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**LOCAL DEVELOPMENT II
URBAN PROJECT**

PD-ABH-887

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Submitted to
USAID / CAIRO

Submitted by
WILBUR SMITH ASSOCIATES

in association with

PUBLIC ADMINISTRATION SERVICE
DEVELOPMENT CONSULTING OFFICE

DELOITTE HASKINS AND SELLS
ENGINEERING AND GEOLOGICAL
CONSULTING OFFICE

**Roads & Streets Maintenance
Giza Governorate
Giza City**

January 1990

LOCAL DEVELOPMENT II URBAN PROJECT

11 GAMAL EL DIN ABOUL MAHASSEN, GARDEN CITY • CAIRO, EGYPT • 354-6469 • 355-7078 • TELEX (927) 22252 SERVE UN

February 28, 1990

HE Mohamed Omar Abdel Akhar
Governor
Giza Governorate

Your Excellency,

It is with pleasure that I forward to you five copies of the Roads and Streets Maintenance Plan for Giza City in English with an Arabic Translation. The plan was developed with the assistance and cooperation of officials of Giza Governorate and Giza City and their contribution is acknowledged in the plan. Copies of the plan are also being furnished to Mr. Gisiger, USAID, Cairo.

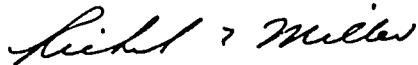
Should you wish to discuss any portion of the plan or have questions in regard to any recommendations or proposals, I will be most happy to meet with you at your convenience.

Investment Plan allocations provided from the USAID Local Development II Project may be used to fund the implementation of some of the recommendations or proposals.

Your continued support of and assistance to the LD-II Urban Program is appreciated.

With deepest respect,

WILBUR SMITH ASSOCIATES



Richard E. Miller
Project Director

cc: Mr. John Gisiger, USAID Cairo
Gen. Fouad Khalil, Mayor, Giza City
Mr. Saad Kamel, Project Coordinator, Giza

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ENGINEERING AND GEOLOGICAL
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From Giza City

- * Mr. Zein El Abdeen Abdel Azim Financial General Manager
- * Mr. Mohamed Abdel Hameed Saleem Personnel Affair Manager

From Giza Road Department

- * Eng. Ahmed Auraby Road Department Director
- * Eng. Hossain Ahmed Hassan Giza Road Department

From Road Sections

- * Eng. Mostaffa Mohamed West District Road Section Director
- * Mr. Hamdy Mohamed Hossony Secretary General Alharam District

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INTRODUCTION

This report is prepared for the Giza City Council and addresses the maintenance and repair of roads and streets. The objective of the report is to assist the Road Department in establishing a more effective and efficient road maintenance management system. This report covers the following main topics:

- o the current organization and staffing of the Road Departments and Road Sections;
- o the inventory and maintenance level of roads and streets;
- o the personnel, equipment and financial resources available;
- o the proposal for developing the road maintenance management system including development of organization, staffing, training and budgeting;
- o the definition of maintenance levels and responsibilities.

The Technical Assistance Contractor appreciates the assistance and cooperation of the Giza City officials who helped in obtaining the data and who contributed to the formulation of the recommendations contained in this report.

The following reports were used as references in preparing this report:

- o Egyptian Maintenance Study - July 1986, prepared for USAID by Wilbur Smith Associates in association with the Engineering and Geological Office.
- o Roads and Streets Maintenance - Suez Governorate - October 1987.
- o Roads and Streets Maintenance - Port Said Governorate - June 1989.
- o Roads and Streets Maintenance - Shoubra El Kheima City Council - September 1989.
- o The information and data obtained from the Giza City, Road Department and Road Sections, by District.

SECTION I
BACKGROUND ANALYSIS

1. ROAD DEPARTMENT AND DISTRICT ROAD SECTIONS:

1.1 Functions and Responsibilities:

- 1.1.1 The Road Department is one of the "Service Agencies" which is controlled by the City Mayor as are the other departments.

The department receives general policy guidance and technical advice from the Giza Road Directorate.

The Giza City Road Department has neither equipment nor work teams. It is dependant financially and administratively on the City.

- 1.1.2 The Road Department not only maintains existing paved roads and streets with the force account of the District Road Sections, but also executes new paving projects and major overlays by contractors under its supervision. The Department reviews requests for such works by districts, sets specifications, estimates costs and, after checking funding approvals, prepares the tender documents and develops programs for contracting the work.

- 1.1.3 There is a Road Section headed by a road engineer in each of the four districts named South, Central, North and West. Another Road Section will be formed in the newly created district named Allharam District. The road sections are under the direct supervision of the district chiefs but are technically advised by the Road Department. They are responsible for the district road maintenance work. By force account the road sections execute such work as; crack filling, pothole repairs, depression filling, curbstone repair or replacement, mastic or tile footpath repair, and basalt brick paving and repair.

- 1.1.4 The District Road Sections are provided with resources in the form of personnel, equipment and operating budget for the purpose of executing some road maintenance work by force account.

- 1.1.5 A significant portion of the need for patching asphalt street surfaces results from cuts in the surface made to install or repair water pipe line, sewer lines and other utilities. These trenches are made by agencies other than the Road Department and are due to the growth of the city, e.g. new building construction. Due to the long delay in getting utility work completed and cleaned up and lack of coordination between different departments, problems and conflicts are added to programming the maintenance work. Painting of lane lines and maintenance of traffic signs and signals are done by the Traffic Department.

1.2 Organization and Staffing:

- 1.2.1 Current organization structure of the Giza City Road Department and District Road Sections is inadequate and not effective for executing road maintenance programs by force account, but is suitable for implementing road maintenance programs by contractors. The District Road Maintenance Unit is controlled by the Utility Director, but the Road Project Unit is controlled by a road engineer headed by the District Chief. The technical relationship between the road maintenance unit and the road project unit is not strong. There is also a shortage of engineers, technicians, foremen, equipment operators and road laborers. Figure 1 shows the organization chart proposed by the Road Department.

- 1.2.2 Recognizing the current organization of the City Road Department as inadequate, the TAC Road Expert in coordination with concerned department proposed an organizational chart to develop more effective execution of road maintenance programs by force account. Figure (2) shows the proposed organizational chart.
- 1.2.3 Staffing of the Road Department is also inadequate. There is a shortage of engineers, technicians, foremen, equipment operators and skilled labor. The current staff for the District Road Department and the District Road Sections is shown in Table (1) (Administrative Staff not included).

Table 1

Existing Staffing - Road Department And Road Section

	<u>Engineer</u>	<u>Technicians</u>	<u>Foremen</u>	<u>Equip. Operator</u>	<u>Labor</u>
Road Dept.	2	1	-	-	-
South District	1	20	10	10	45
Central District	1	30	8	15	25
North District	1	13	-	6	11
West District	1	20	-	12	25
Alharam District	It is newly formed				
	---	---	---	---	---
TOTAL	6	84	18	43	96

Source : Road Department and Road Sections

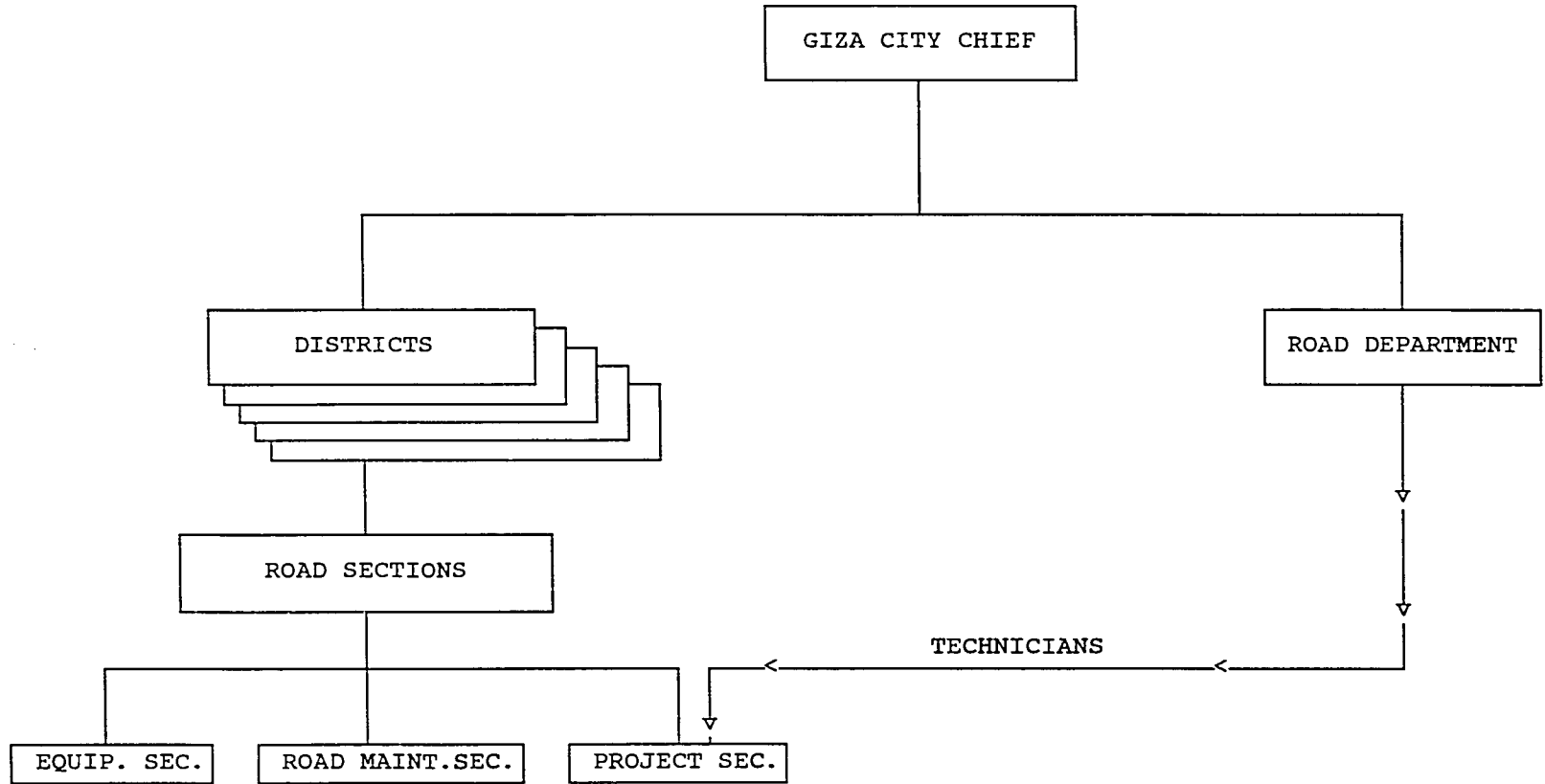
- 1.2.4 Training of road engineers, technicians, equipment operators and other trades is badly needed. These training needs are covered in Section II.

