendation were sent to the Secretary of Roads in September, 1981 together with alternative methods of reconstruction. Testing of materials sources for fill and gravel were made in January 1982.

The Construction Section awarded a contract in February 1982 for crushing road gravel base and stone chips for the project road. The Construction Branch has already drawn up design plans and contractual bid documents and anticipates having them complete by April, 1982. No difficulty is anticipated in completion of this work. Reviews by the PP engineer of partly completed plans and documents shows them to have standards satisfactory to AID. AID will review completed plans and documents in April 1982. A Fixed Amount Reimbursement (FAR) contract mode will be used by AID in providing support for the project. This will eliminate any major change in method of Ministry contract preparation. Bids will be processed, analyzed and awarded by the Central Tender Board under their normal review and award procedures. The Construction Section will monitor construction progress and process construction contractor payments. These payments should take into account FAR method of payments (which will be based on completed kilometers of repairs or portion thereof) for the reconstructed and resealed road.

Supervision of construction will be contracted to an engineering consultant, who will provide his own transportation, equipment and housing. Sampling and laboratory testing support will come from the Provincial Roads Department and Central Laboratories. A sample of the scope of work and request for proposals for the engineering consultancy as developed by the Construction Branch has been given to AID.

2. A.I.D. AID has assessed the capability of the Ministry to prepare design plans, contract documents and to monitor supervision work. This has been found to be satisfactory.

Discussions have been made with the Roads Ministry and the Treasury on the implications and requirements of the Fixed Amount Reimbursement method. The AID/Zambia engineer will certify the contractor's voucher (in terms of units completed) as being satisfactorily completed for construction items at fixed rates. The AID/Zambia engineer will also periodically monitor the quality and quantity of work performed. Payment will be made by the Controller AID/Zimbabwe to the GOZ Treasury.

Given the seasonal nature of construction work in Zimbabwe and the desire to have the contracting process completed and work initiated as early as possible in the 1982 dry season (up to December) special attention and efforts must be applied by all action parties if this project is to be carried out as planned (see attached timetable). These dates have been reviewed with

the Ministry and are considered to be feasible. The schedule is highly dependent on contractor mobilization of the stone crushing contract.

3. Ministry of Finance

The Ministry of Finance will be responsible for forwarding certified progress reports, stated in reconstruction and resealing units, from the MOR to AID/Zimbabwe. The Ministry will also receive all payments from USAID. The mechanisms and process to be followed will have to be determined by the MOF and AID/Zimbabwe at a time in the near future.

B. Implementation Plan

The timetable on implementation actions is based on a rainy season between December 1982 and March 1983 in which only limited construction can be done.

TIMETABLE OF IMPLEMENTATION

General

| Date | Action | Action Party |
|---|---|---|
| 3/82 | PP completed | USAID/REDSO |
| 4/82 | PP reviewed/authorized | USAID, REDSO |
| 6/82 | ProAg signed | RLA, USAID, GOZ |
| 7/82 | Conditions Precedent Satisfied | USAID, RLA, GOZ |
| 10/82 | Monitoring of road rehabilitation initiated | AID/Engineer, GOZ |
| 12/83 | Final Review and Evaluation | USAID, GOZ |

Engineering

| | | |
|---|---|---|
| 3/82 | Stone and gravel contract awarded | GOZ |
| 6/82 | Contract open for tender | GOZ |
| 7/82 | Consultant for construction supervision selected | GOZ |
| 9/82 | Contract awarded | GOZ |
| 10/82 | Initial personnel in place | Contractor |
| 11/82 | Road rehabilitation initiated | Contractor |
| 12/83 | Rehabilitation completed and verified | Contractor |

Construction

| | | |
|---|---|---|
| 6/82 | IFB for construction advertised | GOZ |
| 9/82 | Contracts awarded | GOZ |
| 11/82 | Building sites established and work initiated | Contractor |
| 3/82 | Roughly one-quarter of the road rehabilitation work is complete | Contractor |
| 11/83 | All road rehabilitation work is completed | Contractor |

C. Evaluation and Monitoring

The Ministry will submit to AID monthly reports focussing on physical progress and any constraints inhibiting progress and/or attainment of objectives. AID/Zambia engineering will also provide on-going monitoring of the work on a periodic basis. A complete evaluation will also be scheduled at the end of construction, done by the AID Engineer and the MOR. The monitoring done by the AID engineer should consist of site visits made bi-monthly (or even more frequently if required). It will be necessary for the Engineer to maintain a detailed log of all work performed on the road, in segments of 100 meters (.1 km) over the entire 40 kilometers of road. This log will state the exact status in terms of earthworks, base, surface, shoulders, etc.

D. Negotiation Status, Waivers and Special Conditions

Discussions with the Ministry of Roads, Ministry of Economic Planning and Development and The Ministry of Finance (Treasury) have been open and fruitful. Although the FAR contract concept is 'new' to the GOZ, no major problems are seen at this time in designing a mutually acceptable project agreement. The Ministries are interested in rapid progress, as construction costs will rise with any furter delays. The FAR constracting concept is seen as the best, most direct approach to facilitating the road rehabilitation. There was some query as to why the assistance was in the form of a loan, rather than a grant. The Zambian Phase I and Phase II assistance is provided through a grant and a concessionary loan respectively. The project is a productive enterprise and will earn revenue to help meet payments (tariffs, road licenses, taxes, etc.). These are the basic reasons why a loan is offered rather than a grant.

No waiver requests are necessary, as the FAR contract provides for disbursements on the basis of outputs and completion only. Also USAID is not actively involved in the contractual process with potential builders or engineering firms and therefore it is not pertinent as to the source of materials, vehicles, etc., a matter between the GOZ and contractor.

It is proposed that one major condition be included in the project agreement, besides normal CP's. That is:

The contract between GOZ and the builder to strictly conform to the GOZ manual's terms and specifications as expressed in General Conditions of Contract and Standard Specifications, Ministry of Roads and Road Traffic, Zimbabwe, January, 1980.

It is foreseen that formal agreement with the Government of Zimbabwe can be done within a short period of time, providing that USAID acts promptly on the PP and in drafting a project agreement. Project implementation can take place by mid-1982, a highly desirable progression in order to maximize benefits and minimize construction costs.

# APPENDICES

A. GOZ Request for Assistance

B. PID Approval

C. Logical Framework

D. Engineering Reports
   Exhibit 1 - GOZ Reports on Makuti-Chirundu Road
   Exhibit 2 - Design and Specifications
   Exhibit 3 - MOR Responsibilities and Organization Charts
   Exhibit 4 - Map (Sinoia-Chirundu)

E. Economic/Financial Analyses
   Exhibit 1 - Vehicular Savings and Costs
   Exhibit 2 - Maintenance Savings and Costs
   Exhibit 3 - Construction Costs
   Exhibit 4 - IRR and B/C ratio

F. Legal Documents
   Exhibit 1 - Project Checklist
   Exhibit 2 - Initial Environmental Examination
   Exhibit 3 - 611(e) Certification

Telegrams: "ECONPLAN"
Telex: 2731
Telephone: 794571
Private Bag 7722, Causeway.

Ref: B/02/16/2 44

ZIMBABWE

MINISTRY OF ECONOMIC PLANNING
AND DEVELOPMENT,
Milton Building,
Samora Machel Avenue,
Salisbury.

APPENDIX A

25th September, 1981

Mr. Roy Stacey,
USAID
P.O. Box HG 81,
Highlands,
SALISBURY

Dear Roy

USAID : SALISBURY-CHIRUNDU ROAD 31?-32?

Please find attached a letter from our Ministry of Roads which discusses the findings of the study of the above section of the Salisbury-Chirundu road. We understand that 12 kilometres of the road contain a weak fill which will have to be removed and replaced. Although the remaining 28 kilometres show no sign of visible stress some safe guard measures need to be [illegible] and these are outlined in the letter.

The cost of the [illegible] is estimated at US$[illegible] million. This letter is to [illegible] funding this project preliminary [illegible] the funding. We understand as per our discussion [illegible] the Zambian side of the [illegible] make the Zimbabwean portion an ideal [illegible]. This regional consideration, we hope, will not [illegible] the execution of the project.

Yours sincerely,

SEP 29 1981

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Telephone 70091

In reply please quote

Ref: V/INTERNATIONAL

MINISTRY OF ROADS AND ROAD TRAFFIC,
POSTS AND TELECOMMUNICATIONS,
COGHLAN BUILDING,
FOURTH STREET,
SALISBURY.

16th September, 1981

The Secretary for Economic Planning
and Development

U.S.A.I.D. : [illegible] 212-352

Large scale failures became evident between the 312 and 352 km pegs on the Salisbury-Chirundu road soon after the reopening of the border with Zambia, and the resumption of traffic on this section of road. Zambian maize haul traffic has seriously aggravated the situation.

An exhaustive investigation has been undertaken into the cause of failure, and this has been identified as a loss of shear strength in the fill material. Testing of the fill was undertaken to determine deflection (using Benkelman beam), coarseness index, plasticity index, fineas index, and the exchangeable sodium percentage, a chemical test to determine the sodicity of the fill.

A fairly good correlation was obtained between visible failure, deflection and sodicity. The extent of the sections containing weak fill has been determined to be in the order of 12 km. The sections of fill will have to be removed and replaced with a stable fill. The repaired sections will be reconstructed to a 1,0 E pavement standard. The 40 kilometres of road under consideration has an expired design life in terms of age and except for the 12 km which require reconstruction, the remaining 28 km show no signs of visible distress and the Benkelman beam deflections confirm the adequacy of the road on these sections, but, as a safeguard against possible deterioration, it is recommended that :-

(a) the vegetation be removed from the gravel shoulders and the shoulders be levelled and compacted to 98% Mod. AASHTO.

(b) the road be resealed with a bitumen spray and chip reseal across the full 10 metre width.

The estimated cost of the work is as follows :-

| | | |
|---|---|---|
| Reconstruction 12 km @ $155 000/km | = | $1860 000 |
| Shoulder resealing 28 km @ $20 000/km | = | $ 560 000 |
| | | 2420 000 |
| + 10% contingencies | | 242 000 |
| | | $2662 000 |

2/ .....

At today's rate of exchange this equates to US $5.6 m.

Discussion on the problem section of road have been held with members of the United States Agency for International Development, and the recommendations made by this Ministry concerning the remedial action which should be taken, have been agreed.

USAID is desirous of funding the project and has suggested that this Ministry approach you with a view to your requesting them to provide the necessary funds.

Will you please do so.

L.R. CLARK
for: SECRETARY FOR ROADS AND ROAD TRAFFIC,
POSTS AND TELECOMMUNICATIONS

/KA

APPENDIX 1

OFFICIAL FILE

ACTION

MAY 15 1981

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NCLAS SECTION 01 OF 03 STATE 114885

IDAC, NAIROBI FOR REDSO

.O. 12065: N/A

AGS:

UBJECT: ZIM-ZAM ROAD PID

EF: A) STATE 096865 B) LUSAKA 1720 C) SALISBURY 1525

. SUMMARY. SUBJECT PID WAS REVIEWED BY ECPR ON APRIL 23, 981 AND IS APPROVED FOR PP DESIGN. IF PROJECT IS APPROVED, IMBABWE PORTION WOULD BE FUNDED FROM MAKUTI/CHIRUNDU ROAD ROJECT 613-0207; ZAMBIA PORTION WOULD BE FUNDED FROM EGIONAL TRANSPORT AND STORAGE DEVELOPMENT PROJECT 90-0209. DECISIONS TAKEN DURING THE REVIEW ARE SUMMARIZED ELOW FOR CONSIDERATION IN PP DESIGN AND SEPARATE ACTIONS S SPECIFIED. END SUMMARY.

. ON APRIL 23 ACTING AA/AFR CHAIRED ECPR TO REVIEW UBJECT PID. REDSO IS CONGRATULATED ON RAPIDAND THOROUGH ID. PRINCIPAL ISSUES DECIDED ARE AS FOLLOWS.

. SHOULD THE PROJECT BE EXPANDED TO INCLUDE ANOTHER 28 MS OF ROAD IN ZIMBABWE? ECPR RECOGNIZED THAT PID ADDRESSED NLY THOSE ROAD PORTIONS THREATENED BY COLLAPSE OF SODIC OILS AT TIME OF THEIR VISIT. IT WAS AGREED THAT ROAD PORIONS (BEYOND THE TWELVE KMS COVERED IN THE PID) WHICH HAVE EEN DEFINITELY IDENTIFIED BY SODIC SOIL FAILURES ALSO HOULD BE SUBSUMED INTO PROJECT. IN ADDITION, GOZ MAY HAVE ALID ARGUMENTS FOR EXTENDING U.S. ASSISTANCE TO RETIREENT WORK (BRITISH TECHNICAL TERM FOR REHABILITATION OF ROAD WITH EXPIRED DESIGN LIFE) ON ALL FORTY KMS. HESE SHOULD BE CONSIDERED BY MISSION AND GOZ AGAINST HE OVERALL DEVELOPMENT NEEDS OF ZIMBABWE. SINCE U.S. UNDS FOR ZIMBABWE PORTION OF PROJECT ARE TO COME FROM Y 81-82 BILATERAL LEVELS, THE ECPR FELT THAT THE RIORITY OF ANY WORK BEYOND THE PID-IDENTIFIED 12 KMS HOULD BE ASCERTAINED FROM THE GOZ AND REFLECTED IN THE PROJECT DESIGN AFTER CONSULTATION WITH AID/W (SEE BELOW).

CTION: REDSO/REILLY IS REQUESTED TO VISIT ZAMBIA ON/OR ABOUT MAY 18 TO MAY 22 AND THEN PROCEED TO ZIMBABWE ASAP [illegible] THE FOLLOWING:

A) CONFIRM TOTAL NUMBER OF KMS IDENTIFIED TO DATE AS PROBABLY AFFECTED BY SODIC SOIL FILLS (SEE REFTE PARA 2);

B) EXAMINE ARGUMENTS FOR ASSISTANCE TO REHABILITATE THE REMAINING KMS SCHEDULED FOR RETIREMENT:

1) ON THE BASIS OF ECONOMIES OF SCALE

2) ON THE BASIS OF THE EFFECTS OF PROJECTED TRAFFIC

3) ON THE BASIS OF CURRENT OR PROJECTED DETERIORATION OF THE ROAD SURFACE.

ACTION: USAID/SALISBURY AND REDSO/EA ARE REQUESTED TO APPROACH THE MINISTRIES OF ECONOMIC PLANNING AND FINANCE TO ASCERTAIN GOZ PRIORITY (BEFORE PP TEAM ARRIVES) OF FUNDING 12 VS 40 KMS UNDER PROPOSED PROJECT. ALSO, IF AID PARTICIPATES IN THE COST OF REHABILITATING ALL 40 KMS, WOULD ENTIRE AMOUNT OF GOZ FUNDS CURRENTLY PROGRAMMED/BUDGETED FOR THIS ROAD BE REQUIRED?

