TABLE 8.3-1 REGIONAL OD MATRICES - 2020

a. Passengers (Trip/day)

REGION	NCR	CAR	I	II	III	IV-A	V	TOTAL
NCR	-	10,683	17,694	4,493	321,761	784,215	8,255	1,111,100
CAR	10,683	54,342	44,171	17,849	8,139	6,532	2,558	144,273
I	17,695	44,169	148,613	10,317	43,718	7,777	3,413	275,702
II	4,493	17,849	10,318	200,204	4,307	4,764	2,513	244,447
III	321,761	8,140	43,717	4,308	762,873	16,955	3,832	1,161,586
IV-A	748,213	6,533	7,777	4,764	16,955	730,694	18,486	1,533,422
V	8,255	2,557	3,413	2,513	3,832	18,486	208,890	247,946
TOTAL	1,111,100	144,273	275,702	244,448	1,161,585	1,533,422	247,946	4,718,475

b. Commodities (Ton - Trip/day)

REGION	NCR	CAR	I	II	III	IV-A	V	TOTAL
NCR	-	1,053	1,443	883	13,755	27,186	522	44,842
CAR	956	3,552	655	699	478	559	250	7,148
I	2,592	3,978	13,803	614	5,102	862	351	27,300
II	2,162	1,543	1,210	16,897	3,110	1,353	647	26,922
III	27,933	727	2,971	809	62,531	2,806	423	98,199
IV-A	78,016	586	632	363	1,518	49,095	2,487	132,696
V	467	295	326	234	484	3,224	13,636	18,667
TOTAL	112,125	11,732	21,040	20,500	86,977	85,085	18,315	355,774

c. Vehicles (Trip/day)

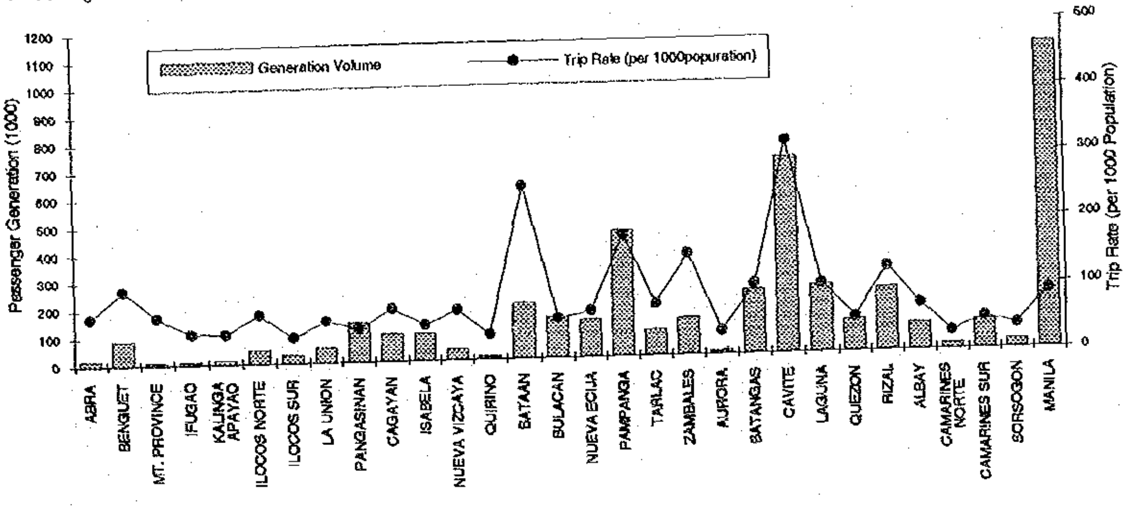
REGION	NCR	CAR	I	II	III	IV-A	V	TOTAL
NCR	-	1,375	2,137	566	58,456	100,240	682	163,457
CAR	1,375	7,543	4,868	1,877	1,001	723	254	17,639
I	2,137	4,868	16,986	1,012	4,607	796	329	30,735
II	566	1,877	1,012	18,143	669	455	233	22,953
III	58,456	1,001	4,607	669	78,106	2,747	384	145,969
IV-A	100,240	723	796	455	2,747	75,140	2,450	182,551
V	682	254	329	233	348	2,450	22,613	26,945
TOTAL	163,457	17,639	30,735	22,953	145,969	182,551	26,945	590,249

A, and high generation in Regions IV-A, III and then NCR. The same three regions are dominating the regional vehicle trips in the future.

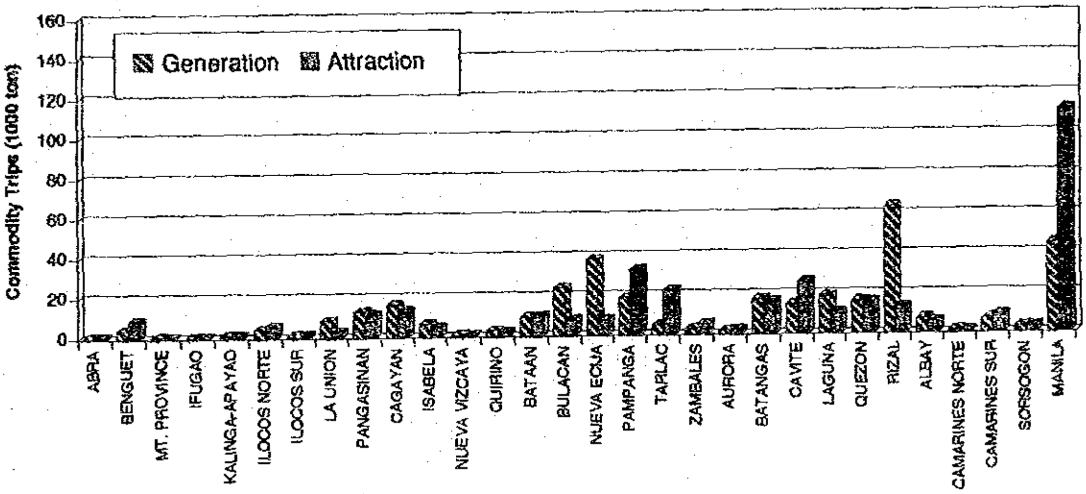
8.3.3 Commodity Trips from/to Metro Manila

The flow of commodity trips from and to Metro Manila, as the center of all the economic activities in Luzon Island, is estimated for the future year 2020, as shown in the desire-line charts of the total commodity trips in both directions in Figure 8.3-5. All the provinces in Luzon Island represent destinations for commodities from Metro Manila, however, the four provinces of Rizal, Pampanga, Cavite and Laguna are the most attractors of such trips and followed by Batangas and Bulacan. That is followed by the general pattern which clarifies that the northwestern provinces have more commodity trips from Metro Manila than other provinces.

1. Passengers



2. Commodities



3. Vehicles

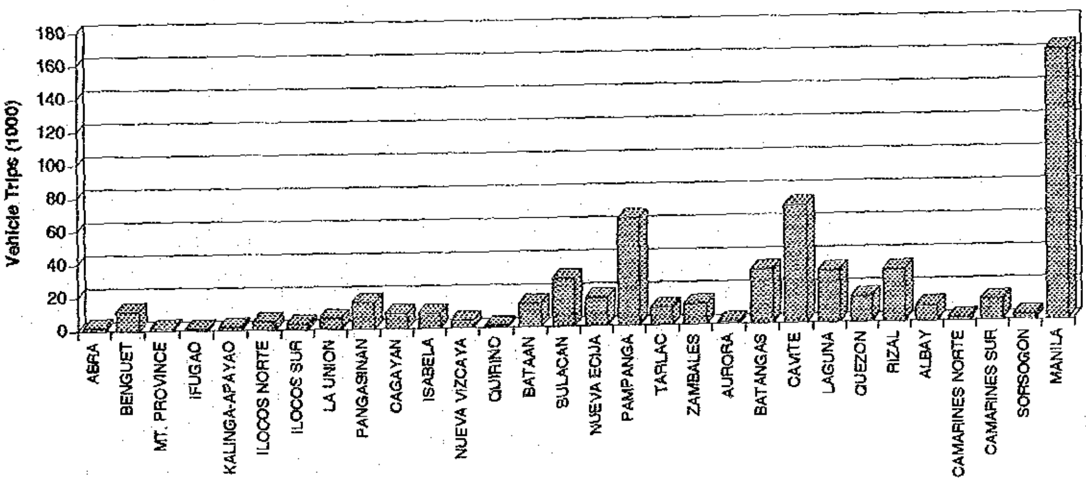
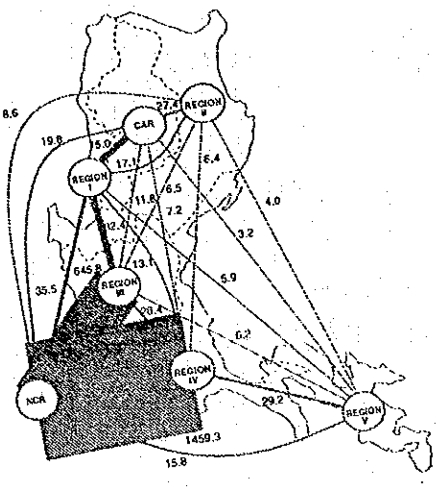


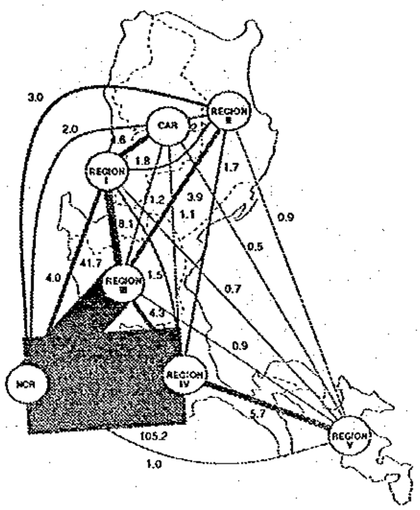
FIGURE 8.3-2 PROVINCIAL TRIP GENERATION AND ATTRACTION - 2020

1. Passengers



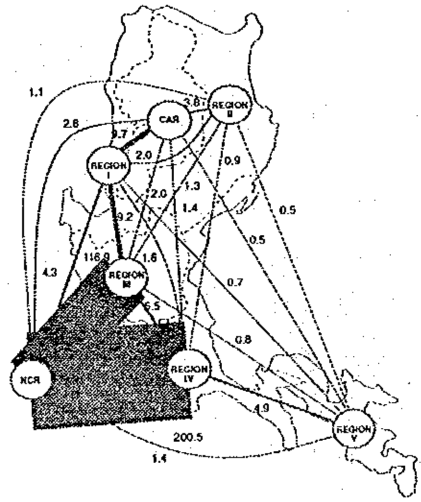
(1,000 Passenger-Trip)

2. Commodities



(1,000 Ton-Trip)

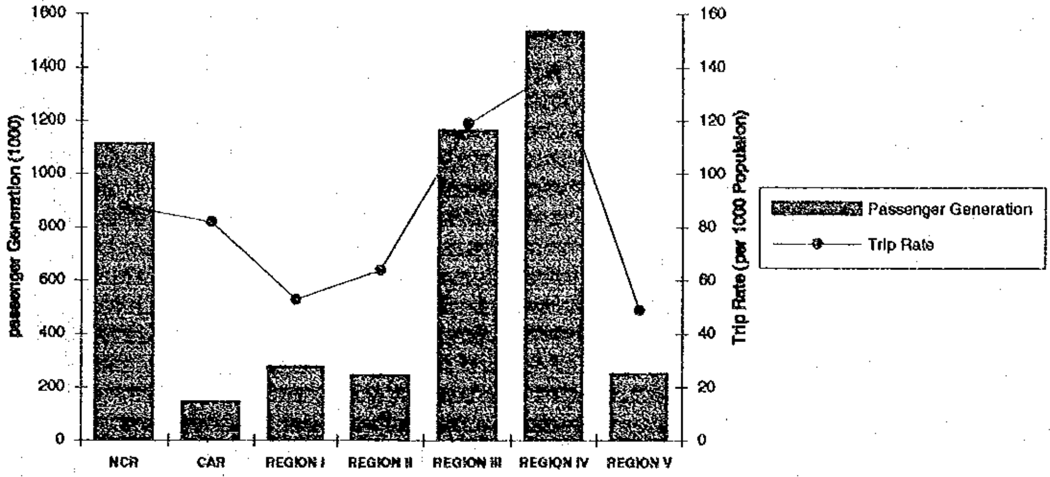
3. Vehicles



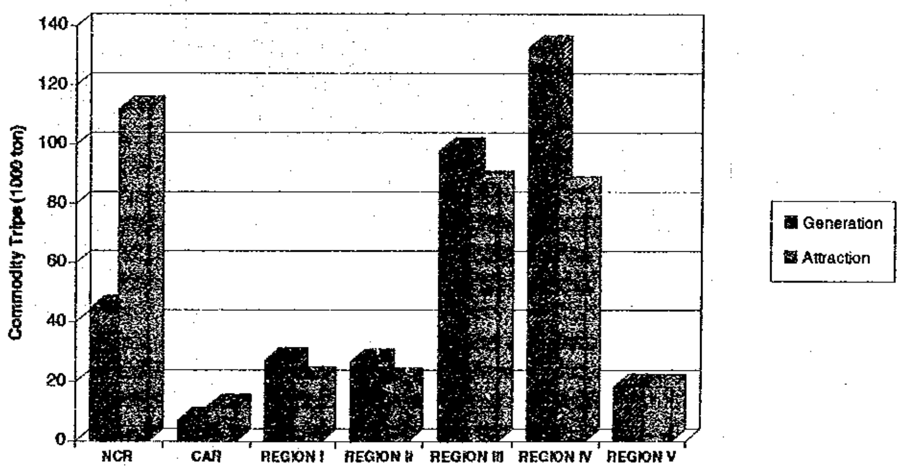
(1,000 Vehicle-Trip)

FIGURE 8.3-3 REGIONAL DESIRE-LINE CHART - 2020

1. Passengers



2. Commodities



3. Vehicles

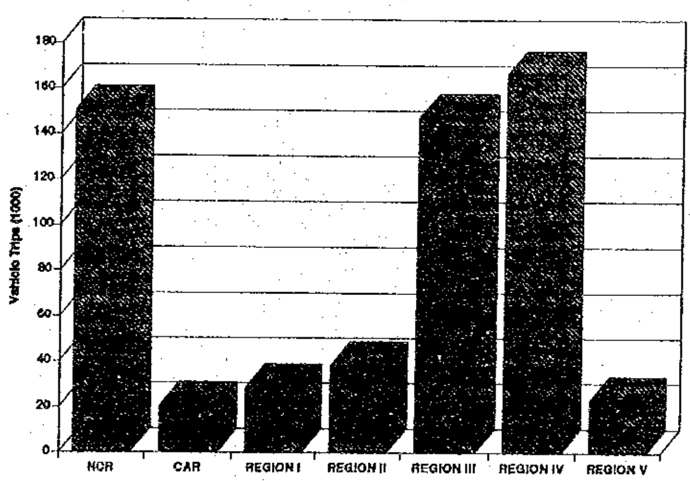


FIGURE 8.3-4 REGIONAL TRIP GENERATION AND ATTRACTION - 2020

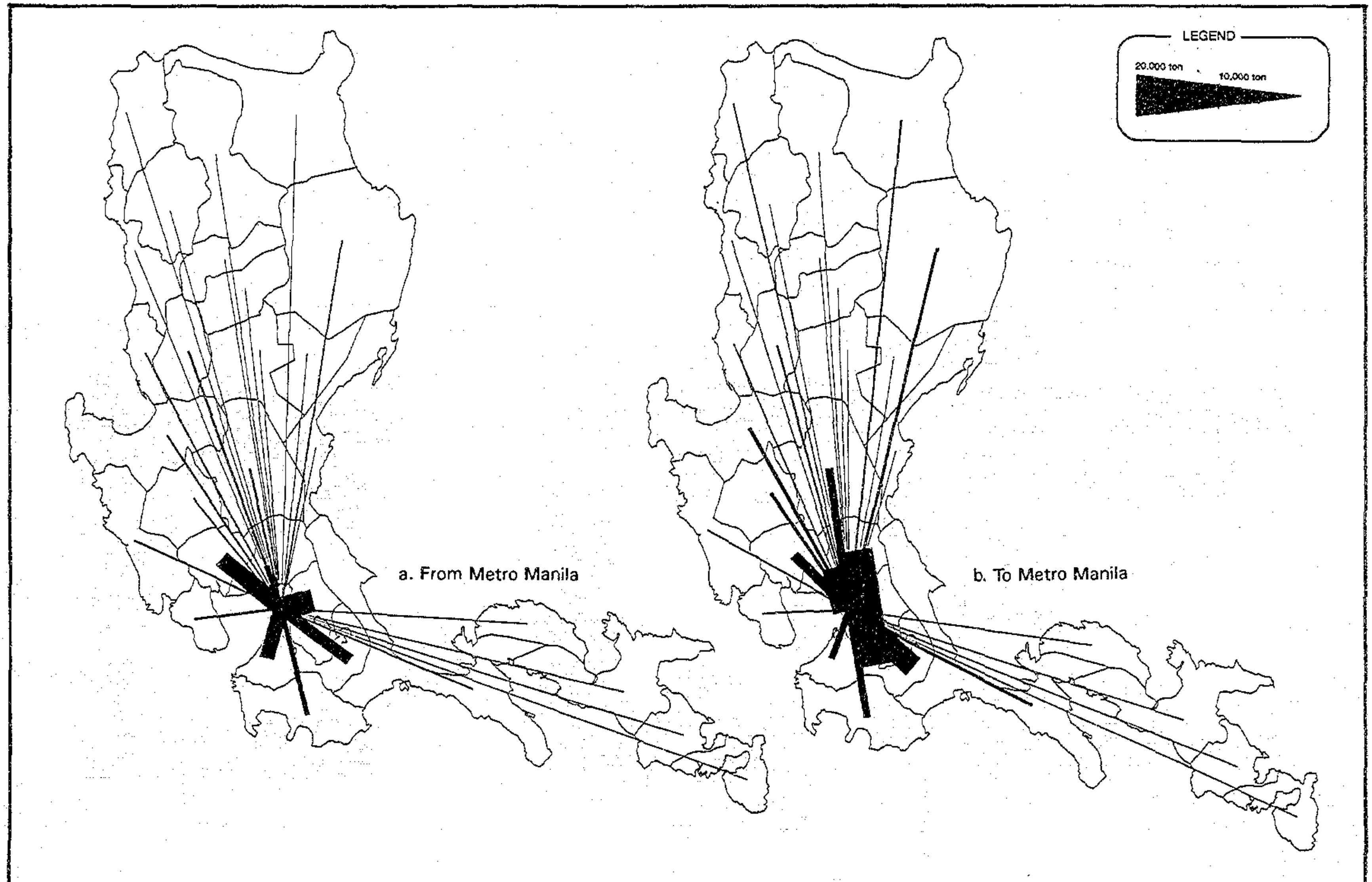


FIGURE 8.3-5 COMMODITY TRIPS FROM/TO METRO MANILA - 2020

Commodity flow to Metro Manila in the year 2020 is expected to be originated also from all the provinces in the island in different rates but most of the flow will be coming from the surrounding provinces of Rizal, Bulacan and Laguna. Other provinces with high potential are Pampanga, Batangas, Cavite and Nueva Ecija, then followed by Pangasinan and Quezon.

8.3.4 Growth in Trip Generation and Attraction

A comparative analysis between the present and future generated and attracted trips is carried out to estimate the growth rates in the different trip patterns. Results of this analysis give indications on the expected growth in the trips of passengers, commodities and vehicles till the year 2020 for the two cases of "Without Project" and "With Project".

As shown in Figure 3.4-6, the growth trend of trips is higher in the first period till the year 2000 than the growth from 2000 to the year 2020, and the growth in passenger trips is slightly increasing than vehicle trips while commodity trips comes later. In the case of "Without Project" the growth in all trips is lower than that of the "With Project" case due to the induced trips which will result with introducing improvements in the road condition and adopting LISR network. Numerically, growth rates in the first case are 2.3 for passenger trips, 2.17 for commodities and 2.28 for vehicles while the rates in the second case are 2.17, 2.05 and 2.14 respectively.

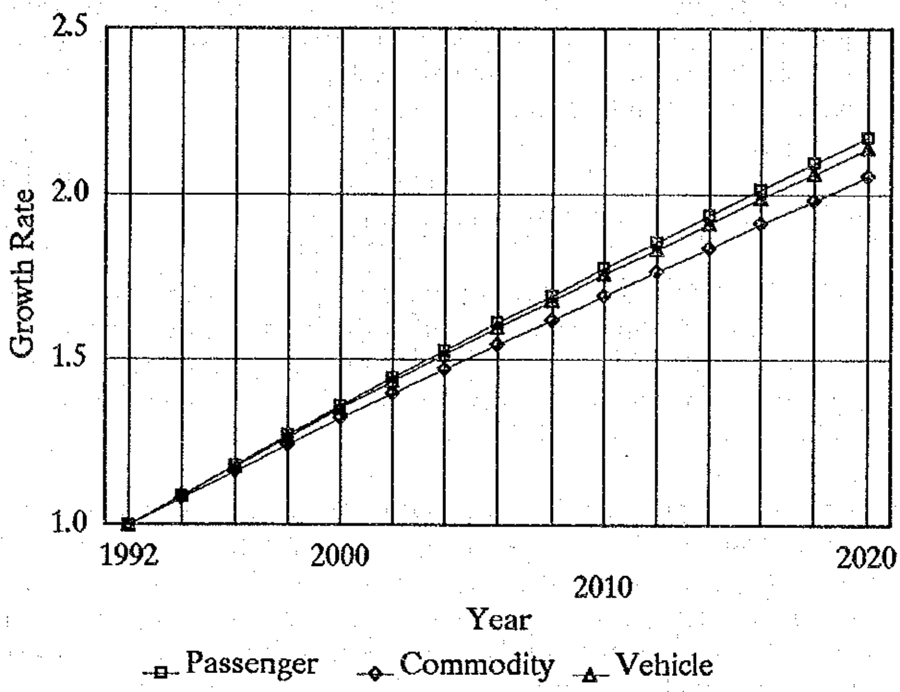
8.4 FUTURE TRAFFIC VOLUMES

Forecasted OD matrices of the vehicle trips, for the future years of 2000, 2010 and 2020 in the case of "Without Project", are assigned on the existing road network to produce the daily traffic volumes in this case. On the other hand, OD matrices for the second case of "With Project" are assigned on the road network when applying the upgrading measures in LISR project, which will result in better traffic conditions and higher accessibility through the new roads, to produce daily traffic volumes for the case of "With Project". Link and node data applied in the assignment procedure, however, are composed of the whole road network with programming conditions identifying each network separately. Impassable roads due to road or bridge conditions as well as non-existing links in the "Without Project" case will not handle traffic volumes resulting through the assignment of the inter-zonal trips.

