REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS & HIGHWAYS

Feasibility Study
on
The Rural Road Network Development Project

FINAL REPORT (Volume 4)

PROJECT EVALUATION
IN
THE PROVINCE OF LA UNION

OCTOBER, 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

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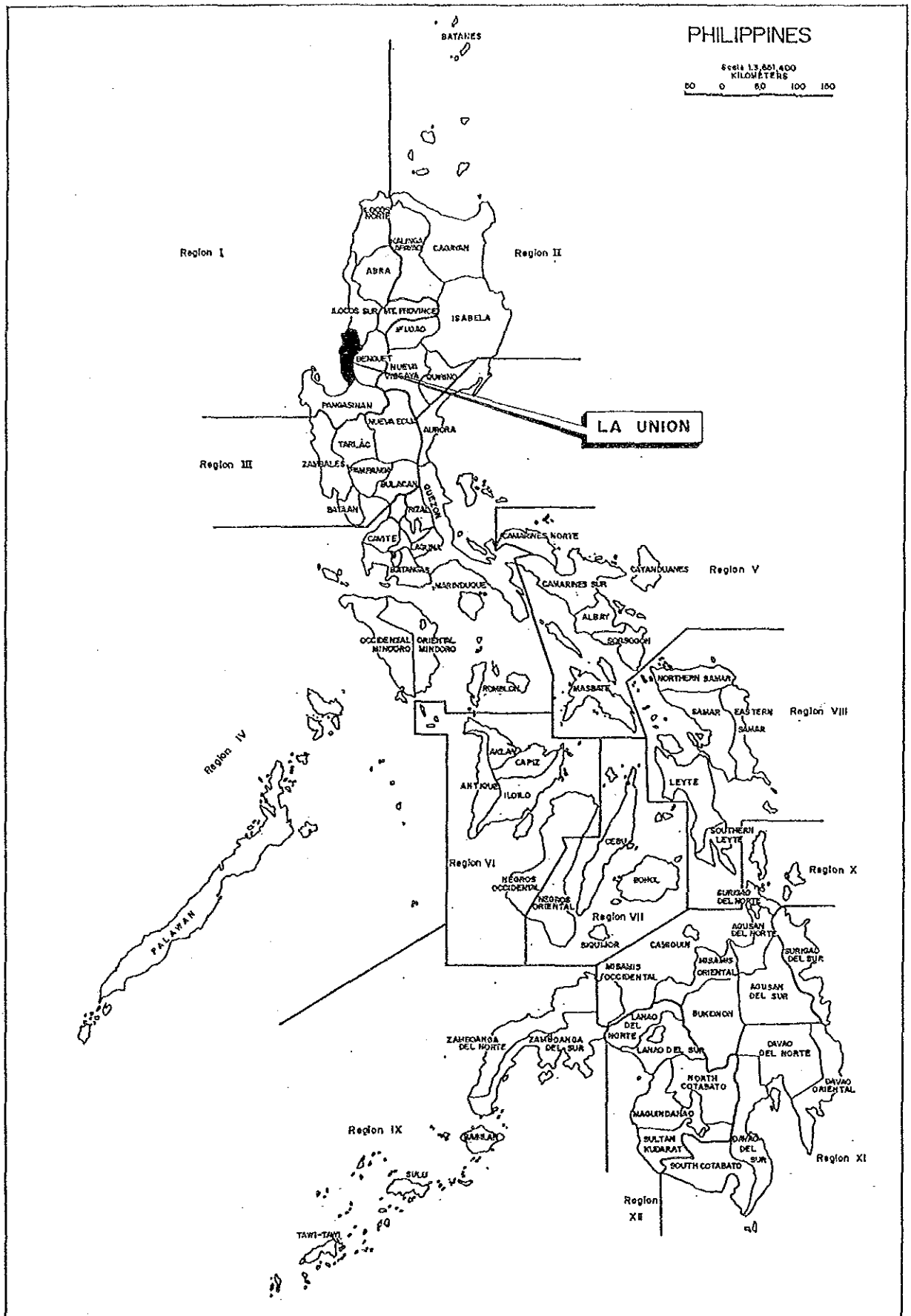

FEASIBILITY STUDY
ON
THE RURAL ROAD NETWORK DEVELOPMENT PROJECT

LOCATION MAP

VOLUME - 4
PROVINCE OF LA UNION

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CHAPTER 1
SOCIO-ECONOMIC PROFILE OF THE PROVINCE

1.1 GENERAL

The Province of La Union was selected as one of the Study Provinces which represents the province of the following characteristics:

- Economically developed
- Average level in road development
- Topographically seaside mountainous

1.2 GEOGRAPHY AND TOPOGRAPHY

The province is located in the western part of Northern Luzon, bounded on the north by Ilocos Sur Province, on the east by Benguet Province, on the south by Pangasinan Province and on the west by China Sea.

The province is narrow but long in the north-south direction. Topography of the Province is predominantly mountainous with narrow coastal plain in the west. Due to these topographical characteristics, the province is one of the typical seaside mountainous provinces with numerous rivers running from east to west.

Slope map of the province is shown in Figure 1.2-1.

1.3 POPULATION

The province is composed of (20) municipalities and the provincial capital is located at San Fernando, which is also the regional capital of Region 1.

Population in 1990 is estimated at 568,900. The average annual population growth rate for the period of 10 years from 1980 to 1990 was estimated 2.3% which is slightly lower than the national average of 2.4%. Population density of the province in 1990 is 381.0 persons per square kilometer which is higher by 1.9 times than the national average of 205 persons per sq. km.

Population, the average annual population growth rate and population density by municipality are presented in Table 1.3-1. Distribution of municipal towns together with their population is shown in Figure 1.3-1. Most municipal towns are located in the narrow coastal plain which are linked by Manila North Road. Several municipal towns are located in the inland area. San Fernando is the biggest urban center.

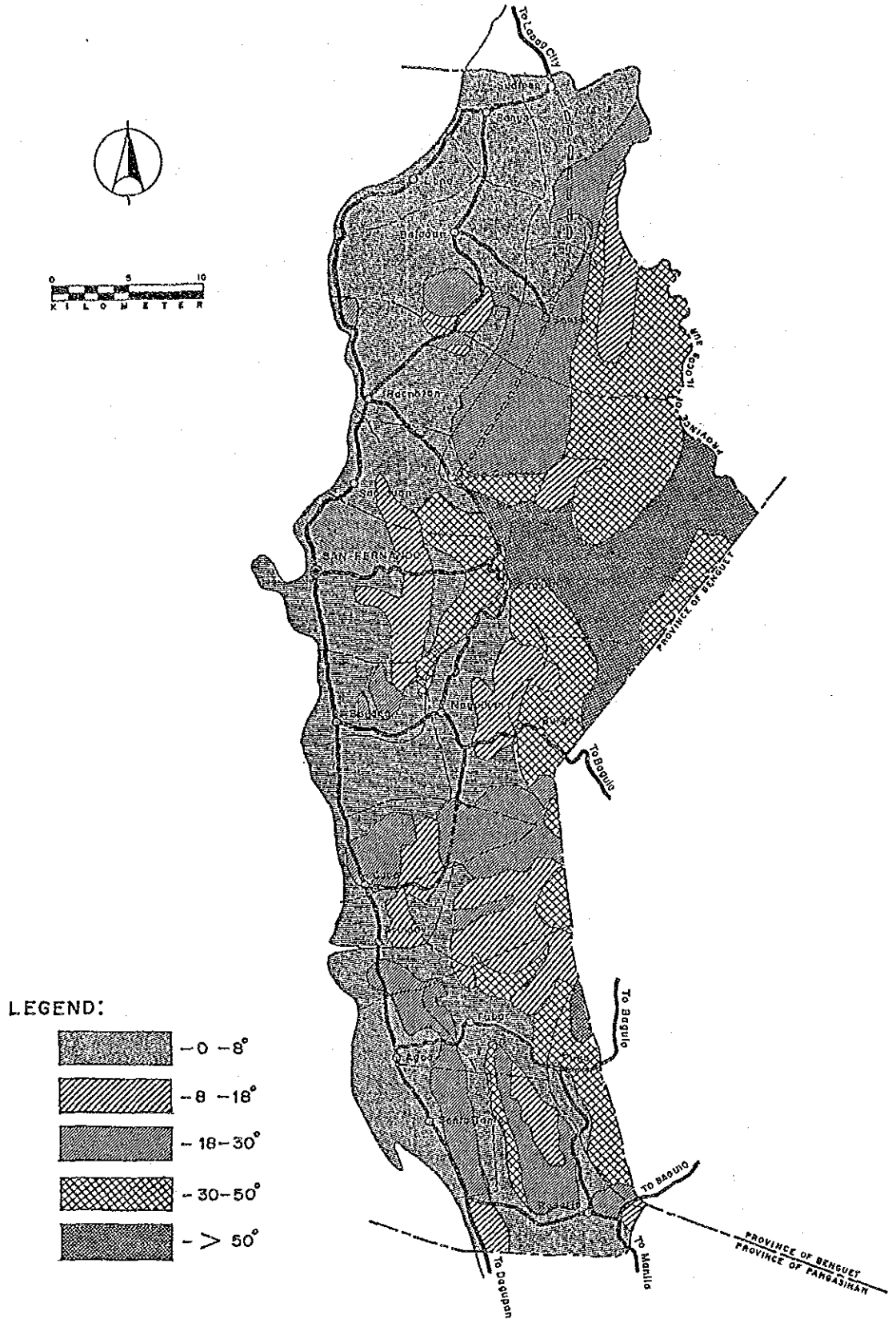

FIGURE 1.2 - 1 SLOPE MAP

Table 1.3-1

POPULATION, LAND AREA AND DENSITY (1990)
Province of La Union

City/Municipality	Projected Population (1990)	Annual Growth Rate (%)	Land Area (km^2)	Density (p/km^2)
1. San Fernando	89,333	2.7	120.8	739.5
2. Agoo	42,867	2.1	39.1	1,096.3
3. Aringay	34,810	2.4	109.5	317.9
4. Bacnotan	30,455	2.1	76.6	397.6
5. Bagulin	8,752	2.2	49.5	176.8
6. Balaoan	30,537	1.9	60.4	505.6
7. Bangar	30,888	2.7	47.4	651.6
8. Bauang	52,272	2.2	72.9	717.0
9. Burgos	5,355	2.6	70.8	75.6
10. Caba	17,623	2.2	66.7	264.2
11. Luna	30,190	1.9	52.6	574.0
12. Naguilian	35,929	2.0	78.1	460.0
13. Pugo	9,681	2.2	43.2	224.1
14. Rosario	38,881	2.8	72.8	534.1
15. San Gabriel	12,796	2.2	178.1	71.8
16. San Juan	25,828	2.4	55.7	463.7
17. Santol	9,219	1.6	93.7	98.4
18. Santo Tomas	27,570	2.0	64.0	430.8
19. Sudipen	13,095	1.9	84.4	155.2
20. Tubao	22,850	2.6	56.8	402.3
T O T A L	568,931	2.3	1,493.1	381.0

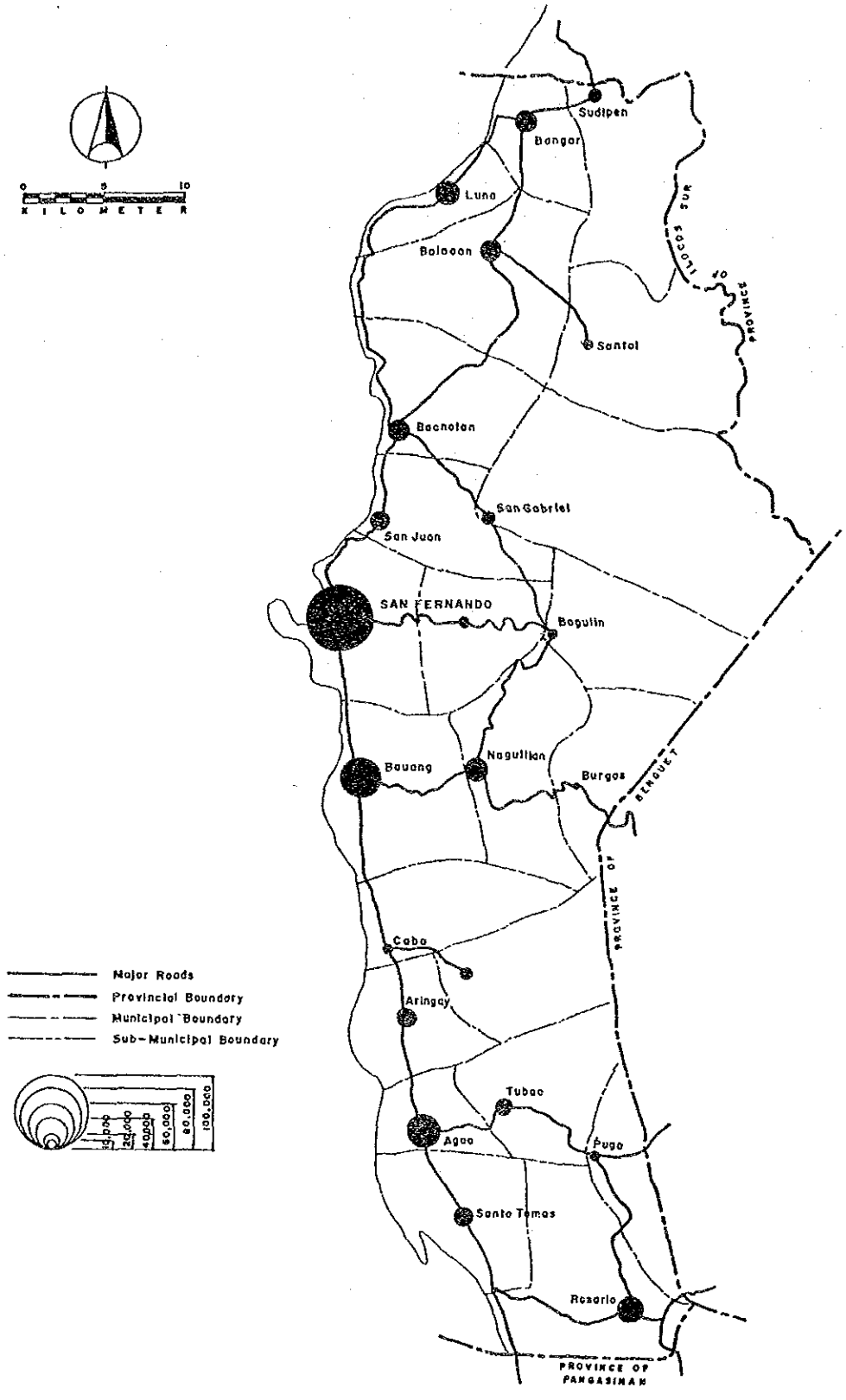

FIGURE 1.3-1 POPULATION BY MUNICIPALITY (1990)

1.4 SOCIO-ECONOMIC PROFILE

Table 1.4-1 shows major socio-economic data of the province in comparison with the national value.

Gross Regional Domestic Product which shows economic output of the province shares 0.5% of the total national output. In view of land area and population share of the province to the country, the province's economic output is slightly lower than the national average.

Per capita income of the province is higher than the national average by 1.16 times. Incidence of poverty is lower than the national average. Unemployment and underemployment rates also shows almost the same level as the national average.

Agriculture is the predominant industry of the province and shares 56% in terms of number of workers.

Table 1.4-1
MAJOR SOCIO-ECONOMIC DATA OF PROVINCE OF LA UNION

	La Union (A)	Philippines (B)	(A)/(B)
1. Total Land Area (sq.km.)	1,493	300,000	0.005
2. Population in 1990 (1000 persons)	569	61,483	0.009
3. Population Density (persons/sq.km.)	381	205	1.86
4. GRDP (Million ₱ at 1000 prices)	3,455	623,051	0.005
5. Per Capita Income in 1985 (₱/person)	6,461	5,593	1.16
6. Number of Workers by Industrial Sector in 1980 (1000 persons)			
* Agricultural	67.9 (56%)	7,303 (51%)	0.009
* Industry	5.9 (5%)	2,177 (15%)	0.003
* Service	36.6 (30%)	4,552 (32%)	0.008
* Total 1/	122.2 (100%)	14,197 (100%)	0.009
7. Incidence of Poverty in 1985 (%)	42.8	59.3	-
8. Unemployment Rate in 1988 (%)	9.0	8.3	-
9. Underemployment Rate in 1988 (%)	11.4	11.6	-

Note: 1/ Includes other workers who cannot be classified as any one of three (3) sectors.

1.5 AGRICULTURAL LAND USE AND MAJOR CROPS

La Union has a total land area of 1,493 square kilometers, representing 0.5% of the total land area of the Philippines. Table 1.5-1 shows general land use of the province. About 57% of the province are occupied by grass/shrub land areas, about 24% by agricultural land and about 12% by forest land.

Figure 1.5-1 illustrates the agricultural land use of the province. Table 1.5-2 shows major crops produced in the province. Five (5) major crops of the province are palay, tobacco, corn, banana and mango. Tobacco output of the province is about 23% of aggregate Philippine production.

Table 1.5-1
LAND USE OF LA UNION

Land Use	Area in sq.km.	%
Agricultural Area	361.3	24.2
Grass/Shrub Land Area	852.6	57.1
Forest of Wooded Area	171.7	11.5
Bare Land Area	43.3	2.9
Wet Land Area	11.9	0.8
Built-up Area	52.3	3.5
Total	1,493.1	100.0

Source: Bureau of Soil

Table 1.5-2
MAJOR CROPS OF PROVINCE OF LA UNION

Major Crops	Area Utilized (ha.)		Production (M.T.)	
	1985	1986	1985	1986
Palay	31,760	32,190	82,605	88,340
Tabacco	8,200	12,700	7,740	13,140
Corn	1,520	1,840	1,220	1,325
Banana	1,750	1,770	13,740	20,585
Mango	1,142	1,220	4,886	8,693

Source: Bureau of Agricultural Statistics

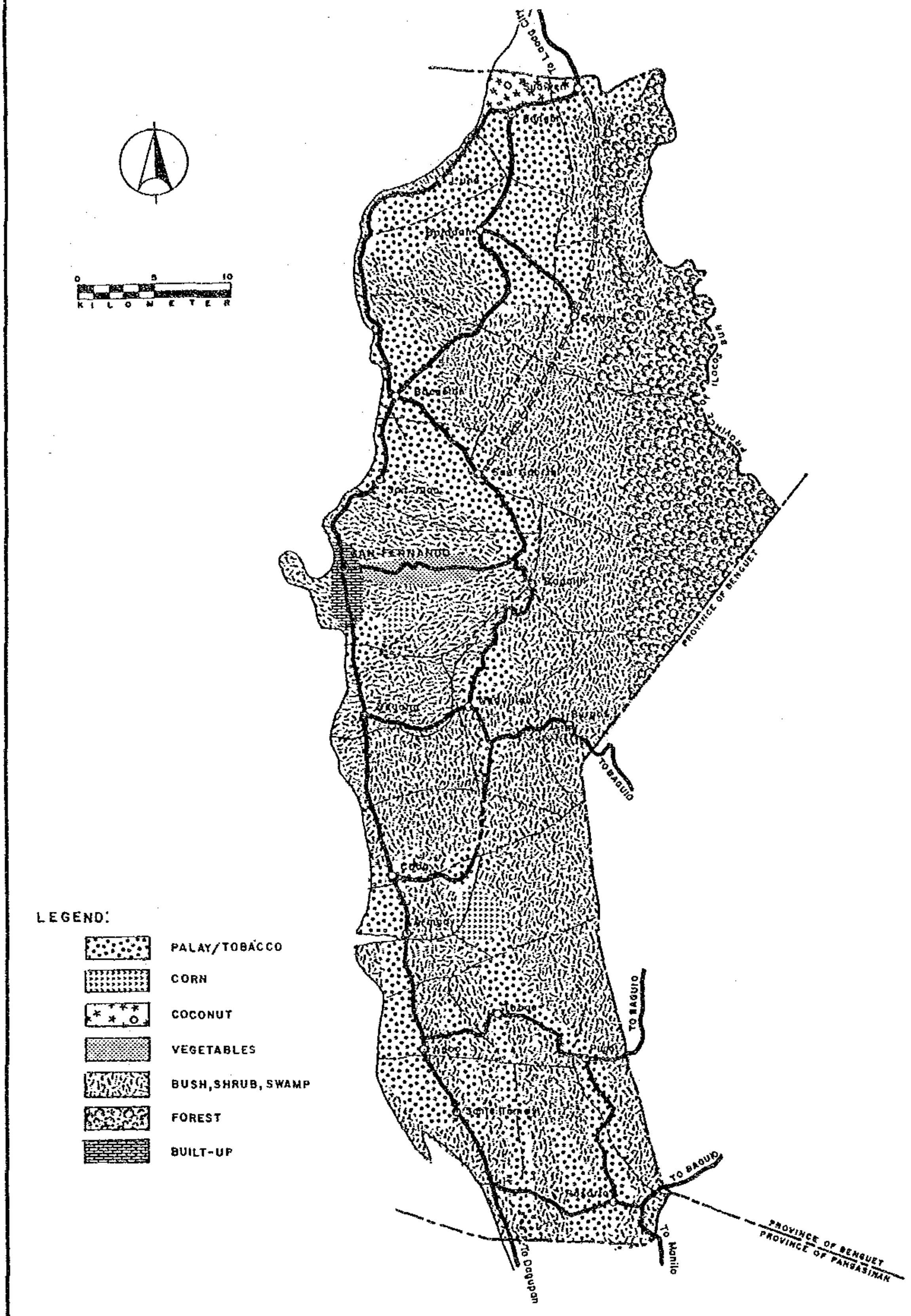

FIGURE 1.5 - 1 AGRICULTURAL LAND USE

CHAPTER 2
ROAD NETWORK OF THE PROVINCE

2.1 GENERAL

The province was classified as one of the provinces of which road network development represents the average level of the Philippines. In this Chapter, present level of road network development is assessed more in details, then general direction of the future road network development is established. Based on the said assessment and the functional road classification criteria, the major road network for the province is proposed.

2.2 PRESENT LEVEL OF ROAD NETWORK DEVELOPMENT

Present level of the road network development level is assessed in terms of road extension (quantity of roads), surface type and conditions (quality of roads) and road network pattern.

2.2.1 Present Level of Road Development in terms of Road Extension

La Union has a total of 1,228.6 kms. of roads, comprising 216.0 kms. of National, 251.9 kms. of Provincial, 121.5 kms. of Municipal and 638.9 kms. of Barangay Roads in 1987.

Table 2.2-1 shows road density by class of road which is compared with national average. In comparison with the national average, road development level of the province in terms of road extension is summarized as follows:

National roads .....higher by 1.22 times
Provincial roads.....higher by 1.28 times
Barangay roads.....higher by 1.10 times
All roads.....higher by 1.15 times

In terms of road extension, road development level of the province is in high standard.

2.2.2 Present level of Road development in terms of surface type and surface condition

The Study Team conducted an extensive field survey on the existing road conditions of which results are summarized in Table 2.2-2.

TABLE 2.2-1
EXISTING ROAD LENGTH AND ROAD DENSITY
Province of La Union

Road Class	Road Length In 1987 (kms.)	Road Density (L/ PA)		
		La Union	Philippines	La Union/Phils
National Rd.	216.0 (17.6)	0.2424	0.1994	1.22
Prov'l. Rd.	251.9 (20.5)	0.2827	0.2211	1.28
Sub-Total	467.9 (38.1)	0.5251	0.4205	1.25
City Rd.	- -	-	0.0304	-
Municipal Rd	121.5 (9.9)	0.1364	0.0981	1.39
Barangay Rd.	638.9 (52.0)	0.7170	0.6536	1.10
TOTAL	1,228.3(100.0)	1.3785	1.2026	1.15

*SOURCE: DPWH Infrastructure Atlas, 1989

TABLE 2.2-2
EXISTING SURFACE CONDITION (SURVEYED ROADS ONLY)
Province of La Union

Road Class	Pavement Type	Surface Condition 1/			% of Pavement Type 2/	
		Good/Fair	Bad/Very Bad	Total (%)	La Union	Phils.
National Road	PCC	50.0(100.0)	- -	50.0 (100.0)	23.1	23.6
	Bituminous	126.2 (96.8)	4.2 (3.2)	130.4 (100.0)	61.1	22.3
	Gravel	12.0 (41.1)	17.2 (58.9)	29.2 (100.0)	15.8	51.3
	Earth	-	2.6 (100.0)	2.6 (100.0)	-	2.8
	Total:	188.2 (88.7)	24.0 (11.3)	212.2 (100.0)	100.0	100.0
Provincial Road	PCC	2.9(100.0)	- -	2.9 (100.0)	9.1	2.5
	Bituminous	7.8 (24.5)	24.0 (75.5)	31.8 (100.0)	22.7	8.9
	Gravel	- -	87.5 (100.0)	87.5 (100.0)	67.4	70.6
	Earth	- -	34.6 (100.0)	34.6 (100.0)	0.8	18.0
	Total:	10.7 (6.8)	146.1 (93.2)	156.8 (100.0)	100.0	100.0
National and Provincial Road	PCC	52.9(100.0)	- -	52.9 (100.0)	15.5	12.5
	Bituminous	134.0 (82.6)	28.2 (17.4)	162.2 (100.0)	40.4	15.3
	Gravel	12.0 (10.3)	104.7 (89.7)	116.7 (100.0)	43.6	61.4
	Earth	- -	37.2 (100.0)	37.2 (100.0)	0.5	10.8
	Total:	198.9 (53.9)	170.1 (46.1)	369.0 (100.0)	100.0	100.0

SOURCE: 1/ Survey by Study Team in 1989
2/ DPWH Infrastructure Atlas, 1989

Present level of road development in terms of surface type and surface condition (quality of roads) could be summarized as follows:

National Roads

- About 84% of national roads in the Province are paved with either PCC or bituminous surfaces, whereas the national average is only 46 %.
- Surface condition of national roads are well maintained. About 89% of national roads in the province were rated either good or fair.
- In terms of road quality, national roads in the province are in quite high level.

