7.5 PROJECT IDENTIFICATION

7.5.1 Identification Criteria

1) Prescreening

Major Roads

Since no prescreening was made for major roads, all major roads were subjects of the Study, except for National Primary Roads defined in Executive Order No. 113, which are excluded from the Study as per the Scope of the Study.

Minor Roads

Minor roads are quite extensive in length as well as in number of links as shown in the Table 7.5-1; therefore, it was not practical to investigate and survey all minor roads. Prescreening of minor roads was made by two approaches.

TABLE 7.5-1 LENGTH OF EXISTING MINOR ROADS

Unit : km

Province	National Roads	Provincial/ City Roads	Barangay Roads	Total
Cavite	79.4	376.3	746.7	1,202.4
Masbate	-	34.6	227.5	262.1
Bohol	2.0	759.8	2,697.2	3,459.0
Agusan del Norte	21.0	239.4	612.0	872.4
TOTAL	102.4	1,410.1	4,283.4	5,795.9

i) Prescreening by the Study Team

Based on provincial road maps, national and provincial roads which are considered to function as collector class roads were selected and subjected to the field survey. Pre-screening of barangay roads was not made by the Study Team due to lack of information.

ii) Prescreening by local officials

The local officials who are directly involved in road administration, planning and maintenance are most familiar with road conditions and problems therein. The Study Team requested District/Provincial/City/Municipal Engineering Offices to submit a proposed project list for rural roads development. At the same time, each provinces's medium-term plan and investment program were referred to. Based on these, a proposed project list was prepared. Road conditions of proposed projects were obtained by interviewing local officials.

Results of prescreening by the Study Team and local officials were integrated. As a result, the minor roads to be studied were selected.

Streets

Streets were not covered by the Study.

2) Identification Criteria

Existing roads under the Study expose many types of problems such as conditional deterioration, functional deficiencies and substandard facilities. Among those, severe problems associated are: a) substandard pavement types, b) deteriorated surface conditions, c) abandoned/non-existing, d) narrow carriageway widths, e) ford crossings or temporary bridges, f) geometric deficiencies, and g) drainage inadequacies, etc.

Considering the characteristics of the Study, however, the following five (5) conditions were used to identify road links to be improved:

- Pavement Type .....Substandard pavement type
- Road Surface Condition .....Bad/very bad condition
- Abandoned/Non-existing road .....To be newly constructed
- Carriageway Width .....Substandard width
- Bridges .....Ford crossings/temporary bridges

In this Study, improvement of geometric deficiencies was not taken up; however, special consideration was paid to steep gradient sections with gravel surfaces.

Correction work of drainage inadequacies was not independently proposed; however, it was included in other associated works such as improvement of surface condition and/or improvement of pavement type.

Based on the above considerations, the identification criteria were established as shown in Table 7.5-2.

TABLE 7.5-2 IDENTIFICATION CRITERIA

Item	Condition of Identification	
	Major Roads	Minor Roads
(1) Existing Links		
. Carriageway Width	Less than 6.0 meters	Less than 4.0 meters
. Pavement Type	Inferior to recommended type in the engineering Standards (Table 7.4-2)	Inferior to Gravel
. Surface Condition	Bad or very bad	Bad or very bad
(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

7.5.2 Improvement Criteria

The improvement works were proposed depending on the type and degree of road deficiencies identified as shown in Table 7.5-3.

TABLE 7.5-3 IMPROVEMENT CRITERIA FOR ROAD

Road Class	Major Road		Minor Road	
	Standard/ Superior	Substandard	Standard/ Superior	Substandard
Good/Fair	No improvement or widening[1] (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 of surface condition (Rehabilitation)	Upgrading of pavement type (Improvement-1)
Abandanced/ Non-existing	Construction of new road (New Construction)			

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

As found in Table 7.5-3, road improvement works were categorized into five (5) types which are summarized in Table 7.5-4.

TABLE 7.5-4 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 narrower 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.

Table 7.5-5 shows the improvement criteria for bridges.

TABLE 7.5-5 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[1)] Carriageway width 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 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.

7.6 PROJECT SCREENING

7.6.1 Categorization

In the categorization of road projects, the following factors were considered:

i) Class of Roads

Major roads were classified into primary major and secondary major roads, while minor roads into national/provincial/city roads and barangay roads.

ii) Type of Improvement

As described in Section 7.5.2, the improvement works were classified into five (5) types: Rehabilitation, Improvement-1, Improvement-2, Widening and New Construction. Road links which include only improvement of bridges were classified as Rehabilitation.

In view of the urgency of improvement, the types of improvement were grouped into two (2): Rehabilitation, Improvement-1 and New Construction in one group as urgent projects, and Improvement-2 and Widening in another group as less urgent projects.

iii) Internal Rate of Return (IRR) for Major Roads

Simplified economic evaluation was conducted for major roads. Internal rates of return were calculated based on roughly estimated values of construction cost and traffic cost savings.

iv) Link Valve (P/L) for Minor Roads

The link value (P/L) is defined as population in road influence area divided by length of road. Link values were calculated for minor roads.

Based on the factors described above, the road projects were categorized into eight (8) groups each for major roads and minor roads as shown in Table 7.6-1.

TABLE 7.6-1 CATEGORY OF ROAD PROJECTS

Class of roads \ Type of Improvements		Rehabilitation, Improvement-1, New Construction				Improvement-2, Widening	
		IRR more than 7.5%		IRR less than 7.5%		IRR more than 15%	IRR less than 15%
Major Road	Primary Major	Category 1		Category 5		Category 3	Category 7
	Secondary Major	Category 2		Category 6		Category 4	Category 8
		Rehabilitation, Improvement-1, New Construction				Improvement-2, Widening	
		P/L More than 600	600-400	400-200	Less than 200		
Minor Road	National/ Provincial/ City	Category 1	Category 3	Category 5	Category 7	Not Identified	
	Barangay	Category 2	Category 4	Category 6	Category 8		

Note: 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.
Improvement-2: Upgrading of acceptable road surface, but substandard pavement class to standard pavement class.
New Construction: Construction of new road.
Widening: Widening of roads with substandard carriageway width.
P/L: Link value

7.6.2 Prioritization

Prioritization was discussed in connection with the categorization described above.

Major Roads

Categories 1 and 2 were considered to have the highest priority in view of the urgent needs of improvement as well as high economic viability. On the other hand, categories 7 and 8 were given low priority because of lesser urgency and lower economic viability. Categories 3 and 4 (Rehabilitation/Improvement-1/New Construction, low IRR) and Categories 5 and 6 (Improvement-2/Widening, high IRR) were given equal priority since few analysis were made to prioritize the two (2) types.

As a consequence of the above considerations, major roads were classified into three priority groups as shown in Table 7.6-2.

Minor Roads

Prioritization of minor roads was made according to the link value as shown in Table 7.6-2.

7.6.3 Selection of Road Links for Feasibility Study

The project evaluation to be conducted as the next stage of the Study has the following two (2) major objectives:

i) Detailed evaluation to select road projects for implementation

ii) Development of simplified and commonly applicable evaluation mechodology for rural roads

To achieve the first objective, high priority projects should be selected, while for the second objective, it is preferable to cover wide-ranging projects. From this point of view, the criteria for selecting the road links for the Feasibility Study were proposed as follows:

i) Out of four pilot study provinces, one province which has a road network composed of varied types of roads should be selected as the case study province. In this province, all road links identified should be covered.

ii) In other provinces, the following priority road links shall be selected:

- Major roads classified as priority MA-I and MA-II (categories 1-6)
- Minor roads classified as priority MI-I and MI-II (categories 1-4)

Cavite Province was selected as the case study province in consideration of the development of road network.

TABLE 7.6-2 PRIORITIZATION OF ROAD PROJECTS

Major Roads

Category	Road Class	Type of Improvement	IRR	Priority
1	Primary	A	More than 7.5	MA-I
2	Secondary	A	More than 7.5	
3	Primary	B	More than 15.0	MA-II
4	Secondary	B	More than 15.0	
5	Primary	A	Less than 7.5	
6	Secondary	A	Less than 7.5	
7	Primary	B	Less than 15.0	MA-III
8	Secondary	B	Less than 15.0	

Minor Roads

Category	Road Class	Type of Improvement	Link Value	Priority
1	National/Provincial/City	A	More than 600	MI-I
2	Barangay	A	More than 600	
3	National/Provincial/City	A	400 - 600	MI-II
4	Barangay	A	400 - 600	
5	National/Provincial/City	A	200 - 400	MI-III
6	Barangay	A	200 - 400	
7	National/Provincial/City	A	Less than 200	MI-IV
8	Barangay	A	Less than 200	

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

CHAPTER 8

PROJECT IDENTIFICATION AND SCREENING IN THE PILOT PROVINCES

8.1 PROJECT IDENTIFICATION IN THE PILOT PROVINCES

Table 8.1-1 summarizes the major outputs of the project identification for the pilot provinces.

1) Functional Road Classification

A major road network for each province was proposed by the Study Team in accordance with the functional road classification criteria described in Section 7.3.2. In the provinces of Masbate and Agusan del Norte, new road links were proposed to be added to form an appropriate network.

Functional road classification in each province is discussed in detail in Chapters 10 to 13.

2) Prescreening

Studied roads were selected in accordance with the prescreening criteria described in Section 7.5.1 1).

The studied road length is 920.2 km or 58.5% of the existing road length of 1,571.7 km in Cavite Province, 789.3 km including proposed new road links or 104.2% of the existing 757.5 km in mainland Masbate, 1,587.2 km or 37.1% of the existing 4,273.3 km in Bohol and 884.9 km or 76.2% of the existing 1,163.7 km in Agusan del Norte.

Agusan del Norte has longer national roads in the studied roads than existing national roads because the latter is based on data as of 1985 and some provincial roads have been newly classified as national roads since 1985.

3) Project Identification

Road projects were identified in accordance with the identification criteria described in Section 7.5.1 2).

The total length of the identified road links was 665.4 km or 36.6% of the existing road length in Cavite, 768.4 km or 101.4% in Masbate, 1116.1 km or 26.1% in Bohol and 635.2 km or 54.6% in Agusan del Norte.