8.4.1 "Without Project" Case

Resulted traffic volumes through the assignment procedure applied on the future OD matrices are graphically plotted on the flow map in Figure 8.4-1. The flow map consists volumes of the three future years of 2000, 2010 and 2020.

a. "Without Project" Case



b. "With Project" Case

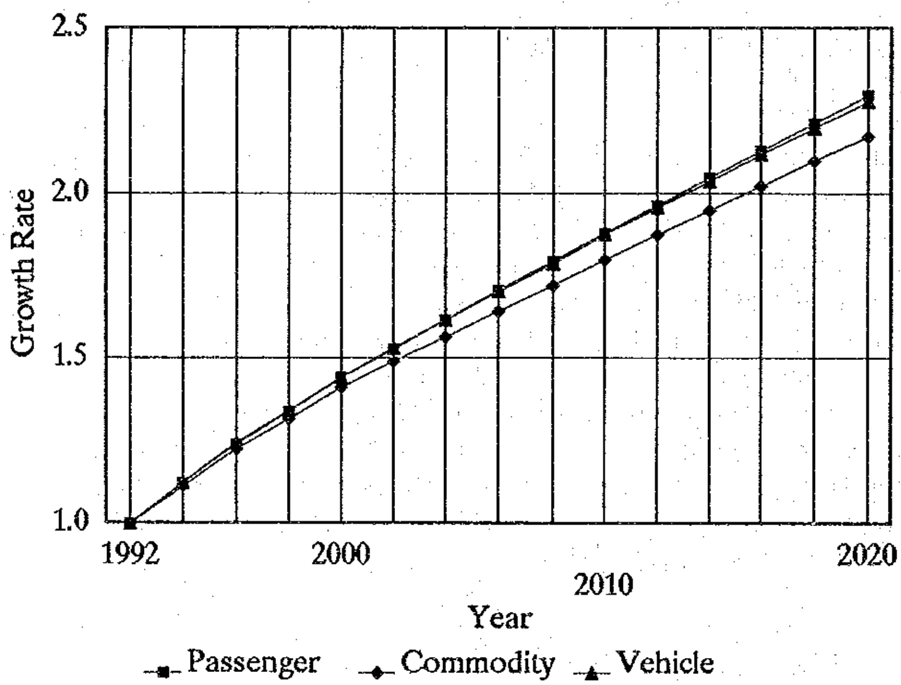


FIGURE 8.3-6 GROWTH RATE OF TRIP GENERATION AND ATTRACTION

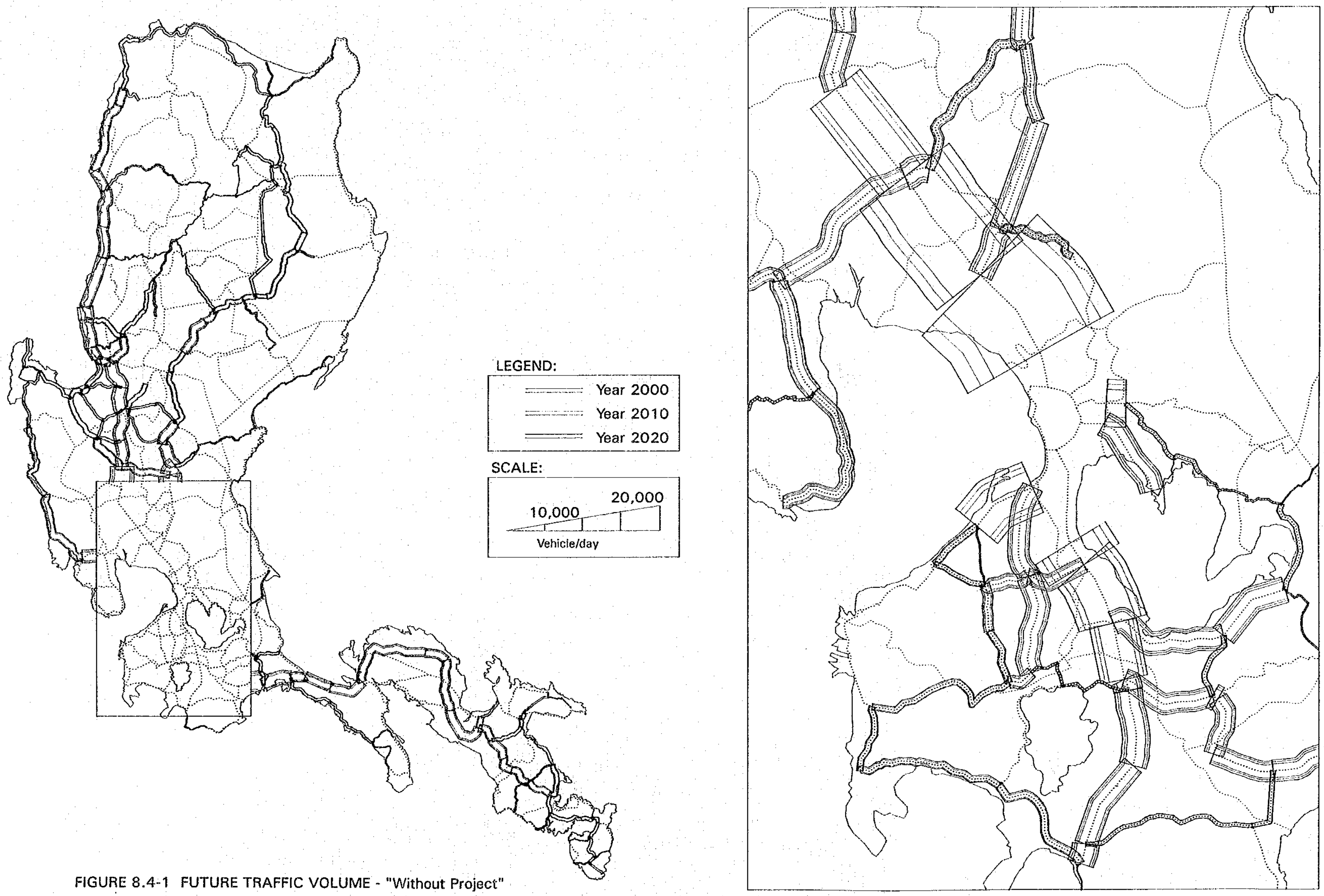


FIGURE 8.4-1 FUTURE TRAFFIC VOLUME - "Without Project"

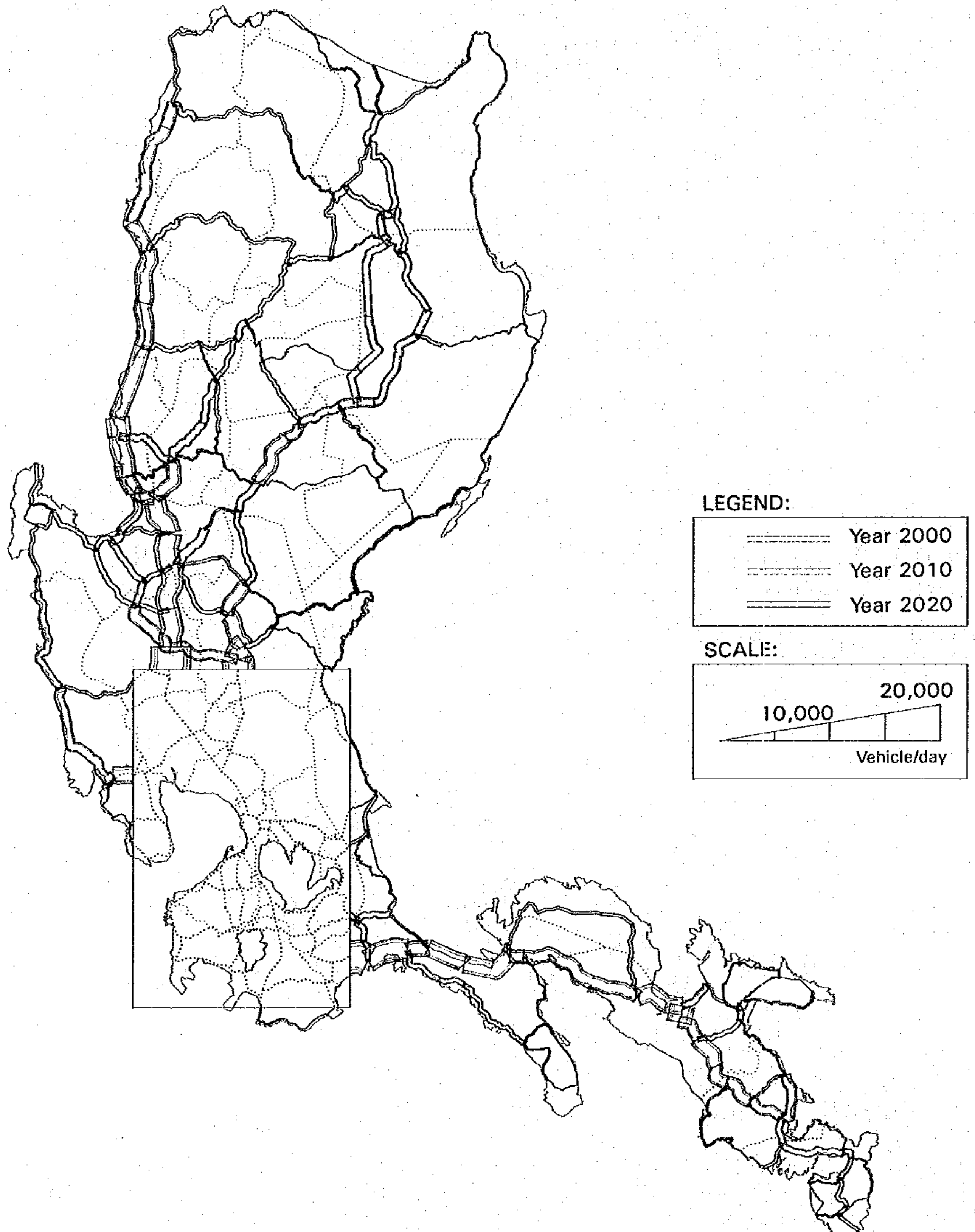
Numerical values of the future traffic volumes per vehicle category on each road link in the network are included in Appendices 8.8, 8.9 and 8.10 for the future years 2000, 2010, and 2020 respectively. In this case, the existing road network with its normal condition is used in the assignment procedure. Used link codes are those presented in the provincial road maps of Appendix 3.1

8.4.2 ""With Project" Case

Forecasted traffic volumes on the road network in the case of "With Project are shown graphically in the flow map of Figure 8.4-2 for the three future years of 2000, 2010 and 2020. Values of forecasted traffic volumes by vehicle category for this case are presented in Appendices 8.11, 8.12 and 8.13 for the future years 2000, 2010 and 2020 respectively. This case of "With Project" is showing more balanced distribution of traffic volumes on the road network with less traffic volumes on congested links due to its better road condition and the increase in number of alternative and passable roads.

8.4.3 Growth in Traffic Volumes

The average growth rate of traffic volumes on roads of each province between 1992 and 2020 is shown in Figure 8.4-3 for the two cases of "Without Project" and "With Project". In general, the "With Project" case shows higher average growth with peak values for provinces with very low traffic volumes at present such as Kalinga Apayao, Mt. Province, Aurora and Abra. Implementation of new roads and improving the road network are expected to introduce induced volumes and balance the traffic volumes on the whole network. The lowest provincial growth is expected in Camarines Norte as most of the traffic directed from/to the south, currently handles by the Pan-Philippine Highway, will be handled instead by the Quirino Highway which is considerably shorter and running in the provinces of Quezon and Camarines Sur.



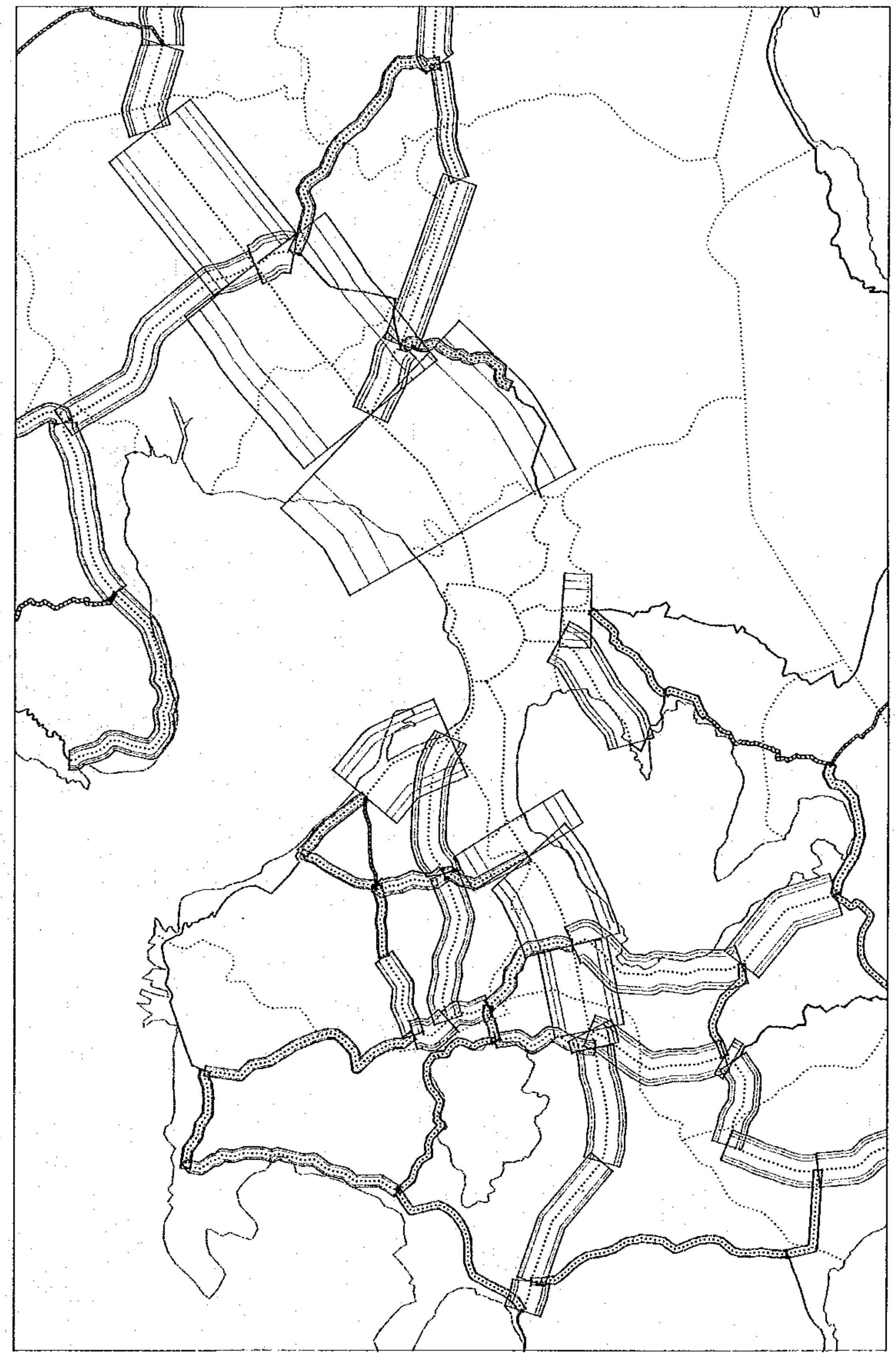


FIGURE 8.4-2 FUTURE TRAFFIC VOLUME - "With Project"

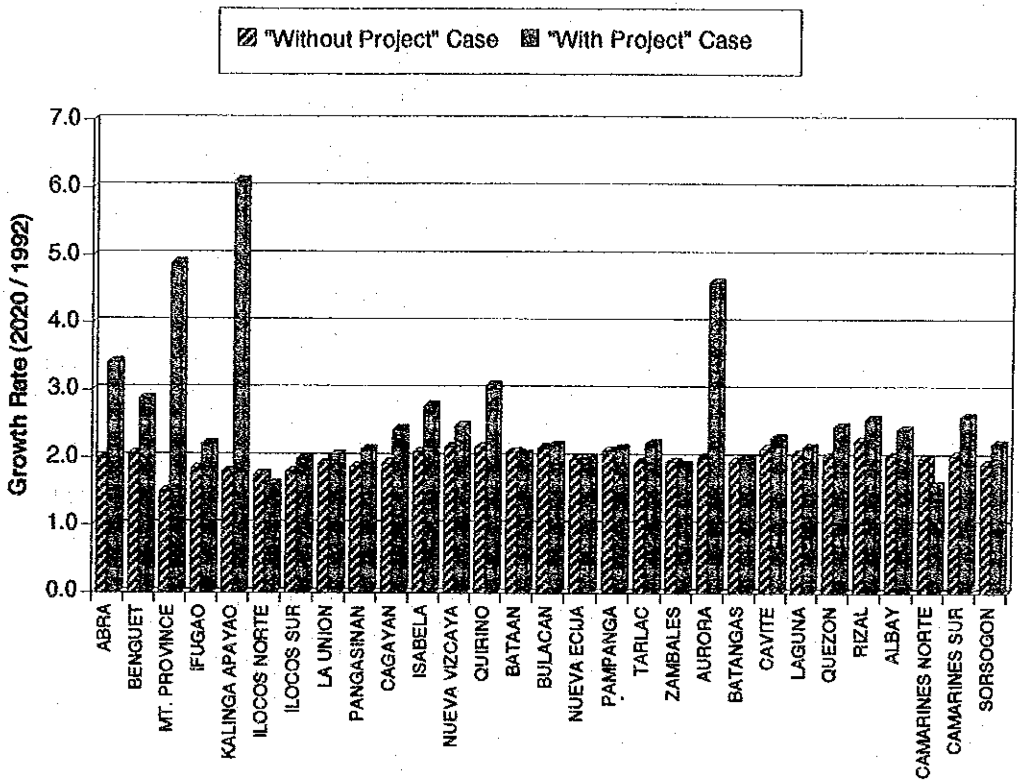


FIGURE 8.4-3 PROVINCIAL TRAFFIC VOLUME GROWTH RATES

PART III

LUZON ISLAND STRATEGIC ROAD (LISR) NETWORK DEVELOPMENT PLAN

CHAPTER 9

OBJECTIVES AND TARGETS OF THE PLAN

9.1 PROBLEMS ON EXISTING ROAD NETWORK

Existing road condition in Luzon Island is described in Chapter 3. Major problems thereof are summarized as follows:

- Most areas in Luzon Island rely on only one trunk road for access thereto, i.e., Manila North Road in northwestern part and Pan-Philippine Highway in north-eastern and southern parts. Even those trunk roads have partly weak portions which oftenly suffer from a disaster resulting in complete isolation of the area.

- While north-south backbones are relatively well developed, east-west laterals are still underdeveloped being discontinuous, not all-weathered, or extremely substandard in many sections.

- Except in the central plain from Pangasinan to Batangas, network formation is quite incomplete. Most roads branch off from a trunk road without forming a network. Thus, each road functions independently causing low transport efficiency as a whole.

- There are areas with very sparse road density, even vast area without any road. Such situation is disagreeable for effective use of land and preservation of peace.

- Many roads are seriously deteriorated as a results of initial substandard design, heavy axle loads and insufficient maintenance effort.

- Many roads, especially outside 100 kilometers area from Metro Manila, are substandard such as unpavement making vehicular passage difficult during rainy season in some cases, narrow width disabling vehicles from passing each other, temporary or old bridges with low loading capacity enabling no heavy vehicle to pass or even stream crossing without bridge, insufficient countermeasures against road disaster causing repeated road closure, etc.

- Some roads, particularly those located near Metro Manila, suffer traffic congestion due to insufficient road capacity to meet growing traffic demand.

Weakness in major road network as described above is deemed to impede the sound regional development.

9.2 OBJECTIVES OF THE PLAN

To solve the above problems and support a balanced regional development, the objectives of the Luzon Island Strategic Road Network Development Plan (LISR Plan) are set up as follows:

1) To enlarge and reinforce the physical foundation of the regional economy by providing reliable and high quality of transport services to encourage the extension of socio-economic activity and market area and thus activate the regional economy as well as to provide direct economic impact due to savings in transport cost;

2) To promote the regional development in the areas where sound development is presently restrained due to poor accessibility inspite of high development potential by eliminating such physical constraints;

3) To promote the effective use of land and contribute to unity of nation and preservation of peace by providing access to the vast areas presently without any road; and

4) To minimize the disturbance to people's activity and economic loss in case of emergency like a closure of a road due to disaster by developing a closed network to enable road users to take a substitutive route as well as by strengthening roads with preventive measures.

9.3 TARGETS OF THE PLAN

In view of the above objectives, the final targets of the LISR Plan are set up as follows:

1) The plan aims to complete a major road network meeting the following requirements:

- The network shall provide connection among economically and/or administratively important regional centers, including provincial capitals, cities and highly populated municipalities, interface with rail, sea and air transport, and base municipalities for industrial and tourism development.

- The network shall support the regional development especially in the areas where sound development is presently restrained due to poor accessibility inspite of high development potential. For example, Cagayan and Bicol districts have a high potential of agricultural development but road network is deemed to be insufficient for realizing targeted development.

- The network shall cover the whole island, not leaving the area which is more than 25 kilometers distant from the nearest component road of the network. Also, the network shall cover all coast as far as possible, not leaving a vast area without road.

- The network shall consist of continuous roads without stub connection except short stretch in special cases, so that efficiency of the network will be improved and in case of emergency, a detour road may easily be found.

- The component road shall be well distributed over the island according to transport demand,

2) To complete the network with acceptable level of quality, all component roads not meeting the minimum requirements shall be improved and non-existing sections shall be newly constructed. The minimum level is as follows:

   - Carriageway of 6.0-6.7m in width,
   - Paved with concrete or asphalt, and
   - All bridges being permanent structures.

3) Proper preventive measures against road disaster shall be taken for all component roads with disaster potential.

4) All component roads shall be maintained in acceptable level of service. In this Study, the volume-to-capacity ratio is used as a parameter to evaluate the level of service, and allowable volume-to-capacity ratio is set up as 0.8.

CHAPTER 10

FORMATION OF LISR NETWORK

Basic road network necessary to interconnect important regional centers and support balanced regional development is called "Basic LISR Network". Roads to reinforce the basic LISR Network, such as substitutive roads in case of road closure due to disaster and expressways/bypasses to cope with traffic congestion due to insufficient capacity, are incorporated into the network. The road network including such reinforcement roads is called "LISR Network".

10.1 PROCEDURE FOR ESTABLISHMENT OF LISR NETWORK

Procedure for establishment of LISR Network is shown in Figure 10.1-1. The procedure is divided into two main steps as follows:

1) Establishment of Basic LISR Network

At first, important regional centers and corridors of importance for regional development are selected. Then, the road network is drawn up to connect/cover the selected centers/corridors taking into consideration the topographic condition, existing road condiction, traffic flow, etc. Where alternative routes are considered, preliminary comparative study is conducted for selection of better one. When vast areas without road (areas more than 25 km distant from the already selected roads) are found, additional roads are selected to eliminate such situation. Thus, an initial road network is established. Next, the initial network is examined on whether the component roads are well distributed or not. The "Network Value" defined in Chapter 10.2 is used as an indicator for the examination. If the indicator shows unbalanced road distribution, necessary adjustment is made for finalization of the basic LISR Network.

The basic LISR Network is considered as a skeleton expressing the routes necessary to attain the objectives of the Plan, not taking into consideration road capacity and flexibility in the occurrence of disaster.