Provincial Roads

- About 32% of provincial roads are paved with either PCC or bituminous surfaces, which is in higher level than the national average of 11%.
- Surface condition of provincial roads in the province is still in very poor state. Only 7% of provincial roads are assessed either in good or fair condition.
- Compared with national roads in the province, quality of provincial roads is still very low standard.

2.2.3 Present Road Network Pattern

Present road network is presented in Figure 2.2-1, which shows all existing national and provincial roads. Present road network of the province is assessed as follows:

- Comb type network pattern is formed. Manila North Road which runs along the coastal line, is functioning as the most important axis where other national/provincial roads are branching off from the said road.
- Another inter-provincial roads are Naguilian Road and Agoo-Baguio Road, both leading to Baguio City.
- All municipal towns are accessed with either a national or a provincial road, therefore, basic network is considered formed. However, if the three (3) currently impassable/abandoned roads, stated hereunder will be improved, road network in the province will be more efficient and flexible.

Currently impassable/abandoned roads

* San Fernando - Bagulin Road
* Bagulin - San Gabriel Road
* Naguilian - Aringay Road

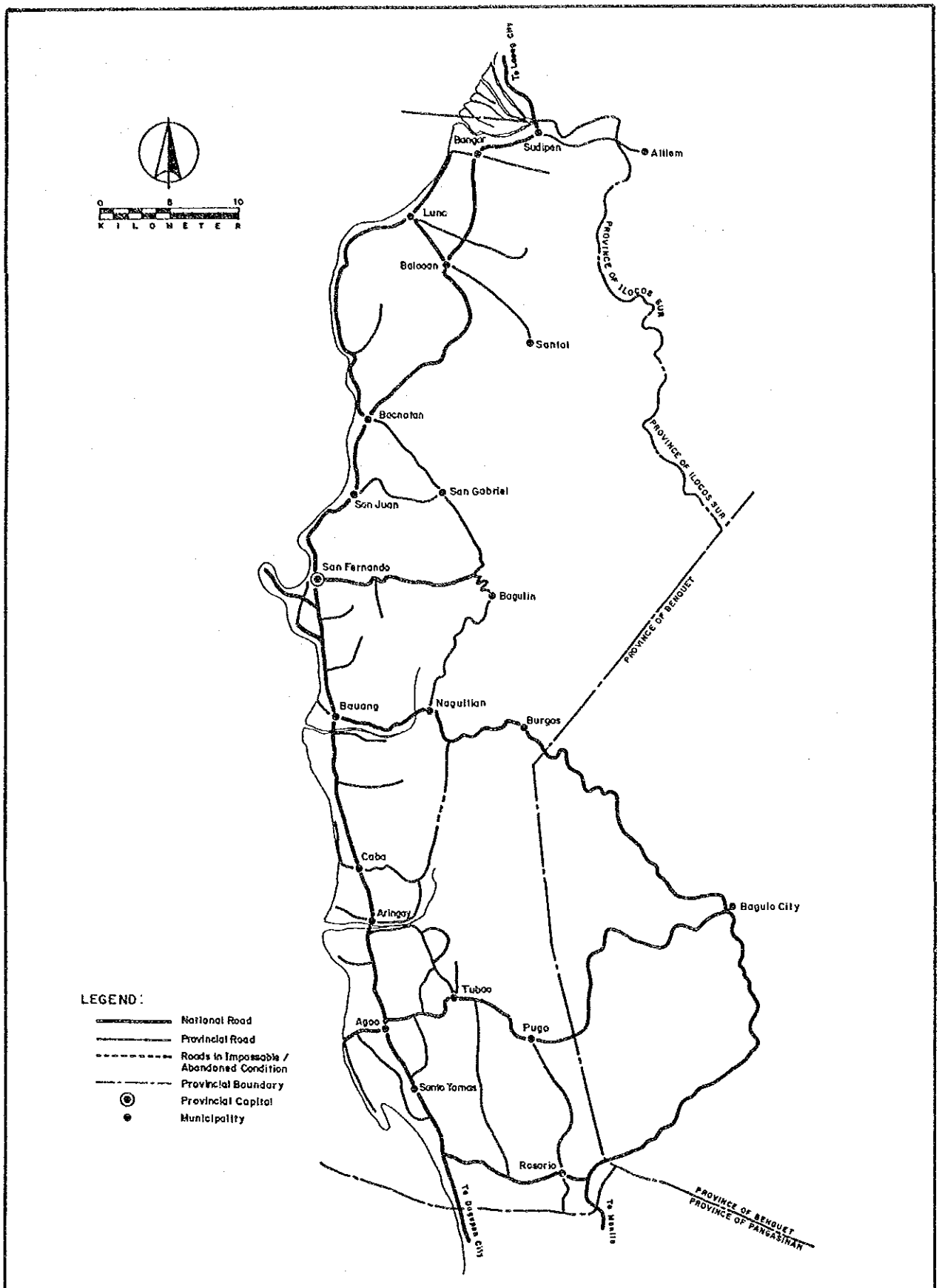

FIGURE 2.2-1 EXISTING ROAD MAP

2.3 GENERAL DIRECTION OF ROAD NETWORK DEVELOPMENT

Results of assessment of present road network development level are summarized as follows:

- In terms of road extension, all class of roads are higher level than the national average.
- In terms of surface type and conditions, national roads are in quite high level, however, provincial roads are still very low standard.
- Comb type of road network is formed. Accesses to all municipal towns are provided, therefore, basic network is considered formed.

Based on the above assessment, general direction of road network development of the Province will be as follows:

(1) Priority should be placed on improvement of existing roads, particularly on improvement of provincial roads and barangay roads.

(2) Construction of new roads should be given lower priority, unless otherwise justified.

(3) In order to improve efficiency of road network, improvement of three (3) roads which are currently abandoned (Section 2.2.3) should be positively considered.

2.4 PROPOSED MAJOR ROAD NETWORK

2.4.1 Procedure

To identify major roads, all existing roads are firstly classified in accordance with the functional road classification criteria which is shown in Table 2.4-1. Functional classification groups roads according to importance and quality of services they are intended to provide. Individual road links of similar importance and quality of services are organized into systems so that a road network in accordance with the hierarchy of functions can be planned and formed. They can be efficiently managed with consistent policies, design and operation.

After identification of existing major roads, necessity of additional new links is assessed. For example, if a certain municipal town has no access, a new major road is added to the existing major road network. Thus, the initial major road network is proposed and subjected to evaluation whether the proposed one is well-balanced or not. Evaluation is made by two (2) indicators as follows:

a) Network Value

$$Nv = \frac{L}{\sqrt{PA}}$$

Where: Nv = Network Value
L = Road length delineating a block
P = Population in a block
A = Land Area in a block
Block= Area delineated by major roads

b) Accessibility

Accessibility $AC = \sum pl$

Average Accessibility $A\ ave = \frac{\sum pl}{P}$

Where
p = Population of a Barangay
l = Distance from a barangay center to respective major road
P = Total population in a block

If indicators of some blocks show imbalanced value, additions or deletions of major road links are made until indicators show almost balanced values. After these adjustment, the major road network is finally proposed.

Table 2.4-1 Proposed Functional Road Classification Criteria for Rural Road Network

Functional Classification		General Definition	General Characteristics and Services Provided	Relationship with Administrative Classification				
				National Road	Provincial Road	City Road	Municipal Road	Barangay Road
Major Road	Primary Major Road	. Major inter-provincial roads. . Intra-provincial roads linking two (2) or more municipal towns to the Provincial Capital . Intra-provincial roads which form a skelton road network of a province	. Provides the highest level of service at the high speed for the long uninterrupted distance . Serves for long distance trips . Mobility is given the highest consideration	●				
	Secondary Major Road	. Roads linking municipal towns each other . Roads linking a municipal town to the Provincial Capital . Roads linking one (1) or more municipal towns to the primary major road network	. Provides high level of service . Serves for medium distance trips . Mobility is given high consideration	●	●	●		
Minor Road	Collector Road	. Roads linking secondary major roads each other or a primary road with a secondary road . Roads linking two (2) or more barangays to the municipal town or to the higher level network	. Provides rather low level of mobility . Serves for short distance trips . Collects traffic from feeder roads and connects them with major roads . Mobility and land access		●	●		●
	Feeder Road	. Roads linking one or more barangays centers to the higher level network . Roads linking farm areas to their respective barangay centers or to the higher level network	. Primarily provides access to abutting land with little or no through traffic . Serves for local traffic . Land access is given high			●		●
Street		. Roads within built-up population centers (Poblacion) with essentially urban rather than rural rural functions	. Primarily provides access to abutting land in urban areas . Through traffic usage discouraged			●	●	

NOTE: Relationship between functional classification and administrative classification gives only general guideline, therefore, some national roads may be classified as minor roads, or some barangay roads may be classified as major roads.

2.4.2 Proposed Major Road Network

The major road network for the Province of La Union was proposed as shown in Figure 2.4-1. For establishing the major road network, the following are taken into consideration:

- Present network of comb type is basically considered.
- Local officials have strong desire to construct a road which is almost parallel to Manila North Road and transversing the Province from the north to the south, to develop a mesh type road network. The Study Team judged that this proposal is still premature considering the traffic demands and topographical constraints. However, three (3) roads currently impassable/abandoned mentioned in Section 2.2.3, are considered vital to formulate a major road network.
- Existing national roads are mostly included in major road network.
- As existing national and provincial roads are extensive in length, no new links were considered necessary.

Network value and accessibility of each block were computed to evaluate whether the proposed major road network is a balanced one. Based on these values, addition or deletion of road links was made and finally the major road network was proposed as shown in Figure 2.4-1.

Network value and accessibility of the proposed major road network are presented in Table 2.4-2.

Proposed major road network has a total length of 266.9 kms. and composed of the following roads.

National Road	198.6 kms.	(92 % of total national)
Provincial Road	68.3 kms.	(27 % of total provincial roads)
Total	266.9 kms.	

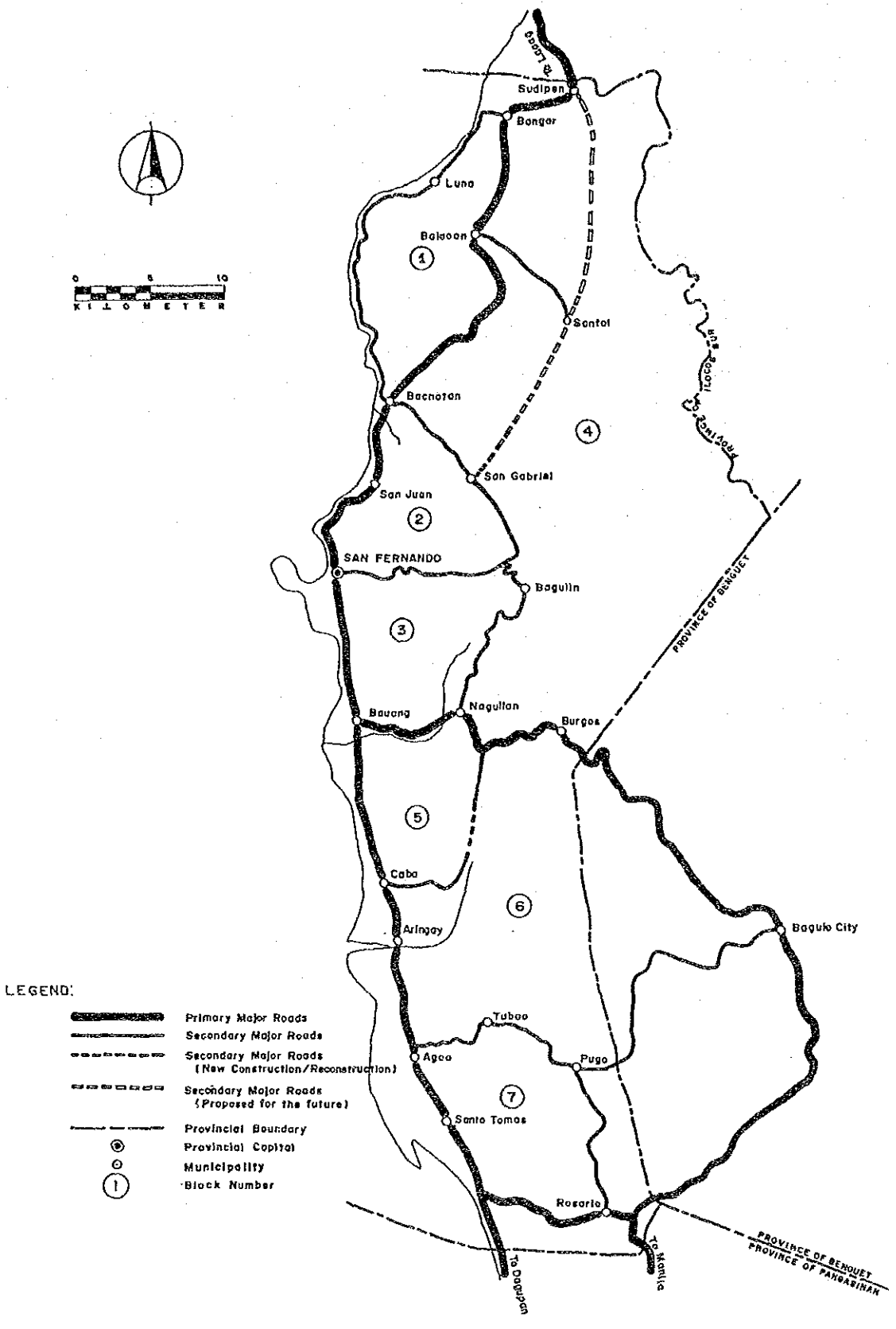

FIGURE 2.4-1 PROPOSED MAJOR ROAD NETWORK

Table 2.4-2

NETWORK VALUE/ACCESSIBILITY
Province of La Union

Block No.	Population (1990)	Land Area (km^2)	Road Length (km)	Network Value	Access (p.km)	Average Access. (km.)
1	61,462	108.3	51.8	0.635	43,295	0.704
2	52,472	93.2	51.9	0.742	31,570	0.602
3	72,124	99.3	50.0	0.591	47,577	0.660
4	102,806	572.7	93.3	0.385	234,714	2.283
5	43,341	95.2	39.5	0.615	32,317	0.746
6	53,977	204.5	54.8	0.522	82,392	1.526
7	54,185	108.6	48.2	0.628	48,780	0.900
Ave.	62,910	183.1	55.6	0.518	74,378	1.182

CHAPTER 3
TRAFFIC

3.1. TRAFFIC SURVEY RESULTS

Roadside traffic count survey was conducted on selected roads. Traffic counts were carried out on two (2) consecutive days for 12 hours from 6:00 AM to 6:00 PM each day. Traffic volume was counted by direction and by vehicle type every hour. The vehicle type was classified as follows:

- Car
- Jeep
- Van
- Jeepney
- Bus (mini bus & large bus)
- Truck (including trailer)
- Motor-tricycle
- Motorcycle
- Animal drawn
- Pedestrian
- Others

Figure 3.1-1 shows the location of traffic count stations. Traffic survey results are summarized in Table 3.1-1.

Survey results were converted to Average Daily Traffic (ADT) by using the hourly factors based on the data from the Nationwide Traffic Counts Program (NTCP). Considering other factors such as market days, harvest season, rainy season, etc., AADT were estimated by vehicle type.

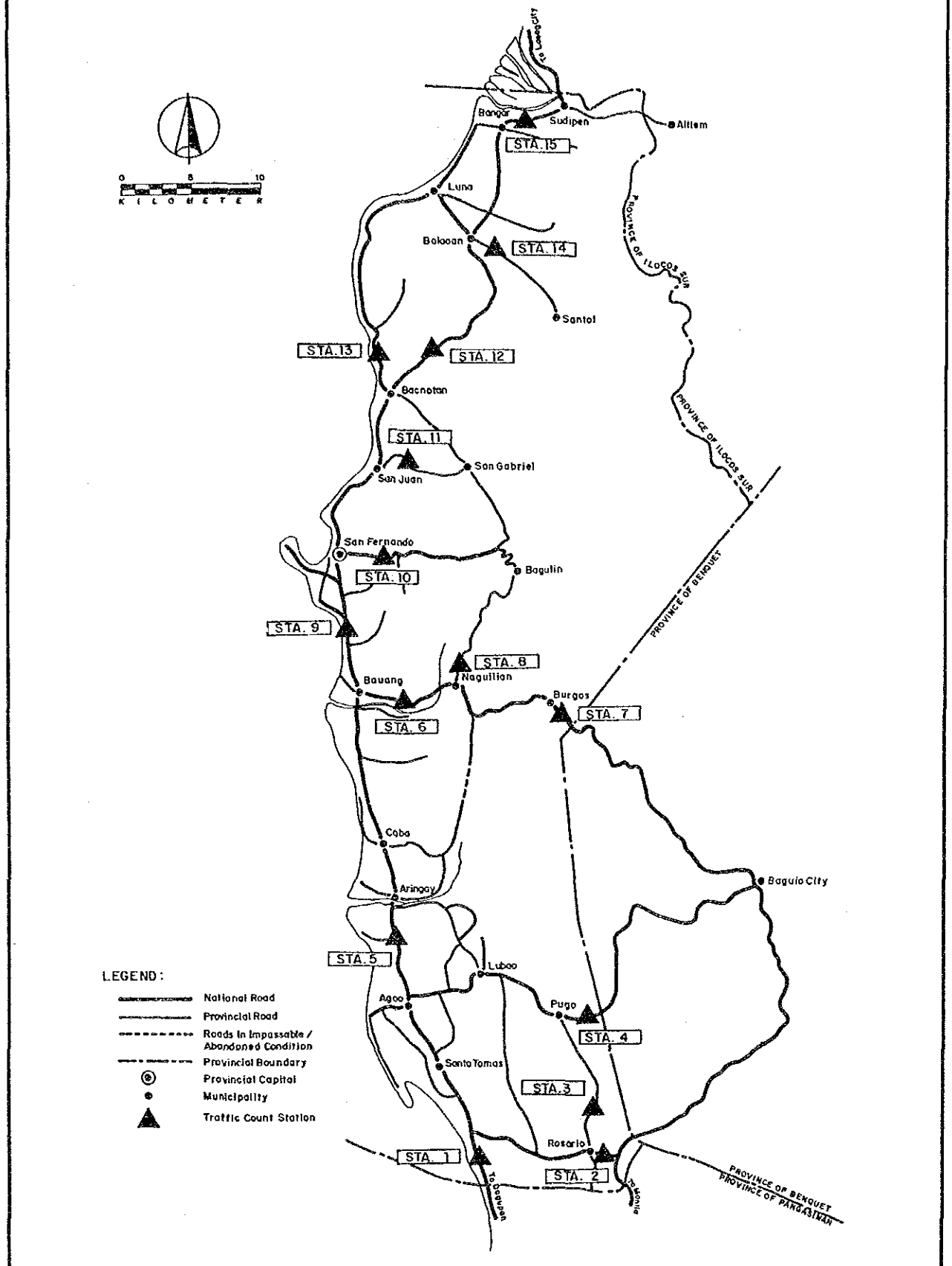

FIGURE 3.1-1 TRAFFIC COUNT STATIONS

TABLE 3.1-1 SUMMARY OF TRAFFIC SURVEY RESULTS
- LA UNION -

(ADT as of May, 1990)

Station No.	Car	Jeep	Pickup /Van	Jeepney	Bus	Truck	Sub-Total	Tri-cycle	Motor-cycle	Animal Drawn	Total
1	346	149	325	246	414	434	1914	208	72	1	2194
2	446	163	527	495	504	665	2800	1822	146	9	4777
3	0	1	11	72	0	10	93	65	23	4	186
4	59	12	35	112	1	24	243	45	22	0	310
5	628	277	546	897	1110	1020	4477	278	161	1	4917
6	406	125	333	1385	185	480	2913	140	90	0	3143
7	249	66	168	489	153	418	1542	0	0	0	1542
8	8	11	22	204	0	20	265	95	10	0	370
9	1374	686	1163	2918	1148	1206	8495	204	252	1	8952
10	5	2	0	75	1	1	85	6	11	0	102
11	48	106	54	289	3	42	541	156	78	8	783
12	346	256	392	1118	435	627	3173	74	138	0	3384
13	6	13	20	121	0	58	218	75	58	9	360
14	1	28	19	153	0	22	223	205	81	11	520
15	209	145	230	701	381	434	2100	75	66	0	2240

Source: Traffic Survey by Study Team (May, 1990)

3.2 TRAFFIC ANALYSIS AND FORECAST: TRAFFIC PROJECTS.

3.2.1 Analysis of Present Traffic

1) General Procedure

Present traffic on each major road network was analyzed according to the procedure shown in Figure 3.2-1.

The analysis is divided into three major steps:

Step I : Analysis of Traffic Survey Results

The number of passengers and commodity tonnage were obtained from the results of the traffic survey. These data are, however, available only on the surveyed road links and used for calibration purposes for the traffic model described below.

Step II : Analysis by Traffic Model

Traffic generation and attraction, in terms of passengers and commodity tons, were estimated based on population and per capita traffic generation factors; traffic distribution (OD distribution) was estimated by the gravity model; then, OD distribution was assigned to the major road network expressed by the node and link system. In the analysis, since only traffic generation factors were unknown, assumed values were used in the first step.

Step III : Comparison of Both Figures

The number of passengers and commodity tonnage estimated by the traffic model were compared with those derived from the traffic survey. On the basis of the comparison, traffic generation factors were appropriately adjusted and the traffic model analysis was reiterated until the traffic model reflected the actual people and freight movements with a high accuracy.

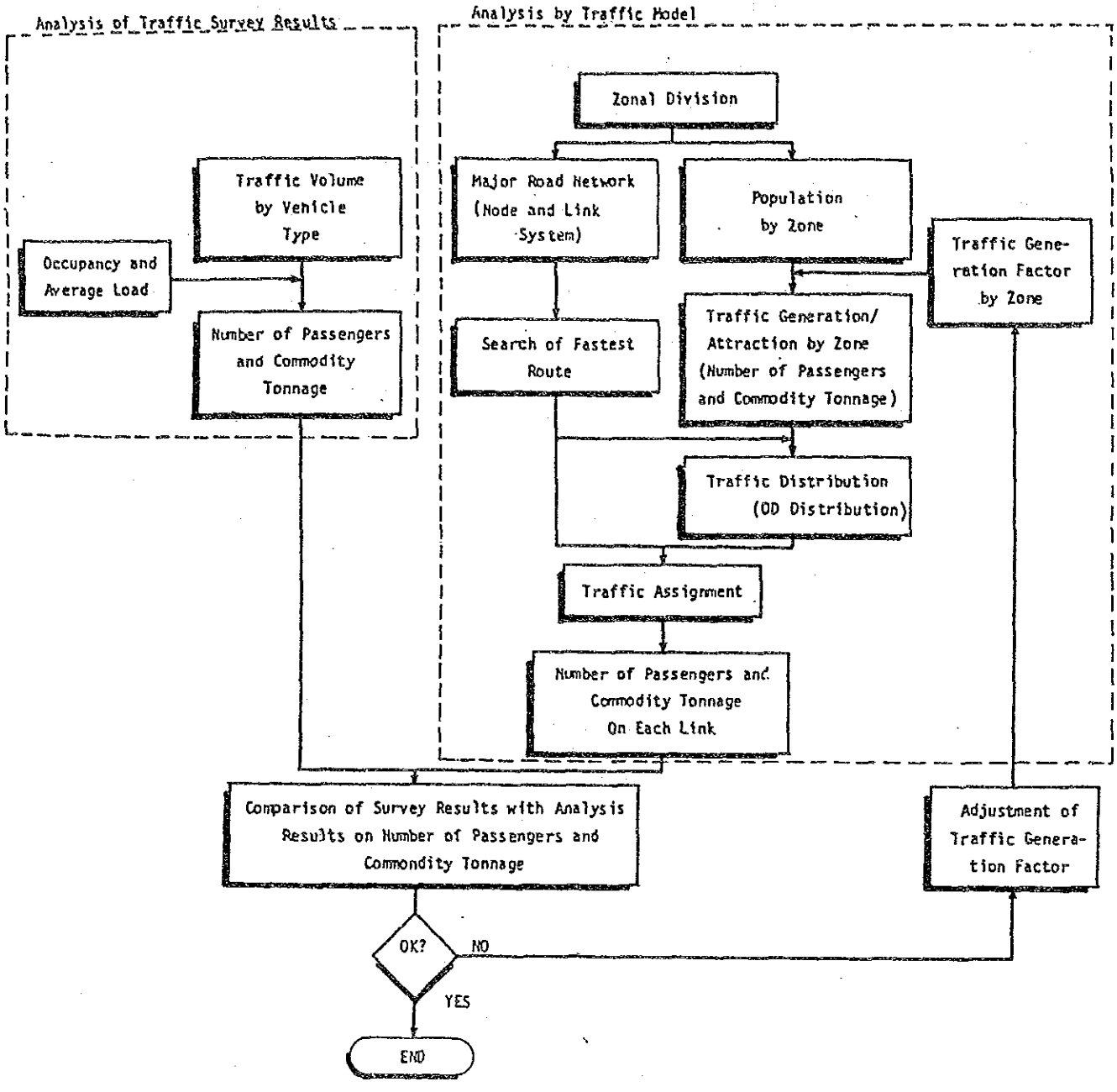

FIGURE 3.2-1
PROCEDURE OF ANALYSIS OF PRESENT TRAFFIC ON MAJOR ROAD NETWORK

2) Analysis of Traffic Survey Results

Traffic volume by vehicle type counted in the traffic survey was converted to number of passengers and commodity tonnage using the occupancy and average load shown in Table 3.2-1.

