REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS & HIGHWAYS

Pilot Study for the Rural Road Network Development Project

FINAL REPORT

GUIDE FOR SUBPROJECT IDENTIFICATION AND EVALUATION

(VOLUME Ⅷ)

FEBRUARY, 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

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CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Preparation of the Guide

Provinces were classified into four types according to socio-economic development and adequacy of road as follows:

AD: Province with average road density and economically well developed

BL: Province with low road density and economically less developed

GL: Province with high road density and economically less developed

AL: Province with average road density and economically less developed

The provinces representing their respective types were selected as pilot provinces.

Feasibility studies were conducted for the following road projects in the pilot provinces:

Province Type	Pilot Province	Number of Road Projects Studied	Total Length (Km)
AD	Cavite	138	665.4
BL	Masbate	61	523.3
GL	Bohol	78	551.8
AL	Agusan del Norte	52	291.1
	Total	329	2,031.6

The results of the studies were statistically analyzed with the objective of developing a series of estimation models and based thereupon, the procedures and methodologies in this Guide were prepared.

1.2 Use of the Guide

This Guide deals with the following:

- Formulation of major road network in the province
- Engineering standards and typical road sections
- Subproject identification
- Cost estimate, evaluation and rating

1.3 Limitation of the Guide

As per Scope of the Study, the Study covered all roads except national primary roads defined in Executive Order No.113 "Establishing the Classification of Roads" and roads serving as streets within built-up population centers. This Guide is, therefore, not applicable to national primary roads and streets.

It was found by the analysis of the results of the feasibility studies that unit benefits vary with province type due to different situation in socio-economic development. In this Guide, the results in the pilot provinces were commonly applied to all provinces belonging to the respective type, although there may possibly be a difference even among provinces of the same type. Therefore, this Guide may have some deficiencies in application to the province different from the pilot province in socio-economic situation. It is sincerely desired to improve the Guide by providing more samples in various types of provinces.

CHAPTER 2

FUNCTIONAL ROAD CLASSIFICATION
FORMATION OF MAJOR ROAD NETWORK IN THE PROVINCE

CHAPTER 2 FUNCTIONAL ROAD CLASSIFICATION
— FORMATION OF MAJOR ROAD NETWORK IN THE PROVINCE —

To attain a systematic development of a road network, it is necessary to draw up the major road network (basic road network) in the province based on functional road classification.

The functional classification criteria are shown in Table 2-1 and conceptually in Figure 2-1.

In order to establish a well-balanced major road network, two indicators are introduced to examine the balance of network size. If indicators show imbalanced values, addition or deletion of major road links should be considered. Two indicators are as follows:

a)Network Value

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

where:

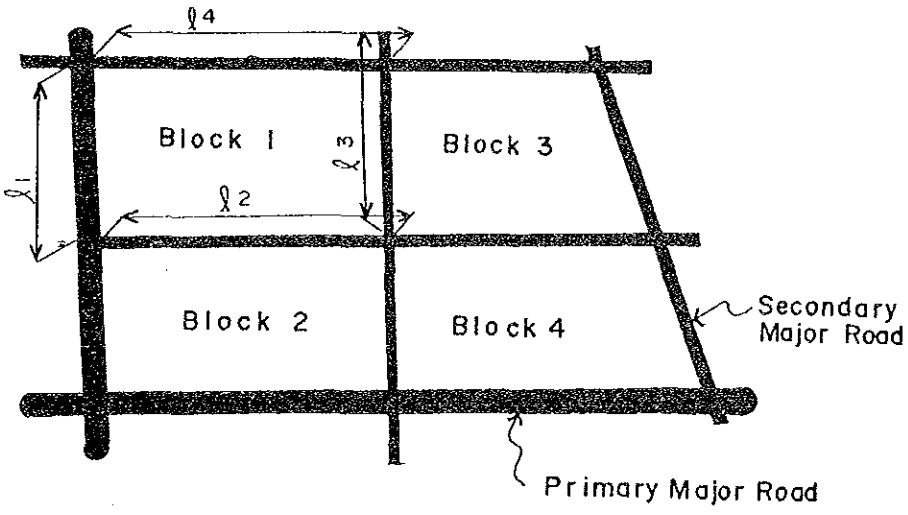
N_V = Network value

L = Road length delineating a block ($= \ell 1 + \ell 2 + \ell 3 + \ell 4$, in case of block 1 of the figure below)

P = Population in a block

A = Land area in a block

Block = Area delineated by primary and/or secondary major road



b)Accessibility

Accessibility $Ac = \sum p \cdot \ell$

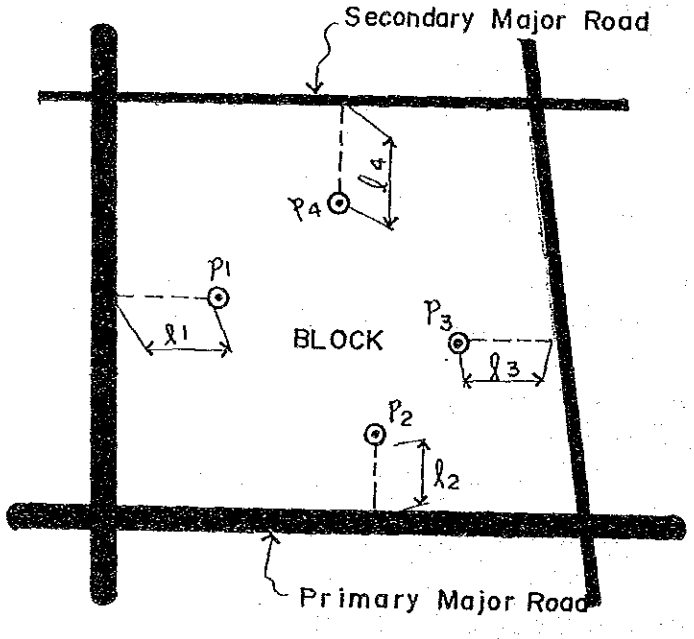
Average accessibility $A_{ave} = \dfrac{\sum p \cdot \ell}{P}$

where:

p = Population of a barangay

ℓ = Distance from a barangay center to respective primary or secondary major road

P = Total Population in a block



: Barangay center

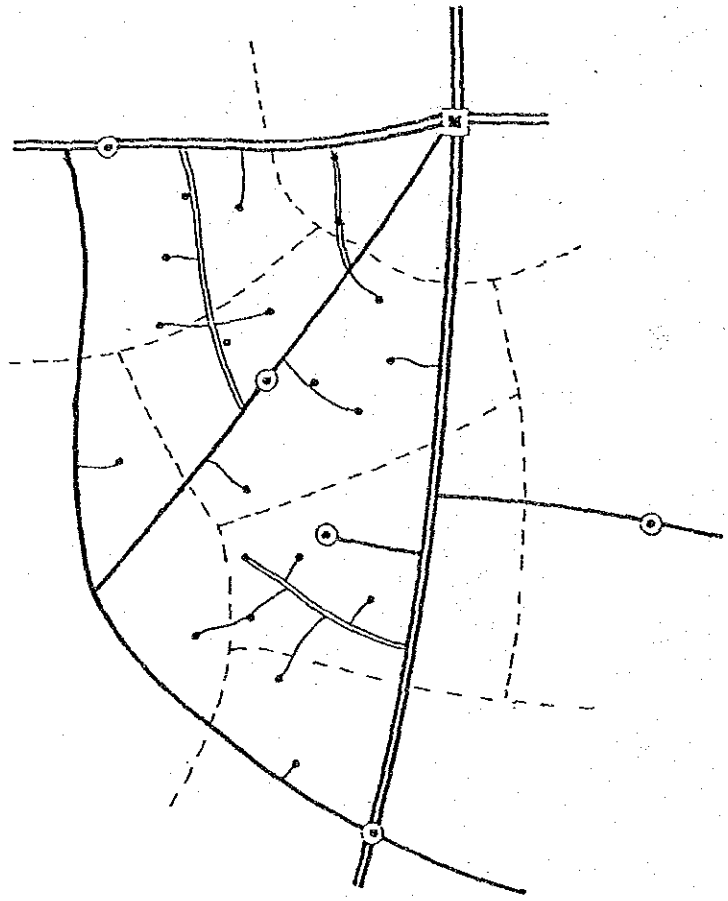
Accessibility = $p_1 \cdot \ell_1 + p_2 \cdot \ell_2 + p_3 \cdot \ell_3 + p_4 \cdot \ell_4$

Average accessibility = $\dfrac{\text{Accessibility}}{p_1 + p_2 + p_3 + p_4}$

The major road networks proposed for the pilot provinces are shown in Appendix.

TABLE 2-1 PROPOSED FUNCTIONAL CLASSIFICATION 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 functions be harmonized		●	●		●
	Feeder Road	• Roads linking one or more barangay 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 consideration			●		●
Street		• Roads within built-up population centers (Poblacion) with essentially urban rather than rural functions	• Primarily provides access to abutting land in urban areas • Through traffic usage discouraged			●	●	



Legends :

- Primary Major Road
- Secondary Major Road
- Collector / Distributor Road
- Feeder Road
- Municipal Boundary
- Provincial Capital
- Municipal Town
- Barangay

FIGURE 2-1 CONCEPTUAL ROAD NETWORK BY FUNCTIONAL CLASSIFICATION

CHAPTER 3

ENGINEERING STANDARDS AND TYPICAL ROAD SECTIONS

CHAPTER 3 ENGINEERING STANDARDS AND TYPICAL ROAD SECTIONS

3.1 Design Concept

The principal objective of the rural road network development project is to provide all-weather transport facilities to depressed areas. In line with this objective, the basic design concept was formulated as follows:

- Improvement of surface condition is the principal concern of design.
- Improvement of horizontal and vertical alignment is limited to the required minimum.
- In the case where all-weather access is not attained only by improvement of surface condition, special consideration is given, e.g., PCC paving for steep gradient sections to enable vehicles to climb up even in the wet season and grade raising in flood sections.
- Adequate cross and side drainage is provided.
- Permanent structures are provided in accordance with the improvement criteria for bridges.

3.2 Engineering Standards

See Table 3-1.

3.3 Type of Improvement

The improvement works are categorized into five types according to the type and degree of road deficiencies, as shown in Table 3-2.

3.4 Typical Road Section

See Table 3-3 and Figures 3-1 to 3-6.

TABLE 3-1 PROPOSED ENGINEERING STANDARDS

Functional Classification	Major Road										Minor Road							
	Primary Major Road						Secondary Major Road					Collector Road				Feeder Road			
Administrative Classification	National Road						National/Provincial City Road					Provincial/City/ Barangay Road				City/Barangay Road			
AADT in Opening Year	Under 100	100-200	200-400	400-1,000	1000-2,000	Over 2,000	Under 200	200-400	400-1,000	1000-2,000	Over 2,000	Under 50	50-200	200-400	Over 400	Under 50	50-200	200-400	Over 400
1) Design speed (km/hr.)																			
Flat		60	70	70	80	90	50	60	60	70	80	40	50	60	60	40	40	50	50
Rolling		40	50	60	60	70	40	50	50	50	60	30	40	40	50	30	30	40	40
Mountainous		30	40	40	50	60	30	40	40	40	50	30	30	30	30	30	30	30	30
2) Carriageway Width (m)		6.0	6.0	6.7-6.0	6.7	6.7	6.0	6.0	6.0	6.0	6.7	5.5[2]	5.5-6.0	5.5-6.0	6.0	4.0	4.0-5.5	5.5-6.0	6.0
3) Shoulder Width (m)																			
Flat		1.5	2.0	2.0	2.5	3.0	1.0	1.5	2.0	2.5	2.5	1.0	1.0	1.5	1.5	0.5	1.0	1.0	1.5
Rolling		1.0	1.5	1.5	1.5	2.0	0.5	1.0	1.5	1.5	1.5	0.5	0.5	1.0	1.0	0.5	0.5	0.5	1.0
Mountainous		0.5	1.0	1.0	1.0	1.5	0.5	1.0	1.0	1.0	1.0	0.5	0.5	1.0	1.0	0.5	0.5	0.5	0.5
4) ROW Width (m)		20	30	30	30	30	20	20	30	30	30	20	20	20	20	10	10	15	15
5) Radius (m)																			
Flat		120	160	160	220	280	85	120	120	160	220	55	85	120	120	55	55	85	85
Rolling		55	85	120	120	160	55	85	85	85	120	30	55	55	85	25	30	55	55
Mountainous		30	50	50	80	120	30	50	50	50	80	30	30	30	30	25	30	30	30
6) Grade (%)																			
Flat		6.0	6.0	5.0	4.0	4.0	7.0	6.0	6.0	5.0	4.0	8.0	7.0	6.0	6.0	8.0	8.0	7.0	7.0
Rolling		8.0	7.0	6.0	5.0	5.0	8.0	7.0	7.0	7.0	5.0	10.0	8.0	8.0	7.0	10.0	10.0	8.0	8.0
Mountainous		10.0	9.0	8.0	7.0	7.0	10.0	9.0	8.0	8.0	7.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
7) Acceptable Pavement Type	.S or DBST .BMP .BPT .Cr. Gr.		.AC .DBST	.PCC .AC	.PCC .AC	.PCC .AC	.S or DBST .BMP .BPT .Cr. Gr.		.AC .DBST	.PCC .AC	.PCC .AC	.Cr. .Gr.	.BPT .Cr. Gr.	.S or DBST .BMP	.AC .DBST	.Nat or Cr. Gr.	.Nat or Cr. Gr. .BPT	.S or DBST .BMP	AC DBST
8) Pavement Type Recommended In This Study	Gr.	1) BMP/ DBST	1) BMP/ DBST	.AC	.PCC	.PCC	.Gr.	1) BMP/ DBST	.AC	.PCC	.PCC	.Gr.	.Gr.	1) BMP/ DBST	.AC	.Gr.	.Gr.	1) BMP/ DBST	.AC

Pavement Type
- S or DBST.....Single or double bituminous treatment
- BMP.....Bituminous macadam pavement
- BPT.....Bituminous preservative treatment
- Nat. or Cr. Gr. .....Natural or crushed gravel
- AC.....Asphalt concrete pavement
- PCC.....Portland cement concrete pavement

NOTE:
1) Choice of BMP/DBST depends on the conditions of subgrade, traffic loading, drainage, etc.

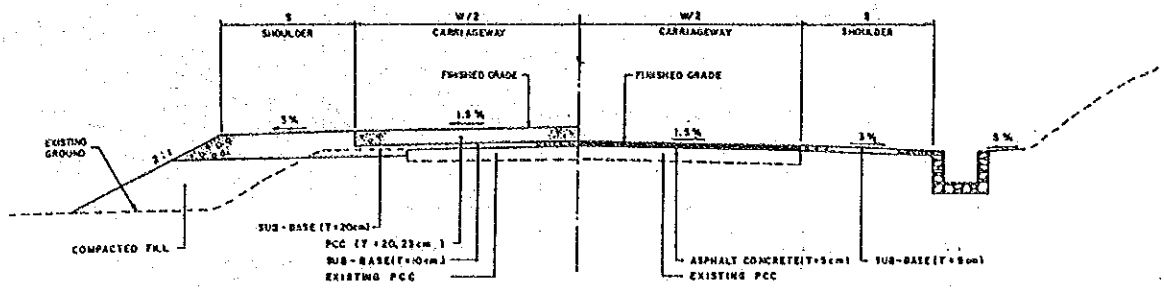
2) 4.0 m in case of less than 25 AADT.

TABLE 3-2 TYPE 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 narrower than standard)	Good/Fair	Widening of Existing Road
New Construction	Impassable/Abandoned Non-existing		Construction of New Road

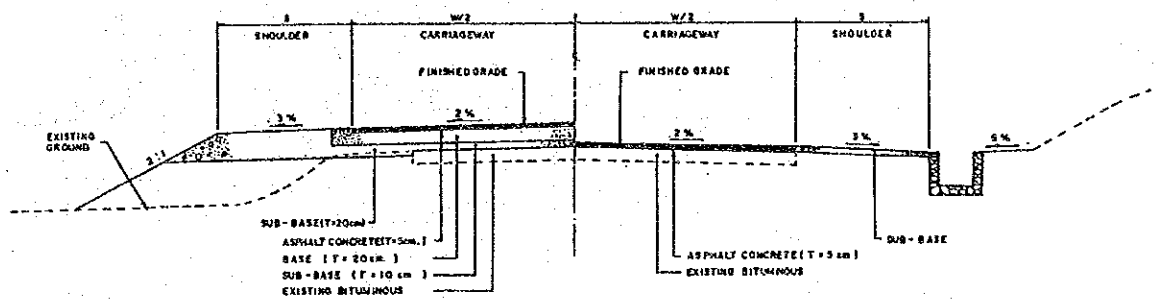
TABLE 3.3 TYPICAL ROAD SECTION

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					



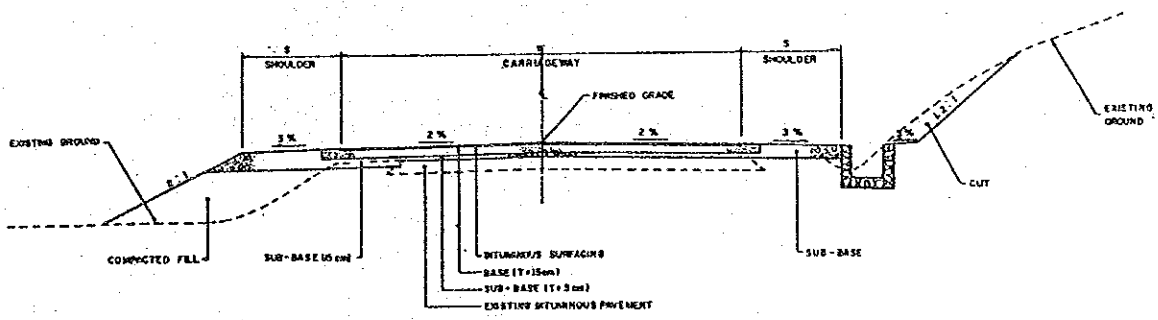
TYPE I-1
PROPOSED PAVEMENT : PCC
EXISTING PAVEMENT : PCC (BAD/VERY BAD)

TYPE I-2
PROPOSED PAVEMENT : ASPHALT CONCRETE OVERLAY
EXISTING PAVEMENT : PCC (BAD/VERY BAD)

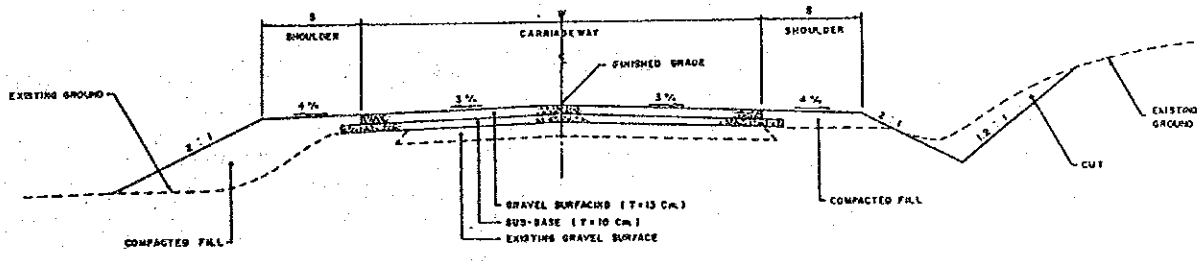


TYPE I-3
PROPOSED PAVEMENT : ASPHALT CONCRETE
EXISTING PAVEMENT : BITUMINOUS (BAD/VERY BAD)

