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CAIRO-ASSUIT HIGHWAY FEASIBILITY STUDY

FINAL REPORT

MAIN REPORT

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بواسطة
ويلبر سميث وشركاه
المجموعة الإستشارية المصرية
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EXECUTIVE SUMMARY

This is a report on the findings of the Cairo-Assuit Highway Feasibility Study which was undertaken for the Roads and Bridges Authority (RBA) of the Egyptian Ministry of Transport and Communications between October 1985 and September 1986.

The Study was sponsored by the United States Agency for International Development (USAID) under the Project Grant Agreement with Egypt for Technical Cooperation and Feasibility Studies (Project No. 263-0102). USAID funded the entire foreign exchange budget, and the local budget was jointly funded by USAID and RBA.

The Contract was signed on September 18, 1985. A month was allowed for mobilization of staff and ordering equipment for use on the Study (computers and traffic survey equipment), and the Study got underway on October 17th with the arrival of the Project Director in Egypt. Several reports were issued during the Study, culminating in the draft final report presented in late September 1986.

The final report is accompanied by seven volumes containing 33 appendices to the report, detailing the analyses and findings of the Study. Plans of the new highway prepared to scale 1:25,000, together with typical cross-sections, interchange layouts and geological sections, are contained in the Plan Volume accompanying the report.

Objectives of the Study

The intent of the Study was to undertake engineering and economic feasibility studies of a new or improved highway in Upper Egypt between Cairo and Assuit.

The Contract specified the major objectives of the Study as follows:

1. Determine whether a major investment in road construction and/or improvement is warranted.

2. Explain and document whether such an investment is economically feasible and what types and magnitudes of benefits and costs will occur.

3. If the investment is found to be feasible and financially viable, determine the best type of road, and/or improvement, alignment location, design standards, and a recommended implementation program schedule.

The detailed scope of work required a preliminary engineering design for a completely new road from Cairo to Assuit, together with an engineering assessment of the requirements for upgrading the existing highway. The task of the Study was then to evaluate the economic feasibility of these projects, and to recommend a program of investment.

The Study Area

The Cairo-Assuit Corridor is located in the northern part of Upper Egypt in the Governorates of Giza, Fayoum, Beni Suef, Minia and Assuit. The Corridor reaches from the boundaries of Greater Cairo to the town of Assuit located about half-way between Cairo and Luxor, a distance by road of 365 kilometers.

The Corridor consists of a narrow strip of agricultural land located on both sides of the River Nile, but with most development on the west bank. The width of the agricultural land varies along the Corridor, at some points reducing to as little as 5 kilometers, but averaging between 10 and 20 kilometers.

Beyond the agricultural land along the Nile lies barran desert which is virtually uninhabited. The one exception to this is the large cultivated oasis of Fayoum located in the Western Desert and separated from the main corridor by about 10 km of desert.

The agricultural land is intensely cultivated, but is also densely populated. Nearly 8 million people live in the Corridor, out of a total population for Egypt of 47 million, and a population of over 13 million for Upper Egypt.

Most of Upper Egypt is currently served by a single paved road and a railway, both located on the west bank of the Nile within the limits of the Study Corridor. In the northern section of the Corridor, there are two additional main paved highways. One serves the east bank between Cairo and Beni Suef, a road currently being extended to Minia, and the other links Fayoum with Cairo and Beni Suef.

EXISTING TRANSPORT

The Study conducted a set of traffic surveys to collect information on existing highway transport in the Corridor. Information on other modes was obtained from Government Agencies and the recently completed Egypt National Transport Study (ENTS).

Traffic Surveys

Four major surveys of highway traffic were undertaken in the period from mid-December 1985 to end-February 1986, as follows:

Roadside Interview and Manual Traffic Count Survey
Automatic Traffic Count Survey
Truck Weighing Survey
Journey Time Survey

The Roadside Interview Survey took one month to complete. Interview stations were located at 16 sites in the Corridor, 8 of which were located along the main West Bank Cairo-Assuit Highway. Each station was operated in both directions of travel for at least two days during daylight hours, with four stations operated continously for 24 hours over three days. A further 11 sites were selected for additional two-day and three-day traffic counts. The main objective of the survey questionnaire completed for each vehicle was to obtain the origin and destination of the journey. Additional information was collected on vehicle and journey characteristics. A total of 127,337 interviews were completed which represents a 77 percent sample of the traffic passing the interview stations during interview hours.

Using a set of scales imported from the United States, a truck weighing survey was conducted in February 1986. Three locations were selected along the main west bank Cairo-Assuit Highway and truck weighing operations were conducted for four days at each site. The objective of the survey was to measure truck weights and axle loads for a representative selection of loaded trucks. In total, 2,756 trucks were weighed during the survey.

A journey time survey was conducted to determine light and heavy vehicle speeds under different traffic conditions and within different types of Corridor development. The survey was also used to obtain additional traffic counts covering all sections of the existing highway, and to provide an inventory of highway characteristics related to traffic capacity.

Some automatic traffic counts were conducted at the same time as the Roadside Interview and Manual Traffic Count Survey, mainly to provide a check on the manual counts. After the Roadside Interview Survey was completed, two long-term recording traffic counters were set up on the main West Bank Cairo-Assuit Highway to monitor traffic variations over a six week period.

1986 Highway Traffic Volumes

Traffic volumes on the main West Bank Highway varied between 12,000 vehicles per day near Cairo to 6,000 vehicles per day near Assuit. Traffic was classified by 12 different vehicle types. The main vehicle represented was the pickup which accounted for 27 percent of the total. While most of these pickups were used for goods transport, about 10 percent were adapted for low-cost passenger transport. Trucks made up 26 percent of the traffic stream. Half were single trucks, and the rest were large trucks towing trailers or semi-trailers. Private cars (12 percent) and taxis made up about 40 percent of the total traffic and buses, rather surprisingly, only 5 percent.

The surveys indicated that 25 percent of trucks and 15 percent of passenger vehicles moved during the nighttime hours from 10:00 pm to 6:00 am. During daylight hours (6:00 am to 5:00 pm at the time of the survey), 53 percent of trucks and 60 percent of passenger vehicle movements were recorded.

Traffic speeds in the corridor were similar for light and heavy vehicles, averaging 61 and 55 kilometers per hour between Cairo and Assuit. Probably the straight alignment and complete absence of grades, both factors which can reduce truck speeds significantly, explains the similarity. Of course, traffic speeds vary from place to place depending upon road type and the characteristics of the area alongside the route. In particular, only 60 percent of the route could be called open country; the rest was either urban or, more commonly, village development, and congestion in these areas slowed traffic considerably.

Comparisons with past traffic counts indicate that the rapid traffic growth in the Corridor between 1979 and 1983 of 25 percent per year, slowed over the last two years to an average of 8.2 percent per year. Annual traffic growth rates 1983-1985 at individual count sites in the Corridor ranged from 23 percent on the Fayoum Desert Road to 2 percent between Beni Suef and Minia. However, not too much weight shoud be put on individual count comparisons when made by different studies. It is unfortunate that a regular count program is not yet started, although plans are in hand to do this.

Passenger Vehicle Characteristics

The main passenger carrying vehicles in the Corridor were the various forms of taxi (car, van and pick-up) and they carried nearly 50 percent of all passengers. The two classes of buses carried nearly 30 percent with most in the larger standard bus. About 25 percent of private cars had a driver only and they accounted for only 6 percent of the total passenger volume.

Truck Characteristics

The most significant findings of the traffic surveys concerned trucks. In particular, the Truck Weighing Survey revealed that a very high proportion of trucks on the Cairo-Assuit Highway were overloaded --

grossly overloaded in many instances. Comparisons were made with truck weighing surveys previously conducted in Egypt in 1979 and 1981 and these indicated that what was already a bad situation had got significantly worse.

Three main types of truck operate on the Cairo-Assuit Highway: single trucks, combination trucks (single trucks towing a trailer), and articulated trucks (a tractor unit attached to a semi-trailer). It was estimated that of all loaded trucks, about 75 percent of the large combination and articulated trucks, and about one third of all single trucks exceeded the legal axle load limits. Particularly severe offenders were the combination trucks carrying bags of cement. On average, these trucks weighed 63 tons (maximum legal weight is 48 tons for the largest size of combination truck). It was further estimated that 60 percent of all single axles (excluding front axles), 81 percent of all tandem axles and 63 percent of all tridem axles were overloaded (again considering loaded trucks only).

Part of the problem is that trucks are routinely licensed to carry more than permitted by the current legal axle load law. Also, until recently trucks could be imported from countries permitting much higher axle loads than Egypt, and were then licensed to carry these loads. However, the main problem is that vehicles are loaded beyond their licensed capacity.

The implications for pavement design are serious. Damage done to a road pavement increases 20 to 30 times when an axle load is doubled. Hence even slight overloading has serious consequences for maintenance and rehabilitation, and gross overloading, as observed in the Cairo-Assuit Corridor, rapidly accelerates the rate of deterioration of the pavement.

Journey Lengths

The great majority of journeys were short distance with over one half of 30 kilometers or less. There was great variation in journey length between the different vehicle types. Most passenger vehicles had relatively short journey lengths with only about 5 percent exceeding 150 kilometers. The large multi-unit trucks, on the other hand, showed much longer journey lengths, with 2 percent of journeys as long as 800 kilometers.

Movement Patterns in the Corridor

It was found that the Governorates in the Corridor are very self-contained, with the bulk of all daily traffic movements taking place entirely within each Governorate. In fact, traffic entirely within Governorates represented almost 50 percent of all movements observed in the Corridor, considering all internal and external movements together. Movements between Governorates in the Corridor represented only about 7 percent of the total.

External movements to and from the Cairo and the North represented nearly 25 percent of all traffic. Only one third of this (about 7.5 percent of all Corridor traffic) was truly long distance passing beyond Fayoum and the part of Giza located in the Corridor. There was very little interaction between the Corridor and Upper Egypt south of Assuit. Through movements without intermediate stops amounted to just over 1000 vehicles per day, representing less than 2 percent of all traffic.

Traffic Accidents

Existing traffic accident data in the Corridor were reviewed. Comparisons were difficult because of the different basis for each set of statistics. Based on these results, accident rates were derived for different classes of road, distinguishing between 2-lane and 4-lane roads, and between roads located in desert regions and those in agricultural areas.

Road Transport Services

The total vehicle fleet in Egypt experienced a high rate of increase during the last decade, about 16.5 percent per year on average. The most recent registration statistics indicate that the rate of increase slowed for 1984/86 to about 13.7 per cent per year.

Passenger and freight transport service are provided by both the public and private sectors. The General Nile Company for Upper Egypt provides public bus service within the Corridor. Non-transport public and private firms also supply bus service for their employees. The private sector currently accounts for 57.2 percent of total bus registration. Private taxis provide service between and within the cities, towns and villages. The inter-city taxi fleet is quite extensive and active with per-passenger kilometer charges higher than air-conditioned bus rates.

Freight transport services are supplied by five public transport companies, "own account" trucks registered by non-transport public and private firms, cooperative trucking associations, small private transport firms and individual truckers. The truck fleet increased rapidly during the 1975-1984 period with an average annual growth rate in excess of 21 percent. The pick up category (<3 tons) was responsible for much of this growth with an annual average rate of increase in excess of 30 percent for the period. Freight transport is essentially not regulated with no restrictions as to entry, routing or vehicle specifications. Official axle load limits are not enforced. The five public companies function as price leaders in setting freight tariffs for the commodities they transport. Other rates are determined by competition.

Non-Highway Transport

A review was made of transport by railroad, waterways and pipelines in order to complete the picture of transport in the Cairo-Assuit corridor. This review was based partly on interviews with each of the modal authorities, and partly on the reports of the recent Egypt National Transport Study (ENTS). In the case of railroads, a consultant railroad specialist visited Egypt for one month and reviewed operations.

Railroads - The railroad from Giza to Assuit is a double track standard guage rail line comprising a route length of 375 kilometers. It is located close to the main West Bank Highway, paralleling a major north-south irrigation canal. The alignment is relatively straight and, since the topography of the Corridor is flat, there are no problems of grade. South of Assuit, the line becomes single track.

In 1985/86, the line carried approaching 2 million tons of freight in the Corridor compared with about 19 million tons of inter-Governorate movements carried by road. Rail carried a greater proportion of rail passengers, sharing inter-governorate movements equally with bus and with taxi.

As well as recommending investments in rail, ENTS forecast a substantial increase in rail traffic, with a quadrupling of freight volumes serving origins and destinations in the Corridor by 2000. However, ENTS emphasized the "target setting" nature of these forecasts and admitted that they would be difficult to achieve. While improvements in train operations had clearly been made since ENTS, this Study was not convinced that the ENTS forecasts of high rail traffic growth could be met. Available evidence did not point to major growth in rail operations sufficient to attract traffic from other modes.

Waterways - The section of the Nile between Cairo and Assuit is the most heavily used part of the Egyptian waterway system with current freight volumes at about the same level as for the railroad. ENTS envisaged a large increase in products carried on this section of the Nile but again admitted that they would be difficult to achieve. Discussions with the River Transport Authority indicated that no start has been made on the changes necessary for the ENTS forecasts to be realized. It was concluded that no new developments could be expected which might impact road transport traffic forecasts.

Pipeline Transport - There is at present no pipeline in the Cairo-Assuit Corridor but a petroleum product pipeline is currently under construction to link Cairo with the new refinery also under construction at Assuit. In future, it is expected that all inter-Governorate transport of petroleum products will be by pipeline, but local distribution of products will continue to be made by road.

ENGINEERING ASSESSMENT OF THE EXISTING HIGHWAYS

The principal route serving the Corridor is located on the west bank of the Nile where almost all settlements and activities are located. At the northern end of the Corridor are two other principal routes; the East Bank Highway between Cairo and Beni Suef, and the Giza-Fayoum-Beni Suef Road.

Route Descriptions

The main West Bank Highway from Cairo to Assuit is 365 kilometers long and is very well aligned, typically with long straight sections of 5-15 kilometers linked by gentle curves. Grades are extremely flat. The first 46 kilometers of route out of Cairo to Aiyat are 4-lane divided standard. Apart from some sections through towns, the remainder is 2-lane only, mostly without shoulders.

The highway passes through a mixture of agricultural land (60 percent) and both small and large communities. The communities are scattered in short lengths along the route with about 200 changes of classification between Cairo and Assuit. A feature of the highway is the great frequency of police check points where typically the road is narrowed to a single lane using temporary barricades. Over 40 check points, or one every 8 kilometers, were observed.

East Bank Highway - This road assumed greater importance on the opening of the new Nile Bridge at Beni Suef in 1985, since this enabled it to serve as an alternative to the existing West Bank Highway. South of Helwan, the road has similar characteristics to the main West Bank Highway -- mainly 2-lane construction through agricultural land but with frequent passages through small villages. After Koraimat, the road passes through desert (30 kilometers) until reaching the new bridge at Beni Suef.

Giza-Fayoum-Beni Suef Road - The first part of this route out of Giza is the 53 kilometer Fayoum Desert Road, mainly 2-lane with gravel shoulders. After entering the Fayoum Oasis, the road has similar characteristics to the main West Bank Highway. The section through the center of the Fayoum Governorate Capital is very difficult with crowded urban streets in poor condition. After exiting Fayoum, this is generally a good well-surfaced and well aligned 2-lane road with paved shoulders.

Nile Bridges

Until recently, the only crossings of the River Nile were at the northern and southern extremities of the Cairo-Assuit Corridor with 350 kms of highway between them. In 1985, a new 4-lane bridge was opened at Beni Suef, allowing Beni Suef to expand into non-agricultural land on the East Bank of Nile, and linking with the East Bank Highway to Helwan and Cairo. A new 4-lane bridge is also under construction at Minia due to be completed in 1987.

Recent and Current Construction

A substantial investment in highways is currently in progress in the Corridor. It is estimated that investments have been of the order of LE 10-15 million per year for the last six to eight years.

A major part of this work is a rehabilitation program for the main West Bank Highway which will transform it into a good 2-lane highway with paved shoulders for the entire distance from Cairo to Assuit. However, pavement strength is low as commented later in this section. Two other major construction projects are also underway, as follows:

New East Bank Highway - The opening of the Nile Bridge at Beni Suef, and the rehabilitation of the existing highway between Helwan and Beni Suef, have created a new East Bank Highway capable of relieving the existing West Bank Highway of significant volumes of long distance traffic. A second stage of the East Bank Highway is now under construction between Beni Suef and Minia and will link with the new Nile Bridge now under construction at Minia. Completion is programmed for early 1988, and will then provide an alternative route to the existing West Bank Highway for two-thirds of the distance along the Cairo-Assuit Corridor.

Inspection of the new construction between Beni Suef and Minia raised two concerns. First, the geometric alignment is deficient in places, with some blind summits and sharp curves. Secondly, the pavement structure is not particularly strong, and is unlikely to withstand the high axle loads imposed by heavy trucks. Therefore, if trucks (which dominate long distance traffic) transfer to the new road in significant quantities as expected by this Study, the new sections are likely to deteriorate rapidly.

The Inter-Governorate Highway - The Governorates of Fayoum, Beni Suef and Minia are collaborating on upgrading 221 kilometers of existing highway to form a new route linking the three Governorates. The roads selected for upgrading follow the line of the Bahr Youssef Canal parallel to the main West Bank Highway located in the agricultural area.

Potentially, this project could provide significant relief to the main existing highway, but it suffers from poor alignment in sections and a weak pavement design. Funding is restricted and the completion date is uncertain. It was concluded that this new Inter-governorate route could serve a useful role in relieving the existing main West Bank Highway of local traffic, but that most traffic would continue to use the existing highway.

Highway Maintenance

For the main roads now in use in the Corridor, RBA has followed a policy which reduces maintenance to a minimum. The asphaltic concrete pavements are a high-type, modern surfacing, plant-mixed and machine-laid. They are relatively massive pavements for most of the length, consisting usually of 6 cm open-graded "premix" or "binder"

course, followed by 5 cm wearing couses of denser gradation. Such heavy pavements do not develop potholes and breaks in the same way as thinner pavements and surface treatments. If well-constructed they can withstand much use and overloading without requiring the constant small repairs which are typical of lighter surfacings under such conditions. They do fail, of course, if subjected to traffic in excess of the load capacities of the base and surface layers, and there is extensive failure of this kind evident in the Corridor now. However, overlays and rehabilitation to correct this fall outside normal routine maintenance, and are discussed separately.

One serious problem of shoulder usage exists. Much of the length of the present Cairo-Assuit highway is closely parallel to main irrigation canals, and the channel and slopes of the canals have to be maintained constantly by the Irrigation Authority. The crawler-mounted draglines and other machines used for this work often occupy part of the shoulder, including even having one track on the edge of the travelway pavement. The silt and organic matter dredged from the canals is frequently cast on or near the shoulder.

There is no obvious solution to this problems, since the canal maintenance is a legitimate and necessary function, and the working space available for it is often limited. Nevertheless, the effects on the highway are serious, and the water saturated dredged material, entirely bad for the road, should be removed promptly from the highway shoulders. It would appear to be good material for land reclamation and of considerable value if hauled to suitable disposal sites. Wherever space permits, the embankments should be widened or lower terraces constructed to provide working platforms for the draglines.

For the purposes of this feasibility study, pavement maintenance was estimated to include patching, smoothing overlays to correct local deficiences, sealing over patches and any other repairs which may be susceptible to raveling, and periodic seal coating (surface dressing) for the roadway full width, at intervals of several years. The rates and frequency for all such work were estimated considering pavement age and traffic volumes, plus the initial observed condition of the pavement where applicable. Costs were also estimated for maintenance of drainage and other structures, embankments, line painting and sign maintenance. However, given the relatively low maintenance needs of the existing highways (overlaying being treated as infrastructure investment), estimated maintenance costs were low.

Evaluation of Highway Pavements

A visual rating of pavement surface conditions was undertaken early in the Study. Based on this, 20 locations were selected for field borings to establish pavement structure and to provided samples for laboratory analysis. An evaluation was then made of the strength of the existing pavements, and this was used, together with projected traffic data, to establish future pavement strengthening requirements.

It was concluded that a proper program of overlaying could maintain these pavements in good condition, for less cost than the current RBA policy of overlaying and rehabilitation only when pavements become seriously deteriorated. However, action will be required early since, despite the present program of rehabilitation, pavements in most sections of the Corridor are weak and are unlikely to be able to withstand current or expected axle loadings, even with some form of axle weight control, for more than a few years.

It is estimated that over 1.23 million cubic meters of asphaltic overlay will be required on the existing road system over the period 1987 to 2009, reducing to 1.12 million cubic meters if the main West Bank Highway is improved as described below, or 1.06 million cubic meters if the new Cairo-Assuit Highway is constructed. At a financial cost of LE 55.7 per cubic meter, this implies an investment of between LE 59 and 67 million over the period, averaging LE 2.6 to 3.0 million per year. Higher expenditures are likely to be necessary in the early part of the period to bring pavements up to an acceptable strength. However, a proper program of pavement overlaying must be determined based on a detailed analysis of pavement strengths, identifying priority sections for early treatment. It is emphasized that the evidence compiled by this Study is not sufficient to identify a detailed program of pavement strengthening.

Candidate Construction Projects on the Existing Highways

Two major investment projects were considered for improving the existing West Bank Highway: constructing bypasses around the major towns along the highway, and widening the highway to 4-lane standard.

Alignments for bypasses were located around 14 towns on the existing West Bank Highway where conditions in the center of the town seriously impeded through traffic, a condition which could be expected to get worse over time. The total length of bypasses was 82 kilometers.

An assessment was also made of the requirement for widening all sections of the existing West Bank Highway to 4-lane standard. A total of 246 kilometers of highway were involved from Aiyat, where the existing 4-lane construction out of Cairo ends, to Manqabad where the existing 4-lane construction into Assuit begins. Significant sections of the existing highway had canals on both sides of the road, one being the main canal and the other being a smaller feeder canal. Widening the road would mean relocating the smaller canal, and the engineering and cost estimates took this into account.

Unit Highway Construction Costs - For the most part, financial costs (the prices actually paid to contractors) were derived from comparisons of recent bids. For economic evaluation purposes, it was necessary to convert these costs to economic resource costs, which adjust for taxes, import duties and subsidies, to obtain a truer measure of National resources consumed by construction.

Land Costs - Generally, the prices adopted assumed that land would be expropriated by Government for construction, which implied much lower prices than, for example, if the land were to be used for industry. Land prices adopted ranged from zero for desert land to LE 5 per square meter for agricultural land close to the existing main highway.

Costs of both 2-lane and 4-lane bypasses, and the costs of widening the existing highway between bypasses are summarized below.

COST OF CONSTRUCTION OF BYPASSES AND WIDENING
(LE millions, 1986)

IMPROVEMENT	FINANCIAL COSTS	ECONOMIC COSTS
2-lane bypasses	24.8	31.6
4-lane bypasses	37.9	49.6
Widening	74.8	95.0

DESIGN OF THE NEW CAIRO-ASSUIT HIGHWAY

The principal project evaluated by the Study was a completely new road from Cairo to Assuit. The Study considered all aspects of the new road, from the broad issue of location -- which side of the Nile River, how far from the existing communities -- through to detailed route location, preliminary engineering design and costing.

Alignment Options Evaluated

The first task of the Study was to evaluate alternative alignment options for the new highway and recommend an alignment for more detailed study. This task, which occupied the first two months of the Study, considered alignments on both sides of the Nile, including some located in the desert far from the main Corridor.

Principally on the grounds of lower construction costs, better accessibility to existing communities in the Corridor, and potential for opening new areas for development, an alignment on the West bank of the Nile was selected, located in the desert just outside the existing developed agricultural area.

After agreeing the alignment with RBA, an aerial photographic survey of the alignment was completed and a set of US Army topographic maps of the Corridor were obtained from USAID. Both photographs and maps were prepared to scale 1:25,000. A detailed soils survey was conducted along the length of the alignment.

Prelimimary Engineering Design

The main constraints for locating the new alignment were:

i) Location of the high voltage transmission lines from Aswan to Cairo.

ii) Location of the planned new petroleum product pipeline from Cairo to Assuit.

iii) The limits of agricultural development, including new extensions of agricultural land reclaimed from the desert.

iv) Topography (only a significant issue in the south of the Corridor).

Geometric design standards used for the preliminary engineering design of the new highway were based on USA standards. A design speed of 110 kilometers per hour was assumed for the new highway, and 65 kilometers per hour for the access roads. All other parameters, including curvatures, superelevation, stopping and passing sight distances were selected appropriate to these speeds.

The terrain is generally easy and there were few problems in locating the new highway in conformity with these standards. The only sections which presented any difficulty were those opposite Minia, where the new alignment enters the narrow section between the rock escarpment and the agricultural land, and between Mallawi and Dairut. However, the road could be located in both these sections according to design standards. It was concluded that a full 4-lane expressway could be located in the selected Corridor designed to the highest standards of alignment.

The total length of the final alignment, from the Fayoum Desert Road to the New Valley Road, is 343.3 kilometers.

Pavement Design

Much pavement construction in Egypt appears to use standard designs with little regard to actual or predicted axle loadings. An important element of the Study was the preparation of realistic designs capable of withstanding forecast axle loadings.

Based on forecast axle loading of up to 60 million equivalent standard axles over 20 years, and with measured base soil CBR values of 8 percent or better, a standard pavement structure was adopted as follows:

Crushed stone sub-base	15 cm
Asphalt base course	18-20
Wearing surface	5

It was assumed that an additional 5 cm strengthening overlay would be placed after 10 years.

Costs of Construction

Costs of construction were estimated based on preliminary design quantities. Cut and fill was estimated from the road profile, and pavement quantities from the cross-section design. Structures for interchanges, crossings of wadis, and protection against sand dunes in some locations were estimated individually. Allowance was made for an additional slip road for the Cairo Ring Road/Fayoum Desert Road intersection, located just to the North of the northern terminus of the new highway. Some agricultural land would be required where the road crosses the agricultural strip linking Beni Suef and Fayoum.

Total costs of construction are summarized below.

CONSTRUCTION COSTS OF THE NEW CAIRO-ASSUIT HIGHWAY
(LE millions, 1985/86)

COST CLASS	FIRST STAGE CONSTRUCTION (1)	TOTAL CONSTRUCTION (2)
Financial	88.6	179.4
Economic	118.2	240.7
Foreign Exchange	33.6	69.4

NOTE: Access roads with their intersections costed separately
(1) 2-lane construction with at-grade intersections
(2) 4-lane construction with grade-separated intersections

Access Roads

An important feature of the design of the new highway was the identification of suitable access roads linking the new road to the existing communities in the Corridor. The aim was to provide a link to each of the Markez capitals. Since these communities are almost exclusively located along the existing West Bank Highway, access roads would have to cross the existing agricultural area which is in places 20 kilometers wide. It is therefore inevitable that some agricultural land would be used in the construction of access roads. To reduce this to minimum, use was made of existing roads, improving and extending them to the line of the new highway.

Field inspections of the candidate access roads showed most to be sub-standard in terms of width, pavement condition and shoulders. Therefore costs were estimated for widening the existing roads, and extending the roads to the line of the new highway. Pavement design was based on forecast traffic and axle loadings which varied by location. All new construction was in desert areas or areas of reclaimed land on the fringe of the desert.

The total length of access road was estimated at 181 kilometers of which 143 kilometers was existing roadway. A total of 1.2 million square meters of agricultural land would be required adjacent to the existing roads for improvement, and 72 thousand square meters of reclaimed land.

Construction costs are summarized below:

CONSTRUCTION COSTS OF ACCESS ROADS
(LE millions, 1985/86)

COST CLASS	FIRST STAGE CONSTRUCTION (1)	TOTAL CONSTRUCTION (2)
Financial	28.6	64.0
Economic	36.9	84.7
Foreign Exchange	9.3	25.4

(1) At-grade intersections
(2) Grade separated intersections

ECONOMIC STUDIES

The economic studies covered population, economic growth and costs of transport.

Economic Parameters

The Study made a number of necessary assumptions on economic parameters to be used both in the traffic forecasting and economic evaluation stages. The key assumptions were as follows:

1) Inflation - On the basis that inflation affects all sectors of the economy, it was disregarded in the Study forecasts. Therefore all economic and financial values used in the Study were in terms of constant 1985/86 LE.

2) Discount Rate - Following the lead of the recent Egypt National Transport Study, a discount rate of 12 percent was selected for economic evaluations.

3) Interest Rate - After considering a range of market interest rates, a value of 12 percent was selected by the Study for financial calculations in the transport sector. This was modified for the evaluation of toll systems, as discussed later.

4) Shadow Pricing - Special prices (or shadow prices) were required for certain items to allow for scarcity or distortions in the market which, if left uncorrected, would bias the evaluations. These covered foreign exchange (adopting US$1.00 = LE 1.80), price of petroleum (adopted long term price of US$20 per barrel), labor costs and values of time for passengers and cargo.

National Economic Base

Detailed reviews were made of the recent development of Egypt in terms of population growth and growth in the Economy. These served as a base from which to make projections of future trends in development which provided the background for the forecasts of traffic by the Study.

Population - The Study made an extensive review of the four recent censuses in Egypt. An original contribution by this Study was a detailed assessment of the comparability of census results, taking account of the many administrative boundary and regional classification changes introduced over recent years. By adjusting all census results to common boundaries, new light was shed on the rate of urbanization, which the Study believes has been overstated in other recent studies.

Population forecast methodology utilized by this Study gave a projected year 2000 national population of 68 million, compared with 47 million today. Population in the Corridor is forecast to grow from 7.6 million today to 10.6 million by the year 2000.

The year 2000 projection for Egypt is 2.7 percent higher than the midpoint between high and low projections used in ENTS Phase III. It is, however, only four tenths of one percent higher than the medium projection of the National Urban Policy Study (NUPS), and this difference is not statistically significant.

This Study utilized the United Nations URGD method to forecast urbanization trends. The use of this method, plus a careful and thorough comparability adjustment, yielded an urbanization rate lower than previous studies. For the year 2000, the ENTS Phase III urban proportion was 60 percent, the NUPS urban proportion was 54.8 percent, and the urban proportion in this Study was 50.5 percent. It is felt that the methodology used in the Cairo-Assuit Highway Feasibility Study provides a more reliable basis for projection of travel demands.

Economics - Long term growth of the National gross domestic product has been about 5.8 percent annually for the period 1956 to 1985. The 1975-80 period was one of high growth, around 9.3 percent annually, funded primarily by large increase in foreign exchange earnings from the petroleum sector, Suez Canal, expatriate remittances, tourism and foreign assistance. With the advent of the 80s the rates of growth declined, averaging 6.4 percent for the period 1980-1985. By the end of the first quarter 1986, international and domestic events signalled the end of rapid growth prospects and the beginning of an austerity period for the Egyptian economy. Sizeable absolute decreases in the petroleum sector, tourism and expatriate remittances are considered probable, with Suez earnings either stable or showing a modest increase. Other export earnings are thought not likely to increase significantly in the medium run and foreign assistance to replace the entire magnitude of the expected decrease is unlikely. The Study therefore adopted a modest annual economic rate of growth for 1985-1990 of 4 percent, increasing to 6 percent for 1990-2000.

Traffic Model Input - The schematic selected to represent transport network flows within Egypt for transport planning and analysis purposes divides the nation into 64 traffic/economic analysis zones. Within the Cairo-Assuit Corridor, zone boundaries, in general, conformed to the administrative boundaries at the marakez (district) level. Beyond the Corridor, less detail was required and zone boundaries, in general, conformed to administrative boundaries at the governorate level. Zonal gross domestic product estimates were derived by combining regional population and per capita income estimates. Per capita income estimates by region and by urban-rural classification were based on the CAPMAS Urban-Rural Household Expenditures surveys of 1974/75 and 1981/82.

Costs of Highway Transport

Costs of highway transport were required for two purposes in the Study; traffic forecasting and project evaluation.

For forecasting traffic, the price paid for transport was required, since this is what determines behavior and route choice. The price paid could be tariffs for users of transport services (taxis, buses, trucking

companies), or the financial costs of owning and operating vehicles, for private owners. The situation is complicated by the fact that private car owners generally do not perceive the full costs of motoring, disregarding such items as maintenance and depreciation, although they are more aware of personal time consumed in journeys. For forecasting traffic demand and routing, perceived financial costs were developed by the Study to take account of all these factors.

Project evaluation required the use of economic resource costs which eliminate financial transfers in the economy, such as duties, taxes and subsidies. Shadow pricing was also used to better establish the true cost of resources consumed in transport operations. The most dramatic difference between financial and economic costs is in the price of diesel fuel, which is 3 piastres per liter to purchase (financial cost), whereas the resource valuation is about 20 piastres per liter (economic cost).

Selected Vehicles - Since costs vary considerably by size and function of vehicle, a range of nine vehicle types were selected for traffic forecasting and evaluation. Vehicle operating costs were derived for each vehicle type separately.

The vehicles were selected based on the traffic survey results, and guided by previous studies of transport in Egypt. They consisted of two cars (sub-divided according to trip purpose), two taxis (car and van), a pickup, a bus, and three trucks of varying sizes. Vehicle characteristics, including utilization rates, and unit costs (considering the vehicle, tires, fuel, oil, maintenance labor, spare parts and depreciation) were estimated for each.

Free-flow Vehicle Operating Costs - Costs of vehicle operations assuming congestion free conditions were estimated using the World Bank Highway Design and Maintenance Standards Model (HDM). The operation of this model was first calibrated to Egyptian conditions by running with data from the Egypt National Transport Study (ENTS) and adjusting the model to reproduce the ENTS final costs. The calibrated model was then used to estimate operating costs for this Study based on current vehicle characteristics and unit costs.

Compared with ENTS 1983 costs, vehicle operating costs for this Study were generally only a little higher. This was a result of two contrary factors: increases in unit costs from ENTS of the order of 20 percent, but decreases in costs due to assumed higher vehicle utilization rates derived from the Study surveys.

Vehicle Operating Cost Adjustment - Adjustments are generally made to free-flow operating costs to adjust for three items: road geometry, road surface condition and congestion.

No adjustments were made for road geometry in this Study, since the great majority of the roads under study were well aligned with flat grades.

Four classes of road surface were recognized: excellent, very good, good and fair. For each, the HDM model was used to estimate cost adjustment factors.

The main attention was focussed on congestion costs. The Study made use of standard tables of costs and time associated with speed-change cycles (slowing down and speeding up again), stop cycles (slowing down to a complete halt, before re-starting and coming back up to the original speed), and idling (when the vehicle waits in a completely halted traffic stream). In each case, the costs and time associated with congestion were stated as "excess" cost and time, to be added to the costs of free-flow vehicle operations. Excess cost tables for this Study were prepared as a function of the free-flow costs estimated previously using the HDM model.

Time Costs - The values of passenger and cargo time per vehicle were estimated for each of the selected vehicle types, based on vehicle occupancies, passenger time values (which depended on vehicle type and purpose) and cargo values (derived from the mix of cargoes found in the roadside interview survey). Passenger time values ranged from LE 1.45 per vehicle hour for private car non-work purpose, to LE 4.58 per vehicle hour for the bus. Cargo time values per vehicle hour were very low, with a maximum of LE 0.074 for the Combination Truck.

Toll Costs - Toll costs were derived from the only toll road in operation in Egypt, the Alexandria Desert Road, ranging from 5 to 25 milliemes per vehicle-kilometer depending on vehicle size. These are very low toll rates, representing just 5 percent of free-flow vehicle operating costs.

HIGHWAY TRAFFIC FORECASTS

Following a review of the non-highway modes of transport in the Corridor, it was concluded that growth in highway transport would be affected principally by the new Cairo-Assuit petroleum product pipeline, but that a major switch from highway to rail and waterways as in the "target-setting" forecasts of ENTS was unlikely to occur. Hence the main highway traffic forecasts for this Study took account only of the new pipeline, and disregarded the ENTS forecasts for rail and waterways. In the evaluation phase, sensitivity tests were made to assess the impact of lower growth in highway traffic which could be attributed to, among other things, a faster growth rate in rail and waterways.

The approach of the Study to highway traffic forecasting was in two stages. In the first stage, initial traffic forecasts were prepared for each of the two forecast years 1990 and 2000 based on i) population and GDP projections, and ii) growth rates by vehicle type relative to the national economic growth rate. Adjustments were made to take account of the new Cairo-Assuit petroleum product pipeline, and for expected changes in the distribution of cement following the opening of the new cement plant in Assuit. In the second stage, the initial traffic forecasts for each year were analyzed using the computer traffic model, which adjusted the traffic forecasts according to the level of traffic congestion detected.

Vehicle Growth Rates

While the overall rate of traffic growth is determined by changes in population and GDP, growth rates by individual vehicle type are likely to vary considerably. Therefore, an analysis was made for each vehicle type to determine likely growth rates relative to the overall growth rate in the economy. Past growth rates by vehicle type were studied, and account was taken of the traffic forecasts made by ENTS (although noting their policy bias towards non-highway transport discussed earlier).

With assumed GDP annual growth rates of 4 percent and 6 percent for the years 1985-1990 and 1990-2000 respectively, the following vehicle annual growth rates were selected:

VEHICLE GROWTH RATES TO 1990 AND 2000

VEHICLE TYPE	1985-1990	1990-2000
Private car	6.5 percent	8.0 percent
Taxi-car	2.5	3.5
Taxi-van	6.4	8.2
Pickup	5.0	6.5
Bus	4.0	6.0
Truck	4.0	6.0

These were the starting point for forecasting traffic growth in the Corridor. The initial forecasts of traffic varied by traffic zone according to the particular growth in GDP of the zone, and all initial forecasts were modified in the traffic model according to the degree of congestion detected on the road system.

Initial Traffic Forecasts

The initial forecasts of traffic, before taking traffic congestion into account, showed an increase of 1.25 times to 1990 and 2.4 times to 2000, compared with the 1985/86 Base Year. These represent average annual growth rates of 5 percent to 1990 and 6.5 percent to 2000. These traffic growth rates are lower than have been experienced in the last years prior to the Study, and reflect the expected lower future growth rates in the National Economy.

A case can certainly be made for traffic growth rates higher than reported here, based on past traffic growth rates. However, a strong case could also be made for lower traffic growth, on the basis that the reduction in the National economic growth could be much sharper over the next few years than assumed by this Study, and by assuming a greater role for waterway and railroad transport, both of which have opportunities for increasing their share of transport in the Corridor. Hence the traffic forecasts presented here represented a middle ground, suitable for project identification and evaluation. Sensitivity tests were also prepared to assess the affect of different growth rate assumptions on Study recommendations.

Alternative Investment Packages

For each highway alternative considered for the Cairo-Assuit Corridor, it was necessary to define the road characteristics in a form for computer analysis. These descriptions were termed "coded road networks". Each network defined covered all of Egypt, but with the finest detail concentrated in the Cairo-Assuit Corridor.

Five basic coded networks were prepared for the Study, as follows:

Base Year Network
Committed Network
Overlay Network
Expressway Network
Improved Network

The Base Year Network described the existing road conditions and was used to establish reference travel times and costs for comparison with estimated future conditions.

The Committed Network represented the likely future road system with the addition of only those current projects which were actually in construction or definitely funded. It also assumed the current policy for road surface improvement, which allows the roads to deteriorate to a poor quality of surface before rehabilitation.

The Overlay Network consisted of the Committed Network, but with a program of more frequent road surface overlays. Thus the configuration of the network in terms of links and nodes was identical to the Committed Network, but a better quality of road surface was assumed. This network was the principal reference network, against which the performance of the other networks containing new highway investments could be compared.

The Expressway Network consisted of the Overlay Network with the addition of the new Cairo-Assuit Highway for which preliminary designs have been prepared by this Study. The term 'Expressway' referred to the possible final layout of the Highway with divided carriageways, and grade separated intersections. The evaluation stage decided by what year such a configuration could be justified, and use of the term Expressway to describe the network containing the new highway did not imply a pre-judgement on the construction recommendations.

The Improved Network was the alternative to the Expressway Network, and consisted of the Overlay Network (Committed Network plus improved overlay policy) together with improvements to the alignment of the existing West Bank Highway. In fact, two distinct networks were prepared assuming a staging of improvements. In the first stage, two-lane bypasses were assumed for all towns along the West Bank Highway which currently did not have one. In the second stage, the entire West Bank Highway, including the new bypasses, was assumed to be widened to four lanes.

Committed Network Traffic Forecast

The Traffic Model results for the Committed Network showed that with no new highway improvement projects in the Cairo-Assuit Corridor beyond those already in construction or otherwise committed, traffic congestion could be expected to increase. This would have the effect of slowing traffic growth to below the initial forecast level, which implies a stagnation in economic development in the Corridor. The reduction in trips from initial forecast levels would be slight by 1990 - about 1 percent - because of the current road improvement program in the Corridor, but would be much more significant by 2000 with a forecast 7 percent reduction.

Traffic volumes on the existing West Bank Highway were forecast to be lower than in Base Year by 1990, and this was because of the impact of the new East Bank Highway assumed to be complete from Cairo to Minia. By the year 2000, however, forecast volumes exceed Base Year traffic considerably, it was estimated that the resulting increased congestion would increase travel times between Cairo and Assuit by one third, or between 2 and 3 hours.

Improved Network Traffic Forecast

For 1990, the Improved Network consisted of the Committed Network with the addition of 14 two-lane bypasses. Hence the network would offer a good two-lane road with paved shoulders all the way from Cairo to Assuit, avoiding all passages through the twons and cities along the route.

However, this improvement made little difference to forecast traffic flows, indicating that the benefits to traffic of being able to bypass congested town centers, was offset by the increased length of highway along the Bypass alignments. Overall, the bypasses added 16 kms to the length of the existing Cairo-Assuit Highway.

The year 2000 forecasts showed the Improved Network was substantially better in traffic impact through the widening of the entire route between Aiyat (46kms south of Cairo) to Assuit, including the 1990 bypasses. Not surprisingly, traffic volumes on the existing West Bank Highway under this alternative were the highest of all the network alternatives, ranging between 5 and 15 percent above the volumes recorded on the other networks. Travel times between Cairo and Assuit by the year 2000 were estimated to be an hour less than in Base Year, indicating the congestion-free nature of the Improved Network.

Expressway Network Traffic Forecast

Forecast volumes on the new highway in the year 2000 ranged from about 10,000 vehicles day between Giza and Beni Suef to about 3,000 vehicles per day near Assuit. Volumes in 1990 were at about half this level.

Traffic volumes on the existing West Bank Highway were reduced by the new highway, but not greatly. This was because much of the long distance traffic on the sections from Cairo to Minia had already been taken by the new East Bank Highway. South of Minia, where there was no East Bank Highway, the new highway relieved the existing road of about 3-4,000 vehicles per day, with some additional traffic on the expressway due to traffic generation.

Travel times between Cairo and Assuit were forecast to be of the same order as the Improved Network by 2000, that is to say, a total travel time of about 1 hour less than today. However, this reduction in travel time applied only to long distance traffic using the new highway. Short distance traffic remaining on the existing West Bank Highway would gain little benefit from the new highway, unlike the Improved Network which reduced travel times generally for both long and short distance traffic.

The volumes forecast on the new Cairo-Assuit Highway are not particularly high for an expressway, and do not support 4-lane construction in the early stages of the project. The reason is that much of the traffic in the Corridor is very short distance. Half the total traffic volume in the Corridor moves entirely within the Governorates, and only 2 percent of total traffic is moving from one end of the Corridor to the other. Overall, only about 20 percent of the traffic in the Corridor is a candidate for travel on the Expressway, and even this traffic is shared by other roads, in particular the East Bank Highway.

However, although the forecast volumes of traffic on the new highway are not high, this traffic gains great benefit from bypassing the congested existing highways. It was the task of the evaluation to judge whether these benefits would be sufficient to justify construction.

Staging and Sensitivity Tests

Some further traffic forecasts were made for the purpose of evaluating economic feasibility and staging of the new highway construction. The main result to emerge was that forecast traffic volumes for the new Cairo-Assuit highway assuming 2-lane construction instead of 4-lane as above, were very little reduced.

EVALUATIONS

The alternative investments considered by the Study were evaluated from several different viewpoints, including economic, financial, social and environmental.

Economic Evaluation

The task of the economic evaluation was to assess the economic value to the Nation of each investment considered by the Study. This was done by comparing the costs of construction and maintenance for each investment with the economic benefits expected to be brought about by the investment.

Each network described in the previous section was treated as a complete package of investments; the separate projects included in each network were not evaluated individually.

Project Costs and Benefits - Project costs for either improving the existing highway or building a new highway were presented earlier; it is sufficient to note here that the economic evaluation required economic resource costs, which are on average about one quarter to one third higher than financial costs paid to contractors.

The three types of benefit considered in the economic evaluation were the savings in vehicle operating costs, passenger time, and traffic accidents. In all cases, the savings were calculated in comparison to costs on the Overlay Network, which was identical in configuration to the Committed Network but which assumed an improved program of pavement strengthening by overlays.

Development benefits, that is to say, the benefits from opening up regions for new growth, were included in the economic evaluation, not explicitly in terms of locations of new factories and cities, but implicitly in the valuation of generated traffic benefits. Other benefits for which quantification in economic terms is more controversial, in particular environmental and social benefits, were considered in a qualitative manner, as discussed later.

It was concluded that the two major types of projects considered by the Study -- the new Cairo-Assuit Highway and improvements to the existing highway -- both showed strong benefits by the year 2000 and were both serious candidates for consideration.

It is also worth noting that the vehicle operating costs benefits of the Overlay Network compared with the Committed Network were substantial, exceeding the benefits of both the Expressway and Improved Networks (compared with Overlay). This emphasises the the fact that considerable benefits can be obtained by providing good pavement surfaces on existing roads.

Cost Benefit Evaluation - The cost/benefit evaluation brought together all the estimates of costs and benefits for each year and arrayed them in a time series, interpolating and extrapolating cost and benefit values

where necessary. Cost and benefit values were then discounted to a common year, 1986, using the Study selected discount rate of 12 percent, and a set of economic indicators were calculated to show project feasibility.

Expressway Network - The evaluation indicated that a new highway from Cairo to Assuit could be economically justified for opening in the 1990s. Results indicated clearly from the purely economic viewpoint, that it should be built initially to 2-lane standard and not 4-lane. These conclusions were supported by the traffic evaluation which indicated no need of a 4-lane highway in the first stage.

Project benefits mainly came from savings in vehicle operating costs, in particular truck operating costs, but passenger time savings were significant as well. However, these were reduced to one third of the calculated value in one of the sets of evaluation parameters presented to demonstrate that they were not essential at the full rate for economic feasibility.

Accident savings were negligible, if not negative. This was mainly because traffic would be diverted from the 4-lane Cairo-Aiyat section of the existing highway, where accident rates could be expected to be lower than on the new 2-lane highway presented here.

The striking feature of the Expressway Network results is that few benefits (3.4 percent) accrued to internal movements in the Corridor. Such benefits as did accrue to this traffic arose from the longer distance inter-Governorate movements, and from the slight relief in congestion in the main Corridor brought about by the new highway. This clearly demonstrates that the main benefit of the new highway would be to long distance traffic moving to, from, and through the Corridor.

Inspection of the net cost/benefit stream indicated a starting date for construction as 1990. Assuming that international funding would be required to finance the project, with the checks and controls that this necessarily implies, this was considered realistic, if not optimistic. Assuming the start of construction as 1990 (with the period up to 1990 being consumed in agreeing financing, final design and contractor tendering), and a 4-year construction period, the economic evaluation shows an Internal Rate of Return (IRR) of 16.8 percent, a Net Present Value (NPV) of LE 47.7 million and a Benefit/Cost (B/C) Ratio of 1.55.

Sensitivity tests indicated that lower traffic growth rates, caused either by slower economic growth or by some transfer of traffic to other modes, could postpone the optimum date of opening by a few years.

It was concluded that in terms of the foreign exchange component alone, the evaluation was not favorable, indicating that costs in foreign exchange of constructing the new highway would not be justified by the savings in foreign exchange in reduced operating costs.

Improvements to the Existing Highway - The network with the best economic performance was the Improved Network. Even counting just one third of time benefits, the network achieved an IRR of 18.5%, an NPV of LE 81.7 million and a B/C ratio of 2.06.

It was assumed that improvements would start with the construction of 14 bypasses around the major towns and cities along the route which lack such a bypass (the great majority). This construction was assumed for the period 1987-1989 (which financial period ends in mid-1990). Construction would then commence on widening those sections of the road which are not divided highway; essentially the entire route between Aiyat and Assuit. This work was assumed to last until the Year 2000, allowing for significant difficulties in acquiring land for right-of-way.

Bypasses on their own in the early 1990s would generate few benefits (since they add length to a road which was expected to be no more congested in 1990 than in the Study Base Year 1985/86). In fact, economic benefits were estimated as negative, but they were set to zero in this evaluation on the basis that there would be sufficient benefits within the bypassed towns to at least off-set the negative benefits for traffic passing through. Benefits were expected to build up over the construction period of widening, since each section of widening would be a complete and useable while other sections were still in construction.

Vehicle operating cost savings were nearly equalled by passenger time savings due to the traffic congestion likely to prevail with no new highway construction in the Corridor. Estimated traffic accident savings were considerable with completion of the safer 4-lane highway.

It was concluded that the Improved Network shows a better spread of benefits than the Expressway Network. Benefits to traffic moving entirely within the Corridor were increased greatly, external benefits were also increased, but at the same time, through traffic benefits were scarcely changed.

Financial Evaluation of the New Cairo-Assuit Highway

Since the highway was envisaged to be a high quality road with limited access, the possibilities for financing, or at least offsetting, construction costs from toll revenues was considered.

Two main alternative types of toll system were evaluated; a barrier system which places toll booths across the main highway between each access road, and a closed toll system which effectively seals off the tolled highway by placing barriers on all access roads.

Costs of the two systems were similar. A lower cost barrier system was also considered which assumed barriers on only 3 of the 13 sections of the new highway. However, the lower cost advantage of this reduced barrier system is counterbalanced by the prospect of reduced revenues.

Estimated Toll Revenues - Several alternative toll rates were evaluated ranging from current tolls, as charged on the existing Cairo-Alexandria Desert Road, to a rate 15 times higher. Under these assumptions, the charge for a private car travelling from Cairo to Assuit would range from about LE 2 to LE 26. The charge for a multi-unit truck would range from LE 9 to LE 130. Although traffic would decrease with

progressively higher tolls, total toll revenues were estimated to increase with each toll increase.

Toll Evaluation Procedure - The evaluation of tolls brought together the estimates of costs and revenues, and arrayed them in a project lifetime table. Various economic parameters were calculated in a similar manner to the economic evaluation.

The results for both the Closed system and the Complete Barrier system were very promising. The evaluation for the Closed System (slightly the more costly of the two) indicated an Internal Rate of Return (IRR) of 10.3 percent, a Benefit/Cost (B/C) ratio of 1.47 and a Net Present Value (NPV) of LE 68.7 million. It is emphasised that the IRR of 10.3 percent represents a real return on investment, excluding inflation. Moreover, net revenues were estimated to reach the level debt service required to pay off capital and interest by the early 1990s. It was estimated that an even better result could be obtained with higher tolls.

The Limited Barrier toll system would be less costly to implement and run but would suffer a shortfall in revenue compared with the Closed System and the Complete Barrier System. A slight fall in revenues to, say, 80 percent would not be very serious, but a revenue loss of 50 percent would reduce revenues to below the point of full financial feasibility, although still making a substantial contribution to project costs.

The results of a sensitivity test assuming revenues reduced by 20 percent and all costs, including highway construction and implementing and operating the toll system, increased by 20 percent indicated that revenues in these circumstances would fall only fractionally below those required for full financial feasibility.

Conclusions on the Toll Evaluation - The financial evaluation indicated that tolls could make a substantial contribution to the costs of constructing and maintaining a new Cairo-Assuit Highway. It is possible, with tolls at a sufficiently high level, that the new highway could be completely financed from tolls. However, the estimates of revenues are theoretical, and more information on driver behaviour in the face of high tolls would be required before a final conclusion was reached. In addition, traffic safety, and security for remote toll stations (which could be collecting LE 2-3,000 per day) would have to be considered. The high risk and uncertainty appears to make private financing of the highway unlikely, but this is a prospect which deserves fuller investigation.

A closed toll system with toll booths on access roads appears to be the best alternative, since toll collection could be complete without the safety hazards and delays associated with barrier tolls located on the road itself. A medium toll level at about four times the 1986 tolls charged on the Alexandria Desert Road gave high revenues with little loss of economic benefits and would appear to be a suitable toll level to aim at.

Environmental and Social Evaluation

The purpose of the environmental and social assessment was to identify significant environmental effects and social issues which could be examined in more detail as appropriate if a full scale assessment is deemed necessary at a later time.

Water Quality Assessment - The most significant factor determining potential water quality impacts is the very low rainfall. The small amount of rainfall provides almost no transport of pollutants into the waterways. For this reason, potential water quality impacts produced by the alternatives can all be considered as insignificant or marginal. However, the new highway has an advantage over improving the existing road since it removes traffic from the area of the main irrigation canals.

Air Quality Assessement - Overall, the amount of change in volumes of traffic as well as the total volume of traffic moving along the Corridor under all of the alternatives is low enough to consider any air quality impacts as marginal or insignificant. Traffic volumes would change by only about one half of the amounts necessary to produce significant impacts. However, the new highway produces the lowest adverse impact and the highest level of improvement. It does this by allowing higher, more efficient operating speeds and by removing the pollutant source away from the exposed population.

Noise Assessment - It would be possible to effect a significant reduction in noise levels which would be perceptible by the local population if a reasonable volume of truck traffic were diverted off the West Bank road. Bypasses offer some potential for doing this by carrying traffic around town centers instead of through the town centers. However, the new desert highway offers a better possibility of significant noise reduction by removing traffic volumes and noise sources from exposed population.

Land Resources Assessment - The new highway would require about 1.3 million square meters of agricultural land, mostly for access roads, which could be considered as a moderate adverse impact. The adverse impact of the bypasses and widening the West Bank Highway, requiring about 6.3 million square meter of agricultural land, would probably be considered significant.

Ecological, Historic, Cultural, and Aesthetic Resources - No significant impacts resultant from the highway alternatives were identified with respect to ecological, historic, cultural or aesthetic resources. Accessibility of ancient sites and other historic and cultural resources would be improved to the extent that each alternative improves overall accessibility.

Social Impact Assessment - Complex and varied social impacts, both adverse and beneficial, can be identified. However, those which can be most directly related to the alternatives appear to be the the controversial issue of the taking of agricultural land. Social issues

surrounding the conversion of agricultural land are in approximate proportion to the required amounts of land taking as described above in connection with land resources. There are expected developmental benefits to be derived from a new desert highway in the form of opening new land in the desert fringe for development or reclamation. However, these developmental benefits could not be solely derived from highway construction, but would require supplemental investment in infrastructure and other economic incentives. Accessibility of social and cultural facilities would be improved generally by any of the alternate options.

General Conclusion - Environmental and social impacts can be quantified to a certain extent, but they remain largely subjective and judgmental. In the current case, it appears that the environmental factors which have the highest probability of either producing or receiving significant impacts are noise and land resources.

On balance, it appears that the new highway offers the least risk of adverse impacts and the highest expectation of positive benefits. It accomplishes this not so much by producing lower impact values, but by removing the source of impact away from the exposed receptors, primarily by shifting the highway and its traffic away from the exposed human population.

Policy and Administration

A review was made of transport policy as it affects highway planning, and the capacity of RBA to implement major new highway projects.

Transport Policy - As set forth in the current Five Year Plan, National Policy appears directed toward expanding the rail and water share of passenger and cargo internal transport vis a vis highways. The East Nile and the Sudanese highways are mentioned as priority road construction projects for RBA. However, within the highway sector, the major emphasis is on the improvement and maintenance of the existing network. RBA internal policies support the national objectives.

Finance - The current Five Year Plan budget for the inter-city road network allocates LE 200 million to RBA, 47.6 percent of the total, the rest being allocated to the Ministries of Reconstruction and Local Administration. The amount originally requested by RBA for the period was on the order of LE 350 million. The emphasis of the current RBA five year plan is on road rehabilitation with 60 percent of the total budget allocated to this activity. 1985/86 expenditure is estimated at LE 46 million in 1985 prices and the 1986/87 expenditure is planned at LE 48 million. Current expectations, however, anticipate an austerity budget on the order of LE 41.4 million.

RBA Implementation Capacity - The amount of road construction and rehabilitation completed annually through the RBA appears to be a function mainly of the amount of funds available. For example, when a supplementary budget provided funds, the second carriageway of the Cairo-Alexandria Toll Road (about 200 kms) was designed and tendered by the RBA in about one year. Using four companies, construction was completed in three years.

The organizational structure of the RBA is assessed as satisfactory and poses no serious problem to project implementation. Under the World Bank assisted Egypt Highway Maintenance Project, personnel and equipment deficiencies at the headquarters and district levels of RBA have been identified and are being corrected. Recent RBA performance indicates a capacity for construction and rehabilitation in the neighborhood of 400-500 kms annually.

It is estimated that professional, technical and labor manpower is available to support an annual increase in production on the order of 34-38 percent for the public and private construction companies. Given adequate funding, including foreign exchange, there would appear to be no severe constraints to the successful implementation of a Cairo-Assuit highway project by the RBA.

Recource to private funding sources for the financing of intercity highway projects is not within the experience or legal authority of the RBA. Such a proposal, in the opinion of RBA, would be rejected by the Ministry of Transportation and higher political authority.

CONCLUSIONS AND RECOMMENDATIONS

The main objective of this Study was, in the words of the Contract, "to determine whether a major investment in road construction and/or improvement is warranted". The conclusion of this Study is that a major investment is warranted, and that it should take the form of a new highway constructed from Cairo to Assuit, located in the desert just outside the existing agricultural lands on the west bank of the Nile. This is preferred to the other main alternative examined by the Study which is to make major improvements to the existing West Bank highway.

The economic evaluation showed that the new highway would generate sufficient economic benefits to justify construction. In addition, it is believed that a key role of the new highway could be to provide a focus for a new development of Upper Egypt which has been for long a relatively neglected backwater of the Nation. This is not an issue for highway planning engineers alone, but requires and deserves the attention of Government at the highest level. The new highway would also constitute an important section of the proposed East African Highway from Cairo to southern Africa, linking the principal East African nations.

A decision on the project can only be taken by Government in relation to other priorities, both in the transport sector and elsewhere. The function of this Study has been to establish the necessary factual basis on which further discussions and plans can be based.

If the conclusions of this Study on a new Cairo-Assuit Highway are accepted, the Study recommends that procedures leading to final design and construction tendering are commenced immediately with a view to starting construction in 1990. It is estimated that the first stage of construction, consisting of a 2-lane highway with at-grade intersections, would cost LE 117 million in 1985/86 financial costs.

Existing Situation and Likely Developments

The existing highway from Cairo to Assuit is an unpleasant and hazardous highway to drive along. In particular, it lacks shoulders for much of the route, the road pavement is in poor condition, and the road passes through many communities where through traffic mingles with animal carts, street vendors, pedestrians and all the other local traffic associated with rural townships.

However, while the existing highway has some severe problems, a major program of improvements is in hand to rehabilitate the existing pavement and to construct new highways in the Corridor, which will alleviate many of these problems by 1990. In fact, the additional traffic capacity currently being added in the Corridor will result in traffic volumes on the West Bank Highway remaining at about the current levels up to 1990. After that, traffic conditions are likely to deteriorate seriously. Unless something is done, the Cairo-Assuit Corridor, and the rest of Upper Egypt for which the Corridor is the gateway, will be increasingly isolated from the rest of Egypt. This is a serious problem considering that Upper Egypt contains about 30 percent of the National population.

Improvement of the Existing Highway

The obvious solution to the transport problems of the Corridor is to increase the traffic capacity of the main West Bank Highway. Almost all the communities of the Corridor are located on, or very close to, this road and it clearly offers the most direct link between all the communities. There is little wrong with the alignment of the road, and widening and strengthening could convert it into an excellent all-purpose highway. This Study considered the addition of bypasses for 14 towns along the route, and widening the entire route to 4-lane standard.

It was concluded that improving the existing highway was, in fact, by far the best solution from the traffic and economic viewpoints. However, such a project would be in serious conflict with Government land policy, both by taking an estimated 6 million square meters of agricultural land for initial road construction and widening, and thereafter by acting as focus for all subsequent urban and other developments in the Corridor. Moreover, the project would likely to encounter such severe political opposition as to make implementation impossible in a reasonable time scale. The Study doubts that such a project could be put into effect, and does not recommend pursuing it further. Improvements to the existing highway should concentrate on providing and maintaining a good surface with adequate paved shoulders. Further growth in local traffic can probably be accomodated by improving parallel roads in the agricultural areas, such as the current project by the Governorates of Fayoum, Beni Suef and Minia. However, it is likely that most traffic will tend to concentrate on the main West Bank Highway, and this poses problems for the longer distance movements in the Corridor.

Construction of a New Cairo-Assuit Highway

The alternative to improving the existing road is to construct an entirely new road from Cairo to Assuit. Such a project could solve the problems of access for the long distance movements in the Corridor.

Traffic Analysis - Traffic volumes of 10,000 vehicles per day in 2000 were forecast for the northern section of the highway, dropping to 3-5,000 south of Beni Suef. These volumes are fairly low, mainly because much of the Corridor traffic is short distance (over half of all journeys are less than 30 kilometers) and would not find it worthwhile to travel to and from the new highway.

Economic Evaluation - It was concluded that, despite the comparatively low volumes of traffic forecast for the new road, the new highway would generate sufficient economic benefits to justify a start of construction by 1990. In view of the relatively high cost of the project, foreign funding would be essential. With the necessary checks and controls associated with foreign funding, 1990 is probably the earliest realistic start date for construction.

Financial Evaluation - The financial evaluation indicated that tolls on the new highway could contribute substantially to construction costs, and could possibly finance the new highway entirely. Much would depend driver reactions to tolls - levels of four times the very low tolls currently charged on the Alexandria Desert Road are envisaged. However, given the build up in congestion forecast by the Study for the existing road, the toll revenue forecasts are not considered over-optimistic.

Environmental and Social Evaluation - It was concluded that the new highway would have some environmental and social advantages by removing traffic from the existing populated areas. However, at the levels of traffic forecast, these benefits could not be a major consideration. The new road would require some agricultural land -- about 1.3 million square meters -- almost entirely to widen the existing roads across the agricultural areas to give access to the new highway.

Development Prospects - The Study firmly believes that there is a great planning opportunity associated with a new Cairo-Assuit Highway and that this is where the real potential of the highway lies. Within the Corridor, a potential population of over 10 million people would be living within 5 to 20 kilometers of the new road. Opportunities exist for extending the agricultural area in what is currently the fringe of the accessible zone. It provides an opportunity for new towns and communities having the advantages of good access to north and south, close proximity to the existing population centers from where the people would come, and room to expand industry, major and minor, without the contraints imposed by the ban on using arable land. In short, it would give the Corridor room to breath.

Potential development benefits of a new highway are ofter regarded by lending institutions with great and justifiable suspicion. Too often, it is the easy way to justify a new road which could not be justified by other means. In this case though, the Study believes that there is a sound economic case for constructing the new highway, and that the potential development opportunities and benefits are simply an additional argument in its favor.

Staging of the New Highway - The Study recommends that the initial construction should be to 2-lane standard with at-grade intersections. Reservation of land for full 4-lane construction should be made, but timing of further construction would depend on actual traffic growth. For development reasons the Study recommends construction starting from Cairo, since this will create a stronger impression of opening up the Corridor for new development which would probably gain most strength from ties to Cairo and the North.

Conclusions on the New Highway - It is considered that if a major improvement of the existing highway is ruled out for Government land policy and practical implementation reasons, then long distance access to Upper Egypt communities both in and beyond the Cairo-Assuit Corridor must be provided for. While rail, waterways and continued development of the East Bank Highway could all contribute to further growth, the potential of a new West Bank Highway is much greater.

Other Issues

Other important issues raised during the Study are summarized here.

Traffic Census Program - A regular program of traffic counts with an annual report would have assisted the Study considerably. It is known that plans are in hand for just such a program and this is strongly endorsed by this Study.

Truck Weights - The Study recommends that the issue of truck weight licensing and and axle load enforcement are studied in more detail. A National solution is required, which could include an increase in legal axle loads.

Pavement Strengthening Policy - This Study strongly recommends that RBA adopt more modern methods of planning for pavement strengthening. Various methods, such as taking deflection measurements at regular intervals, are available to assess pavement condition, and some procedure should be adopted by RBA as part of the regular pavement maintenance program.

In particular, it is feared that the current program of rehabilitation in the Corridor will not be sufficient to prevent deterioration under the high axle loads imposed by heavy trucks. However, the data on which this conclusion is based were limited, and were certainly insufficient for detailed programming purposes. There is no satisfactory substitute for a detailed survey of pavement condition for preparing a program of new work.

Urban Traffic Planning in the Corridor - Although urban traffic planning issues were clearly beyond the scope of this Study, it was observed that many of the towns in the Corridor present chaotic traffic conditions which can be expected to get worse over time as car ownership and population increase. In particular, the Governorate capitals of Fayoum, Beni Suef, Minia and Assuit are facing traffic problems which deserve detailed study.

MAIN REPORT

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Chapter 1

INTRODUCTION

This is a report on the findings of the Cairo-Assuit Highway Feasibility Study which was undertaken for the Roads and Bridges Authority (RBA) of the Egyptian Ministry of Transport and Communications between October 1985 and September 1986.

The Study was sponsored by the United States Agency for International Development (USAID) under the Project Grant Agreement with Egypt for Technical Cooperation and Feasibility Studies (Project No. 263-0102). USAID funded the entire foreign exchange budget but the local currency budget was jointly funded by USAID and RBA.

The Study was conducted by Wilbur Smith and Associates in collaboration with Egyptian Consultants Consortium, an association of Engineering and Geological Consulting Office (EGCO), the office of Dr. Abdel Moneim Osman, and Maadi Consulting Group.

