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INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT  
INTERNATIONAL DEVELOPMENT ASSOCIATION

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APPRAISAL OF  
A HIGHWAY RECONSTRUCTION PROJECT  
ZAMBIA

September 7, 1966

CURRENCY EQUIVALENTS

Currency Unit:		Zambian Pound (LZ)
U.S. \$1	=	LZ .357
LZ 1	=	U.S. \$2.80
LZ 1,000,000	=	U.S. \$2,800,000
LZ 1	=	240 pence
1 pence	=	U.S. ¢ 1.16

FISCAL YEAR

July 1 - June 30

WEIGHTS AND MEASURES

English

ZAMBIA

APPRAISAL OF A HIGHWAY RECONSTRUCTION PROJECT

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## ZAMBIA

### APPRAISAL OF A HIGHWAY RECONSTRUCTION PROJECT

#### SUMMARY

- i. The Government of the Republic of Zambia has asked the Bank to help finance the improvement of the Great East Road linking Lusaka, the capital, with the agriculturally-rich Eastern Province and Malawi, and of the Great North Road, linking the center of Zambia with the Northern Province and East Africa.
- ii. The project consists of: (1) the reconstruction and bituminous paving of two sections of the Great East Road, totalling 251 miles; (2) the reconstruction and bituminous paving of a 122-mile section of the Great North Road and (3) the engineering and supervision of construction of the above road sections and the detailed engineering of a further 147-mile section of the Great North Road by consultants. The project is expected to be completed by the end of 1969.
- iii. The cost of the project is estimated at about \$29 million equivalent, including engineering and contingencies. The construction cost estimate is based on actual contract prices for the project works, which have already been put to tender. The foreign exchange cost component is estimated at about 60 per cent, or about \$17.5 million equivalent and would be financed by the proposed loan. The Government would finance the local currency requirements.
- iv. Design of the road sections to be reconstructed has been carried out by engineering consultants. All construction contracts have been awarded on a unit price basis and in accordance with procedures satisfactory to the Bank. Execution of the project is the responsibility of the Roads Department of the Ministry of Works. Supervision of construction is being performed by consultants.
- v. The project has high priority in the Government's highway program, which is based on recommendations of the Bank-financed survey of transport in Zambia. Reconstruction of the road sections will reduce transport costs substantially and prevent a rapid rise in transport costs in the near future. The estimated rate of economic return on the investment from savings in transport and road maintenance costs is about 12-13 per cent, which is satisfactory. Other benefits can also be expected from the project, although they are not readily quantifiable.
- vi. Design standards have been determined on the basis of normal traffic requirements. The present extraordinary transport problem facing Zambia may cause heavier than normal traffic loading on the project roads. However, the road built to normal standards would be capable of sustaining heavier than normal traffic loadings for a substantial period of time, and the proposed standards are considered appropriate by both the Government and the Bank.

vii. During loan negotiations the Government confirmed its intention to make adequate budgetary allocations to properly maintain the country's road system and to improve maintenance of the roads under the responsibility of the Rural Local Authorities. The Government will also ensure that the professional standard and strength of the Roads Department is maintained and increased if necessary to carry out the road development program now in preparation.

viii. The Government has agreed to conduct an investigation to determine the appropriate extent of competition between goods carriers in the areas affected by the road improvements in the Project, and to initiate the administrative steps required to remove restrictions to this competition.

ix. The project constitutes a suitable basis for a Bank loan in the amount of US\$17.5 million equivalent. An appropriate loan term would be 20 years including a four year period of grace.

## ZAMBIA

### APPRAISAL OF A HIGHWAY RECONSTRUCTION PROJECT

#### 1. INTRODUCTION

1.1. The Government of the Republic of Zambia submitted in July 1965 an application to the Bank to help finance (1) the reconstruction of two sections of the 386-mile Great East Road from Lusaka to the Malawi border, (2) reconstruction of a section of the Great North Road from Kapiri Mposhi to Mpika, and (3) reconstruction of the Mpika-Lake Tanganyika road. The Government's application covered a total of 728 miles of road for reconstruction, and was based primarily on the findings of the Netherlands Engineering Consultants (NEDECO), who in 1964 conducted a transport survey of Zambia which was financed by the Bank. A Bank appraisal mission visited Zambia in November/December 1965 and found the reconstruction of the two sections of the Great East Road (251 miles) and a 122-mile section of the Great North Road ready for appraisal and suitable for financing. The detailed engineering of the remainder of the Great North Road section (147 miles) was also found suitable for financing at this time. The Mpika-Lake Tanganyika road section was not ready for appraisal.

1.2. This appraisal report is based on the recommendations of the NEDECO survey, on engineering and economic studies carried out by the Roads Department, on final engineering and design carried out by the engineering consultants (Brian Colquhoun and Partners, and Edwards and Burrows), and on the findings of the Bank appraisal mission consisting of Messrs. Soges and Jaycox.

1.3. This would be the first lending operation by the Bank or IDA in independent Zambia. Previously, the Bank made two loans for railways (NR-74 and RN-197) in Northern and Southern Rhodesia and two loans for power (RN-145 and RMS-392) to the Central African Power Corporation jointly owned by Zambia and Rhodesia. Zambia has assumed responsibility for its share of these lendings.

#### 2. BACKGROUND

2.1. Zambia is a landlocked country in central Africa with an area of about 291,000 square miles, comparable to the areas of France and West Germany combined. Zambia's population is estimated at 3.7 million, and is growing at an estimated rate of 2.8 per cent per annum. Ninety-eight per cent of the population is of African origin. The Gross Domestic Product (at factor cost) in 1965 is estimated at E2 306 million (\$858 million equivalent) and the annual per capita income is about \$232.

2.2. Most of Zambia is a high plateau with a general elevation of between 3,500 and 4,500 feet. The plateau is cut by the valleys of the Zambezi River and its tributaries, the Kafue and the Luangwa. The geology of the northeastern and eastern parts of the country is affected by the Great African Rift Valley. Vegetation is predominantly of wooded

savanna type; the climate is tropical and average annual rainfall ranges from 50 inches in the northeast decreasing southwestward to about 30 inches around Lusaka, the capital. The southwestern parts of the country verge on the Kalahari Desert. Rainfall is seasonal and concentrated in the months December through March.

2.3. Zambia's economy has two main sectors. The primary sector is the copper mining and refining industry which dominates the economy and constitutes the third largest in the world, ranking in value of output after those of the U.S. and U.S.S.R. Copper production is valued at about £Z 137 million per annum and accounts for nearly 50 per cent of GDP and 90 per cent of export proceeds. The second main productive sector consists of European farming primarily situated astride the rail line serving the copper industry.

2.4. Economic activity in Zambia is concentrated in the "Copperbelt" and along the "Line of Rail." The Copperbelt is a relatively small area located in the north central part of the country against the border with Katanga Province of the Congo. The Line of Rail area is a narrow, north-south strip where the larger towns of the country are located and the bulk of the economic and administrative activity takes place. Neither the copper industry nor the European farming has had much effect upon the development of the rest of Zambia. Zambia's population is essentially rural and engaged in subsistence farming. Less than one third of the people live within the zone of influence of the Line of Rail/Copperbelt complex.

2.5. During the country's federation with Rhodesia and Nyasaland (1953-1963), the economy grew in real terms at the relatively slow annual rate of about 3.6 per cent. In the period 1960-1963, GDP virtually stagnated mainly due to a fall in copper prices and the political uncertainties arising out of the movement toward dissolution of the Federation (December 31, 1963) and achievement of national independence (October 24, 1964). However, in 1964 the economy registered an 8.9 per cent increase in real GDP, and in 1965 an increase of about 9 per cent is again expected.

### 3. TRANSPORT SYSTEM

#### A. General

3.1. Zambia's transport system consists of 665 miles of railway line, 20,800 miles of public roads, water transport in some limited areas, and a network of light aircraft services. The share of transport in GDP is only about 4 per cent; this share appears low because copper accounts for such a large proportion of GDP. In 1964, the Bank financed a survey of transportation in Zambia by NEDECO which recommended a transport development plan for the period 1966-1970. As a landlocked country depending heavily on exports and imports, Zambia must concern itself with ensuring a reliable access to the sea as well as building a practical internal network to facilitate economic development.

B. Access to the Sea (see Map 1)

3.2. Zambia's primary link to the sea is via the Rhodesia Railways from the Copperbelt through Southern Rhodesia to the Mozambique ports of Beira and Lourenco Marques, both about 1,500 rail miles from the Copperbelt. The Rhodesia Railways is owned in equal shares by the Governments of Zambia and Southern Rhodesia and is operated by a well-managed statutory corporation as a common service to the two countries. Existing alternative rail routes include: (1) the Bas-Congo-Katanga (BCK)-Benguela railways through Katanga Province and Angola to the Angolan port of Lobito; (2) the Katanga-Matadi rail/water route via Port Francqui; and (3) the Katanga-Lake Tanganyika-East African Railways line to Dar es Salaam, Tanzania. In addition to the alternative rail links, Zambia is connected through its trunk road network to the neighboring national highway/rail systems in Tanzania and Malawi, which provide outlets to the sea. However, road transport of bulk imports or exports appears impractical except as an emergency solution in a situation where rail access is temporarily denied.

3.3. The movement of Zambia's copper production (currently about 750,000 tons per year) has been historically governed by several international agreements <sup>1/</sup>, which have had the effect of ensuring that at least 80 per cent of Zambia's copper output would move via the Rhodesia Railways and the port of Beira. A 1960 arrangement between the Federal Government and the Copperbelt Mines has limited export via Lobito to 36,000 tons per annum. As a result of these arrangements, the alternative rail routes have not developed sufficient capacity to handle more than a small amount of Zambian copper. Relatively small capital investments would be required to increase the capacity of the Lobito route. When the Federation of Rhodesia and Nyasaland was being dissolved (December 1963), Zambia and Southern Rhodesia signed an agreement which stipulates that either Government would compensate the Rhodesia Railways for financial losses arising from any unilateral decision that it might take to build or to use alternate rail systems which would divert existing traffic or deny new traffic to the Railways. Under normal circumstances, most of Zambia's imports, a high percentage of which originate in Rhodesia (including the coal and coke from Wankie required for copper refining), have also utilized the Rhodesia Railways.