4. SHOULD AID PROVIDE THE ONLY DONOR FINANCING FOR THIS PROJECT? THE ECPR NOTED THE SIZEABLE COST OF THE ZAMBIAN PORTION OF THE ROAD (DOLS 18-25 MILLION) IN RELATION TO LIMITED (UP TO DOLS 12.5 MILLION) REGIONAL TRANSPORT FUNDS AVAILABLE DURING FY 81. WE WOULD PREFER NOT TO MORTGAGE FY 82-83 FUNDS BECAUSE IT WOULD RESTRICT OUR ABILITY TO SUPPORT OTHER SOUTHERN AFRICA REGIONAL TRANSPORT NEEDS. OUR PREFERENCE (SEE BELOW) IS TO A) SEEK GRZ FUNDS FOR THE SHORTFALL AND B) ACTIVELY SOLICIT CO-FINANCING WITH OTHER DONORS (ASSUMING GRZ COULD NOT MEET FULL SHORTFALL). AID/W IS WELL AWARE OF THE PROBLEMS OF TIMING AND FUNDING MODALITIES THAT THIS APPROACH IMPLIES, BUT LIMITED U.S. FUNDS SUGGEST SOME MIX OF FUNDS. ACTION: REQUEST USAID/LUSAKA AND SALISBURY COMMENT REGARDING RECOMMENDED APPROACH FOR SOLICITING CONTRIBUTION BY OTHER DONORS, INCLUDING THE APPROPRIATE ROLES OF GRZ/GOZ AND POSSIBLE ROLE FOR SATCC. WE WOULD LIKE TO DISCUSS POSSIBLE COLLABORATION WITH CADA MEMBERS AND OTHER POSSIBLE DONORS (EEC, IBRD, BADEA, JAPAN) AS SOON AS AN AGREED APPROACH IS FORMULATED. IN ANY CASE, WE WOULD RECOMMEND AUTHORIZATION REPEAT AUTHORIZATION OF FULL ZAMBIA REQUIREMENT, IF OTHER DONOR FUNDING NOT YET ARRANGED WHEN PP PRESENTED.

5. WHAT FISCAL CONTRIBUTION CAN THE GRZ BE EXPECTED TO MAKE? GOZ WILL EFFECT SIGNIFICANT CONTRIBUTION THROUGH FIELD WORK, DESIGN, AND SUPERVISION. WHILE THE ECPR RECOGNIZED THAT THERE IS NO LEGAL REQUIREMENT PERTAINING TO THIS REGIONAL ESF PROJECT IT NOTED THAT A SIGNIFICANT GRZ FINANCIAL INVOLVEMENT IS CRITICAL TO THE INTEGRITY OF THE PROJECT. GIVEN THE PRESENT SHORTAGE OF FOREIGN

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TO RUTAOH/AMEMBASSY LUSAKA IMMEDIATE 5184
RUEHSB/AMEMBASSY SALISBURY IMMEDIATE 3205
RUEHNR/AMEMBASSY NAIROBI IMMEDIATE 1306
BT
UNCLAS SECTION 02 OF 03 STATE 114885

AIDAC, NAIROBI FOR REDSO

EXCHANGE IN ZAMBIA, HOWEVER, ECPR FELT GRZ WOULD ENCOUNTER DIFFICULTIES NOT ONLY IN FUNDING BUT ALSO IN RAPIDLY IMPLEMENTING THE RESEALING OF THE ROAD AS RECOMMENDED IN THE PID. GIVEN THE SIGNIFICANT SAVING INVOLVED IN THE RESEALING EFFORT AID/W IS PREPARED TO MOVE IMMEDIATELY WITH A LIMITED PP FOR THE RESEALING INSTEAD OF CALLING ON GRZ FOR THIS CONTRIBUTION. SUCH ACTION IS DEEMED APPROPRIATE BOTH BECAUSE OF THE URGENCY INVOLVED IN STABILIZING THE ROAD AND REDUCTION OF ULTIMATE PROJECT COST. WE HOPE THIS ACTION BY AID WILL PROVIDE OCCASION FOR NEGOTIATING A SIGNIFICANT GRZ FINANCIAL CONTRIBUTION TO THE PROJECT.

ACTION: THE ECPR REQUESTS MISSION PURSUE A PROJECT CONTRIBUTION BY THE GRZ ALONG THE FOLLOWING LINES:

A) PLEASE STRESS THE IMPORTANCE OF A SIGNIFICANT CONTRIBUTION BY THE GRZ.

B) PLEASE NOTE THAT GRZ COVERAGE OF RESEALING COSTS AS PROPOSED IN THE PID WAS INTENDED TO SERVE AS A DEMONSTRATION OF GRZ COMMITMENT.

C) RECOGNIZING THE NEED FOR TIMELY ACTION AND RECOGNIZING EXISTING GRZ BUDGETARY CONSTRAINTS, AID IS PREPARED TO PURSUE WITH GRZ DEVELOPMENT OF LIMITED, INTERIM PROJECT TO COVER RESEALING REQUIREMENT.

D) HAVING TAKEN THIS ACTION AID WILL EXPECT THE GRZ, WITHIN THE NEXT TWO YEARS (BEGINNING NOVEMBER 1982 WITH CONSTRUCTION CONTRACT) TO MAKE A SIZEABLE CONTRIBUTION (DOLS 4-5 MILLION) TO THE MAIN REHABILITATION PROJECT. THIS WILL ALLOW THE GRZ TO PLAN AND BUDGET ITS CONTRIBUTION AND TAKE INTO ACCOUNT THE IMPACT OF THE IMF AGREEMENT AND THE IBRD LOAN FOR ROAD MAINTENANCE.

5. CAN THE TIMEFRAME FOR ACCELERATED PROJECT IMPLEMENTATION BE SUPPORTED AS CALLED FOR IN THE PID?

A) PROJECT SAVINGS (DOLS 7.4 MIL) FROM IMMEDIATE RESEALING AND ACCELERATED IMPLEMENTATION WERE NOTED BY ECPR. THESE SHOULD BE REVERIFIED BY PP TEAM. IN THE MEANTIME, AS NOTED ABOVE, ECPR AUTHORIZES IMMEDIATE AID/W DEVELOPMENT OF A SEPARATE PP FOR THE RESEALING.

SEPARATE RESEALING PROJECT.

1) RECONFIRM ECONO F PROCEEDING NOW WITH R ALING.

2) VERIFY GRZ CAPACITY TO MANAGE THE TENDERING/SELECTION PROCESS, INCLUDING WRITING THE IFB.

3) DETERMINE/VERIFY TECHNICAL SPECIFICATIONS, INCLUDING IDENTIFICATION OF SPECIFIC ROAD SECTIONS WHICH WILL BE RESEALED, SCHEDULE FOR TENDERING PROCESS, CONTRACTOR MOBILIZATION AND RESEALING TIME, ETC.

4) VERIFY GRZ CAPACITY TO SUPERVISE RESEALING. RECOMMEND ALTERNATIVE ARRANGEMENTS IF JUDGED NECESSARY.

5) MAKE FAA 611(A) DETERMINATION RE COMPLETENESS OF ENGINEERING DATA AND ACCURACY OF RESEALING COST ESTIMATES.

6) MAKE NATIONALITY DETERMINATION AS TO FIRMS MOS; LIKELY TO BID AND DEVELOP/DRAFT WAIVER FOR APPROPRIATE GEOGRAPHIC CODE, AS NECESSARY.

B) SEPTEL FOLLOWS WITH FURTHER DETAILS REGARDING ACTIONS TO BE TAKEN PREPARATORY TO RESEALING.

C) ECPR SUPPORTED ACCELERATED IMPLEMENTATION WHENEVER POSSIBLE BUT THIS CANNOT BE AT THE EXPENSE OF SOUND PROJECT IMPLEMENTATION. PP SHOULD CONTAIN ALTERNATIVE PROPOSALS. PROJECT DESIGN IS SCHEDULED TO BE COMPLETED FOR AUTHORIZATION BY END AUGUST 1981.

7. WHAT SPECIAL REQUIREMENTS WILL BE NECESSARY FOR PROJECT MANAGEMENT? ECPR IS IN FULL ACCORD WITH NEED FOR ARRANGING PROJECT MANAGEMEN- AS EARLY IN PRE-IMPLEMENTATION PROCESS AS POSSIBLE. AID/W REQUESTS THAT UNTIL A PROJECT MANAGER HAS BEEN IDENTIFIED, REDSO FULFILL PROJECT MANAGEMENT RESPONSIBILITIES IN CONJUNCTION WITH AID REP LUSAKA. AID/W HAS INITIATED A SEARCH FOR A DIRECT HIRE PROJECT MANAGER. REQUEST LUSAKA AND REDSO DEVELOP PD AND CABLE SAME TO AID/W ASAP. WE ARE ALSO CONSIDERING TCN, IQC OR PSC COVERAGE AS AN INTERIM MEASURE.

8. WHAT IS THE CAPACITY OF THE GRZ TO MAINTAIN THE ROAD AFTER IT HAS BEEN REHABILITATED? AID/W HAS CONFERRED WITH THE IBRD CONCERNING DELAYED IMPLEMENTATION OF THE LOAN FOR ROAD MAINTENANCE (THIRD HIGHWAY PROJECT). IBRD BELIEVES LONG TIME QUOTE LOG-JAM END QUOTE HAS BEEN BROKEN. IBRD IS OPTIMISTIC THAT FULL STAFF WILL BE ON

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RUEHSB/AMEMBASSY SALISBURY IMMEDIATE 3206
RUEHNR/AMEMBASSY NAIROBI IMMEDIATE 1307
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UNCLAS SECTION 03 OF 03 STATE 114885

AIDAC, NAIROBI FOR REDSO

BOARD BY SEPT-DEC 1981, AND PROJECT WILL PROCEED ON SCHEDULE. AID/W FEELS PROGRESS SHOULD BE VERIFIED BY PP TEAM AND CONTINUOUSLY MONITORED BY.FIELD. (MEMO OF IBRD FINDINGS BEING POUCHED).

9. WE BELIEVE ONLY OTHER ISSUE IN PID REQUIRING AID/W GUIDANCE CONCERNED LOAN VS. GRANT FUNDING. AID/W CONCURS WITH POSITION STATED IN PID THAT PROJECT FUNDING SHOULD BE MADE AVAILABLE ON A LOAN BASIS ON AID'S MOST CONCESSIONAL TERMS.D

10. ISSUES DEFERREDFOR RESOLUTION IN THE FIELD INCLUDE THE ECONOMIC ANALYSIS AND IMPLEMENTATION CAPACITY OF THE GRZ. AID/W FOLLOW-UP ACTIONS INCLUDE: CONTRACTED SERVICES OF A TRANSPORT ECONOMIST (MOELLER) ARE BEING ARRANGED FOR JUNE TDY FOR ECONOMIC ANALYSIS IN ZAMBIA AND REVIEW SAME IN ZIMBABWE; CONTRACTED ENGINEERING ASSISTANCE IN CONJUNCTION WITH REDSO FOR GRZ APPRAISAL OF CAPACITY OF ROADS DEPARTMENT TO PARTICIPATE IN PROJECT DESIGN, TENDERING, IMPLEMENTATION AND SUPERVISION.

11. AID/W IS CONCERNED ABOUT ACTIONS TO BE TAKEN BY THE GOZ/GRZ IN ADVANCE OF THE ARRIVAL OF THE PP TEAM IN JULY. INCLUDED IN THIS ARE THE ECONOMIC FEASIBILITY STUDY OF THE MAKUTI/CHIRUNDU SECTION TO BE UNDERTAKEN BY THE GOZ AND A TRAFFIC COUNT AND COLLECTION OF DATA ON THE CHIRUNDU/KAFUE SECTION BY THE GRZ IN ADVANCE OF THE ARRIVAL OF TRANSPORT ECONOMIST MOELLER IN EARLY JUNE TO DO AN ECONOMIC APPRAISAL FOR THE ZAMBIAN SECTION OF THE ROAD. THE MINISTRIES ARE REQUESTED TO VERIFY THE STATUS OF SUCH ACTIONS AND PROVIDE ANY RELEVANT COMMENTS. SPECIFIC DETAILS TO FOLLOW IN SEPTEL. SEPTEL ON PP

DESIGN GUIDANCE INCLUDING SCHEDULE TO FOLLOW. CLARK
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## LOGICAL FRAMEWORK - MAKUTI-CHIRUNDU ROAD

| Objective Summary | Verifiable Indicators | Means of Verification | Assumptions |
|---|---|---|---|
| U.S. Objective is to support pragmatic solutions to regional problems in Southern African states. | 1. Key regional economic problems being addressed on a cooperative basis. | 1. SADCC and technical working minutes. | 1. Southern Afric countries (nine) continue to work together on region economic problems seek U.S. assista |
| | 2. Number of regional projects equals or exceeds number in 1980. | Field Reports (State and AID). | 2. Regional progr continue to recei U.S. Administratio and Congressional support. |
| | | 3. AID Budget and CP documents. | |
| | | 4. Specific local government documents, budgets. | |

| Project Goal | Measures of Goal Achievement | Verification | Assumptions |
|---|---|---|---|
| Enhance the economic development and improve the welfare of the general population in Zimbabwe and Zambia. | 1. Economic development is enhanced by the improvement of the Zim-Zam Road's transport capacity. | 1. Annual GOZ statistical reports; types and amounts of cargo transported over the Zim-Zam Road. | 1. General economic and political clim does not deteriora |
| | 2. Increase of road usage and less pressure on other and more costly alternative routes. | 2. GOZ published reports on food/commodity prices and freight rates. | 2. Goods transport over this road wil be for developmenta and basic human requirements, not for luxury goods. |
| | | 3. Traffic counts on road usage (Ministry of Roads). | |

| Project Purpose | End of Project Status | MEANS OF VERIFICATION | IMPORTANT ASSUMPTIONS |
|---|---|---|---|
| To facilitate the exchange of goods and services between Zimbabwe and Zambia and with other countries in the region by improving the Makuti-Chirundu link in the Zim-Zam Road. | 1. Year round, reliable access for trucks with cargoes of food and industrial, commercial, and consumer goods on this road | 1. Customs documentation at both frontiers. | 1. Terms of trad between Zimbabw Zambia continue favor the exchan of goods. |
| | 2. Exports and imports to and from Zimbabwe and Zambia are not hindered by the condition of the road. | 2. Agricultural Marketing Authority reports, MOR reports, and AID project visits. | 2. All sections o Zim-Zam Road are properly maintain |
| | | | 3. Road transport over this route continues to be competitive and efficient. |

| Project Outputs: | Magnitude of Outputs: | Verification: | Assumptions for achieving Outputs: |
|---|---|---|---|
| Rehabilitation of 40 kms. of road between Makuti and Chirundu in Zimbabwe. | 1. 12 kms. of road undergo complete reconstruction. | 1. Reports from MOR and contractors. | 1. Qualified engineer and contractors are engage |
| | 2. 28 kms. of road undergo shoulder improvement and road resealing. | 2. Periodic reports from AID engineer through site inspections. | 2. MOR provides adequate financial support for both rehabilitation and maintenance. |
| | | 3. Laboratory tests. | 3. Construction w completed on schedule. |
| | | 4. Payment vouchers and certificates. | 4. Gravel crushin output sufficient for contractor's needs. |

| Project Inputs | Implementation Targets: | Verification: | Assumptions for providing inputs: |
|---|---|---|---|
| 1. AID provides $4.2 million for construction under FAR. | 1. Contract let in June, 1982 with construction starting in September, 1982. | 1. MOR monthly reports and certificates. | 1 Funding is made available by USAID and GOZ in a timely fashion. |
| 2. GOZ provides $1.25 million in local currency for gravel, stone and construction supervision, as well as contract payments. | 2. Consulting engineer contract let in August, 1982. All works completed by September, 1983. | 2 Contract documents. | 2. Selection of contractor and consulting engineer done on a timely basis. |
| | | 3. Site Monitoring. | 3. Contractor(s) is able to comply with terms of contract(s) and does so within the time-frame allowed. |
| | | | 4. There are no unusual weather or political events that adversely influence construction. |
| | | | 5. Cost over-runs are met by the GOZ. |

## ENGINEERING ANALYSIS

### REPAIR PROCEDURES

These procedures have been developed by the Construction Department of the Ministry of Roads and Road Traffic, Posts and Telecommunications. They have been reviewed by the PP Team engineer for adequacy and found to be acceptable.