TYPE I-4
PROPOSED PAVEMENT : ASPHALT CONCRETE OVERLAY
EXISTING PAVEMENT : BITUMINOUS (BAD/VERY BAD)



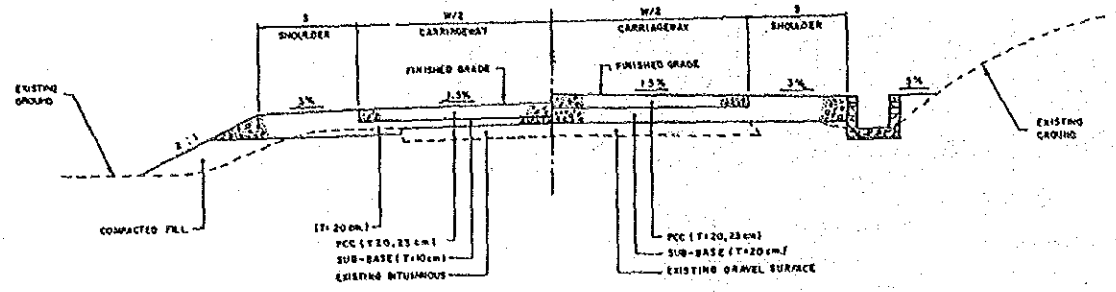
TYPE I-5
PROPOSED PAVEMENT : BITUMINOUS MACADAM/DOUBLE BITUMINOUS SURFACE TREATMENT
EXISTING PAVEMENT : BITUMINOUS (BAD/VERY BAD)



TYPE I-6
PROPOSED PAVEMENT : GRAVEL SURFACING
EXISTING PAVEMENT : GRAVEL SURFACING (BAD/VERY BAD)

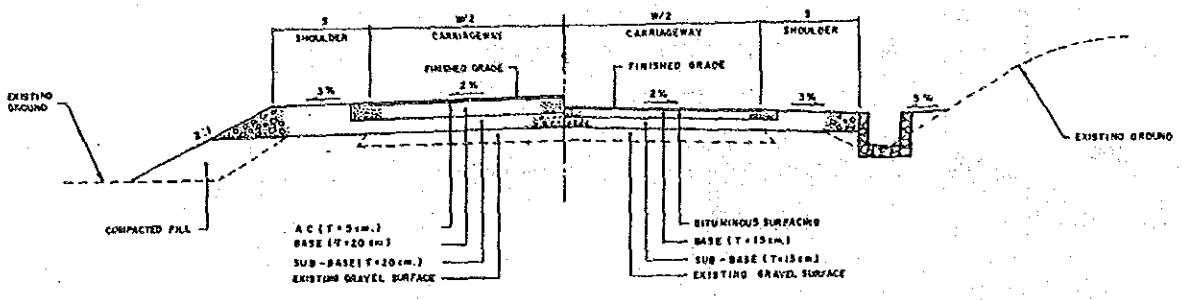
REHABILITATION

FIGURE 3-1 TYPICAL ROAD SECTIONS (1)



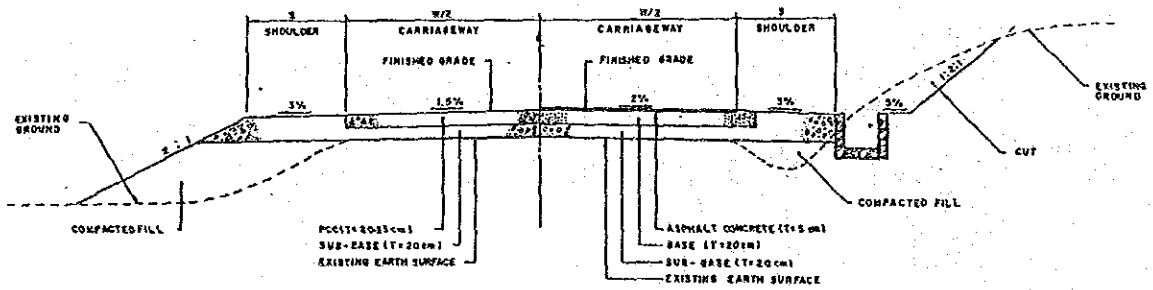
TYPE 2-1
PROPOSED PAVEMENT : PCC
EXISTING PAVEMENT : BITUMINOUS (BAD/VERY BAD)

TYPE 2-2
PROPOSED PAVEMENT : PCC
EXISTING PAVEMENT : GRAVEL SURFACING (BAD/VERY BAD)



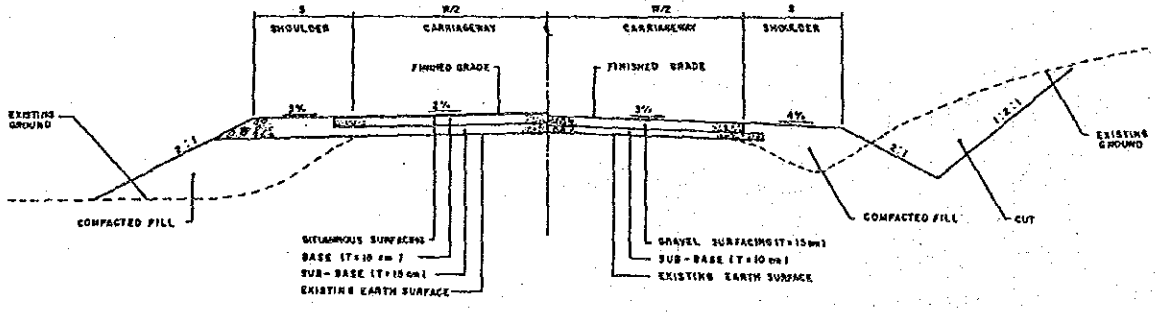
TYPE 2-3
PROPOSED PAVEMENT : ASPHALT CONCRETE
EXISTING PAVEMENT : GRAVEL SURFACING (BAD/VERY BAD)

TYPE 2-4
PROPOSED PAVEMENT : BITUMINOUS MACADAM / DOUBLE BITUMINOUS SURFACE TREATMENT
EXISTING PAVEMENT : GRAVEL SURFACING (BAD/VERY BAD)



TYPE 2-5
PROPOSED PAVEMENT : PCC
EXISTING PAVEMENT : EARTH SURFACE

TYPE 2-6
PROPOSED PAVEMENT : ASPHALT CONCRETE
EXISTING PAVEMENT : EARTH SURFACE

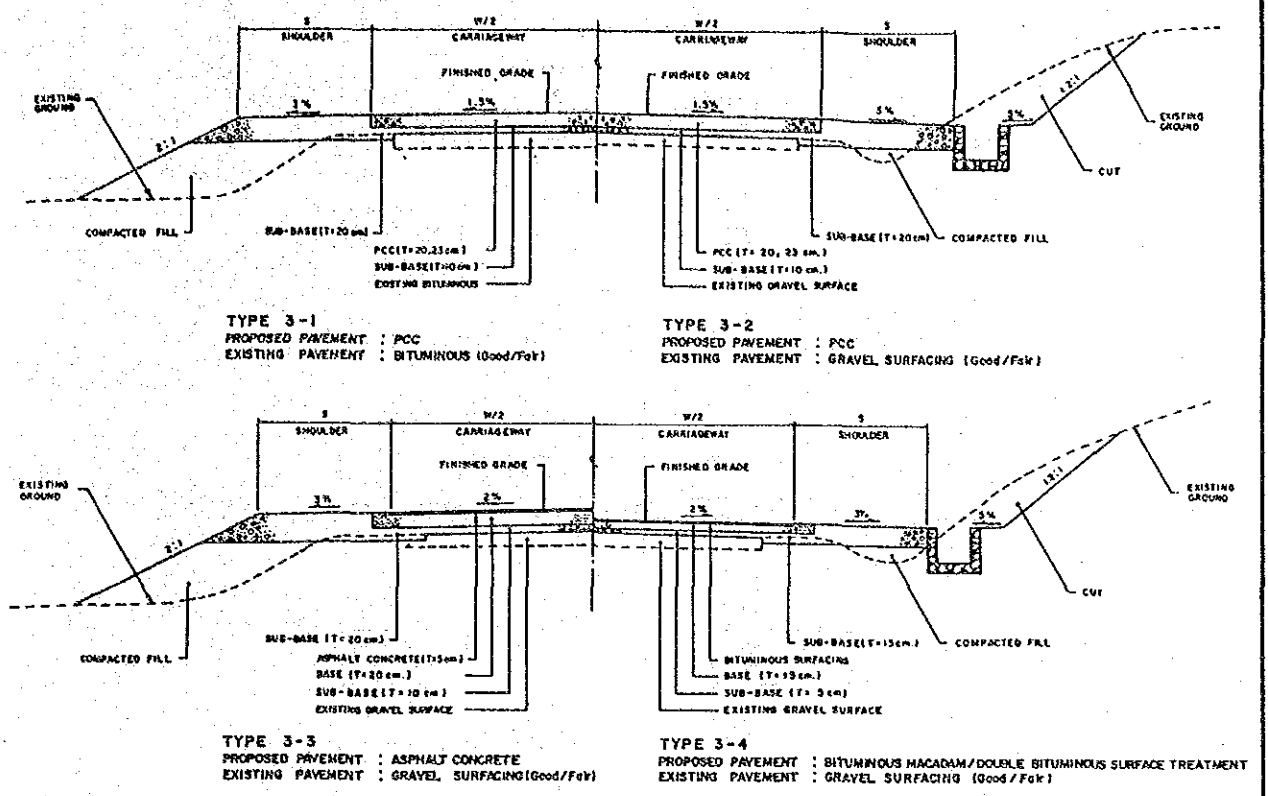


TYPE 2-7
PROPOSED PAVEMENT : BITUMINOUS MACADAM/ DOUBLE BITUMINOUS SURFACE TREATMENT
EXISTING PAVEMENT : EARTH SURFACE

TYPE 2-8
PROPOSED PAVEMENT : GRAVEL SURFACING
EXISTING PAVEMENT : EARTH SURFACING

IMPROVEMENT - I

FIGURE 3-2 TYPICAL ROAD SECTIONS (2)



TYPE 3-1
PROPOSED PAVEMENT : PCC
EXISTING PAVEMENT : BITUMINOUS (Good/Fair)

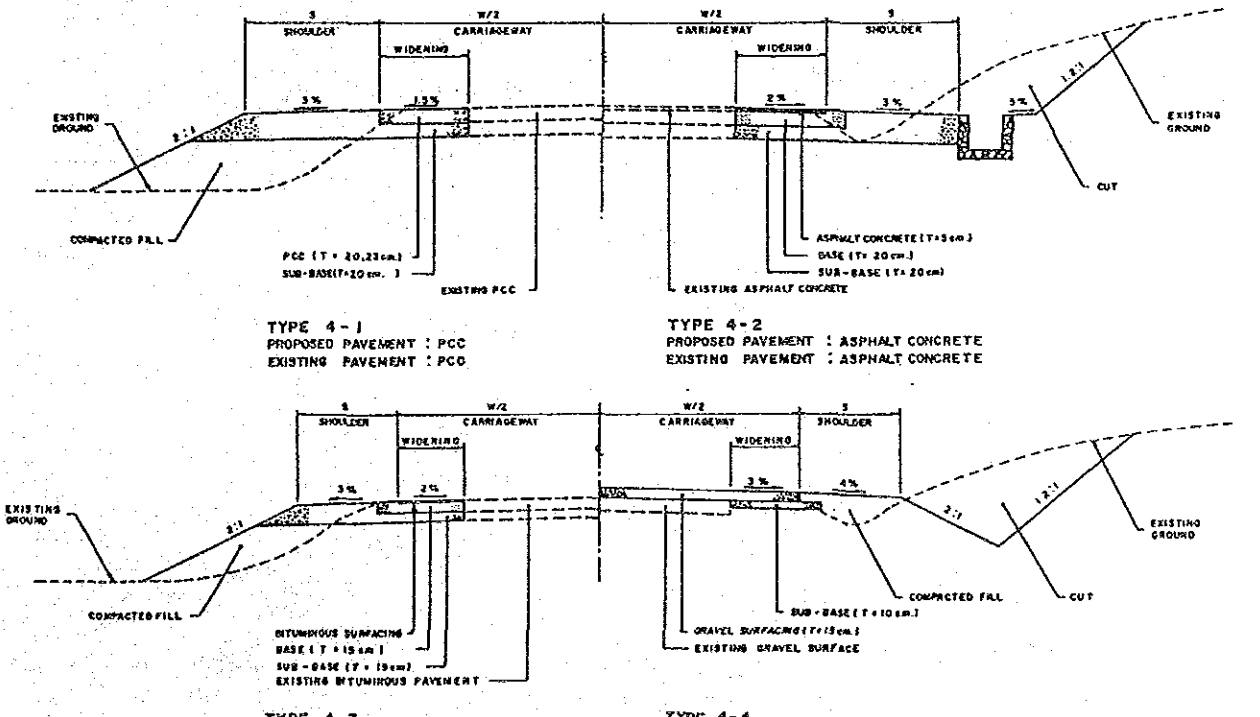
TYPE 3-2
PROPOSED PAVEMENT : PCC
EXISTING PAVEMENT : GRAVEL SURFACING (Good/Fair)

TYPE 3-3
PROPOSED PAVEMENT : ASPHALT CONCRETE
EXISTING PAVEMENT : GRAVEL SURFACING (Good/Fair)

TYPE 3-4
PROPOSED PAVEMENT : BITUMINOUS MACADAM/DOUBLE BITUMINOUS SURFACE TREATMENT
EXISTING PAVEMENT : GRAVEL SURFACING (Good/Fair)

IMPROVEMENT-2

FIGURE 3-3 TYPICAL ROAD SECTIONS (3)



TYPE 4-1
PROPOSED PAVEMENT : PCC
EXISTING PAVEMENT : PCC

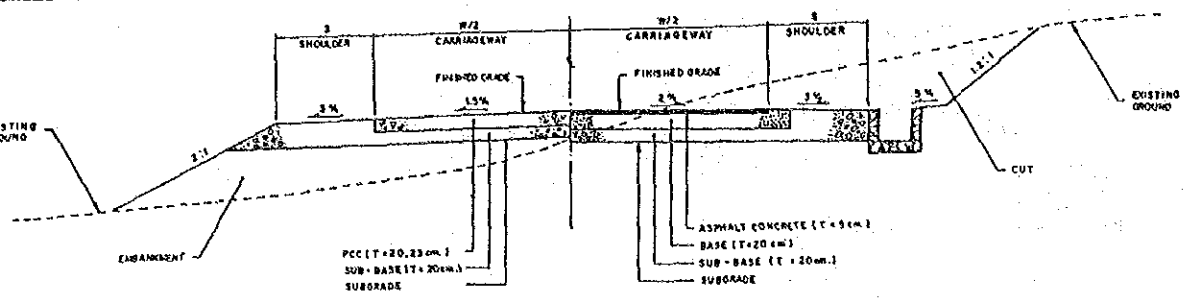
TYPE 4-2
PROPOSED PAVEMENT : ASPHALT CONCRETE
EXISTING PAVEMENT : ASPHALT CONCRETE

TYPE 4-3
PROPOSED PAVEMENT : BITUMINOUS MACADAM/ DOUBLE BITUMINOUS SURFACE TREATMENT
EXISTING PAVEMENT : BITUMINOUS

TYPE 4-4
PROPOSED PAVEMENT : GRAVEL SURFACING
EXISTING PAVEMENT : GRAVEL SURFACING

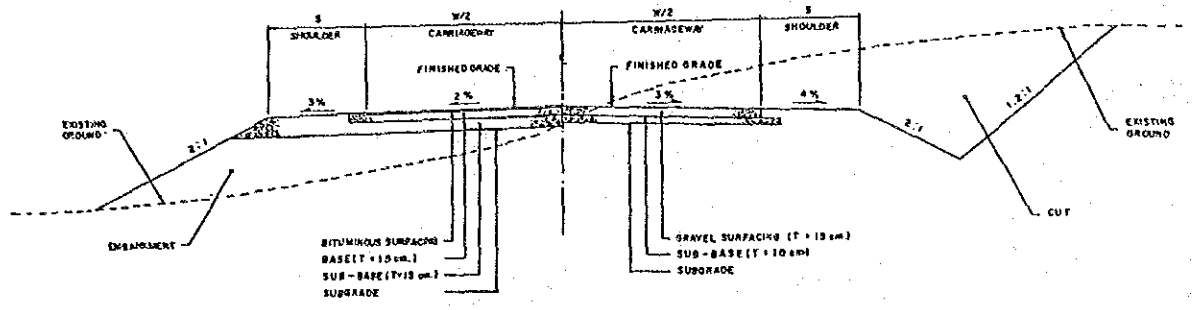
WIDENING

FIGURE 3-4 TYPICAL ROAD SECTIONS (4)



TYPE 5-1
PROPOSED PAVEMENT : PCC

TYPE 5-2
PROPOSED PAVEMENT : ASPHALT CONCRETE

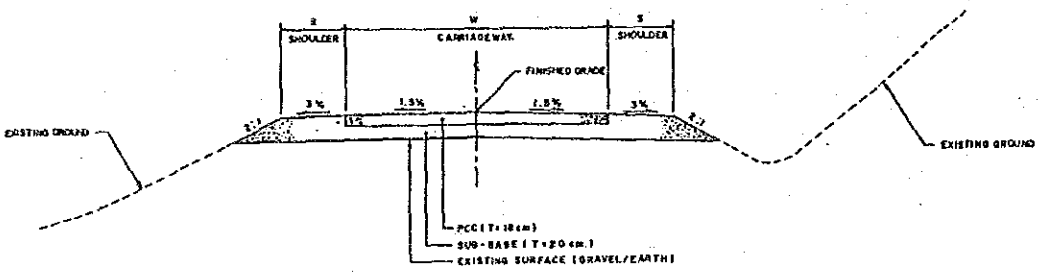


TYPE 5-3
PROPOSED PAVEMENT : BITUMINOUS MACADAM / DOUBLE BITUMINOUS SURFACE TREATMENT

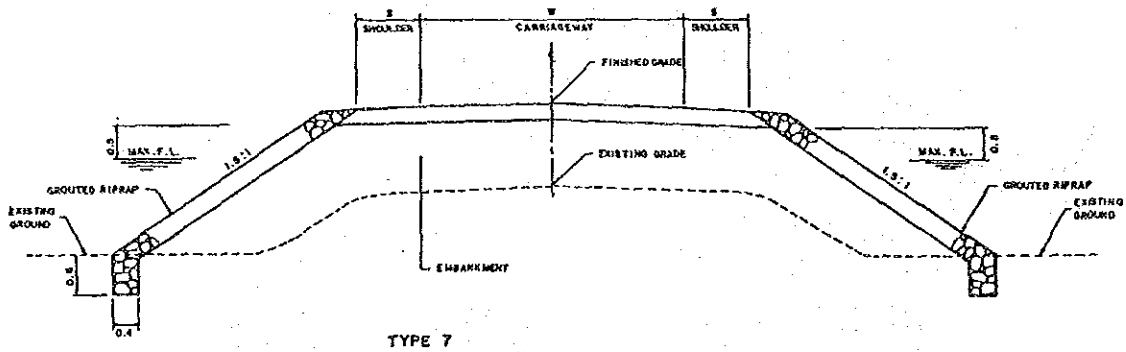
TYPE 5-4
PROPOSED PAVEMENT : GRAVEL SURFACING

NEW CONSTRUCTION

FIGURE 3-5 TYPICAL ROAD SECTIONS (5)



TYPE 6
PCC PAVEMENT FOR STEEP GRADIENT SECTIONS



TYPE 7
GRADE RAISING IN FLOOD AREA

FIGURE 3-6 TYPICAL ROAD SECTIONS (6)

CHAPTER 4

SUBPTOJECT IDENTIFICATION

CHAPTER 4 SUBPROJECT IDENTIFICATION

4.1 Application Form

Table 4-1 shows the proposed format for application. Instructions for entry are as follows:

1) Name of Road: Official road name/names of places at both ends of the road

2) Location: Province and City/Municipality where the road is located.