3.4. The orientation of Zambia's trade, economy, and transport facilities toward Southern Rhodesia is an outcome of African history and Zambia's federal past. It is the established long-range policy of the Government of Zambia to reduce the country's dependence upon Southern Rhodesia for access to the sea and for the supply of a wide variety of

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<sup>1/</sup> The Tripartite Agreement between Rhodesia Railways, Chemin de Fer du Bas Congo au Katanga, and Caminho de Ferro de Benguela (1956); the Beira Convention between the U.K. (on behalf of Zambia, Malawi, Rhodesia and the U.K.) and Portugal (1950); the Agreement between Southern Rhodesia and Northern Rhodesia relating to Rhodesia Railways (1963).

manufactured and raw material requisites. Zambia wishes to develop new and closer trade relations with neighboring nations to the north and east, and to change the inherited and somewhat arbitrary pattern of international traffic. Pursuant to this policy, Zambia, together with Tanzania, have announced their intention to build a rail link between the Rhodesia Railways system and the East African Railways. This policy has continued to evolve despite the findings of a Bank mission (1963) and of the NEDECO mission (1964) that construction of the Zambia-Tanzania rail link could not be justified on economic or financial grounds for at least 10 to 15 years.

3.5. The rail link proposal is now being studied by a joint UK/Canadian team of economic and engineering consultants under the leadership of Maxwell Stamp Associates, at the request of the Governments of Tanzania, Uganda, Kenya and Zambia. The terms of reference of the study do not include systematic studies of alternative routes and modes and stipulate that consideration be given to strategic and political factors which were not considered in the Bank or NEDECO studies. USAID has financed a study by another consulting firm, the Stanford Research Institute, of the Great North Road in Zambia and Tanzania as an alternative trunk connection with East Africa. The field work for both the USAID and UK/Canadian studies was completed early in 1966; draft reports have been submitted for Government comment and are expected to be finalized in the near future.

3.6. The unilateral declaration of independence (UDI) by Southern Rhodesia has aggravated the already sensitive political atmosphere of Central Africa and faced Zambia with an emergency transport situation. Since UDI, the Zambian Government has given added priority to the long-range policy of altering the country's international transport pattern. At this time copper movement through Rhodesia on the railway has been reduced to a minimum monthly allocation, due to a dispute between Zambia and Rhodesia with regard to Rhodesia's demand of prepayment in foreign currency for the transport of copper by Rhodesia Railways. The shipment of copper by various alternate routes is proceeding on an emergency basis. Due to the international embargo on oil for Rhodesia, Zambian petroleum imports, formerly shipped entirely by rail via Rhodesia, are now being transported over the Great North Road from Dar es Salaam and on a smaller scale via the Malawi railway system and the Great East Road.

### C. Internal Transport

3.7. Within Zambia, the Rhodesia Railways contributes little to the internal exchange among the various regions. Extension of the rail system to meet inter-regional transport requirements is not practical. However, the road network, which branches from the main trunk road along the rail line, is basically appropriate for meeting these needs. River and canal transport and air transport, while important in certain areas or for limited purposes, are not suited to the major task of integrating the economy. As far as transport is concerned, the process of economic development and diversification will be helped most by investment in improving the existing trunk road network and in improving and constructing agricultural feeder roads.

#### D. Highway Transport

##### Highway Traffic and Vehicle Fleet

3.8. Highway transport in Zambia is relatively undeveloped. It is mainly concentrated in the line of rail, utilizing the country's only long distance bitumen-surfaced highway. Light vehicle traffic is especially concentrated in this area. Traffic on the gravel trunk roads to the outlying areas is generally heaviest near the rail line, and falls off rapidly according to distance from the rail, except for the Great East Road where traffic thins out from Lusaka but then grows in proximity to Fort Jameson.

3.9. The motor vehicle fleet of Zambia expanded rapidly in the 1950's until the general economic downturn of the early 1960's. Since 1960, the average growth rate of the light vehicle fleet (cars, pickups, etc.) has been 7 per cent per annum, while for trucks and tractor-trailers, the expansion has been on the order of 4 per cent (see Table 1). Statistical information on vehicle age is limited, but on the basis of registration data the fleet appears to be relatively young, with over 60 per cent of all vehicles less than 5 years old. The road fleet should expand more rapidly in the next few years, as a result of the current economic boom and the extraordinary transport situation.

3.10. Over the decade 1954-1964, road consumption of gasoline rose about 6 per cent per annum. During 1960-1964, gasoline consumption increased at only 3.5 per cent, reflecting the shift of virtually all truck consumption to diesel fuel, a gradual shift from heavier to lighter passenger vehicles, and the general economic slowdown. Diesel fuel consumption by road users rose 13 per cent in 1963 and over 28 per cent in 1964 (see Table 2).

3.11. On the basis of a 50-point traffic count system instituted under the supervision of the U.K. Road Research Laboratory in 1961, the current traffic growth is estimated at about 8 per cent per annum. NEDECO, in its transport survey, concludes that an over-all traffic growth rate of 7 per cent can be expected in Zambia.

##### Highway Transport Industry

3.12. Most of the commercial vehicles engaged in public road transport are run by small owner-operator firms. However, the industry is dominated by two relatively large companies: Central African Road Services (CARS), a subsidiary of the United Transport Group (U.K.); and Smith and Youngson, Ltd. CARS is the largest single transport organization; it has a near monopoly of passenger road transport by virtue of a 21-year concession (until 1976) to provide required passenger service throughout the country. CARS is also the largest public carrier of goods, and by contract is currently the exclusive carrier of government traffic over the roads. This situation is undergoing rapid change. In order to reduce the country's dependence on Rhodesia Railways for access

to the sea, the Government is establishing a government-controlled trucking company jointly with Tanzania and a foreign vehicle supplier, which will operate over the Great North Road, carrying bonded export/import goods.

3.13. Under existing regulations, all public transport must be licensed by the Road Traffic Commissioner except concession holders (presently only CARS for passenger service). No special license is required of traders or employers who transport their own goods or employees. Each applicant for a goods-carrying license on a particular route must prove the need for his service in a public hearing. Under the passenger concession, bus service by other than the concession holder cannot be introduced without the consent of CARS. In all reasonable cases, the Road Traffic Commissioner may require CARS to provide the service.

3.14. The Road Traffic Commissioner also has the power to fix rates and fares. In practice, this power has been exercised only in instances of price war chaos in specific areas. The two largest transport companies have a rate agreement between them and restrict their competition to service features. Most highway freight traffic outside the line of rail moves toward the outlying areas, because agricultural development has not yet proceeded far enough to balance the load factor. Truck transport rates are 20 per cent lower in the inbound direction to attract back loads. Average outbound transport rates are high, at about 7.5 pence (8.8 U.S. cents) per ton mile for van load quantities of dense materials. On the Great East Road, where truck operating costs are estimated to be significantly higher, but where the possibility of back loads is better than for most gravel trunk roads, the comparable charge is about 9 pence (10.5 U.S. cents) per ton mile. Rates appear high in relation to estimated vehicle operating costs including taxes and overheads.

3.15. The highway transport industry is not very competitive due to rate agreements and licensing restrictions but, in general, there is a reliable and adequate supply of transport for goods and passengers in most parts of the country served by adequate roads. However, considering that extensive main road and feeder road improvements are planned, more competition among highway transporters appears desirable. In order to ensure that road improvements yield maximum economic benefits, a policy of introducing transport competition as a corollary to highway and feeder road improvements should be followed. In rural areas, the freight licenses now held by small owner-operators and cooperative transport organizations could be extended to include the main roads to market. This would tend to bring prices of main road transport closer to costs, and lower feeder road transport charges by permitting more efficient use of the truck fleet. During loan negotiations the Government agreed that an investigation would be conducted to determine the appropriate extent of competition between goods carriers in the areas to be affected by improvement of the project roads. The Government also agreed to initiate the administrative steps required to remove obstacles to the desired level of competition.

E. Road-Rail Competition

3.16. The Zambian Government and its predecessors have pursued a policy, in conjunction with Southern Rhodesia, of protecting the Rhodesia Railways from highway transport competition. By the 1963 agreement between Zambia and Southern Rhodesia concerning the Rhodesia Railways (see paragraph 3.3), Zambia has been bound to continue this policy. While this policy does not directly affect traffic on the project roads, it does affect the development of the road transport industry generally, and has led to uneconomic distortions in the transport system as a whole.

3.17. Protection of the Railways has in the past been implemented through private agreements, the Governments acting through the Railways management. By a 1960 agreement (renewed in 1963 for a 4-year period) between Rhodesia Railways and the Federal Long Distance Road Transport Operator's Association, the Association agreed to restrict its licensed capacities along the rail line within Zambia and on the Lusaka-Salisbury route, and not to solicit traffic consigned to or destined outside Zambia or Rhodesia. The Association also agreed that highway transporters would not charge less than the railroad for commodities in the high-rated rail tariff classes which apply to less-than-carload quantities and high value, low bulk items. For bulk goods, for which trucking is less competitive, road transporters are free to set their own rates. As a consequence, the railway is guaranteed a large share of the high-rated general goods traffic, and is enabled through cross-subsidization to quote rates for bulk goods that are so low that highway transport cannot compete. This arrangement creates economic distortions, but the Government has considered that they are justified because low bulk rates for certain low value commodities are important for the development of Zambia.

3.18. The railway mileage from Salisbury to Lusaka is 885 miles, whereas the direct road connection is only 305 miles. The railways charge their rates for 885 miles and by the agreement road transporters do the same. Undoubtedly the cost of transport on this route could be reduced considerably. Also, road haulage between Beira and Zambia, if allowed, might be considerably cheaper than rail for higher rated imported commodities.