TABLE 8.1-1 SUMMARY OF THE PROJECT IDENTIFICATION

	Cavite	Masbate (Mainland)	Bohol	Agusan del Norte	Total
1. Population (1985)	933,600	490,400	871,900	419,900	2,715,800
2. Land Area (sq.km)	1,288	3,200	4,117	2,590	11,195
3. No. of Cities/Municipalities	23	15	48	12	98
4. Existing Road Length (1985)(km)					
. National Road	303.9	276.0	588.5	218.2	1,386.6
. Provincial/City Road	521.1	83.9	987.6	298.9	1,891.5
. Barangay Road	746.7	397.6	2,697.2	646.6	4,488.1
Total	1,571.7	757.5	4,273.3	1,163.7	7,766.2
5. Proposed Major Road Network (km)					
. National Road	224.5	276.0	586.5	197.2	1,284.2
. Provincial/City Road	144.8	49.3	227.8	59.5	481.4
. Barangay Road	-	170.1	-	34.6	204.7
Total	369.3	495.4	814.3	291.3	1,970.3
6. Studied Road Length(km)					
. National Road	281.8	276.0	591.8	260.2	1,409.8
. Provincial/City Road	414.8	83.9	705.0	245.7	1,449.4
. Barangay Road	223.6	429.4	290.4	379.0	1,322.4
Total	920.2	789.3	1,587.2	884.9	4,181.6
7. Identified Road Projects(km)					
Major Road					
. National Road	86.0	257.7	248.1	63.4	655.2
. Provincial/City Road	121.1	49.3	227.8	59.5	457.7
. Barangay Road	-	170.1	-	34.6	204.7
Total	207.1	477.1	475.9	157.5	1,317.6
Minor Road					
. National Road	11.2	-	5.3	42.9	59.4
. Provincial/City Road	230.3	32.0	344.5	153.3	760.1
. Barangay Road	216.8	259.3	290.4	281.5	1,048.0
Total	458.3	291.3	640.2	477.7	1,867.5
Total					
. National Road	97.2	257.7	253.4	106.3	714.6
. Provincial/City Road	351.4	81.3	572.3	212.8	1,217.8
. Barangay Road	216.8	429.4	290.4	316.1	1,252.7
Total	665.4	768.4	1,116.1	635.2	3,185.1
9. Selcted Road Projects for Detailed Evaluation (km)					
. Major Road	207.1	379.7	321.3	139.0	1,047.1
. Minor Road	458.3	143.5	230.5	152.1	984.4
Total	665.4	523.2	551.8	291.1	2,031.5

8.2 PROJECT SCREENING IN THE PILOT PROVINCES

1) Categorization and Prioritization

In accordance with the criteria described in Sections 7.6.1 and 7.6.2, the road projects were categorized and prioritized as summarized in Tables 8.2-1 and 8.2-2 for the major roads and the minor roads, respectively.

2) Selection of Road Links for Feasibility Study

The road projects for the Feasibility Study were selected in accordance with the selection criteria described in Section 7.6.3. Cavite Province was selected as a case study province, wherein all identified road projects were covered by the Feasibility Study. In the other provinces, major roads classified as priority MA-I and MA-II (categories 1-6) and minor roads classified as priority MI-I and MI-II (categories 1-4) were selected for the Feasibility Study.

Table 8.2-3 summarizes the total length of selected road projects, while Table 8.2-4 shows the number and average length.

In Cavite Province, a total road length of 574.6 km was proposed, which is composed of 145 road links with an average length of 4.0 km.

In Masbate, a road length of 521.0 km consisting of 61 road links with an average length of 8.5 km was proposed.

In Bohol, 429.5 km of road length composed of 81 road links with an average length of 5.3 km was proposed.

In Agusan Del Norte, a road length of 254.9 km composed of 69 road links with an average length of 3.7 km was proposed.

The road length proposed for the Feasibility Study totaled 1780.0 km, of which 891.6 km is for major roads and 888.4 km is forminor roads. It is composed of 355 road links with an averagelength of 5.0 km.

TABLE 8.2-1 CATEGORIZATION AND PRIORITIZATION OF MAJOR ROADS

Category	Road Class	Type of Improvement	IRR	Cavite		Masbate		Bohol		Agusan del Norte		Priority
				Category Total	Cummulative	Category Total	Cummulative	Category Total	Cummulative	Category Total	Cummulative	
1	Primary Major	. Rehabilitation . Improvement-1 . New Construction	More than 7.5%	35.2 (₱127.2M)	35.2 (₱127.2M)	209.6[1] (₱534.6M)	209.6 (₱534.6M)	31.6 (₱56.1M)	31.6 (₱56.1M)	- (-)	- (-)	MA-I
2	Secondary Major	. Rehabilitation . Improvement-1 . New Construction	More than 7.5%	83.5 (₱261.0M)	118.7 (₱388.2M)	188.7 (₱331.7M)	398.3 (₱866.3M)	45.8 (₱62.3M)	77.4 (₱118.4M)	45.5 (₱128.0M)	45.5 (₱128.0M)	
3	Primary Major	. Improvement-2 . Widening	More than 15.0%	- (-)	118.7 (₱388.2M)	- (-)	398.3 (₱866.3M)	13.1 (₱23.5M)	90.5 (₱141.9M)	- (-)	45.5 (₱128.0M)	
4	Secondary Major	. Improvement-2 . Widening	More than 15.0%	6.0 (₱21.1M)	124.7 (₱409.3M)	- (-)	398.3 (₱866.3M)	- (-)	90.5 (₱141.9M)	19.3 (₱58.9M)	64.8 (₱186.9M)	MA-II
5	Primary Major	. Rehabilitation . Improvement-1 . New Construction	More than 7.5%	- (-)	124.7 (₱409.3M)	34.8 (₱79.3M)	433.1 (₱945.6M)	- (-)	90.5 (₱141.9M)	33.6 (₱66.3M)	98.4 (₱253.2M)	
6	Secondary Major	. Rehabilitation . Improvement-1 . New Construction	More than 7.5%	- (-)	124.7 (₱409.3M)	44.0 (₱63.0M)	477.1 (₱1,008.6M)	148.8 (₱222.6M)	239.3 (₱364.5M)	38.0 (₱45.9M)	136.4 (₱299.1M)	
7	Primary Major	. Improvement-2 . Widening	More than 15.0%	- (-)	124.7 (₱409.3M)	- (-)	477.1 (₱1,008.6M)	113.7 (₱206.8M)	353.0 (₱571.3M)	7.6 (₱12.1M)	144.0 (₱311.2M)	MA-III
8	Secondary Major	. Improvement-2 . Widening	More than 15.0%	19.1 (₱47.2M)	143.8 (₱456.5M)	- (-)	477.1 (₱1,008.6M)	122.9 (₱132.6M)	475.9 (₱703.9M)	13.5 (₱24.0M)	157.5 (₱335.2M)	

Note: 1) Including 105.0 km of roads being studied under the 4th UNDP Feasibility Study
2) Road lengths in this table were slightly adjusted to suit for project evaluation during feasibility studies

TABLE 8.2-2 CATEGORIZATION AND PRIORITIZATION OF MINOR ROADS

Category	Road Class	IRR	Cavite		Masbate		Bohol		Agusan del Norte		Priority
			Category Total	Cummulative	Category Total	Cummulative	Category Total	Cummulative	Category Total	Cummulative	
1	National/ Provincial/ City Roads	More than 600	64.5 (P158.7M)	64.5 (P158.7M)	19.4 (P25.3M)	19.4 (P25.3M)	38.2 (P68.7M)	38.3 (P68.7M)	51.8 (P122.6M)	51.8 (P122.6M)	MI-I
2	Barangay Roads	More than 600	25.9 (P27.8M)	90.4 (P186.5M)	66.5 (P52.5M)	85.9 (P77.8M)	14.4 (P12.3M)	52.7 (P81.0M)	7.1 (P4.1M)	58.9 (P126.7M)	
3	National/ Provincial/ City Roads	400-600	34.4 (P49.0M)	124.8 (P235.5M)	- (-)	85.9 (P77.8M)	102.9 (P182.3M)	155.6 (P263.3M)	33.6 (P45.3M)	92.5 (P172.0M)	MI-II
4	Barangay Roads	400-600	34.4 (P26.7M)	159.2 (P262.2M)	63.0 (P52.0M)	148.9 (P129.8M)	34.7 (P24.1M)	190.3 (P287.4M)	26.0 (P35.4M)	118.5 (P207.4M)	
5	National Provincial/ City Raods	200-400	87.4 (P132.0)	246.6 (P394.2M)	4.5 (P5.9M)	153.4 (P135.7M)	179.3 (P262.3M)	369.6 (P549.7M)	48.8 (P70.6M)	167.3 (P278.0M)	MI-III
6	Barangay Roads	200-400	85.0 (P54.8M)	331.6 (P449.0M)	95.3 (P75.3M)	248.7 (P211.0M)	116.6 (P83.4M)	486.2 (P633.1M)	67.3 (P70.7M)	234.6 (P348.7M)	
7	National/ Provincial/ City Roads	Less than 200	34.2 (P42.9M)	365.8 (P491.9M)	8.1 (P13.2M)	256.8 (P224.2M)	29.3 (P36.7M)	515.5 (P669.8M)	62.0 (P77.2M)	296.6 (P425.9M)	MI-IV
8	Barangay Raods	Less than 200	65.0 (P40.9M)	430.8 (P532.8M)	34.5 (P28.6M)	291.3 (P252.8M)	124.7 (P77.2M)	640.2 (P747.0M)	181.1 (P141.9M)	477.7 (P567.8M)	

Note: 1) Road length in this table were slightly adjusted to suit for project evaluation during feasibility studies

TABLE 8.2-3 ROAD LENGTH PROPOSED FOR FEASIBILITY STUDY

Major Roads

Priority	Category of Proposed Work	Cavite	Masbate	Bohol	Agusan del Norte	Total
MA-I	1	35.2	104.6[1)]	31.6	-	171.4
	2	83.5	188.7	445.8	45.5	363.5
MA-II	3	-	-	13.1	-	13.1
	4	6.0	-	-	19.3	25.3
MA-II	5	-	34.8	-	33.6	68.4
	6	-	44.0	148.8	38.0	230.8
MA-III	7	-	*	*	*	0
	8	19.1	*	*	*	19.1
	Subtotal	143.8	372.1'	239.3	136.4	891.6

Minor Roads

MA-I	1	64.5	19.4	38.2	51.8	173.9
	2	25.9	66.5	14.4	7.1	113.9
MA-II	3	34.4	-	102.9	33.6	170.9
	4	34.4	63.0	34.7	26.0	158.1
MA-III	5	87.4	*	*	*	87.4
	6	85.0	*	*	*	85.0
MA-IV	7	34.2	*	*	*	34.2
	8	65.0	*	*	*	65.0
	Subtotal	430.8	148.9	190.2	118.6	888.4
	TOTAL	574.6	521.0	429.5	254.9	1,780.0

Note: -: Not identified
*: Not proposed for F/S
1) Excluding 105.0 km of roads being studied under the 4th UNDP Feasibility Study

TABLE 8.2-4 NUMBER AND AVERAGE LENGTH OF ROADS PROPOSED FOR FEASIBILITY STUDY

Major Roads

Priority	Category of Proposed Works	Cavite		Masbate		Bohol		Agusan del Norte		Total	
		N	L	N	L	N	L	N	L	N	L
MA-I	1	7	5.0	9[1)]	11.6[1)]	3	10.5	-	-	19	9.0
	2	15	5.6	15	12.6	5	9.2	11	4.1	46	7.9
MA-II	3	-	-	-	-	2	6.5	-	-	2	6.5
	4	1	6.0	-	-	2	-	4	4.8	5	5.1
MA-II	5	-	-	3	11.6	-	-	3	11.2	6	11.4
	6	-	-	5	8.8	22	6.8	6	6.3	33	7.0
MA-III	7	-	-		*		*		*	-	-
	8	2	9.5		*		*		*	2	9.5
	Subtotal	25	5.8	32	11.6	32	7.5	24	5.7	113	7.9

Minor Roads

MA-I	1	16	4.0	6	3.2	9	4.2	15	3.4	46	3.8
	2	17	1.5	14	4.8	8	1.8	6	1.2	45	2.5
MA-II	3	8	4.3	-	-	16	6.4	11	3.1	35	4.9
	4	15	2.3	9	7.0	16	2.2	13	2.0	53	3.0
MA-III	5	11	7.9		*		*		*	11	7.9
	6	31	2.7		*		*		*	31	2.7
MA-IV	7	5	6.8		*		*		*	5	6.8
	8	17	3.8		*		*		*	17	3.8
	Subtotal	120	3.6	29	5.1	49	3.9	45	2.6	243	3.7
	TOTAL	145	4.0	61	8.5	81	5.3	69	3.7	356	5.0

Note: N: Number of road links
L: Average length of road links (km.)
-: Not identified
*: Not proposed for F/S
1) Excluding 105.0 km of road being studied under the 4th UNDP Feasibility Study

PART IV PROJECT EVALUATION

CHAPTER 9

PROJECT EVALUATION METHODOLOGY

9.1 GENERAL PROCEDURE

9.1.1 Project Classification

The project roads selected for feasibility studies were grouped, mainly by the method of economic analysis required, into two types:traffic projects and development projects.

