

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION (CDR)
REPUBLIC OF LEBANON

THE STUDY
OF
ENVIRONMENTAL FRIENDLY INTEGRATED
TRANSPORTATION PLAN
FOR
GREATER TRIPOLI

FINAL REPORT

TECHNICAL REPORT - 4

TRAFFIC MANAGEMENT PLAN

DECEMBER 2001

KATAHIRA & ENGINEERS INTERNATIONAL

REPORT COMPOSITION

The Final Report of the Study is structured to meet the requirements of each user-group. It contains an executive summary, two main reports and six technical reports as follows:

EXECUTIVE SUMMARY: is designed to address the decision-makers as ministers and politicians who do not need deep information in technical and engineering aspects. It contains brief information on all the aspects of the Study and concentrates on the input and output of each aspect. It has also a more concentrated summary for the main conclusions in two pages.

MAIN REPORT – 1 “Integrated Transport Plan”: is designed for planners and directors of CDR and concerned ministries and authorities, who need more technical information on the Master Plan formulation. It contains applied planning policies, development and evaluation of alternatives, main information on the plan of each sector, evaluation results of the Master Plan and the overall implementation plan.

MAIN REPORT - 2 “Short-term Improvement Plan”: integrates more detailed studies and information on the urgent projects included under the Short-term Improvement Plan. The report gives the necessity, objectives, preliminary design, cost estimate and project evaluation on the technical, environmental and economic viability of each project.

TECHNICAL REPORT - 1 “Traffic Analysis and Forecast”: is basically prepared for technology transfer purposes. It addresses transport planners and contains the forecast procedures of forecasting future transport demand. The procedure starts with traffic surveys and analysis, socioeconomic framework, trip generation and attraction and the future transport demand.

TECHNICAL REPORT - 2 “Road Network Plan”: is for the specialists in the road planning and network development. It includes the present road network pattern as well as the planning concept and strategies, which are the basis of the proposed network pattern. Projects of the developed plan are prioritized for implementation under each of the planning periods.

TECHNICAL REPORT - 3 “Public Transport Plan”: is for the specialists in the public transport sector and schemes planned under the Master Plan. It includes the estimated future demand, proposed routes, required number of buses and cost estimation in addition to the implementation plan. It includes also plans and measures for taxi service and school buses.

TECHNICAL REPORT - 4 “Traffic Management”: is for the specialists in the traffic management sector and projects included under the Master Plan. It demonstrates the problems under existing conditions and the formulated plan that includes different procedures and measures for traffic signalization, parking control as well as safety and education measures.

TECHNICAL REPORT - 5 “Environmental Assessment”: gives the environmental conditions and initial environmental examination for the Study Area. Through an environmental impact study, it highlights the environmental issue in establishing the urban transport plan in order to emphasize the importance of preserving and improving the environment.

TECHNICAL REPORT - 6 “Project Management and Financing”: is addressing the administrative issues that will affect the successful implementation of the planned projects. It includes the present legislation, organization and funding system of agencies that will implement the projects under the Study. For the successful implementation of the projects as scheduled, management and financing plans are presented.

APPENDIX

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LIST OF ABBREVIATIONS

AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ADT	Average Daily Traffic
B/C	Benefit-Cost Ratio
BOT	Built, Operate and Transfer
CAS	Central Administration of Statistics
CBD	Central Business District
CDR	Council for Development and Reconstruction
CEGP	Council Executive des Grand's Projects
CNG	Compressed Natural Gas
CO	Carbon Monoxide
COM	Council of Ministers
DGHB	Directorate General of Highways and Buildings
DOR	Directorate of Road
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ERM	Environmental Resource Management
EU	European Union
FAR	Floor Area Ratio
FHWA	Federal Highway Administration
FYDP	Five Year Development Plan
GDP	Gross Domestic Products
GNP	Gross National Products
GOJ	Government of Japan
GOL	Government of Lebanon
HC	Hydrocarbon
HCM	Highway Capacity Manual
IBRD	International Bank for Reconstruction and Development
IEE	Initial Environmental Examination
ISF	Internal Security Force
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
LL	Lebanon Lira, Lebanon Pound
LOS	Level of Service
LRT	Light Railway Track
MEA	Middle East Airlines
M/P	Master Plan
MOE	Ministry of Environment
MOF	Ministry of Foreign Affairs
MOMRA	Ministry of Municipal and Ruler Affairs
MOI	Minister of Interior
MOPWT	Ministry of Public Works and Transport

MPWT	Ministry of Public Works and Transportation
NAC	Noise Abatement Criteria
NERP	National Emergency Reconstruction Program
NGOs	National Governmental Organizations
NO	Nitrogen Dioxide
NPV	Net Present Value
OD	Origin-Distention
ODA	Official Development Assistance
O & M	Operation and Management
ORRPT	Office of Rail Road & Public Transport
PCE	Passenger Car Equivalent
PCU	Passenger Car Unit
PDR	Plan Dimension Ratio
PIU	Project Implementation Unit
PMT	Project Management Team
RC	Reinforced Concrete
RER	Real Estate Registry
ROW	Right of Way
STRADA	JICA System for Traffic Demand Analysis
TCC	Technical Coordination Committee
TSP	Total Suspended Particulate
TTC	Travel Time Cost
UNICEF	United Nation Children's Fund
USEPA	United State Environmental Protection Agency
V/C	Volume-Capacity Ratio
VOC	Vehicle Operating Cost
WHO	World Health Organization
WTW	Water Treatment Works

CHAPTER 1

PRESENT TRAFFIC MANAGEMENT SYSTEM

CHAPTER 1

PRESENT TRAFFIC MANAGEMENT SYSTEM

1.1 PRESENT MANAGEMENT PRACTICE

Three major areas that in particular affect the flow of traffic and road safety conditions will be briefly identified before the description of the current existing management system, which are:

- The composition of traffic;
- The behavior of road users; and
- The condition of vehicles.

In Greater Tripoli the distribution of transportation, modes and the means of transport differ considerably from many other cities in developing countries. Private car and taxi are main modes of transport. City public buses are not yet in service at all. The use of bicycles and motorcycles is very limited.

The road users have little common and general understanding of the nature of traffic and its risks. Even, one should expect professional drivers to be better trained and to show a higher capability of driving than other drivers, this does not in general seem to be the case. In Beirut, drivers may stop their cars to give the pedestrians a chance to cross the road. In Tripoli, this behavior cannot be recognized. The drivers use the horn without a serious reason, and especially the taxi drivers. Taxi drivers almost use their vehicles horn to ask attention of passengers. This is very annoyance and the alarm in Greater Tripoli almost loss its main purpose as a tool of alarm in case of unavoidable danger cases. The drivers careless, park their cars wherever and whenever they like. Double and sometime triple on street side parking and sometime parking on sidewalks are common. Drivers almost forget about priority at intersections and roundabouts. Blocking intersection due to fighting between two drivers which one have to pass first in many locations can be also observed.

The city is also suffering from the mixing of vehicles having different performance conditions. Very old models are running side-to-side with the most new ones. All the taxi are very old models with doubtful performance standard. The big difference between the vehicles performance creates a considerable effects on the safety of the road users and congestion of the road network.

The traffic management concept in Tripoli depended mainly in utilizing of one-way street management system. In city, downtown area the system is adopted as shown in Figure 1.1-1.

The Engineering Department of Tripoli Municipality takes the responsibility regarding this management polices. They mentioned that the one-way implementation was depended on the field observation and engineering judgment. The effects of traffic rerouting are not estimated. The implementation aimed to reduce the number of conflicts at the intersection and increase the capacity of the corridors.

The current traffic circulation is one of the main reason of traffic congestion in the downtown area especially at Sahet El-Taal (J. Abd El-Nasser Square) and El-Saraya El-Kadima.

Therefore, it can be concluded that presently the concept of traffic management is limited by applying the one-way corridors especially in the downtown area. Others traffic management techniques are not in use.

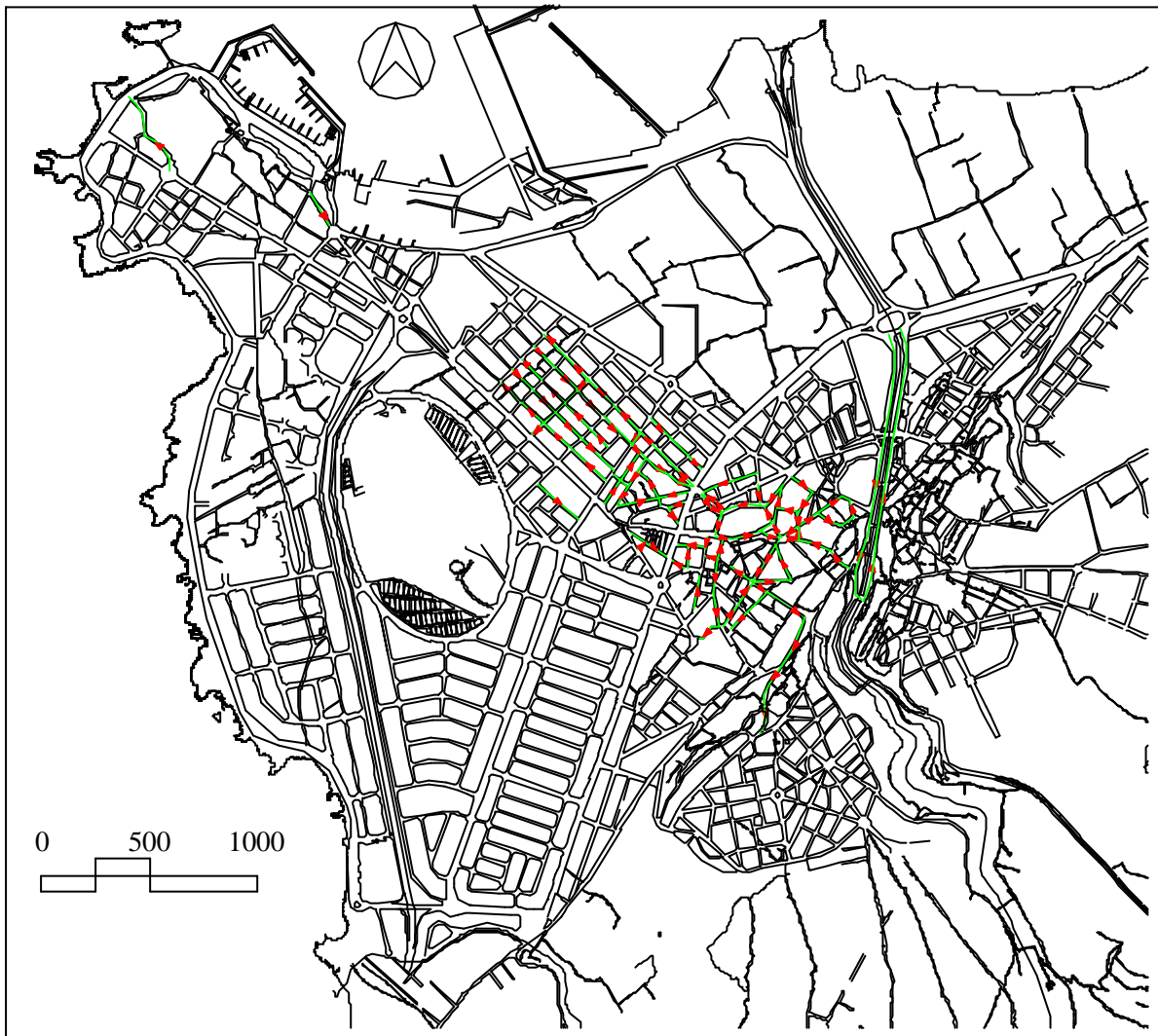


Figure 1.1-1 Existing One-Way Streets

1.2 TRAFFIC SIGNALS

From the field investigation, it is recognized that there are no signals all around the Greater Tripoli. The officials mentioned that before the civil war there were about 12 traffic signals located in the main intersections of Tripoli City. During the war all of these signals are completely destroyed. Currently, the municipality does not have a plan to show the location of these intersections. The authority also mentioned that in the past the selected locations based on the Municipality engineer judgments and field observation.

Recently, and due to the absent of the traffic signals, during the peak hours at the main intersections characterized by heavy traffic volumes, the traffic control is carrying out by a police officers. The number of officers is not sufficient to carry out the practical control. The officers are suffering and struggling to manage the vehicles crossing the intersection as far as they can. Police officers have the respect from the drivers but due to the few number of officers, one officer has to control an intersection alone. The intersection may include more than 16 crossing conflict points and the officer task becomes too difficult. As mentioned by the police official authority in Tripoli, enforcement is a problem. The authority mentioned that the police, lack resources in terms of the enough skilled staff and equipments. Proper enforcement may require a clearer definition of rules and regulations as well as better information to drivers in terms of signing and marking.