3.19. It is clear that the present restrictions on road transport protect the railways from competition. Modification of rail rates would be required if the restrictions were relaxed. It is not recommended that the Bank require a change of policy in the field of road/rail transport coordination as a condition of this proposed lending since Zambia has not been free to change its policy unilaterally, and the situation with respect to transport is presently very unsettled. Recently, both Rhodesia and Zambia have expressed their desire to split the unified railway system and consultants are being engaged to examine how this should be done. The Bank is involved in discussions of this proposal, since Bank approval is required under certain of its loan agreements. The reorganization of the railway system should provide an appropriate occasion to reexamine the arrangements between the trucking enterprises and the railways in order to achieve a better coordination of transport.

## F. The Highway System

### Network (see Map 2)

3.20. The Zambian road network has been gradually built up in the last half century. The first roads were concentrated in the rail zone through which runs the country's main trunk road. With the progress of administrative control over outlying areas, and of economic activities further away, the public road network grew and spread. It reached its peak mileage early in this decade and at the end of 1965 stood at 20,818 miles, as shown in Table 3.

3.21. The only bituminous paved road is the trunk road along the rail line; other roads are gravel surfaced or earth roads. The geographical distribution of the main gravel roads is generally adequate to meet the current transport requirements of administration and economic activity. However, the structural and geometric standards of many of these main roads are not satisfactory. The main gravel roads are maintained in relatively good condition by continuous and, in many cases, laborious maintenance; however, many sections are inadequate for present traffic volumes and show signs of deterioration in the form of excessive corrugation in the long dry season and structural failure during the rainy season. Other sections can be expected to deteriorate rapidly in the near future as traffic grows. Feeder roads are generally poor and those for which the Rural Local Authorities are responsible (see paragraph 3.22) are poorly maintained if at all.

### Administration (see Chart)

3.22. The responsibility for the general administration of the road system is vested in the Director of the Roads Department under the Ministry of Transport and Works. The Roads Department is also in charge of the construction and maintenance of airfields and other civil engineering works. The Director's immediate responsibility is limited to the main roads and those district roads considered of national importance. The Rural Local Authorities are responsible for the other district roads and for the Rural Local Authority roads, while city streets come under municipal administration. The Road Traffic Commissioner, under the Ministry of Transport and Works, is responsible for vehicle licensing and highway transport regulations. The Mechanical Services Department takes care of road construction and maintenance equipment.

3.23. The Roads Department has central services in Lusaka and four regional divisions headed by Provincial Road Engineers. The central services include divisions for planning and economic studies, for engineering and design, for supervision of construction and maintenance, for central administration, and a laboratory for materials analysis. The provincial engineers are responsible for the execution of road maintenance and of minor design and construction work in their respective regions.

3.24. The Mechanical Services Department is a financially self-supporting organization which provides vehicles and plant for all government services on a hire basis. The Department has large central workshops in Lusaka, and is efficiently managed. The original cost value of the Department's road construction and maintenance equipment amounts to about £Z 2.0 million (US\$5.6 million equivalent). Renewals are made from a depreciation fund which is appropriated from the Department's revenues; annual allocations to the fund in recent years have been at the rate of 11 per cent of the original cost, which is satisfactory.

3.25. Functions and lines of authority in the Road Department, road regulations, and procurement procedures are appropriate. The "Roads and Road Traffic Ordinance" covers legal matters such as road classification, authority for construction and maintenance, vehicle and driving licenses, compulsory insurance, examination of vehicles, maximum dimensions and weight of vehicles, traffic regulations, etc. Rules for tendering and procurement procedures are set down in the "Financial Orders"; these rules are consistent with the general procedures required by the Bank.

3.26. All professional posts and most of the middle and lower level technical positions are held by expatriate civil servants under a program of the British Ministry for Overseas Development. However, there are vacancies which, in spite of serious efforts, have not been satisfactorily filled. While the shortage is within acceptable limits at the professional level, it is serious at the middle technical level. The percentage of positions filled by Zambian nationals has been slowly increasing, but is still low. The present staff is competent to perform all administrative functions, and to carry out the maintenance of the road system. With the assistance of consultants, this staff should also be able to carry out an appropriate road development program. In previous years, the Department's staff was heavily engaged in road design and construction. However, in view of the increases envisaged in road construction, the Government has adopted the policy of using the services of engineering consultants and contractors for major road construction projects to supplement as necessary the Department's own design and construction capacity. During loan negotiations, the Government agreed to: (1) make every effort to ensure that the professional standard and strength of the Roads Department will be maintained and increased if necessary; (2) continue the present policy of using engineering consultants and contractors for the design and construction of major road projects; and (3) assign a senior engineer within the Roads Department to have, as his primary responsibility, the administration of the proposed Bank project.

3.27. Technical education of Zambian nationals is in an early stage. A few students in engineering are enrolled in foreign universities through government scholarships. A technical college is in operation in Ndola, and a university is being established in Lusaka. Training courses are run by the Ministry of Works to provide foremen and road plant operators; these courses are being enlarged to meet rising needs.

### Highway Budgets and Funds (see Table 4)

3.28. Highway expenditures rose from E2 2.5 million in 1960/1961 to an estimated E2 5.0 million in 1965/66. The increase was not gradual: a sudden increase in the maintenance budget occurred between 1961/62 and 1962/63: the budget for new construction has been substantially increased between 1964/65 and 1965/66. The recent increase in the construction expenditures indicates the start of a new period of intensive road development. In 1966/67, new construction is expected to account for two thirds of highway expenditures; in the future, this share will probably increase.

3.29. Highway budget funds are allocated from general government revenues. In recent years, the highway budget was equivalent to about 6 per cent of the national budget, and investment in new construction represented about 10 per cent of the public capital formation. These figures must be considered as low; the NEDECO study recommends that 15 per cent of public capital investment be in the road system.

### Receipts from Road Users and Highway Costs

3.30. Government's receipts from road users accrue from the various import duties, fees, and taxes placed on private motor vehicle ownership and operation. It has been estimated that, as an order of magnitude, these receipts cover about half of the highway costs, as measured by administration, maintenance costs, and depreciation and interest on the total highway investments. While this is low, it is not unreasonable, considering the relatively small fleet compared to the length of the highway network, and the fact that in this early stage of the country's development the road system has also a relatively important social and administrative function to play which the transport industry and the private road users should not be expected to pay for. However, with general development and growth of traffic, consideration should be given to ensuring that a higher percentage of highway costs is covered from road user charges. The level of road user taxation should be considered in relation to the over-all problem of transport coordination (see paragraph 3.19).

### Maintenance

3.31. The Roads Department is directly responsible for the maintenance of the main road network (3,753 miles) and for about half of the district roads (6,750 miles), while the Rural Local Authorities are responsible for the rest of the district roads (6,725 miles) and for the Rural Local Authority roads (3,550 miles). The execution of the maintenance of the departmental roads is carried out by maintenance units operating from camps located throughout the country. Maintenance equipment is supplied on a hire basis by the Mechanical Services Department.

3.32. Maintenance of departmental roads is almost entirely mechanized; on other public roads, maintenance is generally done by hand. Contractors also are employed for major resurfacing and reconditioning of bituminous

roads. The Roads Department is adequately organized for road maintenance and its maintenance practices are sound.

3.33. Budgetary allocations for maintenance are insufficient. In recent years, an average amount of EZ 114 (\$320 equivalent) per mile was spent on the main and the district roads maintained by the Department. The average was higher on the main roads; for example, it amounted to EZ 173 (\$485 equivalent) per mile per year on the Great East Road. Expenditures for routine maintenance are considered sufficient, but periodic maintenance needs are not fully covered and the roads appear to be deteriorating.

3.34. While the condition of the roads maintained by the Roads Department is at the moment generally satisfactory, the condition of the roads maintained by the Rural Local Authorities is poor. The Local Authorities rely for road maintenance on grants from the central Government, which amount at present to EZ 23 (\$65 equivalent) per mile per year for the registered public roads, but there is also an unknown mileage of non-registered roads for which no central Government funds are allocated. This is the case for the feeder roads built in recent years by the Agriculture Department in connection with its development programs. Having no funds for road maintenance the Agriculture Department has tried to turn over these roads to the Roads Department or the Rural Local Authorities. It is now planned to introduce a system whereby the Rural Local Authorities will be able to raise funds through local taxes and levies, part of which would be used to maintain the roads under their authority.

3.35. During negotiations the Government confirmed its intention to allocate sufficient funds to maintain the highway system properly and to increase allocations from time to time consistent with the extension of the highway system and the increase in traffic. For the purpose of budgetary requests, the amount of necessary funds will be estimated by the Roads Department in accordance with sound engineering practices for all the roads maintained by the Department. The Department will also assist the Rural Local Authorities in estimating budget requirements for proper maintenance of roads under local jurisdiction. The Government also confirmed its intention to improve the maintenance of the roads under the responsibility of the Rural Local Authorities and to ensure that funds will be sufficient to achieve this purpose. It has been agreed that the Government and the Bank will exchange views from time to time regarding the amount of maintenance allocations for the highway system.

#### Construction Planning and Design Standards

3.36. The systematic planning of road development on a basis of economic justification and financial programming has recently been made a function of the Roads Department's division of planning. The programs are reviewed by the Office of National Development and Planning which has a unit in charge of transportation planning.

3.37. Design standards are codified, and a new edition issued in 1965 embodies latest technical developments. The standards follow American and British patterns, with appropriate adaptations to local conditions. The geometric standards and the pavement design methods make it practical to build and improve the roads in stages according to traffic densities. The design standards are considered appropriate.

3.38. Physical conditions are favorable for road construction and maintenance in most parts of Zambia. The terrain is generally flat or rolling. Natural materials suitable for road construction and maintenance exist in abundance except in the Kalahari sand region in the southwestern part of the country. Road construction and maintenance are relatively inexpensive.

