8.4 Initial Environmental Examination (IEE)

8.4.1 Study Flow and Environmental Items of IEE Study

(1) Study Flow of IEE

In order to evaluate whether Environmental Impact Assessment (EIA) is necessary for a proposed project of a master plan, generally, initial environmental examination (IEE) study is required. Through IEE study, scope of the EIA is determined for the identified projects. However, if the project is evaluated not necessary for EIA, then countermeasures for mitigating impacts of the project which requires environmental consideration are examined from the point of view of environment impact.

In this Master Plan study, IEE for the major proposed projects was started with basic data collection on environmental situations in the Study Area through literature reviews and field surveys. These data and facts were analyzed for identifying present environmental issues of each proposed project as for some environmental items. The environmental items were selected as explained in the following section by holding meetings with ALMA and MARENA before execution of IEE study.

These results analyzed were used for examining possible environmental impacts, which would be caused by implementation of each proposed project, from the viewpoint of environmental impacts, and for judging finally whether EIA would be required for each project.

(2) Environmental Items

Environmental fields to be evaluated have very wide range including social aspects, natural aspects and pollution. The environmental items for IEE were selected to analyze and summarize the environmental aspects and issues, in consideration of the purpose of IEE and the characteristics of Managua as shown in Table 8.4.1.

Table 8.4.1 Environmental Items

1. Social Environment	2. Natural Environment	3. Pollution
1.1 Resettlement	2.1 Topography and Geology	3.1 Air Pollution
1.2 Economic Activities	2.2 Soil Erosion	3.2 Water Pollution (surface & ground)
1.3 Traffic and Public Facilities	2.3 Ground Water	
1.4 Spilt of Community	2.4 Hydrological Situation	3.3 Soil Contamination
1.5 Cultural Heritage & Properties	2.5 Coastal Zone	3.4 Noise and Vibration
1.6 Water Rights and Rights of Common (Property of the land)	2.6 Fauna and Flora (Protected and Fragile Areas)	3.5 Ground Subsidence
		3.6 Offensive Odors
1.7 Public Health Condition	2.7 Meteorology	-
1.8 Waste	2.8 Landscape	-
1.9 Disaster (Risks)	-	-

In the meetings with ALMA and MARENA for discussing the items, the following three points were agreed to be included and considered in the environmental items.

- A land property shall be considered in item 1.6 if some impact is predicted.
- Protected and fragile areas shall be considered in item of 2.6.
- Both surface and ground water shall be considered in item 3.2.

8.4.2 Summary of Environmental Issues and Examinations

(1) Social Environment

1) Resettlement

By the execution of each project, resettlement of existing housing and buildings is predicted at some locations of proposed road widening, new roads and new public bus terminals.

- Spontaneous and Progressive Settlements

There are many "spontaneous" and "progressive" settlements to be relocated in Managua, as shown in Figure 8.4.1. "Spontaneous" is a settlement of urban squatters and "progressive" is another settlement which became legal settlement from spontaneous settlement by planning orders and urbanization program implemented. Relocation of these settlements is one of the social issues to be solved by urban development.

Especially, several spontaneous settlements have occupied illegally some sections of Managua Ring-road Project (1994) since the earthquake of 1972. Some portions of Travesía (Class 1 six-lane road) is proposed to be constructed as a part of the ring-road project. Total length of the ring-road project is approximately 16.8km. As of May 1994, 19 spontaneous settlement areas having 2,089 houses exist on a section of 4.07 km in the ring road project area. It is said, however, that total number of these settlements at present is estimated as more than two or three times of 1994.

It is predicted that some spontaneous and progressive settlements existing in areas of the proposed projects have to be relocated for the implementation of each project. Therefore, detailed study on such settlements will be required to look for measures to solve the issue.

- Road Sections to be Widened

As one of the results of roads and road traffic analysis, the current right-of-way (ROW) of the road network can be addressed as follows:

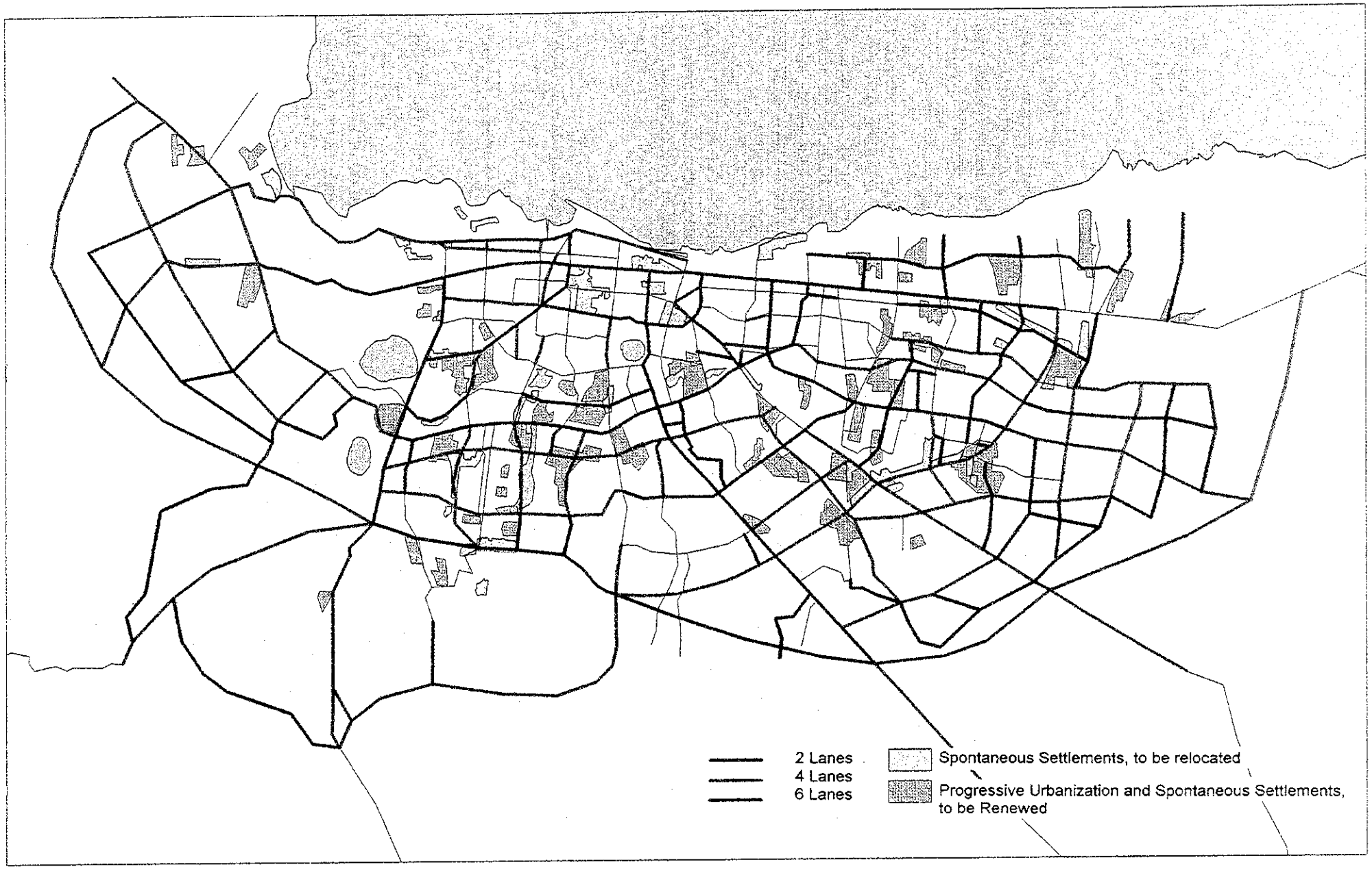
- Most of existing four-lane roads can be widened to six-lane road using the existing ROW.
- Most of existing two-lane roads have a ROW of less than 18 m.
- There are some roads that can be widened from two lanes to four lanes or more using existing ROW.

Accordingly, existing housings along two-lane roads having a ROW of less than 18m will have a possibility to be resettled by the execution of these roads widening. Detailed study is required for the resettlement on such a road.

- New Road Construction Sections

New road construction sections have a relation with the proposed land use plan as follows:

Figure 8.4.1 New Road Construction Project vs Spontaneous and Progressive Settlements



- New road constructed by 2003
  Most of "new road by 2003" will be constructed in/near the urban core and axis, and district center according to proposed land use plan of Managua for 2003.

- New road constructed by 2008
  Most of "new road by 2008" will be constructed in the residential area near the urban core and axis, and district center according to proposed land use plan of Managua for 2008.

- New road constructed by 2018
  Most of "new road by 2018" will be constructed in outskirts of the residential area and others according to proposed land use plan of Managua for 2018.

Some existing housings in areas of the proposed new roads will have a possibility to be resettled by execution of these road constructions. Therefore, detailed study is required for the resettlement on such an area with consideration of above noted characteristics.

- Public Bus Terminals

- Improvement of existing markets (Short and Medium-Term)

Among three terminals which are proposed to be constructed in parallel to the redevelopment and expansion of the existing markets, adjacent huge areas of *Mercado Oriental* are occupied by a lot of small stalls. Most of the stalls are illegal occupation and not authorized. There is a total area of 182,463 m^2, however, only 36,493 m^2 belong to ALMA. Many of these small stalls are occupying not only in the blocks but also both sides of many roads in the areas. Therefore, removals of these stalls will be required depending on the design and plan of the redevelopment, expansion and construction before the implementation.

Both *Mercado San Judas* and *Mercado Virgen de Candelaria* are relatively small markets located in a residential area. Accordingly, resettlements of some housings in these surroundings are predicted in accordance with the design and plan of the redevelopment, expansion and construction.

- New construction sites (Long-Term)

Among three sites of new bus terminals proposed, *Villa Flor* is located in a residential area with three blocks. However, there is no existing bus terminal in the area and suitable space for it at present. Therefore, resettlements of some housings in the area are be predicted depending on the design and plan of the construction.

As for *Sabanagrande* and *Satélite Asososca (Eduardo Contreras)*, they are developing areas in the outskirts of Managua. Present condition of roads in both areas is quite bad. Almost all roads are not paved well.