3) Administrative Classification of Project Road:
Either National, Provincial, City, Municipal or Barangay

4) Total Length

5) Road Data:

Project road shall be divided into subsections, each of which is homogeneous in terrain, cross-section, surface type and condition.

Station Stations at both ends of the subsection

Length of Subsection

Terrain

Flat: Any combination of grades and horizontal and vertical alignment permitting heavy vehicles to maintain approximately the same speed as passenger cars.

Rolling: Any combination of grades and horizontal and vertical alignment causing heavy vehicles to reduce their speed substantially below that of passenger cars, but not causing heavy vehicles to operate at crawl speed for any significant length of time.

Nountainous: Any combination of grades and horizontal and vertical alignment causing heavy vehicles to operate at crawl speed for significant distances or at frequent intervals.

Cross-section

Existing width of carriageway and shoulder (average of both sides) In case of non-existing subsection, enter 0.

Surface Type

PCC : Portland Cement Concrete Pavement
AC : Asphalt Concrete Pavement
BST : Bituminous Surface Treatment
G : Gravel Surface
E : Earth Road

Surface Condition

Good : No potholes or rutting or corrugation. Less than 5 potholess per 1000 meters. Cracking which does not affect driving condition may be ignored.

Fair : More than 5 but less than 20 potholes per 1000 meters and/or slight cracking and/or rutting and/or corrugated (less than 50% of the section length). Passenger car speed will exceed 30 km per hour.

Bad : More than 20 potholess per 1000 meters and/or slightly rutted and/or corrugated (more than 50% of the section length) and/or corrugated over approximately the entire length. Pavements, if any, starting to break up. Maximum comfortable travel speed (car) is 30 km/hr.

Very Bad :
Pavement breaking up and gravel surface deteriorated into numerous potholes. Just passable for cars. Maximum comfortable travel speed (car) is about 20 km/hr.

Impassable :
Impassable to motorized vehicles at all times or in the wet season, or non-existing.

Possibilitoy of Rehabilitating by AC Overlay

Yes : Subgrade, subbase and drainage are in sound condition and pavement distress is primarily caused by traffic

and by surface course material.

No : Other than above

Flood Section

Total length of flood sections within the subsection and maximum water depth above existing road surface

Length of Steep Gradient Sections

Steep gradient section is defined as a portion of a road where motorized vehicles cannot climb up in muddy condition. Enter total length of steep gradient sections within the subsection.

6) Bridge Data

Station

Bridge Type

Steel Bridge
Concrete Bridge
Bailey Bridge
Timber Bridge
Spillway
Ford (including non-existing)

Length

Width

Structural Condition

Good : Bridges that have been carrying normal traffic for a longer length of time, no sign of distress/deterioration and their load carrying capacity is considered adequate; no work or improvement to be done.

Fair : Bridges that show sign of deterioration on the superstructure and substructure such as spalling on concrete deck, light cracks on concrete surfaces, rusty steel trusses, scouring on piers, damaged slope protection.

Bad : Bridges that show signs of heavy deterioration on the structure such as showing heavy longitudinal

cracks/random cracks, splitting of concrete at tension reinforcement level, heavy spalling of concrete surfaces, exposed rusty reinforcing bars at girders and bridges that are extensively damaged and structurally unsafe for vehicular traffic.

Very Bad : Bridges incapable of carrying future traffic, structurally and hydraulically deficient, and liable to collapse.

Proposed Bridge Length

7) Traffic Data

Present traffic

Potential Traffic Diverted

Total

Note: Traffic data are omissible for minor road.

8) Socio-economic Data

Population Served

Cultivated Area within Road Influence Area

Average Household Income per Month

Note: Population and cultivated area are omissible for major road.

9) General Remarks

Specific matters on the project, ex., needs and effects of the project, special site conditions, etc.

Attachment

Map indicating the location of proposed project preferably in 1 : 50,000 topographic map.

TABLE 4-1 PROPOSED FORMAT FOR APPLICATION

SUBPROJECT PROPOSAL FORM

1. Name of Road _____
2. Location : Province _____ City/Municipality _____
3. Administrative Classification of Project Road _____
4. Total Length _____km
5. Road Data

Station	Length of Sub-section (km)	Terrain	Cross-Section		Surface Type	Surface Condition	Possibility of Rehabilitating by AC Overlay	Flood Section		Length of Steep Gradient Section (m)	Remarks
			Carriageway (m)	Shoulder (m)				Length (km)	Water Depth (m)		
—											
—											
—											
—											
—											

6. Bridge Date

Station	Bridge Type	Length (m)	Width (m)	Structural Condition	Proposed Bridge Length (m)	Remarks

7. Traffic Data (omissible for minor road)

	Present Traffic	Potential Traffic Diverted	Total
Car/Van			
Jeepney			
Bus			
Truck			
Total			

Date of Survey _____
Name of Road from which diversion is expected _____

8. Socio-economic Date (omissible for major road, except average household income)

	Total for entire road
Population Served	
Cultivated Area Within Road Influence Area (ha)	
Average Household Income per Month (Peso)	

9. General Remarks _____

Note: Attach map indicating general location of proposed project preferably in 1:50,000 topographic map.

4.2 Identification Criteria

1) One or more of the following conditions should be met:

	Major Road	Minor Road
(1) Existing Link		
- Carriageway with	Below 6.0 meters	-
- Pavement Type	Inferior to recommended type (Table 3-1)	Inferior to gravel
- Surface Condition	Bad or worse	Bad or worse
(2) New Link	Impasable/Non-existing	
(3) Bridges	Ford Spillway Timber bridge Bailey bridge	Ford Spillway in structural unsound condition Timber bridge Bailey bridge serving AADT more than 300

2) (1) In case of major road presently in good/fair condition, AADT in the opening year should be more than 150.

(2) In case of major road presently in bad or worse condition, AADT in the opening year should be more than 100.

(3) In case of minor road, population served per km of road should be more than 300.

CHAPTER 5

COST ESTIMATE, EVALUATION AND RATING

CHAPTER 5 COST ESTIMATE, EVALUATION AND RATING

This Chapter presents the worksheets for cost estimate, evaluation and rating of subprojects and step-by-step instructions for their use.

5.1 Major Road Subproject

The computation for evaluating/rating major road subproject is conducted and/or summarized on the worksheet shown in Table 5-1, using the Subproject Proposal Form (Table 4-1, hereinafter referred to simply as the Proposal) as basic input data.

1) Name of Road and 2) Province

These are taken directly from the Proposal.

2) AADT in Opening Year

AADT in the opening year is calculated assuming 3% annual traffic growth rate based on present traffic shown in the Proposal.

$$\text{AADT in Opening Year} = \text{present AADT} \times 1.03^{n}$$

where, n : Number of years to the opening year

4) Construction Cost

Road

- Length of subsection, terrain, and existing pavement type and condition are taken directly from the Proposal.
- Proposed pavement type and width are obtained from Table 5-4.
- Type of improvement is obtained from Table 5-5.
- Construction cost per km is found by looking up Table 5-7. Construction cost per subsection is obtained by multiplying the construction cost per km by length of subsection.
- For subsection including flood sections, additional cost necessary for grade raising is calculated as average additional cost per km times flood section length shown in

the Proposal. The average additional cost per km is obtained from Table 5-8.

- Total cost of the subsection is computed as the sum of construction cost and additional cost for flood sections.

- Length and total cost of the subsection to be improved are summed up and entered in respective columns. Total length does not include the length of no-improvement subsections.

Bridge

- Existing bridge type is obtained from the Proposal.

- Proposed bridge type and number of lanes is obtained from Table 5-6.

- Length of bridge is obtained from the Proposal.

- Number of spans should be decided based on site conditions. The standard number of spans is given by dividing bridge length in meters by 20 and rounding, unless site conditions indicate that another value is appropriate. In the case of a spillway, the number of spans is one (1).

- Unit costs of superstructure, abutment and pier are obtained from Table 5-9. In the case of a spillway, unit costs of abutment and pier are both 0.

- Total costs are computed as follows:

Superstructure	: Unit cost per m times length
Abutment	: Unit cost times 2
Pier	: Unit cost times (number of spans - 1)
Total	: Sum of above three items

Total Construction Cost

This is computed as the sum of total road cost and total bridge cost.

5) Economic Evaluation

Benefit

- Province type is found from Table 5-3.

- Existing pavement type and condition are represented by these predominating in the whole subproject road.

- Proposed pavement type is as decided above.

- Traffic benefit per km per vehicle is obtained by looking up Table 5-10. It is multiplied by total improvement length and by AADT to get traffic benefit.

- Maintenance cost savings per km per vehicle is computed as:

$$MS' = -3.87 - 0.162 \times TB'$$

where, MS' : Maintenance cost savings in thousand peso per km per veh
TB' : Traffic benefit in thousand peso per km per veh

It is multiplied by total improvement length and by AADT to get total savings. Maintenance cost savings are always a negative value.

- Total benefit is computed as the sum of traffic benefit and maintenance cost savings.

- Economic cost is computed as total construction cost times 0.831, under the following assumptions:

Year	Item	Economic Cost	Discounted Economic Cost
1st year	Detailed Engineering	0.04C	0.04C
2nd year	Construction	0.85C	$\frac{0.85+0.06}{1.15}C=0.791C$
	Construction Supervision	0.06C	
Total			0.831C

Note: C = Total construction cost

- B/C ratio is computed by dividing total benefit by economic cost.

- IRR is computed as :
  B/C $\geq$ 1 : IRR = 1.676 + 13.224 x B/C
  B/C $<$ 1 : IRR = -3.018 + 18.018 x B/C

6) Rating

Project rating is computed as follows:

PR = 70% MP(IRR) + 20% MP(HI) + 10% MP(SB)

where, PR : Project rating
MP(IRR) : Merit points of economic internal rate of return (IRR)
MP(HI) : Merit points of household income per month (HI)
MP(SB) : Merit points of social benefits (SB)

- Economic internal rate of return (IRR):

IRR is as decided above. Merit points are computed as follows:

IRR	MP (IRR)	70% MP (IRR)
IRR $<$ 40	20 + 2 x IRR	14 + 1.4 x IRR
IRR $\geq$ 40	100	70

- Household income per month (HI):

HI is taken from the Proposal. Merit points are computed as follows:

HI	MP (HI)	20% MP (HI)
₱ 5,000 or above	25	5
₱ 2,000 - 5,000	150-HI/40	30-HI/200
below ₱ 2,000	100	20

- Social benefit (SB)

Social benefit is evaluated as either High, Medium or Low, according to the degree of contribution of the subproject to the promotion of health, education communication, safety, security and preservation of environment in the influence area of the subproject. Merit points are obtained as follows:

SB	MP(SB)	10% MP(SB)
High	100	10
Medium	65	6.5
Low	30	3

5.2 Minor Road Sub-project

The worksheet for evaluating/rating minor road subprojects is presented in Table 5-2. The Subproject Proposal Form (Table 4-1, hereinafter referred simply as the Proposal) is used as basic input data.

1) Name of Road and 2) Province

These are taken directly from the Proposal. Province type is decided from Table 5-3.

3) AADT in Opening Year

Population served (P) and cultivated area within road influence area (A) are taken from the Proposal. AADT in the opening year is estimated as follows, depending on province type:

Province Type	Equation
MR	AADT = 0.031P + 0.015A - 2.4
BP	AADT = 0.003P + 0.002A + 2.4
GP	AADT = 0.014P + 0.007A - 8.1
MP	AADT = 0.011P + 0.008A - 1.8

4) Construction Cost

Construction cost is computed in the same manner as used for major road subproject.

5) Economic Evaluation

Category

- Province type is as decided above.

- Road type is selected between the following two:

  1-direction access : connected to a higher standard road at one end

  2-direction access : connected to a higher standard roads at both ends

  The location map attached to the Proposal is referred to in the selection.

- Existing pavement type and condition are represented by these predominating in the whole subproject road.

- Proposed pavement type is as decided above.

- Terrain is that predominating in the whole subproject road.

- Cultivated area within road influence area used for estimating AADT is again entered and divided by the total improvement length.

Benefit

- Traffic benefit per km per vehicle is obtained by looking up Table 5-10. It is multiplied by total improvement length and by AADT to get traffic benefit.

- Development benefit per km is obtained by looking up Table 5-11. It is multiplied by total improvement length to get development benefit.

- Maintenance cost savings is computed in the same manner as used for major road subprojects.

- Total benefit is computed as the sum of traffic benefit, development benefit and maintenance cost savings.

- Economic cost, B/C ratio and IRR are computed in the same manner as used for major road subprojects.

Rating

Project rating is conducted in the same manner as used for major road subprojects.

TABLE 5-1 WORKSHEET FOR EVALUATING/RATING MAJOR ROAD SUBPROJECT

SUBPROJECT EVALUATION/RATING SHEET (MAJOR ROAD)

1) Name of Road _____

2) Province _____

3) AADT in Opening Year = Present AADT _____ x 1.03^{n} = ① _____ (n: Number of years to the opening year = ___)

4) Construction Cost

Road

Subsection No.	② Length of Subsection (km)	Terrain	Existing Pavement: Type	Existing Pavement: Condition	Proposed Pavement: Type (Table 5-4)	Proposed Pavement: Width (m)	Type of Improvement (Table 5-5)	Construction Cost (1,000 ₱): ③ Cost per km (Table 5-7)	Construction Cost (1,000 ₱): ④ Cost (② x ③)	Additional Cost for Flood Section (1,000 ₱): ⑤ Flood Section Length (km)	Additional Cost for Flood Section (1,000 ₱): ⑥ Add. Cost per km (Table 5-8)	Additional Cost for Flood Section (1,000 ₱): ⑦ Add. Cost (⑤ x ⑥)	Total Cost (1,000 ₱) (④ + ⑦)
1													
2													
3													
4													
	⑧ ← Total Improvement Length (excluding no-improvement subsection)											Total	⑨

Bridge

No.	Existing Bridge Type	Proposed Bridge: Type (Table 5-6)	Proposed Bridge: No. of Lanes	Proposed Bridge: ⑩ Length (m)	Proposed Bridge: ⑪ No. of Spans (⑩/20 & round)	Unit Cost (1,000 ₱): ⑫ Superstruct. per m	Unit Cost (1,000 ₱): ⑬ Abutment (Table 5-9)	Unit Cost (1,000 ₱): ⑭ Pier	Cost (1,000 ₱): ⑮ Superstruct. (⑩ x ⑫)	Cost (1,000 ₱): ⑯ Abutment (2 x ⑬)	Cost (1,000 ₱): ⑰ Pier ((⑪ -1) x ⑭)	Cost (1,000 ₱): Total (⑮ + ⑯ + ⑰)
1												
2												
3												
4												
											Total	⑱

Total Construction Cost = ⑨ + ⑱ = ⑲ _____ x 1,000 ₱

5) Economic Evaluation

Benefit

Province Type (Table 5-3)	Existing Pavement Type (Predominant)	Existing Surface Condition (Predominant)	Proposed Pavement Type	Traffic Benefit (1,000 ₱): ⑳ Benefit per km per veh (Table 5-10)	Traffic Benefit (1,000 ₱): ㉑ Benefit (⑳ x ⑧ x ①)	Maintenance Cost Savings (1,000 ₱): ㉒ Benefit per km per veh (-3.87-0.162 x ⑳)	Maintenance Cost Savings (1,000 ₱): ㉓ Benefit (㉒ x ⑧ x ①)	㉔ Total Benefit (1,000 ₱) (㉑ + ㉓)

Economic Cost = ⑲ x 0.831 = ㉕ _____ x 1,000 ₱

B/C Ratio = ㉔ / ㉕ = ㉖ _____

IRR = 1.676 + 13.324 x ㉖ (㉖ ≧ 1) = ㉗ _____ %

= -3.018 + 18.018 x ㉖ (㉖ < 1)

6) Rating

	IRR _____ % (㉗)	Household Income per Month (HI) _____ ₱	Social Benefit (SB) _____	Project Rating
Formula	IRR < 40 : 14 + 1.4 x IRR IRR ≧ 40 : 70	HI ≧ 5,000 : 5 2,000 < HI < 5,000 : 30-HI/200 HI ≦ 2,000 : 20	High : 10 Medium : 6.5 Low : 3	㉘ + ㉙ + ㉚
Merit Points x Weight	㉘	㉙	㉚	

TABLE 5-2 WORKSHEET FOR EVALUATING/RATING MINOR ROAD SUBPROJECT

SUBPROJECT EVALUATION/RATING SHEET (MINOR ROAD)

1) Name of Road _____

2) Province _____ Province Type (Table 5-3) _____

3) AADT in Opening Year

Population Served (P) _____

Cultivated Area within Road Influence Area (A) _____ ha

AADT in Opening Year ① _____

AADT = 0.031P + 0.015A – 2.4 (Province Type MR)
AADT = 0.003P + 0.002A + 2.4 (Province Type BP)
AADT = 0.014P + 0.007A – 8.1 (Province Type GP)
AADT = 0.011P + 0.008A – 1.8 (Province Type MP)

4) Construction Cost

Road

Subsection No.	② Length of Subsection (km)	Terrain	Existing Pavement		Proposed Pavement		Type of Improvement (Table 5-5)	Construction Cost (1,000 ₱)		Additional Cost for Flood Section (1,000 ₱)			Total Cost (1,000 ₱) (④ + ⑦)
			Type	Condition	Type (Table 5-4)	Width (m)		③ Cost per km (Table 5-7)	④ Cost (② x ③)	⑤ Flood Section Length (km)	⑥ Add. Cost per km (Table 5-8)	⑦ Add. Cost (⑤ x ⑥)	
1													
2													
3													
4													
	⑧ ← Total Improvement Length (excluding no-improvement subsection)											Total	⑨

Bridge

No.	Existing Bridge Type	Proposed Bridge				Unit Cost (1,000 ₱)			Cost (1,000 ₱)			
		Type (Table 5-6)	No. of Lanes	⑩ Length (m)	⑪ No. of Spans (⑩ /20 & round)	⑫ Superstruct. per m	⑬ Abutment (Table 5-9)	⑭ Pier	⑮ Superstruct. (⑩ x ⑫)	⑯ Abutment (2 x ⑬)	⑰ Pier ((⑪ -1) x ⑭)	Total (⑮ + ⑯ + ⑰)
1												
2												
3												
4												
											Total	⑱

Total Construction Cost = ⑨ + ⑱ = ⑲ _____ x 1,000 ₱

5) Economic Evaluation

Category

Province Type	Road Type	Existing Pavement Type (Predominant)	Existing Surface Condition (Predominant)	Proposed Pavement Type	Terrain (Predominant)	Cultivated Area within RIA	
						⑳ Area (ha)	Area per km (⑳ / ⑧)