Table 3.2-1 OCCUPANCY AND AVERAGE LOAD
Province of La Union

	Average Number of Passenger per vehicle	Average Load (ton per vehicle)
Car/Taxi	3.40	1.00
Jeep	3.40	1.00
Van/Pickup	3.40	1.00
Jeepney	11.80	1.00
Bus	35.00	1.00
Truck	5.00	5.00
Motor-tricycle	2.90	0.30
Motorcycle	1.60	0.10
Animal Drawn	3.00	0.15

3) Analysis by Traffic Model

i) Zonal Division:
The province was divided into traffic zones corresponding to municipal divisions in principle.

ii) Major Road Network:
The major road network was expressed by a node and link system. Each link was given length and average speed according to the actual road condition. A node and link system of the Province is presented in Figure 3.2-2.

iii) Search for the Fastest Route:
The fastest route for each zone pair was calculated by Moore's Method.

iv) Traffic Generation Factor:
Per capita traffic generation factors (trip/person/day and ton/person/day) vary between zones even in the same province with many factors such as:

- Economic Activity
- Size of Population
- Distance from Provincial Capital
- Road Condition
- Other Physical Conditions

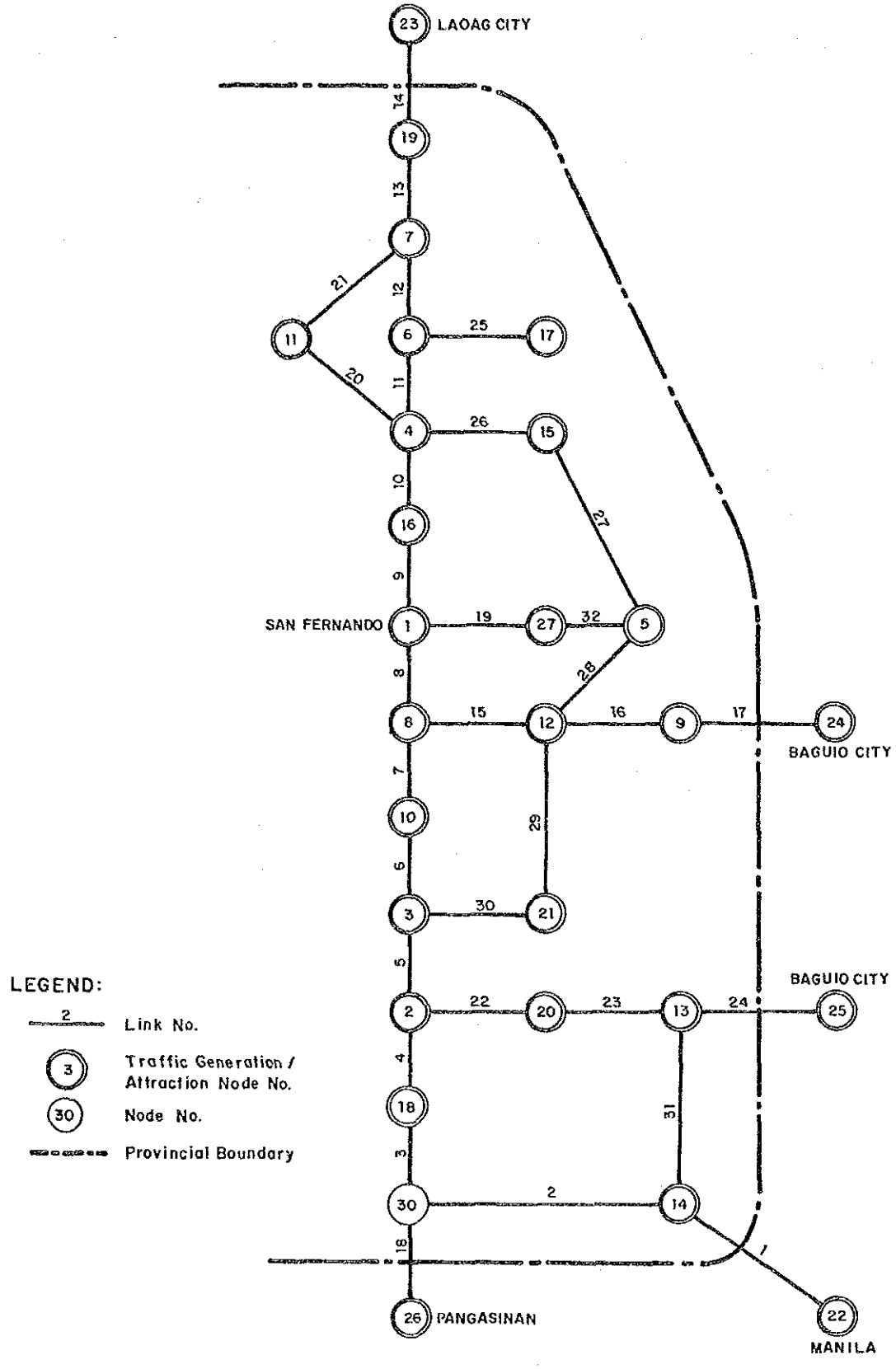

FIGURE 3.2-2 LINK / NODE SYSTEM
PROVINCE OF LA UNION

The generation factors which best illustrate the observed people and freight movement were estimated by the iterative method. The traffic generation factors thus estimated are summarized in Table 3.2-2.

TABLE 3.2-2 PER CAPITA TRAFFIC GENERATION FACTORS (MAJOR ROAD, 1990 W/O) Province of La Union

	Passenger Movement (trip/person/day)	Commodity (kg/person/day)
Range	0.077 - 0.770	26.5 - 88.5
Mean Value	0.591	68.0

v) Traffic Generation and Attraction by Zone:

Traffic generation and attraction were obtained in terms of passengers and commodity tonnage as the product by generation factors.

vi) Traffic Distribution:

Traffic distribution (OD distribution) was estimated by the gravity model:

$$Xij = k\frac{Gi.Aj}{tiJ^2}$$

Where, Xij = Traffic from zone i to zone j
k = Parameter
Gi = Traffic generation in zone i
Aj = Traffic attraction in zone j
tij = Travel time from zone i to zone j along the fastest route

OD distribution was adjusted so as to satisfy the following conditions by the Frator Method:

$$Gi = \sum_{j+1}^{n} Xij$$

$$Aj = \sum_{i+1}^{n} Xij$$

Where, n = Number of zones

vii) Traffic Assignment:

Each OD traffic was assigned to the major road network expressed by the node and link system on an all-or-nothing basis. Thus, the number of passengers and commodity tonnage for each link were calculated.

3.2.2 Traffic Forecast

Figure 3.2-3 illustrates the procedure of traffic forecast.

The traffic model prepared for the analysis of present traffic was basically used for forecasting future traffic on the major road network with the following additions/ modifications:

1) Major Road Network and Fastest Route Search

The node and link system for the "with" case was prepared by changing the characteristics of the links included under this feasibility study as well as the links committed to be improved.

The fastest route search was carried out both in the "w/o" and "with" case networks.

2) Traffic Generation/Attraction and Distribution

The future population was based on the NCSO 1980 Census of Population and Housing.

Per capita traffic generation factors in the "with" case were estimated referring to the generated transport demand/transport cost reduction elasticity shown in "Highway Planning Manual, Volume 3, MPWH" and also based on the results of the analysis of present traffic. For instance, a zone showing a small generation factor at present due to poor road conditions is expected to increase the factor to some extent by road improvement, and the degree of increase can be estimated referring to other zones in similar situations but with better road conditions.

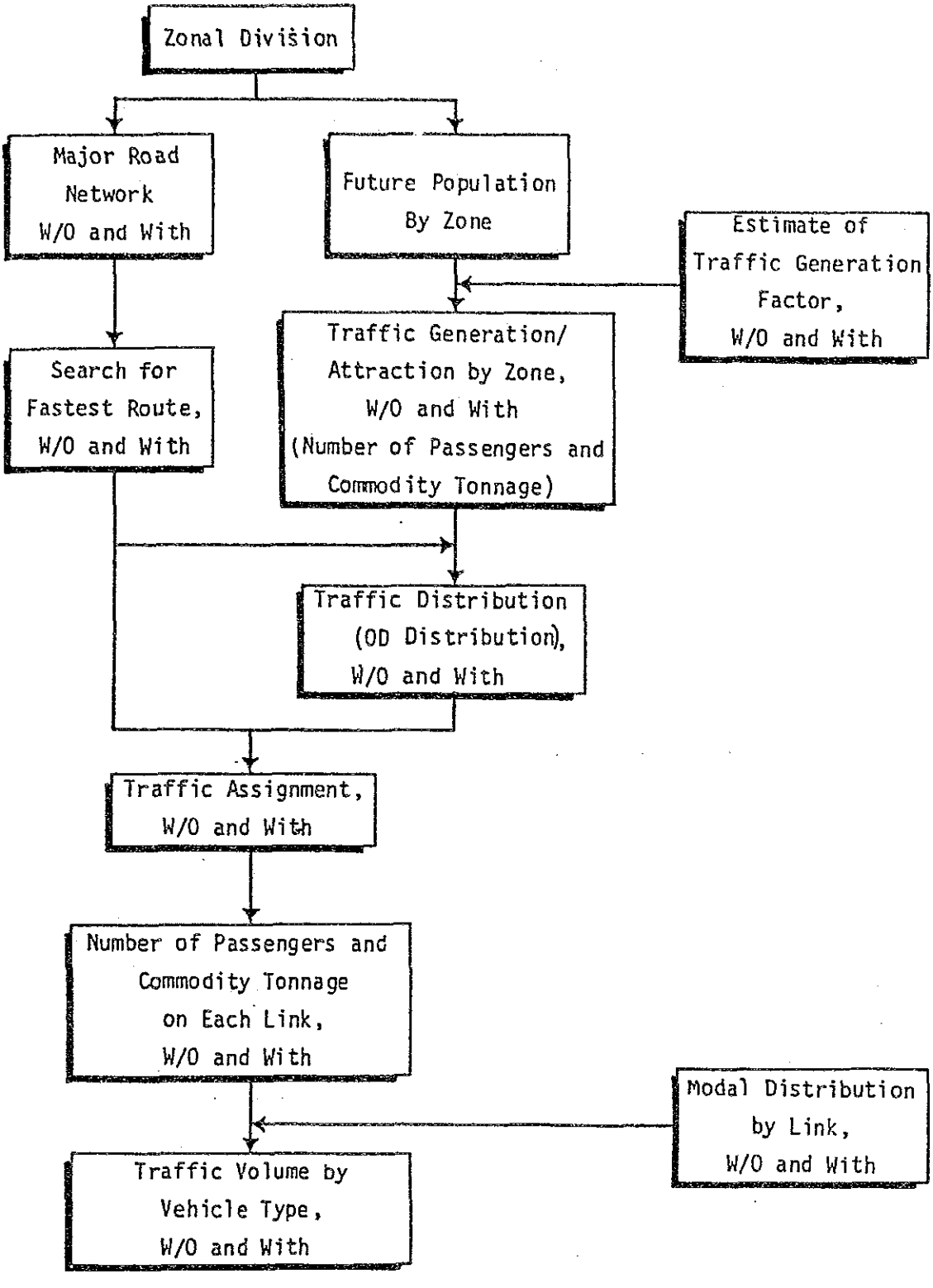

FIGURE 3.2-3
PROCEDURE OF FORECASTING TRAFFIC ON MAJOR ROAD NETWORK

The traffic generation factors thus estimated are summarized in Table 3.2-3.

TABLE 3.2-3 PER CAPITA TRAFFIC GENERATION FACTORS (MAJOR ROAD, 1990 WITH) Province of La Union

	Passenger Movement (trip/person/day)	Commodity (kg/person/day)
Range	0.077 - 0.770	35.4 - 88.5
Mean Value	0.644	74.0

The transition period, i.e., the period which will elapse after opening of the improved road before the full impact on generation will take place, was assumed to be three years.

Traffic distribution for the "with" case was estimated by the same method as used in the analysis of present traffic.

3) Traffic Assignment

The number of passengers and commodity tonnage on each link in the "with" case was estimated by assigning OD traffic to the major road network in the "with" case. They were converted to the number of vehicles using the modal distribution in the "with" case. Changes in modal distribution with changes in road condition were estimated reffering to the present distribution in other road links in a similar situation but in the road condition. The transition period of a complete change in modal distribution was assumed to be three years.

The traffic in the "with" case was broken down into following four categories for convenience of traffic benefit estimation:

Normal Traffic: Flow of passengers and freight which will occur even without road improvement. However, changes in the number of vehicles is possible due to changes in modal distribution.

Diverted Traffic-1: Traffic which diverts to a certain road from other routes as a consequence of road improvement. This is usually called simply diverted traffic.

Diverted Traffic-2: Traffic which changes destination as a consequence of road improvement but for the same trip purpose as in the "w/o" case. This is possible in the case of improvement of the access road to the nearest town which is at present barely accessible due to poor conditions. This traffic is called "Diverted Traffic-2" in this Study, distinguished from Diverted Traffic-1.

Generated Traffic: Increased traffic brought about by road improvement.

3.2.3 Estimated Present and Future Traffic

Estimated present and future traffic on the major road is illustrated in Figure 3.2-4 and Figure 3.2-5, respectively.

Estimated present and future movements of passengers and commodity by link are presented in Table 3.2-4, and estimated traffic volumes are presented in Table 3.2-5.

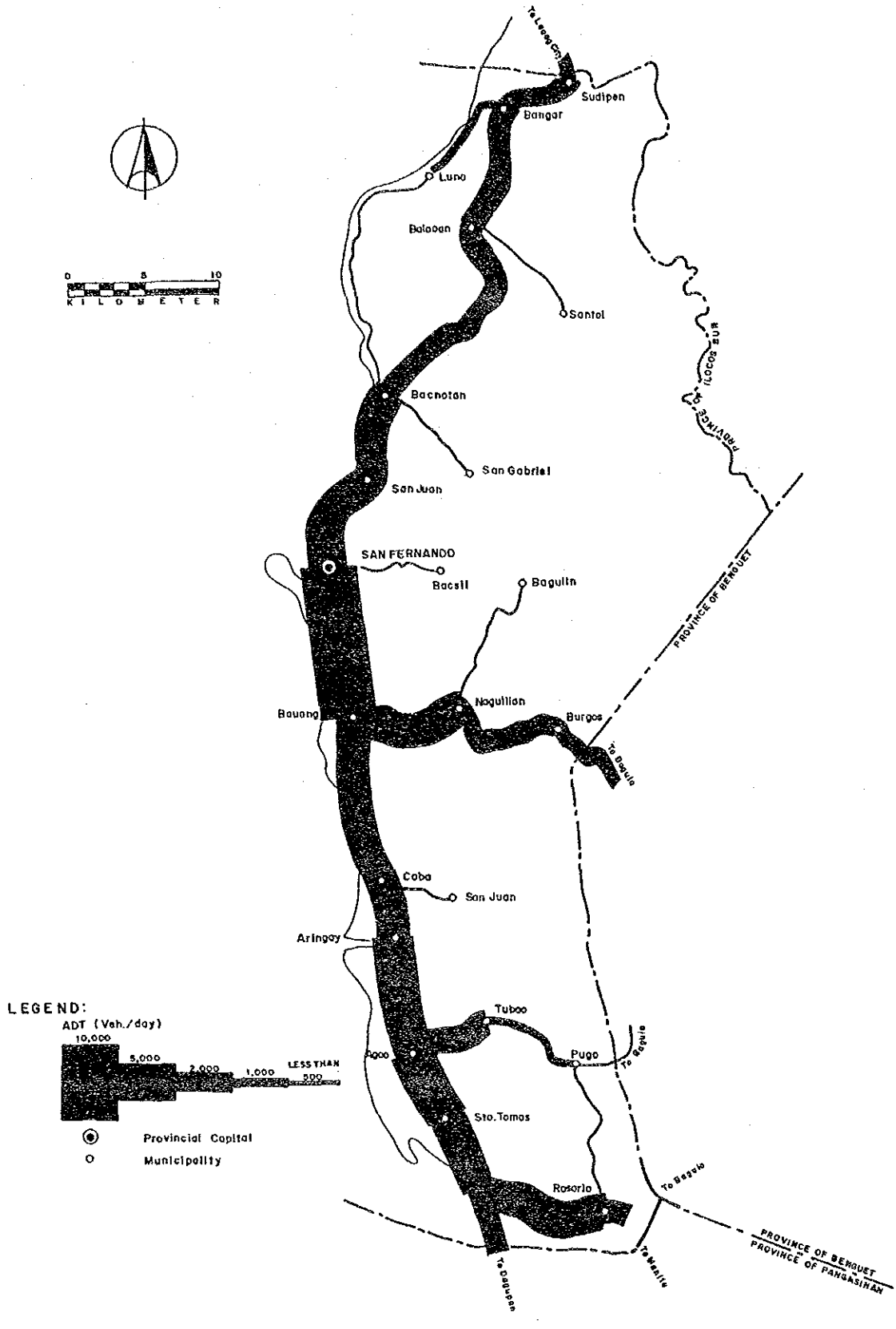

FIGURE 3.2-4 ESTIMATED TRAFFIC VOLUME(1990)

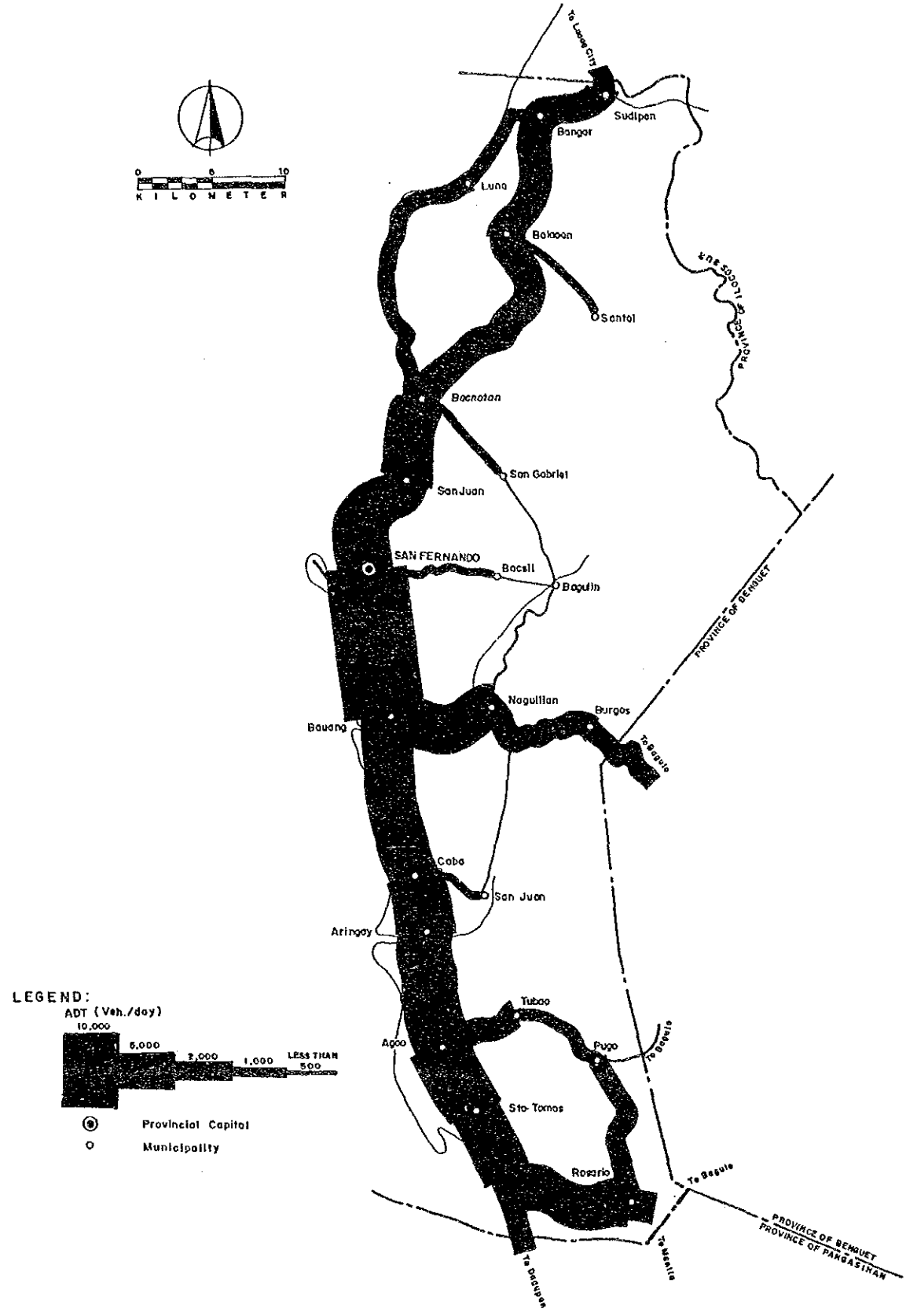

FIGURE 3.2-5 ESTIMATED TRAFFIC VOLUME (1993)
"WITH PROJECT" CASE

TRAFFIC PROJECTION LA UNION

Movement of Passengers and Commodity

Link	Year	Number of Passengers					Commodity Tonnage				
		Normal	Diverted-1	Diverted-2	Generated	Total	Normal	Diverted-1	Diverted-2	Generated	Total
1	1990	23825				23825	4092.79				4092.79
	1993	28010	-	-	-	28010	4673.61	-	-.03	-	4673.58
	1997	34756	-	-	-	34756	5578.24	-	-.04	-	5578.20
	2007	57477	-	-	-	57477	8371.10	-	-.05	-	8371.05
	2017	91686	-	-	-	91686	12117.42	-	-.07	-	12117.35
2	1990	42201				42201	5885.38				5885.38
	1993	49918	-	-40	-	49877	6749.82	-	-4.39	-	6745.43
	1997	62449	-	-51	-	62399	8103.64	-	-5.31	-	8098.32
	2007	105149	-	-86	-	105062	12318.79	-	-8.22	-	12310.57
	2017	170146	-	-141	-	170005	18016.54	-	-12.17	-	18004.37
3	1990	43300				43300	6015.33				6015.33
	1993	51090	-	-79	-	51011	6884.36	-	-9.13	-	6875.23
	1997	63706	-	-99	-	63607	8242.06	-	-10.95	-	8231.11
	2007	106506	-	-166	-	106340	12453.36	-	-16.60	-	12436.75
	2017	171395	-	-267	-	171128	18126.82	-	-24.23	-	18102.59
4	1990	51812				51812	6956.52				6956.52
	1993	60884	-	-89	-	60795	7937.51	-	-9.98	-	7927.53
	1997	75508	-	-111	-	75397	9464.93	-	-11.96	-	9452.97
	2007	124770	-	-186	-	124585	14177.77	-	-18.10	-	14159.67
	2017	198968	-	-298	-	198669	20497.66	-	-26.37	-	20471.29
5	1990	47576				47576	6426.93				6426.93
	1993	55986	-	-136	-	55850	7342.55	-	-14.54	-	7328.01
	1997	69561	-	-169	-	69392	8770.00	-	-17.39	-	8752.61
	2007	115382	-	-281	-	115101	13182.53	-	-26.23	-	13156.30
	2017	184515	-	-451	-	184065	19108.50	-	-38.09	-	19070.40
6	1990	45723				45723	6197.06				6197.06
	1993	53811	-74	-137	1472	55071	7080.66	-10.02	-13.69	164.20	7221.15
	1997	66869	-92	-171	5473	72079	8458.39	-11.87	-16.40	587.26	9017.37
	2007	110954	-149	-284	8987	119508	12718.17	-17.55	-24.77	875.13	13550.98
	2017	177484	-233	-455	14244	191039	18440.38	-25.09	-36.05	1259.75	19639.00
7	1990	42116				42116	5787.79				5787.79
	1993	49570	-74	-137	1472	50831	6613.26	-10.02	-13.66	164.20	6753.79
	1997	61607	-92	-171	5473	66817	7900.51	-11.87	-16.35	587.26	8459.54
	2007	102257	-149	-284	8987	110811	11881.52	-17.55	-24.71	875.13	12714.39
	2017	163627	-233	-455	14244	177183	17230.71	-25.09	-35.95	1259.75	18429.42
8	1990	60710				60710	7394.85				7394.85
	1993	71640	-348	-91	1472	72672	8473.63	-39.29	-10.60	164.20	8587.93
	1997	89339	-430	-115	5473	94267	10161.41	-46.63	-12.85	587.26	10689.18
	2007	149360	-701	-196	8987	157450	15406.25	-69.11	-19.93	875.13	16192.34
	2017	240305	-1105	-321	14244	253124	22482.51	-98.99	-29.59	1259.75	23613.69