Around *Satélite Asososca (Eduardo Contreras)* area, there is private land space which is considered as a bus terminal. Several buses park in the space and a bus cooperative is situated in the space for coordinating operations of buses.

In *Sabanagrande*, there is no bus terminal at present. Only two buses are available in the settlement. The final stopping place for bus turning is called as "bus terminal" by the peoples of *Sabanagrande*.

Accordingly, social benefits and conveniences will increase for these two settlements by the execution of the project. It is evaluated as a result of field reconnaissance that enough spaces to construct a bus terminal exist in the fringe areas of these settlements at present. Therefore, bus terminals in these two settlements should be planned and constructed to increase positive impacts in accordance with the future urbanization and development plan.

2) Economic Activities

Approximately 80% of industries such as Textile Industry, Food Industry, Chemical-Textile Industry, Chemical-Petroleum Industry, Metal-Mechanical Industry and Chemical-Pharmaceutical Industry, and about 83% of the industrial employment of the nation are concentrated in Managua. Most of these large industries are located along *Pista Pedro Joaquin Chamoro* and *Carretera Norte Via Panamericana*. North part of the City is characterized by these large industrial activities. It is supposed that improvement of the roads and traffic conditions by the implementation of the proposed projects would give benefits and conveniences to these industrial activities.

On the contrary to this situation in the north, the east, the west, and the south of the City are less developed. However, changes of economic structures and land use values including agricultural productions, commercial activities and job opportunities are envisioned in the areas around new road construction and widening sections in the long-term. These changes may have impact of both positive and negative on the economic structures depending on the situations in these areas. Therefore, new road and widening sections in these areas shall be planned and designed to mitigate possible negative impacts with consideration of future developments and land use plans.

In addition to the above, some changes in the economic activities of/around *Mercado Oriental*, *Mercado San Judas* and *Mercado Virgen de Candelaria* are anticipated by the construction of new bus terminals. Accordingly, these construction plans shall be elaborated carefully to eliminate the negative impacts on these activities in cooperation and concert with the redevelopment and expansion plans of the markets.

3) Traffic and Public Facilities

In order to keep airplane operations safe, there exist two zones where constructions are restricted in the south-west of Managua International Airport as follows:

- Zone 1: A height is restricted to be less than 100 m high from the ground.
- Zone 2: A gradient is restricted to be less than 5 % degree slope.

In the proposed projects, no construction of more than 100 m high is planned. However, some locations of proposed new road will be in the zone 2. Zone 2 includes the following areas:

- South-west side of the airport
- Between 4,000 m and 6,100 m from the landing strip
- South-east side of *Mercado San Miguel (I. Montenegro)*

Therefore, new road construction in zone 2 shall be planned and designed in accordance with the restriction.

4) Split of Community

Road sections to be widened of the proposed road network are designed naturally along the existing roads. Therefore, the existing communities along these roads will not be split. However, little information of community structures in some fringe areas in the east, west, and south of the City, especially "blank" areas on the Land Use Map, is available at present. Accordingly, it is unknown whether there would be some possible impacts on communities located in the area of new road construction.

5) Cultural Heritages and Properties

Many facilities and properties in Managua were destroyed and damaged by two major earthquakes in March 1931 and in December of 1972. Most part of the City center was rebuilt after the earthquake of 1931. However, since the earthquake in 1972, the area has been left without remarkable construction development due to the Government decision.

Some of cultural heritages exist in the Managua including *Plaza de la Revolución*, *Palacio Nacional*, *Ruinas de la Catedra* (heavily damaged by the 1972 earthquake), *Palace of Arts*, *Montoya and Cacique Diriangen Monuments*, *Ruben Dario Teather* and so on. Almost of these heritages are located in the center of the City and along the existing roads.

Several archeological sites had been investigated in Managua. A total of 10 archeological sites were found so far. Eight locations among them are scattered along the southern shore of Managua Lake (*Lago de Managua*), namely between the lake and *Pedro Joaquin Chamorro*. Other two of UNI (*Predios*) and *Vill Tiscapa* are located around *Tiscapa* Lake, and remaining one *San Cristobal* is located on the south side of *Caretera Norte* at the east of the Managua International Airport. In Nicaragua, Decree No.1142 (December 1982) "*Ley de Proteccion al Patrimonio, Cultural de la Nacion*" protects archeological sites of the country.

Therefore, the proposed widening section around the *Tiscapa* Lake, and proposed new road sections around eight sites along Managua Lake and *San Cristobal* shall be carefully designed to avoid negative impacts on these archeological sites.

6) Water Rights and Rights of Common

There is no river in the Study Area. Therefore, no impacts on water rights are expected by the execution of the proposed project.

7) Public Health Condition

Some sanitation issues such as generation of solid waste and wastewater shall be considered in the construction of proposed bus terminals at 6 locations. Especially, three terminals will be planned to be constructed in parallel to the redevelopment and expansion of the existing markets. Therefore, adequate management to control these issues shall be taken in accordance with the following Decrees:

- Decree No.33-95 Regulations on the Evacuation and Polluted Waters of Domestic, Industrial and Agricultural Water
- Decree No.432 of April 17, 1989 Rules and Regulations of Sanitary Inspection
- Decree No.394 of October 12, 1988, Sanitary Regulations

8) Waste

Generation of surplus soil, construction and demolition waste, debris and logs are anticipated during the construction stage of the proposed project. Proper solid waste management will be required during the construction stage.

9) Disaster (Risks)

- Earthquake

Earthquake is a serious issue in this region and has negative impacts on social and natural environment, and to the urban development. As a matter of the fact, Managua was hit and destroyed by two major earthquakes in March 1931 and December 1972.

There are many seismic faults and inferred faults which mainly cross in a direction from north-east to south-west in the City. The positions of 12 major seismic faults have been identified according to existing data and literatures. This situation is critical for the proposed projects, therefore, particular geological survey and study is required at the detailed design stage of each proposed project. Some preventive measures shall be considered, especially for construction of fly-over and public bus terminals.

- Road Flood

High precipitation is recorded in the rainy season from May to November in Managua. Particularly, after a heavy rainfall, which is frequently observed in the season, some roads in the City are flooded and submerged. These conditions would cause not only traffic congestion, disorders and accidents but also economic damages. Followings are the critical sections of the road flooding and submerging of the City.

- *Intersection de Ferrentería Lang 150 mts arriba (Inundación y Sedimentación)*
- *Dupla Norte : Frente al Taller Los Martínez*
- *De Montoya 4c. al Lago*
- *Semáforos de Linda Vista 1 c. arriba*
- *Costado de San Antonio*

Some rainwater drainage systems along the road, which are connected mainly to the nearest storm-water drainage ditches called as *Cauce*, are constructed in the City. It is supposed that, however, the reasons for the floods and submerging on roads are clogs in pipes of the systems by some solid wastes and other substances, and/or overflows from the drainage systems caused by huge amount of the rainfall at one stroke, and so on.

Therefore, further study will be needed on actual conditions of the rainfall patterns, critical area of the floods and submerging and the rain drainage systems in Managua including position of its networks, acceptance capacities and, operation and management systems.

Improvement of existing rainwater drainage systems and construction of new systems shall be considered at the detailed design stage. Public notice and environmental education shall be considered to prevent illegal solid waste dumping into the drainage ditches and road side gutters.

- Flooding Area

According to existing data, areas of flooding are found around *Ciudad Sandino* (west part of Managua), circumference of *Laguna de Acahulinca* and east of the Managua International Airport. Especially, some of the proposed projects will be located around flooding areas of *Ciudad Sandino* and in east of the Managua International Airport. Therefore, a study on the flooding and surrounding areas, and a topographical and geological survey is required for collecting basic data including extent of the critical areas, history of flooding and present situation. Provided that the flooding disasters in these areas have been observed frequently, the projects should be designed to avoid these areas.

(2) Natural Environment

1) Topography and Geology

The configuration of Managua extends with gently slope from South to North. The altitude of the City is from approximately 42m at south shore of the lake up to approximately 220m nearby *Sierras* (mountains) and the mean altitude is approximately 82.97m above sea level.

Land configurations around *Asososca* Lake and *Nejapa* Lake located in the west part of the City are relatively complicated with hills, lakes and valleys. It is said that the geology around these lakes consists of a fragile soil of some igneous rocks. As a matter of fact, the existing road section of *Carretera Nueva A Leon* between *Asososca* Lake and *Motastepe* hill has been moved from previous position due to landslides. Therefore, a study on the geology around these surroundings would be needed before the proposed construction of road widening and new road around the area.

2) Soil Erosion

No large scale excavation is proposed by the proposed projects. Therefore, no impact on the soil is predicted by project implementation. However, If excavation and slope cut is required during construction of new road and road widening around *Asososca* Lake and *Nejapa* Lake, due to the relatively complicated configurations of topography and geology, some consideration to avoid soil erosion would be needed during the construction stage.

Removal of existing vegetation is anticipated for the construction of new roads and widenings. Accordingly, in such a case, necessary measurements will be required to avoid exposure of the surface soil during and after construction including forestation.

3) Ground Water

On the east side of Managua, there is an aquifer mantle bed. However, the depth of the water level is approximately 22 m - 23 m from the surface of the earth. Also, there are a lot of water wells for domestic use in Managua. Ground water levels of some wells in the City are shown in the following Table.

Table 8.4.2 Ground Water Level of Wells in Managua

Well	Position in Managua	Depth (m)
C. Sandino	North West	64
Eduardo Contreras	North West	95
Nejapa	South West	116
Centroamerica	South	110
Sabanagrande	East	43
Mercado Oriental	North	38

Source: *ENACAL (INAA)*

No large scale excavation is proposed by the execution of each project. Therefore, no impact on the groundwater is expected by the project implementation.

4) Hydrological Situation

There is no river in Managua. However, some rainwater drainage ditches called as *Cauce* are located in the City. Due consideration to minimize the damage on these ditches and rainwater reserve ponds by construction of each project is required at the detailed design stage.

5) Coastal Zone

There is no sea coastal zone in the Managua. The City, however, spreads along the southern shore of Managua Lake with the length of approximately 23.5 km.

The project area does not include or face the coastal line of the Lake. Therefore, no impact is predicted on the line by the execution of each proposed project.