Objectives of the Study

The intent of the Study was to undertake engineering and economic feasibility studies of a new or improved highway in Upper Egypt between Cairo and Assuit. Early discussions between USAID and RBA had considered the possibility of a study of the whole of Upper Egypt from Cairo to Aswan, but Assuit, located about half way between Cairo and Aswan, was eventually selected as the southern boundary for the Study.

The Contract specified the major objectives of the Study as follows:

1. Determine whether a major investment in road construction and/or improvement is warranted.

2. Explain and document whether such an investment is economically feasible and what types and magnitudes of benefits and costs will occur.

3. If the investment is found to be feasible and financially viable, determine the best type of road, and/or improvement, alignment location, design standards, and a recommended implementation program schedule.

The detailed specification of work tasks in the Contract clarified the scope of work by requiring a preliminary engineering design for a completely new road from Cairo to Assuit, together with an engineering assessment (but not plans) for upgrading the existing highway. The task of the Study was then to evaluate the economic feasibility of these projects, and to recommend a program of investment.

The Study Area

The Cairo-Assuit Corridor is located in the northern part of Upper Egypt in the Goverorates of Giza, Fayoum, Beni Suef, Minia and Assuit. The Corridor reaches from the boundaries of Greater Cairo to the town of Assuit, a distance by road of 365 kilometers. The Corridor is illustrated in Figure 1-1

Geography - The Corridor consists of a narrow strip of agricultural land located on both sides of the River Nile, but with most development on the west bank. The width of the agricultural land varies along the Corridor, at some points reducing to as little as 5 kilometers, but averaging between 10 and 20 kilometers.

The outer boundaries of the agricultural land mostly mark the extent of the fertile silt deposits laid down over thousands of years during the annual Nile floods and which must still be irrigated by water from the River Nile. However, the historical boundaries are being pushed back as desert is reclaimed by transporting top soil and introducing irrigation.

Beyond the agricultural land along the Nile lies barran desert which is virtually uninhabited. A major exception to this is the large cultivated oasis of Fayoum located in the Western Desert and separated from the main Corridor by about 10 km of desert. Fayoum is also dependent on waters brought from the River Nile.

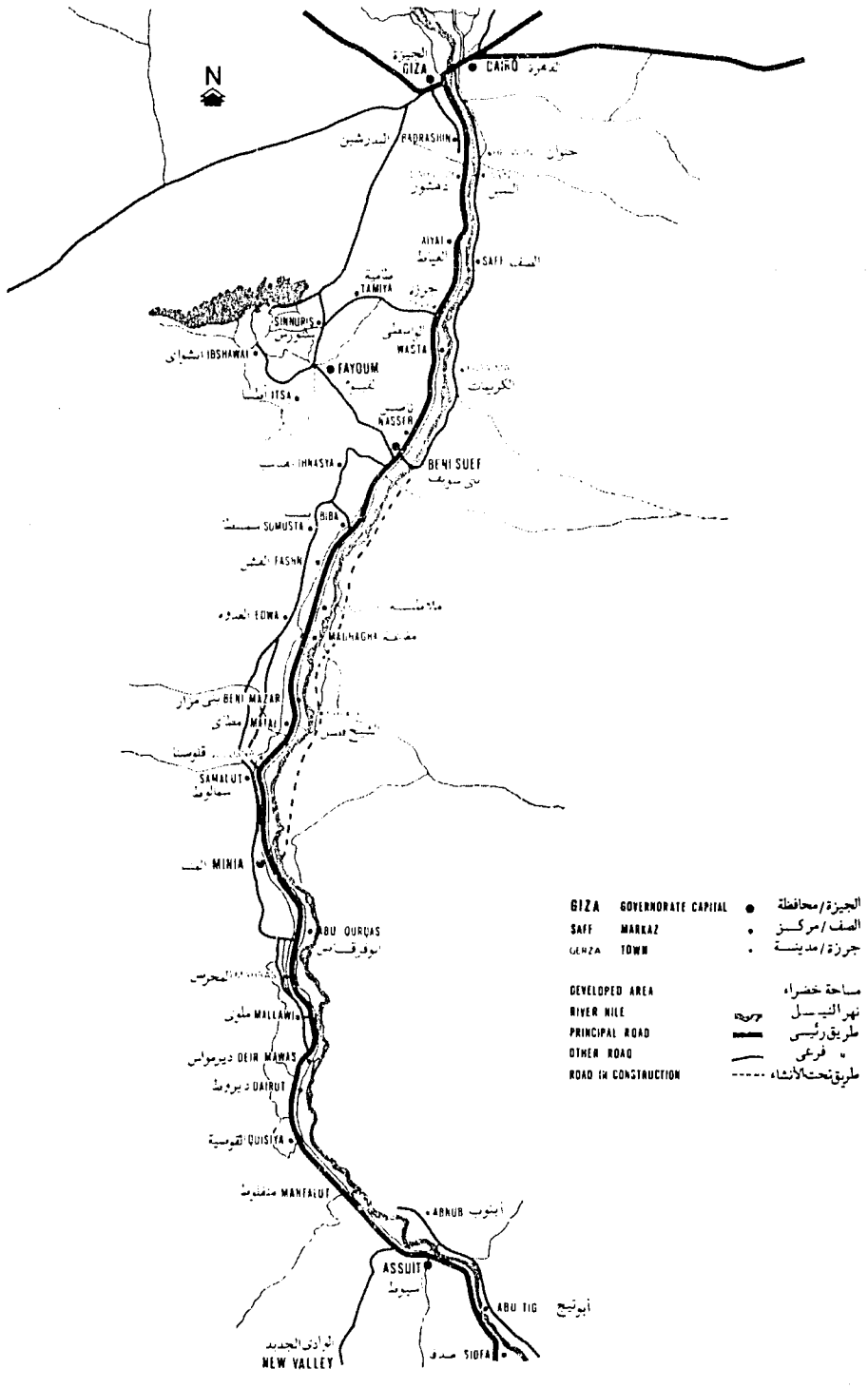
The land on the east bank of the Nile slopes up to the hills lying between the Nile Valley and the Red Sea which reach a height of 800-900 meters. Near Cairo the land near the Nile is flat, but at the southern end of the Corridor the east bank terrain becomes quite rugged, with limestone cliffs coming to the edge of the Nile in some places.

The land on the west bank of the River Nile is much flatter, which is why the Nile silt deposits, and hence the developed areas of the Corridor, are concentrated on the west bank. The main exceptions to the generally flat terrain on the west bank are the low hills near Assuit, and the occasional rock escarpments in the Western Desert.

Population - The agricultural land in the Corridor is intensely cultivated, but is also densely populated. Nearly 8 million people live in the Corridor, out of a total population of Egypt of 47 million, and a population of over 13 million for Upper Egypt.

About 75 percent of the Corridor population are classified as rural. However, there are 13 towns along the Corridor with more than 50,000 inhabitants, the largest being the Governorate capitals. Assuit is the largest city with a population of over 300,000. One of the key planning issues in the Corridor is the preservation of scarce agricultural land from encroachment by urban and industrial development.

Access - Most of Upper Egypt is currently served by a single paved road and a railway, both located on the west bank of the Nile within the



Cairo – Assuit Highway Feasibility Study

THE CAIRO-ASSUIT CORRIDOR

Wilbur Smith and Associates
Egyptian Consultants Consortium

FIGURE 1-1

limits of the Study Corridor. In the northern section of the Corridor, there are two additional main paved highways. One serves the east bank between Cairo and Beni Suef, a road currently being extended to Minia, and the other links Fayoum with Cairo and Beni Suef.

Other paved and unpaved roads perpendicular to the main West Bank Highway penetrate the agricultural area on the west bank. These are in turn connected to feeder roads which run parallel to the main highway. Some of the feeder roads are paved, but most are unpaved. In very few places do these parallel feeder roads link up to form an alternative route to the main highway, although plans are in progress to make these links.

Nile Bridges - Until recently, the only crossings of the River Nile were at Maraziq (near Helwan) and Assuit, located respectively at the northern and southern extremities of the Cairo-Assuit Corridor and with 350 kms of highway between them. In 1985, a new 4-lane bridge was opened at Beni Suef, and a 4-lane bridge is under construction at Minia due to be completed in 1987. The primary purpose of both new bridges is to allow the Governorate capitals where they are located to expand into the desert lands on the East Bank of the Nile, but each bridge also links with the East Bank Highway currently being extended from Beni Suef to Minia.

Study Work Program

The overall schedule for the Study is illustrated in Figure 1-2. The Contract was signed on September 18, 1985. A month was allowed for mobilization of staff and ordering equipment for use on the Study (computers and traffic survey equipment), and the Study got underway on October 17th with the arrival of the Project Director in Egypt.

Alignment Options Study - The initial phase of the Study was of a preparatory nature to identify, in broad terms, the best location for a new Cairo-Assuit highway. No attempt was made to evaluate the worth of building a new highway in this Phase. The task was simply to answer the question "If a new highway is to be built between Cairo and Assuit, where should it be located?" This phase culminated in an Alignment Options Report presented in mid-December 1985 which recommended an alignment on the west side of the Nile in the desert just outside the existing agricultural area. Following intensive discussions, this recommendation was accepted and authorization was given at a meeting on December 30, 1985 to proceed with the detailed engineering and economic feasibility studies.

Traffic Surveys - A program of traffic surveys was started in December 1985 to provide up-to-date information on traffic movements in the Cairo-Assuit Corridor. The main survey was a driver interview survey conducted at 16 locations in the Corridor, supplemented by classified counts at 11 other locations. This survey took one month to complete, ending on January 15 just before the University holidays started. A major survey truck weights was completed in February using a set of portable scales imported from the USA. Other surveys of journey speeds and some automatic traffic counts were made, all surveys being completed by the end of February 1986.

Processing of the survey data for computer analysis started immediately after commencement of the first survey, but the great quantity of data collected meant that the task of analyzing the survey data was not completed until the end of April.

Engineering Studies of the Proposed New Highway - With the acceptance of the Alignment Options Report, plans were made to fly the selected alignment to obtain up-to-date aerial photographs for use in detailed alignment definition. The photographic survey started in late January and photographs were received in mid-February. A photo-interpretation was undertaken to determine the main geological features of the region of the road, and to define a program of soil sampling. The soils survey started in March and laboratory tests on the 40 samples were received by the Study in mid-May.

Alignment definition proceeded based on photographs, maps and field inspections, and the final alignment was presented to RBA at a special meeting in the Study offices on May 8. This was followed by the preparation of alignment layout plans, together with more detailed plans of intersections for alternative traffic levels.

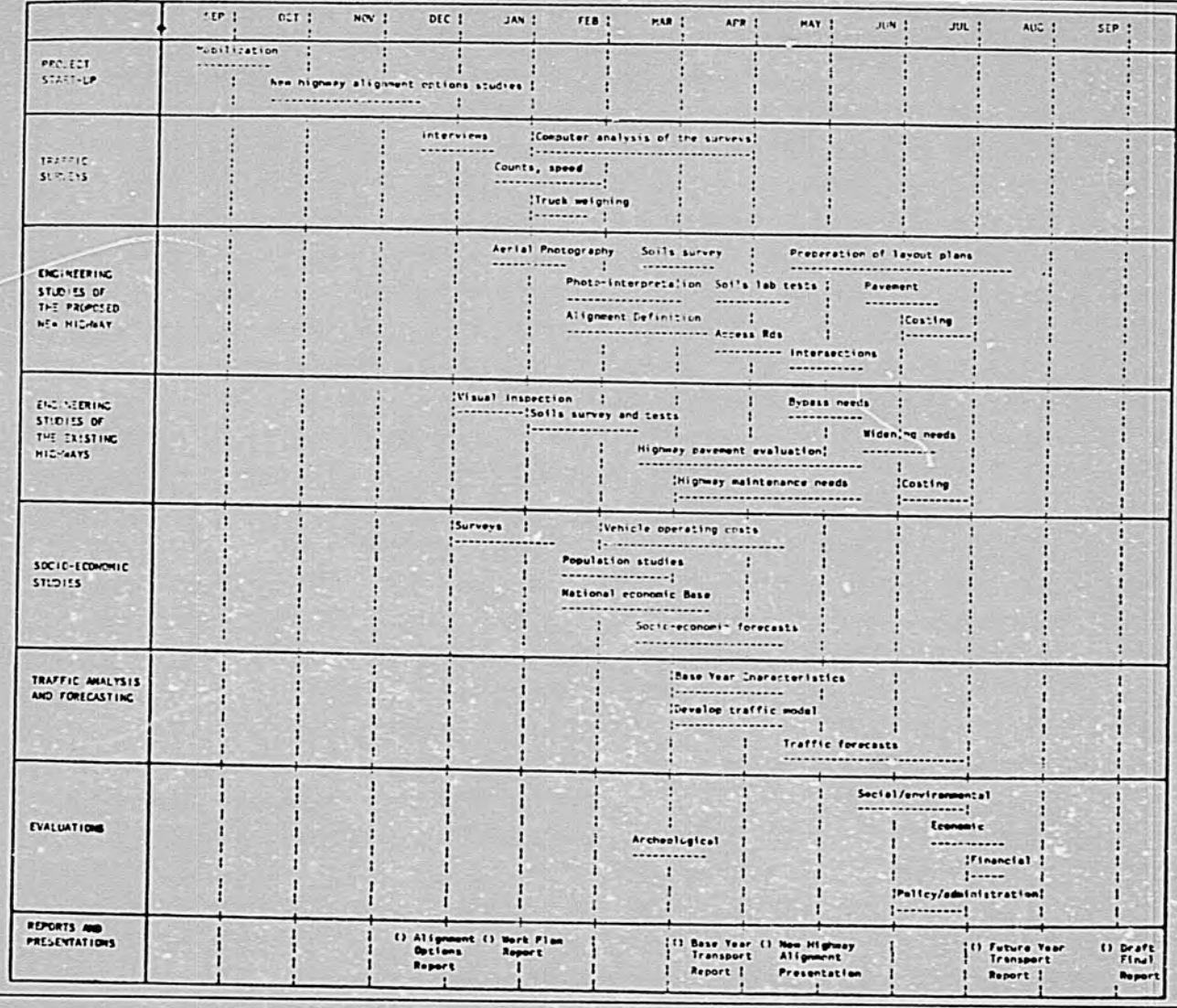
Access roads merited special attention, since good access to the existing communities along the Corridor was perceived as an important feature of the new highway, yet there was a need to reduce the use made of agricultural land to build the roads. It was decided to adapt existing roads crossing the the agricultural area, and this required field inspections of each one.

Pavement design was completed late in the Study, based on the forecast traffic levels and taking detailed account of the problem of vehicle overloading in the Corridor. Accordingly, a much heavier pavement was designed than normally used in Egypt to ensure a good pavement surface over the design life.

Engineering Studies of the Existing Highways - A visual inspection of the 500 kilometers of existing East and West Bank Highways was completed during January 1986 and a pavement rating report prepared detailing pavement condition by 95 highway sub-sections. Based on this, 20 locations along the highways were located for borings to obtain information on pavement structure and condition. The borings were completed in February and laboratory test reports were received by the Study in March.

An assessment was then made of existing pavement strengths, updated by the rehabilitation and overlaying projects either actually in progress or committed to be completed in the next few years. Forecast traffic and axle loads were used to prepare estimates of pavement strengthening needs. Routine maintenance needs were also assessed.

The Study also examined major infrastructure projects for the existing West Bank Highway, including a program of bypasses to take the road around the existing towns, and a program of widening the highway to 4-lane standard. These studies were completed between May and July.



Cairo - Assuit Highway Feasibility Study

STUDY WORK SCHEDULE

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Figure 1-2

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Costing of all projects was undertaken in the last month of the Study, after engineering requirements had been adjusted to final forecast traffic volumes.

Socio-economic Studies - An important element of the traffic forecasting and evaluation process was the projection of future development and growth in the Cairo-Assuit Corridor. This was set in the context of the overall growth in the Egyptian economy. Detailed studies of population and economic trends were started in January 1986 and projections for the two forecast years of 1990 and 2000 were completed in May.

This element of work also examined costs of highway transport, determing costs in a suitable format for traffic forecasting and later project evaluation.

Traffic Analysis and Forecasting - The main source of information on traffic patterns in the Corridor was, of course, the traffic surveys undertaken by the Study. The results of the traffic surveys were analysed to determine the characteristics of travel in the Corridor -- origin and destination patterns, vehicle types, journey lengths, passengers and cargo transported, journey speeds, etc. Information was also collected on the other modes of transport in the Corridor; essentially rail, water and pipeline. The findings of these analyses were presented in the Base Year Transport Report issued in April 1985.

Based on the analyses of Base Year traffic patterns, a computer Traffic Model was developed for use in projecting and analysing future traffic in the Corridor. The model worked in two stages. The first stage made an initial forecast of traffic for each forecast year (1990 and 2000) based on projected growth in population and the economy. The second stage analyzed the initial forecasts in relation to alternative highway investment projects, allocating traffic among competing routes (eg existing highway vs new highway) and modifying the forecasts to take account of congestion. Thus for each alternative highway investment plan investigated by the Study, a unique traffic forecast was prepared. The model was eventually used to analyze 28 alternative combinations of investment type and year, including sensitivity, staging and toll analyses. This stage was completed in July.

Evaluations - A review of archeological conflicts of the new highway was made in April as part of the final alignment definition.

An evaluation of the environmental and social implications of alternative investments was completed in June and July. There was insufficient base information to complete a full environmental evaluation according to accepted US standards, but assesments were made based on experience and judgement.

A review was made of the administrative capacity of the Roads and Bridges Authority, to assess the capability of implementing any new highway project in the Cairo-Assuit Corridor.

The economic evaluation compared the economic benefits of the alternative investments with the costs of implementation. The methodology for benefit estimation required detailed traffic data -- volumes, costs, speeds -- from the Traffic Model, and so the process for benefit estimation was computerized and incorporated directly into the Traffic Model process. Construction cost estimates were derived from the engineering studies of the proposed new road and the existing highways. The financial evaluation analyzed the revenue earning potential of tolls on the new highway. The economic and financial evaluations used a similar methodology and both were completed in the final stages of the Study.

Study Reports

Several reports were prepared in the course of the Study which are issued separately from this Final Report. They are as follows:

Alignment Options Report	December 1985
Work Plan Report	January 1986
Existing Highway Soil Testing Laboratory Report (Sami Saad Company)	March 1986
Base Year Transport Report	April 1986
New Highway Soil Testing Laboratory Report (Sami Saad Company)	May 1986
Future Year Transport Report	August 1986
Computer Program Operating Instructions	August 1986
Visual Rating Survey of the Existing Highway	September 1986

Layout of the Final Report

This report is accompanied by seven volumes containing 33 appendices to the report, detailing the analyses and findings of the Study. The volumes are as follows:

Appendix Volume 1	Traffic Surveys
Appendix Volume 2	Base Year Transport
Appendix Volume 3	Existing Highways
Appendix Volume 4	Proposed New Highway
Appendix Volume 5	Socio-economic Studies
Appendix Volume 6	Traffic Forecasts
Appendix Volume 7	Evaluations

Plans of the new highway prepared to scale 1:25,000, together with typical cross-sections, interchange layouts and geological sections, are contained in the Plan Volume accompanying the report.

Chapter 2

EXISTING TRANSPORT

This chapter describes the existing transport patterns in the Cairo-Assuit Corridor. It is based mainly on surveys of highway transport conducted by the Study, but is supplemented by analyses of available data on other modes of transport.

Traffic Surveys

Four major surveys of highway traffic were undertaken in the period from mid-December 1985 to end-February 1986, as follows:

Roadside Interview and Manual Traffic Count Survey
Automatic Traffic Count Survey
Truck Weighing Survey
Journey Time Survey

Locations of survey sites for the first three surveys are shown in Figure 2-1.

Roadside Interview and Manual Traffic Count Survey

This survey was started on December 16th 1985 and took one month to complete. Interview stations were located at 16 sites in the Corridor. Three sites were located on the roads entering Fayoum, two were located on the East Bank Helwan-Beni Suef road and three were located on the roads entering Assuit from the South. The remaining eight stations were located along the main West Bank Cairo-Assuit Highway.

Each station was operated in both directions of travel for at least two days during daylight hours. This was generally from 6:00am to 5:00pm, but early morning mist sometimes delayed the start of interviewing for safety reasons. One station was operated for less than two days because a road re-paving operation commenced requiring the early abandonment of interviewing. Four stations were operated continuously for 24 hours over three days.

Manual counts of vehicles passing each station were maintained over a period of 16 hours at each interview site, covering all the hours of interviewing and also the evening hours up to 10:00pm. At the 24-hour interview sites, counts were maintained continously over the entire three days. Traffic was counted separately for each direction of travel, and vehicles were classified by 11 vehicle types. In addition to the manual counts at the 16 interview stations, two-day 16-hour counts were made at 11 additional locations to provide further information on traffic volumes.

The main objective of the survey questionnaire completed for each vehicle was to obtain the origin and destination for each vehicle. Additional information was collected on vehicle characteristics, including vehicle classification, number of axles, number of seats and, for trucks

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only, the licensed empty and loaded weights. The number of occupants was recorded for all vehicles, together with the purpose of the journey for cars, taxis and pick-ups. Cargo type and weight of load were obtained for trucks. In total 127,337 interviews were completed which represents a 77 percent sample of the traffic passing the interview stations during interview hours.

The survey questionnaires were prepared in the office for computer analysis. This entailed converting the survey information into numerical codes and then entering this data into the computer. The first stage of the analysis was to edit the interviews for completeness and consistency. After editing the interviews, about 8 percent were rejected because of incomplete information and the remainder were passed to the survey tabulating and analysis procedures.

Automatic Traffic Count Survey

Some automatic traffic counts were conducted at the same time as the Roadside Interview and Traffic Count Survey, mainly to provide a check on the manual counting procedures. However, the disadvantage of automatic counts is that they provide no classification of traffic, so apart from this checking function the automatic counts were not used further.

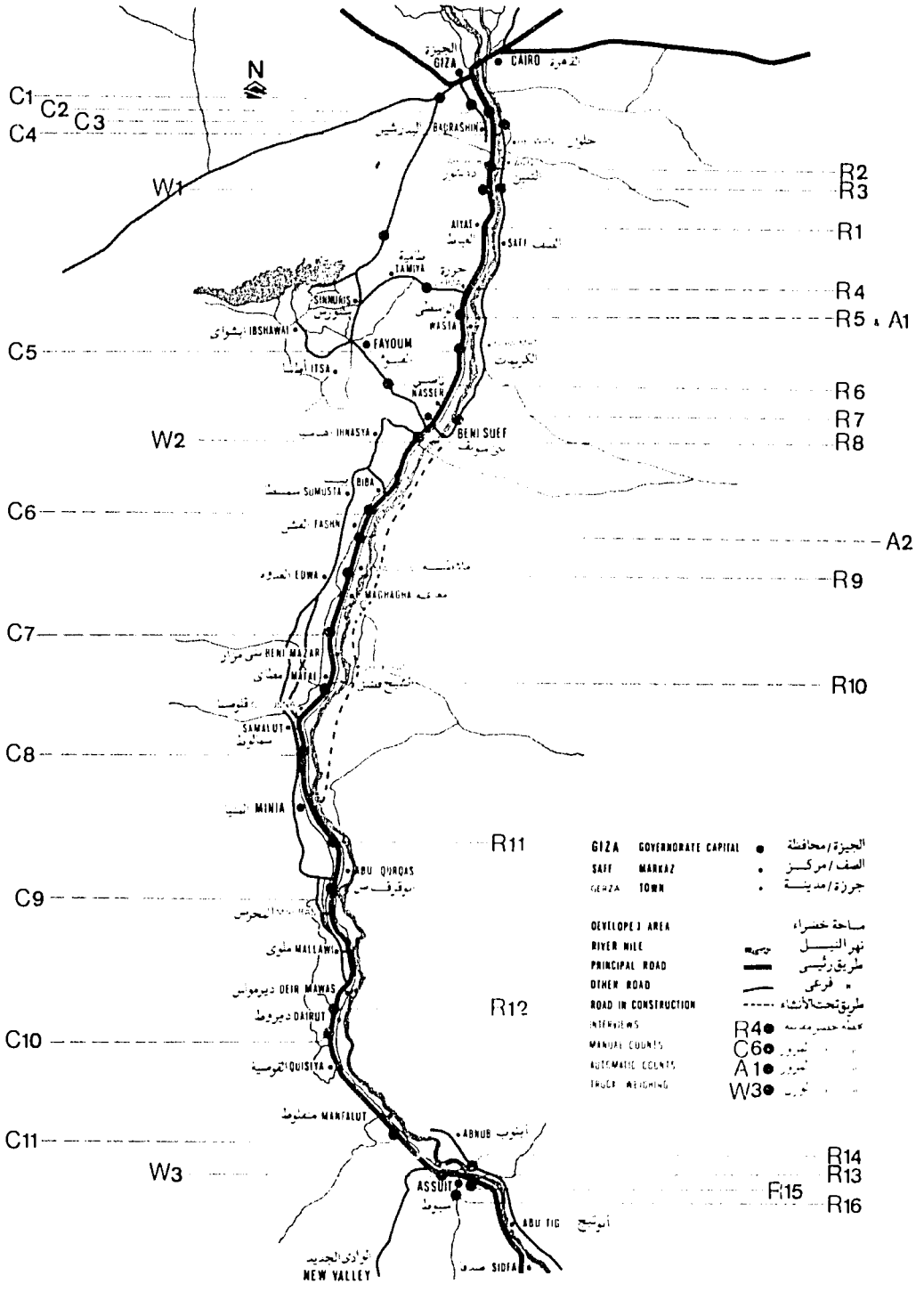
After the Roadside Interview Survey was completed, two long-term recording traffic counters were set up on the main West Bank Cairo-Assuit Highway to monitor traffic variation over a longer period. The counters were checked at weekly intervals and the paper tapes containing the counts were brought back to the office for analysis. This survey was carried out over a 6-week period from January 27th to March 8th.

Truck Weighing Survey

Using a set of Lodec scales imported from the United States, a truck weighing survey was conducted between February 7 and February 19. Three locations were selected along the main West Bank Cairo-Assuit Highway and truck weighing operations were conducted for four days at each site. It was originally intended to weigh trucks for two days in each direction, but the pattern of cargo movements meant that a large proportion of northbound trucks during daylight hours at each station were empty. Hence the survey was conducted for three days southbound and only one day northbound at each site.

The objective of the survey was to measure truck weights and axle loads for a representative selection of loaded trucks. Empty weights were obtained from the vehicle licence, but a selection of empty trucks were weighed also to verify the licence information.

The scales consisted of two platforms, one for each wheel track, and each platform was capable of weighing a standard tridem wheel group. The two scales were linked by cables to a portable computing device which provided a visual reading and a printed record of each complete axle group.



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LOCATIONS OF SURVEY STATIONS

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FIGURE 2-1

Additional information was requested from the driver in order to complete a questionnaire compatible with the Roadside Interview Survey. Origin and Destination information was not collected, and no counts were maintained of the total traffic stream. Expansion of the survey results to represent the total traffic stream (of trucks) was based on the control totals from the Roadside Interview Survey.

In total, 2756 trucks were weighed. After editing the data by computer, some 8 percent samples were rejected and the rest were passed to the analysis and tabulation procedures.

Journey Time Survey

A journey time survey was conducted on the main West Bank Highway from February 2-14. Four complete return trips were made between Cairo and Assuit measuring light vehicle speeds on two runs and heavy vehicle speeds on the others. A similar set of runs were made in May to collect data on the Giza-Fayoum-Beni Suef Road and the East Bank Highway from Helwan to Beni Suef.

The moving observer method was used which requires the survey car to drive at the same speed as the vehicles in the class being measured, at the same time maintaing counts of opposing traffic and of vehicles overtaking, or being overtaken by, the survey car. The highway was divided into 222 sections determined by intersections with other roads, road construction class, and the nature of development along the roadside. The survey was used primarily to determine light and heavy vehicle speeds under different conditions. However, the results were also used to obtain traffic counts for all sections of the existing highway, and to provide an inventory of highway characteristics related to traffic capacity.

1986 Highway Traffic Volumes

Traffic volumes in the Cairo-Assuit Corridor are shown in Figure 2-2. The main characteristics are summarized below.

Vehicle Types - Traffic was classified by 12 different vehicle types. The average composition of the traffic stream is illustrated in Figure 2-3.

The main vehicle represented was the pickup which made up 27 percent of the total. While most pickups were used for goods transport, about 10 percent were adapted for low-cost passenger transport.

Trucks made up 26 percent of the traffic stream. Half were single trucks, and the rest were large trucks towing trailers. Cars and taxis (excluding pickup taxis) make up about 40 percent of the total traffic and buses, rather surprisingly, only 5 percent.

Road Capacity Considerations - When considering road capacity, it is necessary to take account of the different sizes of vehicles, converting each vehicle to an equivalent passenger car unit (PCU). For example, a

large multi-unit truck was considered equivalent to 3.5 passenger cars in terms of road space occupancy.

The average distribution of vehicles measued in PCUs is also shown in Figure 2-3. This indicates that while trucks and large buses make up 30 percent of the number of vehicles on the road, they constitute 46 percent of the volume of the traffic stream when measured in PCUs.

Traffic by Time of Day - Traffic volumes vary by time of day. The surveys indicated that 25 percent of trucks and 15 percent of passenger vehicles moved during the nighttime hours from 10:00 pm to 6:00 am. During daylight hours when most of the survey stations were operated (6:00 am to 5:00 pm), 53 percent of trucks and 60 percent of passenger vehicle movements were recorded.

Traffic Variation by Day of Week - Traffic variation through the week during the survey period was significant. In particular, Tuesday volumes were low at all sites recorded, while Monday volumes were particularly high. Truck volumes decreased over Friday and Saturday, but passenger vehicle volumes remained more even.

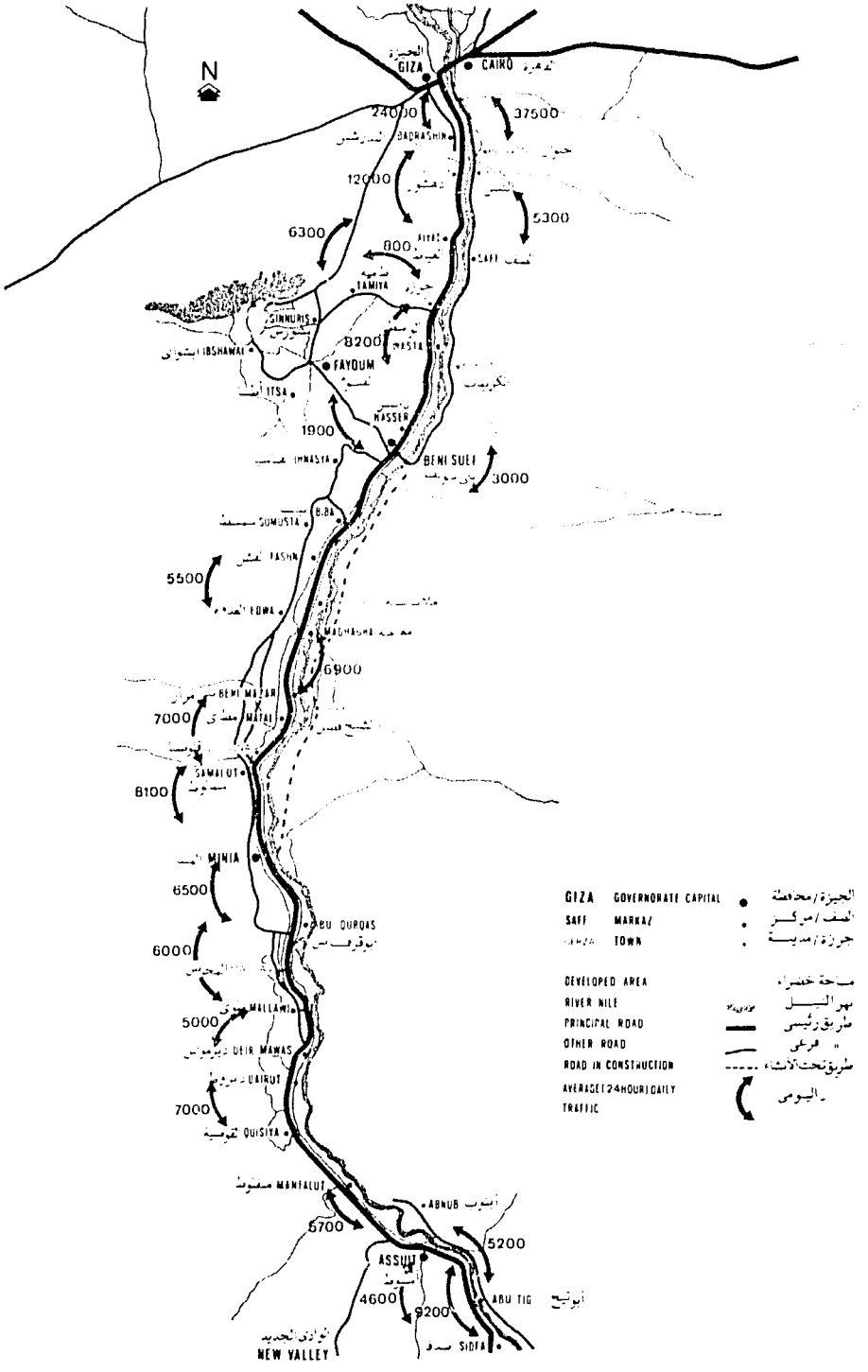
Traffic Speeds - Traffic speeds in the Corridor were similar for light and heavy vehicles on the main West Bank Highway between Cairo and Assuit, averaging 61 and 55 kilometers per hour respectively. Probably the straight alignment and complete absence of grades, both factors which can slow truck speeds significantly, explains the similarity. Of course, traffic speeds varied from place to place depending upon road type and the characteristics of the area alongside the route. In particular, only 60 percent of the route could be called open country; the rest was either urban or, more commonly, village development, and congestion in these areas could slow traffic considerably.

Traffic Growth - Comparisons with past traffic counts indicate that the rapid traffic growth in the Corridor between 1979 and 1983 of 25 percent per year, slowed over the last two years to an average of 8.2 percent per year. Annual traffic growth rates 1983-1985 at individual count sites in the Corridor ranged from 23 percent on the Fayoum Desert Road to 2 percent between Beni Suef and Minia. However, not too much weight should be put on individual count comparisons when made by different studies. It is unfortunate that a regular count program is not yet started, although plans are in hand to do this.

Characteristics of Passenger Carrying Vehicles

Figure 2-4 illustrates the distribution of passengers by vehicle type, and indicates the purpose of journey for car and taxi passengers. (Bus passengers were not interviewed).

The main passenger carrying vehicles in the Corridor were the various forms of taxi (car, van and pickup) and they accounted for about 49 percent of all passengers. The taxi van is rapidly growing more popular in Egypt, combining greater comfort when compared with a bus, and greater economy compared with a standard taxi. The two classes of bus carried



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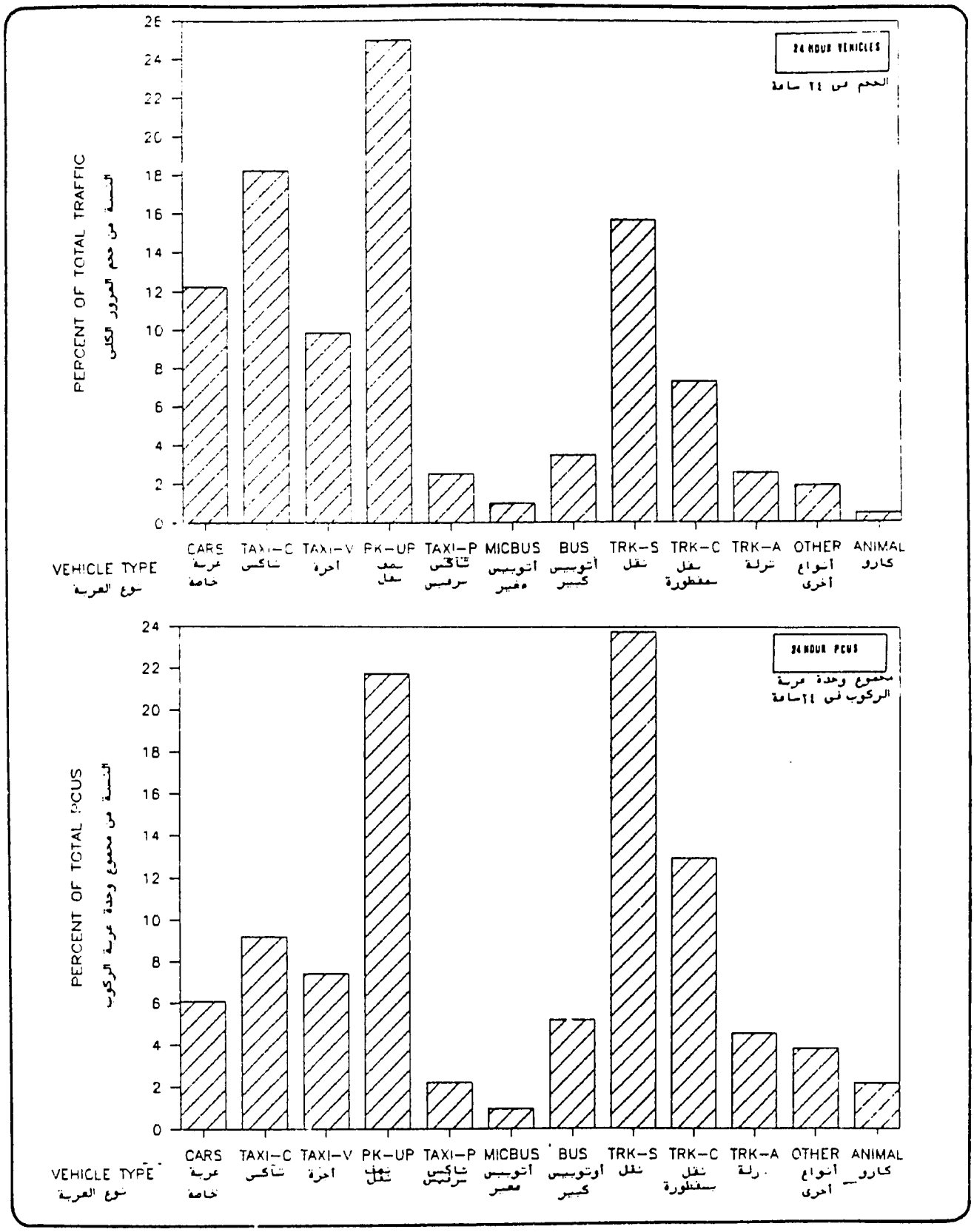
1986 ANNUAL AVERAGE DAILY TRAFFIC

FIGURE 2-2



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TRAFFIC DISTRIBUTION BY VEHICLE CLASS

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Figure 2-3

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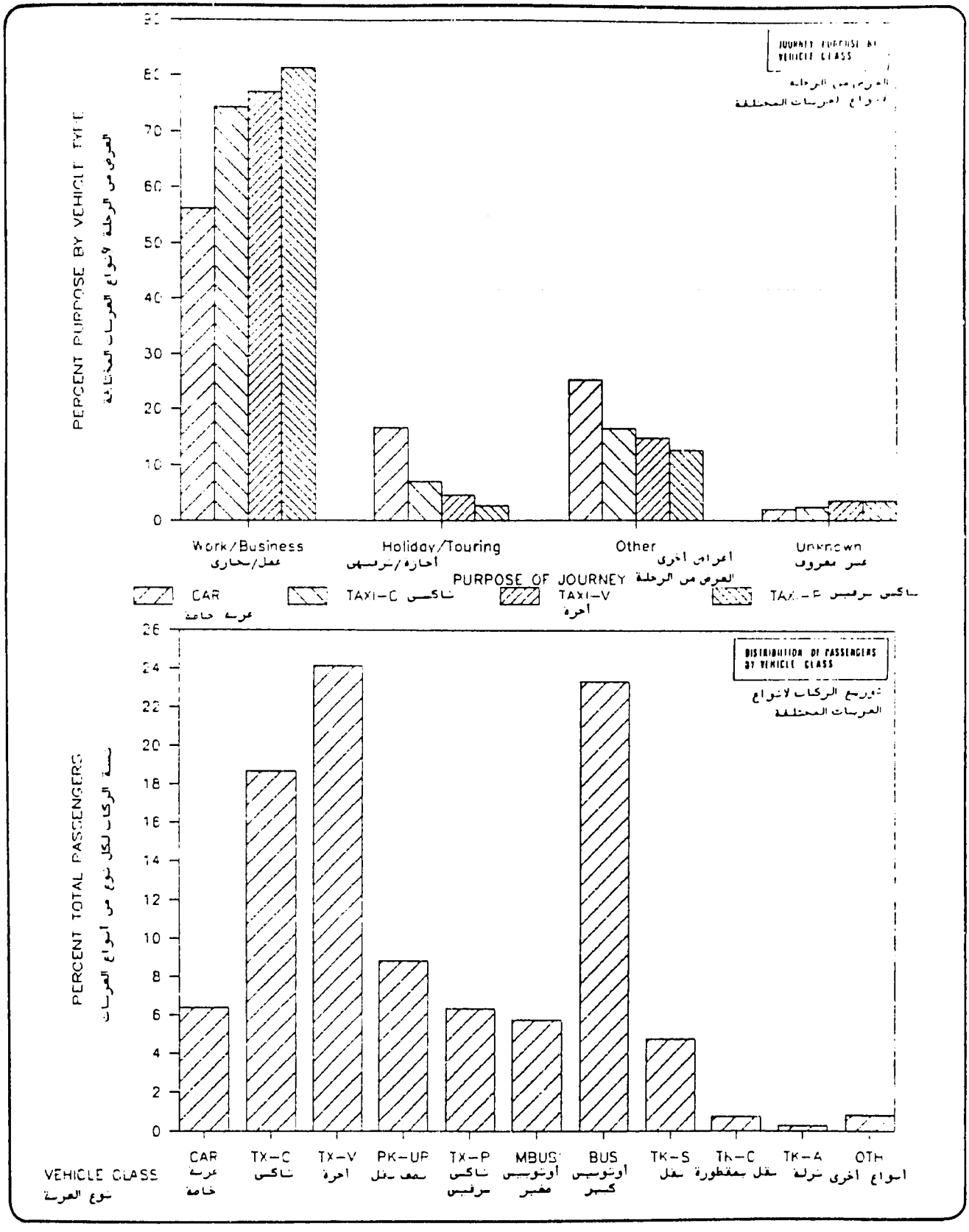

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PASSENGERS BY PURPOSE AND VEHICLE TYPE

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Figure 2-4

just over 30 percent with most in the larger standard bus. About 28 percent of private cars had a driver only and they accounted for only 6 percent of the total passenger volume. Trucks and pick-ups carried an average of one passenger who was probably a relief driver or assistant.

Over 75 percent of taxis of all classes gave work or business as the journey purpose. The remainder of taxis mostly quoted "other" meaning some form of personal business such as shopping. About 7 percent of taxi cars were used for holiday or touring, but only 3-5 percent of the other taxi types were used for this purpose.

Only 55 percent of private cars were used for work or business. Nearly 20 percent were involved in touring or holiday and 25 percent were used for other purposes.

Characteristics of Trucks

Three main types of truck operate on the Cairo-Assuit Highway: single trucks with no trailer, combination trucks (single trucks pulling a draw-bar trailer which has axles at the front and rear), and articulated trucks (tractor units pulling a semi-trailer with axles only at the rear). The multi-unit trucks (combination and articulated) come in a variety of configurations, and the distribution by each type is shown in Figure 2-5.

Licensed Truck Weights - Trucks are normally measured in terms of either their empty weight, their carrying capacity or their fully loaded weight.

The empty weight is determined by the characteristics of the manufactured truck, either as purchased or as subsequently modified. This also determines the actual carrying capacity of the truck: this capacity can be exceeded only at risk of damage to the truck. The sum of the empty weight and the carrying capacity give the fully loaded weight of the truck.

After allowing for vehicle dimensions and capacities as manufactured, an additional very important consideration is the law regarding legal loads which are permitted on axles. These laws are necessary since overloaded axles can cause a disproportionate amount of damage to the highway resulting in high costs of maintenance and repair for the highway authorities. Legal axle loads in Egypt are as follows:

Single axle, single tires (normal front axle)	- 6 tons
Single axle, double tires (normal rear axle)	- 10 tons

Tandem axle
(two axles closely spaced) - 16 tons

Tridem axle
(three axles closely spaced) - 22 tons

Quadram axle
(four axles closely spaced) - 30 tons

Therefore, to keep within the legally allowed axle loadings, the maximum licensed weight of any truck should be no more than 52 tons which applies to the largest possible articulated truck configuration. The largest 6-axle combination trucks should be licensed for no more than 48 tons.

However, it appears that many trucks are routinely licensed to carry loads which put them considerably in excess of the maximum legal loads. For example, licensed loaded weights for 6-axle combination trucks as recorded in the Truck Highway Survey, are shown in Figure 2-6 which shows that over 60 percent of these trucks are licensed to carry more than the axle load law specifies.

Measured Truck Weights - The truck weighing survey revealed that a very high proportion of trucks on the Cairo-Assuit Highway were overloaded -- grossly overloaded in many instances. Comparisons were made with truck weighing surveys previously conducted in Egypt in 1979 and 1981 and these indicated that what was already a bad situation has got significantly worse. Figure 2-6 cited above also records the measured loads on tandem axles: 81 percent of those measured in the truck weight survey were over the legal limit of 16 tons (excluding trucks with no load).

It was estimated that of all loaded trucks, 75 percent of the large combination and articulated trucks, and about one third of all single trucks exceeded the legal load limits. Particularly severe offenders were the combination trucks carrying bags of cement, essentially because bags of cement are very dense and many bags can be loaded onto a vehicle with little difficulty. The average combination truck loaded with cement (and about 90 percent of all cement is carried in this type of truck) weighs 63 tons, and 28 percent weigh over 70 tons.

Anyone who doubts these weights can readily observe cement trucks passing through Cairo at night. It is common to see as many as 1300 bags on a combination truck, 800 on the trailer (20 rows, 4 across and 10 deep) and 500 on the truck (which has less "capacity" because of the drivers cab). Each bag weighs a standard 50 kgs, giving a total load of 65 tonnes. With an empty weight of 15 tons, this gives an 80 ton truck. Some can be observed more heavily loaded than this.

Part of the problem is that, as noted above, trucks are licensed to carry more than permitted by the current legal axle load law. However, the main problem is that vehicles are loaded beyond even their licensed capacity.

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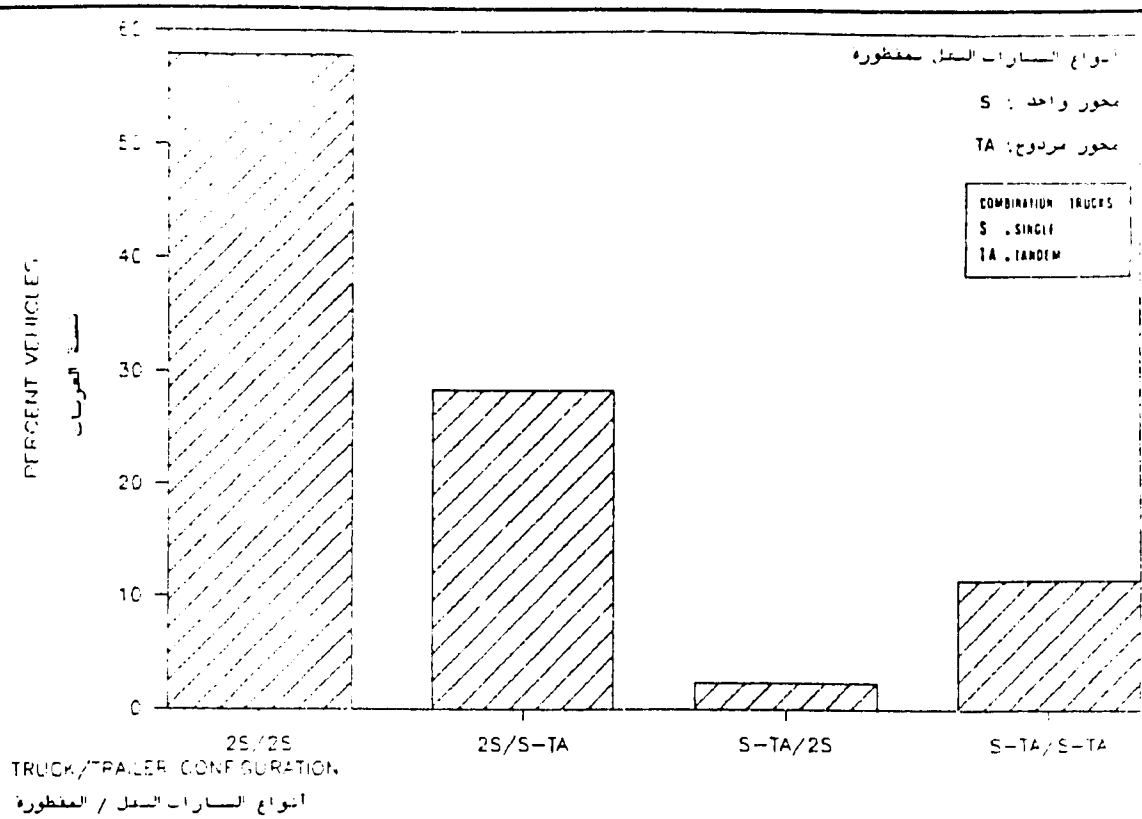

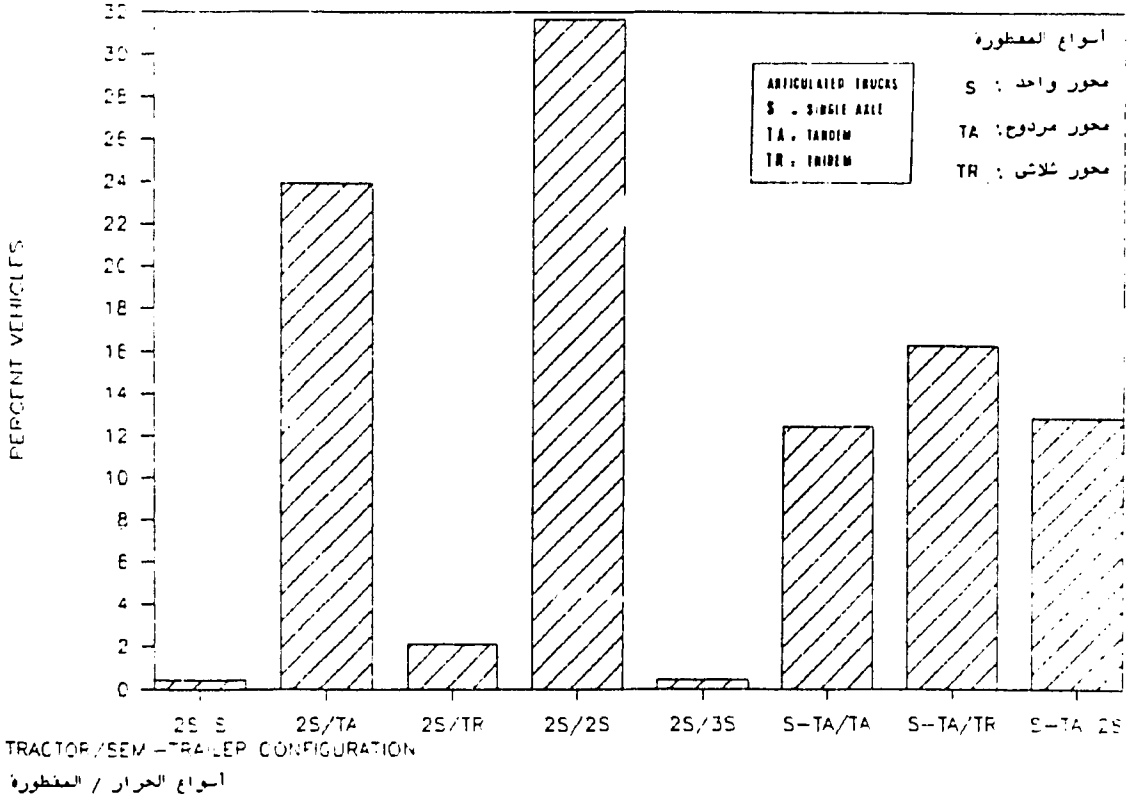

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TRUCK CONFIGURATIONS

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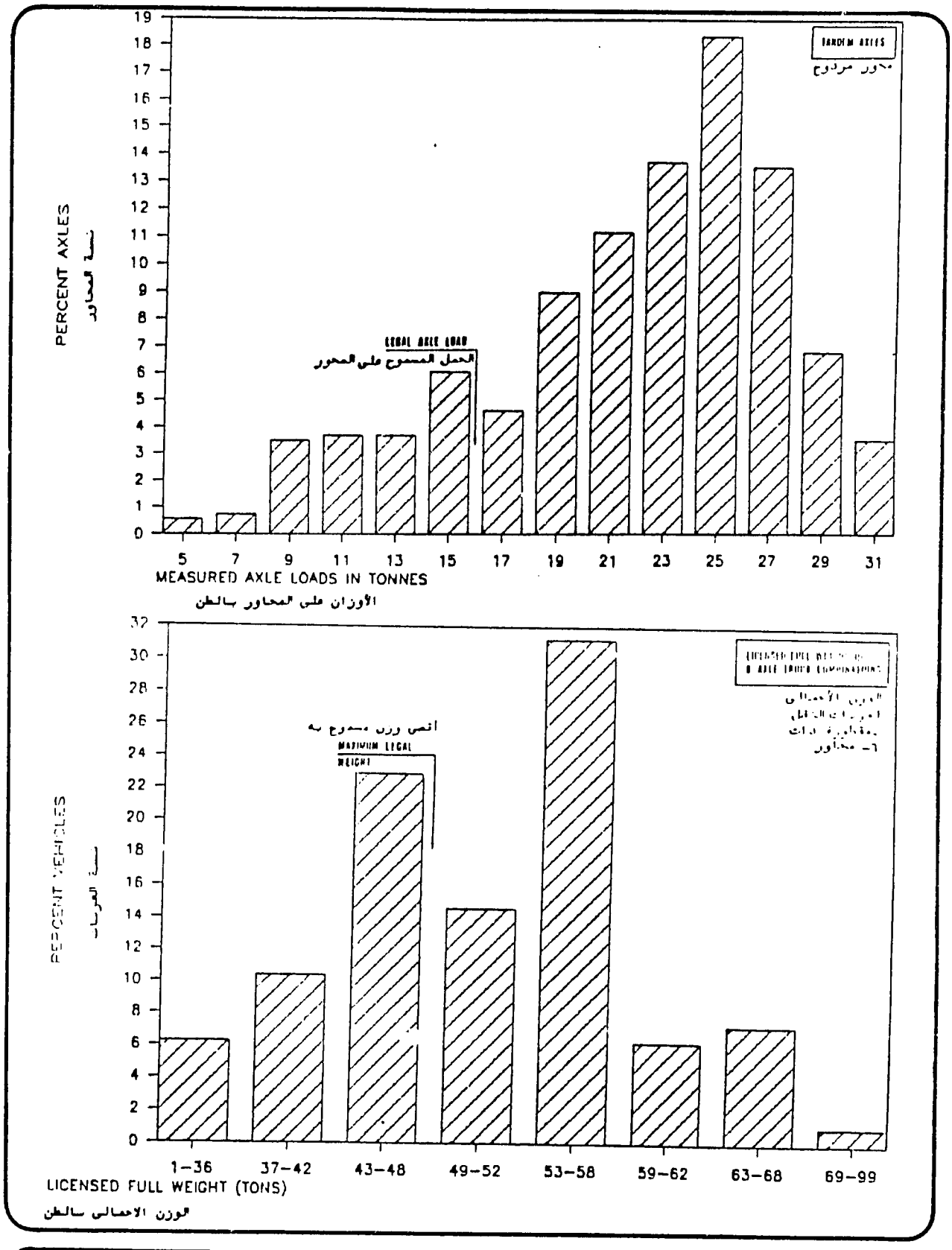
Figure 2-5



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TRUCK WEIGHTS AND AXLE LOADINGS

Figure 2-6

Trip Length Distributions

Figure 2-7 shows the distribution of movements in the Corridor by journey length, separately for all vehicles, and then for large trucks only.

This clearly demonstrates that the great majority of trips were short distance with over one half of 30 kilometers or less. There was great variation in journey length between the different vehicle types. Most passenger vehicles had relatively short journey lengths with only about 5 percent exceeding 150 kilometers. The large multi-unit trucks, on the other hand, showed much longer journey lengths, with 2 percent of journeys as long as 800 kilometers.

Movement Patterns in the Corridor

Figure 2-8 illustrates the relative size of movements between the Governorates in the Corridor and Figure 2-9 shows the volumes of external movements to and from the Corridor. The volumes shown are average 24 hour daily volumes in vehicles.

It can be appreciated that the Governorates in the Corridor are very self-contained, with the bulk of all movements taking place entirely within each Governorate. In fact, the volume of movements entirely within Governorates represented almost 50 percent of all movements observed in the Corridor, considering all internal and external movements together. Movements between Governorates in the Corridor represented only about 7 percent of all trips, and the great majority of these were to the adjoining Governorate.

Most external movements to and from the Cairo-Assuit Corridor were associated with Greater Cairo and the North. There were strong movements into Giza and Fayoum, and the movements to Beni Suef, Minia and Assuit were substantial. External movements to and from the North represented nearly 25 percent of all traffic in the Corridor. Only one third of this (about 7.5 percent of all Corridor traffic) was truly long distance passing beyond Fayoum and Giza.

Movements between the Corridor and the South (rest of Assuit Governorate, Upper Egypt, New Valley and the Red Sea) were much lighter. By far the largest part of this movement movement was traffic into and out of Assuit, most of which were movements within Assuit Governorate which is cut in two by the Study Corridor boundary. There was very little interaction between the South and the rest of the Corridor.

Through movements passing along the Corridor without intermediate stops were significant, although representing less than 2 percent of all traffic in the Corridor.

Road Transport Services

The total vehicle fleet in Egypt experienced a high rate of increase during the last decade, about 16.5 percent per year on the average. The most recent registration statistics indicate a decrease in the rate of increase for 1984/86 to about 13.7 per cent per year.

Within the Study Corridor, passenger and freight transport service are provided by both the public and private sectors.

Passenger Services - The General Nile Company for Upper Egypt provides public bus service within the Corridor. Non-transport public and private firms also supply bus service for their employees. The private sector currently accounts for 57.2 percent of total bus registration. Private taxis provide service between and within the cities, towns and villages. The inter-city taxi fleet is quite extensive and active with per-passenger kilometer charges higher than air condition bus rates. This no doubt indicates the inadequacy of public bus services.

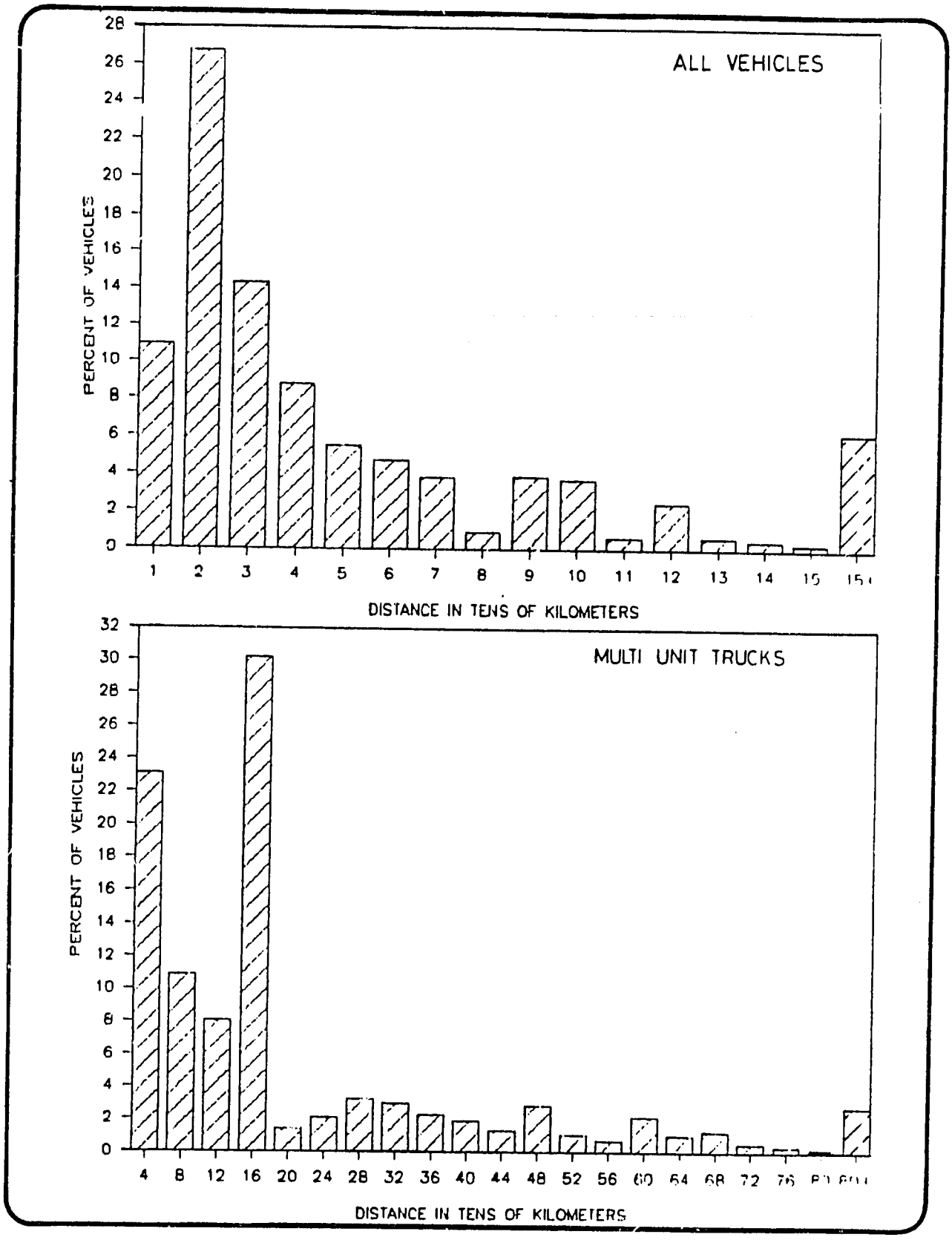
Freight Services - Freight transport services are supplied by five public transport companies, "own account" trucks registered by non-transport public and private firms, cooperative trucking associations, small private transport firms and individual truckers. The truck fleet increased rapidly during the 1975-1984 period with an average annual growth rate in excess of 21 percent. The pick up category (<3 tons) was responsible for much of this growth with an annual average rate of increase in excess of 30 percent for the period. Freight transport is essentially not regulated with no restrictions as to entry, routing or vehicle specifications. Official axle load limits are not enforced. The five public companies function as price leaders in setting freight tariffs for the commodities they transport. Other rates are determined by competition.

Traffic Accidents

Existing traffic accident data in the Corridor were reviewed, but comparisons were difficult because of the different basis for each set of statistics. The available statistics are summarized in Table 2-1.