Benefit

Traffic Benefit (1,000 ₱)		Development Benefit (1,000 ₱)		Maintenance Cost Savings (1,000 ₱)		㉑ Total Benefit (1,000 ₱) (㉒ + ㉑ + ㉖)
㉑ Benefit per km per veh (Table 5-10)	㉒ Benefit (㉑ x ⑧ x ①)	㉓ Benefit per km (Table 5-11)	㉔ Benefit (㉓ x ⑧)	㉕ Benefit per km per veh (–3.87 –0.162 x ㉑)	㉖ Benefit (㉕ x ⑧ x ①)	

Economic Cost = ⑲ x 0.831 = ㉗ _____ x 1,000 ₱

B/C Ratio = ㉒ / ㉗ = ㉘ _____

IRR = 1.676 + 13.324 x ㉘ (㉘ ≧ 1) } = ㉙ _____ %
= –3.018 + 18.018 x ㉘ (㉘ < 1) }

6) Rating

	IRR _____ % (㉙)	Household Income per Month (HI) _____ ₱	Social Benefit (SB) _____	Project Rating
Formula	IRR < 40 : 14 + 1.4 x IRR IRR ≧ 40 : 70	HI ≧ 5,000 : 5 2,000 < HI < 5,000 : 30–HI/200 HI ≦ 2,000 : 20	High : 10 Medium : 6.5 Low : 3	㉑ + ㉜ + ㉝
Merit Points x Weight	㉛	㉜	㉝	

TABLE 5-3 PROVINCE TYPE

Province	Province Type
Region I	
Abra	GL
Benguet	AD
Ilocos Norte	GL
Ilocos Sur	GL
La Union	AD
Mountain Province	AL
Pangasinan	AL
Region II	
Batanes	GL
Cagayan	AL
Ifugao	AL
Isabela	BL
Kalinga-Apayao	BL
Nueva Vizcaya	GL
Quirino	AL
Region III	
Bataan	GL
Bulacan	AD
Nueva Ecija	AL
Pampanga	AD
Tarlac	AL
Zambales	AD
Region IV	
Aurora	BL
Batangas	GL
Cavite	AD
Laguna	AD
Marinduque	AL
Occcidental Mindoro	BL
Oriental Mindoro	BL
Palawan	BL
Quezon	BL
Rizal	AL
Romblon	GL
Region V	
Albay	AL
Camarines Norte	AL
Camarines Sur	AL
Catanduanes	AL
Masbate	BL
Sorsogon	AL
Region VI	
Aklan	AL
Antique	AL
Capiz	AL
Iloilo	AL
Negros Occidental	AL
Region VII	
Bohol	GL
Cebu	AL
Negros Oriental	BL
Siquijor	GL
Region VIII	
Leyte	AL
Southern Leyte	AL
Eastern Samar	BL
Northern Samar	BL
Samar	BL
Region IX	
Basilan	BL
Sulu	BL
Tawi-Tawi	BL
Zamboanga del Norte	AL
Zamboanga del Sur	BL
Region X	
Agusan del Norte	AL
Agusan del Sur	BL
Bukidnon	AL
Camiguin	GL
Misamis Occidental	GL
Misamis Oriental	AL
Surigao del Norte	AL
Region XI	
Davao del Norte	BL
Davao del Sur	BL
Davao Oriental	BL
South Cotabato	AL
Surigao del Sur	BL
Region XII	
Lanao del Norte	GL
Lanao del Sur	BL
Maguindanao	BL
North Cotabato	BL
Sultan Kudarat	BL

TABLE 5-4 PROPOSED PAVEMENT TYPE AND WIDTH

Major Road

AADT in Opening Year	Primary Major [1]		Secondary Major [1]	
	Pavement Type[2]	Width (m)	Pavement Type[2]	Width (m)
Over 2,000	PCC [4]	6.7	PCC [4]	6.7
1,000 - 2,000				6.0
400 - 1,000	AC [4]	6.7	AC [4]	6.0
200 - 400	BMP [3] [4]	6.0	BMP [3] [4]	6.0
100 - 200			Gravel	6.0
Under 100	Gravel	6.0		

Minor Road

AADT in Opening Year	Collector Road [1]		Feeder Road [1]	
	Pavement Type[2]	Width (m)	Pavement Type[2]	Width (m)
Over 400	AC [4]	6.0	AC [4]	6.0
200 - 400	BMP [3] [4]	6.0	BMP [3] [4]	6.0
50 - 200	Gravel	6.0	Gravel	4.0
Under 50		4.0		

Note : 1) Classification is made in accordance with Table 2-1. For minor road, national/provincial/city roads are, generally classified as collector roads and barangay roads as feeder roads.

2) Where existing pavement type is superior to that proposed above, the former should be used.

3) BMP is replaced by DBST as the case may be (Refer to Section 18.1 3) of the Main Report). It is, however, recommended to assume BMP for budgetary and evaluating purposes.

4) AC overlay is applied where existing pavement type is equivalent or superior to that proposed above and existing conditions warrant the use of AC overlay. The possibility of AC overlay is indicated in the Proposal.

TABLE 5-5 TYPE OF IMPROVEMENT

Road Class / Existing Pavement Type / Surface Condition		Major Road		Minor Road	
		Standard	Substandard	Standard	Substandard
Good/Fair	Wc[1] < 6.0 m	Widening	Improvement-2	-	-
	Wc ≥ 6.0 m	-			
Bad/Very Bad		Rehabilitation	Improvement-1	Rehabilitation	Improvement-1
Impassable		New Construction			

Note : 1) Wc = Existing carridgeway width

TABLE 5-6 PROPOSED BRIDGE TYPE AND NUMBER OF LANES

Existing Bridge Type	Proposed Improvement	
	Major Road	Minor Road
Ford Crossing	2-lane Permanent Bridge	Carridgeway Width in Abutting Road Section 4.0 m : 1-lane Spillway [1] Carridgeway Width in Abutting Road Section 6.0 m : 2-lane Spillway [1]
Spillway	2-lane Permanent Bridge	No Improvement [2]
Timber Bridge	2-lane Permanent Bridge	AADT less than 200 : 1-lane Permanent Bridge AADT more than 200 : 2-lane Permanent Bridge
Bailey Bridge	2-lane Permanent Bridge	AADT less than 300 : No Improvement AADT more than 300 : 2-lane Permanent 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 timber bridges.

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

TABLE 5-7 CONSTRUCTION COST BY TYPE OF IMPROVEMENT
(Thousand Pesos per Km. in 1988 Price)

Type of Improvement	Road Sect. Type	Existing Pavement		Proposed Pavement		Terrain		
		Type	Condition	Type	Width	Flat	Rolling	Mountain
Rehabilitation	1-1	PCC	Bad/V.Bad	PCC	6.7 m.	2,839	2,886	2,974
	1-1	PCC	- do -	PCC	6.0 m.	2,613	2,639	2,762
	1-2	PCC	- do -	Overlay	6.7 m.	1,333	1,314	1,295
	1-2	PCC	- do -	Overlay	6.0 m.	1,207	1,188	1,169
	1-3	Bitum.	- do -	AC	6.7 m.	2,432	2,573	2,646
	1-3	Bitum.	- do -	AC	6.0 m.	2,246	2,365	2,473
	1-4	Bitum.	- do -	Overlay	6.7 m.	1,296	1,277	1,258
	1-4	Bitum.	- do -	Overlay	6.0 m.	1,174	1,155	1,136
	1-5	Bitum.	- do -	BMP/DBST	6.0 m.	1,547	1,672	1,982
	1-6	Gravel	- do -	Gravel	6.0 m.	658	736	1,073
	1-6	Gravel	- do -	Gravel	4.0 m.	440	459	482
Improvement-1	2-1	Bitum.	Bad/V.Bad	PCC	6.7 m.	2,863	2,921	3,219
	2-1	Bitum.	- do -	PCC	6.0 m.	2,624	2,659	2,907
	2-2	Gravel	- do -	PCC	6.7 m.	3,006	3,077	3,336
	2-2	Gravel	- do -	PCC	6.0 m.	2,765	2,813	3,078
	2-3	Gravel	- do -	AC	6.7 m.	2,597	2,764	3,006
	2-3	Gravel	- do -	AC	6.0 m.	2,395	2,539	2,790
	2-4	Gravel	- do -	BMP/DBST	6.0 m.	1,692	1,843	2,297
	2-5	Earth	Any	PCC	6.7 m.	3,006	3,077	3,336
	2-5	Earth	- do -	PCC	6.0 m.	2,765	2,813	3,078
	2-6	Earth	- do -	AC	6.7 m.	2,597	2,764	3,006
	2-6	Earth	- do -	AC	6.0 m.	2,395	2,539	2,790
	2-7	Earth	- do -	BMP/DBST	6.0 m.	1,692	1,843	2,297
	2-8	Earth	- do -	Gravel	6.0 m.	671	771	1,133
	2-8	Earth	- do -	Gravel	4.0 m.	440	478	526
Improvement-2	3-1	Bitum.	Good/Fair	PCC	6.7 m.	2,863	2,921	3,219
	3-1	Bitum.	- do -	PCC	6.0 m.	2,624	2,659	2,907
	3-2	Gravel	- do -	PCC	6.7 m.	2,863	2,969	3,247
	3-2	Gravel	- do -	PCC	6.0 m.	2,623	2,704	2,994
	3-3	Gravel	- do -	AC	6.7 m.	2,455	2,656	2,916
	3-3	Gravel	- do -	AC	6.0 m.	2,255	2,430	2,706
	3-4	Gravel	- do -	BMP/DBST	6.0 m.	1,555	1,733	2,213
Widening	4-1	PCC	Good/Fair	PCC	6.7 m.	1,420	1,552	1,790
	4-1	PCC	- do -	PCC	6.0 m.	1,174	1,279	1,540
	4-2	Bitum.	- do -	AC	6.7 m.	1,262	1,441	1,664
	4-2	Bitum.	- do -	AC	6.0 m.	1,054	1,206	1,452
	4-3	Bitum.	- do -	BMP/DBST	6.0 m.	753	914	1,274
	4-4	Gravel	- do -	Gravel	6.0 m.	607	747	1,082
	4-4	Gravel	- do -	Gravel	4.0 m.	344	385	434
New Construction	5-1	-	-	PCC	6.7 m.	3,552	3,610	3,918
	5-1	-	-	PCC	6.0 m.	3,327	3,386	3,694
	5-2	-	-	AC	6.7 m.	3,165	3,305	3,602
	5-2	-	-	AC	6.0 m.	2,979	3,119	3,415
	5-3	-	-	BMP/DBST	6.0 m.	2,300	2,462	2,862
	5-4	-	-	Gravel	6.0 m.	1,079	1,160	1,514
	5-4	-	-	Gravel	4.0 m.	562	585	624

TABLE 5-8 ADDITIONAL COST FOR FLOOD SECTION
(Thousand Pesos per km in 1988 Price)

Road Class	Pavement Width	Additional Cost
Primary Major Road	6.7 m	2,600
	6.0 m	2,400
Secondary Major Road	6.7 m	1,700
	6.0 m	1,500
Minor Road	6.0 m	1,300
	4.0 m	1,100

TABLE 5-9 BRIDGE CONSTURCTION COST
(Thousand Pesos in 1988 Price)

Bridge Type		Unit	Cost
2-lane Bridge	Supersturcture	Lin.M	40.2
	Abutment	Each	288.0
	Pier	Each	258.5
1-lane Bridge	Supersturcture	Lin.M	30.3
	Abutment	Each	202.4
	Pier	Each	181.5
2-lane Spillway		Lin.M	15.4
1-lane Spillway		Lin.M	11.4

TABLE 5-10 STANDARD TRAFFIC BENEFIT (1,000₱/km/veh)

Minor Road: 1-direction Acess

Existing Pavement Condition	Province AD			Province BL			Province GL			Province AL		
	Proposed Pavement Type			Proposed Pavement Type			Proposed Pavement Type			Proposed Pavement Type		
	PCC/AC	BMP/DBST	Gravel	PCC/AC	BMP/DBST	Gravel	PCC/AC	BMP/DBST	Gravel	PCC/AC	BMP/DBST	Gravel
Paved (Bad)	9.874	8.468	.064	23.963	22.557	14.153	30.477	29.071	20.667	18.233	16.827	8.423
(Very Bad)	14.103	12.697	4.293	28.192	26.786	18.382	34.706	33.300	24.896	22.462	21.056	12.652
(Impassable)	28.241	26.835	18.431	42.330	40.924	32.520	48.844	47.438	39.034	36.600	35.194	26.790
Gravel (Good/Fair)	5.997	4.591	-	20.086	18.680	-	26.600	25.194	-	14.356	12.950	-
(Bad)	12.198	10.792	2.388	26.287	24.881	16.477	32.801	31.395	22.991	20.557	19.151	10.747
(Very Bad)	16.427	15.021	6.617	30.516	29.110	20.706	37.030	35.624	27.220	24.786	23.380	14.976
(Impassable)	30.565	29.159	20.755	44.654	43.248	34.844	51.168	49.762	41.358	38.924	37.518	29.114
Earth (Bad)	22.041	20.635	12.231	36.130	34.724	26.320	42.644	41.238	32.834	30.400	28.994	20.590
(Very Bad)	26.270	24.864	16.460	40.359	38.953	30.549	46.873	45.467	37.063	34.629	33.223	24.819
(Impassable)	40.408	39.002	30.598	54.497	53.091	44.687	61.011	59.605	51.201	48.767	47.361	38.957

Minor Road: 2-direction Acess

Existing Pavement Condition	Province AD			Province BL			Province GL			Province AL		
	Proposed Pavement Type			Proposed Pavement Type			Proposed Pavement Type			Proposed Pavement Type		
	PCC/AC	BMP/DBST	Gravel	PCC/AC	BMP/DBST	Gravel	PCC/AC	BMP/DBST	Gravel	PCC/AC	BMP/DBST	Gravel
Paved (Bad)	2.168	.762	0.003	16.257	14.851	6.447	22.771	21.365	12.961	10.527	9.121	.717
(Very Bad)	6.397	4.991	0.020	20.486	19.080	10.676	27.000	25.594	17.190	14.756	13.350	4.946
(Impassable)	20.535	19.129	10.725	34.624	33.218	24.814	41.138	39.732	31.328	28.894	27.488	19.084
Gravel (Good/Fair)	0.067	0.046	-	12.380	10.974	-	18.894	17.488	-	6.650	5.244	-
(Bad)	4.492	3.086	0.249	18.581	17.175	8.771	25.095	23.689	15.285	12.851	11.445	3.041
(Very Bad)	8.721	7.315	0.590	22.810	21.404	13.000	29.324	27.918	19.514	17.080	15.674	7.270
(Impassable)	22.859	21.453	13.049	36.948	35.542	27.138	43.462	42.056	33.652	31.218	29.812	21.408
Earth (Bad)	14.335	12.929	4.525	28.424	27.018	18.614	34.938	33.532	25.128	22.694	21.288	12.884
(Very Bad)	18.564	17.158	8.754	32.653	31.247	22.843	39.167	37.761	29.357	26.923	25.517	17.113
(Impassable)	32.702	31.296	22.892	46.791	45.385	36.981	53.305	51.899	43.495	41.061	39.655	31.251

Major Road

Existing Pavement Condition	Province AD			Province BL			Province GL			Province AL		
	Proposed Pavement Type			Proposed Pavement Type			Proposed Pavement Type			Proposed Pavement Type		
	PCC/AC	BMP/DBST	Gravel	PCC/AC	BMP/DBST	Gravel	PCC/AC	BMP/DBST	Gravel	PCC/AC	BMP/DBST	Gravel
Paved (Bad)	3.996	2.590	0.020	18.085	16.679	8.275	24.599	23.193	14.789	12.355	10.949	2.545
(Very Bad)	8.225	6.819	0.053	22.314	20.908	12.504	28.828	27.422	19.018	16.584	15.178	6.774
(Impassable)	22.363	20.957	12.553	36.452	35.046	26.642	42.966	41.560	33.156	30.722	29.316	20.912
Gravel (Good/Fair)	.119	0.093	-	14.208	12.802	-	20.722	19.316	-	8.478	7.072	-
(Bad)	6.320	4.914	0.397	20.409	19.003	10.699	26.923	25.517	17.113	14.679	13.273	4.869
(Very Bad)	10.549	9.143	.739	24.638	23.232	14.828	31.152	29.746	21.342	18.908	17.502	9.098
(Impassable)	24.687	23.281	14.877	38.776	37.370	28.966	45.290	43.884	35.480	33.046	31.640	23.236
Earth (Bad)	16.163	14.757	6.353	30.252	28.846	20.442	36.766	35.360	26.956	24.522	23.116	14.712
(Very Bad)	20.392	18.986	10.582	34.481	33.075	24.671	40.995	39.589	31.185	28.751	27.345	18.941
(Impassable)	34.530	33.124	24.720	48.619	47.213	38.809	55.133	53.727	45.323	42.889	41.483	33.079

TABLE 5-11 DEVELOPMENT BENEFIT (1,000 ₱/km)

Province Type AD

Terrain	Existing Surface Condition	Cultivated Area (ha./km) 0-50	50-100	100-150	150-200	200-
Flat	Bad	59.6	81.7	92.6	111.0	131.0
	Very Bad	67.4	89.6	100.4	118.8	138.8
	Impassable	106.6	128.8	139.6	158.0	178.0
Rolling	Bad	88.9	111.1	121.9	140.3	160.3
	Very Bad	96.7	118.9	129.8	148.2	168.2
	Impassable	135.9	158.1	169.0	187.4	207.4
Mountainous	Bad	62.0	84.2	95.0	113.4	133.4
	Very Bad	69.8	92.0	102.9	121.3	141.3
	Impassable	109.0	131.2	142.1	160.5	180.5

Province Type BL

Terrain	Existing Surface Condition	Cultivated Area (ha./km) 0-50	50-100	100-150	150-200	200-
Flat	Bad	79.7	101.8	112.7	131.1	151.1
	Very Bad	87.5	109.7	120.6	138.9	158.9
	Impassable	126.7	148.9	159.8	178.1	198.1
Rolling	Bad	109.0	131.2	142.0	160.4	180.4
	Very Bad	116.8	139.0	149.9	168.3	188.3
	Impassable	156.0	178.2	189.1	207.5	227.5
Mountainous	Bad	82.1	104.3	115.1	133.5	153.5
	Very Bad	90.0	112.1	123.0	141.4	161.4
	Impassable	129.2	151.3	162.2	180.6	200.6

Province Type GL

Terrain	Existing Surface Condition	Cultivated Area (ha./km) 0-50	50-100	100-150	150-200	200-
Flat	Bad	81.0	103.2	114.1	132.5	152.4
	Very Bad	88.9	111.1	121.9	140.3	160.3
	Impassable	128.1	150.3	161.1	179.5	199.5
Rolling	Bad	110.4	132.5	143.4	161.8	181.8
	Very Bad	118.2	140.4	151.2	169.6	189.6
	Impassable	157.4	179.6	190.4	208.8	228.8
Mountainous	Bad	83.5	105.6	116.5	134.9	154.9
	Very Bad	91.3	113.5	124.4	142.7	162.7
	Impassable	130.5	152.7	163.6	181.9	201.9

Province Type AL

Terrain	Existing Surface Condition	Cultivated Area (ha./km) 0-50	50-100	100-150	150-200	200-
Flat	Bad	64.5	86.7	97.6	116.0	135.9
	Very Bad	72.4	94.6	105.4	123.8	143.8
	Impassable	111.6	133.8	144.6	163.0	183.0
Rolling	Bad	93.9	116.0	126.9	145.3	165.3
	Very Bad	101.7	123.9	134.7	153.1	173.1
	Impassable	140.9	163.1	173.9	192.3	212.3
Mountainous	Bad	67.0	89.1	100.0	118.4	138.4
	Very Bad	74.8	97.0	107.9	126.2	146.2
	Impassable	114.0	136.2	147.1	165.4	185.4

5.3 Sample Calculations

(1) Calculation 1 : Major Road

(2) Calculation 2 : Minor Road

TABLE 5-12 SUBPROJECT PROPOSAL FORM FOR CALCULATION 1

SUBPROJECT PROPOSAL FORM

1. Name of Road Magallanes - Amuyong City/Municipality Magallanes/Alfonso
2. Location : Province Cavite
3. Administrative Classification of Project Road Provincial
4. Total Length 16.7 km
5. Road Data

Station	Length of Sub-section (km)	Terrain	Cross-Section: Carriageway (m)	Cross-Section: Shoulder (m)	Surface Type	Surface Condition	Possibility of Rehabilitating by AC Overlay	Flood Section: Length (km)	Flood Section: Water Depth (m)	Length of Steep Gradient Section (m)	Remarks
60.0-60.7	0.7	Flat	6.0	2.0	PCC	Fair	—	—	—	—	
60.7-64.2	3.5	Flat	6.0	1.5	Gravel	Very bad	No	—	—	—	
64.2-70.5	6.3	Hill	6.0	1.5	Earth	Very bad	No	—	—	—	
70.5-76.7	6.2	Mt	6.0	1.0	PCC	Fair	—	—	—	—	
—											

6. Bridge Date

Station	Bridge Type	Length (m)	Width (m)	Structural Condition	Proposed Bridge Length (m)	Remarks
73.0	Bailey	6	3.0	Fair	10	

7. Traffic Data (omissible for minor road)

	Present Traffic	Potential Traffic Diverted	Total
Car/Van	44	—	44
Jeepney	123	—	123
Bus	—	—	—
Truck	32	—	32
Total	199	—	199

Date of Survey June 23, 1988
Name of Road from which diversion is expected

8. Socio-economic Date (omissible for major road, except average household income)

	Total for entire road
Population Served	—
Cultivated Area Within Road Influence Area (ha)	
Average Household Income per Month (Peso)	4,200

9. General Remarks

Note: Attach map indicating general location of proposed project preferably in 1:50,000 topographic map.