6) Fauna and Flora

- Fauna and Flora

Some endangered fauna is identified in Managua such as *Garrobos (Ctenosaura similis similis), Iguanas (Iguana iguana rhinolopha), Chichiltotes (Icterus gularis), Sinsonte (dromococeyx phsianellus) and Piches (Dendrocygna autumnalis)*. However, detailed information regarding the habitats, ecology and distributions of these species is not available at present. And there is no specific protected area of Fauna and Flora in Managua. Taking the result of discussions with MARENA, ALMA and Nicaraguan environmental experts into consideration, it is supposed that there is no serious impact on the Fauna and Flora in Managua by the execution of each project.

- Protected and Fragile Areas

Several crater lakes (*Laguna*) of old volcano exist in and around Managua. Most of the crater lakes and surrounding areas have been protected against development by Presidential Decrees. *Motastepe* hill having a 359.5 m height above sea level which is located at north-west side of the *Nejapa* Lake is also a natural reserve.

Therefore, a study on the fauna and flora will be needed before implementation of each project.

Table 8.4.3 Protected Crater Lake Areas

Crater Lake	Area (km^2)	Remarks
Apoyeque	6.00	*Chiltepe* Natural Reserve (Decree No.1320)
Xiloa	8.00	*Chiltepe* Natural Reserve (Decree No.1320)
Acahualinca	0.06	*Chiltepe* Natural Reserve (Decree No.1320)
Asososca	0.69	*Tiscapa, Asososca, Nejapa* Natural Reserves (Decree No.42-91)
Nejapa	0.19	*Tiscapa, Asososca, Nejapa* Natural Reserves (Decree No.42-91)
Tiscapa	0.13	*Tiscapa, Asososca, Nejapa* Natural Reserves (Decree No.42-91)

7) Meteorology

No large-scale excavation and land reclamation which lead to a significant change of existing topography and geology widely, and no construction like high-rise buildings are proposed in the Master Plan. Therefore no impact is predicted on meteorological situation by the execution of each project.

8) Landscape

There is no specific views to be interfered by the execution of the proposed projects. However, at the design stage, some attention shall be paid on the design and layout of pedestrian bridges and fly-overs in the Public Transportation Corridor, public transportation facilities and bicycle and pedestrian path to make harmony with the surrounding environment.

(3) Pollution

1) Air Pollution

It is evaluated that air quality in Managua is not critical at present, according to field survey results and existing data. As a matter of course, increase of total number of vehicles in the City will make easily the air quality situation worse, particularly if existing inadequate vehicle maintenance remains unchanged.

In order to control quality and quantity of vehicle exhaust gas, in general, overall measures including establishment of national standard, car inspection system, monitoring system of spread of gases and so on are required. And also, it is required to decrease vehicle trips and increase average travel speed through a comprehensive urban transpiration projects and management.

As for national standards for air pollution and vehicle exhaust gas emission, they are not available in Nicaragua at present. However, a committee organized by MARENA, MTI and the Custom Office of Nicaragua has decided to check the exhaust gas of every vehicle from January 1999, and to control vehicle gas emissions from 2002. These movements by the Government will contribute to reduce air pollution caused by vehicle traffic.

MTI conducts periodically mechanical inspection for city buses. However, this system is limited only for mechanical check.

2) Water Pollution

On the east side of Managua, there is an aquifer mantle bed. The depth of the water level is approximately 22 m - 23 m from the surface of the earth. And there is no river in Managua. Accordingly, no impact is expected on both surface and groundwater by the execution of the proposed projects. As discussed earlier, however, proper management of the surplus soil, construction and demolition waste and so on is also required to prevent contamination of the water of *Asososca, Nejapa* and *Tiscapa* Lake caused by the wastes during the construction stage.

3) Soil Contamination

During implementation of the proposed projects, construction materials such as asphalt emulsion may possibly be dispersed on the earth along the construction sites. Therefore, suitable construction management is required to control the disperse.

After implementation of the proposed projects, vehicle exhaust gases will be dispersed on the roadside soil by the traffic. However, this situation would be not so serious as heavy metal contamination because that lead-containing gasoline has been prohibited to use in Nicaragua.

4) Noise and Vibration

Road noise levels of more than 60 dB(A) were observed during the field survey in Managua. It is one of the environmental issues in the City. Most of the sound sources at survey locations were:

- Gasoline and diesel engines
- Exhaust system without any muffler device or out-of-order
- Horn of such a vehicle as old and reconditioned cars, buses, trucks and motorcycles
- Interlocking paved road

Even though traffic situation is improved by the completion of proposed new road network plan, the situation of noise level would not be improved at all without any control of these sound sources.

Therefore, introduction of obligatory systems for equipping muffler devices and muted horn as a national standard to all vehicles will be a principal measure for mitigating road noise situation.

Interlocking paved road itself has a potential for generating noise and vibration by vehicle traffic. Most of the roads in Managua are paved either by asphalt or interlocking. Accordingly, conversion of interlocking to asphalt pavement may be required as one of the countermeasures for mitigating noise and vibration in critical areas.

5) Ground Subsidence

No large scale excavation which will affect the groundwater and geographical situation is proposed. Therefore, no ground subsidence is anticipated by the implementation of the proposed projects.

However, if excavation and cutting is required during construction of new road and road widening around *Asososca* Lake and *Nejapa* Lake, due to the relatively complicated configurations of these areas, consideration to avoid an affect on groundwater stream and ground subsidence should be given in the construction.

6) Offensive Odors

Specific offensive odors will not be produced by the implementation of the proposed projects except exhaust gas from vehicle. In order to control odors from exhaust system, vehicle engine maintenance is essential. Therefore, introduction of vehicle inspection system is awaited.

8.4.3 Results of Initial Environmental Examination

(1) Summary of IEE Results

Based on the examinations and discussions in the previous section, the initial environmental examination (IEE) was carried for the following projects:

- **Road Network:** Widening and new construction sections in the Short, Medium and Long-Term.
- **Public Transportation Corridor:** Short, Medium and Long-Term
- **Public Transportation Terminals:** Every proposed public transportation terminal

(2) Results of IEE

Each environmental item was rated according to the four categories shown in Table 8.4.4.

Table 8.4.4 Examination Category

Category	Examination and Evaluation	Remarks
A	Serious impact is expected	
B	Some impact is expected	
C	Extent of impact is unknown	Further study will be required
D	No impact is expected	

The results of Initial Environmental Examination (IEE) can be summarized as presented in Table 8.4.5. The environmental items which were evaluated as categories "A","B" and "C" are considered to require further studies on environmental impacts and the mitigation measures.

Table 8.4.5 Summary of IEE Results

Environmental Item		Road Network						Public Transportation Corridor			Public Transportation Terminal					
		Widening Sections			New Road Sections			Phase			Location					
		Short	Medium	Long	Short	Medium	Long	Short	Medium	Long	*MO*	*MSJ*	*MVC*	*VF*	*SG*	*CSA*
Social Environment	Resettlement	B	B	C	A	A	A	C	C	C	A	B	A	A	C	C
	Economic Activities	D	D	D	C	C	C	C	C	C	B	B	B	C	C	C
	Traffic and Public Facilities	D	D	D	C	C	C	C	C	C	C	C	C	C	D	D
	Split of Communities	D	D	D	C	C	C	D	D	D	C	C	C	C	C	C
	Cultural Property	D	D	D	C	C	C	D	D	D	D	D	D	D	D	D
	Water Rights and Rights of Common	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
	Public Health Condition	D	D	D	D	D	D	D	D	D	C	C	C	C	C	C
	Waste	D	D	D	D	D	D	C	C	C	C	C	C	C	C	C
	Hazards (Risk)	D	D	C	C	C	C	C	D	D	D	D	D	D	D	D
Natural Environment	Topography and Geology	D	C	D	C	C	C	C	C	C	D	D	D	D	D	D
	Soil Erosion	C	C	C	C	D	C	D	D	D	D	D	D	D	D	D
	Groundwater	C	C	C	C	C	C	D	D	D	D	D	D	D	D	D
	Hydrological Situation	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
	Coastal Zone	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
	Fauna, Flora and Protected Area	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
	Meteorology	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
	Landscape	D	D	D	D	D	D	D	C	C	D	D	D	D	D	D
Pollution	Air Pollution	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
	Water Pollution (Surface & Ground)	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
	Soil Contamination	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
	Noise and Vibration	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
	Land Subsidence	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
	Offensive Odor	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D

Note:

Short : 1999 - 2003
Medium : 2004 - 2008
Long : 2009 - 2018

A : Serious impact is expected
B : Some impact is expected
C : Extent of impact is unknown (Further study will be required)
D : No impact is expected

MO : *Mercado Oriental*
MSJ : *Mercado San Judas*
MVC : *Mercado Virgen de Candelaria*
VF : *Villa Flor*
SG : *Sabana Grande*
CSA : *Ciudad Satélite Asososca*

8.4.4 Overall Evaluation

(1) Environmental Items Required for EIA

Based on the results of IEE, the environmental items shown below are considered to be affected by the execution of each proposed project. Particularly, resettlement will be the most critical issue in the execution of projects of road and public transportation terminal from the point of view of environmental impact.

In Nicaragua, however, no specific technical guidelines for environmental impact assessment (EIA) is existing, in spite that the national EIA system has been set up by MARENA as shown in the next section. EIA will be needed on the following aspects:

- Resettlement

The prediction for resettlement shall be done using a detailed map of distribution of the housing in the target area. A mapping survey by project will be required in order to identify the population, their economic conditions and related information. The situation of the resettlement site shall be studied to identify whether the site is suitable as an alternative land for living.

Regarding a compensation on properties affected by a road project, according to ALMA, there are two systems as follows:

- **Partially affected:** A compensation is given to the affected portion of land and building based on an appraisal made by Ministry of Finance.

- **Totally affected:** The Municipality gives alternative land if available, otherwise, pays a compensation according to appraisal value.

However, a compensation system for resettlement and relocation of the spontaneous settlements and illegal stalls around markets have not been established yet at present. Therefore, specific program to resettle and relocate the affected people shall be prepared to mitigate negative impacts before the execution of each project.

- Economic Activities

Market structures, distribution of the illegal stalls around the markets, local economy and industry and future plans including regional economic development shall be studied in order to identify the actual condition of each existing market proposed to be redeveloped with public bus terminals.