Based on these results, accident rates were derived for different classes of road in the Corridor as follows:

ROAD CLASS	INJURY ACCIDENT RATE	
	Injury only	Fatal
	(per million veh-kms)	
2-lane valley highway	1.20	0.300
2-lane desert highway	0.50	0.030
4-lane divided highway	0.25	0.016



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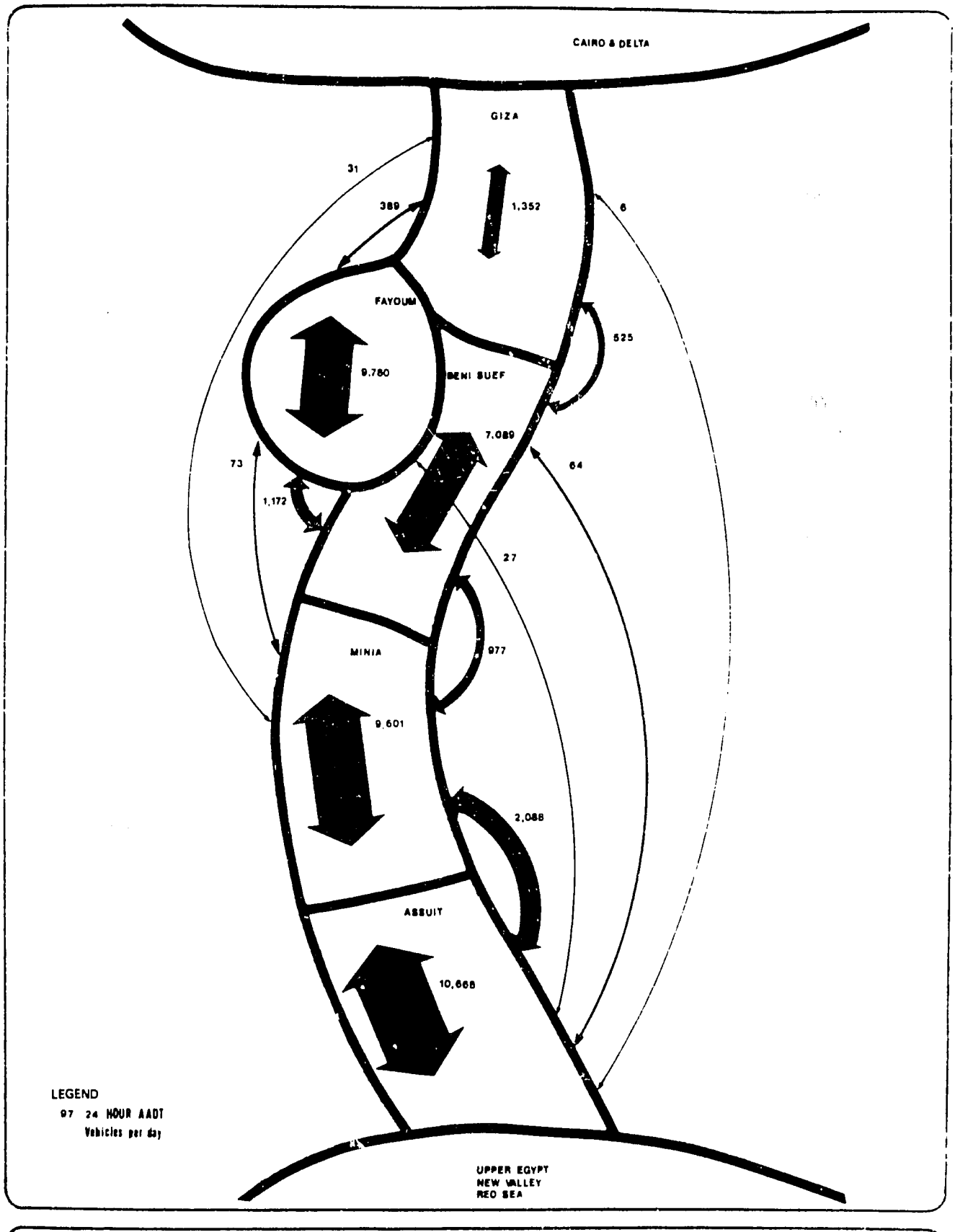
JOURNEY LENGTH DISTRIBUTIONS

Figure 2-7



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MOVEMENTS WITHIN THE CAIRO-ASSUIT CORRIDOR

(1985 / 1986)

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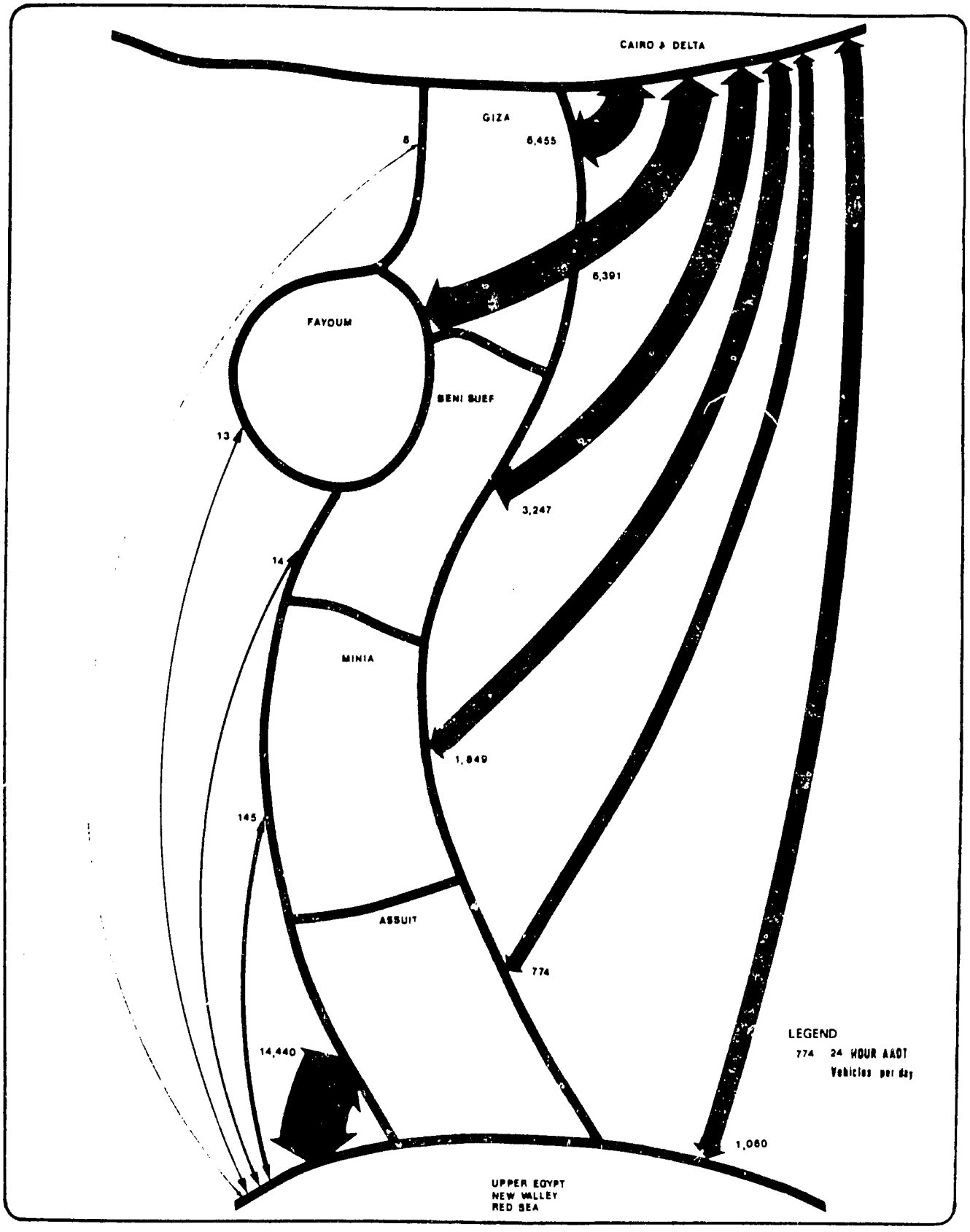
Figure 2-8



Cairo – Assuit Highway Feasibility Study

MOVEMENTS TO AND FROM CAIRO-ASSUIT CORRIDOR

(1985 / 1986)

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Figure 2-9

Table 2-1

VEHICLE ACCIDENTS - UPPER EGYPT

LOCATION	ACCIDENTS				PERCENT OF TOTAL		
	Fatal	Injury	Damage	Total	Fatal	Injury	Damage
Within Governorate of Beni-Suef, Minia, Assuit, Sohag, Qena, Aswan(Av.1980-84)	1045	3037	1595	5677	18.4%	53.5%	28.1%
Within Governorates of Beni-Suef, Minia, Assuit(Av.1980-84)	366	974	694	2034	18.%	47.9%	34.1%
Giza South(0-70km) Cairo-Assuit Highway(1985)	28	65	42	135	20.7%	48.1%	31.2%
Giza South(0-160km) Cairo-Assuit Highway(Av.1983-84)(1)	20	- 108 -		128	15.6%	- 84.4% -	
Fayoum Desert Road (Av.1980-84)	10	68	39	117	8.5%	58.1%	33.4%
Cairo-Assuit Highway Beni-Suef(Av.1980-85)	120	382	232	734	16.4%	52.0%	31.6%

SOURCE: Central Traffic Agency
(1) Injury and damage data were not separated

Other Modes of Transport

A review was made of transport by railroad, waterways and pipelines in order to complete the picture of Corridor transport. This review was based partly on interviews with each of the modal authorities, and partly on the reports of the recent Egypt National Transport Study (ENTS). In the case of railroads, a consultant railroad specialist visited Egypt for one month and made extensive reviews of actual operations.

Railroads - The railroad from Giza to Assuit is a double track standard guage rail line comprising a route length of 375 kilometers. It is located close to the main West Bank Highway, paralleling a major north-south irrigation canal. The alignment is relatively straight, and since the topography of the Corridor is flat, there are no problems of of grade. South of Assuit, the line becomes single track.

In 1986, the line carried approaching 2 million tons of freight in the Corridor, of which perhaps 75 percent served locations in the Corridor, the rest being through traffic. This compares with about 19 million tons of inter-Governorate movements carried by road. Rail carries a greater proportion of rail passengers, sharing inter-governorate movements evenly with bus and with taxi (approximately 20 million passengers annually for each).

The ENTS Study (Reference 1) recommended a substantial program of track and signalling improvements in the Corridor, and both observations and interviews with the Egyptian National Railways Authority (ENRA) indicated that work was being done. For example, investments have been made in automatic train control and centralized traffic control, track is being upgraded and investments have been made in mechanized track maintenance equipment.

As well as recommending investments in rail, ENTS forecast a substantial increase in rail traffic, with a quadrupling of freight volumes serving origins and destinations in the Corridor by 2000. However, ENTS also emphasized the "target setting" nature of these forecasts and admitted that they would be difficult to achieve.

While improvements in train operations had clearly been made since ENTS, this Study was not convinced that the ENTS forecasts of rail traffic could be met. The investments in centralized traffic control south of Beni Suef envisaged by ENTS did not appear to be committed, and standards of track maintenance, even in the rehabilitated sections, fell short of that required to substantially increase train operations. It was concluded that ENRA should be able to keep up with normal growth in traffic associated with general growth in economic activities, but available evidence did not point to major growth in rail traffic sufficient to attract traffic from other modes.

Waterways - The section of the Nile between Cairo and Assuit is the most heavily used part of the Egyptian waterway system with freight volumes at about the same level as for the railroad. ENTS envisaged a sharp increase in products carried on this section of the Nile, with a a doubling of total traffic between 1983 and 2000, including a near tripling of traffic serving locations in the Corridor. As with the ENTS rail forecasts, however, these represented "target setting" forecasts and again ENTS admitted that they would be difficult to achieve.

In contrast to rail, discussions with the River Transport Authority indicate that no real start has been made on the changes necessary for the ENTS forecasts to be realized, although some investments were being made by the authorities responsible for the new cement plant at Assuit. A particular problem noted by the River Transport Authority is that control of the river system is in the hands of the Ministry of Irrigation since the main function of the waterways is the supply of water to the agricultural lands. Hence investments are determined by the Irrigation Ministry and dredging to provide adequate navigable depth does not appear to have a high priority. This was supported by comments made by the Egyptian General Petroleum Corporation about the need to use rail transport at times of low water in the Nile.

Pipeline Transport - There is at present no pipeline in the Cairo-Assuit Corridor but a petroleum product pipeline is currently under construction to link Cairo with the new refinery under construction at Assuit. Both are expected to be completed by 1987.

Petroleum products currently move to each of the Governorate capitals by river, rail and road. River is stated to be the preferred mode, and then rail at times of low water in the Nile. It was said that trucks are not used extensively for Governorate supply, although significant volumes were observed in the Roadside Interview Survey.

In future, it is expected that all inter-Governorate transport of petroleum products will be by pipeline, but local distribution of products will continue to be made by road.

Chapter 3

ENGINEERING ASSESSMENT OF THE EXISTING HIGHWAYS

This chapter describes the engineering assessments made of the existing main roads in the Cairo-Assuit Corridor.

General Description of the Corridor Highways

The principal route serving the Corridor is on the west bank of the Nile where almost all settlements and activities are located. At the northern end of the Corridor, two other principal routes serve the Corridor: the East Bank Highway between Cairo and Beni Suef, and the Giza-Fayoum-Beni Suef Road.

These principal routes were inventoried, noting construction standard (2-lane or 4-lane), the presence of shoulders, and the type of development along the road. Development was classified into five classes as follows:

> Urban represents city centers and also the centers of major towns such as Beni Suef or Minia.
>
> Heavy Village represents sections outside urban centers where the dwellings and commercial developments of the village or town front onto the road, with consequent interference to traffic.
>
> Light Village represents areas where the road passes through settled areas which generate some local movements on the main road, but where the main road traffic has clear priority and suffers only slight interference.
>
> Open Country represent sections of road with no adjacent buildings. However, all land in the Corridor is intensely cultivated and there is almost no wild undeveloped land. Hence even road sections in open country have significant levels of local traffic accessing the farms and holdings along the route.
>
> Desert represents sections of route through barren desert, usually with no development whatsoever, apart from some factories or storage areas near major communities.

A classification of the principal routes in the Corridor is presented in Table 3-1.

The West Bank Highway - The main highway from Cairo to Assuit on the west bank of the Nile is 365 kilometers in length measured from Monib (approximately where the Cairo Ring Road is planned to cross the road) to the rail level crossing just short of the centre of Assuit. For the most

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Table 3-1

EXISTING HIGHWAY CLASSIFICATION
(kilometers)

DESCRIPTION	CAIRO ASSUIT (1)	GIZA FAYOUM (2)	FAYOUM BENI SUEF	CAIRO BENI SUEF (3)
4-lane				
Urban	12.7	1.1	0.4	23.0
Light Village	15.4	1.8	0.0	0.9
Open Country	31.8	0.0	0.0	4.3
Desert	0.0	10.5	0.0	2.7
	59.9	13.4	0.4	30.9
2-lane, with shoulders				
Heavy Village	17.9	0.0	0.8	3.1
Light Village	12.1	0.0	0.0	1.2
Open Country	37.6	0.0	37.9	0.0
Desert	0.0	42.3	0.0	6.3
	67.6	42.3	38.7	10.6
2-lane, no shoulder				
Urban	1.1	0.0	1.4	0.6
Heavy village	12.9	0.3	2.1	5.1
Light Village	72.8	4.7	1.5	10.5
Open Country	150.2	20.3	2.7	36.9
Desert	0.0	0.0	0.0	21.7
	237.0	25.3	7.7	74.8
TOTAL DISTANCE	364.5	81.0	46.8	116.3

(1) West Bank Highway, measured from Monib.
(2) Measured from the Western Desert Road
(3) East Bank Highway, measured from planned intersection with Cairo Ring Road.

part, the West Bank Highway is located alongside the navigable Ibrahimiya Canal. The highway is very well aligned, typically with long straight sections of 5-15 kilometers linked by gentle curves. Grades are extremely flat, the entire road rising no more than 30 meters over the entire distance from Cairo to Assuit.

The first 46 kilometers of route out of Cairo to Aiyat are 4-lane divided standard. Apart from some sections through towns along the route, including the last 7 kilometers into Assuit, the remaining 305 kilometers of the highway is 2-lane only. At the time of the route inventory in early 1986, only 70 kilometers had shoulders but, as discussed later, work is currently in hand to add shoulders to much of the route.

About 60 percent of the route could be classed as Open Country, but this is intensely worked land and generates a substantial flow of short distance local traffic on the route. About 100 kilometers of route passes through Light Village development; areas with communities close to the route, although without any frontage on the main road itself. Heavy Village, with shops, housing and other urban development fronting onto the road takes up 30 kilometers or 8.5 percent of the route. The sections of light and heavy village are scattered in short lengths along the route with about 200 changes of class in the entire route.

Another feature of the route is the great frequency of police check points where typically the road is narrowed to a single lane using temporary barricades. A total of 44 check points, or one every 8 kilometers, were observed.

Giza-Fayoum - The first part of this route out of Giza is the 53 kilometer Fayoum Desert Road, mainly 2-lane with gravel shoulders. After entering the Fayoum Oasis, the road has similar characteristics to the main West Bank Highway -- mainly Open Country classification, but passing through small communities with Light Village and Heavy village classification. The section through the center of the Fayoum Governorate Capital is very difficult with crowded urban streets in poor condition.

Fayoum-Beni Suef - After exiting Fayoum, this is generally a good well-surfaced and well aligned 2-lane road with paved shoulders. The major problem on this route is the crossing of the Bahr Youssef Canal at El Lahoun on the boundary between Beni Suef and Fayoum. The road follows a tortuous alignment in order to use an old and narrow bridge.

East Bank Highway - This road assumed greater importance on the opening of the new Nile Bridge at Beni Suef in 1985, since this enabled the road to serve as an alternative to the existing West Bank Highway. The initial section of the road out of Cairo is a 4-lane urban arterial serving the important communities of Maadi and Helwan, now part of Greater Cairo.

South of Helwan, the road changes to 2-lane with similar characteristics to the main West Bank Highway -- mainly Open Country classification but with frequent passages through small villages. After Koraimat, the east bank agricultural area reduces to a narrow strip close

to the Nile, and for about 30 kilometer, the road is located in the desert outside this area. On reaching Beni Suef, the road changes to 4-lane standard around which the developments of the new town of Beni Suef are taking place.

Nile Bridges -- Until recently, the only crossings of the River Nile were at the northern and southern extremities of the Cairo-Assuit Corridor with 350 kms of highway between them. At the northern end, the crossing at Maraziq near Helwan is a narrow and congested 2-lane road crossing the Nile on a bridge shared with the rail line from Helwan to the Baharia Oasis. At the southern end, the road crosses the top of the Assuit barrage, again a narrow and congested 2-lane road.

In 1985, a new 4-lane bridge was opened at Beni Suef. Built primarily to allow the city of Beni Suef to expand into non-agricultural land on the east bank of Nile, the bridge links with the East Bank Highway to Helwan and Cairo. The bridge is well located to the south of Beni Suef so that traffic from Upper Egypt can cross the Nile to the East Bank Highway without passing through Beni Suef.

A new 4-lane bridge is under construction at Minia due to be completed in 1987. As with the Beni Suef bridge, the primary purpose of the Minia bridge is to allow the city of Minia to expand into the desert lands on the east bank of the Nile. This bridge will also link with the East Bank Highway which is currently being extended from Beni Suef to Minia. However, the Minia bridge is being built with the western bridgehead located within Minia, and this is likely to impede its function of diverting traffic from the West Bank Highway.

No other bridges across the Nile within the Cairo-Assuit Corridor are planned at present.

Recent and Current Construction

Recent and current construction projects on the main East and West Bank Highways is summarized in Table 3-2. All prices are in current financial costs, some being estimates several years old. Insufficient data were available to convert all prices to LE 1985/86, but it can be taken that this would substantially increase the sums in Table 3.2.

The principal roads in the Corridor were constructed and paved in a 10 year period from the mid-1940s to the mid-1950s. Some major rehabilitation work was undertaken ten years later and in the late 1970s a further round of rehabilitation commenced which is still underway today. The aim of the current program is to strengthen the existing pavement by rehabilitation or overlaying, and to add paved shoulders. In a few locations -- Aiyat, Fashn and Dairut -- bypasses have been added, but there is no general program of bypass construction for all places in need.

In addition to pavement strengthening, significant new construction projects are also underway. These include the new Nile bridges at Beni Suef and Minia, the new East Bank Highway from Cairo to Minia, and an Inter-governorate road linking Fayoum, Minia and Beni Suef. The new Nile bridges were discussed earlier, and the other two projects are discussed

Table 3-2

RECENT AND CURRENT HIGHWAY CONSTRUCTION AND IMPROVEMENT PROJECTS
(1978-1988, current prices)

PROJECT	DISTANCE (kms)	PROJECT TYPE (1)	ESTIMATED COST (LE mils)	PLANNED COMPLETION
East Bank Highway				
Helwan-Saff	32	Rehabilitation	3.2	Dec 1987
Saff-Koraimat	32	Rehabilitation	2.5	1985
Koraimat-Beni Suef	32	Rehabilitation	2.4	Jun 1986
Beni Suef-Shek Fadl	74	Reconstruction	14.9	Jun 1987
Shek Fadl-Minia	60	Reconstruction	9.8	Jan 1988
Abnub-Assuit	8	Rehabilitation	0.7	1985
	238		33.5	
West Bank Highway				
Giza-Dahshur (2)	23	New construction	4.0	1985
Dahshur-Aiyat (2)	23	New construction	6.0	Nov 1985
Aiyat-Beni Suef	64	Rehabilitation	6.4	May 1988
Beni Suef-Maletia	50	Rehabilitation	3.9	Oct 1987
Malatia-Abu Qurqas	95	Rehabilitation	11.4	Dec 1986
Abu Qurqas-Dairut	43	Rehabilitation	4.0	1984
Dairut-Assuit (3)	62	Rehabilitation	7.5	1985
	360		43.2	
Inter-Governorate Highway				
Fayoum section	21	Reconstruction	2.5	1989
Beni Suef section	65	Reconstruction	4.0	1989
Minia section	135	Reconstruction	12.0	1989
	221		18.5	
Nile Bridges				
Beni Suef	-	New construction	9.5	1985
Minia	-	New construction	10.5	Dec 1986
			20.0	
TOTAL	819		115.2	

(1) Rehabilitation includes overlaying and construction of shoulders. Reconstruction implies major re-building of the road.
(2) Constructed to 4-lane standard
(3) Including the Dairut Bypass

New East Bank Highway - The opening of the Nile Bridge at Beni Suef, and the rehabilitation of the existing highway between Helwan and Beni Suef, have created a new East Bank Highway capable of relieving the existing West Bank Highway of significant long distance traffic. At the time of the traffic surveys conducted by this Study (December 1985 to February 1986), little traffic had transferred to the East Bank Highway. This was probably due to two reasons; first, the Beni Suef Bridge had only recently been opened so many drivers were not aware of the new route, and secondly, major road works were still in progress near Helwan which made the northern end of the route unattractive. However, the Helwan Autostrade opened in May 1986 and this completed this first section of the East Bank Highway, and greater transfer of traffic to the East Bank Highway has now taken place.

A second stage of the East Bank Highway is now under construction between Beni Suef and Minia. Like the first section, it is being built with a 7.5 meter carriageway and a 2.5 meter paved shoulder on each side. The first section from Beni Suef to Shek Fadl (74 kilometers) was started in December 1984 and at April 1986 was estimated to be 34 percent complete. The second section from Minia to Shek Fadl (60 kilometers) was started in January 1986. Completion of the East Bank Highway from Beni Suef to Minia, programmed for early 1988, will provide an alternative route to the existing West Bank Highway for two-thirds of the distance along the Cairo-Assuit Corridor.

Inspection of the new construction between Beni Suef and Minia raised two concerns. First, the geometric alignment is deficient in places, with some blind summits and sharp curves. These occur in the relatively easy terrain close to Beni Suef and it can be expected that the more difficult terrain near Minia will present more problems of this nature. These alignment deficiencies have been due to restricted funding which has limited the quantities of earthworks which can be undertaken. Secondly, the pavement structure (25 cm pit run gravel sub-base with 5 cm ashphalt base and 5 cm asphalt wearing surface) is not particularly strong, and is unlikely to withstand the high axle loads imposed by heavy trucks. Therefore, if trucks (which dominate long distance traffic) transfer to the new road in significant quantities as expected by this Study, the new sections are likely to deteriorate rapidly.

RBA would like to complete the East Bank Highway from Minia to Assuit, a distance of about 130 kilometers, but terrain becomes much more severe south of Minia and no construction plans have been prepared. RBA would also like to construct a new section of this highway from the Helwan Autostrade to Koraimat located in the desert outside the existing agricultural area, in order to complete a desert route from Cairo to Assuit on the east bank. At the specific request of RBA, this Study has provided an alignment and profile for the 60 kilometer Helwan-Koraimat section, but no costing or evaluations were undertaken.

The Inter-Governorate Highway - The Governorates of Fayoum, Beni Suef and Minia are collaborating on upgrading 221 kilometers of existing highway to form a new route linking the three Governorates. Some of the

existing roads are currently unpaved, and others are paved but of sub-standard construction. All sections are being re-constructed with a 7.5 meter paved carriageway and two 2-meter paved shoulders. The roads selected for upgrading follow the line of the Bahr Youssef Canal parallel to the main West Bank Highway located in the agricultural area.

The Roads and Bridges Authority are not involved in this project. Construction of the first sections started in August 1985 with funds allocated from the Ministry of Planning. The planned construction period was initially 4 years, but funding at present is not sufficient to meet this schedule.

Potentially, this project could provide significant relief to the main existing highway, but there are some problems. First, the existing roads are not all well-aligned. In some places, the road crosses from one side of an irrigation canal to the other, involving two right angle turns onto and off the bridge over the canal; in other places there are sharp curves. The Governorates have insisted that no agricultural land be taken for the construction, even to to give a better alignment, and this is likely to limit the usefulness of the road in giving relief to the existing highway.

A second concern is that there are still construction problems to be solved such as the relocation of electricity pylons and the design and funding of major bridges. Thirdly, the pavement stucture of the new road (45 cm pit run gravel sub-base, 5 cm asphalt base and 5 cm asphalt wearing surface), would be insufficient to withstand the axle loadings imposed by the large trucks on the main highway.

It was concluded that this new Inter-governorate route would serve a useful role in relieving the existing main West Bank Highway of local traffic, but that most traffic would continue to use the existing highway.

Conclusions on Recent and Current Construction - A substantial investment has been, and is still being, made in highways the Cairo-Assuit Corridor. Allowing for an adjustment current prices quoted in Table 3-2 to 1985/86 levels, and for improvements to the Giza-Fayoum-Beni Suef Road not included in the Table, it is estimated that the current investments have been of the order of LE 10-15 million per year for the last six to eight years.

This current improvement phase will transform the West Bank Highway from Cairo to Assuit into a good 2-lane highway with shoulders. However there is cause for concern about pavement strength, even after the current rehabilitation, and this is discussed later in this Chapter.

Some traffic relief will be provided by the new Inter-Governorate road and East Bank Highway. However, neither of these latter routes would be able to withstand the heavy axle loads imposed by the large multi-unit trucks in the Corridor without re-inforcement, and the geometric alignments fall short of desirable standards. Therefore neither is really suitable to fulfill the function of a main trunk route, although the East Bank Highway is likely to be forced into this role.

Highway Maintenance

A review was made of current highway maintenance activities, and future maintenance activities identified.

Review of Current Maintenance Practice - For the main route now in use to the south of Cairo, the Roads and Bridges Authority of Egypt (RBA) has followed a policy which reduces maintenance to a minimum. The asphaltic concrete pavements are a high-type, modern surfacing, plant-mixed and machine-laid. They are relatively massive pavements for most of the length, consisting usually of 6 cm open-graded "premix" or "binder" courses, followed by 5 cm wearing courses of denser gradation. Such heavy pavements do not develop potholes and breaks in the same way as thinner pavements and surface treatments, and if well-constructed they can withstand much use and overloading without requiring the constant small repairs which are typical of lighter surfacings under such conditions. They do fail, of course, if subjected to traffic in excess of the load capacities of the base and surface layers, and there is extensive failure of this kind evident in the Corridor now.

It has not been the policy of RBA to do seal coats (surface dressing with stone aggregates) on these major road sections, so this maintenance activity is also absent. Seal coating is practised by most national highway agencies but it is not universal, and in Egypt two of the main reasons for the work are not fully pertinent, those of sealing against wetting and of providing a better braking surface under wet conditions. It is believed that other important benefits would justify the cost of surface dressings, and it is recommended that they be done in the future, but the justification will perhaps be uncertain until some careful studies are made.

Some shoulders are paved on the existing Corridor highways, and where they are not paved this improvement is now in progress on almost all sections. This again reduces maintenance since the upkeep of paved shoulders is much less than that for soil or gravel shoulders, especially where they are used by non-vehicular traffic.

One serious problem of shoulder usage exists. Much of the length of the present Cairo-Assuit highway is closely parallel to main irrigation canals, and the channel and slopes of the canals have to be maintained constantly by the Irrigation Authority. The crawler-mounted draglines and other machines used for this work often occupy part of the shoulder, including even having one track on the edge of the travelway pavement, and the silt and organic matter dredged from the canals is frequently cast on or near the shoulder. This practice has several negative aspects:

(1) The dragline is an obstruction to and a danger to highway traffic.
(2) These operations are causing some damage to pavement edges and shoulders,
(3) The saturated dredged material puts large amounts of free water into unpaved shoulders and embankments, reducing the

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lateral support for the pavements and the stability of the slopes and perhaps even the base layers. Furthermore, the draglining sometimes leaves very steep embankment slopes.

(4) The dredged material is left to dry in place along the highway, sometimes, it appears, for months or even years. This nullifies the purpose of the shoulder for highway use, prevents shoulder maintenance, and obstructs highway drainage.

(5) The eventual removal of the spoil material may cause further damage to the shoulders and pavements, depending on how it is done.

There is no obvious solution to these problems, since the canal maintenance is a legitimate and necessary function, and the working space available for it is often limited. Nevertheless, the effects on the highway are serious, and the dredged material, entirely bad for the road, should apparently be quite good for land reclamation and of considerable value if hauled to suitable disposal sites. It should be removed promptly from the highway shoulders, and wherever space permits, the embankments should be widened or lower terraces constructed to provide working platforms for the draglines.

Identification of Road Maintenance Activities - For the purposes of this feasibility study, travelway maintenance was estimated to include patching, smoothing overlays to correct local deficiencies, sealing over patches and any other repairs which may be susceptible to raveling, and periodic seal coating (surface dressing) for the roadway full width, at intervals of several years. The rates and frequency for all such work were estimated considering pavement age and traffic volumes, plus the initial observed condition of the pavement where applicable.

A separate estimate was made of total overlay quantities required to strengthen existing pavements. These overlay quantities were considered as additional highway investments (not as maintenance) with thicknesses similar to those now used by RBA in rehabilitations.

The maintenance of paved shoulders was considered; with minimum patching of pavement damage, along with periodic sealing of the surface. Unpaved shoulders need more attention. It is important to have a well-compacted, stable shoulder up to the level of the pavement edge, to minimize breakage of the edge. In addition, in agricultural zones, there is a need to replace the shoulder material worn away or displaced by pedestrian traffic, carts and animals.

Drainage maintenance was expected to be a major cost in the Cairo-Assuit Corridor. In the desert areas it is necessary to keep channels cleared of encroachments, to check pipe and box culverts annually, and to re-shape dikes and channels after the infrequent storms. Cleaning of any ditches in cut sections is needed. The more numerous drainage crossings in agricultural zones impose a higher cost for checking and cleaning, even if they are maintained in part by irrigation authorities, but little ditch or channel work was expected.

Regarding the right of way, the principal concern was the stability of the embankment slopes in farm areas. Maintenance includes shaping and the replacement of eroded or settled slope material. Within the Nile Valley, some control of vegetation is needed along the highway shoulders.

Very little maintenance is required for bridges and other structures of reinforced concrete, but some minor cost can be expected for the repair of spalled concrete decks, damaged railings, and problems around piers and abutments.

The upkeep of pavement striping and the painting or replacement of signs can be a significant expense on high-volume highways. These traffic service elements are important for the safe and efficient use of the road.

It appears that emergency maintenance is a minor concern between Cairo and Assuit. However, some funds should be provided in overall maintenance costs for the repair of occasional damage caused by high-intensity rains, pavement clearing and repair after serious accidents, and the possible encroachment of dune sands during unusual desert storms.

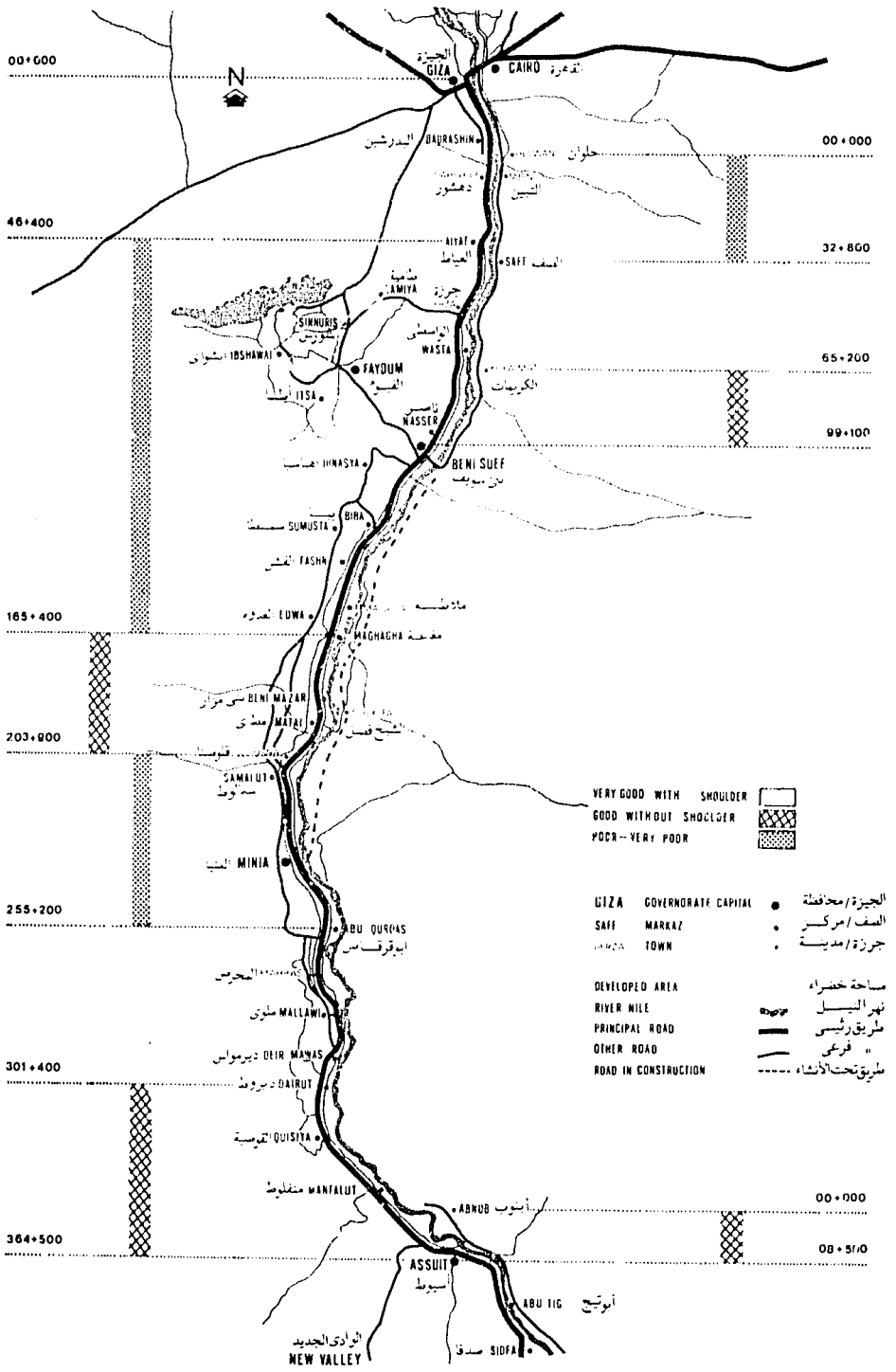
Evaluation of Highway Pavements

A visual rating of pavement surface conditions was undertaken early in the Study. Based on this, 20 locations were identified for field borings to establish pavement structure and to provided samples for laboratory analysis. An analysis was then made of the strength of the existing pavements, and this was used, together with projected traffic data, to establish future pavement overlay requirements.

The Visual Rating Survey - This was undertaken in January 1986 by two engineers of the Study. A detailed report was produced containing a link inventory, link ratings and photographs of each link. The results of the visual rating are summarised Figure 3-1. The rating revealed a wide range of pavement conditions, from good for the recently overlayed sections, to extremely poor for many sections which have received no reinforcement in 10-15 years.

Pavement Structure - The 20 field samples were all hand-dug within the travelway to 100 cm depth. They showed a variety of structures, generally consisting of asphaltic concrete (A.C) wearing and binder courses over unbound granualar base, the latter either crushed stone or pit run gravel. Many pavements showed multi-layers of A.C. as a result of overlaying operations, with one boring showing a total depth of A.C. material of 43 cms. Other borings showed new granular base courses laid over old A.C. surfaces. Typical structures revealed by four of the borings are illustrated in Figure 3-2.

Tests on the asphaltic materials indicated significant variations in bitumen content which points to inadequate control of plant mixing. Marshall test stabilities ranged from 1500 to 2900 with associated flow values of 7 to 12. This seems satisfactory, although indicating somewhat brittle pavements.

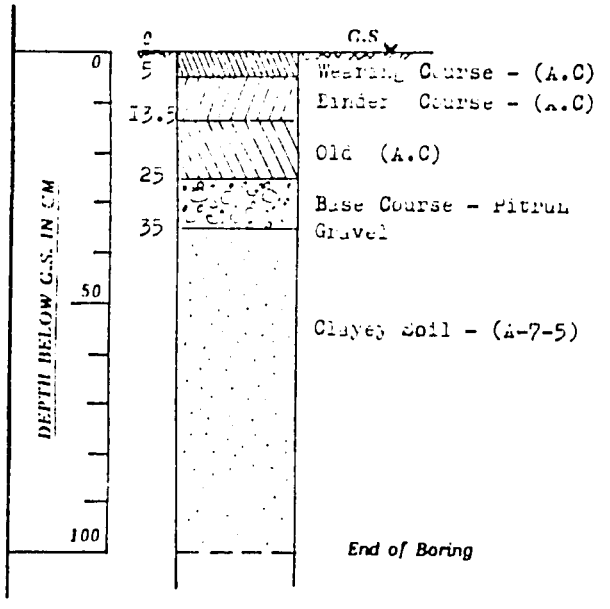


Cairo – Assuit Highway Feasibility Study

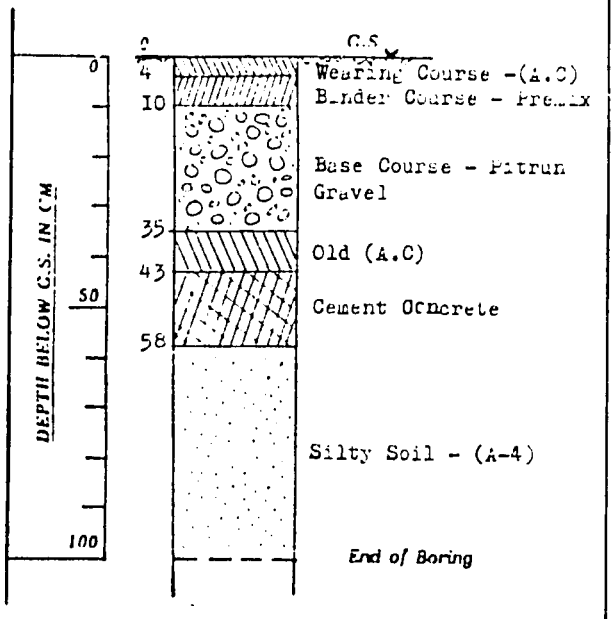
SUMMARY OF PAVEMENT RATINGS

Wilbur Smith and Associates
Egyptian Consultants Consortium

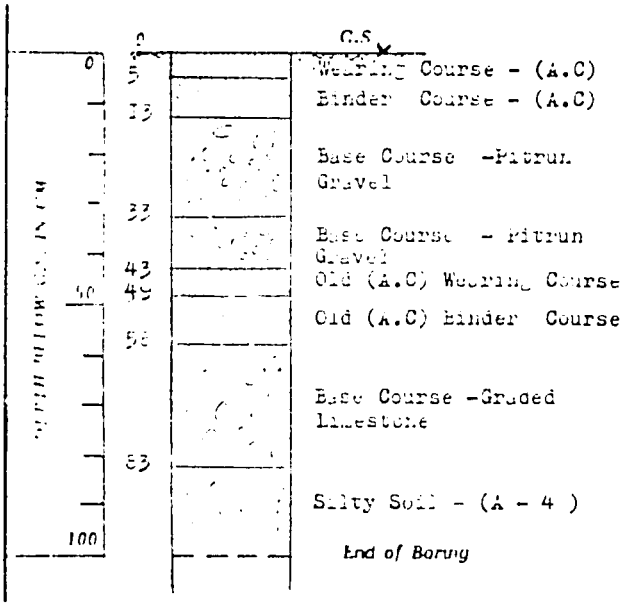
FIGURE 3-1



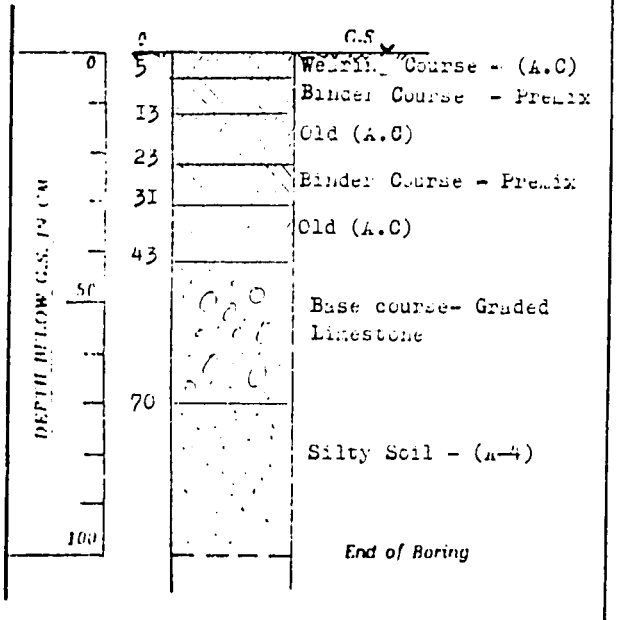
BORING 3 - SAFF



BORING 13- MALLAWI



BORING 10 MATAI



BORING 20 NASSER

Cairo – Assuit Highway Feasibility Study

TYPICAL PAVEMENT STRUCTURES FROM BORINGS

Wilbur Smith and Associates
Egyptian Consultants Consortium

Figure 3-2

The granular bases were reasonably uniform and were in generally in good condition with little intrusion of silt or breakdown of aggregate. However, over half the samples performed poorly in the abrasion tests which indicates poor selection of materials.

The CBR tests on the bearing soils were a little inconclusive, showing considerable variation for soils with similar classifications. On the evidence available, a CBR of about 4 percent was adopted for soils in the agricultural areas, and 8-10 percent for the desert areas on the East Bank.

Evaluation of the Strength of Existing Pavements - A common means for assessing the structural adequacy of existing pavements is to take deflection measurements annually or every two or three years. This procedure measures the deformation, or rebound, of the pavement under a standard loading. Other methods of determining pavement performance are also in use. All are intended to find weakness and potential failure in the pavement structure before the effects are visible on the surface, in order to quantify the remaining structural value.

Lacking deflection or similar measurements, estimates of pavement strength were made from the results of the borings and visual rating. The adopted procedure was to estimate an equivalent asphalt thickness at each site investigated, which could then be taken as an indicator of pavement strength for adjacent sections of highway. Not much accuracy could be expected from this method, since 20 borings in a total of about 470 kilometers of highway, at sites selected with no real information about how typical the sites were, was a very limited sample to work from.

Using the boring data and the condition rating survey, it was possible to assign rough asphaltic concrete (A.C.) equivalent thicknesses to the different road construction layers in place, guided by the descriptions in the Asphaltic Institute (AI) manual on overlays. There was no way of judging the integrity of the old pavements now overlayed or buried, but it seemed safe (and conservative) to assume that they were substantially cracked and deformed.

This exercise was done for the 20 borings on existing pavements, with an estimated total A.C. equivalent thickness in mm at each site, designated Te. These values were then modified to reflect rehabilitation and overlay work either in progress or committed to be completed by 1990. The results are included in Annex 3B-3 with the location of each boring and the links of existing road to which each was presumed to apply.

The results are summarized in Table 3-3. Considering the high axle loads recorded in the Truck Weighing Survey conducted by this Study in February 1986, the results are not very encouraging. The survey indicated that a typical loading on the existing West Bank Highway was about 14,000 equivalent standard axles (EAL) per day, or about 5 million per year. At these axle loads, the pavement strengths in Table 3. indicate the onset of pavement deterioration in less than a year in most locations, with few locations having an expected life of much more than 4 or 5 years.

Table 3-3

ESTIMATED PAVEMENT STRENGTHS OF EXISTING HIGHWAYS
ON COMPLETION OF CURRENT REHABILITATION PROGRAM
(Equivalent asphalt thickness)

SECTION	DISTANCE	EST EQUIV ASPHALT THICKNESS		ESTIMATED LIFE IN EAL (1)
		Surveyed	After Cur Rehab	
	(kms)	(mm)	(mm)	(millions)
East Bank Highway				
Helwan-Saff	32	122-150	221-249	1-3
Saff-Koraimat	32	184-201	184-201	<1
Koraimat-Beni Suef	32	248-274	248-274	10-20
Beni Suef-Minia (2)	134	-	165	<1
Abnub-Assuit	8	200-242	200-242	1-3
West Bank Highway				
Monib-Aiyat	46	203-218	203-218	1-2
Aiyat-Wasta	34	150	249	3
Wasta-Beni Suef	30	266	365	50
Beni Suef-Maletia	50	120-195	219-280	1-8
Maletia-Qulusna	44	252-316	252-316	3-20
Qulusna-Minia	28	245	344	30
Minia-Abu Qurqas	23	177	222	1-2
Abu Qurqas-Deir Mawas	34	257-322	257-322	4-20
Deir Mawas-Assuit	76	257-304	257-304	4-12
Giza-Fayoum-Beni Suef (3)				
Giza-Dahshur Road	10	280	280	8
Dahshur Road-Edge Oasis	44	180	180	<1
Edge Oasis-Fayoum	27	141-150	141-150	<1
Fayoum-Beni Suef	47	141	141	<1

(1) Equivalent standard axle loads.
(2) Estimated from construction specification.
(3) Estimated from pavement structures indicated by RBA engineers.

Estimates of Overlay Needs

Estimates of overlay needs were based on pavement strength, estimated according to the process set out in the previous section, and expected traffic loadings.

Axle Loading - Using the traffic forecasts of the Study, estimates were made of the cumulative equivalent axle loadings (EAL) likely to be sustained by each road link over the 25 year period up to 2009. Since traffic varied by investment case evaluated, separate estimates were required for each case. Three cases were evaluated for the Committed, Improved and Expressway Networks (see Chapter 6 for definitions of the Networks).

It was necessary to make some assumptions on axle loadings. As reported elsewhere, axle loads measured in the Corridor in the Truck Weighing Survey were exceptionally high, with axles weighing as much as twice the legal limit. At the time of the Study, Roads and Bridges Authority were planning a campaign to enforce legal axle loads, and several weighing scales had been purchased for this purpose. Given the prevalance of high axle loads, and the fact that most vehicles are licensed for loads in excess of axle load limits, it was assumed for the purposes of this evaluation that only the very highest axle loadings would be restricted, and that up to 50 percent overloads would persist.

Required Thickness of Overlay - Analyses were made to identify the road structure required to support different axle loadings, considering the types of materials available in Egypt.

The pavement structure required for each value of cumulative EAL was expressed as a total equivalent asphalt thickness, designated Ta. Values of required Ta for a range of axle loadings are shown in Figure 3-3. For each link, the required asphaltic thickness Ta to withstand the estimated cumulative EAL for the period up to 2009 was computed. This value was then compared with the asphaltic thickness Te of the link, as estimated from borings and modified by current and committed overlay and rehabilition works. The difference between the values for Ta and Te gave the total thickness of asphaltic overlay required on the link for the period up to 2009. Actual overlays would be in thinner layers staged over time, but the data available did not permit programming of overlays by link to be determined.

Assuming that overlays would be required to cover both pavement and shoulders, the total volume of asphalt was computed for each link, and summed for all existing roads in the Corridor.

Comment on Method - The methodology described for estimating overlay needs was the best that could be done with available data, and was thought adequate for estimating the total overlay requirements for existing roads for feasibility study purposes. However, the results depended on a few samples of the road structure and many assumptions were made. Therefore the results should not be taken as a program of overlaying, and actual overlay needs should be established from pavement condition and

deterioration over time. As noted earlier, RBA would be well advised to investigate more scientific methods of estimating overlay needs than are now used.

Summary of Overlay Needs - Results were also calculated for legal axle loadings and for current axle loadings. The results are summarized in Table 3-4.

Table 3-4

PAVEMENT OVERLAY NEEDS
(thous cu m of asphalt, 1987-2009)

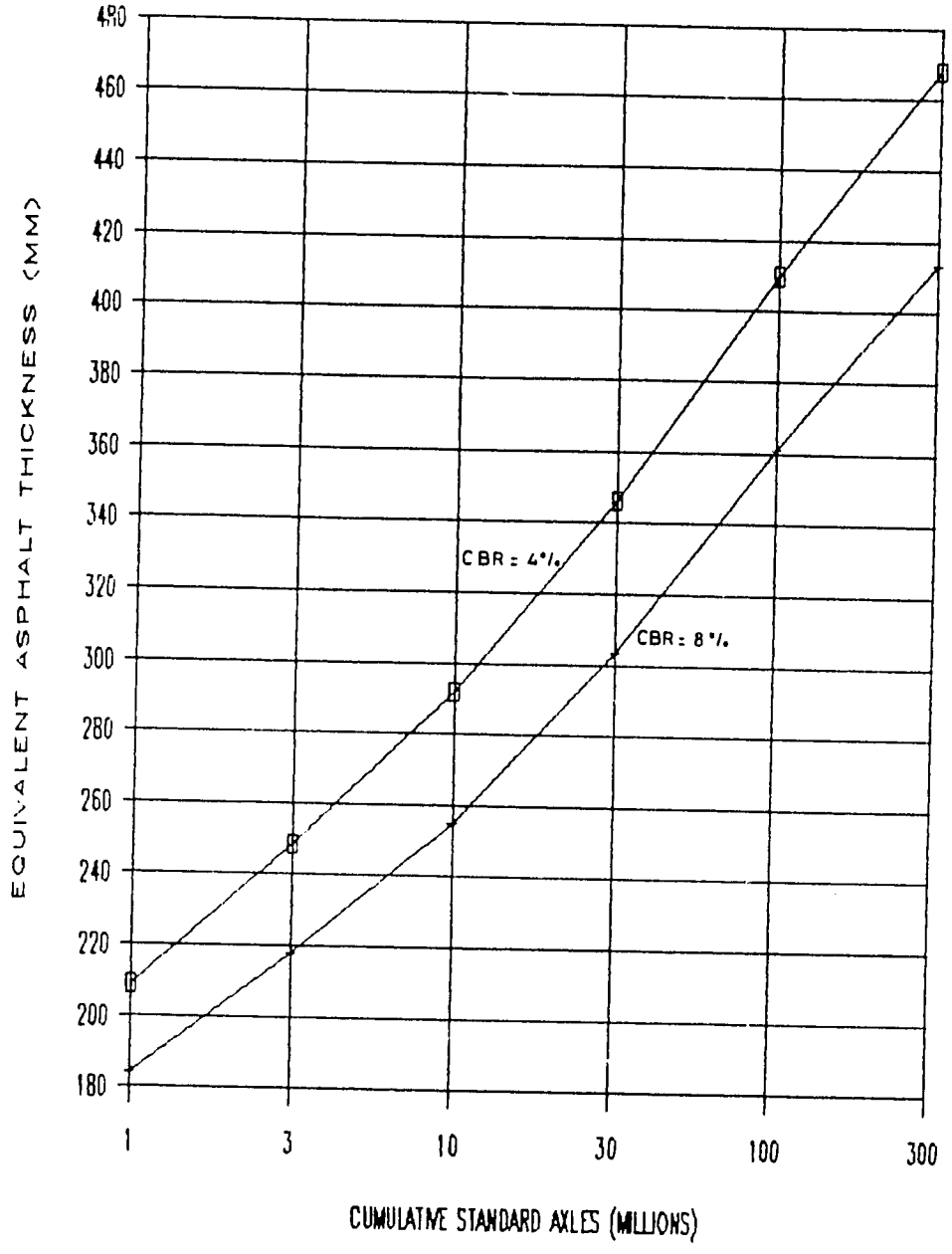
AXLE LOAD POLICY	TRANSPORT NETWORK ASSUMED		
	Committed	Improved	Expressway
Current axle loads (1)	1,327	1,211	1,157
Legal axle loads	870	797	706
Axles up to 50% overloaded	1,232	1,125	1,061

(1) Up to 100% overloaded

It is estimated that over 1.23 million cubic meters of asphaltic overlay will be required on the existing road system over the period 1987 to 2009, reducing to 1.125 million cubic meters if the main West Bank Highway is improved as described later in this chapter, or 1.06 million cubic meters if the new Cairo-Assuit Highway is constructed. At a financial cost of LE 55.7 per cubic meter, this implies an investment of between LE 59 and 67 million over the period, averaging LE 2.6 to 3.0 million per year. Higher expenditures are likely to be necessary in the early part of the period to bring pavements up to an acceptable strength. However, a proper program of pavement overlaying must be determined based on a detailed analysis of pavement strengths, identifying priority sections for early treatment. It is emphasized that the evidence compiled by this Study is not sufficient to identify a detailed program of pavement strengthening.

Comparison with Current Policy - The policy of RBA since pavements were first placed in the 1940s and 50s has been to overlay pavements with about 6cms of base course plus 5cm of wearing course when the pavement shows advanced signs of distress -- potholes, severe cracking, rutting etc. A levelling course is usually required which adds, on average, about 2-4 cms of asphaltic material. The interval between overlays has been about 12 to 15 years.

It was estimated that an overlay of this type every 12 to 15 years would require about 1,500 thousand cubic meters of asphalt base and wearing course, and about 400 thousand cubic meters more of levelling course, over the period 1987-2009. This is considerably in excess of the



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EQUIVALENT ASPHALT THICKNESS
REQUIRED AT DIFFERENT AXLE LOADINGS

Figure 3-3

volumes indicated above, which at first sight appears surprising since the program of reduced overlaying estimated by the Study is expected to produce better surfaces than the current RBA policy.

The reason for this is that the overlay policy recommended by this Study assumes that overlays are placed in advance of visible pavement deterioration. This has the key advantage that the existing pavement being overlayed remains intact and contributes to the strength of the final pavement. It can be seen from Figure 3-3 that 10 cm of asphalt added to a pavement of total equivalent asphalt thickness of 300 mm would add about 80 million EALs to the life of the pavement, but adding the same overlay to a pavement which has deteriorated to an equivalent asphalt thickness of 200 mm adds only about 9 million EALs to the life. Thus timely overlays reduce the need for later overlays, wheras delayed overlays require much more work and materials to make good the deteriorated surface and add sufficient strength to withstand further axle loads.

A further extremely important advantage of early pavement overlaying is that the road surface remains in good condition with associated lower vehicle operating costs.

Conclusions on Pavement Strengthening - Based on the assessment of pavement condition from the visual rating survey and the borings, and taking into account the current program of rehabilitation in the Corridor, it was concluded that a proper program of overlaying could maintain these pavements in good condition, probably for less cost than a policy of overlaying and rehabilitation only when pavements become seriously deteriorated. However, action will be required early since, despite the present program, pavements in most sections of the Corridor are weak and cannot withstand current or expected axle loadings, even with some form of axle weight control, for more than a few years.

New Construction on the Existing Highways

Some major investment projects were considered for improving the existing West Bank Highway: constructing bypasses around 14 of the major towns along the highway, and widening the highway to 4-lane standard.

Construction of Bypasses - Alignments for bypasses were located around all towns on the existing West Bank Highway where conditions in the center of the town seriously impeded through traffic, a condition which could be expected to get worse over time. A total of 14 towns where identified as requiring bypasses as shown in Figure 3-4.

Within the limits of this Study, it was not possible to undertake a full engineering design of each bypass. The procedure adopted, therefore, was to examine aerial photographs of the highway (at scale 1:10,000 taken in August 1984) and plot an appropriate line for a bypass, avoiding urban development and taking account of features such as irrigation canals and other obstacles. The length of bypasses, and the distance bypassed, were estimated for traffic forecasting purposes. Engineering cost estimates were prepared based on a standard cross section, and estimates for particular structures were identified separately. A total of 82 kilometers of bypasses were costed.

a3

Widening the Existing Highway - Costs were estimated for widening all sections of the existing West Bank Highway between bypasses to 4-lane standard. A total of 246.3 kilometers of highway were involved from Aiyat, where the existing 4-lane construction out of Cairo ends, to Manqabad where the existing 4-lane construction into Assuit begins.

Significant sections of the existing highway had canals on both sides of the road, one being the main canal and the other being a smaller feeder canal. Widening the road would mean relocating the smaller canal, and the engineering and cost estimates took this into account.

Unit Highway Construction Costs - For the most part, financial costs (the prices actually paid to contractors) were derived from comparisons of recent bids. The price values adopted were generally towards the higher end of the Roads and Bridges Authority sources, on the assumption that construction standards would be high and that good specifications would be written and enforced for new constuction of the major projects considered by this Study. Some special costs, in particular for structures, were determined individually for each application. For economic evaluation purposes, it was necessary to convert these costs to economic resource costs, which adjust for taxes, import duties and subsidies to obtain a truer measure of National resources consumed by construction.

Land Costs - Land costs were established by discussions with RBA and with the different Governorates in the Corridor. It was difficult to establish agricultural land costs with any certainty, since much depended on location and ownership. Generally, the prices adopted assumed that land would be expropriated by Government for construction, which implied much lower prices than, for example, if the land were to be used for industry. The issue was complicated by the general ban on further use of agricultural land for non-agricultural purposes; it was assumed that this would be dealt with as a policy issue for the development of the Corridor.

Land prices adopted were as follows:

Agricultural land:	
Existing road widening	LE 5.0 per square meter
Bypasses	3.6
Reclaimed land	1.4
Desert land	0.0

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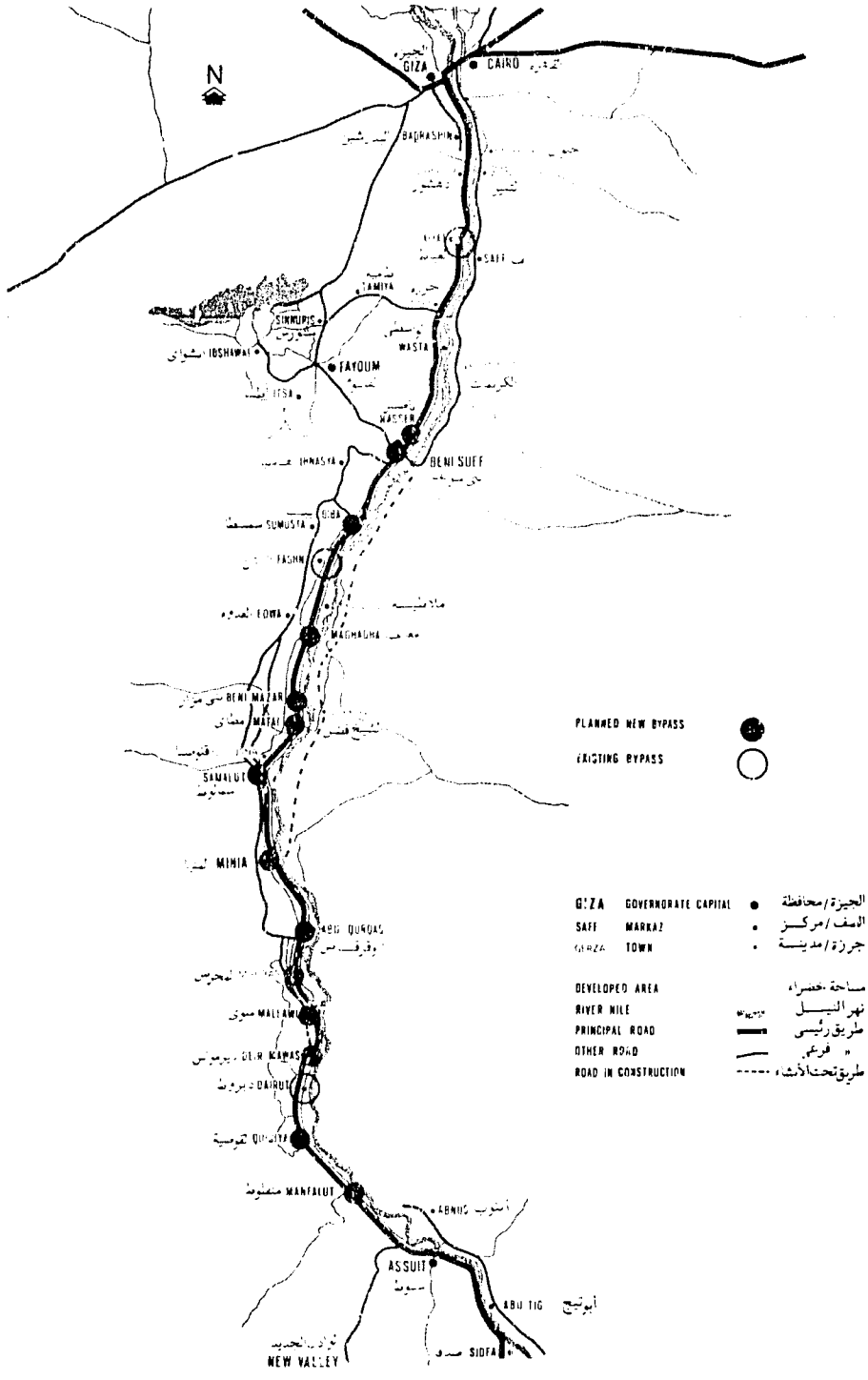

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LOCATIONS OF BY PASSES

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FIGURE 3-4

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Construction Cost Estimates - Costs of both 2-lane and 4-lane bypasses, and the costs of widening the existing highway between bypasses are summarized in Table 3-5 below.

Table 3-5

COST OF IMPROVEMENTS TO THE EXISTING
WEST BANK HIGHWAY
(LE millions, 1986)

IMPROVEMENT	FINANCIAL COSTS	ECONOMIC COSTS
2-lane bypasses	24.8	31.6
4-lane bypasses	37.9	49.6
Widening	74.8	95.0

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Chapter 4

DESIGN OF THE NEW CAIRO-ASSUIT HIGHWAY

The principal project evaluated by the Study was a completely new road from Cairo to Assuit. The Study considered all aspects of the new road, from the broad issue of location -- which side of the Nile River, how far from the existing communities -- through to detailed route location, preliminary engineering design and costing. The plans for the new highway are presented in a separate Plan Volume on 29 drawings, with the aligment plans to scales of 1:25,000 horizontal and 1:250 vertical.

Alignment Options Evaluated

The first task of the Study was to evaluate alternative alignment options for the new highway and recommend an alignment for more detailed study. This task, which occupied the first two months of the Study, considered alignments on both sides of the Nile, including some located in the desert far from the existing Corridor. The alternatives are shown in Figure 4-1.

The alignment options were evaluated from several viewpoints, as follows:

Construction cost
Forecast traffic
Economic feasibility
Access and Development
Strategic
Archeological
Social

It was considered that neither of the alignments located far from the Nile, the Eastern Desert Alignment and the Western Desert Alignment, were suitable for a new Cairo-Assuit highway. The only advantage they appeared to offer was slightly easier traffic conditions for vehicles travelling between Cairo and south of Assuit, but the benefits from this were negligible. These alignments could do little to relieve the existing highway, could not serve the existing communities, and could not assist new development in the Corridor. Egypt cannot afford the luxury of a separate road to serve only the part of Upper Egypt south of Assuit, and so it was recommended that the two desert alignments not be considered further.

It was also concluded that the West Nile Alignment via Construction Segment D which passed on the west side of Fayoum had no advantages, and some disadvantages, compared with the other Nile Alignments and should not be considered further.

Therefore the choice of alignment lay between the two Nile Alignments which were located close to the Nile but just outside the existing developed and agricultural areas.

The East Nile Alignment did have certain advantages. A new paved road was already in construction on the east bank and, by incorporating this construction in the East Nile Alignment, savings in costs could be made compared with building in a completely new location. However, further south between Minia and Assuit, construction costs would be particularly high due to the difficult terrain.

The East Nile Alignment could also give most relief to the Governorate capitals of Minia and Beni Suef since it is actually closer in location, although on the opposite bank of the Nile. However, The Nile barrier presented a problem for the East Nile Alignment in giving access to the other communities along the Cairo-Assuit Corridor which could only be overcome by the construction of bridges. This could double the cost of the road. Without these access bridges, the benefits to the East Nile Alignment were reduced considerably.

It was concluded that most of the advantages lay with the West Nile Alignment. Construction costs were not high because the terrain was easy and access could be provided to all the communities along the route at reasonable cost. This alignment could open up new areas for development for both industry and agriculture more easily than a road on the east bank, which would in any case be adequately provided for by other new road construction projects there. The approaches to Cairo and the links through to the port of Alexandria were good and provided a better connection than the East Nile Alignment. Finally, the preliminary economic analysis indicated that the West Nile Alignment had the best chance of being economically feasible.

Therefore it was recommended that the West Nile Alignment be selected for preliminary engineering design, and for aerial photography. Of the two alternative alignments on the immediate approach to Cairo, the route via Construction Segment B was preferred on engineering and cost grounds.

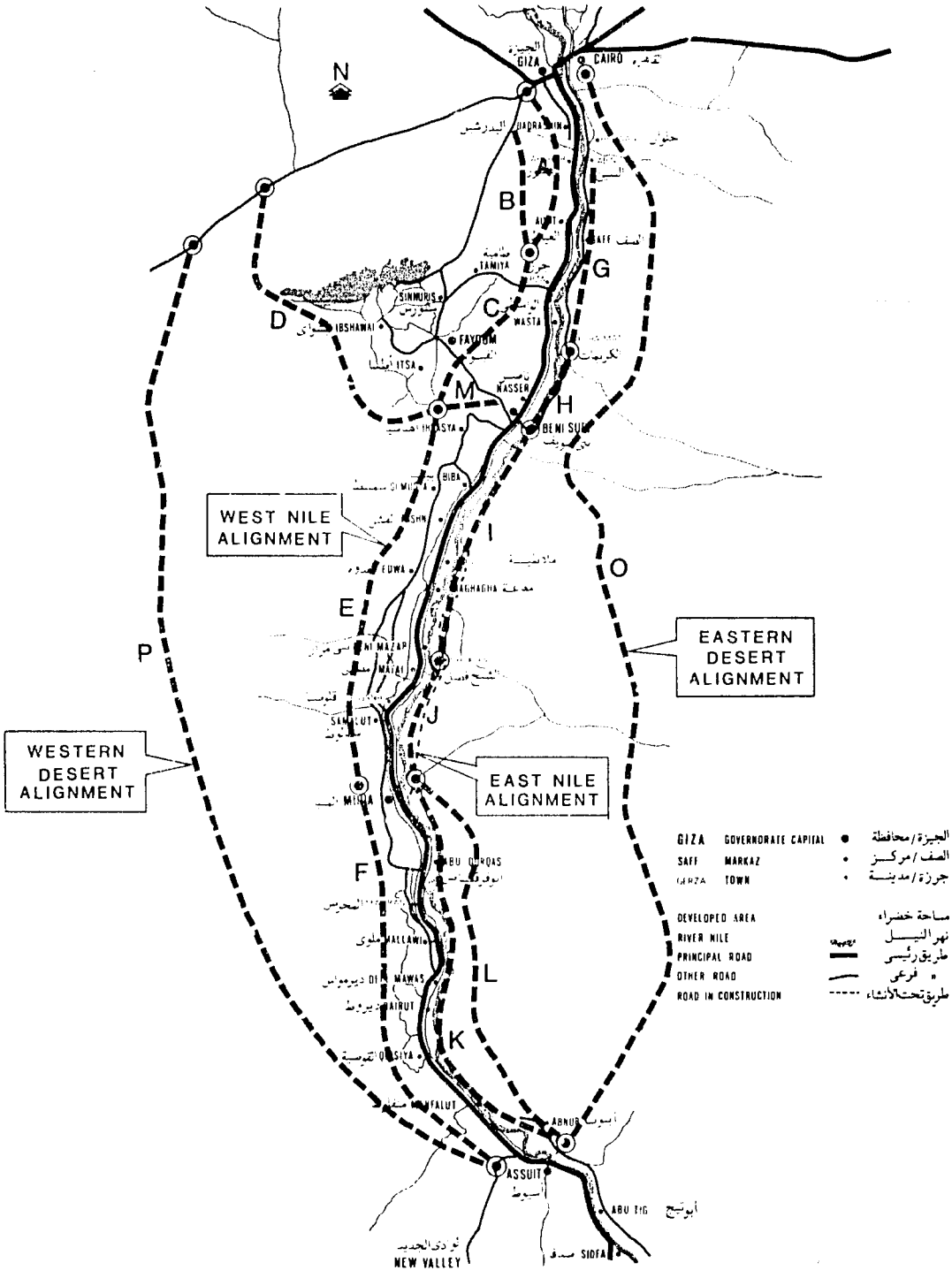
Mapping and Photographs

An alignment for the new highway was selected based on available mapping during the Alignment Options Phase. This alignment was used to define a flight plan for a complete aerial photographic survey of the new route. A set of US Army topographic maps of the Corridor to scale 1:50,000 (Cairo to Minia) and scale 1:100,000 (Minia to Assuit) were obtained from USAID. The maps along the alignment of the highway were then enlarged by the Study to scale 1:25,000.