TRAFFIC PROJECTION LA UNION

Movement of Passengers and Commodity

Link	Year	Number of Passengers					Commodity Tonnage				
		Normal	Diverted-1	Diverted-2	Generated	Total	Normal	Diverted-1	Diverted-2	Generated	Total
	1990	46831				46831	5595.58				5595.58
	1993	55172	-345	-50	1814	56591	6399.36	-38.92	-5.41	202.41	6557.45
9	1997	68653	-425	-63	6698	74863	7654.03	-46.19	-6.53	718.80	8320.12
	2007	114239	-693	-107	10915	124354	11539.28	-68.43	-10.03	1063.04	12523.86
	2017	183122	-1092	-174	17201	199057	16764.82	-98.00	-14.79	1520.46	18172.48
	1990	42197				42197	5038.91				5038.91
	1993	49529	-303	-51	1814	50989	5742.45	-34.65	-5.34	202.41	5904.88
10	1997	61326	-374	-63	6698	67586	6835.96	-41.11	-6.42	718.80	7507.24
	2007	100941	-609	-106	10915	111141	10199.74	-60.88	-9.78	1063.04	11192.13
	2017	160414	-960	-171	17201	176484	14697.22	-87.15	-14.32	1520.46	16116.21
	1990	27446				27446	3239.71				3239.71
	1993	32188	-	-8	92	32272	3689.67	-	-.21	10.28	3699.73
11	1997	39816	-	-10	349	40155	4388.94	-	-.27	37.48	4426.16
	2007	65427	-	-17	579	65989	6540.90	-	-.44	56.44	6596.90
	2017	103889	-	-28	918	104778	9420.93	-	-.70	81.86	9502.10
	1990	31141				31141	3552.79				3552.79
	1993	36631	-	-6	457	37082	4060.12	-	-.30	51.01	4110.84
12	1997	45493	-	-8	1657	47142	4851.78	-	-.36	177.75	5029.17
	2007	75407	-	-13	2573	77967	7303.00	-	-.55	250.50	7552.94
	2017	120547	-	-21	3907	124433	10600.73	-	-.82	344.83	10944.74
	1990	27348				27348	3038.08				3038.08
	1993	32077	-	-1	-	32075	3460.36	-	-.04	-	3460.32
13	1997	39679	-	-1	-	39677	4116.25	-	-.05	-	4116.21
	2007	65178	-	-2	-	65176	6132.07	-	-.07	-	6132.00
	2017	103421	-	-4	-	103417	8825.36	-	-.10	-	8825.26
	1990	18542				18542	2005.64				2005.64
	1993	21798	-	-	-	21798	2290.22	-	-	-	2290.22
14	1997	27047	-	-	-	27047	2733.45	-	-	-	2733.45
	2007	44726	-	-	-	44726	4101.88	-	-	-	4101.88
	2017	71344	-	-	-	71344	5937.55	-	-	-	5937.55
	1990	35013				35013	4988.41				4988.41
	1993	41011	-423	-136	-	40453	5679.86	-49.30	-12.51	-	5618.05
15	1997	50640	-521	-168	-	49950	6753.38	-58.51	-14.86	-	6680.02
	2007	82847	-849	-275	-	81723	10050.01	-86.66	-22.05	-	9941.30
	2017	131019	-1338	-435	-	129245	14450.62	-124.07	-31.63	-	14294.92
	1990	12928				12928	2625.59				2625.59
	1993	15218	-	-6	-	15212	2999.35	-	-.76	-	2998.59
16	1997	18915	-	-8	-	18907	3581.77	-	-.92	-	3580.85
	2007	31392	-	-13	-	31378	5381.17	-	-1.40	-	5379.78
	2017	50215	-	-21	-	50194	7796.40	-	-2.04	-	7794.35

TRAFFIC PROJECTION LA UNION

Movement of Passengers and Commodity

Link	Year	Number of Passengers					Commodity Tonnage				
		Normal	Diver-ted-1	Diver-ted-2	Gene-rated	Total	Normal	Diver-ted-1	Diver-ted-2	Gene-rated	Total
	1990	10380				10380	2444.34				2444.34
	1993	12203	-	-	-	12203	2791.18	-	-.03	-	2791.16
17	1997	15141	-	-	-	15141	3331.39	-	-.03	-	3331.36
	2007	25038	-	-	-	25038	4999.14	-	-.05	-	4999.09
	2017	39938	-	-	-	39937	7236.20	-	-.07	-	7236.13
	1990	18112				18112	2648.92				2648.92
	1993	21295	-	-	-	21295	3024.86	-	-	-	3024.86
18	1997	26424	-	-	-	26424	3610.40	-	-	-	3610.39
	2007	43701	-	-	-	43701	5418.17	-	-.01	-	5418.17
	2017	69714	-	-	-	69714	7843.15	-	-.01	-	7843.15
	1990	967				967	111.05				111.05
	1993	1148	-4	-	1063	2207	128.01	-.37	-.08	118.59	246.16
19	1997	1442	-5	-1	4009	5446	154.74	-.44	-.09	430.14	584.34
	2007	2451	-8	-1	6799	9242	238.63	-.67	-.12	662.04	899.87
	2017	3993	-13	-1	11061	15040	352.80	-.98	-.16	977.38	1329.04
	1990	2949				2949	369.11				369.11
	1993	3420	-	-1	2236	5655	415.76	-	-.05	249.44	665.14
20	1997	4167	-	-2	8193	12358	487.15	-	-.06	879.11	1366.20
	2007	5615	-	-3	13201	19814	701.37	-	-.10	1285.47	1986.74
	2017	10205	-	-4	20634	30834	981.41	-	-.15	1821.88	2803.14
	1990	6356				6356	699.48				699.48
	1993	7398	-	1	457	7857	790.99	-	.05	51.01	842.05
21	1997	9059	-	2	1657	10718	932.01	-	.06	177.75	1109.82
	2007	14557	-	3	2573	17132	1360.12	-	.10	250.50	1610.71
	2017	22700	-	4	3907	26611	1926.10	-	.15	344.83	2271.07
	1990	13285				13285	1564.52				1564.52
	1993	15699	-	-6	-	15692	1795.50	-	-.64	-	1794.86
22	1997	19614	-	-8	-	19606	2157.52	-	-.76	-	2156.76
	2007	32925	-	-13	-	32912	3285.36	-	-1.13	-	3284.22
	2017	53140	-	-20	-	53119	4810.43	-	-1.63	-	4808.80
	1990	4693				4693	563.86				563.86
	1993	5496	-	-3	-	5493	641.66	-	-.39	-	641.27
23	1997	6783	-	-4	-	6779	762.35	-	-.47	-	761.88
	2007	11084	-	-7	-	11077	1132.19	-	-.69	-	1131.50
	2017	17505	-	-11	-	17494	1624.85	-	-.98	-	1623.86
	1990	1219				1219	195.02				195.02
	1993	1433	-	-	-	1433	222.70	-	-	-	222.70
24	1997	1778	-	-	-	1778	265.80	-	-	-	265.80
	2007	2940	-	-	-	2940	398.86	-	-	-	398.86
	2017	4690	-	-	-	4690	577.34	-	-	-	577.34

TRAFFIC PROJECTION LA UNION

TABLE 3.2 - 4 (1)

Movement of Passengers and Commodity

Link	Year	Number of Passengers					Commodity Tonnage				
		Normal	Diverted-1	Diverted-2	Generated	Total	Normal	Diverted-1	Diverted-2	Generated	Total
	1990	2133				2133	244.97				244.97
	1993	2465	-	-	550	3015	275.00	-	-	61.29	336.29
25	1997	2990	-	-	2006	4996	320.83	-	-	215.22	536.06
	2007	4703	-	-	3153	7856	457.96	-	-	306.94	764.90
	2017	7209	-	-	4825	12034	637.02	-	-	426.69	1063.71
	1990	2962				2962	340.13				340.13
	1993	3476	86	-19	844	4387	387.65	2.09	-1.24	94.09	482.59
26	1997	4302	106	-24	3111	7495	461.49	2.42	-1.51	333.72	796.12
	2007	7071	172	-40	5048	12251	688.41	3.39	-2.35	491.42	1180.87
	2017	11222	271	-65	7931	19360	991.43	4.64	-3.49	700.76	1693.34
	1990	-				-	-				-
	1993	-	345	119	321	784	-	38.92	13.22	35.79	87.94
27	1997	-	425	147	1178	1750	-	46.19	15.70	126.34	188.23
	2007	-	693	240	1901	2834	-	68.43	23.27	185.06	276.77
	2017	-	1092	379	2975	4446	-	98.00	33.35	262.73	394.08
	1990	2028				2028	232.90				232.90
	1993	2379	-106	-101	124	2297	265.44	-4.06	-11.11	13.88	264.15
28	1997	2945	-131	-124	467	3157	316.00	-4.77	-13.20	50.13	348.17
	2007	4840	-213	-204	777	5201	471.34	-6.89	-19.59	75.65	520.51
	2017	7681	-335	-322	1246	8269	678.77	-9.69	-28.09	109.78	750.76
	1990	-				-	-				-
	1993	-	74	1	124	200	-	10.02	-.15	13.88	23.74
29	1997	-	92	1	467	560	-	11.87	-.18	50.13	61.82
	2007	-	149	2	777	928	-	17.55	-.30	75.65	92.90
	2017	-	233	3	1246	1482	-	25.09	-.46	109.78	134.41
	1990	1358				1358	155.96				155.96
	1993	1593	-74	-1	1472	2990	177.79	-10.02	.10	164.20	332.07
30	1997	1973	-92	-2	5473	7352	211.73	-11.87	.13	587.26	787.24
	2007	3245	-149	-3	8987	12081	316.08	-17.55	.21	875.13	1173.87
	2017	5154	-233	-4	14244	19161	455.54	-25.09	.33	1259.75	1690.53
	1990	1606				1606	210.36				210.36
	1993	1895	-	3	-	1898	240.69	-	.37	-	241.06
31	1997	2362	-	4	-	2366	288.04	-	.44	-	288.49
	2007	3942	-	7	-	3949	434.73	-	.66	-	435.39
	2017	6334	-	10	-	6345	632.03	-	.94	-	632.97
	1990	-				-	-				-
	1993	-	4	1	82	87	-	.37	.13	9.13	9.62
32	1997	-	5	1	311	317	-	.44	.15	33.43	34.03
	2007	-	8	2	537	548	-	.67	.23	52.36	53.27
	2017	-	13	3	883	899	-	.98	.33	78.33	79.64

TRAFFIC PROJECTION LA UNION

TABLE 3.2 - 5 (1)

Traffic Volume

Link	Year	w/o									with							
		Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total	Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total
1	1990	964	608	511	655	2738	-	-	-	2738									
	1993	1113	708	600	748	3169	-	-	-	3169	1113	708	600	748	3169	-	-	-	3169
	1997	1348	868	745	893	3853	-	-	-	3853	1348	868	745	893	3853	-	-	-	3853
	2007	2101	1393	1232	1339	6065	-	-	-	6065	2101	1393	1232	1339	6065	-	-	-	6065
	2017	3166	2160	1965	1939	9229	-	-	-	9229	3166	2160	1965	1939	9229	-	-	-	9229
2	1990	1503	1010	904	942	4359	-	-	-	4359									
	1993	1747	1184	1070	1080	5080	-	-	-	5080	1745	1183	1069	1079	5076	-	-	-	5076
	1997	2134	1464	1338	1297	6232	-	-	-	6232	2132	1463	1337	1296	6228	-	-	-	6228
	2007	3394	2398	2253	1971	10016	-	-	-	10016	3392	2396	2251	1970	10009	-	-	-	10009
	2017	5205	3785	3646	2883	15518	-	-	-	15518	5201	3782	3643	2881	15506	-	-	-	15506
3	1990	1539	1035	928	962	4464	-	-	-	4464									
	1993	1784	1210	1095	1101	5190	-	-	-	5190	1781	1208	1093	1100	5183	-	-	-	5183
	1997	2173	1492	1365	1319	6349	-	-	-	6349	2170	1490	1363	1317	6340	-	-	-	6340
	2007	3434	2428	2282	1993	10137	-	-	-	10137	3429	2424	2279	1990	10122	-	-	-	10122
	2017	5240	3811	3673	2900	15624	-	-	-	15624	5232	3806	3667	2896	15601	-	-	-	15601
4	1990	1805	1226	1110	1113	5255	-	-	-	5255									
	1993	2086	1429	1305	1270	6089	-	-	-	6089	2083	1427	1303	1268	6081	-	-	-	6081
	1997	2530	1753	1618	1514	7416	-	-	-	7416	2527	1751	1616	1512	7405	-	-	-	7405
	2007	3962	2824	2674	2268	11727	-	-	-	11727	3956	2820	2670	2266	11711	-	-	-	11711
	2017	6001	4397	4264	3280	17941	-	-	-	17941	5992	4391	4257	3275	17916	-	-	-	17916
5	1990	1664	1128	1019	1028	4839	-	-	-	4839									
	1993	1925	1316	1200	1175	5615	-	-	-	5615	1921	1313	1197	1172	5603	-	-	-	5603
	1997	2338	1618	1491	1403	6850	-	-	-	6850	2333	1614	1487	1400	6835	-	-	-	6835
	2007	3674	2615	2472	2109	10871	-	-	-	10871	3666	2609	2466	2105	10846	-	-	-	10846
	2017	5580	4083	3954	3057	16674	-	-	-	16674	5567	4073	3944	3051	16636	-	-	-	16636
6	1990	1602	1085	980	992	4658	-	-	-	4658									
	1993	1853	1266	1153	1133	5406	-	-	-	5406	1893	1294	1180	1155	5523	-	-	-	5523
	1997	2252	1556	1433	1353	6595	-	-	-	6595	2413	1673	1545	1443	7072	-	-	-	7072
	2007	3539	2516	2378	2035	10468	-	-	-	10468	3790	2703	2561	2168	11222	-	-	-	11222
	2017	5376	3930	3803	2950	16060	-	-	-	16060	5755	4220	4094	3142	17211	-	-	-	17211
7	1990	1488	1003	902	926	4319	-	-	-	4319									
	1993	1721	1171	1062	1058	5012	-	-	-	5012	1761	1199	1089	1081	5130	-	-	-	5130
	1997	2091	1439	1320	1264	6114	-	-	-	6114	2252	1555	1432	1354	6592	-	-	-	6592
	2007	3286	2327	2191	1901	9706	-	-	-	9706	3537	2514	2375	2034	10459	-	-	-	10459
	2017	4991	3635	3506	2757	14889	-	-	-	14889	5370	3925	3797	2949	16040	-	-	-	16040
8	1990	2729	2540	1006	1035	7310	-	-	-	7310									
	1993	3170	2972	1187	1186	8515	-	-	-	8515	3214	3014	1204	1202	8635	-	-	-	8635
	1997	3872	3666	1480	1423	10441	-	-	-	10441	4079	3865	1562	1496	11002	-	-	-	11002
	2007	6156	5971	2475	2157	16759	-	-	-	16759	6480	6289	2609	2267	17646	-	-	-	17646
	2017	9444	9376	3982	3148	25950	-	-	-	25950	9934	9869	4195	3306	27304	-	-	-	27304

TRAFFIC PROJECTION LA UNION

TABLE 3.2 - 5 (2)

Traffic Volume

Link	Year	w/o									with							
		Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total	Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total
9	1990	1528	1074	1004	895	4500	-	-	-	4500								
	1993	1771	1255	1182	1024	5232	-	-	-	5232	1816	1287	1213	1049	5365	-	-	-	5365
	1997	2158	1546	1471	1225	6400	-	-	-	6400	2349	1685	1604	1331	6969	-	-	-	6969
	2007	3411	2513	2448	1846	10218	-	-	-	10218	3707	2734	2665	2004	11110	-	-	-	11110
	2017	5208	3942	3924	2682	15756	-	-	-	15756	5653	4282	4266	2908	17109	-	-	-	17109
10	1990	1376	967	904	806	4054	-	-	-	4054									
	1993	1590	1127	1061	919	4696	-	-	-	4696	1636	1159	1093	945	4832	-	-	-	4832
	1997	1927	1381	1314	1094	5716	-	-	-	5716	2120	1521	1448	1201	6290	-	-	-	6290
	2007	3014	2221	2163	1632	9030	-	-	-	9030	3313	2443	2382	1791	9929	-	-	-	9929
	2017	4564	3454	3437	2352	13806	-	-	-	13806	5013	3797	3782	2579	15170	-	-	-	15170
11	1990	890	627	588	518	2623	-	-	-	2623									
	1993	1027	730	690	590	3037	-	-	-	3037	1030	732	692	592	3045	-	-	-	3045
	1997	1244	894	853	702	3694	-	-	-	3694	1254	902	860	708	3725	-	-	-	3725
	2007	1943	1436	1402	1047	5828	-	-	-	5828	1960	1448	1414	1056	5878	-	-	-	5878
	2017	2941	2232	2226	1507	8906	-	-	-	8906	2966	2251	2245	1520	8983	-	-	-	8983
12	1990	991	705	667	568	2932	-	-	-	2932									
	1993	1148	824	785	650	3406	-	-	-	3406	1162	834	795	658	3448	-	-	-	3448
	1997	1397	1014	975	776	4162	-	-	-	4162	1448	1050	1010	805	4313	-	-	-	4313
	2007	2204	1643	1616	1168	6632	-	-	-	6632	2280	1699	1671	1208	6858	-	-	-	6858
	2017	3363	2573	2583	1696	10215	-	-	-	10215	3472	2656	2666	1751	10545	-	-	-	10545
13	1990	858	615	586	486	2545	-	-	-	2545									
	1993	991	717	687	554	2948	-	-	-	2948	991	717	687	554	2948	-	-	-	2948
	1997	1201	878	850	659	3588	-	-	-	3588	1201	878	850	659	3588	-	-	-	3588
	2007	1878	1411	1397	981	5667	-	-	-	5667	1878	1411	1397	981	5667	-	-	-	5667
	2017	2845	2194	2216	1412	8667	-	-	-	8667	2845	2194	2216	1412	8667	-	-	-	8667
14	1990	574	415	397	321	1706	-	-	-	1706									
	1993	664	484	467	366	1982	-	-	-	1982	664	484	467	366	1982	-	-	-	1982
	1997	808	595	580	437	2420	-	-	-	2420	808	595	580	437	2420	-	-	-	2420
	2007	1273	963	958	656	3851	-	-	-	3851	1273	963	958	656	3851	-	-	-	3851
	2017	1940	1506	1529	950	5925	-	-	-	5925	1940	1506	1529	950	5925	-	-	-	5925
15	1990	1529	1834	450	798	4611	-	-	-	4611									
	1993	1774	2132	527	909	5342	-	-	-	5342	1752	2104	520	899	5275	-	-	-	5275
	1997	2165	2607	651	1081	6503	-	-	-	6503	2137	2573	642	1069	6421	-	-	-	6421
	2007	3442	4164	1065	1608	10279	-	-	-	10279	3398	4111	1051	1591	10150	-	-	-	10150
	2017	5299	6442	1685	2312	15737	-	-	-	15737	5231	6358	1662	2287	15538	-	-	-	15538
16	1990	643	756	166	420	1985	-	-	-	1985									
	1993	748	880	196	480	2303	-	-	-	2303	747	880	196	480	2303	-	-	-	2303
	1997	914	1079	243	573	2810	-	-	-	2810	914	1079	243	573	2809	-	-	-	2809
	2007	1461	1735	404	861	4461	-	-	-	4461	1461	1735	403	861	4460	-	-	-	4460
	2017	2257	2695	646	1247	6844	-	-	-	6844	2256	2694	645	1247	6842	-	-	-	6842

TRAFFIC PROJECTION LA UNION

TABLE 3.2 - 5 (3)

Traffic Volume

Link	Year	w/o									with							
		Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total	Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total
17	1990	550	640	133	391	1715	-	-	-	1715									
	1993	638	744	157	447	1986	-	-	-	1986	638	744	157	447	1986	-	-	-	1986
	1997	778	911	195	533	2417	-	-	-	2417	778	911	195	533	2417	-	-	-	2417
	2007	1236	1455	322	800	3813	-	-	-	3813	1236	1455	322	800	3813	-	-	-	3813
	2017	1898	2247	513	1158	5816	-	-	-	5816	1898	2247	513	1158	5816	-	-	-	5816
18	1990	664	439	388	424	1915	-	-	-	1915									
	1993	767	512	456	484	2219	-	-	-	2219	767	512	456	484	2219	-	-	-	2219
	1997	930	628	566	578	2702	-	-	-	2702	930	628	566	578	2702	-	-	-	2702
	2007	1455	1012	936	867	4270	-	-	-	4270	1455	1012	936	867	4270	-	-	-	4270
	2017	2202	1574	1494	1255	6524	-	-	-	6524	2202	1574	1494	1255	6524	-	-	-	6524
19	1990	36	98	-	4	139	124	91	-	353									
	1993	42	114	-	5	162	145	108	-	414	73	210	-	18	301	211	184	-	696
	1997	52	141	-	6	200	178	135	-	513	139	403	-	82	583	188	340	-	1211
	2007	84	230	-	10	324	286	230	-	839	226	767	-	126	1119	319	578	-	2016
	2017	129	361	-	14	504	442	374	-	1321	354	1222	-	186	1762	519	940	-	3221
20	1990	56	249	-	59	364	65	147	-	577									
	1993	63	288	-	67	418	75	171	-	664	119	477	-	106	702	101	247	-	1051
	1997	76	349	-	78	503	90	208	-	801	318	1048	-	219	1585	128	386	-	2099
	2007	114	547	-	112	773	138	331	-	1242	490	1660	-	318	2467	205	619	-	3292
	2017	169	833	-	157	1159	206	510	-	1875	734	2554	-	449	3736	319	964	-	5019
21	1990	112	528	-	112	752	134	318	-	1204									
	1993	129	612	-	127	867	155	370	-	1392	158	655	-	135	947	137	344	-	1428
	1997	154	746	-	149	1049	187	453	-	1689	209	901	-	178	1347	111	335	-	1793
	2007	237	1185	-	218	1639	291	728	-	2659	413	1424	-	258	2095	177	535	-	2808
	2017	354	1828	-	308	2490	442	1135	-	4067	618	2189	-	363	3171	275	832	-	4278
22	1990	977	1180	11	188	2356	-	249	-	2605									
	1993	1144	1384	13	215	2756	-	294	-	3051	1144	1383	13	215	2755	-	294	-	3050
	1997	1412	1711	17	259	3399	-	368	-	3767	1412	1711	17	259	3398	-	368	-	3766
	2007	2303	2806	28	394	5531	-	617	-	6149	2302	2804	28	394	5529	-	617	-	6146
	2017	3619	4430	46	577	8672	-	996	-	9668	3618	4428	46	577	8668	-	996	-	9664
23	1990	347	419	4	68	838	-	88	-	926									
	1993	403	487	5	77	972	-	103	-	1075	403	487	5	77	971	-	103	-	1074
	1997	492	595	6	91	1184	-	127	-	1311	491	595	6	91	1183	-	127	-	1310
	2007	781	950	10	136	1876	-	208	-	2083	780	949	9	136	1874	-	208	-	2082
	2017	1200	1467	15	195	2877	-	328	-	3206	1199	1466	15	195	2876	-	328	-	3204
24	1990	100	119	1	23	243	-	23	-	266									
	1993	116	138	1	27	282	-	27	-	309	116	138	1	27	282	-	27	-	309
	1997	142	169	2	32	345	-	33	-	378	142	169	2	32	345	-	33	-	378
	2007	227	272	3	48	549	-	55	-	604	227	272	3	48	549	-	55	-	604
	2017	350	421	4	69	845	-	88	-	933	350	421	4	69	845	-	88	-	933

TRAFFIC PROJECTION LA UNION

TABLE 3.2 - 5 (4)

Traffic Volume

Link	Year	w/o									with							
		Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total	Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total
25	1990	68	185	-	27	280	155	133	-	568									
	1993	78	212	-	30	319	177	154	-	650	89	272	-	40	401	154	138	-	694
	1997	92	254	-	35	382	210	187	-	779	127	488	-	75	690	52	62	-	805
	2007	138	391	-	50	579	315	294	-	1188	192	752	-	107	1051	81	98	-	1231
	2017	202	586	-	70	857	461	451	-	1769	283	1131	-	149	1563	124	150	-	1838
26	1990	95	256	-	37	388	216	185	-	789									
	1993	109	298	-	43	450	249	217	-	917	129	394	-	58	581	223	201	-	1005
	1997	132	366	-	51	549	302	269	-	1120	190	731	-	111	1032	78	94	-	1203
	2007	207	587	-	76	870	473	442	-	1785	298	1171	-	165	1634	127	153	-	1914
	2017	314	912	-	109	1334	717	701	-	2753	454	1815	-	237	2506	200	242	-	2949
27	1990	-	-	-	-	-	-	-	-	-									
	1993	-	-	-	-	-	-	-	-	-	26	75	-	8	109	36	65	39	249
	1997	-	-	-	-	-	-	-	-	-	45	149	-	26	220	60	109	-	389
	2007	-	-	-	-	-	-	-	-	-	69	235	-	39	344	98	177	-	618
	2017	-	-	-	-	-	-	-	-	-	105	361	-	55	521	153	278	-	952
28	1990	83	236	-	23	342	-	25	-	367									
	1993	96	274	-	27	397	-	30	-	426	80	266	-	28	375	-	24	-	399
	1997	117	335	-	32	483	-	37	-	520	72	359	-	42	472	-	20	-	492
	2007	185	534	-	47	766	-	61	-	826	113	575	-	62	751	-	33	-	783
	2017	283	823	-	68	1174	-	96	-	1270	172	891	-	90	1153	-	52	-	1205
29	1990	-	-	-	-	-	-	-	-	-									
	1993	-	-	-	-	-	-	-	-	-	2	6	-	1	9	2	4	150	165
	1997	-	-	-	-	-	-	-	-	-	14	48	-	9	71	19	35	-	125
	2007	-	-	-	-	-	-	-	-	-	23	78	-	13	113	32	58	-	203
	2017	-	-	-	-	-	-	-	-	-	35	121	-	19	175	51	93	-	319
30	1990	59	137	-	9	205	70	127	52	455									
	1993	68	159	-	11	237	82	149	59	528	110	284	-	29	423	137	249	74	883
	1997	82	193	-	13	288	102	185	71	646	187	625	-	110	922	254	460	-	1636
	2007	127	305	-	19	451	168	304	105	1028	295	1003	-	164	1462	417	755	-	2634
	2017	190	466	-	27	683	267	483	152	1585	451	1556	-	237	2243	661	1198	-	4102
31	1990	21	161	-	25	208	90	100	-	399									
	1993	24	189	-	29	242	105	118	-	465	24	190	-	31	245	81	99	-	425
	1997	29	232	-	35	295	129	148	-	573	29	238	-	40	307	41	74	-	422
	2007	43	376	-	52	472	208	246	-	926	44	388	-	61	493	68	123	-	684
	2017	63	587	-	76	727	324	396	-	1446	63	611	-	89	762	109	198	-	1070
32	1990	-	-	-	-	-	-	-	-	-									
	1993	-	-	-	-	-	-	-	-	-	3	8	-	.8	12	4	7	4	27
	1997	-	-	-	-	-	-	-	-	-	8	27	-	5	40	11	20	-	71
	2007	-	-	-	-	-	-	-	-	-	13	45	-	7	66	19	34	-	119
	2017	-	-	-	-	-	-	-	-	-	21	73	-	11	105	31	56	-	193

3.3 TRAFFIC ANALYSIS AND FORECAST: DEVELOPMENT PROJECT

Traffic on development project roads was forecasted separately for passenger traffic, non-agricultural traffic and agricultural traffic. The number of passengers and commodity tonnage were estimated first, and then they were converted to the number of vehicles assuming modal distribution and occupancy/average load. Figure 3.3.-1 shows the schematic diagram of traffic forecast for development project.