2. ROADS, STREETS AND FOOTPATHS INVENTORY AND CONDITIONS:

2.1 General:

- 2.1.1 Most main streets and roads of Giza City are four or six paved lanes wide, usually with double medium width carriageway. They have curbs of pre-cast concrete which designate sidewalks and medians. The other subsidiary streets are single carriageway without medium. These streets may or may not be paved, curbed or more than one lane wide. Many streets in Giza City are unpaved, especially in the areas which are randomly constructed without any planning.
- 2.1.2 Four basic types of surfacing were observed on the existing roads, streets and sidewalks:
- asphalt concrete for paved streets;
 - natural soil or selected local soil for unpaved streets;
 - mastic asphalt (sand mix) for footpaths; and
 - street creel colored tiles or layer cement concrete squares for footpaths.

ORGANIZATION STRUCTURE FOR RAOD DEPARTMENT AND ROAD SECTIONS
ROPOSED BY ROAD DEPARTMENT



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Figure (1)

ORGANIZATION STRUCTURE FOR ROAD DEPARTMENT AND ROAD SECTIONS

PROPOSED BY TAC

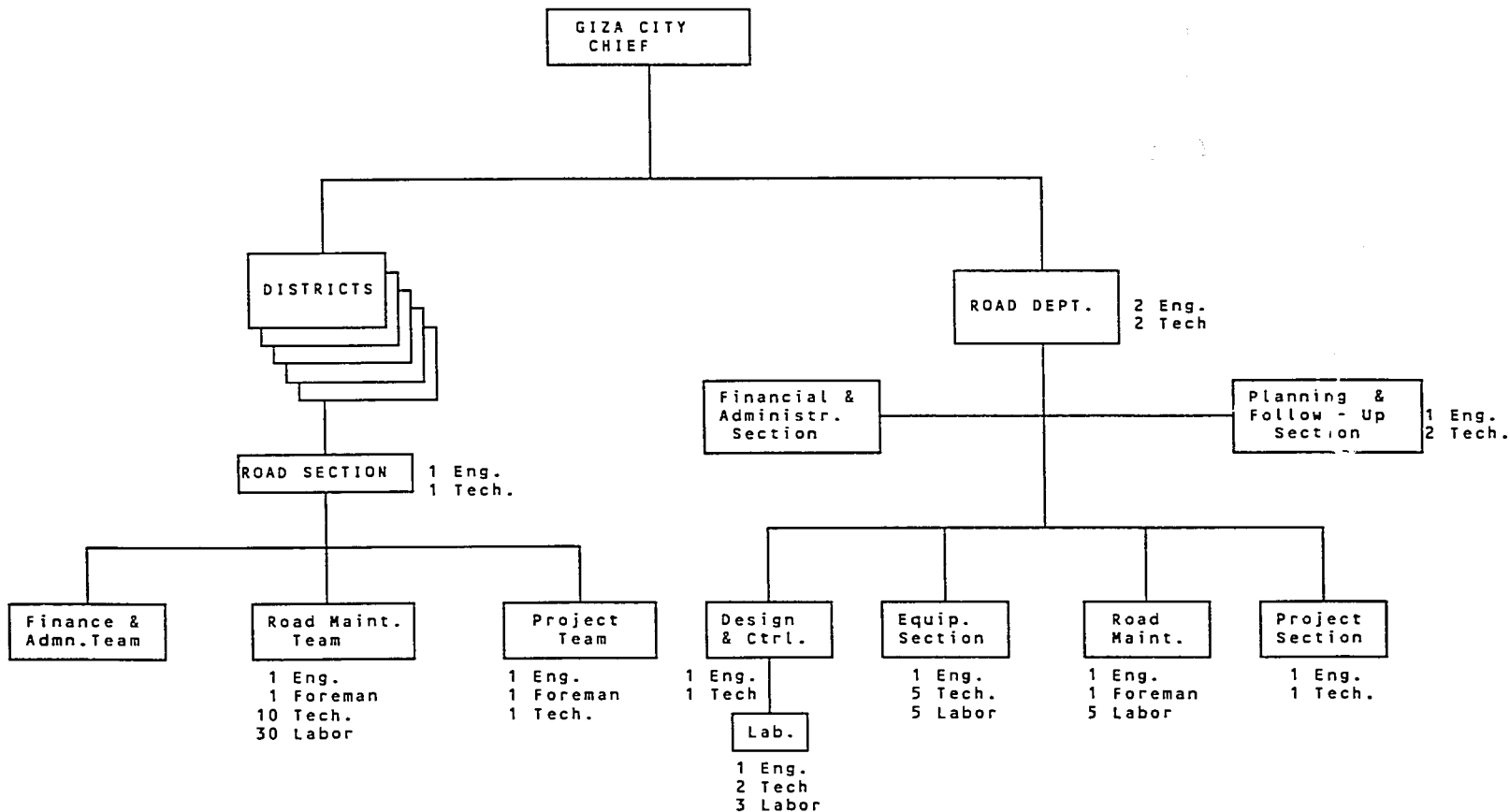


Figure (2)

2.1.3 The asphalt concrete streets are constructed of hot-mix asphalt concrete surfacing product and provided by paving contractors according to annual tenders, either for construction for patching and maintenance work.

The unpaved streets are built of natural local soil, sometimes surfaced with selected materials as a sub-base course or crushed stone as a base course.

2.2 Inventory And Condition:

Inventory and condition of Giza City roads and streets were obtained in December 1989. The Inventory logs recorded surface type, the condition and the dimensions of streets, the length and condition of curb lines, the type of paving (if any) and the dimensions of footpaths. Random inspection was done to check these data. The results are summarized in Table 2, 3, 4, and 5.

Pictures were taken for some paved and unpaved roads and streets to show the condition of the roads, streets, footpaths and curbstones. These streets are shown in figures 3 through 10.

3. AVAILABLE RESOURCES:

3.1 Personnel:

The Giza Road Department has no road maintenance staff. The district road maintenance staffs are headed by technicians under the control of the Utility Department Directors, not under control of the Road Section Directors. The existing road maintenance staffs are inadequate for developing and executing a cohesive road maintenance program. There are shortages in engineers, technicians, foremen and equipment operators. Existing personnel (other than administrative staff) are shown in Table 1.

3.2 Vehicles And Equipment:

All the Road Sections in the Giza City districts have sufficient vehicles and equipment for developing and executing a road maintenance program except the Alharam district Road Section which is newly formed. Some of these vehicles and equipment are out of operation and need to be repaired. Table 6 shows the inventory of these vehicles and equipment. Figures 11 and 12 are photographs of the vehicles and equipment.

TABLE 2

ROAD INVENTORY & CONDITION

ROAD LENGTH IN KILOMETERS

DISTRICT	PAVED									UNPAVED			TOTAL No. Of STREETS	TOTAL LENGTH (KM)	PERCENT OF TOTAL
	GOOD			MEDIUM			POOR			No. Of Streets	Length (KM)	Percent			
	No. Of Streets	Length (KM)	Percent	No. Of Streets	Length (KM)	Percent	No. Of Streets	Length (KM)	Percent						
South District	6	24.200	40.6	114	27.270	45.7	18	2.250	3.8	22	5.890	9.9	160	59.61	19.09
Central District	30	12.872	8.1	184	79.111	49.9	110	49.295	31.00	92	17.365	10.9	416	158.64	50.82
North District	3	4.950	32.2	2	1.950	12.7	5	3.350	21.8	30	5.100	33.3	40	15.35	4.92
West District	12	15.900	36.7	10	6.300	14.5	3	6.250	14.4	25	14.930	34.4	50	43.38	13.89
Al Haram District	2	6.00	17.1	3	13.000	36.9	2	3.000	8.5	85	13.200	37.5	92	35.20	11.28
TOTAL	53	63.92	20.48	313	127.63	40.88	138	64.145	20.55	254	56.485	18.09	758	312.18	100

Source: Giza City Road Department, Road Section & TAC Calculation

road2/sy

TABLE 3
ROAD INVENTORY & CONDITION
ROAD AREA IN SQUARE METERS

DISTRICT	PAVED									UNPAVED			TOTAL No. Of STREETS	TOTAL AREA (m ²)	PERCENT OF TOTAL
	GOOD			MEDIUM			POOR			No. Of Streets	Area (m ²)	Percent			
	No. Of Streets	Area (m ²)	Percent	No. Of Streets	Area (m ²)	Percent	No. Of Streets	Area (m ²)	Percent						
South District	6	552000	44.05	114	346270	27.63	18	19250	1.54	22	335532	26.78	160	1253052	31.38
Central District	30	109785	8.24	184	681055	51.15	110	470028	35.30	92	70697	5.31	416	1331565	33.35
North District	3	82000	45.29	2	19000	10.49	5	49950	27.59	30	30100	16.63	40	181050	4.53
West District	12	251665	32.76	10	69700	9.07	3	73750	9.62	25	372920	48.55	50	768035	19.24
Al Haram District	2	126000	27.45	3	242000	52.72	2	28000	6.10	85	63000	13.73	92	459000	11.50
TOTAL	53	1121450	28.09	313	1358025	34.01	138	640978	16.05	254	872249	21.85	758	3992702	100