Traffic Projects: In projects involving the restoration/reconstruction/upgrading of the existing road which is accessible to motorized vehicles at all times, the impact of the investment would be generally confined to the transport sector. The effect of such projects would have a limited impact on the overall structure of the economy in the area served by the road.

Development Projects: In projects for providing all-weather access to the area which presently has either no motorized access or only seasonal access, the impact of the investment would affect not only the transport sector but also sectors in the local economy, especially the agricultural sector.

Roads located in the area of high agricultural potential served by very rough but all-weather roads were considered development project roads.

The project classification was determined during the field surveys. The major roads were generally classified as traffic projects, with the minor roads as development projects, except for several minor roads in Cavite which were considered as traffic projects. A considerable number of secondary major roads in the other pilot provinces were regarded as development projects.

The evaluation methods for traffic and development projects differ as outlined below:

Traffic Projects: Traffic demand is analyzed as a component of the overall road network in the province. Economic analysis is focused on the quantification of road user cost savings and road maintenance cost changes.

Development Projects: Traffic demand is analyzed independently as a feeder road based on population and agricultural activities in the area served by the road. Economic evaluation deals with changes in transport mode and traffic costs as well as increased agricultural development.

9.1.2 General Procedure

Figure 9.1-1 shows the procedure for project evaluation. Different procedures were applied to traffic projects and development projects.

Supplemental Survey

Road inventory surveys were carried out covering all project roads. Traffic surveys were conducted on the selected road links, mainly on the major roads but including a few minor roads for the purpose of getting informations on the present movement of people and freight and on transport means. Socio-economic surveys were carried out concentrating on the development project roads.

Evaluation of Traffic Projects

Present traffic on the overall major road network system in the province was analyzed, and based thereupon changes in traffic flow after completion of the projects were estimated. Then, preliminary design and estimate of project costs and benefits were carried out to provide input data for economic evaluation.

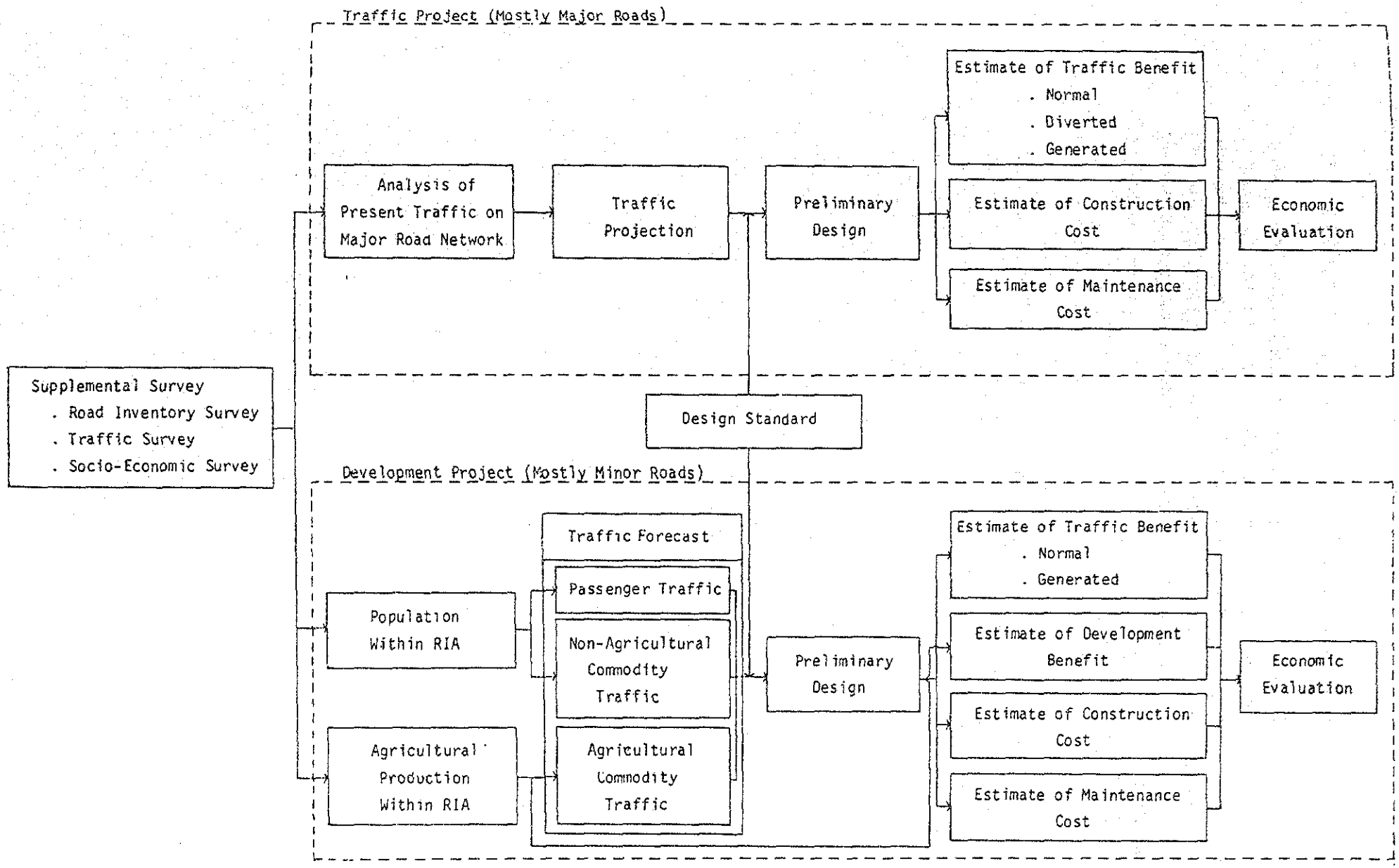


FIGURE 9.1-1 PROCEDURE FOR PROJECT EVALUATION

Evaluation of Development Projects

The development projects were analyzed on the basis of the results of the road inventory survey and the socio-economic survey. In each step of the analysis, the treated data such as agricultural production per population, net value of production per hectare, average transport cost per person-km or ton-km and estimated future values thereof were summarized by road condition category and by terrain so that unusual/unreasonable data subject to review could be detected.

9.2 SUPPLEMENTAL SURVEY

The following surveys were conducted to obtain basic data for traffic forecast, preliminary design and economic analysis (refer to Figure 9.2-1):

i) Road Inventory Survey
ii) Traffic Survey
iii) Socio-economic Survey

9.2.1 Road Inventory Survey

In the project identification and screening stage, 1,780.0 km of roads were selected for evaluation in this stage. However, the road inventory survey was conducted for 2,031.5 km of roads as shown in Table 9.2-1, including related road links as well as the selected road links.

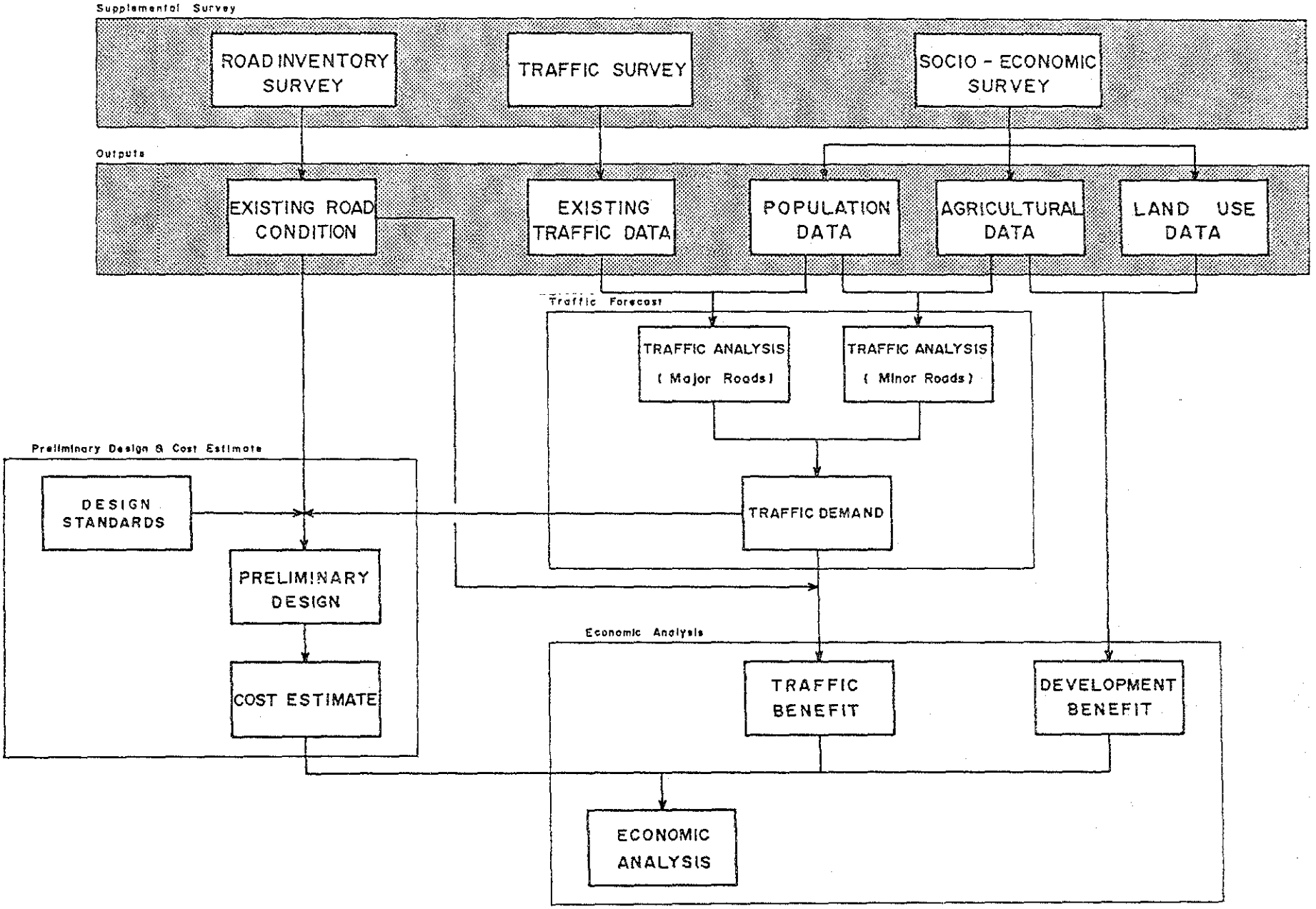


FIGURE 9.2-1 SUPPLEMENTAL SURVEY AND OUTPUT UTILIZATION

TABLE 9.2-1 LENGTH OF SURVEYED ROADS

Province	Total Length (km)	No. of Links
Cavite	665.4	138
Masbate	523.3	61
Bohol	551.8	78
Agusan del Norte	291.0	52
Total	2,031.5	329

In the course of the field survey, each road was divided into homogeneous subsections. Road conditions of each subsection and bridge conditions of each bridge were surveyed in the field sheets which are shown in Tables 9.2-2 and 9.2-3, respectively. Survey results are presented in Volume IV to VII, Drawings.