Detailed Alignment Selection

The West Nile Alignment selected in the Alignment Options Phase was refined considerably as a result of more detailed studies. The main constraints were:

i) Location of the high voltage transmission lines from Aswan to Cairo.



Cairo – Assuit Highway Feasibility Study

ALIGNMENT OPTIONS EVALUATED

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FIGURE 4-1

ii) Location of the planned new petroleum product pipeline from Cairo to Assuit.

iii) The limits of agricultural development, including new extensions of agricultural land reclaimed from the desert.

iv) Topography (only a significant issue in the south of the Corridor).

Route Description - The maps at the back of this volume show the final alignment selected for the new highway, together with the associated access roads.

The northern terminus of the road is a junction with the Fayoum Desert Road about 4 kilometers south of the Dahshur Road/Fayoum Desert Road intersection. The new road is aligned in a south-easterly direction heading across desert land towards the region of Aiyat and Gerza. The alignment then turns south to pass between the Fayoum Oasis and the agricultural developments in the main Nile Corridor. The route crosses the Gerza-Tamiya Road turning south-west to reach the Beni Suef-Fayoum Road. The terrain from the northern terminus of the road to the Beni Suef-Fayoum Road is easy and the few rock escarpments in this area are easily avoided.

The alignment crosses the Beni Suef-Fayoum at a point 6.5 kms west of El Lahoun which marks the boundary between Beni Suef and Fayoum. Since there is continuous agricultural development along the road linking Beni Suef with Fayoum, it is inevitable that the new route passes through some agricultural land. The crossing point selected is at the narrowest point of this agricultural strip where it is only 1.25 kms wide.

South of this point, the alignment of the new road meets the high voltage transmission lines from Aswan to Cairo, and the alignment of the planned new petroleum product pipeline from Cairo to Assuit. From this point for much of the way to Assuit, the alignments of the new road, the high voltage transmission lines and the product pipeline all share the same general alignment in the desert just outside the existing agricultural area.

The alignment of the new highway crosses the high voltage transmission lines at three points between Beni Suef and Assuit, and many of the access roads also cross the transmission lines. This was discussed with the National Electricity Company who made no objection as long as sufficient reserve was allowed between the pylons and the edge of highway. The pipeline is crossed at two locations. This was discussed with the National Pipeline Company who made no objection as long as all crossings were at right angles to the pipeline (which will be buried) and the edge of highway was maintained at least 50 meters from the pipeline in sections where the two followed parallel alignments.

Between Beni Suef and Maghagha, some poor soil conditions were

encountered and a few wadis, but these were the only problems. South of Maghagha, extensive new agricultural areas were identified from aerial photographs, extending to Minia. The line of both the high voltage transmission line and the pipeline pass through this reclaimed land, but the new highway was located further to the west in the desert.

From Matai to Mallawi (about 75 kilometers located on either side of Minia), the road alignment passes through an area of dunes which would require stabilization.

The most difficult section for road construction is between Dairut and Quisiya, where the desert between the agricultural land and the rock escarpments narrows to between 100 and 150 meters. However, study of the aerial photographs and field visits showed that the new highway could be located in this strip without undue problems.

South of Mallawi, the escarpments are set back further from the agricultural land and there is little difficulty in locating the new highway. Close to Assuit, the line of the road avoids the new cement plant and oil refinery under construction, passing between them and the agricultural land.

The new highway terminates on the New Valley Road in a junction about 8 kms from the existing highway. This location was chosen to permit extension of the new road beyond Assuit in a later stage. A choice is available to take this southern extension either close to Assuit town or over the high ground to the west of Assuit. The terminus chosen in this Study permits either alignment, but no investigation was made of these alternatives.

The total length of the alignment from the Fayoum Desert Road (station 12.5) to the New Valley Road (station 355.8) is 343.3 kilometers.

Prelimimary Engineering Design

Geometric design standards used for the preliminary engineering design of the new highway were taken from the ASHTO standard given in the 1984 edition of "A Policy on Geometric Design of Highways and Streets" (Reference 15). The key paramenters are summarized in Table 11.

A design speed of 110 kilometers per hour was assumed for the new highway, and 65 kilometers per hour for the access roads. All other parameters, including curvatures, superelevation, stopping and passing sight distances were selected appropriate to these speeds.

The terrain is generally easy and there were few problems in locating the new highway in conformity with these standards. The only sections which presented any difficulty were those opposite Minia, where the new alignment enters the narrow section between the rock escarpment and the agricultural land, and between Mallawi and Dairut. However, the road could be located in both these sections according to design standards.

The design team went to the extent of calculating spiral transitions

for horizontal curves taking full account of the length of transition to achieve full superelevation. Vertical transition curves between grades were also calculated, assuming parabolic curves and ensuring minimum sight distances were adhered to. It was concluded that a full 4-lane expressway could be located in the selected Corridor designed to the highest standards of alignment.

The cross-section adopted for the 4-lane design is shown in Figure 4-2. It consists of two 8.5 meter carriageways marked as two 3.75 meter lanes with a 1.0 meter strip adjacent to the median. Shoulders of 3.0 meters were adopted, and a median of 10.0 meters. Staged construction for a 2-lane design would use just one carriageway, adding an additional shoulder of 2.0 meters adjacent to the 1.0 meter carriageway strip, giving two 3.0 meters as in the full design.

Pavement Design

Much pavement construction in Egypt appears to use standard designs with little regard to actual or predicted axle loadings. A typical section consists of a 30 cm crushed stone sub-base, a 6 cm asphaltic concrete (A.C.) base, and a 5 cm A.C. wearing surface. It is estimated that this design would be good for a maximum cumulative axle loading of perhaps 2 million equivalent axle loads (EAL) with favorable soil conditions (CBR greater than about 8 percent). Measurements of axle loads in this Study indicate that this loading could be accumulated with less than one year's traffic, indicating early pavement failure for such a design. An important element of the Study, therefore, was to prepare realistic designs capable of withstanding forecast axle loadings.

Axle Loadings - Axle loadings on the new highway were estimated for a 10 and 20 year period assuming opening in 1990 (recommended opening year is discussed elsewhere in this report). It was assumed that some control of axle loadings would be introduced, but that loadings as high as 50 percent over legal axle loads would still persist.

Soil Conditions - The soils survey indicated that CBR values for soils along the route were generally good, being above 8 percent for almost all sections. However, there were some low CBR values encountered between Aiyat and Gerza, and between Beni Suef and Fashn. Therefore the minimum sub-base thickness of 15 cm was adopted for the main design, but a 20 cm sub-base was costed for the two sections indicated. The analysis of quarry materials indicated that they were satisfactory for sub-base construction.

Pavement Structure - Based on forecast axle loadings of up to 60 million equivalent standard axles over 20 years, and with measured base soil CBR values of 8 percent or better, a standard pavement structure was adopted as follows:

Crushed stone sub-base	15 cm
Asphalt base course	18-20
Wearing surface	5

It was assumed that an additional 5 cm strengthening overlay would be placed after 10 years. South of Beni Suef, a reduction in thickness of the base course from 20 to 18 cm was allowed based on lower axle loadings forecast for this section of the highway.

Costs of Construction

Costs of construction were estimated based on preliminary design quantities. Cut and fill was estimated from the road profile, and pavement quantities from the cross-section design. Some agricultural land would be required where the road crosses the agricultural strip linking Beni Suef and Fayoum.

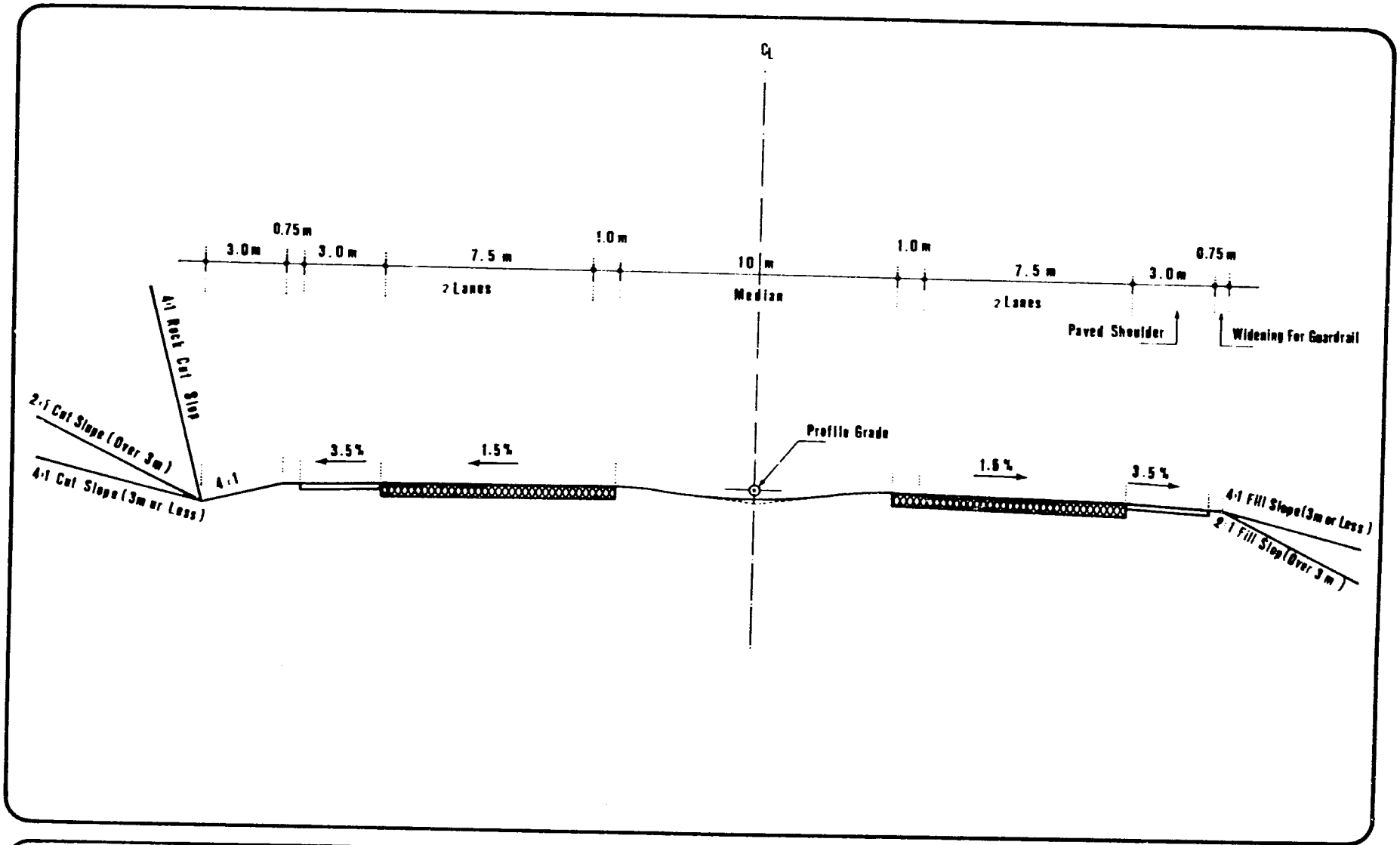
Unit prices were derived from recent bids for both RBA and for the inter-Governorate road in construction between Fayoum, Beni Suef and Minia. In general, the higher bid prices associated with the RBA contracts were selected, on the basis that the new Cairo-Assuit Highway would be built to the highest standards of materials and workmanship.

Structures - The first stage of construction assumed at-grade intersections which have little additional cost to the main cost of the roadway. Preliminary designs were prepared for grade-separated interchanges at the Northern termimus on the Fayoum Desert Road, and at the intersection with the Beni Suef-Fayoum Road. All other grade-separated interchanges are discussed later in relation to access roads.

The opening of the new highway would put additional traffic pressure on the Cairo Ring Road/Fayoum Desert Road intersection, located just to the North of the northern terminus of the new highway. The initial design for this intersection envisages at-grade construction, but it is understood that a grade-separated design is considered necessary by the year 2000. While no additional costs would be imposed on the at-grade design, an additional slip road would be required to accomodate Cairo-Assuit highway traffic in the grade-separated design.

Wadis - Photographs and maps showed numerous wadis crossing the proposed alignment of the new highway. Flooding of the wadis can be expected to be rare, although the aerial photographs did indicate water in one wadi. Structures were costed for each important wadi location,

Dune Stabilization - In the 75 kilometer section between Matai and Mallawi, stabalization of dunes would be required. This could be achieved placing rock facing for about 7-10 meters on either side of the carriageway.



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TYPICAL CROSS SECTION OF NEW HIGHWAY

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Figure 4-2

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Total Costs of Construction - Total costs of construction are summarized in Table 4-1 below.

Table 4-1

CONSTRUCTION COSTS OF THE NEW CAIRO-ASSUIT HIGHWAY
(LE millions, 1985/86)

COST CLASS	FIRST STAGE CONSTRUCTION (1)	TOTAL CONSTRUCTION (2)
Financial	88.6	179.4
Economic	118.2	240.7
Foreign Exchange	33.6	69.4

NOTE: Access roads with their intersections costed separately
(1) 2-lane construction with at-grade intersections
(2) 4-lane construction with grade-separated intersections

Access Roads

An important feature of the design of the new highway was the identification of suitable access roads linking the new road to the existing communities in the Corridor. The aim was to provide a link to each of the Markez capitals. Since these communities were almost exclusively located along the line of the existing West Bank Highway, the access roads had to cross the existing agricultural area which is in places 20 kilometers wide. It was therefore inevitable that some agricultural land would be used in the construction of access roads. To reduce this to minimum, use was made of existing roads, improving and extending them to the line of the new highway.

Only one major Markaz capital remained unconnected, that of Abu Qurqas, where no existing road suitable for modification was found. Other Markaz capitals shared the same access road. Excluding the connections with existing main roads at the northern terminus (Fayoum Desert Road) and with the Beni Suef-Fayoum Road, a total of 12 access roads were identified, including the connection along the New Valley Road to the southern terminus of the route.

Access Road Improvement - Field inspections of the candidate access roads showed most to be sub-standard in terms of width, pavement condition and shoulders. Therefore costs were estimated for widening the existing roads, and extending the roads to the line of the new highway. Pavement design was based on forecast traffic and axle loadings which varied by location.

All new construction was in desert areas or areas of reclaimed land on the fringe of the desert. No new construction, other than widening, was

envisaged in the existing agricultural area.

All of the access roads pass through some small settlements, but the only villages of any consequence are Idwa (Maghagha Road), Sandafa el Far (Beni Mazar Road) and Talba (Minia Road). A minimum 7.5 meter carriageway width is available through all villages.

The total length of access road was estimated at 181 kilometers of which 143 kilometers was existing roadway. A total of 1.2 million square meters of agricultural land would be required adjacent to the existing roads for improvement, and 72 thousand square meters of reclaimed land.

Access Road Intersections and Structures - It was assumed that all intersections with the new highway would be at-grade in the first stage of construction, but that grade-separated intersections would be required when traffic volumes increased. Most intersections were 3-leg with the access road terminating at the new highway. Three 4-leg intersections were required, one each at Gerza and New Valley Road where the road continues on the west side of the new highway, and one at Mallawi to allow access to the important Tuna El Gabel archeological site.

Inspections of the access roads showed some narrow or otherwise inadequate bridges which would have to be replaced. Four larger bridges would also be required to cross the Bahr Youssef Canal where the existing crossing is inadequate.

Although the Beni Suef-Fayoum Road was not treated as an access road as such, one major item of construction on this route would be required to accomodate traffic to and from the new highway. This would be a new bridge over the Bahr Youssef Canal in the area of El Lahoun, on the boundary between Beni Suef and Fayoum Governorates. The existing road crossing of the canal is very tortuous and could not handle increased volumes of traffic.

Costs of Access Roads - Costs are summarized in Table 4-2 below.

Table 4-2

CONSTRUCTION COSTS OF ACCESS ROADS
(LE millions, 1985/86)

COST CLASS	FIRST STAGE CONSTRUCTION (1)	TOTAL CONSTRUCTION (2)
Financial	28.6	64.0
Economic	36.9	84.7
Foreign Exchange	9.3	25.4

(1) At-grade intersections
(2) Grade separated intersections

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Chapter 5

ECONOMIC STUDIES

This chapter describes the studies of population and economic growth, and the analyses of highway transport costs. This work provided the basis for the highway traffic forecasts described in Chapter 6 and the economic evaluation of projects described in Chapters 7 and 8.

ANALYSIS ZONES

To provide a common format for all analyses of traffic, population and economic factors, Egypt was sub-divided into 64 analysis zones. The zone plan adopted is shown in Figure 5-1. The zones were based on existing administrative and statistical boundaries, the main unit being the Governorate. Within and immediately adjacent to the Cairo-Assuit Corridor, more detail was required, so zones there were defined by the marakez boundaries.

The final objective of the population and economic studies was to produce forecasts of population (sub-divided into rural and urban) and Gross Domestic Product (GDP) by analysis zone.

ECONOMIC PARAMETERS

Project appraisal methodology required the use of various factors to adjust computed or estimated values for either the passage of time or irregularities in the market pricing system. Such factors or parameters were required for both financial and economic evaluations.

Inflation

As inflation could be expected to affect all sectors equally, it was disregarded in the Study forecasts. Therefore all economic and financial values for the Study were in terms of constant 1985/86 LE.

Discount Rate

In the economic evaluation, future streams of benefits and costs were discounted to the base year using an estimate of the opportunity cost of capital within Egypt. Little or no research was available on either the macro or micro productivity of capital in Egypt for guidance on an appropriate discount rate to use. Phases II and III of the Egypt National Transport Study (ENTS) (Reference 1) used a rate of 12 percent and therefore the same rate of 12 percent was adopted by this Study.

Interest Rate

The statutory ceiling on interest rates was rescinded in 1975 and the Central Bank was empowered to fix interest rates. The 1986 Central Bank discount rate reached 13% with five year commercial loans to the private sector in the neighborhood of 15-16 percent. Concessionary rates were

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applicable to organizations and companies in the public sector, ranging from 7-9 percent. For financial calculations within the transport sector relating to tariffs and perceived costs of vehicle operations, a uniform commercial rate of 12 percent was adopted for this Study.

Shadow Pricing

Shadow pricing techniques eliminate subsidies and transfer payments, both direct and indirect, and correct for market discontinuities. Four cases required particular attention: foreign exchange, petroleum prices, labor costs and the value of time.

Foreign Exchange - Continuing pressure on the Egyptian pound is expressed in the "own exchange" and "black" markets which were in the neighborhood of US$1.00 = LE 2.00 during 1985/86. A rate of US$1.00 = LE 1.80 was adopted for economic evaluations in this Study. This compares with a rate of US$1.00 = LE 1.20 used by ENTS.

Petroleum - A shadow price of US$ 20.00 per barrel was selected for application in the economic analyses portion of this study. This price was an estimate of the long run equilibrium value of petroleum.

Labor - No further information on the Egyptian labor market situation was available since the completion of the ENTS Phase III (1984). Therefore, the shadow wage rate set forth in that study was maintained at 0.5 for unskilled labor and 1.0 for skilled labor.

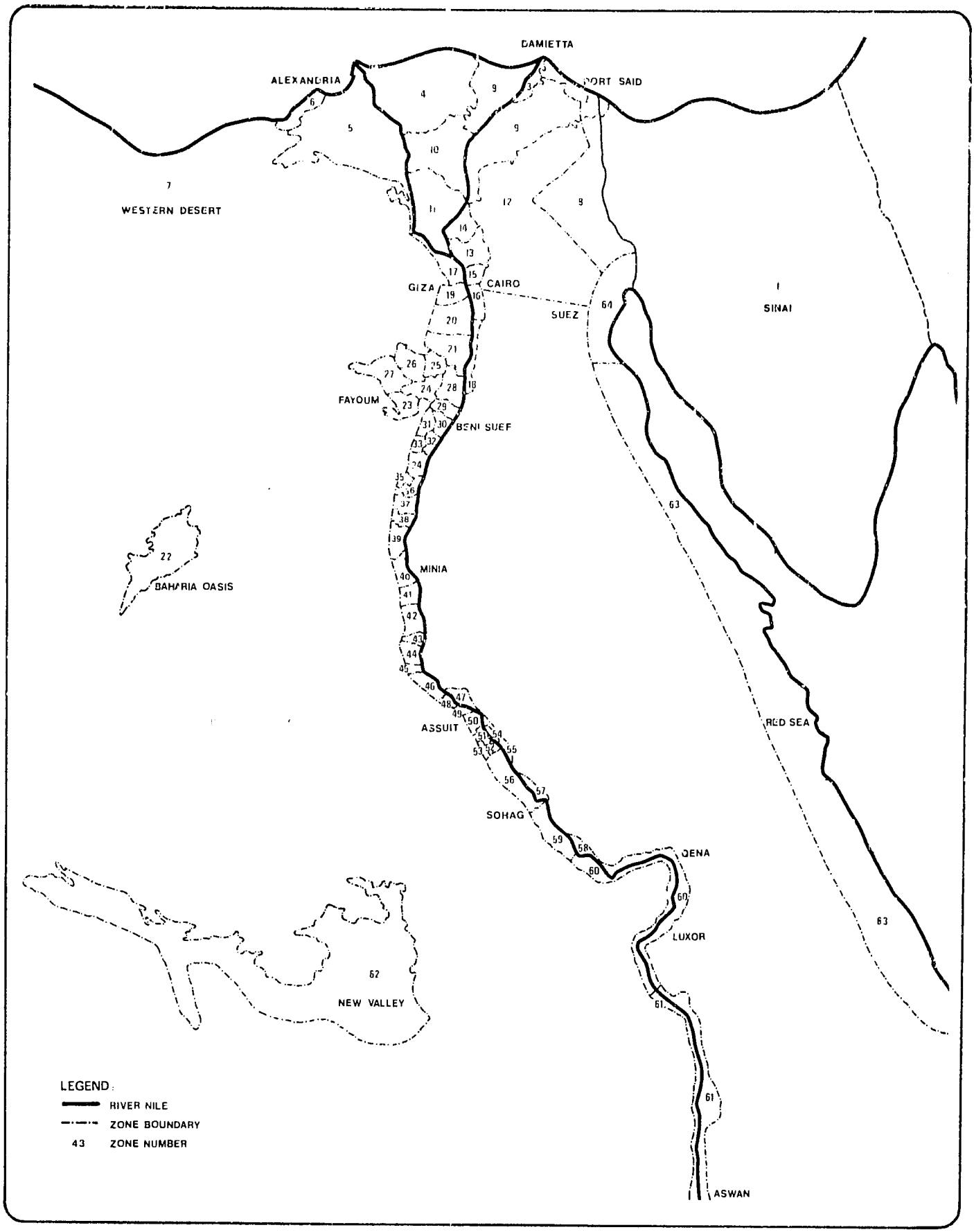
Value of Time - Savings in time attributable to the new or improved facility were calculated for both cargo and passengers. For cargo a weighted mixed cargo was derived for each truck type and a per ton value estimated based on the roadside interview and truck weighing surveys. Benefits which might result from inventory cost savings were estimated using the appropriate interest rate for financial and economic evaluations.

Passenger time value is a function of trip purpose and the wage rate. In general, business trips are normally valued at 100 percent of the wage rate while work related and other trips are valued in the neighborhood of 60 percent and 30 percent of the average wage rate respectively.

POPULATION STUDIES

Egypt is one of the most ancient inhabited areas in the World with a civilization going back 5000 years. It exemplifies a typical densely inhabited developing country with a high population growth and limited economic resources.

It is doubtful whether national population ever exceeded 10 million prior to 1900. Examination of total population figures in census years showed an increase from about 10 million in 1897 to about 38 million in 1976. Thus the 28 million added to Egypt's population during 80 years amounted, approximately, to a threefold increase over Egypt's population



Cairo – Assuit Highway Feasibility Study

Wilbur Smith and Associates
Egyptian Consultants Consortium

ZONE PLAN - EGYPT

FIGURE 5-1

accumulated throughout the long historical period prior to 1897. This high rate of population growth is officially recognized as a major national problem increasing the difficulty of resolving other social and economic problems due to the limited potential of the inhabitable areas and other resources.

National Population Growth

As delineated in Table 5-1 the annual growth rate of the Egyptian population declined from 1.48 percent during the period 1897-1907 to 1.10 percent during the period 1917-1927. The rate thereafter increased, attaining a level of 2.53 percent during the period 1960-1966. The latest census (1976) recorded a decrease to an annual rate of 2.31 percent, or 1.96 percent if Egyptians abroad are excluded. Wars and depressed socio-economic conditions probably contributed to this recent decline.

Comparability of Population Census Data

The urban population in Egypt was officially defined according to administrative criteria in 1960 as that population within the four urban governorates, the capitals of the provincial governorates, and the capitals of the districts (Markez) within these governorates. In addition to these administratively defined urban units, a few other areas were given urban status. According to such criteria, many settlements formally defined as urban had predominantly rural economic and sociologic characteristics. Similarly, some settlements that were statistically classified as rural surpassed many urban settlements in size and other urban characteristics.

Administrative borders within Egypt have been altered for several reasons during the last 40 years, including the creation of three new governorates and many districts. The capitals of these new districts, nominally villages, were reclassified as towns. The total number of Egyptian cities and towns increased from 96 to 160 betwen 1947 and 1976. Also, urban settlements experienced numerous boundary changes, including rural settlements frequently being annexed to existing towns, and parts of some towns being detached and incorporated within rural settlements.

Unless adjusted for consistency, these boundary changes lead to comparability errors in defining urban versus rural population. A careful examination of various reference studies was carried out as a part of this project. It was noted that failure to adjust properly for comparability errors appears to have resulted in overestimation of urban population and inflated projections of urbanization. For transport planning purposes, an accurate projection of urban versus rural population concentrations was critical because the interchange of trips among urban centers and the distinction in travel patterns between urban and rural areas were important factors in making reliable projections of future travel demands. Urban-rural population differences were important not only in describing travel patterns and trip characteristics, but also in projection of socio-economic parameters. In this Study, a United Nations developed model utilizing urban-rural growth differences was applied to obtain projected population distribution.

Table 5-1

POPULATION TOTALS AND GROWTH RATES 1897-1976

CENSUS YEARS	POPULATION IN THOUSANDS(1)		ANNUAL RATE OF GROWTH FOR INTERVENING PERIODS(4)	
1897	9,749		-	
1907	11,287		1.48	
1917	12,751		1.23	
1927	14,218		1.10	
1937	15,933		1.15	
1947	19,022		1.79	
1960	26,085		2.37	
1966	30,076	(2)	2.53	
1976	38,198	(36773)(3)	2.31	(1.93)

SOURCE: CAPMAS, Egyptian Censuses conducted during each of the assigned years.

Notes

(1) Nomadic population are included.

(2) 1966 Census figures used in this Study are based on complete count of population, but other census population characteristics are of sample base

(3) 1976 population includes estimates of Egyptians living abroad(1.425 million) and living in occupied land (147,000 persons), but figures in parentheses discount Egyptians abroad.

(4) Exponential function is utilized in calculations. Intercensal periods are 10 years for all periods prior 1947, 13.5 years for 1947-1960, 5.7 years for 1960-1966, and 10.5 for 1966-1976 period.

For this Study, therefore, a detailed review was made of the results of the last four censuses, and all data were adjusted to the 1976 enumeration boundaries before analyzing trends in rural and urban population. The results of this review are summarised in Table 5-2. While the results do represent some departure from former demographic analyses, it is felt that the data obtained by these adjustments represent a necessary refinement in order to make reliable travel demand projections.

Urbanization Trends

As measured by the percent of the population living in urban areas, the level of urbanization in Egypt increased by 8.1 percent in 30 years, from 35.9 percent in 1947 to 44.0 percent in 1976. An apparently faster pace of urbanization was seen in Upper Egypt, with the urban population reaching 30.7 percent of the total in 1976, compared with 26.4 percent in Lower Egypt. However, the faster pace in Upper Egypt was attributable to the effect of the growing urban population in Giza governorate associated with the Greater Cairo Conurbation. With Giza Governorate excluded from the Upper Egypt figures, the proportion of urban population in Upper Egypt decreases to 20.4 percent and 24.3 percent in 1947 and 1976 respectively.

Within the Cairo-Assuit Corridor, Assuit governorate was relatively more urbanized in 1976 (27.7 percent urban); Minia governorate was least urbanized (21.0 percent); while Fayoum and Beni Suef governorate were moderately urbanized (24.9 and 24.2 percent urban respectively).

Urban and Rural Growth Rates

The annual population growth rates of all urban areas were 3.28 percent for the period 1947-1960, 3.52 percent for the period 1960-1966, and declined to 2.20 percent during the period 1966-1976. The corresponding rural rates for the same periods were 1.80 percent, 1.83 percent, and 1.73 percent respectively. This suggests a substantial rural-to-urban migration.

The decline in urban growth rates during the last intercensal period were probably attributable to the selective nature of the emigration of urban population, evacuation of Suez-Canal Zone cities because of the war conditions, and acute problems related to over-urbanization in urban areas in general and Cairo governorate in particular.

Regional Population Growth

Table indicates that higher rates of growth were experienced where "urban primacy" exists; that is to say, in Greater Cairo (Cairo, Giza and Kalyubia Governorates), Alexandria and the Suez Canal governorates (Port Said, Suez and Ismailia). War conditions were responsible for the observed discontinuities in growth for the Suez Canal Governorates. Higher population growth was also indicated in conjunction with land reclamation projects in Lower Egypt (Damietta, Behera, Sharkia and Kafr El Shiekh) and with short term developments in Aswan. The absorption capacity

Table 5-2

URBAN AND RURAL POPULATION: 1947-1976
(thousands)

GOVERNORATE	1947 Urban	1947 Rural	1960 Urban	1960 Rural	1966 Urban	1966 Rural	1976 Urban	1976 Rural	URBAN POPULATION AS PERCENTAGE OF TOTAL 1947	1960	1966	1976
Urban Governorates												
1. Cairo	2,082		3,360		4,232		5,074		100.0	100.0	100.0	100.0
2. Alexandria	961		1,531		1,818		2,318		100.0	100.0	100.0	100.0
3. Port Said	165		252		291		263		100.0	100.0	100.0	100.0
4. Suez	110		206		264		194		100.0	100.0	100.0	100.0
TOTAL	3,318	0	5,349	0	6,605	0	7,849	0	100.0	100.0	100.0	100.0
Lower Egypt												
1. Damietta	79	186	97	296	127	318	143	433	29.8	24.7	28.5	24.8
2. Dakahlia	318	1,125	437	1,563	497	1,764	657	2,080	22.0	21.9	22.0	24.0
2. Sharkia	198	1,164	333	1,498	426	1,693	530	2,088	14.5	18.2	20.1	20.2
4. Kalyubia	173	563	293	723	399	806	685	996	23.5	28.8	33.1	40.7
5. Kafr El Sheikh	135	548	190	783	213	906	292	1,115	19.8	19.5	19.0	20.8
6. Gharbia	355	909	525	1,150	606	1,295	764	1,529	28.1	31.3	31.9	33.3
7. Menufia	196	940	250	1,105	277	1,181	337	1,374	17.3	18.5	19.0	19.7
8. Beheria	275	944	413	1,280	483	1,506	595	1,869	22.6	24.4	24.3	24.1
9. Ismailia	94	83	147	131	182	155	174	180	53.1	52.9	54.0	49.2
TOTAL	1,823	6,462	2,685	8,529	3,210	9,624	4,177	11,664	22.0	23.9	25.0	26.4
Upper Egypt												
1. Giza	302	546	638	698	871	784	1,395	1,022	35.6	47.8	52.6	57.7
2. Beni Suef	151	576	197	663	219	709	276	834	20.8	22.9	23.6	24.9
3. Fayoum	144	526	193	646	222	713	276	866	21.5	23.0	23.7	24.2
4. Minia	222	1,046	305	1,255	344	1,362	431	1,623	17.5	19.6	20.2	21.0
5. Assuit	242	788	332	991	375	1,043	470	1,227	23.5	25.1	26.4	27.7
6. Sohag	247	1,042	313	1,272	336	1,353	410	1,515	19.2	19.7	19.9	21.3
7. Qena	234	872	285	1,066	317	1,154	392	1,317	21.2	21.1	21.5	22.9
8. Aswan	63	228	100	286	182	339	235	384	21.6	25.9	34.9	38.0
TOTAL	1,605	5,624	2,363	6,877	2,866	7,457	3,885	8,788	22.2	25.6	27.8	30.7
Frontier Governorates (1)												
1. Red Sea	21	3	26	5	31	6	48	7	87.5	83.9	83.8	87.3
2. New Valley	9	32	13	28	21	39	35	50	22.0	31.7	35.0	41.2
3. Matrouh	7	57	24	60	25	61	52	61	10.9	28.6	29.1	46.0
4. Sinai	52	9	112	14	115	16	133	20	85.2	88.9	87.8	86.9
TOTAL	89	101	175	107	192	122	268	138	46.8	62.1	61.1	66.0
TOTAL EGYPT	6,835	12,187	10,572	15,513	12,873	17,203	16,179	20,590	35.9	40.5	42.8	44.0

Source: CAPMAS; compiled from census records, with urban classification adjusted by Study (see text)
(1) Pre-1966 data and Sinai 1976 data estimated.

of the other governorates, especially those of Upper Egypt, appeared to be less than the natural rates of population increase and they have always been the source of out-migration to other parts of Egypt.

While the percentage share of Lower Egypt remained relatively stable at around 43.3 percent, If Giza Governorate, which was really a part of Greater Cairo, is excluded from Upper Egypt, then Upper Egypt's share of population decreased significantly from 33.5 percent to 27.9 percent during the 1947-1976 period.

Population Projections

Population projections were made using the "Component" method whereby age-sex cohorts were projected in five year increments using accepted age-specific fertility and mortality rates, and accounting for net migration as outlined above. These were prepared in a series of low, medium and high projections as given in Table 5-3.

Table 5-3

PROJECTED NATIONAL POPULATION 1985-2000
(THOUSAND)

YEAR	POPULATION Low	Medium (thousand)	High
1985	46,437	47,349	47,554
1990	51,988	53,701	54,572
1995	57,441	60,470	62,259
2000	63,167	67,792	70,564

SOURCE: Consultant
Note:Projections are for end calendar year (31 December).

According to these estimates, national population was forecast in the range of 63.2 to 70.6 million. The medium level projection of 67.8 million was adopted for traffic projections. The medium projection was about 2.7 percent higher than the midpoint between the ENTS Phase III high and low projections. There is not a significant difference, however, between the medium projection of this Study and that of the National Urban Policy Study (NUPS) (Reference 2), the difference being only plus four tenths of one percent above the NUPS projection of 67.5 million.

Projected Population Distribution

Total population for each governorate was derived from national population by a ratio method. Trends in governorate ratios to national population were projected based on 1960 and 1976 ratios, and derived ratios were applied to national figures. The same ratio or "step down" method was then used to derive traffic zone projections within governorates, and all projections were balanced to governorate and national baseline projections. Urban and rural population projections

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within the traffic zones and governorates were accomplished by applying the urban-rural growth difference (URGD) method developed by the United Nations.

The final results of urban, rural, and total population projections are included in Appendix 5D. The data indicate an urban and rural population of 34.251 and 33.541 million by 2000 respectively. The implied corresponding percent is 50.5 percent urban and 49.5 percent rural. This proportion of urban population appeared reasonable considering the fast growing urban population during the period from 1947 which resulted in an urban population of 44.0 percent by 1976. However, the projected urban population as projected was higher than that anticipated by national policy targets. The National Population Council has a goal of reducing the urban proportion to 40.0 percent by the year 2000 (This target was approved by the National Population Council in a session held 19 June 1986, and superintended by President Mubarek).

The 50.5 percent urban population for 2000 adopted by this Study compares with ENTS Phase III of 60 percent urban and NUPS at 54.8 percent urban in the year 2000.

STUDIES OF THE NATIONAL ECONOMY

This section presents a review and analysis of Egypt's National economic characteristics. Included are discussions of gross domestic product, balance of payments and public finance.

Gross Domestic Product

Historic growth rates of the Egyptian gross domestic product at constant factor costs are displayed in Table 5-4. During the period 1956-1985, the Egyptian economy grew at an average rate on the order of 5.8 percent per year.

After a period of low growth between 1966 and 1971, a new strategy was enunciated by President Anwar El-Sadat in the "October 1973 Working Paper". Policies enacted thereafter, in general attempted to implement the principles and priorities set forth in the paper to modernize Egyptian society by the year 2000 by accelerating economic growth. The planning framework emphasized modernization of industry, intensive high value agriculture, oil and energy development, and tourism while the "outward-looking "economic policy was designed to attract requisite foreign capital and technical assistance. Liberalization policies and encouragement of the private sector were accompanied by a reorientation of the public sector to increase efficiency. Concentrated efforts on basic development projects not attractive to the other sectors and the provision of services to private and foreign investment were enunciated as appropriate public sector objectives. The necessity of balanced social development was stressed with the goal of reducing disparities between the capital and the provinces.

Table 5-4

AVERAGE ANNUAL GROWTH RATES
EGYPT GROSS DOMESTIC PRODUCT
(Constant Prices)

YEAR	ANNUAL GROWTH RATE (%)
1956-61	5.3
1961-66	6.1
1966-71	2.9
1971-75	4.7
1975-80	9.3
1980-85	6.4
1956-1985	5.8

Source: Consultant

Note: From 1980 onward, government practice switched from a calendar year to a budget year.

To what extent the above policies affected the rapid economic growth during the last portion of the 70s, in excess of 9 percent, is impossible to ascertain. Exogeneous factors unrelated to productive economic factors undoubtedly played the major role. Large increases in the foreign exchange earnings from expatriate worker remittances and petroleum exports plus significant increases in receipts from tourism, the Suez Canal and foreign assistance encouraged a relatively unrestrained growth of commodity imports and partially alleviated government budgetary deficits.

Rates of real economic growth decreased during the first half of the 1980's. Various factors (multiple exchange rate accounting, discounting procedure for market prices, 8 percent annual real growth rate goal of the current five year plan) suggested an element of overstatement in the latest gross domestic product estimates. The data presented indicate an annual growth rate of about 6.4 percent for the five years 1980-1985. ENTS Phase III assumed a rate of 8 percent for the period 1982-1987, but economic performance failed to achieve this expectation. The real rate of growth may have been in the neighborhood of 4-5 percent annually during the period 1980-1984.

Balance of Payments

The use of multiple rates and alterations in those rates makes a precise analysis of this statistical series impossible. Available figures are delineated in Table 5-5.

Within exports, agriculture and industry presented a near stagnant picture with no discernable growth trend. Commodity imports, however, were increasing. The magnitude of Egypt's traditional current account deficit had been cushioned by petroleum exports and the service sector. The remaining deficit was covered by an increase in external debt and foreign assistance. The IMF estimated that Egypt's external debt was on the order of $ 33 billion (including military debt) at end 1985, compared to an estimated $ 6.5 billion at end 1975.

The continuous deterioration of the current account balance clearly could not be sustained, particularly when considered in the context of the latest developments. Of the four major sources of foreign exchange, only Suez dues showed possibilities of remaining constant. Oil revenues were expected to decrease by around 50 percent and significant increases of other exports in the remaining years of this decade were not thought probable. Tourism receipts were expected to decline by as much as 40 percent, with a slow recovery into the 1990s. Expatriate remittances were expected to remain stable for another year as workers returned with accumulated savings but were likely to decline thereafter as employment opportunities overseas decrease as a result of decreased oil revenues.

Egypt imported about 50 percent of its total foods requirements in 1986. A sizeable reduction in agricultural imports appeared unlikely. The critical issue was how to reduce the remaining import sectors without a reduction in the importation of necessary capital and intermediate commodities which might impose serious restraints on the rate of economic development.

Table 5-5

BALANCE OF PAYMENTS
(current LE millions)

SECTOR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Current Account - Exports										
Agriculture	185	201	241	180	283	523	526	537	606	NA
Oil (1)	58	99	202	252	638	1,414	1,452	1,424	1,332	NA
Industry	306	296	226	248	367	843	790	723	921	NA
TOTAL	549	596	669	680	1,288	2,780	2,768	2,684	2,859	2,839
TOTAL EXCLUDING OIL	491	497	467	428	650	1,366	1,316	1,260	1,527	NA
Current Account - Imports										
Agriculture	380	414	405	674	615	1,703	1,471	1,537	1,992	NA
Oil (1)	260	405	567	859	823	1,676	1,715	1,779	2,050	NA
Industry	899	671	912	1,099	1,248	3,300	3,383	3,061	3,307	NA
TOTAL	1,539	1,490	1,884	2,632	2,686	6,679	6,569	6,377	7,349	7,734
Current Account Balance (Visibles)	(990)	(894)	(1,215)	(1,952)	(1,398)	(3,899)	(3,801)	(3,693)	(4,490)	(4,895)
Other Sources of Foreign Currency										
Tourism	NA	263	439	396	320	414	318	247	231	NA
Suez Canal	NA	122	167	360	412	546	636	670	682	NA
Expatriate Remittance	NA	720	854	1,676	1,587	2,105	1,407	2,328	2,814	NA
TOTAL	NA	1,105	1,460	2,432	2,319	3,065	2,361	3,245	3,727	NA

Source: Central Bank of Egypt, Consultant estimates

(1) Excludes exports by partner foreign oil companies
(2) Excludes Foreign Aid

Note: From 1980 onwards, Government switched from a calender year to a budget year (mid-year to mid-year). Hence data presented for the period 1980-1984 are as of mid-budget year (December 31).

In addition, the burden of servicing foreign debt was expected to increase from its current level of about $ 2.6 billion for the medium and long term public and private obligations. This implied an existing debt service ratio of about 32.8 percent. It was thought that international creditors could face payment delays thus jeopardizing Egypt's credit rating and rendering further credit extensions more difficult. Management of Egypt's balance of payments situation thus implied Government austerity measures.

Public Finance

The Government planned expenditures budget increased at an annual rate of about 11 percent during the 1980's. While revenues increased substantially, actual collections did not attained the planned yearly growth rate of 14 percent, while actual expenditures consistently exceeded the plan, resulting in an annual gross deficit on the order of 5-6 billion LE.

About 65-70 percent of this deficit was covered by domestic borrowing from pension funds and foreign loans and grants. The balance (net deficit) was funded by recourse to the public sector banking system, thus compounding the problem of controlling expenditures by increasing inflationary pressures. Other main contributors to the expenditure control problem were growth of government and public sector payrolls, subsidies for basic necessities and the deficit of public sector companies.

The 1986/87 budget was under review at the time of this Study. Considering the revenue reductions attributable to the drop in international oil prices and decreased tourism, government announced that sizeable cuts in expenditures could be expected with the intention of balancing the budget within five years. While such objectives and an austerity budget were sensible from a financial and economic viewpoint, implementation was undoubtedly politically unattractive and potentially dangerous. However commendable, large cuts in the budget implied major changes in pricing, subsidy, and investment policies and programs. The option of expanded deficit financing via public banking channels remained politically attractive, if financially illusory, but it was throught unwise to anticipate major alterations in the short run. It was thought that multilateral and unilateral foreign assitance could buffer what will be a difficult period for Egypt during the remainder of the 1980's.

Conclusions on Economic Growth Prospects

Long term growth of the National gross domestic product was about 5.8 percent annually for the period 1956 to 1985. The 1975-80 period was one of high growth, around 9.3 percent annually. This was funded primarily by a large increase in foreign exchange earnings from the petroleum sector, the Suez Canal, expatriate remittances, tourism and foreign assistance. The rates of growth declined in the 1980's, averaging 6.4 percent for the period 1980-85. By mid 1986, international and domestic events appeared to have ended rapid growth prospects and signalled the beginning of an austerity period for the Egyptian economy.

Sizeable absolute decreases in the petroleum sector, tourism and expatriate remittances must now be expected, with Suez Canal earnings either stable or showing a modest increase. Other export earnings are not expected to increase significantly, and foreign assistance to replace the entire decrease is thought unlikely. A strategy to reduce the current account balance of payments deficit is required, and a further increase in financing the budget deficit via domestic banking channels is expected to be difficult.

In view of prevailing and forecast economic conditions, the Study adopted a modest annual economic rate of for 1985-1990 of 6 percent, increasing to 6 percent for 1990-2000.

Projected Gross Domestic Product by Zone

No direct information was available on regional and/or personal income in Egypt at the macro-economic level. Following procedures adopted by the World Bank and ENTS, this Study used the expenditure data disclosed by the 1974/75 and 1981/82 household budget surveys to estimate regional economic activity.

Based on these surveys, zones were grouped into three categories, depending on average per capita income levels. These were estimated separately for urban and rural population. National GDP was then distributed by zone based on estimated urban and rural population by zone, weighted by average per capita income according to zone category.

Forecasts of Zonal GDP - It was estimated that the urban and rural shares of total National GDP were 62 percent and 38 percent respectively in 1985. It was expected that the urban share would increase, both because of the higher growth rate in urban population caused by rural migration, and because the per capita income growth rate for urban population was expected to be higher.

Rural/urban shares assumed by this Study reflected the administrative nature of these categories and were as follows:

YEAR	PERCENT GDP Urban	PERCENT GDP Rural
1985	62%	38%
1990	65%	35%
2000	70%	30%

Using the above indicated GDP shares, the traffic zone populations were weighed by the income category and the resulting share distributed to each traffic zone for the forecast years. The results are included in Appendix 5D. The totals indicated that, for all of Egypt, rural GDP per capita might experience a constant level or a modest increase of 0.3 percent annually 1985-1990 and 2.6 percent 1990-2000, while the urban per capita shares would increase at 1.75 and 3.7 percent respectively. By 2000, the urban share per capita was expected to have increased from 1.91 times rural to 2.29 times the rural, on the average.

HIGHWAY TRANSPORT COSTS

Highway transport costs were required at two separate stages of the Study; traffic forecasting and evaluation.

Costs for Transport Forecasting - The volume of traffic using the roads, and the route chosen, is influenced by the price paid for transport. This normally means tariffs for users of transport sevices, and the financial costs of operating vehicles for private owners.

Although tariffs were assumed to be related to financial operating costs, it was recognized that there were major subsidies in public trucking operations. It was also recognized that private car owners do not fully perceive all their operating costs when making decisions about using their vehicle, generally considering only fuel, oil and tires.

Therefore, costs for traffic forecasting were based on financial operating costs of vehicles, adjusted for tariff shortfalls, and for the perception of costs (including time costs) by private car owners. Toll charges were also included. These costs were referred to as financial perceived costs.

Costs for Evaluation - While financial costs of transport shape transport making decisions by private vehicle owners and users of transport services, they are a poor guide to the true costs of transport when viewed from the point of view of the Nation. This is because financial costs include duties and taxes, which are simply a transfer of money from citizens and companies to Government, and also reflect subsidies which represent a transfer of money in the reverse direction. None of duties, taxes or subsidies reflect the consumption of real economic resources of the Nation. This is better measured by what are termed economic resource costs, or economic costs for short. They are obtained by adjusting financial costs to eliminate duties, taxes and subsidies, and to reflect any special valuation of particularly scarce resources.

Since time is a National resource, valuations of both passenger travel time and time in transit of cargo were included in the evaluation stage. Since the value placed on time can vary widely, any project benefits due to time savings were maintained and reported separately.

During the evaluation, it is also useful to identify the foreign exchange content of transport costs, in order to assess the implications of borrowing abroad for the alternative investments.

Finally, the evaluation process must identify any social and environmental costs of transport operations. In practice, this was restricted to the costs of traffic accidents for each alternative. Identification of the costs associated with noise, vehicle emissions, spills, visual intrusion and other pollutions are required in many developed countries, but require a very detailed knowledge of costs and attitudes. Without adequate information on these subjects in the context

of the Egyptian environment, these aspects were treated in a qualitative manner in this Study.

Selected Vehicles

Transport costs vary considerably by vehicle type, ranging per kilometer from perhaps ten piastas for a car to over a pound for a large truck. Therefore a range of vehicle types was selected and vehicle operating costs estimated separately for each.

After examining the characteristics of vehicles revealed in the Roadside Interview Survey tabulations, the vehicle groups shown in Table 5-6 were selected.

Table 5-6

SELECTED VEHICLE TYPES

1. Private car (work purpose)
2. Private car (other purpose)
3. Taxi car
4. Taxi van
5. Pickup
6. Bus
7. Single truck
8. Combination truck
9. Articulated truck

Vehicle Characteristics - A survey was made of the characteristics and costs of vehicles in Egypt, guided by the RIS survey results and by the Egypt National Transport Study (ENTS) (Reference 1). Study. Vehicle characteristics are summarized in Table 5-7. With the main exception of the taxi car, none of the selected vehicles represented one specific model, rather average characteristics were compiled to represent the spread of vehicles observed in the Study surveys, considering such things as carrying capacity (passenger and cargo) and vehicle weights.

All vehicle characteristics were based on locally manufactured or assembled vehicles, with two exceptions; the taxi car and the articulated truck. The taxi car was taken as the Peugot 504, capable of seating 7 persons and which remains the pre-dominant inter-city taxi car. The articulated truck was based on the imported Mercedes models. Increases were made in the utilization rates of vehicles assumed by the ENTS study, considering the average vehicle journey lengths found in the Study surveys. The values of annual driving hours, annual kilometers and vehicle life given in Table 5-7 reflect these adjustments.

Unit Costs of Vehicles - Table 5-8 sets out all unit costs associated with vehicle operations, including labor and fuel costs.

Table 5-7

VEHICLE CHARACTERISTICS

ITEM	PRIVATE CAR	TAXI CAR	TAXI VAN	PICKUP	BUS	TRUCK SINGLE	TRUCK COMB	TRUCK ARTIC
Engine								
Fuel (Petrol=1, Diesel=2)	1	1	1	1	2	2	2	2
Engine Power (BHP)	51	96	80	80	125	125	250	250
Vehicle Weight (tons)								
Empty	1.0	1.0	1.2	1.5	10.0	5.0	12.5	12.5
Maximum Weight	1.5	1.9	2.7	3.5	12.0	13.0	42.5	37.5
Load Factor	0.00	0.00	0.50	0.25	0.86	0.50	0.50	0.50
Average Weight	1.0	1.0	2.0	2.0	11.7	9.0	27.5	25.0
Number of Passengers	2.5	5.0	9.0	2.0	30.0	1.0	1.0	1.0
Vehicle Utilization								
Annual Driving Hours	417	1,667	1,500	1,270	2,000	1,000	1,500	1,500
Annual Kilometers (thous)	25	100	75	70	100	50	75	75
Vehicle Life (years)	10	7	7	7	8	10	8	8

Source: Consultant

Table 5-8

UNIT COSTS OF VEHICLES, PARTS AND LABOR
(All costs in LE)

ITEM	COST TYPE	PRIVATE CAR	TAXI CAR	TAXI VAN	PICKUP	BUS	TRUCK SINGLE	TRUCK COMB	TRUCK ARTIC
Vehicle	For X	5,044	7,770	9,697	5,544	9,900	8,506	28,733	83,300
	Eco	7,265	13,871	16,710	14,070	40,815	20,740	80,519	125,922
	Fin	6,705	19,660	21,780	15,918	42,884	21,520	83,220	119,278
Tire	For X	5	8	5	8	18	23	27	27
	Eco	54	83	54	83	182	225	267	267
	Fin	55	85	55	85	186	230	273	273
Mechanic	For X	0	0	0	0	0	0	0	0
(per hour)	Eco	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
	Fin	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Crew	For X		0.0	0.0	0.0	0.0	0.0	0.0	0.0
(per year)	Eco		4,500	4,500	3,800	6,000	4,500	6,000	6,000
	Fin		4,500	4,500	3,800	6,000	4,500	6,000	6,000
Fuel	For X	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(per liter)	Eco	0.214	0.214	0.214	0.214	0.214	0.214	0.214	0.214
	Fin	0.200	0.200	0.200	0.200	0.030	0.030	0.030	0.030
Oil	For X	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(per liter)	Eco	1.20	1.20	1.20	1.20	0.78	0.78	0.78	0.78
	Fin	1.20	1.20	1.20	1.20	0.78	0.78	0.78	0.78
Interest Costs	For X	12%	12%	12%	12%	12%	12%	12%	12%
(%)	Eco	12%	12%	12%	12%	12%	12%	12%	12%
	Fin	12%	12%	12%	12%	12%	12%	12%	12%
Standing Costs	For X	0%	0%	0%	0%	0%	0%	0%	0%
(%)	Eco	8%	7%	7%	7%	12%	24%	17%	17%
	Fin	10%	8%	8%	8%	14%	28%	19%	19%

Vehicle costs were taken directly from the results of the cost survey. Tire costs were based entirely on locally manufactured tires, which is a trend which appeared to have strengthened since ENTS. Costs of mechanics were based on a survey of repair shops, and crew costs were based on information derived from contacts with the trucking community, in particular the public trucking companies and the Trucking Cooperatives.

The foreign exchange component of costs were estimated separately for vehicles and tires, considering import of raw materials (such as rubber for tires) and the imported components which are assembled in Egypt. Estimates of the foreign exchange component of spare parts (required in the vehicle operating cost model) was estimated at 20 percent of the economic cost, since most spare parts are manufactured locally, and vehicle operators do not often use original manufacturer parts.

The financial costs of gasoline and diesel fuel were included at the current prices of 20 and 3 piastas per liter respectively. For economic costs of fuel, no differentiation was made between the two fuel types and a value of 21.4 piastas per liter was adopted. This was based on a shadow price of US$ 20 per barrel and exchange rate of US$ 1.00 = LE 1.80 (see Chapter 2 for a discussion on shadow pricing and exchange rates). Since all fuel is produced locally, a zero foreign exchange component was appropriate.

Interest rates of 12 percent were used as in ENTS. The standing costs which represent a a fixed overhead cost on vehicle operations, were derived from ENTS data

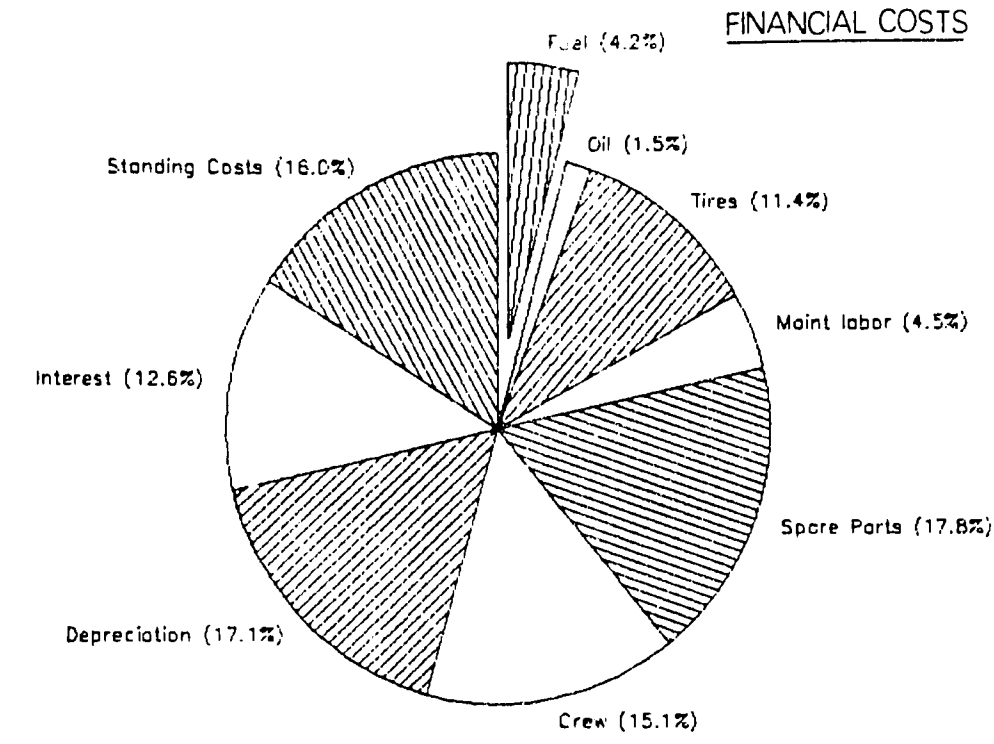
Free-Flow Vehicle Operating Costs

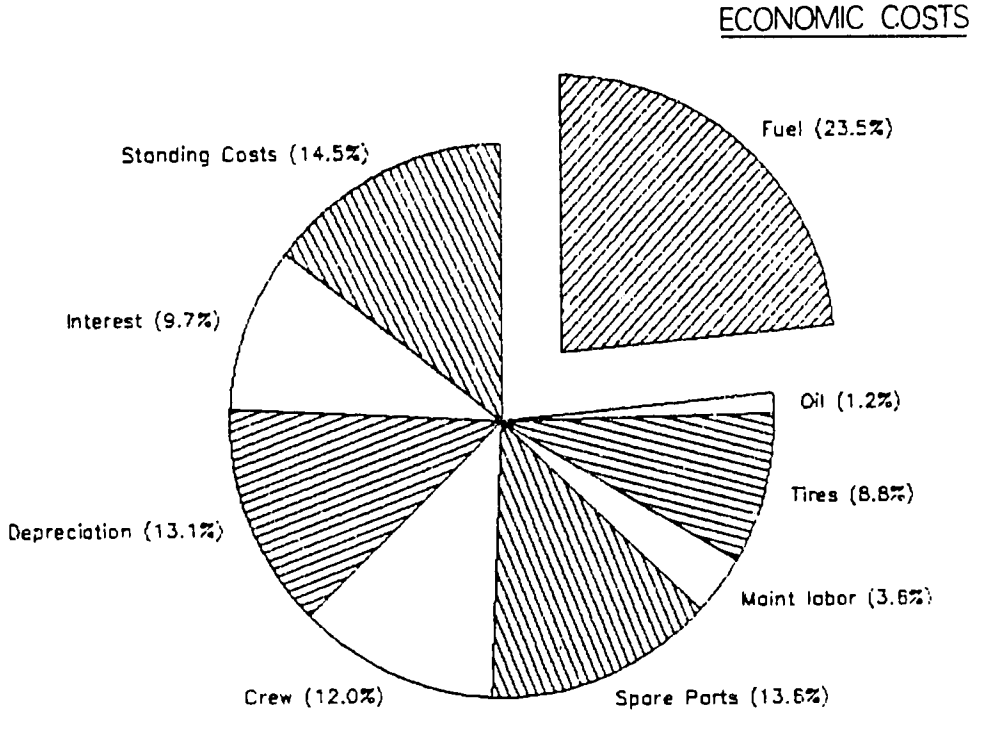
Estimates of free-flow vehicle operating costs were made using the the vehicle operating cost module of Release II of the Highway Design and Maintenance Standards Model (HDM) issued by the World Bank (Reference 6) The ENTS study also estimated free-flow vehicle operating costs. To ensure the utmost comparability between this Study and ENTS, the HDM model was calibrated to give the same results as ENTS for the ENTS vehicle characteristics and unit costs. This process developed calibration factors which could then be applied to all subsequent estimates of free-flow costs by this Study using the updated vehicle characteristics and unit costs.

All free-flow costs were calculated for a flat straight road in excellent condition. Detailed results are presented in Appendix 5E to this report, and are illustrated for the Combination Truck in Figure 5-2.

Depreciation and interest costs make up a large proportion of total costs for all vehicle types. These represent the rate at which the vehicle is being used up over the lifetime, and the economic costs of keeping capital tied up in the vehicle.

Fuel is a large component for all vehicles for economic costs, but shrinks to a very small item for vehicles using the heavily subsidized diesel fuel when considering financial costs, the cost actually paid when the fuel tank is filled. For this reason, the fuel component in Figure 5-2





Cairo – Assuit Highway Feasibility Study

TRUCK COMBINATION OPERATING COSTS

Wilbur Smith and Associates
Egyptian Consultants Consortium

Figure 5-2

has been highlighted. Oil costs are low for most vehicles, reaching a maximum of nearly 7 percent of costs for private cars.

Labor costs components (crew and maintenance) are the same for both financial and economic costs; only the percentage costs varies as the other components go up or down. In all cases, apart from private cars, crew costs are a substantial item of operating cost.

Vehicle Operating Cost Adjustments

Having established vehicle operating costs for a flat and straight road in excellent condition, it was necessary to consider adjustment factors to cover less than perfect conditions. These include the following:

i) Road Geometry
ii) Road Surface
iii) Congestion

Road Geometry - It is normal to adjust operating costs for both curvature and grades, but in these respects, the main West Bank Highway is quite unusual in being exceptionally well aligned. The road runs along the banks of the El Ibrahim canal for most of its length, and sections of 5-15 kms at a stretch are perfectly straight and level. Almost the same can be said of the existing East Bank Highway from Helwan to Beni Suef, although the section south of Beni Suef now under construction will have some gentle grades. Certainly the new Cairo-Assuit Highway is planned to have gentle curves and few grades. Some minor roads considered by the Study (access roads to some marakez capitals off the main highway) do have curves, but carried relatively little traffic in relation to the main road.

For these reasons, no adjustments or additions were made to the vehicle operating cost tables to correct for road geometry. The only correction for this aspect was to code an increase of 5 percent over the planned length for the new East Bank Highway under construction between Beni Suef and Minia, to allow for the grades in that section.

Road Surface - Road surface conditions have a very significant effect on vehicle operating costs. The HDM vehicle cost model, as calibrated for this Study, was used to investigate the impact of surface condition on the operating costs for each vehicle type. It was estimated that operating costs increase by betwee 8-11 percent for trucks, and 16-26 percent for passenger vehicles, going from excellent to fair road condition. This demonstrates the value of good road maintenance in reducing the transport costs of the Nation.

Congestion Costs - As traffic volumes build up on a road, the effects of congestion start to be felt. Drivers must make more frequent adjustments to speed to adjust for other vehicles, both in the same traffic stream and, on two-lane roads, for vehicles coming in the opposite direction. In extreme congestion, such as may be experienced in towns, vehicles may have to stop and wait for periods. This results in

additional, or "excess" costs and times which must be added to the free-flow cost estimates.

The tables of excess time chosen for this Study were taken from the Highway Investment Analysis Package (HIAP) issued by the US Department of Transportation (Reference 7). For excess operating costs associated with congestion, a more recent report was used, also issued by the US Department of Transportation (Reference 8), which contains the results of a major study updating vehicle operating costs.

Time Costs

The value of passenger time is normally held to vary with trip purpose. Values adopted by this Study were 75 percent of the wage rate for work or business related travel, and 30 percent of the wage rate for other travel. Based on occupancies and journey purpose mix observed in the surveys, the passenger time values set out in Table 5-9 below were adopted:

Table 5-9

PASSENGER TIME VALUES PER VEHICLE HOUR

VEHICLE	PERSONS PER VEHICLE (1)	AVERAGE WAGE	PERCENT APPLIC.	COST PER VEH/HOUR
Car work	2.54	LE 1.90	75%	LE 3.62
Car other	2.54	1.90	30	1.45
Taxi car	4.80	0.90	60	2.59
Taxi van	8.90	0.90	60	4.81
Bus	30.50	0.25	60	4.58

(1) Car work and Car other include the driver.

Cargo value of time was taken simply as the interest cost per hour. This Study assumed a 8760 hour year and a 12 percent interest rate to derive cargo time value per ton-hour. Values of 2, 7 and 6 piastras were estimated for single, combination and articulated trucks respectively,

Toll Costs

Tolls are charged on only one road in Egypt at present: the Alexandria Desert Road. The following toll costs apply to a trip over the entire length of approximately 200 kilometers:

Private car	LE 1	=	5	milliemes/km
Pickup	2		10	
Bus	2		10	
Truck single	3		15	
Truck comb/artic	5		25	

These are extremely low rates, representing about 5 percent of free-flow running costs. Higher rates were evaluated for the Cairo-Assuit Highway, as discussed in Chapter 7.

Chapter 6

HIGHWAY TRAFFIC FORECASTS

This Chapter presents the traffic forecasts for each of the two forecast years 1990 and 2000. The underlying assumptions in the forecasting process and an outline of the modelling approach are also described.

Approach to Traffic Forecasting

There were considered to be three main determinants of highway traffic growth; the overall growth of the national economy, the development of other modes of transport, and the degree of congestion on the road system.

Growth in the Economy - The growth of the economy was measured by the projected increase in Gross Domestic Product (GDP) for each traffic zone. Projections of GDP were discussed and presented in Chapter 5.

Other Modes - Other modes of transport were discussed in Chapter 2 where it was concluded that, with the single exception of petroleum product pipelines, there were no likely developments which were likely to have a significant affect on the growth in road traffic. This is contrary to Government policy, and probably to good economic planning, which would indicate a growing use of waterways and railways for long distance freight transport. Sensitivity tests were used to examine the effect of alternative assumptions.