Source: Giza City Road Department, Road Section & TAC Calculation

road3/sy

TABLE 4

ROAD INVENTORY & CONDITION

ROAD CURB LENGTH IN LINEAR METERS

DISTRICT	PAVED									UNPAVED			TOTAL No. Of STREETS	TOTAL LINEAR METERS	PERCENT OF TOTAL
	GOOD			MEDIUM			POOR			No. Of Streets	Length (m)	Percent			
	No. Of Streets	Length (m)	Percent	No. Of Streets	Length (m)	Percent	No. Of Streets	Length (m)	Percent						
South District	97	58000	41.43	11	62000	44.29	18	10000	7.14	34	10000	7.14	160	14000	23.99
Central District	28	28000	17.28	187	60000	37.03	77	40000	24.7	124	34000	20.99	416	162000	27.76
North District	3	10000	10.93	3	4500	4.92	4	66000	72.13	30	11000	12.02	40	91500	15.68
West District	11	31000	35.63	10	12000	13.79	4	14000	16.10	25	3000	34.48	50	87000	14.91
Al Haram District	2	13000	12.62	3	28000	27.18	2	6000	5.83	85	56000	54.37	92	103000	17.66
TOTAL	141	140000	23.99	214	166500	28.53	105	136000	23.31	298	141000	24.17	758	583500	100

Source: Giza City Road Department, Road Section & TAC Calculation

road4/sy

TABLE 5

SIDEWALK INVENTORY & CONDITION

SIDEWALK AREA IN SQUARE METERS

DISTRICT	SIDEWALK TYPE - WITH CURBSTONE									UNDEFINED			TOTAL No. Of WALKS	TOTAL AREA (m2)	PERCENT OF TOTAL
	TILE			MASTIC			UNPAVED			No. Of Walks	Area (m2)	Percent			
	No. Of Streets	Area (m2)	Percent	No. Of Walks	Area (m2)	Percent	No. Of Walks	Area (m2)	Percent						
South District	14	50000	15.72	120	200000	62.89	48	43000	13.53	20	25000	7.86	202	318000	20.15
Central District	62	49000	6.3	108	489000	62.35	184	200000	25.71	30	40000	5.14	384	778000	49.29
North District	-	-	-	9	59000	38.56	40	34000	22.22	56	60000	39.22	105	153000	9.69
West District	5	2800	2.71	16	12500	12.10	50	36000	34.85	46	52000	50.34	117	103300	6.55
Al Haram District	5	30000	13.27	10	76000	33.63	20	12000	5.31	80	108000	47.79	115	226000	14.32
TOTAL	86	131800	8.35	263	836500	53.00	342	325000	20.59	232	285000	18.06	923	1578300	100

Source: Giza City Road Department, Road Sections & TAC Calculation

road5/sy



Good-paved Streets - Giza City
Figure 3



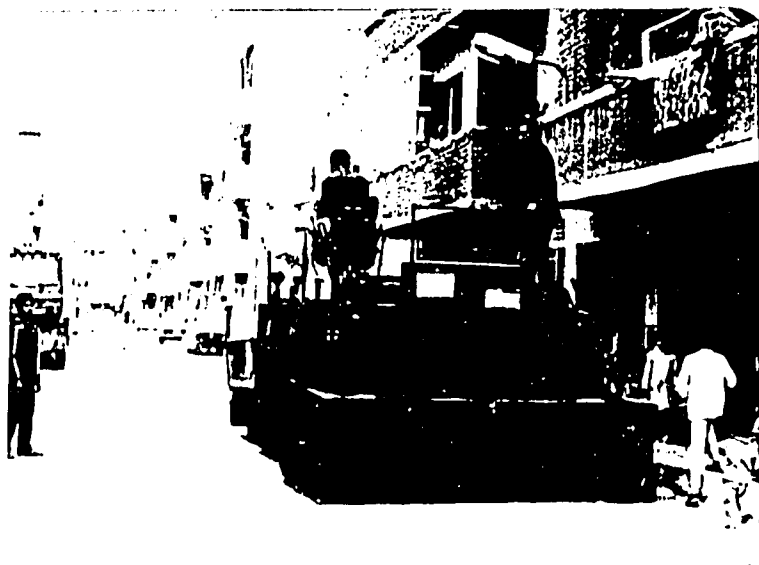
Some Paved Streets in Giza City
Figure 4



Bad-paved Streets in Giza City
Figure 5



Some Streets Under Maintenance Works
Figure 6



Some Streets Under Maintenance Works
Figure 7



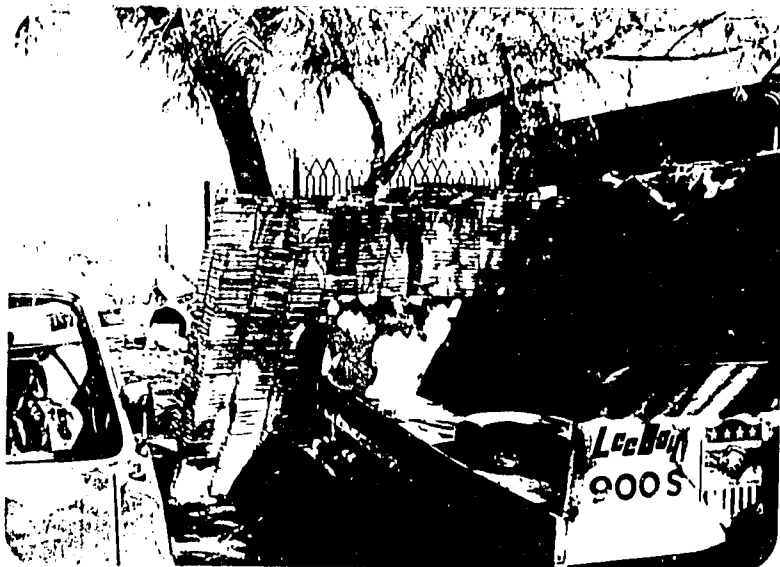
Road Section Garage In South District
Figure 8



Road Section Garage In South District
Figure 9



Road Section Garage In Central District
Figure 10



Some Road Equipment In South District
Figure 11



Some Road Equipment In Giza City
Figure 12

Table 6

Inventory And Conditions of Vehicles And Equipment

VEHICLE/EQUIPMENT	DISTRICTS					TOTAL	
	South	Central	North	West	Al Haram	In Operat.	Out of Operat.
Loader	1	1	2	1	Will	3	2
Grader	1	1	1	1	get	3	2
Vibrating Roller 2-4t	5	3	2	3	some	8	5
Vibrating Roller 8-12t	2	2		5	equip.	6	3
Air Compressor				2	from	1	1
Dump Truck 6-10t	2	5	5	3	West	11	4
Dump Truck more than 10t	2	2		3	Dist.	5	2
Transport Vehicle 1/2 - 3t	1	2		2		4	1
Asphalt finisher	1						1
Generator				1			1
Battery Charger				1			1

road-6/sy

3.3 Road Materials:

Repair and maintenance of Giza City roads and streets is executed by road paving contractors under supervision of the road section directors. No road materials are provided to the Road Departments or Road Section districts except a small amount of hot-mix asphaltic concrete (by the paving contractors for small patching repairs), and a small amount of cement tiles and curbstone (for footpath and curb sections repairs).

3.4 Annual Budget Resources:

The Road Department and District Road Sections do not have all necessary funds and facilities for the road maintenance due to the following reasons:

- o The organizational structure of the Road Department and Road Sections lacks sufficient supervision of the main activities.
- o The district road maintenance units are controlled by the Utility Department Director, instead of the Road Sections Directors. Therefore, it appears that the road maintenance work is subordinate to utility work.
- o Priority is awarded to new construction, and while this maybe justified, there is no definition of the need for regular and adequate maintenance.

- o Unfinished and unsatisfactory utility work affects the streets' surface for long periods of time. The Road Department does not have authority to require cooperation of the Utility Departments.
- o Maintenance of roads seems to be subordinate to construction, or not clearly independent from it.

The annual road maintenance and road construction are funded by BAB II, BAB III, Governorate Service Treasure, Gasoline Revenues and from repaving revenues from utility agencies. The approximate current budget for FY 89/90 which is used in Road Maintenance and Paving Projects is as follows:

From BAB II

Road and Street Maintenance	LE	28,780
-----------------------------	----	--------

From BAB III Investment

Roads and Streets Construction	LE	1,900,000
--------------------------------	----	-----------

North District	LE	300,000
West District	LE	500,000
Alharam District	LE	500,000
South District	LE	300,000
Central District	LE	300,000

From USAID

Road Maintenance and Construction	LE	870,000
-----------------------------------	----	---------

West District	LE	450,000
Alharam District	LE	270,000
South District	LE	150,000

From Gasoline Revenues

Road Maintenance and Construction	LE	550,000
-----------------------------------	----	---------

Alharam District	LE	300,000
Central District	LE	250,000

From Repaving Revenues from Utility Agencies

These revenues are used for repaving the roads and streets after utility renewal or repair. These revenues are not constant but depend on the annual utility repair or renewal amount.

The above revenues are inadequate to cover all maintenance and new paving.

SECTION II - ROAD MAINTENANCE PLANNING

1. JUSTIFICATION OF MAINTENANCE:

Some of Giza roads and streets are very narrow, unpaved and without any drainage system, especially in dense population areas which were built at random without any planning. The periodic maintenance of these streets is needed each three or four months by laborers or grader depending on the street width. Current installation of utilities, such as sewer lines and water pipe lines in various main streets, will continue for a some time according to construction plans. Some of the defects which occur in street pavements are due to breaks, cuts and other damage which are either unpatched or poorly patched, or are caused by poorly set manholes. Roads and streets are always subjected to wear, damage and weathering. These deteriorative forces begin as soon as the pavement construction is completed and continues indefinitely. Ineffective maintenance is due to absence of maintenance plans, lack of cooperation between agencies and lack of funds and facilities necessary for maintenance. Neglecting street maintenance allows accumulations of refuse and soil which significantly reduce the capacity and utilization of the streets. Sometimes this reaches such a state that several blocks of streets can be considered as unpaved due to the large amount of debris that cover the pavement.