3.3.1 Passenger Traffic and Non-Agricultural Traffic

The population residing within the road influence area, which is defined as the area from which local existing or potential traffic using the road derives, was obtained mainly from distribution of barangays shown in 1:50,000 topographical maps and the NCSO 1980 Census of Population and Housing, and supplemented by information obtained from barangay interviews. The population forecasts were prepared using the NCSO report.

The number of passengers and non-agricultural commodity tonnage were obtained as the product of population by the per capita generation factor. Table 3.3-1 shows the generation factors commodity used in the analysis, which was derived mainly based on the traffic survey and referring to previous studies. In the case of particular roads where the common values were deemed inapplicale, specific values were used.

TABLE 3.3-1 PER CAPITA TRAFFIC GENERATION FACTORS (MINOR ROAD): Province of La Union

Existing Road Condition	Passenger Movement (trip/person/day)		Non-Agricultural Commodity (kg/person/day)	
	w/o	with	w/o	with
Paved/Gravel				
Good/Fair	0.30	0.30	6.0	6.0
Bad	0.25	0.28	4.8	5.4
Very Bad	0.20	0.28	1.8	3.0
Earth Road	0.15	0.28	1.5	3.0
Impassable to motoried vehicle	0.03	0.10	1.2	3.0

The modal distribution and the occupancy/average load used in the conversion to traffic volume by vehicle type were estimated individually for each road based on the road

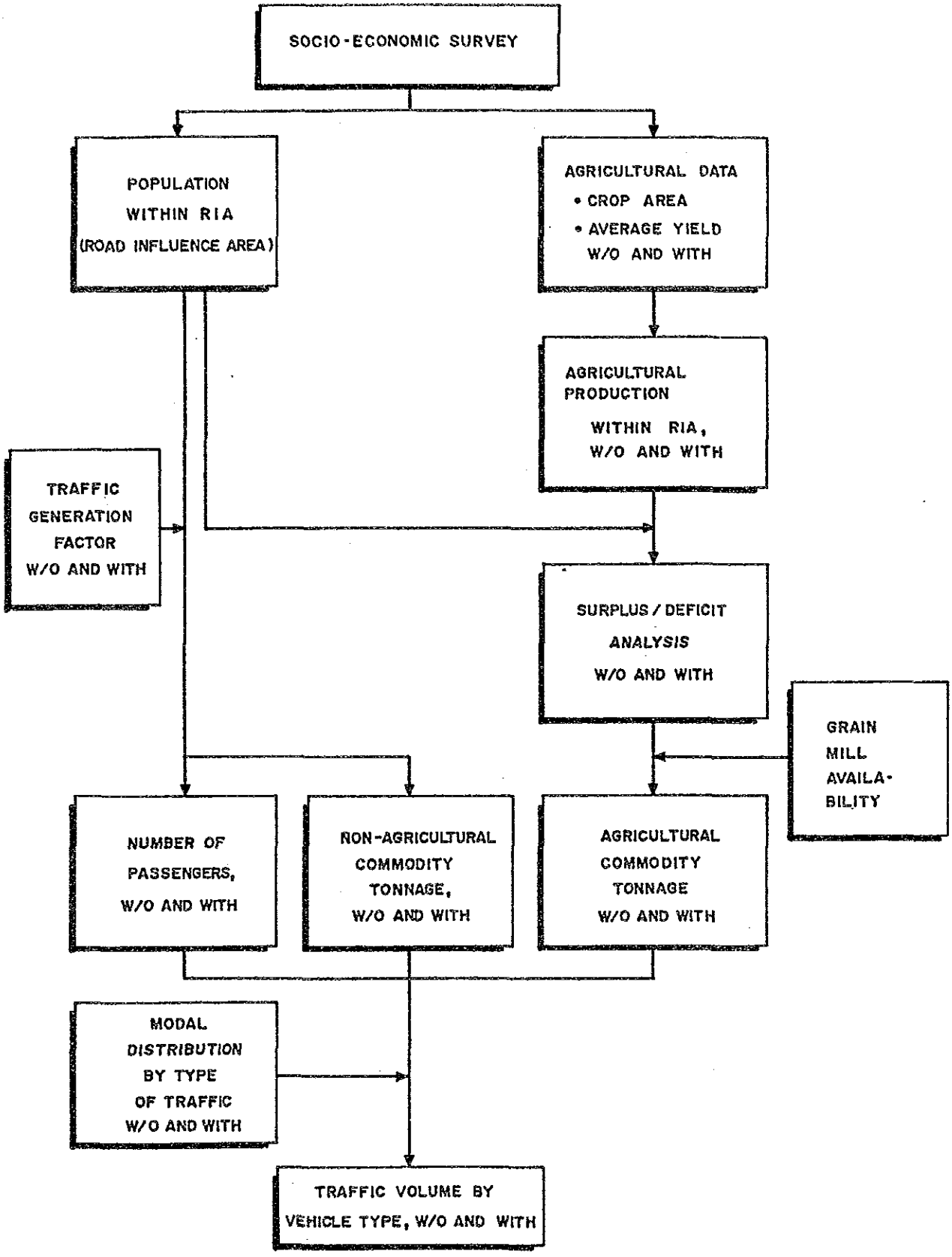

FIGURE 3.3-1
PROCEDURE OF TRAFFIC FORECAST FOR DEVELOPMENT PROJECTS

inventory survey and the traffic survey.

3.3.2 Agricultural Traffic

Agricultural commodity tonnage was estimated based on the agricultural production within the road influence area, taking into consideration i) home consuption and surplus/deficit and ii) availability of grain mill(s) in the road influence area, as regards food grain.

i) Home consumption of food grain was calculated as population times per capita grain consumption (assumed to be 130 kg in a milled form), and the surplus or deficit production was calculated based thereupon.

ii) In case of no mill in the road influence area, all net production is assumed to move out in the form of palay/unmilled corn. Milled grain products for home comsumption are then transported back. An eventual deficit moves into the road influence area in the form of milled products.

Provided one or more mills exist in the road influence area, the transport flows are assumed as follows:

- Home consumption remains in the road influence area (no transport movement assumed).
- Surplus production would be transported out, traditionally in the form of unmilled food grains.
- Deficit production would be moved into the road influence area in milled form.

Agricultural commodity tonnage was cnverted to number of vehicles using the modal distribution and average load, which were estimated individually for each road considering the transport circumstances.

3.3.3 Estimated Present and Future Traffic

Estimated present and future traffic is presented in Table 3.4-1 in the next Section.

3.4 SUMMARY OF TRAFFIC VOLUME ON STUDIED ROADS

Estimated present and future traffic volumes of the studied roads comprising of traffic and development projects are presented by each road project in Table 3.4-1.

TABLE 3.4 - 1 (1)

Traffic Volume by Vehicle Type LA UNION

Class of Road	Type of Impr't	Road Number	w/o										with									
			Car	Jeep-ney	Bus	Truck	Total	Tri-cycle	Motor cycle	Ani-mal	Walk-ing	Boat	Car	Jeep-ney	Bus	Truck	Total	Tri-cycle	Motor cycle	Ani-mal	Walk-ing	Boat
Second'y	Rehab/	P12	109	298	-	43	450	249	217	-	-	-	129	394	-	58	581	223	201	-	-	-
Major	Imp-1	P22-1	68	159	-	11	237	82	149	59	-	-	110	284	-	29	423	137	249	74	-	-
		P104	-	-	-	-	-	-	-	-	-	-	26	75	-	8	109	36	65	39	-	-
		P14	78	212	-	30	319	177	154	-	-	-	89	272	-	40	401	154	138	-	-	-
		P22-2	-	-	-	-	-	-	-	-	-	-	2	6	-	1	9	2	4	150	-	-
		P36	96	274	-	27	397	0	30	-	-	-	80	266	-	28	375	0	24	-	-	-
		N6	-	-	-	-	-	-	-	-	-	-	3	8	-	1	12	4	7	4	-	-
	Imp-2/	N11	129	612	-	127	867	155	370	-	-	-	158	655	-	135	947	137	344	-	-	-
	Widen	N7-1	63	288	-	67	418	75	171	-	-	-	119	477	-	106	702	101	247	-	-	-

TABLE 3.4 - 1 (2)

Traffic Volume by Vehicle Type LA UNION

Class of Road	Type of Impr't	Road Number	w/o										with									
			Car	Jeep-ney	Bus	Truck	Total	Tri-cycle	Motor cycle	Ani-mal	Walk-ing	Boat	Car	Jeep-ney	Bus	Truck	Total	Tri-cycle	Motor cycle	Ani-mal	Walk-ing	Boat
Minor (Nat'l/ Prov'l)	Rehab/ Imp-1	P78	10	110	-	-	120	257	-	-	534	-	12	153	-	1	167	149	135	-	-	-
		P56	9	107	-	-	115	251	-	-	516	-	11	150	-	1	163	148	134	-	-	-
		P23	-	29	-	-	29	82	-	16	195	-	2	42	-	-	45	50	38	-	41	-
		P64	6	58	-	-	63	137	-	-	282	-	6	100	-	1	107	42	38	-	-	-
		P11	3	36	-	-	39	85	-	-	174	-	3	52	-	0	56	53	48	-	-	-
		P73	-	-	-	-	-	134	112	44	558	-	-	41	-	-	41	18	65	24	641	-
		P79	7	81	-	1	89	78	71	-	-	-	7	82	-	1	90	79	72	-	-	-
		P76	-	-	-	-	-	266	255	111	1296	-	-	137	-	-	137	186	131	56	281	-
		P6	-	51	-	-	51	142	-	25	331	-	4	56	-	-	60	126	-	-	284	-
		P43	-	39	-	-	39	99	-	22	269	-	3	57	-	-	60	68	51	-	56	-
		P39	-	3	-	-	3	56	49	11	252	-	2	22	-	-	24	49	-	-	114	-
		N7-2	10	114	-	-	124	253	-	-	586	-	10	151	-	-	160	179	134	-	158	-
	Imp-2/ Widen	P45	4	37	-	-	40	85	-	-	179	-	5	49	-	1	54	46	42	-	-	-
		P41	7	117	-	-	124	139	104	-	119	-	7	118	-	-	126	141	106	-	120	-
		P16	6	105	-	-	111	125	94	-	102	-	6	105	-	-	111	125	94	-	102	-

TABLE 3.4 - 1 (3)
Traffic Volume by Vehicle Type LA UNION

Class of Road	Type of Impr't	Road Number	w/o										with									
			Car	Jeep-ney	Bus	Truck	Total	Tri-cycle	Motor cycle	Ani-mal	Walk-ing	Boat	Car	Jeep-ney	Bus	Truck	Total	Tri-cycle	Motor cycle	Ani-mal	Walk-ing	Boat
Minor (Barangay)	Rehab/ Imp-1	B4-2	-	25	-	-	25	20	39	15	382	-	3	39	-	-	42	88	-	-	197	-
		B9-4	-	13	-	-	13	8	21	5	198	-	0	20	-	-	21	51	-	6	121	-
		B14-3	-	27	-	-	27	15	45	10	408	-	-	41	-	-	41	102	-	13	244	-
		B11-38	5	48	-	-	53	113	-	-	236	-	4	65	-	0	69	74	58	-	53	-
		B2-10	-	9	-	-	9	151	130	31	674	-	5	78	-	-	82	92	69	-	81	-
		B17-10	-	-	-	-	-	96	77	34	395	-	-	33	-	-	33	85	-	19	231	-
		B15-13	-	15	-	-	15	43	-	8	103	-	-	24	-	-	24	33	23	10	48	-
		B10-16	-	43	-	-	43	122	-	25	294	-	-	59	-	-	59	82	56	26	131	-
		B4-10	-	22	-	-	22	13	36	9	335	-	0	28	-	-	28	8	47	10	428	-
		B7-51	-	21	-	-	21	14	33	10	314	-	0	28	-	-	28	68	-	8	167	-
		B15-1	-	19	-	-	19	56	-	13	140	-	2	34	-	-	36	21	12	-	35	-
		B5-30	-	12	-	-	12	10	19	7	190	-	1	25	-	-	26	30	23	-	21	-
		B9-2	-	22	-	-	22	12	33	15	344	-	-	22	-	-	22	12	35	16	357	-
		B0-11	-	8	-	-	8	6	12	5	116	-	1	11	-	-	12	25	-	-	57	-
		B13-7	-	19	-	-	19	48	-	12	134	-	-	26	-	-	26	36	24	12	61	-
		B19-1	1	9	-	-	9	20	-	-	42	-	1	15	-	0	16	15	14	-	-	-
		B11-23	-	8	-	-	8	31	11	8	126	-	1	13	-	-	14	28	-	-	66	-
		B15-4	-	22	-	-	22	62	-	11	145	-	2	34	-	-	36	41	32	-	29	-
		B18-5	1	11	-	-	12	5	15	-	134	-	1	21	-	0	23	21	19	-	-	-
		B0-15	3	25	-	-	28	59	-	-	123	-	4	37	-	0	41	35	31	-	-	-
	Imp-2/ Widen	B3-28	-	2	-	-	2	36	28	9	156	-	1	11	-	-	13	5	15	-	141	-

CHAPTER 4
PROJECT IDENTIFICATION AND SCREENING

4.1 PROJECT IDENTIFICATION

4.1.1 Field Surveys

Field survey was conducted by the Study Team to assess present condition of all major roads and some other typical minor roads (these are referred to as "Surveyed Roads").

Road projects (mostly minor roads) proposed by the local officials were also collected and road conditions of these roads were obtained by the interview survey (these are referred to as " Road Projects proposed by local officials").

Road projects surveyed by the Study Team and proposed by the local officials were combined and integrated, because some road projects were both surveyed by the Study Team and also proposed by the local officials, and a list of Studied Roads was prepared.

Summaries of "Surveyed Roads", "Road Projects proposed by Local officials "and" Studied Roads" are shown in Table 4.1-1.

TABLE 4.1-1 SUMMARY OF SURVEYED ROADS
Road Projects Proposed by Local Officials and Studied Roads
Province of La Union

	Road Class	National Roads	Prov'l/City Roads	Barangay Roads	Total
Surveyed Road	Major Rd.	198.6	58.3	-	256.9
	Minor Rd.	13.6	110.8	-	124.4
	Total	212.2	169.1	-	381.3
Rd. Proj. Proposed by Local Officials	Major Rd.	47.2	41.1	-	88.3
	Minor Rd.	4.2	130.3	214.1	348.6
	Total	51.4	171.4	214.1	436.9
Studied Road	Major Rd.	198.6	68.3	-	266.9
	Minor Rd.	13.6	149.8	214.1	377.5
	Total	212.2	218.1	214.1	644.4

4.1.2 Project Identification

1) Project Identification Criteria

Project identification criteria are shown in Table 4.1-2.

TABLE 4.1-2 PROJECT IDENTIFICATION CRITERIA

Item	Condition of Identification	
	Major Roads	Minor Roads
(1) Existing Links		
* Carriageway Width	Less than 6.0 meter	Less than 4.0 meters
* Pavement Type	Inferior to recommended type in the engineering Standards	Inferior to gravel
* Surface Condition	Bad or very bad 1/	Bad or very bad2/
(2) New Links	Impassable Abandoned Non-existing	
(3) Bridges	Ford crossing Spillway Timber bridge Bailey bridge	Ford crossing Spillway in structurally unsound condition Bailey bridge for AADT more than 300

Notes: 1/ Gravel road which is proposed for improvement by local officials shall be identified, even though surface condition is "fair".

2/ Gravel road of which surface condition is "fair" shall be identified, as the surface condition of gravel minor roads is easily deteriorated.

2) Identified Road Projects

All studied Roads, except those of the national primary roads and committed roads, were evaluated in accordance with the identification criteria. Road projects identified are summarized in Table 4.1-3.

TABLE 4.1-3 SUMMARY OF IDENTIFIED ROAD PROJECTS
Province of La Union

Road Class		National Road	Prov'l/City Road	Barangay Road	Total
Major Road	Length (kms.)	47.2	55.1	-	102.3
	(% to Studied Roads)	(24%)	(81%)	-	(38%)
Minor Road	Length (kms.)	4.2	149.8	214.1	368.1
	(% to Studied Roads)	(31%)	(100%)	(100%)	(98%)
Total	Length (kms.)	51.4	204.9	214.1	470.4
	(% to Studied Roads)	(24%)	(94%)	(100%)	(73%)

4.2 PROJECT SCREENING

4.2.1 Categorization

Road projects are categorized by the following factors in order to establish comprehensive prioritization criteria:

(1) Class of Roads

Major Roads	Minor Roads
* Primary major roads	*National/provincial/city roads
* Secondary major roads	* Barangay roads

(2) Urgency of work

Improvement criteria for roads and bridges are established as shown in Tables 4.2-1 and 4.2-2, respectively. Improvement works are classified into five (5) types as shown in Table 4.2-3. In view of the urgency of work to be implemented, the types of improvement are grouped into two (2) as follows:

Type A (Urgent Projects)

* Rehabilitation: Improvement of deteriorated road surface, but standard or superior class pavement, to acceptable condition.
* Improvement -1: Improvement of deteriorated road surface and substandard class pavement, to acceptable and standard pavement.
* New Construction: Construction of new road including re-construction of abandoned road.

Type B (Less Urgent Projects)

* Improvement -2: Upgrading of substandard pavement class to standard pavement class, though existing road surface condition is acceptable.
* Widening : Widening of roads with substandard carriageway width, other conditions meet engineering standards.

Note: Road projects which include only improvement of bridges are classified as "Rehabilitation".

(3) Economic Viability

Major Roads

Simplified economic evaluation is conducted for major roads. Internal Rate of Return (IRR) is calculated based on roughly estimated construction cost and traffic cost savings. Categorization is made as follows:

Improvment Type A:

* IRR of 7.5% or more
* IRR of less than 7.5%

Improvement Type B:

* IRR of 15% or more
* IRR of less than 15.0%

Minor Roads

Minor road Pre-evaluation Indicator (MPI) is developed based on Phase-1 Study results. Categorization of minor roads is made based on calculated MPI as follows:

* MPI of 7.5 or more
* MPI of less than 7.5

TABLE 4.2-1 IMPROVEMENT CRITERIA FOR ROAD

Road Class	Major Road		Minor Road	
	Standard/ Superior	Substandard	Standard/ Superior	Substandard
Good/Fair	No improvement or widening (widening)	Upgrading of pavement type (improvement-2)	No improvement	No improvement
Bad/Very bad	Improvement of surface condition (Rehabilitation)	Upgrading of pavement type (improvement-1)	Improvement surface con (Rehabilitation)	Upgrading of pavement type (Improvement-1)
Abandoned/ Non-existing	Construction of new road (New Construction)			

Note: 1) In case of carriageway width less than 6.0 meters.

TABLE 4.2-2 IMPROVEMENT CRITERIA FOR BRIDGES

Existing Bridge Type	Proposed Improvement		
	Major Road	Minor Road	
Ford Crossing	2-lane permanent bridge	Carriageway width 4.0 m: 1-lane spillway Carriageway width 6.0 m: 2-lane spillway	
Spillway	2-lane permanent bridge	No improvement	
Timber Bridge	2-lane permanent bridge	AADT less than 200	1-lane permanent bridge
		AADT more than 200	2-lane permanent bridge
Bailey Brridge	2-lane permanent bridge	AADT less than 300	No improvement
		AADT more than 300	2-lane permannet bridge

Note: 1) Where the site condition is not favorable for a spillway, a permanent bridge should be planned in accordance with the criteria for a timber bridge.

2) When the existing spillway is structurally sound and traffic disturbance is estimated less, the existing one can be utilized. Under other conditions, a permanent bridge should be planned in accordance with the criteria for a timber bridge.

TABLE 4.2-3 TYPES OF IMPROVEMENT

Type	Existing Pavement Type	Existing Surface Condition	Proposed Improvement Work
Rehabilitation	Standard or superior	Bad/ very bad	Improvement of surface condition
Improvement-1	Substandard	Bad/ very bad	Upgrading of surface type
Improvement-2	Substandard	Good/Fair	Upgrading of surface type
Widening	Standard (carriageway is narrowed than standard)	Good/Fair	Widening of existing road
New Construction	Impassable/abandoned non-existing		Construction of new road

Note: Improvement-2 and widening are not applied to minor roads.

4.2.2 Prioritization and Selection Criteria

Prioritization and selection criteria of road projects for feasibility studies are established as shown in Tables 4.2-4 and 4.2-5.

TABLE 4.2-4 PRIORITIZATION AND SELECTION OF ROAD PROJECTS
- Major Roads -

Category	Road Class	Type of Improvement	IRR	Priority Criteria	Selection Criteria
1	Primary	A	7.5 ≦ IRR	MA-1	↑
2	Secondary	A	7.5 ≦ IRR	MA-1	↑
3	Primary	B	15.0 ≦ IRR	MA-2	To be selected for F/S
4	Secondary	B	15.0 ≦ IRR	MA-2	To be selected for F/S
5	Primary	A	IRR < 7.5	MA-2	To be selected for F/S
6	Secondary	A	IRR < 7.5	MA-2	To be selected for F/S
7	Primary	B	IRR < 15.0	MA-3	↓
8	Secondary	B	IRR < 15.0	MA-3	↓

TABLE 4.2-5 PRIORITIZATION AND SELECTION OF ROAD PROJECTS
- Minor Roads -

Category	Road Class	Type of Improvement	MPI	Priority Criteria	Selection Criteria
1	National/Provincial/City	A	7.5 ≦ MPI	MI-1	↑
2	Barangay	A	7.5 ≦ MPI	MI-1	To be selected for F/S
3	National/Provincial/City	A	MPI < 7.5	MI-2	↓
4	Barangay	A	MPI < 7.5	MI-2	↓

Note: Improvement Type A: Rehabilitation, Improvement-1, New Construction
Improvement Type B: Improvement-2, Widening

4.2.3 Priority of Identified Road Projects

Identified projects were evaluated and prioritized in accordance with criteria discussed and summarized in Tables 4.2-6 and 4.2-7.

TABLE 4.2-6 PRIORITY OF IDENTIFIED MAJOR ROADS
Province of La Union

Category	Road Class	Type of Improvement	IRR	Priority Group	Road Length	No. of Road Links
1	Primary	A	7.5 ≤ IRR	MA-1	-	-
2	Secondary	A	7.5 ≤ IRR	MA-1	65.4	6
3	Primary	B	15.0 ≤ IRR	MA-2	-	-
4	Secondary	B	15.0 ≤ IRR	MA-2	-	-
5	Primary	A	IRR<7.5	MA-2	-	-
6	Secondary	A	IRR<7.5	MA-2	36.9	3
7	Primary	B	IRR<15.0	MA-3	-	-
8	Secondary	B	IRR<15.0	MA-3	-	-
	Total				102.3	9

Table 4.2-7 PRIORITY OF IDENTIFIED MINOR ROADS
Province of La Union

Category	Road Class	Type of Improvement	MPI	Priority Group	Road Length	No. of Rd.Links
1	Nat'l/Provi/ City	A	7.5 ≤ MPI	MI-1	104.4	16
2	Barangay	A	7.5 ≤ MPI	MI-1	180.3	37
3	Nat'l/Provi/	A	MPI < 7.5	MI-2	49.6	10
4	Barangay	A	MPI < 7.5	MI-2	33.8	11
	Total				368.1	74

4.2.4 Selection of Road Projects For Feasibility Studies

In accordance with selection criteria discussed above, road projects under priority groups MA-1 and MA-2 for major roads and priority groups MI-1 for minor roads were initially selected, and these were plotted on 1:100,000 map to evaluate the following:

- Distribution of initially selected road projects (when these are concentrated in certain area, some minor roads were deleted, and where road projects are scarce, some minor roads were added.)

- Linkage of road projects
  (There is a case that a selected lower class road is connected with a higher class road, however, the latter is not selected due to lower priority. Such a case, a higher class road is also selected to maintain similar condition of road after implementation.)

After adjustment mentioned above, road projects were finally selected and summarized as follows:

Major Road	111.6 kms.	(9 projects)
Minor Road	202.1 kms.	(36 projects)
Total	313.7 kms.	(45 projects)

CHARTER 5
PROJECT EVALUATION

5.1 PRELIMINARY DESIGN AND COST ESTIMATE

5.1.1 Preliminary Design

1) Design Concept
There are two options in design concept for rural road improvement, as follows :

* Designing rural roads with optimum standards aimed at improving all aspects including horizontal and vertical alignments, which sometimes require massive earth works and is costly.

* Designing rural roads by basically concentrating on improving surface conditions, thus improving horizontal and vertical alignments is limited to the required minimum.

Rural roads are extensive in the number of road links as well as in length, and their present conditions are still at a poor level. Thus, requirements for rural road improvement are quite huge, while financial resources are limited. Under these circumstances, the Study Team placed priority on improving surface conditions of more roads. The preliminary design was undertaken in line with the concept of the second option.

2) Preliminary Design
On the basis of the findings of the road inventory survey, the type of improvement was determined for each subsection of road in accordance with the engineering standards and the improvement criteria.

Typical road sections for each type of improvement/rehabilitation are summarized as shown in Table 5.1-1.

Special considerations were given to steep gradient sections and flood section.

"PCC pavement for steep gradient section" was applied to sections with steep gradients where otherwise gravel surfacing might be applied, as a countermeasure against excessive gravel losses during heavy rains and impossibility for vehicles to climb. "Grade raising in flood area", was applied to sections located in flood areas.

Table 5.1-2 shows the proposed improvement for each road project subjected to the feasibility study.