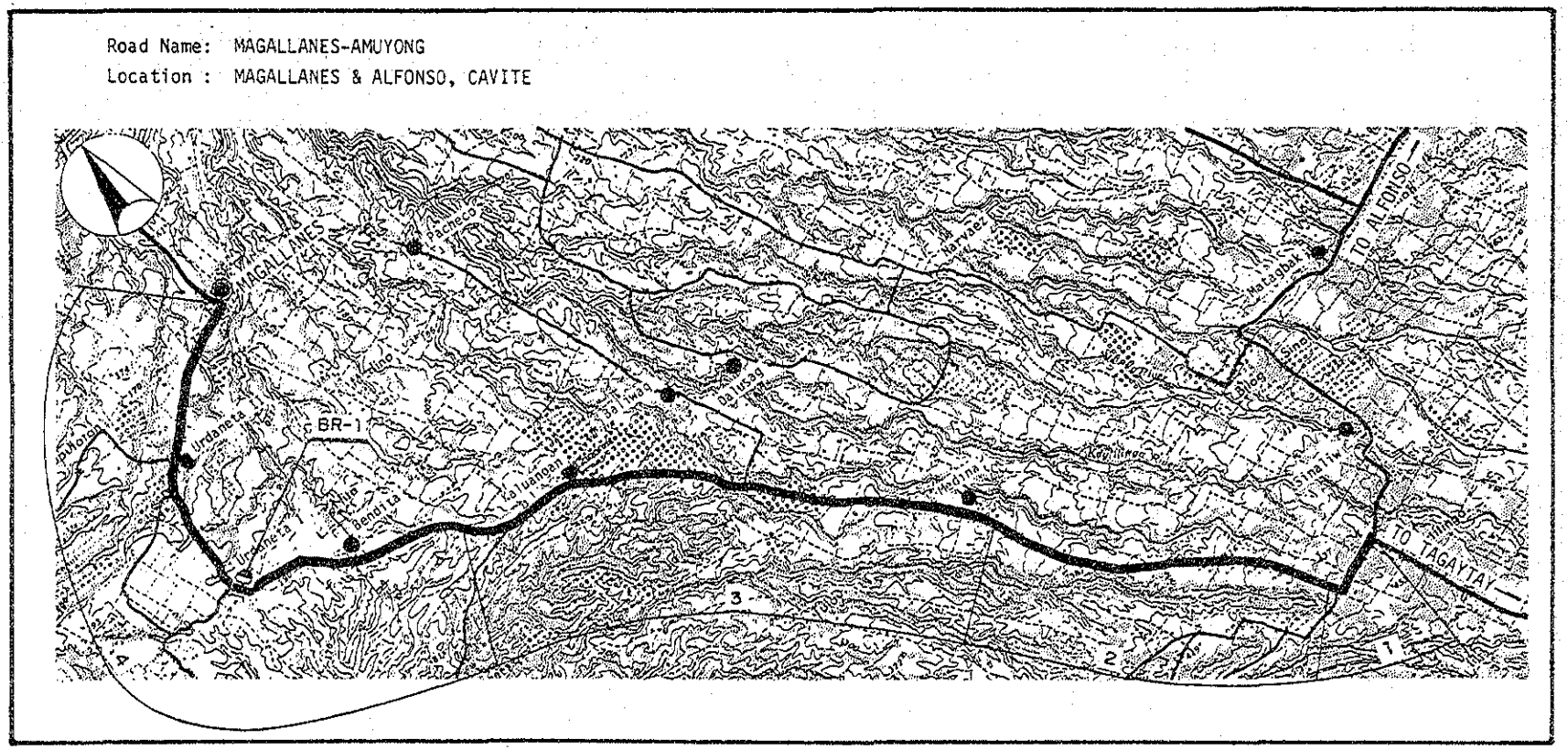


FIGURE 5-1 LOCATION MAP FOR CALCULATION 1

TABLE 5-13 SUBPROJECT EVALUATION/RATING WORKSHEET FOR CALCULATION 1

SUBPROJECT EVALUATION/RATING SHEET (MAJOR ROAD)

1) Name of Road Magallanes - Amuyong

2) Province Cavite

3) AADT in Opening Year = Present AADT 199 x 1.03^{n} = ① 224 (n: Number of years to the opening year = 4)

4) Construction Cost

Road

Subsection No.	② Length of Subsection (km)	Terrain	Existing Pavement: Type	Existing Pavement: Condition	Proposed Pavement: Type (Table 5-4)	Proposed Pavement: Width (m) (Table 5-4)	Type of Improvement (Table 5-5)	Construction Cost (1,000 ₱): ③ Cost per km (Table 5-7)	Construction Cost (1,000 ₱): ④ Cost (②x③)	Additional Cost for Flood Section (1,000 ₱): ⑤ Flood Section Length (km)	Additional Cost for Flood Section (1,000 ₱): ⑥ Add. Cost per km (Table 5-8)	Additional Cost for Flood Section (1,000 ₱): ⑦ Add. Cost (⑤x⑥)	Total Cost (1,000 ₱) (④+⑦)
1	0.7	Flat	PCC	Fair	—	—	—	—	—	—	—	—	—
2	3.5	Flat	Gravel	Very bad	BMP	6.0	Impr.-1	1,692	5,922	—	—	—	5,922
3	6.3	Rolling	Earth	Very bad	BMP	6.0	Impr.-1	1,843	11,611	—	—	—	11,611
4	6.2	Mountain	PCC	Fair	—	—	—	—	—	—	—	—	—
	⑧ 9.8 ← Total Improvement Length (excluding no-improvement subsection)											Total	⑨ 17,533

Bridge

No.	Existing Bridge Type	Proposed Bridge: Type (Table 5-6)	Proposed Bridge: No. of Lanes	Proposed Bridge: ⑩ Length (m)	Proposed Bridge: ⑪ No. of Spans (⑩/20 & round)	Unit Cost (1,000 ₱): ⑫ Superstruct. per m	Unit Cost (1,000 ₱): ⑬ Abutment (Table 5-9)	Unit Cost (1,000 ₱): ⑭ Pier	Cost (1,000 ₱): ⑮ Superstruct. (⑩x⑫)	Cost (1,000 ₱): ⑯ Abutment (2 x ⑬)	Cost (1,000 ₱): ⑰ Pier ((⑪-1) x ⑭)	Cost (1,000 ₱): Total (⑮+⑯+⑰)
1	Bailey	Permanent Bridge	2	10	1	40.2	288.0	258.5	402	576	—	978
2												
3												
4											Total	⑱ 978

Total Construction Cost = ⑨ + ⑱ = ⑲ 18,511 x 1,000 ₱

5) Economic Evaluation

Benefit

Province Type (Table 5-3)	Existing Pavement Type (Predominant)	Existing Surface Condition (Predominant)	Proposed Pavement Type	Traffic Benefit (1,000 ₱): ⑳ Benefit per km per veh (Table 5-10)	Traffic Benefit (1,000 ₱): ㉑ Benefit (⑳x⑧x①)	Maintenance Cost Savings (1,000 ₱): ㉒ Benefit per km per veh (-3.87-0.162 x ⑳)	Maintenance Cost Savings (1,000 ₱): ㉓ Benefit (㉒x⑧x①)	㉔ Total Benefit (1,000 ₱) (㉑+㉓)
AD	Earth	Very bad	BMP	18,986	41,678	-6.95	-15,257	26,421

Economic Cost = ⑲ x 0.831 = ㉕ 15,383 x 1,000 ₱

B/C Ratio = ㉔ / ㉕ = ㉖ 1.72

IRR = 1.676 + 13.324 x ㉖ (㉖ ≧ 1) = ㉗ 24.6 %

= -3.018 + 18.018 x ㉖ (㉖ < 1)

6) Rating

	IRR: 24.6 % (㉗)	Household Income per Month (HI): 4,200 ₱	Social Benefit (SB): Medium	Project Rating
Formula	IRR < 40 : 14 + 1.4 x IRR IRR ≧ 40 : 70	HI ≧ 5,000 : 5 2,000 < HI < 5,000 : 30-HI/200 HI ≦ 2,000 : 20	High : 10 Medium : 8.5 Low : 3	㉘ + ㉙ + ㉚
Merit Points x Weight	㉘ 48	㉙ 9	㉚ 6.5	63.5

TABLE 5-14 SUBPROJECT PROPOSAL FORM FOR CALCULATION 2

SUBPROJECT PROPOSAL FORM

1. Name of Road San Rafael Road
2. Location : Province Masbate City/Municipality Catamgan
3. Administrative Classification of Project Road Barangay
4. Total Length 5.5 km
5. Road Data

Station	Length of Sub-section (km)	Terrain	Cross-Section		Surface Type	Surface Condition	Possibility of Rehabilitating by AC Overlay	Flood Section		Length of Steep Gradient Section (m)	Remarks
			Carriageway (m)	Shoulder (m)				Length (km)	Water Depth (m)		
2.0-2.2	0.2	Flat	4.0	0.2	Earth	Very bad	No	—	—	—	
2.2-2.7	0.5	Hill	3.5	0.2	Earth	Very bad	No	—	—	—	
2.7-7.5	4.8	Hill	—	—	Earth	Impassable	No	—	—	—	
—											
—											

6. Bridge Date

Station	Bridge Type	Length (m)	Width (m)	Structural Condition	Proposed Bridge Length (m)	Remarks

7. Traffic Data (omissible for minor road)

	Present Traffic	Potential Traffic Diverted	Total
Car/Van			
Jeepney			
Bus			
Truck			
Total			

Date of Survey _____
Name of Road from which diversion is expected _____

8. Socio-economic Date (omissible for major road, except average household income)

	Total for entire road
Population Served	2,325
Cultivated Area Within Road Influence Area (ha)	610
Average Household Income per Month (Peso)	1,245

9. General Remarks _____

Note: Attach map indicating general location of proposed project preferably in 1:50,000 topographic map.

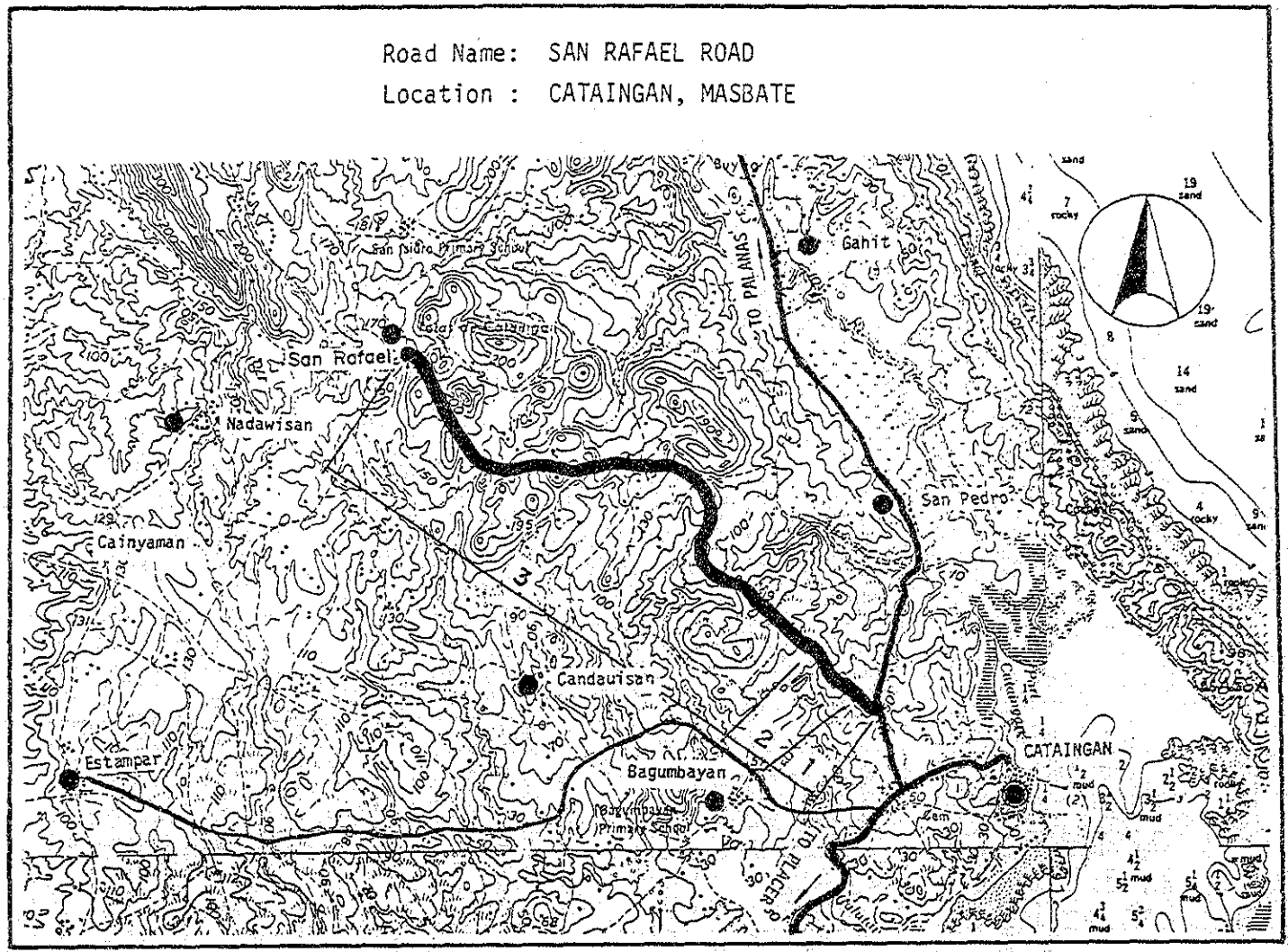


FIGURE 5-2 LOCATION MAP FOR CALCULATION 2

TABLE 5-15 SUBPROJECT EVALUATION/RATING WORKSHEET FOR CALCULATION 2

SUBPROJECT EVALUATION/RATING SHEET (MINOR ROAD)

1) Name of Road: San Rafael Road

2) Province: Masbate — Province Type (Table 5-3): BP

3) AADT in Opening Year

Population Served (P): 2,325

Cultivated Area within Road Influence Area (A): 610 ha

AADT in Opening Year ①: 10.6

AADT = 0.031P + 0.015A – 2.4 (Province Type MR)
AADT = 0.003P + 0.002A + 2.4 (Province Type BP)
AADT = 0.014P + 0.007A – 8.1 (Province Type GP)
AADT = 0.011P + 0.008A – 1.8 (Province Type MP)

4) Construction Cost

Road

Subsection No.	② Length of Subsection (km)	Terrain	Existing Pavement: Type	Existing Pavement: Condition	Proposed Pavement: Type (Table 5-4)	Proposed Pavement: Width (m)	Type of Improvement (Table 5-6)	Construction Cost (1,000 ₱): ③ Cost per km (Table 5-7)	Construction Cost (1,000 ₱): ④ Cost (② x ③)	Additional Cost for Flood Section (1,000 ₱): ⑤ Flood Section Length (km)	Additional Cost for Flood Section (1,000 ₱): ⑥ Add. Cost per km (Table 5-8)	Additional Cost for Flood Section (1,000 ₱): ⑦ Add. Cost (⑤ x ⑥)	Total Cost (1,000 ₱) (④ + ⑦)
1	0.2	Flat	Earth	Very bad	Gravel	4.0	Impr.-1	440	88				88
2	0.5	Rolling	Earth	Very bad	Gravel	4.0	Impr.-1	478	239				239
3	4.8	Rolling	Earth	Impassable	Gravel	4.0	New Const	585	2,808				2,808
4													
	⑧ 5.5 ← Total Improvement Length (excluding no-improvement subsection)											Total	⑨ 3,135

Bridge

No.	Existing Bridge Type	Proposed Bridge: Type (Table 5-6)	Proposed Bridge: No. of Lanes	⑩ Length (m)	⑪ No. of Span (⑩ /20 & round)	Unit Cost (1,000 ₱): ⑫ Superstruct. per m	Unit Cost (1,000 ₱): ⑬ Abutment (Table 5-9)	Unit Cost (1,000 ₱): ⑭ Pier	Cost (1,000 ₱): ⑮ Superstruct. (⑩ x ⑫)	Cost (1,000 ₱): ⑯ Abutment (2 x ⑬)	Cost (1,000 ₱): ⑰ Pier ((⑪ -1) x ⑭)	Cost (1,000 ₱): Total (⑮ + ⑯ + ⑰)
1												
2												
3												
4												
											Total	⑱

Total Construction Cost = ⑨ + ⑱ = ⑲ 3,135 x 1,000 ₱

5) Economic Evaluation

Category

Province Type	Road Type	Existing Pavement Type (Predominant)	Existing Surface Condition (Predominant)	Proposed Pavement Type	Terrain (Predominant)	Cultivated Area within RIA: ⑳ Area (ha)	Cultivated Area within RIA: Area per km (⑳ / ⑧)
BL	1-direction Access	Earth	Impassable	Gravel	Rolling	610	111

Benefit

Traffic Benefit (1,000 ₱): ㉑ Benefit per km per veh (Table 5-10)	Traffic Benefit (1,000 ₱): ㉒ Benefit (㉑ x ⑧ x ①)	Development Benefit (1,000 ₱): ㉓ Benefit per km (Table 5-11)	Development Benefit (1,000 ₱): ㉔ Benefit (㉓ x ⑧)	Maintenance Cost Savings (1,000 ₱): ㉕ Benefit per km per veh (–3.87 –0.162 x ㉑)	Maintenance Cost Savings (1,000 ₱): ㉖ Benefit (㉕ x ⑧ x ①)	㉗ Total Benefit (1,000 ₱) (㉒ + ㉔ + ㉖)
44.687	2,605	189.1	1,040	-11.1	-647	2,998

Economic Cost = ⑲ x 0.831 = ㉘ 2,605 x 1,000 ₱

B/C Ratio = ㉗ / ㉘ = ㉙ 1.15

IRR = 1.676 + 13.324 x ㉙ (㉙ ≧ 1) } = ㉚ 17.0 %
= –3.018 + 18.018 x ㉙ (㉙ < 1) }

6) Rating

	IRR: 17 % (㉚)	Household Income per Month (HI): 1,245 ₱	Social Benefit (SB): High	Project Rating
Formula	IRR < 40 : 14 + 1.4 x IRR IRR ≧ 40 : 70	HI ≧ 5,000 : 5 2,000 < HI < 5,000 : 30–HI/200 HI ≦ 2,000 : 20	High : 10 Medium : 6.5 Low : 3	㉛ + ㉜ + ㉝
Merit Points x Weight	㉛ 38	㉜ 20	㉝ 10	68

APPENDIX

FORMATION OF MAJOR ROAD NETWORK IN THE PILOT PROVINCES

A.1 Province of Cavite

A.1.1 Present Level of Road Network Development

The province of Cavite has a total of 1,639.6 km. of roads, comprising 303.9 km. (18.5%) of national, 429.5 km (26.2%) of provincial, 91.6 km. (5.6%) of city, 67.9 km. (4.1%) of municipal and 746.7 km. (45.6%) of barangay roads.