TABLE 9.2-2 ROAD INVENTORY SURVEY FIELD SHEET (FORM-1)

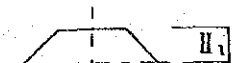
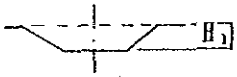
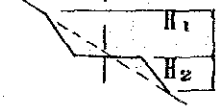
Name of Road				
Road Number				
Sub-Sect. No.				
Length (km)				
Width (m)	Road Width			
	Pavement Width			
Surface Type	(P) PCC, (A) AC, (G) Gravel, (E) Earth			
Surface Condition	(1) Good, (2) Fair, (3) Bad, (4) Very Bad (5) Impassable for vehicle			
Terrain	(1) Flat, (2) Rolling, (3) Mountainous			
Cross Section	(1)  (2)  (3)  (4)  (5) (6) Others			Shape H_1 (m) H_2 (m)
Length of Section with Steep Gradient (km)				
Number of Sharp Curves				
Side Ditch	(1) Good Condition, (2) Poor, (3) None			
No. of Bridges	(Fill up Form-2 for each bridge)			
Motorised Access	Frequency of road impassable (time/year)			
	Average period of road impassable (days)			
	Cause of road impassable: (1) Flood, (2) Muddy, (3) Lack of bridge, (4) Slope failure, (5) Others ( )			
	If cause is flood,	Length (km)		
		Depth of water (m)		
	If cause is slope failure,	Cut slope (m)		
		Embankment slope (m)		
Average Speed for Car (km/hour)				
Major Transport Means (Minor Roads)	(1) Car/Jeep (2) Jeepney (3) Bus (4) Truck (5) Tricycle (6) Motorcycle (7) Carabao/horse (8) Walking (9) Boat	Passenger	mostly	
			often	
			sometimes	
		Commodity	mostly	
			often	
			sometimes	
Date of Survey	, 1988	Surveyor		

TABLE 9.2-3 ROAD INVENTORY SURVEY FIELD SHEET (FORM-2)

Road Number			
Sub-Section No.			
Bridge No.			
Location (Distance in km from the end of Sub-section)			
Existing Condition	Bridge Type	(1) Ford Crossing, (2) Timber Bridge, (3) Bailey Bridge, (4) Concrete Bridge, (5) Steel Bridge, (6) Others ( )	
	Slab Type	(1) Timber, (2) Concrete, (3) Others	
	Bridge Length(m)		
	Span Length (m)		@
			@
			@
	Width (m)	Carriageway	
		Side walk	
	Slab	(1) Good/Fair, (2) Needed to improve	
	Super-structure	(1) Good/Fair, (2) Needed to improve	
	Sub-structure	(1) Good/Fair, (2) Needed to improve	
Proposed Bridge Length (m)			
Profile, Cross section, etc., if necessary			
Date of Survey	, 1988	Surveyor	

9.2.2 Traffic Survey

The traffic survey was conducted at 80 stations, of which the provincial breakdown is shown in Table 9.2-4.

TABLE 9.2-4 NUMBER OF TRAFFIC COUNT STATIONS

Province	Number of Stations
Cavite	26
Masbate	16
Bohol	26
Agusan del Norte	12
Total	80

Traffic counts were carried out on two consecutive weekdays 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

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

9.2.3 Socio-economic Survey

Road influence areas were specified considering the topography, road network, location of barangay and land use. Then, lists of the barangays located within the road influence areas were prepared.

The following data were collected for each barangay:

a) Location of barangay center
b) Population
c) Nearest market (name, location and market day)
d) Social facilities (schools and health facilities)
e) Land area (total, cultivated, uncultivated and potential area)
f) Road access
g) Agricultural data (cultivated area, average yield, farmgate price and production cost of major crops)

Major data sources were as follows:

- Provincial Planning & Development Office (PPDO)
- City/Municipal Planning & Development Office (CPDO/MPDO)
- Municipal Agricultural Office (MAO)
- Barangay

Collected data were compiled by road link as exemplified in Appendix 9-1.

9.3 TRAFFIC FORECAST

9.3.1 Traffic Project

1) Analysis of Present Traffic

General

Present traffic on each major road network was analyzed according to the procedure shown in Figure 9.3-1.

The analysis is divided into three major parts:

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.

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.

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.

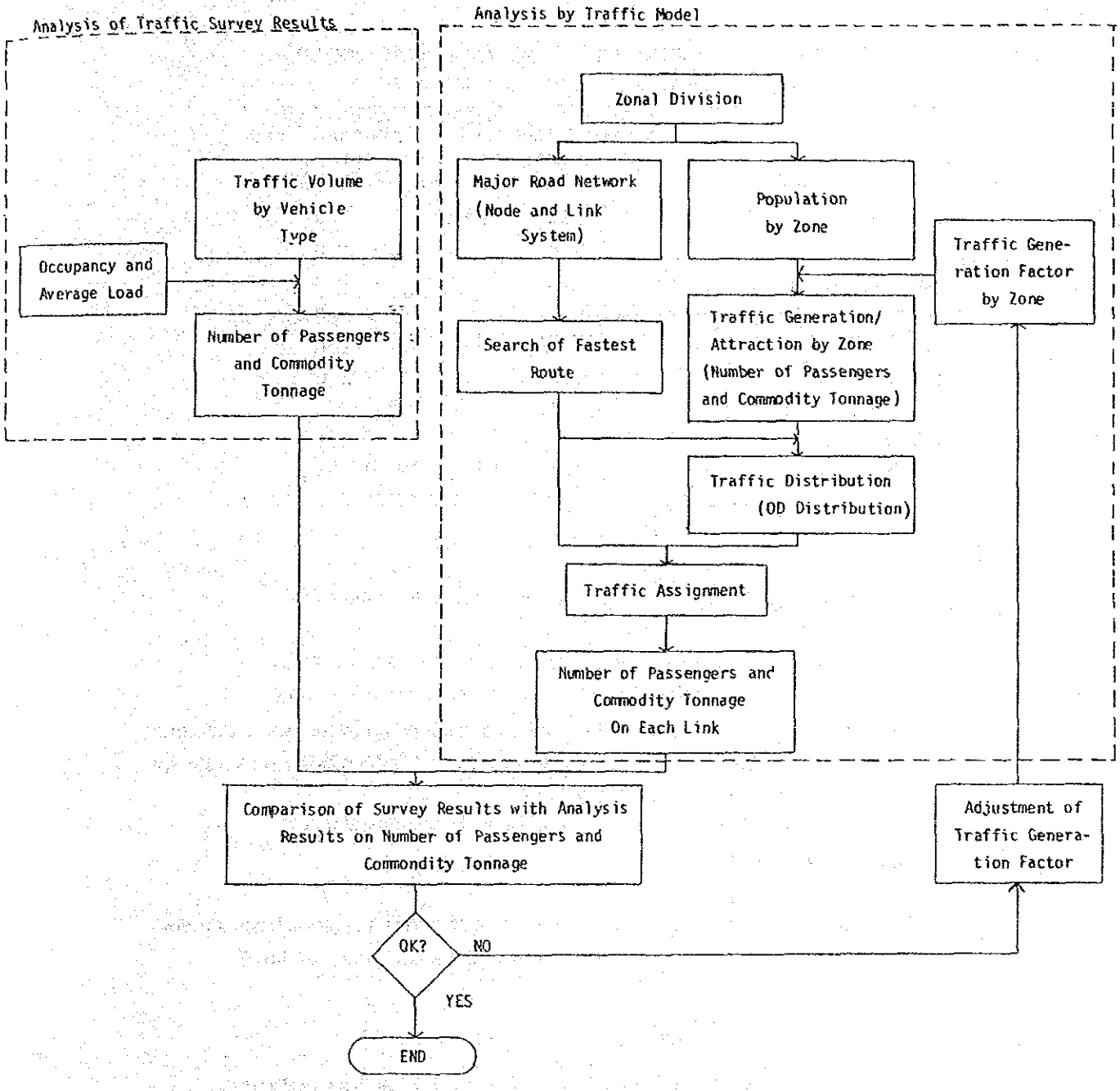


FIGURE 9.3-1 PROCEDURE OF ANALYSIS OF PRESENT TRAFFIC ON MAJOR ROAD NETWORK

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 9.3-1.

TABLE 9.3-1 OCCUPANCY AND AVERAGE LOAD

	Average Number of Passengers	Average Load (ton)
Car/Taxi	3.4	1.0
Jeep	3.4	1.0
Van/Pickup	3.4	1.0
Jeepney	11.8-17.7	1.0
Bus	25.3-38.0	1.0
Truck	5.0	3.0
Motor-tricycle	2.0-2.9	0.3
Motorcycle	1.6-2.3	0.1
Animal Drawn	1.5-3.0	0.15

Analysis by Traffic Model

i) Zonal Division:

The province was divided into traffic zones corresponding to municipal divisions in principle. For Cavite and Agusan del Norte, which adjoin other provinces by land, some external zones were provided.

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.

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

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 9.3-2.

TABLE 9.3-2 PER CAPITA TRAFFIC GENERATION FACTORS (MAJOR ROAD, 1988, W/O)

	Passenger Movement (trip/person/day)	Commodity (kg/person/day)
Cavite	0.29-0.54	18-45
Masbate	0.006-0.14	0.6-21
Bohol	0.05-0.24	2.8-11
Agusan del Norte	0.01-0.11	4-33

v) Traffic Generation and Attraction by Zone:

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

2) Traffic Forecast

Figure 9.3-2 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:

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.

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.