Reconstruction (12 km)

Remove existing Base 1 material and stockpile for reuse if possible.

Remove existing embankment material and cut to waste.

Import new embankment material of SG9 quality or better.

Construct Base 12 layer (100 mm) in imported gravel of Triaxial Class 3.0.

Construct Base 1 layer (100 mm) in imported crushed natural growth.

Construct surfacing comprising tar prime, bituminous tack coat (19 mm stem), bituminous seal coat (7 mm stone).

B. Shoulder Work

Cut away existing material on shoulders only and import crushed gravel to give 120 mm layer and compact, 1.5 meters from road edge.

Prime shoulders and seal entire road using 7 mm. stone.

## PROJECT SITE; PHYSICAL CHARACTERISTICS

General: The project road is part of the Salisbury-Sinois-Karoi-Makuti-Chirundu-Kafue-Lusaka trunk road. The project road begins 6 kilometers north of Marangora on the Makuti-Chirundu section. It is within tribal lands except near the border and is within the Urungwe and Nyaksanga controlled hunting areas. The exception is 5 km on the north

side of the road; 10 kms on the south. Annual Rainfall is 600 to 800 mm with temperature range 6 to 30° C.

Geology and Topography: The project road begins on the downward slopes of the Zambezi Escarpment leading to the Flats. Although the high point of the escarpment is some 1250 meters, the road begins at elevation 600 meters with the flats varying from 500 m to 400 m at Chirundu border. Geology is Older Gneiss on the escarpments and sediments in the Flats. All of the reconstruction work is in the Flats.

Soils and Vegetation: The project road begins in sandy soils usually with heavier textured leached subsoils (mainly granitic) and leads into soils of lower major river valleys. These soils are brown medium textured alkaline maponi soils and to a lesser extent leached sandy soils.

Vegetation is scrub and trees with extremely limited agricultural areas. Mopane woodlands, characteristic of sodium influenced soils are dominated by the trees Colophospermum morane. Sodic soils have expansive properties dictated by variation in moisture quantity.

APPENDIX D, EXHIBIT 1

Ref: 901/2/JBS

HEAD OFFICE

22nd September, 1981

Management Engineer Co-ordination,
Management Engineer Operations,
Management Engineer Development,
Chief Engineer Construction,
Chief Engineer Materials and Training,
C.M.P.O.,
Provincial Road Engineer, Mashonaland West

SALISBURY-CHIRUNDU ROAD : KM 312 - 352

It is advised that the Secretary has agreed to the following recommendations for the reconstruction of the above-mentioned section of road.

1. The sections of weak fill tabulated below will be removed and replaced with a stable fill and subgrade in accordance with the laboratory report MSW/901/HKG/563 dated 19th August, 1981.

| | | | |
|---|---|---|---|
| 320 + 700 | to | 321 + 800 | 1.100 |
| 323 + 400 | to | 324 + 100 | 0.700 |
| 326 + 000 | to | 326 + 300 | 0.300 |
| 327 + 100 | to | 331 + 400 | 4.300 |
| 332 + 400 | to | 334 + 100 | 1.700 |
| 338 + 300 | to | 339 + 500 | 1.200 |
| 340 + 000 | to | 341 + 200 | 1.200 |
| 347 + 300 | to | 347 + 800 | 0.500 |
| | | | 11.000 |

It is accepted that at the time of construction the lengths given may have to be extended slightly.

2. The repaired sections will be reconstructed to a 1,0 M pavement standard.

3. The balance of the 40 km section will be treated thus :

(a) The vegetation removed from the shoulders and the shoulders levelled and compacted to a suitable standard.

(b) The road will then be sealed across the full 10 metres with a bitumen spray and stone application.

The U.S.A.I.D. have approved the method of reconstruction and will most probably provide the funds for the total project including the shoulder improvement and 10m wide seal.

J.B. SADDLER
CHIEF ENGINEER (PLANNING)

HEAD OFFICE

10th September, 1981

Road Maintenance (Development)

[illegible] - 312 - 352

1. [illegible]

Large scale failures became evident between the 310 and 352 km pegs on the [illegible] Road soon after the reopening of the border with Zambia, and the resumption of traffic on this section of the road.

Whilst the border was closed the traffic was essentially nil.

The cause of the failures has been identified as a loss of shear strength in the fill material. Testing of the fill was undertaken to determine deflection (using Benkelman Beam), consistency index, plasticity index, liquidity index and the exchangeable sodium percentage, a chemical test to determine the sodicity of the fill.

A fairly good correlation was obtained between visible failure, deflection and sodicity, although there were notable exceptions.

The mechanism of failure, the localities of the failed sections, and the recommendations for repair are documented in the following reports :-

Reference [illegible]/901/JW dated the 29th August, 1980
Reference 901/2/JIC dated the 10th July, 1981
Reference [illegible]/901/BRG/563 dated the 19th August, 1981

2. [illegible] PAVEMENT

The 40 km of road under consideration have an expired design life in terms of age. It has not been possible to establish the relationship between the designed pavement and the number of repetitions of a standard axle to which the road has been subjected during its life, but, in view of the fact that the road was virtually closed during the war years, the pavement could not be expected to have reached an overstressed condition unless something untoward such as an unstable fill was causing failure.

There are long sections within the 40 km length that show no signs of visible distress and the Benkelman Beam deflections confirm the adequacy of the road on these sections.

2/ .....

This indication that the pavement itself is not in an advanced stage of disrepair and that the major force which has to be resolved is to determine the extent of the work field and, when this is achieved, to ensure it is not made a stable replacement.

Assuming the work field can be identified with confidence, the results in sections have every indication of a reasonably high residual value and therefore no necessity for improvement on our estimated programme.

3. [illegible] REQUIRING COMPLETE RECONSTRUCTION

(a) The Chief Engineer Materials and Training recommends the complete reconstruction of the following sections :-

| | | | | | | |
|---|---|---|---|---|---|---|
| 520 | + | 700 | to | 521 | + | 600 | (0.9 km) |
| 523 | + | 700 | to | 523 | + | 900 | (0.2 km) |
| 527 | + | 200 | to | 527 | + | 600 | (0.4 km) |
| 528 | + | 100 | to | 529 | + | 500 | (1.4 km) |
| 529 | + | 600 | to | 531 | + | 400 | (1.8 km) |
| 532 | + | 400 | to | 534 | + | 100 | (1.7 km) |
| 538 | + | 400 | to | 539 | + | 900 | (1.1 km) |
| 540 | + | 00 | to | 541 | + | 200 | (1.2 km) |

This totals 9.7 km

(b) From visual inspection, bearing in mind a small element of uncertainty in the radio theory, I have extended the sections requiring complete reconstruction to the following :-

Ground Truth

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 520 | + | 700 | to | 521 | + | 800 | (1.1 km) |
| 523 | + | 400 | to | 524 | + | 100 | (0.7 km) |
| 526 | + | 000 | to | 526 | + | 500 | (0.5 km) |
| 527 | + | 100 | to | 531 | + | 400 | (4.3 km) |
| 532 | + | 400 | to | 534 | + | 100 | (1.7 km) |
| 538 | + | [illegible] | to | 539 | + | 900 | (1.2 km) |
| 540 | + | [illegible] | to | 541 | + | 200 | (1.2 km) |
| 547 | + | 300 | to | 547 | + | 800 | (0.5 km) |

This totals 11.0 km

1M

4. [illegible] FOR THE RECONSTRUCTED SECTIONS

The following alternative pavement designs have been calculated using the heavy vehicle traffic counts taken when the maize haul was in progress.

3/ .....

| | Design Life | Cover in mm |
|---|---|---|
| 0.1 M | 5 years | 150/- |
| 0.3 M | 12 years | 120/120 |
| 1.0 M | 23 years | 150/150 |
| 3.0 M | 36 years | 150/150/150 |

(i) An 0.1 M standard with a 5 year life is rejected on the grounds that it is not an adequate pavement for a road of such importance.

(ii) An 0.3 M standard which is subsequently upgraded to a 1.0 M standard requires 240 mm of cover immediately and subsequently another 150 mm of cover, a total of 390 mm of cover to achieve a 1.0 M standard.

(iii) A 1.0 M standard constructed now can be achieved with 300 mm of cover, which is only 60 mm additional over the 0.3 M standard, and is 90 mm less than the 1.0 M standard achieved by stage construction.

(iv) A 3.0 M standard is not justified at the present time but it can be achieved by stage construction, adding a 150 mm layer to the 1.0 M pavement when the added strength is required.

The 0.3 M pavement has considerable merit in view of the fact that -

(a) It gives an acceptably strong pavement with a life which is not too far removed from the remaining sections which do not require reconstruction.

(b) It avoids the heavier expenditure of a 1.0 M pavement on a road which has areas of uncertainty for its future.

On balance however, the additional 60 mm of cover to achieve a 1.0 M pavement is considered to be a good investment.

5. RECOMMENDATIONS

(i) That the sections of weak fill which are identified and tabulated in paragraph 3 (b) be removed and replaced with a stable fill and subgrade.

It is possible that at the time of construction the lengths may have to be extended.

(ii) That the repaired sections be reconstructed to a 1.0 M pavement standard.

(iii) That the balance of the 40 km remain in their present condition but as a reserved against possible deterioration; the following treatment is undertaken as soon as possible:-

(a) The vegetation removed from the shoulders and the shoulders levelled and compacted to a suitable standard; and

(b) The road resealed with a spray and stone application (not slurry) across the full 10 metre width.

J.I. GARDINER
Chief Engineer (Planning)

/A.

REF: MSW/9 BW

MINISTRY OF ROADS & ROAD TRAFFIC
POSTS & TELECOMMUNICATIONS
CENTRAL LABORATORY

29th August,,1980.

Secretary for Roads & Road Traffic
Posts & Telecommunications
Attention Management Engineer [Operations]

c.c. Provincial Road Engineer
Mashonaland West

SALISBURY-CHIRUNDU ROAD : REPORT ON FAILURES

1. GENERAL

An appraisal of the results of the investigation into failures on the above road has identified the problem to be associated with the use of 'sodic' soils in the fill material resulting in a complete loss in shear strength at the moisture contents prevailing at the time of the investigation.

2. MECHANICS OF FAILURE

2.1. The wetting up of the fill material by a type of capillary action from moisture contained in the road bed. Such materials have a definite affinity for water and absorb moisture that is concentrated within the gravel immediately below the road structure due to an absence of vegetation.

2.2. Following two or three rainy seasons by the above process the in-situ moisture content rises above optimum and the material loses its shear strength progressively. Deformation under traffic occurs, causing cracking to the bituminous surfacing.

2.3. The surfacing, becoming pervious, allows direct ingress of surface water - thus accelerating the loss of strength to the stage that the CBR tends to zero.

2.4. In areas where a moisture gradient can occur, any moisture movement, however small, will cause transportation in suspension of sodium salts contained in soil, this process being known as dispersion.

2.5. This process will result in a fine, continuous, network of 'pipes' in the soil which will enlarge on further ingress of water until cavities of up to 100 mm in diameter occur.

/page 2.....

2.6. At some stage in the latter process [4 and 5] depending on the size and location of these cavities, traffic loading causes a dramatic and sudden collapse of the pavement.

Thus the different modes of distress/failure are :-

[i] Deformation; [ii] cracking; [iii] more severe deformation; [iv] collapse.

3. RECOMMENDED REHABILITATION MEASURES

3.1. Removal of base to temporary stockpile for re-use.
Note: Care should be taken to remove as much base as possible, including, if necessary, a proportion of the lime stabilised sub-base.

3.2. Removal to waste of the sodic fill material to original ground level.

Note: [i] A trial section should be tackled first, using a D4 or similar, successively dozing material to waste. Monitoring of this operation will be carried out initially by Central Laboratory staff, who will determine the depth to which spoiling is to be carried out.

[ii] It is hoped that the saturated condition will not be prevalent into the roadbed [below original ground level]. Care should be taken to avoid excessive disturbance of any side drains cut into the sodic material.

3.3. Rolling of the roadbed.

Note: This operation will be dependent on conditions pertaining on completion of the fill removal operation.

3.4. Construction of the fill using suitable material.

3.5. Importation and stabilised compaction of sand sub-base [Base 2 ] material.

Note: Should be readily available.

3.6. Replacement, stabilisation, and compaction of the original crushed base gravel [Base 1].

Note: Additional base gravel is <u>not</u> readily available [crushing required].

3.7. Surfacing.
Normal 2-coat surface dressing.

4. OBSERVATIONS FROM TEST RESULTS

4.1. From a deflection study carried out using the Benkelman Beam, sections of high deflection coincide well with indicator tests showing high plasticity and likelihood of sodic materials.

/page 3...

4.2. Results of CBR testing done on samples from the worst areas of failure indicate zero CBR following ± 10 days soaking.

4.3. There is general agreement between high plasticity and areas of failure.

4.4. Densities of the top 150 mm of fill material at time of construction were recorded as being in excess of 95% LCE.

4.5. Results of in-situ CBR measurements using the Dynamic Cone Penetrometer generally give low values at the moisture content prevailing at the time of test.

4.6. Suggested section to be tackled first in the rehabilitation exercise is 341+000 to 341+500. This is part of the largest section and includes the airfield. It extends into an area that was repaired in 1974 [and since failed], and a recently failed area.

4.7. The order of priorities for the remainder of the work is as follows :-

[i] Completion of 340+00 - 341+500;

[ii] 320+300 to 329+200;

*[iii] Either 329+900 to 331+000 or 333+200 to 334+000;

[iv] 320+600 to 321+300

with priorities to be advised later. The total of the foregoing amounts to 5,0 km but the results of investigations to hand indicate that this may extend to 12 km.