2) Establishment of LISR Network

Future traffic demand is estimated assuming the completion of the basic LISR Network. Then, the following analyses are carried out to decide the grade of each component road and to identify additionally necessary roads:

Disaster-Detour Analysis: Although preventive measures are to be taken for all disaster-prone sections, it is still very difficult and too costly to completely eliminate the occurrence of road disaster in some critical areas. In this case, detour route with tolerable extra distance should be secured to avoid severe damage to the socio-economic activity in the influenced area. To examine the adequacy of the basic LISR network in this view and to find the necessity of supplemental link, detour route to be taken and extra distance thereof in the occurrence of disaster are analyzed.

Congestion Analysis: To find the roads which are anticipated to be congested in the future and therefore need some countermeasures, volume-to-capacity ratio of each road is calculated based on the projected future traffic demand, assuming that all narrow/non-existing roads will have been widened/constructed with two lanes.

Based on the above analyses, grade of each component road (either 2-lane road or 4-lane road) and additional roads are decided. Thus, the LISR network is established.

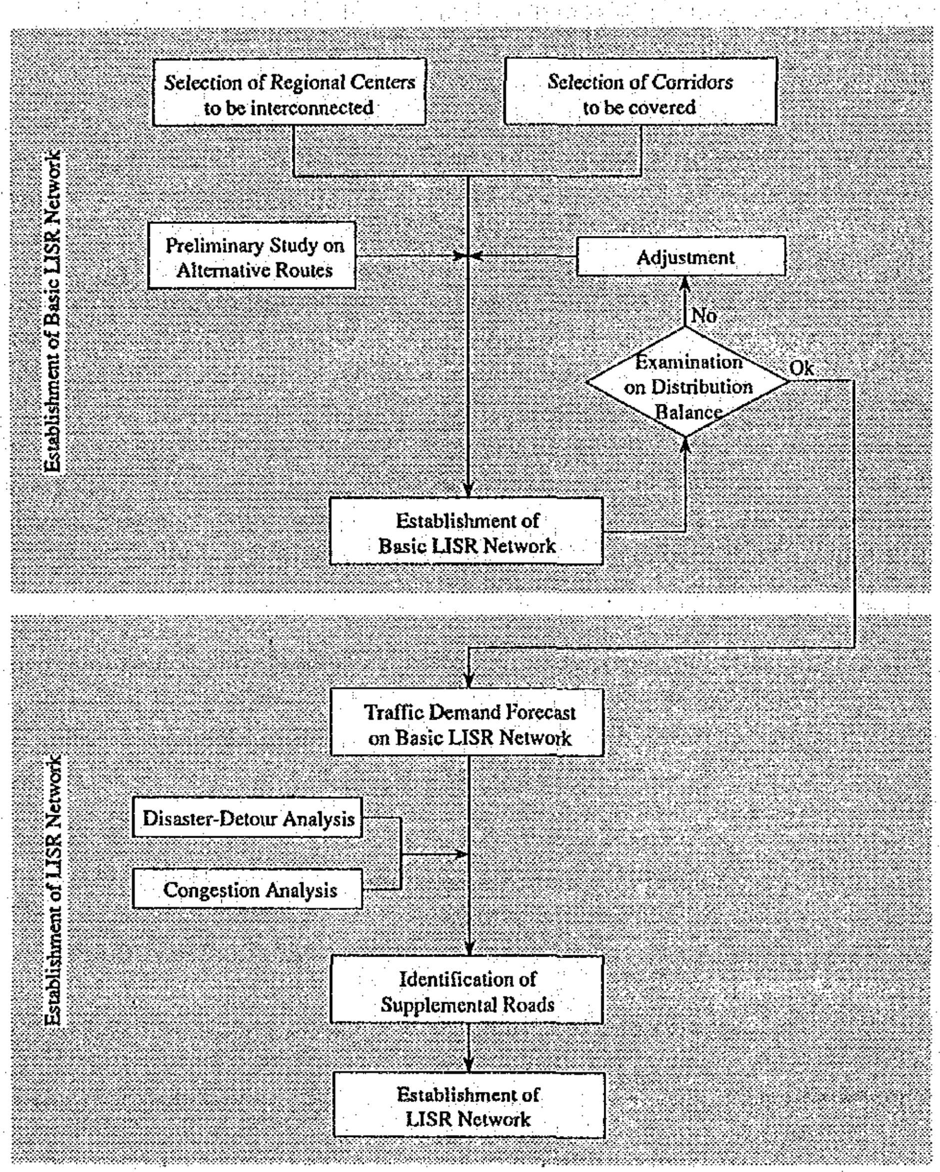


FIGURE 10.1-1 PROCEDURE FOR ESTABLISHMENT OF LISR NETWORK

10.2 ESTABLISHMENT OF BASIC LISR NETWORK

10.2.1 Requirements of the Basic LISR Network

Requirements of the basic LISR network are summarized as follows:

- Interconnection of economically and/or administratively important regional centers,
- Coverage of development potential areas, especially in the agricultural sector,
- Coverage of the whole island not leaving vast area without road,
- Formation of closed network eliminating stub connection except short stretch in special cases, and
- Well balanced distribution of the component roads over the island.

Important Centers to be Interconnected

28 provincial capitals and 98 major activity centers are selected as important centers to be interconnected. Major activity centers are decided in accordance with the following criteria:

- City
- Municipality with 50,000 or more population and 500 per square kilometers or more population density in 1990.
- City/municipality with base or terminal port.
- City/municipality with airport which handled 10,000 or more passengers in 1991.
- City/municipality with PNR station which handled 10,000 or more passengers in 1991.
- Regional Industrial Center (RIC) identified by NEDA in Updates on the Medium-Term Philippine Development Plan 1990-1992.
- Base city/municipality of major tourism spots.

Provincial capitals and major activity centers are shown in Figure 10.2-2 and listed in Appendix 10.1 with justification.

Important Areas with High Development Potential to be Covered by the Network

Cagayan Valley and Bicol districts have a high potential of agricultural development, needing the improvement of accessibility to help in realizing the targets of their development plans.

10.2.2 Route Selection

In accordance with the above criteria, the following four categories of roads were selected to form the basic LISR network:

1) Inter-Province-Capital Roads which interconnect provincial capitals through the shortest routes as possible.

2) Inter-Major-Activity-Center Roads which connect the major activity centers selected previously to the inter-province-capital roads.

3) Agricultural Development Support Roads which penetrate vast agricultural areas not covered by the above two categories of roads.

4) National Integration Roads which run along the coasts which are not covered by the above three categories of roads over a wide area.

Thus, the initial network was established.

For the blocks which have an area more than 25 km distant from the already selected roads, additional roads were selected to eliminate such situation. In this case, priority was attached to the roads covering as many population as possible. In most cases, these roads connect two or more municipalities with 10,000 or more population to the already selected roads. According to similarity of their roles and chracteristics, these roads are classified as inter-major-activity-center road.

10.2.3 Preliminary Study on Alternative Routes

In the following three sections, preliminary comparative study was conducted for route selection:
· Cagayan North Coastal Route,
· Dalton Pass Substitutive Route, and
· Tarlac-Zambales Cross Country Route.

Location of alternative routes and major justification of selection are shown in Figure 10.2-1.

10.2.4 Examination on Balance of Road Distribution

Component roads of the basic LISR network should be well distributed according to demand. Since demand of road depends in general on land area and population, "Network Value" defined as follows is used as an indicator to examine the appropriateness of distribution:

Network Value

The area is divided into blocks by the component roads of the network, and network value of each block is determined as follows:

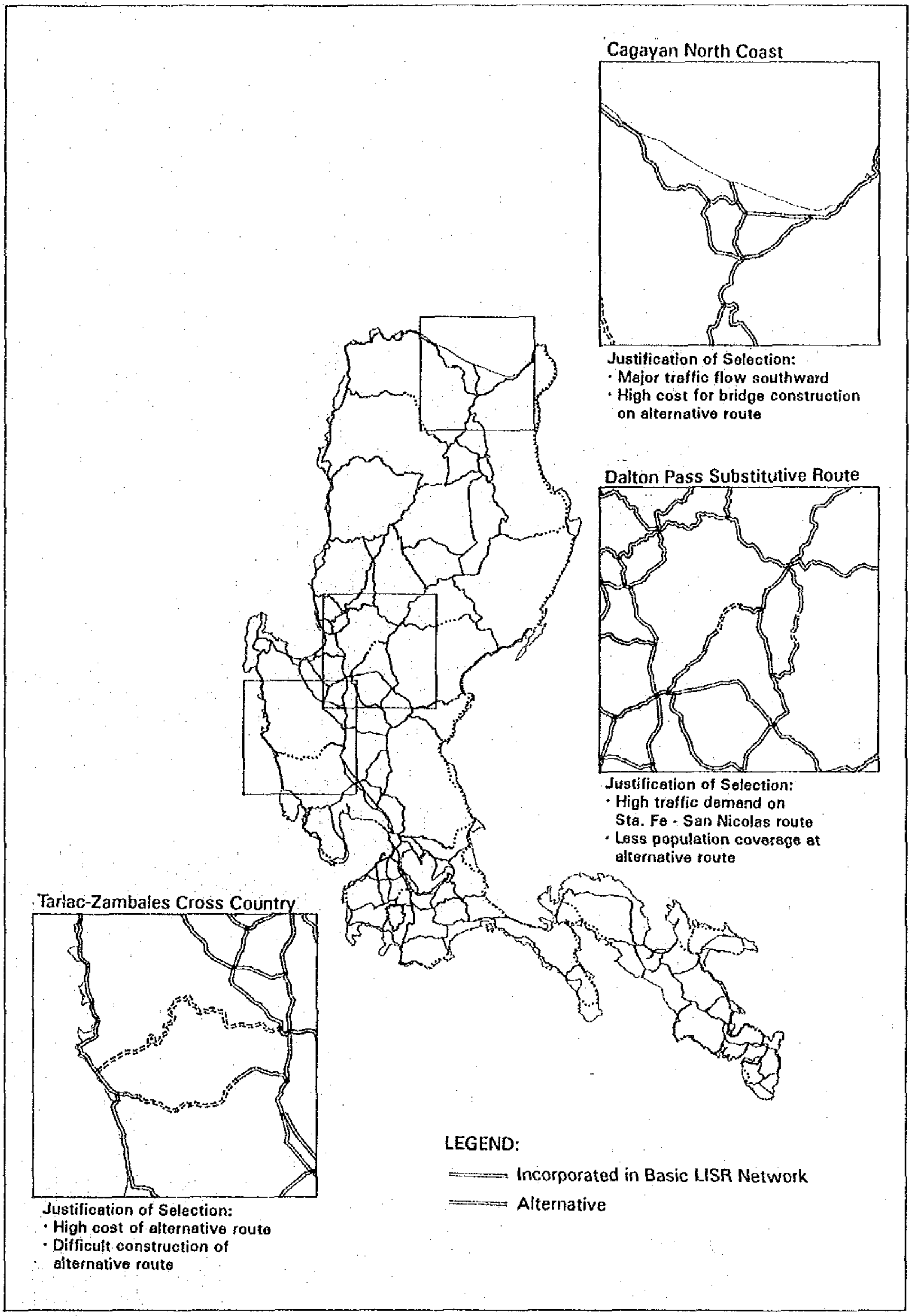
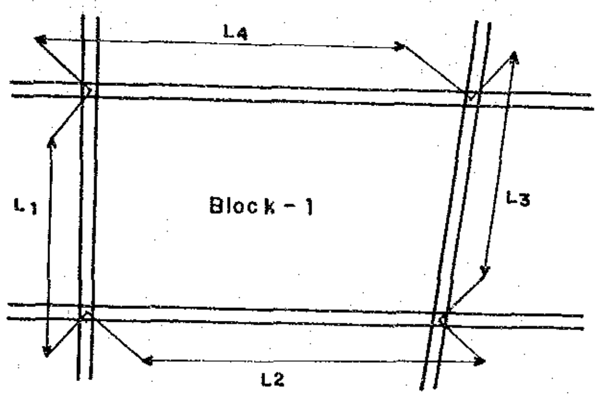


FIGURE 10.2-1 PRELIMINARY STUDY ON ALTERNATIVE ROUTES

$NV = L/\sqrt{PA}$

where:

NV = Network value
L = Total length of roads surrounding a block (=L1 + L2 + L3 + L4 in case of Block-1 in the figure below), in km
P = Population in a block, in 1,000 persons
A = Land area of a block, in km^2



Network value of each block in the finally established network is shown in Table 10.2-1.

10.2.5 Formation of Basic LISR Network

Through the above procedure, the basic LISR Network was established as shown in Figure 10.2-2. The network is composed of the following roads:

	Existing Road	Impassable/ Non-existing Road	Total
Inter-Provincial-Capital Rd	3,852.0 km	-	3,852.0 km
Inter-Major-Activity-Center Rd	2,522.3 km	637.2 km	3,159.5 km
Agricultural Development Support Rd	602.6 km	133.5 km	736.1 km
National Integration Rd	82.7 km	626.1 km	708.8 km
Total:	7,059.6 km	1,396.8 km	8,456.4 km

The network value of each block divided by the component roads of the network is shown in Table 10.2-1 and Figure 10.2-3. As shown in the table and figure, there is no block which has a network value below 0.2 and therefore the component roads are considered to be well distributed.

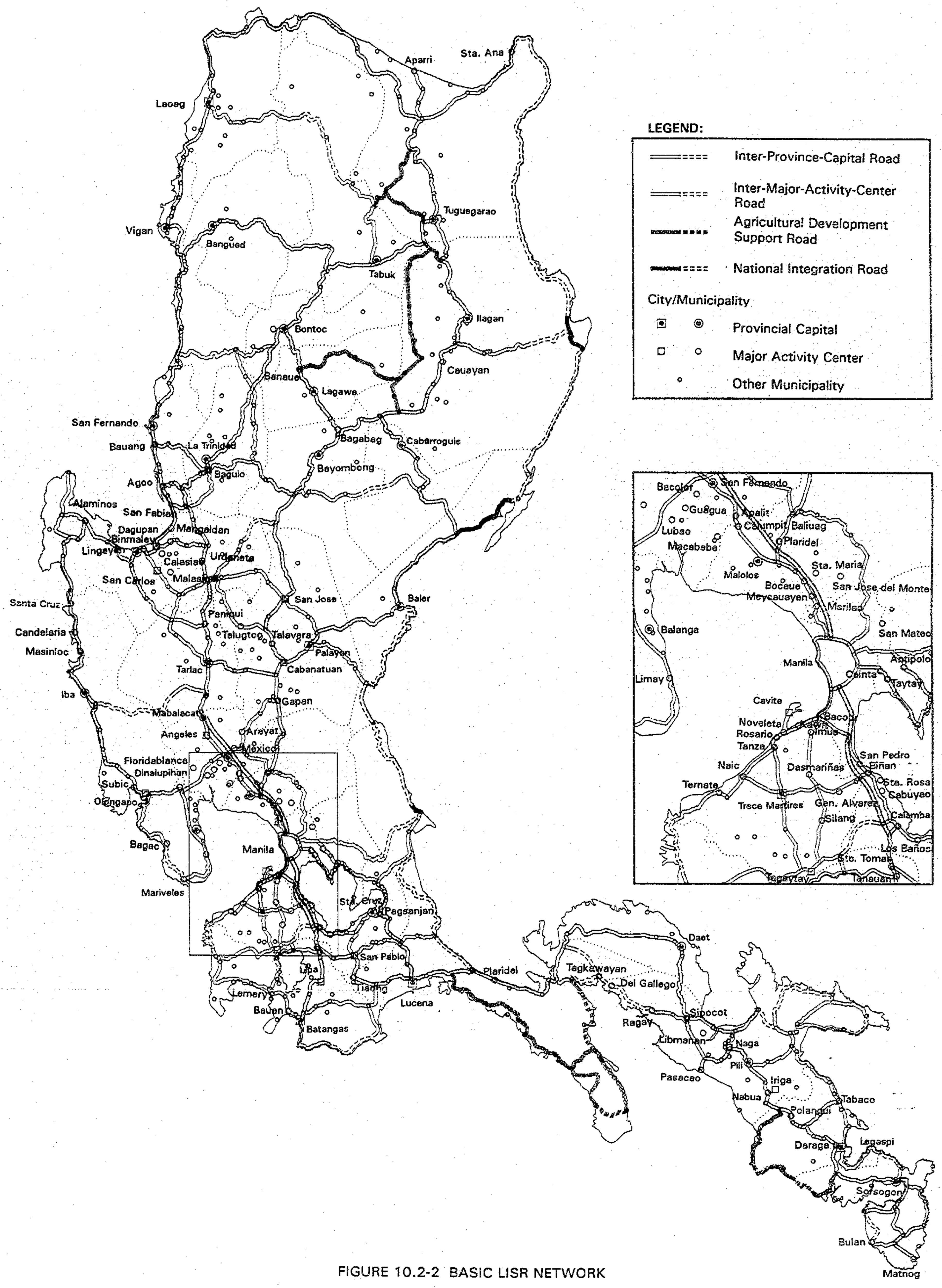


FIGURE 10.2-2 BASIC LISR NETWORK

TABLE 10.2-1 NETWORK VALUE OF BASIC LISR NETWORK

Block* No.	1990 Population P	Land Area (Km2) A	Road Length (Km) L	Network Value L/√(PA/1000)
1	439,770	5,874.75	410.00	0.2551
2	118,899	483.75	100.00	0.4170
3	92,078	398.25	72.50	0.3786
4	344,534	5,931.00	415.00	0.2903
5	90,049	706.50	122.50	0.4857
6	138,697	567.00	108.50	0.3869
7	85,587	177.75	61.00	0.4946
8	294,602	7,614.00	500.00	0.3338
9	419,293	4,371.75	303.00	0.2238
10	199,070	3,253.50	290.00	0.3603
11	460,286	1,782.00	235.00	0.2595
12	105,248	137.25	38.50	0.3203
13	401,260	2,218.50	222.50	0.2358
14	33,861	207.00	75.00	0.8958
15	84,254	396.00	135.00	0.7391
16	189,952	2,351.25	243.50	0.3644
17	139,162	1,372.50	172.50	0.3947
18	165,608	1,739.25	210.00	0.3913
19	396,735	6,597.00	377.50	0.2333
20	192,756	400.50	95.00	0.3419
21	74,586	104.63	47.50	0.5377
22	71,754	173.25	62.50	0.5606
23	184,186	310.50	90.00	0.3763
24	411,830	1,730.25	210.50	0.2494
25	170,293	767.25	140.00	0.3873
26	222,752	5,049.00	325.00	0.3065
27	75,414	510.75	60.00	0.3057
28	40,995	141.75	52.50	0.6887
29	204,036	333.00	95.50	0.3664
30	450,972	4,396.50	317.50	0.2255
31	282,937	470.25	95.00	0.2604
32	512,483	580.75	140.50	0.2575
33	113,994	319.50	77.50	0.4061
34	134,487	254.25	77.50	0.4191
35	582,460	1,102.50	177.50	0.2215
36	145,082	713.25	110.00	0.3420
37	230,359	553.50	100.00	0.2801
38	73,494	976.50	257.50	0.9612
39	58,620	87.75	20.00	0.2789
40	761,350	1,531.25	232.50	0.2153
41	128,786	947.25	157.50	0.4509
42	1,296,778	969.75	228.50	0.2038
43	578,525	1,090.25	162.50	0.2046
44	299,855	515.00	102.50	0.2608
45	178,637	154.12	62.50	0.3767
46	400,164	483.56	97.50	0.2216
47	623,377	5,240.25	361.50	0.2000
48	592,188	144.00	66.00	0.2260
49	265,946	600.75	173.00	0.4328
50	595,842	308.25	100.00	0.2333
51	103,224	816.75	160.00	0.5510
52	60,674	63.00	37.50	0.6065
53	556,938	146.25	57.50	0.2015
54	161,453	180.00	57.50	0.3373
55	183,261	733.50	115.00	0.3137
56	112,227	164.25	65.00	0.4788
57	94,007	220.50	75.00	0.5209
58	142,819	204.88	34.50	0.2017
59	109,496	533.25	135.00	0.5587
60	67,740	141.75	52.50	0.5358
61	234,337	185.63	50.00	0.2397
62	406,638	616.50	122.50	0.2447
63	193,988	819.00	122.50	0.3073
64	405,027	672.75	143.70	0.2753
65	195,278	234.00	75.00	0.3509
66	203,726	292.50	90.00	0.3687
67	394,575	555.75	105.00	0.2242
68	209,951	540.00	108.80	0.3231
69	358,355	1,725.75	245.00	0.3115
70	117,189	477.00	110.00	0.4653
71	20,110	342.00	60.00	0.7235
72	186,912	1,791.00	205.00	0.3543
73	290,303	1,082.25	120.00	0.2141
74	256,990	333.00	82.50	0.2820
75	358,168	1,401.75	165.00	0.2329
76	208,185	585.00	109.00	0.3123
77	36,388	524.25	41.00	0.2968
78	85,982	416.25	104.00	0.5497
79	69,977	393.75	95.00	0.5723
80	442,221	1,023.80	147.50	0.2192
81	337,140	1,206.00	162.50	0.2548
82	195,100	321.75	80.20	0.3201
83	71,138	229.50	40.50	0.3170
84	140,981	396.00	120.50	0.5100
85	69,782	171.00	25.00	0.2289
86	101,150	330.75	75.00	0.4100
87	114,169	254.25	86.00	0.5048
88	37,882	162.00	40.00	0.5106
89	12,979	184.50	27.50	0.5620

* See Figure 10.2-3

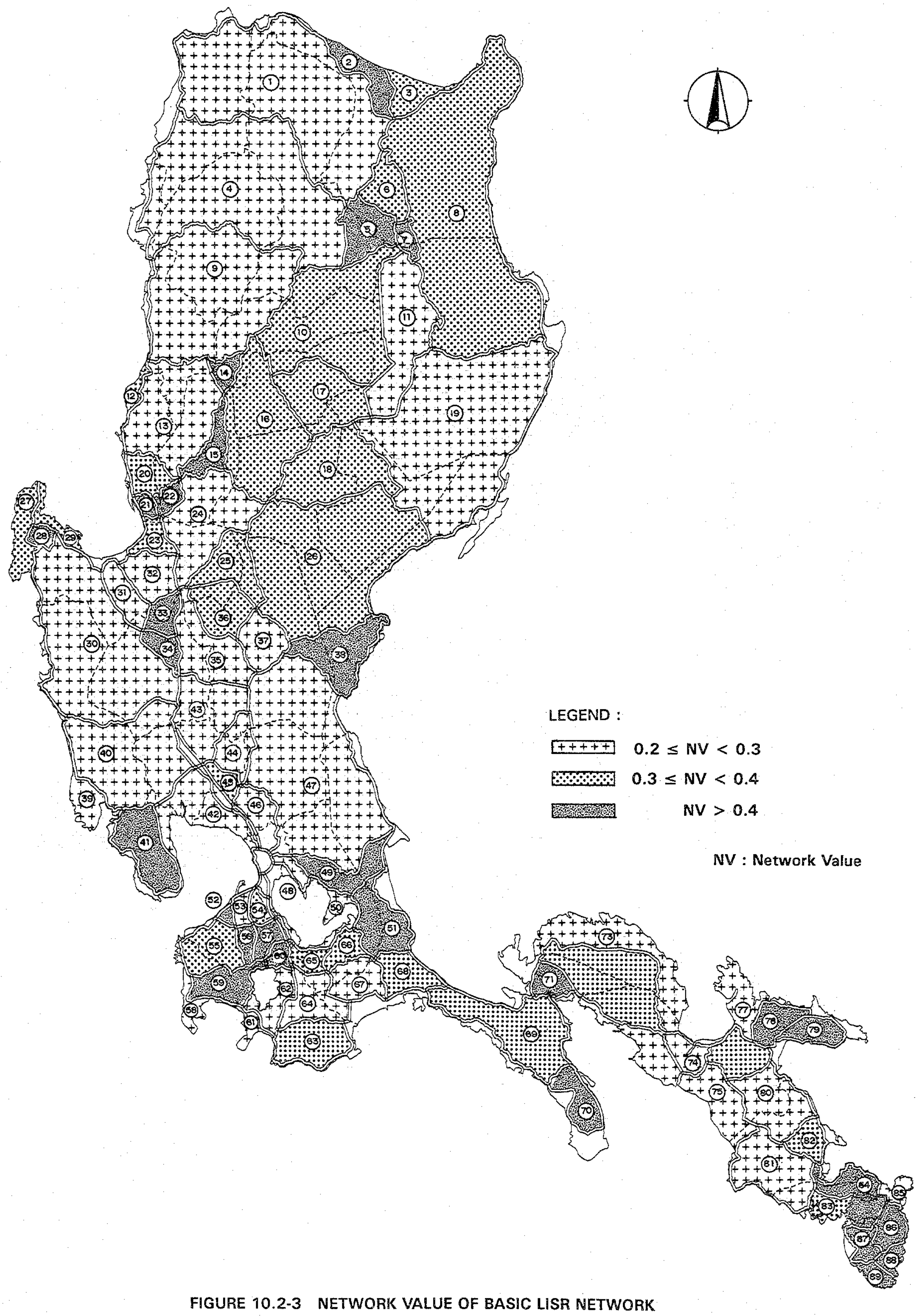


FIGURE 10.2-3 NETWORK VALUE OF BASIC LISR NETWORK

10.3 ESTABLISHMENT OF LISR NETWORK

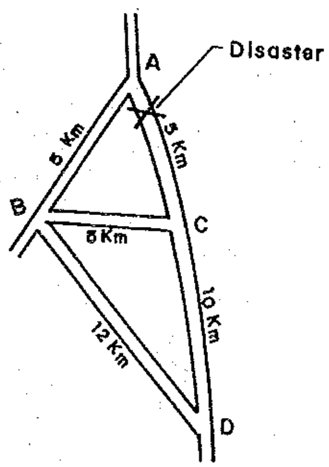
The LISR network is established by deciding the grade of each component road of the basic LISR network and selecting supplemental roads to the basic network. For this purpose, disaster detour analysis and congestion analysis were conducted, based on the projected traffic for the year 2020 assuming the completion of the basic LISR network.