Even there are no traffic signals now in Greater Tripoli but a study was carried out to install about 30 traffic signals at the most important intersections in Tripoli, El-Mina, El-Bedaoui and Ras-Maska. The locations proposed by CDR are shown in Figure 1.2-1. Field observation and judgment without traffic volume measurements or pedestrian volume observations are the base on which the specified locations are selected as mentioned by the authorities. As mentioned by the CDR officials, the first phase for traffic signals will includes 12 locations in Tripoli and another 4 locations in El-Mina. Upon the start of this master plan study, there is no plan yet to clarify these proposed locations of the first phase. The implementation plan was under consideration in the Ministry of Public Works and CDR. Later by the end of the first phase of this master plan study the implemented plan made by the CDR was available. This plan is shown in Figure 1.2-2.

The study team mentioned to the CDR that applying a phasing system for the installation and checking the actual existing and future traffic and pedestrians volumes at these proposed signal locations is very important before the implementation of the project.

It was recognized also that the mentioned traffic signals project does not includes any proposal for pedestrian traffic signals. There are many locations especially near to schools and along the major roads where pedestrian's traffic signals must be considered. The safety for pedestrian during the crossing of the major corridors is doubtful. Complains regarding the safety of students while they are crossing the major streets are reported in different municipalities especially in El-Bedaoui.

1.3 TRAFFIC SIGNS AND ROAD MARKING

The specification for traffic signs and road marking in Lebanon are issued by Lebanon Institute of Measures and Specification NL 130, 1999. The Transport Officials in Beirut mentioned that this standard must be considered in the all-ongoing and new projects. However, hereafter the presently conditions will be described.

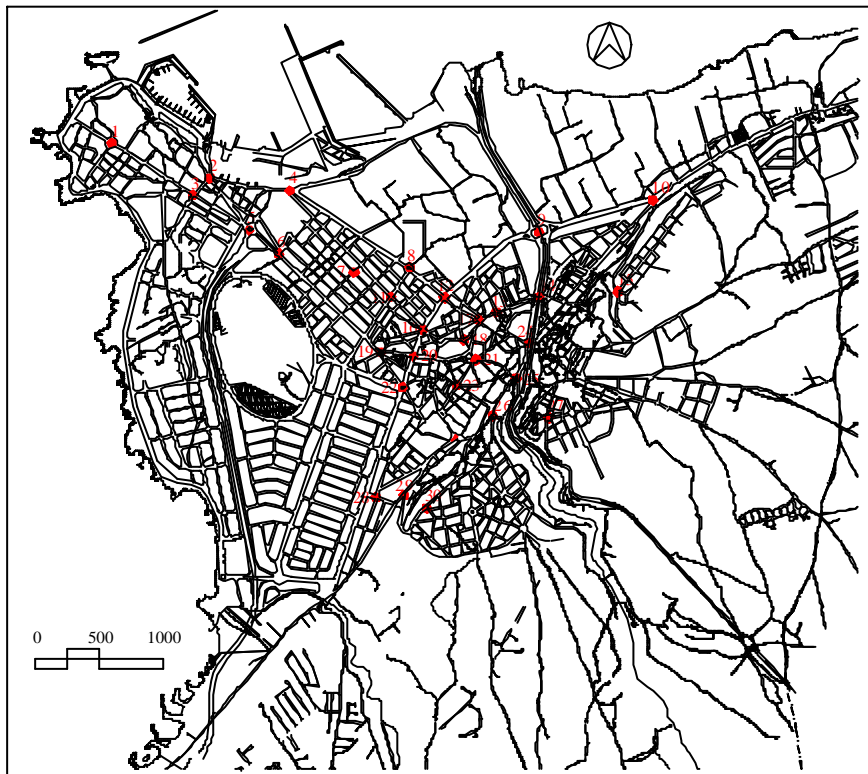


Figure 1.2-1 Preliminary Proposed Traffic Signals Plan by CDR

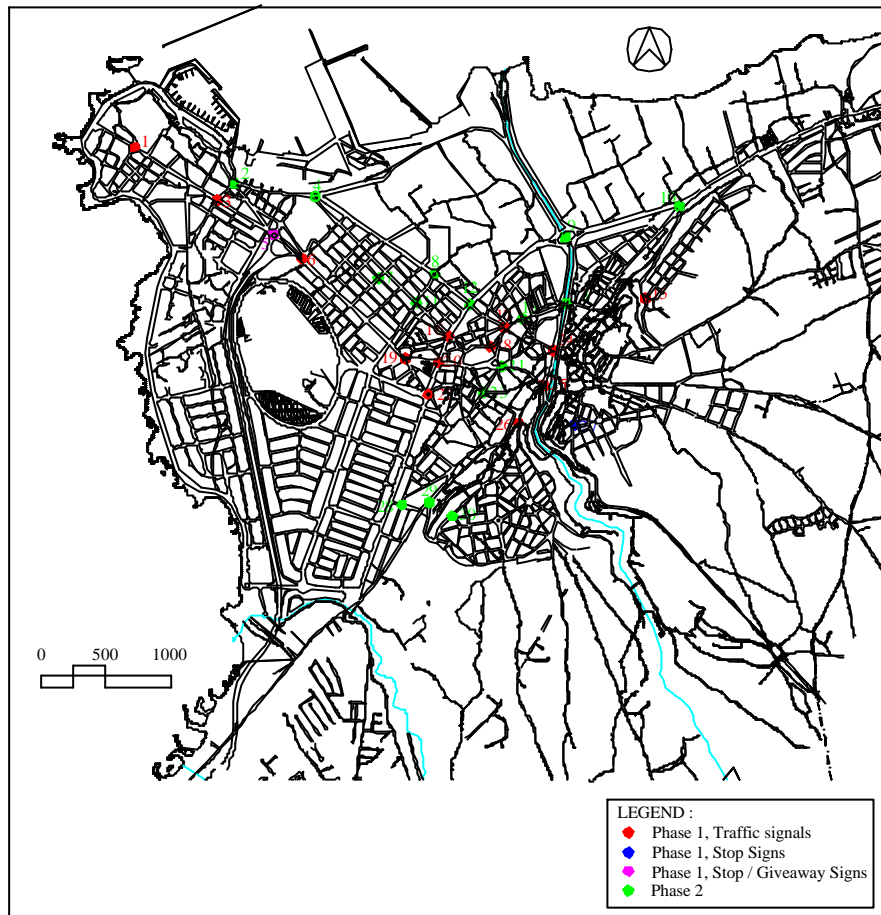


Figure 1.2-2 Final Implemented Traffic Signals Plan by CDR

(1) Traffic Signs

1) Informatory Signs

Where traffic informatory signs can be observed, even they are well designed but they are out of the standard regarding the reasonable numbers and locations. Signs are located only in arterial roads such as Beirut–Tripoli Autostrad and Old Beirut–Tripoli Highway at the entrances and exits to the cities. These signs come under the responsibility of the Ministry of public works. The municipalities within the study area as mentioned by their officials have no engineers in charge for the design and installation of this kind of traffic signs.

The cities inside the study area miss this kind of informatory signs. For the city resident's, it is difficult and for visitors it is almost impossible to drive for their own due to the recognizable insufficiency of informatory signs even at and near to the major intersections.

The installed signs have a blue background with white lettering that follows the international standard. Information wrote in both Arabic and English. The letter sizing is readable form a reasonable sight distance. The signs are mounted on the side of the road. There is no repetition for the signs and this is out of the international standard. Overhead signs can no be observed.

2) Warning and Prohibitory Signs

Most of these signs are placed at and near to the city center. Far away from the center, these signs are few.

A workshop follow Tripoli Municipality is taken the responsibility for preparing the required warning and prohibitory signs for Tripoli and its surrounding municipalities. Tripoli Municipality officials thought that this workshop has the enough power to supply the essential signs.

Regarding the warning and prohibitory signs, they follow the international standards. The Tripoli Municipality mentioned that the 3M Standard is considered in the design of these signs. For the study team it is not clear from where they got this standard and in this regard, the officials mentioned that it is the standard of a worldwide company and Lebanon adopted its specification.

The Internal Security Force (ISF) gathered in its booklet and its internet homepage the standard useable signs. However, many of these signs cannot be noticed on the streets. Almost, no parking, no enter and speed limits signs can be only noticed.

As mentioned early the study team fined the Lebanon standard issued by the Lebanon Institute of Measures and Specification and now on these standard must be adopted in Greater Tripoli.

(2) Road Marking

Except arterial corridors that come under the responsibility of central government represented by the Ministry of Public Works and Transport, road marking cannot be recognized in Greater Tripoli. Even in arterial roads, only lane marking can be noticed. Stop line, edge marking and marking for pedestrian crossing could not be observed.

Recently, the city is suffering from a considerable shortage concerning road-marking facility. Depending on the authority explanation for this sever shortage of road marking, two main reasons were mentioned which are:

- All the municipalities in Greater Tripoli have no fund to consider about road marking.
- The pavement conditions in general are not levelheaded to make the road marking.

That means rehabilitation of road pavements must be related with the implementation of the road marking. In the future and as a first priority at least for the arterial roads, the implementation for the road pavement rehabilitation must be considered in parallel with the implementation of the road marking. The municipalities have to consider about the required fund resources.

Even at major intersections inside the cities, marking cannot be seen. Marking for pedestrian crossing even in heavily pedestrian areas near to markets and schools also are not provided. Needless to mentioned that edge marking and curb one for parking, bus stops, truck loading and un-loading is almost unmindful.

There is no factory within Greater Tripoli to take the responsibility for setting or producing the required materials of road marking. There is no standard mentioned in any documents in the concerning municipalities on the topic of marking and in this respect the standard by the Lebanon Institute of measures and specification must be followed.

1.4 PARKING FACILITIES

For the first glance upon entering, the city of Tripoli anyone can be very easily recognized that the city severely suffering from the parking problems. The problems are not only at the city center but also at and near to all the places where high demands are expected especially in the city center, old town, shopping areas and near to schools and universities. Double and some time triple parking can be noticed in many corridors. Illegal parking can be noticed even at intersections.

Service taxi have great shear in the parking problem in Greater Tripoli since taxi stands cannot be recognized and the existing terminals are not sufficient. Taxi drivers park their cars whenever and

wherever they like. Repeated stooping of school buses is another reason of the parking problem. Desire of private car drivers to park exactly in the front of their destinations is another reason of the problem. Drivers are used to not pay for the parking charge is also a serious mentality problem.

Hereafter the existing parking facilities for the following parking categories will be discussed.

- Paid On-street Parking
- Unpaid On-Street Parking
- Paid Off-Street Parking
- Unpaid Off-Street Parking
- Multi Story Car Park
- Loading and Un-Loading of Heavy Vehicles
- Parking Regulation
- Illegal Parking Penalty

1.4.1 On-Street Parking

(1) Paid On-Street Parking

Currently, this type of parking cannot be observed in any street in Greater Tripoli. Depending on the recent information from CDR and Tripoli Municipality, there is a plan to install as a first stage 500 parking meters in some of the main streets in the Tripoli downtown area. The implemented plan includes Ami, Nadim El-Jaser, Rafik El-Fatal and El-Massarf streets. Officials mentioned that these corridors are selected by the engineering judgment and this parking meters project will be related with the implementation of the multistory underground parking project at Sahet El-Taal and the public transport intercity terminal project in Tripoli at Behsass.

The Tripoli Municipality hopes that the unpaid on-street parking can be completely prohibited in the downtown area of Tripoli after the implementation of these three projects. The selected streets are shown in Figure 1.4-1. The parking fee is decided by a governmental declare in 23 of November 1999 as:

250 LL,	up to 30 min.	
500 LL,		up to 1 hr.
1000 LL,		up to 3 hr.
1500 LL ,		up to 7 hr.
and 2000 LL,		up to 10 hr.

These fees will be from 7:00 AM to 5:00 PM excluding Sundays and National holidays.

(2) Unpaid On-Street Parking

Recently, in Greater Tripoli all on-street parking is going under the unpaid system. The current law in Lebanon prohibits parking in all arterial roads and boulevard, that is mean on the other street classes there is no parking ban system.

In many corridors in the study area the parking prohibition signs can be recognized especially in arterial roads and near to the downtown area. However, under the prohibition sign many parked cars can be observed and some time in more than one line. This is due to the insufficient enforcement rather than the high parking demand as will be clarified later. In many cases these parked vehicles block the road in the front of through traffic. Sever traffic congestion in many locations can be related to this illegal on-street parking.