* Both to be done, order to be advised later.

4.8. The suggestion of carrying out supercompaction of the affected sections using either a 50 tonne single axle pneumatic roller, an impact roller or a vibratory roller has been considered but it is believed that this operation would be ineffective due to the high moisture content in the material. Furthermore, even if compaction could be achieved, it is anticipated that the same condition leading to failure would eventually reoccur.

5. PROPOSED PAVEMENT DESIGN

5.1. Rip and scarify existing surfacing and Base 1 to a depth of 170 mm. [If necessary incorporate up to 50 mm Base 2 material].

5.2. Carefully recover and stockpile all ripped Base 1 and surfacing for re-use as Base 1 treated with 2% cement.

5.3. Excavate to waste all remaining Base 2 and fill material down to ground level - not below.

5.4. Replace excavated fill with an approved non plastic sand in 150 mm lifts compacted to 93% Mod.AASHTO to within 300 mm of FRL.

/page 4...

5.5. Import 150 mm of approved Base 2 material [can be NP sand treated with 3% cement] and compact to 98% Mod. AASHTO.

5.6. Replace ripped and scarified Base 1 and surfacing material to a depth of 150 mm - treat with 2% cement and compact to 98% Mod. AASHTO.

5.7. Apply prime and conventional 2 coat surface treatment, i.e. 19 mm tack followed by 7 mm grit seal.

6. CONCLUSION

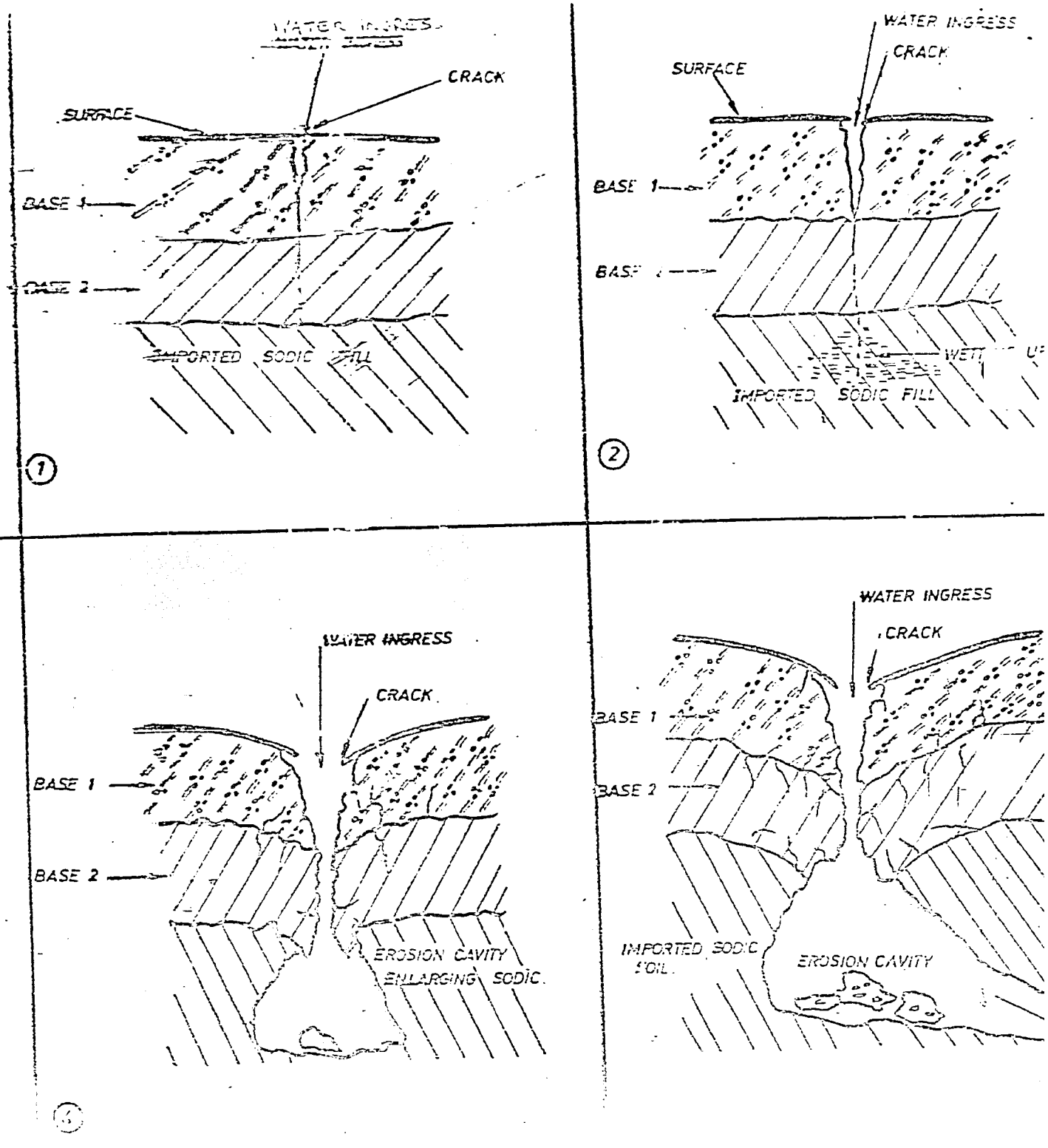
The foregoing report is based on the last information available and the recommendations given are considered realistic. The situation will be reviewed as re-construction work proceeds and further suspect areas will be investigated at the same time. Furthermore, the results of chemical testing are awaited from the Ministry of Agriculture.

A drawing containing the detailed information available at the present time is under preparation and will be forwarded in due course.

B. Warren
CHIEF ENGINEER [MATERIALS & TRAINING]

BW/mb

PROGRESSIVE DEVELOPMENT OF A SODIC SOIL TUNNEL FAILURE IN IMPORTED FILL UNDER A ROAD — ZAMBEZI VALLEY C. 1980.



Subgrade materials are tested for grading, plasticity index and California Bearing Ratio [CBR] values.

In the subgrade classifications 'SG 3', 'SG 5' and 'SG 9' the numerals are the CBR values of the soils, i.e. their design CBR's, as previously defined. For expansive soils an additional classification, 'SG E' is used.

This method of classifying soils by CBR facilitates the use of this standardised pavement design.

The design CBR [$CBR_d$] is assessed according to design traffic as shown in the table below:

| Design Traffic | Recommended Design CBR |
|---|---|
| Less than 50 000 E80 | Mean CBR |
| 50 000 to 1 000 000 E80 | Lower Quartile CBR |
| More than 1 000 000 E80 | Lower Decile CBR |

## 20.5. SUBGRADE CLASSIFICATION, DESCRIPTION AND COMMENTS ON USE

SG E: Any expansive soil. A soil is potentially expansive if it exhibits all three of the following properties:

[i] The 'Liquid Limit of the whole Sample' [$W_{LW}$] exceeds 55%.

[ii] The 'Clay Fraction' exceeds 20%, and

[iii] The 'Free Swell' exceeds 60%.

Notes:

a] $W_{LW} = \frac{W_L \times \% \text{ passing } 425\ \mu m}{100}$

b] Clay fraction = % < 2 µm

c] Free swell to be determined as specified in CAS No. 185 Part I.

d] The criteria listed above should be regarded as a guide to the identification of expansive soils. Before commencing extensive and costly construction works the engineer should satisfy himself on the nature and extent of the expansive material. His judgement and experience will be of prime importance.

e] Such soils cannot be control compacted and should be removed where possible.

SG 3: Any non-expansive soil with a design CBR of 3 or more but less than 5. It may be used in fills not exceeding 3 m in height. It is normally compacted to 90% Mod. AASHTO [95% LCE] density.

SG 5: Any soil with a design CBR of 5 or more but less than 9. It may be used in all fills. The upper 150 mm layer is usually compacted to 93% Mod. AASHTO [100% LCE] density.

SG 9: Any soil with a design CBR of 9 or greater. It requires minimum cover on all design standards and is preferred in all fills. The upper 150 mm layer is usually compacted to 93% Mod. AASHTO [100% LCE] density.

Note: Subgrade classification of materials having CBR values greater than 9 are not considered due to the minimum pavement thickness requirement over the subgrade to satisfy design traffic. Requirements are not affected by design CBR values greater than 9 in the subgrade.

## 20.6. COMPACTION

To facilitate comparison between Central African Standards and AASHTO Compactive Efforts the following approximate equivalents are given :

| EQUIVALENT TEST METHOD | | APPROXIMATE MOD. AASHTO EQUIVALENT |
|---|---|---|
| CAS 185 | AASHTO | |
| Lower Compactive Effort [LCE] | Method T.99-61 Referred to as Standard AASHTO Compactive Effort | 93% |
| Intermediate Compactive Effort [ICE] | Method T.212-65 As used in Texas triaxial Test | 98% |
| Higher Compactive Effort [HCE] | Method T.180-61 Referred to as Modified AASHTO Compactive Effort | 100% |

Density specification for the various layers are shown in the Table below:

| PAVEMENT LAYER | MOD. AASHTO | CAS 185 |
|---|---|---|
| Fills | 90% | 95 - 97% LCE |
| Selected Subgrade | 90 - 95% * | 95 - 100% LCE * |
| Base: Standard 0,05 M to 1 M pavements | 98% | 100% ICE |
| Base: Standard 5 M pavements and Aerodrome pavements | 100% | 100% HCE |

* Depending on depth of layer and quality of material.

Cement or Lime Modified Materials

The addition of even small amounts of cement or lime to natural materials reduces the compacted density which can be achieved.

Delay in rolling after addition of cement and lime requires progressively increasing effort if the specified density is to be attained within the limited time permitted.

Measurement of Relative Compaction

Relative compaction of natural soil is a highly variable parameter, and accepted statistical control methods should be used.

## 20.7. DESIGN TRAFFIC

A pavement is normally designed for a definite life span, e.g. 10, 15 or 20 years, at the end of which it is expected to be due for realignment or other improvement or strengthening. The total number of heavy vehicles carried is the major determinant of the time that the road will remain serviceable and it is necessary to express this traffic in terms of a single equivalent. This is the basis of the Equivalent Single Axle [ESA] concept.

The ESA is taken as 80 kN with twin wheels and roads are designed to withstand a maximum number of repetitions of this load, over the design life.

Equivalency factors for single and double axles are given in Table 1. These factors, from the AASHTO Road Test, apply to a terminal PSI of 2,0 and vary slightly for other PSI conditions.

Design traffic must be calculated for the lane carrying the most heavy vehicles and in the case of single lane bituminous surfacings this will be the total of the ESAs for vehicles travelling in both directions.

The traffic intensity of light vehicles is a factor which may dictate the width of a pavement but it has a negligible effect on pavement design. Only the numbers of heavy vehicles in differing axle load groupings is required to determine the design traffic.

The percentage of heavy vehicles will vary according to the location of the road, but is normally between ten and thirty percent on major roads. Again, the standard axle equivalency of the average heavy vehicle will vary, for example it is particularly high on mine development roads where ore is transported.

The ideal basis for determining the traffic loading for a road construction project to replace or upgrade an existing road would be the actual on-site measurement of current heavy vehicle masses. Where such data cannot be obtained or where there is no more reliable information available of the probable number and mass of heavy vehicles and axles expected to use a proposed road, then a factor of 0,250 equivalent 80 kN axles per heavy vehicle axle is recommended [1976 data]. This factor is reviewed from time to time.

TABLE 1. 80 KN EQUIVALENCY FACTORS FOR TERMINAL PRESENT SERVICEABILITY OF 2,0

| AXLE LOAD TONNE | TERMINAL PSI | |
|---|---|---|
| | SINGLE AXLE | TANDEM AXLE |
| 1 | 0,0003 | 0,00005 |
| 2 | 0,004 | 0,0004 |
| 3 | 0,02 | 0,002 |
| 4 | 0,05 | 0,005 |
| 5 | 0,15 | 0,012 |
| 6 | 0,28 | 0,024 |
| 7 | 0,52 | 0,04 |
| 8 | 0,92 | 0,07 |
| 9 | 1,52 | 0,12 |
| 10 | 2,41 | 0,18 |
| 11 | 3,[illegible]7 | 0,27 |
| 12 | 5,43 | 0,38 |
| 13 | 7,79 | 0,53 |
| 14 | 10,91 | 0,72 |
| 15 | 14,96 | 0,96 |
| 16 | 20,13 | 1,26 |
| 17 | 26,62 | 1,63 |
| 18 | 34,69 | 2,09 |
| 19 | | 2,65 |
| 20 | | 3,31 |
| 21 | | 4,11 |
| 22 | | 5,05 |
| 23 | | 6,17 |
| 24 | | 7,46 |
| 25 | | 8,97 |
| 26 | | 10,71 |
| 27 | | 12,72 |
| 28 | | 15,01 |
| 29 | | 17,62 |
| 30 | | 20,58 |
| 31 | | 23,92 |

Allowance for different climatic conditions is made by means of regional climatic factors which are applied to increase or reduce the effect of traffic. In the dry southern areas of Rhodesia a factor of 0,8 is used whilst a factor of 1,2 is used in the eastern part. A factor of 1,0 is used in the remainder [80%] of the country. See Figure 20-5.

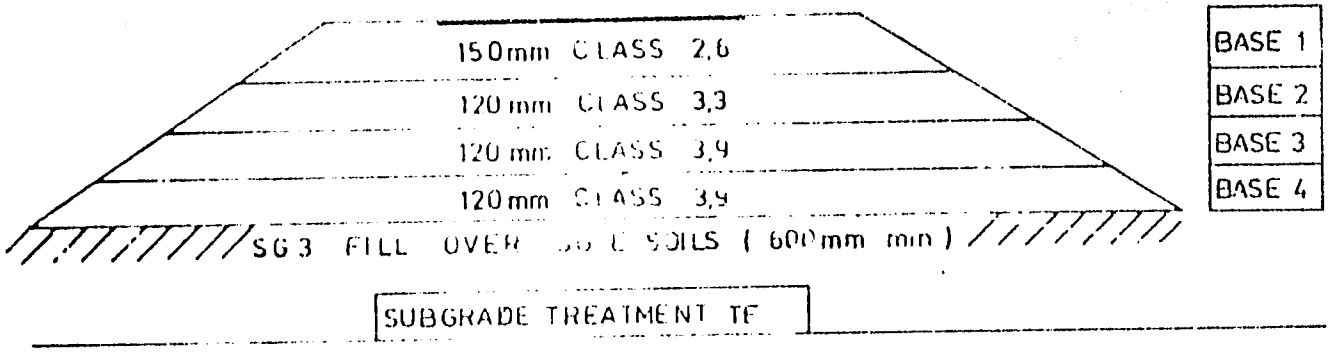
Having selected the design life, a traffic growth rate appropriate to the area of industry served must be chosen. In the absence of an actual figure, a growth of 8% per annum should be assumed, and growth figures are shown in Table 2. It must be borne in mind that the establishment of a single additional mine or industry will have a smaller effect on a road designed for, say $10^6$ repetitions than on one designed for only $0,1.10^6$ repetitions.