#### Road Construction Industry

3.39. Most of the road contractors are locally established subsidiaries of foreign firms. The present capacity of the industry to undertake road works was recently assessed by the contractors' professional organization at the value of £Z 5 million per annum; this may be an overestimate. The value of road works carried out by contractors in 1965 has been estimated at £Z 2.5 million. Additional contractor capacity could be built up as necessary to meet increasing requirements of road development programs, since in normal circumstances there should be no difficulty in attracting outside contractors. Road construction contractors are prequalified and registered with the Roads Department.

#### Development Plans

3.40. Upon achieving independence, the Zambian Government drew up a Transitional Development Plan to run 18 months from January 1965 to June 1966. The road program of this period was based entirely on the NEDECO mission's recommendations. The first five-year development plan was being formulated while the appraisal mission was in the field: indications at that time were that the NEDECO recommendations were being followed. However, there was considerable pressure upon the Roads Department to include trunk road projects not considered by the consultants to be of high priority. The program recommended by NEDECO involved an estimated expenditure of £Z 17.3 million over the 5-year period 1965/66 - 1969/70, but it is now apparent that the costs to accomplish the works recommended have been considerably underestimated.

3.41. During negotiations the Government confirmed its plan to have a road program as part of its Four-Year Development Plan ready by the end of 1966, and agreed to discuss the road program with the Bank as soon as it has been established. The Government further agreed to discuss with the Bank annually, during the construction period of the project, any proposed changes in the road program. During these discussions the Bank should see that the pressures to increase the scope of the road program do not endanger the ability of the Roads Department to carry out the project.

#### 4. THE PROJECT

##### A. Description (see Map 2)

4.1. The project consists of: (1) the improvement, reconstruction and bituminous paving of two sections of the Great East Road, from Chelston to Rufunsa (92 miles) and from Nyimba to 3 miles east of Fort Jameson (159 miles); (2) the improvement and bituminous paving of a section of the Great North Road from Kapiri Mposhi to Serenje (122 miles); and (3) the engineering and supervision of construction on the above road sections and the detailed engineering by consultants of the Great North Road from Serenje to Mpika (147 miles). The Great East Road is a main artery linking Lusaka, the capital of Zambia (population about 120,000) with Fort Jameson, a provincial capital, and Malawi at Mchinje (total length 386 miles). The Great North Road is a main artery branching from the rail line at Kapiri Mposhi and providing a link with Tanzania to the northeast and to Lake Tanganyika to the north. The Great North Road is also part of the main highway from Cape Town, South Africa, to Nairobi, Kenya, and beyond. This road is paved all the way from Cape Town to Kapiri Mposhi.

4.2. The development of the Great East Road as a main artery commenced in the early 1930's. The only major structure on the road, the Luangwa River bridge, was opened to traffic in 1932. Originally, the road was an earth track, but it has undergone several stages of betterment. The alignment of the project sections has been progressively improved and they have been gravel surfaced, but to low standards. The road is better at the eastern end where it runs in long straight stretches. On the western end, the terrain is more hilly, and the gravel surface is weak.

4.3. The central section of the Great East Road between Rufunsa and Nyimba (118 miles) runs through mountainous terrain, with numerous curves and grades. The Roads Department began in 1957 to reconstruct this road section with its own forces to improved gravel standards. Work on 84 miles has been completed and the road is satisfactory for present and foreseeable traffic until about 1970-75. The remaining bad section is under reconstruction by Department forces; the Government intends to negotiate a contract to speed up the removal of this bottleneck and does not wish Bank financial assistance for this section. The condition of the central section of the road has bearing on the successful development of the traffic on the project sections of the road. During negotiations, the Government committed itself to complete reconstruction of the central section to satisfactory standards before December 31, 1968.

4.4. The Great North Road from Kapiri Mposhi to Mpika runs in long straight stretches through unchanging and almost horizontal terrain. This road has been substantially improved during the last decade from an old earth track and has been gravel surfaced. It will require only minor improvement in geometry before bituminous paving. However, riding conditions on the present gravel surface are deteriorating with the increase of traffic, in spite of intensive maintenance.

4.5. No competing modes of transportation exist along the project road sections, and none can be anticipated along the Great East Road. However, possible competition would be created if the Zambia-Tanzania rail link were built as proposed along the general alignment following the Great North Road. The improvement of the road to the proposed standard is economically justified on the basis of traffic which is primarily generated by local economic activity; no significant part of this traffic is likely to be diverted to a railway. The NEDECO report agrees with this judgment.

#### B. Design Standards

##### Description

4.6. The project generally follows the design standards recently adopted by the Roads Department (see Table 5). Design speeds range from 40 mph to 60 mph with maximum grades of 5 per cent and exceptionally 8 per cent. The pavement structure would consist of a sub-base course of graded granular soil, a base course of higher quality stabilized granular soil or crushed stone, and a surfacing of one or two layers of bituminous chippings. This type of pavement lends itself to stage strengthening through bituminous carpet overlays. The pavement as designed should provide appropriate service throughout the planned 20 years' economic life of the road. If traffic develops much faster than now projected, the pavement can be maintained to its original standard or strengthened as required. The roads will have ample capacity to accommodate expected normal traffic volumes, including possible traffic increases which would result from expansion of Zambia's trade relations with neighboring countries to the north and east and could also cope with extraordinary emergency traffic of heavy import and export goods for considerable periods if the need should arise.

##### Special Problem with Regard to the Design Standards

4.7. In view of the uncertainties as to possible developments in East and Central Africa, which could change traffic composition and increase traffic volumes on the project roads, the physical characteristics and economic justification of alternative road design standards have been analyzed. The analysis focused on the Great North Road which was considered to be the more likely to handle heavy import/export traffic. The technical and economic implications of building the Great North Road have been considered on two alternative bases for the purpose of this appraisal: (1) to build the road now to the normal standard as requested in the Government's application and upgrade it as and if necessary later, or (2) to build it to heavy duty standard from the outset.

4.8. The only design feature of the road which would require variation to meet various traffic requirements is the pavement strength. The thicknesses of the various layers of the pavement structure determine its strength, that is, its capacity to carry a particular wheel loading and traffic volume. Higher than normal pavement strength to deal with

additional permanent heavy traffic could be achieved in two ways: either by building the pavement stronger from the outset by increasing the sub-base and/or base thicknesses, and using a low cost bituminous surfacing; or by upgrading the strength of a pavement already built to normal standard with higher cost asphalt carpet overlays. In the case of the Great North Road section, the cost of building the road to heavy duty standard at the outset is about 20 per cent less than that of building the road to normal standard first and upgrading it later; however, on a discounted future cost basis, the economics of upgrading depend on the timing of execution and the interest rate assumed.

4.9. The economic aspects of building the road to higher strength from the outset, or upgrading it later, were examined on the basis of road user savings compared to investments under various assumptions as to the development of traffic. The analysis (see Annex) points to building the road to normal standards at the outset and upgrading it when and if necessary. If additional heavy traffic should materialize immediately, there would be only a marginal loss of return, as compared with building the road to heavy duty standards from the outset. On the other hand, if the road section were built to higher strength at the outset and the expected additional traffic did not materialize, the additional cost 1/ to build the road to higher strength would yield practically no benefit at all. This loss would reach considerable proportions if the whole 1,100 miles of the Great North Road between Zambia and Dar es Salaam were improved beyond normal traffic requirements unnecessarily.

4.10. Both the previous Bank railway study and the NEDECO study recommend that the Great North Road be built to standards appropriate for normal traffic, considering that in an emergency such a road would ensure that vital exports and imports could be transported for considerable periods of time. Under various possible additional traffic loads, the serviceability of the 122 mile road section built for normal traffic requirements would decline faster than it would under normal traffic, to the point that the road would require resurfacing to restore its original condition. As indicated in the Annex, the pavement designed to normal strength can sustain, for example, 600,000 tons per annum additional heavy traffic for 3 years, or 1.2 million tons per annum for one to two years, without requiring other than appropriate maintenance. Generally speaking, it is only when the heavy traffic materializes close to the outset and continues substantially over the life of the road that initial construction to heavy duty standards is justified.

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1/ Estimated cost per mile (orders of magnitude):

- a) Normal design - \$60,500 per mile;
- b) Normal + 600,000 tons design - \$69,000 per mile or 14 per cent more;
- c) Normal + 1.2 million tons design - \$73,000 per mile or 21 per cent more.

4.11. The USAID study recently completed by Stanford Research Institute was carried out on the basis of four traffic assumptions for the period 1967-1980: (1) "normal" traffic; (2) normal traffic plus traffic generated by possible complementary investments; (3) traffic under (2) plus traffic associated with copper production in excess of current levels; and (4) traffic under (2) plus traffic associated with all copper production. These traffic assumptions are similar to those used in the Bank's analysis of alternative design possibilities. The USAID study concluded with regard to the project section of the Great North Road, that the standards specified in this project are economically justified and technically sound for traffic assumptions (1) through (3). For the permanent transport of total copper production, higher road standards would be required, but alternate modes of transport would presumably be more suitable for this volume of long distance heavy duty traffic.

C. Execution

4.12. Execution of the project is the responsibility of the Ministry of Transport and Works with the Roads Department in charge of its administration. Consultants satisfactory to the Bank have carried out the final design and engineering of the roads to be reconstructed in the project and are employed for the supervision of the construction. Consultants satisfactory to the Bank are carrying out the final design of the Serenje-Mpika section of the Great North Road which is expected to be completed by the end of 1966. A unit price contract for the construction of the 27-mile section of the Great East Road between Chelston and 5 miles east of the Chongwe river was awarded in June 1965 on the basis of bidding procedures satisfactory to the Bank. Construction of the remaining project sections will also be carried out under unit price contracts which have recently been awarded on the basis of international competitive bidding in accordance with procedures satisfactory to the Bank. Both the completed final design and the contracts are considered eligible for retroactive Bank participation from June 1, 1965.

4.13. It is expected that work on all road sections in the construction project will have begun by the end of 1966, and that all work will be completed by the end of 1969.