TABLE 5.1-1 EXISTING CONDITION VS PROPOSED IMPROVEMENT/REHABILITATION

Type of Improvement	Road Section Type	Existing Pavement Type	Existing Pavement Condition	Proposed Pavement Type	Pavement Structure (cm) Surface Course	Base	Subbase
Rehabilitation	1 - 1	PCC	Bad/Very Bad	PCC	20 - 23	-	10
	1 - 2	PCC	Bad/Very Bad	AC Overlay	5	-	-
	1 - 3	Bituminous	- do -	AC	5	20	10
	1 - 4	Bituminous	- do -	AC Overlay	5	-	-
	1 - 5	Bituminous	- do -	BMP/DBST	5.5/1.6	15	5
	1 - 6	Gravel	- do -	Gravel	15	-	10
Improvement - 1	2 - 1	Bituminous	Bad/Very Bad	PCC	20 - 23	-	10
	2 - 2	Gravel	- do -	PCC	20 - 23	-	20
	2 - 3	Gravel	- do -	AC	5	20	20
	2 - 4	Gravel	- do -	BMP/DBST	5.5/1.6	15	15
	2 - 5	Earth	Any Condition	PCC	20 - 23	-	20
	2 - 6	Earth	- do -	AC	5	20	20
	2 - 7	Earth	- do -	BMP/DBST	5.5/1.6	15	15
	2 - 8	Earth	- do -	Gravel	15	-	10
Improvement - 2	3 - 1	Bituminous	Good/fair	PCC	20 - 23	-	10
	3 - 2	Gravel	- do -	PCC	20 - 23	-	10
	3 - 3	Gravel	- do -	AC	5	20	10
	3 - 4	Gravel	- do -	BMP/DBST	5.5/1.6	15	5
Widening	4 - 1	PCC	Good/fair	Widening w/PCC	20 - 23	-	20
	4 - 2	Bituminous	- do -	Widening w/AC	5	20	20
	4 - 3	Bituminous	- do -	Widening w/BMP/DBST	5.5/1.6	15	15
	4 - 4	Gravel	- do -	Widening w/Gravel	15	-	10
New Construction	5 - 1	-	-	PCC	20 - 23	-	20
	5 - 2	-	-	AC	5	20	20
	5 - 3	-	-	BMP/DBST	5.5/1.6	15	15
	5 - 4	-	-	Gravel	15	-	10
Special Treatment	6	PCC pavement for steep gradient section					
	7	Grade raising in flood area					

TABLE 5.1 - 2 (2)

Summary of Proposed Improvement LA UNION

Minor(National/Provincial)

Type of Impr't	Road Number	Length (km)	1993 AADT w/o	1993 AADT with	Existing Condition L	Width	Type Condition	Proposed Improvement	Proposed Bridge (Number/Total Length)	Cost (Million Peso) Road	Bridge	Total	IRR (%)
Rehab/ Imp-1	P78	10.0	120	167	.3	3.8	BT Bad	Rehab(6.0-BMP)	2-lane Br (n= 1,L= 13m)	12.39	13.12	25.51	26.2 (D)
					3.1	4.0	GRV Fair	Widen(6.0-GRV)	1-lane Br (n= 1,L=270m)				
					3.3	3.2-4.0	GRV Bad	Rehab(6.0-GRV)					
					3.3	3.2-4.0	EAR Bad/Impas	Imp-1(6.0-GRV)					
	P56	15.1	115	163	8.6	4.5	GRV Bad	Rehab(6.0-GRV)	2-lane Br (n= 1,L= 13m)	10.28	2.50	12.77	15.3 (D)
					1.0		None	New-C(4.0-GRV)	1-lane Sp (n= 2,L= 50m)				
					5.5	3.6	GRV Bad/V.Bad	Rehab(4.0-GRV)	2-cell BC (n= 1,L= 7m)				
	P23	3.9	29	45	1.2	5.0	BT Fair	-	2-cell BC (n= 1,L= 8m)	1.75	.53	2.28	10.6 (D)
					1.5	5.5	GRV Bad	Rehab(4.0-GRV)					
					.8		None	New-C(4.0-GRV)					
					.4	4.0	BT Bad	Rehab(4.0-BMP)					
	P54	9.1	63	107	.3	5.0	PCC Good	-		13.06	.00	13.06	9.7 (D)
					6.1	5.0	BT V.Bad	Rehab(6.0-BMP)					
					2.7	4.7-5.7	GRV Bad/V.Bad	Rehab(6.0-GRV)					
	P11	5.4	39	56	1.4	4.2	GRV Fair	-	2-cell BC (n= 2,L= 12m)	1.95	3.06	5.00	9.6 (D)
					2.8	3.2-3.6	GRV Bad/V.Bad	Rehab(4.0-GRV)	1-lane Br (n= 2,L= 28m)				
					1.2	3.2	EAR V.Bad	Imp-1(4.0-GRV)					
	P73	9.3	0	41	4.1	3.2-4.0	GRV Bad	Rehab(4.0-GRV)	1-lane Br (n= 2,L= 39m)	4.55	2.87	7.43	8.4 (D)
					5.2	3.2-3.6	EAR V.Bad	Imp-1(4.0-GRV)	2-cell BC (n= 1,L= 7m)				
	P79	5.3	89	90	.5	5.0	BT Good	-		1.44	.00	1.44	6.9 (D)
					.4	5.0	PCC Good	-					
					2.6	5.3	GRV Fair	-					
					1.8	5.0	GRV Bad	Rehab(6.0-GRV)					
	P76	6.3	0	137	3.1	4.0	GRV Fair	Widen(6.0-GRV)	2-lane Br (n= 1,L= 12m)	8.39	1.30	9.70	5.4 (D)
					3.2	4.0	GRV Bad	Rehab(6.0-GRV)					
	P6	3.5	51	60	2.7	4.2	BT Bad	Rehab(6.0-BMP)	2-lane Br (n= 1,L= 50m)	7.92	3.43	11.35	2.3 (D)
					.8	5.2	GRV V.Bad	Rehab(6.0-GRV)					
	P43	3.8	39	60	1.6	2.9	GRV Fair	Widen(4.0-GRV)	2-cell BC (n= 1,L= 6m)	6.04	.88	6.91	1.0 (D)
					2.2	2.2-2.8	GRV Bad	Rehab(4.0-GRV)	1-cell BC (n= 1,L= 4m)				
	P39	3.5	3	24	.2	4.1	PCC Good	-	1-lane Sp (n= 1,L= 15m)	4.61	.20	4.81	.7 (D)
					2.3	2.7-3.0	GRV Bad	Rehab(4.0-GRV)					
					1.0		None	New-C(4.0-GRV)					
	N7-2	4.5	124	160	3.2	5.2	BT Fair	Rehab(6.0-BMP)		12.02	.00	12.02	.0 (D)
					1.3	5.2	BT Fair	Widen(6.0-BMP)					
Imp-2/ Widen	P45	5.8	40	54	3.3	3.2-3.6	GRV Fair	Widen(4.0-GRV)	2-cell BC (n= 1,L= 6m)	2.94	1.90	4.84	22.1 (D)
					1.6	3.2-3.6	GRV Bad	Rehab(4.0-GRV)	1-lane Br (n= 1,L= 20m)				
					.9	2.8	EAR V.Bad	Imp-1(4.0-GRV)	1-lane Sp (n= 1,L= 15m)				
	P41	5.2	124	126	2.0	6.0	GRV Fair	-		2.15	.00	2.15	1.8 (D)
					1.2	6.0	GRV Bad	Rehab(6.0-GRV)					
					2.0	4.5	GRV Fair	Widen(6.0-GRV)					
	P16	5.1	111	111	.3	4.0	BT Fair	Widen(6.0-BMP)		3.79	.00	3.79	1.2 (D)
					5.8	5.0	GRV Fair	Widen(6.0-GRV)					

(T):Traffic Project
(D):Development Project

TABLE 5.1 - 2 (3)

Summary of Proposed Improvement LA UNION

Minor(Barangay)

Type of Impr't	Road Number	Length (km)	1993 AADT w/o	1993 AADT with	Existing Condition L	Existing Condition Width	Existing Condition Type Condition	Proposed Improvement	Proposed Bridge (Number/Total Length)	Cost (Million Peso) Road	Cost (Million Peso) Bridge	Cost (Million Peso) Total	IRR (%)
Rehab/ Imp-1	B4-2	7.5	25	42	.3	5.0	PCC Good	-		5.14	.00	5.14	21.1 (D)
					7.2	3.2	EAR Bad/V.Bad	Imp-1(4.0-GRV)					
	B9-4	2.8	13	21	2.8	2.4-3.6	EAR V.Bad	Imp-1(4.0-GRV)		1.54	.00	1.54	19.1 (D)
	B14-3	12.9	27	41	1.8	3.0-3.2	GRV V.Bad	Rehab(4.0-GRV)	1-cell BC (n= 2,L= 8m)	7.85	.65	8.51	13.2 (D)
					11.1	3.2	EAR V.Bad	Imp-1(4.0-GRV)					
	B11-38	4.5	53	69	1.8	2.8	GRV Fair	Widen(4.0-GRV)	1-lane Br (n= 1,L= 13m)	2.17	.96	3.13	11.8 (D)
					1.3	2.6	GRV Bad	Rehab(4.0-GRV)					
					1.4	2.8	EAR V.Bad	Imp-1(4.0-GRV)					
	B2-10	3.4	9	82	3.0	4.0	GRV Bad	Rehab(4.0-GRV)	1-lane Br (n= 1,L= 30m)	6.21	1.78	7.99	10.4 (D)
					.4	4.0	EAR Impas	Imp-1(4.0-GRV)					
	B17-10	5.6	0	33	3.0	2.8-4.0	GRV Bad	Rehab(4.0-GRV)	1-lane Br (n= 2,L= 26m)	2.78	2.41	5.20	10.3 (D)
					1.8	2.4-2.8	EAR Bad	Imp-1(4.0-GRV)	2-cell BC (n= 1,L= 6m)				
					.8		None	New-C(4.0-GRV)					
	B15-13	4.2	15	24	.8	3.2	GRV Bad	Rehab(4.0-GRV)		2.29	.00	2.29	10.2 (D)
					3.4	3.2	EAR V.Bad	Imp-1(4.0-GRV)					
	B10-16	5.3	43	59	1.7	3.2	GRV Fair	Widen(4.0-GRV)	1-lane Br (n= 1,L= 25m)	3.27	1.39	4.66	10.1 (D)
					1.2	2.8-3.2	EAR Bad/V.Bad	Imp-1(4.0-GRV)					
					2.4	3.2	GRV Bad	Rehab(4.0-GRV)					
	D4-10	11.1	22	28	11.1	3.2	EAR Bad	Imp-1(4.0-GRV)	1-lane Sp (n= 1,L=100m)	8.39	1.32	9.71	9.8 (D)
	B7-51	4.2	21	28	1.2	5.0	BT V.Bad	Rehab(6.0-BMP)		3.38	.00	3.38	8.4 (D)
					3.0	3.2	GRV Bad/V.Bad	Rehab(4.0-GRV)					
	B15-1	3.8	19	36	2.4	3.6	GRV Bad	Rehab(4.0-GRV)	1-lane Br (n= 1,L= 24m)	2.88	1.35	4.24	7.9 (D)
					1.2	2.8	EAR V.Bad	Imp-1(4.0-GRV)					
					.2		None	New-C(4.0-GRV)					
	B5-30	4.8	12	26	1.2	3.2	GRV Bad	Rehab(4.0-GRV)	1-lane Sp (n= 1,L= 25m)	3.92	.33	4.25	7.4 (D)
					2.1	2.8	EAR V.Bad	Imp-1(4.0-GRV)					
					1.5		None	New-C(4.0-GRV)					
	B9-2	1.4	22	22	1.4	3.2	GRV Bad	Rehab(4.0-GRV)	1-lane Br (n= 1,L= 46m)	.70	2.35	3.05	6.7 (D)
	B0-11	3.6	8	12	1.1	4.0	GRV Bad	Rehab(4.0-GRV)	1-cell BC (n= 1,L= 4m)	1.86	.33	2.19	6.7 (D)
					2.5	3.6	EAR V.Bad	Imp-1(4.0-GRV)					
	B13-7	2.4	19	26	2.4	3.6	GRV Bad	Rehab(4.0-GRV)		1.13	.00	1.13	6.1 (D)
	B19-1	2.7	9	16	2.7	2.8	EAR Bad/V.Bad	Imp-1(4.0-GRV)	1-lane Br (n= 2,L= 34m)	1.36	2.47	3.84	6.0 (D)
									1-lane Sp (n= 1,L= 20m)				
	B11-23	3.3	8	14	3.3	3.1-3.4	EAR Bad/V.Bad	Imp-1(4.0-GRV)		1.72	.00	1.72	5.3 (D)

(T):Traffic Project
(D):Development Project

TABLE 5.1 - 2 (4)

Summary of Proposed Improvement LA UNION

Minor(Barangay) (Continued)

Type of Impr't	Road Number	Length (km)	1993 AADT w/o	1993 AADT with	Existing Condition L	Existing Condition Width	Existing Condition Type Condition	Proposed Improvement	Proposed Bridge (Number/Total Length)	Cost (Million Peso) Road	Cost (Million Peso) Bridge	Cost (Million Peso) Total	IRR (%)
Rehab/ Imp-1	B15-4	3.1	22	36	3.1	4.0	GRV Bad/V.Bad	Rehab(4.0-GRV)	2-cell BC (n= 1,L= 7m) 1-lane Br (n= 1,L= 19m)	1.43	1.66	3.09	2.9 (D)
	B18-5	7.9	12	23	7.9	3.2-3.6	EAR Bad/V.Bad	Imp-1(4.0-GRV)	1-lane Sp (n= 1,L= 15m)	3.90	.20	4.09	1.0 (D)
	B0-15	4.8	28	41	4.8	2.8-3.4	GRV Bad/Impas	Rehab(4.0-GRV)	2-cell BC (n= 1,L= 7m)	7.25	.49	7.74	.0 (D)
Imp-2/ Widen	B3-28	6.0	2	13	3.5 1.0 1.5	3.2 3.2	GRV Fair EAR Impas None	Widen(4.0-GRV) Imp-1(4.0-GRV) New-C(4.0-GRV)	1-lane Sp (n= 1,L= 15m)	2.93	.20	3.13	2.7 (D)

(T):Traffic Project
(D):Development Project

TABLE 5.1 - 2 (5)
Summary of Proposed Improvement LA UNION

Secondary Major

Type of Impr't	Road Number	Length (km)	1993 AADT w/o	1993 AADT with	Existing Condition L	Width	Type Condition	Proposed Improvement	Proposed Bridge (Number/Total Length)	Cost (Million Peso) Road	Bridge	Total	IRR (%)
Rehab/ Imp-1	P12	8.6	450	581	8.6	6.0	BT Bad/V.Bad	Rehab(6.0-AC)		20.23	.00	20.23	34.2 (T)
	P22-1	5.4	237	423	2.5	4.5	GRV Fair	Imp-2(6.0-AC)	2-lane Br (n= 2,L= 32m)	16.20	2.98	19.18	30.2 (T)
					2.9	4.5	GRV Bad	Imp-1(6.0-AC)					
	P104	7.3	0	109	3.1	3.2	GRV Bad	Rehab(6.0-GRV)	2-lane Br (n= 1,L=100m)	8.29	6.45	14.74	25.9 (T)
					4.2	2.4	EAR V.Bad	Imp-1(6.0-GRV)					
	P14	9.9	319	401	1.0	6.2	PCC Good	-		21.80	.00	21.80	21.0 (T)
					1.0	3.3	PCC Fair	Widen(6.0-PCC)					
					1.2	3.3	PCC Fair	Widen(5.4-PCC)					
					1.4	4.8	BT Bad	Rehab(6.0-AC)					
					2.0	6.0	GRV Fair	Imp-2(6.0-AC)					
					3.3	4.0-4.5	GRV Bad	Imp-1(6.0-AC)					
	P22-2	15.4	0	9	5.5	3.6-4.5	GRV Bad	Rehab(6.0-GRV)	2-lane Br (n= 2,L=201m)	18.76	15.34	34.10	19.7 (T)
					7.8	2.8-3.6	EAR Bad/Impas	Imp-1(6.0-GRV)	2-cell BC (n= 3,L= 20m)				
					1.4		None	New-C(6.0-GRV)	1-cell BC (n= 1,L= 4m)				
					.7	4.5	GRV Fair	Widen(6.0-GRV)					
	P36	14.6	397	375	.6	6.7	PCC Good	-	2-lane Br (n= 6,L=146m)	11.31	11.94	23.26	18.9 (T)
					8.4	6.0-6.5	BT Fair	-					
					3.1	4.5	BT V.Bad	Rehab(6.0-BMP)					
					1.3	4.5	GRV Fair	Imp-2(6.0-BMP)					
					1.2	4.5	BT Fair	Widen(6.0-BMP)					
	N6	21.5	0	12	3.6	6.1	BT Fair	-		11.71	.00	11.71	9.5 (T)
					1.8	6.0	GRV Fair	Rehab(6.0-GRV)					
					14.4	3.2-4.0	GRV V.Bad/Impa	Rehab(4.0-GRV)					
					1.7	3.2	EAR Impas	Imp-1(4.0-GRV)					
Imp-2/ Widen	N11	8.2	867	947	.5	4.3	BT Fair	Widen(6.0-AC)		15.81	.00	15.81	45.6 (T)
					.6	6.7	PCC Good	-					
					6.3	5.9	GRV Fair	Imp-2(6.0-AC)					
					.8	6.1	BT Fair	-					
	N7-1	20.7	418	702	2.2	6.1	BT Good	-		23.31	.00	23.31	40.7 (T)
					3.0	4.5	BT Fair/V.Bad	Rehab(6.0-AC)					
					7.0	6.0	GRV Fair	Imp-2(6.0-AC)					
					8.5	6.1-6.8	PCC Good	-					

(T):Traffic Project
(D):Development Project

5.1.2 Cost Estimate

1) Unit Cost

Unit prices for construction equipment, materials and labor were obtained from Associated Construction Equipment Lessors, Inc. (ACEL), the Price Monitoring Section of DPWH, market price survey by the Study Team and relevant studies. Based on the data collected, unit prices at April 1990 prices were developed. Exchange rates used were : P22.50 = US$1.00 = Y155.

Unit costs for major construction items are presented in Table 5.1-3.

2) Construction Cost Estimate

Based on the results of the road inventory survey and proposed type of improvement, the quantity of each construction item was computed for each road project. Then the constuction cost was estimated.
Table 5.1-4 presents estimated quantities and construction cost of each road project.

TABLE 5.1-3 UNIT COST OF MAJOR CONSTRUCTION ITEMS

Unit: Pesos at April 1990 Prices

Item No.	Description	Unit	Unit Price
100	Clearing nad Grubbing	sq.m.	2.10
102	Stripping	cu.m.	52.00
106	Roadway and Drainage Excavation	cu.m.	58.00
107	Borrow	cu.m.	110.00
108	Aggregate Subbase	cu.m.	225.00
118-1	Preparation Of Previously Constructed Road (Gravel)	sq.m.	7.00
118-2	Preparation Of Previously Constructed Road (Asphalt)	sq.m.	8.00
118-3	Preparation of Existing Pavement Surface (PCC)	sq.m.	22.50
118-4	Preparation of Existing Pavement Surface (AC)	sq.m.	17.00
200	Crushed Aggregate Base Course	cu.m.	305.00
300	Crushed Aggregate Surface Course	cu.m.	305.00
302	Bituminous Prime Coat	MT	11,100.00
303	Bituminous Tact Coat	MT	11,500.00
306	Bituminous Macadam Pavement	sq.m.	95.00
310	Bituminous Concrete Surface Course	MT	1,350.00
314	Double Bituminous Surface Treatment	sq.m.	45.00
316-1	PCC Pavement (t = 23cm)	sq.m.	320.00
316-2	PCC Pavement (t = 20cm)	sq.m.	280.00
316-3	PCC Pavement (t = 18cm)	sq.m.	250.00
413-1	RCPC (Ø 910mm)	sq.m.	1,550.00
413-2	Headwal T for RCPC (Ø 910mm)	set	2,900.00
500	Grouted Riprap	sq.m.	625.00
517	Side Ditch (Grouted Riprap)	m	360.00
Bridge Cost			
	2-lane Superstructure	m	43,500.00
	Abutment for 2-lane bridge	each	330,000.00
	Pier for 2-lane bridge	each	285,000.00
	1-lane Superstructure	m	32,000.00
	Abutment for 1-lane bridge	each	230,000.00
	Pier for 1-lane bridge	each	200,000.00
Reinforced Concrete Box Culvert			
	1-Cell RCBC	m	20,600.00
	2-Cell RCBC	m	36,000.00
	Wing wall and Apron for 1-Cell RCBC	set	132,000.00
	Wing wall and Apron for 2-Cell RCBC	set	155,000.00
Spillway			
	2-lane Spillway	m	16,500.00
	1-lane Spillway	m	12,000.00
Slope Protection Cost			
	Cut Slope Protection	m	23,000.00
	Embankment Slope Protection	m	25,000.00

TABLE 5.1 - 4 (1)
Quantity and Construction Cost. LA UNION

		Unit	P12	P22-1	P104	P14	P22-2	P36	N6	N11	N7-1	P78	P56
Total Road Length		km	8.6	5.4	7.3	9.9	15.4	14.6	21.5	8.2	20.7	10.0	15.1
Improvement Length		km	8.6	5.4	7.3	8.9	15.4	5.6	17.9	6.8	10.0	10.0	15.1
Proposed Pavement Type			6.0-AC	6.0-AC	6.0-GRV	6.0-PCC 5.4-PCC 6.0-AC	6.0-GRV	6.0-BMP	6.0-GRV 4.0-GRV	6.0-AC	6.0-AC	6.0-BMP 6.0-GRV	6.0-GRV 4.0-GRV
Quantity													
100	Clearing & Grubbing	m2	-	-	-	-	35000	-	-	-	-	-	15000
	Stripping	m3	-	-	-	-	3780	-	-	-	-	-	1500
102	Roadway & Drainage Excavation	m3	8186	33042	22102	31823	55979	40234	49864	11376	12624	29058	20943
104	Borrow	m3	3344	-	9880	5139	8780	392	4065	4932	1242	23560	3803
200	Aggregate Subbase	m3	21348	12929	4818	21379	9849	6104	7406	14638	24750	5676	8666
	Preparation of Prev.Road(Grvl)	m2	-	28650	25000	29300	64500	5850	78780	37170	42000	42690	70300
	Preparation of Prev.Road(Asph)	m2	51600	-	-	6720	-	13950	-	-	13500	1140	-
	Preparation of Pave.Surf.(PCC)	m2	-	-	-	-	-	-	-	-	-	-	-
	Preparation of Pave.Surf.(AC)	m2	-	-	-	-	-	-	-	-	-	-	-
202	Crushed Aggregate Base Course	m3	11610	7290	-	9045	-	4845	-	8713	13500	307	-
300	Crushed Aggr. Surface Course	m3	-	-	6570	-	13590	-	10980	-	-	8730	11640
301	Bituminous Prime Coat	M.T.	62	39	-	48	-	34	-	46	72	2	-
302	Bituminous Tack Coat	M.T.	-	-	-	-	-	-	-	-	-	-	-
305	Bituminous Macadam Pavement	m2	-	-	-	-	-	28200	-	-	-	1800	-
310	Bitum.Concrete Surface Course	M.T.	5676	3564	-	4422	-	-	-	4252	6600	-	-
304	Double Bitum.Surface Treatment	m2	-	-	-	-	-	-	-	-	-	-	-
311-1	PCC Pavement (t=23 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-2	PCC Pavement (t=20 cm)	m2	-	-	-	5220	-	-	-	-	-	-	-
311-3	PCC Pavement (t=18 cm)	m2	-	-	-	-	1800	-	2000	-	-	-	-
500	RCPC (dia.910mm)	m	255	165	225	242	570	151	346	218	300	345	375
	Headwall for RCPC (dia.910mm)	Set	17	11	15	18	38	11	38	15	20	23	32
504	Grouted Riprap	m3	-	-	-	-	1116	-	431	512	-	1672	-
	Side Ditch (Grouted Riprap)	m	-	5400	4200	3300	10060	4400	900	-	-	2200	2600
	Slope Protection (Cut Slope)	m	-	-	-	-	-	-	-	-	-	-	-
	Slope Protection (Embank't Sl)	m	-	-	-	-	-	-	-	-	-	-	-
	2-lane Bridge,Superstructure	m	-	32	100	-	201	146	-	-	-	13	13
	1-lane Bridge,Superstructure	m	-	-	-	-	-	-	-	-	-	270	-
	2-lane Bridge,Abutment	Each	-	4	2	-	4	12	-	-	-	2	2
	1-lane Bridge,Abutment	Each	-	-	-	-	-	-	-	-	-	2	-
	2-lane Bridge,Pier	Each	-	-	3	-	7	2	-	-	-	-	-
	1-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-	8	-
	2-lane Spillway	m	-	-	-	-	-	-	-	-	-	-	-
	1-lane Spillway	m	-	-	-	-	-	-	-	-	-	-	50
	1-cell RCBC	m	-	-	-	-	10	-	-	-	-	-	-
	2-cell RCBC	m	-	-	-	-	30	-	-	-	-	-	8
	Wingwall for 1-cell RCBC	Set	-	-	-	-	1	-	-	-	-	-	-
	Wingwall for 2-cell RCBC	Set	-	-	-	-	3	-	-	-	-	-	1
	Miscellaneous	l.s.	1	1	1	1	1	1	1	1	1	1	1
Road Construction Cost		M.p.	20.23	16.20	8.29	21.80	18.76	11.31	11.71	15.81	23.31	12.39	10.28
Bridge Construction Cost		M.p.	.00	2.98	6.45	.00	15.34	11.94	.00	.00	.00	13.12	2.50
Total Construction Cost		M.p.	20.23	19.18	14.74	21.80	34.10	23.26	11.71	15.81	23.31	25.51	12.77
Road Construction Cost/Impr't km		M.p.	2.35	3.00	1.14	2.45	1.22	2.02	.65	2.32	2.33	1.24	.68
Total Construction Cost/Total km		M.p.	2.35	3.55	2.02	2.20	2.21	1.59	.54	1.93	1.13	2.55	.85