The city has a special characteristic through the existing of many commercial and some time workshops or car repair shops on the ground level of the residential building. This phenomenon creates a high

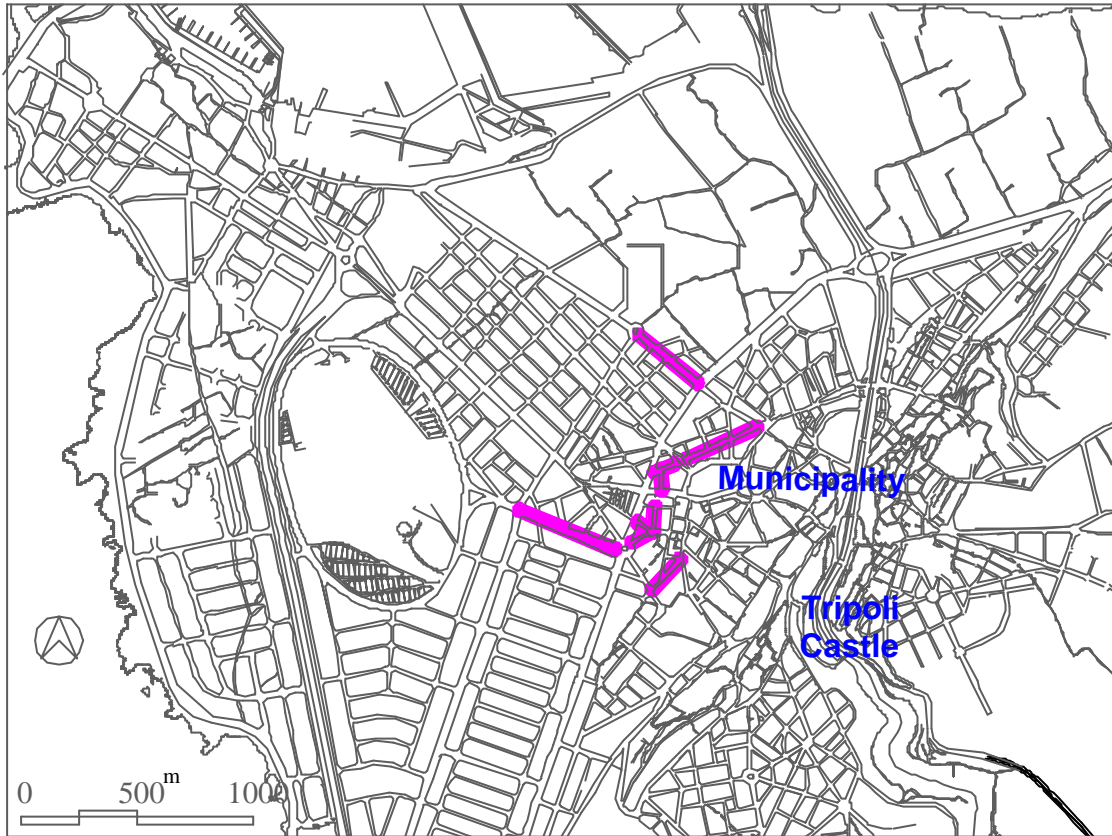


Figure 1.4-1 Proposed Locations of Parking Meters

demand about the on-street parking. The shops owners almost occupy the on-streets parking spaces since they come early, and the clients when come by their cars later have to park as a second row and sometime as a third one. In this respect time limit paid on street parking policy it may solve this problem.

1.4.2 Off-Street Parking

(1) Paid Off-Street Parking

The number of available areas for paid off-street parking is estimated in the main zones as shown in Table 1.4-1. The mentioned locations are assigned in Figure 1.4-2.

Table 1.4-1 Paid Off-Street Parking

Suburban Location	Code	Parking Capacity	Facilities			Area (m ²)
			Entrance	Fence	Surface	
El-Taal – Azmi	AA1	96	3	With	Gravel	2400
	AA3	24	2	Without	Gravel	600
	AA4	40	1	Without	Gravel	1000
El-Taal – Zahiria	AA5	120	1	Without	Gravel	3000
	AZ1	320	1	Without	Gravel	8000
El-Mina	-	-				-
Rashied Karami	RK2	48	1	Without	Gravel	1200
	RK3	60	1	Without	Gravel	1500
	RK4	40	1	With	Gravel	1000
Abou Samra	-	-	-	-	-	-
Total		748				18700

As can be noticed from the table some zones do not include any areas for paid off-street parking like Abou Samra. All parking areas are unpaved. Some parking areas have only one entrance. Some parking areas have no fence gate.

The parking fare at different zones is almost same and equal 1000 up to 1500 LL (1 US\$) per car regarding less the duration of parking duration time. For the same charge, the car can park one hour or even one day.

As also can be noticed from Table 1.4-1, the total number of parking stalls is less than 800. For a city like Greater Tripoli this capacity is too limited. The capacity of paid off-street parking gives an indication about the existing of a problem about the off-street parking facilities. Why this capacity is too small that will be considered more deeply later.

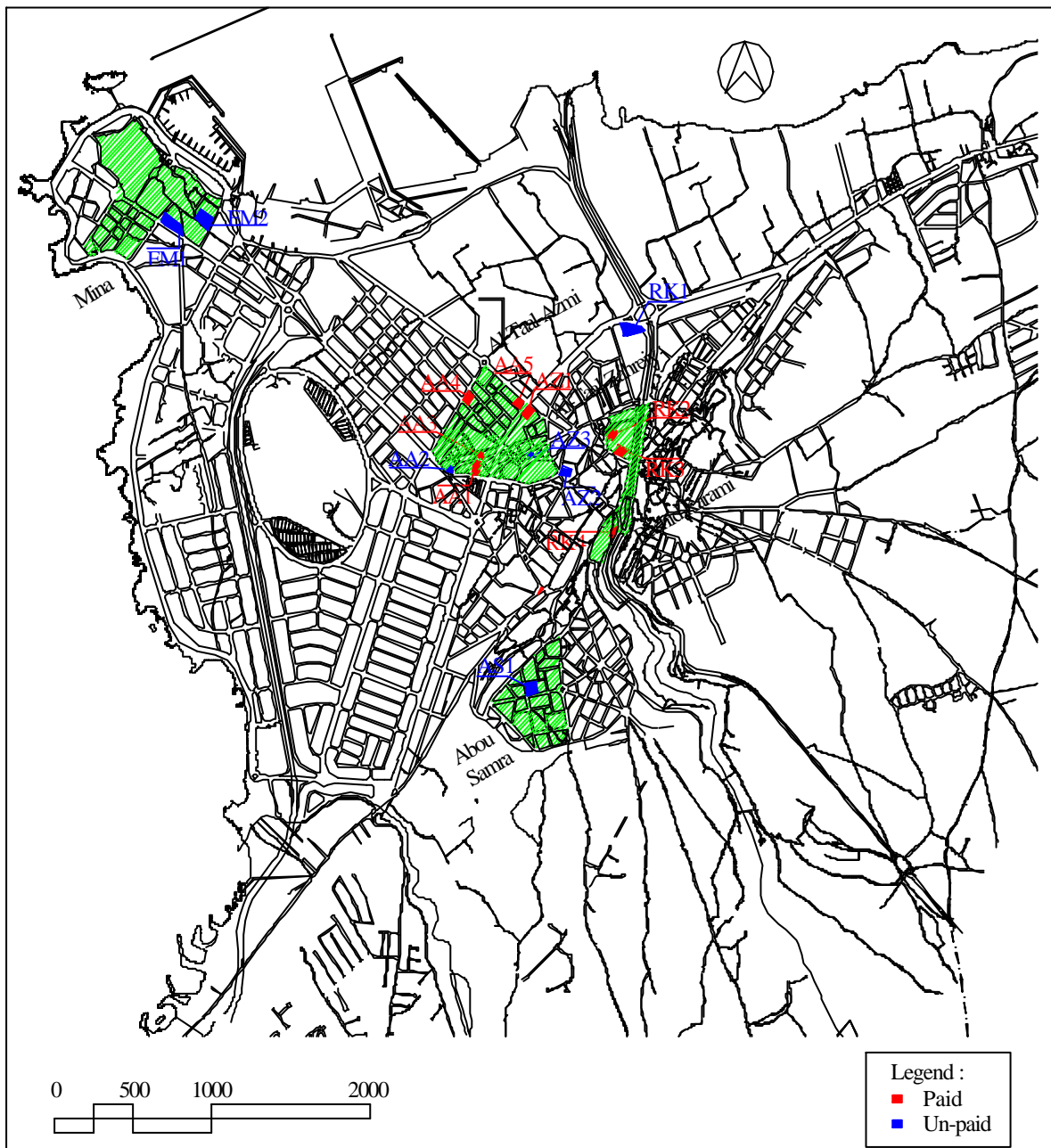


Figure 1.4-2 Existing Locations of Off-Street Parking Areas

(2) Unpaid Off-Street Parking

Concerning the number of available areas for unpaid off-street parking, it can be estimated in main zones as shown in Table 1.4-2. The mentioned locations are assigned in Figure 1.4-2.

Table 1.4-2 Unpaid Off-Street Parking

Suburban Location	Code	Parking Capacity	Facilities			Area (m ²)
			Entrance	Fence	Surface	
El-Taal – Azmi	AA2	16	1	With	Asphalt	400
	AZ2	24	1	With	Asphalt	600
	AZ3	24	1	With	Asphalt	600
El-Mina	EM1	80	1	With	Asphalt	2000
	EM2	40	1	With	Asphalt	1000
Rashied Karami	RK1	40	1	Without	Gravel	1000
Abou Samra	AS1	160	Private	Without	Gravel	4000
Total		384				9600

As can be noticed in the all zones, unpaid off-street parking areas are existed. Most of areas are paved. These results are illogical if compared with the paid off-street parking areas, where all areas are unpaved and some zones do not have this kind of parking facility. As will be discussed in more details in latter, this uneven facilities of paid and unpaid off-street parking can creates among the vehicles users the habit that they dislike to pay for the parking charge.

As also can be noticed from Table 1.4-2, the total number of parking stalls is about 400 spaces that is almost equal to half the number of paid off-street parking. Still this off-street parking capacity for a city like Greater Tripoli is too limited. The capacity of paid and unpaid off-street parking that is about 1200 stalls gives a significant warning for the severity of not only the parking problems in the city but also the driver mentalities. It can be concluded that for quite long time drivers are used to do not pay for their car parking charges. This is the main reason of the limited capacity of off-street parking and especially the paid one. The current driver trends make the profits coming from the utilizing the land, as a parking area is not certain.

(3) Multi Story Car Parking

Throughout all the municipalities in Greater Tripoli, multistory car park cannot be observed.

As mentioned by the authority of Tripoli Municipality, there is a plan to construct a multistory car park by the Decision No.335 in 25/10/2000 under Sahet El-Taal, (Gamal Abd El-Nasser). It is not clear yet when the implementation of this project will start. As mentioned in the accepted plan by the Municipality Committee the main objectives of this project are:

- Upgrade the CBD level and create the services for the citizen in this area that needs upgrading and animating.
- Solve the parking problem especially for private and public vehicles in the central area and consequently relieve the traffic congestion.
- Create attraction point to activate the commercial activities and encourage the maximum volume of citizen to come to the central area after almost all of them abandon to visit this area.
- Enforce the power of municipality authority in the implementation of the commercial center and developing the commercial activities by upgrading the level of services in the city and that is one of the major municipality duties.

The general components of this project are shown in Table 1.4-3.

Table 1.4-3 Sahet El-Taal Multistory Underground Parking Area

Component	Description
Total Project Area	4200 m ²
Total Area of Commercial Stores	4000 m ²
Total Area for Commercial Investment	2000 m ²
Number of Stores	40
Number of Restaurants and Coffee Shops	3
Area of Taxi Stands including 8 line	4200 m ²
Number of Taxi Stalls	56
Number of Car Stalls	20
Number of Parking Stalls for Private Cars (133 x 2 floors)	266

The feasibility study for this project shows that:

- Construction will take 2 years
- The estimated required cost is 2,724,000 US\$.
- Profit per year is 550,000 US\$ (about 20% from the required cost).

This area is only green area in the downtown and the implementation must reserve this green area. Furthermore, it is the only area available in the downtown to be utilized as a terminal for the city buses, judgment, to utilize this area, as a multi story underground parking or city bus terminal is critical.

(4) Other Parking Regulations

Only no parking signs and no parking concept are comprehended. Mention about concept or terminology like no stopping and no standing is completely ambiguous due to the low level of driver's education. Furthermore, there is no kind of any marking for parking regulations.

Parking regulation policies such a permission of parking during certain times of day, specify which corridors can be operated under one side or two side parking, specify and educate drivers other type of parking concepts such as standing and stopping and prohibition of parking near the exits and the entrances of the intersections, all seem to be out of act. There is no parking policy or any limitation about the long-term parking.

The field observation shows that there is no regulation in Greater Tripoli commercial areas concerning heavy vehicles loading and un-loading. During the coming years this issue should be considered especially in and around the Tripoli downtown and other commercial centers in the other municipalities. Regulation of truck loading and un-loading has been proofed to have recognizable effects on the reduction of traffic congestion in the central areas.

Even the traffic law includes the main items for the parking regulations but in the actual conditions, they are not in act. Insufficient enforcement, driver's mentality and behaviors seem to be behind that phenomenon. Drivers dislike walking and preferring illegal double or triple parking near to their destinations especially in the absent of the sufficient enforcement. Penalties in Traffic Law are classified to four main groups. Illegal parking comes in the third one (Article 37 & 38). The penalty charge stated for this group is 2000 LL (1.33 US\$). It is clear how far this value is too low to represents the required enforcement against illegal parking. In this respect revise of penalty charge is recommended.