D. Cost Estimate and Financing (see Table 6)

4.14. The cost estimate of the project is summarized as follows:

	<u>Zambian £ Thousand</u>	<u>US\$ Thousand Equivalent</u>
(1) Construction	7,600	21,220
(2) Engineering and supervision of construction	700	1,960
(3) Detailed engineering of the Serenje-Mpika road section	150	420
(4) Price contingencies (about 25 per cent on construction and 10 per cent on engineering costs)	<u>1,950</u>	<u>5,400</u>
TOTAL	10,400	29,000

4.15. The construction cost estimates are based on contract prices for the project works increased by an allowance of 10 per cent for quantity contingencies. A relatively large additional contingency allowance of 25 per cent on construction costs has been included to cover both the cost increases which might normally occur due to price escalation during the construction period and also the risk of further increases in costs which might result from the present political situation. The customary source of bitumen is Rhodesia. Fuel, equipment, and services are largely imported. In the event of continuing difficulties, the cost of goods and services would undoubtedly increase. Intensive use of the project roads for emergency transport could cause physical deterioration from their present state and increase the cost of improving them to the desired standard. The large contingency allowance is believed to be adequate to meet these situations.

4.16. The foreign exchange component in the project cost is estimated at an average of about 60 per cent. It includes depreciation of equipment, imported materials, fuels and spare parts, and the foreign cost of expatriate personnel, overhead, and contractor's profit. The local cost component includes mainly labor, services and locally produced construction materials (lime, cement, etc.), and about 3 per cent of the total cost for import duties on fuel, equipment, and materials.

4.17. The annual financial requirements are tentatively estimated as follows:

	<u>£ Zambian Million</u>		<u>US\$ Million Equivalent</u>	
	<u>Total</u>	<u>Foreign Exchange Requirement</u>	<u>Total</u>	<u>Foreign Exchange Requirement</u>
1966	1.5	0.9	4.2	2.5
1967	4.4	2.7	12.3	7.4
1968	3.5	2.1	9.7	5.9
1969	<u>1.0</u>	<u>0.6</u>	<u>2.8</u>	<u>1.7</u>
TOTAL	10.4	6.3	29.0	17.5

4.18. The total foreign exchange requirement is estimated at US\$17.5 million equivalent and would be covered by the proposed Bank loan. The Government will cover the local currency cost, estimated at EZ 4.2 million (US\$11.5 million equivalent), through budgetary appropriations.

## 5. ECONOMIC JUSTIFICATION

### A. Importance of the Area

5.1. The 386-mile Great East Road and the 500-mile Great North Road with its 235-mile branch to Lake Tanganyika are the two most important trunk roads in Zambia outside the line of rail. Respectively, they link the outlying Eastern and Northern Provinces of Zambia with the Central Province and the commercial/administrative centers on the line of rail. The zones of influence of these trunk roads are very large due to the lack of alternative access to the areas they serve. The Great East Road forms the backbone of a secondary system that serves an area of about 30,000 square miles with a population estimated at 600,000. The Great North Road provides access to an area of nearly 60,000 square miles with a population of about 600,000. Together, these roads serve about 40 per cent of the inhabited area of the country and about one-third of the population. They are both international routes; the Great East Road connects with the main trunk road of Malawi, and the Great North Road connects Zambia with East Africa.

5.2. Both roads traverse important agricultural areas. The Eastern Province, despite its distance from the rail line, is the most highly developed and rapidly developing region of the country outside the Line of Rail. African farmers here produce 33 per cent of the Turkish tobacco, 90 per cent of the burley tobacco, and about 90 per cent of the ground-nuts offered commercially in Zambia. These crops are among the most important in Zambia. Maize, cotton, and cattle are also produced in the Eastern Province. Production, depending on place of origin within the province, is transported over the Great East Road either east through Malawi or west through Lusaka for final sale or enroute to Beira and overseas markets. Growth in output over the past five years has been remarkable. (See Table 7 for past production and 1970 estimates). While tonnages are still small, the rate of growth of production, despite periodic bad weather, unfavorable transport, and a long period of political uncertainty, is impressive. The production targets for 1970 could be considered extremely conservative if there were not major problems concerning the continued adequacy of the extension staff, and the continued development of badly needed feeder roads. Both these problems deserve close attention.

5.3. The Great North Road serves the Mkushi and Mkushi River areas (60 miles from the rail line), where a small group of European farmers produce maize and tobacco. Output in this area is important for supply of maize to the labor force of the Copperbelt; maize production has increased

five-fold since 1962. (See Table 7). Beyond Ikushi, commercial production falls off rapidly; north of Mpika there is currently nothing but subsistence level farming and a small amount of local marketing.

5.4. Government agricultural development plans are in a formative stage, but the need for provision of feeder roads and extension services in a coordinated manner is obvious and recognized by the Government. At this stage, the benefits to future agricultural development as a result of the proposed improvement of the 122-mile section of the Great North Road are considered only minor. However, in the case of the Great East Road, these benefits would be substantial, insofar as transport savings are passed to the producer in the form of lower cost inputs and reduced farm-to-market transport prices. For the purposes of this economic analysis, normal growth in agricultural production not attributable to road improvement has been taken into consideration in forecasting normal traffic growth over the roads. Additional net production as a result of lower transport costs has been translated into generated traffic, for which the corresponding road user savings are accounted as benefits for one-half their value.

#### B. Savings in Transport Costs

5.5. The immediate quantifiable benefits from the improvement of the project road sections would be the reduced costs of vehicle operation and, on a much smaller scale, savings in road maintenance costs. Detailed studies of vehicle operating costs in Zambia have been conducted by the U.K. Road Research Laboratory; the results of their studies have been adjusted by NEDECO, the Road Research Laboratory itself, and by the appraisal mission in the light of data received from major transporters. Table 8 sets out vehicle operating costs over (1) a typical bitumen surfaced road, (2) a good gravel road, and (3) a lower class gravel or earth road.

5.6. Costs of vehicle operation on the road sections of the project have been adjusted in relation to the "typical" roads for which data have been compiled, taking into account alignment, surface conditions, and gradients. (See Table 9).

5.7. Studies indicate that for gravel roads, vehicle operating costs increase in a roughly linear fashion with increases in traffic. Costs increase mainly due to the inability of routine maintenance to keep the road in a satisfactory condition. Operating costs on a good gravel road with a traffic volume of about 100 vehicles per day are estimated to rise to those of a poor gravel or mediocre earth road when traffic reaches about 300 vehicles per day. Thus, the present high costs of transport will rise as traffic on the project road sections increases, unless the road is upgraded and provided with a durable surface.

5.8. Routine maintenance costs (grading, etc.) and the frequency of periodic reballasting on a gravel road also increase in direct relation to traffic volumes. The protection afforded by a bitumen seal obviates a large part of the grading requirements; periodic resealing requirements

(more costly than regravelling) are much less sensitive to traffic volume, and resealing is required less often than regravelling.

5.9. Recent traffic counts conducted by the Government indicate that average daily traffic volumes on the project road sections range from 80 to 180 on the Great East Road and from 80 to 150 on the Great North Road. (See Table 10). On both roads, traffic falls off rapidly in proportion to distance from the rail line, but on the Great East Road it begins to pick up east of Nyimba and grows in proportion to proximity to Fort Jameson. On both of these roads, truck traffic accounts for a large percentage of total traffic, ranging between 35 and 60 per cent. The trucks in use tend to be large; it is estimated that in the rural areas heavy trucks account for almost 75 per cent of the truck mileage. The typical long-distance hauler is a 12-ton payload capacity truck with a trailer of 10-ton capacity.

5.10. The annual rates of traffic growth on the project road sections appear to be somewhat higher than the national average of 5½ per cent for trucks and 9 per cent for passenger cars. Traffic growth on the Great East Road has been retarded by the road barriers which control traffic in the difficult central section between Mtomboli and Nyimba (55 miles). These barriers restrict heavy traffic (over 5 tons capacity trucks) to one way, with a shift in direction every 12 hours. This section is being improved outside the present project. The traffic generation from removal of this bottleneck will be substantial. The bad condition of the central section is the primary reason that operating costs on the Great East Road are estimated to be twice those on a typical bituminous road. Considering all factors, truck traffic on the Great East Road sections is conservatively projected to grow at the rate of 7.5 per cent for the next 10-12 years, with growth slowing in the later years of the road's economic life. Passenger car traffic in these rural areas may increase somewhat faster than truck traffic, but the composition of traffic should not change substantially.

5.11. Traffic on the Great North Road from Kapiri Mposhi to Mkushi has been growing at the rate of about 9-10 per cent per annum over the last four years, and from Mkushi to Mpika the rate has been about 7 per cent per annum. The economic analysis assumes that traffic growth will continue for at least the next 10 years at about 7.5 per cent over the entire section from Kapiri Mposhi to Mpika, with both truck and car traffic growing at about this rate. The long range policy of the Zambian Government to achieve a closer economic and political relationship with East Africa may mean that there will be a higher traffic growth rate on the Great North Road. The traffic growth projection used in the economic analysis is considered conservative.

5.12. In addition to these estimated normal trends of growth, it should be expected that improvement of the roads will induce transport of commodities now below the threshold of profitable production or effective demand due to the present high transport costs. This induced traffic has been taken at an average annual 15 per cent increase of the normal

traffic on the project sections over a period of five years after completion. Past experience with rural road improvement indicates that this may be a conservative assumption.

5.13. In addition to savings from reduced vehicle operating costs, there would be savings in road maintenance costs. However, the latter represent only about 7 per cent of total quantifiable benefits from the road improvements.

5.14. Comparing the streams of total benefits and costs over the twenty-year economic life of the project, road improvements result in an annual economic rate of return on the investment of about 12-13 per cent. The project would earn an annual economic return of more than 10 per cent even if the cost of the project were to increase by the full amount of the 25 per cent price contingency allowance. Rates of economic return were calculated for the various road sections, to determine the scope of project that is justifiable and the extent of bituminous paving that is economic. Rates of return on investment not including price contingency range from over 14 per cent on the Chelston-Chongwe River, and Kapiri Mposhi-Mkushi sections to about 11 per cent on the Chongwe River-Rufunsa, Nyimba-Katete and the Mkushi-Serenje sections. These rates of return are judged satisfactory.