The surfacing cost, too, must not be overlooked, and as it is high compared with pavement layer costs, it is of doubtful wisdom to economise on pavement design at the risk of wasting a surfacing.

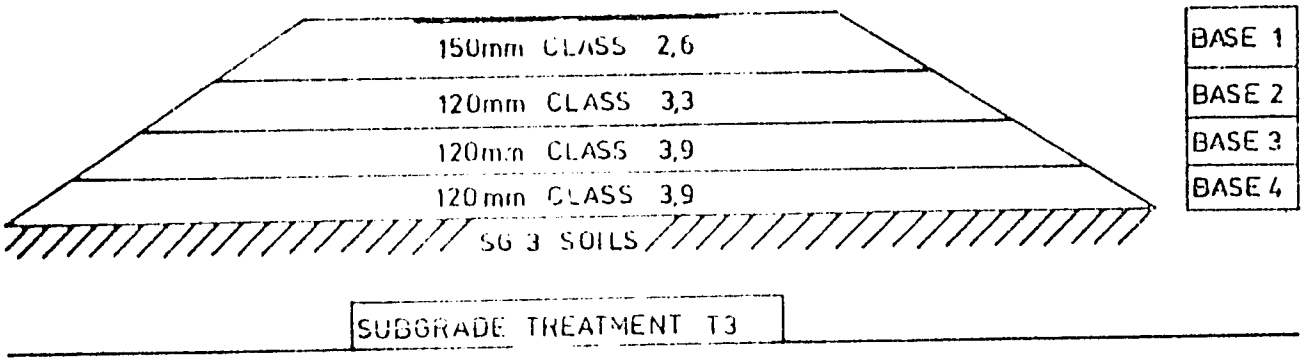
# STANDARD 1 M PAVEMENTS

DESIGN TRAFFIC 0,3 - 1.10$^6$ E 80

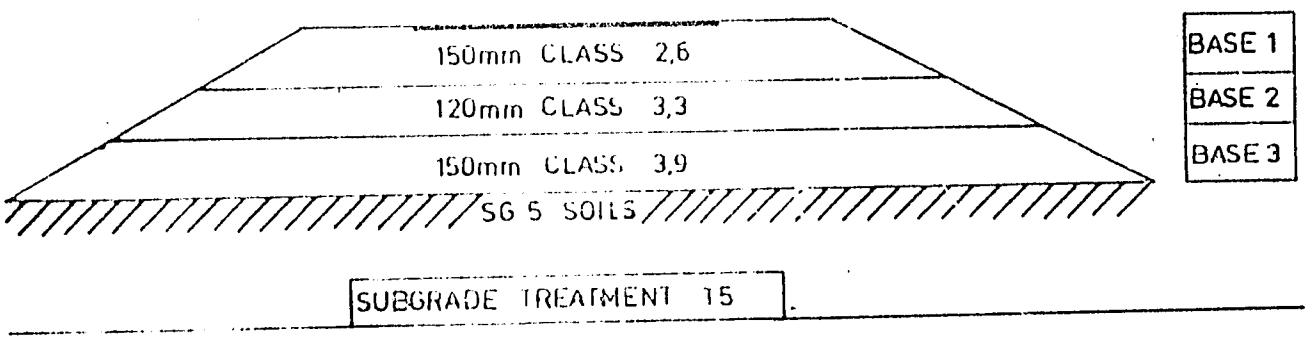
## SG E SOILS




## SG 3 SOILS




## SG 5 SOILS




## SG 9 SOILS

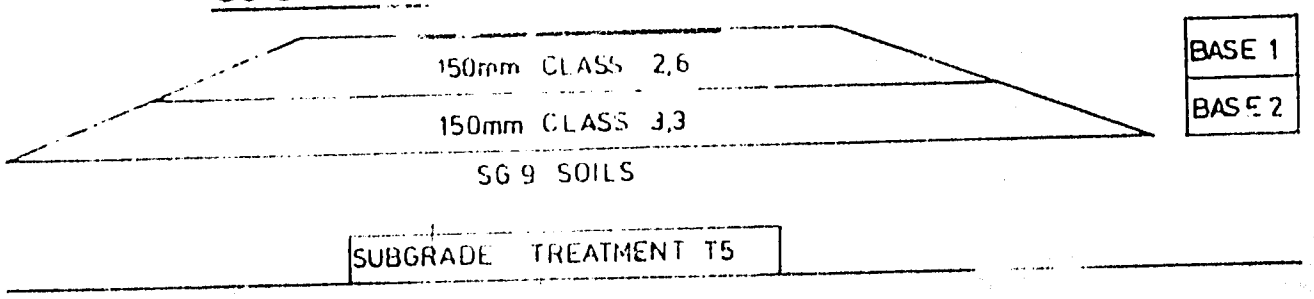



FIGURE 20-7

It should be noted that power paraffin is highly inflämable and has a relatively low flash point. It is, therefore, essential to have suitable fire extinguishers on hand during these operations.

## 7.3. MAINTENANCE OF ROAD SHOULDERS

### 7.3.1. General

The shoulders, normally 1,5 metres wide, are those parts of the formed road surface on each side of the demarcated carriageway. New roads are constructed with surfaced shoulders, and it is policy to surface the shoulders of existing two lane roads as rapidly as the necessary funds can be made available for this work.
However, there remain very considerable lengths of older roads which still have unsurfaced shoulders.

The shoulders form an important and integral part of the road structure [See Section 2, subsections 2.2.1. and 2.2.2.], being used by traffic in emergencies and affording protection to the surfacing by providing lateral support.

The shoulders are given the same slope or cross-fall as the carriageway in order to ensure adequate and unimpeded drainage and safe travelling.

### 7.3.2. Maintenance of Surfaced Shoulders

Surfaced shoulders are normally constructed to the same pavement design as the pavement proper, but the tack stone layer is omitted from the surfacing. Such shoulders must be maintained in exactly the same way as the carriageway proper, with due attention being given to the repair of potholes and other failures, and to resealing at appropriate intervals. It is generally most convenient and economical to undertake resealing at the same time as the carriageway is resealed.

Special attention must be given to the outside of the shoulder surfacing to prevent undermining and encroachment of couch grass. Herbicide applied by knapsack sprayer is the best method of controlling couch grass encroachment.

### 7.3.3. Causes of Deterioration of Gravel Shoulders

These are:-

[i] wind erosion from speeding traffic close to the edge of the mat;

[ii] abrasive action from traffic riding on the shoulders; this is common on curves where traffic tends to cut the curve;

[iii] erosion by water draining off the surface. This takes the form of runnels along the edges of the mat and gullies across the shoulders;

[iv] displacement by traffic of saturated gravel during the rainy season;

[v] encroachment by grass of the couch variety.

## Maintenance of Gravel Shoulders

Gravel shoulders shall be maintained at all times to their full width, with a smooth and even surface, to the correct slope and flush with the road surfacing.

Whether or not the shoulders should be kept clear of grass is left to the discretion of the Provincial Road Engineer, However, it is essential that a 300 mm wide strip adjacent to the mat edge be kept free of grass at all times. This must be accomplished by use of a suitable herbicide e.g. 5-bromo-3-Sec butyl-6 methyl uracil. This exercise is necessary to prevent couch grass from growing into the mat causing it to crack and crumble at the edges. Scuffing of this 300 mm strip should be avoided, as this can lead to erosion of the shoulder material and encourage grass re-growth.

However, where grass is allowed to grow on the remainder of the shoulder, it must be kept cut short at all times. This will aid visibility, and show that a shoulder exists which can be used by traffic in an emergency.

On no account may either motorised or towed graders be used to clear vegetation from gravel shoulders. This is because the use of a grader blade loosens the shoulder material to a much greater extent than does scuffling, and leaves it susceptible to erosion. Repeated use of graders results in the shoulder slope becoming much steeper than the camber and eventually merging into the fill slope; in other words the shoulder is lost.

Running course material must be brought in from elsewhere to make good any loss of gravel, especially next to the edge of the mat, and this must be properly compacted to minimise further erosion.

## Surfacing of Gravel Shoulders

It is now accepted that the shoulders of existing wide mat roads should be surfaced wherever possible, in order to avoid the continual problems associated with maintaining gravel shoulders, and to provide a better and safer road for the public. Cyclists tend to make use of surfaced shoulders thus leaving the carriageway free for motor vehicles.

Thus in order to allow for this exercise to proceed as quickly as possible, it must be given a high priority when considering the allocation of rehabilitation funds each financial year.

Priorities must be decided on the merits of each case after taking the following factors into consideration:-

[a] Volume of traffic.

[b] Rate of attrition of the gravel shoulders.

[c] Length of haul and availability of suitable gravel.

[d] Planned date for reconstruction or retirement of the road.

Generally the work should proceed outwards from the major centres. Surfacing should also be undertaken on the insides of sharp curves on rural roads where the shoulders require frequent regravelling as a result of traffic erosion.

The full width of the shoulder shall be surfaced, i.e.

[i] on a cross-section of 7,0 m surfacing on 12,5 m formation the shoulder shall be surfaced to a width of 2,5 m.

[ii] on a cross-section of 7,0 m surfacing on 10,0 m formation, or 6,7 m surfacing on a 9,7 m formation, the shoulder shall be surfaced to a width of 1,5 m.

The existing shoulder material shall be cut off from the edge of the surfacing to a depth of 120 mm below the required finished shoulder level. The in situ material shall be watered and thoroughly rolled. Import 120 mm Base Class 2,8 material which shall be control compacted to 98% Mod A.A.S.H.T.O. This material shall be stockpiled, sampled, and plans submitted to the Chief Engineer [Materials and Training], in accordance with Part 4, Section 2.4. of the Manual.

The compacted shoulder shall be primed with T.P.7 or MC30 at the rate of approximately 1,0 l/m$^2$.

Surface the primed shoulder using either a 7 mm single sized aggregate with a bituminous binder applied at the rate of approximately 1,2 l/m$^2$, or a slurry seal or such other form of surfacing as may be approved by the Chief Engineer [Maintenance]. There must be an overlap of the new surface on the existing surface of a minimum of 100 mm in order to seal the joint between old and new work.

At intersections, lay-bys and rest places, the surfacing must be in bituminous concrete a minimum of 13 mm thick.

Yellow edge of carriageway markings are to be provided as soon as possible after completion of the work.

## 7.4. VERGES AND SIDE SLOPES

From the commencement and to the height of the grass growing season, the grass on the shoulder slopes and verges up to a distance of 3 m from the mat edge shall be kept cut short at all times in order to improve sight distance, to enable road signs, guide stones and guard posts to be clearly seen and to reveal animals or other hazards near the road.

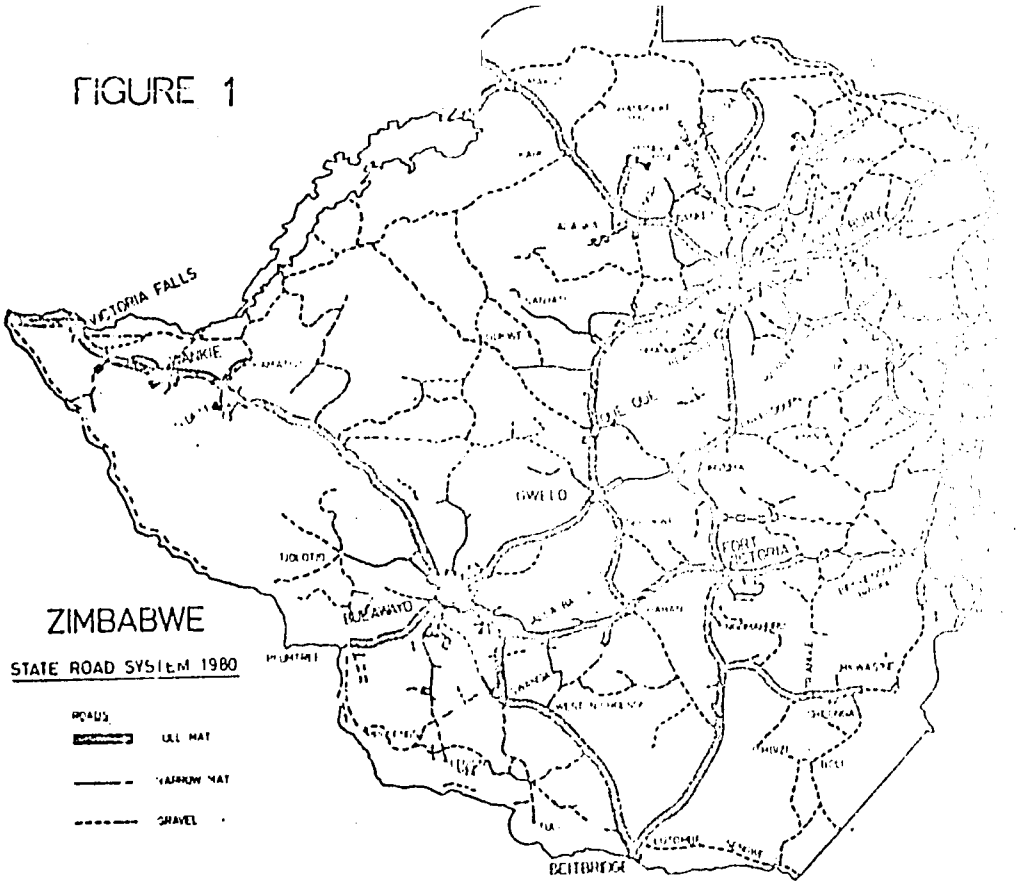
On the inside of curves, at the approaches to road junctions and level crossings, and at entrances, the grass shall be kept short over the full extent of the road servitude on the side or sides of the road where this is needed for good visibility.

As the growth of grass begins to tail off, the grass shall be cut down to the invert of the side drain and in and around beds of planted trees and shrubs.