10.3.1 Disaster-Detour Analysis

Proper preventive measures against road disaster are proposed to be taken for all disaster-prone road sections. However, it may not be possible to totally eliminate the occurrence of road disaster considering severe natural environment in the country. Under such situation, construction of the road network to evade serious economic loss is one of the objectives of the plan. For this, detour route with tolerable extra distance should be secured. To examine the adequacy of the network from this viewpoint, disaster-detour analysis was conducted as follows:

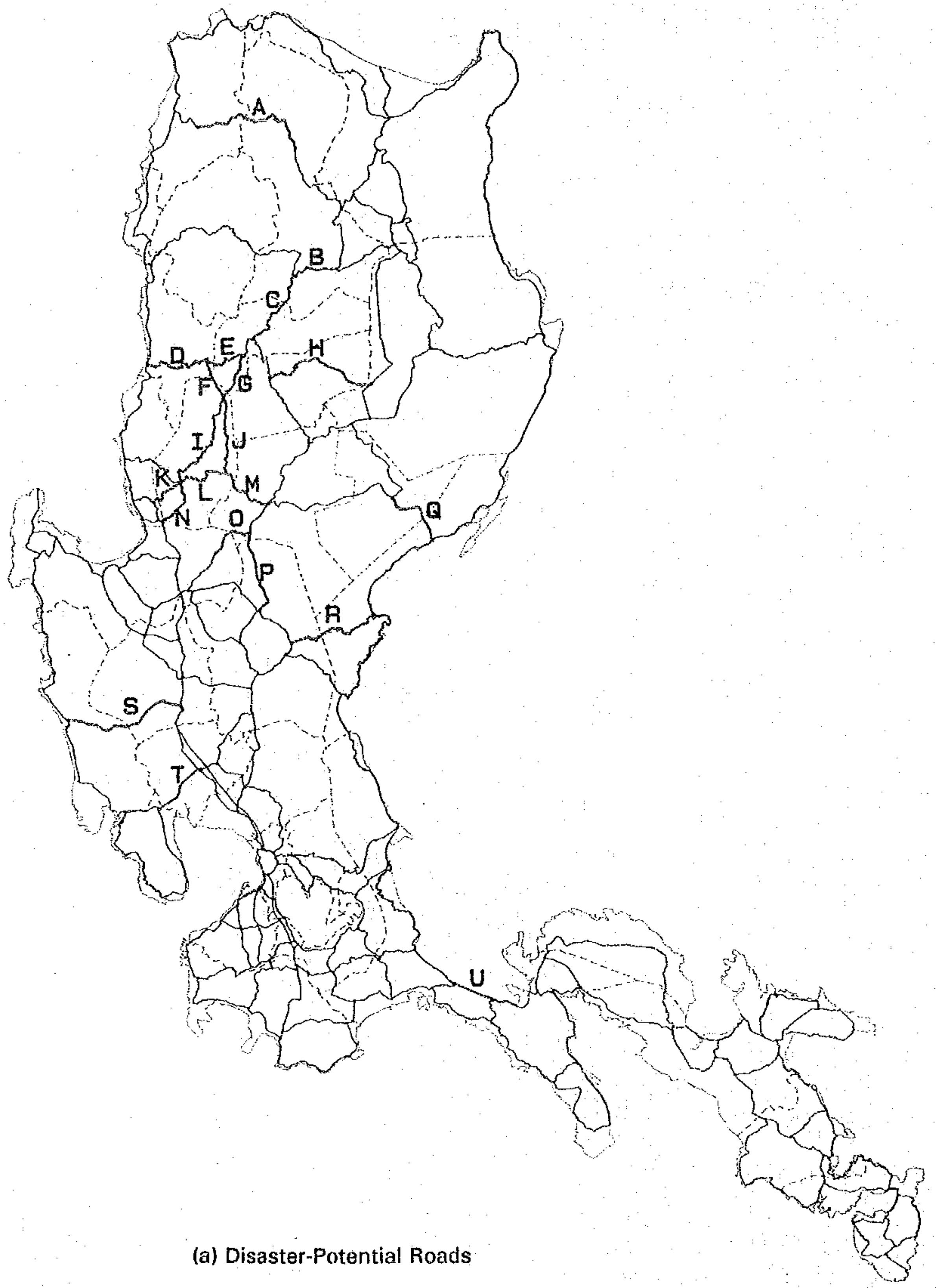
- 21 road links shown in Figure 10.3-1 are presumed as the links where disaster may recur. Roads being damaged by lahar from Mt. Pinatubo are excluded from the analysis since it is a special case and this situation will not last permanently.

- Detour route which will be taken by affected vehicles in case of closure of a certain link is searched and extra distance is calculated. Results of the calculation are summarized in Figure 10.3-1. Since detour route and accordingly extra distance depend on the origin and destination of the affected traffic as exemplified below, both maximum extra distance and its weighted average of all affected vehicles are presented in Figure 10.3-2.



<u>Traffic from A to C</u>
Detour route = A - B - C
Extra distance = 5 km

<u>Traffic from A to D</u>
Detour route = A - B - D
Extra distance = 2 km



(a) Disaster-Potential Roads

Interrupted Link(s)	Extra Distance due to Detour: Average (km)	Extra Distance due to Detour: Maxmum (km)	Number* of Affected Vehicles (veh)	Total* Extra veh-km
In case of 1 link interrupted				
A	110.8	353.3	1,473	163,100
B	87.3	321.5	2,482	216,800
C	64.8	248.4	2,047	132,700
D	54.1	130.6	2,066	111,700
E	26.5	32.0	1,386	36,800
F	37.0	50.9	680	25,200
G	29.0	34.7	2,436	70,600
H	8.7	9.7	45	400
I	53.6	110.0	4,437	238,000
J	58.6	159.1	559	32,800
K	12.1	14.4	934	11,300
L	49.4	81.9	914	45,100
M	55.4	170.5	586	32,500
N	11.9	12.9	7,327	87,300
O	8.5	81.2	1,146	9,700
P	34.6	73.7	3,035	105,000
Q	63.0	196.5	233	14,700
R	62.6	86.6	978	61,200
S	18.4	84.7	1,328	24,500
T	154.3	186.0	15,836	2,442,900
U	34.7	82.4	9,209	319,600
In case of 2 links simultaneously interrupted				
A & B	112.2	353.3	3,950	443,100
B & C	112.8	492.3	2,960	334,100
E & G	88.8	217.8	3,822	339,300
I & J	112.5	195.4	4,996	562,200
I & L	105.0	195.4	5,343	561,000
K & N	43.2	56.1	8,261	356,600
O & P	75.3	165.9	4,181	314,700
S & T	301.2	361.5	17,164	5,169,800
In case of 3 links simultaneously interrupted				
A & B & C	135.1	604.0	4,428	598,100
A & B & H	113.2	353.3	3,995	452,400
D & I & L	147.6	297.3	7,409	1,093,400
E & F & G	85.0	217.8	4,502	382,900
E & G & M	119.0	341.2	4,408	524,600
I & J & L	110.9	195.4	5,458	605,100
M & O & P	90.5	333.4	4,727	427,600
In case of 4 links simultaneously interrupted				
I & L & O & P	111.3	325.4	9,524	1,059,500
K & N & O & P	61.0	218.7	12,442	759,600

* Traffic Volume in 2020

(b) Extra Distance due to Detour

FIGURE 10.3-1 DISASTER-DETOUR ANALYSIS

- Likewise, detour analysis is made in case of simultaneous closure of related two or more roads.

Allowable limit of extra distance is given in terms of maximum distance and vehicle-kilometer of all affected vehicles as follows:

Number of Roads Simultaneously Cut	Maximum Extra Distance in Km	Total Extra Vehicle-Km
1	100	250,000
2	200	500,000
3	300	750,000
4	400	1,000,000

Results of analysis are summarized as follows:

- In case of closure of San Fernando-Olongapo Road (Road T in Figure 10.3-1) and its combination with Botolan-Capas Road (Road S in Figure 10.3-1), both maximum extra distance and total vehicle-km exceed allowable values sharply.

- In case of all other roads and their combinations, either maximum extra distance or total vehicle-km or both are within allowable.

The analysis results in the necessity of substitutive route for San Fernando-Olongapo Road.

10.3.2 Congestion Analysis

To find the roads which are congested or will be congested in future, volume-to-capacity ratio of each road is calculated based on 2020 traffic, assuming that all narrow/non-existing roads will have been widened/constructed with two lanes. Major assumptions in the calculation are as follows:

- PCEF (passenger car equivalent factor)

  = 1.0 for car/van
  1.5 for jeepney
  2.0 for bus
  2.0 for truck

- Peak hour factor and directional factor combined = 0.08
- Capacity = 2,000 per hour for 2-lane road
  2,000 per hour per lane for multi-lane road

- Volume-to-capacity ratio over which judged to be congested
  (critical volume-to-capacity ratio)
  = 0.4 for ordinary road
  = 0.8 for expressway

  It is noted that traffic volume discussed in Chapter 8 and used in the congestion analysis is only for interzonal traffic, and local traffic with short trip distance on ordinary road is not included therein. That is the main reason why critical vehicle-to-capacity ratio of ordinary road is lower than that of expressway.

Results of analysis are shown in Figure 10.3-2. The following roads are anticipated to be congested in 2020.

- North Luzon Expressway
- South Luzon Expressway
- Pan-Philippine Highway, Sta. Rita-San Jose
- Pan-Philippine Highway, Calamba-Legaspi
- Manila North Road, Mabalacat-Laoag
- San Fernando-Olongapo Road
- Dinalupihan-Mariveles Road
- Manila East Road, Manila-Binangonan
- Manila-Cavite Coastal Road
- Bacoor-Tagaytay-Tanza Road
- Calamba-Sta. Cruz Road
- Manila-Batangas Road

10.3.3 Reinforcement of Basic LISR Network

Based on the disaster-detour analysis and congestion analysis, raods to supplement the basic LISR network and component roads of the basic LISR network to be upgraded are identified as follows:

- Widening of North Luzon Expressway (from 4-lane to 6-lane up to San Fernando and from 2-lane to 4-lane up to Mabalacat)
- Extension of North Luzon Expressway from Mabalacat to Rosario (4-lane) or Construction of New Manila-Rosario Expressway (4-lane)
- Widening of South Luzon Expressway (from 4-lane to 6-lane)
- Extension of South Luzon Expressway from Calamba to Batangas (4-lane) and from Calamba to Lucena (4-lane)
- Construction of Manila-Bataan Road (4-lane)
- Construction of Manila-Cavite Expressway (4-lane)
- Strengthening of the following roads by widening of existing 2-lane road to 4-lane or construction of new road (4-lane)
  - Pan-Philippine Highway, Sta. Rita-San Jose Section
  - Pan-Philippine Highway, Lucena-Legaspi Section
  - Manila North Road, Rosario-Laoag Section

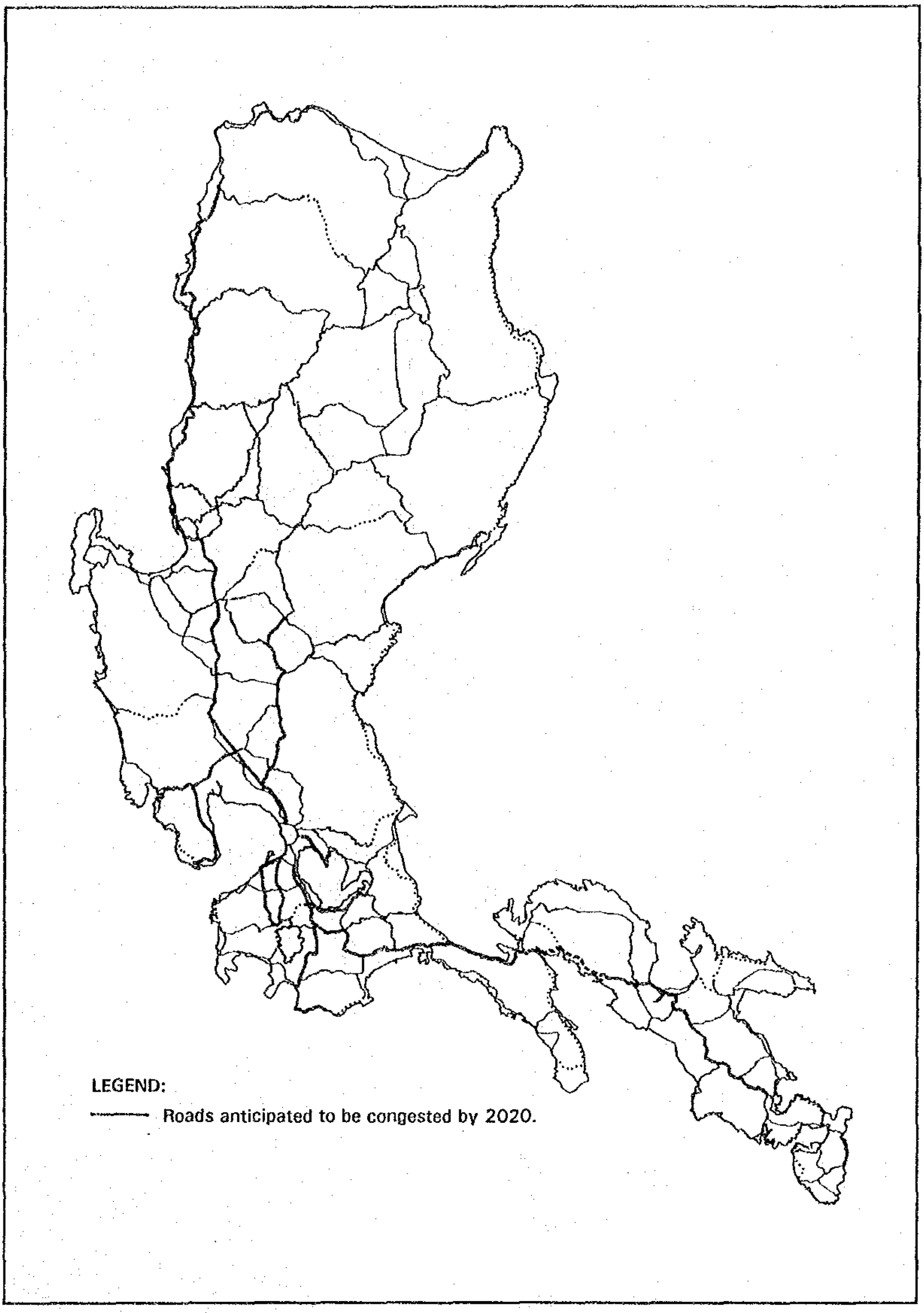


FIGURE 10.3-2 RESULTS OF CONGESTION ANALYSIS

- Olongapo-Dinalupihan-Mariveles Road
- Manila-Binangonan Road
- Bacoor-Tagaytay-Tanza Road
- Calamba-Sta. Cruz Road

Preliminary comparative study on North Luzon Expressway route up to Rosario was conducted among the following three alternatives:

Route-A: Extension of the existing section
Route-B: Diverting from the existing section eastward at Pulilan avoiding Mt. Pinatubo affected area
Route-C: Different route from the existing section starting from Metro Manila

The preliminary study is summarized in Figure 10.3-3. Route-C was selected taking account of its advantages of avoiding Mt. Pinatubo affected area and mitigating congestion of the existing section.

Upgrading of roads is, in some aspects, competative with development of other transport modes like railways, as exemplified by the upgrading of Pan-Philippine Highway, Lucena Legaspi Section, especially Calanag-Sipocot Diversion Road (Quirino Highway) which may be competitive with PNR South Line. In this regard, however, it is a general concept that development of towns and cities, which depends on development of roads rather than railways, will result in an increased transport demand not only for roads but also for other modes. Therefore, road development is necessary even if it is parallel to existing railways as in the case of Quirino Highway.

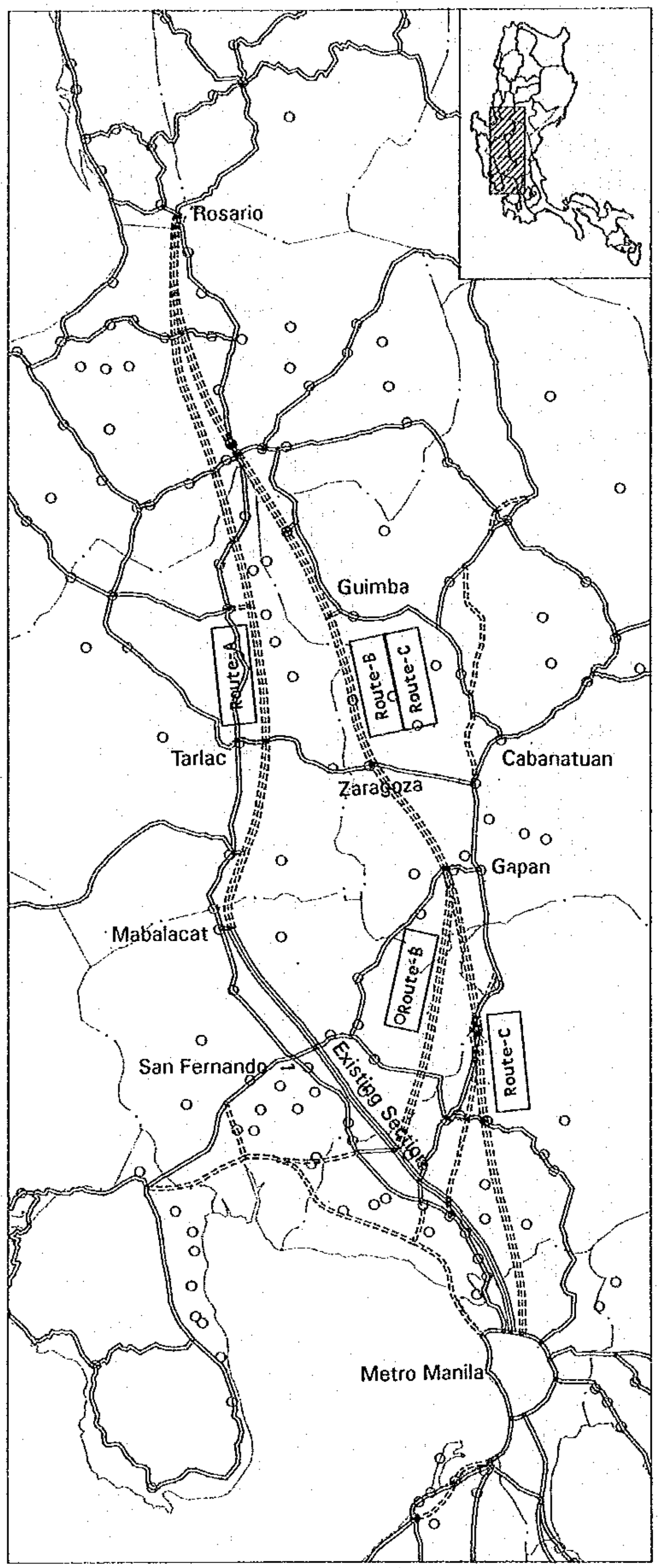
Road sections in urban areas involve a substantial share of jeepney and tricycle traffic causing turbulences in the traffic flow due to slow and frequent-stopping operation. To minimize such impact and secure smooth traffic flow, proper measures, such as provision of additional lane for these vehicles, are recommended depending on the local conditions which should be further studied individually.