The decline in road surface quality over time is most apparent in the gradual loss of smoothness. This results from settlement in soil, faulty initial construction. Travel safety is sometimes reduced by these pavement defects due to the surface roughness and the loss of pavement strength to withstand heavy loads. Maintenance and renewal then becomes necessary. Maintenance can slow the deterioration of what was built and preserve the roads and streets at a high standard level. Simple regular maintenance can do much to avoid these negative effects of road wear and preserve the integrity and utility of streets. Routine road maintenance saves money and minimizes vehicle accidents.

To establish an effective road maintenance program the following must be done:

- o Define the network of roads and streets to be maintained.
- o Collect detailed information on streets by districts or sections.
- o Identify the kind of maintenance work which is needed.
- o Decide the best way of doing each activity, then develop performance standards.
- o Determine how many crew-days of each activity will be needed annually.
- o Calculate the resources needed for each crew-day.
- o Review the calculated resources needed to decide on staffing and budget.
- o Convert the previous crew-days calculation into work programs.
- o Schedule the work according to resources and priorities.
- o Execute, inspect and control performance standards and production.

2. MAINTENANCE LEVELS AND ACTIVITIES:

Giza City streets and footpaths were inventoried and inspected to define the kinds of maintenance activities needed to keep the streets and footpaths in usable condition.

2.1 Maintenance Classification:

- o Casual Maintenance

This is done when prompt repair is needed, such as: sudden depressions; potholes; upheavals; and bleeding which requires short asphalt overlays.

o Periodic Maintenance

This is done each three or four months and includes grading unpaved streets of five meters or more width with grader or shaping unpaved streets of less than five meters width with laborers.

o Annual Maintenance

Annual maintenance includes major overlays and rehabilitation, surface dressing, footpaths repair and curbstone replacement. The overlay should be done for approximately 10% of the paved streets annually.

2.2 Road Maintenance Responsibilities:

Table 7 shows levels of road maintenance activities for each level and who is responsible for executing the needed maintenance work.

TABLE 7

ROAD MAINTENANCE RESPONSIBILITIES

<u>Code</u>	<u>Work Type</u>	<u>Responsibility</u>
01	Major overlays and rehabilitation	District Road Sections
02	Short asphalt overlays	District Road Sections
03	Small pavement repairs	District Road Sections
04	Curb repair or replacement	District Road Sections
05	Basalt brick pavement repairs	District Road Sections
06	Footpaths repair (tile surface)	District Road Sections
07	Footpaths repair (mastic asphalt surface)	District Road Sections
08	Grading unpaved streets (grader)	District Road Sections
09	Shaping unpaved streets (labor)	District Road Sections
10	Surface dressing	Contractors
11	Traffic service (signs, signals, stripping)	Traffic Departments
12	Draining maintenance	Utility Departments

Source : Giza City Road Department

2.3 Annual Maintenance Requirements

To estimate the amount of work for each activity, it is necessary to set quality standards. By these quality standards the number of annual crew-days necessary to keep up the maintenance program can be estimated. From observation, experience and consultation with Road Department personnel a percentage of pavement areas that have to be patched each year has been determined. Table 8 reflects these percentages.

TABLE 8
ANNUAL MAINTENANCE REQUIREMENTS BY PERCENTAGE

CODE	ACTIVITY DESCRIPTION	SURFACE	CONDITION	YEARLY % OF AREA OR LENGTH	FREQUENCY
02	Short Overlay	Paved	Good	1.0 % Area	Continual
			Medium	1.1 % Area	Continual
			Poor	1.2 % Area	Continual
03	Small Pavement Repairs	Paved Surface	Good	0.1 % Area	Continual
			Medium	0.15% Area	Continual
			Poor	0.2 % Area	Continual
04	Curbstone Repair or Replacement	Sectional Curb	Good	4.0 % Length	Continual
			Medium	5.0 % Length	Continual
			Poor	6.0 % Length	Continual
05	Basalt Bricks Pavement Repairs	Paved Surface		2.0 % Area	Continual
06	Footpaths Repair	Tile Surface		1.0 % Area	Continual
07	Footpaths Repair	Mastic Surface		1.0 % Area	Continual
08	Grading Unpaved Streets (Grader)	Unpaved Surface		100 % Length	4 month
09	Shaping Unpaved Streets (Laborers)	Unpaved Surface		100 % Length	Annual

Source: Giza City Road Department and TAC
Road-8/sy

2.4 Performance Standards:

1.4.1 After identifying maintenance work needed, it is necessary to decide on:

- o how the job should be done;
- o work procedure on site, tasks and sub-tasks;
- o size of crew needed for the work;
- o equipment and materials needed; and
- o how to control quality.

2.4.2 Performance standards must be developed for the various tasks and should be adjusted periodically to reflect actual performance.

2.4.3 Figure 18 through 25 are initial performance standards sheets for executing different maintenance work. They should be adjusted based on field experience.

2.5 Work Quantities And Crew-Days:

Calculations are made separately for streets of the five Giza City road districts to determine the work quantities and crew-days for each activity. The result of these estimates are shown in Table 9, 10, 11, 12, 13 and 14.

PERFORMANCE STANDARD

<u>ACTIVITY</u>		<u>CODE</u>
Short Asphalt Overlays		02
<u>DESCRIPTION & PURPOSE</u>		
Due to wear, settlement and damage, it may be necessary to restore road smoothness or strength. If so, place hot-mix asphalt surfacing over existing pavement where required.		
<u>PERFORMANCE GUIDELINE</u>		
This work is limited to repair of short sections of usual damage or failure, normally not more than 100 m in length. Long sections or general failure should receive engineering study and control. Short overlays are generally placed over full lane width, carriageway or two-lane roadway.		
TEAM OF WORK	WORK METHOD	
1 Foreman 1 Grader Operator 1 Roller Operator 3 Truck Drivers 8 Laborers	1. Place flagmen or warning signs for safety. 2. Remove loosed and damaged surface. 3. Repair and compact base, and patch old pavement as necessary 4. Prime new base, lightly tack old surface to be overlaid. 5. Place overlay with laydown machine or dump new hot-mix and spread with grader. 6. Compact new overlay. 7. Clean up area.	
EQUIPMENT		
1 Motor Grader 2 Roller 3 Dump Trucks		
MATERIAL PER DAY	ESTIMATED DAILY PRODUCTION	
12 m ³ Hot-mix-Asphalt 75 KG tack coat 6 m ³ Crushed stibe for base 0.5 m ³ Motor	150 m ²	
<u>NOTES:</u>		
The standard assumes that spreading with grader will be the normal method. Material quantities are loose volume, based on 8 cm average surface thickness and 15 cm base before compaction. Base repair is assumed to be 25% overlay area.		

Source: Road and Street Maintenance, Giza City

perform/sy

Fig. 13

PERFORMANCE STANDARD

<u>ACTIVITY</u>		<u>CODE</u>	
Small Pavement Repairs		D3	
<u>DESCRIPTION & PURPOSE</u>			
To restore smoothness and uniform surface, repair potholes, utility cuts and other damage or failure in existing asphalt pavement by applying hot-mix patching.			
<u>PERFORMANCE GUIDELINE</u>			
Patching is to be done as soon as potholes, damage or edge breakage occur, before failure is enlarged by traffic. If the cause is evident, such as water seepage, the cause must be corrected without delay, before patching the surface. Avoid excessive primary and tack coat which might cause instability in the patch.			
<u>TEAM OF WORK</u>		<u>WORK METHOD</u>	
1 Foreman 2 Roller Operator 3 Truck Drivers 6 Laborers		1. Place flagmen or warning signs for safety. 2. Trim potholes or damaged areas back to sound edges, and remove loose or weak materials. 3. Repair and compact base as necessary. 4. Prime new base, lightly tack sides and bottom of areas to be patched. 5. Place patching hot-mix. 6. Compact thoroughly, to same level as adjacent pavement or slightly higher (one to two cm). 7. Clean up area.	
<u>EQUIPMENT</u>			
1 Roller 2 Dump trucks			
<u>MATERIAL PER DAY</u>		<u>ESTIMATED DAILY PRODUCTION</u>	
8 m ³ Hot-mix Asphalt 20 KG Tack Coat 4 m ³ Crushed stone for base		100 m ²	
<u>NOTES:</u>			
Materials are loose, based on 8 cm average thickness of asphalt patches and 15 cm base, before compaction. Base repair is assumed to be necessary for under 15% of patches.			

Source: Road and Street Maintenance, Giza City

Fig. 14

perform2/sy

PERFORMANCE STANDARD

<u>ACTIVITY</u>		<u>CODE</u>	
Curbstone Repair or Replacement		04	
<u>DESCRIPTION & PURPOSE</u>			
Restore or replace curbstone sections which are loose, tilted, broken or missing.			
<u>PERFORMANCE GUIDELINE</u>			
This work is intended to be the maintenance of lines of precast or cutstone sectional curbs constructed earlier.			
<u>TEAM OF WORK</u>		<u>WORK METHOD</u>	
1 Foreman 1 Truck Driver 3 Masons 6 Laborers		1. Place flagmen or warning signs for safety. 2. Remove and dispose of broken curbstone sections and other unusable materials. 3. Excavate and correct line and grade. Compact underlaying soil and new bedding materials as necessary. 4. Re-set existing usable sections and add new curbstone sections as necessary with mortar base and joint. Check for finish line and grade. 5. Clean up area.	
<u>EQUIPMENT</u>			
1 Dump Truck			
<u>MATERIAL PER DAY</u>		<u>ESTIMATED DAILY PRODUCTION</u>	
50 Pre-Cast Curbstones (0.5 m length each) 1.0 m ³ Bedding Sand 0.5 m ³ Mortar		100 m ²	
<u>NOTES:</u>			
The standard assumes that in maintaining existing lines of curbs which have been damaged or disturbed, half of the old sections can be re-used.			