- Air Pollution

Total quantity of emission pollutant from vehicle exhausts shall be predicted for evaluating future air pollution. As one of the prediction methods, there is a model developed by the Public Works Research Institute, Ministry of Construction, Japan.

In this model, an "emission factor" and "traffic volume" of each vehicle type shall be prepared as parameters for the prediction. The emission factor per vehicle is obtained generally through a literature survey or assumed through related data and a field survey. Total emission pollutant produced by vehicle is given as a product of the emission factor of every vehicle type and traffic volume predicted for the target year.

- Noise

Several prediction models of road noise level have been proposed and developed to evaluate impacts from noise generated by vehicle traffic. The models usually calculate a sound pressure level (SPL) (dB(A)) using some parameters of average power level (PWL) of noise per vehicle (L_w) (dB(A)), traffic volume (vehicle/h), velocity (km/h), and so on. Therefore, these parameters shall be obtained in the prediction.

(2) Other Environmental Items

The projects classified as category "C" require further studies on the following items:

- Traffic and Public Facilities
- Split of Community
- Cultural Property
- Disaster (risks)
- Topography and Geology
- Soil Erosion
- Fauna, Flora and Protected Area
- Landscape

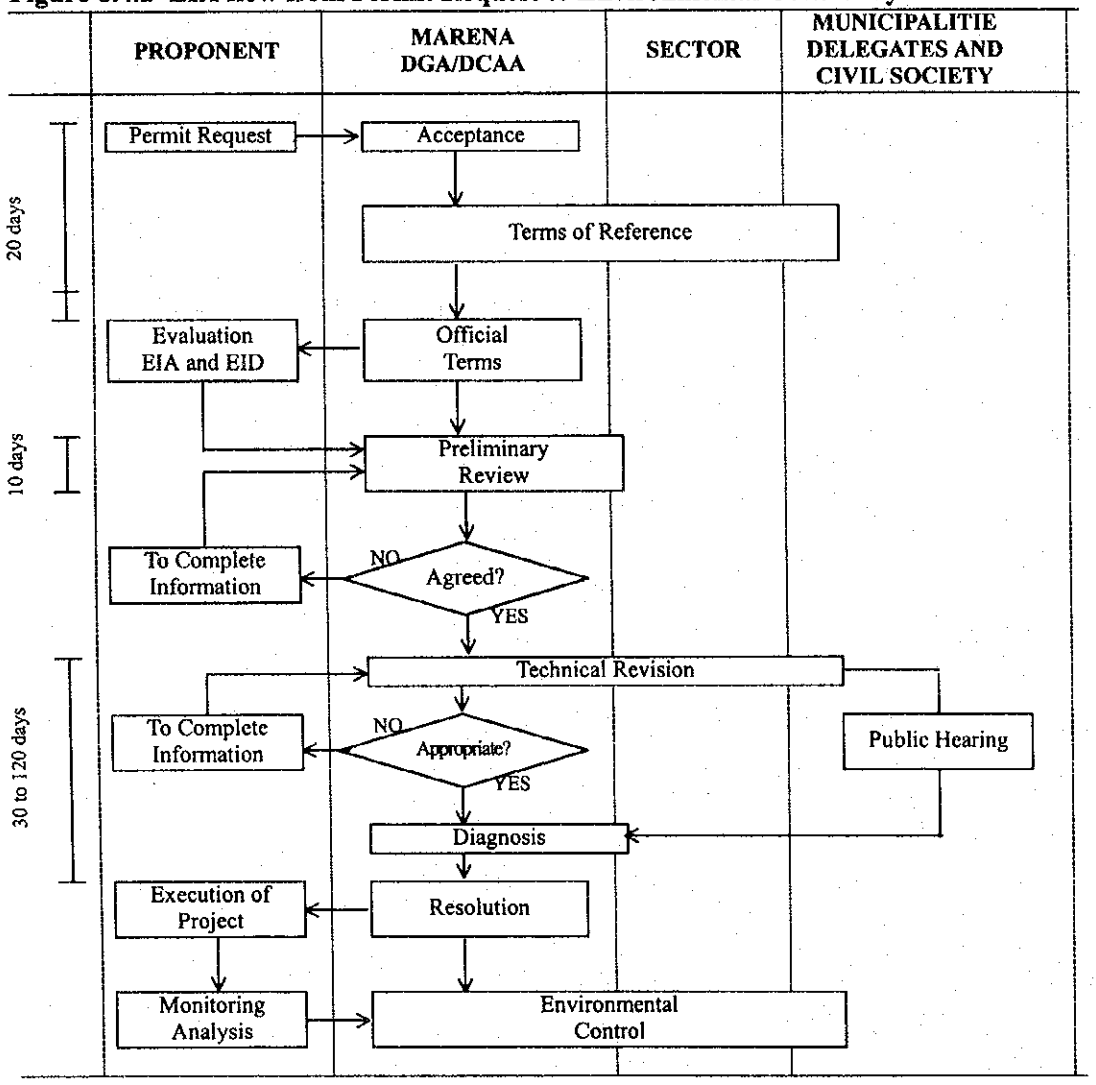
8.4.5 EIA system in Nicaragua

"Regulations to the Permission on the Environmental Impact Assessment (EIA: *Evaluación de Impacto Ambiental*)" has been established by Presidential Decree No. 45-94 in October 1994, and the procedural system of EIA was created at the same time by the Ministry of Environment and Natural Resources (MARENA) . The regulation of EIA and its procedures can be summarized as follows:

(1) Procedural Flow of EIA

The Division of Control of Environmental Activities and Economies (DCAA) of Directorate General of Environment (DGA: *Direccion General del Ambiente*) of MARENA is responsible for the EIA system. Figure 8.4.2 is the procedural flow chart of EIA. In this chart, SECTOR stands for an *Ad Hoc* committee consisting of delegates from such entities as Ministries, organizations, authorities and private sectors involved in the project. The proponent submits the application form for issuing the permit to MARENA. The SECTOR discusses and/or evaluates the project at each step required in the flow.

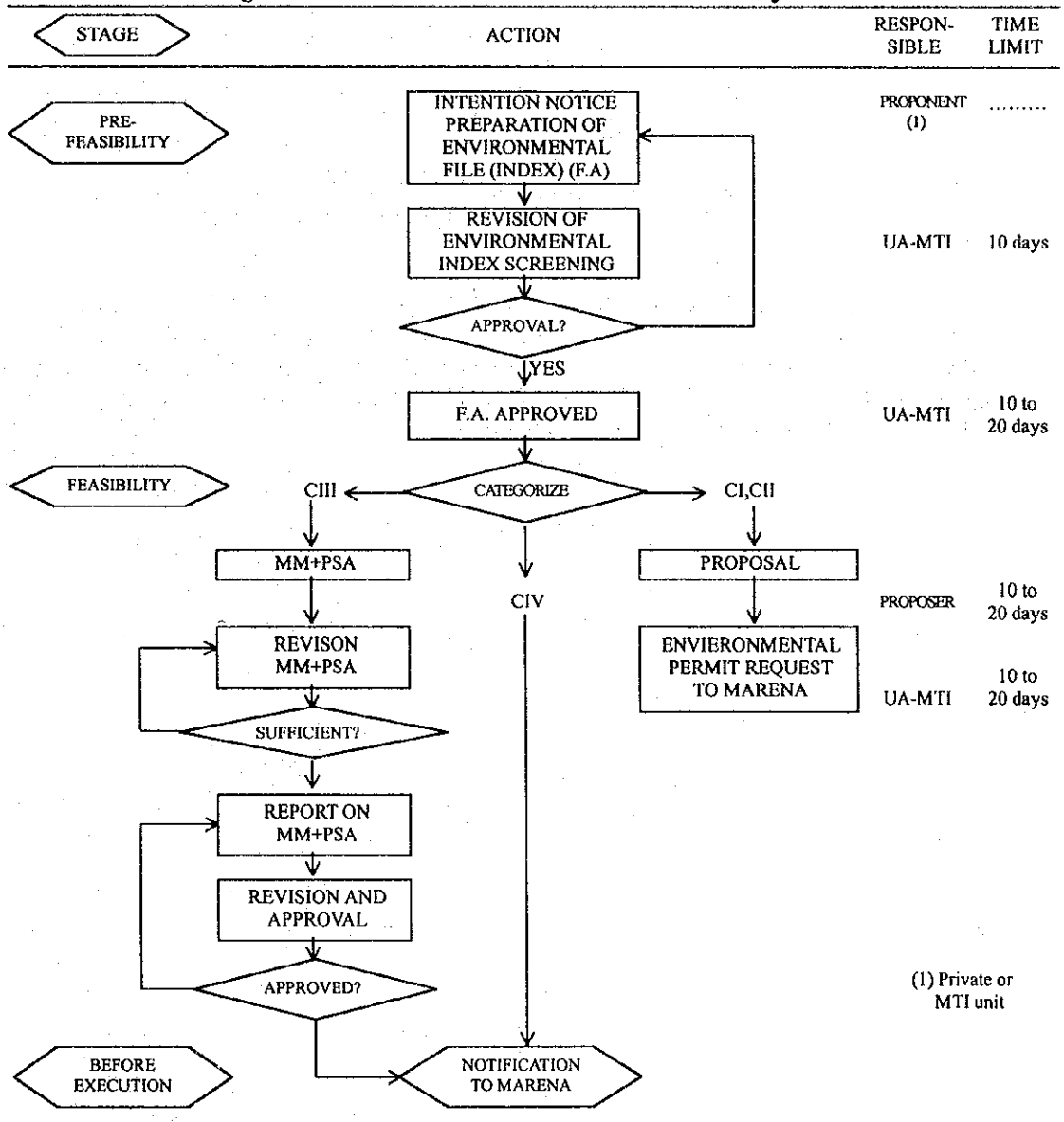
Figure 8.4.2 EIA flow from Permit Request to Environmental Control by MARENA



(2) EIA for Construction Project by MTI

Regarding construction projects by the Ministry of Transportation and Infrastructure (MTI), the Ministry has its own internal EIA system. Figure 8.4.3 is the procedural flow of the internal EIA process for a construction project including road development by MTI.