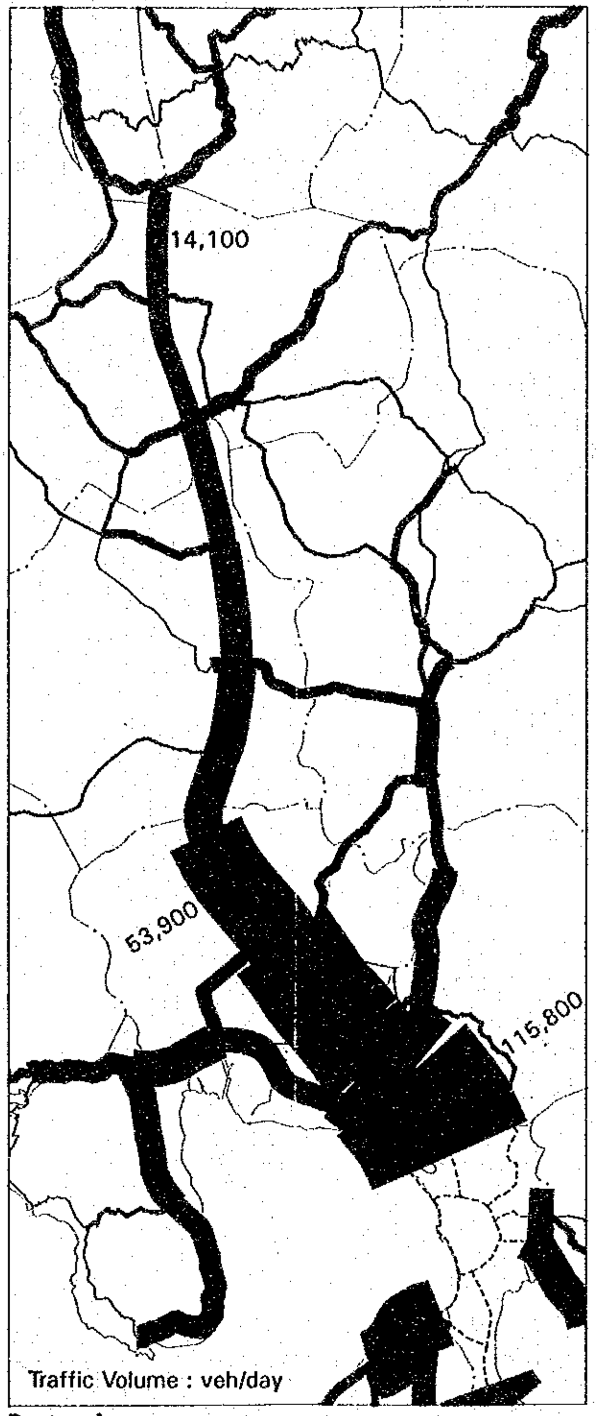
10.3.4 Establishment of LISR Network

LISR Network, i.e., targetted network of the plan, is established as shown in Figure 10.3-4 based on the above-mentioned analyses. The LISR network is composed of the following roads:

	Existing 1) Road (km)	Non-existing Road (km)	Total (km)
2-lane Road	6,865.2	636.7	7,501.9
4-lane Road	764.9	380.9	1,145.8
4-lane Expressway	21.7	311.3	333.0
6-lane Expressway	109.8	0	109.8
T o t a l	7,761.6	1,328.9	9,090.5

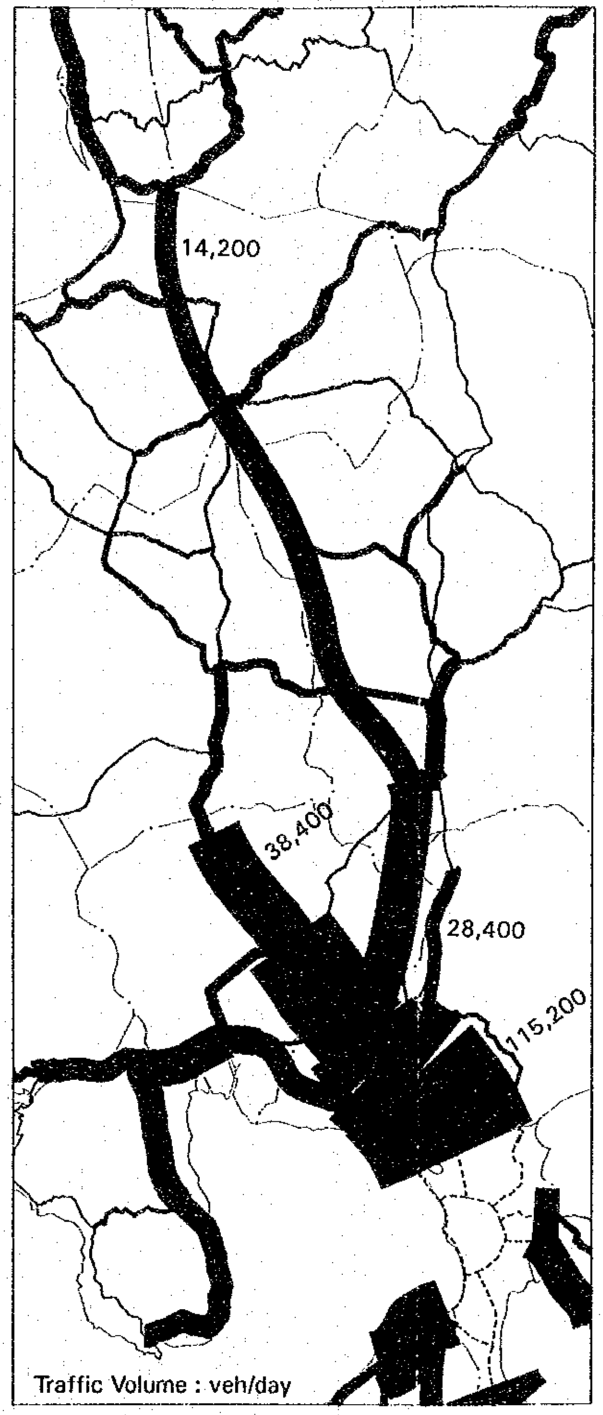
1) including narrow/impassable roads proposed to be widened/reconstructed.





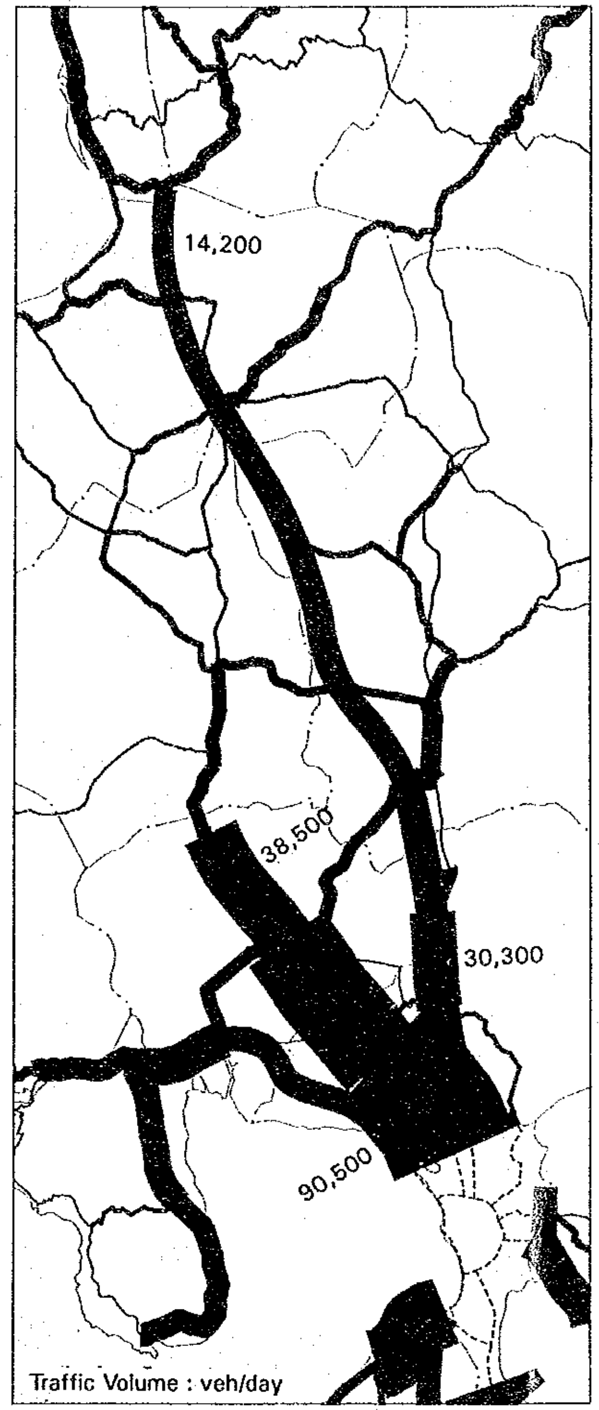
Route - A
Length : 117.0 km
Cost : ₱8,507 M
Vehicle-km on Expressway : 8,980,000
Advantages :
- Low Cost

Disadvantages :
- Construction will be affected by Lahar, or delayed until settlement of Lahar.
- Congestion is anticipated on existing section.



Route - B
Length : 155.5 km
Cost : ₱10,591 M
Vehicle-km on Expressway : 9,509,000
Advantages :
- Free from Lahar problem.

Disadvantages:
- Congestion is anticipated on the section between EDSA and diverting point.



Route - C
Length : 186.5 km
Cost : ₱12,017 M
Vehicle-km on Expressway : 9,118,000
Advantages:
- Free from Lahar problem
- Two expressways going north from Metro Manila resulting in :
  a) Mitigation of congestion on existing section.
  b) More flexible road network

Disadvantages:
- High Cost
- R-O-W acquisition problem in built-up area.

FIGURE 10.3-3 PRELIMINARY STUDY ON NORTH LUZON EXPRESSWAY ROUTING

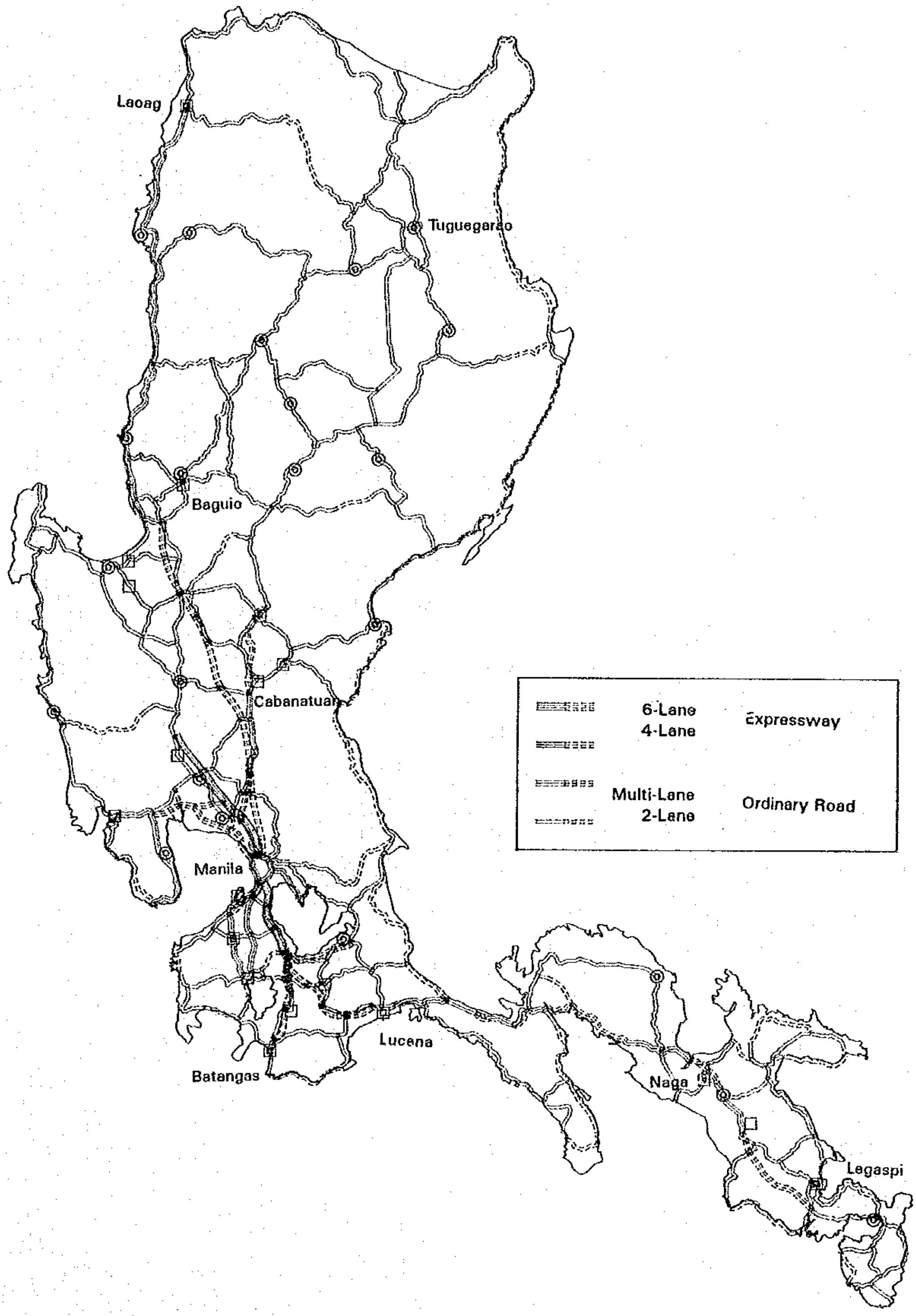


FIGURE 10.3-4 LISR NETWORK

CHAPTER 11

PROJECT IDENTIFICATION

11.1 PRESENT CONDITION OF LISR NETWORK

The LISR network is composed of 7,762 km of existing roads and 1,329 km of non-existing roads. Present condition of the LISR network is summarized in Table 11.1-1 and graphically shown in Figure 11.1-1.

Out of 7,762 km of existing roads, approximately 57% is adequate, 34% substandard and 9% impassable. Adequate road is defined as one that satisfies all the following conditions:

- Carriageway width is 6.0m or more,
- Carriageway is paved with concrete or asphalt, and
- Pavement surface is in good or fair condition.

The road that fails in one or more conditions is classified as substandard road. Adequate/substandard distinction is just according to physical condition of road, not reflecting traffic condition. Adequate roads include the roads proposed to be widened.

Adequate roads are concentrated in the central plain from Pangasinan to Batangas. In the other areas, especially in mountainous areas, quality of road is low as most roads are narrow and/or unpaved except Pan-Philippine Highway and Manila North Road.

Except on impassable sections, there are 288 defective/temporary/non-existing bridges with aggregate length of 10,765m, of which 86% in number and 51% in length is temporary bridges. These bridges are located all over the island, mostly on unpaved roads (Refer to Chapter 3).

Disaster-prone sections are concentrated in mountainous area in northern part of Luzon Island except influence area of Mt. Pinatubo which suffers from damage due to lahar, and short sections scattered mainly in coastal areas. Frequent occurrence of disaster in the mountainous area remarkably weakens east-west linkage in northern part of Luzon Island.

Major roads located within 100 km area from Metro Manila and trunk roads such as Pan-Philippine Highway and Manila North Road are anticipated to be saturated by year 2020.

TABLE 11.1-1 PRESENT CONDITION OF LISR NETWORK

Existing road		
Adequate road	4,430.1 km	(48.7%)
Substandard road		
Narrow section (width <6.0m)	1,634.6 km	(18.0%)
Unpaved section	772.0 km	(8.5%)
Paved, but in bad or very bad condition	233.5 km	(2.6%)
Sub-total	2,640.1 km	(29.0%)
Impassable road	691.4 km	(7.6%)
Existing road total	7,761.6 km	(85.4%)
Proposed Road (Non-existing road)		
2-lane road	636.7 km	(7.0%)
4-lane road	380.9 km	(4.2%)
Expressway	311.3 km	(3.4%)
Proposed road total	1,328.9 km	(14.6%)
Grand Total	9,090.5 km	(100.0%)

Defective/temporary bridges, excluding those on impassable/proposed sections

	Number	Total Length
Permanent bridge with heavy damage	21	1,137m
Temporary bridge (bailey, timber, spillway)	248	5,440m
Ford crossing or no bridge	19	4,187m
Total	288	10,765m

Section with other problems	
Portion needing to take disaster preventive measures	431.1 km
Congested section in future (2020)	1,372.5 km

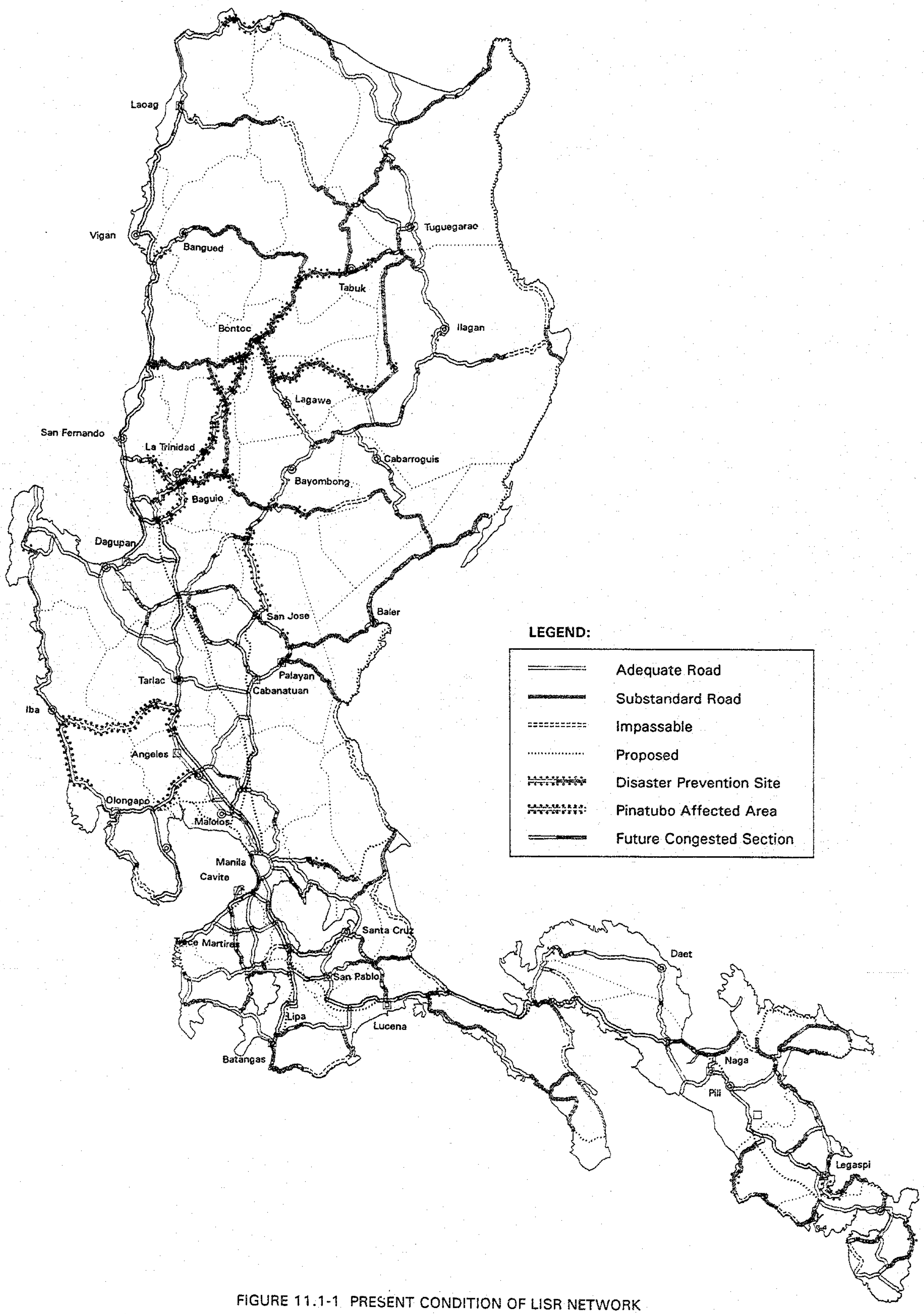


FIGURE 11.1-1 PRESENT CONDITION OF LISR NETWORK

11.2 PROJECT IDENTIFICATION

Road improvement works necessary to complete the LISR network are identified depending on target grade of each component road and its present condition in accordance with the criteria shown in Table 11.2-1.

TABLE 11.2-1 TYPE OF WORK AND SELECTION CRITERIA

Item	Target grade of road	Present Condition	Type of Work	Abbreviation
Road	2-lane ordinary road	Paved, but in bad or very bad condition	Pavement rehabilitation	REH
		Unpaved	Pavement construction	PAV
		Width less than 6.0m	Widening of ordinary road to 2-lane 1)	WO2
		Non-existing	New construction of 2-lane ordinary road 2)	NO2
	4-lane ordinary road	2-lane road	Widening of ordinary road to 4-lane 1)	WO4
		Non-existing	New construction of 4-lane ordinary road 2)	NO4
	4-lane expressway	2-lane expressway	Widening of expressway to 4-lane 1)	WE4
		Non-existing	New construction of 4-lane expressway 2)	NE4
	6-lane expressway	4-lane expressway	Widening of expressway to 6-lane 1)	WE6
Bridge	2-lane ordinary road	Defective/temporary/ non-existing	New construction of 2-lane bridge	NO2
	4-lane ordinary road	2-lane bridge	Widening of bridge to 4-lane	WO4
		Defective/temporary/ non-existing	New construction of 4-lane bridge	NO4
	4-lane expressway	2-lane bridge	Widening of expressway bridge to 4-lane	WE4
		Non-existing	New construction of 4-lane expressway bridge	NE4
	6-lane expressway	4-lane bridge	Widening of expressway bridge to 6-lane	WE6
Disaster Prevention	Any	Existing road with disaster potential	Disaster prevention work	DIS

Note: 1) Widening of road includes improvement of existing portion if necessary.
2) New construction of road includes disaster prevention measures if necessary.

Road improvement works thus identified are shown in Figure 11.2-1. These works were divided into 91 road projects considering characteristics and function of road and improvement effect. Each project was further subdivided into 1 to 9 segment(s), totaling 178 segments. Project location map and project list are presented in Figure 11.2-2 and Table 11.2-2, respectively.

The full description of each project is presented in the attached volume "PROJECT PROFILE".