Source: Road and Street Maintenance, Giza City

Fig. 15

perform³/sy

PERFORMANCE STANDARD

<u>ACTIVITY</u>		<u>CODE</u>	
Basalt Brick Pavement Repair		05	
<u>DESCRIPTION & PURPOSE</u>			
Replace, level, strengthen and smooth the broken basalt bricks which are in poor condition due to settlement or damage.			
<u>PERFORMANCE GUIDELINE</u>			
This work is limited to repair of short sections of unusual damage or failure, normally not more than 50 m in length.			
<u>TEAM OF WORK</u>		<u>WORK METHOD</u>	
1 Foreman 2 Masons 1 Truck Driver 6 Laborers		1. Place flagmen or warning signs for safety. 2. Remove loose and damaged surface. 3. Repair and compact base course under basalt bricks. 4. Place mortar under basalt bricks. 5. Place basalt bricks and grout after checking level. 6. Clean up the surface after completion.	
<u>EQUIPMENT</u>			
1 Dump Truck			
<u>MATERIAL PER DAY</u>		<u>ESTIMATED DAILY PRODUCTION</u>	
50 m ² Basalt bricks 5 m ³ Sand 0.5 m ³ Mortar		50 m ²	
<u>NOTES:</u>			

Source: Road and Street Maintenance, Giza City

Fig. 16

perform/sy

PERFORMANCE STANDARD

<u>ACTIVITY</u>		<u>CODE</u>	
Footpaths Repair (Tile Surface)		D6	
<u>DESCRIPTION & PURPOSE</u>			
Replace, restore, strengthen and smooth loose and broken tiles which are in poor condition due to settlement or damage.			
<u>PERFORMANCE GUIDELINE</u>			
This work is limited to repair of short sections of unusual damage or failure, normally not more than 100 m in length.			
<u>TEAM OF WORK</u>		<u>WORK METHOD</u>	
1 Foreman 2 Masons 2 Truck Drivers 6 Laborers		1. Place flagmen or warning signs for safety. 2. Remove loose or damaged surface. 3. Repair and compact base course under tiles. 4. Overlay mortar under tiles. 5. Place tiles and grout after checking leveling. 6. Clean up the surface after completion.	
<u>EQUIPMENT</u>			
2 Dump Truck			
<u>MATERIAL PER DAY</u>		<u>ESTIMATED DAILY PRODUCTION</u>	
100 m ² Tiles 10 m ³ Sand 2 m ³ Mortar 0.5 m ³ Motor		100 m ²	
<u>NOTES:</u>			

Source: Giza City Road Directorate and TAC

Fig. 17

prform5/sy

PERFORMANCE STANDARD

ACTIVITY		CODE
Footpath Repair (Mastic Asphalt Surface)		07
DESCRIPTION & PURPOSE		
Apply new mastic asphalt to restore smoothness and strength.		
PERFORMANCE GUIDELINE		
This work is limited to repair of short sections of unusual damage or failure, normally not more than 100 m in length.		
TEAM OF WORK		WORK METHOD
1 Foreman 2 Masons 2 Truck Drivers 6 Laborers		1. Place flagmen or warning signs for safety. 2. Remove loose or damaged surface. 3. Repair and compact base course under tiles. 4. Overlay mortar under tiles. 5. Place tiles and grout after checking leveling. 6. Clean up the surface after completion.
EQUIPMENT		
2 Dump Truck		
MATERIAL PER DAY		ESTIMATED DAILY PRODUCTION
100 m ² Tiles 10 m ³ Sand 2 m ³ Mortar 0.5 m ³ Motor		100 m ²
NOTES:		

Source: Giza City Road Directorate and TAC

Fig. 17

prform6/sy

PERFORMANCE STANDARD

<u>ACTIVITY</u>		<u>CODE</u>	
Grading Unpaved Streets (Grader)		08	
<u>DESCRIPTION & PURPOSE</u>			
Use machines to reshape and restore previously constructed streets to an acceptable uniform grade and cross section.			
<u>PERFORMANCE GUIDELINE</u>			
This work is required at intervals of about four months on unpaved streets in regular use. Typically, the streets have developed holes, corrugation, traffic ruts, uneven settlement, or accumulation of debris which obstruct vehicul us.			
<u>TEAM OF WORK</u>		<u>WORK METHOD</u>	
1 Grader Operator		1. With motor grader, cut high places and fill low areas on travelway of unpaved street. Starting with the outside edges and blading usable material toward center.	
<u>EQUIPMENT</u>		2. Blade off large stones, trash and other debris, dispose of it beyond the travelway or gather it for later collection.	
1 Grader		3. Strike off and spread evenly any excess usable material bladed toward the center of the street. Create a firm, even grade and cross-section.	
<u>MATERIAL PER DAY</u>		<u>ESTIMATED DAILY PRODUCTION</u>	
None		1.5 KM of street length	
<u>NOTES:</u>			

Source: Road and Street Maintenance, Giza City

Fig. 19

perform7/sy

PERFORMANCE STANDARD

<u>ACTIVITY</u>		<u>CODE</u>	
Shaping Unpaved Streets (labor)		09	
<u>DESCRIPTION & PURPOSE</u>			
Reshape and restore grade, width and riding surface of unpaved streets.			
<u>PERFORMANCE GUIDELINE</u>			
With the assistance of a loader, manually reshape and restore previously constructed unpaved streets to an adequate grade and width.			
<u>TEAM OF WORK</u>		<u>WORK METHOD</u>	
1 Foreman/rader Operator 1 Loader Operator 2 Truck Drivers 8 Laborers		1. Cut down high places in street surface. Use suitable material to fill low places. Use pick shovel, assisted by loader when feasible, to cut and move material, and to compact filled area. 2. Load and dispose of trash, debris and another unsuitable material.	
<u>EQUIPMENT</u>			
1 Loader 2 Dump Truck			
<u>MATERIAL PER DAY</u>		<u>ESTIMATED DAILY PRODUCTION</u>	
None		1.5 KM of street length	
<u>NOTES:</u>			
This work is needed to maintain public access streets too narrow for general vehicle use (normally less than five meters wide).			

Source: Road and Street Maintenance, Giza City

Fig. 20

perform8/sy

TABLE 9

DERIVATION OF WORK QUANTITIES AND CREW-DAYS

SOUTH DISTRICT

CODE	ACTIVITY		CONDITION RATING	ANNUAL % OF AREA OR LENGTH	INVENTORY QUANTITIES	ANNUAL WORK QUANTITY	DAILY PRODUCTION RATE	CREW-DAYS	CREW-DAYS ROUNDED UP
	DESCRIPTION	SURFACE							
02	Short Overlay	Paved Surface	Good	1.0 %	552000	5520	150	36.8	} 63
			Medium	1.1 %	346270	3809	150	25.4	
			Poor	1.2 %	19250	231	150	1.5	
03	Small Pavement Repairs	Paved Surface	Good	0.1 %	552000	252	100	2.54	} 8
			Medium	0.15%	346270	519	100	5.19	
			Poor	0.2 %	19250	39	100	0.39	
04	Curbstone Repair	Sectional Curb	Good	4.0 %	58000	2320	50	46.4	} 121
			Medium	5.0 %	62000	3100	50	62	
			Poor	6.0 %	10000	600	50	12	
05	Basalt Brick Repairs	Paved Surface		2.0 %	-	-	50	-	-
06	Footpath Repair	Tile Surface		1.0 %	50000	500	100	5	5
07	Footpaths Repair	Mastic Surface		1.0 %	200000	2000	100	20	20
08	Grading Unpaved Streets	(Grader)		100 %	4.0	4.0	1.5	2.7	3
09	Shaping Unpaved Streets	(Labors)		100 %	1.890	1.890	0.5	3.78	4

Source: TAC calculation

* From Table 8

** From Tables 2 through 5

road-9/sy

TABLE 10

DERIVATION OF WORK QUANTITIES AND CREW-DAYS

CENTRAL DISTRICT

CODE	ACTIVITY		CONDITION RATING	ANNUAL % OF AREA OR LENGTH	INVENTORY QUANTITIES	ANNUAL WORK QUANTITY	DAILY PRODUCTION RATE	CREW-DAYS	CREW-DAYS ROUNDED UP
	DESCRIPTION	SURFACE							
02	Shert Overlay	Paved Surface	Good	1.0 %	109785	1098	150	7.3	} 94
			Medium	1.1 %	681055	7492	150	49.9	
			Poor	1.2 %	470028	5640	150	37.6	
03	Small Pavement Repairs	Paved Surface	Good	0.1 %	109785	110	100	1.1	} 21
			Medium	0.15%	681055	1022	100	10.2	
			Poor	0.2 %	470028	940	100	9.4	
04	Curbstone Repair	Sectional Curb	Good	4.0 %	28000	1120	50	22.4	} 131
			Medium	5.0 %	60000	3000	50	60	
			Poor	6.0 %	40000	2400	50	48	
05	Basalt Brick Repairs	Paved Surface		2.0 %	-	-	50	-	-
06	Footpath Repair	Tile Surface		1.0 %	490000	490	100	4.9	5
07	Footpaths Repair	Mastic Surface		1.0 %	489000	4890	100	48.9	49
08	Grading Unpaved Streets	(Grader)		100 %	12.000	12	1.5	8	8
09	Shaping Unpaved Streets	(Labors)		100 %	5.365	5.4	0.5	10.8	11

Source: TAC calculation

* From Table 8

** From Tables 2 through 5

TABLE 11

DERIVATION OF WORK QUANTITIES AND CREW-DAYS

NORTH DISTRICT

CODE	ACTIVITY		CONDITION RATING	ANNUAL % OF AREA OR LENGTH	INVENTORY QUANTITIES	ANNUAL WORK QUANTITY	DAILY PRODUCTION RATE	CREW-DAYS	CREW-DAYS ROUNDED UP
	DESCRIPTION	SURFACE							
02	Short Overlay	Paved Surface	Good	1.0 %	82000	820	150	5.47) 11
			Medium	1.1 %	19000	209	150	1.39	
			Poor	1.2 %	49950	499	150	3.33	
03	Small Pavement Repairs	Paved Surface	Good	0.1 %	82000	82	100	0.82) 3
			Medium	0.15%	19000	28.5	100	0.29	
			Poor	0.2 %	49950	100	100	1.00	
04	Curbstone Repair	Sectional Curb	Good	4.0 %	10000	400	50	8) 92
			Medium	5.0 %	4500	225	50	4.5	
			Poor	6.0 %	66000	3960	50	79.2	
05	Basalt Brick Repairs	Paved Surface		2.0 %	-	-	50	-	-
06	Footpath Repair	Tile Surface		1.0 %	-	-	100	-	-
07	Footpaths Repair	Mastic Surface		1.0 %	59000	590	100	5.9	6
08	Grading Unpaved Streets	(Grader)		100 %	4.00	4.0	1.5	2.67	3
09	Shaping Unpaved Streets	(Labors)		100 %	1.10	1.10	0.5	2.2	3