Congestion - Increased congestion on the road system, by making the costs of transport higher, tends to slow the growth rate in traffic. Since the level of congestion depends, amongst other things, on the transport system in place, congestion effects had to be measured separately for each transport network. This was the main function of the computer Traffic Model.

The approach of the Study, therefore, was to make initial forecasts of zone to zone road transport movements for each forecast year 1990 and 2000, based on the projected growth in the national economy, and adjusted to developments in other modes. These initial forecasts were then input to the Traffic Model which determined, separately for each network evaluated, the effects of congestion on growth in road traffic, and on the distribution of traffic between the available routes.

Vehicle Growth Rates

Although growth in the economy controls overall growth in traffic, individual vehicle types can be expected to grow at significantly different rates. For example, as national wealth increases a higher proportion of the population can be expected to choose more comfortable, although more expensive, modes of transport, leading to a switch from buses to taxis or private cars. Therefore, an important step in preparing the initial forecasts of traffic was to determine the growth rate for each vehicle type relative to the growth in the economy. With assumed GDP

annual growth rates of 4 percent and 6 percent for the years 1985-1990 and 1990-2000 respectively, the annual growth rates set out in Table 6-1 were selected:

Table 6-1

TRAFFIC ANNUAL GROWTH RATES TO 1990 AND 2000

VEHICLE TYPE	1985-1990	1990-2000
Private car	6.5 percent	8.0 percent
Taxi-car	2.5	3.5
Taxi-van	6.4	8.2
Pickup	5.0	6.5
Bus	4.0	6.0
Truck	4.0	6.0

These were the starting point for forecasting traffic growth in the corridor. The initial forecasts of traffic varied by traffic zone according to the particular growth in GDP of the zone, and all initial forecasts were modified in the computer Traffic Model according to the degree of congestion detected on the road system.

Forecasting Methodology

This section presents a brief outline of the methodology followed in forecasting traffic. A detailed description of the Traffic Model is presented in Appendix 6B.

The traffic forecasting procedure involved three separate main stages, as follows:

1. Preparation of initial forecasts of traffic based on expected national and zonal economic growth, and the likely growth in vehicles relative to economic growth. This stage was undertaken once only for each forecast year for the main tests, but alternative estimates were prepared for the sensitivity tests.

2. Assessment of the degree of congestion on the road system resulting from the initial traffic forecasts, and the likely impact that this would have on transport costs.

3. Adjustment of the initial forecasts to take account of the changes in traffic congestion and transport costs. If congestion increased, the initial traffic forecasts were reduced, and vice versa.

Stages 2 and 3 were undertaken separately for each network examined. The two stages were linked together in the Traffic Model with the results of stage 3 automatically providing a new starting point for stage 2. Thus a cycle of iterative calculations were made until the modified traffic forecasts produced in stage 3 were in balance with traffic congestion detected in stage 2. With the completion of cost files required for the evaluation phase, the Traffic Model could take as long as 12 hours to run for a single transport network.

Model Stage 1 - Initial Traffic Forecasts

The starting point for estimating initial traffic forecasts was a set of tables (matrices) of zone-to-zone travel movements by each vehicle type in Base Year (1985/86).

Before forecasting future traffic, adjustments were made to the vehicle movement matrices to reflect two future changes expected in the Cairo-Assuit Corridor. First, all long distance supply movements by road petroleum tankers were removed -- these movements were expected to be replaced by the new Cairo-Assuit petroleum product pipeline now under construction. Secondly, all long distance supplies of cement by road to the Corridor from Greater Cairo and Lower Egypt were replaced by similar supplies from Assuit. This reflected the expected opening of the new cement plant in Assuit.

Production of the initial forecast matrices - one for each of the nine vehicle types for each of the two forecast years 1990 and 2000 - were made using the Fratar process. This technique "grows" the traffic from each traffic zone according to the overall growth rate selected for each vehicle type, modified by the relative increase in economic activity of the zone as measured by growth in zonal Gross Domestic Product (GDP).

Growth in local traffic on the main roads in the Corridor was set at a lower than average rate on the basis that as congestion grew, and as the local roads improved, more of the local traffic would move off the main highway and would not contribute to congestion there.

Model Stage 2 - Analysis of Congestion and Impact Costs

For each network tested, the Traffic Model was used to assess the degree of congestion on each road link in the network, and then to estimate transport costs on the link under these congested conditions.

It was necessary to recognize that traffic volumes vary throughout the day and so does the level of congestion. Therefore, calculations were performed separately for each of six segments of the day, covering operating conditions ranging from very light traffic, as could be expected in the hours after midnight, to the heaviest traffic volumes which could be expected in the peak period of the day. The final link costs with congestion taken into account were estimated by taking an average of costs in each of the six periods of the day, weighted by the number of vehicles in each of the time periods.

Some modifications were made to costs, principally to reflect expected road surface conditions. It was assumed that all roads in the Committed Network were in "fair" condition and that all roads in other networks would benefit from a more intensive road repair and overlay program and would be in "good" condition. It was assumed that the new Cairo-Assuit Highway would be built and maintained to high standards and would be in "very good" condition.

Model Stage 3 - Modified Traffic Forecasts

At the conclusion of the Stage 2 Model, an analysis was made of the cost of travel in the Corridor, and a comparison was made with Base Year costs to determine whether costs had fallen or risen. This was done separately for each vehicle type. A rise in costs could be due to increased congestion, and a fall in costs could be due to an improved pavement surface or to reduced congestion, perhaps due to the inclusion of a new route which was not present in Base Year for that movement.

On the basis of the change in costs detected, new traffic was generated if costs had decreased, or traffic was reduced traffic if costs had risen. This was done on the basis of a selected elasticity of demand for each vehicle type, which measures how much demand for transport changes in response to changes in transport costs.

Model Iteration

After the Traffic Model had completed stages 2 and 3 for the first time, the modified matrices from Stage 3 were processed again by both the Stage 2 and Stage 3 models. On the second pass through, zone to zone transport costs were compared the costs after the previous cycle through the model in order to modify the matrices once more. In every case, this second modification was of much lower magnitude and in the opposite direction to the first - that is to say, if costs had previously risen leading to de-generation of trips, costs now declined (relative to the previous cycle) leading to the generation of trips. At this point, the model was said to have converged. All that remained was to prepare a set of link costs based on the final movement patterns ready for the evaluation stage of the Study.

Initial Traffic Forecasts

The initial forecasts, before congestion effects were analyzed by the Traffic Model, showed a growth in the number of movements in the Corridor, combined with a slight increase in journey length. The increase in journey length was brought about by forecast stronger economic growth outside the Corridor increasing the forecast proportion of longer distance movements to and from the Corridor. The overall result was that vehicle kilometers were forecast to increase by 1.25 times to 1990 and by 2.4 times to the year 2000, compared with Base Year. This represented an average annual growth rate of nearly 5 percent to 1990 and 6.5 percent from 1990 to 2000.

Growth rates were quite different by vehicle type, with the strongest growth shown in taxi vans. This was consistent with the assumption that taxi vans were expected to take an increasing proportion of total taxi traffic, leading to a decline in the use of taxi cars. Accordingly, taxi car growth was the lowest of all vehicles. Private car growth was also strong, and growth in pickups was above average.

These traffic growth rates were lower than had been experienced in the years immediately prior to the Study, and reflected the expected lower future growth rates in the National Economy. A case could certainly be made for traffic growth rates higher than reported here based on past traffic growth rates. However, a strong case could also be made for lower traffic growth, on the basis that the reduction in National economic growth could be much sharper in the late 1980s than assumed by this Study, and by assuming a greater role for waterway and railroad transport, both of which have opportunities for increasing their share of transport in the Corridor. Hence the traffic forecasts presented here represented a middle ground, suitable for project identification and evaluation. Sensitivity tests were made to assess the affect of different growth rate assumptions on Study recommendations.

Investments Packages

The alternative highway investments considered by this Study were assembled into coherent packages and coded for computer analysis. Each package was referred to as a "coded network" since the major task of defining the package consisted of specifying the characteristics of each link of the road network, both within and connecting with the Cairo-Assuit Corridor.

Five basic coded networks were prepared for the Study, as follows:

Base Year Network
Committed Network
Overlay Network
Expressway Network
Improved Network

The Base Year Network described the existing road conditions and was used to establish reference travel times and costs for comparison with estimated future conditions.

The Committed Network represented the likely future road system with the addition of only those current projects which were actually in construction or definitely funded. It also assumed the current maintenance practice for road surface improvement, which allows roads to deteriorate to a poor quality of surface before rehabilitation.

The Overlay Network consisted of the Committed Network, but with a program of more frequent road surface overlays. Thus the configuration of the network in terms of links and nodes was identical to the Committed Network, but a better quality of road surface was assumed. Estimates of the additional costs of more frequent overlaying were made for the

evaluation phase. This network was the principal reference network against which the performance of the other networks containing new highway investments could be compared.

The Improved Network consisted of the Overlay Network (Committed Network plus improved overlay policy) together with improvements to the alignment of the existing West Bank Highway. In fact, two distinct networks were prepared assuming a staging of improvements. In the first stage for 1990, 2-lane bypasses were assumed for all towns along the West Bank Highway which currently did not have one. In the second stage, the entire West Bank Highway, including the new bypasses, was assumed to be widened to 4-lane standard.

The Expressway Network consisted of the Overlay Network with the addition of the new Cairo-Assuit Highway for which preliminary designs were being prepared by this Study. The term 'Expressway' referred to the possible final layout of the Highway with divided carriageways, and grade separated intersections. The evaluation stage decided by what year such a configuration could be justified, and use of the term Expressway to describe the network containing the new highway should not be taken as a pre-judgement on the initial construction recommendations.

Each network as prepared for computer analysis is described in more detail in Appendix 6A. The infrastructure projects included in the Networks are described in Appendices 3D and 4D.

Test Network Traffic Forecasts

The traffic forecasts are presented in Table 6-2, summarizing total number of journeys per day, average journey length, total vehicle-kilometers and growth in vehicle kilometers, by all vehicle types and for both forecast years. The 1985/86 Base Year situation is included in Table 6-2, as are the initial forecasts for each year which represent the traffic forecasts prior to taking account of congestion on the road system. Results for all four test networks represent final network conditions fully reflecting the effects of traffic congestion.

The Committed Network showed a decline from initial forecast levels, confirming that increased congestion would slow traffic growth as a whole in the absence of further new projects.

The other three networks -- Overlay, Improved and Expressway -- showed an increase in vehicle kilometers compared with the Initial Forecast for 1990, indicating that the road investments included in the networks would reduce transport costs, thus increasing traffic overall.

By the year 2000, only the Expressway Network showed an increase in vehicle-kilometers compared with the Initial Forecast, indicating that only this network provided sufficient new capacity to off-set the congestion effects of traffic growth. However, this increase in vehicle kilometers combined with a decrease in the number of journeys (compared with the initial forecast), clearly showed the role of the Expressway in

Table 6-2

TRAFFIC FORECASTS: 1990 AND 2000
(24 hour AADT)

VEHICLE	BASE YEAR	1990 INITIAL	1990 MAIN TESTS (1) Com	Over	Impr	Expr	2000 INITIAL	2000 MAIN TESTS (1) Com	Over	Impr	Expr
Total Movements in Corridor (thousands)											
1. Car work	7.1	9.7	9.5	9.8	9.8	9.9	20.6	16.6	16.8	18.9	18.0
2. Car other	5.4	7.4	7.2	7.6	7.5	7.7	15.6	12.5	12.8	14.4	13.8
3. Taxi car	15.1	17.1	17.0	17.5	17.5	17.6	24.2	22.9	23.6	23.8	23.9
4. Taxi van	15.0	20.3	20.1	20.8	20.6	20.8	44.4	41.8	43.1	43.3	43.3
5. Pickup	18.7	23.6	23.5	23.8	23.7	23.9	43.7	42.3	43.0	43.3	43.2
6. Bus	4.0	4.8	4.7	4.9	4.8	4.9	8.6	8.1	8.2	8.4	8.3
7. Truck single	10.5	12.5	12.5	12.6	12.5	12.6	21.9	21.5	21.6	21.8	21.7
8. Truck comb	1.7	2.0	2.0	2.0	2.0	2.1	3.6	3.5	3.5	3.6	3.6
9. Truck artic	0.7	0.9	0.9	0.9	0.9	0.9	1.5	1.5	1.5	1.5	1.5
ALL VEHICLES	78.3	98.3	97.4	99.8	99.4	100.4	184.0	170.7	174.3	179.0	177.4
FACTOR	1.00	1.26	1.24	1.27	1.27	1.28	2.35	2.18	2.23	2.29	2.27
Average Journey Length (Kilometers)											
1. Car work	49	50	52	52	52	57	52	55	55	50	63
2. Car other	57	59	59	59	60	62	62	65	[illegible]	61	71
3. Taxi car	67	70	69	69	70	74	76	76	76	76	81
4. Taxi van	30	31	31	31	31	33	33	33	33	34	35
5. Pickup	70	71	70	70	72	75	74	74	74	74	78
6. Bus	65	67	68	68	69	73	71	74	74	72	79
7. Truck single	73	75	75	75	76	80	76	77	77	74	82
8. Truck comb	204	203	213	214	216	221	206	220	219	209	227
9. Truck artic	215	217	226	225	225	234	218	228	230	219	238
ALL VEHICLES	63.3	63.9	64.1	64.0	64.9	68.2	64.7	66.5	66.3	64.8	70.7
FACTOR	1.00	1.01	1.01	1.01	1.03	1.08	1.02	1.05	1.05	1.02	1.12
Total Vehicle-kilometers (thousands)											
1. Car work	349	484	495	507	507	563	1,071	915	925	945	1,141
2. Car other	310	436	426	446	451	480	967	814	835	878	980
3. Taxi car	1,014	1,197	1,172	1,210	1,222	1,297	1,839	1,739	1,797	1,809	1,942
4. Taxi van	451	630	624	644	640	684	1,465	1,379	1,421	1,472	1,510
5. Pickup	1,310	1,675	1,642	1,669	1,709	1,787	3,231	3,131	3,184	3,204	3,364
6. Bus	258	322	322	330	333	357	608	597	610	605	658
7. Truck single	765	939	937	942	953	1,014	1,664	1,656	1,663	1,613	1,772
8. Truck comb	348	413	434	438	443	459	737	774	776	752	817
9. Truck artic	154	187	196	196	196	206	330	339	346	329	360
ALL VEHICLES	4,959	6,282	6,247	6,383	6,453	6,848	11,912	11,344	11,556	11,608	12,545
FACTOR	1.00	1.27	1.26	1.29	1.30	1.38	2.40	2.29	2.33	2.34	2.53

Source: Study estimates

(1) Key to the Test Networks:
Com = Committed, Over = Overlay,
Impr = Improved, Expr = Expressway

promoting long distance journeys without providing significant help to the short distance movements.

The Improved Network showed a slight decline in both vehicle-kilometers and the total number of journeys compared with the Initial Forecasts. This indicates that additional capacity had been added to almost offset congestion by traffic growth, and with a more even spread of benefits to all movements in the Corridor.

Forecast Highway Traffic Volumes

Forecast traffic volumes are discussed below for each test network.

Committed Network - Forecast volumes on the Committed Network are shown in Figure 6-1. The Committed Network volumes reflected the general increase in trip making to the two forecast years, with traffic volumes more than doubling by the year 2000. The main difference from Base Year, apart from the increase in traffic, was the use made of the East Bank Highway.

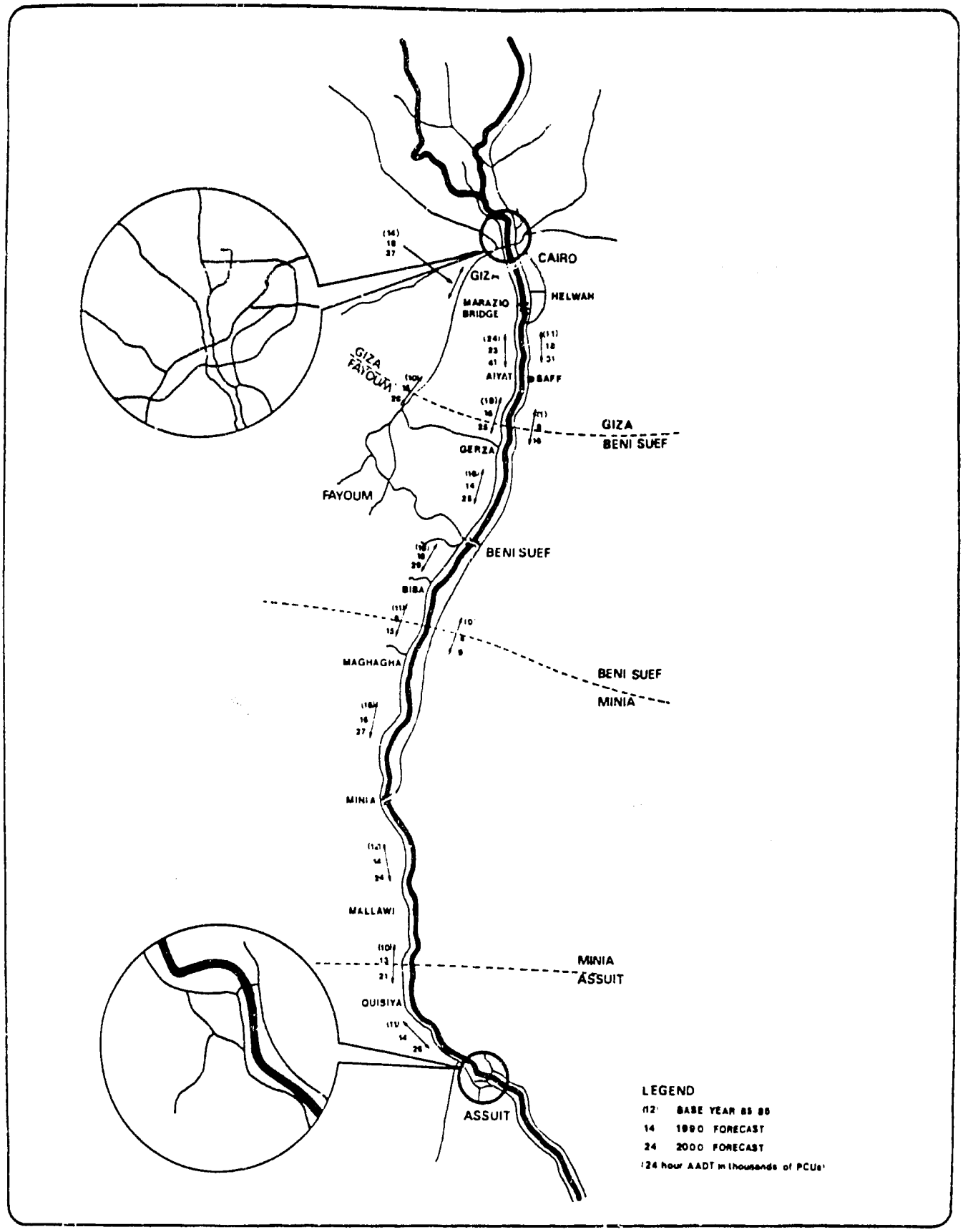
The Committed Network showed 1990 traffic volumes on the West Bank Highway between Cairo and Minia lower than Base Year due to diversion to the East Bank Highway. By 2000, however, volumes on the West Bank Highway were forecast to be significantly higher on all sections, and volumes on the East Bank Highway were expected to be at, or above, the Base Year West Bank Highway volumes.

Overlay Network - Overlay Network forecast traffic volumes were very similar to those for the Committed Network and are not shown here. See Appendix 6C for details.

Improved Network - Forecast volumes on the Improved Network are shown in Figure 6-2. It is apparent from the traffic volumes that the addition of bypasses in 1990 made little difference to the forecast traffic flows compared with the Committed Network.

The year 2000 forecasts showed the Improved Network was substantially better in traffic impact through the widening of the entire route between Aiyat (46kms south of Cairo) to Assuit, including the 1990 bypasses. Not surprisingly, traffic volumes on the existing West Bank Highway under this alternative were the highest of all the network alternatives, ranging between 5 and 15 percent above the volumes recorded on the other networks.

Expressway Network - Forecast volumes on the Expressway Network are shown in Figure 6-3. Volumes on the new Cairo-Assuit Highway for 2000 ranged from about 22,000 PCUs per day between Giza and Beni Suef to about 8,000 PCUs per day near Assuit. Volumes in 1990 were at about half this level. The average PCU factor was about 2 (2.1 on the new highway and 1.9 on the existing highway) so the PCU volumes can be divided by two to arrive at an approximate daily vehicle count.



Cairo – Assuit Highway Feasibility Study

FORECAST TRAFFIC
COMMITTED NETWORK

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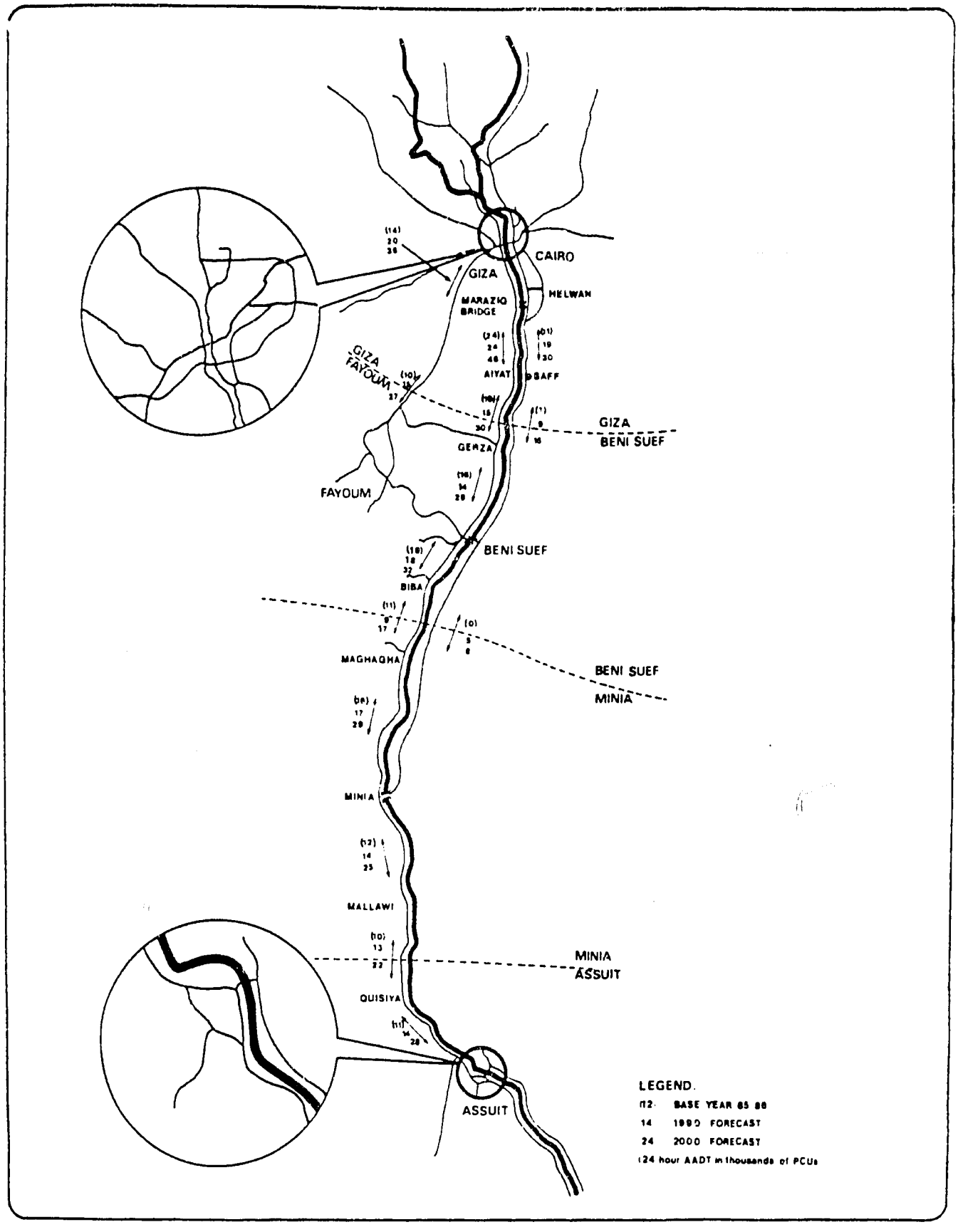
Figure 6-1



Cairo – Assuit Highway Feasibility Study

FORECAST TRAFFIC
IMPROVED NETWORK

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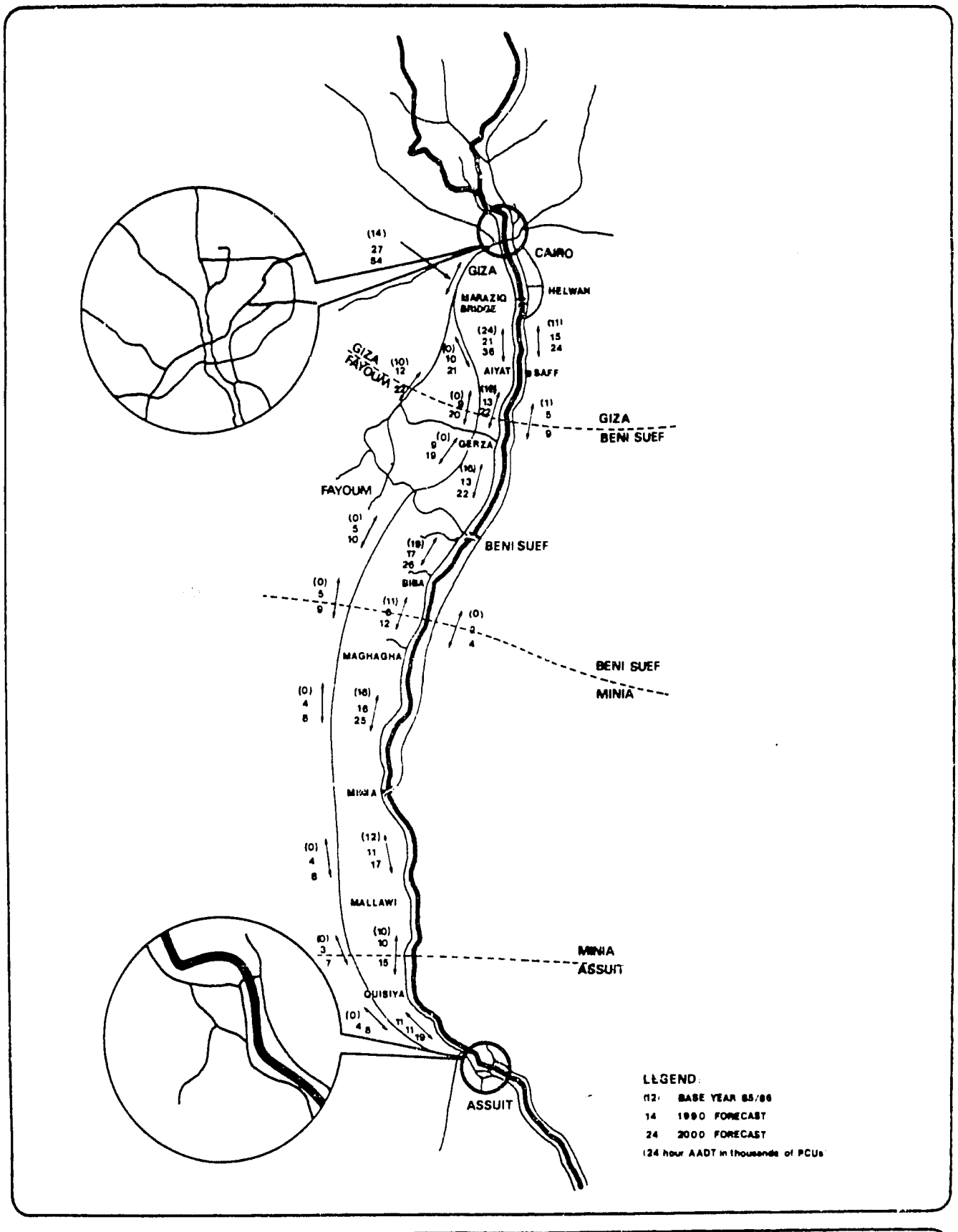
Figure 6-2



Cairo – Assuit Highway Feasibility Study

FORECAST TRAFFIC
EXPRESSWAY NETWORK

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Figure 6-3

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Traffic volumes on the existing West Bank Highway were reduced by the new road, but not greatly. This was because much of the long distance traffic on the sections from Cairo to Minia had already been taken by the new East Bank Highway. South of Minia, where there was no East Bank Highway, the new road relieved the existing road of about 6-7,000 PCUs per day, with some additional traffic on the new road due to traffic generation.

Volumes on the new Cairo-Assuit Highway reported here were not particularly high for an expressway, and south of Beni Suef they did not support 4-lane construction in the early stages of the project. The low traffic volumes are explained by the fact that most journeys in the Corridor are short distance, with the average being about 70 kms. Therefore, a high proportion of Corridor movements would not be attracted to the new highway, since the extra journey length of perhaps 30 kms along the access roads to and from the new highway, would offset the advantages such a route would give. It was concluded that only a small proportion of the Corridor traffic was likely to be attracted to a new West Bank Desert Highway, consisting of the following main movements (as a percentage of all forecast 2000 traffic in the Corridor):

Through traffic	1.9 percent
External traffic between Cairo and points in the Corridor south of Fayoum	9.0
Inter-governorate traffic in the Corridor	7.5
	18.4 percent

A further 9.0 percent, representing external movements between Fayoum and the North, were candidates, but only for the northern section of the new highway. Some of this traffic would be shared with the other roads in this part of the Corridor, in particular, the East Bank Highway and the Fayoum Desert Road (for the North-Fayoum movements), either because they represent more efficient routes for certain movements, or because the costs by new highway and the alternatives would be so similar that the traffic would divide between the two. Lastly, some traffic would always stick to the existing road, no matter how attractive the new highway, either because of dislike of expressway travel, or because of a need or desire to stop frequently in towns and villages. Locations of favorite stopping places for truck drivers are mainly on the existing road, and such popular venues are an impediment for traffic to transfer to the more efficient route. The diversion procedure used in Traffic Modelling reflected all this.

Overall, then, it was considered that the traffic assignments to the new Cairo-Assuit Highway were reasonable having regard to the nature of movements in the Corridor, and to the likely behavior of drivers when faced with alternative routes.

Congestion

As traffic builds up on the road system, so congestion increases. It is useful to compare travel times on the different networks in order to appreciate the relative effects of congestion.

Table 6-3 shows the time in hours to travel from the center of Cairo to the center of Assuit for selected vehicles on each of the different networks presented here.

Table 6-3

TRAVEL TIMES CAIRO TO ASSUIT
(hours, city center to city center)

NETWORK	YEAR	PRIVATE CAR	PICKUP	BUS	LARGE TRUCK
Base Year	1986	7.0	7.0	7.8	8.1
Committed	1990	6.4	6.4	7.1	7.3
Overlay	1990	6.2	6.3	7.0	7.2
Improved	1990	6.1	6.2	6.9	7.0
Expressway	1990	4.8	5.3	5.6	5.5
Committed	2000	9.6	9.6	10.5	11.0
Overlay	2000	9.5	9.5	10.5	10.9
Improved	2000	5.9	5.9	6.6	6.9
Expressway	2000	5.9	5.7	6.5	6.3

The 1990 networks showed reduced travel times compared with Base Year reflecting the degree of investment included in each network. All networks contained the committed East Bank Highway from Helwan to Minia. The largest time reductions come with the Expressway Network which cut over 1.5 hour from the total travel time on the Committed Network, and nearly 2.5 hours from travel times in the Base Year.

The results for the Year 2000 are more dramatic. The Committed Network, with a doubling of traffic from 1990 but with no new infrastructure, showed an increase in travel times compared with Base Year of between 2.5 and 3 hours. Thus a journey by car from the center of Cairo to the center of Assuit which takes 7 hours today, could take over 9 hours by the Year 2000 if no more road improvements are made other than those already committed.

Both the Improved and the Expressway Networks made a substantial impact on these times, both cutting the Committed Network times by a third.

Figures 6-4 to 6-6 show the congested road links on the Committed, Improved and Expressway Networks respectively under conditions of 2000 traffic forecasts. Traffic volumes above practical capacity (about 70 to 80 percent of possible capacity) indicate poor driving conditions with slow traffic during substantial periods of the day. Volumes above possible capacity indicate very difficult driving conditions for most of the day with reasonable conditions only during the evening and at night.

In the Committed Network, most sections of the existing West Bank Highway, together with the Fayoum Desert Road into Sinnuris and the East Bank Highway from Helwan to Saff, were above practical capacity and several sections, mostly in towns along the route, were above possible capacity.

The Improved Network showed almost complete relief to the West Bank Highway, and took some traffic off the East Bank Highway giving relief to the Helwan-Saff section.

The Expressway Network showed significant relief to the existing West Bank Highway compared to the Committed Network, but still left a high proportion of the route over practical capacity.

Sensitivity and Staging Tests

After the main tests were completed, a series of sensitivity and staging tests were undertaken. They were all completed with versions of the Expressway Network. The main objective of these tests was to explore the effect of different economic growth rates, and different construction staging possibilities, on the economic evaluation results. The results of the tests are presented in Appendix 6C and are discussed further in Chapter 7.

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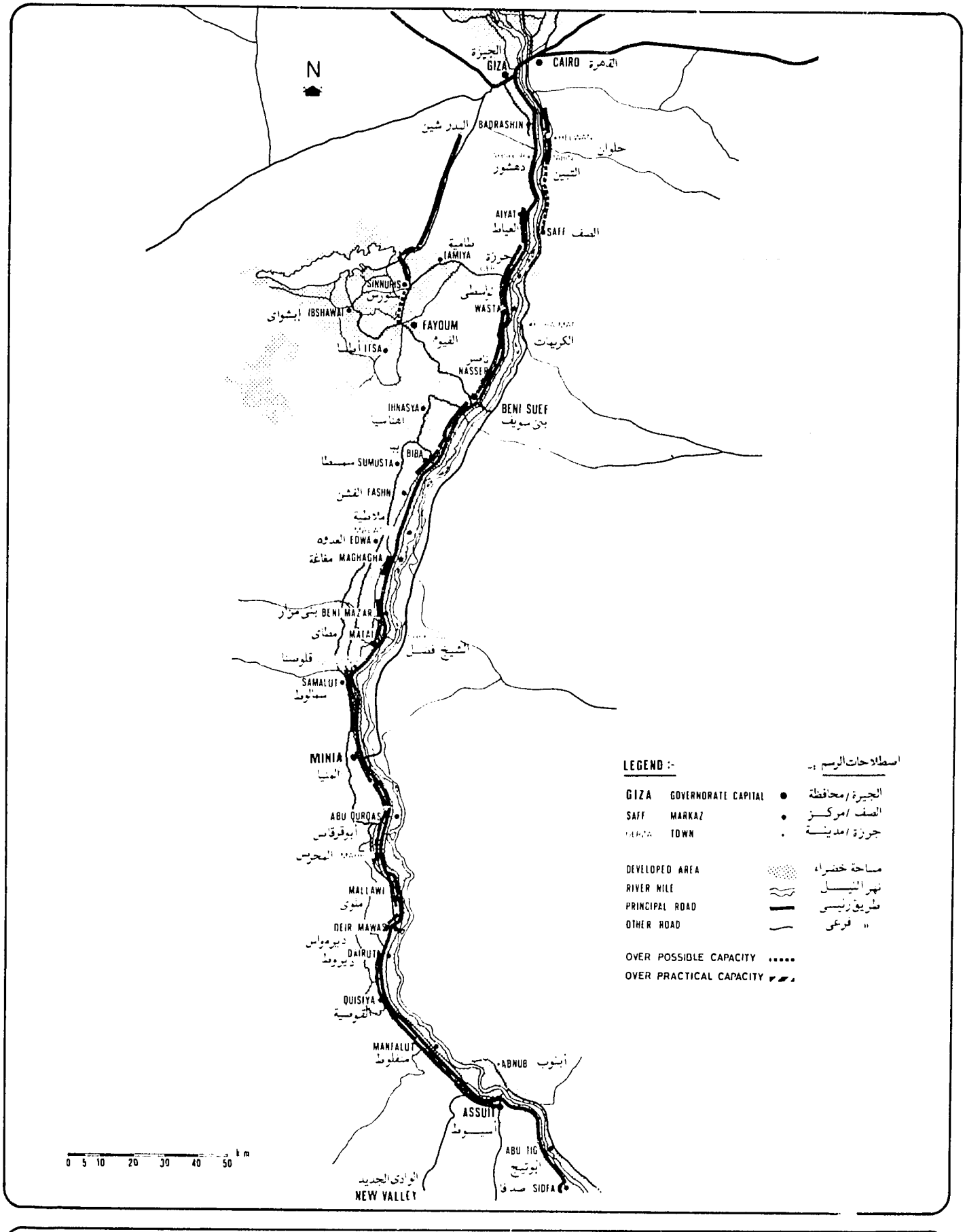

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CONGESTION ON THE 2000 COMMITTED NETWORK

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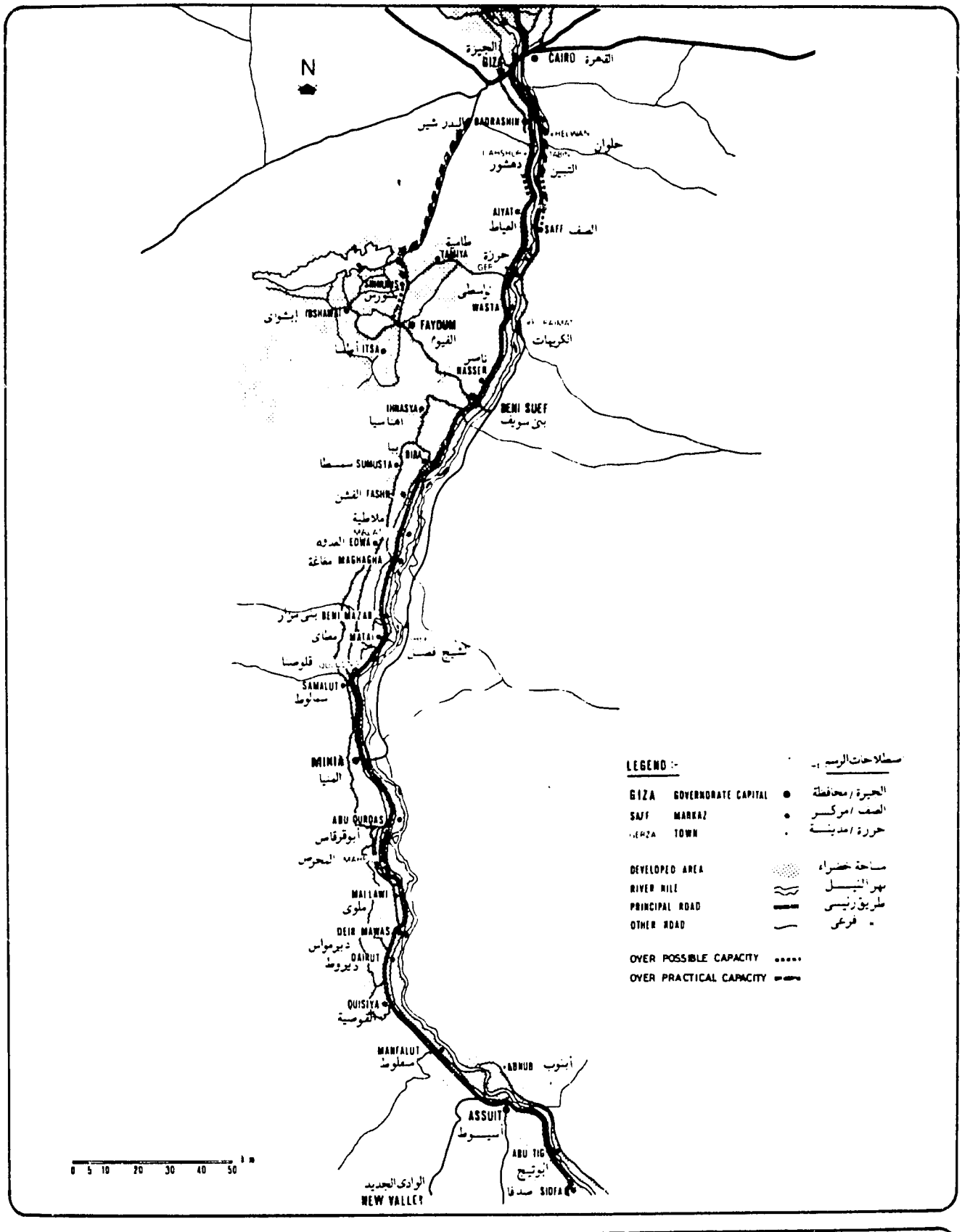
FIGURE 6-4



Cairo – Assuit Highway Feasibility Study

CONGESTION ON THE 2000 IMPROVED NETWORK

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Figure 6-5

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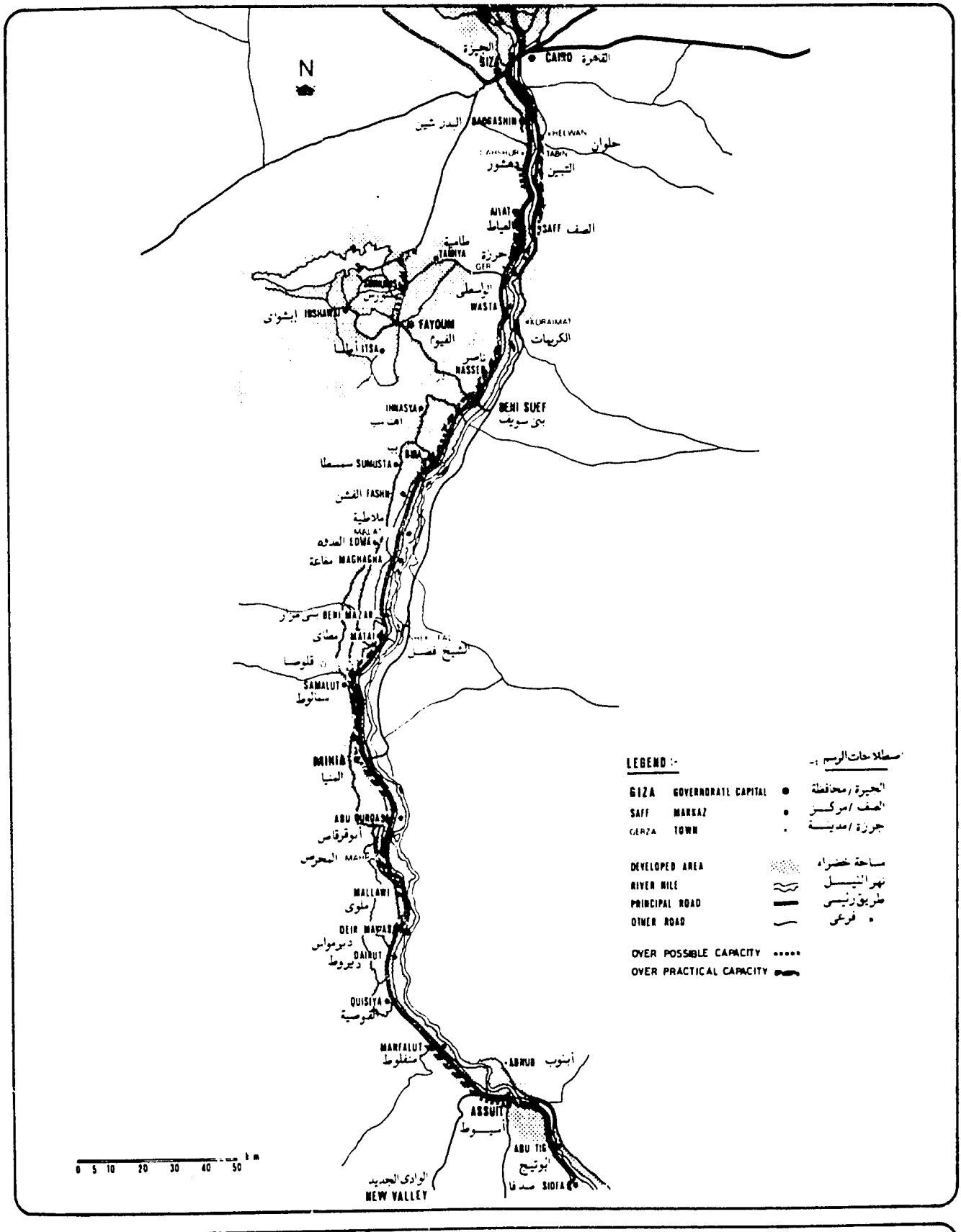

Cairo – Assuit Highway Feasibility Study

CONGESTION ON THE 2000 EXPRESSWAY NETWORK

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Figure 6-6

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Chapter 7

ECONOMIC EVALUATION

The task of the economic evaluation was to assess the economic value to the Nation of each investment considered by the Study. This was done by comparing the costs of construction and maintenance for each investment with the economic benefits expected to be brought about by the investment.

The two main types of investment considered were i) building a completely new road between Cairo and Assuit in the desert just outside the existing agricultural lands on the west bank of the Nile, and ii) improving the existing West Bank Highway by building bypasses and widening. A third case was also examined; namely, an improved program of highway pavement overlaying. These three sets of investments were defined in the Expressway, Improved and Overlay Networks as described in Chapter 6. In addition, various intermediate networks were evaluated for staging and sensitivity assessments.

Project Costs

Costs of construction, maintenance and overlaying are summarized in this section. In all cases, economic costs are given, which are on average between one quarter and one third higher than financial costs. The costs for the Expressway and Improved Networks are additional costs to those estimated to implement the Committed/Overlay Network.

Committed/Overlay Network Costs - The economic evaluation was concerned with possible investments in the Cairo-Assuit Corridor additional to those already committed. The costs of implementing the Committed Network, which contains all such projects identified in the corridor, had no affect on the evaluation results and therefore these costs are not discussed here.

The point of reference (or base case) for the evaluations of each test network was not the Committed Network but rather the Overlay Network. This had the same configuration as the Committed Network but assumed an improved pavement overlay policy in the Corridor. As with the Committed Network, the costs of implementing the Overlay Network, which in this case were negative, did not affect the evaluation and are not discussed further here. See Chapter 3 for a discussion.

Expressway Network Costs - Expressway Network costs are summarized in Table 7-1. The main costs are those associated with the construction of the new Cairo-Assuit Highway. Construction costs of the main highway were estimated to rather more than double from LE 118.2 million to LE 240.0 million with 4-lane construction, which additionally assumed grade-separated interchanges at the intersections with the Fayoum Desert Road and the Beni Suef-Fayoum Road. Costs of the access roads increased from LE 36.9 to LE 84.7 million, due entirely to the addition of grade-separated interchanges at all access points to the new road.

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Table 7-1

EXPRESSWAY NETWORK COSTS
(Economic costs, LE millions, 1985/1986)

ITEM	2-LANE	4-LANE
New Cairo-Assuit Highway construction:		
Main highway (1)	118.2	240.0
Access roads (1)	36.9	84.7
Additional cost for Cairo Ring Road grade-separated I/C (2)	4.9	4.9
5cm overlay (3)	33.7	49.8
Additional annual maintenance	0.36	0.57
Additional annual pavement overlay costs elsewhere in network (4)		
1990	-0.46	-0.46
2000	-0.79	-0.79

(1) Assumes at-grade interchanges for 2-lane construction and grade-separated interchanges for 4-lane.
(2) Cost of additional slip road at intersection of Fayoum Desert Road with Cairo Ring Road when this is grade-separated (assumed necessary by the year 2000).
(3) Assumes one tack coat, surfacing to cover pavement and shoulder, and a seal coat (new highway plus access roads).
(4) In fact a reduction in costs of overlaying due to heavy traffic being diverted to the new highway.

Improved Network Costs - The costs of the Improved Network are shown in Table 7-2. The principal costs are associated with the construction of 2-lane bypasses round 14 towns in the corridor by 1990 (LE 31.6 million), and widening of the both the existing West Bank Highway (LE 97.7 million) and the bypasses (LE 29.3 million) to 4-lane standard by 2000. The widening costs for the bypasses assumed a 25 percent addition to the cost difference between 2-lane and 4-lane construction.

Project Benefits

The three types of benefit considered in the economic evaluation were the savings in vehicle operating costs, passenger time, and traffic accidents. Development benefits, that is to say, the benefits from opening up regions for new growth, were included in the economic evaluation, not explicitly in terms of locations of new factories and cities, but implicitly in the valuation of generated traffic benefits. Other benefits for which quantification in economic terms is more controversial, in particular environmental and social benefits, were considered in a qualitative manner and are discussed in Chapter 8.

Of the three types of benefit considered, both vehicle operating cost savings and passenger time savings were calculated by computer, using results generated by the Traffic Model described in Appendix 6B. Indeed, the Traffic Model was designed expressly so that the computation of these benefits could be an automatic operation following forecasts of traffic for the two networks being compared. These two sets of benefits were generally referred to as the "model" benefits. Benefits from savings in traffic accidents were estimated manually based on traffic forecasts.

Summary of Model Benefits

Benefits estimated using the Traffic Model are presented in detail in Appendix 7A. It was concluded that the two major types of projects considered by the Study -- a new Cairo-Assuit Highway and improvements to the existing highway -- both showed strong benefits by the year 2000 and were both serious candidates for consideration.

The tests on the Expressway Network indicated that a full length highway from Giza to Assuit had significantly more benefits than partial highways covering only part of the corridor. Only the partial alternative from Beni Suef to Assuit showed reasonable level of benefits. In particular, short lengths of Expressway starting either from Giza or Assuit had negative benefits. Finally, results showed that the reduction in benefits for a 2-lane highway compared with a 4-lane highway were not great.

Cost Benefit Evaluation

The cost/benefit evaluation brought together all the estimates of costs and benefits for each year and arrayed them in a time series, interpolating and extrapolating cost and benefit values where necessary.

Table 7A-2

IMPROVED NETWORK COSTS
(LE millions, 1985/1986)

ITEM	COST
2-lane bypass construction	31.6
Widening bypasses to 4-lane (1)	29.3
Widening remainder of existing West Bank Highway to 4-lane	97.7
5cm Overlay (2):	
2-lane bypasses	4.9
4-lane bypasses	7.9
Additional carriageway added during widening	11.8
Additional annual maintenance:	
Bypasses	0.01
Widening (including bypasses)	0.16
Additional annual pavement overlay costs elsewhere in network:	
1990	-0.29
2000 (3)	-0.49

(1) Assumes 25 percent added to cost difference between 2-lane and 4-lane construction.
(2) Assumes one tack coat, surfacing to cover pavement and shoulder, and a seal coat.
(3) In fact a reduction in costs of overlaying due to heavy traffic being concentrated on the existing highway which by 2000 would have the strongest pavement in the corridor.

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Cost and benefit values were then discounted to a common year, 1986, using the Study selected discount rate of 12 percent, and a set of economic indicators were calculated to show project feasibility.

Economic Indicators - The following indicators were calculated:

Internal Rate of Return (IRR)	- an IRR above the discount rate of 12 percent indicates project feasibility.
Net Present Value (NPV)	- a positive NPV indicates project feasibility.
Benefit/Cost Ratio (B/C Ratio)	- a B/C ratio greater than 1.0 indicates project feasibility.

A fourth economic indicator was also considered, that of First Year Rate of Return (FYRR). This is the ratio of benefits in the opening year to the single year cost of construction of the project, and should equal or exceed the Study discount rate for full economic feasibility. Single year cost of construction is the year-by-year costs of construction brought forward to the year of project opening by applying the Study discount rate of 12 percent. In fact, FYRR was not calculated, but instead the level of annual benefits required to achieve the minimum FYRR was estimated. This gave a good guide to the optimum year of project opening.

Evaluations Completed - An inspection of the model and accident benefits led to some network alternatives being discarded. The remaining evaluations were completed:

1. New Cairo-Assuit Highway (4-lane) - Base assumptions
2. - Low sensitiviy
3. - High sensitivity
4. New Cairo-Assuit Highway (2-lane) - Base assumptions
5. - Low sensitiviy
6. - High sensitivity
7. New Cairo-Assuit Highway (2-lane) Beni Suef to Minia only - Base assumptions
8. Improvement of the Existing Cairo Assuit Highway (Bypasses by 1990, widening by 2000)

All of these evaluations assumed the Overlay Network as the base case and therefore indicate project feasibilility after completion of all currently committed projects, and after the implementation of an improved pavement overlaying policy.

One further evaluation was then undertaken (9) comparing a new 4-lane Cairo-Assuit Highway with a 2-lane highway base case in the high sensitivity case.

The high sensitivity evaluations assumed the model benefits associated with higher growth rates in the Corridor; in other words, a more favorabl

assumption for the project. The low sensitivity evaluation assumed benefits estimated for lower growth, and also that construction costs would be 20 percent higher.

Project Life - The evaluations had to consider a reasonable lifetime for the projects evaluated, and 25 years was selected for this Study. An earliest year of opening for a new highway project was established as 1990, which was the first traffic forecast year of the Study. Therefore, a project lifetime from 1990 to 2014 was assumed. Since construction costs are incurred in the years prior to opening, the complete analysis period considered by the Study ran from 1987 to 2014, a period of 28 years.

It was necessary to estimate costs and benefits for each year of this analysis period to build up a complete record over the project life. Project costs could be estimated year by year with reasonable certainty. Project benefits, on the other hand, were estimated in detail for just two years, 1990 and 2000, the years for which traffic forecasts were made. Benefits for other years were obtained by interpolation and extrapolation. In all cases, benefits for years after the second traffic forecast year of 2000, were estimated to grow at half the estimated growth rate between 1990 and 2000.

Evaluation Results - The results of the evaluations are summarized in Table 7-3. Since time benefits assumed large values in many networks by the year 2000, two main cases were evaluated, one assuming full time cost savings, and the second assuming that only one third of the time savings were applicable.

Of the two main Expressway Networks, the 4-lane highway succeeded in meeting the evaluation criteria in only one of the six cases presented -- high sensitivity and assuming the full value of passenger time savings. It also came close to feasibility for high sensitivity case with only one third of the time benefits. On the other hand, the 2-lane highway failed in only the two cases for low sensitivity, in this case coming close to feasibility with full time savings included.

The apparent case for the 4-lane highway under high sensitivity fails when considering evaluation 9. This showed that the additional investments required to build a 4-lane instead of 2-lane would not produce sufficient additional benefits to justify them. These results indicated quite firmly from the purely economic viewpoint that if a new Cairo-Assuit Highway is to be built, it should be initially to 2-lane standard and not 4-lane. These conclusions were supported by the traffic evaluation which indicated no need of a 4-lane highway in the first stage.

The single staging test for the new highway, evaluating a construction from Beni Suef to Assuit only, indicated feasibility only if full time savings were counted. However, it only just failed with one third of the time savings included. Since this was the best performing staged contruction alternative, it was concluded that none of the staging options which omitted a section of the route performed particularly satisfactorily. Clearly, the complete highway would produce more benefits than the sum of its parts. This is almost certainly because the each

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Table 7-3

SUMMARY OF THE ECONOMIC EVALUATION

NETWORK	FULL TIME SAVINGS IRR	FULL TIME SAVINGS NPV(1)	FULL TIME SAVINGS B/C	1/3RD TIME SAVINGS IRR	1/3RD TIME SAVINGS NPV(1)	1/3RD TIME SAVINGS B/C
Expressway vs Overlay						
1. 4-lane, base assumption	11.9%	-2.9	0.99	9.5%	-61.9	0.77
2. 4-lane, low sens	7.3%	-126.4	0.61	5.7%	-157.7	0.51
3. 4-lane, high sens	14.1%	+65.4	1.24	11.3%	-19.7	0.93
4. 2-lane, base assumptions	16.8%	+76.3	1.59	13.7%	+24.1	1.18
5. 2-lane, low sens	11.4%	-8.2	0.95	9.3%	-35.7	0.77
6. 2-lane, high sens	19.2%	+131.9	2.02	15.6%	+56.2	1.43
7. 2-lane, BS-Assuit only	12.5%	+5.4	1.05	11.6%	-3.9	0.96
8. Improved vs Overlay	21.9%	+140.7	2.83	18.5%	+81.7	2.06
9. New Cairo-Assuit Highway, 4-lane vs 2-lane, high sensitivity	6.4%	-66.9	0.51	5.3%	-76.1	0.45

(1) NPV valued in LE millions.

section of the route channels traffic on to the other sections, which would increase the number of vehicles gaining benefit and also increase the benefit for each individual vehicle.

The network with the best economic performance was the Improved Network. Even counting just one third of time benefits, the network achieved an IRR of 18.5% and NPV of LE 81.7 million and a B/C ratio of 2.06.

Detailed evaluation results for each network are presented in Appendix 7A. The results for the two main networks -- 2-lane Expressway and Improved Network -- are discussed below.

New 2-lane Highway - Table 7-4 presents the detailed economic evaluation for a new 2-lane highway from Cairo to Assuit. Construction was assumed to take place over a three year period from 1987 to 1989 (Government fiscal years indicating the period from mid-1987 to mid-1990), but with the access roads being completed in the year of main project opening. Since access roads were forecast to carry relatively light traffic and were based on existing roads, this was not an unreasonable assumption. It was assumed that any new construction needed to link access roads with the main highway would be completed in the initial three year period.

The pavement design assumed that an additional 5cm overlay would be required after 10 years, and this was programmed for 1999, with a further 5cm overlay in 2009. It was assumed that the interchange with the Cairo Ring Road would be grade-separated in the year 2000, and that this would require an additional slip road to carry the traffic to the new Cairo-Assuit Highway.

Additional highway maintenance of LE 0.36 million a year was assumed, but it was calculated that an increasing quantity of pavement overlaying in other parts of the corridor would be avoided by heavy vehicles diverting to the new highway.

Project benefits mainly came from savings in vehicle operating costs, but passenger time savings were significant as well. As noted earlier, these were reduced to one third of the calculated value in one of the sets of evaluation parameters presented to demonstrate that they were not essential at the full rate for economic feasibility.

Accident savings were negligible, if not negative. This was mainly because traffic would be diverted from the 4-lane Cairo-Aiyat section of the existing highway, where accident rates could be expected to be lower than on the new 2-lane highway presented here. Accident savings would be significant only for a new 4-lane highway.

The single year construction cost was estimated at LE 172.1 million for a 3-year construction period (as displayed in the table) or LE 182.9 for a 4-year construction period. Hence in order to achieve a FYRR equal to the Study discount rate of 12 percent, opening year benefits of LE 20.7 or 21.9 million respectively would be required. Inspection of the net

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Table 7-4

EVALUATION OF THE CAIRO-ASSUIT HIGHWAY (2-LANE)
BASE ASSUMPTIONS
(millions of LE, 1985/86)

YEAR	PROJECT COSTS: Construction	Addition Maint	Addition Overlays	Total Costs	PROJECT BENEFITS: Vehicle Op Cost Savings	Passenger Time Savings	Reduced Traffic Accidents	Total Savings	NET COST/BEN STREAM: Full Time Savings	One third time savings
1987	45.6			45.6				0.0	-45.6	-45.6
1988	45.6			45.6				0.0	-45.6	-45.6
1989	45.6			45.6				0.0	-45.6	-45.6
1990 (1)	18.5	0.36	-0.46	18.4	11.2	2.7	-0.10	13.8	-4.5	-6.3
1991		0.36	-0.49	-0.1	12.4	3.4	-0.08	15.7	15.8	13.5
1992		0.36	-0.51	-0.2	13.7	4.2	-0.06	17.8	17.9	15.2
1993		0.36	-0.54	-0.2	15.1	5.2	-0.05	20.3	20.4	17.0
1994		0.36	-0.57	-0.2	16.7	6.5	-0.04	23.1	23.4	19.0
1995		0.36	-0.60	-0.2	18.4	8.1	-0.03	26.5	26.7	21.3
1996		0.36	-0.64	-0.3	20.3	10.1	-0.03	30.4	30.7	24.0
1997		0.36	-0.67	-0.3	22.5	12.6	-0.02	35.0	35.3	27.0
1998		0.36	-0.71	-0.3	24.8	15.7	-0.02	40.5	40.8	30.4
1999 (2,3)	38.6	0.36	-0.75	38.2	27.4	19.5	-0.01	46.9	8.7	-4.3
2000		0.36	-0.79	-0.4	30.3	24.3	.0	54.6	55.0	38.8
2001		0.36	-0.81	-0.5	31.8	25.5	.0	57.3	57.8	40.8
2002		0.36	-0.83	-0.5	33.4	26.8	.0	60.2	60.7	42.8
2003		0.36	-0.86	-0.5	35.1	28.1	.0	63.2	63.7	44.9
2004		0.36	-0.88	-0.5	36.8	29.5	.0	66.4	66.9	47.2
2005		0.36	-0.91	-0.5	38.7	31.0	.0	69.7	70.2	49.5
2006		0.36	-0.93	-0.6	40.6	32.6	.0	73.2	73.7	52.0
2007		0.36	-0.96	-0.6	42.6	34.2	.0	76.8	77.4	54.6
2008		0.36	-0.98	-0.6	44.8	35.9	.0	80.7	81.3	57.4
2009 (3)	33.7	0.36	-1.01	33.0	47.0	37.7	.0	84.7	51.6	26.5
2010		0.36	-1.04	-0.7	49.4	39.6	.0	88.9	89.6	63.2
2011		0.36	-1.07	-0.7	51.8	41.6	.0	93.4	94.1	66.4
2012		0.36	-1.10	-0.7	54.4	43.6	.0	98.1	98.8	69.7
2013		0.36	-1.13	-0.8	57.1	45.8	.0	103.0	103.7	73.2
2014 (4)	-11.4	0.36	-1.16	-12.2	60.0	48.1	.0	108.1	120.3	88.2
Totals -	216.0	9.00	-20.40	204.6	836.4	612.3	-0.52	1448.1	1243.5	835.3
Discounted -	132.0	2.01	-3.69	130.3	128.5	78.3	-0.2	206.6	76.3	24.1

Discount Rate 12%

	CONSTRUCTION PERIOD: 3 years	4 years
Single year construc cost (5)	172.1	182.9
Req opening year benefits (incl cost savings)	20.7	21.9

	ASSUMPTION ON TIME SAVINGS: Full	1/3rd
Internal Rate of Return	16.8%	13.7%
Benefit/Cost Ratio	1.59	1.18
Net Present Value	76.3	24.1 million LE

(1) 50 percent of access roads completed after main project opening.

(2) Additional costs of interchange with Cairo Ring Road.

(3) Cost of 5 cm overlay.

(4) Residual value @ 5 percent of total construction.

(5) In year of opening, excluding remaining access road costs.

cost/benefit stream indicated that this could be achieved in the early to mid-1990s.

This indicated a likely starting date for construction as 1990, rather than 1987 assumed in the evaluation. Assuming that international funding would be required to finance the project, with the checks and controls that this necessarily implies, a 1990 start date for construction was considered realistic, if not optimistic. Table 7-5 shows a revision of the evaluation with the start of construction put back three years to 1990 (the period up to 1990 being consumed in agreeing financing, final design and contractor tendering), and assuming a 4-year construction period. The economic parameters for this more realistic option show and IRR of 16.8 percent, and NPV of LE 47.7 million and a B/C Ratio of 1.55.

Improvements to the Existing Highway - Table 7-6 presents the evaluation of the main alternative to the new Cairo-Assuit Highway; improvement of the existing West Bank Highway.

It was assumed that improvements would start with the construction of 14 bypasses around the major towns and cities along the route which lack such a bypass (the great majority). This construction was scheduled for the period 1987-1989 (which financial period ends in mid-1990. Construction would then commence on widening those sections of the road which are not divided highway; essentially the entire route between Aiyat and Assuit. This work was assumed to last until the Year 2000, allowing for significant difficulties in acquiring land for right-of-way.

Maintenance costs would build up steadily as road widening progressed. So also would the savings in pavement overlaying on other roads in the corridor, as traffic increasingly diverted to the improved West Bank route.

Benefits were estimated to build up slowly in the opening years, mainly because the bypasses on their own in the early 1990s would generate few benefits (since they add length to a road which was expected to be no more congested in 1990 than in the Study Base Year 1985/86). In fact, economic benefits were estimated as negative, but they were set to zero in this evaluation on the basis that their would be sufficient benefits within the bypass towns to at least off-set the negative benefits for traffic passing through. Benefits for the Improved Network were expected to build up over the construction period of widening, since each section of widening would be a complete and useable while other sections were still in construction.

Vehicle operating cost savings were nearly equalled by passenger time savings due to the traffic congestion likely to prevail with no new highway construction in the corridor. Traffic accident savings were likely to be considerable with completion of the safer 4-lane highway.

The economic indicators showed a good economic return on this project to improve the existing highway. For this evaluation, a First Year Rate of Return (FYRR) was not estimated since the project would really be a series of connected smaller projects which would need to be evaluated separately to establish individual FYRRs.