Table A.1-1 shows the present level of road development and Figure A.1-1 illustrates the present road network. The present level of road development was assessed and summarized as follows:

Road development level in terms of road extension (quantity)

- Road density is higher by about 1.18 times than the national average.
- Road densities of national and provincial roads are much higher than the national average.
- Road density of barangay roads is almost equivalent to the national average.
- In terms of road extension, national and provincial roads are relatively well developed; however, development of barangay roads is at rather lower level considering vigorous agricultural and other economic activities.

Road development level in terms of surface type and conditions (quality of roads)

- About 36% of roads are paved with PCC or bituminous surfaces, which is much higher than the national average of 13%.
- Most national roads (about 95%) are paved with PCC or bituminous surfaces. Surface conditions are also at a high level, 79% being rated either good or fair. In terms of quality of roads, national roads in Cavite are at a quite high standard.
- About 48% of provincial roads are paved with PCC or bituminous surfaces, which is much higher than the national average of 11%. On the other hand, surface conditions are still in poor

state, only 36% were rated good or fair. Improvement of surface conditions is be the major priority of provincial roads.

- Most barangay roads have still gravel or earth surfaces.

Road Network Formation

- A mesh type of road network pattern is formed with relatively fine intervals.

- North-to-south links are extensive in line with traffic demands going to/from Metro Manila and due to topographical characteristics.

- East-to-west links are rather scarce. Their development is constrained by numerous rivers running south to north, and road conditions are not yet satisfactory.

- The road network of western areas (the municipalities of Alfonso, Gen. Aguinaldo and Magallanes) is formed only by provincial roads and their condition is not in good state. Therefore, some should be developed as major roads.

- In general, since the network itself is well formed, improvement of road conditions including upgrading of pavement type should be given high priority.

TABLE A.1-1 PRESENT LEVEL OF ROAD DEVELOPMENT: PROVINCE OF CAVITE

Indicator	National Roads	Provincial Roads	City Roads	Municipal Roads	Barangay Roads	Total
1) Road Length in km [1]	303.5	429.5	91.6	67.9	746.7	1,639.6
(% share)	(18.5)	(26.2)	(5.6)	(4.1)	(45.6)	(100.0)
2) Road Density [2]	0.2772	0.3917	0.0838	0.0621	0.6811	1.4959
(Ratio to national average)	(1.35)	(1.76)	(2.69)	(0.62)	(0.97)	(1.18)
3) Pavement Type in % [3]						
PCC	16.0% (23.3%)	21.0% (2.5%)	25.9% (16.0%)	62.2% (13.3%)	0% (0 %)	12.5% (5.7%)
Bituminous	79.5% (21.8%)	26.8% (8.6%)	32.9% (50.6%)	8.0% (12.3%)	0% (0 %)	23.9% (7.3%)
Gravel	4.5% (51.8%)	46.0% (69.5%)	20.2% (29.3%)	22.0% (49.3%)	100% (100.0%)	63.6% (87.0%)
Earth	- (3.1%)	6.2% (19.4%)	21.0% (4.1%)	7.8% (25.1%)		
( ): National average						
4) Surface Condition in % [4]						
Good/fair	78.7%	35.8%	N.A.	N.A.	N.A.	N.A.
Bad/very bad	21.3%	64.2%	N.A.	N.A.	N.A.	N.A.

Note: 1) Road length in 1985, DPWH Infrastructure Atlas (1986)

2) Road density = $L/\sqrt{PA}$, L: Road length in km, P: 1985 population in thousand, A: Total land area in km^2

3) Based on the survey by the Study Team for National and Provincial Roads, and based on DPWH Infrastructure Atlas (1986) for other roads

4) Based on the survey by the Study Team N.A. : Data not available

PROVINCE OF CAVITE

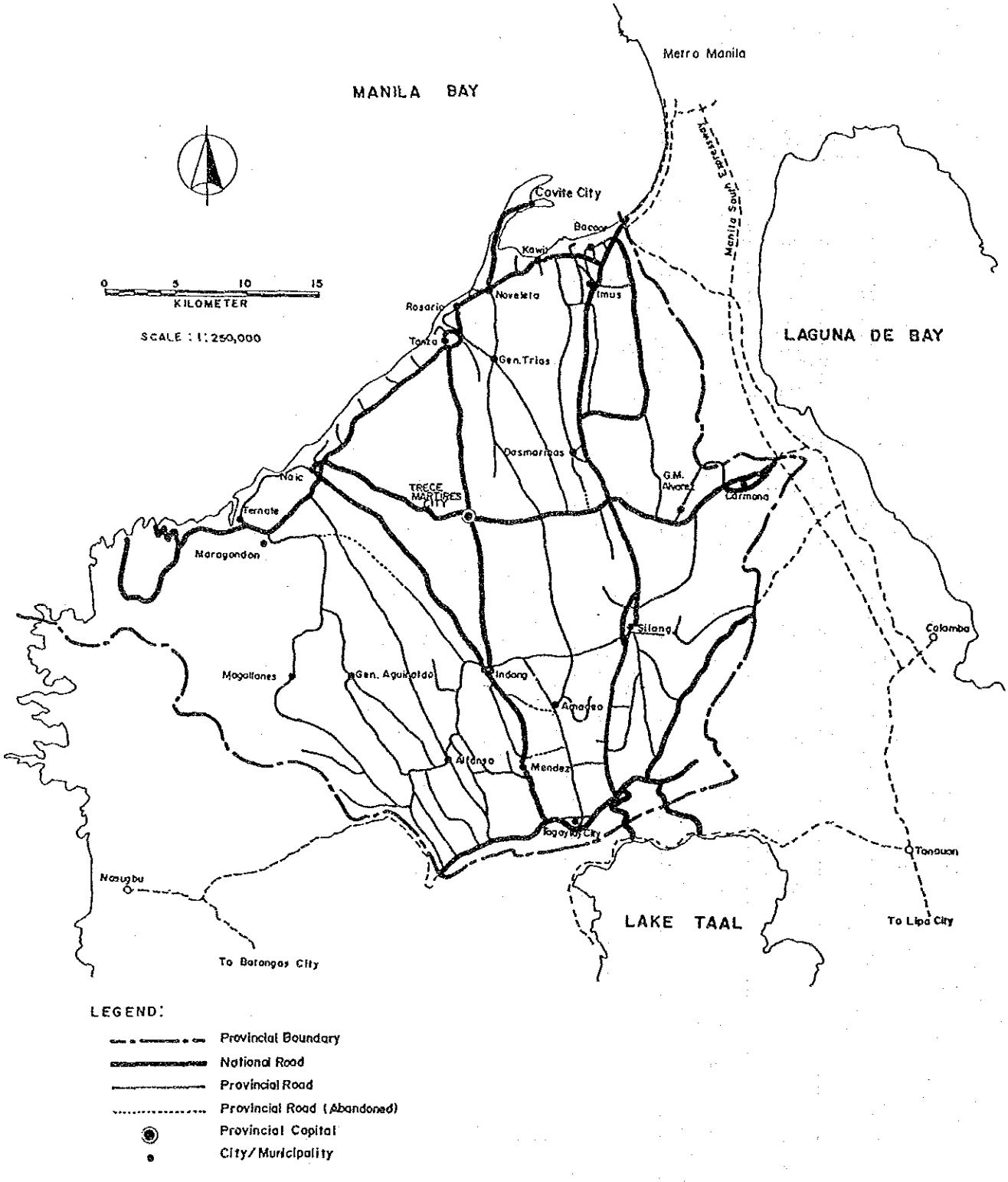


FIGURE A.1-1 EXISTING ROAD MAP

A.1.2 Proposed Major Road Network

Based on an assessment of the present road network and in accordance with functional road classification criteria, the major road network for the province of Cavite was proposed as shown in Figure A.1-2. In establishing the major road network, the following were taken into consideration:

- In order to have as much compatibility as possible, with the administrative classification existing national roads were basically adopted to form the major road network.

- As existing national and provincial roads are extensive in length, no new link was considered necessary.

- As in the existing east-to-west links are less developed, strengthening of these was focused on.

- Strengthening of the road network in the western area was considered by assigning a provincial road to a primary major road.

PROVINCE OF CAVITE

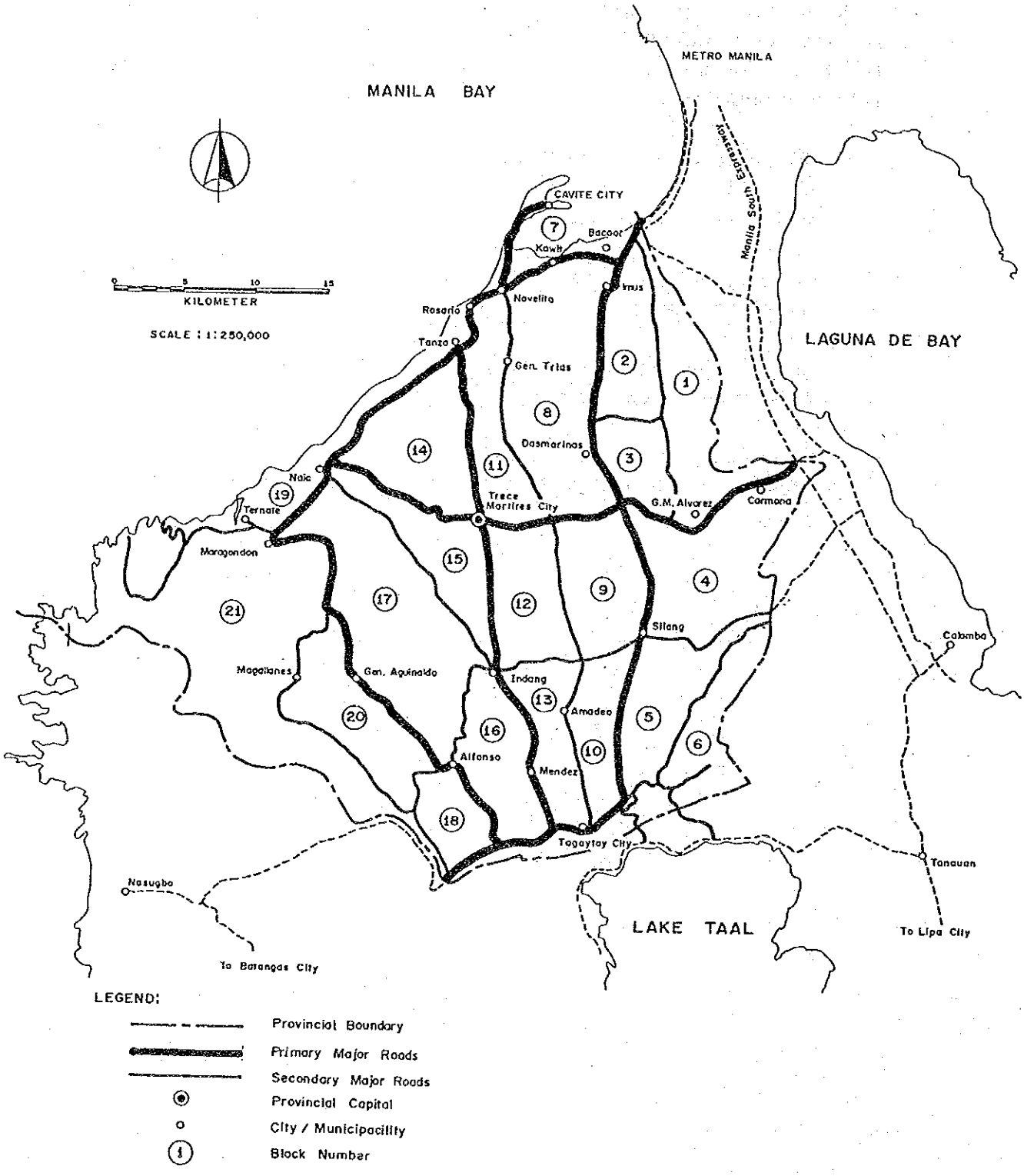


FIGURE A.1-2 PROPOSED MAJOR ROAD NETWORK

The proposed major road network has a total length of 369.3 km. which is equivalent to 23.5% of existing roads. Composition of the major and minor roads is shown in Table A.1-2.

Table A.1-3 shows network value and accessibility defined in Chapter 2, which were used as indicators to check the balance of the major road network. Examined was the evenness of these indicators between blocks delineated by major roads.

TABLE A.1-2 COMPOSITION OF MAJOR AND MINOR ROADS (km)

	Major Roads	Minor Roads[1)]	Total
National Road	224.5	79.0	303.5
Provincial/City Road	144.8	376.3	521.1
Barangay Road	-	746.7	746.7
Total	369.3 (23.5%)	1,202.0 (76.5%)	1,571.3 (100%)

Note: 1) Based on 1985 road length

TABLE A.1-3 NETWORK VALUE/ACCESSIBILITY (Cavite)

Block No.	Population	Land Area (km^2)	Road (km)	Network Value	Access (Pxkm)	Average Access(km)
1	123,352	52.11	31.0	.387	87,485	.709
2	34,691	44.86	30.2	.766	9,834	.283
3	7,915	30.95	23.1	1.476	2,221	.281
4	37,991	72.73	35.2	.670	18,565	.489
5	28,098	49.79	36.9	.987	16,760	.596
6	16,788	53.96	30.7	1.020	11,452	.682
7	206,046	18.77	15.1	.243	57,413	.279
8	139,281	104.41	44.8	.372	88,618	.636
9	29,178	55.49	30.9	.768	12,073	.414
10	21,421	36.18	30.7	1.103	7,032	.328
11	86,633	52.13	41.4	.616	23,864	.275
12	11,880	47.25	33.8	1.427	5,527	.465
13	26,485	40.67	32.9	1.002	5,632	.213
14	68,348	84.42	38.0	.500	45,831	.671
15	15,788	52.43	45.7	1.588	4,158	.263
16	32,826	49.58	34.6	.858	17,206	.524
17	43,862	123.98	60.9	.826	27,871	.635
18	13,219	27.15	23.6	1.246	4,443	.336
19	31,575	18.40	7.4	.307	25,146	.796
20	17,177	59.97	43.1	1.343	6,245	.364
21	20,456	203.46	55.6	.862	6,950	.340
Average	48,239	60.89	34.6	.638	23,063	.478

Note : Network Value = $L/\sqrt{P*A}$

where, L : Road Length in km

P : Population in 1000

A : Land area in km^2

A.2 Province of Masbate

A.2.1 Present Level of Road Network Development

The province of Masbate (main island only) has a total of 822.6 km. of roads, comprising 276.0 km. (33.6%) of national, 83.9 km. (10.2%) of provincial, 65.1 km. (7.9%) of municipal and 397.6 km. (48.3%) of barangay roads.

Table A.2-1 shows the present level of road development and Figure A.2-1 illustrates the present road network. The present level of road development was assessed and summarized as follows:

Road development level in terms of road extension (quantity)

- Road development in Masbate is far behind the national average. The density of all roads is only 51%, of provincial roads 28% and of barangay roads 45% of the national average.

- Much remains to be done in extending roads to provide basic access to residents of Masbate.

Road development level in terms of surface type and conditions (quality of roads)

- Both national and provincial roads are at a very low level in terms of quality of roads.

- Only 24% of national roads are pave with PCC or bituminous surfaces, which is far below the national average. Surface conditions are also at a very poor level. Only 18.3 km. (or 6.6%) were rated fair and the rest bad or very bad.

- None of the provincial roads are paved with PCC or bituminous pavement. Surface conditions are in an extremely poor state, only 2.6 km. (or 4.7%) being rated fair and the rest in bad or very bad condition.

TABLE A.2-1 PRESENT LEVEL OF ROAD DEVELOPMENT: PROVINCE OF MASBATE

Indicator	National Roads	Provincial Roads	City Roads	Municipal Roads	Barangay Roads	Total
1) Road Length in km [1]	276.0	83.9	-	65.1	397.6	822.6
(% share)	(33.6)	(10.2)	(-)	(7.9)	(48.3)	(100.0)
2) Road Density [2]	0.2203	0.0624	-	0.0520	0.3174	0.6521
(Ratio to national average)	(1.07)	(0.28)	-	(0.52)	(0.45)	(0.51)
3) Pavement Type in % [3]						
PCC	0.7% (23.3%)	0 % (2.5%)	-	18.6% (13.3%)	0% (0 %)	1.7% (5.7%)
Bituminous	23.5% (21.8%)	0 % (8.6%)	-	10.7% (12.3%)	0% (0 %)	8.7% (7.3%)
Gravel	67.0% (51.8%)	100.0% (69.5%)	-	42.7% (49.3%)	100% (100.0%)	89.6% (87.0%)
Earth	8.8% (3.1%)	0 % (19.4%)	-	28.0% (25.1%)		
( ): National average						
4) Surface Condition in % [4]						
Good/fair	6.6%	4.7%	-	N.A.	N.A.	N.A.
Bad/very bad	93.4%	95.3%	-	N.A.	N.A.	N.A.