Source: TAC calculation

* From Table 8

** From Tables 2 through 5

road-11/sy

TABLE 12

DERIVATION OF WORK QUANTITIES AND CREW-DAYS

WEST DISTRICT

CODE	ACTIVITY		CONDITION RATING	ANNUAL % OF AREA OR LENGTH	INVENTORY QUANTITIES	ANNUAL WORK QUANTITY	DAILY PRODUCTION RATE	CREW-DAYS	CREW-DAYS ROUNDED UP
	DESCRIPTION	SURFACE							
02	Short Overlay	Paved Surface	Good	1.0 %	251665	2517	150	16.78) 28
			Medium	1.1 %	69700	767	150	5.11	
			Poor	1.2 %	73750	885	150	5.9	
03	Small Pavement Repairs	Paved Surface	Good	0.1 %	251665	252	100	2.52) 6
			Medium	0.15%	69700	105	100	1.05	
			Poor	0.2 %	73750	148	100	1.48	
04	Curbstone Repair	Sectional Curb	Good	4.0 %	31000	1240	50	24.8) 72
			Medium	5.0 %	12000	600	50	30.00	
			Poor	6.0 %	14000	840	50	16.80	
05	Basalt Brick Repairs	Paved Surface		2.0 %	-	-	50	-	-
06	Footpath Repair	Tile Surface		1.0 %	2800	28	100	0.28	1
07	Footpath Repair	Mastic Surface		1.0 %	12500	125	100	0.125	1
08	Grading Unpaved Streets	(Grader)		100 %	10.930	10.93	1.5	7.29	8
09	Shaping Unpaved Streets	(Labors)		100 %	4.000	4.00	0.5	8.00	8

Source: TAC calculation

* From Table 8

** From Tables 2 through 5

road-12/sy

TABLE 13

DERIVATION OF WORK QUANTITIES AND CREW-DAYS

AL HARAM DISTRICT

CODE	ACTIVITY		CONDITION RATING	ANNUAL % OF AREA OR LENGTH	INVENTORY QUANTITIES	ANNUAL WORK QUANTITY	DAILY PRODUCTION RATE	CREW-DAYS	CREW-DAYS ROUNDED UP
	DESCRIPTION	SURFACE							
02	Short Overlay	Paved Surface	Good	1.0 %	126000	1260	150	8.4	} 29
			Medium	1.1 %	242000	2662	150	17.75	
			Poor	1.2 %	28000	336	150	2.24	
03	Small Pavement Repairs	Paved Surface	Good	0.1 %	126000	126	100	1.26	} 6
			Medium	0.15%	242000	363	100	3.63	
			Poor	0.2 %	28000	56	100	0.56	
04	Curbstone Repair	Sectional Curb	Good	4.0 %	13000	520	50	10.4	} 46
			Medium	5.0 %	28000	1400	50	28	
			Poor	6.0 %	6000	360	50	7.2	
05	Basalt Brick Repairs	Paved Surface		2.0 %	-	-	50	-	-
06	Footpath Repair	Tile Surface		1.0 %	30000	300	100	3	3
07	Footpath Repair	Mastic Surface		1.0 %	76000	760	100	7.6	8
08	Grading Unpaved Streets	(Grader)		100 %	9.000	9	1.5	6	6
09	Shaping Unpaved Streets	(Labors)		100 %	4.200	4.2	0.5	8.4	9

Source: TAC calculation

* From Table 8

** From Tables 2 through 5

TABLE 14

SUMMARY OF CREW DAY

ACTIVITY	DISTRICT					TOTAL
	South	Central	North	West	Al-Harm	
02	63	94	11	28	29	225
03	8	21	3	6	6	44
04	121	131	92	72	46	462
05	-	-	-	-	-	-
06	5	5	-	1	3	14
07	20	49	6	1	8	84
08	3	8	3	8	6	28
09	4	11	3	8	9	35

Source: Table 9 through 13 and TAC Calculation

road14/sy

3. FIVE-YEAR MAINTENANCE PLAN:

Based on the study of the Giza City Road Department and District Road Sections, a five-year master plan and one-year maintenance plan are outlined.

3.1 Required work is as shown in Table 15

3.2 Required Labor Hours:

Foreman	25,920	hrs
Grader operator	7,590	hrs
Roller operator	10,590	hrs
Loader operator	1,050	hrs
Truck driver	44,730	hrs
Mason	47,460	hrs
Laborer	166,080	hrs

3.3 Equipment Operating Hours:

Grader	7,590	hrs
Roller	10,590	hrs
Loader	1,050	hrs
Dump Truck	44,730	hrs

3.4 Required Materials:

Hot-Mix Asphalt	15,260	m ³
Tack Coat	88,775	kg
Crushed Base	7,530	m ³
Curbstone	155,500	m.l
Sand	7,210	m ³
Motor	1,170	m ³
Basalt Brick	-	
Tiles	7,000	m ²
Mastic Asphalt	2,100	m ³

Estimated cost of materials is shown in Table 16.

TABLE 15

QUANTITIES OF REQUIRED WORKS

FIVE YEAR PERIOD

EXECUTION	ACTIVITIES	UNIT	DISTRICTS					TOTAL
			SOUTH	CENTRAL	NORTH	WEST	ALHARAM	
By Sections in Districts	Short asphalt overlay	m3	47800	71150	7640	20845	21290	168725
	Small pavement repair	m2	4050	10360	1055	2525	2725	20715
	Curb repair	m.l	30100	32600	22925	13400	11400	110425
	Basalt brick repair	m2	-	-	-	-	-	-
	Footpath repair (tile)	m2	2500	2450	-	140	1500	6590
	Footpath repair (mastic)	m2	10000	24450	2950	625	3800	41825
	Grading unpaved streets	km	20	60	20	55	45	200
Shaping unpaved streets	km	9.5	27.0	5.5	20.0	21.0	83.0	
By Contractors Under Road Department Supervising	Major overlay	m2	358760	630440	75475	197560	135000	1497235
	Curbstone replacement	m.l	65000	64000	40250	28500	23500	221250
	Footpath overlay	m2	100000	244500	29500	6250	38000	418250
	Provision of road material							

Source: TAC Calculation

Road-15\sy

TABLE 16
ESTIMATED COST OF MATERIALS
FIVE YEAR PERIOD

MATERIALS	UNIT	QUANTITIES	QUANTITIES + 10% LOSSES	ESTIMATED UNIT COST/LE	TOTAL COST LE
Hot-Mix Asphalt	m3	15260	16785	60	1,007,100
Tack Coat	kg	88775	97653	0.06	5,860
Crushed Base	m3	7530	8285	20	165,700
Curbstone	l.m	115500	127050	8	1,016,400
Sand	m3	7210	7930	6	47,580
Morter	m3	1170	1285	50	64,250
Basalt Brick	m2	-	-	-	-
Tile	m2	7000	7700	8	61,600
Mastic Asphalt	m3	2100	2410	50	120,500
					2,488,990

Source: TAC Calculation

road-16/sy

3.5 Equipment Services and Repair Cost:

Equipment services and repair	LE 250,000
Spare parts	LE 250,000

TOTAL	LE 500,000

3.6 Estimated Fuel Cost For Equipment Operating Hours:

Total operating hours	63,960 hrs	
Total fuel cost = 63,960 hrs X 100 avg.hp X 0.2 kg fuel/hr X LE 0.10		= LE 127,920
Oil and Grease = 63,960 hrs X 100 avg.hp X 0.2 kg fuel/hr X 0.05 X LE 1.25 =		LE 79,950

TOTAL LE 207,870

3.7 Estimated Cost For Contractor's Work:

Major overly with 4 cm hot-mix	=	1497235 m ² X 2.5 LE/m ²	=	LE 3,743,087
Curbstone replacement	=	221250 l.m X 8 LE/m	=	LE 1,770,000
Footpath overlay	=	418,250 m ² X 2.0 LE/m ²	=	LE 836,500
Adjusting level of manhole cover	=		=	LE 150,000

		TOTAL		LE 6,499,587

3.8 Estimated Cost For Paving Construction For Unpaved Roads: (872,249 m²)

Levelling ground work	=	872,249 X 1.5	=	LE 1,308,375
Crushed stone 25 cm base course	=	872,249 X 3.0	=	LE 2,616,747
Prime coat course	=	872,249 X 0.25	=	LE 218,062
Hot-mix asphalt concrete 6 cm binding course	=	872,249 X 3.25	=	LE 2,834,809
Tack coat course	=	872,249 X 0.2	=	LE 174,450
Hot-mix asphalt concrete 5 cm surface course	=	872,249 X 3.0	=	LE 2,616,747
Curbstone works	=	141,000 X 8.0	=	LE 1,128,000
Mastic asphalt course for footpaths	=	325,000 X 2.5	=	LE 812,500
Adjusting level of manhole covers	=		=	LE 200,000

TOTAL LE 11,909,690

3.9 Road Materials And Soil Testing Laboratory:

A small asphalt, material and soil testing laboratory is required for quality control of hot-mix asphalt, road materials and soil testing. A proposed list of test equipment which is required for the Road Department is shown in Table 17. The estimated cost for the laboratory equipment and furnishing is as follows:

Laboratory equipment and apparatus	LE 40,815
Furnishing the laboratory	LE 9,185

TOTAL	LE 50,000

3.10 Equipment Purchase:

Existing equipment in Road Department and District Road Sections are listed in Table 6. The existing equipment is insufficient for road maintenance and is in unacceptable condition. It is necessary to provide the Road Sections with new equipment to fulfil the road maintenance plan and program by the force account. The required types, number and estimated cost are as shown in Table 18.