The traffic generation factors thus estimated are summarized in Table 9.3-3.

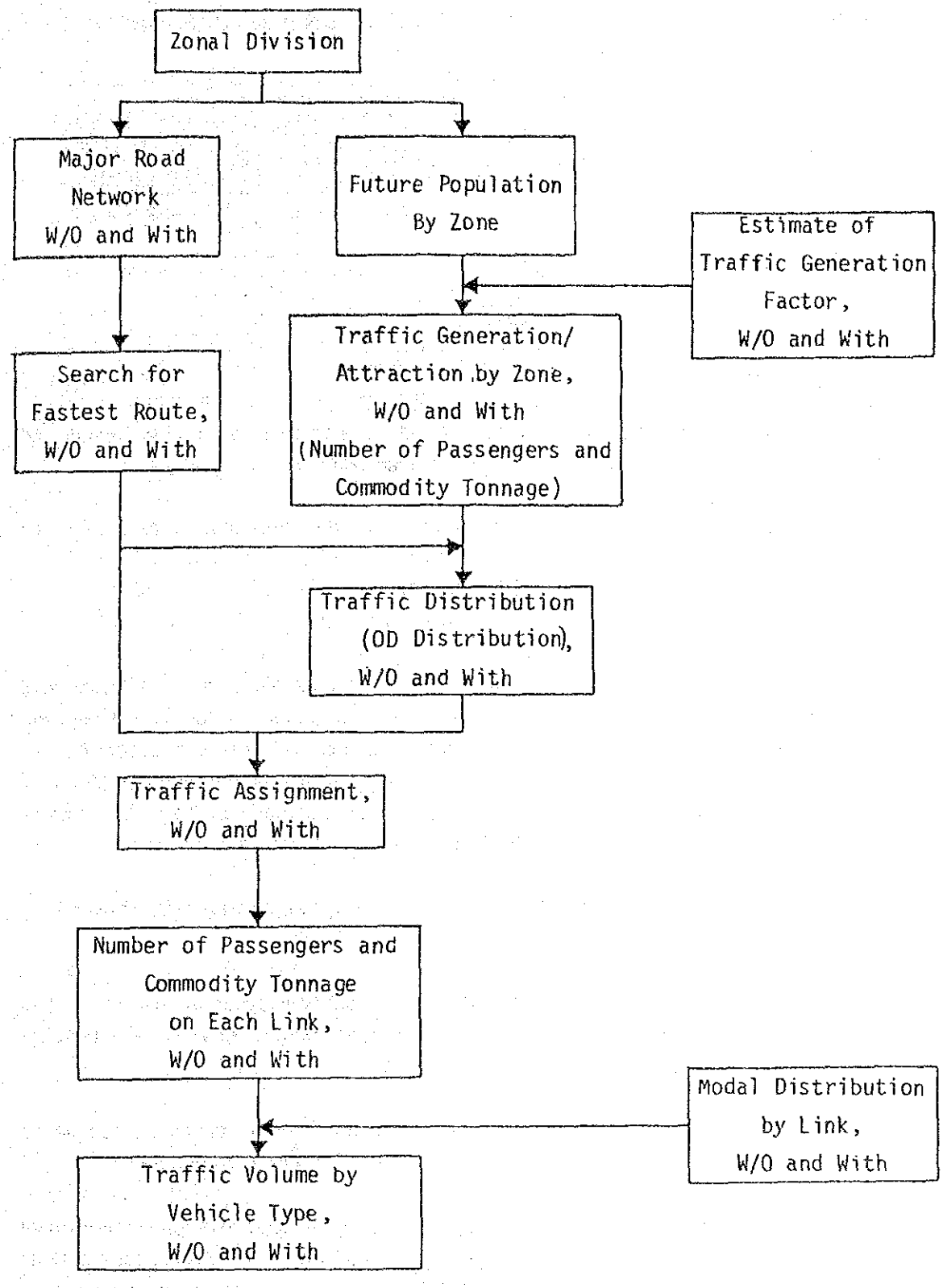


FIGURE 9.3-2 PROCEDURE OF FORECASTING TRAFFIC ON MAJOR ROAD NETWORK

TABLE 9.3-3 PER CAPITA TRAFFIC GENERATION FACTORS (MAJOR ROAD, 1988, WITH)

	Passenger Movement (trip/person/day)	Commodity (kg/person/day)
Cavite	0.36-0.54	18-45
Masbate	0.02-0.18	2-23
Bohol	0.10-0.24	4-11
Agusan del Norte	0.05-0.12	10-35

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.

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 referring to the present distribution in other road links in a similar situation but in better road condition. The transition period for 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 road 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.

9.3.2 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 9.3-3 shows the schematic diagram of traffic forecast for development project.

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 on 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 9.3-4 shows the generation factors commonly 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 inapplicable, specific values were used.

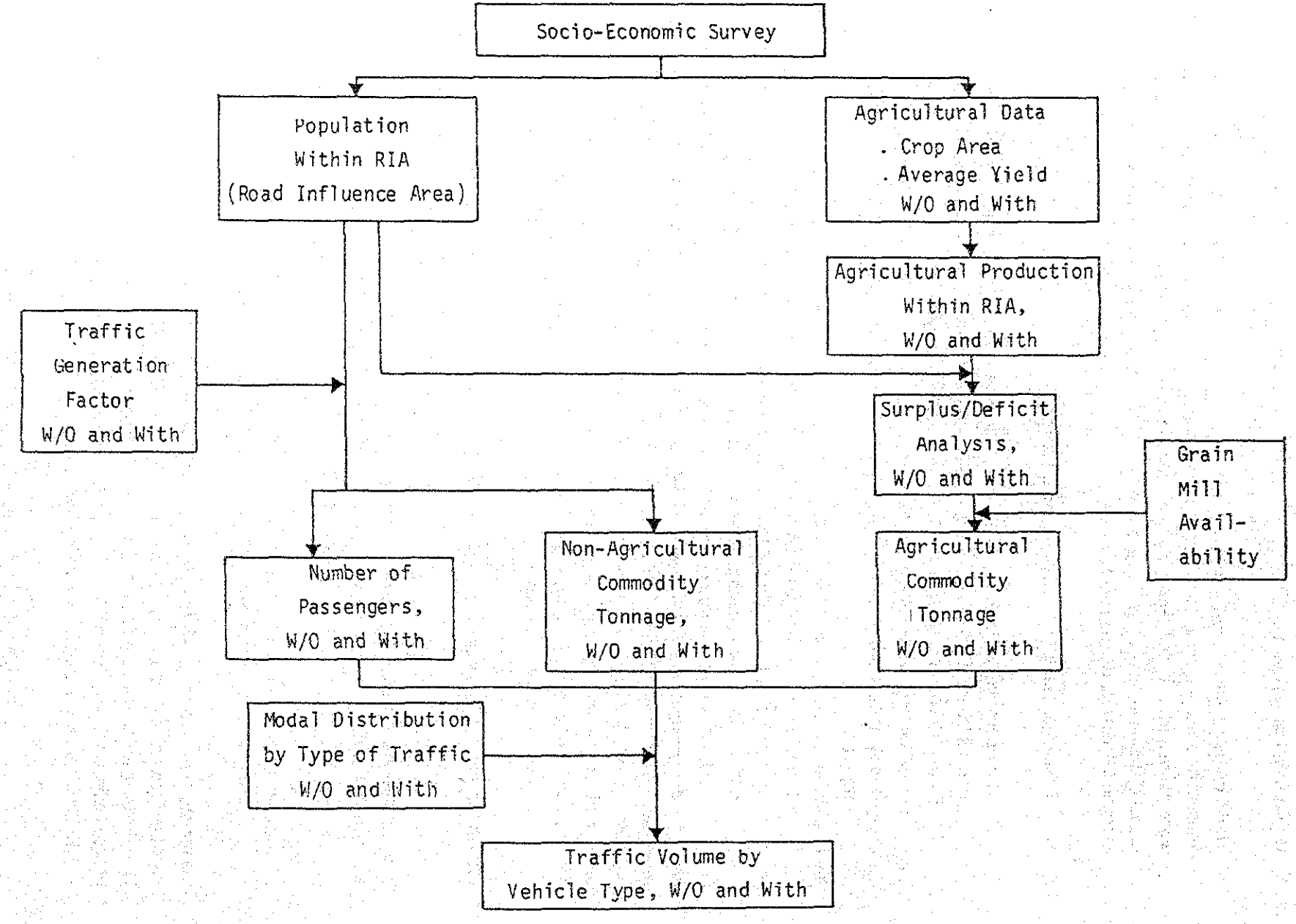


FIGURE 9.3-3 PROCEDURE OF TRAFFIC FORECAST FOR DEVELOPMENT PROJECTS

TABLE 9.3-4 PER CAPITA TRAFFIC GENERATION FACTORS (MINOR ROAD)

Province	Existing Road Condition	Passenger Movement (trip/person/day)		Non-Agricultural Commodity (kg/person/day)	
		w/o	with	w/o	with
Cavita	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	0.15	0.28	1.5	3.0
	Impassable to motorized vehicle	0.03	0.10	1.2	3.0
Masbate	Paved/gravel				
	Good/fair	0.06	0.06	2.0	2.0
	Bad	0.05	0.055	1.6	1.8
	Very bad	0.04	0.055	0.6	1.0
	Earth	0.015	0.03	0.5	1.0
	Impassable to motorized vehicle	0.005	0.015	0.4	1.0
Bohol/ Agusan del Norte	Paved/gravel				
	Good/fair	0.12	0.12	2.0	2.0
	Bad	0.10	0.11	1.6	1.8
	Very bad	0.08	0.11	0.6	1.0
	Earth	0.03	0.06	0.5	1.0
	Impassable to motorized vehicle	0.01	0.03	0.4	1.0

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 inventory survey and the traffic survey.

2) Agricultural Traffic

Agricultural commodity tonnage was estimated based on the agricultural production within the road influence area, taking into consideration i) home consumption 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 consumption 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 converted to number of vehicles using the modal distribution and average load, which were estimated individually for each road considering the transport circumstances.

9.4 PRELIMINARY DESIGN AND COST ESTIMATE

9.4.1 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 the requirements for rural road improvement are quite high, 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 described in Sections 7.4 and 7.5.2, respectively.

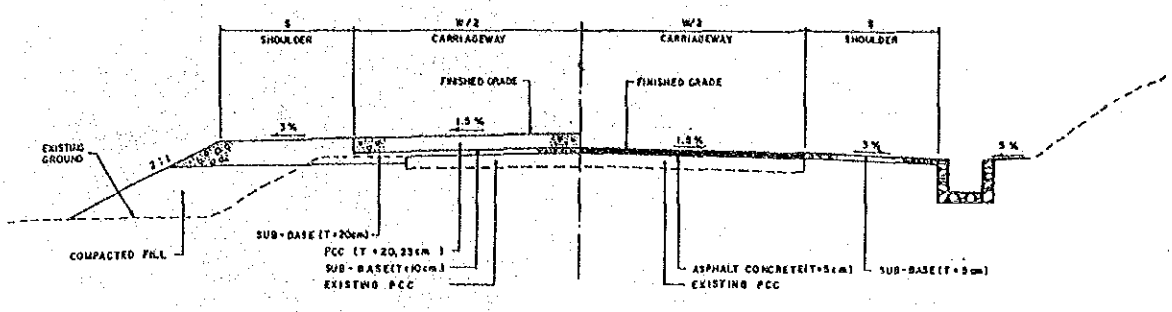
Typical road sections for each type of improvement are summarized as shown in Table 9.4-1, and shown in Figures 9.4-1 to 9.4-6.