Figure 8.4.3 EIA Flow of MTI Construction Project



EIA : Environmental Impact Assessment
F.A. : Environmental File (*Ficha Ambiental*)
MM+PSA : Mitigation Measures Document
MM : Mitigation Measures
PSA : Environmental Follow –up Plan

Note: The stated time is for UA and Proposer

Source: Ministry of Construction and Transportation (MTI)

In the MTI's EIA process, every MTI construction project is screened and categorized in accordance with the project classification defined as Category A, Category B, Category C and Category D based on the EIA system of the World Bank (WB) as shown in Table 8.5.6.

Table 8.4.6 Project Category for EIA process of MTI

WB Categories	MTI Categories	Projects
Category A	CI	Environmental assessment (EA) is normally required, as the project may have diverse and significant environmental impacts.
Category B	CII	More limited environmental analysis is appropriate, as the project may have specific environmental impacts.
Category C	CIII	Environmental analysis is normally unnecessary, as the project is unlikely to have significant environmental impacts.
Category D	CIV	Environmental projects for which separate EAs are not required, as environment is a major focus of project preparation.

Source: *"Environmental Assessment Sourcebook, Volume I, Polices, Procedures, and Cross-Sectoral Issues, World Bank Technical Paper Number139"*, 1991, Environmental Department, World Bank (Table arranged by JICA Study Team)

In any case of the categories CI, CII, CIII and CIV, the result of MTI EIA process is submitted to MARENA EIA process. The EIA results by MTI might be used on behalf of the formal appreciation form for the Environmental Permit of MARENA and the MTI delegate would be involved in the "SECTOR" of MARENA EIA process as one of the member for discussing and evaluating the MTI project.

9. Implementation Program

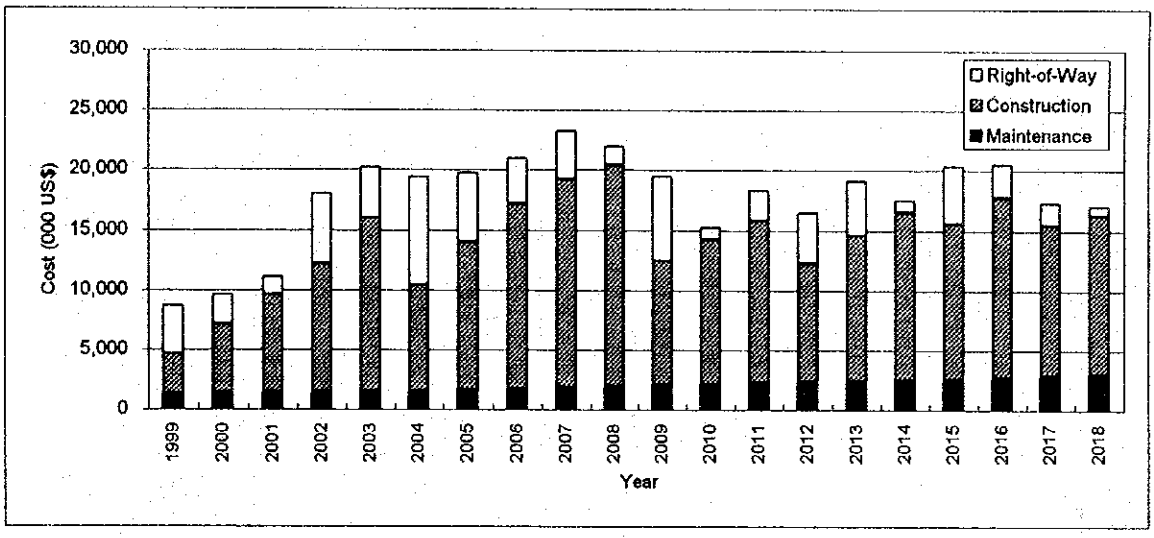
9. IMPLEMENTATION PROGRAM

9.1 Investment Program

(1) Road Development Projects

- Table 9.1.1 presents the investment program of road development projects. Figure 9.1.1 summarizes investment requirement by year.

Figure 9.1.1 Summary Investment Program of Road Development Projects



(Unit: 000 US$)

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Right-of-Way	4,048	2,519	1,503	5,858	4,251	8,983	5,692	3,795	4,031	1,553	7,013	1,021	2,561	4,194	4,524	985	4,788	2,779	1,859	828	72,785
Construction	3,353	5,793	8,236	10,766	14,511	8,875	12,385	15,458	17,377	18,448	10,445	12,097	13,573	9,969	12,203	14,006	12,984	15,052	12,640	13,295	241,463
Maintenance	1,279	1,328	1,379	1,432	1,487	1,573	1,664	1,761	1,863	1,971	2,053	2,138	2,226	2,318	2,414	2,514	2,618	2,727	2,839	2,957	40,542
Total	8,680	9,640	11,118	18,056	20,249	19,432	19,741	21,013	23,271	21,972	19,511	15,256	18,360	16,481	19,141	17,505	20,391	20,557	17,338	17,080	354,790

- The investment amount by project package and by planning period is summarized in Table 9.1.2.

Table 9.1.1 Investment Program of Road Development Projects

Package	Project Name / Project Component	Cost (000 US$) Const.	ROW	Total	Phase	Period (years)	Start Year	Year 1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	C. Norte	**17,348**	**3,260**	**20,608**				**0**	**3,948**	**2,087**	**6,019**	**3,397**	**0**	**0**	**0**	**0**	**0**	**3,011**	**2,147**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	VM101	6,260	1,861	8,121	Short	3	2000		3,948	2,087	2,087																
	VM201	2,983	393	3,376	Short	2	2002				1,885	1,492															
	VM401	3,811	142	3,953	Short	2	2002				2,048	1,906															
	VC205	4,294	864	5,158	Long	2	2009											3,011	2,147								
2	Travesia	**37,628**	**10,536**	**48,164**				**0**	**0**	**0**	**0**	**0**	**8,368**	**4,027**	**4,027**	**0**	**0**	**7,409**	**4,289**	**4,289**	**7,302**	**4,227**	**4,227**	**0**	**0**	**0**	**0**
	VC210	12,681	3,075	15,756	Long	3	2012														7,302	4,227	4,227				
	VC301	12,080	4,341	16,421	Medium	3	2004						8,368	4,027	4,027												
	VC432	12,867	3,120	15,987	Long	3	2009											7,409	4,289	4,289							
3	P. J. Pablo II	**8,904**	**2,536**	**11,440**				**0**	**0**	**0**	**0**	**0**	**0**	**4,762**	**2,226**	**2,226**	**2,226**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	VM105	5,543	1,407	6,950	Medium	4	2005							2,793	1,386	1,386	1,386										
	VM106	3,361	1,129	4,490	Medium	4	2005							1,969	840	840	840										
4	C. Sur	7,460	2,471	9,931				0	0	0	0	0	0	0	3,380	1,395	1,395	0	0	0	0	0	0	2,124	1,638	0	0
	VM204	4,184	1,985	6,169	Medium	3	2006								3,380	1,395	1,395										
	VM205	3,276	486	3,762	Long	2	2015																	2,124	1,638		
5	P. Portezuelo	**8,872**	**2,276**	**11,148**				**3,298**	**1,494**	**1,899**	**0**	**0**	**0**	**0**	**0**	**2,418**	**2,038**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	VM301	313	92	405	Short	1	2001			405																	
	VM303	4,076	380	4,456	Medium	2	2007									2,418	2,038										
	VC304	4,483	1,804	6,287	Short	3	1999	3,298	1,494	1,494																	
6	P. Rural de Circunvalacion	**10,151**	**3,456**	**13,607**				**4,103**	**1,859**	**3,877**	**914**	**914**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,940**	**0**	**0**	**0**	**0**
	VM405	1,832	108	1,940	Long	1	2014																1,940				
	VC423	2,743	1,104	3,847	Short	3	2001			2,018	914	914															
	VC424	5,576	2,244	7,820	Short	3	1999	4,103	1,859	1,859																	
7	P. Sabana Grande	**10,891**	**3,430**	**14,321**				**0**	**1,012**	**354**	**2,582**	**1,132**	**0**	**0**	**0**	**1,860**	**1,520**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2,609**	**1,627**	**1,627**
	VM107	1,557	1,450	3,007	Short	2	2002				2,229	779															
	VM404	3,039	340	3,379	Medium	2	2007									1,860	1,520										
	VC433	1,414	658	2,072	Short	4	2000		1,012	354	354	354															
	VC438	4,881	982	5,863	Long	3	2016																		2,609	1,627	1,627
8	A. Ruben Dario-C. a Masaya	**9,575**	**1,770**	**11,345**				**0**	**0**	**0**	**0**	**2,867**	**0**	**0**	**2,535**	**1,772**	**1,772**	**0**	**0**	**0**	**0**	**1,283**	**1,117**	**0**	**0**	**0**	**0**
	VM104	1,427	682	2,109	Short	1	2003					2,109															
	VM114	599	159	758	Short	1	2003					758															
	VM305	5,315	763	6,078	Medium	3	2006								2,535	1,772	1,772										
	VM306	2,234	166	2,400	Long	2	2013															1,283	1,117				
9	C. Nueva a Leon	**7,536**	**721**	**8,257**				**0**	**0**	**0**	**1,408**	**1,004**	**0**	**0**	**0**	**3,081**	**2,764**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	VM202	5,528	317	5,845	Medium	2	2007									3,081	2,764										
	VC209	2,008	404	2,412	Short	2	2002				1,408	1,004															
10	C. Vieja a Leon	**3,984**	**591**	**4,575**																						2,583	1,992
	VM203	3,984	591	4,575	Long	2	2017																			2,583	1,992
11	P. Alterna a Masaya	**8,678**	**2,094**	**10,772**																				4,264	2,170	2,170	2,170
	VC437	8,678	2,094	10,772	Long	4	2015																	4,264	2,170	2,170	2,170
12	Central Road Package (Short-term)	**6,248**	**6,485**	**12,733**				**0**	**0**	**1,522**	**4,930**	**6,281**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	VM102	3,154	3,353	6,507	Short	2	2002				4,930	1,577															
	VM109	1,085	192	1,277	Short	1	2001			1,277																	
	VM110	130	115	245	Short	1	2001			245																	
	VM116	381	336	717	Short	1	2003					717															
	VC103	737	1,321	2,058	Short	1	2003					2,058															
	VC105	485	871	1,356	Short	1	2003					1,356															
	VC109	276	297	573	Short	1	2003					573															
13	Central Road Package (Medium-term)	**5,757**	**7,021**	**12,778**				**0**	**0**	**0**	**0**	**0**	**4,786**	**2,071**	**762**	**2,636**	**2,524**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	VM113	701	1,030	1,731	Medium	1	2005							1,731													
	VM115	334	88	422	Medium	1	2006								422												
	VM117	316	168	484	Medium	1	2004						484														