5.15. The economic justification of the Serenje-Mpika section of the Great North Road is less obvious but investment in detailed engineering is deemed to be justified at this time. If it is assumed that the costs per mile for upgrading this section would be similar to those for the Kapiri Mposhi-Serenje section, and that construction would begin two years from now, a preliminary economic analysis indicates that the economic rate of return from improving this section would be about 9-10 per cent; while this return is somewhat low, investment in detailed engineering is justified in order to obtain reliable cost estimates, especially in view of uncertainty as to the future rate of traffic growth on the Great North Road. Construction should be deferred until warranted by traffic prospects.

### C. Other Benefits

5.16. In addition, there will be other benefits which cannot be readily expressed in monetary terms. These include time savings and transport reliability for both passengers and freight. In the longer run, with general economic development, these benefits would become considerable and could be quantified in terms of lower inventory requirements, reduced damage to perishable goods, and fewer man hours required for travel. As traffic volumes increase, safe speeds will be substantially reduced if the road is not improved. Probably the most important unquantifiable benefits at this stage in Zambia's development are the increased efficiency and effectiveness of public administration which these road improvements would make possible, and the

definite contribution these improvements will make toward better economic integration of the outlying Northern and Eastern Provinces with the growth points located in the line of rail area.

## 6. CONCLUSIONS AND RECOMMENDATIONS

6.1. The project will greatly improve the conditions of road transport on two of the most important trunk roads in Zambia. It is well planned, technically feasible and will yield a satisfactory economic return on the investment from lower transport costs alone. The Roads Department under the Ministry of Transport and Works is capable of administering the project; construction is being executed by contractors and supervised by engineering consultants satisfactory to the Bank.

6.2. The Government is prepared to cover from its own funds the local currency costs of the project and has asked the Bank to finance the foreign exchange component.

6.3. The project constitutes a suitable basis for a Bank loan in the amount of US\$17.5 million equivalent. An appropriate loan term would be 20 years including a four year period of grace.

September 7, 1966.

ZAMBIA

HIGHWAY RECONSTRUCTION PROJECT

Economic Implications of Alternative Design  
Standards and Traffic Assumptions  
(Kapiri Mposhi-Serenje)

1. The economic aspects of building the road section to higher strength from the outset or building it to normal standards and upgrading it later as and if necessary, were examined on the basis of road user savings compared to investments under various assumptions as to the development of traffic. The results of this analysis can be summarized as follows:

(i) with only normal traffic materializing:

- a) Built to normal standards, the road will yield an internal rate of return of about 12 per cent if normal traffic projections are realized.
- b) If the road is built from the outset to handle an additional 600,000 tons per year (half of copper exports plus loaded returning vehicles), the internal rate of return would be reduced to about 9.5 per cent if the additional traffic did not materialize which indicates that the return on the incremental investment would be very low.
- c) If the road is built to handle an additional 1.2 million tons per year (total copper exports plus loaded returning vehicles), the internal rate of return would be reduced to below 9 per cent if the additional traffic did not materialize.

(ii) with additional heavy duty traffic materializing from the outset:

- d) If the road built to normal standards is required to handle a permanent additional 600,000 tons of traffic per annum from the outset, it would necessitate appropriate upgrading 3 years after original construction. In this case the internal rate of return on the original and subsequent investment would be about 12.5 per cent.
- e) If the road is built to handle permanent additional traffic of 600,000 tons per year, and this traffic materializes, the internal rate of return would be 13-14 per cent.
- f) If the road built to normal standards is required to handle a permanent additional 1.2 million tons of traffic per year from the outset, it would necessitate the appropriate upgrading one to two years after original construction. In

this case, the internal rate of return on original and subsequent investment would be about 15 per cent.

- g) If the road is built to handle permanent additional traffic of 1.2 million tons per year, and this traffic materializes, the internal rate of return would be about 16 per cent.

2. The fact that the internal rate of return appears to be higher if copper traffic uses the road does not mean that this traffic should be encouraged. The alternatives used in the analysis were limited to the existing gravel road versus an improved bituminous or asphalt surfaced road. Rail alternatives for copper traffic were not considered, and since the cost of transporting copper by the improved road is likely to be higher than by existing rail facilities, copper traffic on the road may involve economic losses rather than savings.

ZAMBIA  
HIGHWAY RECONSTRUCTION PROJECT

LICENSED MOTOR VEHICLES

Year	Cars and Station Wagons	Pickups and Vanettes	Motor- cycles Auto- cycles	Trucks	Private Con- struc- tion Vehicles	Omni- buses	Tractors	Trailers	TOTAL
1955	19,478	4,954	1,794	4,157	304	245	1,032	-	31,964
1956	24,511	6,063	2,218	4,980	461	261	1,340	-	39,834
1957	27,166	6,130	1,901	4,778	426	274	1,384	-	42,059
1958	27,932	6,241	1,841	4,538	275	309	1,194	-	42,330
1959	29,906	6,447	1,776	4,306	250	250	1,085	-	44,020
1960	32,724	6,544	1,879	3,969	211	262	1,049	1,444	48,082
1961	34,300	6,474	1,942	3,687	144	279	1,097	2,130	50,053
1962	36,930	6,943	2,064	3,766	135	292	1,115	2,267	53,512
1963	39,491	6,807	2,145	3,566	33	306	862	2,531	55,741
At June 1965	40,253	7,661	2,081	3,419	53	245	1,006	2,380	57,098

Source: Road Traffic Commissioner

TABLE 2

ZAMBIA  
HIGHWAY RECONSTRUCTION PROJECT

GASOLINE AND DIESEL FUEL CONSUMPTION  
(IMPERIAL GALLONS)

	<u>Gasoline for Road Use</u>	<u>Diesel Fuels for Road Use</u>
1954	12,460	NA
1955	14,975	NA
1956	17,207	NA
1957	18,555	NA
1958	18,980	NA
1959	19,884	NA
1960	20,510	NA
1961	21,045	NA
1962	21,595	5,012
1963	22,015	5,646
1964	23,068	7,250

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Source: Roads Department

ZAMBIA

HIGHWAY RECONSTRUCTION PROJECT

THE HIGHWAY SYSTEM

Technical Classification

<u>Administrative Classification</u>	<u>Responsible Authority</u>	<u>Class I Bituminous Paved Roads</u>	<u>Class II and Subclass II Gravel Roads</u>	<u>Improved Earth Roads</u>	<u>Unimproved Earth Roads</u>	<u>Total</u>
Main Roads	Roads Department	703	2,145	905	-	3,753
	Municipalities	40	-	-	-	40
District Roads	Roads Department	77	1,061	5,612	-	6,750
	Rural Councils	-	-	-	6,725	6,725
Rural Council Roads	Rural Councils	-	19	-	3,531	3,550
TOTALS		820	3,225	6,517	10,256	20,818

Source: Roads Department

TABLE 4

ZAMBIA  
HIGHWAY RECONSTRUCTION PROJECT  
HIGHWAY BUDGETS  
(£ 1,000)

<u>Year</u>	<u>Administration</u>	<u>Maintenance</u>	<u>Construction</u>	<u>Total</u>
1960/61	266	900	1,376	2,542
1961/62	354	818	1,379	2,551
1962/63	393	1,391	1,688	3,472
1963/64	457	1,333	1,122	2,912
1964/65	337	1,463	1,293	3,093
1965/66	509	1,461	3,000	4,970
1966/67 (Est)	534	1,530	3,250	5,314

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Source: Roads Department

TABLE 5

## ZAMBIA

HIGHWAY RECONSTRUCTION PROJECTDESIGN STANDARDS

	- - T e r r a i n - -		
	<u>Flat</u>	<u>Rolling</u>	<u>Mountainous</u>
Width of right-of-way, feet	200	200	200
Design speed, mph	60	50-60	40-50
Roadway width*, feet (minimum)	32	32	32
Pavement width*, feet	20	20	20
Shoulder width, feet (minimum)	6	6	6
Limiting grades, per cent	5	6	8
Maximum length of limiting grade, feet	--	700	500
Minimum stopping sight distance, feet	475	475	350
Minimum design passing sight distance, feet	2,000	2,000	1,700
Type of pavement subbase	Free draining graded granular soil		
Type of pavement base	Stabilized free draining graded granular soil or graded crushed stone		
Type of pavement surfacing:			
Chelston-Chongwe River; Lutembwe River to 3 miles east of Fort Jameson; and Kapiri Mposhi-Serenje road sections	{ Double bituminous surface treatment		
Chongwe River-Rufunsa; and Nyimba-Lutembwe River road sections	{ Single bituminous surface treatment		
Pavement design:			
In accordance with "A guide to the structural design of bituminous-surfaced roads in tropical and sub-tropical countries." Road note 31, of the U.K. Road Research Laboratory.			
Design wheel load, pounds	9,000		
Bridge structure width:			
Span less than 30 feet	Equal to roadway width		
Span more than 30 feet	24 feet		
Bridge loading	According to British Standards 153, type HA loading		

\* Roadway width 34 feet (minimum) and pavement width 22 feet on Kapiri Mposhi-Mkushi road section and 32 feet (minimum) and 22 feet, respectively, on Chelston-Chongwe River road section.