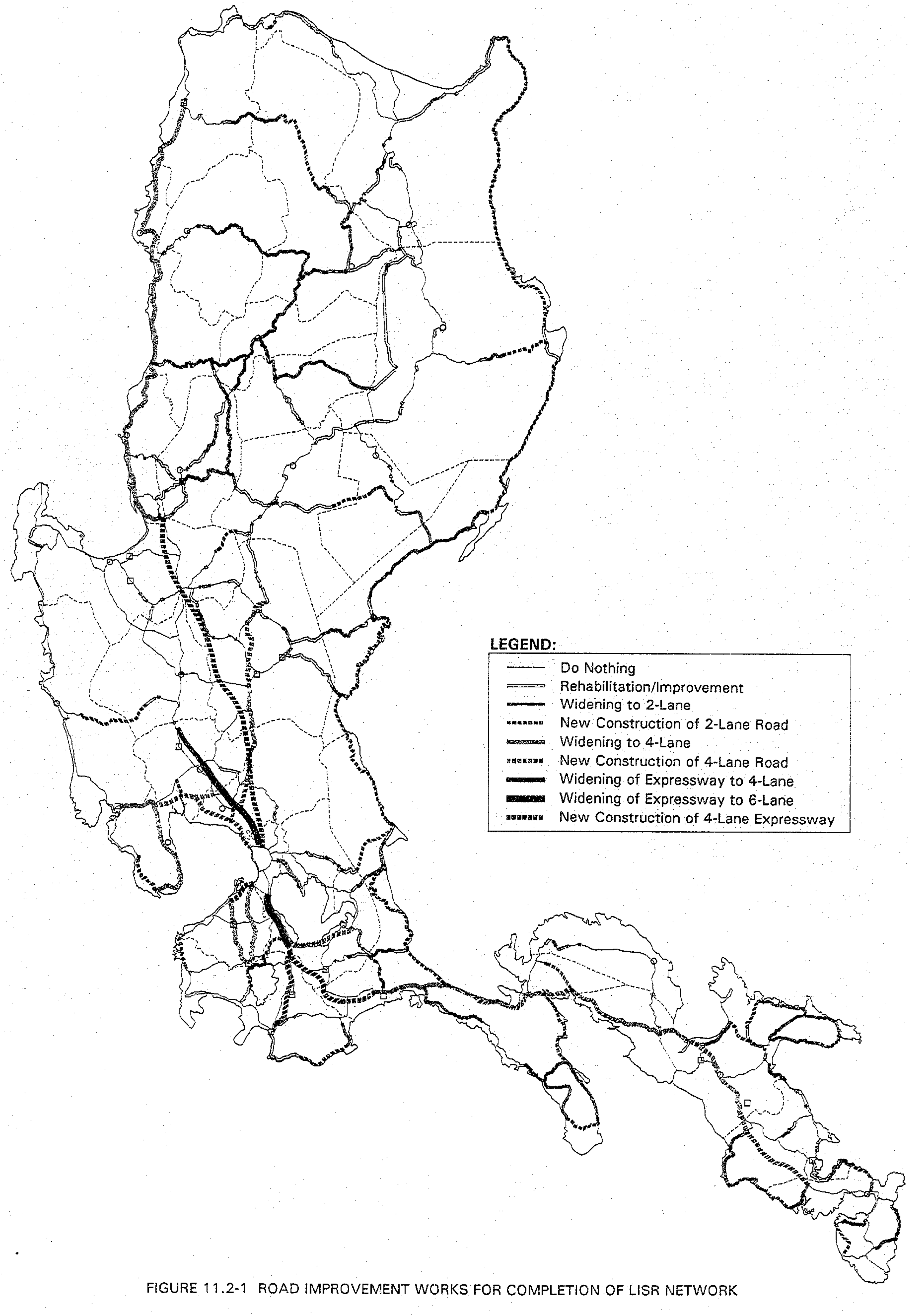


FIGURE 11.2-1 ROAD IMPROVEMENT WORKS FOR COMPLETION OF LISR NETWORK

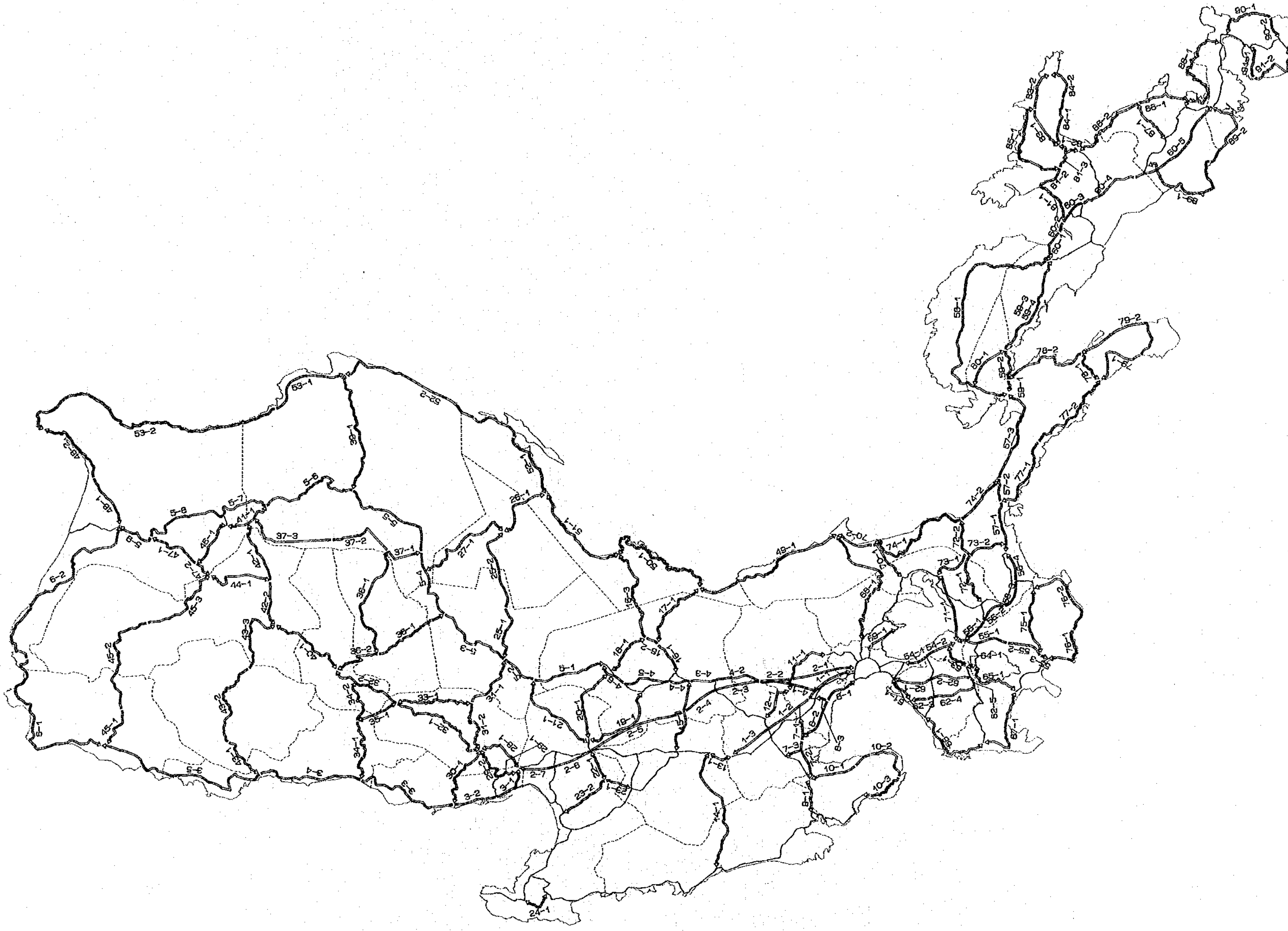


FIGURE 11.2-2 PROJECT LOCATION MAP

TABLE 11.2-2 LIST OF IDENTIFIED PROJECTS

No.	Project	Segment	Segment Length (km)	Road Improvement/Widening/Construction (km)									Bridge Widening/Construction (m)						Disaster Prevention (km)
				REH	PAV	WO2	NO2	WO4	NO4	WE4	NE4	WE6	NO2	WO4	NO4	WE4	NE4	WE6	DIS
1	North Luzon Expressway	1-1 to 1-3	78.6	-	-	-	-	-	-	21.7	-	56.9	-	-	-	431	-	6768	-
2	New North Luzon Expressway	2-1 to 2-7	186.6	-	-	-	-	-	-	-	186.6	-	-	-	-	-	2675	-	-
3	Manila North Rd, Rosario-Laoag	3-1 to 3-5	273.5	-	-	-	-	273.5	-	-	-	-	-	4569	-	-	-	-	2.5
4	Pan-Phil H'way, Sta.Rita-San Jose	4-1 to 4-6	122.3	-	-	-	-	43.8	78.6	-	-	-	-	674	900	-	-	-	0.1
5	Pan-Phil H'way, San Jose-Magapit	5-1 to 5-9	388.8	69.2	1.6	-	-	-	-	-	-	-	-	-	-	-	-	-	27.9
6	Laoag-Magapit Rd	6-1 to 6-2	228.3	2.1	50.4	0.6	-	-	-	-	-	-	206	-	-	-	-	-	4.9
7	Manila-Bataan Coastal Rd, North	7-1 to 7-3	42.7	-	-	-	9.0	-	33.7	-	-	-	320	-	790	-	-	-	-
8	Manila-Bataan Coastal Rd, South	8-1 to 8-3	51.7	-	-	-	7.0	-	44.7	-	-	-	95	-	1400	-	-	-	-
9	Dinalupihan-Olongapo Rd	9-1	26.2	-	-	-	-	26.2	-	-	-	-	-	223	-	-	-	-	-
10	Dinalupihan-Mariveles-Bagac Rd	10-1 to 10-3	102.9	-	-	3.2	34.9	64.0	-	-	-	-	249	22	-	-	-	-	-
11	Baliuag-San Jose Del Monte Rd	11-1	36.9	9.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	Baliuag-Sta.Ana Rd	12-1	23.6	-	11.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	Mabalacat-Capas Rd	13-1	14.1	-	-	-	-	-	-	-	-	-	194	-	-	-	-	-	-
14	Capas-Botolan Rd	14-1	81.8	-	8.2	-	49.0	-	-	-	-	-	70	-	-	-	-	-	-
15	Sta.Rosa-Tarlac Rd	15-1	40.6	-	-	-	-	-	-	-	-	-	90	-	-	-	-	-	-
16	Cabanatuan-Baler Rd	16-1 to 16-3	114.4	6.3	37.7	39.8	-	-	-	-	-	-	274	-	-	-	-	-	-
17	Palayan-Dingalan Rd	17-1	47.0	1.3	34.7	6.5	-	-	-	-	-	-	191	-	-	-	-	-	-
18	San Jose-Bongabon Rd	18-1	29.1	-	7.9	9.3	-	-	-	-	-	-	225	-	-	-	-	-	4.8
19	Rosales-Baloc Rd	19-1	46.3	-	21.8	-	-	-	-	-	-	-	6	-	-	-	-	-	-
20	Rosales-San Jose Rd	20-1	42.3	9.6	1.2	-	-	-	-	-	-	-	15	-	-	-	-	-	-
21	Rosales-Sta.Fe Rd	21-1	76.0	-	17.4	-	29.9	-	-	-	-	-	165	-	-	-	-	-	-
22	Carmen-Bautista Rd	22-1	18.3	0.4	1.4	-	-	-	-	-	-	-	156	-	-	-	-	-	-
23	Camiling-Binmaley Rd	23-1 to 23-2	40.6	8.3	2.4	-	-	-	-	-	-	-	12	-	-	-	-	-	-
24	Burgos-Bani Rd	24-1	17.6	6.0	0.3	4.2	-	-	-	-	-	-	-	-	-	-	-	-	0.1
25	Aritao-Maddela Rd	25-1 to 25-2	100.3	-	31.8	36.5	23.5	-	-	-	-	-	724	-	-	-	-	-	16.6
26	Maddela-Dinalongan Rd	26-1	58.6	-	10.9	36.5	-	-	-	-	-	-	310	-	-	-	-	-	-
27	Cordon-Maddela Rd	27-1	49.2	-	-	-	-	-	-	-	-	-	135	-	-	-	-	-	-
28	Kennon Rd	28-1	36.4	2.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19.9
29	Rosario-Pugo-Baguio Rd	29-1 to 29-2	46.7	4.8	7.0	0.4	-	-	-	-	-	-	-	-	-	-	-	-	13.2
30	Naguilian Rd	30-1	47.1	15.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.9
31	Aritao-Baguio Rd	31-1 to 31-2	107.6	-	38.6	66.8	-	-	-	-	-	-	602	-	-	-	-	-	69.7
32	Baguio-Bontoc Rd	32-1 to 32-2	141.5	2.2	1.3	67.3	-	-	-	-	-	-	57	-	-	-	-	-	89.1
33	Bokod-Abatan Rd	33-1	65.8	-	1.6	64.2	-	-	-	-	-	-	323	-	-	-	-	-	6.8
34	Tagudin-Sabangan Rd	34-1 to 34-2	101.8	-	4.7	94.9	-	-	-	-	-	-	204	-	-	-	-	-	10.8
35	Cervantes-Abatan Rd	35-1	33.3	0.8	5.1	27.2	-	-	-	-	-	-	-	-	-	-	-	-	6.7
36	Bagabag-Bontoc Rd	36-1 to 36-2	105.4	0.3	9.7	39.4	-	-	-	-	-	-	205	-	-	-	-	-	16.3
37	Santiago-Sta.Maria Rd	37-1 to 37-3	103.1	2.6	79.7	5.0	-	-	-	-	-	-	-	-	-	-	-	-	2.0
38	Ramon-Banaue Rd	38-1	107.3	-	6.7	100.5	-	-	-	-	-	-	54	-	-	-	-	-	72.0
39	Naguilian-Palanan Rd	39-1	79.0	-	1.4	7.8	47.5	-	-	-	-	-	467	-	-	-	-	-	-
40	Lubuagan-Bontoc Rd	40-1	72.4	-	-	72.0	-	-	-	-	-	-	300	-	-	-	-	-	40.2
41	Cabagan-Solana Rd	41-1	30.2	-	24.6	-	-	-	-	-	-	-	1000	-	-	-	-	-	-
42	Enrile-Lubuagan Rd	42-1 to 42-2	71.5	3.6	27.7	25.1	-	-	-	-	-	-	396	-	-	-	-	-	13.5
43	Narvacan-Lubuagan Rd	43-1 to 43-3	177.2	7.0	4.9	123.1	-	-	-	-	-	-	265	-	-	-	-	-	0.5
44	Abbut-Tabuk Rd	44-1	40.8	-	5.2	35.6	-	-	-	-	-	-	267	-	-	-	-	-	-
45	San Nicolas-Abbut Rd	45-1 to 45-3	201.1	-	55.5	47.3	70.0	-	-	-	-	-	264	-	-	-	-	-	0.1
46	Solana-Piat Rd	46-1	28.7	-	-	-	-	-	-	-	-	-	273	-	-	-	-	-	-
47	Nassiping-Abbut Rd	47-1 to 47-2	44.0	0.4	23.3	5.9	-	-	-	-	-	-	1053	-	-	-	-	-	0.7
48	Magapit-Sta.Ana Rd	48-1 to 48-2	80.4	-	54.2	11.0	-	-	-	-	-	-	369	-	-	-	-	-	-
49	Infanta-Dingalan Rd	49-1	101.5	-	4.1	6.5	89.9	-	-	-	-	-	1390	-	-	-	-	-	-
50	Dingalan-Baler Rd	50-1	118.7	-	-	-	118.7	-	-	-	-	-	655	-	-	-	-	-	-
51	Baler-Dinalongan Rd	51-1	64.6	-	9.0	52.4	-	-	-	-	-	-	12	-	-	-	-	-	-
52	Dinalongan-Palanan Rd	52-1 to 52-2	171.8	-	7.5	56.3	108.0	-	-	-	-	-	1675	-	-	-	-	-	-
53	Palanan-Sta.Ana Rd	53-1 to 53-2	206.5	-	10.0	-	196.5	-	-	-	-	-	1769	-	-	-	-	-	-
54	South Luzon Expressway	54-1 to 54-2	27.7	-	-	-	-	-	-	-	-	27.7	-	-	-	-	-	395	-
55	S.Luzon Expwy Ext, Batangas Line	55-1 to 55-3	51.0	-	-	-	-	3.3	-	-	47.7	-	-	-	-	-	480	-	-
56	S.Luzon Expwy Ext, Lucena Line	56-1 to 56-4	62.0	-	-	-	0.7	-	-	-	61.3	-	80	-	-	-	1155	-	-
57	Pan-Phil H'way, Lucena-Calauag	57-1 to 57-3	94.5	-	-	-	-	69.1	25.4	-	-	-	-	2382	250	-	-	-	0.2
58	Pan-Phil H'way, Calauag-Sipocot	58-1	161.8	9.3	3.6	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1
59	Calauag-Sipocot Diversion Rd	59-1 to 59-4	109.9	-	-	-	42.0	72.7	37.2	-	-	-	-	-	1035	-	-	-	-
60	Sipocot-Putiao Diversion Rd	60-1 to 60-5	127.1	-	-	-	-	44.8	82.3	-	-	-	-	194	1466	-	-	-	-
61	Manila-Cavite Expressway	61-1	15.7	-	-	-	-	-	-	-	15.7	-	-	-	-	-	395	-	-
62	Bacoor-Tagaytay-Tanza Rd	62-1 to 62-5	81.5	-	-	-	-	81.5	-	-	-	-	-	122	-	-	-	-	-
63	Calamba-Tagaytay Rd	63-1	24.7	-	-	-	16.2	-	-	-	-	-	46	-	-	-	-	-	-
64	Tagaytay-Talisay Rd	64-1	7.6	-	0.6	6.1	-	-	-	-	-	-	-	-	-	-	-	-	-
65	Talisay-Lemery Rd	65-1	42.2	9.5	7.0	11.5	13.5	-	-	-	-	-	100	-	-	-	-	-	-
66	Naic-Nasugbu Rd	66-1	71.4	-	-	1.7	40.3	-	-	-	-	-	135	-	-	-	-	-	-
67	Nasugbu-Lemery Rd	67-1	46.2	11.6	-	-	-	-	-	-	-	-	129	-	-	-	-	-	-
68	Marikina-Infanta Rd	68-1	103.7	11.4	35.8	5.8	36.0	-	-	-	-	-	80	-	-	-	-	-	0.2
69	Pasig-Binangonan Rd	69-1	21.2	-	-	-	-	21.2	-	-	-	-	-	260	-	-	-	-	-
70	Famy-Infanta Rd	70-1 to 70-2	54.4	-	18.3	32.1	-	-	-	-	-	-	45	-	-	-	-	-	-
71	Calamba-Pagsanjan Diversion Rd	71-1	38.9	-	-	-	-	1.8	37.1	-	-	-	-	-	850	-	-	-	-
72	San Pablo-Mauban Rd	72-1 to 72-2	72.7	5.8	25.7	18.7	-	-	-	-	-	-	80	-	-	-	-	-	-
73	Pagsanjan-Lucena Rd	73-1 to 73-2	51.1	8.0	9.5	10.9	-	-	-	-	-	-	12	-	-	-	-	-	-
74	Tignuan-Atimonan Rd	74-1 to 74-2	115.0	-	-	1.5	113.0	-	-	-	-	-	1585	-	-	-	-	-	-
75	Batangas-San Juan Rd	75-1	40.0	11.0	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
76	Batangas-San Juan Coastal Rd	76-1 to 76-2	87.2	8.4	25.8	14.4	29.3	-	-	-	-	-	569	-	-	-	-	-	-
77	Malicboy-Mulanay Rd	77-1 to 77-2	120.4	-	-	76.2	-	-	-	-	-	-	-	-	-	-	-	-	-
78	Mulanay-Panagon-Jinabaan Rd	78-1 to 78-2	88.3	-	-	43.6	44.7	-	-	-	-	-	504	-	-	-	-	-	-
79	Mulanay-San Francisco-Panagon Rd	79-1 to 79-2	96.6	-	-	42.5	54.1	-	-	-	-	-	1275	-	-	-	-	-	-
80	San Miguel-Tagkawayan Rd	80-1	27.6	-	-	-	21.1	-	-	-	-	-	110	-	-	-	-	-	-
81	Parigsa-Goa Rd	81-1 to 81-3	47.5	1.4	0.8	28.4	15.0	-	-	-	-	-	140	-	-	-	-	-	-
82	Tigaon-Lagonoy Rd	82-1	17.2	-	-	-	-	-	-	-	-	-	74	-	-	-	-	-	-
83	Lagonoy-Caramoan Rd	83-1 to 83-2	84.7	-	-	84.7	-	-	-	-	-	-	301	-	-	-	-	-	-
84	Lagonoy-Presentacion-Caramoan Rd	84-1 to 84-2	52.7	-	-	32.7	20.0	-	-	-	-	-	460	-	-	-	-	-	-
85	Lalud-Garchitorena Rd	85-1	68.9	-	5.9	-	63.0	-	-	-	-	-	682	-	-	-	-	-	-
86	Legaspi-Tigaon Rd	86-1 to 86-2	87.7	-	3.4	22.8	-	-	-	-	-	-	383	-	-	-	-	-	-
87	Ligao-Tabaco Rd	87-1	27.4	-	5.3	6.9	-	-	-	-	-	-	-	-	-	-	-	-	-
88	Legaspi-Manito-Sorsogon Rd	88-1	82.1	-	-	29.7	20.0	-	-	-	-	-	461	-	-	-	-	-	0.4
89	Matacong-Putiao Rd	89-1 to 89-2	128.8	4.9	8.8	64.1	34.7	-	-	-	-	-	506	-	-	-	-	-	0.1
90	Abuyog-Bulusan-Iroshin Rd	90-1 to 90-2	50.0	-	-	35.8	-	-	-	-	-	-	-	-	-	-	-	-	1.0
91	Juban-Magallanes Rd	91-1 to 91-2	64.2	-	-	19.1	22.7	-	-	-	-	-	56	-	-	-	-	-	-
	T O T A L		7274.4	233.5	771.9	1634.6	1370.1	701.8	339.0	21.7	311.3	84.6	22848	8445	6691	431	4705	7163	433.5

LEGEND:

Roads:

REH : Pavement Rehabilitation
WO2 : Widening of ordinary road to 2-lane
WO4 : Widening of ordinary road to 4-lane
WE4 : Widening of expressway to 4-lane
WE6 : Widening of expressway to 6-lane
PAV : Pavement Construction
NO2 : New Construction of 2-lane ordinary road
NO4 : New Construction of 4-lane ordinary road
NE4 : New Construction of 4-lane expressway

Bridges:

NO2 : New Construction of 2-lane bridge
NO4 : New Construction of 4-lane bridge
NE4 : New Construction of 4-lane expressway bridge
WO4 : Widening of bridge to 4-lane
WE4 : Widening of expressway bridge to 4-lane
WE6 : Widening of expressway bridge to 6-lane

CHAPTER 12

PROJECT COST ESTIMATE

12.1 GENERAL

The project road network in Luzon Island covers a total length of 5,426.59 kms., inclusive of 37,984 meters of bridge projects and 433.45 kms. of disaster projects. It is composed of ninety-one (91) road projects derived from one hundred eight (108) road segments of different characteristics and level of improvement. Since, the type of works involved varies from one road project to another, project types were classified as follows:

- REH : Pavement Rehabilitation
- PAV : Pavement Construction
- WO2 : Widening of Ordinary Roads (to 2-lane)
- WO4 : Widening of Ordinary Roads (to 4-lane)
- NO2 : New Construction of Ordinary Roads (2-lane)
- NO4 : New Construction of Ordinary Roads (4-lane)
- WE4 : Widening of Expressway (to 4-lane)
- WE6 : Widening of Expressway (to 6-lane)
- NE4 : New Construction of Expressway (4-lane)

The outline of cost estimate procedure is shown in Figure 12.1-1. In order to simplify works for the master plan cost study, overall quantity estimates were calculated by computer based on road inventory data, however, unit work per kilometer of roads, bridges and disasters were estimated based on the MINIMUM DESIGN STANDARDS OF PHILIPPINE HIGHWAYS as presented in Appendix 12.1 and the typical cross-sections shown in Figures 12.1-2(1),(2),(3).

Moreover, total project cost estimate was derived in accordance with Department Order No. 30, dated 15 February 1991, RE: PREPARATION OF AGENCY ESTIMATE. It is a composition of direct cost, indirect cost, land acquisition cost and engineering services cost.