Table 9.1.1 Investment Program of Road Development Projects

Package	Project Name / Project Component	Cost (000 US$) Const.	ROW	Total	Phase	Period (years)	Start Year	Year 1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
13	VC101	1,547	1,862	3,409	Medium	2	2007									2,636	774										
	VC102	1,004	1,801	2,805	Medium	1	2004						2,805														
	VC104	561	604	1,165	Medium	1	2008										1,165										
	VC107	1,020	1,157	2,177	Medium	3	2004						1,497	340	340												
	VC108	274	311	585	Medium	1	2008										585										
14	Central Road Package (Long-term)	**6,706**	**3,320**	**10,026**				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,268**	**1,829**	**3,009**	**1,043**	**1,726**	**0**	**0**	**882**	**270**	**0**
	VM103	2,886	386	3,272	Long	2	2010												1,829	1,443							
	VM108	1,023	543	1,566	Long	1	2011													1,566							
	VM111	674	594	1,268	Long	1	2009											1,268									
	VM112	1,011	537	1,548	Long	2	2012														1,043	506					
	VC106	572	648	1,220	Long	1	2013															1,220					
	VC110	540	612	1,152	Long	2	2016																		882	270	
15	Western Road Package (Medium-term)	**12,862**	**2,477**	**15,339**				**0**	**0**	**0**	**0**	**0**	**3,096**	**5,250**	**3,390**	**1,381**	**2,223**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	VC201	4,143	897	5,040	Medium	3	2005							2,278	1,381	1,381											
	VC202	6,026	1,087	7,113	Medium	3	2004						3,096	2,009	2,009												
	VC204	1,883	340	2,223	Medium	1	2008										2,223										
	VC208	810	153	963	Medium	1	2005							963													
16	Western Road Package (Long-term)	**8,750**	**1,636**	**10,386**				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2,371**	**1,038**	**0**	**0**	**1,444**	**2,416**	**2,224**	**894**
	VC203	2,096	396	2,492	Long	2	2015																	1,444	1,048		
	VC206	873	165	1,038	Long	1	2012														1,038						
	VC207	2,009	362	2,371	Long	1	2011													2,371							
	VC211	1,985	375	2,360	Long	2	2016																		1,368	993	
	VC212	1,787	338	2,125	Long	2	2017																			1,232	894
17	Southern Road Package (Short-term)	**1,294**	**257**	**1,551**								**1,551**															
	VM304	1,294	257	1,551	Short	1	2003					1,551															
18	Southern Road Package (Medium-term)	**5,695**	**2,036**	**7,731**				**0**	**0**	**0**	**0**	**0**	**0**	**1,967**	**891**	**2,465**	**2,407**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	VM302	768	136	904	Medium	1	2008										904										
	VC305	429	162	591	Medium	1	2008										591										
	VC306	2,674	1,076	3,750	Medium	3	2005							1,967	891	891											
	VC308	1,824	662	2,486	Medium	2	2007									1,574	912										
19	Southern Road Package (Long-term)	**13,663**	**3,774**	**17,437**				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2,497**	**1,448**	**1,448**	**1,448**	**3,087**	**2,870**	**2,196**	**1,266**	**0**	**1,179**
	VC302	5,791	1,049	6,840	Long	4	2009											2,497	1,448	1,448	1,448						
	VC303	5,064	1,821	6,885	Long	4	2013															3,087	1,266	1,266	1,266		
	VC307	1,859	674	2,533	Long	2	2014																1,604	930			
	VC309	266	101	367	Long	1	2018																				367
	VC310	683	129	812	Long	1	2018																				812
20	Eastern Road Package (Short-term)	**1,943**	**444**	**2,387**				**0**	**0**	**0**	**771**	**1,616**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	VM402	655	116	771	Short	1	2002				771																
	VM403	418	15	433	Short	1	2003					433															
	VC408	870	313	1,183	Short	1	2003					1,183															
21	Eastern Road Package (Medium-term)	**5,102**	**1,858**	**6,960**				**0**	**0**	**0**	**0**	**0**	**1,609**	**0**	**2,043**	**2,175**	**1,134**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	VC403	234	89	323	Medium	1	2004						323														
	VC404	1,536	527	2,063	Medium	3	2006								1,039	512	512										
	VC406	1,243	470	1,713	Medium	2	2007									1,092	622										
	VC409	1,143	432	1,575	Medium	2	2006								1,004	572											
	VC416	946	340	1,286	Medium	1	2004						1,286														

Table 9.1.1 Investment Program of Road Development Projects

Package	Project Name / Project Component	Cost (000 US$) Const.	ROW	Total	Phase	Period (years)	Start Year	Year 1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
22	Eastern Road Package	**42,416**	**10,336**	**52,752**				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3,273**	**3,405**	**5,017**	**3,333**	**6,404**	**4,837**	**7,745**	**6,851**	**5,625**	**6,262**
	(Long-term)																										
	VM406	1,780	182	1,962	Long	2	2009											1,072	890								
	VC401	3,787	1,252	5,039	Long	4	2011													2,199	947	947	947				1,048
	VC402	881	167	1,048	Long	1	2018															574					
	VC405	417	157	574	Long	1	2013														746						
	VC407	627	119	746	Long	1	2012															1,676	975				
	VC410	1,950	701	2,651	Long	2	2013																				
	VC411	2,992	1,204	4,196	Long	3	2009											2,201	997	997					1,452	1,067	
	VC412	2,134	385	2,519	Long	2	2016																	1,317	766		
	VC413	1,532	551	2,083	Long	2	2015																	1,015	737		
	VC414	1,473	278	1,751	Long	2	2015																739				
	VC415	536	203	739	Long	1	2014														405						
	VC417	294	111	405	Long	1	2012														131						
	VC418	95	36	131	Long	1	2012																	1,327	975		
	VC419	1,950	352	2,302	Long	2	2015																			1,361	1,000
	VC420	2,000	361	2,361	Long	2	2017																			996	723
	VC421	1,445	273	1,718	Long	2	2017																				1,048
	VC422	881	167	1,048	Long	1	2018															2,102	1,364	1,364			
	VC425	4,093	738	4,831	Long	3	2013																	855			
	VC426	719	136	855	Long	1	2015																			1,078	782
	VC427	1,564	296	1,860	Long	2	2017																				1,661
	VC428	1,397	264	1,661	Long	1	2018															1,105	812				
	VC429	1,624	293	1,917	Long	2	2013																	1,868	1,373		
	VC430	2,745	495	3,240	Long	2	2015																		1,549	1,124	
	VC431	2,247	425	2,672	Long	2	2016												1,518	883							
	VC434	1,766	635	2,401	Long	2	2010													938	534						
	VC435	1,068	404	1,472	Long	2	2011														570						
	VC436	419	151	570	Long	1	2012																				
23	Road Maintenance Cost						1998 1,232	1,279	1,328	1,379	1,432	1,487	1,573	1,664	1,761	1,863	1,971	2,053	2,138	2,226	2,318	2,414	2,514	2,618	2,727	2,839	2,957

Note: ROW costis allocated in the first year while construction cost is divided equally to construction period.

Table 9.1.2 Summary Investment Program by Road Project Package and Planning Period

Unit: 000 US$)

	Package	Short Term	Medium Term	Long Term	Total
1	Carretera Norte	15,450	0	5,158	20,608
2	Travesia	0	16,421	31,743	48,164
3	Pista Juan Pablo II	0	11,440	0	11,440
4	Carretera Sur	0	6,169	3,762	9,931
5	Pista Portezuelo	6,692	4,456	0	11,148
6	Pista Rural de Circunvalacion	11,667	0	1,940	13,607
7	Pista Sabana Grande	5,079	3,379	5,863	14,321
8	Ave. Ruben Dario-Carretera a Masaya	2,867	6,078	2,400	11,345
9	Carretera Nueva a Leon	2,412	5,845	0	8,257
10	Carretera Vieja a Leon	0	0	4,575	4,575
11	Pista Alterna a Masaya	0	0	10,772	10,772
12	Central Road Package (Short-Term)	12,733	0	0	12,733
13	Central Road Package (Mediun-Term)	0	12,778	0	12,778
14	Central Road Package (Long-Term)	0	0	10,026	10,026
15	Western Road Package (Medium-Term)	0	15,339	0	15,339
16	Western Road Package (Long-Term)	0	0	10,386	10,386
17	Southern Road Package (Short-Term)	1,551	0	0	1,551
18	Southern Road Package (Medium-Term)	0	7,731	0	7,731
19	Southern Road Package (Long-Term)	0	0	17,437	17,437
20	Eastern Road Package (Short-Term)	2,387	0	0	2,387
21	Eastern Road Package (Medium-Term)	0	6,960	0	6,960
22	Eastern Road Package (Long-Term)	0	0	52,752	52,752
23	Road Maintenance	6,906	8,833	24,804	40,542
	Total	67,744	105,429	181,618	354,790

(2) Public Transportation Projects

- The investment program of the proposed public transportation projects is summarized by project package and planning period as shown in Table 9.1.3.

Table 9.1.3
Summary Investment Program by Public Transportation Project Package and Planning Period

(US$000)

Package No./Project Package Name	Immediate	Short Term	Medium Term	Long Term	Total
1. Public Transportation Corridor: Carretera Norte	-	5,749	2,273	6,336	14,358
2. Public Transportation Corridor: J. Pablo/ S. Grande	-	-	8,731	7,392	16,123
3. Security Enhancement	400	1,600	2,000	4,000	8,000
4. Rerouting	-	-	-	-	-
5. Fare Adjustment	-	-	-	-	-
6. Introduction of New Service	-	-	-	-	-
7. Public Bus Terminal: Mercado Oriental	-	1,500	-	-	1,500
8. Public Bus Terminal: Mercado San Judas	-	-	850	-	850
9. Public Bus Terminal: Merc. Virgen de Candelaria	-	-	850	-	850
10. Public Bus Terminal: Villa Flor	-	-	-	800	800
11. Public Bus Terminal: Sabana Grande	-	-	-	800	800
12. Public Bus Terminal: Ciudad Satélite Asososca	-	-	-	800	800
Total	400	8,849	14,704	20,128	44,081

(3) Traffic Management Projects

- The investment program of the proposed traffic management projects is summarized by project package and planning period as shown in Table 9.1.4.