Note: 1) Road length in 1985, DPWH Infrastructure Atlas (1986)

2) Road density = $L/\sqrt{PA}$, L: Road length in km, P: 1985 population in thousand, A: Total land area in km2

3) Based on the survey by the Study Team for National and Provincial Roads, and based on DPWH Infrastructure Atlas (1986) for other roads

4) Based on the survey by the Study Team N.A. : Data not available

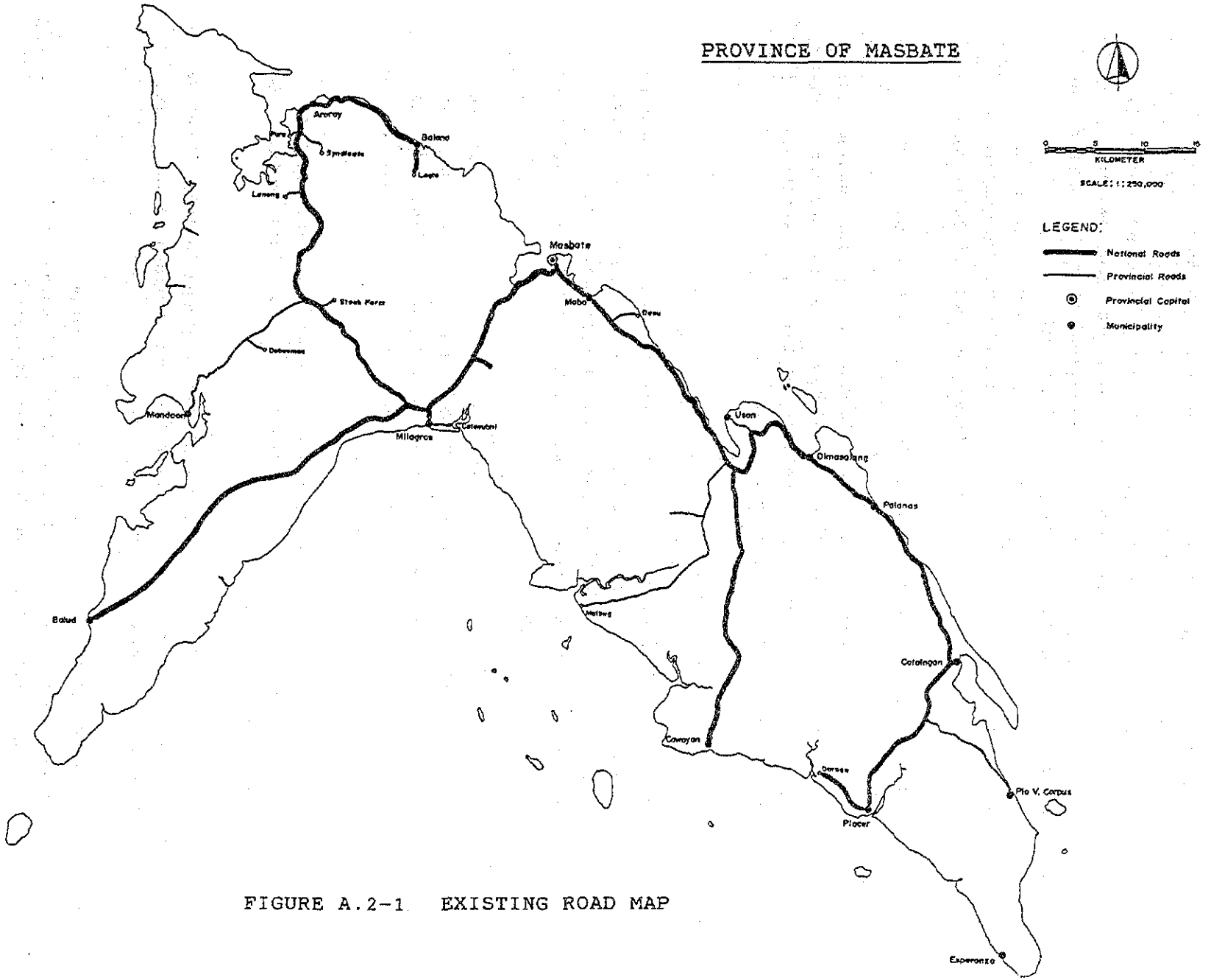


FIGURE A.2-1 EXISTING ROAD MAP

Road Network Formation

- Road network development in Masbate is still very primitive. There are many areas where no access is provided, especially in the southern and western areas where people rely on walking or banca boats for transportation.

- No network is as yet formed. National roads penetrate only limited areas, and their interlinkages are not yet fully made.

- Most provincial roads function only as a feeder road.

- In general, road development in Masbate is far behind the national average. Construction of new lines in accordance with the proposed major road network, as well as improvement of existing roads, should be given priority.

A.2.2 Proposed Major Road Network

Based on an assessment of the present road network and in accordance with functional road classification criteria, the major road network for the province of Masbate (mainland) was proposed as shown in Figure A.2-2. To establish the major road network, the following were taken into account:

- Existing national and provincial roads are still in very poor state in terms of both quantity and quality. All of them, with the exception of some provincial roads whose function will only be feeders even in the future, were considered necessary to formulate a major road network.

- In addition some barangay roads which are vital for forming a major road network were included. These roads should be developed as major roads.

The following roads were considered vitally needed to form a better road network. However, those roads were not included in this Study because of their cost and lower urgency.

- Southern coastal road from Milagros to Cawayan
- Southeastern coastal road from Placer to Esperanza
- Western coastal road from Mandaon to Dayhagan
- Northwestern coastal road from San Agustin to Sawang

The proposed major road network has a total length of 495.4 km. which includes 81.4 km. of new links. Composition of the major and minor roads is shown in Table A.2-2.

Table A.2-3 shows network value and accessibility defined in Chapter 2, which were used as indicators to check the balance of major road network. Examined was the evenness of these indicators between blocks delineated by major roads.

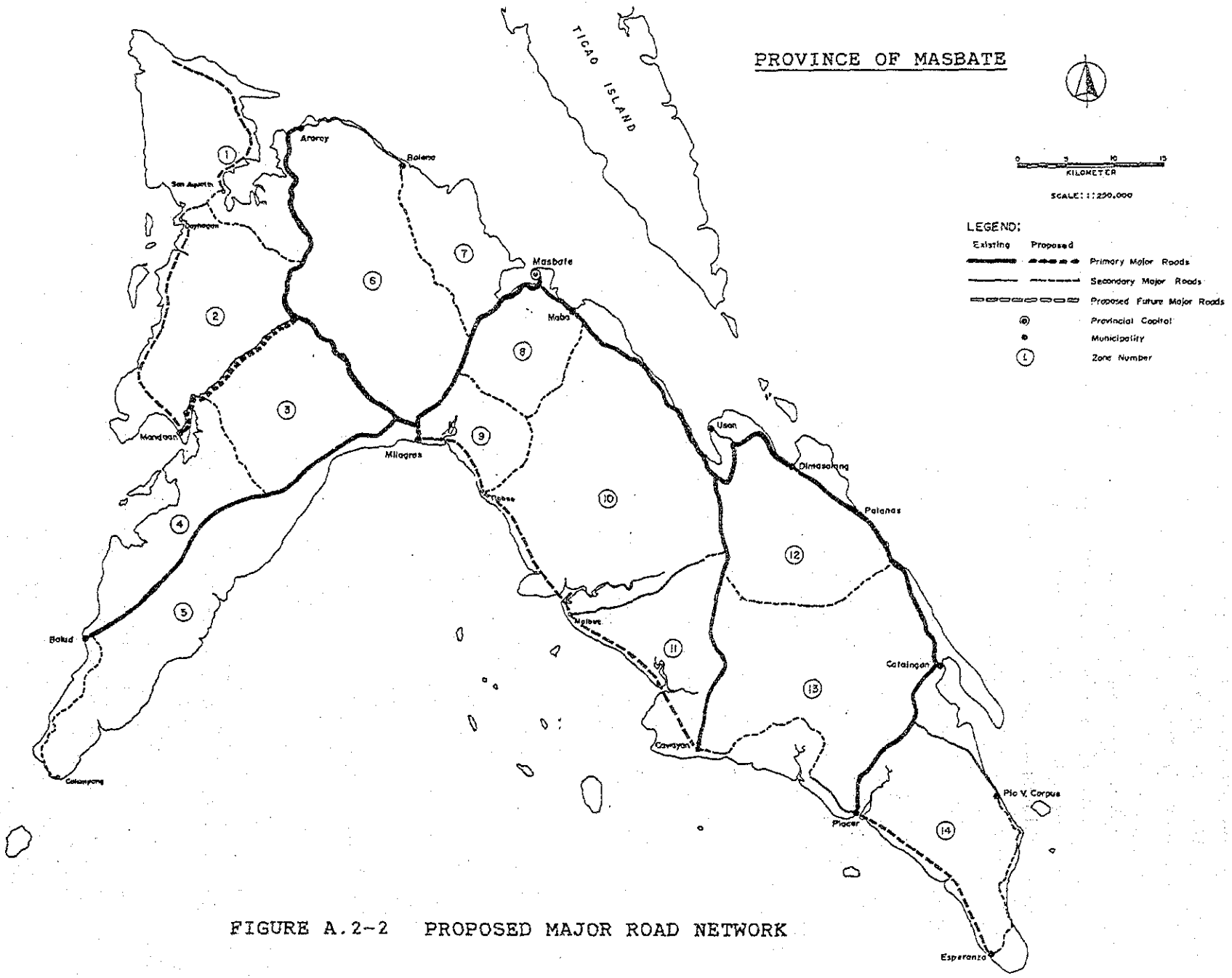


FIGURE A.2-2 PROPOSED MAJOR ROAD NETWORK

TABLE A.2-2 COMPOSITION OF MAJOR AND MINOR ROADS (km)

	Major Road	Minor Road[1)]	Total
National Roads	276.0	0	276.0
Provincial/City Roads	49.3	34.6	83.9
Barangay Roads	170.1[2)]	308.9	479.0
Total	495.4 (59%)	343.5 (41%)	838.9 (100%)

Note: 1) Based on 1985 road length
2) Including 81.4 km. of new links

TABLE A.2-3 NETWORK VALUE/ACCESSIBILITY (Masbate)

Block No.	Population	Land Area (km^2)	Road (km)	Network Value	Access (Pxkm)	Average Access(km)
1	25,285	207.60	36.6	.505	129,292	5.113
2	16,861	221.90	41.1	.672	47,668	2.827
3	8,228	207.20	61.1	1.480	1,995	.242
4	20,007	124.40	45.4	.910	39,221	1.960
5	34,996	260.30	64.9	.680	67,439	1.927
6	41,782	352.80	97.8	.806	44,227	1.059
7	26,221	101.60	35.2	.682	57,215	2.182
8	49,983	121.30	41.3	.530	19,470	.390
9	12,482	77.80	24.2	.777	21,140	1.694
10	54,525	413.10	75.5	.503	78,957	1.448
11	18,927	193.80	42.4	.700	42,853	2.264
12	60,894	300.60	68.9	.509	72,809	1.196
13	90,249	348.40	103.7	.585	123,512	1.369
14	62,937	269.20	51.5	.396	102,197	1.624
Average	37,384	228.57	56.4	.610	60,571	1.620

Note: Network Value = $L/\sqrt{P*A}$
where, L = Road Length in Km
P = Population in 1000
A = Land area in km^2

A.3 Province of Bohol

A.3.1 Present Level of Road Network Development

Province of Bohol has a total of 4,561.6 kms. of roads, comprising 588.5 kms. (12.9%) of National, 922.2 kms. (20.2%) of Provincial, 65.1 kms. (14%) of City, 288.3 kms. (6.3%) of Municipal and 2,697.2 kms. (59.1%) of Barangay roads.

Table A.3-1 shows present level of road development and Figure A.3-1 illustrates present road network. Present level of road development was assessed and summarized as follows:

Road development level in terms of road extension (quantity)

- In terms of road extension, the development level of Bohol belongs to the highest group of provinces in the country.

- Road density of all roads in higher by 1.9 times than the national average.

- By class of road, road densities of national, provincial and barangay roads are higher by 1.5, 2.2 and 2.0 times than the national average, respectively.

Road development level in terms of surface type and condition (quality of road)

- Although roads in Bohol are well-developed in terms of quantity, roads are less developed in terms of quality. Only 7.5% of roads are paved with PCC or bituminous surfaces, which is quite low compared with the national average of 13%.

- About 35% of national roads are paved with PCC or bituminous surfaces, which is lower than the national average of 45%. In spite of the low share of high-type pavement, the surface condition of national roads is well-maintained. About 79% were rated good or fair.

- Paving of provincial roads with high pavement type is still at a very low level (only 1.3% of roads with bituminous pavement). Surface conditions of provincial roads are still in a poor state, about 65% being rated bad or very bad.

Road Network Formation

- Basically a mesh type road network pattern is formed with relatively fine intervals. In particular, the network of national roads is well formed.

- As the road network itself is well-formed, improvement of road conditions including upgrading of pavement type should be given higher priority.

A.3.2 Proposed Major Road Network

Based on an assessment of the present road network and in accordance with the functional road classification criteria, the major road network for the province of Bohol is proposed as shown in Figure A.3-2. To establish the major road network, the following were taken into account:

- As road extension is extensive, no new road links were considered necessary.

- As the existing road network is well-formed, a major road network was planned based on the existing national road network.

- Since population and urban centers are almost evenly scattered on the island, a rather extensive major road network was proposed compared with other provinces.

The proposed major road network has a total length of 814.3 km, which is equivalent to 19% of existing roads. Composition of the major and minor roads is shown in Table A.3-2.

Table A.3-3 shows network value and accessibility defined in Chapter 2, which were used as indicators to check the balance of major road network. Examined was the evenness of these indicators between blocks delineated by major roads.

TABLE A.3-1 PRESENT LEVEL OF ROAD DEVELOPMENT: PROVINCE OF BOHOL

Indicator	National Roads	Provincial Roads	City Roads	Municipal Roads	Barangay Roads	Total
1) Road Length in km [1]	585.5	922.2	65.4	288.3	2,697.2	4,561.6
(% share)	(12.9)	(20.2)	(1.4)	(6.3)	(59.1)	(100.0)
2) Road Density [2]	0.3106	0.4867	0.0345	0.1522	1.4236	2.4076
(Ratio to national average)	(1.51)	(2.19)	(1.11)	(1.52)	(2.02)	(1.91)
3) Pavement Type in % [3]						
PCC	3.4% (23.3%)	0 % (2.5%)	0 % (16.0%)	9.0% (13.3%)	0% (0 %)	1.0% (5.7%)
Bituminous	31.8% (21.8%)	1.3% (8.6%)	100.0%(50.6%)	10.7% (12.3%)	0% (0 %)	6.5% (7.3%)
Gravel	64.8% (51.8%)	79.7% (69.5%)	0 % (29.3%)	47.9% (49.3%)	100% (100.0%)	92.5% (87.0%)
Earth	0 % (3.1%)	19.0% (19.4%)	0 % (4.1%)	32.4% (25.1%)		
( ): National average						
4) Surface Condition in % [4]						
Good/fair	78.6	34.9	N.A.	N.A.	N.A.	N.A.
Bad/very bad	21.4	65.1	N.A.	N.A.	N.A.	N.A.

Note: 1) Road length in 1985, DPWH Infrastructure Atlas (1986)

2) Road Density = $L/\sqrt{PA}$, L: Road length in km, P: 1985 population in thousand, A: Total land area in sq. km2

3) Based on the survey by the Study Team for National and Provincial Roads, and based on DPWH Infrastructure Atlas (1986) for other roads