1.5 PROBLEM IDENTIFICATION

The investigation of the current traffic control and management system in Greater Tripoli clarified the following problems:

(1) Traffic Composition

Recently, citizens depend mainly on the private cars and taxi. There are no city bus services. Due to the limited occupancy rate of small vehicles, the number of running vehicles becomes larger. In this respect, introduce of the city bus services can reduce the number of vehicles. Reduce the traffic volumes by using the city buses as environmental friendly mode of transport is recommended.

(2) Road Users

The drivers are used to park their cars wherever and whenever they like. Pedestrians are used to cross the street also wherever and whenever they like. Drivers are used to park their car free of any charge. Follow of traffic regulation is neglected and safety awareness is deserted by all of the road users. Walking is disliked by the road users.

(3) Vehicle Condition

Most new models are running side-to-side with very old ones. Performance of the old models is doubtful. This mixing of new and old models slowdown the average vehicle traveling speed and makes bad environmental condition.

(4) Control Facilities

There are no traffic signals even at the heavily congested intersection. Missing of this type of control causes recognizable delays at the intersections that produce negative effects concerning environment. The city suffers from shortage of other control facilities like traffic signs and road marking.

(5) Traffic Management

The concept of traffic management is limited by using the one-way system. Other management concepts like closing of side street, tidal flow, rerouting of left turning, parking polices, loading and unloading zones of heavy vehicle, etc. cannot be observed. The insufficient management increases the trip times and consequently increases the time required when the vehicles will be in the operating condition. Increasing the operating time (engine running time) of the vehicles due to the long travel time is always against the environmental aspects.

(6) Parking

- a) Control for the on-street parking even at the approaches of intersections is not efficient.
- b) There is no parking policy for the on-street parking.
- c) Bad geometrical planning of the off-street parking areas.
- d) The school buses have no parking stalls.
- e) Taxi stands capacity is insufficient.
- f) There is no geometrical design for the city and intercity taxi terminals and the capacities of the existing terminals are insufficient.
- g) There is no geometrical design for the intercity bus terminals and the current terminals capacities are limited.

This considerable shortage in the parking control and facilities almost will have great undesirable and unlikely effects on the environmental condition of the city.

CHAPTER 2

TRAFFIC MANAGEMENT PLAN

CHAPTER 2

TRAFFIC MANAGEMENT PLAN

2.1 PLANNING CONCEPT

2.1.1 Major Issues

The major issues in the sector of the traffic management are identified as follows:

- **Street Network:** The roads are mostly narrow and in downtown and old city are like a maze. The width is not fully used by traffic due to heavy on-street parking. There are no spaces for road widening or construction of new roads.
- **Bus Terminals:** There is no off-street city bus terminal. The existing roads near to the center are used as on-street terminals.
- **Taxi Terminal:** There is no off-street taxi terminal. Taxi parking is always on-street that reduce the road capacity.
- **Taxi Oversupply:** Survey results show that taxi oversupply is occupying road space for long periods, reducing street capacity and increasing parking demand.
- **On-Street Parking:** Double and triple on-street parking and parking on the sidewalks are daily practice. Illegal parking causes bottlenecks for the traffic flow.
- **One-Way Operation:** One-way traffic operation is being extensively adopted in many roads. The system is successful but there are some locations where rerouting is required to improve the traffic circulation.
- **Traffic Speed:** Due to traffic congestion, the travel speed of traffic is slow. The fleet of vehicles includes many old-age modals. Therefore, the air quality is seriously deteriorated.

The current serious traffic problems have severe drawback effects on the socioeconomic activities of the city. For tourism sector, most of the historical places are located in the Old City area that is excessively near to the city center.

2.1.2 Objectives

To achieve the Master Plan, the objectives of the Traffic Management Plan are:

- To prepare efficient traffic management plan in order to reduce traffic congestion in the Study Area.
- To prepare comfortable and safely transport system for road users in the Study Area.
- To improve the urban environment through reduction of traffic congestion at the Central Area.
- To provide an efficient, comfortable and safer transport system by integrating road improvement projects and public transport system.

2.1.3 Strategies

To achieve the above mentioned objectives, the strategy is formulated as follows:

- Strengthening traffic education
- Strengthening traffic enforcement
- Improvement of traffic signal system
- Improvement of traffic safety, control and management facilities
- Introduction of parking control

CHAPTER 3

TRAFFIC SIGNALIZATION PLAN

CHAPTER 3

TRAFFIC SIGNALIZATION PLAN

Traffic signals, because of their high cost are used only where certain criteria of heavy traffic volumes and/or accident experience suggest this to be necessary. Signals always are used where a major street intersects another major street, an important collector, or freeway ramps. Signals can be utilized to make travel on major street network more attractive when compared to those using local street alternatives.

3.1 ONGOING PROJECT

For the time being there are no traffic signals in Greater Tripoli. As mentioned before there is an ongoing project to install traffic signals at the major intersections. The final implementation plan for the first phase of traffic signals was modified by CDR on February 2001 to include instead of sixteen signalized intersections as mentioned before, the installation of 13 traffic signals and providing another two intersections one with yield signs and the other with yield and stop signs. This phase will represent the first stage of the construction of about 30 signals in main intersections. Table 3.1-1 shows the numbers of the selected intersections and the assigned number of traffic phasing. Figure 3.1-1 shows the locations of these intersections. This information has been obtained from the recent implemented plan by CDR.

Table 3.1-1 Proposed Signals by CDR for Phase I

No.	Intersection No.	Control Type	No. of Traffic Phase
1	1	Signal	2
2	3	Signal	4
3	5	Signal	2
4	6	Signal	3
5	15	Stop & Giveaway	-
6	16	Signs	4
7	17	Signal	3
8	18	Signal	2
9	19	Signal	3
10	20	Signal	4
11	22	Signal	3
12	24	Signal	2
13	25	Signal	2
14	26	Signal	2
15	27	Stop Signs	-

The review shows that the implementation was based on judgment. No traffic volumes were available. The project does not include the necessary revision for the intersections geometrical design. The phasing system needs to be reconsidered especially regarding the pedestrian crossing and safety. The priority for intersections included in the first phase is better to be revised. The study team assessment is shown hereafter.

3.2 FUTURE IMPLEMENTATION PLAN

Priorities of intersections were assessed by the weight analyses based on the following five main criteria, respectively.

- 1) Level of Service
- 2) Heavy Traffic Volume
- 3) Heavy Pedestrians Crossing
- 4) High Number of Conflict Points
- 5) Linked with other intersections

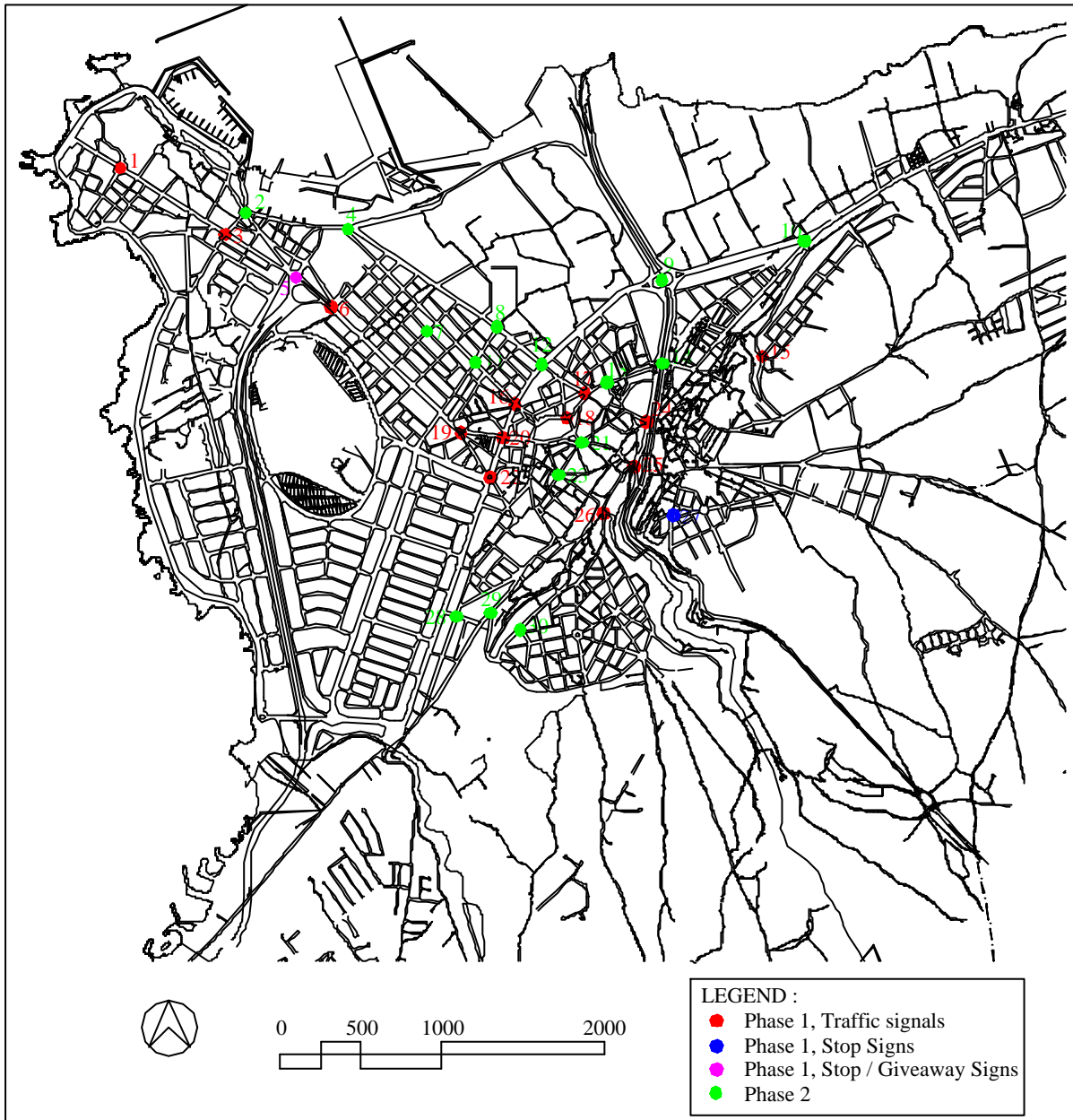


Figure 3.1-1 CDR Traffic Signal Locations

A weight analyses was carried out considering that each of these five criteria is given three ranks as high, medium and low.

The result of the assessment was utilized to classify the intersections into two groups. The first group includes the intersection with high priority and coming under phase one start by 2001. The second group includes the intersections to be implemented in phase two start by 2005.

Table 3.2-1 shows the summary of the analyses results. The results are presented graphically as shown in Figure 3.2-1.

Table 3.2-1 Priority for Signalized Intersections

Intersection No.	Location	Priority Assessment Criteria					Implementing Phase
		1	2	3	4	5	
1	El-Mina	A	B	B	C	A	II
2	El-Mina	C	C	C	B	C	II
3	El-Mina	A	C	C	B	A	II
4	New Tripoli	A	B	C	B	B	II
5	New Tripoli	C	A	C	B	A	I
6	New Tripoli	C	B	B	A	A	I
7	New Tripoli	A	B	C	B	C	II
8	New Tripoli	B	B	B	B	B	I
9	Tripoli North	C	A	C	B	A	I
10	Downtown	C	A	B	A	A	I
11	New Tripoli	B	C	C	B	B	II
12	Downtown	B	A	A	B	A	I
13	Downtown	A	C	A	B	A	I
14	Downtown	B	B	A	A	A	I
15	El-Qoubbe	C	B	B	A	C	I
16	Downtown	C	A	A	A	A	I
17	Downtown	C	C	A	A	B	I
18	Downtown	A	C	C	C	C	II
18'	Downtown	C	B	C	C	C	II
19	Downtown	B	C	A	B	A	I
20	Downtown	C	B	A	A	A	I
21	Old Town	A	C	B	B	B	II
22	Tripoli West	C	A	C	A	A	I
23	Downtown	A	C	B	B	B	II
24	Old Town	B	B	B	B	A	I
25	Old Town	B	B	C	C	C	II
26	Old Town	B	B	C	B	C	II
27	El-Qoubbe	A	C	A	A	B	I
28	Tripoli West	A	C	C	B	C	II
29	Abou Samra	B	B	C	B	C	II
30	Abou Samra	B	C	C	C	C	II
31	Tripoli West	A	C	C	B	C	II

Priority Assessment Criteria:

- 1- Level of Service
- 2- Heavy Traffic Volume
- 3- Heavy Pedestrians Crossing
- 4- High Number of Conflict Points
- 5- Linked with other intersections

Rank Criteria:

- A: High
 B: Medium
 C: Low

Phase:

- I: 2000 - 2005
 II: 2005 - 2010

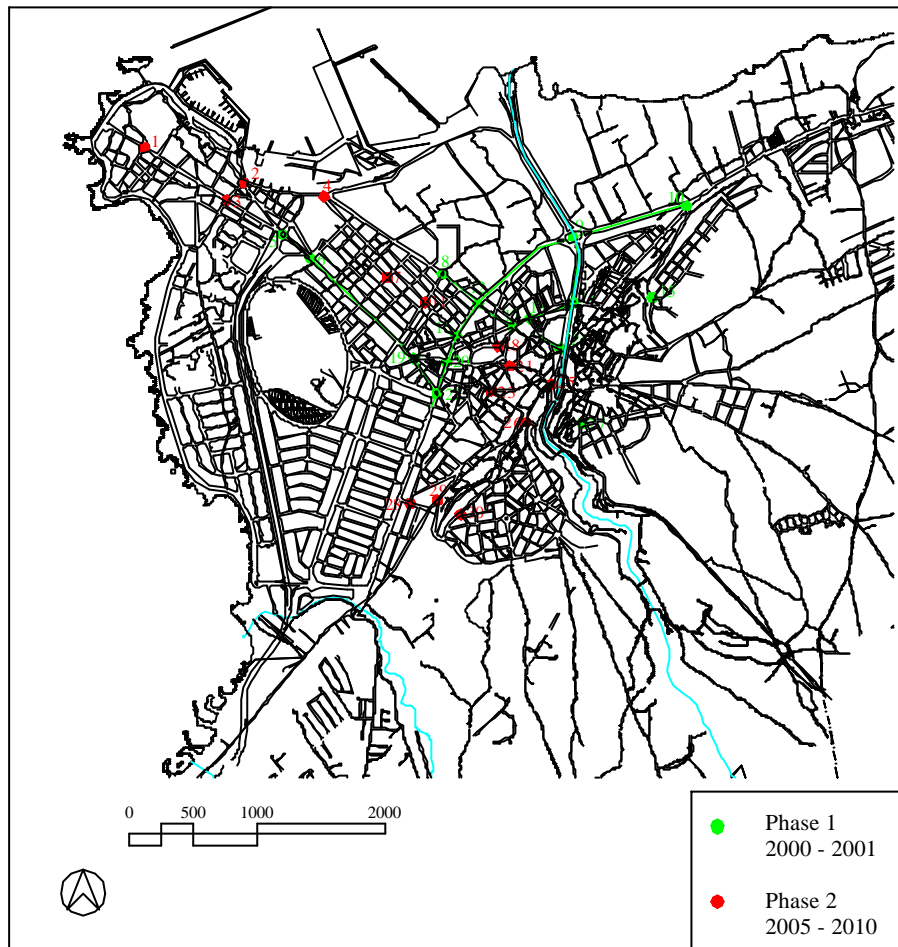


Figure 3.2-1 Implemented Plan of Traffic Signals

The difference between this plan and the previous one carried out by the CDR shown in Table 3.2-1 and Figure 3.2-1 can be easily understood because as mentioned before the CDR plan was depended on field observation and judgment without any data or data analysis. It is highly recommended that the current ongoing project by the CDR be revised again depending on the correct finding mentioned here.

3.3 PEDESTRIAN FACILITIES

As mentioned early, there are many reported complains regarding the safety of pedestrian while crossing the main corridors and especially students. Verification of these complains can be proved by the survey carried out for the traffic control facilities. Insufficient facilities regarding safety of pedestrian such as marking, warning signs, speed limit signs, over or under pass and pedestrian traffic signals almost cannot be observed.

Since, the cost of the pedestrian signal is considerably less than the traffic one, it is recommended to implement a reasonable number of pedestrian signals at the locations characterized with heavy pedestrian volume. It is also recommended to include this implementation in the short-term plan.

Concerning the selected locations, it is reasonable to try first the pedestrian signal at the location in the middle of the corridor from Malloula fly-over to Abou Ali roundabout. If a recognizable delay for through traffic will be recognized, the construction of an over or under pass will be needed. The public will accept such implementation rather than starting directly with over or under pass. Complain about this location from El-Bedaoui Municipality Officials is reported, and the investigation carried out by the study team shows the validity of this complain because the street width is large, vehicle traveling speed is high and the location includes many schools. The accident risk with pedestrian crossing is high even

cannot be reported due to the absent of accident records in the authority offices. The interview with the residents of this area also confirmed that street crossing in this location is quite danger.

There are two locations near to the International Fair where under or overpass are required over the auto-strad. The vehicle traveling speed along these corridors is more than 80 km/hr and the road width is quite large that makes pedestrian crossing at these locations very danger task. Recently, this area is under developing and within few years, it is expected to attract many residents. Furthermore, during any action take place inside the International Fair many visitors come to this area. They create heavy pedestrian crossing that needs for the safety of both vehicle users and pedestrian to consider this pedestrian crossing facility.

There are many other locations where the pedestrian signals are required. These locations are in the front of schools, universities, markets and street characterized with large cross sections. Figure 3.3-1 shows the proposed implementation for traffic signals and Pedestrian Facilities.

3.4 OTHERS TRAFFIC CONTROL FACILITIES

There are two locations where geometrical realignments are impossible. Therefore, at least warning flusher signals must be installed since the warning signals become the everlasting alternative. These two locations need such signal due to the steep slope due to the natural topographic characteristic. The locations are shown in Figure 3.3-1.

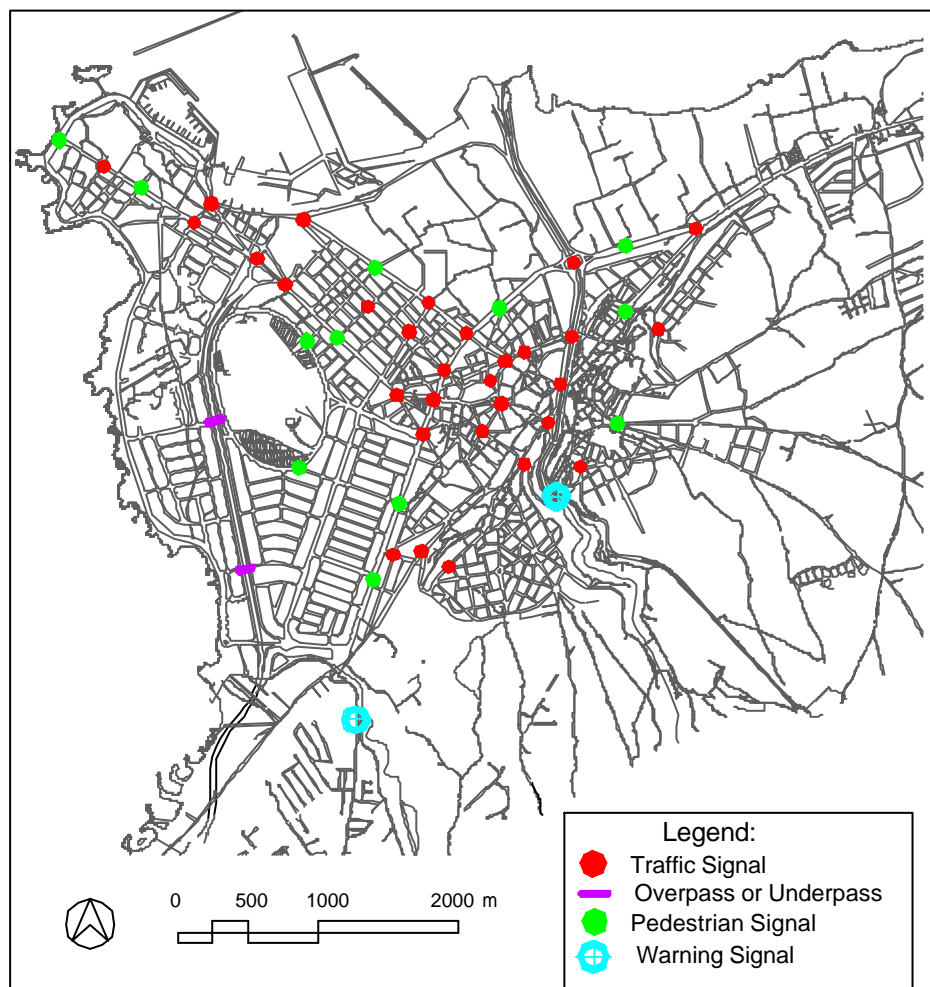


Figure 3.3-1 Traffic Signals & Pedestrian Facilities

CHAPTER 4

PARKING CONTROL PLAN

CHAPTER 4

PARKING CONTROL PLAN

Parking provision and control can directly affect the volume of traffic on streets, particularly where commuters, shoppers heavily use these streets for parking. Parking control may be the only effective traffic management device if the problem traffic is comprised predominantly of outsiders who use the streets for parking. There are basic control approaches to deal with parking such as bans, time limits, parking fee and off-street parking. Hereafter the off-street and on-street parking assessment and recommended implementation are described.

4.1 EXISTING PARKING SITUATION

4.1.1 Off-Street Parking

The survey results regarding off-street parking were utilized to make an overall assessment for parking demand and supply on the different locations within the study area and in total. Figure 4.1-1 shows the comparison between the supply and demand.

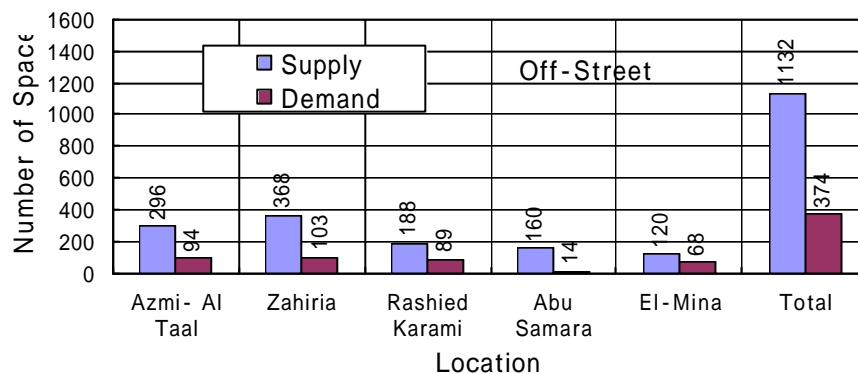


Figure 4.1-1 Off-Street Parking Supply & Demand (2000)

As can be noticed from the figure, at the different locations and in total the supply is greater than the demand. The total supply is about three times the demand. Even in the downtown area such as Azmi - Al Taal and Al Taal - Zahiria, the supply is unforeseen greater than the demand.

This phenomenon needs an explanation because as will be seen hereafter in the downtown area the on-street demand is greater than the supply. Therefore, why the drivers do the illegal on street parking while there are many available spaces inside the off-street parking areas?

4.1.2 On-Street Parking

Unexpected the vehicles on street parking can be recognized not only on the corridors between intersections but also on the intersection approaches. Therefore, hereafter the present on street parking along the corridors and on the intersection approaches are described.

(1) Parking on Corridors

The survey data was utilized to make an overall assessment for parking demand and supply on the different locations within the study area and in total. Figure 4.1-2 shows the comparison between the supply and demand.

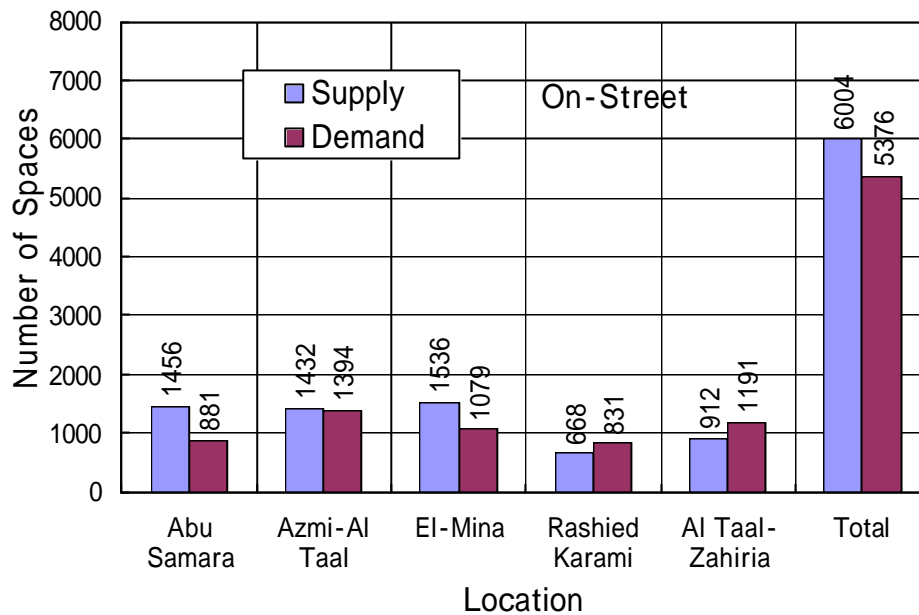


Figure 4.1-2 On-Street Parking Supply & Demand (2000)

As can be noticed from the figure at the different locations and also in total almost the supply is greater than the demand. The total supply is almost in correspondence with the demand. Only in the downtown area and specifically at Al Taal – Zahiria and Rashied Karami the demand is greater than the supply.

Field observed in the downtown area shows that double and triple parking are too heavy in specified and very limited sectors within the CBD. Therefore, concerning the survey results and the field observation this phenomenon needs an explanation why the drivers do the illegal parking while there may be available spaces within a reasonable walking distance.