Table 9.1.4
Summary Investment Program by Traffic Management Project Package and Planning Period

(US$000)

Package No./Project Package Name	Immediate	Short Term	Medium Term	Long Term	Total
1. Improvement of Existing Signals	58	-	-	-	58
2. Signalization and Coordinated Control (Short-Term)	-	9,357	-	-	9,357
3. Signalization and Coordinated Control (Medium-Term)	-	-	3,997	-	3,997
4. Signalization (Long-Term)	-	-	-	7,380	7,380
5. Grade Separation (Short-Term)	-	6,263	-	-	6,263
6. Grade Separation (Medium-Term)	-	-	18,819	-	18,819
7. Grade Separation (Long-Term)	-	-	-	19,217	19,217
8. Roundabout Const. (Short-Term)	-	2,200	-	-	2,200
9. Roundabout Const. (Medium-Term)	-	-	1,150	-	1,150
10. Roundabout Const. (Long-Term)	-	-	-	1,700	1,700
11. Pedestrian Crossing	150	-	-	-	150
12. Bicycle Road and Pedestrian Path	-	-	-	10,000	10,000
13. Public Transportation Priority Area	-	200	1,400	600	2,200
14. On-road Parking Banned Area	-	-	-	-	-
15. Increase of Fuel Consumption Tax	-	-	-	-	-
16. Increase of Vehicle Import Duty	-	-	-	-	-
17. Designation of Truck Routes	-	-	-	-	-
Total	208	18,020	25,366	38,897	82,491

Note: The cost of Public Transportation Priority Area is for installing traffic signals and signs.

(4) Summary

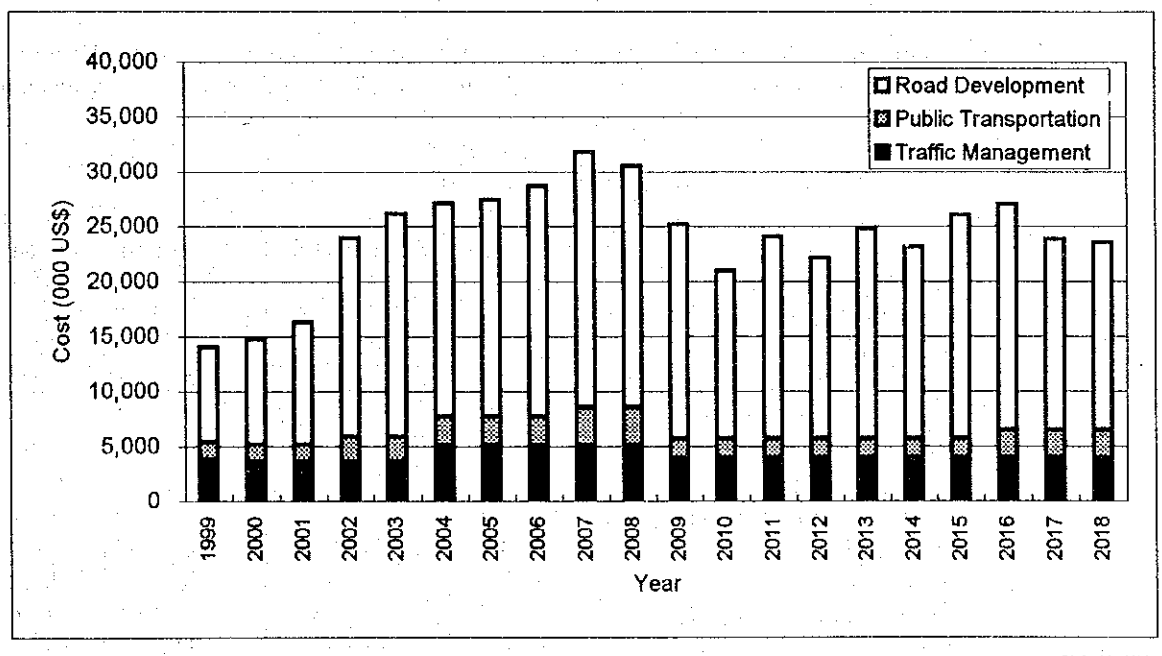
- The total cost of the Master Plan accounts for US$481 million, as shown in Table 9.1.5. The allocation is US$95 million in the Short-Term, US$145 million in the Medium-Term and US$241 million in the Long-Term. Required average annual investment is the highest in the Medium-Term. Figure 9.1.2 presents the annual investment requirement of the Master Plan.

Table 9.1.5
Summary Investment Program of Master Plan by Planning Period

(US$000)

	Short-Term	Medium-Term	Long-Term	Total
Road Project	67,744	105,429	181,618	354,790
Public Transportation Project	9,249	14,704	20,128	44,081
Traffic Management Project	18,228	25,366	38,897	82,491
TOTAL	95,221	145,499	240,643	481,362

Figure 9.1.2 Summary Investment Program of All Projects in Master Plan



(Unit: 000 US$)

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Road Development	8,680	9,640	11,118	18,056	20,249	19,432	19,741	21,013	23,271	21,972	19,511	15,256	18,360	16,481	19,141	17,505	20,391	20,557	17,338	17,080	354,790
Public Transportation	1,550	1,550	1,550	2,300	2,300	2,601	2,601	2,601	3,451	3,451	1,773	1,773	1,773	1,773	1,773	1,773	1,773	2,573	2,573	2,573	44,081
Traffic Management	3,812	3,604	3,604	3,604	3,604	5,073	5,073	5,073	5,073	5,073	3,890	3,890	3,890	3,890	3,890	3,890	3,890	3,890	3,890	3,890	82,491
Total	14,042	14,794	16,272	23,210	26,903	27,106	27,415	28,687	30,945	31,346	25,173	20,918	24,022	22,144	24,803	23,167	26,053	26,220	23,000	25,142	481,362

9.2 Fund Source

(1) Self-Financing Projects

- As was examined by financial evaluation (see Section 8.3), there are some financially viable projects. They are:

  1. Travesía (Road Project Package No. 2).
  2. Public Transportation Corridor Carretera Norte and Pista Juan Pablo II/Pista Sabana Grande (Public Transportation Project Package No. 1 and No. 2).
  3. Public Bus Terminals (Public Transportation Project Package No. 7 ~ No. 12).
  4. Public Transportation Priority Areas (Traffic Management Project Package No. 13).

- For the above-listed projects, allocation of public fund is not necessarily needed due to the following reasons:

  - The private sector can be invited for the construction and operation of the project.
  - If the public sector implements the project by itself, commercial loans can be mobilized due to high financial viability.
  - If external grant can be tapped for the implementation of the project due to the high economic feasibility, the revenue can be used for the implementation of other transportation projects.

- Table 9.2.1 shows the investment requirements of the Master Plan considering the self-financing projects. The total investment of US$481 million has been reduced to US$395 million by about 18%.

Table 9.2.1
Investment Requirements of Master Plan

(US$ million)

	Short Term	Medium Term	Long Term	Total
Road Projects	67.7	105.4	181.6	354.8
Self-Financing Projects	-	16.4	31.7	48.2
Sub-Total	67.7	89.0	149.9	306.6
Public Transportation Projects	9.2	14.7	20.1	44.1
Self-Financing Projects	7.2	12.7	16.1	36.1
Sub-Total	2.0	2.0	4.0	8.0
Traffic Management Projects	18.2	25.4	38.9	82.5
Self-Financing Project	0.2	1.4	0.6	2.2
Sub-Total	18.0	24.0	38.3	80.3
All Projects	95.2	145.5	240.6	481.4
Self-Financing Projects	7.4	30.5	48.5	86.4
Total	87.8	115.0	192.2	394.9

(2) Possible Fund Source

- Table 9.2.2 presents the summary of possible fund sources (refer to Chapter 6). However, the magnitude has a very wide range due to the following reasons:

  1. Aid from foreign countries is not reliable depending largely on the economic, social and political situation of both recipient and donor countries.
  2. Increase of tax needs social consensus and amendments of related laws and regulations. Although the Petroleum Consumption Tax is likely to be raised soon, the municipal Road User Tax and the national Import Tax for cars will require a lengthy discussion to be amended.

- Thus the budget envelope will be US$53 to 143 million in the Short-Term, US$77 to 248 million in the Medium-Term and US$239 to 750 million in the Long-Term to invest on the transportation sector in Managua.

Table 9.2.2
Possible Fund Sources for Managua's Transportation

(US$ million)

	Short Term	Medium Term	Long Term	Total
Public (Existing Source)				
• Internal	36.6	48.2	147.8	232.6
• External (Grant)	(29.7)	(33.0)	(78.8)	(141.5)
• External (Loan)	(10.0)	(59.3)	(181.5)	(250.8)
Sub-Total	36.6~76.3	48.2 ~ 140.5	147.8 ~ 408.1	232.6 ~ 624.9
Proposed Tax Increase				
• Real Property Tax (ALMA)*	0.9	3.3	12.9	17.1
• Road User Tax (ALMA)	(2.1)	(4.5)	(15.6)	(22.2)
• Petroleum Consumption Tax (Nicaragua)**	15.7	25.0	78.0	118.7
• Car Import Tax (Nicaragua)**	(47.5)	(75.0)	(235.0)	(357.5)
Sub-Total	16.6 ~ 66.2	28.3 ~ 107.8	90.9 ~ 341.5	135.8 ~ 515.5
Total	53.2 ~ 142.5	76.5 ~ 248.3	238.7 ~ 749.6	368.4 ~ 1,140.4

Note: * Proposes timely amendment of cadastral values, not increase of tax rate.
** Assumes 25% allocation to Managua.