TABLE 6

ZAMBIA  
HIGHWAY RECONSTRUCTION PROJECT  
ESTIMATED COST OF PROJECT

<u>Item</u>	<u>Estimated Cost</u>	
	E 1,000	\$ 1,000 equivalent
A. Construction of 373 miles of roads (including 10 per cent quantity contingencies)		
1) Great East Road, Chelston-Rufunsa (92 miles) and Nyimba-Fort Jameson (159 miles) sections	5,100	
2) Great North Road, Kapiri Mposhi- Serenje (122 miles) section	2,500	
	<hr/>	
Subtotal, Construction	7,600	21,200
B. Engineering		
1) Engineering and supervision of construction projects under A	700	
2) Final design, Serenje-Mpika (147 miles) section of the Great North Road	150	
	<hr/>	
Subtotal, Engineering	850	2,400
C. Contingencies (about 25 per cent on construction and 10 per cent on engineering costs)	1,950	5,400
	<hr/>	<hr/>
TOTAL	10,400	29,000

ZAMBIA  
HIGHWAY RECONSTRUCTION PROJECT  
AGRICULTURAL PRODUCTION

A. Eastern Province

Year	African Burley Tobacco 000 lbs.	European (African Tenant) Burley Tobacco 000 lbs.	Turkish Tobacco 000 lbs.	Groundnuts sh. tons	Seed Cotton 000 lbs.	Head of Cattle
1960	64.6	570.0	110.6	9,600	5.8	nil
1961	247.6	751.0	58.2	12,800	4.9	1,013
1962	294.2	1,326.0	57.3	14,000	48.2	2,851
1963	1,059.3	2,169.0	69.9	15,900	nil	1,046
1964	1,729.6	2,500.0	162.9	2,800	26.1	2,708
1965	2,100.0	2,100.0	380.0	7,200	110.3	3,013
1966 est.	n.a.	n.a.	n.a.	12,000	700.0	n.a.
1970 est.	5,000.0	4,200.0	450.0	30,000	2,000.0	8,000

B. Mkushi Area  
(European Farming)

Year	Maize sh. tons	Virginia Flue-cured Tobacco (000 lbs.)
1962	8,290	2,433
1963	9,180	3,440
1964	15,340	4,501
1965 est.	41,800	3,524

Source: Agricultural Department

ZAMBIA

HIGHWAY RECONSTRUCTION PROJECT

ESTIMATED VEHICLE OPERATING COSTS IN ZAMBIA<sup>1/</sup>

On - (I) Bitumen (II) Good Gravel (III) Mediocre Gravel and Earth

(Pence per Vehicle Mile)

	12-ton cap. freight vehicle drawing 10-ton capacity trailer			12-ton capacity freight vehicle			7-ton capacity freight vehicle			5-ton capacity freight vehicle			Passenger Bus 53 Seats			Typical Passenger Car		
	<u>Diesel</u>			<u>Diesel</u>			<u>Diesel</u>			<u>Petrol</u>			<u>Diesel</u>			<u>Petrol</u>		
	<u>I</u>	<u>II</u>	<u>III</u>	<u>I</u>	<u>II</u>	<u>III</u>	<u>I</u>	<u>II</u>	<u>III</u>	<u>I</u>	<u>II</u>	<u>III</u>	<u>I</u>	<u>II</u>	<u>III</u>	<u>I</u>	<u>II</u>	<u>III</u>
Fuel	5.2	6.6	8.1	3.9	4.8	6.1	2.0	2.5	3.1	2.5	2.9	3.5	2.0	2.5	3.1	1.9	2.1	2.8
Lubricants	.9	1.1	1.1	.5	.6	.7	.2	.3	.5	.2	.3	.4	.2	.3	.5	.2	.2	.4
Maintenance	7.0	9.7	18.7	4.8	8.4	13.2	2.1	3.2	4.9	1.5	2.5	3.3	2.2	3.3	5.0	1.0	1.4	2.4
Tires/Tubes	3.3	4.9	6.4	2.4	3.3	4.2	1.0	1.3	1.7	.7	.8	1.0	1.0	1.3	1.8	.7	.8	1.3
Crew Wages	4.2	5.0	7.2	2.9	3.5	4.2	4.1	5.1	6.2	3.1	4.1	5.2	4.3	5.3	6.4	-	-	-
Insurance	.8	1.0	1.2	.4	.5	.6	.4	.5	.6	.3	.4	.5	.7	.8	.9	.4	.5	.6
Depreciation	6.1	7.3	8.7	4.2	4.9	6.0	2.2	2.8	3.4	1.9	2.5	3.1	2.3	2.9	3.5	2.9	3.5	4.6
<b>Total</b>	<b>27.5</b>	<b>35.6</b>	<b>51.4</b>	<b>19.1</b>	<b>26.0</b>	<b>35.0</b>	<b>12.0</b>	<b>15.7</b>	<b>20.4</b>	<b>10.2</b>	<b>13.5</b>	<b>17.0</b>	<b>12.7</b>	<b>16.4</b>	<b>21.2</b>	<b>7.1</b>	<b>8.5</b>	<b>12.1</b>

<sup>1/</sup> At traffic volume levels of 75-100 vehicles per day. Costs are presented net of taxes, duties, license fees, etc. and therefore represent economic costs of operation. Costs do not include waybills, handling costs, depot operating costs, administration, etc. which are not affected appreciably by road improvement. Therefore the per cent decrease in operation costs is overstated so far as the operator is concerned, though the absolute amount of reduction due to improvement is deemed realistic.

Source - U.K. Road Research Laboratory (Lab. Note No. LN/761/RSPB.NFS unpublished).  
 NEDECO - Survey of Transportation in Zambia  
 Interviews with Central African Road Services Ltd. and Smith and Youngson Ltd., Zambia.

ZAMBIA  
HIGHWAY RECONSTRUCTION PROJECT  
ESTIMATED VEHICLE OPERATING COSTS ON PROJECT ROAD SECTIONS<sup>1/</sup>  
(Pence per Vehicle Mile)

	<u>12-ton truck and 10-ton trailer</u>	<u>12-ton truck</u>	<u>7-ton truck</u>	<u>5-ton truck</u>	<u>Passenger Bus</u>	<u>Passenger Car</u>
Chelston Chongwe River	40.3	28.6	17.1	14.6	17.8	9.6
Chongwe River - Rufunsa	45.1	31.3	18.5	15.6	19.3	10.7
Nyimba - Petauke	45.1	31.3	18.5	15.6	19.3	10.7
Petauke - Katete	43.5	30.4	18.1	15.3	18.8	10.3
Katete - Ft. Jameson	38.8	27.8	16.6	14.2	17.4	9.2
Kapiri Mposhi - Mkushi	38.8	27.8	16.6	14.2	17.4	9.2
Mkushi - Serenje	40.3	28.6	17.1	14.6	17.8	9.6
Serenje - Mpika	40.3	28.6	17.1	14.6	17.8	9.6

<sup>1/</sup> Costs comparable to totals set out in Table 8

Source - Mission estimate on basis of interviews with transporters.

TABLE 10

ZAMBIA  
HIGHWAY RECONSTRUCTION PROJECT

Estimated Average Daily Traffic on Project Road Sections

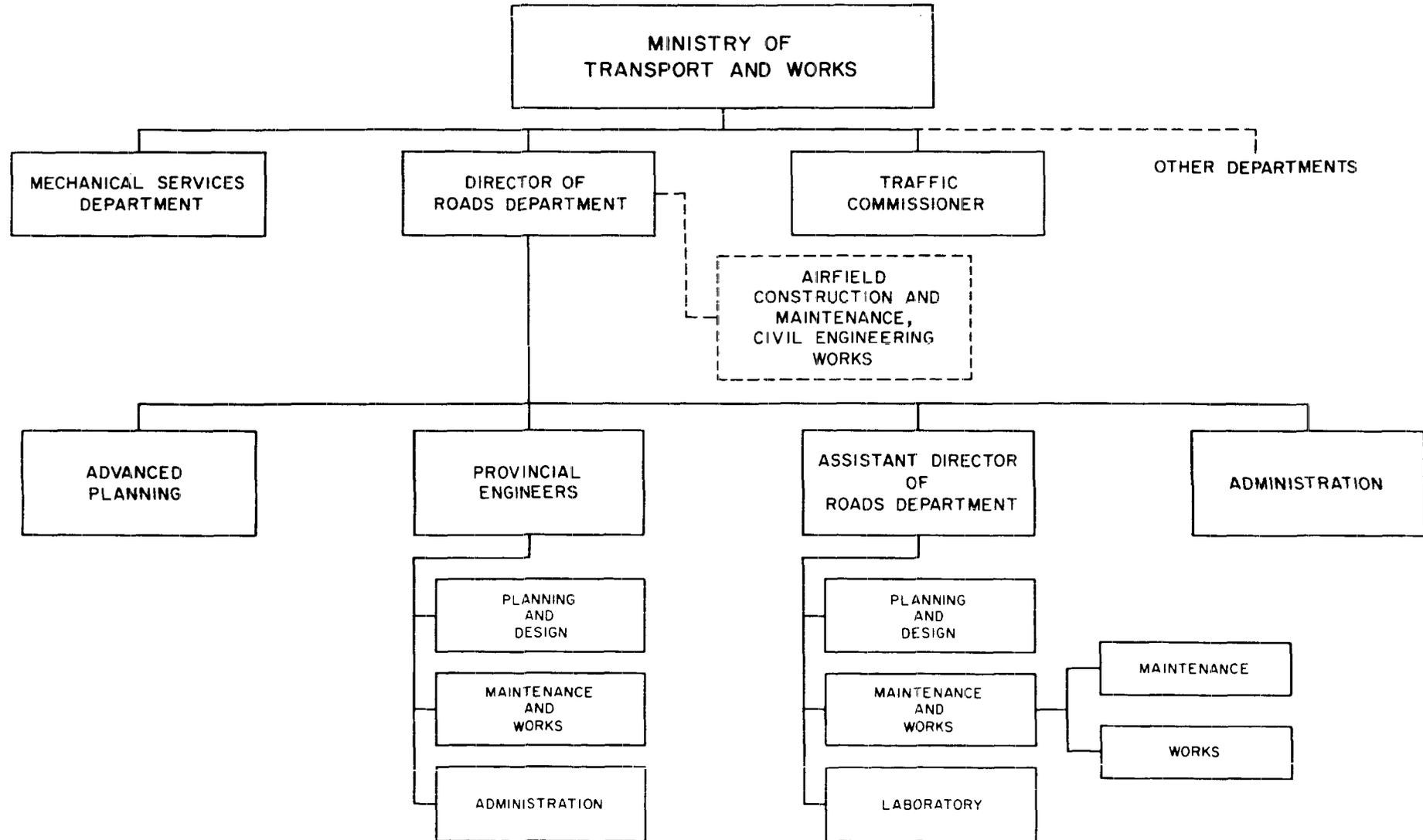
<u>Great East Road</u>	<u>1964/65</u>		
	<u>Heavy Vehicles</u>	<u>Light Vehicles</u>	<u>Total</u>
Chelston-Chongwe River (27 miles)	61	121	182
Chongwe River-Rufunsa (65 miles)	48	32	80
Nyimba-Petauke (47 miles)	35	46	81
Petauke-Katete (58 miles)	38	60	98
Katete-Fort Jameson (50 miles)	45	70	115
<u>Great North Road</u>			
Kapiri-Mposhi-Mkushi (56 miles)	71	73	144
Mkushi-Serenje (66 miles)	48	42	90
Serenje-Mpika (147 miles)	39	40	79