To analyze the downtown parking problem more comprehensively, the downtown area is paid more attention especially Al Taal - Zahiria and Rashied Karami as the areas show high demand greater than the supply. More analyses were carried out to clarify the existing conditions. Figure 4.1-3 shows the on and off-street parking demand and supply for each area and in total. As can be noticed the difference in total is almost obliterate. However, it must be clear that the supply here is not the actual one. It can be said that this is the supply in case when on street two sides parking is allowed. The actual on street supply in this central area must be equal to zero since the on street parking in this area must be prohibited and officially, it is prohibited by the traffic law.

Therefore, it cannot be concluded that if the on-street parking will be allowed there will not be excess on the parking demand.

The data shown represents the actual demand obtained by counting all the parked vehicles including legal and illegal ones. This master plan strategy is to completely prohibit the on street parking in the downtown area and that coincide with the current traffic law and important to improve the environmental condition in the downtown area. To prohibit the on street parking the equivalent off-street parking must be supplied. The plan to create the enough off street supply is shown hereafter.

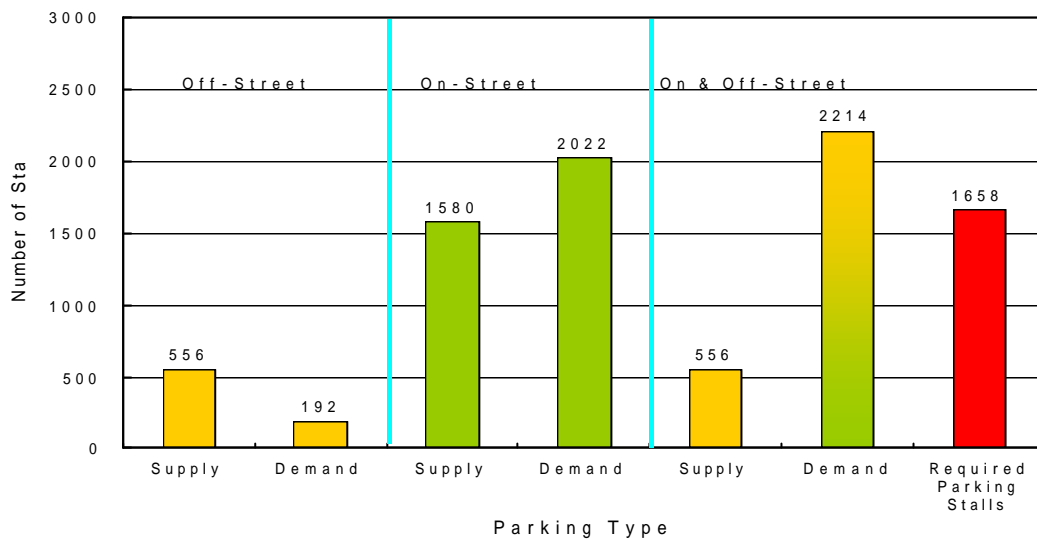


Figure 4.1-3 Demand/Supply Assessments (2000)

In the downtown area, the current demand is estimated about 2214 stalls. The available off street supply is about 556 stalls. This makes the difference between supply and demand about 1700 stalls. The estimated area required to provide this extra supply is about 42,500 square meters. The vacant lands surveyed by the study team at and near to the city center can provide this required area.

It is expected that this off-street parking area will not be increased in the future due to the limitation that will be managed about the developing of the downtown and recently the downtown area is almost arrived to the saturation level.

(2) Parking on Intersection Approaches

Further analysis is carried out under the management plan concerning the effect of car parking in the intersection approaches. This analysis carried out to quantitatively assess the effect of this illegal parking on the saturation flow values (intersection capacity) at the intersection approaches.

During the assessment of the intersection level of service, it can be concluded that the existing of the parked vehicles very near to the intersections, considerably reduced the approach saturation flow values. The prohibition of vehicles parking near to the intersection at least for a distance of about 20m is highly recommended. This can be concluded based on the comparison between the flow/saturated flow ratios before and after parking prohibition. The result of this assessment is presented in Figure 4.1-4. As can be noticed from the figure a recognizable reduction of the ratios can be obtained that is mean recognizable increase of the saturation flow value.

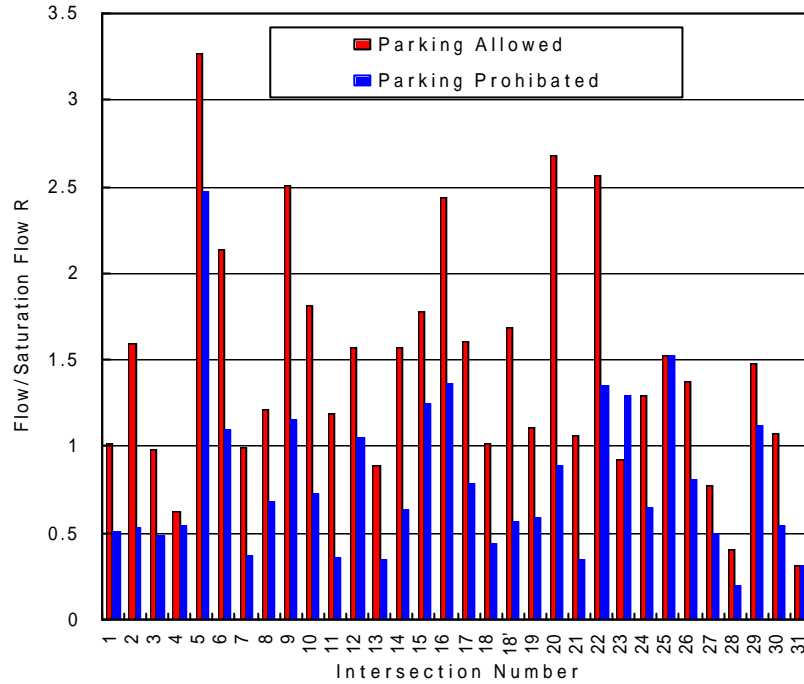


Figure 4.1-4 Intersection Approach Capacities

(3) On-Street Parking Meter

As mentioned early, there is ongoing project to install on street parking meter on some selected corridors in and near to the city center. The feasibility of this project based on the analyses of the parking survey results, is suspected. As mentioned, even there are many available places inside the off-street parking areas but the occupancy rate of these areas is very low. Does there will be the enough enforcement to ban the illegal parking and push the drivers to park in these parking stalls? Does driver will really pay for parking charge? The first phase of this project that includes the installation of about 500 meters can give the reasonable answers.

4.2 PARKING DEMAND

The parking demand is sub-divided into two (2); parking demand and garage demand. Each definition is described as:

- Parking demand : A space in which vehicles may be accommodated mainly at daytime.
- Garage demand : A space used for housing vehicles mainly at nighttime.

These parking and garage spaces are sometimes used in common with each other. In order to formulate the parking control plan, it is necessary to estimate both the parking and garage demands.

(1) Parking Demand

The parking demands at Tripoli Center Area are estimated on the basis of number of vehicle-trips attracted to the same area. The result of estimation is shown in Table 4.2-7. According to this table, the peak hour parking demands in 2020 are estimated to be about 4,125 vehicles.

(2) Garage Demand

The garage demand is largely in proportion to the number of vehicle ownership at Tripoli Center Area. So the number of vehicles at the same area is estimated as shown in Table 4.2-1.

According to this Table, it is estimated that the number of vehicles at this area is 4,350 vehicles in 2020. Both parking and garage demands by the target years are estimated as shown in Table 4.2-2.

Table 4.2-1 Garage and Parking Demand in the Central Area

Parking Demand		
	2000	2020
No. of Trips	45,147	61,851
Garage Demand	14,655	27,600
Parking Demand in Central Zones	30,492	34,251
Parking Demand Rate (%)	10	12
Parking Demand in Central Area	3,000	4,125
Garage Demand		
	2000	2020
Population (persons)	330,900	454,200
Person per HH	4.5	4.5
No. of Households	73,533	100,933
No. of Vehicles	56,620	138,000
No. of Vehicles in Central Zones	14,655	27,600
No. of Vehicles in Central Area	3,150	4,350

Table 4.2-2 Parking and Garage Demands in the Central Area

	2000	2005	2010	2020
Parking Demand	3,000	3,250	3,500	4,125
Garage Demand	3,150	3,450	3,750	4,350

4.3 PARKING MANAGEMENT PLAN

The parking problems in Tripoli is concentrated in the Central Area including the Old City. To provide a smooth and orderly traffic flow in the Central Area and to improve the environmental conditions, on-street parking must be prohibited and that coincides with the current traffic law. The survey results show that the parking demand in the Central Area is about 3,000 parking stalls, while the garage demand is about 3,150 parking stalls.

By prohibiting the on-street parking, the Central Area will need to have about 3,150 parking stalls at nighttime and 3,000 parking stalls at daytime in 2000. In 2005, the demand will increase to about 3,450 parking stalls at nighttime and 3,250 stalls at daytime.

Currently, there are about 850 off-street stalls, and on-going parking meters of 500 stalls are being installed. That makes a difference between the off-street demand and supply of about 2,020 stalls in 2000 and 1,900 stalls in 2005. Table 4.3-1 shows number of the parking stalls required in the Central Area, while Table 4.3-2 shows both required parking spaces and garage space.

Table 4.3-1 Parking Stalls required at the Central Area

	2000	2005	2010	2020
Parking Demand	3,000	3,250	3,500	4,125
Garage Demand	3,150	3,450	3,750	4,350
Parking Stalls to be required	3,105	3,250	3,500	4,125
Off-Street Parking	850	850	850	850
Parking Meters	0	500	500	500
Garage Stalls attached to Building	0	650	650	650
Parking Stalls to be required	0	1,250	1,500	2,125
On-Street Parking	2,020	0	0	0

Table 4.3-2 Parking Stalls required at the Central Area

	2000 ~ 2005	2006 ~ 2010	2011 ~ 2020
Parking Stalls to be required	1,250	250	625
Cumulative Parking Spaces to be required	1,250	1,500	2,125

(1) Off-Street Parking

Figure 4.3-1 shows the vacant lands that can be utilized as off-street parking areas. By the law, the Municipalities can utilize these areas after paying a reasonable rental fee to the owners as off street parking areas. Therefore, regarding the parking locations, there are many places can be used. However, the selected locations must be chosen as near as possible to the city center. Some of the recommended locations are shown in Figure 4.3-2. Utilizing these location can create the required off street supply estimated.

One location of a multi story car park is presented in Figure 4.3-2 since the authority committed this project. This location is in the center of the central area. However, this location is much better to be utilized as a city bus terminal. This utilization will give a good priority for the public transport services. Since the implementation plan of the multistory car park is not decided yet, it is recommended to reevaluate the strategy of using of such important location. Currently, this location belongs to the property of Tripoli Municipality.

Concerning the historical characteristics of the city and the recognizable shortage in parking facilities for tourist buses, a reasonable location is proposed as can be noticed in Figure 4.3-2. The proposed area is located too near to Tripoli Castle and the old marketing area as the most interesting location for tourist. This area now used as a free off street parking area and belonged to Tripoli Municipality.

(2) On-Street Parking

Except the downtown area, the on-street parking is within the reasonable measure. As mentioned early on the central area, on street parking prohibition must be carried out. Since the complete prohibition will needs an extended time until the authorities can provide the substitute off street parking, the parking prohibition is urgently recommended in some major corridors. The locations of these corridors based on the evaluation of traffic volume and street capacity are presented in Figure 4.3-2 to give these locations the first priority. In this respect, the selected locations for off-street parking that can gives the required places to substitute the decrease of supply due to the prohibition of parking in these corridors must be considered. Therefore, the realistic locations for these off-street parking are highlighted on the same figure. The prohibition is very important concerning to the current and future traffic volumes and improvement of the environmental condition in the downtown area.

Prohibition of parking at the intersection approaches is also urgently recommended. The urgent locations are illustrated with the on street parking prohibition in the figure. The indication of these locations does not mean to allow the parking at the other approaches. Parking of vehicles in the intersection approaches cannot be accepted by any engineering standard. The indication of these locations aims to highlighted the enforcement priority until to carry out the complete prohibition of vehicle parking at intersection approaches. Parking of vehicles at intersection approaches, severely reduce the intersection capacities, increase delays, and increase pollution.