TABLE 5.1 - 4 (2)
Quantity and Construction Cost LA UNION

	Unit	P23	P64	P11	P73	P79	P76	P6	P43	P39	N7-2	P45
Total Road Length	km	3.9	9.1	5.4	9.3	5.3	6.3	3.5	3.8	3.5	4.5	5.8
Improvement Length	km	2.7	8.8	4.0	9.3	1.8	6.3	3.5	3.8	3.3	4.5	5.8
Proposed Pavement Type		4.0-GRV 4.0-BMP	6.0-BMP 6.0-GRV	4.0-GRV	4.0-GRV	6.0-GRV	6.0-GRV	6.0-BMP 6.0-GRV	4.0-GRV	4.0-GRV	6.0-BMP	4.0-GRV
Quantity												
100 Clearing & Grubbing	m2	8000	-	-	-	-	-	-	-	12000	-	-
Stripping	m3	800	-	-	-	-	-	-	-	1200	-	-
102 Roadway & Drainage Excavation	m3	1966	9482	5464	12475	-	4154	5141	2835	3438	1219	8047
104 Borrow	m3	2020	9379	694	1936	3267	25993	10654	22220	13481	28531	1799
200 Aggregate Subbase	m3	1616	11506	1840	4278	1188	2918	5048	1287	1518	5969	1538
Preparation of Prev.Road(Grvl)	m2	6900	16170	15270	35530	11700	28720	5280	11958	7210	-	21584
Preparation of Prev.Road(Asph)	m2	1600	30500	-	-	-	-	11340	-	-	16640	-
Preparation of Pave.Surf.(PCC)	m2	-	-	-	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(AC)	m2	-	-	-	-	-	-	-	-	-	-	-
202 Crushed Aggregate Base Course	m3	289	6240	-	-	-	-	2762	-	-	3510	-
300 Crushed Aggr. Surface Course	m3	1380	2430	2400	5580	1620	5670	720	2280	1980	-	3480
301 Bituminous Prime Coat	M.T.	2	44	-	-	-	-	19	-	-	24	-
302 Bituminous Tack Coat	M.T.	-	-	-	-	-	-	-	-	-	-	-
305 Bituminous Macadam Pavement	m2	1600	36600	-	-	-	-	16200	-	-	20240	-
310 Bitum.Concrete Surface Course	M.T.	-	-	-	-	-	-	-	-	-	-	-
304 Double Bitum.Surface Treatment	m2	-	-	-	-	-	-	-	-	-	-	-
311-1 PCC Pavement (t=23 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-2 PCC Pavement (t=20 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-3 PCC Pavement (t=18 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
500 RCPC (dia.910mm)	m	48	270	64	152	60	315	210	96	104	234	112
Headwall for RCPC (dia.910mm)	Set	6	18	8	19	4	21	14	12	13	17	14
504 Grouted Riprap	m3	-	-	-	-	-	2233	2049	2601	1965	4108	379
Side Ditch (Grouted Riprap)	m	-	750	-	-	-	-	-	-	-	-	-
Slope Protection (Cut Slope)	m	-	-	-	-	-	-	-	-	-	-	-
Slope Protection (Embank't Sl)	m	-	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Superstructure	m	-	-	-	-	-	12	50	-	-	-	-
1-lane Bridge,Superstructure	m	-	-	28	39	-	-	-	-	-	-	20
2-lane Bridge,Abutment	Each	-	-	-	-	-	2	2	-	-	-	-
1-lane Bridge,Abutment	Each	-	-	4	4	-	-	-	-	-	-	2
2-lane Bridge,Pier	Each	-	-	-	-	-	-	1	-	-	-	-
1-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-	-	-
2-lane Spillway	m	-	-	-	-	-	-	-	-	-	-	-
1-lane Spillway	m	-	-	-	-	-	-	-	-	15	-	15
1-cell RCBC	m	-	-	-	-	-	-	-	9	-	-	-
2-cell RCBC	m	9	-	18	8	-	-	-	9	-	-	8
Wingwall for 1-cell RCBC	Set	-	-	-	-	-	-	-	1	-	-	-
Wingwall for 2-cell RCBC	Set	1	-	2	1	-	-	-	1	-	-	1
Miscellaneous	l.s.	1	1	1	1	1	1	1	1	1	1	1
Road Construction Cost	M.p.	1.75	13.06	1.95	4.55	1.44	8.39	7.92	6.04	4.61	12.02	2.94
Bridge Construction Cost	M.p.	.53	.00	3.06	2.87	.00	1.30	3.43	.88	.20	.00	1.90
Total Construction Cost	M.p.	2.28	13.06	5.00	7.43	1.44	9.70	11.35	6.91	4.81	12.02	4.84
Road Construction Cost/Impr't km	M.p.	.65	1.48	.49	.49	.80	1.33	2.26	1.59	1.40	2.67	.51
Total Construction Cost/Total km	M.p.	.58	1.44	.93	.80	.27	1.54	3.24	1.82	1.37	2.67	.83

TABLE 5.1 - 4 (3)

Quantity and Construction Cost LA UNION

	Unit	P41	P16	B4-2	B9-4	B14-3	B11-38	B2-10	B17-10	B15-13	B10-16	B4-10
Total Road Length	km	5.2	6.1	7.5	2.8	12.9	4.5	3.4	5.6	4.2	5.3	11.1
Improvement Length	km	3.2	6.1	7.2	2.8	12.9	4.5	3.4	5.6	4.2	5.3	11.1
Proposed Pavement Type		6.0-GRV	6.0-BMP 6.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV
Quantity												
100 Clearing & Grubbing	m2	-	-	-	-	-	-	-	9600	-	-	-
Stripping	m3	-	-	-	-	-	-	-	960	-	-	-
102 Roadway & Drainage Excavation	m3	420	1491	12650	5250	21966	8438	2550	6954	4725	4275	19269
104 Borrow	m3	4568	8091	1368	567	2421	722	15113	1303	3375	9386	2248
200 Aggregate Subbase	m3	1212	1197	3312	1288	5934	1566	1564	2576	1932	1894	5106
Preparation of Prev.Road(Grvl)	m2	16920	29000	24320	7790	43540	12340	15640	15940	15740	18750	30630
Preparation of Prev.Road(Asph)	m2	-	-	-	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(PCC)	m2	-	-	-	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(AC)	m2	-	-	-	-	-	-	-	-	-	-	-
202 Crushed Aggregate Base Course	m3	-	108	-	-	-	-	-	-	-	-	-
300 Crushed Aggr. Surface Course	m3	2880	5220	3336	1620	6858	2700	2040	3360	2520	3180	4830
301 Bituminous Prime Coat	M.T.	-	1	-	-	-	-	-	-	-	-	-
302 Bituminous Tack Coat	M.T.	-	-	-	-	-	-	-	-	-	-	-
305 Bituminous Macadam Pavement	m2	-	600	-	-	-	-	-	-	-	-	-
310 Bitum.Concrete Surface Course	M.T.	-	-	-	-	-	-	-	-	-	-	-
304 Double Bitum.Surface Treatment	m2	-	-	-	-	-	-	-	-	-	-	-
311-1 PCC Pavement (t=23 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-2 PCC Pavement (t=20 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-3 PCC Pavement (t=18 cm)	m2	-	-	6560	400	5880	-	-	-	-	-	12200
500 RCPC (dia.910mm)	m	90	173	112	48	208	72	168	104	64	88	176
Headwall for RCPC (dia.910mm)	Set	6	12	14	6	26	9	21	13	8	11	22
504 Grouted Riprap	m3	-	-	-	-	-	-	3888	-	-	-	-
Side Ditch (Grouted Riprap)	m	-	-	-	-	-	-	-	-	-	-	-
Slope Protection (Cut Slope)	m	-	-	-	-	-	-	-	-	-	-	-
Slope Protection (Embank't Sl)	m	-	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Superstructure	m	-	-	-	-	-	-	-	-	-	-	-
1-lane Bridge,Superstructure	m	-	-	-	-	-	13	30	26	-	25	-
2-lane Bridge,Abutment	Each	-	-	-	-	-	-	-	-	-	-	-
1-lane Bridge,Abutment	Each	-	-	-	-	-	2	2	4	-	2	-
2-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-	-	-
1-lane Bridge,Pier	Each	-	-	-	-	-	-	1	-	-	-	-
2-lane Spillway	m	-	-	-	-	-	-	-	-	-	-	-
1-lane Spillway	m	-	-	-	-	-	-	-	-	-	-	100
1-cell RCBC	m	-	-	-	-	16	-	-	-	-	-	-
2-cell RCBC	m	-	-	-	-	-	-	-	8	-	-	-
Wingwall for 1-cell RCBC	Set	-	-	-	-	2	-	-	-	-	-	-
Wingwall for 2-cell RCBC	Set	-	-	-	-	-	-	-	1	-	-	-
Miscellaneous	l.s.	1	1	1	1	1	1	1	1	1	1	1
Road Construction Cost	M.p.	2.15	3.79	5.14	1.54	7.85	2.17	6.21	2.78	2.29	3.27	8.39
Bridge Construction Cost	M.p.	.00	.00	.00	.00	.65	.96	1.78	2.41	.00	1.39	1.32
Total Construction Cost	M.p.	2.15	3.79	5.14	1.54	8.51	3.13	7.99	5.20	2.29	4.66	9.71
Road Construction Cost/Impr't km	M.p.	.67	.62	.71	.55	.61	.48	1.83	.50	.55	.62	.76
Total Construction Cost/Total km	M.p.	.41	.62	.69	.55	.66	.70	2.35	.93	.55	.88	.88

TABLE 5.1 - 4 (4)
Quantity and Construction Cost LA UNION

	Unit	B7-51	B15-1	B5-30	B9-2	B0-11	B13-7	B19-1	B11-23	B15-4	B18-5	B0-15
Total Road Length	km	4.2	3.8	4.8	1.4	3.6	2.4	2.7	3.3	3.1	7.9	4.8
Improvement Length	km	4.2	3.8	4.8	1.4	3.6	2.4	2.7	3.3	3.1	7.9	4.8
Proposed Pavement Type		6.0-BMP 4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV
Quantity												
100 Clearing & Grubbing	m2	-	2400	22500	-	-	-	-	-	-	-	-
Stripping	m3	-	240	2250	-	-	-	-	-	-	-	-
102 Roadway & Drainage Excavation	m3	6893	2900	8138	1050	6569	1800	4927	5188	2158	12161	6705
104 Borrow	m3	608	4597	4407	791	548	756	401	668	898	1048	13985
200 Aggregate Subbase	m3	2867	1748	2208	644	1656	1104	1242	1518	1426	3634	2208
Preparation of Prev.Road(Grvl)	m2	9900	16560	11040	6440	15980	11040	8470	11340	14050	30550	14550
Preparation of Prev.Road(Asph)	m2	6000	-	-	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(PCC)	m2	-	-	-	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(AC)	m2	-	-	-	-	-	-	-	-	-	-	-
202 Crushed Aggregate Base Course	m3	1228	-	-	-	-	-	-	-	-	-	-
300 Crushed Aggr. Surface Course	m3	1800	2280	2520	840	2160	1440	1620	1980	1860	4740	2880
301 Bituminous Prime Coat	M.T.	9	-	-	-	-	-	-	-	-	-	-
302 Bituminous Tack Coat	M.T.	-	-	-	-	-	-	-	-	-	-	-
305 Bituminous Macadam Pavement	m2	7200	-	-	-	-	-	-	-	-	-	-
310 Bitum.Concrete Surface Course	M.T.	-	-	-	-	-	-	-	-	-	-	-
304 Double Bitum.Surface Treatment	m2	-	-	-	-	-	-	-	-	-	-	-
311-1 PCC Pavement (t=23 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-2 PCC Pavement (t=20 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-3 PCC Pavement (t=18 cm)	m2	-	-	2400	-	-	-	-	-	-	-	-
500 RCPC (dia.910mm)	m	78	88	112	24	56	40	40	56	48	128	208
Headwall for RCPC (dia.910mm)	Set	8	11	14	3	7	5	5	7	6	16	26
504 Grouted Riprap	m3	-	893	462	-	-	-	-	-	-	-	4466
Side Ditch (Grouted Riprap)	m	-	-	-	-	-	-	-	-	-	-	-
Slope Protection (Cut Slope)	m	-	-	-	-	-	-	-	-	-	-	-
Slope Protection (Embank't Sl)	m	-	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Superstructure	m	-	-	-	-	-	-	-	-	-	-	-
1-lane Bridge,Superstructure	m	-	24	-	46	-	-	34	-	19	-	-
2-lane Bridge,Abutment	Each	-	-	-	-	-	-	-	-	-	-	-
1-lane Bridge,Abutment	Each	-	2	-	2	-	-	4	-	2	-	-
2-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-	-	-
1-lane Bridge,Pier	Each	-	-	-	1	-	-	-	-	-	-	-
2-lane Spillway	m	-	-	-	-	-	-	-	-	-	-	-
1-lane Spillway	m	-	-	25	-	-	-	20	-	-	15	-
1-cell RCBC	m	-	-	-	-	8	-	-	-	-	-	-
2-cell RCBC	m	-	-	-	-	-	-	-	-	8	-	8
Wingwall for 1-cell RCBC	Set	-	-	-	-	1	-	-	-	-	-	-
Wingwall for 2-cell RCBC	Set	-	-	-	-	-	-	-	-	1	-	1
Miscellaneous	l.s.	1	1	1	1	1	1	1	1	1	1	1
Road Construction Cost	M.p.	3.38	2.88	3.92	.70	1.86	1.18	1.36	1.72	1.43	3.90	7.25
Bridge Construction Cost	M.p.	.00	1.35	.33	2.35	.33	.00	2.47	.00	1.66	.20	.49
Total Construction Cost	M.p.	3.38	4.24	4.25	3.05	2.19	1.13	3.84	1.72	3.09	4.09	7.74
Road Construction Cost/Impr't km	M.p.	.81	.76	.82	.50	.52	.47	.50	.52	.46	.49	1.51
Total Construction Cost/Total km	M.p.	.81	1.11	.89	2.18	.61	.47	1.42	.52	1.00	.52	1.61

TABLE 5.1 - 4 (5)

Quantity and Construction Cost — LA UNION

	Unit	B3-28
Total Road Length	km	6.0
Improvement Length	km	6.0
Proposed Pavement Type		4.0-GRV
Quantity		
100 Clearing & Grubbing	m2	22500
Stripping	m3	2250
102 Roadway & Drainage Excavation	m3	9979
104 Borrow	m3	1054
200 Aggregate Subbase	m3	1640
Preparation of Prev.Road(Grvl)	m2	15200
Preparation of Prev.Road(Asph)	m2	-
Preparation of Pave.Surf.(PCC)	m2	-
Preparation of Pave.Surf.(AC)	m2	-
202 Crushed Aggregate Base Course	m3	-
300 Crushed Aggr. Surface Course	m3	3600
301 Bituminous Prime Coat	M.T.	-
302 Bituminous Tack Coat	M.T.	-
305 Bituminous Macadam Pavement	m2	-
310 Bitum.Concrete Surface Course	M.T.	-
304 Double Bitum.Surface Treatment	m2	-
311-1 PCC Pavement (t=23 cm)	m2	-
311-2 PCC Pavement (t=20 cm)	m2	-
311-3 PCC Pavement (t=18 cm)	m2	-
500 RCPC (dia.910mm)	m	120
Headwall for RCPC (dia.910mm)	Set	15
504 Grouted Riprap	m3	-
Side Ditch (Grouted Riprap)	m	-
Slope Protection (Cut Slope)	m	-
Slope Protection (Embank't Sl)	m	-
2-lane Bridge,Superstructure	m	-
1-lane Bridge,Superstructure	m	-
2-lane Bridge,Abutment	Each	-
1-lane Bridge,Abutment	Each	-
2-lane Bridge,Pier	Each	-
1-lane Bridge,Pier	Each	-
2-lane Spillway	m	-
1-lane Spillway	m	15
1-cell RCBC	m	-
2-cell RCBC	m	-
Wingwall for 1-cell RCBC	Set	-
Wingwall for 2-cell RCBC	Set	-
Miscellaneous	l.s.	1
Road Construction Cost	M.p.	2.93
Bridge Construction Cost	M.p.	.20
Total Construction Cost	M.p.	3.13
Road Construction Cost/Impr't km	M.p.	.49
Total Construction Cost/Total km	M.p.	.52

5.1.3 Summary of Preliminary Design

Results of preliminary design were summarized in Tables 5.1-5 and 5.1-6 for major and minor roads, respectively.

TABLE 5.1-5 SUMMARY OF PRELIMINARY DESIGN :
Province of La Union
- Major Roads -

	Type of Improvement			
	Rehabilitation/ Improvement - 1	Improvement-2/ Widening	New Construction	Total
Primary Major Roads				
1. No. of Links	-	-	-	-
2. Total Length (km)	-	-	-	-
3. Improvement Length (km)	-	-	-	-
4. Construction Cost (million P)	-	-	-	-
5. Const. Cost/Imp. Length (MP/km)	-	-	-	-
Secondary Major Roads				
1. No. of Links	7	2	-	9
2. Total Length (km)	82.7	28.9	-	111.6
3. Improvement Length (km)	69.1	16.8	-	85.9
4. Construction Cost (million P)	145.0	39.1	-	184.1
5. Const. Cost/Imp. Length (MP/km)	2.10	2.33	-	2.14
Major Roads Total				
1. No. of Links	7	2	-	9
2. Total Length (km)	82.7	28.9	-	111.6
3. Improvement Length (km)	69.1	16.8	-	85.9
4. Construction Cost (million P)	145.0	39.1	-	184.1
5. Const. Cost/Imp. Length (MP/km)	2.10	2.33	-	2.14

TABLE 5.1-6 SUMMARY OF PRELIMINARY DESIGN
Province of La Union
- Minor Roads -

	Type of Improvement		
	Rehabilitation/ Improvement-1&2/ Widening	New Construction	Total
Minor Roads (National/ Provincial/City)			
1. No. of Links	15	-	15
2. Total Length (km)	96.8	-	96.8
3. Improvement Length (km)	88.2	-	88.2
4. Construction Cost (million P)	123.1	-	123.1
5. Const. Cost/Imp. Length (MP/km)	1.4	-	1.4
Minor Roads (Barangay)			
1. No. of Links	21	-	21
2. Total Length (km)	105.3	-	105.3
3. Improvement Length (km)	105.0	-	105.0
4. Construction Cost (million P)	90.0	-	90.0
5. Const. Cost/Imp. Length (MP/km)	0.86	-	0.86
Minor Roads Total			
1. No. of Links	36	-	36
2. Total Length (km)	202.1	-	202.1
3. Improvement Length (km)	193.2	-	193.2
4. Construction Cost (million P)	213.1	-	213.1
5. Const. Cost/Imp. Length (MP/km)	1.10	-	1.10

5.2 ECONOMIC EVALUATION

5.2.1 Basic Assumptions

The commonly used cost-benefit analysis was applied under the following basic assumptions:

i) Analysis Period

1991 - Detailed design
1992 - Construction
1993 ┐
     │
     │ -Project life (25 years)
     │
2017 ┘

ii) Discount Rate: 15% pa

iii) Quantified Cost

Initial construction/improvement costs
Periodic maintenance costs

iv) Quantified Benefit

Traffic benefit
Development benefit (only for development projects)
Maintenance cost savings

The periodic maintenance costs, or rehabilitation costs, such as overlay, reconstruction and regravelling which will be needed after completion of the project to prolong the pavement life, were treated as project costs in this study, while the difference between routine maintenance costs and total maintenance costs in the "w/o" case was taken into account as a project benefit. In the case where the routine maintenance costs are higher than the "w/o" maintenance costs, the difference is considered as a negative benefit.

5.2.2 Economic Costs

1) Initial Construction/Improvement Costs

The construction costs discussed in Section 5.2.1 are the financial costs and do not include the costs for detailed design and construction supervision. In the cost-benefit analysis, the following economic cost was used:

Construction Cost	100%
-Tax	-15%
+Detailed Design Cost	4%
+Construction Supervision Cost	6%
Total Economic Cost	95%

In the cost-benefit stream, 4% for detailed design cost was assumed to be spent in 1991 and the remaining 91% in 1992.

2) Periodic Maintenance Costs

Periodic maintenance, or rehabilitation, will be necessary when the riding quality of a pavement decreases to a certain minimum level of acceptability. Table 5.2-1 shows the periodic maintenance assumed in this Study.

TABLE 5.2-1 PERIODIC MAINTENANCE COST ASSUMED IN THE ANALYSIS

Surface Type	Periodic Maintenance Work	Timing	Financial Cost 1) (million₱/Km)	Economic Cost
Gravel	10cm Regravelling	When thickness of gravel is reduced by 10cm, assuming 1.5cm loss annually from rainfall and 1.5cm loss every 100,000 vehicles (2-6 years)	4.0 m Gravel: ₱ 0.210 M 6.0 m Gravel: ₱ 0.320 M	85% of Cost
BMP	5.5cm BMP Overlay	When pavement serviceability decreases to 2.0, assuming 85,000 ESAL or 350,000 vehicle repetitions (4-10 years)	₱ 0.830 M	85% of Cost
AC	5 cm AC Overlay	When pavement serviceability decreases to 2.0, assuming 800,000 ESAL or 2,300,000 vehicle repetitions (8-20 years)	₱ 1.170 M	85% of Cost
PCC	5 cm AC Overlay	When pavement serviceability decreases to 2.0, assuming 2,000,000 ESAL or 5,700,000 vehicle repetitions (10-25 years)	₱ 1.200 M	85% of Cost

Note: 1) As of April 1990

5.2.3 Benefits

1) Traffic Benefits

a) Traffic Cost

Basic Traffic Costs

The basic traffic costs were provided by PMO-FS, as shown in Table 5.2-2.

TABLE 5.2-2 BASIC TRAFFIC COSTS EXCLUDING TAX (AS OF DECEMBER 1989)

	Running Cost (₱/km)	Fixed Cost (₱/hour)	Time Cost (₱/hour)
Car/Van	1.75	6.30	17.70
Jeepney	1.12	23.76	26.40
Bus	2.81	35.64	95.04
Truck	3.48	38.88	0
Motor-tricycle	0.36	8.76	4.98
Motorcycle	0.31	0.72	8.34

Actual Traffic Costs

The actual traffic costs were estimated according to the dl-system concerning running costs and the dt-system with regard to fixed and time costs. The dl-values and operating speed for different surface conditions are shown in Tables 5.2-3 and 5.2-4, respectively.

TABLE 5.2-3 DL-VALUES IN KM PER ACTUAL KM

Surface Type / Surface Condition	PCC/AC	BMP/DBST	Gravel	Earth
Good	0	0.14	0.29	-
Fair	0.17	0.38	0.60	-
Bad	0.43	0.65	0.87	1.20
Very Bad	0.89	1.04	1.20	1.56
Impassable	1.73	1.73	1.73	1.73

TABLE 5.2-4 OPERATING SPEED IN KM/HOUR

Surface Condition	Surface Type: PCC/AC OV	PCC/AC TR	PCC/AC MC	BMP/DBST OV	BMP/DBST TR	BMP/DBST MC	Gravel OV	Gravel TR	Gravel MC	Earth OV	Earth TR	Earth MC
Good	65	40	60	63	38	55	60	35	50	-	-	-
Fair	55	35	50	53	33	45	50	30	40	-	-	-
Bad	30	20	20	30	20	20	30	20	20	20	10	10
Very Bad	20	10	10	20	10	10	20	10	10	10	5	5
Impassable	10	5	5	10	5	5	10	5	5	10	5	5

Note: OV = Car/Jeepney/Bus/Truck
TR = Motor-tricycle
MC = Motorcycle

Traffic Costs of Other Transport Modes

In addition to the land-based motorized vehicles, the traffic costs of other modes were estimated as shown in Table 5.2-5.

TABLE 5.2-5 TRAFFIC COST OF OTHER MODES (COMMON TO ALL SURFACE TYPES AND CONDITIONS)

Mode	Traffic Cost in ₱/Km
Animal Drawn	4.0
Walking (head loading)	1.2
Banca Boat	2.25

b) Traffic Benefits in Traffic Projects

Traffic on the project roads wwas broken down into four categories: normal traffic, diverted traffic-1, diverted traffic-2 and generated traffic.

The traffic benefits were estimated as follows:

i) Normal Traffic : Difference in traffic costs between "w/o" and "with" cases. The change in traffic costs results not only from the improvement of surface type and condition but also from consequent change in modal distribution.

ii) Diverted Traffic-1 : Difference between traffic costs along the "w/o" route and those along the "with" route. Where diverted traffic passes through two or more project roads, the benefits were allocated to each road in proportion to length.

iii) Diverted Traffic-2 and Generated Traffic: Half of the difference in traffic costs between "w/o" and "with" cases. This is the commonly used approximation.

Traffic costs were calculated assuming the following surface conditions:

"W/O" Case : Present surface condition is maintained.
"With" Case: Gravel/BMP are maintained in a fair condition.
AC/PCC are maintained in a good condition

c) Traffic Benefits in Development Projects

No diverted traffic is expected in most development projects. The benefits from normal traffic generated traffic were estimated in the same way as used for the traffic projects paying attention to the following:

i) The travel distance considered in the benefit calculation is the distrance from the average gravity point of transport (gravity of population for passenger traffic and non-agricultural traffic and gravity of agricultural production for agricultural traffic) to the connecting point with a higher road.

ii) The benefit from generated agricultural traffic is not considered as a traffic benefit because it is included in the development benefit. Therefore, the generated traffic benefits are only from passenger traffic and non-agricultural traffic.