TABLE 17

List Of Required Test Equipment For Road Directorate Laboratory

Item	Description	Number Required	Expected Unit Price	Estimated Total Price
1	Sets of Sieves 203 mm diameter including the following sieve sizes: 75 mm 63 mm 50 mm 37 1/2 mm 25 mm 19 mm 12 1/2 mm 9 1/2 mm 4.75 mm 2.36 mm 1.18 mm 0.425 mm 0.6 mm 0.15 mm 0.075 mm Pan & cover	1	2,220 (185 for each sieve)	2,220
2	Motorized Dynamic Sieve Shaker for 203 mm Sieves (Electrical)	1	4,500	4,500
3	Laboratory Oven 50x50x50 cm minimum, 110 c min.	1	2,200	2,200
4	Balance capacity 20 kg with sensitivity 1 gm.	1	4,200	4,200
5	Balance Capacity 2.610 kg with sensitivity 0.1 gm.	1	1,400	1,400
6	Liquid Limit Devices, complete	1	980	980
7	Complete Proctor Apparatus with four moulds, hammer and sample extruder	1	650	650
8	Mould, CBR, with plate, collar, Penet- ration piston and expansion device.	1	1,395	1,395
9	Sand Cone Density Apparatus	1	550	550
10	Test Set For Penetration of Bituminous Materials.	1	2,600	2,600
11	Complete Bituminous Extraction Apparatus (elect.)	1	7,000	7,000
12	Core Drilling Apparatus with bits	1	12,500	12,500
13	Cubic Moulds 150x150x150 mm	6	70	420
14	Drying Pans 60x90x10	4		
15	Beaker glass 250 ml, 500 ml, 100 ml	2		
16	Thermometer, General Lab 0-200 c +0.5 c	2	From each 200	200
17	Some Brushes, Plates, Trades	4	From each	
Total Estimated Price		L.E.		40,815

Source: Giza City Road Department and TAC
road-17/sy

TABLE 18

NEW EQUIPMENT REQUIREMENT TO BE PURCHASED

<u>Equipment Type</u>	<u>Required No.</u>	<u>Estim. Unit Price</u>	<u>Estim. Total Cost LE</u>
Grader 80-100 hp	1	200,000	200,000
Vibrating Roller 2-4 t	2	25,000	50,000
Vibrating Roller 8-12 t	1	150,000	150,000
Air compressor 50-60 hp	3	60,000	180,000
Dump truck 6-10 t	5	100,000	500,000
Dump truck more than 10 t	3	120,000	360,000
Transport vehicle 1/2 - 1 1/2 t	5	30,000	150,000
Water tank vehicle 3 t	5	70,000	350,000
Bitumen boiler and distributor mobile tank	5	80,000	400,000
Level	10	3,000	30,000
Theodolite	10	5,000	50,000
Survey tools			50,000

Sub-Total			2,470,000
Spare parts 10%			247,000

TOTAL			2,717,000

3.11 Required Budget:

Table 19 shows the required budget

TABLE 19

FIVE YEAR MAINTENANCE PLAN BUDGET

No.	ITEMS	ESTIMATED COST LE	EXECUTING AGENT
1	Cost of materials	2,488,990	By force account of Road Department and District Road Sections.
2	Equipment Servies and repair	500,000	
3	Fuel cost	207,870	
	SUB-TOTAL	3,196,860	
4	Road Maintenance Cost of Major Overlay, Curbstone Replacement and Footpath Overlay	6,499,587	By contractor
5	Road Material and Soil Testing Laboratories	50,000	BAB III and/or USAID LD-II Investment Plan Grant
6	Equipment Purchase	2,717,000	BAB III and/or USAID LD-II Investment Plan Grant
	TOTAL	12,463,447	

Source: Giza City Road Department and TAC

4. YEARLY MAINTENANCE PLAN:

4.1 Quantities Of Required Work:

Are as shown in Table 20

TABLE 20
REQUIRED WORK
YEARLY MAINTENANCE PLAN

EXECUTION	ACTIVITIES	UNIT	DISTRICTS					TOTAL
			South	Central	North	West	Al Haram	
By Sections in Districts	Short asphalt overlay	m2	9560	14230	1528	4169	4258	33745
	Small pavement repairs	m2	810	2072	211	505	545	4143
	Curb repair	m.l	6020	6520	4585	2680	2280	22085
	Basalt brick repair	m2	-	-	-	-	-	-
	Footpaths repair (tiles)	m2	500	490	-	28	300	1318
	Footpaths repair (mastic)	m2	2000	4890	590	125	760	8365
	Grading unpaved streets	km	4.0	12.0	4	11.0	9.0	40
	Shaping unpaved streets	km	1.9	5.4	1.1	4.0	4.2	16.6
By Contractors Under Road Dept.Suprv.	Major overlay	m2	91752	126088	15095	39512	27000	299447
	Curbstone replacement	m.l	13000	12800	8050	5700	4700	44250
	Footpath overlay	m2	2000	48900	5900	1250	7600	83650
	Provision of road materials							

Source: IAC Calculation

road-20/sy

4.2 Required Labor Hours:

Are as shown in Table 21.

TABLE 21

REQUIRED LABOR HOURS

CODE	TOTAL CREW DAYS	FOREMAN		GRADER	OPERATOR	ROLLER	OPERATOR	LOADER	OPERATOR	TRUCK	DRIVER	MASON		LABORER	
		Per C-D	Tot. Hrs	PER C-D	TOTAL HRS	PER C-D	TOTAL HRS	PER C-D	TOTAL HRS	PRT C-D	TOTAL HRS	Per C-D	Tot. Hrs	Per C-D	Tot. Hrs
02	225	6	1350	6	1350	6	1350	0	0	12	4050	0	0	48	10800
03	44	6	264	0	0	6	264	0	0	12	528	0	0	36	1584
04	462	6	2772	0	0	0	0	0	0	6	2772	18	8316	36	16632
05	0	6	0	0	0	0	0	0	0	6	0	12	0	36	0
06	14	6	84	0	0	0	0	0	0	12	168	12	168	36	504
07	84	6	504	0	0	6	504	0	0	12	108	12	1008	24	216
08	28	0	0	6	168	0	0	0	0	0	0	0	0	0	0
09	35	6	210	0	0	0	0	6	210	12	420	0	0	48	1680
TOTAL			5184		1518		2118		210		8946		9492		33216

Source: From Table 14, Performance Standard and TAC Calculation

road-21/sy

4.3 Staff Requirements:

Are as shown in Table 22.

**TABLE 22
STAFF REQUIREMENTS**

PERSONNEL CLASS	ANNUAL HRS NEEDED EACH CLASS	AVAILABLE ANNUAL HRS	NUMBER OF PERSONNEL NEEDED	NUMBER ROUNDED UP
Foreman	5,184	1560	3.32	4
Grader Operator	1,518	1560	0.97	1
Roller Operator	2,118	1560	1.36	2
Loader Operator	210	1560	0.13	1
Truck Driver	8,946	1560	5.73	6
Hason	9,492	1560	6.08	7
Laborer	33,216	1560	21.29	22

road-22/sy

N.B. :

Work hours/day = 6 hours
 Casual leave = 7 days
 Sick leave = 30 days
 Annual leave = 21 days
 Vacation/year = 48 days

TOTAL 106

Work days/year = 366 - 106 = 260 days
 Available annual hours = 260 X 6 = 1,560 hours

Source: Directorate of Operation & Administration Instruction (DOA) and TAC calculation.

4.4 Required Equipment Operating Hours:

Are as shown in Table 23

**TABLE 23
REQUIRED EQUIPMENT OPERATING HOURS**

CODE	TOTAL CREW DAYS	GRADER		ROLLER		LOADER		DUMP TRUCK	
		Per C-D	Tot. Hrs	Per C-D	Tot. Hrs	Per C-D	Tot. Hrs	Per C-D	Tot. Hrs
02	225	6	1350	6	1350	0	0	18	4050
03	44	0	0	6	264	0	0	12	528
04	462	0	0	0	0	0	0	6	2772
05	0	0	0	0	0	0	0	6	0
06	14	0	0	0	0	0	0	12	168
07	84	0	0	6	504	0	0	12	1008
08	28	6	168	0	0	0	0	0	0
09	35	0	0	0	0	6	210	12	420
TOTAL			1518		2118		210		8946

Source: From Table 14, Performance Standard and TAC Calculation

road-23/sy

4.5 Required Equipment:

The required equipment for the yearly maintenance plan is as shown in Table 24.

TABLE 24
REQUIRED EQUIPMENT

<u>Machine Type</u>	<u>Annual Hours Needed Each Type</u>	<u>Avail Mach. Hours,</u>	<u>No. of Mach. Needed</u>	<u>Rounded No. of Machs. Needed</u>
Grader	1518	1350	1.12	2
Loader	210	1350	0.16	1
Roller	2118	1350	1.57	2
Dump Truck	8940	1350	6.62	7

Available machine hours = 300 day X 0.75 availability X 6 hours = 1350 hours

Source : From Table 23 and TAC calculation.

4.6 Required Materials:

Required materials are as shown in Table 25. Table 26 reflects the cost of these materials.

4.7 Equipment Service And Repair Cost:

Equipment service and repair	=	LE 50,000
Spare parts	=	LE 50,000

TOTAL		LE 100,000

4.8 Estimated Fuel Cost For Equipment Operating Hours:

Total operating hours	12792 hrs.	
Total fuel cost =	12792 hrs X 100 avg. hp X 0.2 kg fuel/hp/hr X LE 0.10	= LE25,584
Oil & grease cost =	12792 hrs X 100 avg. hp X 0.2 kg/hp/hr X 0.05 X LE 1.25	= LE15,990

TOTAL		LE41,574

4.9 Estimated Cost For Work By Contractor:

Major overlay with 4.0 cm hot-mix asphalt	=	299,447 m ² X 2.5	=	LE 748,618
Curbstone replacement	=	44,250 l.m X 8	=	LE 354,000
Footpath overlay	=	33,650 m ² X 2.0	=	LE 67,300
Adjustment of manhole covers	=		=	LE 30,000

TOTAL				LE 1,199,918

4.10 Required Budget For Year 90/91:

Is shown in Table 27.

TABLE 25

REQUIRED MATERIALS

CODE	TOTAL CREW DAYS	HOT-MIX ASPHALT m ³		TACK COAT kg		CRUSHED BASE m ³		CURB STONE m. l		SAND m ³		MORTAR m ³		BASALT BRICK m ²		TILE OR MASTIC m ²	
		Per C-D	Total	Per C-D	Total	Per C-D	Total	Per C-D	Total	Per C-D	Total	Per C-D	Total	Per C-D	Total	Per C-D	Total
02	225	12	2700	75	16875	6	1350										
03	44	8	352	20	880	4	176										
04	462							50	23100	1	462	0.5	231				
05	0									5	0	0.5	0	50	0		
06	14									10	140	0.2	30			100	1400
07	84									10	840					5	420
08	28																
09	35																
TOTAL			3052		17755		1526		23100		1442		261				1400 420

Tile

Mastic

Tile

Mastic

Source: From Table 14, Performance Standard and TAC Calculation

road-25/sy

TABLE 26

ESTIMATED COST OF MATERIALS

MATERIALS	UNIT	* QUANTITIES	QUANTITIES + 10% LOSSES	** ESTIMATED UNIT COST L.E.	TOTAL COST L.E.
Hot-Mix Asphalt	m ³	3052	3357	60	201420
Tack Coat	kg	17755	19530	0.60	11718
Crushed Base	m ³	1526	1678	20	33560
Curbstone	l.m	23100	25410	8	203280
Sand	m ³	1442	1586	6	9516
Mortar	m ³	261	287	50	14350
Basalt Brick	m ²	-	-	-	-
Tiles	m ²	1400	1540	8	12320
Mastic Asphalt	m ³	420	462	50	23100
TOTAL					509,264

Source: * From Table of Quantities

** Road Directorate Tender FY 89/90 For Price - TAC Calculation

road-26/sy

TABLE 27

YEARLY BUDGET REQUIREMENT

ITEM	SUBJECT	ESTIMATED COST L.E.	EXECUTING AGENT
1	Cost of materials	509,264	By force account in Road Sections
2	Equip. service & repair	100,000	
3	Fuel cost	41,574	
	Sub-Total	650,838	
4	Road maintenance cost of major overlay, curb- stone replacement and footpath overlay	1,199,918	By contractor
	Sub-Total		
5	Materials and soil testing laboratory	50,000	BAB III and/or USAID LD-II Investment Plan Grant
	Sub-Total		
	Equipment purchase	543,400	BAB III and/or USAID LD-II Investment Plan Grant
	Sub-Total		
	TOTAL	2,444,156	

Source: TAC Calculation

road-27/sy

4.11 Time Schedule For yearly Maintenance Plan:

Is as shown in Table 28.

Table 28
TIME SCHEDULE FOR YEARLY MAINTENANCE PLAN

ITEM	ACTIVITIES	UNIT	ESTIMATED QUANTITIES	MONTHS												EXECUTING AGENT
				1	2	3	4	5	6	7	8	9	10	11	12	
1	Inspection to estimate needed repairs and location															Road Department & Road Section in District
2	Preparation of Specification, Bill of Quantities and documents for needed works and materials			-												
3	Contracting for providing materials of works			-												
4	Thin hot asphalt overlay	m2	10204	-	-	-	-	-	-	-	-	-	-	-	-	
5	Small pavement repairs	m2	1377	-	-	-	-	-	-	-	-	-	-	-	-	
6	Curb repair	m.l	4681	-	-	-	-	-	-	-	-	-	-	-	-	
7	Basalt bricks repair	m2	-													
8	Footpaths repair (Tile)	m2	-													
9	Footpaths repair (mastic)	m2	2061													
10	Grading unpaved streets	km	51		-			-			-			-		
11	Shaping unpaved streets	km	28													
12	Major overlay	m2	214215													Contractor Under Supervision of Road Department
13	Curbstone replacement	m.l	101295													
14	Footpath overlay	m2	61836													
15	Provision of road materials		20000	-	-	-	-	-	-	-	-	-	-	-	-	

Legend: _____ Firm Schedule

..... As Needed

Source: Giza City Road Department and TAC

SECTION III

CONCLUSION AND RECOMMENDATIONS

Section I and II discussed the present status of the Giza City Road Department and the District Road Sections, and developed a road maintenance plan for the city. The essentials of the plan are presented in this section.

1. ORGANIZATION:

The current organization of the Giza City road Department and District Road Sections has no clear organizational structure. The road department is controlled and headed by the Giza City Mayor. Each District Road Section is divided into Road Maintenance Units which are administered by the Utility Director. The Project Units are controlled by an engineer and headed by the District Chief. It appears that there is no technical relationship between the Road Department in the City and the District Road Sections.

The TAC Staff in cooperation with the Giza City Road Department proposed more effective organization as shown in Figure 2. This organization will lead to more effective and efficient road maintenance planning, programming and implementation. The new organization, after approval by the City Mayor, should be sent to DOA for formal approval.

2. STAFFING:

Giza City Road Department and District Road Sections are in dire need of additional staff. The existing staff lacks engineers, technicians, foremen, equipment operators and labor. Table 29 shows a comparison between the existing staff and the staff proposed in the new organization.

TABLE 29

EXISTING AND PROPOSED STAFF

ROAD SECTION	ENGINEERS		TECHNICIANS		FOREMEN		EQUIP. OPERATOR		LABOR	
	Exist.	Propos.	Exist.	Propos.	Exist.	Propos.	Exist.	Propos.	Exist.	Propos.
Road Department	2	8	1	16	-	-	-	1	-	7
South District	1	3	20	12	10	2	10	18	45	30
Central District	1	3	30	12	8	2	15	18	25	30
North District	1	3	13	12	-	2	6	18	11	30
West District	1	3	20	12	-	2	12	18	25	30
Al Haram District	1	3	-	12	-	2	-	18	-	30
TOTAL	6	23	84	76	18	10	43	91	106	157

Source: Giza Road Department and Road Sections and IAC

3. TRAINING:

A training program should be developed and implemented to include the Giza road maintenance staff. The program should concentrate on improving the staff current level of road maintenance skill, and providing necessary instruction to new employees. Suitable courses are available at the National Road Authority Training Center in Cairo or at consulting office specializing in training. Two different courses are needed (one for Engineers and Technicians and the second for Road Equipment Operators). Labor training should take place at the work sites.

3.1 For Engineers And Technicians:

A 15-day course on road maintenance and repair of asphalt concrete pavement is needed. This course should cover the following topics

- o Embankment and base course failures.
- o Crack causes and required remedies.
- o Surface corrugation, potholes, bleeding, rutting, depressions, upheavals and disintegration of flexible pavement.
- o Curb and footpath repair.

3.2 For Road Equipment Operators:

A 15-day course to train operators on the correct use of road equipment is desirable. Practical training is most important to upgrade the operators' skills. Operator equipment maintenance should be a major topic in the training.

3.3 Labor Training:

On the job training should take place at the work sites. Road engineers should be responsible for planning and implementing the required training.

4. EQUIPMENT NEEDS:

- o Road maintenance equipment in Giza are inadequate to carry out road maintenance by force account. Table 6 shows the inventory and status of road equipment. Table 30 indicates needed equipment.
- o It is recommended that the Giza road department be supplied with a test laboratory to control different road materials and asphalt mixtures. A list of proposed laboratory equipment and approximate cost estimate are shown in Table 17.

Table 30

REQUIRED EQUIPMENT FOR ROAD DEPARTMENT AND SECTIONS

EQUIPMENT TYPE	ROAD DEPARTMENT AND SECTIONS		
	EXIST	REQUIRED	EQUIPMENT FOR PURCHASE
Loader	5	5	-
Grader	4	5	1
Vibrating Roller 2-4t	13	15	2
Vibrating Roller 8-12t	9	10	1
Air compressor	2	5	3
Dump Truck 6-10t	15	20	5
Dump Truck more than 10t	7	10	3
Transport Vehicle 1/2-3t	5	10	5
Water Tank Vehicle 3t	-	5	5
Bitumen Boiler & Distributer	-	5	5
Mobile Tank			
Survey Tools			
- Level		10	10
- Theodilite		10	10
- Survey Tools			

road-29/sy

5. **BUDGETING:**

5.1 **Five Year Maintenance Plan:**

To implement the five year maintenance plan the following amount of funding is needed. The Investment Plan Allocations provided from the USAID LD-II Urban Project maybe used to fund some of the requirements:

o Cost of materials	LE 2,488,990
o Equipment service and repair	LE 500,000
o Fuel cost	LE 207,870
o Road maintenance by contractor for major overlay	LE 6,499,587
o Material and soil testing laboratory	LE 50,000
o Equipment purchase	LE 2,717,000

TOTAL	LE 12,463,447

5.2 **Annual Maintenance Plan:**

Based on the Five-Year Maintenance Plan, an annual budget requirement would be:

o Materials	LE 509,264
o Equipment service and repair	LE 100,000
o Fuel	LE 41,574
o Road maintenance by contractor for major overlay	LE 1,199,918
o Material and soil testing laboratory	LE 50,000 - 50,000
o Equipment purchase	LE 543,400

TOTAL	LE 2,444,156

5.3 **Comparison of Available Funding and Requirement**

Table 31 shows a comparison between available funds, the needed funds yearly and the deficit in funding to fulfill the yearly maintenance plan.

TABLE 31
REQUIREMENTS AND AVAILABLE BUDGET

Required		LE 2,309,290
Available		
	From BAB II	LE 28,780
	From Gasoline Revenues	LE 550,000
	From USAID	LE 870,000

TOTAL	LE 1,448,780	LE 1,448,780
Deficit		LE 860,510

This deficit can be rectified by obtaining repaving revenues from utility agencies or increasing the gasoline revenue or modifying the current BAB III allocation (BAB III allocation for FY 1990 approx. 1,900,000).