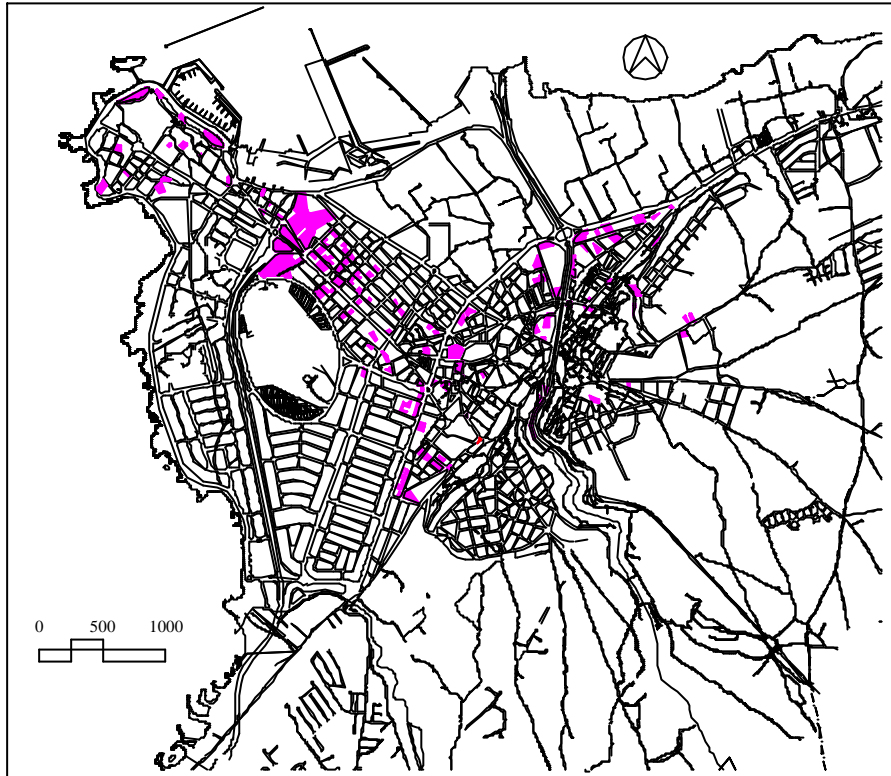


Figure 4.3-1 Parking Vacant Spaces

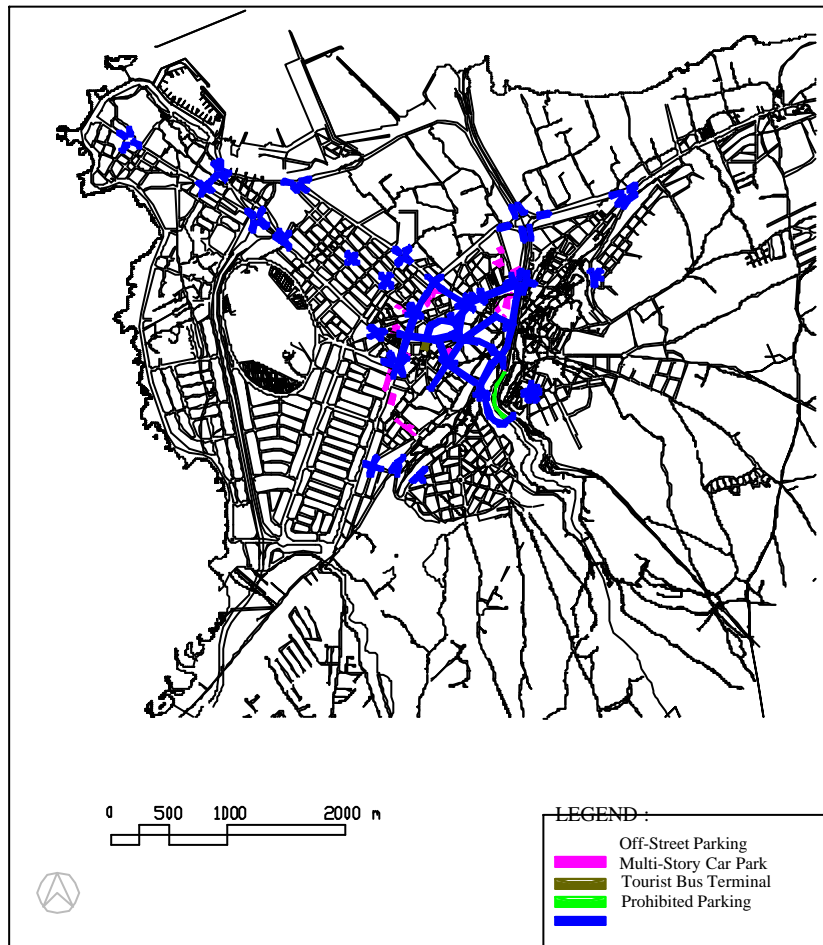


Figure 4.3-2 Off-Street Supply and Prohibited Parking Locations

(3) Enforcement

It seems impossible without sufficient enforcement to change the driver mentalities that they are looking to park their cars exactly at their required destinations, careless about the blocking of the streets. Within the well-known 4E (Engineering, Enforcement, Education and Environment), and on the issue of parking, Enforcement and Education must given the high priority, respectively. Strict enforcement will be needed until the drivers will be adopted with the new parking regulations. Education can support the enforcement by clarifying for the drivers the terrible feedback effects of the illegal parking on the traffic circulation and consequently environment. Understand of road users can support the effort of officials enforcement. The education and enforcement aspects are covered in Chapter 5.

Hereafter some main aspects recommended for further feasibility studies are described.

Bans on On-Street Parking

Parking may be prohibited outright under certain circumstances:

- Where street is too narrow to allow parking on one or both sides
- On major streets, if the curb lane is required for through traffic during peak periods

Time Limited Parking

When long-term parking is a problem, a less drastic measure than a complete parking ban is to limit parking to one or two hours. Establishing time limits would tend to increase the effective parking capacity.

Resident Permit Parking

Resident permit parking (RPP) is used to reduce nonresident parking on residential streets.

CHAPTER 5

SAFETY AND EDUCATION PLAN

CHAPTER 5

SAFETY AND EDUCATION PLAN

5.1 EDUCATIONS AND PUBLIC AWARENESS

Education on traffic rules, regulations, and manner is one of the major components to ensure traffic safety and smooth flow on the road network that are the fundamental goals of traffic management. The responsibility of such plans belongs to different authorities including the Ministry of Education, Ministry of public works and Transport, Ministry of Interior and local municipalities as well as mass-media agencies.

Target groups for education and public awareness include all the road-users, which mean in general the whole population. The proposed education plan is designed to address the four groups of:

- School children and students
- Car drivers
- General public
- Traffic management and enforcement personnel

Each group of road users, however, requires specific plans and programs for education, which should start from early ages of children who will grow up as the road-users of tomorrow.

(1) School Children and Students

Safety education programs for children and students should be included as a part of the normal school system with significant periods for teaching and developing awareness and personnel knowledge on traffic rules and related issues. Educational materials and manuals for traffic safety education should be carefully prepared to be easy to follow, interesting, containing instructions and easily available. Such educational programs are designed for each age sub-group (school level) and would have the following objectives and targets:

- To teach traffic rules, manner and basic laws
- To teach how to use the road safely, especially when crossing
- To develop in children awareness of dangers on the roads
- To understand the main causes of traffic accidents
- To teach how to avoid the involvement in accidents or dangerous situations
- To create the need to be courteous, considerate and careful in all traffic situations
- To realize the impact of accidents on society
- To develop a sense of responsibility when in-charge of a bicycle, motorcycle or vehicle.

Students would participate in traffic safety campaigns to be organized by different involving agencies under the protection of traffic police personnel. The legalization for the private sector, including companies operating in areas related to the road and transport sector, such as car and motorcycle dealers, petrol and insurance companies to sponsor and participate in such campaigns is an important factor for their success.

Related subjects may be incorporated in such programs to include first-aid practices, environmental conservation and community project management as well as the development of communications. Safety school patrol systems and safety clubs could be introduced to increase safety consciousness by school children and to stimulate young people's attitude on safety.

Safety measures for students commuting to/from school should be provided, such as designated safe-routes and safe-zones in order to insure their safety and to provide practical knowledge on safety issues to students.

(2) Car Drivers

Major traffic problems on the streets of Tripoli, and other cities, include the lack of strict observance of traffic manner and regulations, and the wide-spread phenomena of illegal single, double and sometimes triple parking especially in commercial areas in the downtown. In order to decrease the size of such problems, different measures should be applied, such as:

- To insure applicants understanding for traffic manner ad regulations before issuing them a driving license.
- To strengthen the enforcement and fines applied on traffic rule violators

Training programs, with theoretical, practical and medical tests should be compulsory and strictly for all applicants to attend before obtaining driving license. In addition, the periodical education of car drivers on traffic rules and regulations is an important factor to ensure more safety on roads. The main items to be included in educational programs for car drivers may include the followings:

- Knowledge of safer driving, especially when crossing intersections, overtaking other cars or lane changing
- Technical tips for driving and car inspection
- Driving in populated areas with high rate of pedestrians and dangerous situations
- Recognition of signals and different types of traffic signs

Regional traffic safety centers equipped with database systems and required equipment are necessary to provide such training and educational programs. On the national level, media activities should include materials that increase the knowledge of drivers on different traffic safety aspects.

(3) General Public

The general public group includes mainly pedestrians who are always the weaker element in any traffic conflict or accident. Most of car-pedestrian accidents occur when crossing streets or intersections. Improving the crossing facilities either geometrically by providing markings at crossing zones, or physically by providing under- and over-passes, or through time-sharing techniques by providing pedestrian signals will increase the safety level on streets, however, educating the general public on traffic safety aspects is also as important as other engineering techniques.

The following educational and guidance items are forming a base that can be incorporated in traffic police activities and media campaigns for traffic safety weeks by newspapers, local radio stations and TV:

- Basic road traffic rules, regulations and manner
- Teaching own children on basic safety measures
- Safe road-crossing requirements
- Nighttime rules for movement of pedestrians
- Watching own children playing in streets
- Special considerations for elderly people and handicapped

Educational efforts to improve human behavior are in the context of an individual's background and culture. Careful consideration should be given in the selection of specific targets for messages and participants, Road safety campaigns, with the development of posters, leaflets, kits, guidelines and games, are useful means that can be conducted to communicate information as inputs into the road users' marking function and result in the modification of their behavior in a better and safer direction.

(4) Traffic Management and Enforcement Personnel

Efficient and strict enforcement is a key factor to get safer and smoother traffic flow. To achieve such target, one of the main tasks is to provide training and educational programs to the traffic management and enforcement personnel including traffic policemen and municipality engineers. Items that should be included in such programs are:

- Traffic flow principals
- Traffic regulations and laws
- Traffic management and control techniques
- Traffic safety measures
- Traffic accidents' handling and reporting systems
- Traffic data collection and analysis procedures

After implementing the proposed signalization project and installing traffic signals at major intersections in the study area, special considerations should be given to the effective operation of such signals, which requires training on optimum traffic signal operation techniques.

5.2 ENFORCEMENT

To obtain safer and smoother traffic flow, an efficient system for enforcement is a must. The current situation of traffic enforcement in Tripoli is not operated in an effective or sufficient way and consequently cannot accommodate the expected increase in traffic demand in the near future. Taking into consideration the fact that enforcement forces are limited in numbers and facilities, it is necessary to put higher priority on ways to strengthen the traffic police department through increasing the number of personnel and providing them with required training, enforcement facilities and equipment. It is a fact that the behavior of road users is considerably improving if traffic policemen are present.

Traffic policemen and enforcers should be qualified through training programs that may include the following fields:

- Traffic laws and regulations and enforcement techniques
- Human, vehicle and road system and mechanism
- Traffic flow characteristics
- Traffic signal operation and intersection control
- Traffic accident investigation techniques

A general strategy layout is presented in Figure 5.2-1. The strategy considered both education and enforcement. Education for drivers, pedestrians and police officers are considered through three main loops. The police officers loop includes also strengthen their ability.

The road users include two main groups the pedestrian and drivers. Drivers group includes all persons drive any kind of vehicles. These two groups represent the base of the triangle that comes on its head the enforcement. The education process must include these three mentioned groups specifically, pedestrians, drivers and enforcement represented by police officers and the facilities they must have.

The strategy proposed here is trying to create three loops one for each group and to consider about the interrelation among these groups. The loop concept is considered since the process of education and enforcement must keep going. Repetition of the loop will ensure that the new comers will get the required education. Repetition will also ensure to supply police traffic with the most recent knowledge of traffic management and control facilities.

The pedestrian loop includes safety awareness and follows of traffic regulations that can be done through multi-media and schools. This cycle will keep going to supply the pedestrians with up-to-date information concerning their safety.

The driver's loop includes the instruction to the drivers to follow traffic regulations and to be safety awareness that can be obtained through strict driving licenses check and control. The continuous repetition of this loop will ensure in the future that all drivers will have the correct knowledge how they can drive their vehicles in the safety side.

The loop of enforcement includes the management control, the traffic control facilities, periodical training, and feedback to education. The knowledge of traffic police officers concerning the right way of traffic management control and the existing facilities to support this control can be obtained through the periodical training that must always feedback to education to get the most recent techniques in the enforcement field.

Therefore, the enforcement will deal not only with police officers training but also with increasing the police facility capabilities to carry out the management control. Information about new management control techniques and facilities will always be achieved through the repeating of the enforcement loop.