Table 7-5

EVALUATION OF THE CAIRO-ASSUIT HIGHWAY (2-LANE)
FOUR YEAR CONSTRUCTION STARTING 1990
(millions of LE, 1985/86)

YEAR	PROJECT COSTS: Construction	Addition Maint	Addition Overlays	Total Costs	PROJECT BENEFITS: Vehicle Op Cost Savings	Passenger Time Savings	Reduced Traffic Accidents	Total Savings	NET COST/PER SAVEAN: Full Time Savings	One third time savings
1990	34.2			34.2				0.0	-34.2	-34.2
1991	34.2			34.2				0.0	-34.2	-34.2
1992	34.2			34.2				0.0	-34.2	-34.2
1993	34.2			34.2				0.0	-34.2	-34.2
1994 (1)	18.5	0.36	-0.57	18.2	16.7	6.5	-0.04	23.2	4.9	0.6
1995		0.36	-0.60	-0.2	18.4	8.1	-0.03	26.5	26.8	21.4
1996		0.36	-0.64	-0.3	20.4	10.1	-0.03	30.4	30.7	24.9
1997		0.36	-0.67	-0.3	22.5	12.6	-0.02	35.1	35.4	27.0
1998		0.36	-0.71	-0.3	24.9	15.7	-0.02	40.5	40.9	30.4
1999		0.36	-0.75	-0.4	27.5	19.5	-0.01	47.0	47.3	34.3
2000		0.36	-0.79	-0.4	30.3	24.3	.0	54.6	55.0	38.8
2001		0.36	-0.81	-0.5	31.8	25.5	.0	57.3	57.8	40.8
2002		0.36	-0.83	-0.5	33.4	26.8	.0	60.2	60.7	42.8
2003 (2,3)	38.6	0.36	-0.86	38.1	35.1	28.1	.0	63.2	25.1	6.3
2004		0.36	-0.88	-0.5	36.8	29.5	.0	66.4	66.9	47.2
2005		0.36	-0.91	-0.5	38.7	31.0	.0	69.7	70.2	49.5
2006		0.36	-0.93	-0.6	40.6	32.6	.0	73.2	73.7	52.0
2007		0.36	-0.96	-0.6	42.6	34.2	.0	76.8	77.4	54.6
2008		0.36	-0.98	-0.6	44.8	35.9	.0	80.7	81.3	57.4
2009		0.36	-1.01	-0.7	47.0	37.7	.0	84.7	85.3	60.2
2010		0.36	-1.04	-0.7	49.4	39.6	.0	88.9	89.6	63.2
2011		0.36	-1.07	-0.7	51.8	41.6	.0	93.4	94.1	66.4
2012		0.36	-1.10	-0.7	54.4	43.6	.0	98.1	98.8	69.7
2013 (3)	33.7	0.36	-1.13	32.9	57.1	45.8	.0	103.0	70.0	39.5
2014		0.36	-1.16	-0.8	60.0	48.1	.0	108.1	108.9	76.8
2015		0.36	-1.19	-0.8	63.0	50.5	.0	113.5	114.3	80.7
2016		0.36	-1.22	-0.9	66.1	53.0	.0	119.2	120.0	84.7
2017		0.36	-1.26	-0.9	69.4	55.7	.0	125.1	126.0	88.9
2018 (4)	-11.4	0.36	-1.16	-12.2	60.0	48.1	.0	108.1	120.3	88.2
Totals -	216.0	9.0	-23.2	201.8	1042.8	804.1	-0.2	1846.7	1644.9	1108.8
Discounted -	88.2	1.28	-2.77	86.7	108.9	76.8	-0.1	185.6	98.9	47.7

Discount Rate 12%

	CONSTRUCTION PERIOD: 3 years	4 years
Single year construc cost (5)	172.1	182.9
Req opening year benefits (incl cost savings)	20.7	21.9

	ASSUMPTION ON TIME SAVINGS: Full	1/3rd
Internal Rate of Return	20.8%	16.8%
Benefit/Cost Ratio	2.14	1.55
Net Present Value	98.9	47.7 mill

(1) 50 percent of access roads completed after main project opening.
(2) Additional costs of interchange with Cairo Ring Road.
(3) Cost of 5 cm overlay.
(4) Residual value @ 5 percent of total construction.
(5) In year of opening, excluding remaining access road costs.

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Table 7-6

EVALUATION OF THE IMPROVEMENTS TO THE EXISTING CAIRO-ASSUIT HIGHWAY
BYPASSES BY 1990, ALL 4-LANE BY 2000
(millions of LE, 1985/86)

	PROJECT COSTS				PROJECT BENEFITS				NET COST/BEN STREAM	
YEAR	Construction	Addition Maint	Addition Overlays	Total Costs	Vehicle Op Cost Savings	Passenger Time Savings	Reduced Traffic Accidents	Total Savings	Full Time Savings	One third time savings
1987	10.5			10.5				0.0	-10.5	-10.5
1988	10.5			10.5				0.0	-10.5	-10.5
1989	10.5			10.5				0.0	-10.5	-10.5
1990	12.7	0.01	-0.29	12.4	.0	0.4	0.01	0.4	-12.0	-12.3
[illegible]	12.7	0.01	-0.31	12.4	.0	0.6	0.02	0.7	-11.7	-12.2
	12.7	0.02	-0.32	12.4	0.1	1.0	0.04	1.1	-11.3	-12.0
	12.7	0.02	-0.34	12.4	0.1	1.5	0.08	1.7	-10.6	-11.7
	12.7	0.03	-0.36	12.4	0.3	2.4	0.15	2.8	-9.5	-11.1
	12.7	0.04	-0.38	12.4	0.7	3.7	0.30	4.7	-7.6	-10.1
	12.7	0.05	-0.40	12.4	1.6	5.9	0.58	8.1	-4.3	-8.2
	12.7	0.07	-0.42	12.4	3.8	9.2	1.15	14.1	1.8	-4.3
	12.7	0.09	-0.44	12.4	9.0	14.3	2.27	25.5	13.2	3.6
	17.6	0.12	-0.46	17.3	20.9	22.4	4.47	47.8	30.5	15.6
		0.16	-0.49	-0.3	49.0	35.0	8.8	92.8	93.1	69.0
		0.17	-0.50	-0.3	51.5	36.8	9.2	97.4	97.8	73.3
		0.18	-0.52	-0.3	54.0	38.6	9.7	102.3	102.7	76.9
		0.19	-0.53	-0.3	56.7	40.5	10.2	107.4	107.8	80.8
		0.19	-0.54	-0.4	59.6	42.5	10.7	112.8	113.1	84.8
		0.20	-0.56	-0.4	62.5	44.7	11.2	118.4	118.8	89.0
		0.21	-0.57	-0.4	65.7	46.9	11.8	124.4	124.7	93.5
		0.23	-0.59	-0.4	68.9	49.2	12.4	130.6	130.9	98.1
		0.24	-0.61	-0.4	72.4	51.7	13.0	137.1	137.5	103.0
	19.7	0.25	-0.62	19.3	76.0	54.3	13.7	144.0	124.6	88.4
		0.26	-0.64	-0.4	79.8	57.0	14.3	151.2	151.5	113.5
		0.27	-0.66	-0.4	83.8	59.9	15.1	158.7	159.1	119.2
		0.29	-0.67	-0.4	88.0	62.9	15.8	166.7	167.0	125.1
		0.30	-0.69	-0.4	92.4	66.0	16.6	175.0	175.4	131.4
	-9.2	0.32	-0.71	-9.6	97.0	69.3	17.4	183.7	193.3	147.1
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[illegible]	174.0	3.92	-12.62	165.3	1093.9	816.6	198.95	2109.5	1944.2	1399.8
[illegible]	78.6	0.47	-2.30	76.7	108.7	88.5	20.2	217.4	140.7	81.7

D [illegible]te 12%

	ASSUMPTION ON TIME SAVINGS	
	Full	1/3rd
Internal Rate of Return	21.9%	18.5%
Benefit/Cost Ratio	2.83	2.06
Net Present Value	140.7	81.7 million LE

([illegible]s cost of 5 cm overlay on bypasses.
([illegible]rlay on all new construction
([illegible]al value @ 5 percent of total construction.

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Further Consideration of Benefits

The three further aspects of benefits for the 2-lane Expressway Network and the Improved Network are discussed here as follows:

i) Size of benefits

ii) Geographical Distribution of benefits

iii) Foreign Exchange considerations

Size of Benefits - Benefits were divided into large, small and negative benefits. The term "small benefit" has no precise meaning;it was used simply to identify journey benefits which verge on the level of being unnoticeable. The small operating cost benefit was defined as roughly 5 percent of free-flow economic operating cost at 50 kph assuming Base Year average journey lengths. The small time benefit was about 7 percent of average base year journey times. Both networks showed that most positive benefits were large; indicating that benefits would make a real impact on operations.

For the Expressway Network, negative benefits for vehicle operating cost savings were significant at LE 42,000 per day, compared with the total of positive benefits at about LE 95,000 per day. Most of these negative benefits were associated with private car travel and this was partly because the Traffic Model route choice for private cars was influenced by travel time savings, which attracted vehicles to the new highway despite overall increase in vehicle operating costs. These were mostly offset by time savings for Car Work class, although not for Car Other.

A further cause of negative vehicle operating cost benefits for private cars were that drivers were assumed not to perceive all their operating cost, considering fuel oil and tire costs only. This can lead to negative benefits for generated travel, as well as contributing to the negative benefits derived from choice of routes which, when economic resource costs are taken into account, prove to be more costly.

Finally, negative benefits were also a byproduct of the route assignment diversion process in the Traffic Model which divided traffic between competing routes in accordance to relative costs on the two routes. This process inevitably put some traffic on the more expensive route, especially when costs of the two alternatives were similar. This mirrored real life where drivers select routes based on more than just the vehicle operating costs involved, or with an imperfect knowledge of the alternative route costs. However, negative benefits produced in this manner were generally small and were outweighed by the much greater positive benefits.

The proportion of negative benefits was much lower for the Improved Network, and the proportion of benefits for non-truck traffic was also

significantly higher. Small benefits remained low compared with other positive benefits, but made up a greater proportion than for the Expressway Network. This indicates a greater range of benefits than for the Expressway.

Geographical Distribution of Benefits - The striking feature of the Expressway Network results is that few benefits (3.4 percent) accrued to internal movements in the Corridor. Such benefits as did accrue to this traffic arose from the longer distance inter-Governorate movements, and from the slight relief in congestion in the main corridor brought about by the new highway. This clearly demonstrates that the main benefit of the new highway would be to long distance traffic moving to, from, and through the Corridor. Benefits to external traffic made up 36.2 percent of the total, with the highest benefits to the southernmost towns, in particular, Assuit. Through traffic gained the greatest benefit amounting to 60.4 percent of the total.

Apart from the increased quantity of benefits (LE 97,000 per day compared with LE 52,000 per day on the Expressway Network), there was a major change in the distribution of benefits for the Improved Network. Internal traffic benefits totalled 25.4 percent, with most occuring in Minia and Assuit Governorates. The proportion of external benefits also went up from the Expressway Network levels to 43.7 percent of the total, and this represented over a doubling of the volume external benefits. This could be explained by the more direct route provided by the improved existing road to origins and destinations in the corridor, compared with the Expressway Network.

Through traffic, which would appear to have most to gain from a completely new road, suffered little diminution of benefits on the Improved Network, reducing from LE 32,000 to 30,000 per day. As a percentage, the overall share reduced to 30.9 percent because other benefits increased so sharply.

It was concluded that the Improved Network shows a better spread of benefits than the Expressway Network. Benefits to traffic moving entirely within the Corridor were increased greatly, external benefits were also increased, but at the same time, through traffic benefits were scarcely changed.

Foreign Exchange

The foreign exchange component of benefits was not particularly high at about 15 percent of the economic resource valuation of LE 100,000 per day. This is mainly because fuel is produced nationally, and because their is a high local content in the production and assembly of vehicles. The foreign exchange component of construction costs was estimated at between 27 and 30 percent of economic resource costs. It was therefore concluded that in terms of the foreign exchange component alone, the evaluation was not favorable, indicating that cost in foreign exchange of constructing the new highway would not be justified by the savings in foreign exchange in reduced operating costs.

Conclusions of the Economic Evaluation

It was concluded that both the two main projects evaluated -- improving the existing West Bank Highway or building a new highway from Cairo to Assuit -- would both produce significant economic benefits. On economic grounds, the improvements to the existing highway appeared to give the best results, essentially because more benefits would be produced for lower investment. Also, the benefits would be more evenly distributed to the different traffic elements. In contrast, a new Cairo-Assuit Highway would mainly benefit long distance traffic, with little advantage to local traffic.

For the new highway, the evaluation supported the traffic analysis in concluding that a 4-lane highway would not be justified for the first stage of construction. An opening date in the mid-1990s was justified, and this would fit well with a possible program of foreign funding for design and construction.

Chapter 8

OTHER EVALUATIONS

In addition to the economic evaluation presented in Chapter 7, financial, environmental and social evaluations of the alternative investments were also completed. They are described in this chapter, together with a review of the administrative and implementation capacity of the Roads and Bridges Authority.

Financial Evaluation of the New Cairo-Assuit Highway

Since the highway was envisaged to be a high quality road with limited access, the possibilities for financing, or at least offsetting, construction costs from toll revenues was considered.

Toll Systems Evaluated - Three toll systems were evaluated in detail, as follows:

i) Complete Barrier System

ii) Limited Barrier System

iii) Closed System

A barrier system places toll booths across the highway at intervals. Anyone using a section of the highway equipped with toll booths has to pass through this barrier, and has to pay the toll. This system has the advantage of simplicity, but does have some operating disadvantages. If barriers are placed on all sections of the highway between access roads, significant delays and inconvenience would be experienced by long distance drivers, the very drivers who should be encouraged to use the new highway. On the new Cairo Assuit Highway, there would be 13 sections between Cairo and Assuit, averaging 26 kilometers each.

The Limited Barrier System envisaged three barriers, each located on a section of the highway between Govenorate capitals. Exact locations would have to be decided based on maximum inconvenience for traffic to bypass the toll barriers; probably at some point midway between Governorate capitals. The advantages of reduced costs are counterbalanced by reduced revenues.

A closed toll system effectively seals off the tolled highway by placing barriers on all access roads. Once having entered the highway, drivers do not pass another toll barrier until they exit the highway. Hence traffic is not delayed along the route, and the process of paying and checking tickets is encountered at only the entry and exit points. A system of ticketing is required if tolls are to be adjusted according to the length of highway used. With a total length of nearly 350 kilometers, this would be necessary on the Cairo-Assuit highway. A ticket system could be quite complex with 14 points of entry and exit along the route. For a 2-lane highway, such a ticketing system would have to be

sufficiently sophisticated to prevent drivers meeting along the route and swapping tickets.

Toll System Costs - Estimated construction and equipment costs are summarized in Table 8-1 below.

Table 8-1

COSTS OF TOLL BOOTH CONSTRUCTION AND EQUIPMENT
(LE millions, 1985/86)

ALTERNATIVE	NUMBER OF TOLL BOOTHS	ESTIMATED COSTS	ANNUAL MAINTENANCE
Complete Barrier	32	6.4	0.11
Limited Barrier	8	1.6	0.03
Closed System	36	7.2	0.13

Staffing and administration costs assumed crews to operate the toll booths at each location, a local administrative center in the nearest town, and a central administration located in Cairo. Costs were estimated as in Table 8-2.

Table 8-2

ANNUAL COSTS OF TOLL STATION STAFFING AND ADMINISTRATION
(LE thousands, 1985/86)

ALTERNATIVE	NUMBER OF TOLL BOOTHS	NUMBER OF LOCATIONS	TOTAL COST
Complete Barrier	32	13	920
Limited Barrier	8	4	330
Closed System	36	14	1,000

Toll Revenues - Several alternative toll rates were evaluated ranging from current tolls, as charged on the existing Cairo-Alexandria Desert Road, to a rate 15 times higher. Under these assumptions, the charge for a private car travelling from Cairo to Assuit would range from about LE 2 under Current tolls to LE 26 under the Very High tolls. The charge for a multi-unit truck would range from LE 9 to LE 130.

With the higher toll rates, forecast traffic was forecast to decrease, with the Very High tolls reducing traffic to just 30 percent of the no-toll case. Some of the traffic lost from the new highway would transfer back to the existing road, while other traffic would be de-generated; that is to say, the imposition of tolls would slow traffic growth rates in the Corridor.

Although traffic would decrease with progressively higher tolls, total

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toll revenues were estimated to increase with each toll increase. Estimated revenues for each case are set out in Table 8-3.

Table 8-3

ESTIMATED ANNUAL TOLL REVENUES
(LE millions, 1985/86)

ALTERNATIVE	1990	2000
Current		7.0
Low		12.9
Medium	11.9	21.8
High		35.2
Very high		37.6

These revenues were estimated on the assumption that full revenues would be collected, which should be the case with the complete barrier and closed toll systems. With the limited barrier system, some traffic could be expected to deliberately evade the toll booths by selecting a different place to enter and leave the new highway, while other traffic (estimated to be a small proportion) would not pass a toll barrier for the sections of the route they use. It could be assumed that at least 20 percent of the potential revenues would be lost, and perhaps up to 50 percent.

Toll Evaluation Procedure - The evaluation of tolls brought together the estimates of costs and revenues and arrayed them in a project lifetime table. Various economic parameters were calculated in a similar manner to the economic evaluation reported in Chapter 8.

For the financial evaluation, a financial interest rate was required which reflected the real cost of borrowing money to finance investments. Since the project evaluation disregards inflation in calculations of future costs and benefits, the interest rate used for the financial evaluation had also to eliminate the inflation element. A pure rate of interest, stripped of inflation, is normally taken as about 3-4 percent. In other words, a return on an investment should be sufficient to cover the devaluation of the currency due to inflation, and give a return of 3-4 percent on top of that.

Specifically for a toll evaluation, use of a pure inflation-free financial interest rate assumes that both costs and revenues rise with inflation so that the inflationary element cancels out and can be ignored. In practice, while costs tend to rise inexorably, revenues tend to lag since toll roads are in the public sector, and Government, unwilling to add to inflation, will often delay toll increases required to restore the erosion of revenues by inflation. For this reason, the interest rate chosen for this evaluation was 6 percent; above the pure inflation-free interest rate, but still well below a commercial interest rate.

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Evaluation Results - The results for both the Closed system and the Complete Barrier system were very promising. The evaluation for the Closed System (slightly the more costly of the two) assuming Medium tolls is presented in Table 8-4, indicating an Internal Rate of Return (IRR) of 10.3 percent, a Benefit/Cost (B/C) ratio of 1.47 and a Net Present Value (NPV) of LE 68.7 million. It is emphasised that the IRR of 10.3 percent represents a real return on investment, excluding inflation. Moreover, net revenues were estimated to reach the level debt service required to pay off capital and interest by the early 1990s. It was estimated that an even better result would be obtained with High Tolls.

The Limited Barrier toll system would be less costly to implement and run but, as discussed earlier, would suffer a shortfall in revenue compared with the Closed System and the Complete Barrier System. A slight fall in revenues to, say, 80 percent would not be very serious, but a revenue loss of 50 percent would reduce revenues to below the point of full financial feasibility, although still making a substantial contribution to project costs.

A sensitivity test was made assuming revenues reduced by 20 percent and all costs, including highway construction, implementiation and operation of the toll system, increased by 20 percent. This indicated that revenues in these circumstances would fall only fractionally below those required for full financial feasibility.

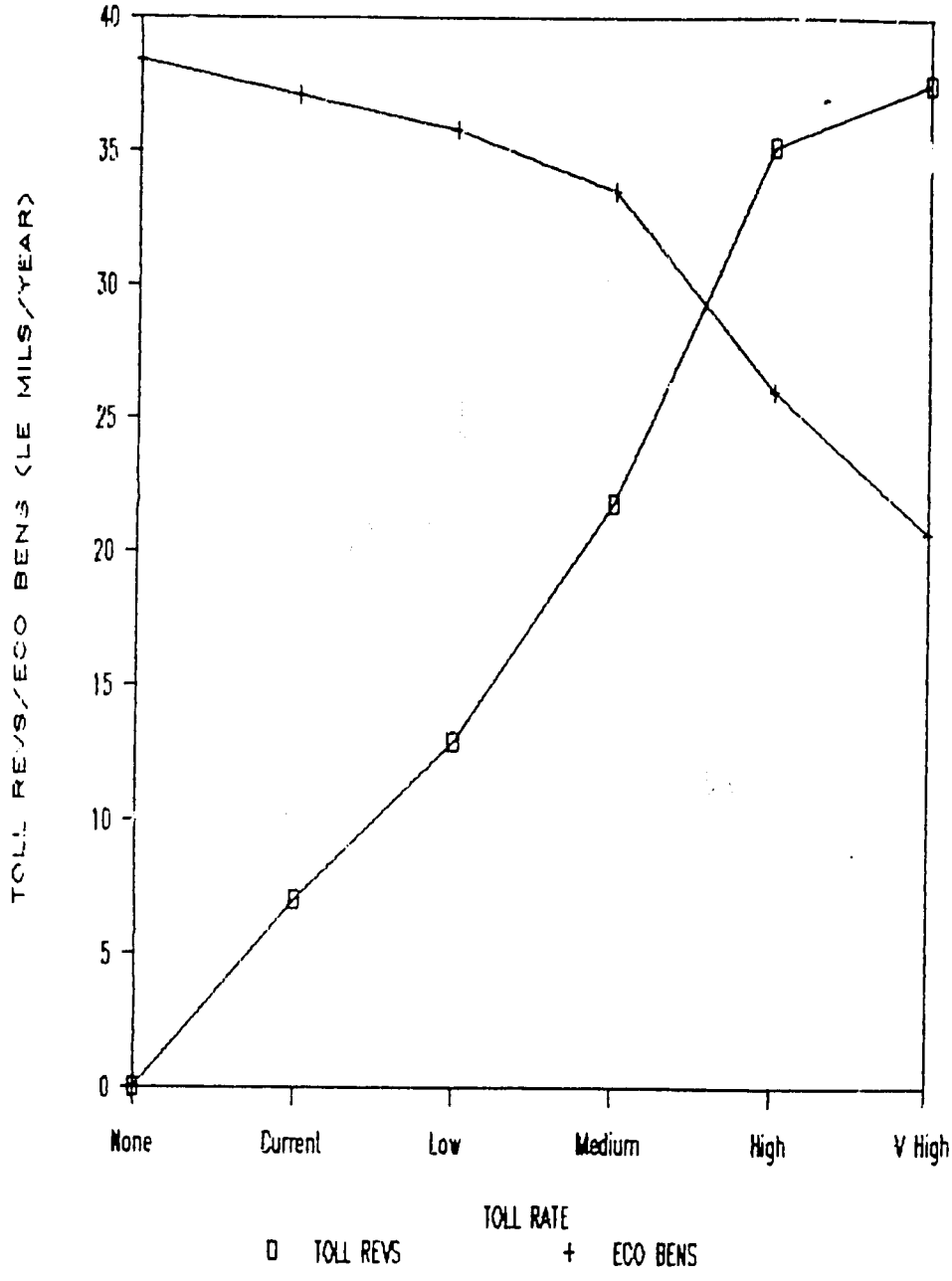
These results indicate that the road could be completely financed from toll revenues over the 25 year life of the project, with a substantial surplus.

Other Considerations

This section deals with a number of other aspects associated with implementing a toll system on the new Cairo-Assuit Highway.

Impact on Economic Benefits - Imposition of tolls modifies driver behaviour and deters some drivers from using the new road. They remain on the existing roads, not only losing economic benefits themselves, but also imposing economic dis-benefits on others by contributing to congestion. To identify this situation more closely, the economic benefits associated with the new Cairo-Assuit Highway were re-assessed for each toll alternative evaluated. The results are illustrated in Figure 8-1 for the Year 2000 traffic forecasts. It was concluded that tolls up to the Medium level (about 4 times current levels on the Alexandria Desert Road) would result in an acceptable reduction in economic benefit (just under 13 percent) but higher toll levels would have a serious impact.

Driver Response - There is little evidence on just how drivers would react to toll levels discussed in this Appendix. The Medium tolls represent rates five times the toll on the Alexandria Desert Road in 1986. It is possible that such levels would be resisted and that a higher proportion of traffic would continue to use the existing roads, despite resulting overall higher costs of operation.



Cairo – Assuit Highway Feasibility Study

Wilbur Smith and Associates
Egyptian Consultants Consortium

ECONOMIC BENEFITS AND TOLL REVENUES
AT DIFFERENT TOLL LEVELS

Figure 8-1

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Table 8-4

FINANCIAL EVALUATION OF THE 2-LANE CAIRO-ASSUIT HIGHWAY
CLOSED TOLL SYSTEM, MEDIUM TOLLS
(LE millions, 1985/86)

YEAR	PROJECT COSTS: Construction	Highway Maint	Toll Booths(1)	Toll Opertns	Total Costs	PROJECT REVENUES	NET COST/ REVENUE STREAM
1987	34.3				34.3	0.0	-34.3
1988	34.3				34.3	0.0	-34.3
1989	34.3		7.2		41.5	0.0	-41.5
1990	14.3	0.34	0.13	1.00	15.8	11.4	-4.4
1991		0.34	0.13	1.00	1.5	12.2	10.7
1992		0.34	0.13	1.00	1.5	13.0	11.5
1993		0.34	0.13	1.00	1.5	13.8	12.4
1994		0.34	0.13	1.00	1.5	14.8	13.3
1995		0.34	0.13	1.00	1.5	15.8	14.3
1996		0.34	0.13	1.00	1.5	16.8	15.4
1997		0.34	0.13	1.00	1.5	17.9	16.5
1998		0.34	0.13	1.00	1.5	19.1	17.7
1999 (2,3)	28.2	0.34	0.13	1.00	29.7	20.4	-9.2
2000		0.34	0.13	1.00	1.5	21.8	20.3
2001		0.34	0.13	1.00	1.5	22.5	21.1
2002		0.34	0.13	1.00	1.5	23.3	21.8
2003		0.34	0.13	1.00	1.5	24.1	22.6
2004		0.34	0.13	1.00	1.5	24.9	23.4
2005		0.34	0.13	1.00	1.5	25.7	24.2
2006		0.34	0.13	1.00	1.5	26.6	25.1
2007		0.34	0.13	1.00	1.5	27.5	26.0
2008		0.34	0.13	1.00	1.5	28.4	26.9
2009 (3)	24.5	0.34	7.33	2.00	34.2	29.3	-4.8
2010		0.34	0.26	2.00	2.6	30.3	27.7
2011		0.34	0.26	2.00	2.6	31.3	28.7
2012		0.34	0.26	2.00	2.6	32.4	29.8
2013		0.34	0.26	2.00	2.6	33.5	30.9
2014 (4)	-8.5	0.34	0.26	2.00	-5.9	34.6	40.5
Totals -	161.4	8.50	18.30	31.00	219.2	571.3	352.1
Discounted -	121.0	3.65	9.47	12.10	146.2	214.9	68.7

6% Interest Rate

	CONSTRUCTION PERIOD: 3 years	4 years
Single year construc cost (5)	115.7	159.1
Level debt service required	9.1	12.4

Internal Rate of Ret	10.3%
Benefit/Cost Ratio	1.47
Net Present Value LE	68.7 million

(1) Including construction and maintenance

(2) Additional costs of interchange with Cairo Ring Road.

(3) Cost of 5 cm overlay.

(4) Residual value @ 5 percent of total construction.

(5) In year of opening

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Private Financing - Given the apparently high rates of return for a toll system, what are the possibilities for a private consortia to finance the construction and operation of the new highway in return for toll revenues? Apart from the lack of any previous experience with private highway construction in Egypt, there are likely to be a number of other obstacles to attracting private finance. Most are associated with the sheer uncertainty of the findings reported here.

The LE 150 million required to finance the new highway is a substantial investment, and would probably be considered high risk. Typically, investors would want to see a revenue return in the first year of operation equal to the level debt service required to fully finance the highway over a 10 to 15 year period, calculated using current commercial interest rates.

An analysis on this basis indicated a shortfall in revenues over level debt service required for the base assumption, and much worse results with the sensitivity test results. The results are poor seen from the viewpoint of the financing company, essentially because of the uncertainty caused by inflation. This raises the level debt service, essentially requiring initial revenues at a sufficiently high level to offset the later erosion in revenue values by inflation. A private financing company would probably be unwilling to rely on promises of toll increases.

Hence it was concluded that the possibility of attracting private consortia to such a project were remote.

Security - Whatever system of toll collection is envisaged, problems of security for toll collection stations must also be considered. Toll stations would be required to operate 24 hours per day and most would be in isolated locations. Security problems would be most severe with a closed toll system, with toll booths on lightly trafficked access roads. Revenue take at such stations could reach as high as LE 2-3,000 per day.

Safety - Barrier toll systems have the disadvantage of reduced safety with high speed traffic being brought to a complete halt before passing the barrier. This would be critical at night and in times of poor visibility during the winter fogs and summer sandstorms experienced in the Cairo-Assuit Corridor.

Conclusions on the Toll Evaluation - The financial evaluation indicated that tolls could make a substantial contribution to the costs of constructing and maintaining a new Cairo-Assuit Highway, and it is possible, with tolls at a sufficiently high level, that the new highway could be completely financed from tolls. However, the estimates of revenues are theoretical, and more information on driver behaviour in the face of high tolls would be required before a final conclusion was reached. The high risk and uncertainty appears to make private financing of the highway unlikely, but this is a prospect which deserves fuller investigation.

A closed toll system with toll booths on access roads appears to be the best alternative, since toll collection could be complete without the safety hazards and delays associated with barrier tolls located on the road itself. A medium toll level at about four times the 1986 tolls charged on the Alexandria Desert Road gave high revenues with little loss of economic benefits and would appear to be a suitable toll level to aim at.

Social and Environmental Evaluation

The purpose of the environmental and social assessment was to identify significant environmental effects and social issues which could be examined in more detail as appropriate if a full scale assessment is deemed necessary at a later time.

Information was obtained on current environmental standards and regulations as well as baseline environmental conditions by research and interviews. Field trips were made along the existing routes of the corridor to obtain information and opinions concerning environmental and social issues.

Alternatives Evaluated - The projects examined consisted of the two major study alternatives for the Cairo-Assuit Highway: improving the existing West Bank Highway by construction of bypasses around some of the urban centers plus widening in rural areas, and constructing a new highway along the desert fringe to the west of the agricultural area. These were compared with a committed road system, which represented likely conditions if no further investments are made beyond those already committed.

Water Quality Assessment - Standards for water quality in the Nile and adjacent waterways are given principally by Law 48 of 1982. Water quality in the Nile is good, with reasonably low levels of bacterial and non-bacterial pollutants. A major factor in this is the high dilution factor provided by the large flow. The major canals, however, have high levels of bacterial contamination and are high in nutrients and other contaminants.

The most significant factor determining potential water quality impacts is the very low rainfall. The small amount of rainfall provides almost no transport of pollutants into the waterways. For this reason, potential water quality impacts produced by the alternatives can all be considered as insignificant or marginal. Since the existing main roads are generally adjacent to the canals, they have a higher risk of direct spill contamination than the desert new highway. Thus, the new highway has a definite advantage over the improving the existing main road, but net impacts are expected to be small in any event.

Air Quality Assessment - Even though there is an official awareness of air quality problems, and actions are now being taken in an attempt to improve conditions, there are no adopted national air quality standards. Conditions vary in the Corridor, but in general the only area of chronic

and severe air pollution is the Cairo urban complex. There are a few other spot sources such as cement plants.

Climatic and topographic conditions are favorable for good dispersion of air pollutants. These conditions include strong winds, good convection currents caused by high day-night temperature differentials, and flat topography.

Overall, the amount of change in volumes of traffic as well as the total volume of traffic moving along the corridor under all of the alternatives is low enough to consider any air quality impacts as marginal or insignificant. Traffic volumes would change by only about one half of the amounts necessary to produce significant impacts. However, the new highway produces the lowest adverse impact and the highest level of improvement. It does this by allowing higher, more efficient operating speeds and by removing the pollutant source away from the exposed population.

Noise Assessment - Noise levels along the existing West Bank road are particularly high in those segments where the route passes through towns and cities. Because of the high level of ambient noise and because of the capacity of exposed population to adapt to noise, increases in noise level caused by higher traffic volumes probably will not be perceived by the local population as significant. However, it would be possible to effect a significant reduction in noise levels which would be perceptible by the local population, particularly if a reasonable volume of truck traffic were diverted off the West Bank road. Bypasses offer some potential for doing this by carrying traffic around town centers instead of through the town centers. However, the new highway offers a better possibility of significant noise reduction by removing traffic volumes and noise sources from exposed population. It would probably be possible to achieve noise reduction of 6 to 8 dB(A) by diverting traffic off the existing West Bank Highway, and this would be a significant reduction. Thus improving the West Bank Highway offers potential for noise reduction, but to a lesser extent than the new highway.

Land Resources Assessment - The principal concern with respect to land resources is the necessity for taking of agricultural land. Agricultural land is a scarce and valuable resource. Both local sentiment and public policy are opposed to the conversion of agricultural land to non-agricultural use. A new highway would require about 1.3 million square meters of agricultural land, mostly for access roads, which could be considered as a moderate adverse impact. The adverse impact of widening the existing West Bank Highway and building bypasses, requiring about 6.3 million square meter of agricultural land, would probably be considered significant.

Ecological, Historic, Cultural, and Aesthetic Resources - No significant impacts resultant from the highway alternatives were identified with respect to ecological, historic, cultural or aesthetic resources. Accessibility of ancient sites and other historic and cultural resources would be improved to the extent that either of the three alternatives improves overall accessibility.

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Social Impact Assessment - Complex and varied social impacts, both adverse and beneficial, can be identified. However, those which can be most directly related to the alternatives appear to be the the controversial issue of the taking of agricultural land. Social issues surrounding the conversion of agricultural land are in approximate proportion to the required amounts of land taking as described above in connection with land resources. There are expected developmental benefits to be derived from a new desert highway in the form of opening new land in the desert fringe for development or reclamation. However, these developmental benefits could not be solely derived from highway construction, but would require supplemental investment in infrastructure and other economic incentives. Accessibility of social and cultural facilities would be improved generally by any of the alternate options. The contribution of the new highway to this accessibility factor would be through allowing the existing roadway network to function more effectively in its role as a carrier of local traffic.

General Conclusion - Environmental and social impacts can be quantified to a certain extent, but they remain largely subjective and judgmental. In the current case, it appears that the environmental factors which have the highest probability of either producing or receiving significant impacts are noise and land resources. Low rainfall runoff and relatively low traffic volumes make it likely that impacts to water and air will be only marginal. Social issues are complex and land taking is the most promiment.

On balance, it appears that the new highway offers the least risk of adverse impacts and the highest expectation of positive benefits. It accomplishes this not so much by producing lower impact values, but by removing the source of impact away from the exposed receptors, primarily by shifting the highway and its traffic away from the exposed human population.

Improvement of the West Bank Highway accomplishes some of the same beneficial effect by routing traffic around some of the town centers, but the decrease of exposure of population is much less than with the new highway. The benefit of shifting the impact source which is enjoyed by improving the existing road is also somewhat diluted by the accompanying requirement for the taking of agricultural land.

Policy and Administration

A review was made of transport policy as it affects planning, and of the capacity of RBA to implement major new highway projects.

Transport Policy - Transport policy guidelines appear in the Five Year Plan for Economic and Social Development, 1982/83 - 1986/87 (December 1982). Strategies, or policies affecting highway transport are:

1. Preserving existing productive assets by regular maintenance and renovation.

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2. Coordination between different transportation means and network.
3. Expanding T&C (Transport & Communications) capacities by additional units of all types.
4. Improving transportation services structure in favor of the less-expensive rail and river transportation.

These general guidelines are further emphasized by the following sector objectives:

1. Better utilization of existing capacities, proper maintenance and replacement policies.
2. Increasing the share of railroad and river cargo transportaion, from 12.6% in 1981/82 to 19% of the total in 86/87, and from 12.6% to 13% respectively.
3. Construction and pavement of roads (East Nile, and the Egyptian-Sudanese highway).

As set forth in the current Five Year Plan, National policy appears directed toward expanding the rail and water share of passenger and cargo internal transport vis a vis highways. The East Nile and the Sudanese highways are mentioned as priority road construction projects for RBA. However, within the highway sector, the major emphasis is on the improvement and maintenance of the existing network. RBA internal policies support the national objectives.

Finance

Several organizations have responsibility for the construction, improvement and maintenance of the highway infrastructure. At the National level, two ministries are involved: The Ministry for Reconstruction is assigned the planning and construction of roads in areas of economic and/or social importance. Within the Ministry of Transportation, the RBA is responsible for the planning, construction and maintenance of highways. Governorates, under the Ministry of Local Administration, also plan, construct and maintain regional and local (urban) roads.

The current Five Year Plan budget for the inter-city road network allocates LE 200 million to RBA, 47.6 percent of the total. The amount originally requested by RBA for the period was on the order of LE 350 million.

Table 8-5 presents the current RBA Five Year Plan by project type. The emphasis on road rehabilitation is apparent in that 60 percent of the total budget is allocated to this activity. 1985/86 expenditure is estimated at LE 46 million in 1985 prices and the 1986/87 expenditure is planned at LE 48 million. Current expectations, however, anticipate an austerity budget on the order of LE 41.4 million.

Road construction and rehabilitation is carried out under contract to RBA by the public construction companies and by private contractors. Routine maintenance is carried out by the direct labor organizations of the RBA in 8 district offices. The amount allocated to routine maintenance for 1985/86 was LE 2.5 million.

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Table 8-5

RBA FIVE YEAR PLAN, 1982/83 - 1986/87

PROJECT TYPE	LE (Thousand)	%
I- Replacement & Renewal Projects		
- Consolidation of embankments	120	(-)
- Investment in paving equipment	10,600	(5%)
Subtotal	10,720	(5%)
II- Rehabilitation Projects		
- Widening & strengthening of main roads	65,164	(33%)
- Construction of divided highways	46,336	(23%)
- Renewal & strengthening of bridges	7,300	(4%)
Subtotal	118,800	(60%)
III-Completion & Extension Projects		
- Construction & pavement of main roads	32,000	(16%)
- Construction of bridges	20,800	(10%)
- Other Activities (building, traffic safety, etc.)	17,680	(9%)
Subtotal	70,480	(35%)
Total	200,000	(100%)

Road construction and rehabilitation is carried out under contract to RBA by the public construction companies and by private contractors. Routine maintenance is carried out by the direct labor organizations of the RBA in 8 district offices. The amount allocated to routine maintenance for 1985/86 was LE 2.5 million.

Resource to private funding sources for the financing of intercity highway projects is not within the experience or legal authority of the RBA. Such a proposal, in the opinion of RBA, would be rejected by the Ministyr of Transportation and higher political authority.

Organization and Manpower

The manpower assigned to RBA Headquarters was 1496 persons in 1985, or about 20 percent of the RBA total employment. Both ENTS (Reference 1) and the Highway Maintenance Project define a shortage of qualified, experienced engineers and technicians at the headquarters and district levels as a major manpower deficiency. The Egypt Highway Maintenance Project (Reference 14) recommends the addition of the following to the RBA engineering and technician staff:

Headquarters:

Central Laboratory	-	6 junior civil engineers.
Geometric Design	-	6 junior civil engineers.
Training	-	6 experienced civil engineers.
Bridges	-	25 junior civil engineers.
Technicians:	-	9

District:

Engineers	-	84
Technicians	-	185

Discussions with RBA officials disclosed that the deficiencies are viewed as temporary in that a list of qualified applicants for about 40 percent of the identified engineering vacancies is currently awaiting final approval for immediate employment. It would appear that under the World Bank assisted Egypt Highway Maintenance Project, personnel and equipment deficiencies at the headquarters and district levels of RBA have been identified and are being corrected.

RBA Implementation Capacity

The amount of road construction an rehabilitation completed annually through the RBA appears to be a function mainly of the amount of funds available. After discounting for inflation, road construction companies appear to have increased output at 34-38 percent annually for the last five years. Considerable flexibility exists within the RBA and the road construction industry. For example, when a supplementary budget provided funds, the second carriageway of the Cairo-Alexandria Toll Road (about 200 kms) was designed and tendered by the RBA in about one year. Using four companies, construction was completed in three years.

It was concluded that, given adequate funding including foreign exchange, there are no constraints to the successful implementation of a Cairo-Assuit project by the RBA.

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Chapter 9

CONCLUSIONS AND RECOMMENDATIONS

The main objective of this Study was, in the words of the Contract, "to determine whether a major investment in road construction and/or improvement is warranted". The conclusion of this Study is that a major investment is warranted, and that it should take the form of a new highway constructed from Cairo to Assuit, located in the desert just outside the existing agricultural lands on the west bank of the Nile. This is preferred to the other main alternative examined by the Study which is to make major improvements to the existing West Bank highway.

The economic evaluation showed that the new highway would generate sufficient economic benefits to justify construction. In addition, it is believed that a key role of the new highway could be to provide a focus for a new development of Upper Egypt which has been for long a relatively neglected backwater of the Nation. This is not an issue for highway planning engineers alone, but requires and deserves the attention of Government at the highest level.

The new highway would also constitute an important section of the proposed East African Highway from Cairo to southern Africa, linking the principal East African nations.

A decision on the project can only be taken by Government in relation to other priorities, both in the transport sector and elsewhere. The function of this Study has been to establish the necessary factual basis on which further discussions and plans can be based.

If the conclusions of this Study on a new Cairo-Assuit Highway are accepted, the Study recommends that procedures leading to final design and construction tendering are commenced immediately with a view to starting construction in 1990. It is estimated that the first stage of construction, consisting of a 2-lane highway with at-grade intersections, would cost LE 117 million in 1985/86 financial costs.

This Chapter summarises the findings of the Study and elaborates on the conclusions reached.

Existing Situation and Likely Developments

The existing highway from Cairo to Assuit is an unpleasant and hazardous highway to drive along. For most of its 365 kilometer length, it is a 2-lane road without paved shoulders. In many places, even the unpaved shoulders that do exist are either clogged with debris or are so badly eroded as to be unusable. As a result, most vehicle breakdowns will block one lane of traffic completely, and local driving habits do not easily accomodate this type of situation.

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Trucks make up a large percentage of the traffic -- 25 percent in numbers, but nearer 40 percent in terms of road space occupied -- and the flat grades and straight alignment permit trucks to travel at similar speeds to light vehicles. The road pavement is in poor condition and some sections are so badly pot-holed that fast moving trucks swing out into the opposing traffic lane to avoid damage to springs. They do well to take such precautions, since most trucks are loaded beyond legal capacities.

Finally in this list of problems, the road passes through many communities ranging in size from the Governorate Capitals of Beni Suef and Minia, to small villages and collections of houses by the roadside. In the centers of towns, through traffic on the main road mingles with animal carts, street vendors, pedestrians and all the other local traffic associated with rural townships. Only three communities have bypasses and it is estimated that there are 14 other towns of sufficient size to warrant bypass construction.

City center to city center, it currently takes about 7 hours to drive from Cairo to Assuit.

Traffic Capacity - Despite the deficiencies of the existing highway, traffic on the roads between towns, while heavy at times, has not yet reached the traffic capacity of the existing road. Nose-to-tail traffic is rare, except in the busiest 2-lane section between Beni Suef and Aiyat, where the 4-lane section out of Cairo ends. While vehicles halted on the highway by breakdowns are a hazard to other traffic, they rarely cause traffic jams. The 44 police check points along the highway, where the road is narrowed to a single lane by a temporary barrier, are a nuisance but do not seriously impede traffic.

However, the road is approaching traffic capacity in many sections, and it will not take much additional traffic for congestion effects to start to be felt.

Prospects up to 1990 - A substantial program of highway improvements is currently underway in the Corridor. The main West Bank Highway is being rehabilitated, with pavement overlays or replacement, and paved shoulders are being constructed on all sections. Thus at the end of this work (programmed to be completed by early 1988) the main West Bank Highway can be expected to be a good, well-aligned, well-surfaced highway with paved shoulders for the entire route. The major deficiency on this road will the sections through existing towns about which nothing is planned to be done.

Moreover, substantial traffic relief will be provided by two new highway construction projects in the Corridor. The East Bank Highway, recently opened as far as Beni Suef, is being extended to Minia, and the Governorates of Fayoum, Beni Suef and Minia are collaborating on the construction of a road upgrading project which will provide at least some sections of highway parallel to the main West Bank Highway. It can be expected that some local traffic will divert to the Inter-Governorate Road, and that some long distance traffic will divert to the other side of the Nile to use the East Bank Highway. Therefore, the likely prospect is

that by 1990, the West Bank Highway will not only be a better road in 1990 than it is now, but traffic volumes using it will be no higher than today. Therefore there is a breathing space. This is just as well since suitable improvements will take time to plan, design and construct.

It would be wrong to be entirely optimistic about the prospects up to 1990. First, and admittedly based on limited evidence, it is concluded that pavement strengths in the Corridor are weak, even considering the current program of pavement rehabilitation. It is feared that unless early action is taken, roads could deteriorate fast under the current very high axle loads imposed by large trucks.

Secondly, there is a serious conflict with the Ministry of Irrigation on the use of road shoulders for dredging the main canals. Not only do the draglines used for this work occupy the highway shoulder, but they dump the saturated dredged material onto the shoulder where it is left for long periods. Road shoulders are an essential part of a modern highway, particularly high volume 2-lane highways, and an accomodation must be reached with the Ministry of Irrigation on this matter. For example, a more acceptable procedure for canal cleaning could be to mount dredging equipment on barges and dump dredged material into other barges.

Prospects from 1990 to 2000 - After 1990, and with no further highway construction or improvement, traffic conditions in the Corridor can be expected to deteriorate steadily. Despite an expected continuing outflow of migrants to other parts of Egypt, the population of the Corridor is expected to grow by 2 million between 1990 and 2000 to 10.6 million (compared with 7.6 million today), and with an increased proportion of the population living in towns. Traffic growth would be inhibited by increasing congestion, but is still forecast to nearly double in the ten years from 1990 to 2000. As a result, most of the route would be above practical traffic capacity (indicating poor driving conditions with slow traffic during substantial periods of the day) with many sections above possible capacity (indicating difficult driving conditions for most of the day). The passages through the towns along the route would be particularly difficult. Driving times from Cairo to Assuit in 2000 could be expected to be 2 to 3 hours longer than the current 7-8 hours.

East Bank Highway - Although the East Bank Highway will be able to relieve the West Bank Highway of long distance traffic, volumes on this route by 2000 are forecast to reach, and in sections exceed, current volumes on the West Bank Highway. By 2000, only the section between Beni Suef and Minia on the East Bank Highway is likely to offer better driving conditions than today. South of Minia, there is no alternative to the West Bank Highway and traffic conditions could be particularly difficult there.

Rail and Waterways - Rail and waterways currently each carry about 2-3 million tons of freight per year in the Corridor, compared with the highway total of 19 million tons of inter-Governorate freight plus at least a further 10 million tons of local freight. Rail carries perhaps 20 million passengers per year in the corridor, a volume matched by both buses and taxis.

The question was asked, could rail and waterways take sufficient of the additional forecast traffic to relieve the existing highway? The Egypt National Transport Study (ENTS) set high growth targets for both these modes, but admitted that they would be hard to achieve. Observations by this Study confirmed that, while progress is being made at least by the railways, the ENTS forecasts are optimistic.

Both rail and waterway transport offer the possibility of reduced transport costs for large volume and long distance movements. Their weakness as modes is that they require a high degree of coordination and planning, and competent staff at all levels of the organization -- management, planning, operations, marketing, equipment maintenance, track maintenance, signalling, storage, collection and delivery. Both rail and waterways are in the public sector and will always find it hard to recruit the staff they need when public and private sector wage structures are so different.

In contrast, highway transport requires little by way of organization, given the availability of vehicle, driver and highway. Ton-kilometer and passenger-kilometer costs for road vehicles might be higher than for rail and waterways, but total door-to-door costs, considering everything including storage charges, timeliness, security and reliability will often swing the calculation in favor of highway transport.

Therefore, while improvements in rail and waterway transport are achievable and worth striving for, it is unrealistic to expect dramatic changes in modal usage. Based on field observations and discussions with the modal agencies, the Study concluded that rail and waterways will do well to maintain their share of passenger and freight traffic, which implies a significant increase in traffic by these modes to accomodate normal growth, and that it would be unrealistic to plan for a major transfer of traffic from roads.

Conclusions on Likely Developments - While the existing highway has some severe problems, work in hand to rehabilitate the existing pavement and to construct new highways in the Corridor will alleviate many of these problems by 1990. After that, traffic conditions are likely to deteriorate seriously. Unless something is done, the Cairo-Assuit Corridor, and the rest of Upper Egypt for which the Corridor is the gateway, will be increasingly isolated from the rest of Egypt. This is a serious problem considering that Upper Egypt contains about 30 percent of the National population.

Improvement of the Existing Highway

The obvious solution to the transport problems of the Corridor is to increase the traffic capacity of the main West Bank Highway. Almost all the communities of the Corridor are located on, or very close to, this road and it clearly offers the most direct link between all the communities. There is little wrong with the alignment of the road, and widening and strengthening could convert it into an excellent all-purpose highway. RBA have made a start on this by widening the first 46 kilometers of road from Cairo (Monib) to Aiyat to 4-lane standard.

Improvements Considered - The Study considered two types of improvement. The first was the construction of bypasses around all communities with serious conflicts between local and through traffic. A total of 14 towns were identified, including the Governorate capitals of Beni Suef and Minia. It was estimated that it would cost LE 25 million (1985/86 financial costs) to construct 82 kilometers of 2-lane bypasses.

The second improvement considered was the widening of the entire road to 4-lane standard, including the bypasses. This was estimated to cost an additional LE 91 million.

Traffic and Economic Impacts - The addition of bypasses and conversion of the entire route to 4-lane standard would transform the West Bank Highway. Not only would travel times be reduced below today's levels with the elimination of traffic congestion, but the road would be significantly safer with an expected sharp drop in traffic accidents. The evaluation indicated that construction would be economically feasible, and that benefits would be felt by all classes of vehicle and all types of traffic, from short distance local movements to long distance through traffic.

Land Requirements - There is a major problem associated with improving the existing Highway, connected with the issue of land requirements.

It is currently the policy of the Egyptian Government that use of agricultural land for other purposes should be restricted as far as possible. The most stringent restrictions are in operation in Upper Egypt, where no agricultural land is permitted to be used for urban or other development. The policy springs from the fact that much of Egypt is desert so that fertile land is a valuable resource which must be maintained for agriculture to feed the rapidly growing population and reduce food imports. Urban and other developments, wherever possible, should therefore be located in desert areas. In practice, this is an extraordinarily difficult policy to enforce, with fringe development edging out from existing urban centers. However, a project to improve the existing West Bank Highway would require over 6 million square meters of agricultural land for widening and bypasses, and would be in blatant conflict with policy.

This argument can be taken a stage further. If Government did give special permission for land to be taken to improve the existing highway, on the basis that this was of strategic importance to promote the development of Upper Egypt, the improved highway would then automatically become the focus of all new development in the Corridor, making the already difficult task of controlling urban encroachment on agricutural land an impossible one. There would be no incentive for new population and factory developments to move away from the existing highway since the desert fringe, where such development could usefully be transferred, would remain isolated and away from the main communications of the Corridor.

It can be concluded that if Government is serious about the policy of preserving agricultural land, the last project to promote is a major improvement to the existing West Bank Highway.

Political Feasibility - A second problem arises in connection with improving the existing highway, again linked to the question of land availability. This is the political feasibility of implementing such a project. Without exception, the Study team faced scepticism and hostility on the possibility of improving the existing road, from RBA headquarters in Cairo to the Governorates and townships along the route.

Aside from questions of cost (taken into account in evaluating economic feasibility) and Government policy on use of agricultural land (discussed above), most doubted that ownership issues could be resolved, especially if houses were involved, in any reasonable timetable. Assuit Govenorate reported that the Dairut Bypass took 8 years to complete with little or no building acquisition required, and quoted long running problems still unresolved after several years in acquiring property in Sohag for road improvement.

RBA headquarters stated that widening the highway from Cairo to Aiyat was possible only because a previously abandoned alignment was available to build the second carriageway. Even so, the road could not be widened through two villages in this section. They also reported that they had studied the question of widening further sections of the route, but found it impossible.

Conclusions on Improving the Existing Highway - Although improving the existing West Bank Highway by adding bypasses and widening to 4-lane standard appears to be the best solution from the traffic and economic viewpoints, such a project would be in serious conflict with Government land policy and would encounter severe political opposition. The Study doubts that such a project could be put into effect, and does not recommend pursuing it further. Improvements to the existing highway should concentrate on providing and maintaining a good surface with adequate paved shoulders. Further growth in local traffic can probably be accomodated by improving parallel roads in the agricultural areas, such as the current project by the Governorates of Fayoum, Beni Suef and Minia. However, it is likely that most traffic will tend to concentrate on the main West Bank Highway, and this poses problems for the longer distance movements in the Corridor.

Construction of a New Cairo-Assuit Highway

The principal engineering task of the Study was the preparation of a preliminary engineering design for a new highway from Cairo to Assuit. This task did not imply a commitment to building the highway; the objective was to study where such a road could be located, identify any potential problems of construction, and estimate costs of construction.

The Alignment Options Report, completed in the first two months of the Study, identified the best location to be on in the desert just outside the agricultural area on the west side of the Nile. During detailed route location, some problems of terrain were encountered at the southern end of the route where the Corridor is confined by rock escarpments on the approaches to Assuit, and areas of sand dunes were identified. Also, the

alignments of the electricity transmission lines from Aswan and the new pipeline to Assuit had to be taken into account. However, it was concluded that a full 4-lane highway could be located in the Corridor designed to the highest geometric standards.

Traffic Analyses - The new highway would suffer some significant disadvantages in attracting traffic from the existing highway. First, it would be longer than the existing highway by nearly 20 kilometers (5 percent of the route length), measured from the center of Cairo to the center of Assuit. Secondly, being located outside the existing developed lands, traffic between destinations within the Corridor would have to travel perhaps an additional 30 kilometers in order to use the new highway, the extra distance being along the access roads to and from the new highway. As the average journey length in the Corridor is only 70 kilometers, this presents a serious disincentive to most traffic, even if conditions on the existing road became intolerable.

For these reasons, the new highway should not be expected to relieve the existing road of large volumes of traffic, and therefore it follows that traffic conditions for local traffic in the Corridor would be improved only marginally by the new highway. However, the new highway would attract a larger proportion of heavy trucks, so the existing road would enjoy some relief from these environmentally damaging vehicles.

Traffic volumes of 10,000 vehicles per day in 2000 were forecast for the northern section of the route between Giza and Beni Suef/Fayoum. South of this point, forecast traffic dropped to between 3,000 and 5,000 vehicles per day. A high proportion of traffic on the route would be trucks (25 percent) and forecast traffic was well distributed among the 14 access points to the road. These forecast volumes indicate 2-lane construction with at-grade intersections in the first construction stage.

Economic Evaluation - The road envisaged by the Study would be of high quality design with good geometrics. A strong pavement would be required able to withstand the high axle loadings prevalent today and likely to persist in view of licensed truck capacities. Estimated costs for a 2-lane highway of this standard are LE 117 million in 1985/86 financial costs.

Despite the comparatively low volumes of traffic forecast for the new road, substantial economic benefits were estimated. These accrued almost exclusively to long distance truck traffic, with 60 percent of the benefits attributable to through movements (Cairo-Assuit without intermediate stops) and less than 4 percent to local traffic moving only within the Corridor.

It was concluded that the new highway would generate sufficient economic benefits to justify a start of construction by 1990. In view of the relatively high cost of the project, foreign funding would be essential. With the necessary checks and controls associated with foreign funding, 1990 is probably the earliest realistic start date for construction. Sensitivity tests indicated that lower traffic growth rates, caused either by slower economic growth or by some transfer of

traffic to other modes, could postpone the optimum date of opening by a few years.

The evaluation is conservative and actual benefits of using the new highway could be substantially higher. In particular, it was assumed that existing road pavements would in future be maintained in better condition than today, with pavement strengthening overlays being performed in advance of obvious pavement distress. If they are permitted to deteriorate as in the past, the new highway (if built to the standards assumed and costed by this Study) would offer a much better surface with significantly lower operating costs.

Also, vehicle operating costs show only modest increases compared with the 1983 ENTS Study (hence benefits are on the low and conservative side), no account was taken of increased congestion if enforcement of axle loads leads to an increase in numbers of trucks, the rate of urbanization was lower than assumed in previous studies (reducing forecast traffic and congestion), benefits from passenger time savings were reduced to one third of the originally calculated values, economic growth rates were modest, and potential major development benefits were not quantified. Less conservative assumptions on these points would strenthen the economic case for the new highway (and also, it must be added, the case for improving the existing road, which was rejected for other reasons).

The reason for making conservative assumptions is the obvious one of not wishing to exagerate the case for the new highway. Consequently, it is believed that the economic justification of the new highway is sound.

Financial Evaluation - The financial evaluation indicated that tolls on the new highway could contribute substantially to construction costs, and could possibly finance the new highway entirely. Much would depend driver reactions to tolls - levels of four times the very low tolls currently charged on the Alexandria Desert Road are envisaged. However, given the build up in congestion forecast by the Study for the existing road, the toll revenue forecasts are not considered over-optimistic.

Environmental and Social Evaluation - It was concluded that the new highway would have some environmental and social advantages by removing traffic from the existing populated areas. However, at the levels of traffic forecast, these benefits could not be a major consideration. The new highway would require some agricultural land -- about 1.3 million square meters -- almost entirely to widen the existing roads across the agricultural area to give access to the new highway.

Role of the East Bank Highway - It is clear that the construction of a new West Bank highway would not be a panacea to all the traffic problems of the Corridor, benefiting long distance truck traffic almost exclusively. The question must therefore be asked, could the East Bank Highway be upgraded and extended to fulfill the same role at lower cost?

The East Bank Highway was not examined in detail in the main phase of the Study, but was examined in the Alignment Options Phase at the start of the Study. It was concluded then that the East Bank Highway suffers from the key disadvantage of limited access to existing Corridor communities.

Good access to all communities in the Corridor is important. A feature of the traffic forecasts for the new West Bank Highway is the even spread of traffic across all the access roads. Although the new highway favors long distance traffic, it is not just traffic between Governorate capitals. Excluding traffic entering and leaving by the northern and southern termini, it was forecast that just under 50 percent of all traffic and nearly 60 percent of trucks accessed the new highway from non-Governorate capitals. Hence an alternative should also provide this even access along the Corridor to have the same impact as the new highway evaluated by this Study.

It would be expensive to provide access from the East Bank Highway to most communities in the Corridor because they are almost exclusively located on the West Bank. Considering only the Governorates of Beni Suef, Minia and Assuit, the 2000 population in the Corridor is forecast to be about 7.6 million, of which only 1.8 million would be living in the existing bridgeheads towns of Beni Suef, Minia and Assuit. New Nile bridges are expensive, with the new Beni Suef and Minia bridges costing about LE 10 million each in terms of early 1980 prices. Considering land acquisition, approach road construction, and the need to cross major irrigation canals and the main line railway, the cost per bridge would probably be of the order of LE 15 million in 1985/86 prices.

Apart from new Nile bridges, the East Bank Highway would require much new construction and upgrading to bring it up to the standards specified for the new West Bank Highway. About 60 kilometers of new construction would be required at the northern end from Helwan to Koralmat, and a further 130 kilometers of new construction through the difficult terrain south of Minia to Assuit. The entire road would require strengthening of the pavement to carry the truck traffic forecast for the new highway. It can confidently be concluded that upgrading the East Bank Highway to extend the road and provide access to the West Bank would certainly not be a low cost alternative to the proposed new West Bank Highway.

Development Prospects - The Study firmly believes that there is a great planning opportunity associated with a new Cairo-Assuit Highway and that this is where the real potential of the highway lies. Within the Corridor, a potential population of over 10 million people would be living within 5 to 20 kilometers of the new road. Opportunities exist for extending the agricultural area in what is currently the fringe of the accessible zone. It provides an opportunity for new towns and communities having the advantages of good access to north and south, close proximity to the existing population centers from where the people would come, and room to expand industry, major and minor, without the contraints imposed by the ban on using arable land. In short, it would give the Corridor room to breath.

There was much enthusiasm in the Corridor over the prospect of a new Cairo-Assuit Highway in the location for just these reasons. Of course it can be argued, with justice, that these opportunities exist now, that communities can move out to the edge of the agricultural area without a new road and create new areas to live and work. The key advantage that

the new highway would bring is one of focus and accessibility. If the new highway is committed, then both Government development agencies and local communities would be able to make similar commitments with a sense of united purpose. A major effort would be required to initiate development plans, and strong controls would be required thereafter to ensure that the advantages of the new highway were not undermined by careless development and uncontrolled access.

Potential development benefits of a new highway are ofter regarded by lending institutions with great and justifiable suspicion. Too often, it is the easy way to justify a new road which could not be justified by other means. In this case though, the Study believes that there is a sound economic case for constructing the new highway, and that the potential development opportunities and benefits are an additional argument in its favor. However, it could be concluded that these additional arguments are sufficiently strong to offset the conclusions from the sensitivity tests; making the recommendation for a 1990 start date for construction a firm one.

Staging of the New Highway - The Study recommends that the initial construction should be to 2-lane standard with at-grade intersections. Reservation of land for full 4-lane construction should be made, but timing of further construction would depend on actual traffic growth.

The traffic analyses suggested that construction should be started from Assuit, extending northwards to Cairo. However, the case is not strong, and the full potential of the route would not be reached until the full route is completed. Development reasons would suggest that the road be started from Cairo extending southwards, since this will create a stronger impression of opening up the Corridor for new development which would probably gain most strength from ties to Cairo and the North. The Study therefore recommends construction starting from Cairo.

Conclusions on the New Highway - It is considered that if a major improvement of the existing highway is ruled out for Government land policy and practical implementation reasons, then long distance access to Upper Egypt communities both in and beyond the Cairo-Assuit Corridor must be provided for. While rail, waterways and continued development of the East Bank Highway could all contribute to further growth, the potential of a new West Bank Highway is much greater.

Other Issues

Other important issues raised during the Study are summarized here.

Traffic Census Program - A difficulty experienced in the Study was the lack of a regular traffic census program from which to judge traffic growth rates, both overall and by vehicle type. Some counts were available from previous Studies, but lack of knowledge of exact count site locations, and uncertainty on the traffic counting and classification procedures made it difficult to make reliable estimates of traffic growth. A better solution would be a regular program of traffic counts with an annual report available to all traffic planning consultants and

agencies. It is known that plans are in hand for just such a program and this is strongly endorsed by this Study.

Truck Weights - The present situation regarding truck weights is most unsatisfactory, with trucks routinely licensed to carry more than legal axle loads permit, and no control of overloading. At the same time, roads are still being designed assuming legal axle loads are adhered to. The result is that pavements deteriorate rapidly, creating dangerous road surfaces, and increasing vehicle operating costs substantially.

A case could probably be made for permitting an increase in legal axle loads to obtain greater cargo carrying capacity of trucks and therefore reduce traffic congestion. This case has been argued in many studies, and is well summarized in the UK Road Research Laboratory Report 1002 "Optimum Axle Loads of Commercial Vehicles in Developing Countries" (Reference 16).

However, a decision to make such a change must be a National decision taking into account the costs of strengthening existing inadequate road and bridge structures. Whatever is done about changing legal axle loads, it is important that new road structures are designed to take full account of actual axle loadings.

This Study strongly recommends that a more detailed study be made of this issue.

Pavement Strengthening Policy - This Study strongly recommends that RBA adopt more modern methods of planning for pavement strengthening. Current practise is to wait for signs of visible distress before planning new overlays or rehabilitation. By the time the work can be financed and implemented, pavement structures and surfaces have deteriorated to unacceptable levels, causing high vehicle operating costs and severely reducing any contribution to final pavement strength of the overlayed structure. In the long run, earlier overlays are less expensive, and maintain better surfaces. Various methods, such as taking deflection measurements at regular intervals, are available to assess pavement condition, and some procedure should be adopted by RBA as part of the regular pavement maintenance program.

In particular, it is feared that the current program of rehabilitation in the Corridor will not be sufficient to prevent deterioration under the high axle loads imposed by heavy trucks. It was estimated that an additional overlay on the improved surfaces, if undertaken in the next few years, would be sufficient to maintain the surface for many years after that. However, the data on which this conclusion is based were limited, and were certainly insufficient for detailed programming purposes. There is no satisfactory substitute for a detailed survey of pavement condition for preparing a program of new work.

Urban Traffic Planning in the Corridor - Although urban traffic planning issues were clearly beyond the scope of this Study, it was observed that many of the towns in the Corridor present chaotic traffic conditions which can be expected to get worse over time as car ownership and population increase. In particular, the Governorate capitals of Fayoum, Beni Suef, Minia and Assuit are facing traffic problems which deserve detailed study.