4) Based on the survey by the Study Team N.A. : Data not available

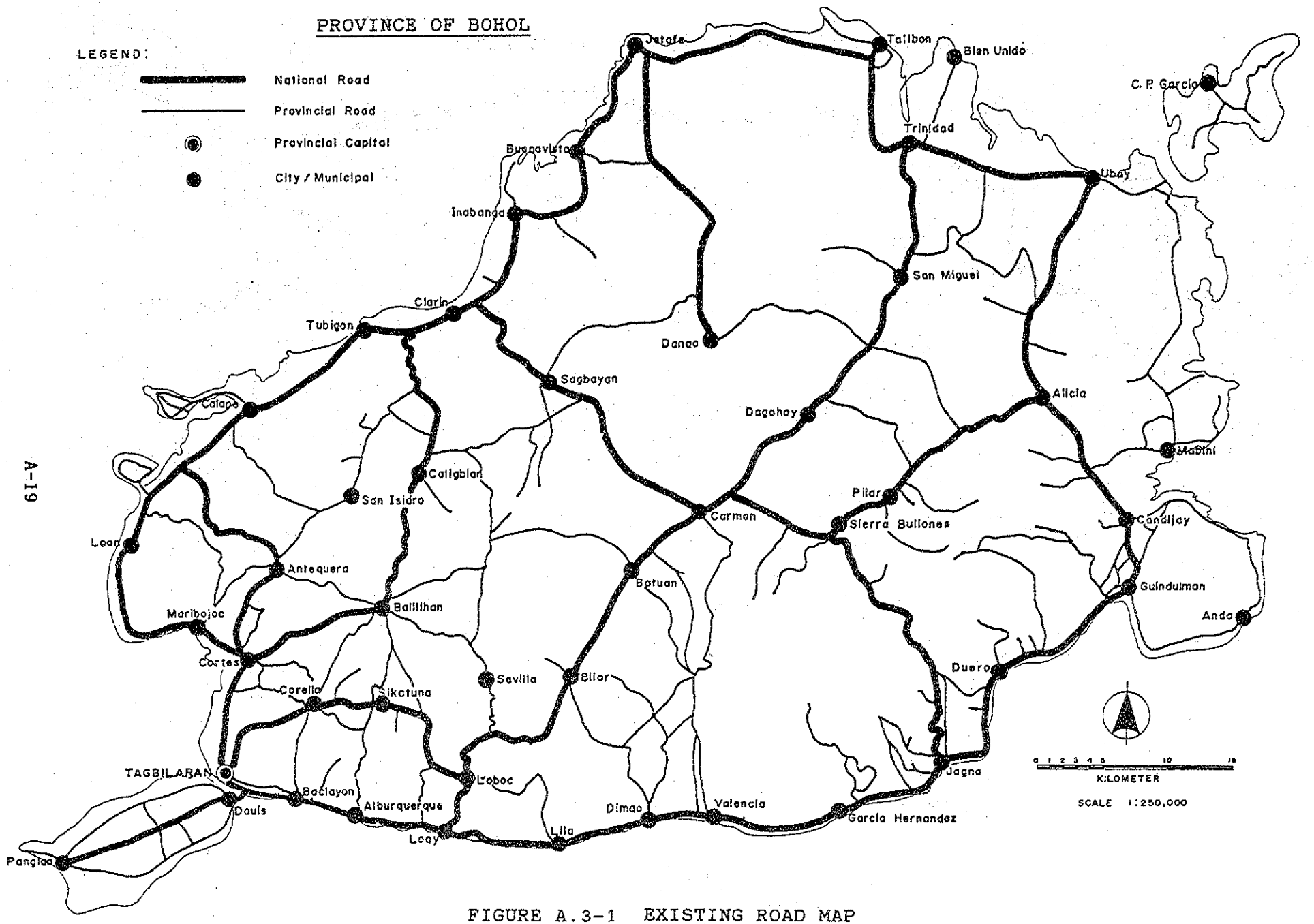


FIGURE A.3-1 EXISTING ROAD MAP

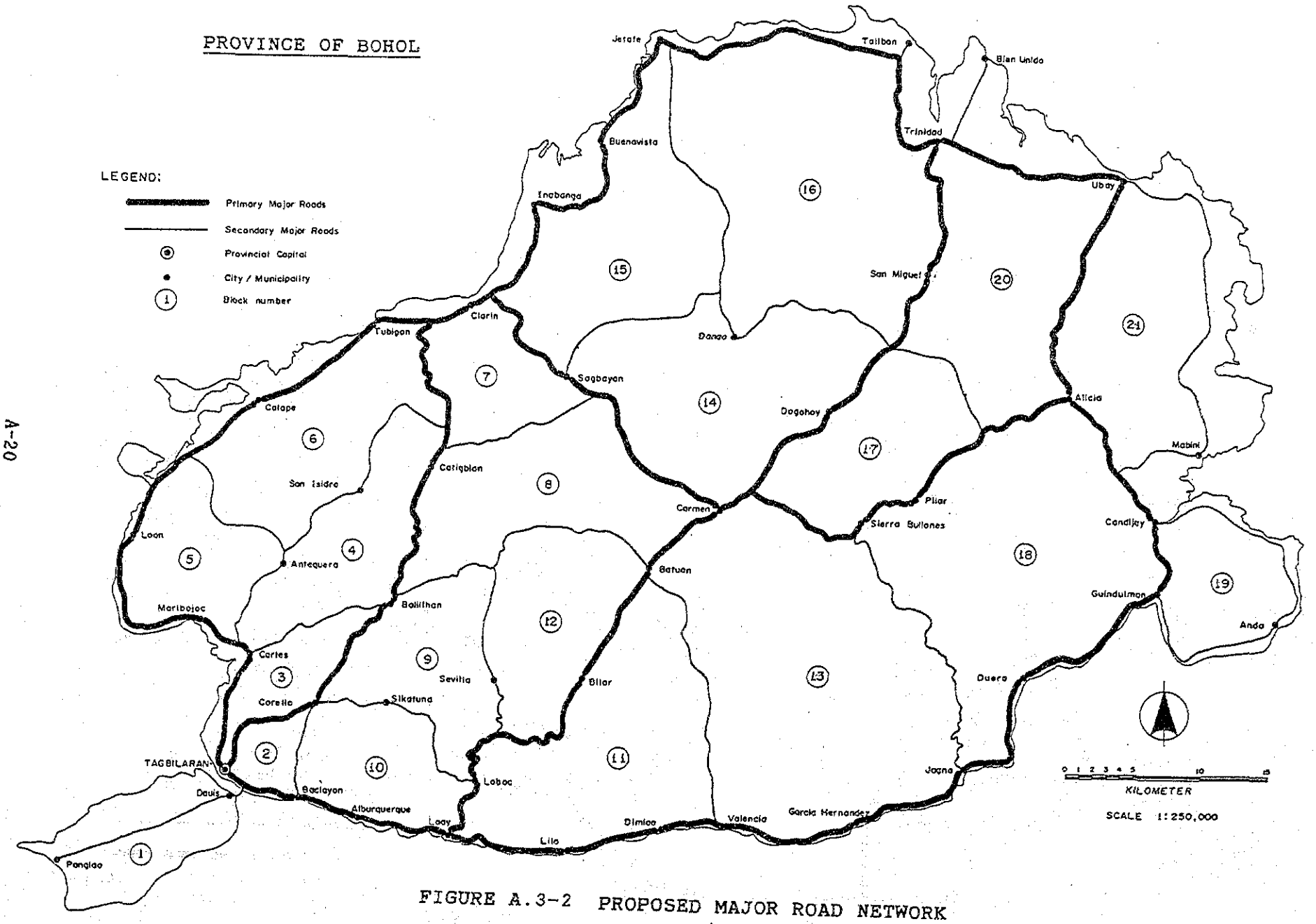


FIGURE A.3-2 PROPOSED MAJOR ROAD NETWORK

TABLE A.3-2 COMPOSITION OF MAJOR AND MINOR ROADS (km)

	Major Roads	Minor Roads[1)]	Total
National Roads	586.5	2.0	588.5
Provincial/City Roads	227.8	759.8	987.6
Barangay Roads	-	2,697.2	2,697.2
Total	814.3 (19.0%)	3,459.0 (81.0%)	4,273.3(100%)

Note: 1) Based on 1985 road length

TABLE A.3-3 NETWORK VALUE / ACCESSIBILITY (Bohol)

Block No.	Population	Land Area (km^2)	Road (km)	Network Value	Access (Pxkm)	Average Access(km)
1	38,067	94.00	18.2	.304	53,342	1.401
2	23,796	35.00	24.3	.842	10,680	.449
3	48,429	62.00	40.8	.745	20,162	.416
4	24,083	121.00	61.7	1.143	27,596	1.146
5	42,026	139.50	44.6	.582	37,217	.886
6	69,847	205.50	65.9	.550	63,488	.909
7	25,005	90.50	49.2	1.034	17,040	.681
8	26,409	175.50	78.4	1.152	33,464	1.267
9	16,211	117.50	59.0	1.352	15,257	.941
10	29,645	99.50	43.3	.797	24,636	.831
11	50,932	239.00	78.5	.711	57,037	1.316
12	19,494	129.50	55.7	1.109	22,238	1.141
13	79,045	415.50	101.9	.562	113,506	1.436
14	30,030	228.50	67.2	.811	42,003	1.399
15	67,818	213.50	84.1	.699	73,739	1.087
16	56,699	410.00	98.3	.645	54,498	.961
17	19,085	133.50	51.1	1.012	17,550	.920
18	86,644	347.00	103.7	.598	139,339	1.608
19	26,694	109.50	35.4	.655	17,600	.659
20	53,813	276.50	81.9	.671	60,264	1.120
21	58,372	261.00	61.5	.498	51,476	.882
Average	42,483	185.88	62.1	.699	45,816	1.078

Note: Network Value = $L/\sqrt{P*A}$

where, L : Road length in km

P : Population in 1000

A : Land area in km^2

A.4 Province of Agsan del Norte

A.4.1 Present Level of Road Development

The province of Agusan del Norte has a total of 1,255.0 km. of roads, comprising 218.2 km. (17.4%) of national, 232.9 km. (18.6%) of provincial, 66.0 km. (5.2%) of city, 91.3 km. (7.3%) of municipal and 646.6 km. (51.5%) of barangay roads.

Table A.4-1 shows the present level of road development and Figure A.4-1 illustrates the present road network. The present level of road development was assessed and summarized as follows:

Road development level in terms of road extension (quantity)

- This province is typical in representing the national average in terms of quantity of roads.

- Road density of national and provincial roads are almost at the same level as the national average.

- Barangay roads are slightly less developed than the national average.

Road development level in terms of surface type and condition (quality of road)

- About 12% of all roads are paved with PCC (there are no bituminous surface sections), which is almost equivalent to the national average of share of PCC and bituminous surfaces (13%).

- About 54% of national roads are paved with PCC, which are all in good condition. The rest of the national roads are all gravel surfaced, whose condition is rated bad or very bad.

- In terms of quality of roads, national roads in the province can be classified into two (2) extreme groups. The first group comprises the roads forming the most important trunk road network system of the country such as the Pan-Philippine Highway (Surigao-Butuan and Butuan-Davao Road), and the Agusan-Misamis Oriental Road, which are PCC paved and maintained in fairly good condition. The other group is all other roads, which are still gravel surfaced. Their condition is not maintained very well.

- Almost all of the provincial roads are gravel surfaced, of which 72% are in bad or very bad condition.

Road Network Formation

- Three (3) national roads: the Surigao-Butuan Road, the Butuan-Davao Road (both of which are part of the Pan-Philippine Highway) and the Agusan-Misamis Oriental Road, form a skeleton road network for the province. Other national and provincial roads branch off from these roads.

- Due to topographical constraints, since closed network could not be formed, the said three (3) roads function as axes.

- The Agusan-Malaybalay Road, which runs along the west bank of the Agusan River, is currently in poor condition; however, in line with the development of the Agusan River Basin, its importance will increase in the future.

TABLE A.4-1 PRESENT LEVEL OF ROAD DEVELOPMENT: PROVINCE OF AGUSAN DEL NORTE

Indicator	National Road	Provincial Road	City Road	Municipal Road	Barangay Road	Total
1) Road Length in km. [1]	218.2	232.9	66.0	91.3	646.6	1,255.0
(% share)	(17.4)	(18.6)	(5.2)	(7.3)	(51.5)	(100.0)
2) Road Density [2]	0.2092	0.2233	0.0633	0.0875	0.6200	1.2033
(Ratio to National Average)	(1.02)	(1.01)	(2.04)	(0.87)	(0.88)	(0.95)
3) Pavement Type in % [3]						
PCC	53.8% (23.3%)	0.0% (2.5%)	30.4%(16.0%)	14.1% (13.3%)	0% (0 %)	12.0% (5.7%)
Bituminous	0.0% (21.8%)	0.0% (8.6%)	0.0%(50.6%)	0.0% (12.3%)	0% (0 %)	0.0% (7.3%)
Gravel	46.2% (51.8%)	98.4% (69.5%)	69.6%(29.3%)	79.0% (49.3%)	100% (100.0%)	88.0% (87.0%)
Earth	0.0% (3.1%)	1.6% (19.4%)	0.0%(4.1%)	6.9% (25.1%)		
( ): National Avarage						
4) Surface Condition in % [4]						
Good/Fair	74.3%	28.4%	N.A.	N.A.	N.A.	N.A.
Bad/Very Bad	25.7%	71.6%	N.A.	N.A.	N.A.	N.A.

Note: 1) Road Length in 1985, DPWH Infrastructure Atlas (1986)
2) Road Density = $L/\sqrt{PA}$, L: Road length in km, P: 1985 Population in thousand, A: Total land Area in sq. km.
3) Based on the Survey by the Study Team for National and Provincial Roads, and based on DPWH Infrastructure Atlas (1986) for other roads.
4) Based on the Survey by the Study Team. N.A. : Data not available

PROVINCE OF AGUSAN DEL NORTE

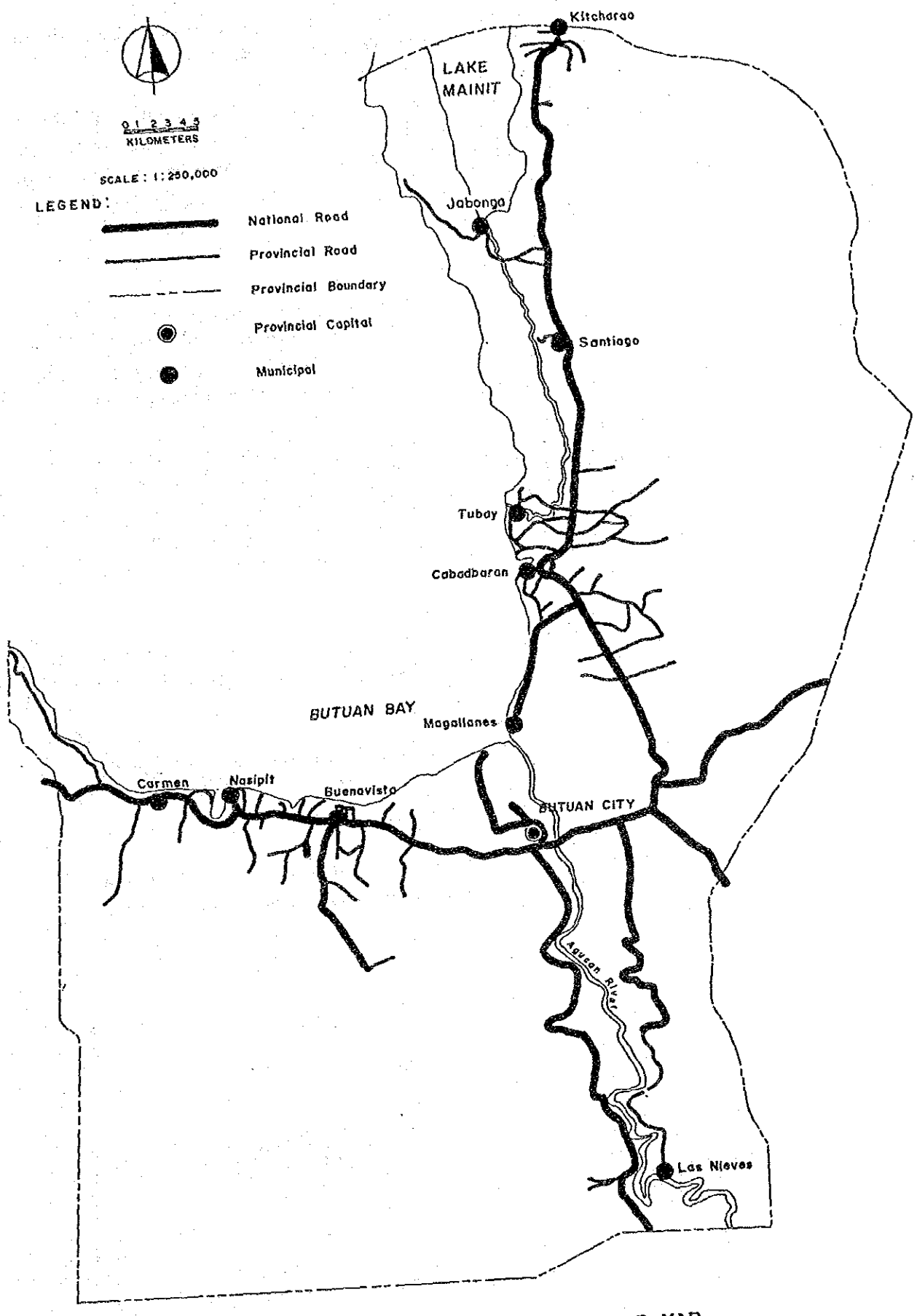


FIGURE A.4-1 EXISTING ROAD MAP

- Provincial and barangay roads are indistinguishable. They have similar functions as well as geometric standards.

- As the three (3) national roads are well developed, priority should be given to the development of secondary major class roads and feeder roads which branch off from the three (3) national roads.

A.4.2 Proposed Major Road Network

Based on an assessment of the present road network and in accordance with the functional road classification criteria, the major road network was proposed as shown in Figure A.4-2. To establish the major road network, the following were taken into consideration:

- Due to topographical constraints, since it is not practical to formulate a closed network, the present pattern of three (3) axes composed of three (3) national roads was basically followed for formulation of a primary major road network. The addition of one more axis, the Agusan-Malaybalay Road was considered in view of its future important function.

- For formulation of a secondary major road network, strengthening of linkages between relatively populated areas along the coastal line was considered.

The proposed major road network has a total length of 291.3 km, which includes 38.8 km, of new links. Composition of the major and minor roads is shown in Table A.4-2.

Table A.4-3 shows network value and accessibility defined in Chapter 2, which were used as indicators to examine the balance of major road network.

PROVINCE OF AGUSAN DEL NORTE

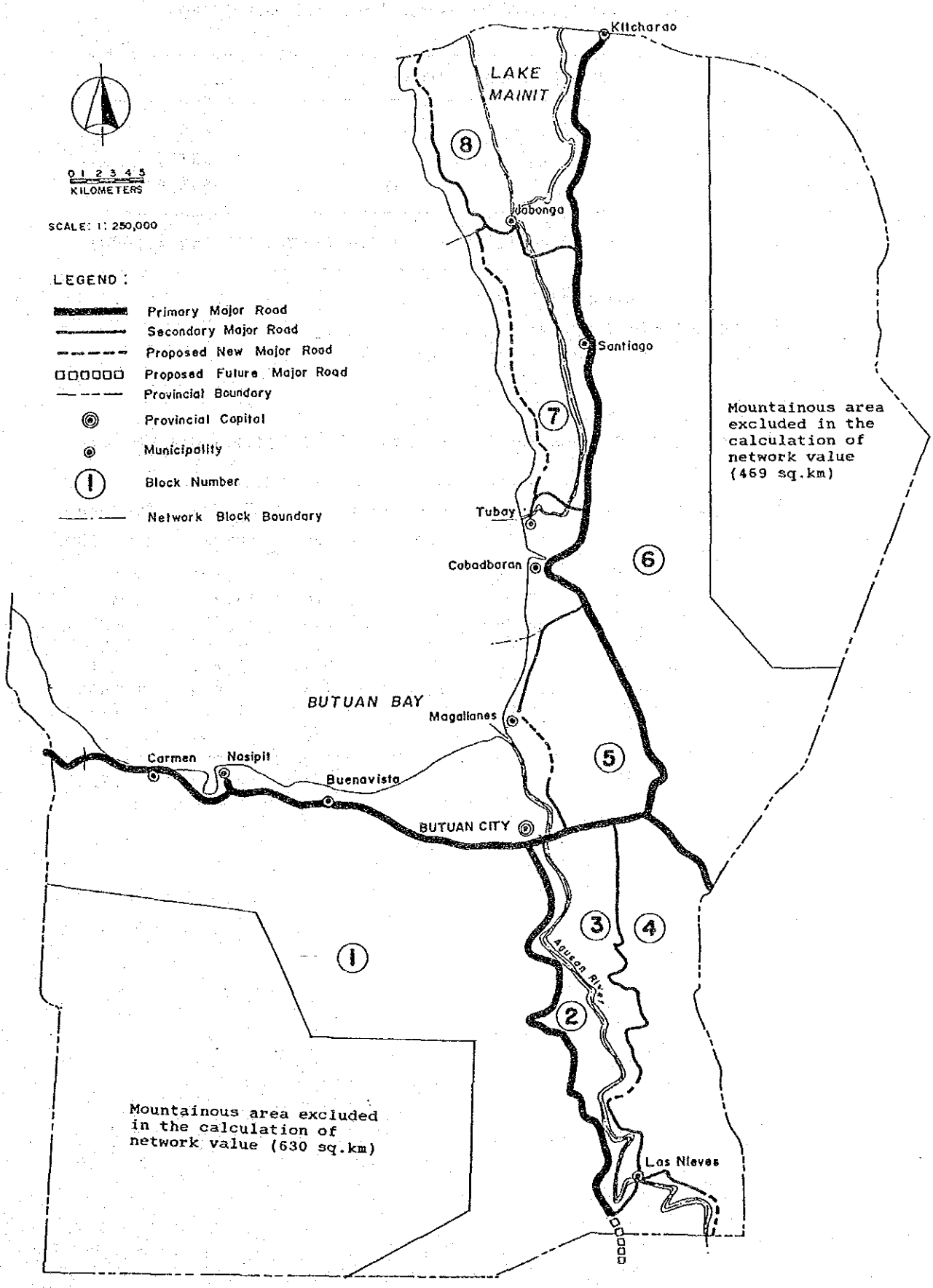


FIGURE A.4-2 PROPOSED MAJOR ROAD NETWORK

TABLE A.4-2 COMPOSITION OF MAJOR AND MINOR ROADS (km)

	Major Roads	Minor Roads[1)]	Total
National Roads	195.7	22.5	218.2
Provincial/City Roads	61.0[2)]	237.9	298.9
Barangay Roads	34.6[3)]	612.0	646.6
Total	291.3 (25.0%)	872.4 (75.0%)	1,163.7(100%)

Note: 1) Based on 1985 road length
2) Includes 20.5 km. of new links
3) Includes 18.3 km. of new links

TABLE A.4-3 NETWORK VALUE / ACCESSIBILITY (Agusan del Norte)

Block No.	Population	Land Area (km^2)	Road (km)	Network Value	Access (P*km)	Average Access(km)
1	193,948	502.19	83.9	.246	253,100	1.305
2	37,975	33.83	43.6	1.216	15,333	.404
3	24,245	53.25	40.7	1.133	22,511	.928
4	18,790	146.32	56.1	1.070	12,793	.681
5	56,030	102.08	43.7	.578	22,451	.401
6	107,087	372.04	82.4	.413	114,018	1.065
7	7,873	62.33	39.2	1.770	1,276	.162
8	7,393	54.37	15.5	.773	1,201	.162
Average	56,668	178.30	50.6	.504	55,335	.976

Note: Network Value = $L/\sqrt{P*A}$
where, L : Road length in km
P : Population in 1000
A : Land area in km^2