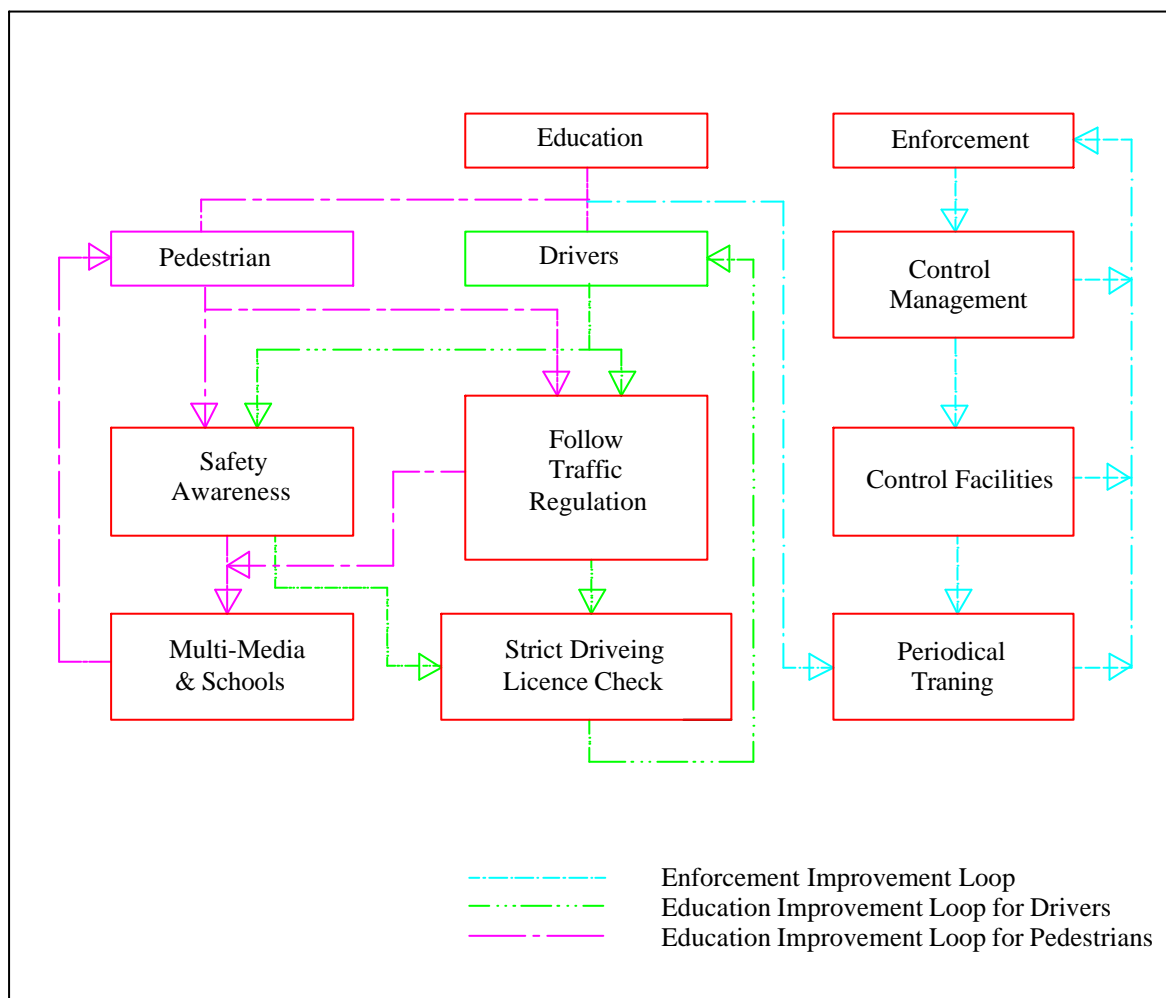


Figure 5.2-1 Educations and Enforcement Improvement Plan

5.3 GEOMETRIC DESIGN

The problem of insuring traffic safety is a universal problem with different degrees between developed and developing countries. All countries, however, are applying measures to increase the safety level and to prevent accidents on their roads. Most of the applied measures are similar in the basic concept but some different measures are applied depending on the special characteristics and nature of the components of traffic systems in each country.

The development and improving of road networks without applying appropriate safety measures is anticipated to cause considerable increase in both accident rates and accident severity. It is a fact that improved and wide roads encourage drivers to increase their driving speeds and the need to separate people and motorized traffic, especially at populated areas, becomes an essential issue.

In recent years, NGOs are doing active works in promoting traffic safety between citizens in the country as they organized three annual national conferences to put, and follow-up, recommendations for safety improvements on roads. The conferences discussed road development and maintenance issues, accident decreasing measures and the mass-media role in safety promotion.

This section deals with the engineering component as other components are discussed in previous sections. The main engineering requirements are those related to the geometric design of streets and intersections as well as providing necessary traffic safety facilities at appropriate locations to assist road users.

Intersections form an area that is subject to higher rates of accidents and conflict points than any other parts of the road network. Many of the intersections in the Study Area are not well designed with insufficient safety facilities. In addition, there are many rotary-type intersections with various radiuses that create many traffic conflicts, which render the efficiency of the intersection in terms of traffic flow and capacity as well as causing traffic accidents.

Major safety measures to be applied at intersections and other locations with high potentiality for traffic accidents include:

- Appropriate geometric design based on internationally recognized standards, with proper sight and stopping distances
- Proper channelization for all movements of traffic with safe lane width, as both wide and narrow channels create confusion and cause accidents.
- Pavement marking for all lanes and pedestrian crossing zones. High quality marking such as thermoplastic glass types, although more expensive than the commonly used low resistance paint, is preferable. Marking performs various functions such as lane identification, guidance for driver sight and driver-visibility improvement at night.
- Installing traffic signs for regulating, warning and guiding traffic, not to cause obstacles for pedestrians on sidewalks, will improve the efficiency of traffic flow.
- Installing signalization system at intersection with high traffic volumes or for pedestrian-safety purposes.
- Installing lighting systems will improve night-driving conditions and reduce the potentiality of accident occurring.
- Providing guardrails to segregate vehicular and non-vehicular traffic at populated and commercial areas as well as near schools.
- Construction on overpasses or underpasses for pedestrian crossing movements at high-density locations. The only overpass for pedestrian movement in Tripoli was removed due to the construction of another overpass for vehicular movement at the same intersection.
- Providing enough space on sidewalks for the safe movement of pedestrians
- Periodical maintenance for all traffic safety facilities is required

A special area that should be considered separately is the Old City in Tripoli. This Old City includes historical monuments, khans, old houses and traditional markets. It has a distinguishing and special character that attracts tourists and increase pedestrian movement. The pedestrianization of some streets, either partially or exclusively, will improve the function of the area to attract more visitors.

Figure 5.3-1 shows very simplified concepts that can increase the safety of the road users. These simplified concepts through good education for the road users can considerably increase the safety in the city. The upper figure shows the desirable pedestrian movement directions along the sidewalks. It is

advisable that pedestrian walk in opposite direction of vehicles flow. It is not safe way to let the vehicle come from your backside. The middle figure shows one of the safe ways to cross the road after getting off the bus. It is advisable to cross the road from the backside of the bus to get the open view sight distance. Crossing in the front of the bus eliminate the sight view and it may cause a delay for the bus to move out the station while the crossing person waiting for the reasonable time gap to cross the road. The lower figure shows the safety of a child when walking along the sidewalk with adulate. The child must walk inside while adulate walk outside and catch the child hand. This make a kind of control about active behavior of child that is sometimes looks danger.

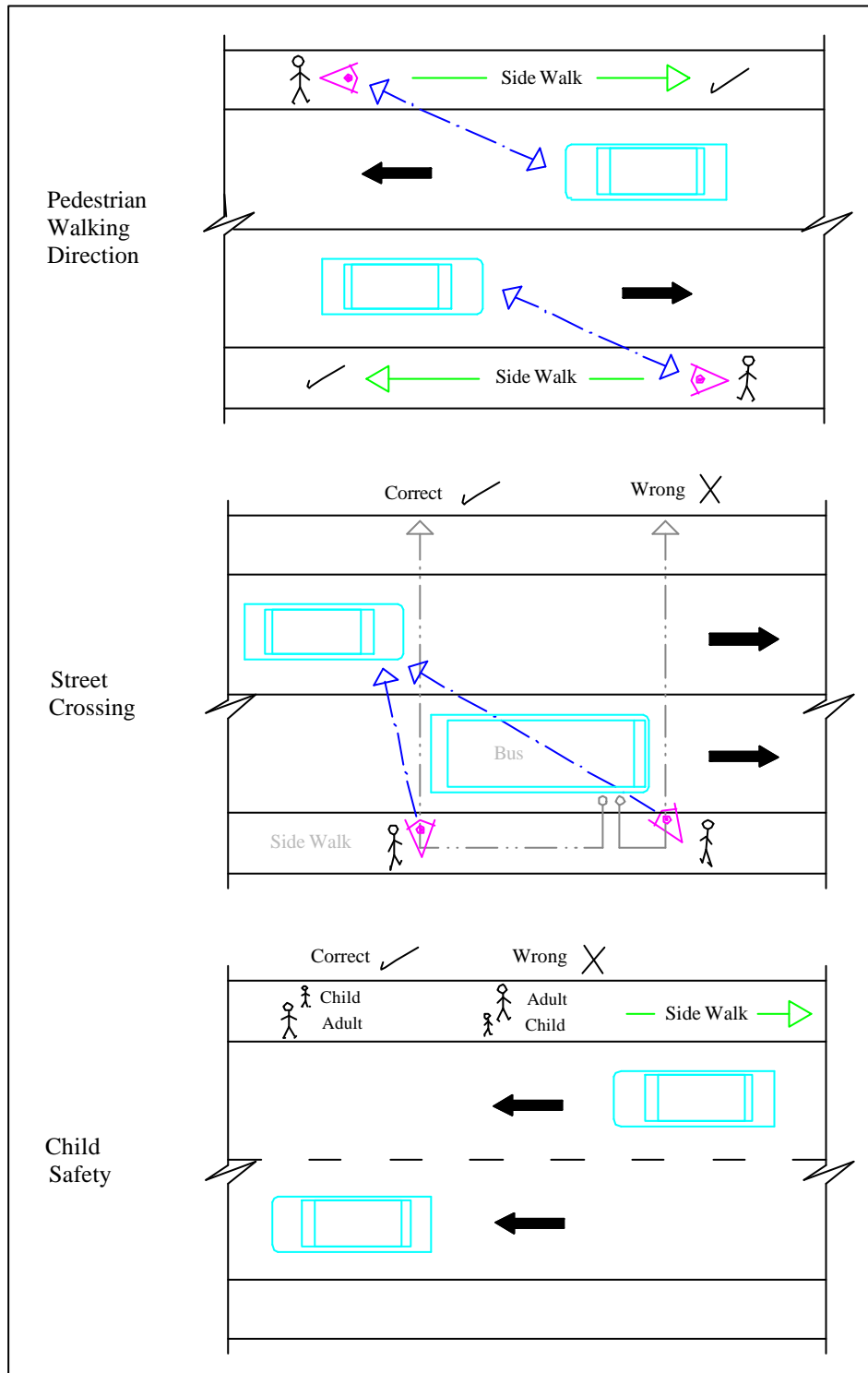


Figure 5.3-1 Safety Concepts

CHAPTER 6

COST AND IMPLEMENTATION PLAN

CHAPTER 6

COST AND IMPLEMENTATION PLAN

The proposed implementation plan for traffic control and management with the estimated cost are shown in Table 6.1-1. To achieve this plan as soon as possible and since most of the recommended projects are located or related to the downtown area, it is recommended to consider the traffic management of the downtown area within the priority projects. The traffic management plan of this area will clarify more specifically the priority, alternatives, feasibility and fund resources of the most proposed projects in this management plan.

Table 6.1-1 Traffic Management Cost and Implementation Plan

Plan	Short 2001-2005	Medium 2005-2010	Total
Signals	1.56	1.00	2.56
Traffic Signal of Main Intersections Phase I	0.59		0.59
Traffic Signals of Main Intersections Phase II	0.78		0.78
Traffic Signals of Secondary Intersections		1.00	1.00
Pedestrian Traffic Signals	0.11		0.11
Warning Traffic Signals	0.08		0.08
Signs	0.17	0.17	0.34
Warning Signs	0.04	0.04	0.08
Informatory Signs	0.02	0.02	0.04
Prohibitory Signs	0.11	0.11	0.22
Marking	0.24	0.12	0.36
Intersections	0.05		0.05
Major Corridors	0.19		0.19
Secondary Corridors		0.12	0.12
Overpass/Underpass	0.26	0.00	0.26
Over Major Corridors	0.26		0.26
Parking	1.35	0.00	1.35
Parking Prohibition at Intersection Approaches	0.10		0.10
Partially Parking Prohibition Along Corridors	0.10		0.10
Completely Parking Prohibition in Main Streets	0.10		0.10
On-Street Paid Parking	0.30		0.30
Off-Street Paid Parking	0.40		0.40
Multi-Story Car Park	0.30		0.30
Truck Loading and Un-Loading areas	0.05		0.05
Education	3.00	1.00	4.00
Enforcement	0.42	0.71	1.13
Cost (Billion LL)	7.00	3.00	10.00