Special considerations was given to steep gradient sections and flood sections.

Type 6, 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.
Type 7, Grade raising in flood area, was applied to sections located in flood areas.

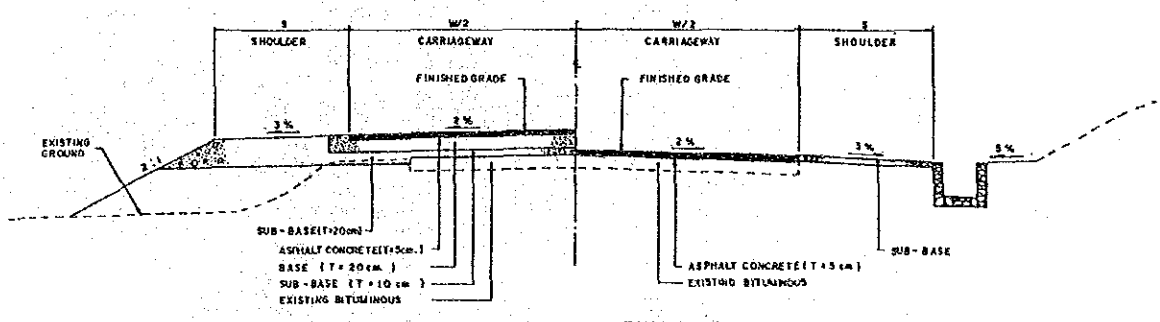
TABLE 9.4-1 TYPICAL ROAD SECTION (1)

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					



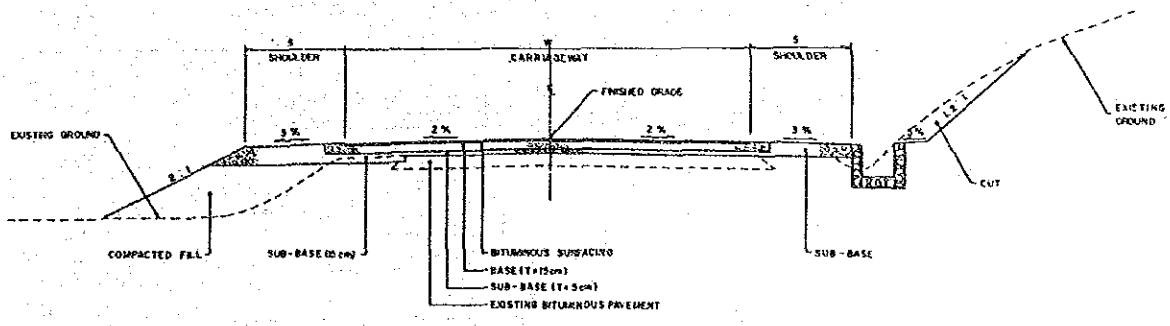
TYPE I-1
PROPOSED PAVEMENT : PCC
EXISTING PAVEMENT : PCC (BAD/VERY BAD)

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

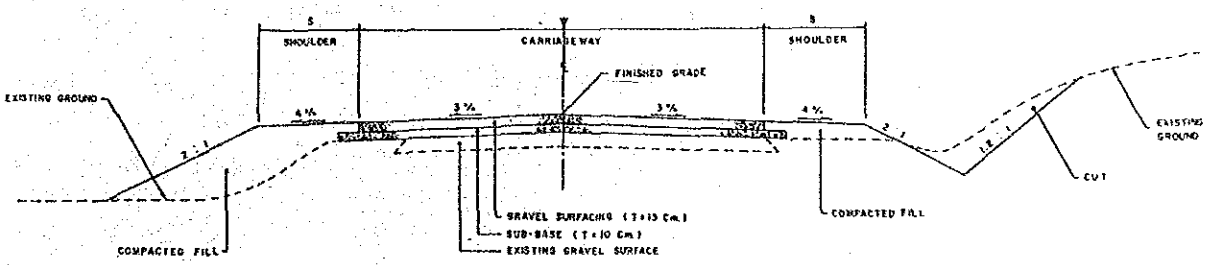


TYPE I-3
PROPOSED PAVEMENT : ASPHALT CONCRETE
EXISTING PAVEMENT : BITUMINOUS (BAD/VERY BAD)

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



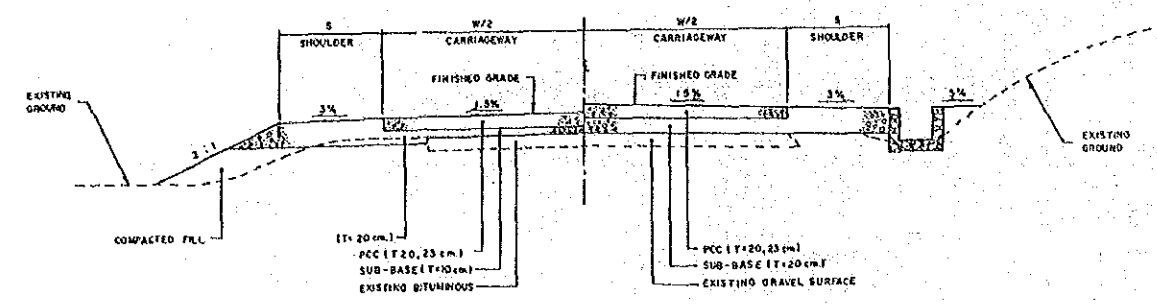
TYPE I-5
PROPOSED PAVEMENT : BITUMINOUS MACADAM/DOUBLE BITUMINOUS SURFACE TREATMENT
EXISTING PAVEMENT : BITUMINOUS (BAD/VERY BAD)



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

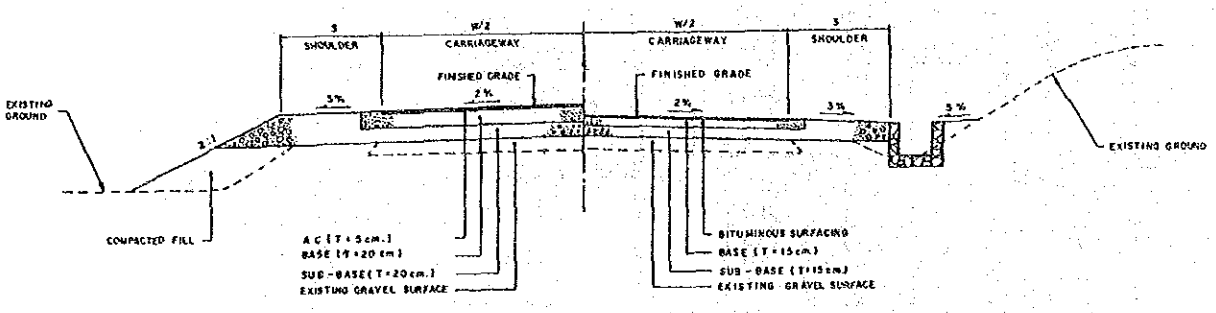
REHABILITATION

FIGURE 9.4-1 TYPICAL ROAD SECTIONS (1)



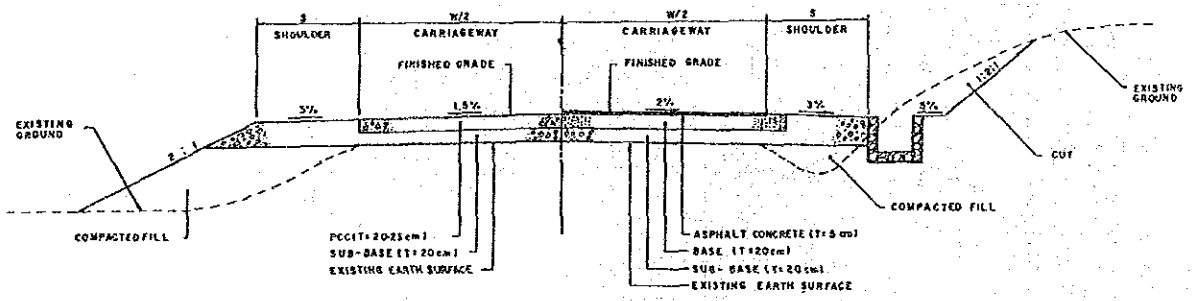
TYPE 2-1
PROPOSED PAVEMENT : PCC
EXISTING PAVEMENT : BITUMINOUS (BAD/VERY BAD)

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



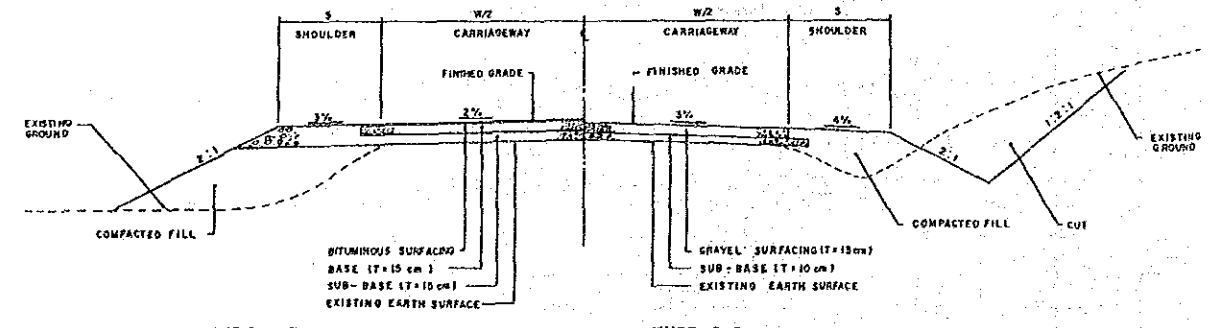
TYPE 2-3
PROPOSED PAVEMENT : ASPHALT CONCRETE
EXISTING PAVEMENT : GRAVEL SURFACING (BAD/VERY BAD)

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 9.4-2 TYPICAL ROAD SECTIONS (2)