At the end of the growing season, grass cutting shall be extended to cover the full road servitude. Care shall be taken not to disturb indigenous or planted trees and shrubs which are to be preserved for aesthetic reasons [illegible]

APPENDIX D
EXHIBIT 3

FIGURE 1




Page 1

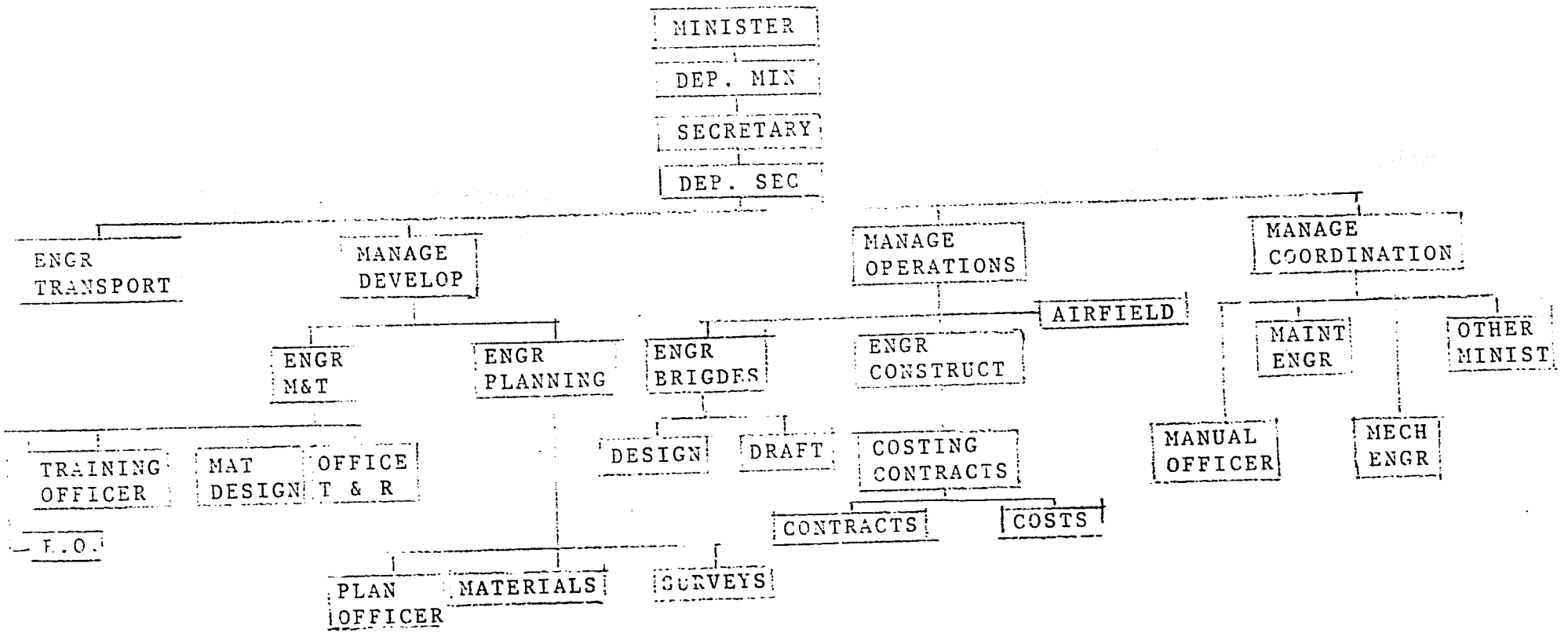
TABLE 1

LENGTHS OF ROAD

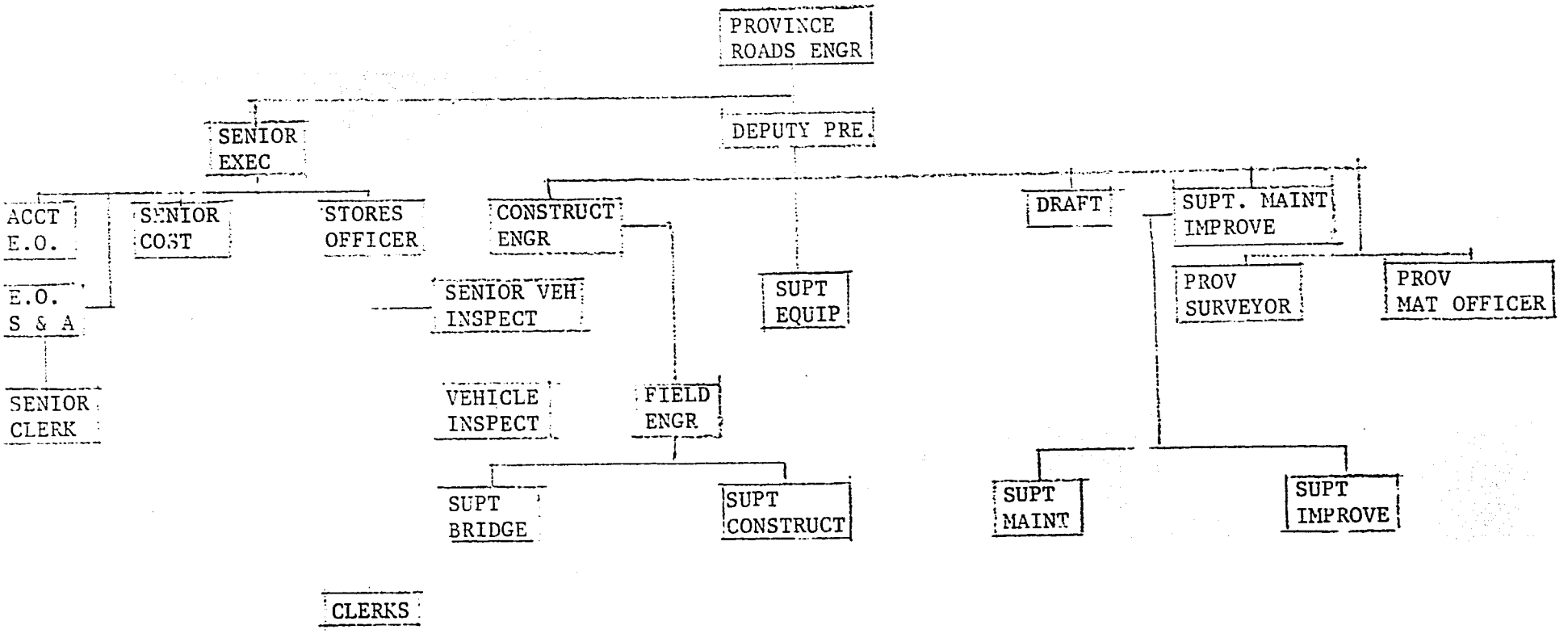
| ROAD AUTHORITY | STATE | RURAL COUNCIL | MUNICIPAL | DISTRICT ADMIN. | TOTAL Km. |
|---|---|---|---|---|---|
| Earth Track | 4 500 | - | - | 22 580 | 27 080 |
| Gravel | 7 750 | 20 236 | 1 153 | 7 267 | 46 406 |
| Strips | 68 | 172 | | | 240 |
| Single Lane Surfaced | 1 409 | 1 443 | 738 | 60 | 3 650 |
| Two Lane and Multi Lane Surfaced | 4 815 | 140 | 3 326 | | 8 281 |
| Dual Carriageway | 2 | | 70 | | 72 |
| TOTAL Km. | 18 636 | 21 991 | 5 287 | 39 907 | 85 821 |

July 1981

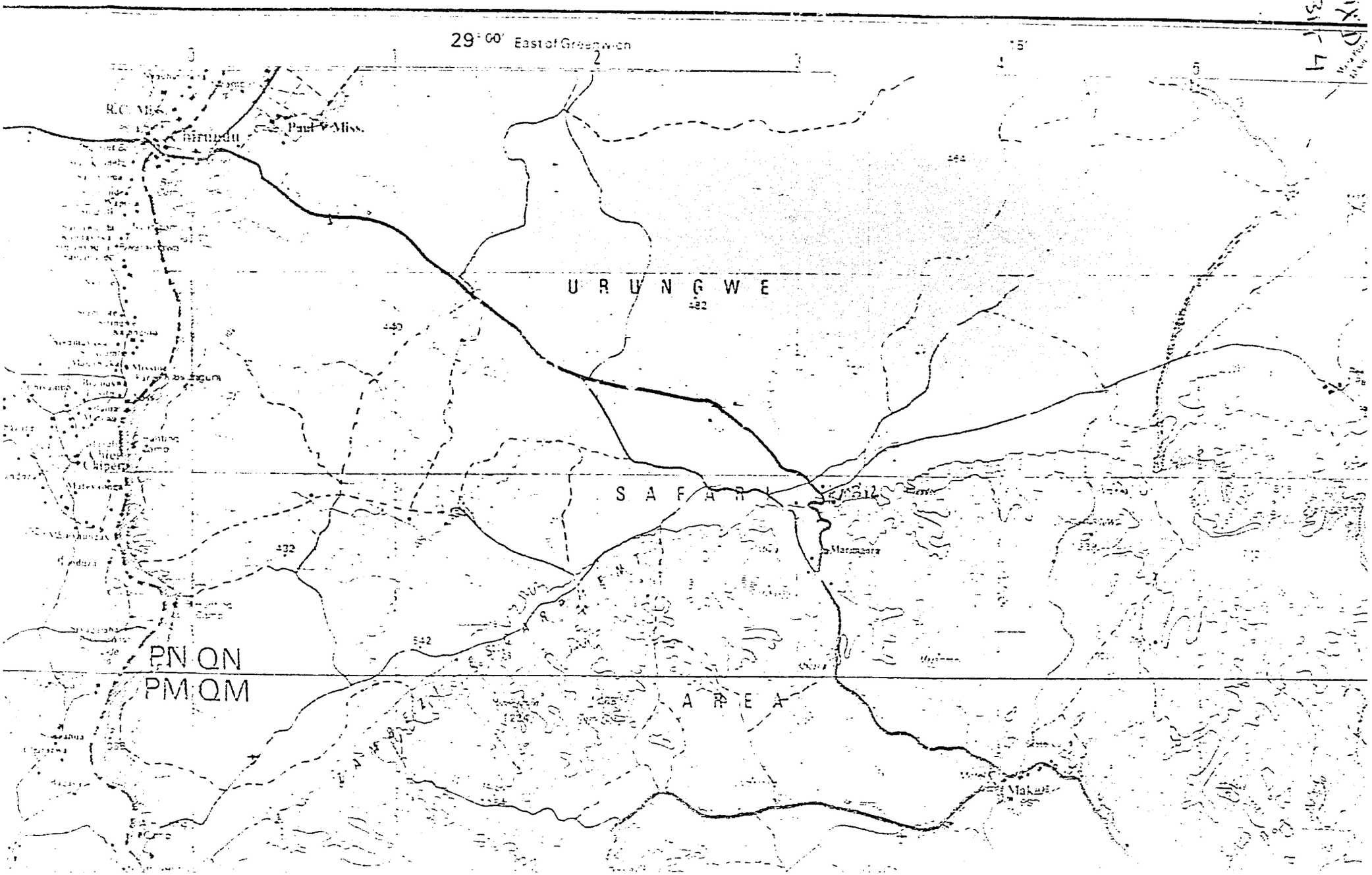
MINISTRY HEADQUATERS STAFFING PATTERN



PROVINCE HEADQUARTERS STAFFING PATTERN



# ZIMBABWE


29° 00' East of Greenwich
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Paul's Miss.
U R U N G W E
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A R E A
Marangara
Makuti
PN QN
PM QM

APPENDIX E

# ECONOMIC ANALYSES

## Exhibit 1 - Vehicular Savings and Costs

Figures for savings on alternative types of road surfaces and conditions were based on calculations derived by the MOR using the Transport and Road Research Laboratory (TRRL) model done by the IBRD from research carried out in Kenya (LR 723, 1976 "Tables for Estimating Vehicle Operating Costs on Rural Roads in Developing Countries"). The actual figures are up-dates on the MOR Report "Pre-Feasibility Study for the Salisbury-Chirundu Road (312-352 km)", September, 1981, Tables 7-14. The number of vehicles traveling over the road were taken from actual counts made by the MOR, utilizing a mechanical counter, and expanded 8% per annum over the actual 1981 figures.

## Exhibit 2 - Maintenance Savings and Costs

Maintenance costs were determined from the historical costs of routine maintenance as given by the MOR (increased by 5% p.a.) and estimated periodic maintenance costs as derived by the FP team from past historical figures. The savings are conservative and are based on the team's estimates, utilizing projected costs without the project vs. probable costs after full rehabilitation.

## Exhibit 3 - Construction/Repair Costs

These were taken from projections made on actual historical costs as shown on pp. 15-16 of the project paper.

## Exhibit 4 - IRR and B/C ratio

Not all savings or benefits lend themselves to quantification. Alternative routes, time savings, new market access, increased communications and interdependence, production linkages and economies of scale and overall monetary savings are all factors of importance for road construction, but the benefits cannot be quantified without an exhaustive sector analysis.

The two benefit streams which can be quantified (and demonstrated) are vehicular operation savings and maintenance savings. Costs, in terms of repairs and maintenance, are also quantifiable. Using these benefit and cost elements, at varying discount rates and utilizing the figures shown in

exhibits 1-3, the very moderate IRR (12%) and B/C (1.16 at 10%) are derived. If other benefits were quantified (such as cost savings over alternate routes), the IRR and B/C ratio would have been much more favorable, but more difficult to demonstrate and "prove".

## VEHICULAR TRAFFIC

### (Makuti-Chirundu Road)

A permanent counter was set up in 1980 on the Salisbury Chirundu Road, located at Makuti intersection kilometer 287.7 from Salisbury. The following daily averages were provided by the Ministry of Roads for the year 1981. From these figures annual estimates were derived. Figures for following years were increased at an annual growth rate of 8%. The figures for 1980 were also provided, but are less reliable (physical counts from the records at the border post of Chirundu).

### DAILY AVERAGES

| | 1980 All Vehicles | 1981 All Vehicles | 1981 Heavy Vehicles |
|---|---|---|---|
| January | 3.2 | 338 | 98 |
| February | 25.0 | 275 | 116 |
| March | 50.4 | 198 | 67 |
| April | 81.8 | 428 | 137 |
| May | 75.0 | 369 | 133 |
| June | 96.7 | 211 | 92 |
| July | 113.7 | 274 | 91 |
| August | 106.7 | 278 | 86 |
| September | 70.2 | 267 | 96 |
| October | 84.8 | 223 | 83 |
| November | 49.8 | 219 | 71 |
| December | 23.3 | 341 | 116 |
| Total | 830.6 | 3,421 | 1,186 |
| Annualized Average | 69 | 285 | 99 |
| Annual Total | 24,919 | 102,600 | 35,640 |

[illegible]

Assuming 1981 figures are correct, that growth in usage is [illegible]% per year, the annual savings (rounded) of having a paved road vs. graveled road are undiscounted at rates given by the MOR.