12.2 CONSTRUCTION COST ESTIMATE

12.2.1 Basic Cost Elements

Normally, basic cost elements of labor, materials and equipments must first be collected and established prior to cost estimation. These data, as summarized in Tables 12.2-1 to 12.2-3, were obtained from the Associated Construction Equipment Lessors, Inc. (ACEL), the DPWH's Price Monitoring Section, market price survey of the study team, credible contractors and relevant agencies concerned. In addition, construction cost survey of the North/South Luzon

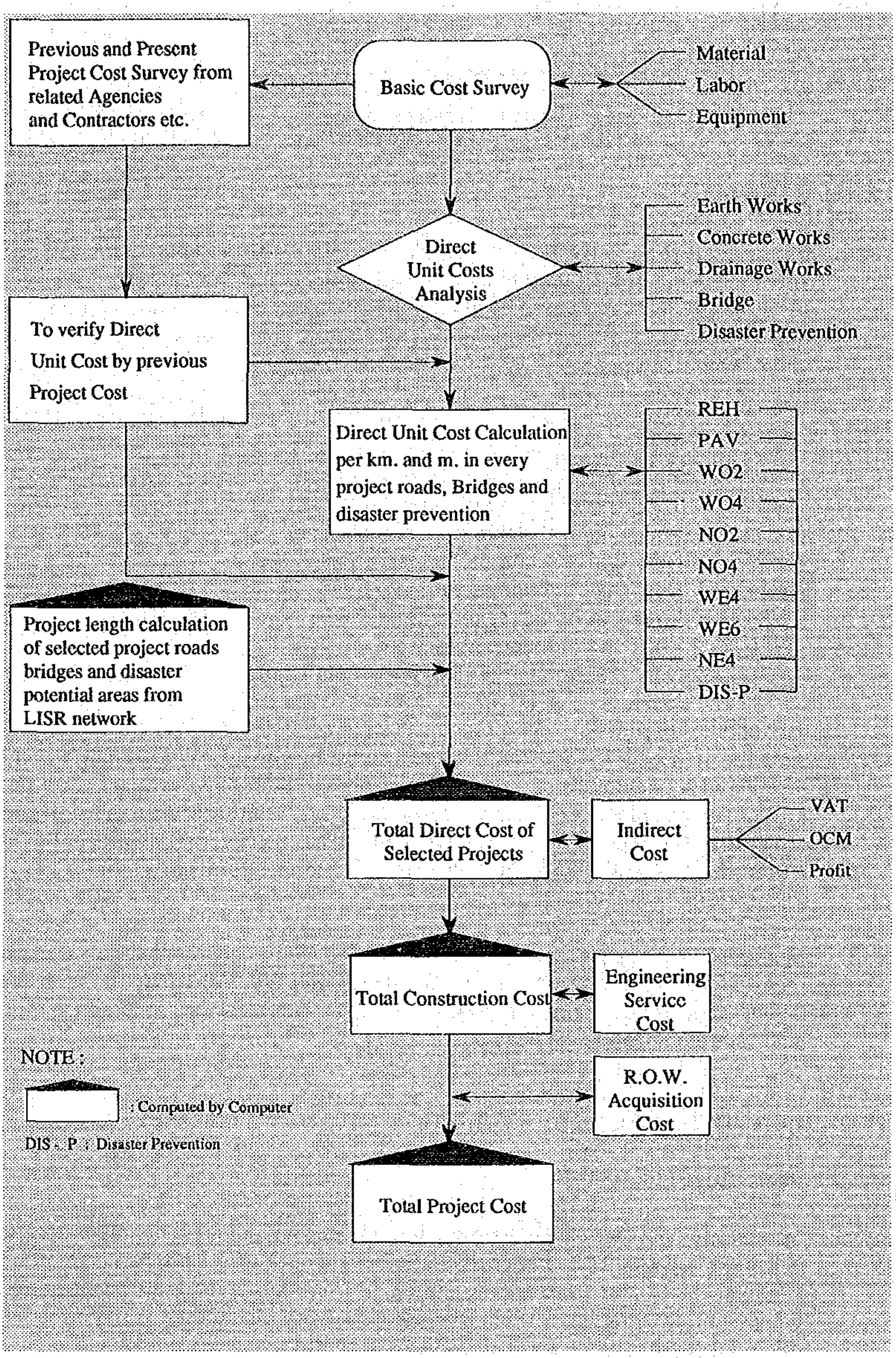


FIGURE 12.1-1 FLOW CHART OF COST ESTIMATE

Expressway was also conducted, analyzed and utilized in the construction cost estimate of New Expressways.

Based on the data collected, direct unit costs at December 1992 level of major construction items were derived and presented in Table 12.2-4.

12.2.2 Estimated Direct Cost

The estimated direct cost per item of work is the combination of equipment, labor and material components. Consequently, the direct construction cost for each type of road construction is developed and summarized in Table 12.2-5.

However, in the project cost analysis, total direct cost for each project type is estimated at the combination of road, bridge, disaster prevention and other miscellaneous works. The manner of estimation was outlined as follows:

1) ROADS

The direct cost of road projects were estimated by linear kilometer for each type of road construction as mentioned in Section 12.1 and illustrated in Figure 12.1-2(1),(2),(3) inclusive of the drainage cost and traffic and other costs in the construction stage. Likewise, Table 12.2-6 presents the type of terrain for each typical project. Drainage facilities, however was estimated based on the following assumptions:

Unit: per kilometer

	Terrain Types		
Type of Drainage	Flat	Rolling	Mountainous
Pipe - Culvert	4 units	6 units	3 units
Box - Culvert	-	-	4 units
Ditches	-	1.0 km.	2.0 km.

Note: Pipe - Culvert --- ϕ910mm + headwalls
Box - Culvert --- 2.4m x 2.4m + Wingwalls
Ditches ---------- V-Typed

On the other hand, traffic and other costs which includes among others the facilities for the engineers, miscellaneous structures, mobilization and demobilization, etc. during construction stage was estimated based from previous and on-going foreign-assisted projects.

In some special cases, like the Manila-Bataan Coastal Road, wherein soft ground treatment is necessary, ground replacement by filling of suitable materials and sand blanket method was adapted due to non-availability of reliable data regarding other methods, besides, it's simple and cheap method of ground treatment.

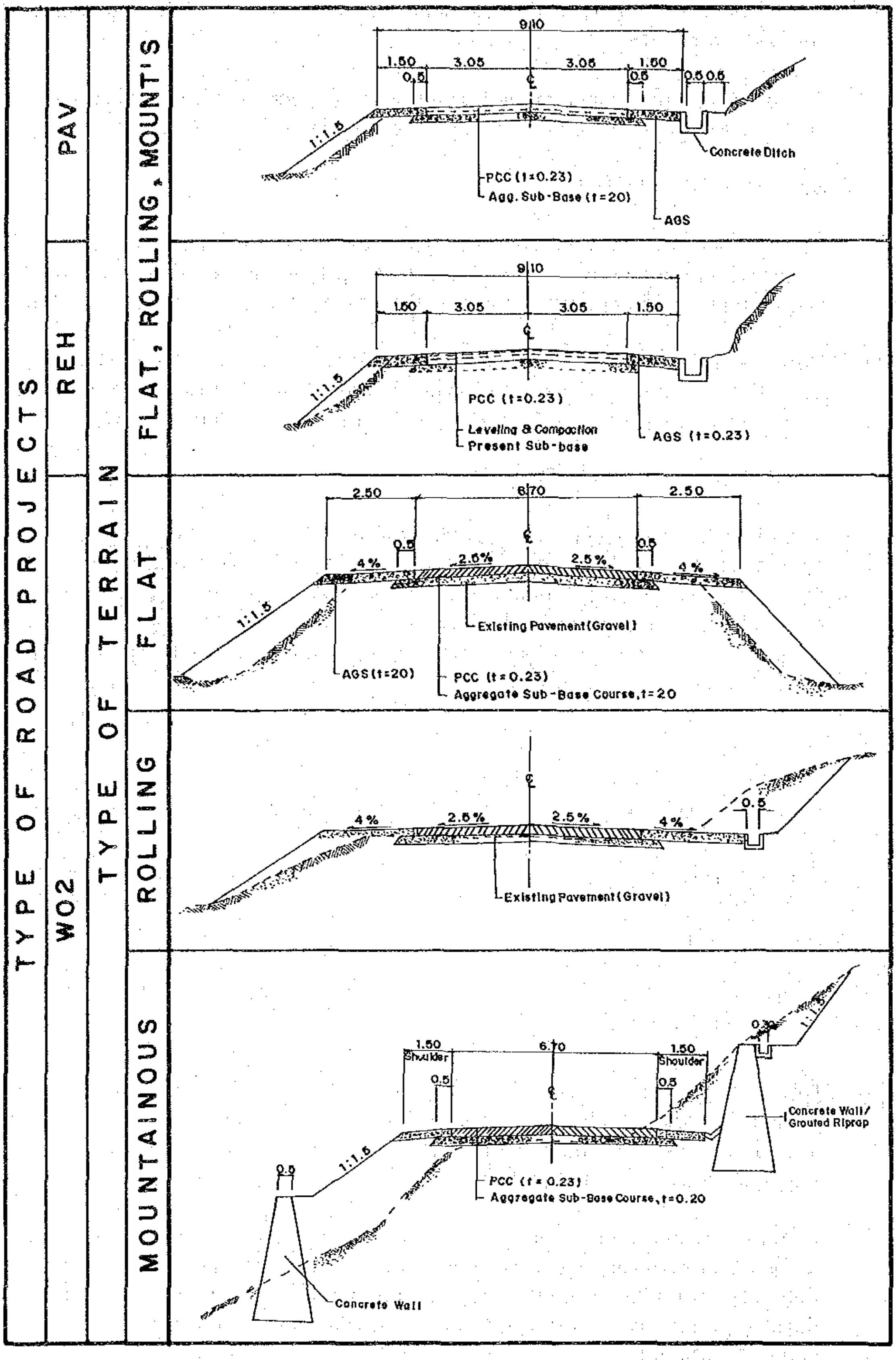


FIGURE 12.1-2(1) TYPICAL ROAD CROSS-SECTION

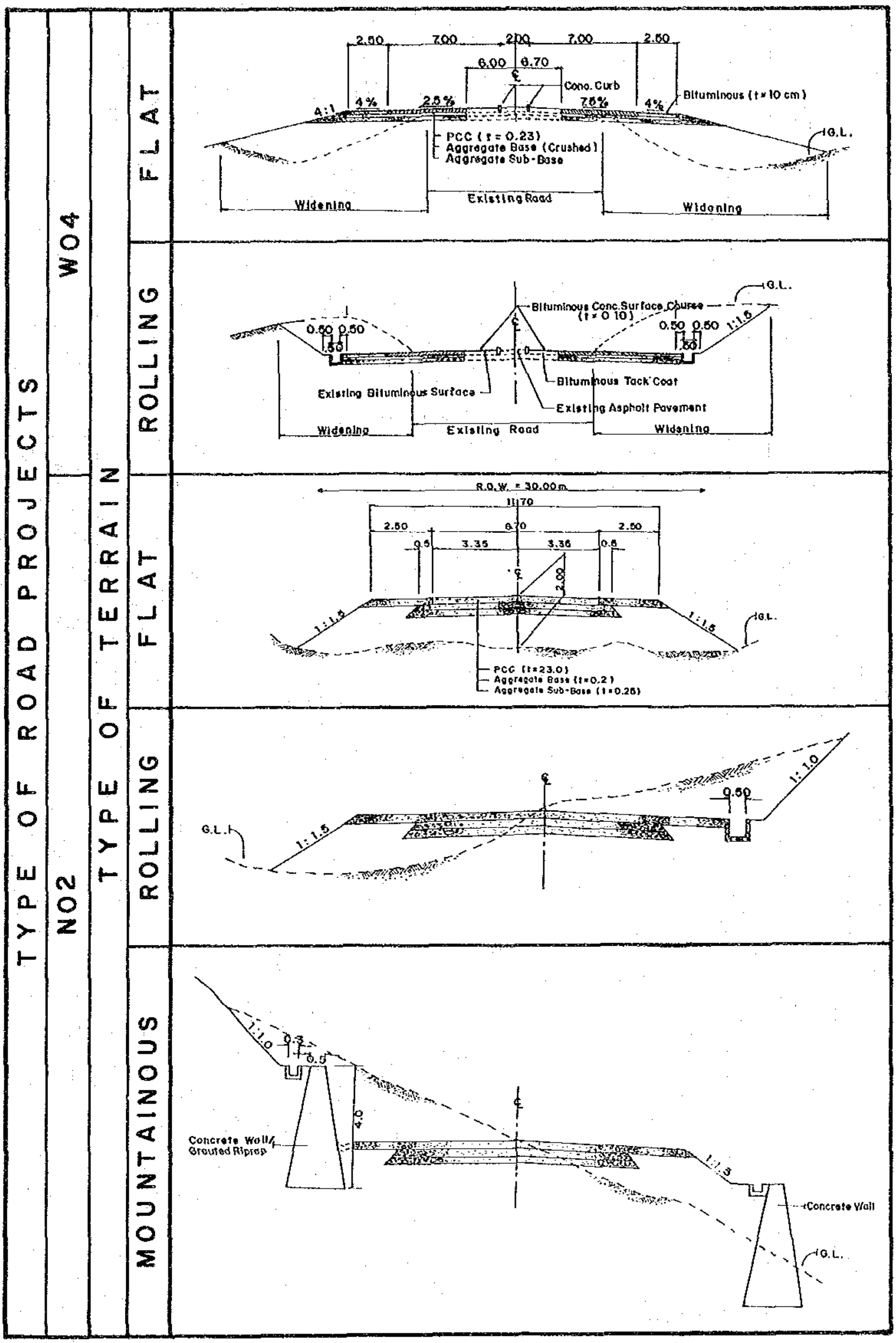


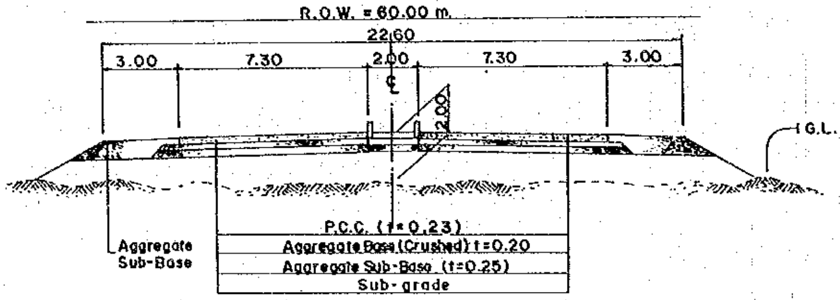
FIGURE 12.1-2(2) TYPICAL ROAD CROSS-SECTION

TYPE OF ROAD PROJECTS

NO4

TYPE OF TERRAIN

FLAT



ROLLING

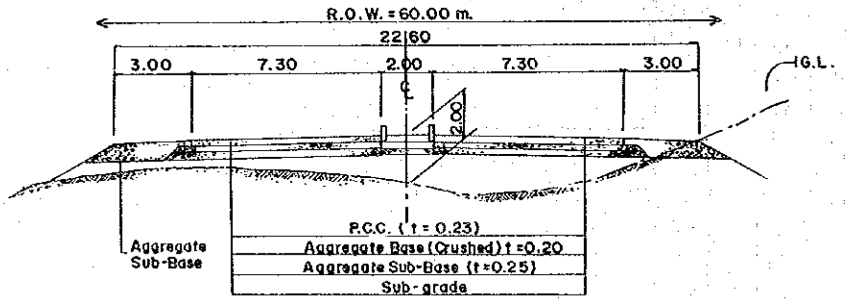


FIGURE 12.1-2(3) TYPICAL ROAD CROSS-SECTION

TABLE 12.2-1 LABOR COST

As of December 1992

Qualification	Labor Cost Index	Basic Wage		Monthly Benefit					Total Rate/ Month (P)	Total Rate/ Day (P)	Total Rate/ Hour (P)
		Daily	Monthly	Leave	Bonus	SSS	Medicare	Employee Compensation Contract			
Foreman	2.14	252.52	6,313.00	526.08	526.08	253.30	25.00	10.00	7,653.47	306.14	38.27
Assistant Foreman	1.90	244.20	6,105.00	508.75	508.75	253.30	25.00	10.00	7,410.80	296.43	37.05
Heavy Equipment Operator	1.65	194.70	4,867.50	405.63	405.63	253.30	25.00	10.00	5,967.05	238.68	29.84
Light Equipment Operator	1.50	177.00	4,425.00	368.75	368.75	228.00	25.00	10.00	5,425.50	217.02	27.13
Carpenter	1.75	206.50	5,162.50	430.21	430.21	253.30	25.00	10.00	6,311.22	252.45	31.56
Mason	1.75	206.50	5,162.50	430.21	430.21	253.30	25.00	10.00	6,311.22	252.45	31.56
Steelman	1.75	206.50	5,162.50	430.21	430.21	253.30	25.00	10.00	6,311.22	252.45	31.56
Skilled Laborer	1.75	206.50	5,162.50	430.21	430.21	253.30	25.00	10.00	6,311.22	252.45	31.56
Unskilled Laborer	1.00	118.00	2,950.00	245.83	245.83	152.00	25.00	10.00	3,628.67	145.15	18.14
Driver	1.40	165.20	4,130.00	344.17	344.17	202.70	25.00	10.00	5,056.03	202.24	25.28

Monthly Wages based on 25 days per month, 8 hours per day

1. Vacation and Sick Leave = $\frac{\text{Basic Monthly Pay}}{12}$

2. Bonus or 13th Month Pay = $\frac{\text{Basic Monthly Pay}}{12}$

3. SSS = Amount Representing Employee's Contribution, Graduated Scale (Effective Jan. 1, 1992)
4. Medicare = Amount Representing Employee's Contribution, Graduated Scale (Effective Jan. 1992)
5. Employee Compensation = Amount Representing Employer's Contribution, Graduated Scale
6. Rate Per Day = $\frac{\text{Total Monthly Pay}}{25}$

Sources: (1) National Wage Council
(2) Department of Labor and Employment
(3) Social Security System (SSS)
(4) Private Contructors
(5) Other Related Sources

TABLE 12.2-2 PRICE OF MAIN MATERIALS

As of December 1992

No.	Market Price of Purchase Materials	Unit	Unit Price
1.	Portland Cement	ton	2,000.00
2.	Sand (Ordinary) white	cu.m.	230.00
3.	Sand Washed Sand or S-1	cu.m.	270.00
4.	Gravel Crushed G-1	cu.m.	357.00
5.	Gravel 3/4"	cu.m.	394.00
6.	Gravel 3/8"	cu.m.	385.00
7.	Stones/Boulders	cu.m.	300.00
8.	Aggregate Subbase Course	cu.m.	159.17
9.	Crushed Aggregate Base Course	cu.m.	302.31
10.	Plywood 1/2" x 4' x 8'	m^2	139.00
11.	Plywood 1/4" x 4' x 8'	m^2	59.68
12.	Reinforcing Steel Bars (Deformed)	kg.	13.00
13.	Reinforcing Steel Bars (Round)	kg.	17.65
14.	Nails	kg.	30.00
15.	G.i. # 16 Tie Wires	kg.	36.00
16.	Lumber Good Lumber, Rough	m^3	7,203.00
17.	Lumber Good Lumber, S-4S (2mx1mx.50m)	m^3	7,733.00
18.	Gabion Steel Mesh, PVC Coated	each	1,584.00
19.	Gabion Steel, Galvanized (2mx1mx.50m)	each	1,094.00
20.	Steel Pipe 48.6mm dia.x 1m.	pc.(8 kg/m)	67.00
21.	Filler	sq.m.	10.00
22.	RCPC 610mm dia.	lm.	490.00
23.	RCPC 910mm dia.	lm.	1,100.00
24.	RCPC 1220mm dia.	lm.	1,350.00
25.	Dynamite	kgs.	52.00
26.	Blasting Caps & Fuse	pc.	21.00
27.	Electrical Wire # 22	m.	3.00
28.	Wire Lead	m.	8.50
29.	Wire Mesh	roll	585.00
30.	Bituminous Cutback SS-1 (for Tack Coat)	ton	11,667.00
31.	Bituminous Cutback MC-70 (Primecoat)	ton	11,614.70
32.	Bituminous Cutback (85-100 Pen)	ton	11,093.00
33.	Asphalt Concrete Mixture	ton	1,440.00

TABLE 12.2-3 HOURLY COST OF CONSTRUCTION EQUIPMENT

As of December 1992

No.	Construction Equipment	Horse Power H.P.	Hourly Cost ₱
1.	Concrete Mixing Plant	-	2,092.00
2.	Asphalt Batching Plant	-	2,631.00
3.	Asphalt Distributor	100	757.00
4.	Asphalt Finisher	-	783.00
5.	Bulldozer, D7E	160	710.00
6.	Bulldozer, D7G	200	2,012.00
7.	Bulldozer, D6C	140	714.00
8.	Bulldozer, D8L with riper	335	3,974.00
9.	Wheel Loader, 1.53 m^3	105	412.00
10.	Wheel Loader, 1.15m^3	80	343.00
11.	Wheel Loader, 0.70m^3	43	320.00
12.	Rubber Tired Roller, 10T	107	332.00
13.	Rubber Tired Roller, 15T	106	361.00
14.	Macadam Roller, 10-12T	-	669.00
15.	Vibratory Tompin Roller, 10T	150	1,001.00
16.	Vibratory Tandem Roller, 8T	65	361.00
17.	Motor Grader	125	572.00
18.	Tractor Shovel, 1.4m^3	110	777.00
19.	Truck Crane, 20T	180	899.00
20.	Trailer Truck, 25T	-	2,173.00
21.	Dump Truck, 8-10T	270	551.00
22.	Dump Truck, 15T	224	832.00
23.	Back Hoe, 0.40m^3	91	693.00
24.	Hydraulic Back Hoe, 0.6m^3	97	709.00
25.	Flat Bed Truck, 4T	-	356.00
26.	Flat Bed Truck, 7T	-	427.00
27.	Crawler Drill	7	335.00
28.	Water truck w/ pump,500-1000 gals	-	753.00
29.	Air Compressor, 10.5m^3/min.	130	598.00
30.	Concrete Mixer, 1.5-2.0 Bagger	-	52.00
31.	Conrete Vibrator	-	41.00
32.	Plate Compactor	7	98.00
33.	Power Broom Towed Type	-	72.00

TABLE 12.2-4 DIRECT UNIT COST OF MAJOR CONSTRUCTION WORKS

No.	Item of Works	Unit	Direct Unit Cost
	A) ROAD WORKS		
1.	Clearing and Grubbing	m^2	2.32
2.	Excavation (Common)	m^3	36.44
3.	Excavation (Soft rock)	m^3	118.55
4.	Excavation (Solid rock)	m^3	255.74
5.	Embankment from Borrow	m^3	89.61
6.	Backfilling	m^3	22.20
7.	Removal of Existing PCC Pavement	m^2	38.50
8.	Preparation of Existing Subbase	m^2	23.70
9.	Aggregate Subbase Course	m^3	282.45
10.	Aggregate Base Course	m^3	429.88
11.	Bituminous Concrete Surface Course	m^2	174.46
12.	AC Surface Course (T=10 cm.)	m^2	348.92
13.	PCC Pavement	m^2	335.17
14.	Stone Masonry Wall	m	2,400.00
15.	Reinforced Concrete Wall	m	9,500.00
16.	Concrete Curb	m	91.00
	B) BRIDGE WORKS		
1.	RCDG (<20m)		
	- Superstructure	m	38,300.00
	- Substructure	m	77,000.00
	- Other Cost	m	69,180.00
2.	Pre-Cast PC Girder (>20m)		
	- Superstructure	m	84,000.00
	- Substructure	m	114,800.00
	- Other Cost	m	79,520.00
	C) DISASTER PREVENTION WORKS		
1.	Cut Slope Failure	m	22,340.00
2.	Embankment Failure	m	15,500.00
3.	Debris Flow	m	47,000.00
4.	Scouring & Flooding	m	33,000.00

TABLE 12.2-5 DIRECT CONSTRUCTION COST FOR EACH TYPE OF ROAD CONSTRUCTION

Type of Road Construction		Direct Cost Per Kilometer		Direct Unit Cost (Pesos/Km.)
		Road Construction	Traffic & Others	
REH	F	2,876,400	470,000	3,346,400
	R	2,945,600	470,000	3,675,600
	M	4,276,200	470,000	4,746,200
PAV	F	3,319,400	470,000	3,789,400
	R	3,643,600	470,000	4,118,600
	M	4,719,200	470,000	5,189,200
WO2	F	4,048,400	670,000	4,718,400
	R	5,069,600	670,000	5,739,600
	M	11,570,700	670,000	12,240,700
WO4	F	11,054,000	670,000	11,963,200
	R	14,301,000	670,000	15,889,800
	M	-	-	-
NO2	F	5,588,400	770,000	6,358,400
	R	6,810,600	770,000	7,580,600
	M	14,416,700	770,000	15,186,700
NO4	F	14,244,400	770,000	15,011,400
	R	16,137,600	770,000	16,907,600
	M	24,976,200	770,000	25,746,200

NOTE: Road construction cost includes drainage facilities like pipe culverts, box culverts and side ditches.