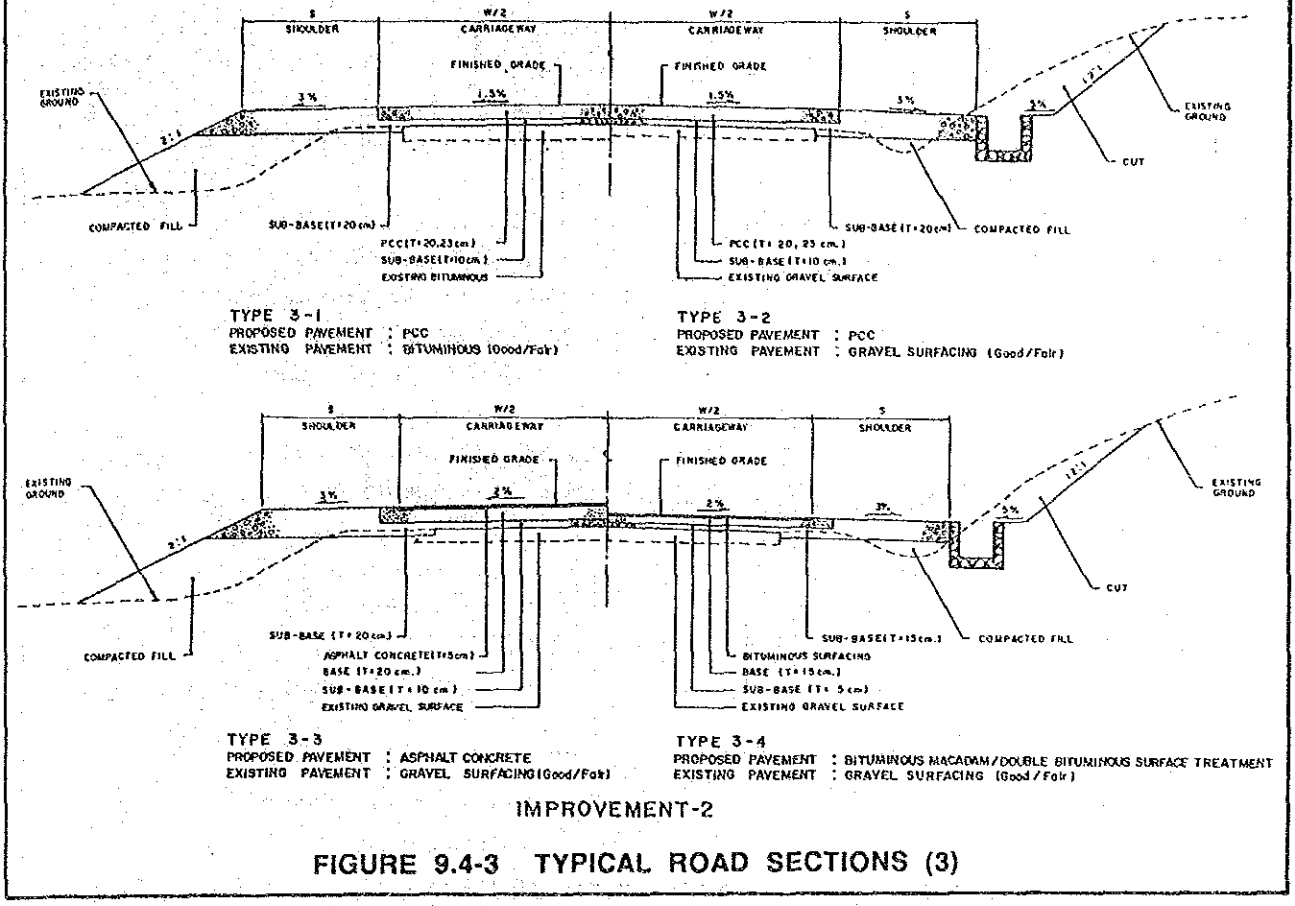


FIGURE 9.4-3 TYPICAL ROAD SECTIONS (3)

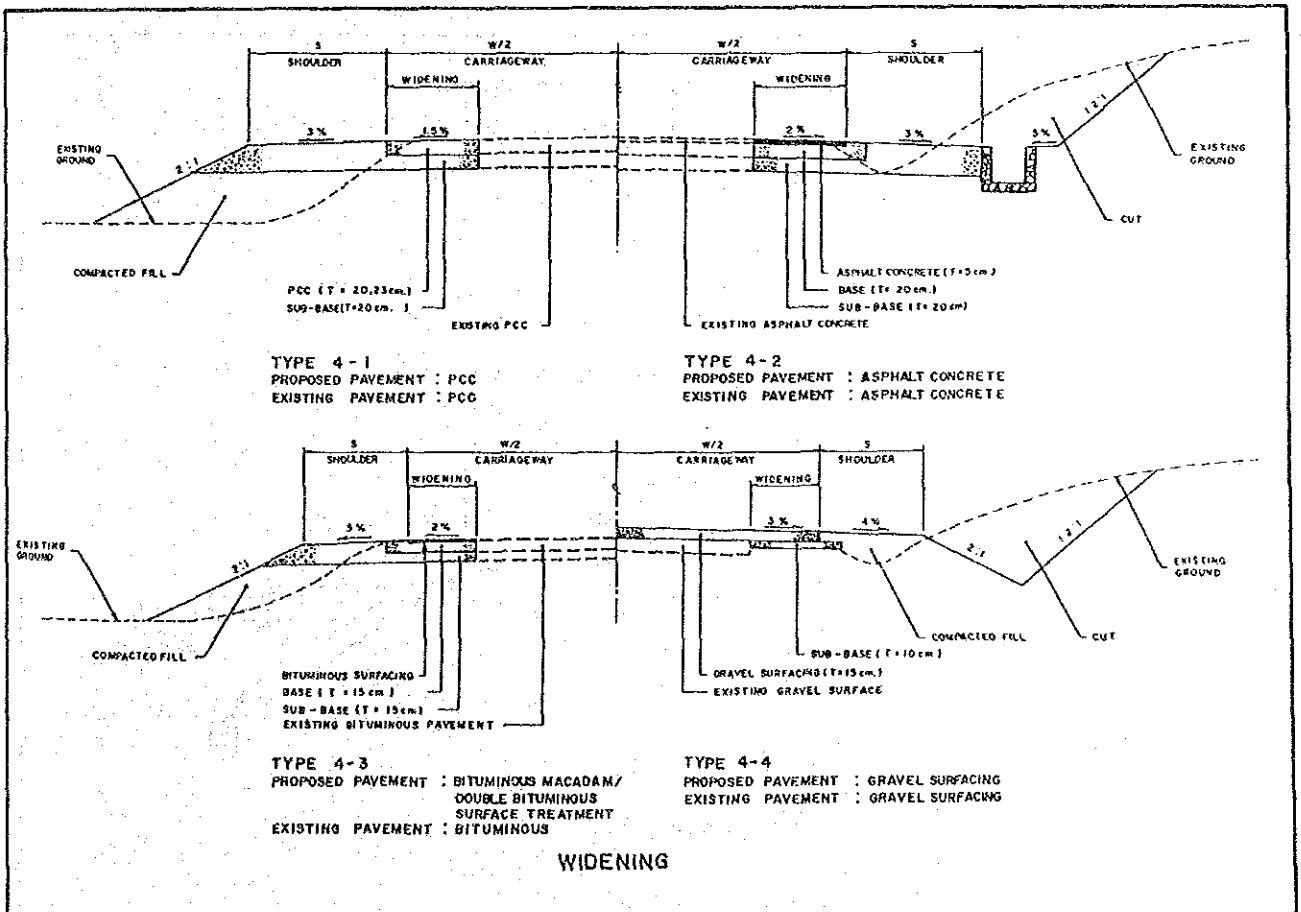
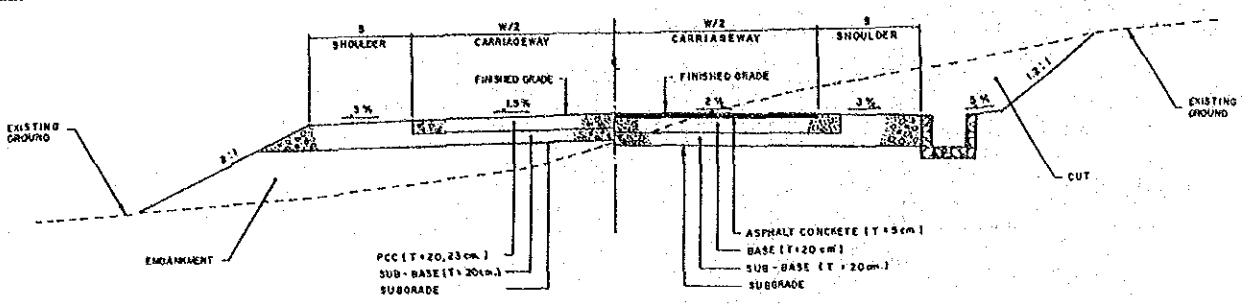
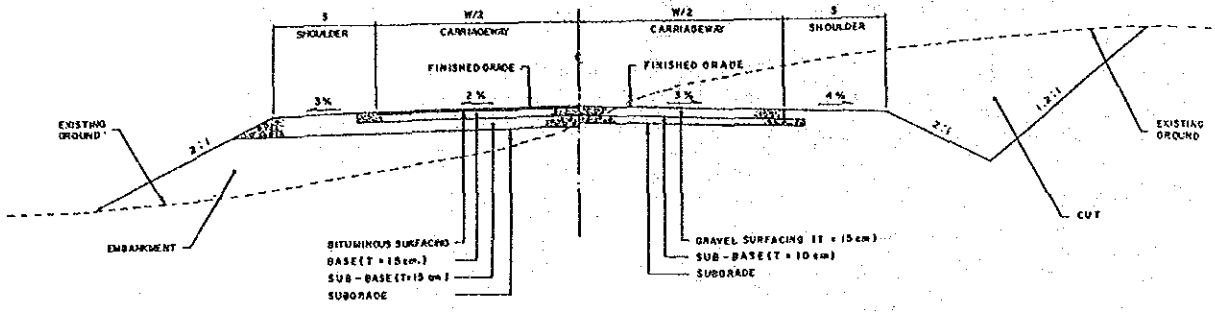


FIGURE 9.4-4 TYPICAL ROAD SECTIONS (4)