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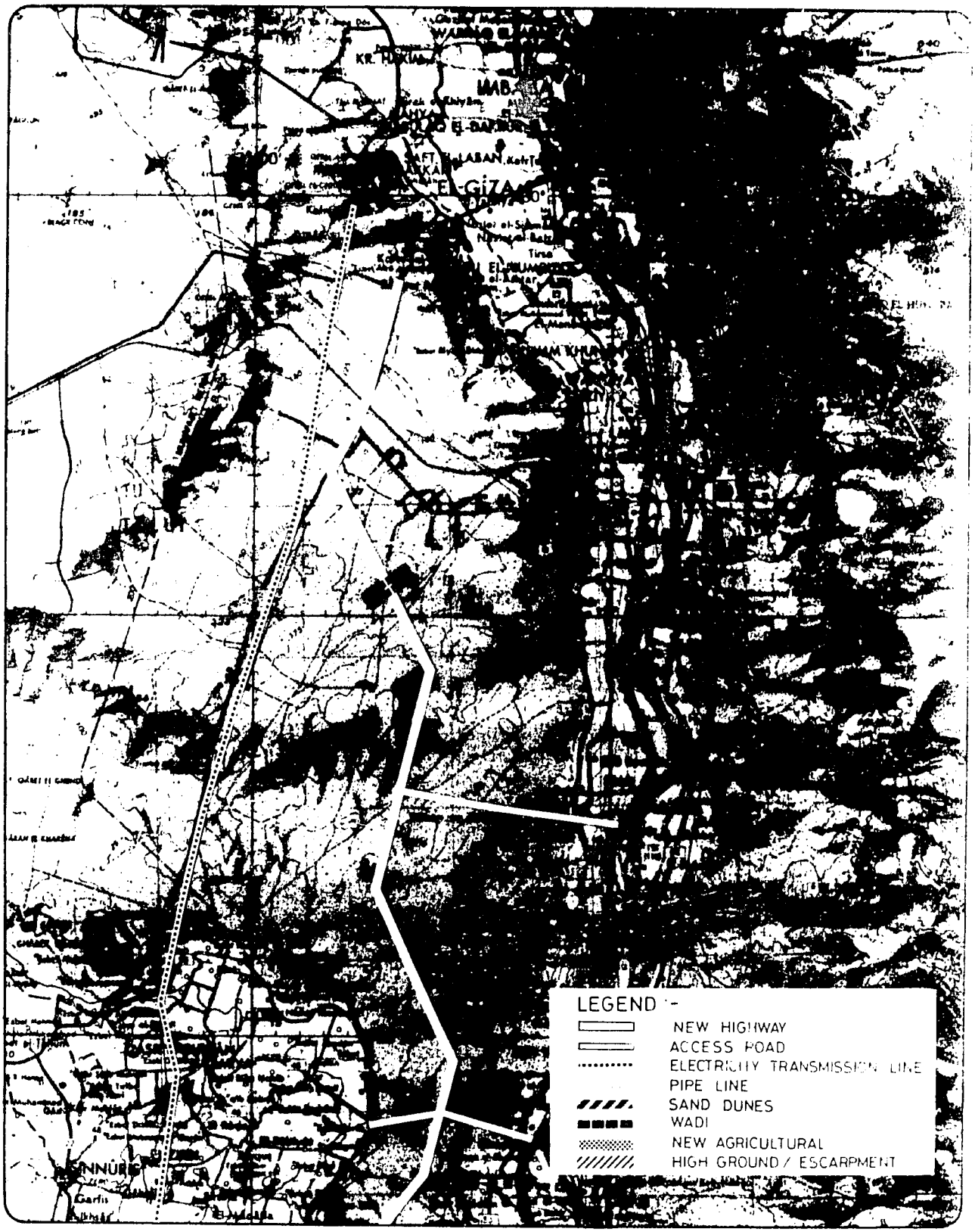
NEW HIGHWAY LOCATION DRAWINGS



Cairo – Assuit Highway Feasibility Study

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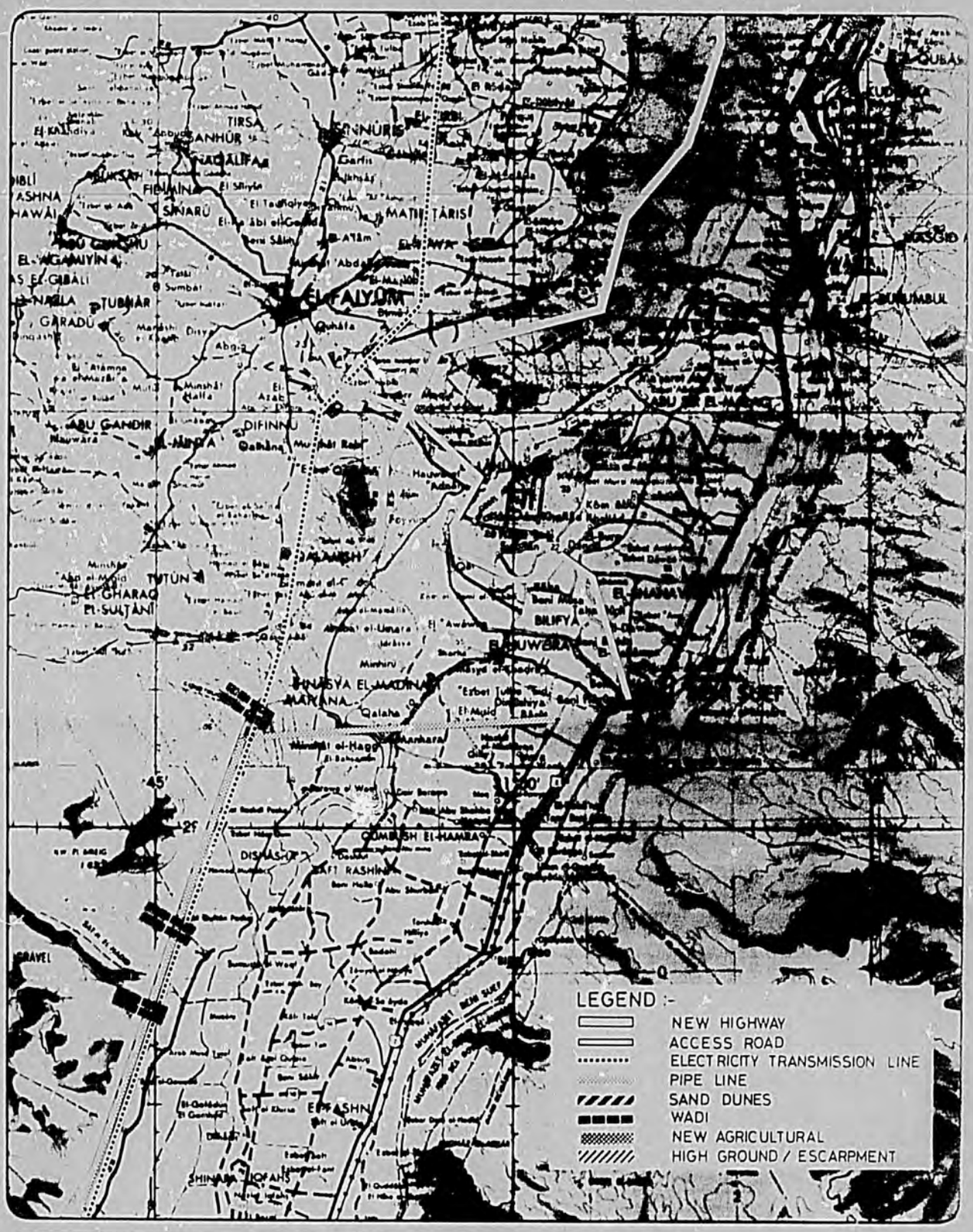
Egyptian Consultants Consortium

NEW HIGHWAY LOCATION
GIZA TO GERZA



Cairo – Assuit Highway Feasibility Study

NEW HIGHWAY LOCATION
GERZA TO FASHN

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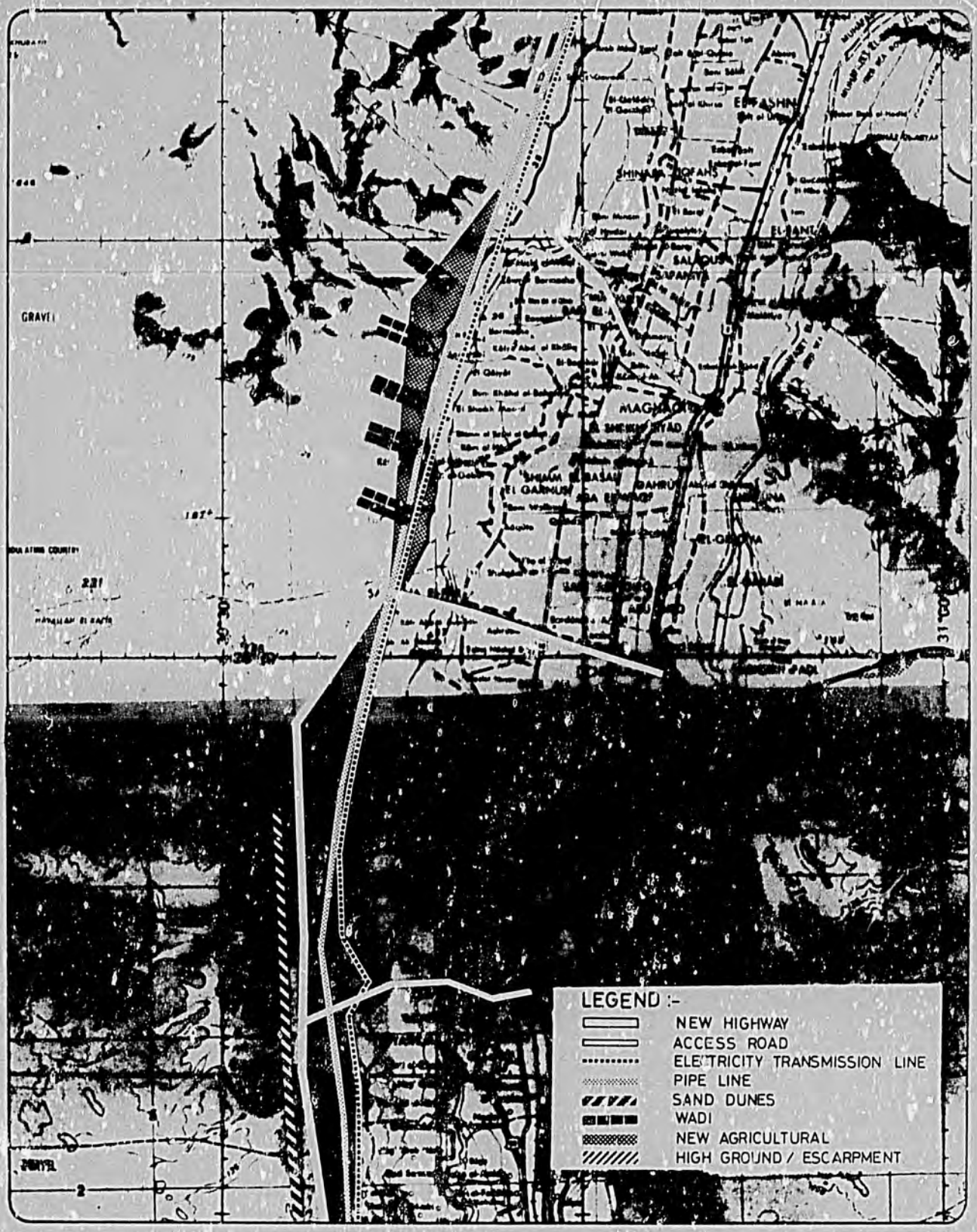

Cairo – Assuit Highway Feasibility Study

NEW HIGHWAY LOCATION
FASHN TO SAMALUT

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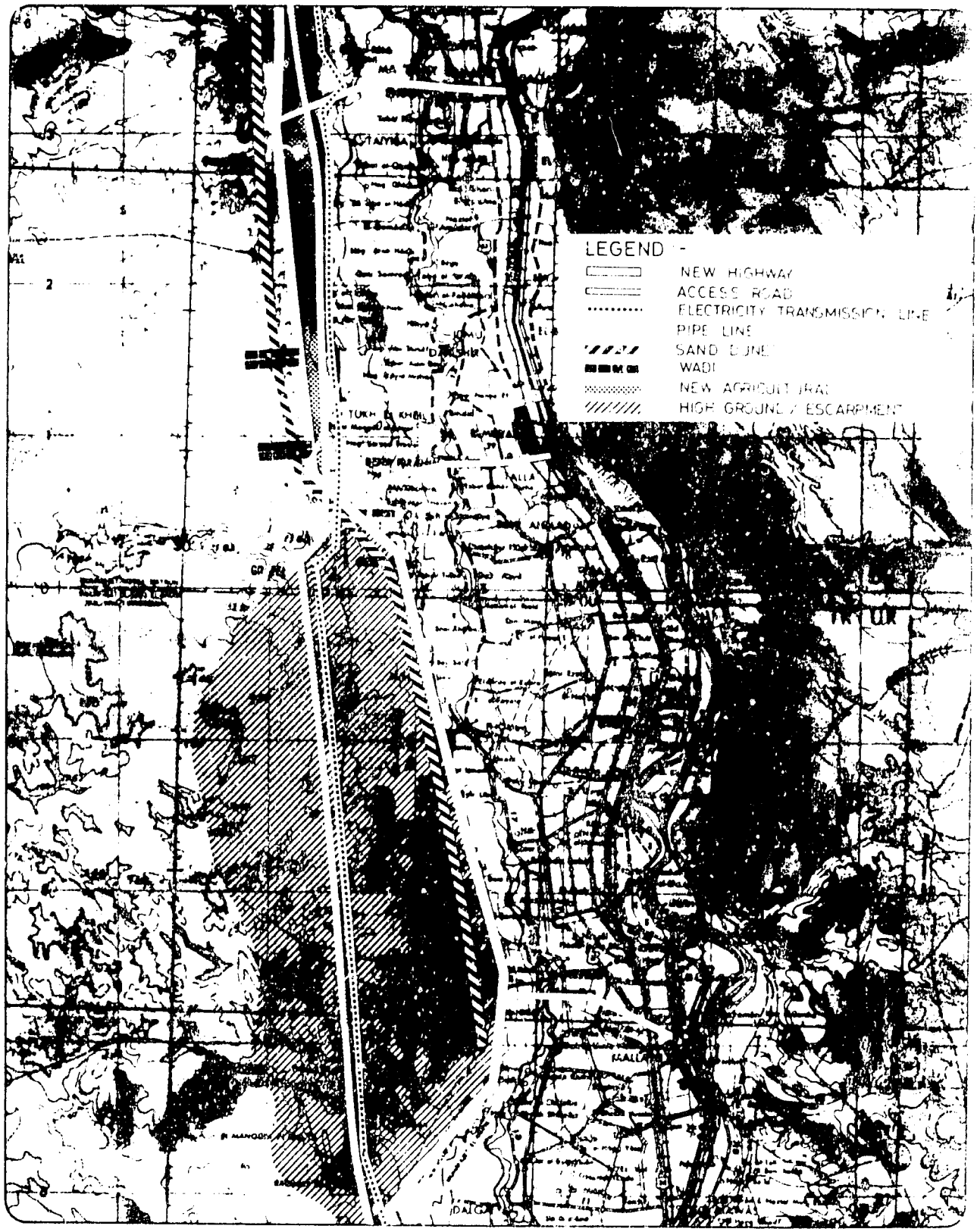

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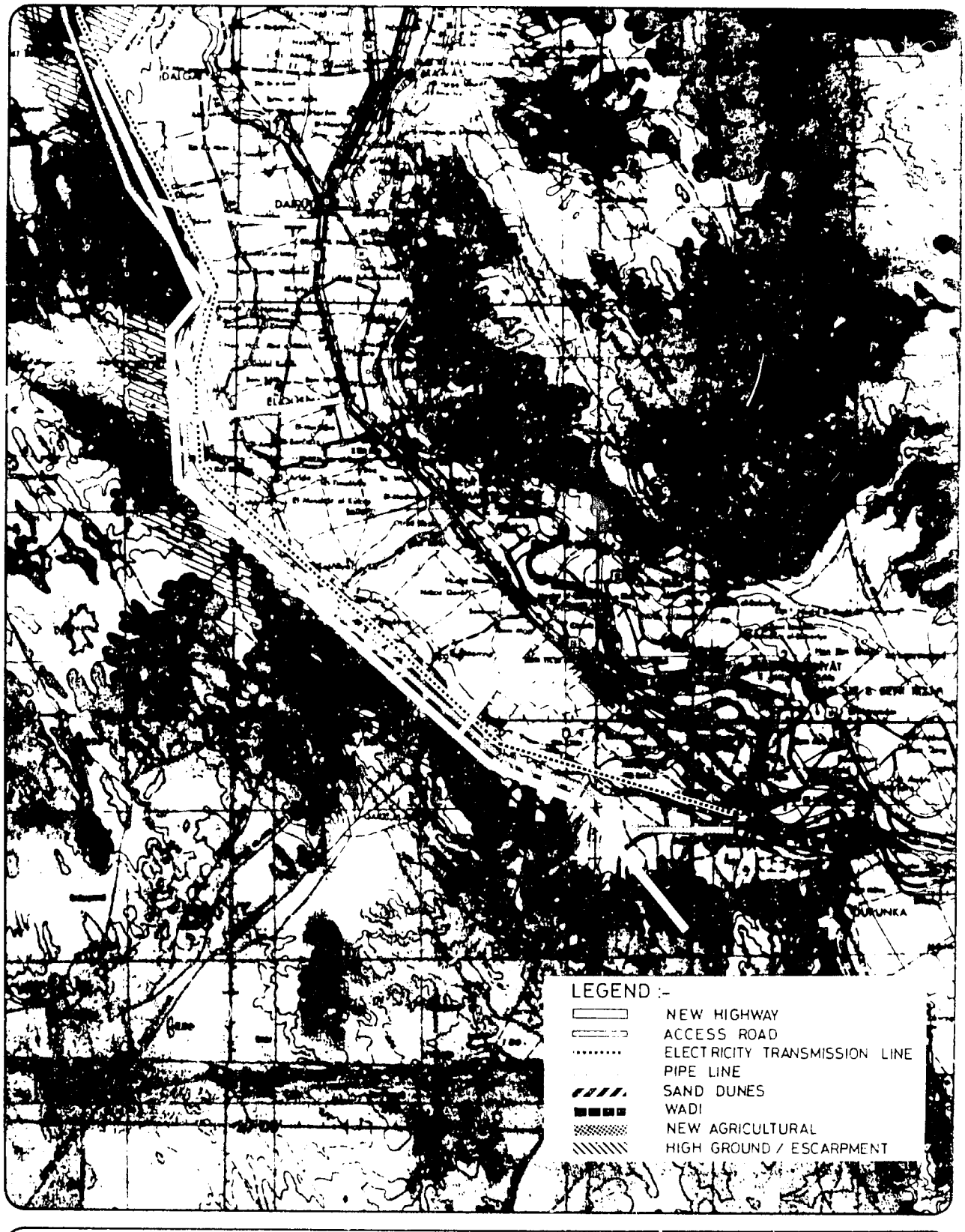
NEW HIGHWAY LOCATION
SAMALUT TO DEIR MAWAS



Cairo – Assuit Highway Feasibility Study

NEW HIGHWAY LOCATION
DEIR MAWAS TO ASSUIT

Wilbur Smith & Associates
Egyptian Consultants Consortium

تخطيط المرور الحضرى فى المحور :

على الرغم من ان نتائج تخطيط المرور الحضرى كانت خارج نطاق هذه الدراسة بشكل واضح ، لوحظ ان عديد من المدن فى المحور تسود فيه ظروف مرور غير منتظمة ومشوشة ويمكن ان تزيد سوءا مع مرور الوقت مع زيادة ملكية السيارات والسكان . وعلى الاخص ، تواجه عواصم محافظات الفيوم وبنى سويف والمنيا واسيوط مشاكل مرور تستحق دراسة مفصلة .

نتائج حول الطريق الجديد :

تم التوصل الى انه اذا لم يتم تحسين كبير للطريق الحالى بسبب سياسة الاراضى التى تتبعها الحكومة، واسباب التنفيذ العملية ، فانه يجب توفير مداخل طويلة المسافة لتجمعات مصر العليا داخل وخارج محور القاهرة - اسيوط . فى حين يمكن ان تساهم السكك الحديدية والطرق النهرية والتطور المستمر فى طريق الضفة الشرقية فى نمو اكثر ، وعلى ذلك يظهر احتمال انشاء طريق جديد على الضفة الغربية بصورة اكبر .

نتائج أخرى :

ظهرت نتائج اخرى خلال الدراسة وقد لخصناها فيما يلى :

برنامج حصر المرور : كان يمكن لبرنامج منتظم لحصر المرور ذو تقرير سنوى ان يساهم ويساعد الدراسة بشكل ملحوظ . ومن المعروف ان الخطط متوفرة حاليا لمثل هذا البرنامج ومثل هذا البرنامج تؤيده هذه الدراسة بقوة .

أوزان عربات النقل : اوصت الدراسة بأنه يجب دراسة تصاريح اوزان عربات النقل ومحاورها بشكل اكثر تفصيلا . وسيتطلب تدخل قومى لحل هذه المشكلة مما قد يتضمن زيادة الحمولة القانونية .

سياسة تقوية الرصف : وتوصى هذه الدراسة بشدة بضرورة تبنى هيئة الطرق والكبارى لوسائل تخطيط حديثة لتقوية الرصف . وهناك مختلف الوسائل كأخذ قياسات الانبعاج على فترات منتظمة لتقدير حالة الرصف ، وهناك بعض الاجراءات التى يجب ان تتبعها هيئة الطرق والكبارى كجزء من برنامج صيانة الطريق المنتظم .
وعلى الاخص ، يخشى الا يكون البرنامج الحالى للاصلاح فى المحور كافيا لمنع التدهور تحت الحمولات الزائدة التى تفرضها عربات النقل الثقيلة . وعموما ، فالمعلومات التى بنيت عليها هذه النتائج كانت محدودة ، وبالتالى غير كافية لاغراض وضع برنامج تفصيلى . ولا يوجد بديل كافى لحصر مفصل عن حالة الطريق لاعداد برنامج لعمل جديد .

التقييم البيئى والاقتصادى :

تم التوصل الى ان الطريق الجديد يمكن أن يكون له فوائد بيئية واجتماعية عن طريق تحويل المرور عن المناطق الحالية العالية الكثافة . وعموما ، عند مستويات توقعات المرور ، فهذه الفوائد لن تكون جديرة بالاعتبار . وسيحتاج الطريق الجديد الى بعض الارض الزراعية - حوالى ٣ر١ مليون متر مربع - وغالبا كلها لتوسيع الطرق الحالية العابرة للمناطق الزراعية بغرض توفير تداخل الى الطريق الجديد .

احتمالات التنمية :

تعتقد الدراسة اعتقادا راسخا بأنه هناك فرصة كبيرة مرتبطة بطريق القاهرة/ اسيوط الجديد حيث يوجد الاحتمال الفعلى للطريق . فداخل المحور كثافة سكانية مقدرة حجمها اكثر من ١٠ مليون نسمة داخل ٥و٢٠ كم من الطريق الجديد - وهناك فرص لمد المنطقة الزراعية لما يطلق عليه حاليا حدود المنطقة التى يمكن الدخول اليها . وهو يوفر الفرص لمدن وتجمعات جديدة لها مميزات الدخول من الشمال والجنوب والقرب من وسط التجمعات الحالية حيث سيأتى الافراد ، كما توفر المكان لنشر الصناعة الكبيرة والصغيرة دون الخوف من استخدام الاراضى الصالحة للزراعة .

والخلاصة انه سيعطى متنفس للمحور .

وفوائد التنمية المتوقعة لطريق جديد تكون محطة شكوك لها مايبررها من مؤسسات الاقراض فكثيرا ماتكون اسهل خط لتبرير طريق جديد لا يبرره الوسائل الاخرى . وفى هذه الحالة تعتقد الدراسة ان هناك فائدة اقتصادية كبيرة لانشاء الطريق الجديد وأن فرص التنمية والفوائد هى مجرد نقطة اخرى لصالح المشروع .

تحسين مراحل الطريق الجديد :

توصى الدراسة بأن تكون المرحلة المبدئية للانشاء من حارتين نموذجيتين مع تقاطعات مستوية . ويجب ويجب ان يعمل حساب الاراضى اللازمة لانشاء ٤ حارات الا ان التوقيت اللازم لها سيعتمد على نمو المرور الحالى . ولاسباب التطور توصى الدراسة ببدء الانشاء من القاهرة ، مما سيعطى اتجاه بابتداء فتح المنطقة للتنمية مما سيجنى الفوائد من ربطها بالقاهرة والشمال .

المرور الى التركيز على الطريق على الضفة الغربية مما يطبع مشاكل امام المـــرور لمسافات اطول على المحور .

انشاء طريق القاهرة ـ اسيوط الجديد :

والبديل لتحسين الطريق الحالى هو انشاء طريق جديد كامل من القاهرة الـى اسيوط . ومثل هذا المشروع يمكنه ان يؤدى الى حل مشاكل التوصيل للتحركـــات طويلة المسافة فـــى المحور .

تحليل المـــرور :

تم توقيع احجام مرور تصل الى ١٠٫٠٠٠ سيارة يوميا سنة ٢٠٠٠ للقطاع الشمالـى من الطريق وتقل الى ٣٠٠٠ ـ ٥٠٠٠ جنوب بنى سويف . وهذه الاحجام منخفضـــة اساسا بسبب ان اغلب المرور فى المحور قصير المسافة (اكثر من نصف الرحلات يتـــم لمسافة اقل من ٣٠ كم) ولن يجد من المفيد السفر الى ومن الطريق الجديد .

التقييم الاقتصادى :

تم التوصل الى انه ، على الرغم من احجام المرور المنخفضة على الطريق الجديـد فهو سيقدم فوائد اقتصادية كافية للبدء فى انشائه حوالى عام ١٩٩٠ . ونظـــرا لتكاليف المشروع العالية نسبيا ، والتمويل الاجنبى سيكون ضرورى مع مايستلزمه مـــن رقابة وتحكم كأساس للتمويل الاجنبى . ويعتبر عام ١٩٩٠ اقرب تاريخ واقعى للبـــدء فى الانشاء .

التقييم المـــالى :

اشار التقييم المالى الى ان رسوم المرور على الطريق الجديد ستساهم بشكـــل فعال فى تكاليف الانشاء بل ويمكنها تمويل المشروع بأكمله ـ وسيعتمد الكثير على رد فعل السائق بالنسبة للرسوم المفروضة ـ المساوية لاربعة اضعاف الرسوم البسيطة المفروضـــة حاليا على طريق القاهرة ـ الاسكندرية الصحراوى . ومع ذلك ، فنظرا لتوقعـــات الازدحام التى توصلت اليها الدراسة للطريق الحالى ـ فتوقعات عوائد الرسوم لا تعتبر شديدة التفـــاؤل .

اصلاح كبير ان يحسن من رصف الطريق الحالى وبناء طرق جديدة فى المحور سيساعد فى حل هذه المشاكل فى عام ١٩٩٠ .

وفى الواقع ، فالسعة الاضافية للمرور الجارى اضافتها حاليا فى المحور سيؤدى الى مستوى احجام مرور على طريق الضفة الغربية بحوالى نفس المستوى الحالى حتى ١٩٩٠ . وبعد ذلك ، فأحوال المرور يتوقع ان تتدهور بشدة . واذ الم يتم عمل شىء فمحور القاهرة اسيوط وباقى مصر العليا الذى يشكل المحور بوابته ، سيتم عزله بدرجة تزداد يوما بعد يوم عن باقى مصر وهذه مشكلة خطيرة باعتبار ان مصر العليا تحوى حوالى ٣٠ ٪ من السكان .

تحسين الطريق الحالى :

والحل الواضح لمشاكل النقل — المحور هو زيادة سعة المرور على الطريق الرئيسى على الضفة الغربية والغالبية العظمى من التجمعات السكنية تقع على او بالقرب من هذا الطريق الذى يشكل تبعا لذلك الوصلة بين كل هذه التجمعات ومسار الطريق لا يصيبه الكثير ، ويمكن بالتوسيع والتنويه ان يتحول الى طريق ممتاز يخدم جميع الاغراض . وقد اخذت هذه الدراسة فى الاعتبار اضافة طرق تحويليه حول ١٤ مدينة بطول الطريق ، وتوسيع الطريق بأكمله الى ٤ حارات نموذجية .

وقد تم التوصل الى ان تحسين الطريق الحالى ، يعتبر افضل حل من وجهات النظر الاقتصادية والمرورية . وعموما ، فهذا المشروع سيدخل فى مناقشات مع سياسة الاراضى للحكومة ، عن طريق اخذ حوالى ٦ مليون متر مربع من الاراضى الزراعية للانشاءات الحديثة للطريق والتوسيع . وبعد ذلك فى التعرف على التطورات الحضرية وغيرها فى المحور . فضلا من ان المشروع محتمل ان يقابل مثل هذه المعارضة السياسية الخطيرة مما سيجعل تنفيذه فى موعد مستحيلا . وتشك الدراسة فى امكانية تنفيذ مثل هذا المشروع ، ولا توصى بالاستمرار فيه اكثر من ذلك . والتحسينات على الطريق الحالى يجب أن تركز على توفير وصيانة طبقة سطح جيدة مع اكتاب مرصوفة جيدا . والزيادة التالية فى المرور المحلى يمكن معالجتها بتحسين الطريق الموازية فى المناطق الزراعية مثل المشروع الحالى فى محافظات بنى سويف والفيوم والمنيا . وعموما . فيحتمل ان يرى اغلب

النتائـج والتوصيـــات

تمثل أهم هدف لهذه الدراسة ، تبعا لنص العقد ، فى تحديد ماذا كـــان استخدام استثمار كبير فى انشاء الطرق او تحسينها له مايبرره . والغرض من هـذه الدراسة هو ان هذا الاستثمار الكبير له مبرر ، وأنه يجب ان يأخذ شكل طريـــق جديد بين القاهرة واسيوط ، يقع فى الصحراء . وأن يكون غير بعيد عن الاراضى الزراعية الحالية فى الضفة الغربية للنيل . وهو مفضل عن البديل الاخر الـــذى عاينته الدراسة والذى يتمثل فى عمل استثمارات كبيرة فى الطريق الحالى على الضفة الغربية .

ولقد اوضح التقييم الاقتصادى ان الطريق الجديد سوف يولد فوائد اقتصادية كافية تؤيد الانشاء وبالاضافة الى ذلك فانه يعتقد ان الدور الاساسى للطريـــق الجديد يمكن ان يلقى الضوء على تنمية جديدة فى مصر العليا والتى كانت مهملـــة لمدة طويلة وهذه ليست قضية لمهندسى تخطيط الطريق فقط ولكن تحتاج ويستحـق انتباه الحكومة على اعلى مستوى .

ويمكن ان تأخذ الحكومة قرار فى المشروع والتى لها علاقة بأولويات اخرى فى قطـــاع النقل وغيره . والغرض من هذه الدراسة هى لوضع القاعدة الاساسية التى تتأسـس عليها المناقشات والخطط .

واذا قبلت نتائج هذه الدراسة لطريق القاهرة اسيوط الجديد ، توصى الدراســة بالبدء فورا فى اجراءات تؤدى الى التصميم النهائى وطرح عطاء الانشاء للبدء فـــى انشائه عام ١٩٩٠ . ولقد قدر ان المرحلة الاولى للانشاء والتى تتكون من طريـــق حارتين بتقاطعات مستوية سوف يتكلف ١١٧ مليون جنيه باسعار ١٩٨٦/٨٥ .

الموقف الحالى والتطورات المحتملة :

الطريق الحالى من القاهرة حـــتى اسيوط طريق خطر وغير مريح فى استعمالـــه وعلى الاخص ، تنقصه الاكتاف فى اغلب الطريق ، وحالة الرصف سيئة ويمر الطريـــق داخل تجمعات عديدة حيث يختلط المرور بالسيارات التى تجرها حيوانات ، والبائعين المتجولين والمشاه وكل انواع المرور الاخرى المرتبطة بالمدن الريفية .

ومع ذلك ، فحين نجد ان الطريق الحالى يعانى من بعض المشكلات فيمكن لبرنامج

وباستخدام شركات تم تنفيذه واتمامه فى ثلاث سنوات .
وقد قدر التكوين الادارى لهيئة الطرق والكبارى كتكوين جيد لا يضع اى عقبات امام تنفيذ المشروع . وبناء على مساعدة البنك الدولى فى مشروع صيانة الطرق بمصر ، تم تحديد العجز فى الاشخاص والمهمات فى الادارات ومستويات المناطق فى هيئة الطرق والكبارى وجارى الان اصلاح هذا العجز .
وتشير اعمال هيئة الطرق والكبارى الحالية الى امكانيتها لانشاء واصلاح حوالى ٤٠٠-٥٠٠ كم سنويا . مقدر ان نستطيع القوى العاملة المتخصصة والفنية أن تتحمل زيادة انتاج سنوية بمقدار من ٣٤-٣٨ ٪ لشركات الانشاء العامه والخاصة وباعطاءها التمويلات اللازمة بما فيها العملة الصعبة ، لن يوجد صعوبات حادة لتنفيذ ناجح لمشروع طريق القاهرة اسيوط من هيئة الطرق والكبارى .

ومصادر التمويل الخاص لتمويل مشروعات الطرق بين المدن لا يدخل فى الاختصاص القانونى لهيئة الطرق والكبارى . فمثل هذا العرض ، فى رأى هيئة الطرق والكبارى ، سيتم رفضه من وزارة النقل . والجهات السياسية العليا .

السياسة والادارة :

تم عمل مراجعة لسياسة النقل ومدى تأثيرها على تخطيط الطريق ، وقدرة هيئة الطرق والكبارى على تنفيذ مشروعات طرق جديدة كبيرة .

سياسة النقل :

كما هو موضح فى الخطة الخمسية ، يبدو ان السياسة القومية تتجه نحو تشجيع ومد نصيب السكك الحديدية والطرق النهرية فى نقل الركاب والبضائع داخليا مقابل نصيب الطرق البرية والطريق على الضفة الغربية والطريق السودانى يبدو أن اهم المشروعات الانشائية لهيئة الطرق والكبارى .

وعموما - يدخل فى قطاع الطريق ، فالتأكيد الاقوى هو التحسين والصيانة لشبكة الطرق الحالية .

وسياسة هيئة الطرق والكبارى الداخلية تدعم الاهداف القومية .

التمويل :

تخصص ميزانية الخطة الخمسية لشبكة الطرق بين المدن مبلغ ٢٠٠ مليون جنيه لهيئة الطرق والكبارى ، ٦ر٤٧٪ من المجموع ، فى حين يبقى الباقى مخصص لوزارات التعمير والحكم المحلى . والمبلغ المطلوب اساسه من هيئة الطرق والكبارى لهذه الفترة هو ٣٥٠ مليون جنيه . وهدف هيئة الطرق والكبارى فى خطتها الخمسية الحالية هو التأكيد على اصلاح الطريق . و٦٠٪ من الميزانية الكلية مخصص لهذه المهمة .

وقدرت نفقات عامى ٨٥/١٩٨٦ بحوالى ٤٦ مليون جنيه باسعار عام ١٩٨٥ ، ونفقات عام ٨٦/١٩٨٧ مقدرة ان تكون ٤٨ مليون جنيه . الا أن التوقعات الحالية تؤكد ميزانية متوسطة تبلغ ٤ر٤١ مليون جنيه .

قدرة هيئة الطرق والكبارى على التنفيذ :

يبدو أن مقدار انشاءات وتحسينات الطرق المتممة سنويا عن طريق هيئة الطرق والكبارى يعتمد اساسا على مبلغ التمويل المتاح . فمثلا ، حين تقدم الميزانية الاضافية ، الاموال يتم تصميم النصف الثانى من طريق القاهرة الاسكندرية (حوالى ٢٠٠ كم) وطرحه فى مناقصة ادارتها هيئة الطرق والكبارى فى حوالى عام ،

تقديرات موارد الارض :

سيتطلب الطريق الجديد حوالى ٣ر١ مليون متر مربع من الاراضى الزراعية غالبيتها لعمل طرق التوصيل الذى يمكن اعتباره اثر معاكس متوسط . حيث نجد ان الاثر المضاد للطرق التحويلية وطريق الضفة الغربية يتطلب حوالى ٣ر٦ مليون متر مربع من الاراضى الزراعية والتى من المحتمل اعتبارها ذات قيمة كبيرة .

الموارد الطبيعية والتاريخية والثقافية والجمالية :

لم يمكن تحديد اى اثار ناتجة عن بدائل الطريق بالنسبة الى الموارد الطبيعية والتاريخية والثقافية والجمالية . وسيتم تحسين التوصيل للمواقع الاثرية والتاريخية والثقافية لدرجة ان كل بديل يحسن امكانية الوصول بأجمعها .

تقدير الاثر الاجتماعى :

يمكن تحديد اثار اجتماعية مختلفة ومركبة ، كل منها مضاد ومفيد . وعموما فتلك ذات الارتباط الاكثر مباشرة بالبدائل هى النتيجة المضادة لاستطلاع الاراضى الزراعية . والنتائج الاجتماعية المرتبطة بتحويل الارض الزراعية تبلغ نسبة مقاربة للمقدار المطلوب من الاراضى كما سبق وشرحنا فيما يتصل بموارد الارض . وهناك فوائد تنمية متوقعة والتى تشتق من الطريق الصحراوى الجديد بشكل فتح اراضى جديدة على حدود الصحراء للاستغلال او الاستصلاح .

وعموما فهذه الفوائد لا يمكن ان تنتج فقط من انشاء الطريق - بل ستتطلب استثمارات اضافية فى البنية التحتيه والمجالات الاقتصادية الاخرى . وسيمكن تحسين التسهيلات الاجتماعية والثقافية بوجه عام عن طريق اى من البدائل المختارة .

نتيجة عامة : يمكن تحديد الاثار الاجتماعية والبيئية لحد معين - الا انها تظل فى جزء كبير احتماله وقابلة للحكم . وفى الحالة الحالية ، فالعوامل البيئية التى لها اعلى نسبة قابلية لاصدار او استقبال الاثار الملحوظة هى الضوضاء وموارد الارض .

وفى شكل متوازن ، يبدو ان الطريق الجديد يمنح اقل مخاطرة للتعرض للآثار العكسية واعلى احتمال للفوائد الايجابية . وهو يقوم بذلك ليس عن طريق تقليل الاثار الناتجة بل عن طريق نقل مصدر الاثر بعيدا عن المعرضين لها . اساسا عن طريق تحويل الطريق ومروره بعيدا عن التجمعات السكنية .

التقييم البيئى والاجتماعى :

وهدف التقرير الاجتماعى والبيئى هو تحديد الاثار البيئية الواضحة والنتائج الاجتماعية التى يمكن فحصها اكثر تفصيلا اذا ظهرت اهمية عمل تقييم مفصل فى مرحلة تالية .

تقدير جودة المياه :

وأهم عامل فى تحديد حالة جودة المياه هو ندرة سقوط الامطار بكمية الامطار القليلة لا تؤدى تقريبا لنقل اى عناصر تلوث للطرق المائية . ولهذا السبب فحالة جودة المياه الناتجه عن البدائل ، يمكن اعتبارها كلها غير ذات معنى او هامشيه وعموما ، فالطريق الجديد يتمتع بميزة اكبر من تحسين الطريق الحالى حيث انه ينقل المرور بعيدا عن منطقة قنوات الرى .

تقدير جودة الهواء :

فضلا عن ان مقدار التغير فى احجام المرور وأيضا الحجم الكلى للمرور المتحرك بطول المحور لكل البدائل قليل بدرجة كافية يمكن معها اعتبار اى تأثير لجودة الهواء غير ذات معنى او هامشية . فأحجام المرور ستتغير بما يساوى نصف المقدار اللازم لاحداث اثار ملحوظة . وعموما ، فالطريق الجديد يؤدى الى اقل الاثار العكسية وأعلى مستوى من التحسين . ويمكن عمل ذلك بعد السماح بسرعة تشغيل اسرع واكثر فاعلية وعن طريق ابعاد مصدر التلوث بعيدا عن التجمعات السكنية .

تقدير الضوضاء :

انه يمكن تسجيل انخفاض واضح فى مستويات الضوضاء التى يمكن قبولها بواسطة السكان المحليين اذا تم تحويل حجم معقول من مرور عربات النقل بعيدا عن طريق الضفة الغربية . والطرق التحويلية تغطى بعض الاحتمالات لتنفيذ ذلك عن طريق تحويل المرور حول وسط المدن بدلا من اختراق وسط المدن . ومع ذلك ، فان الطريق الصحراوى الجديد يقدم احتمال افضل لتقليل الضوضاء عن طريق تحويل احجام المرور ومصدر الضوضاء بعيدا عن التجمعات السكنية .

تمت لتصل الى مستوى الخدمة المطلوب لتغطية رأس المال والفوائد فى بداية اعوام فترة ١٩٩٠ وقد قدر انه ممكن الحصول على نتيجة افضل فى حالة فرض رسوم مرور اعلى .
ونظام رسوم المرور ذو الحواجز المحدود اقل تكلفة فى التنفيذ والادارة الا انه سيتعرض لانخفاض فى العوائد بالمقارنة بالنظام المغلق ونظام الحواجز الكاملة وانخفاض قليل فى العوائد مثلا الى ٨٠٪ لن يكون ذو اثر بالغ ، الا ان خسارة تبلغ ٥٠٪ ستخفض العوائد الى ماتحت نقطة الجدوى المالية الكاملة . على الرغم من استمرار تقديمها مساعدة فعالة لتكاليف المشروع .
ونتائج اختبار الحساسية يفترض انخفاض العوائد بمقدار ٢٠٪ وكل التكاليف متضمنة انشاء الطريق وتنفيذ وادارة نظام رسوم التحصيل زادت بنسبة ٢٠٪ ، اشارت الى ان العوائد ستقل بمقدار ضئيل من تلك المطلوبة للجدوى المالية الكاملة .

نتائج تقييم نظام الرسوم :

اشار التقييم المالى الى المساهمة الفعالة التى يمكن ان يقدمها نظام رسوم المرور فى تكاليف انشاء وصيانة طريق جديد بين القاهرة واسيوط - ومن الممكن ، فى حالة وجود رسوم مرور على مستوى كفاية عالى ، ان يتم تمويل الطريق بالكامل من عوائد هذه الرسوم ومع ذلك - فتقديرات الرسوم نظرية ، وستتطلب الامر معرفة اكثر عن رد فعل السائق امام هذه الرسوم المرتفعة قبل الوصول الى نتيجة نهائية ، بالاضافة الى انه يجب ان يؤخذ فى الاعتبار سلامة المرور والامن لمحطات الرسوم ذات التحكم عن بعد (التى يمكن ان تحصل مابين ٢ر٣ الاف جنيه يوميا) وشكل المخاطرة وعدم التأكد اهم العوائق امام تمويل الطريق شكل خاص - الا ان هذا الاقتراح يستحق دراسة كاملة .

ونظام التحصيل المغلق ذو المحطات على مداخل الطريق يبدو افضل بديل ، حيث ستكون عملية تحصيل الرسوم كاملة دون اجراءات الامان والتأخير المرتبطة بطرق التحصيل ذات الحواجز على الطريق نفسه .
ويبدو مستوى متوسط الرسوم بماثل اربعة مرات الرسوم المفروضة عام ١٩٨٦ على طريق القاهرة الاسكندرية الصحراوى ، يعطى عوائد عالية مع خسارة اقتصادية بسيطة فى الفوائد وسيبدو انه مستوى رسوم مناسب يستحق الوصول اليه .

التقييم المالى لطريق القاهرة- اسيوط الجديد :

نظرا لان الطريق متوقع ان يكون ذو درجة عالية بمداخل محدودة ، فان امكانيات التمويل او على الاقل تعويضها ، واخذ فى الاعتبار الحصول على تكاليف الانشاء من عوائد رسوم المرور .

وتم تقييم نوعين من نظم رسوم المرور ، نظام حواجز يضع مكاتب الرسوم بعرض الطريق الرئيسى بين المداخل للطريق ، ونظام رسوم مرور مغلق والذى يتحكم فى الطريق تماما عن طريق وضع الحواجز عند كل طرق التوصيل .
وقد تماثلت تكاليف كل من القطاعين . وقد تم اعتبار نظام حواجز اقل تكلفة وهو يفترض وضع الحواجز فى ٣ فقط من ١٣ قطاع فى الطريق الجديد . ومع ذلك فميزة التكلفة البسيطة لهذا النظام تتزن مع انخفاض العائد .

تقديرات عوائد رسوم المرور :

تم تقييم معدلات رسوم مرور عديدة تتراوح بين الرسوم الحالية كالمفروضة على طريق القاهرة - الاسكندرية الصحراوى ، ومعدل اعلى بمقدار ١٥ مرة . ووفقا لهذه الافتراضات - فالرسوم المفروض على سيارة خاصة تسافر من القاهرة لاسيوط ستتراوح من حوالى ٢ جنيه حتى ٢٦ جنيه . والرسم المفروض على عربة نقل متعددة الوحدات سيتراوح من ٩ جنيه حتى ١٣٠ جنيه . وعلى الرغم من انه متوقع ان يقل المرور كلما زادت رسومه فمتوقع ان تزيد عوائد الرسوم مع كل زيادة فى عدد محطات التحصيل .

اجراءات تقييم نظام تحصيل رسوم مرور :

وقد جمعت عملية تقييم نظام رسوم المرور تقديرات التكاليف والعوائد ، ووضعتهم فى جدول مشروع دائم . وتم حساب معايير اقتصادية مختلفة بطريقة مماثلة للتقييم الاقتصادى .
والنتائج لكل من النظام المغلق ونظام الحواجز المتكامل كانت مبشرة للغاية . وقد أشار التقييم للنظام المغلق (وهو الاكثر تكلفة فى الاثنين) الى معدل عائد داخلى بلغ ١٠٫٣ ٪ ومعدل فائدة/ تكاليف بلغ ١٫٤٧ ٪ وقيمة حالية صافية بلغت ٦٨٫٧ مليون جنيه . وتؤكد على ان مقدار معدل العائد الداخلى وهو ١٠٫٣ ٪ يمثل عائد استثمار فعلى غير متضمن التضخم . بل ان التقديرات على العوائد الصافية

تحسينات الطريق الحالى :

الشبكة باداء اقتصادى حسن هى شبكة الطرق المحسنة وحتى بحساب ثلث فوائد الوقت فقط ، فقد قدمت هذه الشبكة معدل عائد داخلى = ١٨٫٥ ٪ ، وقيمة صافية حالية = ٨١٫٧ مليون جنيه ومعدل فائدة/ تكلفة = ٢٫٠٦

ولقد فرض انه يمكن البداية فى عمل التحسينات بانشاء ١٤ طريق تحويلى حول المدن الرئيسية بطول الطريق والتى تفتقد وجود مثل هذه التحويلات الغالبية العظمى وافترض هذا الانشاء فى المدة من ١٩٨٧ - ١٩٨٩ (حيث تنتهى الفترة التمويلية فى نصف ١٩٩٠) . ثم ستبدأ الانشاءات بتوسيع هذه القطاعات من الطريق التى ليس لها حزيرة وسطى وبالضرورة الطريق باكمله بين العياط واسيوط .

وافترض ان يستمر هذا العمل حتى عام ٢٠٠٠ مما يعطى الوقت الكافى للاجراءات الصعبة فى الحصول على الارض بان تأخذ مجراها .

وطرق التوصيل فى حد ذاتها او وحدها بالنسبة لعام ١٩٩٠ وماتليه لن تعطى سوى فوائد بسيطة (طالما انها تضيف طول لطريق والذى يتوقع منه الا يكون مزدحما فى عام ١٩٩٠ عما هو عليه فى عام الاساس للدراسة وهو ١٩٨٥ / ١٩٨٦) . وفى الواقع قدرت الفوائد الاقتصادية بقيمة سلبية ، الا انها قدرت بصفر فى هذا التقييم على اساس انه سيكون هناك فوائد كامنة داخل تحويلات المدن على الاقل لتغطية الفوائد السلبية للمرور المار داخلها . يتوقع ان تبدأ اثر الفوائد بعد مدة الانشاء للتوسيع حيث سيكون كل قطاع توسيع كاملا وقابل للاستخدام بينما تكون القطاعات الاخرى مازالت تحت الانشاء .

وقد تساوت تقريبا التوفيرات فى تكاليف التشغيل مع التوفيرات فى وقت المسافر بسبب حالة ازدحام المرور المحتمل سريانها حيث لا توجد انشاءات جديدة فى المحور . وبالنسبة لتقليل حوادث المرور فقد قدرت ان تكون جديرة بالاعتبار عند الانتهاء من انشاء الطريق ذو الاربعة حارات الاكثر امنا .

وقد تم التوصل الى ان شبكة الطرق المحسنة توضح توزيع للفوائد احسن من شبكة الطريق السريع . وقد زادت الفوائد للمرور المتحرك بأكمله داخل المحور بشكل ملحوظ ، كما زادت الفوائد الخارجية ايضا ، ولكن فى نفس الوقت ، ففوائد المرور الداخلى لم تتغير الا قليلا .

تأكيد هذه الخلاصات من التقييم المرورى الذى اشار الى عدم الحاجة لطريق من ٤ حارات فى المرحلة الاولى .

وقد تمثلت فوائد المشروع اساسا عن التوفير فى تكاليف تشغيل العربات ، على الاخص تكاليف تشغيل عربات النقل . كما ان التوفير فى وقت المسافر كله جدير بالاعتبار ايضا . ومع ذلك - فقد قلت هذه النسب بمقدار ثلث القيمة المحسوبة فى احد مجموعات عناصر التقييم المذكورة لايضاح عدم ضروريتهم بكامل معدلاتهم فى الجدوى الاقتصادية وتوفيرات الحوادث كانت معدومة ان لم تكن قد نقصت وكان ذلك اساسا بسبب ان المرور سيتحول من قطاع القاهرة - العياط ذو الاربعة حارات الى الطريق الحالى ، حيث معدلات الحوادث يتوقع أن تكون اقل من الطريق ذو الحارتين المعروض هنا .

والمظهر الغريب الذى وضح من نتائج شبكة الطرق الخاصة بالطريق السريع الى ان فوائد قليلة (٤ر٣ ٪) اضيفت الى التحركات الداخلية فى المحور ، ومثل هذه الفوائد فى المرور نتجت من التحركات طويلة المسافة بين المحافظات ، ومن التخفيف البسيط فى الازدحام فى المحور الذى انشأه الطريق الجديد . ان يشير ذلك الى ان الفائدة الرئيسية للطريق الجديد - سوف تكون لمرور المسافات الطويلة الى ومن بطول المحور - وأشارت معاينة التكاليف / الفوائد الصافية الى تاريخ بداية للانشاء فى ١٩٩٠ . وبافتراض ان التمويل الدولى سيكون مطلوب لتمويل المشروع بالتحكم والمراقبة المرتبطة بذلك - ويعتبر ذلك افتراضيا واقعيا ، ان لم يكن متفائلا وبافتراض بدء الانشاءات فى ١٩٩٠ (وفى المدة حتى ٦٩٩٠ ستجرى عمليات اتفاقيات التمويل والتصميم النهائى وطرح المناقصات) ، وفترة انشاء تستمر ٤ سنوات يشير التقييم الاقتصادى معدل عائد داخلى يساوى ٨ر١٦ ٪ ، وقيمة صافية حالية تساوى ٧ر٤٧ مليون جنيه ونسبة فوائد / تكاليف تساوى ٥٥ر١ - ولقد اشارت تجارب الحساسية ان معدلات منخفضة لنمور المرور (بسبب اما بنمو بطىء للاقتصاد اوتغيير المرور الى وسائل نقل اخرى) يمكن ان يؤجل التاريخ المثالى للافتتاح بعدة سنوات قليلة . وقد تم التوصل الى انه فيما يختص بمكونات العملة الصعبة وحدها فلم يكن التقييم فى صالحها ، مشيرا الى ان تكاليف الانشاء بالعملة الصعبة لن يكون له مايبرره من توفيرات العملة الصعبة فى تكاليف التشغيل المخفضة .

والانواع الثلاثة من الفوائد التى اخذت فى الاعتبار فى التقييم الاقتصادى هى التوفير فى تكاليف تشغيل العربات ، ووقت المسافر ، وحوادث المرور ، وفى جميع الحالات تم حساب هذه التوفيرات بالمقارنة بتكاليف شبكة الطرق المغطاة والتى تماثلت مع شبكة الطرق الحارى تنفيذها الا انها افترضت برنامج رصف محسن يتم تقويته بطبقات تغطية وفوائد التنمية ، أى الفوائد الناتجة عن فتح مناطق جديدة للنمو والتى يشملها التقييم الاقتصادى ، ليس بالمعنى الواضح لافتتاح مصانع ومدن جديدة ، ولكن بالمعنى الباطن فى ايجاد قيمة فوائد المرور المتولد .

أما الفوائد الاخرى التى يصعب تحديدها فى كم اقتصادى ، على الاخص الفوائد البيئية والاجتماعية ، فقد تم اخذها فى الاعتبار بطريقة تقديرية كما سنرى فيما بعد .

وقد تم التوصل الى ان اهم نوعين من المشروعات المأخوذة فى الاعتبار فى الدراسة طريق القاهرة - اسيوط الجديد وتحسين الطريق الحالى - اظهر كلاهما فوائد كبيرة فى عام ٢٠٠٠ ويعتبر الاثنان مرشحان قويان للاعتبار .

ومن الجدير بالذكر أن الفوائد بالنسبة لتكاليف تشغيل العربات على شبكة الطرق المغطاة مقارنة بشبكة الطرق الحارى تنفيذها كانت اساسية ، وهى تزيد عن الفوائد المحصلة على شبكة الطرق الخاصة بالطريق السريع الجديد وشبكة الطرق المحسنة (مقارنة بالمغطاه) وذلك يؤكد حقيقة انه يمكن الحصول على فوائد محققة من توفير سطح مرصوف جيد للطرق القائمة .

تقييم التكاليف / الفوائد :

وجمع هذا التقييم جميع تقديرات التكاليف والفوائد لكل عام ونظمه فى متواليات زمنية ثم رسم متوسطات لها ومدها داخليا وخارجيا اينما كان ذلك ضروريا . ثم تم تخفيض التكاليف والفوائد بعد ذلك على اساس عام موحد - ١٩٨٦ باستخدام معدل الخصم المختار فى الدراسة وهو ١٢ ٪ ومجموعة مؤشرات اقتصادية تم حسابها لتظهر جدوى المشروع .

شبكة الطرق الخاصة بالطريق السريع الجديد :

أشارت التقييمات ان طريق جديد من القاهرة لاسيوط يمكن تبريره اقتصاديا لافتتاحه فى اعوام الـ ١٩٩٠ - وقد اشارت النتائج بوضوح من وجهة النظر الاقتصادية فقط الى انه يجب ان يكون اساسا من حارتين وليس ٤ حارات . وقد تم

وعموما ، حوالى ٢٠ ٪ فقط من المرور فى المحور مرشح لاستخدام الطريق السريع وحتى هذا المرور ستتقاسمه طرق اخرى . وعلى الاخص طريق الضفة الشرقية . ومع ذلك ، فعلى الرغم من ان توقعات احجام المرور على الطريق الجديد ليست عالية ، فان هذا المرور يحصل على فائدة كبيرة من تفاديه للطرق المزدحمة الحالية ومهمة التقييم كانت الحكم على ما اذا كانت هذه الفوائد كافية للانشاء ام لا .

المرحلية واختبارات الحساسية :

تم عمل توقعات مرور اضافية بهدف تقييم الجدوى الاقتصادية ولتحديد مراحل انشاء الطريق الجديد . والنتيجة الرئيسية منها كانت ان احجام المرور المتوقعة لطريق القاهرة - اسيوط الجديد بعد انشاء طريق حارتين بدلا من ٤ حارات ، قلت بمقدار بسيط جدا .

تقييمات :

تم تقييم الاستثمارات البديلة التى اخذتها الدراسة فى اعتبارها من وجهات نظر مختلفة تتضمن النواحى الاقتصادية والمالية والاجتماعية والبيئية .

التقييم الاقتصادى :

ومهمة هذا التقييم تقدير القيمة الاقتصادية لكل استثمار مذكور فى الدراسة بالنسبة للدولة . وتم ذلك بمقارنة تكاليف الانشاء والصيانة لكل استثمار مع الفوائد الاقتصادية المتوقع تحصيلها من هذا الاستثمار . وتم معالجة كل شبكة موصوفة فى البند السابق كمجموعة متكاملة من الاستثمارات ولم تقيم المشروعات المنفصلة التى تشملها كل شبكة على انفراد .

تكاليف المشروع وفوائده :

ناقشنا فيما سبق تكاليف المشروع بالنسبة لتحسين الطريق الحالى او انشاء طريق جديد ويكفى هنا أن نذكر أن التقييم الاقتصادى تطلب معرفة تكاليف الموارد الاقتصادى والتى زادت فى المتوسط بمقدار من ربع الى ثلث اعلى من التكاليف المالية المدفوعة للمقاولين .

وقد اظهرت توقعات عام ٢٠٠٠ الاثر الجيد لشبكة الطرق الحسنة على المرور من خلال توسيع الطريق بالكامل فيما بين العياط (٤٦ كم جنوب القاهرة) واسيوط بما فيها الطرق التحويلية لعام ١٩٩٠ . ولم يكن غريبا ان نجد أن احجام المرور على الطريق الحالى على الضفة الغربية تحت هذا البديل اعلى احجام فى بدائل شبكات الطرق ، بنسبة تتراوح بين ٥ و ١٥ ٪ اعلى من الاحجام المسجلة على شبكات الطرق الاخرى . ومتوقع أن يقل زمن الرحلة بين القاهرة واسيوط فى عام ٢٠٠٠ بمدة ساعة عن عام الاساس مما يشير الى طبيعة عدم الازدحام التى ستتميز بها شبكة الطرق المحسنة .

توقعات المرور لشبكة الطرق الخاصة بالطريق السريع الجديد :

تراوحت الاحجام المتوقعة على الطريق السريع الجديد لعام ٢٠٠٠ بين حوالى ١٠٫٠٠٠ عربة يوميا بين الجيزة وبنى سويف الى حوالى ٣٠٠٠ عربة يوميا قرب اسيوط وبلغت الاحجام لعام ١٩٩٠ حوالى نصف هذا العدد . وقد تناقصت احجام المرور على الطريق الحالى على الضفة الغربية بسبب الطريق الجديد . ولكن ليس بشكل كبير وذلك سببه ان جزء كبير من المرور لمسافات طويلة على القطاعات من القاهرة للمنيا اجتذبه فعلا الطريق على الضفة الشرقية . وجنوب المنيا ، حيث لا يوجد طريق على الضفة الشرقية ، فقد خفف الطريق الجديد من المرور على الطريق الحالى بحوالى ٣٠٠٠ - ٤٠٠٠ مركبة يوميا بالاضافة الى بعض المرور الاضافى الناتج عن تولد المرور .

وقدرت ازمنة الرحلات بين القاهرة واسيوط لتكون على نفس مستوى شبكة الطرق المحسنة لعام ٢٠٠٠ وبعبارة اخرى زمن رحلة كلى يقل بنحو ساعة مما عليه اليوم ومع ذلك فهذا التقليل ينطبق فقط على مرور المسافات الطويلة المستخدمة للطريق الجديد . اما مرور المسافات القصيرة المستخدمة لطريق الضفة الغربية فنصيبه من الاستفادة اقل من الطريق الجديد - بعكس شبكة الطرق المحسنة التى قللت زمن الرحلة لكل من مرور المسافات الطويلة والقصيرة على حد سواء .

والاحجام المتوقعة على الطريق الجديد بين القاهرة واسيوط لم تكن كبيرة بشكل ملحوظ لطريق سريع ، ولا تؤيد انشاء طريق ٤ حارات فى المراحل الاولى للمشروع . والسبب أن كثير من المرور فى المحور يكون لمسافات قصيرة جدا . ونصف حجم المرور الكلى فى المحور يتحرك بين المحافظات ، ٢ ٪ فقط من المرور الكلى يتحرك بين طرفى المحور

الغربية بأكمله متضمنا الطرق التحويلية لبصح ٤ حارات .

توقعات المرور لشبكة الطرق التي يجري انشاؤها :

اظهرت نتائج نموذج المرور لشبكة الطرق الجارى انشاؤها انه لا يوجد مشروعات تحسين جديدة للطريق فى محور القاهرة - اسيوط غير تلك الجارى تنفيذها حاليا او المتفق عليها ويتوقع زيادة فى ازدحام المرور . وممكن أن يكون من نتيجة ذلك ابطاء زيادة المرور لما تحت مستوى التوقع المبدئى مما سيؤدى الى ركود التطور الاقتصادى فى المحور . وسيكون التناقص فى الرحلات عن مستويات التوقع المبدئية بسيط فى عام ١٩٩٠ - حوالى ١ ٪ سبب برنامج تحسين الطرق الحالى فى المحور - الا انه سيكون اكثر حدة حوالى عام ٢٠٠٠ حيث يتوقع أن تصل نسبة النقصان الى ٧ ٪ .
ويتوقع ان تكون احجام المرور على الطريق الحالى فى الضفة الغربية اقل فى عام ١٩٩٠ عما هو عليه فى عام الاساس ، وذلك بسبب اثر الطريق الجديد على الضفة الشرقية المفترض انهاؤه من القاهرة للمنيا . وحوالى عام ٢٠٠٠ ستزيد الاحجام المتوقعة عما هى عليه بالنسبة للمرور فى عام الاساس بشكل ملحوظ ، وقدر أن زيادة الازدحام الناتجة ستؤدى الى زيادة زمن الرحلات بين القاهرة واسيوط بالثلث او مابين ٢و٣ ساعات .

توقعات المرور لشبكة الطرق المحسنة :

تتكون شبكة الطرق المحسنة لعام ١٩٩٠ من شبكة الطرق الجارى انشاؤها بالاضافة الى ١٤ طريق تحويلى يتكون من حارتين . وعلى ذلك ، فقد وفرت هذه الشبكة طريق جديد من حارتين له اكتاف بطول الطريق من القاهرة حتى اسيوط ، متلافيا المرور داخل المدن والقرى بطول الطريق ومع ذلك - فهذه التحسينات لم تحدث سوى فرق صغير فى توقعات تدفق المرور ، التى اشارت الى ان الفوائد المحققة للمرور عن طريق تفادى مراكز المدن المزدحمة ، ستعطيها زيادة طول الطريق بمقدار مسارات الطرق التحويلية وعلى ذلك فقد اضافت الطرق التحويلية ١٦ كم لطول طريق القاهرة - اسيوط الحالى .

ـ شبكة الطرق المحسنة

شبكة طرق سنة الاساس : وقد وصفت على انها حالة الطريق الحالى واستخدمت كمرجع لاوقات السفر والتكاليف لمقارنتها مع الظروف المقدرة مستقبليا .

شبكة الطرق التي يجرى انشاؤها : وتتمثل فى نظام الطريق المحتمل فى المستقبل بالاضافة الى المشروعات الجارية فى الوقت الحالى فقط ، وهى تلك التى يجرى تنفيذها او التى تم تمويلها فعلا . كما تأخذ فى الاعتبار عمليات الصيانة الحالية لتحسين سطح الطريق والتى تسمح بترك الطريق حتى تسوء حالة سطحه قبل اصلاحه .

شبكة الطرق المغطاه : وهى تتكون من شبكة الطرق المتفق عليها بالاضافة الى برنامج لتغطية السطح على فترات اكثر تقاربا . وعلى الرغم من ظهور شبكة الطرق بالنسبة للوصلات والتقاطعات بشكل مطابق لشبكة الطرق المتفق عليها ، الا أنه تم افتراض نوعية افضل لسطح الطريق . وهذه الشبكة هى المرجع الرئيسى للشبكات حيث يمكن الرجوع اليها لعمل المقارنات مع شبكات الطرق الاخرى بما فى ذلك الاستثمارات فى الطريق البرى السريع المقترح .

شبكة الطرق الخاصة بالطريق السريع الجديد : وتتضمن شبكة الطرق المغطاه بالاضافة الى طريق القاهرة ـ اسيوط الجديد الذى تم اعداد تصميماته المبدئية ضمن هذه الدراسة وترجع كلمة " الطريق السريع " الى الصورة النهائية المحتملة للطريق مقسما الى اتجاهات طريق لمرور السيارات ، وتقاطعات متدرجة منفصلة . وستحدد مرحلة التقييم فى اى عام يكون تبرير انشاء مثل هذه الشبكة مقبولا ، ولا يجب ان يعنى استخدام كلمة " الطريق السريع " التى تتضمن الطريق الجديد حكما سابقا لا وانه على معنى التوصيات المبدئية .

شبكة الطرق الحسنة :

وهى البديل لشبكة الطرق المتضمنة للطريق السريع الجديد ، وهى تتكون من شبكة الطرق المغطاة (شبكة الطرق التى يجرى اعدادها بالاضافة الى سياسة التحسين بطبقات التغطية) علاوة على التحسينات لمسار الطريق الحالى على الضفة الغربية للنيل . وفى الواقع فقد تم اعداد شبكتين واضحتين للطرق مفترضا مراحل التحسينات فى المرحلة الاولى ، افترض عمل طرق تحويلية من حارتين لجميع المدن بطول طريق الضفة الغربية والذى لا يوجد به مثل هذه الطرق حاليا . وفى المرحلة الثانية سيتم توسيع طريق الضفة

وتعتبر هذه البيانات هى نقطة البداية لتوقعات الزيادة فى المرور داخل المحور وقد تغيرت التوقعات المبدئية للمرور لكل منطقة مرور تبعا لنمو الناتج المحلى الاجمالى بالمنطقة ، وتم تعديل جميع التوقعات المبدئية فى نموذج المرور تبعا لدرجة ازدحام المرور المسجل على شبكة الطرق .

توقعات المرور المبدئية :

اظهرت التوقعات المبدئية للمرور قبل اخذ ازدحام المرور فى الحسبان ، زيادة بلغت ١٫٢٥ مرة حتى عام ١٩٩٠ و ٢٫٤ مرة حتى عام ٢٠٠٠ بالمقارنة مع عام الاساس وهو ١٩٨٥ ، ويمثل ذلك معدل نمو سنوى يبلغ فى المتوسط ٥ ٪ لعام ١٩٩٠ و ٦٫٥ ٪ لعام ٢٠٠٠ . وتعد معدلات الزيادة هذه اقل من المعدلات المناظرة التى شوهدت فى الاعوام الاخيرة قبيل الدراسة ، والتى تعكس معدلات نمو اقل متوقعة فى الاقتصاد القومى فى المستقبل . وكان يمكن بالتأكيد زيادة المعدلات المذكورة اعتمادا على معدلات زيادة المرور المشاهدة فى الماضى . ومع ذلك ، يمكن الاعتماد على معدلات اقل لنمو المرور على اساس ان الانخفاض فى معدل نمو الاقتصاد القومى سيكون اكثر حدة خلال السنوات القليلة القادمة عما هو مفترض فى هذه الدراسة ، بالاضافة الى الدور الكبير الذى يفترض ان يلعبه النقل بالسكك الحديدية والطرق النهرية ، واللذان يتمتعان بفرصة كبيرة فى زيادة نصيبهما من النقل فى المحور . وعلى ذلك ، فتوقعات المرور المذكورة هنا تمثل حل وسط مناسب لتحديد وتقييم المشروع . ويتم حاليا عمل اختبارات الحساسية لتقدير اثر مختلف معدلات النمو على توصيات الدراسة .