(3) Required Financial Arrangements

- In the Short-Term and Medium-Term, the investment requirements of the Master Plan are considerably larger than the lower limit of the budget envelope by US$35 million and 39 million, respectively. This means that the proposed projects cannot be implemented unless a large amount of foreign aid (grant or loan) and/or new tax revenue are mobilized. There is a way to tap loans from foreign countries having the long-term revenue as a source of its repayment. However, this is also uncertain due to the current guideline set by IMF which is prohibitive for international funding organizations and bilateral sources to arrange new loans for the Government of Nicaragua, though this restriction is expected to be lifted in the near future.

- Therefore, it is strongly recommended for the Government of Nicaragua to secure a revenue enough to fund the proposed projects by increasing the rate of import duty for private cars. In parallel to this action, the arrangement to tap grant aid from external sources should be accelerated for immediate needs of funding.

10. Conclusion and Recommendations

10. CONCLUSION AND RECOMMENDATIONS

10.1 Conclusion

1. Urban transportation system in Managua is entirely road-based. While roads are relatively well provided in terms of right-of way (ROW), the network is configured without explicit functional hierarchy, and existence of missing links and lack of maintenance amplify inefficiency of the network. Construction of new roads is led by low-rise low- density urbanization which occurs inevitably under strong pressure of population increase and in the absence of strict control of the Government. Under these circumstances, Managua will become an energy-consumptive, expensive and environmentally poor auto-based city if road is not developed in compliance with an elaborated land use plan.

2. At present, the magnitude and seriousness of traffic problems are not outstanding yet in Managua as are seen in many other large cities in the world. This is not only because of the smaller scale of Managua's economy but because of the relatively high level of infrastructure stock and well disciplined behavior of the citizen. Due, however, to the increasing population and growing economy, traffic congestion will soon be serious. Volume/capacity ratio of roads, which is 0.6 at present, is projected to reach 1.1, over the capacity, by the year 2003. Hence, it is imperative to construct new roads in a well planned manner. If no measure is taken, road network efficiency as well as people's discipline will be eroded causing irreparable damages in the society and economy.

   However, the problem of traffic congestion has never been solved in the world merely by constructing the road one after another. It is not only a waste of resources but a profanation to the living environment of the City. Road development must be executed in a balance with other measures of public transportation improvement, traffic management, and demand management. In other words, traffic problem cannot be solved by supply-side measures alone, and demand-side measures should be taken into account.

3. Public transportation is much more efficient than private car in terms of travel cost and road space. Managua should adopt a policy towards the creation of public transportation-based city. However, the current levels of service of public transportation should be upgraded in many areas such as safety, comfort, accessibility and diversity. This is very much critical to curb the future modal shift of people from bus to private car as income increases. Introduction of busways and different types of public transportation services including feeder bus, premium bus (e.g. air conditioned, all-seater, etc.), express bus and collective taxi will contribute to the improvement of Managua's public transportation system coupled with other supportive measures such as rerouting, adjustment of fare structure and development of public bus terminals.

   Current public transportation of the City has been operated entirely by the private sector which is not the cases in many other countries. The Government should take advantage of the current situation and refrain from excessive intervention in the future. Therefore, the role of the Government in promoting public transportation-based city is basically to provide with necessary infrastructure for their efficient operation and regulatory framework to encourage entries, competitive operations and new type of services. For this, transit corridors should be defined clearly and public investments be concentrated into these priority areas.

4. At the current level of vehicular traffic, most of traffic congestions and safety problems at some critical sections can be solved or mitigated with low-cost traffic management measures. Usually traffic management measures produce a large

economic benefit compared to its small cost. The role is also important in the future to improve traffic flow, to reduce traffic accidents and to enhance road users' comfort. While conventional traffic management intends to streamline the existing traffic flow, demand management intends to control the demand itself using physical and/or pricing measures. In the context of Managua's situation, the demand management should be looked into from the two important angles. One is to discourage the use of private car and encourage the shift to public transportation, and the other is to generate additional funds for transportation infrastructure development through various user charges and taxes. However, direct pricing measures such as road pricing seem to be immature at present judging from the low time value of the citizen (i.e. distortion of traffic distribution could be unusually large). Presumably in the long-term, these measures should be looked into in relation to clearly determined target roads.

5. Safe and comfortable walking is the most fundamental component of urban transportation system. Sidewalk must be improved or constructed in conjunction with road improvement and construction works. Taking advantage of relatively ample road space, widely distributed open space including greenery and lakes in the City, pedestrian and bicycle paths should be provided to improve recreational and environmental conditions of Managua.

6. The severe natural conditions of Managua, particularly the possibility of earthquake, should be taken into account in planning land use and road network. Although it is impossible to prevent damages, the City must be ready to control the damage by establishing strong regulatory framework on the land use.

7. The proposed projects in the Master Plan will have no significant impact on environment except for possible relocation of housing settlements located in right-of-way of some of the proposed roads and in some sites of the proposed bus terminals. Air pollution, noise and vibration are also critical factors which need to be analyzed in relation to the proposed roads. It should be noted that the proposed projects would contribute positively to the improvement of environment as a whole.

8. There is a sheer lack of public funds to finance the implementation of the proposed projects. Particularly in the Short and Medium-Term, the proposed projects cannot be implemented unless foreign aid (grant/loan) and/or new tax revenue is tapped sufficiently.

10.2 Recommendations

Land Use Plan

- Authorize and legalize the proposed land use plan (with density restrictions) after discussions with relevant agencies and amendment, if any (Immediate Action).

- Conduct an in-depth study to compare various possible alternatives in relation to the proposed expansion of Managua International Airport, coupled with land use planning.

Road Development

- Execute the proposed road projects according to the implementation program. All the proposed projects are economically feasible.

- Pay due attention in the design of proposed road projects to avoid conflict with the proposed Public Transportation Corridors. Improvement of sidewalk and drainage must be taken into account as well.

- Invite the private sector in constructing the proposed Travesía as a toll road (Medium-Term). This project has been proven financially viable. Prior to the negotiation with the private sector, Government should establish the rules and regulations for implementing privately financed infrastructure projects.

- Conduct routine and periodic road maintenance systematically.

Public Transportation

- Construct Public Transportation Corridors, one on Carretera Norte (Short-Term) and the other on Pista Juan Pablo II/Pista Sabana Grande (Medium-Term). Although these projects are economically and financially feasible, a full-scale feasibility study should be conducted for the former (Immediate Action). Government should take a strong initiative in this project considering the huge economic benefit.

- Employ about 400 security guards to randomly inspect running buses in order to prevent in-vehicle crimes. This is an urgent issue to recover people's confidence towards the policy goal of public transportation-oriented city (Immediate Action). In order to reduce the number of traffic accidents, MTI should strengthen its capacity for inspection of bus units and operation.

- Diversify public transportation services by introducing feeder bus (Immediate Action), premium bus (e.g air-conditioned, all-seater, etc.), express bus and collective taxi (Short-Term). For feeder bus, service area should be determined considering the location of urban axes and Public Transportation Corridors.

- Conduct rerouting of bus routes and amendment of fare structure in a timely manner in order to rationalize bus operation and to solve the problems inherent to the commencement of new services. Bus fare structure should be amended from the current flat rate to distance-related system (Immediate Action).

- Construct public bus terminals in conjunction with development or renovation of public markets in Mercado Oriental (Short-Term), Mercado San Judas, Mercado Virgen de Candelaria (Medium-Term), Villa Flor, Sabana Grande and Ciudad Satélite Asososca (Long-Term). These projects seem to be financially viable at a relatively low terminal charge and would desirably be operated by COMMEMA.

Traffic Management

- Improve existing traffic signals by adjusting signal phases coupled with minor geometric improvement (Immediate Action).

- Execute intersection improvement projects according to the implementation program. This includes 259 signal installations coupled with coordinated traffic control on 4 sections, 16 grade separations and 5 roundabouts.

- Develop pedestrian crossings with signal installation to improve safety at 3 critical sections (Immediate Action).

- Develop a bicycle road of about 40 kms and a pedestrian path of about 5 km to connect the shoreline of Managua Lake, vista points, major cultural/recreational zones and universities (Long-Term).

- Designate Public Transportation Priority Area around public markets to improve traffic situation by restricting private cars. This should be done in conjunction with the development of public bus terminals.

- Designate On-Road Parking Banned Area in relation to the proposed Public Transportation Corridors for strict enforcement of parking control (Short-Term and Medium-Term).

- Increase the rate of Fuel Consumption Tax (Immediate Action) and Import Duty on cars (Short-Term) to discourage car use and ownership.

- Restrict truck routes by recommending (Short-Term) and designating (Long-Term) the truck roads in order to avoid the serious damage on road pavement caused by overloaded trucks.

Financing

- Establish an organization to construct and operate the proposed Public Transportation Corridors under strong initiative of the Government (Short-Term).

- Investigate the possibility for COMMEMA to construct and operate the proposed public bus terminals and Public Transportation Priority Areas (Short-Term).

- Take administrative steps to timely re-evaluate the cadastral value of real property to capture the indirect benefit of property owners due to road development (Immediate Action).

- Double the municipal Road User Tax (Rodamiento) for private cars (Short-Term).

- Start negotiation with the national Government regarding the allocation to Managua of the proposed Road Maintenance Fund (Fondo de Mantenimiento Vial) collected from Petroleum Consumption Tax (Immediate Action).

- Negotiate with the national Government regarding the possible increase of Import Duty for cars and its allocation to Managua (Immediate Action). This is important to finance the proposed projects in this Master Plan.

- Accelerate the arrangement to tap grant aid from international funding organizations and bilateral sources (Immediate Action).

Further Studies

- Conduct environmental impact assessment (EIA) for the identified road projects which need relocation of housing settlements.

- Conduct feasibility studies on:

  - Construction of Travesía (Short-Term).
  - Widening of Carretera Sur, Carretera Vieja a León and Carretera Nueva a León (Short-Term).
  - Widening and construction of Pista Portezuelo and Pista Rural de Circunvalación (Short-Term).
  - Widening and construction of Ave. Rubén Darío, Carretera a Masaya and Pista Alterna a Masaya (Short-Term).
  - Widening and Public Transportation Corridor Development of Carretera Norte (Immediate Action).
  - Widening, Construction and Public Transportation Corridor Development of Pista Juan Pablo II and Pista Sabana Grande (Short-Term).
  - Development of Public Bus Terminals and Rationalization of Bus Industry (Short-Term).
  - Intersection Improvement (Short-Term and Medium-Term).