2) Development Benefits

Development benefits were assessed using the producer surplus approach, under the hypothesis that substantial road improvement which removes constraints on development will permit and encourage farmers to adopt modern agricultural techniques and inputs. The development benefit consists of the difference in the

net value of total production (farmgate value less production costs) between the "w/o" and "with" cases. Changes in the volume and value of agricultural production will be achieved by one or more of the following:

i) Increase in cultivated area
ii) Increase in yield
iii) Increase in intensity of land use through increasing the number of harvest or intercropping
iv) Changes in the type of crop

Using the data obtained from the socio-economic survey, development benefits were calculated from the following equation:

Benefit = PRODw(FGPw-CPw)-(FGPw-CPw/o)

where, PRODw = Production in metric tons, with
PRODw/o= Production in metric tons, w/o
FGPw = Farmgate price in pesos per metric ton, with
CPw = Production cost in pesos per metric ton, with
CPw/o = Production cost in pesos per metric ton, w/o

The increase in farmgate price resulting from reduction in traffic cost is not included in the development benefits, because it is considered a part of the traffic benefits.

Table 5.2-6 presents the summary of demographic and agricultural data.

TABLE 5.2 - 6 (1)
Summary of Demographic and Agricultural Data LA UNION

Class of Road	Type of Impr't	Road Number	Road Length (Km)	1990 Population Total	1990 Population /km	1990 Crop Area (ha) Total	Major Crop				1993 AADT w/o	1993 AADT with	IRR (%)
Minor (Nat'l/ Prov'l)	Rehab/ Imp-1	P78	10.0	8029	803	580	300(Palay)	250(Tobac)	30(Banan)		120	167	26.2
		P56	15.1	7832	519	670	460(Palay)	100(Vege.)	60(Tobac)	30(Banan) 20(Root)	115	163	15.3
		P23	3.9	2323	596	200	150(Palay)	30(Tobac)	20(Vege.)		29	45	10.6
		P64	9.1	4564	502	1350	900(Palay)	400(Tobac)	50(Vege.)		63	107	9.7
		P11	5.4	2773	514	240	130(Palay)	100(Tobac)	10(Banan)		39	56	9.6
		P73	9.3	4154	447	680	350(Palay)	200(Tobac)	100(Vege.)	30(Banan)	0	41	8.4
		P79	5.3	3560	672	450	230(Palay)	180(Tobac)	25(Vege.)	15(Banan)	89	90	6.9
		P76	6.3	6636	1053	500	310(Palay)	180(Coco.)	10(Vege.)		0	137	5.4
		P6	3.5	3769	1077	240	110(Palay)	90(Tobac)	20(Coco.)	20(Vege.)	51	60	2.3
		P43	3.8	2610	687	324	180(Palay)	130(Tobac)	10(Vege.)	4(Banan)	39	60	1.0
		P39	3.5	1896	542	154	90(Palay)	60(Tobac)	4(Vege.)		3	24	.7
		N7-2	4.5	6383	1418	560	480(Palay)	80(Tobac)			124	160	.0
	Imp-2/ Widen	P45	5.8	2172	374	607	300(Palay)	270(Tobac)	25(Coco.)	12(Corn)	40	54	22.1
		P41	5.2	5161	993	760	430(Palay)	330(Tobac)			124	126	1.8
		P16	6.1	4336	711	445	350(Palay)	80(Tobac)	15(Banan)		111	111	1.2
Minor (Baran-gay)	Rehab/ Imp-1	B4-2	7.5	3332	444	390	350(Palay)	30(Banan)	10(Vege.)		25	42	21.1
		B9-4	2.8	2008	717	220	110(Palay)	100(Tobac)	10(Banan)		13	21	19.1
		B14-3	12.9	3913	303	90	60(Palay)	30(Banan)			27	41	13.2
		B11-38	4.5	3167	704	350	180(Palay)	120(Tobac)	50(Banan)		53	69	11.8
		B2-10	3.4	4158	1223	180	70(Palay)	60(Coco.)	50(Banan)		9	82	10.4
		B17-10	5.6	2861	511	620	330(Palay)	250(Tobac)	20(Vege.)	20(Banan)	0	33	10.3
		B15-13	4.2	1562	372	300	180(Palay)	100(Tobac)	20(Banan)		15	24	10.2
		B10-16	5.3	3135	592	610	580(Palay)	30(Tobac)			43	59	10.1
		B4-10	11.1	3330	300	115	80(Palay)	20(Vege.)	15(Root)		22	28	9.8
		B7-51	4.2	2207	525	150	120(Palay)	30(Vege.)			21	28	8.4
		B15-1	3.8	1516	399	470	250(Palay)	180(Tobac)	40(Vege.)		19	36	7.9
		B5-30	4.8	1980	412	210	150(Palay)	50(Tobac)	10(Root)		12	26	7.4
		B9-2	1.4	1874	1339	120	50(Palay)	50(Tobac)	20(Coco.)		22	22	6.7
		B0-11	3.6	947	263	200	110(Palay)	80(Tobac)	10(Vege.)		8	12	6.7
		B13-7	2.4	1295	540	357	180(Palay)	170(Tobac)	7(Vege.)		19	26	6.1
		B19-1	2.7	980	363	160	50(Palay)	50(Tobac)	30(Coco.)	30(Banan)	9	16	6.0
		B11-23	3.3	1024	310	440	400(Palay)	30(Banan)	10(Vege.)		8	14	5.3
		B15-4	3.1	1911	616	270	180(Palay)	90(Tobac)			22	36	2.9
		B18-5	7.9	1404	178	370	150(Palay)	150(Tobac)	70(Vege.)		12	23	1.0
		B0-15	4.8	3145	655	160	100(Palay)	50(Tobac)	10(Vege.)		28	41	.0
	Imp-2/ Widen	B3-28	6.0	1038	173	220	130(Palay)	90(Tobac)			2	13	2.7

3) Maintenance Cost Savings

The difference in maintenance costs between the "w/o" and "with" cases is considered one of the benefits. Maintenance costs in the "w/o" case were estimated based on the current EMK system, while maintenance costs in the "with" case were estimated as shown in b) below. It is noted that periodic maintenance cost in the "with" case is not included in the calculation of maintenance cost savings, because it is treated as a part of project costs.

In the case where the routine maintenance costs in the "with" case are higher than the maintenance costs in the "w/o" case (especially in the case of new construction, the maintenance cost in the "w/o" case in zero), the difference is considered as a negative benefit).

a) Maintenance Cost in "w/o" Case

According to the current EMK system, the annual maintenance cost per km was estimated as basic maintenance cost of ₱17,143.00/km times the EMK factor as shown in Table 5.2-7.

TABLE 5.2-7
EMK FACTOR FOR DIFFERENT SURFACING AND AADT

AADT / Surface Type	25	50	75	100	150	200	300	400
Earth	0.35	0.40	0.50					
Gravel	0.40	0.60	0.90	1.40	1.90	2.20	2.40	2.50	2.60

AADT / Surface Type	400	600	1000	1500	2000	3000	5000	10000
Bituminous	1.10	1.55	2.10	2.50	2.60			
Gravel	0.50	0.60	0.80	0.85	0.90	0.95	1.00	1.05	1.10

b) Routine Maintenance Costs in "with" Case

The costs deemed necessary to maintain the improved roads in a fair condition were estimated as shown in Table 5.2-8.

TABLE 5.2-8
ESTIMATED ROUTINE MAINTENANCE COSTS

Surface Type	Operation	Annual Cost (peso/km)
Gravel	Vegetation Control	1,150
	Ditch Cleaning	4.0 m Gravel: 2,650 + 40 AADT
	Grading	6.0 m Gravel: 3,000 + 45 AADT
	Pothole Repair	
	Total	4.0 m Gravel: 3,800 + 45 AADT
		6.0 m Gravel: 4,150 + 45 AADT
BMP	Vegetation Control	1,150
	Ditch Cleaning	1,100
	Shoulder Repair	2,150
	Patching	8,000 + 7.5 AADT
	Regravelling Shoulder	8,600
	Total	21,000 + 7.5 AADT
AC	Vegetation Control	1,150
	Ditch Cleaning	1,100
	Shoulder Repair	2,150
	Crack and Joint Sealing	9,300
	Regravelling Shoulder	8,600
	Total	20,400
PCC	Vegetation Control	1,150
	Ditch Cleaning	1,100
	Shoulder Repair	2,150
	Crack and Joint Sealing	5,600
	Regravelling Shoulder	8,600
	Total	18,600

5.2.4 Economic Evaluation

Results of economic evaluation are summarized in Table 5.2-9 and illustrated in Figure 5.2-1. Results of economic evaluation of each project road is presented in Table 5.2-10.

PROVINCE OF LA UNION

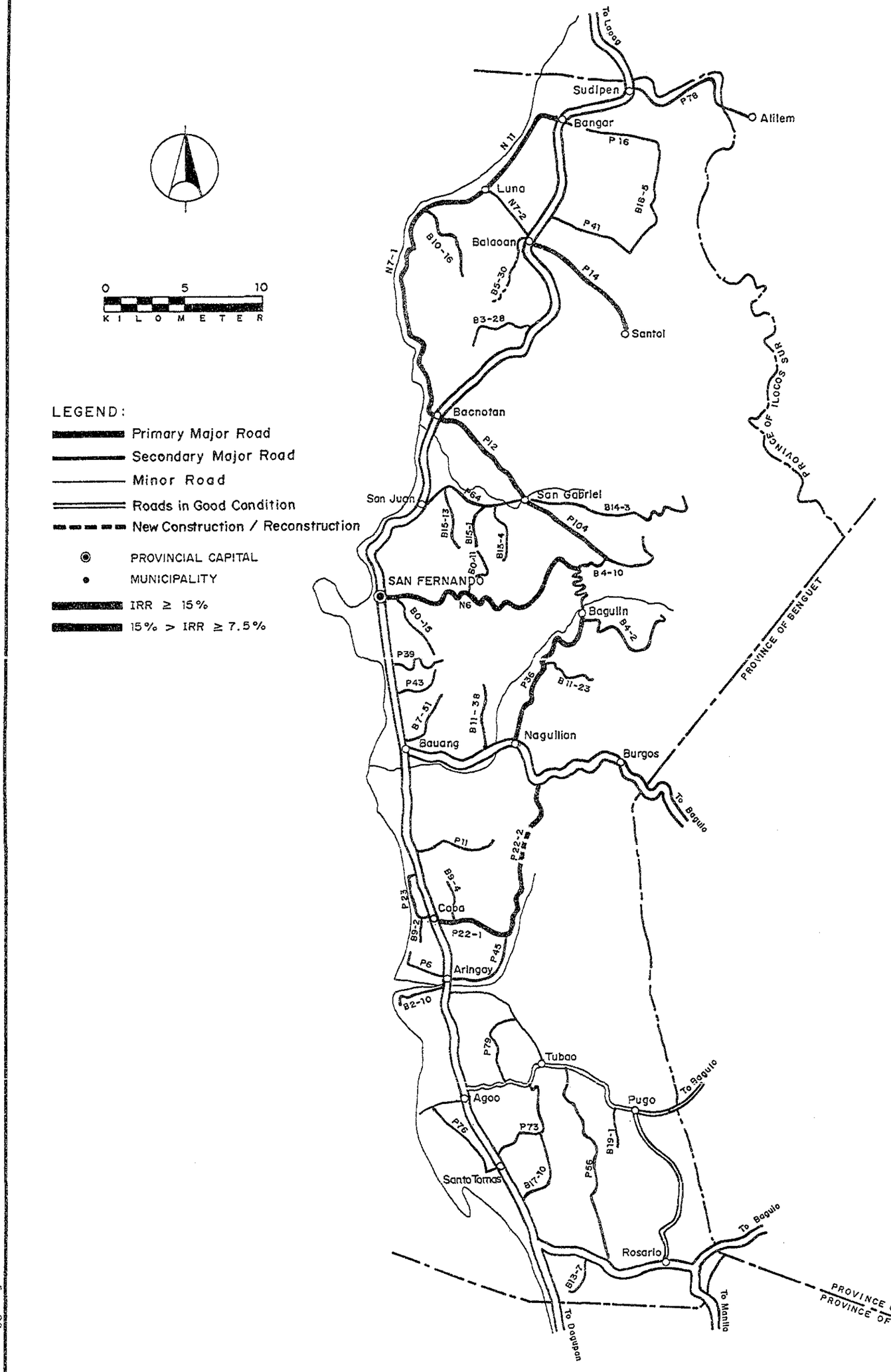

FIGURE 5.2 - 1 PROJECT ROADS and ECONOMIC EVALUATION RESULTS

TABLE 5.2 - 9 (1)

Road Length and Construction Cost LA UNION

Class of Road	Range of IRR	Rehabilitation/Improvement-1						Improvement-2/Widening						New Construction					
		No.	Total Length	Improv Length	Road Cost	Bridge Cost	Total Cost	No.	Total Length	Improv Length	Road Cost	Bridge Cost	Total Cost	No.	Total Length	Improv Length	Road Cost	Bridge Cost	Total Cost
Primary Major	15<	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7.5-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Second'y Major	15<	6	61.2	51.2	96.6	36.7	133.3	2	28.9	16.8	39.1	-	39.1	-	-	-	-	-	-
	10-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7.5-10	1	21.5	17.9	11.7	-	11.7	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	7	82.7	69.1	108.3	36.7	145.0	2	28.9	16.8	39.1	-	39.1	-	-	-	-	-	-
Minor (Nat'l/ Prov'l)	15<	2	25.1	25.1	22.7	15.6	38.3	1	5.8	5.8	2.9	1.9	4.8	-	-	-	-	-	-
	10-15	1	3.9	2.7	1.8	.5	2.3	-	-	-	-	-	-	-	-	-	-	-	-
	7.5-10	3	23.8	22.1	19.6	5.9	25.5	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	6	26.9	23.2	40.4	5.8	46.2	2	11.3	9.3	5.9	-	5.9	-	-	-	-	-	-
	Total	12	79.7	73.1	84.4	27.9	112.3	3	17.1	15.1	8.9	1.9	10.8	-	-	-	-	-	-
Minor (Baran-gay)	15<	2	10.3	10.0	6.7	-	6.7	-	-	-	-	-	-	-	-	-	-	-	-
	10-15	6	35.9	35.9	24.6	7.2	31.8	-	-	-	-	-	-	-	-	-	-	-	-
	7.5-10	3	19.1	19.1	14.7	2.7	17.3	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	9	34.0	34.0	23.3	7.8	31.1	1	6.0	6.0	2.9	.2	3.1	-	-	-	-	-	-
	Total	20	99.3	99.0	69.2	17.7	86.9	1	6.0	6.0	2.9	.2	3.1	-	-	-	-	-	-
Total	15<	10	96.6	86.3	125.9	52.3	178.3	3	34.7	22.6	42.1	1.9	44.0	-	-	-	-	-	-
	10-15	7	39.8	38.6	26.3	7.7	34.1	-	-	-	-	-	-	-	-	-	-	-	-
	7.5-10	7	64.4	59.1	45.9	8.6	54.5	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	15	60.9	57.2	63.7	13.6	77.3	3	17.3	15.3	8.9	.2	9.1	-	-	-	-	-	-
	Total	39	261.7	241.2	261.9	82.3	344.2	6	52.0	37.9	50.9	2.1	53.0	-	-	-	-	-	-

TABLE 5.2 - 9 (2)

Road Length and Construction Cost — LA UNION

Class of Road	Range of IRR	Total					
		No.	Total Length	Improv Length	Road Cost	Bridge Cost	Total Cost
Primary Major	15<	-	-	-	-	-	-
	10-15	-	-	-	-	-	-
	7.5-10	-	-	-	-	-	-
	<7.5	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Second'y Major	15<	8	90.1	68.0	135.7	36.7	172.4
	10-15	-	-	-	-	-	-
	7.5-10	1	21.5	17.9	11.7	-	11.7
	<7.5	-	-	-	-	-	-
	Total	9	111.6	85.9	147.4	36.7	184.1
Minor (Nat'l/ Prov'l)	15<	3	30.9	30.9	25.6	17.5	43.1
	10-15	1	3.9	2.7	1.8	.5	2.3
	7.5-10	3	23.8	22.1	19.6	5.9	25.5
	<7.5	8	38.2	32.5	46.4	5.8	52.2
	Total	15	96.8	88.2	93.3	29.8	123.1
Minor (Baran-gay)	15<	2	10.3	10.0	6.7	-	6.7
	10-15	6	35.9	35.9	24.6	7.2	31.8
	7.5-10	3	19.1	19.1	14.7	2.7	17.3
	<7.5	10	40.0	40.0	26.2	8.0	34.2
	Total	21	105.3	105.0	72.1	17.9	90.0
Total	15<	13	131.3	108.9	168.0	54.2	222.2
	10-15	7	39.8	38.6	26.3	7.7	34.1
	7.5-10	7	64.4	59.1	45.9	8.6	54.5
	<7.5	18	78.2	72.5	72.6	13.8	86.4
	Total	45	313.7	279.1	312.8	84.4	397.2

TABLE 5.2 - 10 (1)

Summary of Economic Analysis LA UNION

Cost/Benefit:1991-2017 Discounted Total

Class of Road	Type of Impr't	Road Number	1993 AADT w/o	1993 AADT with	Length (km) Total	Length (km) Improvement	Economic Cost (Mp/km) Construct.	Economic Cost (Mp/km) Period Maint.	Economic Cost (Mp/km) Total	Benefit (Mp/km) Normal	Diverted	Generated	Develop't	Maint sav'g	Benefit (Mp/km) Total	Econom. Indicator NPV (Mp)	B/C	IRR (%)
Second'y	Rehab/	P12	450	581	8.6	8.6(6.0-AC)	1.96	.18	2.13	4.03	-	1.31	-	.03	5.38	27.9	2.5	34.2
Major	Imp-1	P22-1	237	423	5.4	5.4(6.0-AC)	2.95	.14	3.09	3.15	-	3.94	-	.09	7.18	22.0	2.3	30.2
		P104	0	109	7.3	7.3(6.0-GRV)	1.68	.33	2.01	-	1.65	1.89	-	-.05	3.49	10.8	1.7	25.9
		P14	319	401	9.9	1.0(6.0-PCC)	2.04	.06	2.10	2.30	-	.70	-	.04	3.05	8.5	1.5	21.0
						1.2(5.4-PCC)												
						6.7(6.0-AC)												
		P22-2	0	9	15.4	15.4(6.0-GRV)	1.84	.20	2.04	-	.19	2.59	-	-.01	2.77	11.2	1.4	19.7
		P36	397	375	14.6	5.6(6.0-BMP)	3.45	.60	4.05	4.90	-	.18	-	.01	5.10	5.9	1.3	18.9
		N6	0	12	21.5	1.8(6.0-GRV)	.54	.12	.67	-	.01	.44	-	.00	.45	-3.9	.7	9.5
						16.1(4.0-GRV)												
	Imp-2/	N11	867	947	8.2	6.8(6.0-AC)	1.93	.27	2.20	6.45	-	.53	-	.10	7.09	33.2	3.2	45.6
	Widen	N7-1	418	702	20.7	10.0(6.0-AC)	1.94	.33	2.26	3.54	-	3.06	-	.08	6.68	44.2	3.0	40.7

TABLE 5.2 - 10 (2)

Summary of Economic Analysis LA UNION

Cost/Benefit:1991-2017 Discounted Total

Class of Road	Type of Impr't	Road Number	1993 AADT w/o	1993 AADT with	Length (km) Total	Length (km) Improvement	Economic Cost (Mp/km) Construct.	Economic Cost (Mp/km) Period Maint.	Economic Cost (Mp/km) Total	Benefit (Mp/km) Normal	Diverted	Generated	Develop't	Maint sav'g	Benefit (Mp/km) Total	Econom.Indicator NPV (Mp)	B/C	IRR (%)
Minor (Nat'l/ Prov'l)	Rehab/ Imp-1	P78	120	167	10.0	.3(6.0-BMP) 9.7(6.0-GRV)	2.12	.33	2.45	3.75	-	.36	.08	.04	4.23	17.8	1.7	26.2
		P56	115	163	15.1	8.6(6.0-GRV) 6.5(4.0-GRV)	.70	.30	1.00	.79	-	.08	.07	.08	1.01	.2	1.0	15.3
		P23	29	45	3.9	2.3(4.0-GRV) .4(4.0-BMP)	.70	.13	.83	.53	-	.03	.06	-.01	.62	-.6	.7	10.6
		P64	63	107	9.1	6.1(6.0-BMP) 2.7(6.0-GRV)	1.23	.19	1.42	.70	-	.10	.19	-.01	.99	-3.9	.7	9.7
		P11	39	56	5.4	4.0(4.0-GRV)	1.04	.13	1.17	.63	-	.09	.07	.01	.80	-1.5	.7	9.6
		P73	0	41	9.3	9.3(4.0-GRV)	.66	.12	.79	.30	-	.06	.14	.00	.49	-2.8	.6	8.4
		P79	89	90	5.3	1.8(6.0-GRV)	.66	.24	.90	.09	-	.00	.33	.09	.51	-.7	.6	6.9
		P76	0	137	6.3	6.3(6.0-GRV)	1.28	.27	1.55	.77	-	.02	.06	-.04	.82	-4.6	.5	5.4
		P6	51	60	3.5	2.7(6.0-BMP) .8(6.0-GRV)	2.70	.17	2.86	.81	-	.06	.09	-.01	.95	-6.7	.3	2.3
		P43	39	60	3.8	3.8(4.0-GRV)	1.51	.13	1.64	.34	-	.01	.11	.02	.48	-4.4	.3	1.0
		P39	3	24	3.5	3.3(4.0-GRV)	1.21	.11	1.33	.36	-	.03	.06	.00	.45	-2.9	.3	.7
		N7-2	124	160	4.5	4.5(6.0-BMP)	2.22	.16	2.38	.41	-	.00	.03	-.04	.40	-8.9	.2	.0
	Imp-2/ Widen	P45	40	54	5.8	5.8(4.0-GRV)	.69	.13	.82	.99	-	.05	.12	.02	1.18	2.1	1.4	22.1
		P41	124	126	5.2	3.2(6.0-GRV)	.56	.26	.82	.26	-	.00	.07	.11	.45	-1.2	.5	1.8
		P16	111	111	6.1	.3(6.0-BMP) 5.8(6.0-GRV)	.52	.26	.78	.24	-	.00	.06	.10	.40	-2.3	.5	1.2

TABLE 5.2 - 10 (3)

Summary of Economic Analysis LA UNION

Cost/Benefit:1991-2017 Discounted Total

Class of Road	Type of Impr't	Road Number	1993 AADT w/o	1993 AADT with	Length (km) Total	Length (km) Improvement	Economic Cost (Mp/km) Construct.	Economic Cost (Mp/km) Period Maint.	Economic Cost (Mp/km) Total	Benefit (Mp/km) Normal	Benefit (Mp/km) Diverted	Benefit (Mp/km) Generated	Benefit (Mp/km) Develop't	Benefit (Mp/km) Maint sav'g	Benefit (Mp/km) Total	Econom. Indicator NPV (Mp)	B/C	IRR (%)
Minor (Barangay)	Rehab/ Imp-1	B4-2	25	42	7.5	7.2(4.0-GRV)	.59	.13	.72	.73	-	.22	.05	.00	1.00	.2.0	1.4	21.1
		B9-4	13	21	2.8	2.8(4.0-GRV)	.46	.11	.57	.45	-	.17	.09	.00	.71	.4	1.2	19.1
		B14-3	27	41	12.9	12.9(4.0-GRV)	.55	.13	.67	.45	-	.15	.00	.00	.60	-.9	.9	13.2
		B11-38	53	69	4.5	4.5(4.0-GRV)	.58	.14	.72	.53	-	.04	.00	.03	.60	-.5	.8	11.8
		B2-10	9	82	3.4	3.4(4.0-GRV)	1.95	.15	2.11	1.39	-	.11	.02	-.01	1.50	-2.1	.7	10.4
		B17-10	0	33	5.6	5.6(4.0-GRV)	.77	.12	.89	.55	-	.08	.03	-.01	.65	-1.3	.7	10.3
		B15-13	15	24	4.2	4.2(4.0-GRV)	.45	.11	.57	.34	-	.09	.00	.00	.43	-.6	.8	10.2
		B10-16	43	59	5.3	5.3(4.0-GRV)	.73	.13	.86	.49	-	.04	.08	.02	.63	-1.2	.7	10.1
		B4-10	22	28	11.1	11.1(4.0-GRV)	.73	.12	.85	.41	-	.16	.02	.00	.58	-2.9	.7	9.8
		B7-51	21	28	4.2	1.2(6.0-BMP) 3.0(4.0-GRV)	.67	.13	.80	.39	-	.06	.07	.00	.51	-1.2	.6	8.4
		B15-1	19	36	3.8	3.8(4.0-GRV)	.93	.12	1.04	.35	-	.04	.21	.00	.60	-1.7	.6	7.9
		B5-30	12	26	4.8	4.8(4.0-GRV)	.74	.11	.85	.42	-	.11	.00	-.01	.52	-1.6	.6	7.4
		B9-2	22	22	1.4	1.4(4.0-GRV)	1.81	.11	1.92	.94	-	.05	.00	.01	1.00	-1.3	.5	6.7
		B0-11	8	12	3.6	3.6(4.0-GRV)	.51	.11	.62	.22	-	.05	.09	.01	.37	-.9	.6	6.7
		B13-7	19	26	2.4	2.4(4.0-GRV)	.39	.11	.51	.25	-	.01	.02	.01	.29	-.5	.6	6.1
		B19-1	9	16	2.7	2.7(4.0-GRV)	1.18	.11	1.30	.44	-	.17	.01	.00	.62	-1.8	.5	6.0
		B11-23	8	14	3.3	3.3(4.0-GRV)	.43	.11	.55	.23	-	.06	.02	.00	.31	-.8	.6	5.3
		B15-4	22	36	3.1	3.1(4.0-GRV)	.83	.12	.95	.29	-	.04	.04	.01	.38	-1.8	.4	2.9
		B18-5	12	23	7.9	7.9(4.0-GRV)	.43	.11	.55	.08	-	.03	.10	.00	.20	-2.7	.4	1.0
		B0-15	28	41	4.8	4.8(4.0-GRV)	1.34	.12	1.46	.26	-	.04	.06	.02	.38	-5.2	.3	.0
	Imp-2/ Widen	B3-28	2	13	6.0	6.0(4.0-GRV)	.43	.11	.55	.16	-	.01	.07	.00	.24	-1.8	.4	2.7