| | Average Private & Medium Size Vehicles | Savings Per km | Total # of kms (000's) | Total Private & Med. Size Savings Z$ | Aver. # Commercial Vehicles (Heavy) | Savings per km | Total # of kms (000's) | Total Comm. Vehicle Savings Z$ | Total Savings Z$ | Savings in U.S. $ @ 1.40 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1981 | 66,960 | 2.7¢ | 2678 | - 0 - | 35,640 | 11¢ | 1,426 | - 0 - | - 0 - | - 0 - |
| 1982 | 72,300 | " | 2692 | - 0 - | 38,500 | " | 1,540 | - 0 - | - 0 - | - 0 - |
| 1983 | 78,100 | " | 3124 | 1/3 28,100 | 41,600 | " | 1,664 | 1/3 61,000 | 89,100 | 124,700 |
| 1984 | 84,400 | " | 3376 | 91,200 | 44,900 | " | 1,796 | 197,600 | 288,800 | 404,300 |
| 1985 | 91,100 | " | 3644 | 98,400 | 48,500 | " | 1,940 | 213,400 | 311,800 | 436,[illegible] |
| 1986 | 98,400 | " | 3936 | 106,300 | 52,400 | " | 2,096 | 230,600 | 336,900 | 471,700 |
| 1987 | 106,300 | " | 4252 | 114,800 | 56,600 | " | 2,264 | 249,000 | 363,800 | 509,300 |
| 1988 | 114,800 | " | 4592 | 124,000 | 61,100 | " | 2,444 | 268,800 | 392,800 | 550,000 |
| 1989 | 124,000 | " | 4960 | 133,900 | 66,000 | " | 2,640 | 290,400 | 424,300 | 594,000 |
| 1990 | 133,900 | " | 5356 | 144,600 | 71,200 | " | 2,848 | 313,300 | 457,900 | 641,100 |
| 1991 | 144,600 | " | 5784 | 156,200 | 76,900 | " | 3,076 | 338,400 | 494,600 | 692,400 |
| 1992 | 156,100 | " | 6244 | 168,600 | 83,100 | " | 3,324 | 365,600 | 534,200 | 747,900 |
| 1993 | 168,600 | " | 6744 | 182,100 | 89,700 | " | 3,588 | 394,700 | 576,800 | 807,500 |
| 1994 | 182,100 | " | 7284 | 196,700 | 96,900 | " | 3,876 | 426,400 | 623,100 | 872,300 |
| 1995 | 196,700 | " | 7868 | 212,400 | 104,700 | " | 4,188 | 460,700 | 673,100 | 942,300 |
| 1996 | 212,400 | " | 8496 | 229,400 | 113,100 | " | 4,524 | 497,600 | 727,000 | 1,017,800 |
| 1997 | 229,400 | " | 9176 | 247,800 | 122,100 | " | 4,884 | 537,200 | 785,000 | 1,099,000 |
| 1998 | 247,800 | " | 9912 | 267,600 | 131,900 | " | 5,276 | 580,400 | 848,000 | 1,187,200 |
| 1999 | 267,600 | " | 10704 | 289,000 | 142,400 | " | 5,696 | 626,600 | 915,600 | 1,281,800 |
| 2000 | 289,000 | " | 11560 | 312,100 | 153,800 | " | 6,152 | 676,700 | 988,800 | 1,384,300 |
| 2001 | 312,100 | " | 12484 | 337,100 | 166,100 | " | 6,644 | 730,800 | 1067,900 | 1,495,[illegible] |
| 2002 | 337,100 | " | 13484 | 364,100 | 179,400 | " | 7,176 | 789,400 | 1153,500 | 1,614,[illegible] |
| 2003 | 364,000 | " | 14560 | 393,100 | 193,800 | " | 7,752 | 852,700 | 1245,800 | 1,744,100 |

VEHICLE SAVINGS

DISCOUNTING FUTURE VALUES

Assuming various rates, the "real" value of costs and savings will change considerably over time. Using a life span of 20 years and the rates of 10% and 15%, the following results are derived.

| Year | | | VEHICULAR SAVINGS U.S. DOLLARS @ 10% | | | | VEHICULAR SAVINGS | | @15% |
|---|---|---|---|---|---|---|---|---|---|
| 1983 | NPV | .90 | U.S. $ 124,700 | | 112,200 | .85 | U.S. $ 124,700 | | 106,000 |
| 1984 | | .81 | 404,300 | = | 327,500 | .72 | 404,300 | = | 291,100 |
| 1985 | | .73 | 436,500 | | 318,600 | .61 | 436,500 | = | 266,300 |
| 1986 | | .66 | 471,700 | | 311,300 | .52 | 471,700 | | 245,300 |
| 1987 | | .59 | 509,300 | | 300,500 | .44 | 509,300 | | 224,100 |
| 1988 | | .53 | 550,000 | | 291,500 | .38 | 550,000 | | 209,000 |
| 1989 | | .48 | 594,000 | | 285,100 | .32 | 594,000 | | 190,100 |
| 1990 | | .43 | 641,100 | | 275,700 | .27 | 641,100 | | 173,100 |
| 1991 | | .39 | 692,400 | | 270,000 | .23 | 692,400 | | 159,300 |
| 1992 | | .35 | 747,900 | | 261,800 | .20 | 747,900 | | 149,600 |
| 1993 | | .31 | 807,500 | | 250,300 | .17 | 807,500 | | 137,300 |
| 1994 | | .28 | 872,300 | | 244,200 | .14 | 872,300 | | 122,100 |
| 1995 | | .25 | 942,300 | | 235,600 | .12 | 942,300 | | 113,100 |
| 1996 | | .23 | 1 017,300 | | 234,100 | .10 | 1 017,800 | | 101,800 |
| 1997 | | .21 | 1 099,000 | | 230,800 | .09 | 1 099,000 | | 98,900 |
| 1998 | | .19 | 1 187,200 | | 225,600 | .07 | 1 187,200 | | 83,100 |
| 1999 | | .17 | 1 281,800 | | 217,900 | .06 | 1 281,800 | | 76,900 |
| 2000 | | .15 | 1 384,300 | | 207,600 | .05 | 1 384,300 | | 69,200 |
| 2001 | | .15 | 1 495,100 | | 224,300 | .05 | 1 495,100 | | 74,800 |
| 2002 | | .14 | 1 614,900 | | 226,100 | .04 | 1 614,900 | | 64,600 |
| 2003 | | .12 | 1 744,100 | | 209,300 | .03 | 1 744,100 | | 52,300 |
| | | | | | $5,260,000 | | | | $3 008,000 |

Present Value of vehicular savings @ 10% = US$ 5,260,000
" " " " @ 15% = US$ 3,008,000

Discounting Repair

Costs and Maintenance Costs

Assuming that 25% of the road repairs is done (and paid) in 1982 and the remainder in 1983. Using $1.40 US to 1.00 Zimbabwe.

| | Repair Costs & Maintenance | | | | | Discounted Cost |
|---|---|---|---|---|---|---|
| | Z$ | U.S.$ | | @10% | | @15% |
| 1982 | 937,300 | 1,312,200 | (.9) | 1,181,000 | (.85) | 1,115,400 |
| 1983 | 2 811,700 | 3,936,400 | (.81) | 3,188,500 | (.72) | 2,834,200 |
| 1984 | 18,000 | 25,200 | (.73) | 18,400 | (.61) | 15,400 |
| 1985 | 18,000 | 25,200 | (.66) | 16,600 | (.52) | 13,100 |
| 1986 | 18,000 | 25,200 | (.59) | 14,900 | (.44) | 11,100 |
| 1987 | 18,000 | 25,200 | (.53) | 13,400 | (.38) | 9,600 |
| 1988 | 18,000 | 25,200 | (.48) | 12,100 | (.32) | 8,100 |
| 1989 | 18,000 | 25,200 | (.43) | 10,900 | (.27) | 6,800 |
| 1990 | 460,000 | 644,000 | (.39) | 251,200 | (.23) | 148,100 |
| 1991 | 18,000 | 25,200 | (.35) | 8,800 | (.20) | 5,000 |
| 1992 | 18,000 | 25,200 | (.31) | 7,800 | (.17) | 4,300 |
| 1993 | 18,000 | 25,200 | (.28) | 7,100 | (.14) | 3,500 |
| 1994 | 18,000 | 25,200 | (.25) | 6,300 | (.12) | 3,000 |
| 1995 | 18,000 | 25,200 | (.23) | 5,800 | (.10) | 2,500 |
| 1996 | 18,000 | 25,200 | (.21) | 5,300 | (.09) | 2,300 |
| 1997 | 460,000 | 644,000 | (.19) | 122,400 | (.07) | 45,100 |
| 1998 | 18,000 | 25,200 | (.17) | 4,300 | (.06) | 1,500 |
| 1999 | 18,000 | 25,200 | (.15) | 3,800 | (.05) | 1,300 |
| 2000 | 18,000 | 25,200 | (.14) | 3,500 | (.04) | 1,000 |
| 2001 | 18,000 | 25,200 | (.12) | 3,000 | (.04) | 1,000 |
| 2002 | 18,000 | 25,200 | (.11) | 2,800 | (.03) | 800 |
| 2003 | 18,000 | 25,200 | (.10) | 2,500 | (.02) | 500 |
| | | | | 4,890,400 | | 4,233,600 |

## Road Maintenance Savings

It is assumed that maintenance costs without the project (routine is periodic) will be greater than with the project. The difference was estimated by MOR engineers. Periodic maintenance (reseal) would have to be done every five (5) years, rather than every seven (7) years The figures, only altered for un-realistic periodic maintenance, are those given by the MOR.

| | Project maintenance costs (with rehabilitation) | Maintenance Costs without rehabilitation | Savings in US$ (1.40 to Z$1.00) |
|---|---|---|---|
| 1982 | Z$ | | |
| 1983 | | | |
| 1984 | 18.000 | Z$ 27,800 | U.S.$ 13,700 |
| 1985 | 18,000 | 29,200 | 15,700 |
| 1986 | 18,000 | 30,600 | 17,600 |
| 1987 | 18,000 | 32.200 | 19,900 |
| 1988 | 18,000 | 460,000 | 618,800 |
| 1989 | 18.000 | 35.500 | 24,500 |
| 1990 | 460.000 | 37,200 | (591,900) |
| 1991 | 18.000 | 39,100 | 29,500 |
| 1992 | 18.000 | 41,000 | 32,200 |
| 1993 | 18.000 | 460.000 | 618,800 |
| 1994 | 18.000 | 45,300 | 38,200 |
| 1995 | 18.000 | 47,500 | 41,300 |
| 1996 | 18.000 | 49,900 | 44,700 |
| 1997 | 460,000 | 52.400 | (570,600) |
| 1998 | 18.000 | 460,000 | 618,800 |
| 1999 | 18.000 | 57,800 | 55,700 |
| 2000 | 18.000 | 60,600 | 59,600 |
| 2001 | 18.000 | 63,700 | 64,000 |
| 2002 | 18.000 | 66,900 | 68,500 |
| 2003 | 18.000 | 460,000 | 618,800 |

SAVINGS

Taken from the previous table and discounted at rates between 10% and 15% per annum for the life of the project.

| Year | Savings in U.S. $ | | Discounted at 10% | | at 15% |
|---|---|---|---|---|---|
| 1984 | 13,700 | (.73) | 10,000 | (.61) | 8,400 |
| 1985 | 15,700 | (.66) | 10,400 | (.52) | 8,200 |
| 1986 | 17,600 | (.59) | 10,400 | (.44) | 7,700 |
| 1987 | 19,900 | (.53) | 10,500 | (.38) | 7,600 |
| 1988 | 618,800 | (.48) | 297,000 | (.32) | 198,000 |
| 1989 | 24,500 | (.43) | 10,500 | (.27) | 6,600 |
| 1990 | (591,900) | (.39) | (230,800) | (.23) | (136,100) |
| 1991 | 29,500 | (.35) | 10,300 | (.20) | 5,900 |
| 1992 | 32,200 | (.31) | 10,000 | (.17) | 5,500 |
| 1993 | 618,800 | (.28) | 173,300 | (.14) | 86,600 |
| 1994 | 38,200 | (.25) | 9,600 | (.12) | 4,600 |
| 1995 | 41,300 | (.23) | 9,500 | (.10) | 4,100 |
| 1996 | 44,700 | (.21) | 9,400 | (.09) | 4,000 |
| 1997 | (570,600) | (.19) | (108,400) | (.07) | (39,900) |
| 1998 | 618,800 | (.17) | 105,200 | (.06) | 37,100 |
| 1999 | 55,700 | (.15) | 8,400 | (.05) | 2,800 |
| 2000 | 59,600 | (.15) | 8,900 | (.04) | 2,400 |
| 2001 | 64,000 | (.14) | 9,000 | (.04) | 2,600 |
| 2002 | 68,500 | (.12) | 8,200 | (.03) | 2,100 |
| 2003 | 618,800 | (.11) | 68,199 | (.02) | 12,400 |
| | TOTAL SAVINGS U.S. $ | | 439,500 | U.S.$ | 230,600 |

| | Savings | | Costs | Net Benefit |
|---|---|---|---|---|
| | Road Use | Road Maint. | Road Repair & Mainten. | (Cost) |
| 1982 | - 0 - | - 0 - | 1,312,200 | (1,312,200) |
| 1983 | 124,700 | - 0 - | 3,936,400 | (3,811,700) |
| 1984 | 404,300 | 13,700 | 25,200 | 392,800 |
| 1985 | 436,500 | 15,700 | " | 427,000 |
| 1986 | 471,700 | 17,600 | " | 464,100 |
| 1987 | 509,300 | 19,900 | " | 504,000 |
| 1988 | 550,000 | 618,800 | " | 1,143,600 |
| 1989 | 594,000 | 24,500 | " | 593,300 |
| 1990 | 641,100 | (591,900) | 644,000 | (594,800) |
| 1991 | 692,400 | 29,500 | 25,200 | 696,700) |
| 1992 | 747,900 | 32,200 | " | 754,900 |
| 1993 | 807,500 | 618,800 | " | 1,401,100 |
| 1994 | 872,300 | 38,200 | " | 885,300 |
| 1995 | 942,300 | 41,300 | " | 958,400 |
| 1996 | 1,017,800 | 44,700 | " | 1,037,300 |
| 1997 | 1,099,000 | (570,600) | 644,000 | (115,600) |
| 1998 | 1,187,200 | 618,800 | 25,200 | 1,780,800 |
| 1999 | 1,281,800 | 55,700 | " | 1,312,300 |
| 2000 | 1,384,300 | 59,600 | " | 1,418,700 |
| 2001 | 1,495,100 | 64,000 | " | 1,533,900 |
| 2002 | 1,614,900 | 68,500 | " | 1,658,200 |
| 2003 | 1,744,[illegible]00 | 618,800 | " | 2,337,700 |

The internal rate of teturn, that point at which the benefit/cost ratio is 1 to 1, is 12%. This figure has been rounded. (Using the HP 38, the actual figure is 11.63%).

## BENEFIT/COST ANALYSIS

This is the ratio between benefits and costs over the life of the project (20 years) at varying discount rates. Difficulties arise in projects like the Zim-Zam Road where costs are easily quantifiable, yet the benefits are less discrete and are more discretionary. Two categories of benefits are quantified, road user savings and road maintenance savings.

| | Benefits @ 10% discount | Benefits @ 15% discount |
|---|---|---|
| 1983 | U.S. $ 112,200 | U.S. $ 106,000 |
| 1984 | 337,500 | 299,500 |
| 1985 | 329,000 | 274,500 |
| 1986 | 321,700 | 253,000 |
| 1987 | 311,000 | 231,700 |
| 1988 | 588,500 | 407,000 |
| 1989 | 295,600 | 196,700 |
| 1990 | 44,900 | 37,000 |
| 1991 | 280,300 | 165,200 |
| 1992 | 271,800 | 155,100 |
| 1993 | 423,000 | 223,900 |
| 1994 | 253,800 | 126,700 |
| 1995 | 245,100 | 117,200 |
| 1996 | 243,500 | 105,800 |
| 1997 | 122,400 | 59,000 |
| 1998 | 330,800 | 120,200 |
| 1999 | 226,300 | 79,700 |
| 2000 | 216,500 | 71,600 |
| 2001 | 233,300 | 77,400 |
| 2002 | 234,300 | 66,700 |
| 2003 | 277,400 | 64,700 |
| NPV Total U.S. $ | 5 699,500 | 3,238,600 |

## BENEFIT/COST RATIO

At a discount rate of 10% over the life of the project, using vehicle and maintenance savings as the only benefits and using construction and maintenance expenses as the only costs, the benefit/cost ratio is U.S.$5,699,500 to 4,890,400 or 1.165.