TABLE 12.2-6 TYPICAL ROAD PROJECT & TERRAIN

	TYPE OF ROAD PROJECT \ TERRAIN	FLAT	ROLLING	MOUNT'S.	REMARKS
1	REH	○	○	○	
2	PAV	○	○	○	
3	WO2	○	○	○	
4	WO4	○	○	—	
5	WE4	○	○	—	
6	WE6	○	○	—	
7	NO2	○	○	○	
8	NO4	○	○	○	
9	NE4	○	○	—	

NOTE:
1. REH : Pavement Rehabilitation
2. PAV : Pavement Construction
3. WO2: Widening of Ordinary Road (to 2-lane)
4. WO4: Widening of Ordinary Road (to 4-lane)
5. WE4 : Widening of Expressway (to 4-lane)
6. WE6 : Widening of Expressway (to 6-lane)
7. NO2 : New Construction of Ordinary Road (to 2-lane)
8. NO4 : New Construction of Ordinary Road (to 4-lane)
9. NE4 : New Construction of Expressway (to 4-lane)

○ Typical Section to be applied for Project Cost Estimate

2) BRIDGES

Bridge cost estimate was derived from the typical bridge section as shown in Figure 12.2-1 and from previous and present bridge construction cost data.

Based on these data, typical bridge cost estimate was developed as shown in the following table.

Bridge Type	Super-Structure	Sub-Structure (with piles)	Others Cost	Total Direct Cost (Pesos/lm.)
RCDG (<20 m)	38,300	77,000	69,180	185,000
Precast PC Girder (>20m)	84,000	114,800	79,520	278,000

NOTE: In some cases, direct supporting type substructures are applicable, however, for scouring-prone substructures, pile supporting type substructure is imperative.

Other costs as indicated in the table includes the facilities for engineers, approaches, drainage, slope protections and other general requirements during the construction stage.

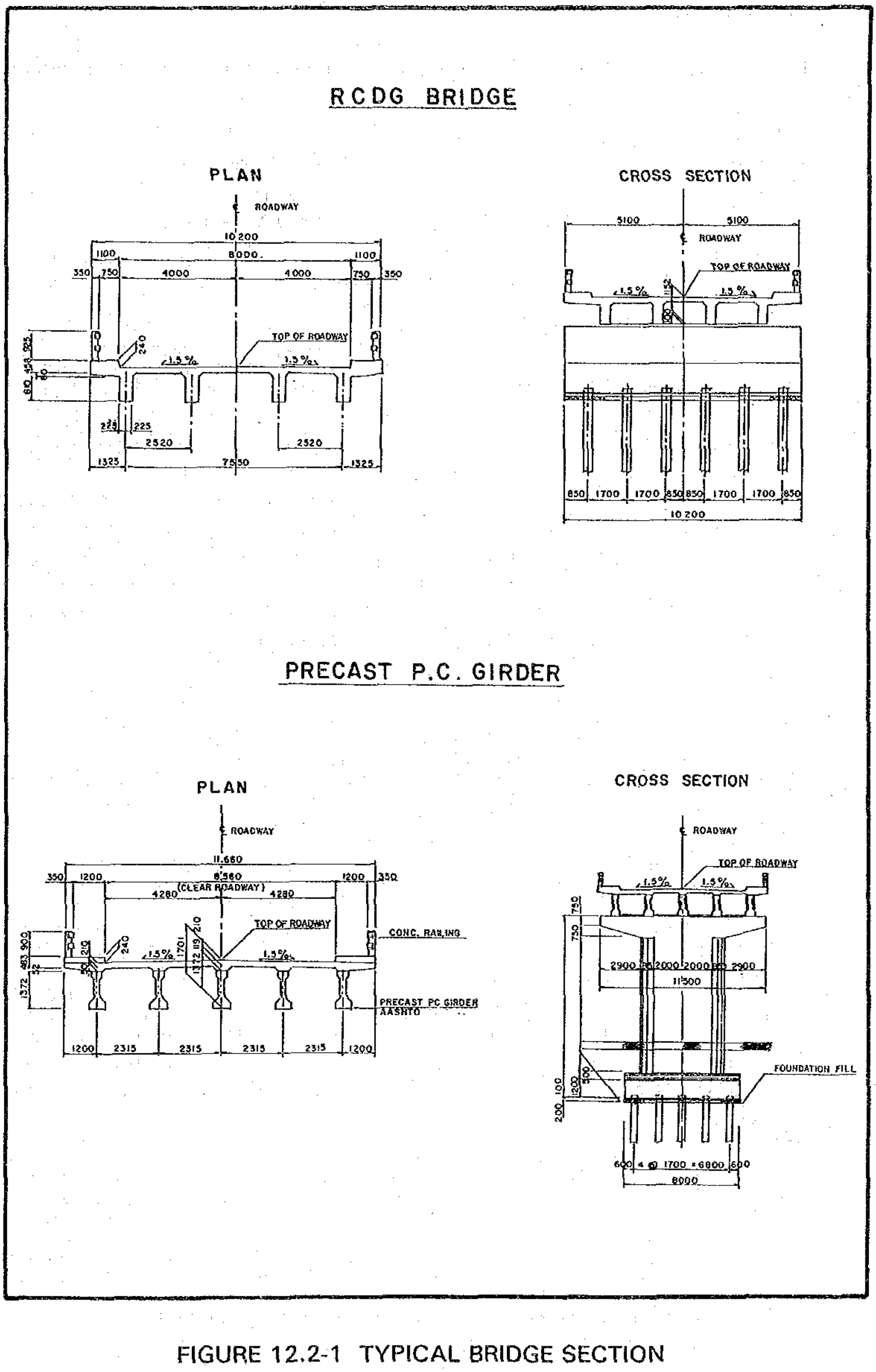


FIGURE 12.2-1 TYPICAL BRIDGE SECTION

3) EXPRESSWAY

Expressway construction was classified into three (3) types as shown hereunder:

Construction Type	Definition
WE4	Expressway Widening from 2-lanes to 4-lanes
WE6	Expressway Widening from 4-lanes to 6-lanes Expressway Widening from 5-lanes to 6-lanes
NE4	New Expressway Construction for 4-lanes

NOTE: Present expressway have enough right-of-way for widening both inside and outside carriageway, constituting no problem for additional lane in the expressway areas.

Cost estimate was conducted based on the collected data from the DPWH, the operator of the Manila North and South Expressway, related contractors, topographic map with a scale of 1:50,000 and from the typical expressway cross section of roads and bridges as shown in Figure 12.2-2 and Figure 12.2-3 respectively. Likewise, Table 12.2-7 indicates the direct cost for the different types of expressway construction. Traffic and other costs, as indicated in the table, includes the facilities for engineer, miscellaneous structures and mobilization/ demobilization during the construction stage.

4) DISASTER PREVENTIONS

The disaster prevention cost was estimated based on the following type of disasters:

- *Cut slope failures*
- Embankment failures
- Debris flow
- Scouring
- Flood

Countermeasures for these type of disasters was selected by a disaster prevention engineer of the Study Team. Based on the selected countermeasures, direct cost estimate of prevention works was established as shown in the following table:

	Cut Slope Failure	Embankment Failure	Debris Flow	Scouring & Flood
Direct cost of Disaster (Pesos/lm)	22,340	15,500	47,000	33,000

NOTE: The disaster high potential road cost were reviewed and revised by past disaster records.

The typical disaster prevention measures is shown in Figure 12.2-4.

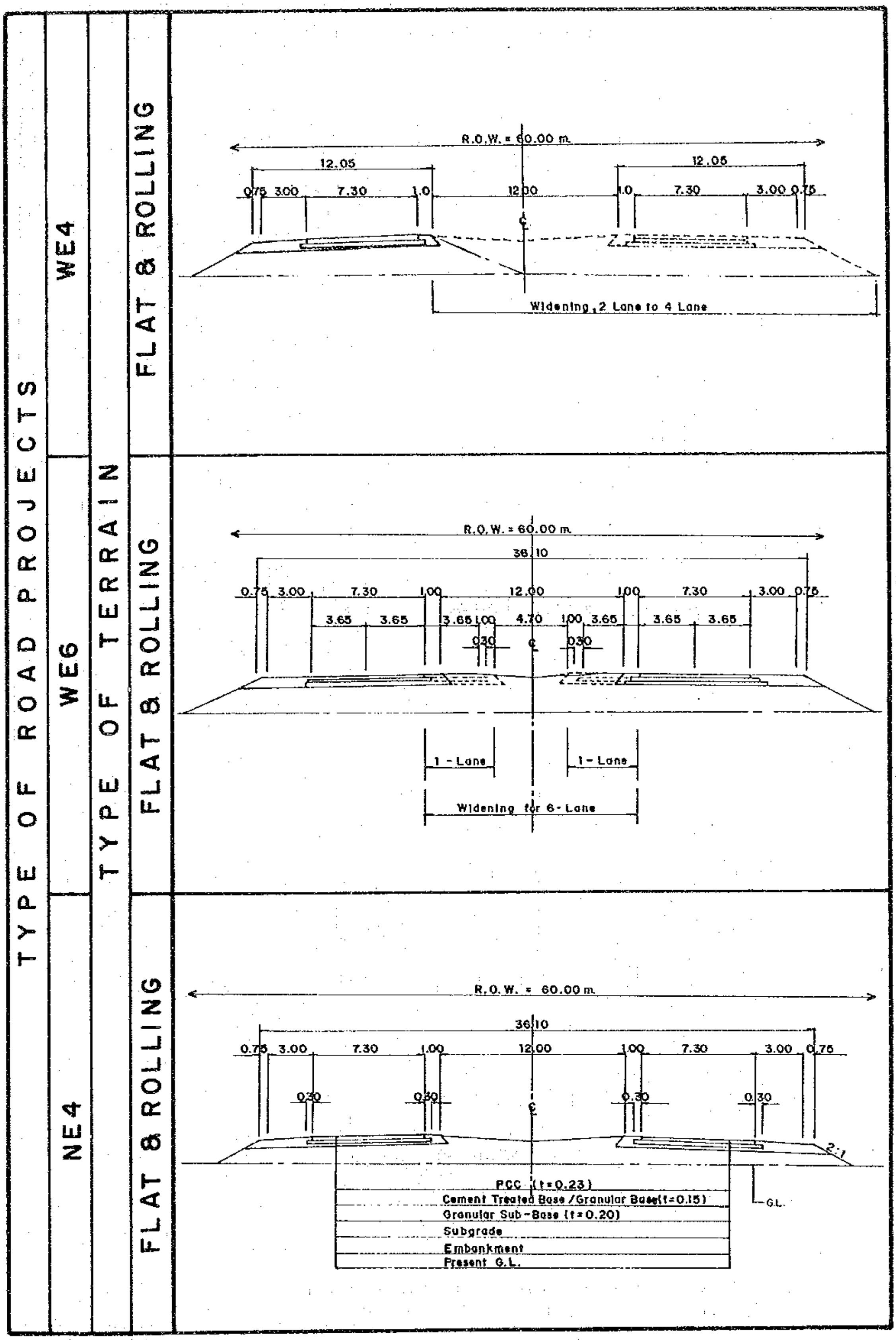
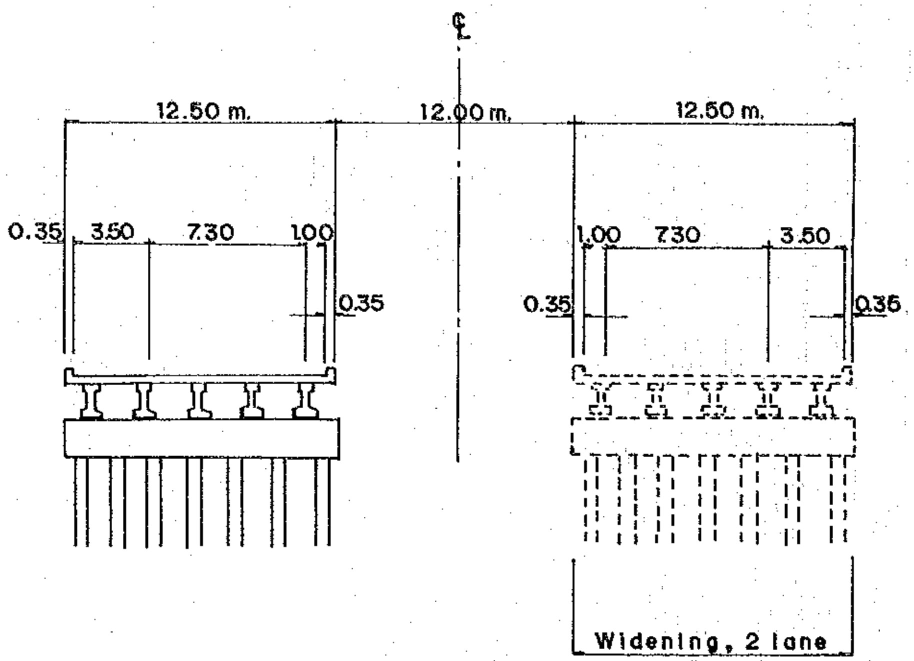
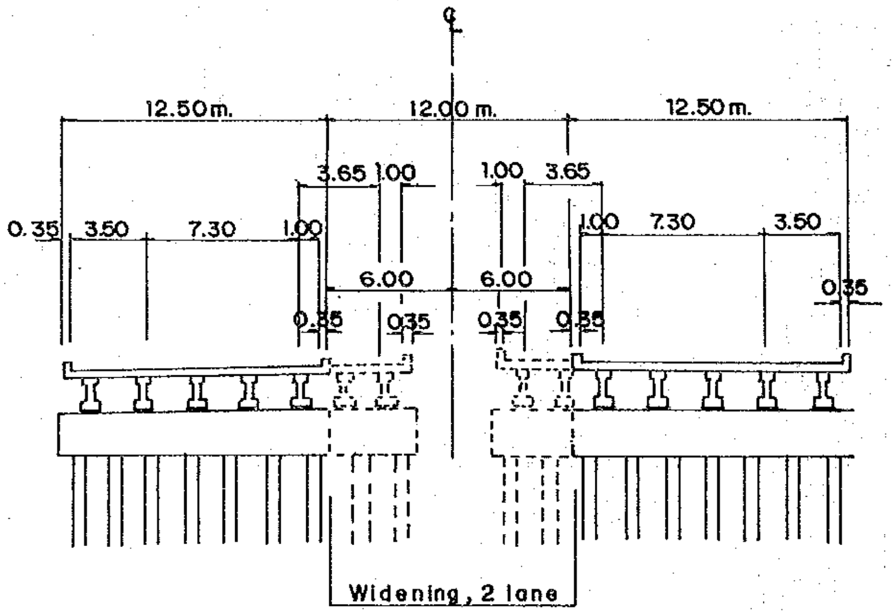


FIGURE 12.2-2 TYPICAL EXPRESSWAY CROSS-SECTION

A). WE 4 (Expresswdy Widening from 2 lane to 4 lane)



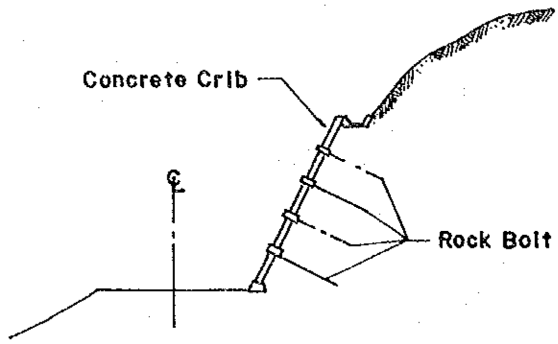
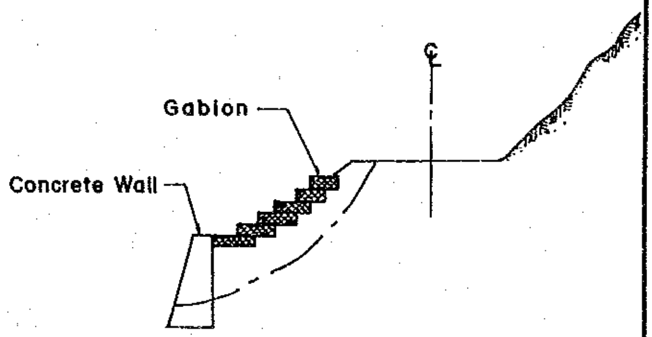
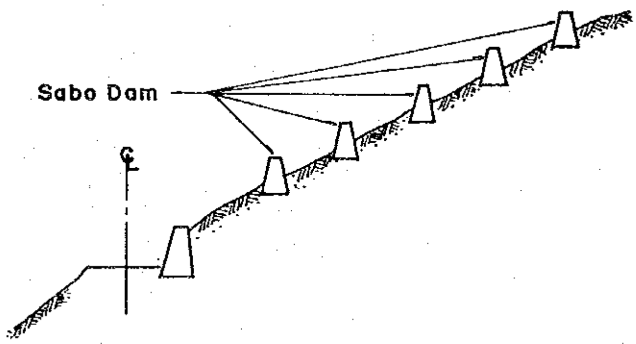
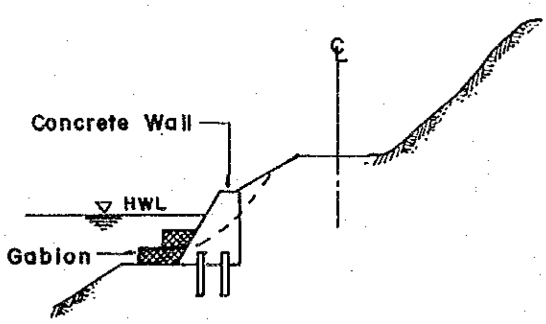
B). WE 4 (Expressway Widening from 4 lane to 6 lane)



NOTE :

NE4 (New Expressway Construction) will be the same typical Section as completed WE 4 Section.

FIGURE 12.2-3 TYPICAL EXPRESSWAY BRIDGE SECTION

TYPE OF DISASTER	PROPOSED COUNTERMEASURES	ILLUSTRATION
Cut Slope Failure	· Concrete Crib with Anchor · Concrete Spray * · Rock Bolts * · Drainages	
Embankment Failure	· Concrete Wall or Grouted Riprap · Gabion · Concrete Ditches · Grouted Riprap Ditches	
Debris Flow	· Sabo Dam · Riprap Wall or Concrete Wall	
Scouring & Flooding	· Concrete Retaining Wall · Piling · Gabions	

Note: * : Adaption depend on ground conditions

FIGURE 12.2-4 DISASTER TYPES AND PREVENTION MEASURES

TABLE 12.2-7 DIRECT COST OF EXPRESSWAY CONSTRUCTION (₱'000)

	Type of Road Construction	Direct Cost Per Kilometer				Total Direct Cost
		Road Construction	*Bridge* Construction	*Interchange* Construction	*Traffic &* Other Cost	
Widening	Manila North Expressway WE4, WE6	649,230	1,315,274	-	52,675	2,017,179
	Manila South Expressway WE6	282,953	69,292	-	22,484	374,729
New Construction	NE4 (Manila-Rosario)	4,631,835	6,668,335	715,000	143,644	8,158,814
	NE4 (Manila-Batangas)	1,260,502	559,719	330,000	36,706	2,186,927
	NE4 (Manila-Lucena)	1,619,269	1,042,581	220,000	47,224	2,929,074
	NE4 (Manila-Cavite)	615,565	312,354	16,500	12,097	956,516

NOTE: Bridge Cost includes Overpass and Underpass.
Road Cost includes drainage, lightning and safety devices for traffic.

12.2.3 Indirect Cost

Indirect cost is composed of Overhead Expenses, Contingencies, Miscellaneous Expenses (OCM) and Profit Margin. These costs varies directly with the Estimated Direct Cost (EDC) as shown in Table 12.2-8.

Table 12.2-8 DETAILED INDIRECT COST RATIO TO EDC

Estimated Direct Cost (EDC)	Indirect Costs % For OCM and Profit (maximum ranges)		% Cost for MOB/ DEMOB (maximum)	Total Maximum Indirect Cost % for OCM and Profit & MOB/ DEMOB (for projects P10M and below)
	OCM (% of EDC)	Profit (% of EDC)		
Up to P1 Million	13	15	2	30
Above P1M to P5M	12	14	2	28
Above P5M to P10M	12	13	2	27
Above P10M to P20M	11	12	(Separate)	23
Above P20M to P50M	11	11	(Pay)	22
Above P50M	10	10	(Item)	20

B.4 Contractor's Profit Margin - See tabulation above.
B.5 Laboratory Tests - included in Miscellaneous Expenses.
Source: Department Order No. 30, Feb. 1991

In the Master Plan Study, above ₱50M Estimated Direct Cost (EDC) was adapted for each project road which means OCM, Contractor's Profit Margin and Value Added Tax (VAT) is 10% of EDC.

12.2.4 Engineering Cost

The Engineering Cost was estimated as follows:

- Detailed Engineering Cost: 5% of Construction Cost
- Construction Supervision : 7% of Construction Cost

12.2.5 Right-of-Way Acquisition Cost

The Right-of-Way Acquisition Costs were based on the type of land use and their corresponding costs, which were determined base from reconnaissance surveys and previous studies of other similar projects. It was classified into three (3) classes as shown below.

Class	Land Category	ROW Cost (P/m^2)
A	Commercial/Industrial	1,500.00
B	Town/Population Center	200.00
C	Agricultural	20.00-35.00
	Non-Agricultural	10.00
	Rolling/Mountainous	5.00

However, the required right-of-way was estimated by each type of road construction as follows:

Type of Works	Required R.O.W. (m)
Pavement Rehabilitation (REH)	-
Pavement Construction (PAV)	-
Widening of Ordinary Road, to 2-lane (WO2)	6.0
Widening of Ordinary Road, to 4-lane (WO4)	11.0
Widening of Expressway, to 4-lane (WE4)	-
Widening of Expressway, t 6-lane (WE6)	-
New Construction of Ordinary Road for 2-lane (NO2)	30.0
New Construction of Ordinary Road for 4-lane (NO4)	60.0
New Construction of Expressway for 4-lane (NEW)	60.0

The total ROW cost and the ROW cost per block is shown in Appendix 12.2.