مجموعات الاستثمارات البديلة :

لكل من الطرق البديلة التى تمت دراستها فى محور القاهرة - اسيوط كان يجب تحديد خصائص الطريق فى صورة تسمح بالتحليل بالكومبيوتر وهذه الخصائص سميت بشبكات الطرق المبرمجة . وقد غطت كل منها مصر كلها ، ولكن بتفصيل اكبر لمحور القاهرة - اسيوط . وقد تم اعداد خمس شبكات رئيسية مبرمجة لاستخدامها فى الدراسة وهى :

- شبكة طرق سعة الاساس
- شبكة الطرق التى يجرى انشاؤها
- شبكة الطرق المغطاه
- شبكة الطرق الخاصة بالطريق السريع الجديد

وتوقعات المرور فى الدراسة تمت فى مرحلتين : فى المرحلة الاولى ، تم اعداد توقعات مرور ابتدائية لكل من اعوام التوقعات ١٩٩٠ و ٢٠٠٠ بالاعتماد على : أولا : السكان وتوقعات الناتج المحلى الاجمالى وثانيا : نسب الزيادة لكل نوع عربات بالنسبة لمعدل نمو الاقتصاد القومى . وتم عمل التعديلات لتأخذ فى اعتبارها خط انابيب البترول الجديد والتغيرات المتوقعة فى توزيع الاسمنت بعد افتتاح مصنع الاسمنت الجديد فى اسيوط فى المرحلة الثانية . ثم تحليل التوقعات الابتدائية لكل عام باستخدام نموذج المرور بالكومبيوتر والذى قام بتعديل توقعات المرور لتتوافق مع مستوى اختناقات المرور الذى تم التعرف عليه فى شبكة الطرق .

معدلات زيادة العربات :

بينما يتحدد المعدل العام لنمو المرور بالتغيرات فى السكان والناتج المحلى الاجمالى ، نجد ان معدلات الزيادة لكل نوع من انواع العربات يختلف بشكل ملحوظ وعلى ذلك ، تم عمل دراسة لكل نوع من العربات لتحديد معدلات الزيادة المحتملة الخاصة بها فى ضوء معدل الزيادة العام فى الاقتصاد . وقد تمت دراسة معدلات الزيادة السابقة تبعا لنوع العربة ، وتم اخذ توقعات المرور للدراسة القومية للنقل فى الاعتبار (على الرغم مما سبق ان ذكرناه حول غموض المعلومات الخاصة بالنقل على غير الطريق البرى) وباقتراض معدلات نمو مستوى قدره ٤ ٪ و٦ ٪ خلال الفترتين ١٩٨٥ ، ١٩٩٠ ، ١٩٩٠ / ٢٠٠٠ على التوالى ، تم اختبار معدلات الزيادة السنوية التالية للعربات .

معدلات زيادة العربات حتى ١٩٩٠ وحتى ٢٠٠٠

نوع العربة	١٩٨٥ / ١٩٩٠	١٩٩٠ / ٢٠٠٠
سيارة خاصة	٦ر٥ ٪	- ر٨ ٪
سيارة تاكسى	٢ر٥ ٪	٣ر٥ ٪
ميكروباص	٦ر٤ ٪	٨ر٢ ٪
بيك آب	- ر٥ ٪	٦ر٥ ٪
اوتوبيس	- ر٤ ٪	- ر٦ ٪
عربة نقل	- ر٤ ٪	- ر٦ ٪

التكلفة الزائدة فى هذه الدراسة اشتقاقا من تكاليف تدفق المرور الحر التى تم تقديرها فى الماضى معتمدا على " نموذج تصميم الطرق والصيانة "

تكاليف الوقت :

امكن تقدير قيمة الوقت بالنسبة للراكب والبضاعة فى العربة لكل نوع من الانواع المختارة للعربات بالاعتماد على نسبة الاشغال فى العربة ، قيمة الوقت للراكب (والتى اعتمدت بدورها على نوع المركبة والغرض) وقيمة البضاعة (المشتقة من خليط البضائع الذى ظهر فى حصر مقابلات جانب الطريق) وتتراوح قيمة الوقت بالنسبة للراكب فيما بين ١٫٤٥ جنيه لكل ساعة عربة للسيارات الخاصة ذات الغرض الغير متعلق بالعمل ، ٤٫٥٨ جنيه لكل ساعة عربة للاوتوبيس . وقيمة الوقت للبضائع عن كل ساعة عربة كانت منخفضة جدا ، بلغت اقصاها ٠٫٠٧٤ جنيه بالنسبة لعربة النقل بالمقطورة .

تكاليف رسوم المرور :

وقد استخلصت تكاليف رسوم المرور من الطريق الوحيد الذى يطبق فيه هذا النظام فى مصر وهو طريق القاهرة - الاسكندرية الصحراوى ، وهى تتراوح بين ٥ الى ٢٥ مليم عن كل عربة كيلو متر حسب حجم العربة ، وهى معدلات رسوم منخفضة جدا - تمثل فقط ٥ ٪ من تكاليف تشغيل العربات تحت ظروف تدفق مرور حر .

توقعات المرور على الطريق :

بمراجعة وسائل النقل الاخرى فى المحور ، تم التوصل الى ان الزيادة فى النقل على الطريق ستتأثر اساسا بخط انابيب البترول الجديد بين القاهرة واسيوط - الا أن ماتوقعته الدراسة القومية للنقل فى مصر من تحول النقل من الطريق البرى لاستخدام السكك الحديدية والنقل النهرى غير محتمل وعلى ذلك فقد اهتمت توقعات المرور فى هذه الدراسة اساسا بخط الانابيب الجديد ، وتجاهلت توقعات الدراسة القومية للنقل بالنسبة للسكك الحديدية والنقل النهرى . وفى فترة التقييم ، تم عمل اختبارات حساسية لتقدير اثر نمو بسيط فى المرور على الطريق والذى يمكن أن يؤدى الى نسبة نمو سريع فى السكك الحديدية والنقل النهرى بخلاف اسباب اخرى .

تكاليف تشغيل العربة تحت ظروف تدفق المرور الحر :

تم تقدير تكاليف تشغيل العربات بافتراض ظروف مرور لا تخضع للاختناقات بالاعتماد على نموذج البنك الدولى لتصميم وصيانة ومعايير الطرق السريعة (HDM) وفى البداية تم معايرة هذا النموذج ليناسب الظروف المصرية عن طريق قياسه بالمعلومات الواردة فى الدراسة القومية للنقل فى مصر (ENTS) وقد استخدم النموذج المعاير بعد ذلك فى تقدير تكاليف التشغيل للدراسة معتمدا على خصائص العربة وتكاليف الوحدة .

وبالمقارنة مع اسعار الدراسة القومية للنقل فى مصر ١٩٨٣ ، فان تكاليف التشغيل فى هذه الدراسة كانت اعلى قليلا على وجه العموم ، وذلك نتيجة لعاملين متضاربين وهما : الزيادة فى تكاليف الوحدة عن الدراسة القومية للنقل فى مصر بنسبة ٢٠ ٪ ، والنقص فى التكاليف الذى نتج عنه الافتراض الاعلى لمعدلات استخدام العربات والمستخلص من عمليات الحصر الميدانى لهذه الدراسة .

تعديل تكاليف تشغيل العربة :

تم عمل التعديلات لتكاليف التشغيل تحت ظروف تدفق مرور حر لتتناسب بشكل عام مع ثلاثة نقاط :

هندسة الطريق ، حالة سطح الطريق ، الازدحام .

كما لم يتم عمل اى تعديل بالنسبة لهندسة الطريق فى هذه الدراسة نظرا لان اغلب الطرق التى تمت دراستها هى طرق حسنة التخطيط ومستوية السطح .

وقد تم التعرف على ٤ درجات من سطح الطريق : ممتازة ، جيدة جدا ، جيدة ومقبولة ولكل منها تم استخدام نموذج " تصميم الطرق والصيانة " (HDM) لتقدير عناصر تعديل التكلفة .

وقد تم التركيز على تكاليف ازدحام المرور . وقد استخدمت الدراسة جداول قياسية للتكلفة والوقت المرتبط بدورات تغيير السرعات (الابطاء ثم الاسراع مرة اخرى) ودورات التوقف (الابطاء حتى التوقف تماما قبل اعادة التشغيل والعودة الى السرعة الاصلية) والتعويق (تنتظر العربة فى تيار مرور متوقف تماما) . وفى اى من هذه الحالات ، تم اعتبار التكاليف والوقت المرتبط باختناق المرور " افراط" او زيادة فى التكلفة والوقت يضاف على تكاليف تشغيل العربات تحت ظروف تدفق مرور حر . وقد تم اعداد جداول

مقابل النقل حيث انه يحدد السلوك واختيار الطريق . ويمكن أن يكون هذا الثمن تعريفة (لمستخدمى خدمات النقل - سيارات الاجرة - الاوتوبيسات - شركات النقل) او تكاليف مالية لامتلاك وتشغيل المركبات بالنسبة لمالكى السيارات الخاصة ، ويبدو الامر معقدا - حيث ان مالكى السيارات الخاصة عموما لا يدركون التكاليف الكاملة للتشغيل - كما انهم يغفلون بعض البنود مثل الصيانة والتقادم - على الرغم من انهم اكثر ادراكا لوقتهم الشخصى الذى تستغرقه الرحلات . وبالنسبة لتوقعات الطلب على المرور واختيار مسار الطريق ، فقد قامت الدراسة بحساب دقيق للتكاليف المالية آخذة فى الاعتبار كل هذه العناصر .

وقد تطلب تقييم المشروع الرجوع الى التكاليف الاقتصادية والتى تستبعد التحويلات المالية فى الاقتصاد مثل الجمارك والضرائب والدعم . وقد استخدمت اسعار الظل ايضا من اجل تحديد افضل للتكلفة الحقيقية للموارد المستهلكة فى عمليات النقل . ويتجلى اوضح فارق بين التكلفة المالية والتكلفة الاقتصادية فى سعر السولار والذى كان يبلغ سعر شراؤه ٣ قروش فقط للتر (تكلفة مالية) فى حين تبلغ قيمته الحقيقية كمورد حوالى ٢٠ قرش للتر (تكلفة اقتصادية) .

العربات المختارة :

بالنظر الى ان الاسعار تتفاوت بشكل ملحوظ حسب حجم وظيفة (استخدام) العربة تم اختيار مجموعة تتكون من ٩ انواع من العربات لاغراض توقعات المرور والتقييم . وقد استخلصت تكاليف التشغيل لكل نوعية من هذه العربات على حدة . وقد استند اختيار تلك النوعيات من العربات على نتائج حصر المرور ، مع الاستعانة بالدراسات السابقة حول النقل فى مصر . وتتكون النوعيات التسع من سيارتان (مصنفتان تبعا لغرض الرحلة) ، وسيارتان تاكسى (سيارة وميكروباس) ، بيك آب واوتوبيس وثلاث عربات لورى باحجام مختلفة . وبالنسبة لخصائص العربات ، بما فيها معدلات الاستخدام وتكاليف الوحدة (باعتبار العربة ، للاطارات ، الوقود ، الزيت ، الصيانة ، قطع الغيار والتقادم) فقد تم تقديرها لكل نوع من المركبات على حدة .

الى حوالى ٣ر٩ سنويا ، وهو مايرجع اساسا الى الزيادة الكبيرة فى الايرادات بالعملة الصعبة من خلال قطاع البترول وقناة السويس وتحويلات العاملين بالخارج والسياحة والمساعدات الخارجية . ومع بداية الثمانينات تناقص معدل النمو ليتراوح بين ٤ر٦٪ فى الفترة من ١٩٨٠-١٩٨٥ - ومع نهاية الربع الاول من عام ١٩٨٦ اشارت الاحداث العالمية والمحلية الى نهاية احتمالات النمو السريع وبداية فترة تقشف للاقتصاد المصرى ومن المتوقع حدوث انخفاض ملحوظ فى قطاع البترول والسياحة وتحويلات العاملين فى الخارج فى حين ان عوائد قناة السويس ستظل ثابتة او تحقق زيادة طفيفة . ومن غير المتوقع حدوث زيادة كبيرة فى عوائد الصادرات الاخرى على المدى المتوسط كما أنه من غير المتوقع ايضا ان تغطى المساعدات الخارجية النقص المتوقع فى هذه العوائد . وعلى ذلك فقد استخدمت الدراسة معدل نمو اقتصادى سنوى معتدل للاعوام من ١٩٨٥ - ١٩٩٠ يبلغ ٤٪ والذى يزيد حتى يصل ٦٪ سنويا خلال الفترة ١٩٩٠-٢٠٠٠ .

من خلال نموذج المرور :

اقتضى النموذج التصورى الذى تم اختياره ليمثل تدفق المرور على شبكات النقل فى مصر ، تقسيم البلاد الى ٦٤ نقطة لتحليل المرور الاقتصادى فى نطاقها ، وبما يحقق اغراض تخطيط النقل ودراساته .

وفى نطاق محور القاهرة - اسيوط ، فقد تطابقت حدود المناطق بوجه عام مع الحدود الادارية على مستوى المراكز - اما خارج نطاق المحور فلم يكن التفصيل مطلوبا ، وتطابقت حدود المناطق بوجه عام مع الحدود الادارية على مستوى المحافظات . وقد استخلصت تقديرات الناتج القومى الاجمالى على مستوى المناطق عن طريق الربط بين سكان الاقاليم وتقديرات متوسط دخل الفرد داخل كل منطقة . وقد اعتمدت تقديرات متوسط دخل الفرد سواء على مستوى الاقاليم او على مستوى الحضر او الريف على نتائج بحث ميزانية الاسرة الذى قام به الجهاز المركزى للتعبئة والاحصاء خلال عامى ١٩٧٤-١٩٧٥ ، ١٩٨٢/١٩٨١ .

تكاليف النقل على الطريق :

كانت تكاليف النقل على الطريق مطلوبة فى هذه الدراسة لسببين : توقعات المرور وتقييم المشروع - وأما بالنسبة لتوقعات المرور ، فقد كان من المطلوب معرفة المبلغ المدفوع

السكان :

قامت الدراسة بعمل مراجعة مكثفة لتعدادات السكان الاربعة الاخيرة فى مصر وتمثلت المساهمة الاساسية لهذه الدراسة فى تقرير مفصل لامكانية المقارنة بين نتائج التعدادات ، مع الاخذ فى الاعتبار التغييرات العديدة فى تصنيف الاقاليم وفى الحدود الادارية التى حدثت خلال الاعوام الاخيرة وبتعديل نتائج التعدادات لتتوافق مع الحدود الحالية ، تم القاء الضوء على معدل التحضر الذى بولغ فى مقداره فى دراسات اخرى حديثة .

وأسفر المنهج الذى اتبع فى تنبؤات السكان فى هذه الدراسة عن تقدير السكان على المستوى القومى بحوالى ٦٨ مليون نسمة فى عام ٢٠٠٠ مقارنة بعدد ٤٧ مليون نسمة اليوم . ومتوقع أن تزيد نسبة السكان فى المحور من ٦ر٧ مليون اليوم الى ٦ر١٠ مليون فى عام ٢٠٠٠ .

وتوقعات عام ٢٠٠٠ بالنسبة لمصر تزيد بنسبة ٧ر٢ ٪ عن النقطة الوسطى للتقديرين العالى والمنخفض المستخدمين فى الدراسة القومية للنقل فى مصر - المرحلة الثالثة - ومع ذلك فهو لا يزيد الا بمقدار ضئيل لا يتجاوز اربعة اعشار الواحد فى المائة عن التقرير المتوسط الذى اعتمدت عليه الدراسة القومية للتنمية الحضرية ، وهو فارق غير ذو معنى من الناحية الاقتصادية .

وقد استخدمت هذه الدراسة المنهج الذى ابتدعه خبراء الامم المتحدة والمعروف باسم فارق النمو بين الحضر والريف (URGD) فى تنبؤات اتجاه النمو فى الحضر . وباستخدام هذه الطريقة بالاضافة الى تعديلات دقيقة ومتكاملة ظهر أن معدلات النمو فى الحضر اقل مما اوردته الدراسات السابقة - فبينما بلغت نسبة سكان الحضر فى عام ٢٠٠٠ حوالى ٦٠ ٪ فى الدراسة القومية للنقل - المرحلة الثالثة - فانها تنخفض الى ٨ر٥٤ ٪ فى دراسة السياسة القومية للتنمية الحضرية ، فى حين تقل نسبة سكان الحضر فى الدراسة الحالية الى ٥ر٥٠ ٪ فى عام ٢٠٠٠ .

وعلى اية حال - فاننا نشعر أن المنهج المتبع فى دراسة الجدوى لمشروع طريق القاهرة / اسيوط يقدم اساسيات يمكن الاعتماد عليها فى تقدير الطلب على النقل .

الاقتصاد :

باقى معدل النمو على المدى الطويل فى الناتج القومى الاجمالى حوالى ٨ر٥ ٪ سنويا للفترة من ١٩٥٦ حتى ١٩٨٥ - وقد زاد معدل النمو خلال الفترة من ١٩٧٥-١٩٨٠

الدراسات الاقتصادية :

وقد غطت الدراسات الاقتصادية السكان والزيادة الاقتصادية وتكاليف النقل

المتغيرات الاقتصادية :

قامت الدراسة بعمل عدد من الافتراضات الضرورية بخصوص المؤشرات الاقتصادية لاستخدامها فى كل من مرحلة توقعات المرور ومرحلة التقييم الاقتصادية . وأهم هذه الافتراضات هى :

١- التضخم : بالنظر الى ان التضخم يؤثر على جميع قطاعات الاقتصاد فى آن واحد فقد تم اغفاله فى توقعات الدراسة . وعلى ذلك فان جميع القيم المالية والاقتصادية التى استخدمت فى هذه الدراسة تمت بناء على سعر الجنيه المصرى الثابت لعام ١٩٨٥/١٩٨٦ .

٢- معدل الخصم : باتباع ماتوصلت اليه الدراسة القومية للنقل فى مصر تم اختيار معدل خصم يبلغ ١٢ ٪ لاجراء التقييم الاقتصادى للدراسة .

٣- معدل الفائدة : بعد دراسة مجموعة معدلات الفائدة فى السوق - تم اختيار نسبة ١٢ ٪ للحسابات المالية فى قطاع النقل . وقد تم تعديل هذه النسبة فى عملية تقييم نظام رسوم المرور ، كما سيأتى فيما بعد .

٤- اسعار الظل : الاسعار الخاصة (اسعار الظل) كانت مطلوبة فى بعض الموضوعات لتغطية النقص او القدرة بالاضافة الى تقلبات السوق التى يمكن ان تؤدى الى اخطاء التحيز فى التقييم فيما لو لم يتم تصحيحها والسيطرة عليها . وقد غطت هذه الاسعار العملة الصعبة (باعتبار ١ دولار = ١٫٨٠٠ جنيه مصرى وسعر البترول (باعتبار سعر البرميل على المدى الطويل = ٢٠ دولار) وتكاليف القوى العاملة وقيمة الوقت بالنسبة للركاب والبضائع .

القاعدة الاقتصادية القومية :

تم عمل مراجعات مفصلة للتطور الحالى فى مصر من خلال النمو السكانى والنمو الاقتصادى وقد استخدمت كأساس يمكن على اساسها عمل توقعات الاتجاهات المستقبلية للتنمية وهو ماوفر الخلفية اللازمة لتوقعات المرور فى الدراسة .

طرق التوصيل :

ومن اهم ملامح تصميم الطريق الجديد هو تحديد طرق توصيل مناسبة تربط الطريق الجديد بالتجمعات. فى المحور هدفها هو توفير وصلة لكل من عواصم المراكز ونظرا لان الغالبية العظمى من هذه التجمعات توجد على طول الطريق الرئيسى على الضفة الغربية ، فلا بد على طرق التوصيل ان تمر فى المنطقة الزراعية الحالية والبالغ عرضها ٢٠ كم . مما يستلزم استخدام بعض هذه الاراضى الزراعية فى انشاءات الطريق الجديد ولتقليل هذا الاستخدام الى ادنى حد ، تم استغلال الطرق الحالية وتحسينها وتوسيعها حتى تصل الطريق الجديد .

والمعاينات الميدانية لطرق التوصيل المقترحة اظهرت ان اغلبها من مستوى المواصفات القياسية من ناحية السعة وحمالة الرصف والاكتاف . وعلى ذلك ، قدرت التكاليف لتوسيع الطرق الحالية ومدها لترتبط بالطريق الجديد . وقد اعتمد تصميم الرصف على توقعات المرور وحمولات المحاور التى اختلفت حسب المناطق . وأن جميع الانشاءات الجديدة تمت فى الصحراء او فى الاراضى المستصلحة على حافة الصحراء .

وقدر الطول الكلى لطرق التوصيل بـ ١٨١ كم منها ١٤٣ كم موجودة فعلا . وسيلزم اخذ ١٫٢ مليون متر مربع من الاراضى الزراعية المجاورة للطرق الحالية لتحسينها و ٧٢ الف متر مربع من الاراضى المستصلحة وتتلخص تكاليف الانشاء فى الاتى :

تكاليف انشاء طرق التوصيل
بالمليون جنيه ١٩٨٥/١٩٨٦

نوع التكاليف	انشاءات المرحلة الاولى (١)	مجموع الانشاءات (٢)
مالية	٢٨٫٦	٦٤٫
اقتصادية	٣٦٫٩	٨٤٫٧
عملة اجنبية	٩٫٣	٢٥٫٤

(١) تقاطعات مستوية

(٢) ،، حرة

واقعية كفيلة بتحمل حمولات المحاور المتوقعة . ومعتمدا على حمولات المحور المتوقعة والتى تصل الى ٦٠ مليون محور قياس مكافىء على مدى ٢٠ سنة وتربة اساس ذو قوة تحمل كاليفورنيا ٨٪ او احسن ، ثم استخدام بنية رصفت قياسية كما يلى :

١٥ سم حصين مجروش لطبقة تحت الاساس

١٨-٢٠سم طبقة اساس اسفلتية

٥ سم طبقة سطحية

وقد افترض ان طبقة تقوية اضافية سمكها ٥ سم سوف توضع بعد ١٠ سنوات

تكاليف الانشاء :

تم تقدير تكاليف الانشاء بالاعتماد على كميات التصميم الابتدائى . وقد قدرت كميات الحفر والردم من القطاع الطولى للطريق ، وكميات الرصف من تصميم القطاعات العرضية . وقد قدرت الانشاءات للكبارى وعبور الوديان والحماية من الكثبان الرملية فى بعض المواقع كل على حدة .

وقد تم عمل حساب طريق توصيلى اضافى لتقاطع طريق القاهرة الدائرى/ طريق الفيوم الصحراوى ، والواقع شمال الطرف الشمالى للطريق الجديد . وسيحتاج الامر الى بعض الاراضى الزراعية حيث يمر الطريق بالشريحة الزراعية التى تربط بنى سويف والفيوم وتلخص التكاليف الكلية للانشاء فيما يلى :

التكاليف الكلية لانشاء طريق القاهرة/ اسيوط الجديد
بالمليون جنيه ، ١٩٨٥/١٩٨٦

نوع التكاليف	الرحلة الاولى للانشاء	مجموع الانشاءات
مالية	٨٨ر٦	١٧٩ر٤
اقتصادية	١١٨ر٢	٢٤٠ر٧
عملة اجنبية	٣٣ر٦	٦٩ر٤

ملحوظة : تكلفة طرق التوصيل وتحويلاتها محسوبة كل على حدة

١- انشاء حارتين بتقاطعات مستوية

٢- انشاء ٤ حارات بتقاطعات حرة

الخرائط الطبوغرافية للمحور والخاصة بالجيش الامريكى من الوكالة الامريكية للتنمية الدولية وتم اعداد الصور والخرائط بمقياس رسم ١ : ٢٥٠٠٠ر٠ - كما تم عمل مسح متصل للتربة بطول المسار .

التصميم الهندسى الابتدائى :

وتمثلت اهم العوائق امام تحديد المسار الجديد فى :

١ . موقع خطوط الضغط العالى من اسوان حتى القاهرة

٢ . موقع خط انابيب منتجات البترول الجديد من القاهرة حتى اسيوط

٣ . حدود الاراضى الزراعية بما فيها امتداداتها المستصلحة من الصحراء

٤ . الطبوغرافيا (مشكلة هامة فقط جنوب المحور)

والمواصفات القياسية للتصميم الهندسى والمستخدمة فى هذا التصميم الابتدائى للطريق الجديد اعتمدت على المواصفات الامريكية . والسرعة التصميمية المفروضة هى ١١٠ /كم ساعة للطرق للطريق الجديد ٦٥ر٢كم/ ساعة بالنسبة لطرق التوصيل . وجميع العناصر الاخرى بما فيها المنحنيات والكبارى العلوية والانتظار والمرور تم اختيارها بما يتفق مع هذه السرعات .

والمنطقة ليست وعرة بشكل عام ، ولا يوجد سوى بعض المشاكل الصغيرة فى عملية تحديد موقع الطريق الجديد بما يتفق مع هذه العناصر والقطاعات الوحيدة التى مثلت صعوبات كانت تلك المواجهة للمنيا حيث يدخل المسار الجديد فى المنطقة الضيقة بين الجرف الصخرى والارض الزراعية .

وكذلك بين ملوى ودير بروط . ومع ذلك يمكن أن يقع الطريق فى كلا هذين القطاعين بما يتفق مع معايير التصميم . وقد تم التوصل الى أن طريق كامل من ٤ حارات يمكن أن يقع فى المحور المختار بتصميم عالى فى المواصفات القياسية .

والطول الكلى للمسار النهائى ابتداء من طريق الفيوم الصحراوى حتى طريق الوادى الجديد هو ٣٤٣ر٣ كم .

تصميم الرصف :

لوحظ أن اغلب انشاءات الرصف فى مصر تستخدم معايير تصميم لا تأخذ فى اعتبارها حمولات المحاور الحالية او المتوقعة . ومن أهم عناصر الدراسة كان اعداد تصميمات

وتراوحت الاسعار المستخدمة للارض من صفر بالنسبة للصحراء الى ٥ جنيهات للمتر المربع بالنسبة للارض الزراعية المجاورة للطريق الرئيسى الحالى .
وفيما يلى ملخص تكاليف الطرق التحويلية من حارتين و٤ حارات وتكاليف توسيع الطريق الحالى بين الطرق التحويلية .

تكاليف انشاء الطرق التحويلية والتوسيع
(بالمليون جنيه ، ١٩٨٦)

التحسين	التكاليف المالية	التكاليف الاقتصادية
طرق تحويلية من حارتين	٢٤ر٨	٣١ر٦
طرق تحويلية من ٤ حارات	٣٧ر٩	٤٩ر٦
توسيع	٧٤ر٨	٩٥ر٠

تصميم طريق القاهرة/ اسيوط الجديد :

المشروع الرئيسى الذى تم تقييمه فى الدراسة هو طريق جديد تماما من القاهرة حتى اسيوط وشملت الدراسة نواحى الطريق الجديد ابتداء من طبيعة الموقع (اى جانب من نهر النيل وكم تبعد عن التجمعات الحالية) وحتى التوقيع التفصيلى للطريق ، والتصميمات الهندسية الابتدائية وتكلفتها .

تقييم اختيارات المسار :

تمثلت اول مهمة للدراسة فى تقييم بدائل اختيارات المسار للطريق الجديد والتوصية بمسار لدراسة اكثر تفصيلا - وهذه المهمة التى استغرقت الشهرين الاولين من الدراسة اخذت فى اعتبارها المسارات على جانبى النيل منها بعض مسارات فى الصحراء بعيدا عن المحور الرئيسى .
وفى الاساس ومعتمدا على تكاليف انشاء اقل وطرق دخول اسهل للتجمعات الحالية فى المحور واحتمالية فتح مناطق جديدة للتعمير - تم اختيار مسار على الضفة الغربية للنيل يقع فى الصحراء خارج حدود المنطقة الزراعية الحالية . وبعد الاتفاق على المسار مع هيئة الطرق والكبارى ، تم عمل مسح بالتصوير الجوى للمسار وتم الحصول على مجموعة من

مشروعات الانشاء المرشحة علي الطرق الحالية :

تم اختيار مشروعين استثماريين كبيرين لتحسين الطريق الحالى على الضفة الغربية : انشاء طرق تحويلية حول المدن الكبرى بطول الطريق ، وتوسيع الطريق ليصبح ٤ حارات .

وقد تم توقيع مسارات الطرق التحويلية حول ١٤ مدينة على الطريق الحالى على الضفة الغربية حالة الطريق داخل المدن شديدة السوء بسبب المرور ، وهى حالة يمكن ان يزيد تدهورها مع الوقت ومجموع اطوال الطرق التحويلية بلغ ٨٢ كم .

كما تم عمل تقديرلاحتياجات توسيع جميع قطاعات الطريق الحالى على الضفة الغربية ليصبح ٤ حارات قياسية ويدخل ضمن ذلك ٢٤٦ كم من الطريق ابتداءا من العياط حيث ينتهى الطريق ذو الاربعة حارات البادىء من القاهرة ، وحتى منفلوط حيث يبدأ الطريق ذو الاربعة حارات الى اسيوط .

وكثير من قطاعات الطريق الحالى يوجد حولها قنوات على جانبى الطريق ، احدهما ترعة رئيسية والاخرى ترعة صغيرة اخرى تقوم بالتغذية - وتوسيع الطريق سيعنى نقل الترعة الصغيرة ، وقد اخذت تقديرات التكلفة والتقديرات الهندسية ذلك فى حسابها .

تكاليف وحدة انشاء الطريق :

فى اغلب الاحوال قدرت التكاليف المالية (الثمن المدفوع فعلا للمقاولين) من المقارنات مع المناقصات الحديثة وللاغراض التقييم الاقتصادى ، كان من الضرورى تحويل هذه التكاليف الى تكاليف موارد اقتصادية والتى تعدل للضرائب ورسوم الاستيراد والدعم لتمثل قياس اصدق للموارد القومية المستهلكة فى الانشاء .

تكاليف الارض :

بوجه عام الاسعار المستخدمة - افترضت ان الاراضى سيتم نزع ملكيتها بمعرفة الحكومة للانشاء وذلك يعنى اسعار اقل بكثير عن مثيلتها للارض التى ستستخدم لاغراض صناعية مثلا .

تقييم رصف الطريق :

تم عمل تصنيف بالرؤيا لحالة الطريق فى بداية الدراسة - وبالاعتماد على ذلك . تم اختيار ٢٠ موقع لاخذ العينات الميدانية لتحديد بنية الرصف ولاخذ عينات للتحليلات المعملية . ثم تم عمل تقييم لقوة الرصف الحالى واستخدم ذلك مع معلومات المرور المتوقعة - لتحديد متطلبات تقوية الرصف فى المستقبل . وقد تم التوصل الى ان برنامج تغطية جيد يمكن ان يحافظ على الرصف فى حالة جيدة وبتكاليف اقل من سياسة هيئة الطرق والكبارى الحالية للتغطية والاصلاح فقط حين يصبح الرصف فى تدهور خطير .

وعموما فيجب البدء فى التحرك سريعا ، نظرا لأنه - على الرغم من برنامج الاصلاح الحالى فالرصف فى كثير من قطاعات المحور ضعيف وليس من المحتمل ايقاف حمولات المحاور الحالية او المتوقعة لعدة اعوام قليلة حتى مع بعض صور التحكم فى حمولات المحاور .

ولقد تم تقدير متطلبات شبكة الطرق القائمة فى المدة من عام ١٩٨٧ حتى عام ٢٠٠٩ بمقدار ١٫٢٣ مليون متر مكعب من التغطية الاسفلتية وتقل الى ١٫١٢٥ مليون متر مكعب اذا تم تحسين الطريق الرئيسى بالضفة الغربية كما هو مذكور فى الشرح فيما بعد أو ١٫٠٦ مليون متر مكعب اذا تم انشاء طريق القاهرة/ اسيوط . وسعر مالى يبلغ ٥٥٫٧ جنيه للمتر المكعب يؤدى ذلك الى استثمار بين ٥٩ ، ٦٧ مليون جنيه عن المدة بمتوسط ٢٫٦ الى ٣٫ مليون جنيه فى السنة .

ومن المحتمل أن تكون المصروفات العالية ضرورية فى الجزء الاول من المدة للوصول بالرصف الى قوة مقبولة وعلى اية حال يجب تحديد برنامج سليم لتغطية الرصف معتمدا على التحليل التفصيلى لقوة الرصف محددا اولويات القطاعات للمعالجة الفورية وأنه لمن المؤكد ان الايضاحات المجمعة فى هذه الدراسة غير كافية لوضع برنامج تفصيلى لتقوية الرصف .

واذا أنشأت بشكل جيد ، فسيمكنها أن تتحمل الاستخدام وزيادة الحمولات دون أن تستلزم الاصلاحات الصغيرة المتعددة اللازمة للسطح تحت مثل هذه الظروف وهى بالطبع لن تتحمل اذا كانت تتعرض لهذه الحمولات الكبيرة على طبقة الأساس والطبقة السطحية - ومثل هذا التقصير موجود بأوضح صورة فى المحور الآن .
وعموما ، فطبقات التغطية والاصلاح ستعالج هذا التقصير خارج عمليات الاصلاح الروتينية والتى ستناقش على حدة .
وتوجد مشكلة حادة فى استخدامات الاكتاف - فأغلب مسافة طريق القاهرة/ اسيوط الحالى واقعة بمحازاة قنوات الرى ، وهذه القنوات وانحدارتها يجب صيانتها بشكل منتظم من جانب هيئات الرى . والآلات المستخدمة لهذه المهمة كثيرا ماتشغل جزء من هذه الاكتاف - بل ايضا تتضمن اشغال جزء من حافة الطريق المرصوف غالبا مايتم جمع المواد العضوية والحصى المستخرج من هذه القنوات او بالقرب من الاكتاف . ولا يوجد حل واضح لهذه المشاكل - نظرا لان صيانة هذه القنوات عمل قانونى ولازم . ومنطقة العمل اللازمة لذلك غالبا ماتكون محدودة ومع ذلك فالاثار بالنسبة للطريق خطيرة والمواد المستخرجة من القنوات ، البالغة السود بالنسبة للطريق ، يمكن أن تكون مفيدة بالنسبة لتخصيب الارض وستكون ذات قيمة كبيرة اذا نقلت الى اماكن تجميع مناسبة . ويجب ازالتها سريعا من على اكتاف الطريق اينما يوجد فراغ ، يجب توسيع الطريق او انشاء تدرجات اقل ارتفاعا لتوفير الاماكن اللازمة لعمل هذه الحضارات .

ولأغراض دراسة الجدوى - تم تقدير صيانة الرصف لتشمل الترقيع - وطبقات التغطية لاصلاح التلفيات المحلية وطبقات تغطية الترقيع وأى اصلاحات اخرى وطبقات دورية (تسوية سطحية) للطريق بكامل عرضه على فترات تبلغ عدة اعوام - ونسب ومعدلات التكرار لمثل هذه الاعمال تم تقديرها باعتبار عمر الرصف واحجام المرور بالاضافة الى الحالة الاصلية للرصف اينما يمكن تطبيقها . كما تم تقدير تكاليف صيانة الصرف والانشاءات الاخرى ، والاكتاف وطلاء الخطوط وصيانة العلامات .
وعموما وباعتبار احتياجات الصيانة البسيطة للطرق الحالية (التغطية تعالك كاستثمار للبنية الاساسية) - تم تقدير تكاليف الصيانة بمبلغ بسيط .

الضفة الغربية من احجام المرور ذو المسافات الطويلة . وجارى حاليا انشاء المرحلة الثانية من طريق الضفة الشرقية بين بنى سويف والمنيا والذى سيصل بالكوبرى الجديد على النيل عند المنيا .

ومن المفترض الانتهاء منه فى عام ١٩٨٨ حيث يخلق طريق بديل للطريق الحالى على الضفة الغربية لثلثى المسافة على طول محور القاهرة/ اسيوط .

وقد أظهرت معاينة الانشاءات الجديدة بين بنى سويف والمنيا ملاحظتين :

أولا : التخطيط الهندسى ضعيف فى بعض الاماكن التى بها بعض المنحنيات الرأسية والافقية الحادة . وثانيا : بنية الرصف ليست قوية بحيث تحتمل لحمولات المحاور الثقيلة . وعلى ذلك ، فاذا تحولت العربيات النقل (وهى الاكثر استخداما فى مرور المسافات الطويلة) الى استخدام هذا الطريق الجديد بكميات كبيرة كما هو متوقع فى هذه الدراسة ، فان القطاعات الجديدة ستتدهور حالتها بشكل سريع .

الطريق بين المحافظات :

تتعاون محافظات الفيوم وبنى سويف والمنيا فى تجديد ٢٢١ كم من الطريق الحالى لتكوين مسار جديد يربط الثلاث محافظات . وتمتد الطرق المختارة للتجديد بمحاذاة خط قناة بحر يوسف موازيا للطريق الرئيسى على الضفة الغربية والواقع فى الارض الزراعية ويحتمل أن يؤدى هذا المشروع الى تخفيف العبء عن الطريق الرئيسى الحالى ، الا أنه يعانى من تخطيط ضعيف للمسار فى بعض القطاعات فضلا عن تصميم ضعيف للرصف وعملية تمويل هذا المشروع محدودة بتاريخ انهاؤه غير مؤكدة . وقد كان مقدرا أن يخفف هذا الطريق الجديد بين المحافظات العبء عن الطريق الحالى بنسبة المرور المحلى ، الا أن معظم المرور سيظل يستخدم الطريق الحالى .

صيانة الطريق :

بالنسبة للطرق الرئيسية المستخدمة حاليا فى المحور ، اتبعت هيئة الطرق والكبارى سياسة تقلل عمليات الصيانة الى الحد الادنى . ويعتبر الرصف بالخرسانة الاسفلتية نوع ممتاز ذو طبقة سطحية حديثة وخلطه مركزية وانشاء آلى ويعتبر نسبيا رصف كمى لمعظم الطول ويحتوى عادة على ٦ سم بريمكس او طبقة رابطة يعلوها ٥ سم طبقة سطحية بتدرج اكثف وهذا الرصف الثقيل لا يولد حفر او كسور بنفس طريقة الرصف الرفيع والمعالجة السطحية .

طريق الجيزة - الفيوم - بني سويف :

والجزء الاول من هذا الطريق ابتداء من الجيزة هو طريق الفيوم الصحراوى المكون من ٥٣ كم ، أغلبه من حارتين وله اكتاف من الحصى . وبعد دخول واحة الفيوم ، نجد أن للطريق نفس خصائص الطريق الرئيسى على الضفة الغربية يعتبر قطاع الطريق المار داخل وسط عاصمة محافظة الفيوم بالغ الصعوبة نظرا للطرق المزدحمة ذات الحالة السيئة ، وبعد الخروج من الفيوم ، نجد الطريق عامة مستوى السطح ومستقيم من حارتين وله اكتاف مرصوفة .

كبارى النيل :

حتى قريبا ، كانت المعابر الوحيدة للنيل توجد فى الاطراف الشمالية والجنوبية لمحور القاهرة - اسيوط ، ويفصل بينها ٣٥٠ كم من الطريق . وفى عام ١٩٨٤ ، تم افتتاح كوبرى جديد من ٤ حارات فى بنى سويف - مما سمح لبنى سويف ان تمتد لأراضى غير زراعية على الضفة الشرقية للنيل ، وأن تربط بالطريق على الضفة الشرقية حتى حلوان والقاهرة . وجارى حاليا انشاء كوبرى جديد من ٤ حارات فى المنيا ويتوقع اتمامه عام ١٩٨٧ .

الانشاءات الحديثة والحالية :

يوجد حاليا استثمارات كبيرة فى قطاع الطرق فى المحور وتقدر هذه الاستثمارات بمبلغ من ١٠ الى ١٥ مليون جنيه فى السنة خلال الـ ٦-٨ سنوات الاخيرة .

ويتمثل جزء كبير من ذلك العمل فى برنامج اصلاح للطريق الرئيسى على الضفة الغربية والذى سيتحول الى طريق جيد من حارتين له اكتاف مرصوفة لكامل المسافة من القاهرة حتى اسيوط . ومع ذلك - فقوة الرصف ضعيفة كما نوقشت فيما بعد فى هذا الجزء وجارى حاليا تنفيذ مشروعين كبيرين وهما :

الطريق الجديد على الضفة الشرقية : ادى افتتاح الكوبرى الجديد فى بنى سويف وعمليات اصلاح الطريق الحالى بين حلوان وبنى سويف - الى خلق طريق جديد على الضفة الشرقية كفيل بتخفيف العبء عن الطريق الرئيسى الحالى على

التقديرات الهندسية للطرق القائمة :

الطريق الرئيسى الذى يخدم المحور يقع على الضفة الغربية من النيل حيث توجد معظم التجمعات والانشطة . وفى الطرف الشمالى من المحور ، يوجد طريقين رئيسيين آخريين . طريق الضفة الشرقية بين القاهرة وبنى سويف ، وطريق الجيزة - الفيوم بنى سويف .

وصف الطريق :

يبلغ طول الطريق الرئيسى على الضفة الغربية من القاهرة الى اسيوط ٣٦٥ كم ، وهو ذو تخطيط جيد جدا بقطاعات مستقيمة يبلغ طولها من ٥ الى ١٥ كم تتصل ببعضها بمنحنيات غير حادة ، وانحداراته مستوية للغاية . والـ ٤٦ كم الاولى من القاهرة الى العياط عبارة عن ٤ حارات بجزيرة وبغض النظر عن بعض القطاعات داخل المدن ، فباقى الطريق يتكون من حارتين فقط وفى الغالب بدون اكتاف . ويمر الطريق فى خليط من الاراضى الزراعية (٦٠ ٪) وتجمعات سكنية كبيرة وصغيرة .
وهذه التجمعات موزعة بأطوال قصيرة بطول الطريق وبها حوالى ٢٠٠ متغير تصنيفى بين القاهرة وأسيوط . ومما يميز هذا الطريق تعدد نقاط تفتيش البوليس اينما يضيق الطريق ليصبح حارة واحدة باستخدام العلامات المؤقتة - وقد تمت ملاحظة اكثر من ٤٠ نقطة تفتيش او نقطة كل ٨ كيلو مترات .

طريق الضفة الشرقية :

وقد حظى هذا الطريق بأهمية كبيرة بعد افتتاح الكوبرى الجديد عند بنى سويف عام ١٩٨٥ - حيث أمكن لهذا الطريق أن يستخدم كبديل للطريق الرئيسى الحالى على الضفة الغربية . وجنوب حلوان ، نجد أن الطريق له خصائص مماثلة للطريق الرئيسى على الضفة الغربية ، فهو اساسا من حارتين ويمر بأراضى زراعية الا انه يمر بعديد من القرى الصغيرة - وبعد الكريمات ، يمر الطريق خلال صحارى ٣٠ كم حتى يصل الكوبرى الجديد فى بنى سويف .

وفى عام ٨٥/١٩٨٦ قام هذا الخط بنقل مايقرب من ٢ مليون طن بضائع فى المحور مقارنة بحوالى ١٩ مليون طن من التحركات بين المحافظات بالطريق .
وقد قام هذا الخط بنقل جزء كبير من المسافرين بالسكك الحديدية مشاركا بالتساوى مع الاوتوبيسات والتاكسى فى التحركات بين المحافظات .
وبالاضافة الى التوصية بالاستثمارات فى السكك الحديدية - فقد توقعت الدراسة القومية للنقل فى مصر زيادة فى مركبات السكك الحديدية بمضاعفتها اربعة مرات لخدمة احجام البضاعة بين مناطق المصادر والاهداف فى المحور حوالى عام ٢٠٠٠ .
وعموما ، فقد اكدت الدراسة القومية للنقل فى مصر على طبيعة " تحديد الهدف " لهذه التوقعات واعترفت بصعوبة وضعها موضع تنفيذ . وعلى الرغم من التحسينات فى عمليات تشغيل القطارات منذ الدراسة القومية للنقل فى مصر ، الا أن دراستنا غير مقتنعة بامكانية تنفيذ توقعات الدراسة القومية للنقل . ولا تشير الدلائل الى زيادة كبيرة فى عمليات تشغيل القطارات تكفى لجذب المرور من وسائل النقل الاخرى .

النقل النهرى :

ويعتبر قطاع النيل من القاهرة الى اسيوط اكثر القطاعات استخداما فى نظام النقل المائى المصرى بحجم بضائع حالى يماثل تقريبا مستوى المنقول بالسكك الحديدية .
وقد توقعت الدراسة القومية للنقل زيادة كبيرة فى المنتجات المنقولة فى هذا القطاع من النيل الا انها مرة اخرى اعترفت بصعوبة تنفيذها . وقد اشارت المناقشات مع هيئة النقل النهرى الى انه لم يتم البدء فى عمل اى تغيرات لازمة لتحقيق توقعات الدراسة القومية للنقل . وتم التوصل الى أنه لا يمكن التوقع بحدوث اى تطورات جديدة يمكن أن تؤثر على توقعات النقل بالطرق البرية .

النقل بخطوط الانابيب :

لا توجد خطوط انابيب حالية فى محور القاهرة - اسيوط ، الا أنه يتم حاليا انشاء خط منتجات بترول جديد يربط بين القاهرة ومعمل التكرير الجديد الجارى انشاؤه فى اسيوط . وفى المستقبل يتوقع أن يتم توريد الاحتياجات من المنتجات البترولية بين المحافظات باستخدام خطوط الانابيب - الا أن التوزيع المحلى لهذه المنتجات سيستمر باستخدام الطريق .

الركاب على اساس تسعيرة للكيلومترات اعلى من تسعيرة الا وتوبيسات المكيفة

اما عن خدمات نقل البضائع ، فتوفرها خمس شركات نقل عامة لحسابها الخاص وهى :

عربات نقل مسجلة لشركات عامة وخاصة لغير النقل ، هيئات تعاونية للنقل ، شركات نقل خاصة صغيرة وعربات نقل شخصية . وقد زاد اسطول عربات النقل سريعا خلال الفترة من ١٩٧٥ الى ١٩٨٤ بمتوسط نسبة زيادة سنوية تزيد عن ٢١ ٪ ، وفئة الشاحنات الصغيرة (اقل من ٣ طن) زادت بصورة كبيرة حيث ان هذه الزيادة تزيد عن ٣٠ ٪ فى السنة لنفس الفترة . ونقل البضائع لا تحكمه تحديدات عند الدخول او التسيير او المواصفات القياسية للعربة . والمحددات الرسمية لحمل المحور غير ملزمه

وتعمل الخمسة شركات التابعة للقطاع العام كمتحكمين فى تحديد تعريفة نقل البضائع التى تقوم بنقلها ، والتعريفات الاخرى يتم تحديدها بالمنافسة .

وسائل النقل بغير الطرق :

تم دراسة النقل باستخدام السكك الحديدية والنقل النهرى والنقل بخطوط الانابيب وذلك بهدف استكمال صورة النقل فى محور القاهرة/ اسيوط . وقد اعتمدت هذه الدراسة جزئيا على المقابلات التى جرت مع الهيئات المختصة ، وجزئيا على التقارير الحديثة من الدراسة القومية للنقل فى مصر . وفيما يختص بالنقل بالسكك الحديدية ، فقد زار مصر خبير سكك حديدية لمدة شهر قام خلالها بالاطلاع على تشغيلها .

السكك الحديدية :

والخط من الجيزة الى اسيوط مزدوج وذو حجم مقياس بطول ٣٧٥كم . ويقع بالقرب من الطريق الرئيسى على الضفة الغربية موازيا لقناة رى شمالية - جنوبية ومساره مستقيما ونظرا لان طبوغرافية المحور مستوية ، فلا توجد مشاكل فى الانحدار ويصير الخط مفرد جنوب اسيوط .

المحافظات يمثل حوالى ٥٠ ٪ من جميع التحركات الملاحظة فى المحور ، آخذا فى الاعتبار جميع التحركات الداخلية والخارجية معا . وتمثل التحركات بين المحافظات فى المحور حوالى ٧ ٪ فقط من المجموع .

وتمثل التحركات الخارجية الى ومن القاهرة والشمال حوالى ٢٥ ٪ من المرور الكلى فى المحور .

فقط ثلث هذه النسبة (حوالى ٧٫٥ ٪ من المرور الكالى فى المحور) كانت فعلا لمسافات طويلة مارة بعد الفيوم وجزء من محافظة الجيزة الواقع فى المحور . وقد كان هناك اتصالا بسيطا بين المحور ومصر العليا جنوب اسيوط . وبلغت التحركات الطويلة بطول المحور دون توقف حوالى ١٠٠٠ عربة يوميا ممثلة لاقل من ٢ ٪ من المرور الكلى فى المحور .

حوادث المرور :

تم مراجعة المعلومات الخاصة بحوادث المرور الحالية فى المحور . الا أن المقارنات كانت صعبة بسبب الاسس المختلفة لكل مجموعة من الاحصائيات . وبالاعتماد على هذه النتائج ، تم استنتاج معدلات الحوادث لمختلف درجات الطريق فى المحور - مع التفرقة بين الطرق المكونة من حارتين وتلك المكونة من ٤ حارات ، وبين الطرق الواقعة فى مناطق صحراوية وتلك الواقعة فى مناطق زراعية .

خدمات النقل على الطريق :

زاد اسطول العربات فى مصر بنسبة كبيرة خلال العشرة سنوات الماضية ، بمتوسط يبلغ ١٦٫٥ ٪ سنويا . وتشير احدث الاحصائيات الى ان نسبة الزيادة بلغت فى الاعوام ٨٤/١٩٨٦ ١٣٫٧ ٪ سنويا وفى داخل محور الدراسة تتوفر خدمات نقل الركاب والبضائع من كلا القطاعين العام والخاص .

وتوفر شركة النقل العامة لمصر العليا اوتوبيسات نقل عام للخدمة داخل المحور . كما توفر المؤسسات العامة والخاصة الغير مختصة بالنقل ، اوتوبيسات لخدمة ونقل موظفيها ويبلغ نصيب القطاع الخاص ٥٧٫٢ ٪ من مجموع عدد الاوتوبيسات المسجلة .

وتقوم التاكسيات الخاصة بتوفير الخدمة بين المدن وداخلها وكذلك بالنسبة للقرى والمدن الصغيرة . كما نجد اسطول كبير من التاكسيات بين المدن وهى تقوم بنقل

حمولتها عن الحمولة المصرح بها .

وبالأخص تمثلت اسوأ المخالفات فى عربات النقل المركبة التى تنقل عبوات الاسمنت . حيث بلغ وزن هذه العربات ٦٣ طن (الوزن الاقصى المصرح به هو ٤٨ طن لاكبر نوع من عربات النقل المركبة) كما قدر ايضا أن ٦٠ ٪ من جميع المحاور المفردة (باستبعاد المحاور الاساسية) ، ٨١ ٪ من جميع المحاور المزدوجة ، ٦٣ ٪ من جميع المحاور الثلاثية كانت محملة فوق طاقتها (أيضا باعتبار حمولات عربات النقل فقط) .

وجزء من المشكلة سببه ان عربات النقل يرخص لها روتينيا بالحمولة الزائدة عن المصرح به فى قانون حمولات المحاور الحالى . كما أنه - حتى وقت قريب ، عربات النقل الكبيرة كان يتم استيرادها من دول تسمح بالحمولات الزائدة ، وعلى ذلك كان يصرح لها بنقل حمولات زائدة - وعلى ذلك - فالمشكلة الرئيسية هى أن العربات يرخص لها بنقل حمولة تزيد عن سعتها المصرح بها .

وآثار ذلك على الرصف بالغة السوء . فالتلفيات التى تحدث للطريق المرصوف تزيد من ٢٠ الى ٣٠ مرة حين تتضاعف حمولة محور . ونظرا لان الحمولة الزائدة البسيطة تؤدى الى تلفيات كبيرة بالنسبة للصيانة والاصلاح - فما بال الحمولة الزائدة بشكل مبالغ فيه - كما هو ملاحظ على طريق القاهرة / اسيوط - تؤدى الى التدهور السريع فى حالة الطريق المرصوف .

اطوال الرحلات :

الغالبية العظمى من الرحلات كانت لمسافات قصيرة تبلغ ٣٠ كيلو متر او اقل لاكثر من ٥٠ ٪ من الرحلات وكان هناك اختلاف كبير فى اطوال الرحلات بين مختلف انواع العربات - فاغلب عربات الركاب كانت لاطوال رحلات قصيرة منها فقط ٥ ٪ زادت اطوال رحلاتها عن ١٥٠ كم ومن ناحية اخرى - وجد أن عربات النقل الكبيرة متعددة الوحدات - تقوم برحلات طويلة منها ٢ ٪ بلغت اطوال رحلاتها ٨٠٠ كم .

انماط حركة المرور فى المحور :

وجد أن المحافظات فى المحور لها كفاية ذاتية كبيرة حيث تتم اغلب حركات المرور اليومية بالكامل داخل حدود المحافظات - فى الواقع ، المرور بالكامل داخل

وقد تماثلت سرعات المرور فى المحور بالنسبة للعربات الخفيفة والثقيلة حيث تراوحت فى المتوسط بين ٦١ و ٥٥ كم/ الساعة بين القاهرة واسيوط - ويرجع ذلك غالبا الى المسار المستقيم والغياب الكلى للانحدارات وهما عاملين يمكنهما التقليل من سرعات عربات النقل بشكل ملحوظ ، مما يفسر التشابه فى السرعة .

وبالطبع فسرعات المرور تختلف من مكان لآخر بحسب نوع الطريق وخصائص المنطقة الواقعة بطوله . وعلى الاخص يمكن ان يطلق على ٦٠ ٪ من الطريق فقط منطقة مفتوحة ، أما الباقى فهو اما مناطق حضرية او - غالبا - تجمعات قروية حيث يكون الازدحام فى هذه المناطق عامل فعال فى بطء المرور بشكل ملحوظ .

وتشير المقارنات مع حصر المرور السابق ان نمو المرور المضطرد فى المحور بين ١٩٧٩ ، ١٩٨٣ البالغ ٢٥ ٪ فى السنة تباطؤ فى السنتين الاخيرتين الى متوسط ٢ر٨ ٪ فى السنة . وتبلغ معدلات نمو المرور السنوى ١٩٨٣-١٩٨٥ فى مواقع حصر متفرقة على المحور من ٢٣ ٪ على طريق الفيوم الصحراوى الى ٢ ٪ بين بنى سويف والمنيا . وعلى اية حال يجب عدم اخذ مقارنات الحصر المتفرقة بجدية عند اجرائها بدراسات مختلفة وانه لمن سوء الحظ ان برنامج حصر منتظم لم يبدأ بعد مع العلم بوجود خطط لعمل ذلك .

خصائص عربات الركال :

العربات الرئيسية الناقلة للركاب المحور تأخذ اشكالا مختلفة للتاكسى (سيارة ، نان - وبيك آب) ونقلت مايقرب من ٥٠ ٪ من مجموع الركاب . واما نوعى الاوتوبيسات فنقلتا فقط حوالى ٣٠ ٪ واغلبها بالاوتوبيسات الكبيرة . وحوالى ٢٥ ٪ من السيارات الخاصة لم يكن يشغلها سوى قائد السيارة وبلغت نسبتها فقط ٦ ٪ من مجموع حجم المسافرين .

خصائص عربات النقل :

وقد كانت اهم النتائج التى توصلت اليها عمليات حصر المرور هى عربات النقل - وعلى الاخص - فقد اظهر حصر اوزان عربات النقل ان جزء كبير جدا من عربات النقل على طريق القاهرة - اسيوط - كانت محملة فوق طاقتها - وفى كثير من الاحيان اكثر من فوق طاقتها وقد تم اجراء مقارنات مع حصر اوزان عربات النقل الذى تم فى مصر خلال ١٩٧٩ ، ١٩٨١ وقد اشارت هذه المقارنات الى انه ماكان يعتبر آنذاك اوضاع سيئة تدهوت حالته الآن ليصبح بالغ السوء .

وتعمل ثلاث انواع رئيسية من عربات النقل على طريق القاهرة / اسيوط عربات النقل المفردة وعربات النقل المركبة (عربات مفردة تجر مقطورة) وعربات النقل المفصلة (جرار موصول بنصف مقطورة) وقد تم تقدير العربات المحملة بحوالى ٧٥ ٪ من العربات المركبة وعربات النقل المفصلة ، وحوالى ثلث عربات النقل المفردة حيث تزيد

كما تم عمل حصر لزمن الرحلة بغرض تحديد سرعات العربات الخفيفة والثقيلة تحت ظروف مرور مختلفة ولأنواع مختلفة من التطور فى المحور . كما استخدم هذا الحصر ايضا للحصول على بيانات اضافية للمرور تغطى جميع قطاعات الطريق الحالى ، ولتوفير قائمة بخصائص الطريق المرتبطة بسعة المرور .

كما تم جمع بعض بيانات المرور الآلية فى نفس وقت حصر مقابلات جانب الطريق والحصر اليدوى للمرور ، وذلك اساسا بهدف مراجعة الحصر اليدوى للمرور .
وبعد اتمام حصر مقابلات جانب الطريق ، تم وضع عدادين مرور تسجيليين لمدد طويلة على الطريق الرئيسى بين القاهرة واسيوط على الضفة الغربية وذلك لتحديد تغيرات المرور لفترة استغرقت ٦ اسابيع .

احجام المرور على الطريق لعام ١٩٨٦

تتغير احجام المرور على الطريق الرئيسى بالضفة الغربية بين ١٢٫٠٠٠ عربة يوميا بالقرب من القاهرة الى ٦٫٠٠٠ عربة يوميا بالقرب من اسيوط . وقد تم تصنيف المرور الـ ١٢ عربة . والعربة الرئيسية التى تم تمثيلها كانت البيك - آب والتى بلغت ٢٧ ٪ من المجموع .
وفى حين أن اغلب استخدام لهذه البيك - آب كان لنقل المواد الغذائية - الا أن حوالى ١٠ ٪ منها استخدمت لنقل الركاب بتكلفة بسيطة . وقد بلغت نسبة عربات النقل ٢٥ ٪ من تيار المرور نصفها كانت عربات نقل مفردة ، والباقى عربات نقل كبيرة تجر مقطورات او نصف مقطورات .
السيارات الخاصة (١٢ ٪) والتاكسى بلغت نسبتها حوالى ٤٢ ٪ من مجموع المرور ومن الغريب أن تبلغ الاتوبيسات نسبة ٥ ٪ فقط .
وقد اشارت عمليات الحصر الى أن ٢٥ ٪ من عربات النقل و ١٥ ٪ من عربات الركاب تتحرك خلال فترة الليل من الساعة ١٠ مساء الى الساعة ٦ صباحا . وخلال ساعات النهار (من الساعة ٦ صباحا حتى الساعة ٥ مساء اثناء اجراء الحصر) تم تسجيل ٥٣ ٪ من تحركات عربات النقل و ٦٠ ٪ من تحركات عربات الركاب .

النقل الحالى :

قامت الدراسة باجراء مجموعة من عمليات حصر المرور لجمع معلومات عن النقل على الطريق الحالى فى المحور . وتم الحصول على معلومات عن وسائل النقل الاخرى من الجهات الحكومية والدراسة القومية للنقل فى مصر والتى تم الانتهاء منها حديثا .

عمليات حصر المرور :

تم اجراء اربعة عمليات حصر رئيسية للمرور على الطريق وذلك فى الفترة من منتصف ديسمبر ١٩٨٥ حتى نهاية فبراير ١٩٨٦ ، كما يلى :

- حصر مقابلات جانب الطريق وحصر يدوى للمرور
- حصر آلى للمرور .
- حصر اوزان عربات النقل .
- حصر من الرحلة .

وقد استغرق حصر مقابلات جانب الطريق شهر كامل لانهاؤه . وتم وضع محطات المقابلة فى ١٦ موقع فى المحور ، ثمانية منهم بطول طريق القاهرة - اسيوط على الضفة الغربية حيث تم تشغيل كل محطة فى اتجاهى السير لمدة يومين على الاقل خلال ساعات النهار بالاضافة الى ٤ محطات عملت بصفة مستمرة ٢٤ ساعة يوميا لمدة ثلاثة ايام . وقد تم اختيار ١١ موقع اضافى لجمع بيانات اضافية عن المرور لمدة يومين وثلاثة ايام . والهدف الرئيسى من عمل استمارة حصر لكل عربية كان الحصول على معلومات عن جهة مصدر وجهة هدف الرحلة . كما تم جمع معلومات اضافية عن خصائص الرحلة والعربة . وتم اجراء عدد ١٢٧٫٣٣٧ مقابلة تمثل عينة حجمها ٧٧٪ من مجموع المرور المار بمحطات المقابلة خلال الزمن المخصص لها .

وباستخدام مجموعة من الموازين المستوردة من الولايات المتحدة - تم عمل حصر لاوزان عربات النقل فى شهر فبراير ١٩٨٦ . وتم اختيار ثلاثة مواقع بطول الطريق الرئيسى بين القاهرة وأسيوط على الضفة الغربية ، واجريت عمليات وزن عربات النقل لمدة اربعة ايام فى كل موقع . وهدف هذا الحصر هو قياس اوزان عربات النقل والحمولات على المحاور لمجموعة ممثلة لسيارات النقل المحملة . وككل ، تم وزن ٢٫٧٥٦ سيارة نقل خلال هذا الحصر .

٣- اذا ثبتت جدوى هذا الاستثمار وامكانية تمويله - يحدد افضل نوع للطريق او التحسين ، موقع المسار ، المواصفات القياسية للتصميم والتوصية بجدول زمنى للتنفيذ .

وقد تطلب العمل التفصيلى القيام بتصميم هندسى ابتدائى لطريق جديد بين القاهرة واسيوط ، بالاضافة الى تقرير هندسى لمتطلبات رفع الخدمة على الطريق الحالى . ثم تقوم الدراسة بعد ذلك بتقييم الجدوى الاقتصادية لهذه المشروعات ، والتوصية ببرنامج للاستثمار .

منطقة الدراسة :

يقع محور القاهرة - اسيوط فى الجزء الشمالى من مصر العليا فى محافظات الجيزة ، الفيوم ، بنى سويف ، المنيا واسيوط - ويبدأ المحور من حدود القاهرة الكبرى حتى مدينة اسيوط الواقعة فى حوالى منتصف الطريق بين القاهرة والاقصر تبلغ مسافتها على الطريق حوالى ٣٦٥ كم .

ويتكون المحور من شريحة ضيقة من الارض الزراعية الواقعة على جانبى نهر النيل ، الا أن النصيب الاكبر من التطور يقع على الضفة الغربية - وتختلف عرض الارض الزراعية بطول المحور ، ففى بعض النقاط تقل الى حوالى ٥ كم الا انها تتراوح فى المتوسط بين ١٠ و ١٠ كم . وخلف المنطقة الزراعية بطول نهر النيل ، نحو الصحراء الممتدة بعرض قارة افريقيا والغير مأهولة بالسكان فعلا . والاستثناء الوحيد من ذلك يتمثل فى واحة الفيوم الكبيرة المزروعة والواقعة فى الصحراء الغربية ويفصلها عن المحور الرئيسى حوالى ١٠ كم من الصحراء . والارض الزراعية فى المحور بشكل مكثف الا أن الكثافة السكانية بها عالية ويقطن حوالى ٨ مليون نسمة فى هذا المحور من مجموع عدد سكان مصر البالغ ٤٧ مليون نسمة . منها اكثر من ١٣ مليون يسكنون فى مصر العليا .

ويخدم اغلب مصر العليا حاليا طريق واحد مرصوف وخط سكة حديد ، وكلاهما يقع على الضفة الغربية للنيل داخل حدود محور الدراسة . وفى القطاع الشمالى من المحور ، يوجد طريقين اضافيين مرصوفين ، يخدم احدهما الضفة الشرقية بين القاهرة وبنى سويف ويتم حاليا مده حتى المنيا ، والآخر يصل الفيوم بالقاهرة وبنى سويف .

ملخص

يعرض هذا التقرير نتائج وخلاصات دراسة الجدوى لطريق القاهرة اسيوط ، والتى تم تنفيذها لحساب هيئة الطرق والكبارى بوزارة النقل والمواصلات المصرية فى الفترة من اكتوبر ١٩٨٥ حتى سبتمبر ١٩٨٦ .

وقد أشرفت على الدراسة الوكالة الامريكية للتنمية الدولية تحت شعار اتفاقية منحة التعاون الفنى ودراسات الجدوى (مشروع رقم ٢٦٣-١٠٢) ، وقد قامت الوكالة الامريكية للتنمية الدولية بتمويل الميزانية بالعملة الاجنبية بالكامل ، فى حين تم تمويل الميزانية بالعملة المحلية مشاركة بين الوكالة الامريكية للتنمية الدولية وهيئة الطرق والكبارى .
وقد تم توقيع العقد فى ١٨ سبتمبر ١٩٨٥ - وقد اعطيت فترة شهر لعمليات انتقال مجموعة العاملين وارسال طلبات المعدات التى ستستخدم فى الدراسة (اجهزة الكومبيوتر ومعدات حصر المرور) ، وقد بدأت الدراسة عملها الفعلى فى ١٧ اكتوبر بوصول مدير المشروع الى مصر ، وقد تم اصدار عدة تقارير خلال فترة الدراسة ، اطولها مسودة التقرير النهائى المقدم فى آخر سبتمبر ١٩٨٦ وتتضمن مسودة التقرير النهائى سبعة اجزاء تحتوى على ٣٣ ملحق للتقرير ، تشرح بالتفصيل تحليلات واستنتاجات الدراسة . ويتضمن الجزء الخاص بالرسومات المصاحب للتقرير ، رسومات الطريق الجديد المعد بمقياس رسم ١ : ٢٥٫٠٠٠ بالاضافة الى رسومات للتقاطعات العرضية النموذجية وكبارى علوية وقطاعات جيولوجية .

أهداف الدراسة :

هدفت الدراسة لعمل دراسات جدوى هندسية واقتصادية لطريق جديد او محسن فى مصر العليا بين القاهرة وأسيوط .

وقد حدد العقد الاهداف الرئيسية للدراسة كما يلى :

١ - تحديد ماذا كان الاستثمار الكبير لانشاء او تحسين الطريق له مايبرره أم لا .

٢ - شرح واثبات ماذا كان مثل هذا الاستثمار ذو جدوى اقتصادية وماهى نوعية وحجم الفوائد والتكاليف الناتجة .

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