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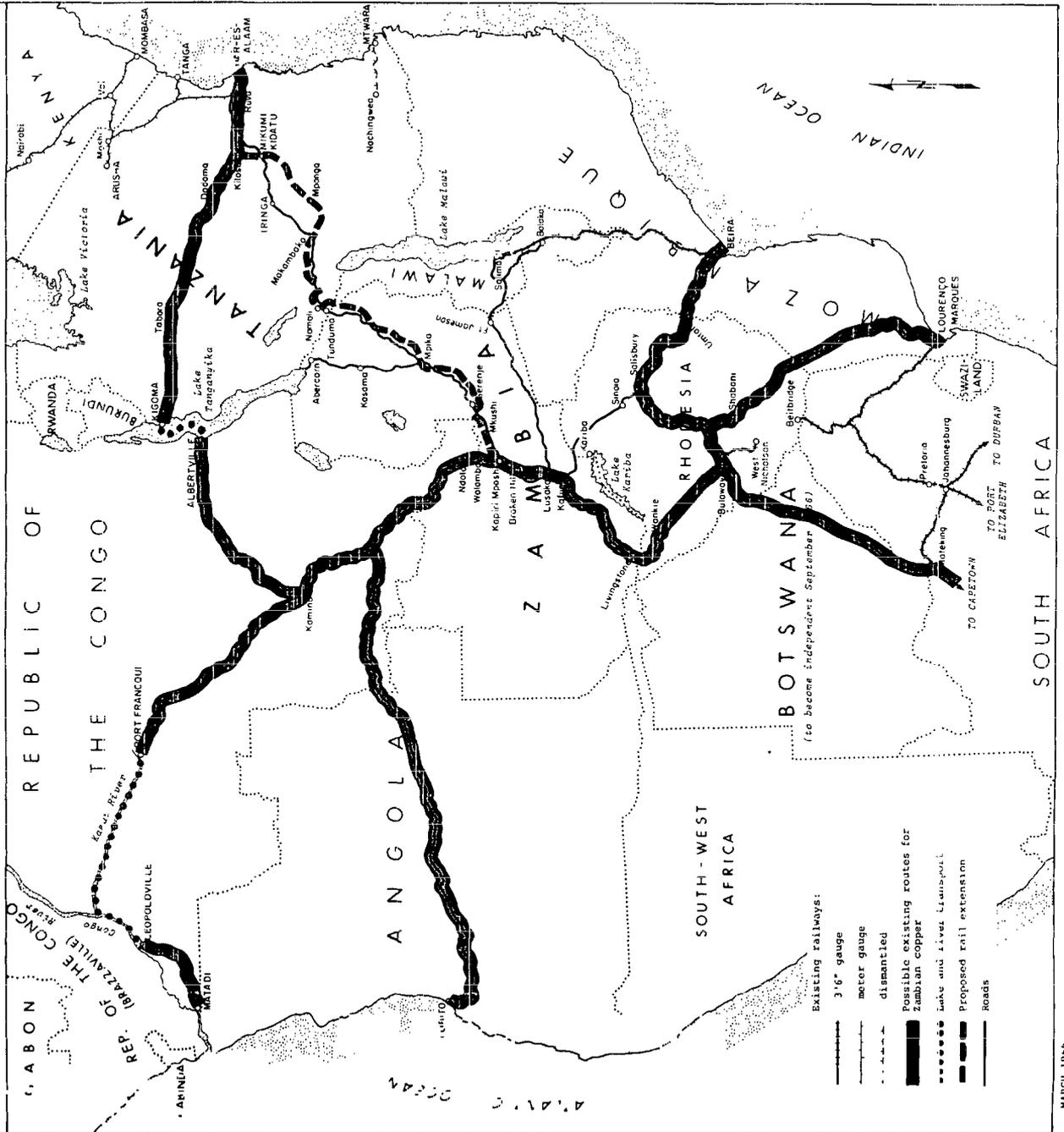
Source: Roads Department  
Mission Adjustments

# ZAMBIA

## ORGANIZATION OF THE ROADS DEPARTMENT



# EAST & CENTRAL AFRICAN RAIL LINKS

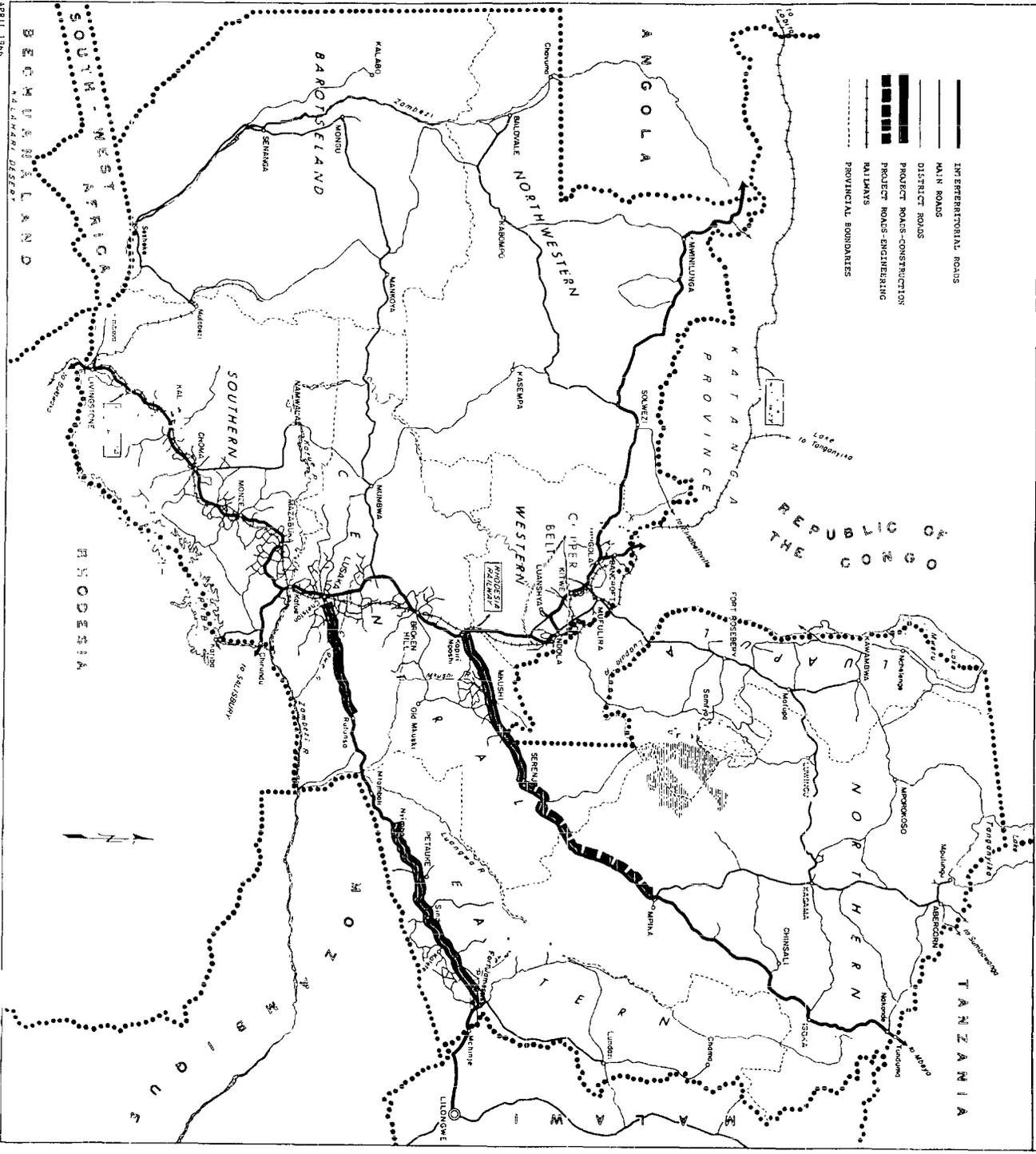


- Existing railroads:
- 3'6" gauge
  - meter gauge
  - - - - - dismantled
  - Possible existing routes for Zambian copper
  - Lakes and rivers transport
  - Proposed rail extension
  - Roads

# ZAMBIA HIGHWAY SYSTEM



- INTERPROVINCIAL ROADS
- MAIN ROADS
- DISTRICT ROADS
- PROJECT MOAS-CONSTRUCTION
- PROJECT MOAS-ENGINEERING
- RAILWAYS
- PROVINCIAL BOUNDARIES



APRIL 1966

BECHUANA  
LAND

SOUTH-WEST  
AFRICA

BAROTSE  
LAND

ANGOLA

WESTERN

KATANGA  
PROVINCE

SOUTHERN

WESTERN

REPUBLIC OF  
THE  
C O N G O

NORTHERN

TANZANIA

RHODESIA

MOZAMBIQUE

BECHUANA  
LAND

APRIL 1966

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