Using a discount rate of 15% the benefit/cost ratio is less than 1, it is 3,2 38,600 to 4,233,600 or 0.765.

## UNITIZED MEASUREMENTS
## Or COST COMPONENTS

Under the Fixed Amount Reimbursable contract (FAR), road rehabilitation costs will be reimbursed on the basis of completed units. These figures have been checked and approved by AID negineers as reliable indicators of probable contracting costs. All figures include a 20% inflation factor over December, 1981 costings and a miscellaneous surcharge to cover the remoteness of the site and subsequent higher contract costs. Figures are translated into U.S. dollars at 1.40 per Z$1.00.

Reconstruction (12 kms) Costs are based on past and current contracts between the MOR and private contractors and have been reviewed by AID engineers. These costs are based on a 7 m. surface, 10 m. formation, with a spray and stone surfacing, base, sub-base and selected earth fill.

| | per km | for 12 kms |
|---|---|---|
| a) earthwork removal | US$ 114,800 | US$ 1,377,600 |
| b) earthwork reinstatement | 84,000 | 1,008,000 |
| c) base 2 | 28,700 | 344,400 |
| d) base 1 | 30,100 | 361,200 |
| e) surfacing | 25,200 | 302,400 |
| | US$ 282,800 | US$ 3,393,600 |

Reshoulder and Reseal. (28 kms) Costs based on 120 mm of base 1 material on shoulders, 1.5 m. from the road bed, also clearing and drain repairs. Reseal is done by using 7 mm stone chips over the full width of the road and shoulders with resealing material.

| | per km | for 28 kms |
|---|---|---|
| Resealing and Reshouldering | US$ 23,800 | US$ 666,400 |

Total in US$ 4,060,000. A small contingency amount of US$140,000 is included bringing the total to U.S.$4,200,000.

## TOTAL CONSTRUCTION COSTS

Stated in U.S. dollars (at 1.4 per Z$ 1.00) and showing GOZ contributions and proposed USAID disbursements.

| Task | AID | GOZ |
|---|---|---|
| Reconstruction (12 kms) | US$ 3,393,600 | |
| Reseal of shoulder (28 kms) | 666,400 | |
| Base Gravel | | US$ 806,400 |
| Surfacing stone | | 207,200 |
| Consulting Engineer | | 235,200 |
| Total | US$ 4,060,000 | US$1,248,800 |

Total Project cost U.S.$ 5,308,800.00

USAID 77% GOZ 23%

## 5C(2) - PROJECT CHECKLIST

Listed below are statutory criteria applicable generally to projects with FAA funds and project criteria applicable to individual funding sources: Development Assistance (with a subcategory for criteria applicable only to loans); and Economic Support Fund.

A. GENERAL CRITERIA FOR PROJECT.

1. Continuing Resolution Unnumbered; FAA Sec. 634A; Sec. 653(b).

   (a) Describe how authorizing and appropriations Committees of Senate and House have been or will be notified concerning the project; (b) is assistance within "Operational Year Budget" country or international organization allocation reported to Congress (or not more than $1 million over that amount)?

   Project described in CP on page 534. Congress notified by CN on September 11, 1981.

2. FAA Sec. 611(a)(1). Prior to obligation in excess of $100,000, will there be (a) engineering, financial, other plans necessary to carry out the assistance, and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?

   (a) Yes

   (b) Yes

3. FAA Sec. 611 (a)(2). If further legislative action is required within recipient country, what is the basis for reasonable expectation that such action will be completed in time to permit

   N/A

| | | |
|---|---|---|
| | orderly accomplishment of purpose of the assistance? | |
| 4. | FAA Sec. 611(b); Continuing Resolution Sec. 501. If for water or water-related land resource construction, has project met the standards and criteria as set forth in the Principles and Standards for Planning Water and Related Land Resources, dated October 25, 1973? | N/A |
| 5. | FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability effectively to maintain and utilize the project? | Yes |
| 6. | FAA Sec. 209. Is project susceptible of execution as part of regional or multilateral project? If so why is project not so executed? Information and conclusion whether assistance will encourage regional development programs. | Project is being executed with regional monies as part of donor effort to improve transport within Southern Africa region. Other donors are funding other transport projects. |
| 7. | FAA Sec. 601(a). Information and conclusions whether project will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; and (c) encourage development and | Project will assist with upgrading an important road link with Zambia through which international trade flows. Project will support the strengthening of items (b) and (c). |

use of cooperatives, and credit unions, and savings and loan associations;. (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions.

| | | |
|---|---|---|
| 8. | FAA Sec. 601(b). Information and conclusion on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise). | Project will provide an opportunity for U.S. firms to compete for contracts. |
| 9. | FAA Sec. 612(b), 636(h); Continuing Resolution Sec. 508. Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized in lieu of dollars. | Zimbabwe is contributing approximately $1.2 million in cash for contracts and an undetermined amount for services. |
| 10. | FAA Sec. 612(d). Does the U.S. own excess foreign currency of the country and, if so, what arrangements have been made for its release? | N/A |

11. FAA Sec. 601(e). Will the project utilize competitive selection procedures for the awarding of contracts, except where applicabale procurement rules allow otherwise? — Yes.

12. Continuing Resolution Sec. 522. If assistance is for the production of any commodity for export, is the commodity likely to be in surplus on world markets at the time the resulting productive capacity becomes operative, and is such assistance likely to cause substantial injury to U.S. producers of the same, similar or competing commodity? — N/A

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria. — N/A

a. FAA Sec. 102(b), 111, 113, 281(a). Extent to which activity will (a) effectively involve the poor in development, by extending access to economy at local level, increasing labor-intensive production and the use of appropriate technology, spreading investment out from cities to small towns and rural areas, and insuring wide participation of the poor in the benefits of development on a sustained basis, using the appropriate U.S. institutions; (b) help

develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and otherwise encourage democratic private and local governmental institutions; (c) support the self-help efforts of developing countries; (d) promote the participation of women in the national economies of developing countries and the improvement of women's status; and (e) utilize and encourage regional cooperation by developing countries?

b. <u>FAA Sec. 103, 103A, 104, 105, 106, 107.</u> Is assistance being made available: (include only applicable paragraph which corresponds to source of funds used. If more than one fund source is used for project, include relevant paragraph for each fund source.) N/A

(1) [103] for agriculture, rural development or nutrition; if so (a) extent to which activity is specifically designed to increase productivity and income of rural poor;[103A] if for agricultural research, full account shall be taken of the needs of small farmers, and extensive use of field testing to adapt basic research to local conditions shall be made; N/A

(b) extent to which assistance is used in coordination with programs carried out under Sec. 104 to help improve nutrition of the people of developing countries through encouragement of increased production of crops with greater nutritional value, improvement of planning, research, and education with respect to nutrition, particularly with reference to improvement and expanded use of indigenously produced foodstuffs; and the undertaking of pilot or demonstration of programs explicitly addressing the problem of malnutrition of poor and vulnerable people; and (c) extent to which activity increases national food security by improving food policies and management and by strengthening national food reserves, with particular concern for the needs of the poor, through measures encouraging domestic production, building national food reserves, expanding available storage facilities, reducing post harvest food losses, and improving food distribution.

(2) [104] for population planning under sec. 104(b) or health under sec. 104(c); if so, (i) extent to which activity emphasizes low-cost, integrated delivery systems for health, nutrition and family planning for the poorest people, with

N/A

particular attention to the needs of mothers and young children, using paramedical and auxiliary medical personnel, clinics and health posts, commercial distribution systems and other modes of community research.

(3) [105] for education, public administration, or human resource development; if so, extent to which activity strengthens non-formal education, makes formal education more relevant, especially for rural families and urban poor, or strengthens management capability of institutions enabling the poor to participate in development; and (ii) extent to which assistance provides advanced education and training of people in developing countries in such disciplines as are required for planning and implementation of public and private development activities. N/A

(4) [106; ISDCA of 1980, Sec. 304] for energy, private voluntary organizations, and selected development activities; if so, extent to which activity is: (i) (a) concerned with data collection and analysis, the training of skilled personnel, research on and development of suitable energy sources, and pilot

projects to test new methods of energy production; (b) facilitative of geological and geophysical survey work to locate potential oil, natural gas, and coal reserves; and (c) a cooperative program in energy production and conservation through research and development and use of small scale, decentralized, renewable energy sources for rural areas;

(ii) technical cooperation and development, especially with U.S. private and voluntary or regional and international development, organizations;

(iii) research into, and evaluation of, economic development process and techniques;

(iv) reconstruction after natural or man-made disaster;

(v) for special development problems, and to enable proper utilization of earlier U.S. infrastructure, etc., assistance;

(vi) for programs of urban development, especially small labor intensive enterprises, marketing systems, and financial or other institutions to help urban poor participate in economic and social development.

| | |
|---|---|
| c. [107] is appropriate effort placed on use of appropriate technology? (relatively smaller, cost-saving, labor using technologies that are generally most appropriate for the small farms, small businesses, and small incomes of the poor.) | |
| d. FAA Sec. 110(a). Will the recipient country provide at least 25% of the costs of the program, project, or activity with respect to which the assistance is to be furnished (or has the latter cost-sharing requirement been waived for a "relatively least developed" country)? | N/A, but at least 23% of the cost of the project will be provided by Zimbabwe. |
| e. FAA Sec. 110(b). Will grant capital assistance be disbursed for project over more than 3 years? If so, has justification satisfactory to Congress been made, and efforts for other financing, or is the recipient country "relatively least developed?" | N/A, but the funds will be disbursed within two years. |
| f. FAA Sec. 281(b). Describe extent to which program recognized the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civil education | N/A |

and training in skills required for effective participation in governmental processes essential to self-government.

g. FAA Sec. 122(b). Does the activity give reasonable promise of contributing to the development of economic resources, or to the increase of productive capacities and self-sustaining economic growth? N/A

2. Development Assistance Project Criteria (Loans Only) N/A

a. FAA Sec. 122(b). Information and conclusion on capacity of the country to repay the loan, at a reasonable rate of interest.

b. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete with U.S. enterprises, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan? N/A

3. Project Criteria Solely for Economic Support Fund.

a. FAA Sec. 531(a). Will this assistance promote economic or political stability? To the extent possible, does it reflect the policy directions of FAA Section 102?

Project will help increase economic stability of Zimbabwe by facilitating the opening of new markets and improving the access to other trade routes.

| | |
|---|---|
| b. FAA Sec. 531(c). Will assistance under this chapter be used for military, or paramilitary activities? | No. |

INITIAL ENVIRONMENTAL EXAMINATION

OR

CATEGORICAL EXCLUSION

Project Country: Southern Africa Regional

Project Title: Regional Transport and Storage (690-0209) Phase

Funding: FY (s) 1981 $ 990,000

IEE Prepared by: D. Reilly, chief Engineer, REDSO/EA, Feb., 1981
Revised 5/28/81, A. Harding, AFR/DR/SAP

Environmental Action Recommended:

Positive Determination _____
Negative Determination X

Approved:
AFR/DR/SDP:BBoyd 6/1/81

Concurrence: Martin V. Dagata
~~Director, AFR/SA~~

Clearance: GC/AFR Date 6/1/81

The r[illegible] to be repaired passe[illegible] through rolling to hilly terrain in southern Zam[illegible] and crosses the Zambezi River flood plain in northern Zimbabwe. The rainfall averages 30 inches per year with heavy rains in December through March period. The area is sparsely populated with from 2 to 10 people per square kilomete

The soils are problematical in Zimbabwe as discussed above; no special foundation problems will occur in Zambia. The vegetation is savanna near the river, changing to broadleaf deciduous forest with many grassy openings north of the river valley.

## Discussion of Environmental Impacts

### A. Land Use

The work proposed will not require additional land use since the existing right-of-way will be used. Runoff in the hilly areas is heavy and erosion in certain areas has been a problem. The proposed work will improve the drainage channels and result in reduced erosion. Fill material to be imported will be from existing gravel and borrow pits and it is unlikely that additional land will be used for such purposes.

### B. Water Quality

Minimal impact on water quality is expected because no change in natural waterways is anticipated. Drainage will be improved as discussed in A above.

### C. Atmosphere

Pollution due to dust can be expected during the reconstruction period, but will not be excessive. Noise and exhaust fumes from the construction effort will not be more objectionable than that being experienced from the heavy goods wagon now using the road. The low population density will further limit the number of disaffected persons.

D: Natural Resources

The project will not cause any inefficient utilization or waste of natural resources in the area. Although the road in Zimbabwe passes through a controlled hunting area, wildlife in the area have adjusted to the existing road and no additional obstruction to their movement will occur. Some dislocation may take place during construction, but the effects will be temporary. Elephant crossings are numerous and are well marked with signs. A national monument protecting a small fossil forest on the Zimbabwe side is already fenced and marked and will not be touched. With the exception of temporary changes, no negative impact on vegetation is anticipated.

E. Cultural:

No additional dilution of cultural patterns will occur as a result of this road improvement.

F. Socio-Economic

Positive changes will result from improved, year-round access of the population to regional markets and government social services. In addition, the population of Zambia, in particular, will benefit by assured accessibility to maize shipped from or through Zimbabwe to Zambia along the routes proposed for rehabilitation.

Recommendations for Environmental Action

The proposed improvements of this road will have numerous positive effects of a socio-economic nature, not only on the population within the road's zone of influence, but also in terms of food availability on the population of Zambia, in particular. Other environmental impacts will either be minimally negative (land use), temporarily negative (water quality, atmospherics, natural resources) or neutral (culture). Since the proposed improvements envision utilization of the existing road's right of way, without realignment, the overall impact of the project will not be negative. If any minor realignments are developed during engineering design, the REDSO Regional Environmental Officer will examine the acceptability of the proposed changes to ensure that appropriate corrective measures are incorporated into the final plans and specifications. In view of the preceding a negative determination is requested.

Annex F

Exhibit 3

## 611(e) CERTIFICATION

Southern Africa Regional Transport and Storage Development (690-0209)

## MAKUTI-CHIRUNDU ROAD

I, Roy A. Stacy, the principal officer of the Agency for International Development in Zimbabwe, having taken into account among other factors, the uses which have been made of projects or programs in Zimbabwe previously financed or assisted by the United States; and the commitment of the Government of Zimbabwe to meet the support costs associated with this project, do hereby certify that in my judgment the Government of Zimbabwe has both the financial and human resource capability to effectively utilize and maintain the capital assistance activity to be carried out under this project.

Roy A. Stacy
Director: USAID /Zimbabwe

Date: