

FD-APA-820
8/6/10
7

LOCAL DEVELOPMENT II URBAN PROJECT

Submitted to

USAID / CAIRO

Submitted by

WILBUR SMITH ASSOCIATES

in association with

PUBLIC ADMINISTRATION SERVICE
DEVELOPMENT CONSULTING OFFICE

DELOITTE AND TOUCHE
ENGINEERING AND GEOLOGICAL
CONSULTING OFFICE

**ROADS AND STREETS MAINTENANCE
ALEXANDRIA GOVERNORATE**

AUGUST 1990

LOCAL DEVELOPMENT II URBAN PROJECT

1097 CORNICHE EL NIL (MOBIL OIL BUILDING), GARDEN CITY • CAIRO, EGYPT • 354-6469 • 355-7078 • 356-1395 • 356-1449 • 356-1836 • FAX 356-4294

August 14, 1990

H. E. El Sayed Ismail EL Gawaski
Governor
Alexandria Governorate

Your Excellency:

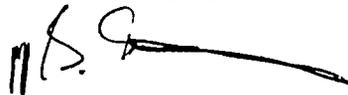
It is with pleasure that I forward to you five copies of the Roads and Streets Maintenance Plan for Alexandria City in English and Arabic. The plan was developed with the assistance and cooperation of Engineer Mahran El Dawi, Director of the Road Directorate. Copies of the plan are also being furnished 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. As stated in the plan, 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. Gisiger, USAID - Cairo
Eng. Mahran El Dawi, Director, Road Directorate
Mr. Monir Mokhtar, Coordinator

19-4-1N,446

MAILING ADDRESS: P.O. BOX 2315 • ATABA SQUARE • CAIRO, EGYPT

WILBUR SMITH ASSOCIATES

DELOITTE HASKINS AND SELLS

DEVELOPMENT CONSULTING GROUP

PUBLIC ADMINISTRATION SERVICE

ENGINEERING AND GEOLOGICAL
CONSULTING OFFICE

Acknowledgement

This Roads and Streets Maintenance Plan was made possible through the assistance and cooperation of HE Governor El Sayed Ismail El Gawsaki and the many officials of the Governorates of Alexandria and the Districts comprising the Governorate. Engineer Mahran El Dawi, Director of Alexandria Road Directorate, made major contributions to the plan and was invaluable in assisting in obtaining data necessary to formulate the plan. Mr. Monir Mokhtar, TAC coordinator for Alexandria Governorate, helped greatly by arranging for meetings between the TAC representative and Governorate officials.

TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>	<u>PAGE NO.</u>
	INTRODUCTION	1
SECTION I	BACKGROUND ANALYSIS	
1.1	ROAD DIRECTORATE AND DISTRICT ROAD SECTIONS	2
1.1.1	Function and Responsibilities	2
1.1.2	Organization and Staffing	3
1.2	ROADS, STREETS AND FOOTPATHS, INVENTORY AND CONDITIONS	7
1.2.1	General	7
1.2.2	Inventory and Conditions	8
1.3	AVAILABLE RESOURCES	8
1.3.1	Personnel	8
1.3.2	Vehicles and Equipment	8
1.3.3	Road Materials	8
1.3.4	Annual Budget Resources	8
SECTION 2	ROAD MAINTENANCE PLANNING	25
2.1	JUSTIFICATION OF MAINTENANCE	25
2.2	MAINTENANCE LEVELS AND ACTIVITIES	26
2.2.1	Maintenance Classification	26
2.2.2	Road Maintenance Responsibilities	26
2.2.3	Annual Maintenance Requirements	27
2.2.4	Performance Standards	27
2.2.5	Work Quantities and Crew-Days	27
2.3	FIVE YEAR MAINTENANCE PLAN	36
2.3.1	Required Work	36
2.3.2	Required Labor Hours	36
2.3.3	Equipment Operating Hours	36
2.3.4	Required Materials	36
2.3.5	Equipment Service And Repair Costs	39
2.3.6	Estimated Fuel Cost For Equipment Operating Hours	39
2.3.7	Estimated Cost For Work By Contractor	39
2.3.8	Estimated Cost Of Paving Construction for Unpaved Roads	39
2.3.9	Road Materials And Soil Testing Laboratory	40

2.3.10	Equipment Purchase	40
2.5.11	Required Budget For Five-Year Maintenance Plan	40
2.4	YEARLY MAINTENANCE PLAN	44
2.4.1	Quantities Of Required Work	44
2.4.2	Required Labour Hours	44
2.4.3	Staff Requirements	44
2.4.4	Required Equipment Operating Hours	44
2.4.5	Required Equipment	44
2.4.6	Required Materials	44
2.4.7	Equipment Services And Repair Costs	44
2.4.8	Estimated Fuel Cost For Equipment Operating Hours	44
2.4.9	Estimated Cost For Work By Contractor	52
2.4.10	Required Budget For Year 90/91	52
2.4.11	Time Schedule For Yearly Maintenance Plan Execution	52
SECTION III	CONCLUSIONS AND RECOMMENDATIONS	55
3.1	ORGANIZATION	55
3.2	STAFFING	55
3.3	TRAINING	55
3.3.1	For Engineers And Technicians	55
3.3.2	For Road Equipment Operator	57
3.3.3	Laborer Training	57
3.4	EQUIPMENT NEEDS	57
3.5	BUDGETING	57
3.5.1	Five Year Maintenance Plan	57
3.5.2	Annual Maintenance Plan	59
3.5.3	Required And Available Budget	59
3.6	GENERAL RECOMMENDATIONS	60

LIST OF FIGURES

<u>FIGURE NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
1	EXISTING ORGANIZATION Alexandria Road Directorate and Road Sections in Districts	4
2	PROPOSED ORGANIZATION Alexandria Road Directorate and Road Sections in Districts Proposed by the Road Directorate	5
3	MODIFIED ORGANIZATION Alexandria Road Directorate and Road Sections in Districts Proposed by the TAC	6
4 thru 10	SOME PHOTOGRAPHS FOR ALEXANDRIA ROADS AND STREETS	13 through 19
11, 12 & 13	SOME PHOTOGRAPHS FOR EXISTING EQUIPMENT & VEHICLES IN ALEXANDRIA R.D. AND R. SEC. IN DISTRICTS	21, 22 & 23
	<u>Performance Standers:</u>	
14	SHORT ASPHALT OVERLAY	63
15	SMALL PAVEMENT REPAIRS	64
16	CURBSTONE REPAIR OR REPLACEMENT	65
17	BASALT BRICK PAVEMENT REPAIR	66
18	FOOTPATHS REPAIR (TILE SURFACE)	67
19	FOOTPATH REPAIR (MASTIC ASPHALT SURFACE)	68
20	GRADING UNPAVED STREETS (GRADER)	69
21	SHAPING UNPAVED STREETS (LABOR)	70

LIST OF TABLES

<u>TABLE NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
1	Existing Staffing - Road Directorate and Districts Road Sections	7
2	Road Inventory and Conditions Roadway Length in Kilometers	9
3	Road Inventory and Conditions Road Area in Square Meters	10
4	Curbstone Inventory and Conditions Road Curb Length in Linear Meters	11
5	Sidewalk Inventory and Conditions Sidewalk Area in Square Meters	20
6	Inventory and Condition of Vehicles & Equipment	20
7	Road Maintenance Responsibilities	26
8	Annual Maintenance Requirements by Percentage	28
9	Derivation of Work Quantities and Crew-Days, East District	29
10	Derivation of Work Quantities and Crew-Days, West District	30
11	Derivation of Work Quantities and Crew-Days, Central District	31
12	Derivation of Work Quantities and Crew-Days, Amria District	32
13	Derivation of Work Quantities and Crew-Days, Montazah District	33
14	Derivation of Work Quantities and Crew-Days, El Gomrok District	34
15	Summary of Crew-Days	35
16	Quantities of Required Works - Five Year Period	37
17	Estimated Cost of Materials - Five Year Period	38
18	List of Required Test Equipment For Road Directorate Laboratory	41
19	New Equipment to be Purchased	42
20	Five Year Maintenance Plan Budget	43
21	Required Work - Yearly Maintenance Plan	45
22	Required Labor Hours	46
23	Staff Requirements	47
24	Required Equipment Operating Hours	48
25	Required Equipment	49
26	Required Materials	50
27	Estimated Cost Of Materials	51
28	Yearly Budget Requirement	53
29	Time Schedule For Yearly Maintenance Plan	54
30	Existing and Proposed Staff	56
31	Required Equipment For Road Directorate And Sections	58

INTRODUCTION

INTRODUCTION

This report is prepared for Alexandria City and addresses the maintenance and repair of roads and streets. The objective of the report is to assist the Road Directorate in establishing a more effective and efficient road maintenance management system including the development of organization and staffing. The report covers the following main topics:

- o The current organization and staffing of the Road Directorate and Road Sections in Districts.
- o Roads and Streets inventory and their technical status and condition.
- o Personnel, equipment and financial resources available
- o Proposal to develop the road maintenance management system including the development of organization, staffing, training and budgeting.
- o Development of five year and yearly plans for effective road maintenance in Alexandria including the introduction of performance standards and indicators.
- o Defining maintenance levels and responsibilities.

The Technical Assistance Contractor appreciates the assistance and cooperation of Alexandria Road Directorate Officials who helped in obtaining the data needed to develop this report and who contributed to the formulation of the recommendations contained in this report.

The following reports were used as references in this report:

- 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 - September 1989
- o Roads and Streets Maintenance - Giza City - January 1990
- o The information and data obtained from Alexandria Governorate, Road Directorate and Road Sections.

1. BACKGROUND ANALYSIS

1.1 ROAD DIRECTORATE AND DISTRICT ROAD SECTIONS

1.1.1 Function and Responsibilities

The Road Directorate is one of the "Service Agencies" which is controlled by the Governor. The Directorate is headed by a civil engineer with the assistance of a staff of civil and mechanical engineers, administrative and financial employees. The Directorate receives general policy and technical advice from the National Road and Bridge Authority.

The Road Directorate not only maintains existing paved roads and streets from the force account of Road Sections in districts, but also executes new paving projects and major overlays by road contractors under its supervision. The maintenance of roads and streets is limited to small road repairs such as potholes or repaving trenches after finishing installation or repair of water pipe lines, sewer pipe lines, telephone cables and electric cables. The asphalt hot-mix needed for such repairs is provided by road contractors according to annual contract. The Road Directorate reviews requests by districts, sets specifications, estimates cost and, after checking funding approvals, prepares the tender documents and develops programs for contracting the work.

There is a road section headed by a technical foreman in each of the six districts. The Roads Sections are under the direct supervision of the districts chiefs but they are technically advised by the Road Directorate. The Road Sections are responsible for road maintenance work in the district. By force account they execute such work as; crack filling, pothole patching, levelling depressions, curb stone repair or replacement, repair of mastic or tile footpaths and repair of basalt brick paving.

In order to execute needed road maintenance work by force account the Road Directorate and Road Sections in districts are provided with resources in the form of personnel, equipment and operating budget.

The primary need for patching asphalt street surfaces results from cuts in the surface made to install or repair water pipe lines, sewer lines and other utilities. These trenches are made by agencies other than the Road Directorate and are due to the growth of the city and new building construction. There are usually long delays in getting utility work completed and cleaned up due to lack of coordination between different directories. Such problems and conflict add difficulties in programming the maintenance work. (Painting of Lane Lines and maintenance of traffic signs and signals are done by the Traffic Department and not by the Road Directorate).

1.1.2 Organization Staffing

The current organization structure of Alexandria Road Directorate and Road Sections in districts is basically suitable for road maintenance work but needs some modification to be more effective. It is noticeable that the Road Sections in districts are completely controlled technically and administratively by the Road Directorate. This differs from the Road Sections in the other Governorates which are controlled by the District Chief. Figure 1 show the current organization chart.

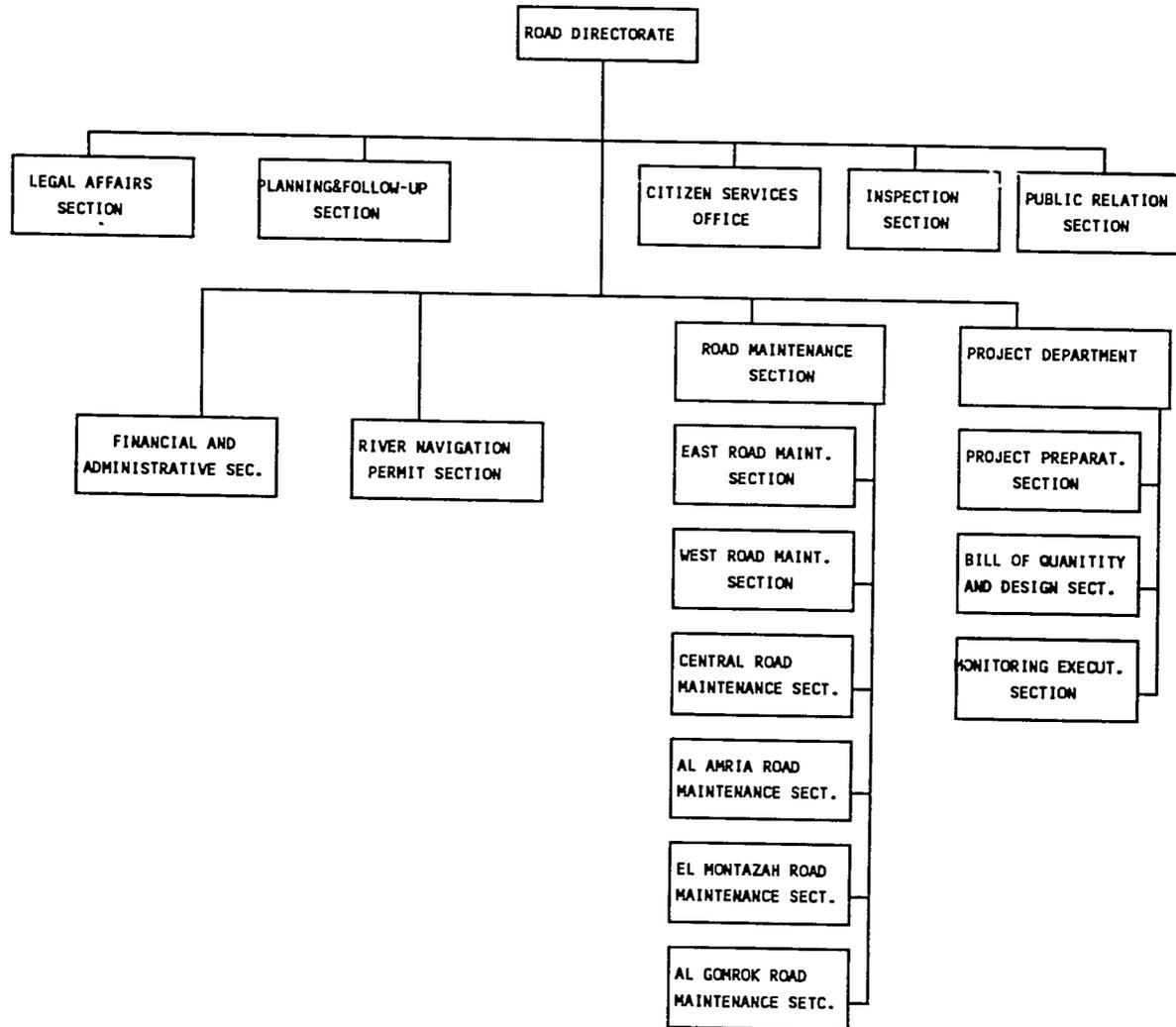
The Road Directorate proposes a modified organization structure to develop more effective execution for road maintenance program by force account. It is noticeable that this modified organization replaces most of the sections by departments and the Road Sections in districts are completely controlled technically and administratively by the Road Directorate Director. Figure 2 show the modified organization chart.

The Technical Assistant Contractor (TAC) proposes an alternative organization structure which differs from the current and modified organizations in that laboratory and survey sections are added. The Road Sections in districts will still be controlled administratively and technically by the Road Director. Figure 3 shows this alternative.

The road maintenance staffs of Road Directorate and Road Sections in districts are generally incomplete. There are shortages of engineers, technicians, foremen, equipment operators and laborers. The road maintenance staffs in road sections need to be enhanced in accordance with the modified organization. The current staff for the Road Directorate and Road Sections in districts is as shown in Table 1 (administrative staffs not included).

Training of road engineers, technicians, equipment operators and other trades is badly needed. The road maintenance staff is locally trained; on the job training only takes place on site for laborers. Training needs are covered in Section III.

Fig. 1
 CURRENT ORGANIZATION
 ALEXANDRIA ROAD DIRECTORATE AND ROAD SECTIONS IN DISTRICTS



4

Figure 2
CURRENT ORGANIZATION
FOR ALEXANDRIA ROAD DIRECTORATE AND ROAD SECTIONS IN DISTRICTS

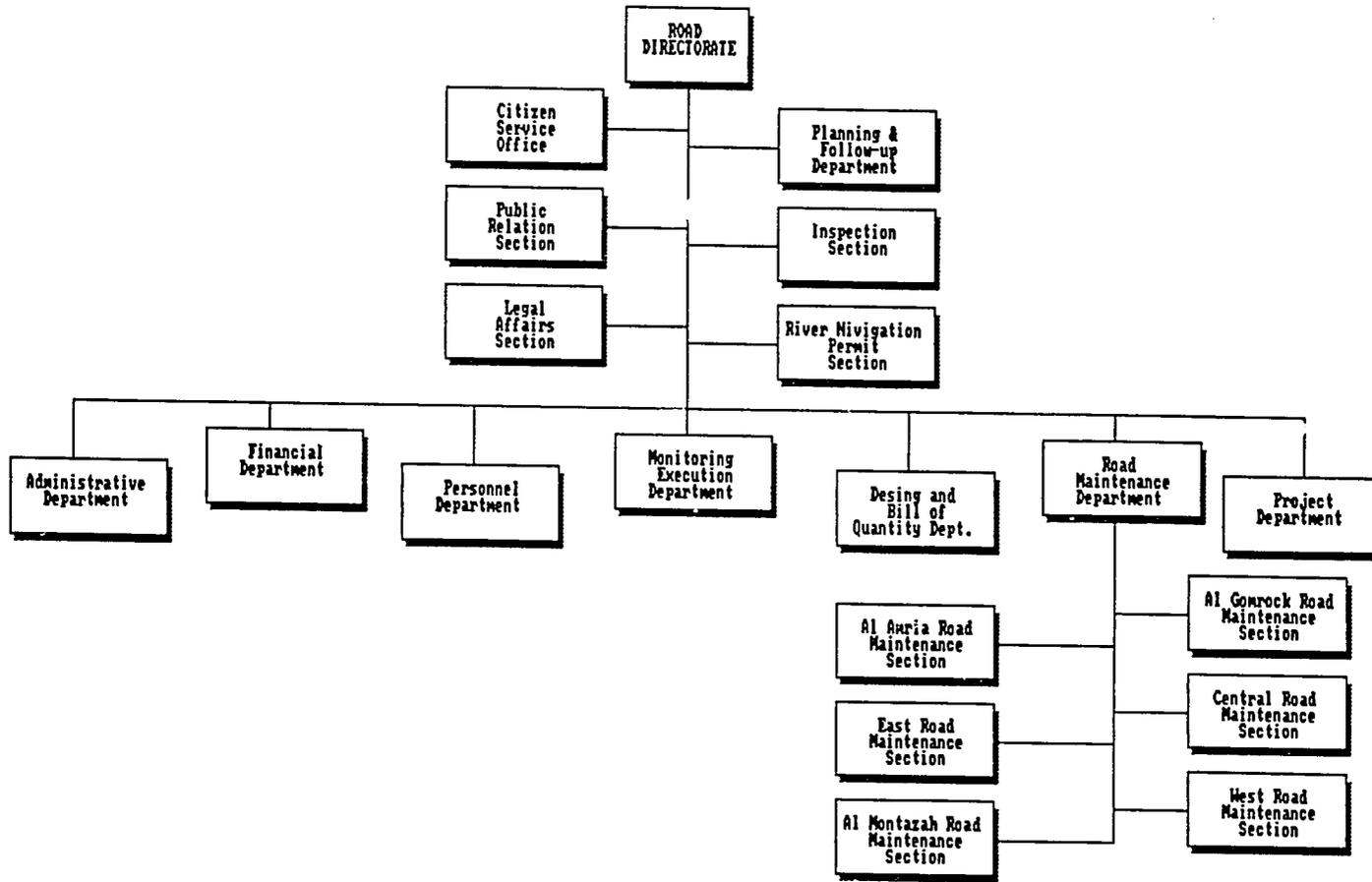


Figure 3
PROPOSED ORGANIZATION CHART
FOR ALEXANDRIA ROAD DIRECTORATE AND ROAD SECTIONS IN DISTRICTS

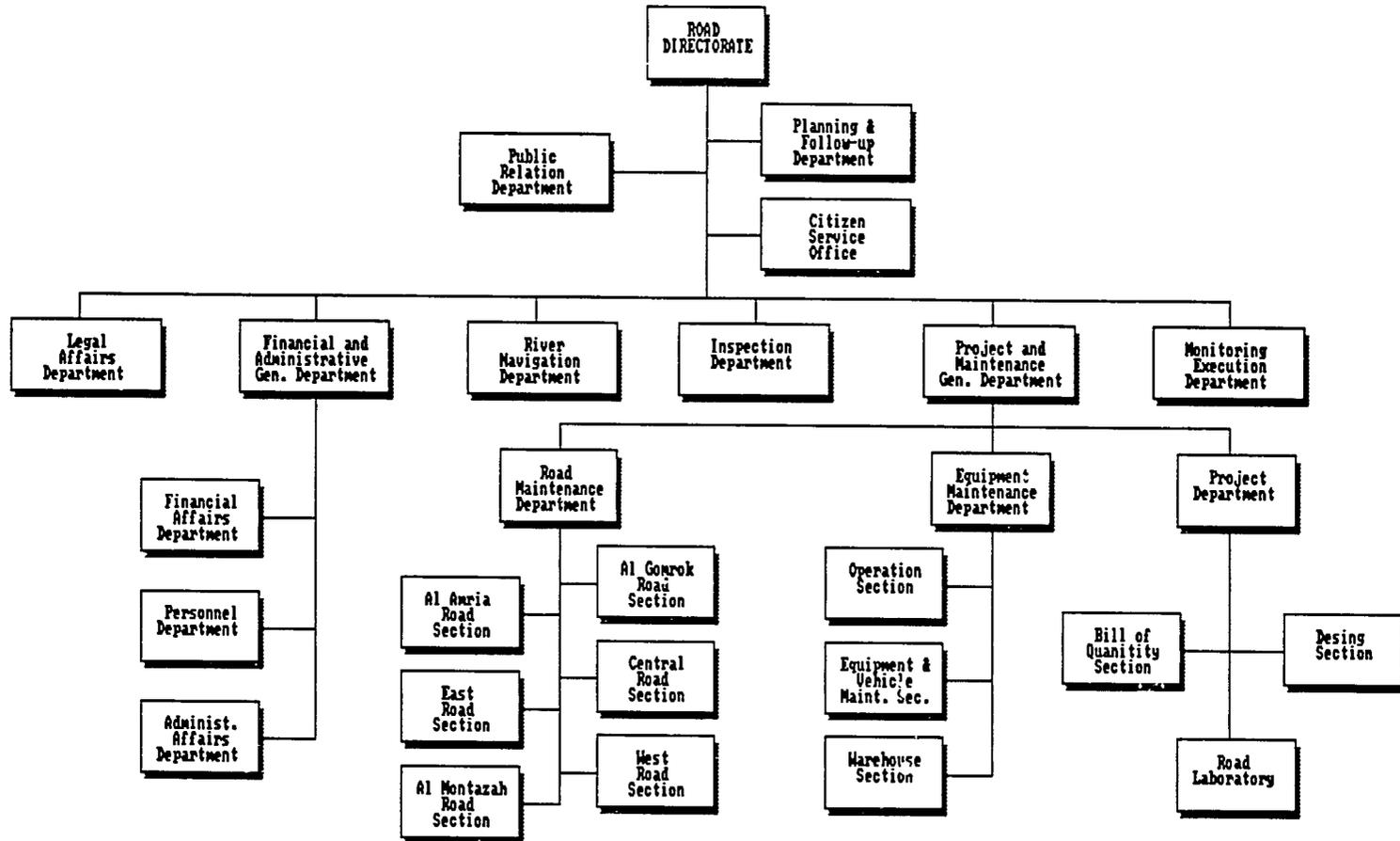


TABLE 1
EXISTING STAFFING-ROAD DIRECTORATE AND DISTRICT ROAD SECTIONS

	Engineer	Technicians	Foremen	Equ. Operators	Laborers
Road Directorate	14	4	30	2	-
East District	-	1	3	5	35
West District	-	1	3	5	35
Central District	-	1	3	5	35
Al Amria District	-	1	3	5	35
Al Montazah District	-	1	3	5	35
Al Gomrok District	-	1	3	5	35
Total	14	10	48	32	210

Source: Alexandria Road Directorate

1.2 ROADS, STREETS AND FOOTPATHS, INVENTORY AND CONDITIONS

1.2.1 General

Most of Alexandria's roads and streets are paved except some secondary streets in the newly constructed zones. There are three types of surfacing in Alexandria, with asphalt concrete (AC) being used in most of the paved streets, basalt bricks (BB) in West District and natural soil (unpaved) streets which exist in the secondary streets of newly constructed zones. The asphalt concrete pavements are constructed of hot-mix asphaltic concrete surfacing produced by local plants owned by paving contractors. The basalt bricks pavements are constructed of basalt brick surfacing (These are no longer used for maintenance and repair work). The unpaved streets of Alexandria are built of local soil surfaced with selected materials from Amria quarries.

Alexandria streets are two, three or four lanes, single or double carriage way, with or without median areas. They have curbing of precast concrete units defining the footpaths. Footpaths are paved with "Steel Crete" colored tiles, mastic or sand mix asphalt, cement concrete squares or are unpaved. There are streets without curbing or defined footpaths.

Alexandria is connected to the other Governorates by three main roads; namely the Desert Cairo-Alexandria road, the Agricultural Cairo-Alexandria road and the Alexandria-Marsamatrough road. These roads are constructed and maintained by the National Road and Bridge Authority (NRBA).

1.2.2 Inventory and Conditions

The Inventory and condition of Alexandria roads and streets were obtained from the Alexandria Road Directorate and Road Sections. Random inspections were made to check data received. Table 2, 3, 4 and 5 show the inventory (including surface type, condition, length and area of streets, footpaths and curbstones). Pictures were taken for some paved and unpaved road and streets to show typical condition of the roads, streets, footpaths and curbstones. These pictures are shown in figures 4 through 10.

1.3 AVAILABLE RESOURCES

1.3.1 Personnel

Alexandria Road Maintenance Units are generally inadequately staffed. There are shortages of engineers, technicians, foremen, equipment operators and laborers. Existing personnel (other than administrative staff) are shown in Table 1.

1.3.2 Vehicles and Equipment

Alexandria Road Directorate and Road Sections in districts have insufficient vehicles and equipment although there are large numbers of Rollers in some Road Sections. The equipment is generally in good condition. Table 6 shows the inventory and condition of vehicles and equipment. Figures 11, 12 and 13 shows photographs of some existing equipment and vehicles.

1.3.3 Road Materials

No road paving materials are provided to the Road Directorate or Road Sections except for a small amount of hot-mix asphaltic concrete provided by paving contractors for small patching repairs or trenches repaving. Major overlays for roads and streets are executed by road paving contractors under supervision of the Road Directorate. This work is tendered for annually.

1.3.4 Annual Budget Resources

The annual budget for road maintenance, equipment repair and paving projects, funded by BAB II and BAB III, seems to be insufficient. Other funds, such as an allocation from benzine revenues, the governorate services account and repaving revenues from utility agencies are used in major road repairs and new paving project construction.

Table 2
Roadway Length in Kilometers

District	Pavement Condition												Total No. of Streets	Total Length	% of Total Length
	Good			Medium			Poor			Unpaved					
	No. of Streets	Length (km)	Percent	No. of Streets	Length (km)	Percent	No. of Streets	Length (km)	Percent	No. of Streets	Length (km)	Percent			
East	179	136.8	53.0%	290	75.4	29.2%	0	0.0		101	46.1	17.8%	570	258.2	27%
West	33	41.3	26.5%	285	90.1	57.8%	8	3.8	2.4%	57	20.7	13.3%	383	155.8	16%
Central	327	128.3	47.3%	580	131.0	48.3%	1	1.8	0.7%	2	10.0	3.7%	910	271.0	28%
El Amria	42	49.8	62.7%	2	1.3	1.6%	6	22.3	28.1%	7	6.1	7.6%	57	79.4	8%
El Montazah	30	35.4	22.5%	50	41.1	26.1%	24	21.7	13.8%	124	59.2	37.6%	228	157.3	16%
El Gomrok	41	23.5	56.6%	20	5.8	14.0%	1	3.0	7.2%	25	9.2	22.1%	87	41.4	4%
Totals	652	414.9	43.1%	1,227	344.6	35.8%	40	52.6	5.5%	316	151.1	15.7%	2,235	963.3	100%

Source: Alexandria Road Directorate and TAC calculation

Table 3
Roadway Area in Square Meters

District	Pavement Condition												Total No. of Streets	Total Area	% of Total
	Good			Medium			Poor			Unpaved					
	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			
East	179	1,385,100	68.0%	290	403,200	19.8%	0	0		101	248,660	12.2%	570	2,036,960	25%
West	33	502,000	37.5%	285	650,580	48.6%	8	39,000	2.9%	57	147,866	11.0%	353	1,339,446	16%
Central	327	1,179,700	64.2%	580	575,980	31.3%	1	21,600	1.2%	2	60,000	3.3%	910	1,837,280	23%
El Amria	42	860,720	67.3%	2	12,500	1.0%	6	341,700	26.7%	7	63,300	5.0%	57	1,278,220	16%
El Montazah	30	277,400	20.3%	50	504,015	36.9%	24	146,395	10.7%	124	438,810	32.1%	228	1,366,620	17%
El Gomrok	41	158,630	59.2%	20	28,280	10.6%	1	12,000	4.5%	25	68,855	25.7%	87	267,765	3%
Totals	652	4,363,550	53.7%	1,227	2,174,555	26.8%	40	560,695	6.9%	316	1,027,491	12.6%	2,235	8,126,291	100%

Source: Alexandria Road Directorate and TAC calculation

Table 4
Curbstone Condition
Curb Length in Linear Meters

District	Pavement Condition												Total * No. of Streets	Total Length	% of Total
	Good			Medium			Poor			Non-Existent					
	No. of Streets	Length (m)	Percent	No. of Streets	Length (m)	Percent	No. of Streets	Length (m)	Percent	No. of Streets	Length (m)	Percent			
East	176	263,650	52.4%	248	156,130	31.0%	0	0		146	83,190	16.5%	570	502,970	25%
West	33	82,300	27.7%	342	203,230	68.3%	6	7,000	2.4%	2	5,000	1.7%	383	297,530	15%
Central	329	272,150	46.1%	566	252,340	42.8%	11	26,500	4.5%	4	39,000	6.6%	910	589,990	29%
El Amria	33	53,400	21.3%	3	22,600	9.0%	1	2,200	0.9%	20	172,500	68.6%	57	250,700	12%
El Montazah	12	27,350	10.0%	55	64,000	23.5%	27	15,380	5.6%	135	165,930	60.9%	227	272,660	14%
El Gomrok	47	57,880	62.4%	37	27,500	29.6%	3	7,400	8.0%	0	0		87	92,780	5%
Totals	630	756,730	37.7%	1,251	725,800	36.2%	48	58,480	2.9%	305	465,620	23.2%	2,234	2,006,630	100%

Source: Alexandria Road Directorate and TAC calculation

* Total length includes allowances for future curbs.

Table 5
Sidewalk Condition
Sidewalk Area in Square Meters

District	Sidewalk Condition												Total No. of Walks	Total Area	% of Total
	Tile			Mastic			Unpaved			Non-Existent					
	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			
East	768	498,820	50.0%	18	16,640	1.7%	152	448,360	45.0%	76	33,500	3.4%	1,014	997,320	36%
West	738	460,430	91.2%	16	18,400	3.6%	0	0		28	26,270	5.2%	782	505,100	18%
Central	1,818	637,970	100.0%	2	180	0.0%	0	0		0	0		1,820	638,150	23%
El Amria	8	8,900	3.7%	0	0		104	222,900	93.8%	10	5,900	2.5%	122	237,700	9%
El Montazah	22	218	0.1%	94	100,790	39.3%	96	55,665	21.7%	126	99,620	38.9%	338	256,293	9%
El Gomrok	159	128,640	89.3%	20	15,400	10.7%	0	0		0	0		179	144,040	5%
Totals	3,513	1,734,978	62.4%	150	151,410	5.4%	352	726,925	26.2%	240	165,290	5.9%	4,255	2,778,603	100%

Source: Alexandria Road Directorate and TAC calculation

Alexandria Governorate



Paved Streets in Good Condition
Figure 4

Alexandria Governorate



Unpaved Footpaths without Curbstone

Figure 5

Alexandria Governorate



Unpaved Street with Some Potholes



Unpaved Street with Some Unremoved Debris

Figure 6

Alexandria Governorate



Asphalt Surface Disintegration needing
major overlay



Street with Some Potholes

Figure 7

Alexandria Governorate



Major Repairs for Streets



Major Repairs for Streets

Figure 8

Alexandria Governorate



Major Repair



Major Repair
Figure 9

Alex. Govern.



Some Streets Paved with Basalt Bricks

Figure 10

TABLE 6
INVENTORY AND CONDITION
OF
VEHICLE AND EQUIPMENT

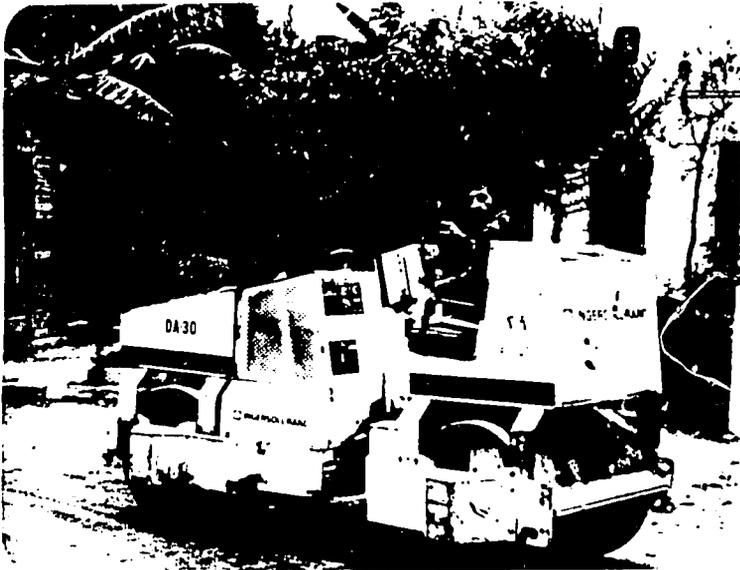
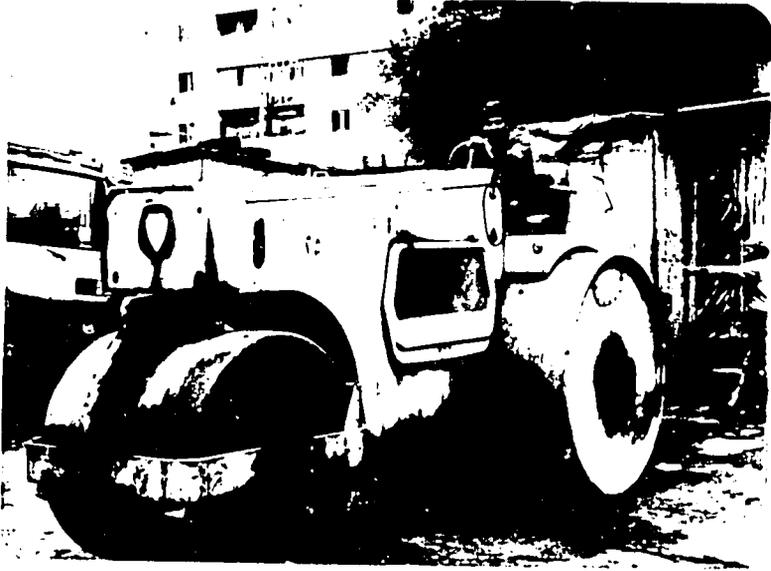
VEHICLE/EQUIPMENT	TYPE	ORIGIN	NO. OF PIECES			DISTRICTS					
			TOTAL	IN OPERATION	FAULTY	EAST DIST.	WEST DIST.	CENTRAL DIST.	AMRIA DIST.	MONTAZAH DIST.	GOMROK DIST.
Roller 12 ton	Hoge		2		2			1		1	
Roller 9 ton	Grevin		2	1	1			1		1	
Roller 8 ton	Zeter		2	1	1		1	1			
Roller 8 ton	Eveling		5	2	3	1	1	1	1		1
Roller 8 ton	Berkenz		1		1						1
Roller 8 ton	Galion		1	1					1		
Roller 8 ton	Angersol		2	2					1		1
Roller 8 ton	Marchal		1		1					1	
Roller 3 ton	Angersol		7	7		1	1	1	1	2	1
Roller 1 1/2 ton	Angersol		5	5		1	1	1	1		1
Roller 1/2 ton			1	1		1					
Loader	Fiat		2	2				2			
Dump Truck 6 ton	Esazo		6	6		1	1	1	1	1	1
Dump Truck 1 ton	Diahatso		6	6		1	1	1	1	1	1

Note: There are 2 Graders one at East District and the other at Amria District)
 6 Loaders one at East District and 5 at Emergency fleet) Not controlled by Road Directorate

Source: Alexandria Road Directorate

nm/TABLE6

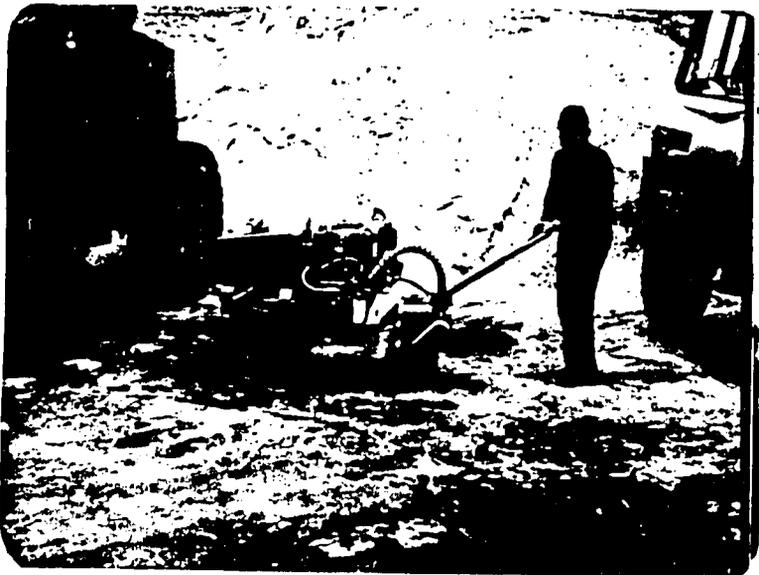
Alexandria Governorate



Some Equipment in Alex. District Road Sections

Figure 11

Alexandria Governorate



Some Equipment in Alex. District Road Sections

Figure 12

Alexandria Governorate



Some Equipment in Alexandria District Road Sections

Figure 13

The Road Directorate does not have all the funds and facilities necessary for the maintenance task due to the following reasons.

- o Priority is awarded to new construction. While this may be justified, there is presently no definition of the need for regular and adequate maintenance by which a comparison can be made.
- o Unfinished and unsatisfactory utility works affect street surfaces for long periods of time. The Road Directorate does not have the authority to require the cooperation of the Utilities Departments.
- o Maintenance of roads seems to be subordinate to construction or not clearly independent from it.

The approximate current budget for FY 88/89 and 89/90 for Road Maintenance and Paving Projects is as follows:

	<u>FY 88/89</u>	<u>FY 89/90</u>
From BAB II	L.E. 218,000	252,000
From BAB III	L.E. 1,210,000	1,510,000
From Benzine Revenues	L.E. 966,000	1,449,000
From Governorate Services Treasure	L.E. --	300,000
From Repaving Revenues from Utility Agencies	L.E. 4,940,000	undefined
From Project Revenues (Industrial Services)	L.E. 125,820	46,557
From American Grant	L.E. 1,225,000	2,203,000
Funds For Equipment Repair	L.E. --	1,500
Total	L.E. <u>8,648,820</u>	<u>5,762,057</u>

Source: Alexandria Road Directorate

2. ROAD MAINTENANCE PLANNING

2.1 JUSTIFICATION OF MAINTENANCE

Some of Alexandria's roads and streets are very narrow, unpaved and without any drainage system. This is especially true in densely populated areas which were built at random without any planning. 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 virtually 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 or, faulty 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 the negative effect 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.

2.2 MAINTENANCE LEVELS AND ACTIVITIES

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

2.2.1 Maintenance Classification

o **Casual Maintenance**

This is done when prompt repair is needed for such things as: sudden depressions; potholes; upheavals; and bleeding.

o **Periodic Maintenance**

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

o **Annual Maintenance**

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

2.2.2 Road Maintenance Responsibilities

Table 7 shows levels of roads 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	By contractor
02	Short asphalt overlays	Road Sections in district
03	Small pavement repairs	Road Sections in district
04	Curb repair or replacement	Road Sections in district
05	Basalt bricks pavement repairs	Road Sections in district

06	Footpaths repair (tile surface)	Road Sections in district
07	Footpaths repair (mastic asphalt surface)	Road Sections in district
08	Grading unpaved streets (grader)	Road Sections in district
09	Shaping unpaved streets (labor)	Road Sections in district
10	Surface dressing	Contractor
11	Traffic service (signs, signals, Stripping)	Traffic Department
12	Draining maintenance	Utility Department

Source: Alexandria Road Directorate

2.2.3 Annual Maintenance Requirments

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. Derivation of Work Quantities and Crew Days is shown on tables 9 thru 15.

2.2.4 Performance Standards

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.

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

Figures 14 through 21, which are shown in the appendices to this report, are initial performance standards sheets for executing various items of maintenance work. They should be adjusted based on field measurement.

2.2.5 Work Quantities and Crew Days

Calculation are made separately for streets of the six districts of Alexandria City to determine the work quantities and crew-days for each activity. The result of these estimates are shown in tables 9 through 15.

TABLE 8
ANNUAL MAINTENANCE REQUIREMENTS BY PERCENTAGE

CODE	ACTIVITY DESCRIPTION	SURFACE	CONDITION	YEARLY % OF AREA OF LENGTH	FREQUENCY
02	Short Overlay	Paved	Good	0.9 % Area	Continuous
			Medium	1.0 % Area	Continuous
			Poor	1.1 % Area	Continuous
03	Small Pavement Repairs	Paved Surface	Good	0.1 % Area	Continuous
			Medium	0.15% Area	Continuous
			Poor	0.2 % Area	Continuous
04	Curbstone Repair or Replacement	Sectional Curb	Good	4.0 % Length	Continuous
			Medium	5.0 % Length	Continuous
			Poor	6.0 % Length	Continuous
05	Basalt Bricks Pavement Repairs	Paved Surface		2.0 % Area	Continuous
06	Footpaths Repair	Tile Surface		1.0 % Area	Continuous
07	Footpaths Repair	Mastic Surface		1.0 % Area	Continuous
08	Grading Unpaved Streets (Grader)	Unpaved Surface		100 % Length	4 month
09	Shaping Unpaved Streets (Laborers)	Unpaved Surface		100 % Length	Annual

Source: Alexandria Road Department and TAC

rm/TABLE8

Table 9
Derivation of Work Quantities and Crew Days
East District

Code	Description	Type	Condt. Rating	Annual % of Area or Length *	Invty Quant	Annual Work Qty **	Daily Prod Rate	Crew Days Rounded-Up
02	Short Overlays	Paved Surf.	Good	0.90%	1,385,100 m ²	12,466 m ²	150 m ²	110
	Short Overlays	Paved Surf.	Med.	1.00%	403,200 m ²	4,032 m ²	150 m ²	
	Short Overlays	Paved Surf.	Poor	1.10%	0 m ²	0 m ²	150 m ²	
03	Small Pave Repairs	Paved Surf.	Good	0.10%	1,385,100 m ²	1,385 m ²	100 m ²	20
	Small Pave Repairs	Paved Surf.	Med.	0.15%	403,200 m ²	605 m ²	100 m ²	
	Small Pave Repairs	Paved Surf.	Poor	0.20%	0 m ²	0 m ²	100 m ²	
04	Curb Repair	Sect. Curb	Good	4.00%	263,650 m	10,546 m	50 m	368
	Curb Repair	Sect. Curb	Med.	5.00%	156,130 m	7,807 m	50 m	
	Curb Repair	Sect. Curb	Poor	6.00%	0 m	0 m	50 m	
05	Basalt Brick Rpr	Paved Surf.		2.00%	0 m ²	0 m ²	50.0 m ²	0
06	Footpath Repair	Tile Surf.		1.00%	498,820 m ²	4,988 m ²	100.0 m ²	50
07	Footpath Repair	Mastic Surf.		1.00%	16,640 m ²	166 m ²	100 m ²	2
08	Grading Unpvd Sts	Unpaved		100.00%	30 m ²	30 m ²	1.5 km	20
09	Shaping Unpvd Sts	Unpaved		100.00%	16 m ²	16 m ²	0.5 km	33
Total Crew Days Required								603

Source: TAC calculation

* From Table 8

** From Table 2 through 5

Table 10
Derivation of Work Quantities and Crew Days
West District

Code	Description	Type	Condt. Rating	Annual % of Area or Length *	Invty Quant	Annual Work Qty **	Daily Prod Rate	Crew Days Rounded-Up
02	Short Overlays	Paved Surf.	Good	0.90%	502,000 m2	4,518 m2	150 m2	77
	Short Overlays	Paved Surf.	Med.	1.00%	650,580 m2	6,506 m2	150 m2	
	Short Overlays	Paved Surf.	Poor	1.10%	39,000 m2	429 m2	150 m2	
03	Small Pave Repairs	Paved Surf.	Good	0.10%	502,000 m2	502 m2	100 m2	16
	Small Pave Repairs	Paved Surf.	Med.	0.15%	650,580 m2	976 m2	100 m2	
	Small Pave Repairs	Paved Surf.	Poor	0.20%	39,000 m2	75 m2	100 m2	
04	Curb Repair	Sect. Curb	Good	4.00%	82,300 m	3,292 m	50 m	278
	Curb Repair	Sect. Curb	Med.	5.00%	203,230 m	10,162 m	50 m	
	Curb Repair	Sect. Curb	Poor	6.00%	7,000 m	420 m	50 m	
05	Basalt Brick Rpr	Paved Surf.		2.00%	147,866 m2	2,957 m2	50.0 m2	60
06	Footpath Repair	Tile Surf.		1.00%	460,430 m2	4,604 m2	100.0 m2	47
07	Footpath Repair	Mastic Surf.		1.00%	18,400 m2	184 m2	100 m2	2
08	Grading Unpvd Sts	Unpaved		100.00%	15 m2	15 m2	1.5 km	10
09	Shaping Unpvd Sts	Unpaved		100.00%	6 m2	6 m2	0.5 km	12
Total Crew Days Required								490

Source: TAC calculation

* From Table 8

** From Table 2 through 5

Table 11
Derivation of Work Quantities and Crew Days
Central District

Code	Description	Type	Condt. Rating	Annual % of Area or Length *	Invty Quant	Annual Work Qty **	Daily Prod Rate	Crew Days Rounded-Up
02	Short Overlays	Paved Surf.	Good	0.90%	1,179,700 m2	10,617 m2	150 m2	111
	Short Overlays	Paved Surf.	Med.	1.00%	575,980 m2	5,760 m2	150 m2	
	Short Overlays	Paved Surf.	Pocr	1.10%	21,500 m2	238 m2	150 m2	
03	Small Pave Repairs	Paved Surf.	Good	0.10%	1,179,700 m2	1,180 m2	100 m2	21
	Small Pave Repairs	Paved Surf.	Med.	0.15%	575,980 m2	864 m2	100 m2	
	Small Pave Repairs	Paved Surf.	Pocr	0.20%	21,600 m2	43 m2	100 m2	
04	Curb Repair	Sect. Curb	Good	4.90%	272,150 m	10,886 m	50 m	502
	Curb Repair	Sect. Curb	Med.	5.00%	252,340 m	12,617 m	50 m	
	Curb Repair	Sect. Curb	Pocr	6.00%	26,500 m	1,590 m	50 m	
05	Basalt Brick Epr	Paved Surf.		2.00%	0 m2	0 m2	50.0 m2	0
06	Footpath Repair	Tile Surf.		1.00%	637,970 m2	6,380 m2	100.0 m2	64
07	Footpath Repair	Elastic Surf.		1.00%	180 m2	2 m2	100 m2	1
08	Grading Unpvd Sts	Unpaved		100.00%	7 m2	7 m2	1.5 km	5
09	Shaping Unpvd Sts	Unpaved		100.00%	3 m2	3 m2	0.5 km	6
Total Crew Days Required								704

Source: TAC calculation

* From Table 8

** From Table 2 through 5

Table 12
Derivation of Work Quantities and Crew Days
El Aaria District

Code	Description	Type	Condt. Rating	Annual % of Area or Length *	Invty Quant	Annual Work Qty **	Daily Prod Rate	Crew Days Rounded-Up
02	Short Overlays	Paved Surf.	Good	0.90%	860,720 m2	7,746 m2	150 m2	78
	Short Overlays	Paved Surf.	Med.	1.00%	12,500 m2	125 m2	150 m2	
	Short Overlays	Paved Surf.	Poor	1.10%	341,700 m2	3,759 m2	150 m2	
03	Small Pave Repairs	Paved Surf.	Good	0.10%	860,720 m2	861 m2	100 m2	16
	Small Pave Repairs	Paved Surf.	Med.	0.15%	12,500 m2	19 m2	100 m2	
	Small Pave Repairs	Paved Surf.	Poor	0.20%	341,700 m2	683 m2	100 m2	
04	Curb Repair	Sect. Curb	Good	4.00%	53,400 m	2,136 m	50 m	68
	Curb Repair	Sect. Curb	Med.	5.00%	22,600 m	1,130 m	50 m	
	Curb Repair	Sect. Curb	Poor	6.00%	2,200 m	132 m	50 m	
05	Basalt Brick Rpr	Paved Surf.		2.00%	0 m2	0 m2	50.0 m2	0
06	Footpath Repair	Tile Surf.		1.00%	8,900 m2	89 m2	100.0 m2	1
07	Footpath Repair	Mastic Surf.		1.00%	0 m2	0 m2	100 m2	0
08	Grading Unpvd Sts	Unpaved		100.00%	4 m2	4 m2	1.5 km	3
09	Shaping Unpvd Sts	Unpaved		100.00%	2 m2	2 m2	0.5 km	5
Total Crew Days Required								166

Source: TAC calculation

* From Table 8

** From Table 2 through 5

Table 13
Derivation of Work Quantities and Crew Days
El Montazah District

Code	Description	Type	Cond. Rating	Annual % of Area or Length *	Invty Quant	Annual Work Qty **	Daily Prod Rate	Crew Days Rounded- Up
02	Short Overlays	Paved Surf.	Good	0.90%	277,400 m2	2,497 m2	150 m2	61
	Short Overlays	Paved Surf.	Med.	1.00%	504,015 m2	5,040 m2	150 m2	
	Short Overlays	Paved Surf.	Poor	1.10%	146,395 m2	1,610 m2	150 m2	
03	Small Pave Repairs	Paved Surf.	Good	0.10%	277,400 m2	277 m2	100 m2	14
	Small Pave Repairs	Paved Surf.	Med.	0.15%	504,015 m2	756 m2	100 m2	
	Small Pave Repairs	Paved Surf.	Poor	0.20%	146,395 m2	293 m2	100 m2	
04	Curb Repair	Sect. Curb	Good	4.00%	27,350 m	1,094 m	50 m	105
	Curb Repair	Sect. Curb	Med.	5.00%	64,000 m	3,200 m	50 m	
	Curb Repair	Sect. Curb	Poor	6.00%	15,380 m	923 m	50 m	
05	Basalt Brick Rpr	Paved Surf.		2.00%	0 m2	0 m2	50.0 m2	0
06	Footpath Repair	Tile Surf.		1.00%	218 m2	2 m2	100.0 m2	1
07	Footpath Repair	Mastic Surf.		1.00%	100,790 m2	1,008 m2	100 m2	11
08	Grading Unpvd Sts	Unpaved		100.00%	40 m2	40 m2	1.5 km	27
09	Shaping Unpvd Sts	Unpaved		100.00%	19 m2	19 m2	0.5 km	39
Total Crew Days Required								219

Source: TAC calculation

* From Table 8

** From Table 2 through 5

Table 14
Derivation of Work Quantities and Crew Days
El Gomrok District

Code	Description	Type	Condt. Rating	Annual % of Area or Length *	Invty Quant	Annual Work Qty **	Daily Prod Rate	Crew Days Rounded-Up
02	Short Overlays	Paved Surf.	Good	0.90%	158,630 m2	1,428 m2	150 m2	
	Short Overlays	Paved Surf.	Med.	1.00%	28,280 m2	283 m2	150 m2	13
	Short Overlays	Paved Surf.	Poor	1.10%	12,000 m2	132 m2	150 m2	
03	Small Pave Repairs	Paved Surf.	Good	0.10%	158,630 m2	159 m2	100 m2	
	Small Pave Repairs	Paved Surf.	Med.	0.15%	28,280 m2	43 m2	100 m2	3
	Small Pave Repairs	Paved Surf.	Poor	0.20%	12,000 m2	24 m2	100 m2	
04	Curb Repair	Sect. Curb	Good	4.00%	57,880 m	2,315 m	50 m	
	Curb Repair	Sect. Curb	Med.	5.00%	27,500 m	1,375 m	50 m	83
	Curb Repair	Sect. Curb	Poor	6.00%	7,400 m	444 m	50 m	
05	Basalt Brick Rpr	Paved Surf.		2.00%	68,855 m2	1,377 m2	50.0 m2	28
06	Footpath Repair	Tile Surf.		1.00%	128,640 m2	1,286 m2	100.0 m2	13
07	Footpath Repair	Mastic Surf.		1.00%	15,400 m2	154 m2	100 m2	2
08	Grading Unpvd Sts	Unpaved		100.00%	6 m2	6 m2	1.5 km	4
09	Shaping Unpvd Sts	Unpaved		100.00%	3 m2	3 m2	0.5 km	7
Total Crew Days Required								146

Source: TAC calculation

* From Table 8

** From Table 2 through 5

Table 15
Summary of Crew Days

Code	Districts						Gov't Total
	East	West	Central	El Amria	El Montaza	El Gomrok	
02	110	77	111	78	61	13	450
03	20	16	21	16	14	3	90
04	368	278	502	68	105	83	1,404
05	0	60	0	0	0	28	86
06	50	47	64	1	1	13	176
07	2	2	1	0	11	2	18
08	20	10	5	3	27	4	69
09	33	12	6	5	39	7	102
Total	603	502	710	171	258	153	2,397

Source: Table 9 through 14 and TAC calculation

23 FIVE-YEAR MAINTENANCE PLAN

The five year maintenance plan is based on the study of Alexandria City Road Directorate and Districts Road Sections. A five-year master plan and a one-year maintenance plan have been outlined. The following are the requirements for the 5 year maintenance plan.

2.3.1 Required Work

Is as shown in Table 16

2.3.2 Required Labour Hours

Foreman	69840	hrs
Grader operator	15570	hrs
Roller operator	16740	hrs
Loader operator	3060	hrs
Truck driver	108420	hrs
Mason	143280	hrs
Laborer	451080	hrs

2.3.3 Equipment Operating Hours

Grader	15570	hrs
Roller	16740	hrs
Loader	3060	hrs
Dump Truck	108080	hrs
TOTAL	143450	hrs

2.3.4 Required Materials

Hot-Mix Asphalt	33660	m ³
Tack Coat	195525	kg
Crushed Base	16830	m ³
Curbstone	386100	l.m
Sand	20815	m ³
Mortar	6040	m ³
Basalt Brick	24200	m ³
Tiles	96250	m ³
Mastic Asphalt	495	m ³

Estimated cost of materials is shown in Table 17

TABLE 16
QUANTITY OF REQUIRED WORK
FIVE YEAR PERIOD

EXECUTION	ACTIVITIES	UNIT	DISTRICTS						TOTAL
			EAST	WEST	CENTRAL	EL AMRIA	EL MONTAZAH	EL GOMROK	
By Section in Districts	Short asphalt overlay	m2	82,990	57,265	83,250	58,150	45,735	8,990	335,880
	Small pavement repairs	m2	9,950	7,735	10,435	7,815	6,630	1,125	43,690
	Curb repair	m	91,765	69,370	125,465	16,490	26,085	20,670	349,845
	Basalt brick repair	m2	-	14,785	-	-	-	6,885	21,670
	Footpaths repair (tile)	m2	24,940	23,020	31,900	445	1,090	6,430	87,825
	Footpaths repair (mastic)	m2	830	920	900	-	500	770	3,920
	Grading unpaved streets	km	150	75	35	20	200	30	510
	Shaping unpaved streets	km	80	30	15	10	100	20	255
By Contractors Under Road Department Supervision	Major overlay	m2	894,150	595,790	898,640	607,460	463,900	99,455	3,559,395
	Curbstone replacement	m	104,945	73,145	137,750	19,550	26,680	23,195	385,265
	Footpaths overlay		257,730	239,415	319,075	4,450	50,490	98,750	969,910
	Provision of road materials								

Source: TAC Calculation

TABLE 17
ESTIMATED COST OF MATERIALS
FIVE YEAR PERIOD

MATERIALS	UNIT	QUANTITIES *	QUANTITIES & 10% LOSSES	ESTIMATED ** UNIT COST L.E	TOTAL COST L.E
Hot-Mix Asphalt	m3	30,600	33,660	60	2,019,600
Tack Coat	kg	177,750	195,525	1	195,525
Crubstone Base	m3	15,300	16,830	20	336,600
Curbstone	l.m	351,000	386,100	8	3,088,800
Sand	m3	18,370	20,815	6	124,890
Mortor	m3	3,905	6,040	50	302,000
Basalt	m2	22,000	24,200	20	484,000
Tiles	m2	87,500	96,250	10	962,500
Mastic Asphalt	m3	600	495	50	24,750
TOTAL					7,538,665

Source: * From Table 26 Multiplied by 5

** Road Directorate TAC Calculation
TAC Calculation

nm/TABLE17

2.3.5 Equipment Services and Repair Cost

Equipment Service and repair	L.E. 300,000
Spare Parts	L.E. 300,000
TOTAL	600,000

2.3.6 Estimated Fuel Cost For Equipment Operating Hours

Total operating hours	143450 hrs	
Total Fuel Cost =	143450 x 100 Avg. HP x 0.2 kg fuel/hrs x L.E. 0.10=	L.E. 286,900
Oil and Grease =	143450 x 100 x 0.2 x 0.05 x L.E. 2.0	= L.E. 286,900
TOTAL		L.E. 573,800

2.3.7 Estimated Cost For Contractor's Work

Major overlay with 5 cm hot-mix asphalt	=	3,559,395 m ² x 2.6 L.E./m ²	=	L.E9,254,427
Curbstone replacement	=	385,265 m.l x 8.0 L.E./m.l	=	L.E3,082,120
Footpaths overlay 4.0 cm thick	=	969,910 m ² x 2.5 L.M/m ²	=	L.E2,424,775
Adjusting Level of manhole covers				300,000

TOTAL				L.E15,061,332

2.3.8 Estimated Cost For Paving Construction For Unpaved Roads

Levelling ground work	=	1,027,491 x 1,00	=	L.E1,027,491
Crushed stone 25 cm base course	=	1,027,491 x 5,00	=	L.E5,137,455
Prime Coat Course	=	1,027,491 x 0.4	=	L.E 410,996
Hot-mix asphalt concrete 6cm binding course	=	1,027,491 x 3.0	=	L.E3,082,473
Tack coat course	=	1,027,491 x 0.4	=	L.E 410,996
Hot-mix asphalt concrete 5cm surface course	=	1,027,491 x 3.6	=	L.E3,698,968
Curbstone works	=	465,620 x 8	=	L.E3,724,960
Mastic asphalt course for footpaths	=	892,215 x 2.4	=	L.E2,141,316

TOTAL				19,634,655

2.3.9 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 Directorate is shown in Table 18. The estimated cost for the Laboratory equipment and furnishing is as follows:

Laboratory equipment and apparatus	L.E	45000
Furnishing the laboratory	L.E	10000

TOTAL	L.E	55000

2.3.10 Equipment Purchase

Existing equipment in Road Directorate and Districts Road Sections are listed in Table 6. It is necessary to provide the Road Sections with new equipment to fulfill the road maintenance plan by the district force account. The required types, number and estimated cost are shown in Table 19. The combined costs for the 5 year maintenance plan are shown in table 20

2.3.11 Required Budget For Five Year Maintenance Plan

As shown in table 20

TABLE 18
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	4,220 (185 for each sieve)	4,220
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	3,000	3,000
4	Balance capacity 20 kg with sensitivity 1 gm.	1	5,000	5,000
5	Balance Capacity 2.610 kg with sensitivity 0.1 gm.	1	2,000	2,000
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, Penetration piston and expansion device.	1	1,380	1,380
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	From each 2	200	200
17	Some Brushes, Plates, Trades	4 From each		
Total Estimated Price		L.E.		45,000

Source: Alexandria Road Department and TAC

TABLE 19
NEW EQUIPMENT REQUIRED TO BE PURCHASED

EQUIPMENT TYPE	REQUIRED NO.	ESTIMATED UNIT PRICE L.E	ESTIMATED TOTAL COST L.E
Grader 80-100 HP	6	180,000	1,080,000
Air Compressor 50-60 HP	6	65,000	390,000
Dump truck 6-10 ton	6	120,000	720,000
Water tank vehicle 3 ton	6	100,000	600,000
Bitumen boiler and distributor mobile tank 3-5 ton	6	60,000	360,000
Transport vehicle (Pickup) 1/2 ton	6	30,000	180,000
Plate compactor with engine about 12 HP	6	5,000	30,000
Level	6	3,000	18,000
Theodilite	6	8,000	48,000
Survey tools			12,000
Sub-Total			2,466,000
Spare Parts 10%			246,600
TOTAL			2,712,600

nm/TABLE19

**TABLE 20
FIVE YEAR MAINTENANCE PLAN BUDGET**

NO.	ITEM	ESTIMATED COST L.E	EXECUTING AGENT
1	Cost of Materials	7,538,665	By force account of Road Sections in Districts
2	Equipment Service and Repair	600,000	
3	Fuel Cost	573,800	
		8,712,465	
4	Road Maintenance Cost of Major Overlay, Curbstone Replacement and footpaths overlay	15,061,322	By Contractor
5	Materials and Soil Testing Laboratory	55,000	
6	Equipment purchases: are as shown in Table 19	2,712,600	
	Total	26,541,387	

Source: TAC Calculation

nm/TABLE20

2.4 YEARLY MAINTENANCE PLAN

2.4.1 Quantities of Required Work

Are as shown in Table 21

2.4.2 Required Labor Hours

Are as shown in Table 22

2.4.3 Staff Requirements

Are as shown in Table 23

2.4.4 Required Equipment Operating Hours

Are as shown in Table 24

2.4.5 Required Equipment

The required equipment for the yearly maintenance plan is as shown in Table 25

2.4.6 Required Materials

Required materials are as shown in Table 26. Table 27 reflects the cost of these materials.

2.4.7 Equipment Service and Repair Cost

Equipment service and repair (10%)	=	L.E	60,000
Spare parts	(10%) =	L.E	60,000

TOTAL		L.E	120,000

2.4.8 Estimated Fuel Cost for Equipment Operating Hours

Total operating hours 28758

Total fuel cost = 28758 hrs x 100 avg. hp x 0.2 kg fuel/hp/hr x L.E 0.1 = L.E 57,516

Oil and Grease Cost = 28722 x 100 x 0.2 x 0.05 x L.E 2.0 = L.E 57,516

TOTAL 115,032

TABLE 21
REQUIRED WORK
YEARLY MAINTENANCE PLAN

EXECUTION	ACTICITIES	UNIT	DISTRICTS						TOTAL
			EAST	WEST	CENTRAL	EL AMRIA	EL MONTAZAH	EL GCMROK	
By Section in Districts	Short asphalt overlay	m2	16,498	11,453	16,650	11,630	9,147	1,798	67,176
	Small pavement repairs	m2	1,990	1,547	2,087	1,563	1,326	225	8,738
	Curb repair	m.l	18,353	13,874	25,093	3,298	5,217	4,134	69,969
	Basalt brick repair	m2	-	2,957	-	-	-	1,377	4,334
	Footpaths repair (tile)	m2	4,988	4,604	6,380	89	218	1,286	17,565
	Footpaths repair (mestic)	m2	166	184	180	-	100	154	784
	Grading unpaved streets	km	30	15	7	4	40	6	102
	Shaping unpaved streets	km	16	6	3	2	20	4	51
By Contractors Under Road Department Supervision	Major overlay	m2	178,830	119,158	179,728	121,492	92,780	19,891	711,879
	Curbstone replacement	m.l	20,989	14,629	27,550	3,910	5,336	4,639	77,053
	Footpaths overlay	m2	51,546	47,883	63,815	890	10,098	19,750	193,982
	Provision of road materials								

Source: TAC Calculation

TABLE 22
 REQUIRED LABOR HOURS
 YEARLY MAINTENANCE PLAN

CODE	TOTAL CREW DAYS	FOREMAN		GRADER OPERATOR		ROLLER OPERATOR		LOADER OPERATOR		TRUCK DRIVER		MASON		LABORER	
		PER C.D	TOTAL HRS	PER C.D	TOTAL HRS	PER C.D	TOTAL HRS	PER C.D	TOTAL HRS	PER C.D	TOTAL HRS	PER C.D	TOTAL HRS	PER C.D	TOTAL HRS
02	450	6	2700	6	2700	6	2700	0	0	18	8100	0	0	48	21600
03	90	6	540	0	0	6	540	0	0	12	1080	0	0	36	3240
04	1404	6	8424	0	0	0	0	0	0	6	8424	18	25272	36	50544
05	88	6	528	0	0	0	0	0	0	6	528	12	1056	36	3168
06	176	6	1056	0	0	0	0	0	0	12	2112	12	2112	36	6336
07	18	6	108	0	0	6	108	0	0	12	216	12	216	48	432
08	69	0	0	6	414	0	0	0	0	0	0	0	0	0	0
09	102	6	612	0	0	0	0	6	612	12	1224	0	0	48	4896
TOTAL			13968		3114		3348		612		21684		28656		90216

Source: From Table 15, Performance Standard (Figure 14 through 21) and TAC Calculation

nm/TABLE22

TABLE 23
STAFF REQUIREMENTS

PERSONNEL CLASS	ANNUAL HRS NEEDED EACH CLASS	AVAILABLE ANNUAL HRS	NUMBER OF PERSONNEL NEEDED	NUMBER ROUNDED UP
Foreman	13968	1560	8.9	9
Grader Operator	3114	1560	1.99	2
Roller Operator	3348	1560	2.14	3
Loader Operator	612	1560	0.38	1
Truck Driver	21660	1560	13.8	14
Mason	28684	1560	18.38	19
Laborer	90216	1560	57.82	58

N.B:

Work hours/day	=	6	hours
Casual Leave	=	7	hours
Sick Leave	=	15	days
Annual Leave	=	18	days
Vacation/year	=	66	days

TOTAL		-----	106 days
-------	--	-------	----------

Work days/year	=	365 - 106	=	260	days
Available annual hours	=	260 x 6	=	1560	hours

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

nm/TABLE23

TABLE 24

REQUIRED EQUIPMENT OPERATOR HOURS

CODE	TOTAL CREW DAYS	GRADER		ROLLER		LOADER		DUMP TRUCK	
		PER C-D	TOTAL HRS.	PER C-D	TOTAL HRS.	PER C-D	TOTAL HRS.	PER C-D	TOTAL HRS.
02	450	6	2700	6	2700	0	0	18	8100
03	90	0	0	6	540	0	0	12	1080
04	1404	0	0	0	0	0	0	6	8424
05	88	0	0	0	0	0	0	6	528
06	176	0	0	0	0	0	0	12	2112
07	18	0	0	6	108	0	0	12	216
08	69	6	414	0	0	0	0	0	0
09	102	0	0	0	0	6	612	12	1224
TOTAL			3114		3348		612		21684

Source: From Table 15, Performance Standard (Figure 14 through 21) and TAC Calculation

nm/TABLE24

TABLE 25
REQUIRED EQUIPMENT

EQUIPMENT TYPE	ANNUAL HOURS NEEDED EACH TYPE	AVAILABLE EQUIP. HOURS	NO. OF EQUIP. NEEDED	ROUNDED NO. OF EQUIP. NEEDED
Grader	3114	1350	2.3	3
Loader	3348	1350	2.48	3
Roller	612	1350	0.45	1
Dumb Truck	21684	1350	16.06	17

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

Source: From Table 24 and TAC Calculation

nm/TABLE25

TABLE 26

REQUIRED MATERIALS

CODE	TOTAL CREW DAYS	HOT-MIX ASPHALT M3		TAC COAT KG		CRUSHED BASE M3		CURB STONE M.L		SAND M3		MORTAR M3		BASALT BRICK M2		TIRE OF MASTIC M2	
		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	450	12	5400	75	33750	6	2700										
03	90	8	720	20	1800	4	360										
04	1404							50	70200	1	1404	0.5	702				
05	88									5	440	0.5	44	50	4400		
06	176									10	1760	2.0	352			100	17600
07	18									10	180					5	90
08	69																
09	102																
TOTAL			6120		35550		3060		70200		3784		1098		4400		17600 90

Tile
Mastic

Source: From Table 15, Performance Standard (Figures 14 through 21) and TAC Calculation

rm/TABLE26

TABLE 27

ESTIMATED MATERIALS AND COST

MATERIALS	UNIT	* QUANTITIES	QUANTITIES & 10% LOSSES	ESTIMATED** UNIT COST L.E	TOTAL COST L.E
Hot-Max Asphalt	m3	6,120	6,732	60	403,920
Tack Coat	kg	35,550	39,105	1	39,105
Crushed Base	m3	3,060	3,366	20	67,320
Curbstone	l.m	70,200	77,220	8	617,760
Sand	m3	3,784	41,63	6	24,978
Mortar	m3	1,098	1,208	50	60,400
Basalt	m2	4,400	4,840	20	96,800
Tiles	m2	17,500	19,250	10	192,500
Mastic Asphalt	m3	90	99	50	4,950
Total					1,507,733

Source: * From Table 26
 ** Road Directorate
 TAC Calculation

nm/TABLE27

2.4.9 Estimated Cost For Work By Contractors

Major overlay with 5 cm hot-mix asphalt	= 711879 m ² x 2.6 L.E/m ²	= L.E 1850885
Curbstone replacement	= 77053 m.l x 8 L.E/m.l	= L.E 616424
Footpath overlay	= 193982 m ² x 2.5 L.E/m ²	= L.E 848955
Adjustment of manhole covers		= L.E 60000

	TOTAL	L.E 3012264

2.4.10 Required Budget For Year 90/91

Shown in Table 28

2.4.11 Time Schedule For Yearly Maintenance Plan Execution

Shown in Table 29

TABLE 28

YEARLY BUDGET REQUIREMENTS

NO.	ITEM	ESTIMATED COST L.E	EXECUTING AGENT
1	Cost of Materials	1,507,733	By force account of road Sections in Districts
2	Equipment Service and Repair	120,000	
3	Fuel Cost	115,032	
		1,742,765	
4	Road Maintenance Cost of Major Overlay, Curbstone Replacement and footpaths overlay	3,012,264	By Contractors
5	Material and Soil Testing Laboratory	55,000	
6	Equipment Purchases: are as shown in Table	542,520	
	TOTAL	5,352,549	

Source: TAC Calculation

nm/TABLE28

TABLE 29

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 repair and location															Road Department & Road Section in District
2	Preparation of Specification, bill of Quantities & documents for needed works and materials			-												
3	Contracting for providing materials of works															
4	Short asphalt overlay	m2	67176	-	-	-	-	-	-	-	-	-	-	-	-	
5	Small pavement repairs	m2	8738	-	-	-	-	-	-	-	-	-	-	-	-	
6	Curb repair	m.l	69969	-	-	-	-	-	-	-	-	-	-	-	-	
7	Basalt bricks repair	m2	4334													
8	Footpaths repair (Tile)	m2	17565													
9	Footpaths repair (mastic)	m2	784													
10	Grading unpaved streets	km	102													
11	Shaping unpaved streets	km	51													
12	Major overlay	m2	711879													Contractor Under Supervision of Road Department
13	Curbstone replacement	m.l	77053													
14	Footpath overlay	m2	193982													
15	Provision of road materials			-	-	-	-	-	-	-	-	-	-	-	-	

Legend: _____ Firm Schedule

----- As Needed

Source: TAC Suggestion

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 ORGANIZATION

Whilst the current organization structure of Alexandria Road Directorate and District's Road Sections is suitable for execution of the road maintenance work by contractors, execution of a road maintenance plan by the Roads Directorate requires adoption of one the modified organization structures shown in figures 2 or 3. Such organization would lead to more effective and efficient road maintenance planning, programming and implementation. The new organization, after approval by the Governorate, should be sent to DOA for ratification.

3.2 STAFFING

Alexandria Road Directorate and Districts Road Sections are in great need of additional technical staff. The existing staff structure is deficient in technicians, foremen, equipment operators and laborers. The road maintenance staff in Road Sections needs to be complementated in accordance with the modified proposed organization. Table 30 shows a comparison between the existing staff and the staff proposed in the new organization (Administrative staffs not included).

3.3 TRAINING

A training program needs to be developed and implemented to provide a sound base for the road maintenance staff. The program should concentrate on improving the current staffs level of road maintenance skill, and providing necessary instruction to new employees. Suitable courses are available at the National Road Authority Training Center (NRATC). The following courses are recommended:

- o Course for Engineers and Technicians
 - o Course for road equipment Operators
- Labor training should take place at the work site

The Road Director suggested that these training courses must take place at the end of the summer season because all the road staff are very busy during the summer period.

3.3.1 For Engineers And Technicians

A 5 day course on road maintenance and repair of asphalt concrete pavement has been prepared by the TAC team and is available to the staff of the Alexandria governorate. The course covers the following topics:

TABLE 30
EXISTING AND PROPOSED STAFF

ROAD SECTIONS	ENGINEERS		TECHNICIANS		FOREMEN		EQUIP OPERATOR		LABOR	
	EXIST.	PROPOSED	EXIST.	PROPOSED	EXIST.	PROPOSED	EXIST.	PROPOSED	EXIST.	PROPOSED
Road Directorate	14	11	4	16	30	3	2	2	-	4
East District	-	4	1	18	3	5	5	15	35	45
West District	-	4	1	18	3	5	5	15	35	45
Central District	-	4	1	18	3	5	5	15	35	45
El Amria District	-	4	1	18	3	5	5	15	35	45
El Montazah District	-	4	1	18	3	5	5	15	35	45
El Gamrok District	-	4	1	18	3	5	5	15	35	45
TOTAL	14	35	10	124	48	33	32	92	210	274

Source: Alexandria Road Directorate and Road Sections and TAC.

nm/TABLE30

- o Different types of failures for embankments and base courses; causes and the needed remedies
- o Different types of failures of asphalt concrete pavement; causes and needed remedies (Surface corrugation, potholes, bleeding, rutting, depressions, upheavals and disintegration)
- o Curbstone and footpath repair.

3.3.2 For Road Equipment Operators

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

3.3.3 Labor Training

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

3.4 EQUIPMENT NEEDS

- o Road maintenance equipment in Alexandria is generally inadequate to carry out road maintenance by force account. Table 6 shows the inventory and status of road equipment. Table 31 indicates needed equipment.
- o It is recommended that the Alexandria Road Directorate 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 18.

3.5. BUDGETING

3.5.1 Five Year Maintenance Plan

To implement the five year maintenance plan the following amount of funding is needed. The investment plan allocations provided from USAID LD-II Urban Project may be used to fund some of the requirements:

- | | |
|--------------------------------|---------------|
| o Cost of materials | L.E 7,538,665 |
| o Equipment service and repair | L.E 600,000 |
| o Fuel Cost | L.E 573,800 |

TABLE 31

REQUIRED EQUIPMENT FOR ROAD DIRECTORATE AND SECTIONS

EQUIPMENT TYPE	ROAD DIRECTORATE AND SECTIONS		
	EXIST	REQUIRED	EQUIPMENT FOR PURCHASE
Loader	2	-	-
Grader	-	6	6
Roller	29	10	-
Dump truck	12	18	6
Water Tank Vehicle	-	6	6
Bitumen boiler and distributor	-	6	6
Transport vehicle	-	6	6
Plate compactor	-	6	6
Level	-	6	6
Theodolite	-	6	6

nm/TABLE31

o	Road maintenance by contractors for major overlay	L.E	15,061,322
o	Material and soil testing laboratory	L.E	55,000
o	Equipment purchase	L.E	2,712,600

	TOTAL	L.E	26,541,387

3.5.2 Annual Maintenance Plan

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

o	Materials	L.E	1,507,733
o	Equipment Service and repair	L.E	120,000
o	Fuel Cost	L.E	115,032
o	Road maintenance by contractor for major overlay	L.E	3,012,264
o	Material and soil testing laboratory	L.E	55,000
o	Equipment purchase	L.E	542,520

	TOTAL	L.E	5,352,549

3.5.3 Comparison of Available Funding and Requirement

Table 32 shows a comparison between available funds, the needed funds yearly and the deficit in funding to fulfill the yearly maintenance plan.

TABLE 32
REQUIRED AND AVAILABLE BUDGET

Required		L.E	5,352,549
Available			
	From BAB II	L.E	252,000
	From Benzine Revenues	L.E	1,449,000
	From Governorate Services treasure	L.E	300,000
	From Repairing Revenues	L.E	---
	From Project Revenues	L.E	46,557
	From American Grant	L.E	2,203,000
	Funds For Equipment Repair	L.E	1,500

	TOTAL	L.E	4,252,057
		L.E	4,252,057

	Deficit	L.E	1,100,492

This deficit fund (L.E 1,100,492) may be rectified by obtaining repair revenues from utility agencies or increasing the Benzine revenues or modifying the current BAB III allocation. (BAB III allocation for FY 1990 approx. L.E. 1,510,000)

3.6 GENERAL RECOMMENDATIONS

3.6.1 Five year and annual road maintenance plans defining the required work, materials, equipment and funds need to be prepared. The annual plans must be prepared and approved by November to be put on implementation at the beginning of the fiscal year. By well developed plans and budgets proposals, Districts and Road Directorate must convince financial and planning authorities of their needs. If Road Directorates receive less funds through BAB II than their realistic budget proposal, other resources must be found to support road maintenance activities.

3.6.2 It is recommended to raise percentage of road maintenance allocations from benzine revenues to develop road maintenance resources and implement road maintenance programs.

3.6.3 The cost of road repaving revenues due to utility installation or repair should be paid to the Road Directorate in advance (i.e they should not be paid to the districts).

3.6.4 It is recommend that at least 5-7 percent of the cost of construction of new streets should be allocated for road maintenance in the BAB II budget.

3.6.5 The two graders in the districts need to be put under the control of the Road Directorate.

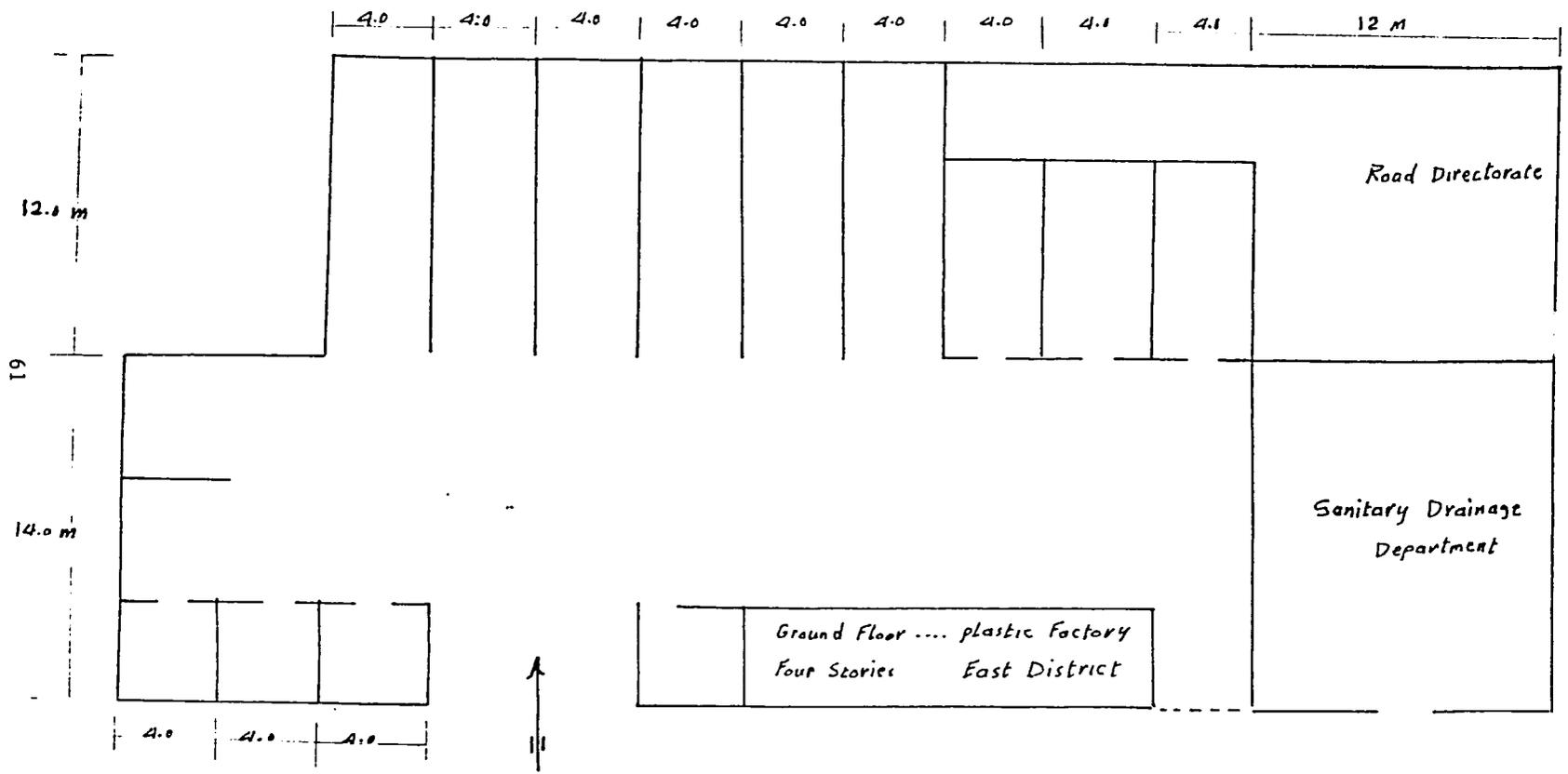
3.6.6 After completion of the new East District garage (now under construction). The present East District Garage should be remodeled and used for parking and repairing of the Road Equipment. The remodeled facility should include some small workshops and a laboratory. The following estimated costs of the remodelling are:

(1)	Existing Building modification	=	L.E 10,000
(2)	Small workshops for tire repair, welding, battery charging & mechanics	=	L.E 50,000

			L.E 60,000

Attached plan shows the existing garage

EAST DISTRICT GARAGE



3.6.7 The TAC have road maintenance specialists available to assist the Roads Directorates implement the training and reorganization phases of these proposals. The assistance of these specialists may be sought as and when required.

APPENDICES

Figures 14 to 21 inclusive

PERFORMANCE STANDARD

<u>ACTIVITY</u>		<u>CODE</u>	
Short Asphalt Overlays		02	
<u>DESCRIPTION & PURPOSE</u>			
Placing new hot-mix asphalt surfacing over existing pavement which is in poor condition due to wear, settlement or damage, to restore smoothness and strength.			
<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. Long sections or generalized failure should receive engineering study and control. Short overlays are generally placed over the full width of lane, carriageway or two-lane roadway			
<u>TEAM OF WORK</u>		<u>WORK METHOD</u>	
1 Foreman 1 Grader operator 1 Roller operator 3 Truck Drivers 8 Labourers		1. Place flagmen or warning signs for safety 2. Remove Loose or 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	
<u>EQUIPMENT</u>			
1 Motor Grader 1 Roller 3 Dump Trucks			
<u>MATERIAL PER DAY</u>		<u>ESTIMATED DAILY PRODUCTION</u>	
12 m ³ Hot-mix-Asphalt 75 KG tack coat 6 m ³ Crushed stone for base		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% of overaly area.			

Source: Roads and Streets Maintenance, Road Directorate, Road Sections and TAC

Figure 14

m/perform1

PERFORMANCE STANDARD

<u>ACTIVITY</u>		<u>CODE</u>	
Small Pavement Repairs		03	
<u>DESCRIPTION & PURPOSE</u>			
Repairing potholes, utility cuts and other damage or failure in existing asphalt pavement, by placing hot-mix patching to restore smoothness and uniform surface.			
<u>PERFORMANCE GUIDELINE</u>			
Patching 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 1 Roller Operator 2 Truck Drivers 6 Labourers		1. Place flagmen or warning signs for safety 2. Trim pothole or damaged areas back to sound edges 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: Roads and Streets Maintenance, Road Directorate, Road Sections and TAC

Figure 15

nm/perform2

PERFORMANCE STANDARD

ACTIVITY		CODE	
Curbstone Repair or Replacement		04	
DESCRIPTION & PURPOSE			
Re-set or replace curbstone sections which are loose, tilted, broken or missing to restore previously - existing curbing			
PERFORMANCE GUIDELINE			
This work is intended to be the maintenance of lines of precast or cutstone sectional curbs constructed earlier			
TEAM OF WORK		WORK METHOD	
1 Foreman 1 Truck Driver 3 Masons 6 Labourers		1. Place flagmen or warning signs for safety 2. Remove and dispose of broken curbstone sections and other unusable materials 3. Excavate to correct line and grade, compacting underlying soil and new bedding material as necessary 4. Re-set existing usable sections and add new curbstone section as necessary, with mortared base and joint. Check for finish line and grade 5. Clean up area	
EQUIPMENT			
1 Dump Truck			
MATERIAL PER DAY		ESTIMATED DAILY PRODUCTION	
50 Pre-Cast Curbstones (0.5 m Length each) 1.0 m ³ Bedding Sand 0.5 m ³ Mortar		50 m Length	
NOTES:			
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: Roads and Streets Maintenance, Road Directorate, Road Sections and TAC

Figure 16

PERFORMANCE STANDARD

ACTIVITY		CODE	
Basalt Bricks Pavement Repair		05	
DESCRIPTION & PURPOSE			
Replacing and leveling the broken basalt bricks which are in poor condition due to settlement or damage 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 50 m in length			
TEAM OF WORK		WORK METHOD	
1 Foreman 2 Masons 1 Truck Driver 6 Laborers		1. Place flagmen or warning signs for safety 2. Remove loose or 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 for level 6. Clean up the surface after finishing	
EQUIPMENT			
1 Dump Truck			
MATERIAL PER DAY		ESTIMATED DAILY PRODUCTION	
50 m ² Basalt bricks 5 m ³ Sand 0.5 m ³ Mortar		50 m ²	
NOTES:			

Source: Roads and Streets Maintenance, Road Directorate, Road Sections and TAC

Figure 17

nm/perform4

PERFORMANCE STANDARD

<u>ACTIVITY</u>		<u>CODE</u>	
Footpaths Repair (Tile Surface)		06	
<u>DESCRIPTION & PURPOSE</u>			
Replacing loose and broken tiles which are in poor condition due to settlement or damage to restore smoothness and strength.			
<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 Driver 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 levelling 6. Clean up the surface after finishing	
<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		100 m ²	
<u>NOTES:</u>			

Source: Roads and Streets Maintenance, Road Directorate, Road Sections and TAC

Figure 18

PERFORMANCE STANDARD

<u>ACTIVITY</u>		<u>CODE</u>	
Footpaths Repair (Mastic Asphalt Surface)		07	
<u>DESCRIPTION & PURPOSE</u>			
Placing new mastic asphalt to restore smoothness and strength			
<u>PERFORMANCE GUIDELINE</u>			
This work is Limited 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>	
<ul style="list-style-type: none"> 1 Foreman 2 Plasters 1 Roller operator 2 Truck Drivers 8 Laborers 		<ul style="list-style-type: none"> 1. Place flagmen or warning signs for safety 2. Remove loose or damaged surface 3. Repair and compact base course 4. Place new mastic asphalt and spread it with shovels 5. Compact new overlay 6. Clean up area 	
<u>EQUIPMENT</u>			
<ul style="list-style-type: none"> 1 Roller 0.5 - 1.0 t 2 Dump Truck 			
<u>MATERIAL PER DAY</u>		<u>ESTIMATED DAILY PRODUCTION</u>	
<ul style="list-style-type: none"> 5 m³ Mastic asphalt 10 m³ Sand 		100 m ²	
<u>NOTES:</u>			

Source: Roads and Streets Maintenance, Road Directorate, Road Sections and TAC

Figure 19

nm/perform6

PERFORMANCE STANDARD

<u>ACTIVITY</u>		<u>CODE</u>	
Grading Unpaved Streets (Grader)		08	
<u>DESCRIPTION & PURPOSE</u>			
The re-shaping of unpaved streets previously constructed for vehicular use, by machine, to restore a reasonably 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, when they have developed holes, corrugation, traffic ruts, uneven settlement, or accumulations of debris which obstruct vehicular use.			
<u>TEAM OF WORK</u>		<u>WORK METHOD</u>	
1 Grader Operator		<ol style="list-style-type: none"> 1. With motor grader, cut high places and fill low areas on travelway of unpaved street. Starting outside edges and blading usable material toward center 2. Blade off large stones, trash and other unusable material, disposing of it beyond the travelway or windrowing the material for later collection and disposal. 3. Strike off and spread evenly any excess usable material bladed toward the center of the street, obtain a firm, even grade and cross-section 	
<u>EQUIPMENT</u>			
1 Grader			
<u>MATERIAL PER DAY</u>		<u>ESTIMATED DAILY PRODUCTION</u>	
None		1.5 KM of street length	
<u>NOTES:</u>			

Source: Roads and Streets Maintenance, Road Directorate, Road Sections and TAC

Figure 20

nm/perform7

PERFORMANCE STANDARD

<u>ACTIVITY</u>		<u>CODE</u>	
Shaping Unpaved Streets (Labor)		09	
<u>DESCRIPTION & PURPOSE</u>			
Reshaping unpaved streets to restore grade, width and riding surface			
<u>PERFORMANCE GUIDELINE</u>			
Reshaping unpaved streets previously constructed and in use, to restore an adequate grade and width, using hand methods assisted by a loader			
<u>TEAM OF WORK</u>		<u>WORK METHOD</u>	
1 Foreman 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 other unsuitable material	
<u>EQUIPMENT</u>			
1 Loader 2 Dump Truck			
<u>MATERIAL PER DAY</u>		<u>ESTIMATED DAILY PRODUCTION</u>	
None		0.5 KM of street length	
<u>NOTES:</u>			
_____ This work is needed to maintain public access streets too narrow for general vehicular use, normally less than five meters wide.			

Source: Roads and Streets Maintenance, Road Directorate, Road Sections and TAC

Figure 21

M. J. ...

Table 61
LIST OF UNIT PRICE^S FOR RESTORATION AND PAVING
CAIRO GOVERNORATE STREETS
FY 1989/1990

SERIAL No.	ITEM	UNIT	UNIT PRICE L.E
1	Earth Work Levelling	m ³	2.00
2	Earth Work Levelling and Transport Excess Soil to Public Disposal	m ³	6.50
3	Procurement and Laying Crushed Stone Aggregate of: 10 cm thick compacted layer 15 cm thick compacted layer 30 cm thick compacted layer	m ²	2.00
		m ²	3.25
		m ²	5.50
4	Procurement and Laying Prime Coat of Liquid Bitumen (MCo) at the Rate of 1.5 kg/m ²	m ²	0.25
5	Procurement and Laying Tack Coat of Liquid Bitumen (RCs) at the Rate of 0.5 kg/m ²	m ²	0.20
6	Procurement and Laying an Asphaltic Concrete Binder Course of 6 cm Thick Compacted Layer	m ²	3.75
7	Procurement and Laying an Asphaltic Concrete Wearing Surface Course of 5 cm Thick Compacted Layer	m ²	3.60
8	Procurement of Asphaltic Concrete Hot-mix for Patching	m ³	60.00
9	Re-set or Replace Curbstone that are Loose, Tilt, Broken or Missing	m.l	3.00
10	Procurement and Installation Concrete Curbstone Using Cement Mortar for Fixation: 25 Large type with dimension 50x30x -- cm 30 12 Medium type with dimension 50x30x -- cm 25 Small type with dimension 50x25x10 cm	m.l	11.00
			7.50
		m.l	4.00
11	Procurement and Laying Mastic Asphalt Course for Sidewalks of 3 cm Compacted Layers	m ²	2.50
12	Procurement and Installation Concrete Tiles 40x40x5 cm	m ²	12.00
13	Procurement and Installation of Color Cement Tiles 20x20x3 cm	m ²	15.0
14	Re-set Manhole Cover after Adjusting Levelling		

Source: Cairo Road Directorate

1.91 11