TYPE 5-1
PROPOSED PAVEMENT : PCC

TYPE 5-2
PROPOSED PAVEMENT : ASPHALT CONCRETE

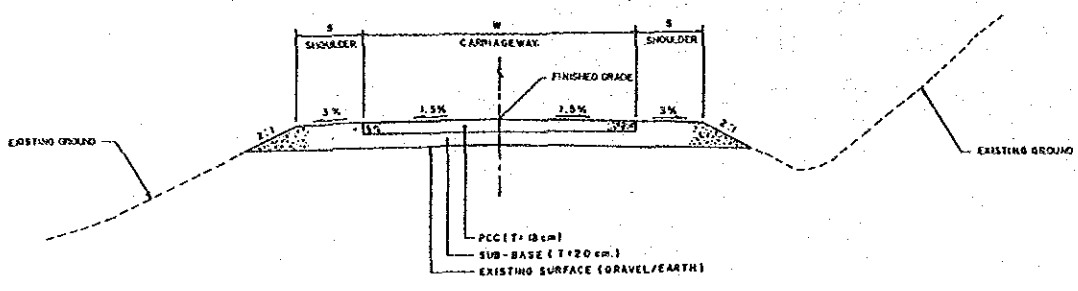


TYPE 5-3
PROPOSED PAVEMENT : BITUMINOUS MACADAM / DOUBLE BITUMINOUS SURFACE TREATMENT

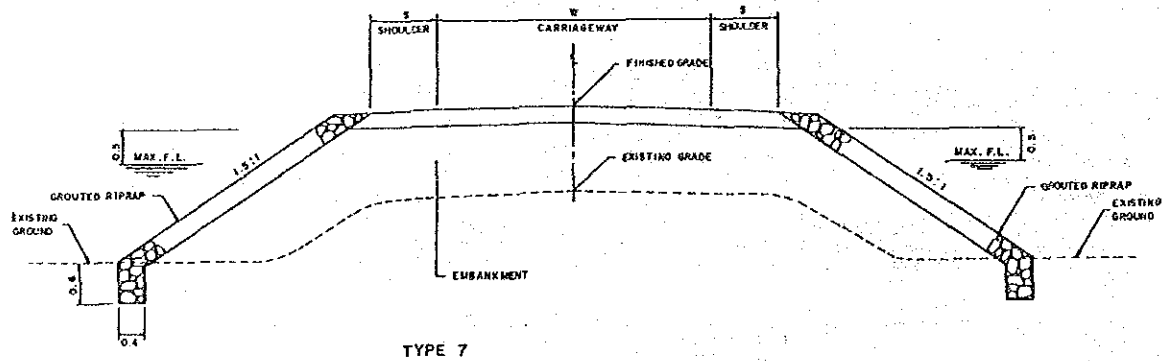
TYPE 5-4
PROPOSED PAVEMENT : GRAVEL SURFACING

NEW CONSTRUCTION

FIGURE 9.4-5 TYPICAL ROAD SECTIONS (5)



TYPE 6
PCC PAVEMENT FOR STEEP GRADIENT SECTIONS



TYPE 7
GRADE RAISING IN FLOOD AREA

FIGURE 9.4-6 TYPICAL ROAD SECTIONS (6)

9.4.2 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 June 1988 prices were developed. Exchange rates used were: ₱21.00 = US$1.00 = ¥130.

Hourly cost of major construction equipment, unit prices of main materials and labor cost are presented in Tables 9.4-2, 9.4-3 and 9.4-4, respectively.

Based on these unit prices, price analyses were conducted to develop unit costs for major construction items, which are shown in Table 9.4-5.

2) Construction Cost Estimate

Based on the results of road inventory survey and proposed type of improvement, the quantity of each construction item was computed for each road link. Then the construction cost was estimated.

TABLE 9.4-2 HOURLY COST OF CONSTRUCTION EQUIPMENT

Unit: Pesos at June 1988 Prices

Construction Equipment	Hourly Cost(Ø)
A. Earthworking Equipment	
1. Tractor Crawler with Dozer, 11t, 110 HP	565.00
2. Tractor Crawler with Dozer, 21t, 200 HP	784.00
3. Wheel Loader, 0.57 m^3 , 39 HP	178.00
4. Wheel Loader, 1.24 m^3 , 80 HP	324.00
5. Wheel Loader, 1.91 m^3 , 100 HP	392.00
6. Motorized Grader, 10t, 115 HP	331.00
B. Excavating Equipment	
7. Backhoe Crawler, 0.08 m^3 , 21.3 HP	155.00
8. Backhoe Crawler, 0.4 m^3 , 82 HP	370.00
9. Backhoe Crawler, 0.5 m^3 , 100 HP	415.00
C. Hauling Equipment	
10. Dump Truck, 6.1 m^3 , 190 HP	250.00
D. Compaction Equipment	
11. Macadam Roller, 10-12t, 105 HP	279.00
12. Tandem Roller, 6- 8t, 105 HP	275.00
13. Tandem Roller, 9-11t, 105 HP	282.00
14. Vibratory Roller, 12t, 175 HP	570.00
15. Penumatic Roller, 15t, 106 HP	229.00
16. Sheepsfoot Roller, Towed Type, 5- 8t	262.00
E. Concreting Equipment	
17. Transit Mixer, 5 m^3 , 190 HP	505.00
18. Concrete Vibrator for small works	34.00
19. Concrete Pavement Vibrator with Engine	170.00
20. Concrete Finisher/Paver, 120 HP	573.00
21. Concrete Saw, 180 kg, 5 HP	122.00
22. Mixer, 1·1/2 - 2 bagger	35.20
F. Asphalt Equipment	
23. Asphalt Sprayer	286.00
24. Asphalt Paver, 3.1 m	515.00
G. Plant	
25. Crushing Plant, 80-135 TPH, 200 HP	1,230.00
26. Screening and Washing Plant, 150 TPH, 24 HP	609.00
27. Batching Plant, 60 TPH	918.00
28. Asphaltic Concrete Plant, 50 TPH, 150 HP	1.379.00
H. Others	
29. Air Compressor	221.00
30. Generator, 100 kw	248.00
31. Water Truck, 6000 lit., 140 HP	359.00
32. Water Pump	32.00

Note: Cost Component: 70% foreign, 15% local and 15% taxes, based on 10% custom duty, 10% advance taxes and 20% overhead and profit.

TABLE 9.4-3 UNIT PRICES OF MAIN MATERIALS

Unit: Pesos at June 1988 Prices

Main Materials	Unit	Unit Price	Component(%) F	L	T
A. Market Price of Purchase Material					
Portland Cement	bag	58.00	55	30	15
Steel Reinforcement	kg	9.50	72	10	18
Plywood, 1/2"x4'x8'	each	250.00	25	60	15
Lumber, Yacal/Guijo	bd.ft.	16.00	25	60	15
Asphalt Cement Pen. 60-70	MT	8,980.00	65	6	29
Cutback Asphalt MC-70	MT	9,070.00	65	6	29
Emulsified Asphalt SS-1	MT	9,110.00	65	6	29
B. Processed Materials					
Coarse Aggregate for Cement Concrete	m^3	102.00	66	19	15
Fine Aggregate for Cement Concrete	m^3	90.20	63	23	14
Crushed Aggregate for Base	m^3	149.50	66	19	15
Coarse Aggregate for Subbase	m^3	97.00	64	21	15
Concrete - Class A, delivered	m^3	820.00	60	25	15
Concrete - Class B, delivered	m^3	790.00	60	25	15

TABLE 9.4-4 LABOR COST

Unit: Pesos at June 1988 Prices

Labor Category	Hourly Rate	Daily Rate
Foreman	18.75	150.00
Assistant Foreman	17.50	140.00
Heavy Equipment Operator	16.25	130.00
Light Equipment Operator	15.65	125.00
Carpenter	15.65	125.00
Mason	15.65	125.00
Steelman	15.65	125.00
Skilled Laborer	15.65	125.00
Driver	14.00	112.00
Unskilled Laborer	10.00	80.00

TABLE 9.4-5 UNIT COSTS OF MAJOR CONSTRUCTION ITEMS

Unit: Pesos at June 1988 Prices

Item No.	Description	Unit	Unit Price
100	Clearing and Grubbing	m^2	2.00
102	Stripping	m^3	45.00
106	Roadway and Drainage Excavation	m^3	50.00
107	Borrow	m^3	95.00
108	Aggregate Subbase	m^3	210.00
118-1	Preparation of Previously Constructed Road (Gravel)	m^2	6.50
118-2	Preparation of Previously Constructed Road (Asphalt)	m^2	7.50
118-3	Preparation of Existing Pavement Surface (PCC)	m^2	20.00
118-4	Preparation of Existing Pavement Surface (AC)	m^2	15.00
200	Crushed Aggregate Base Course	m^3	280.00
300	Crushed Aggregate Surface Course	m^3	280.00
302	Bituminous Prime Coat	MT	9,700.00
303	Bituminous Tack Coat	MT	10,000.00
306	Bituminous Macadam Pavement	m^2	85.00
310	Bituminous Concrete Surface Course	MT	1,200.00
314	Double Bituminous Surface Treatment	m^2	37.50
316-1	PCC Pavement (t = 23cm)	m^2	280.00
316-2	PCC Pavement (t = 20cm)	m^2	250.00
316-3	PCC Pavement (t = 18cm)	m^2	220.00
413-1	RCPC (Ø 910mm)	m	1,400.00
413-2	Headwal T for RCPC (Ø 910mm)	set	2,530.00
500	Grouted Riprap	m^2	550.00
517	Side Ditch (Grouted Riprap)	m	315.00
Bridge Cost			
	2-lane Superstructure	m	36,500.00
	Abutment for 2-lane bridge	each	262,000.00
	Pier for 2-lane bridge	each	235,000.00
	1-lane Superstructure	m	27,500.00
	Abutment for 1-lane bridge	each	184,000.00
	Pier for 1-lane bridge	each	165,000.00
Spillway			
	2-lane Spillway	m	14.000.00
	1-lane Spillway	m	10,300.00
Slope Protection Cost			
	Cut Slope protection	m	19,000.00
	Embankment Slope Protection	m	21,000.00

9.5 ECONOMIC EVALUATION

9.5.1 General

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

i) Analysis Period

1990 - Detailed design
1991 - Construction
1992 ┐
 ├ Project life (25 years)
2016 ┘

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.

9.5.2 Initial Construction/Improvement Costs

The construction costs discussed in Section 9.4.2. 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 1990 and the remaining 91% in 1991.

9.5.3 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 9.5-1 shows the periodic maintenance assumed in this Study.

TABLE 9.5-1 PERIODIC MAINTENANCE ASSUMED IN THE ANALYSIS

Surface Type	Periodic Maintenance Work	Timing	Financial [1] Cost (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 (2-6years)	4.0m Gravel: 0.183 6.0m Gravel: 0.275	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)	0.693	
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)	0.975	
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)	1.000	

Note: 1) As of June 1988

9.5.4 Traffic Benefits

1) Traffic Cost

Basic Traffic Costs

The basic traffic costs were provided by PMO-FS, DPWH, as shown in Table 9.5-2.

TABLE 9.5-2 BASIC TRAFFIC COSTS EXCLUDING TAX (AS OF MARCH 1988)

	Running Cost (₱/km)	Fixed Cost (₱/hour)	Time Cost (₱/hour)
Car/Van	1.45	6.30	34.59
Jeepney	1.41	23.76	22.61
Bus	2.82	35.64	65.61
Truck	3.50	38.88	0
Motor-tricycle	0.40	8.76	4.45
Motorcycle	0.30	0.72	5.64

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 9.5-3 and 9.5-4, respectively.

TABLE 9.5-3 DL-VALUES IN KM PER ACTUAL KM

Surface Condition \ Surface Type	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 9.5-4 OPERATING SPEED IN KM/HOUR

Surface Condition \ Surface Type	PCC/AC			BMP/DBST			Gravel			Earth		
	OV	TR	MC	OV	TR	MC	OV	TR	MC	OV	TR	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 9.5.5.

TABLE 9.5-5 TRAFFIC COST OF OTHER MODES (COMMON TO ALL SURFACE TYPES AND CONDITIONS)

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

2) Traffic Benefits in Traffic Projects

As described in Section 9.3.1, traffic on the project roads was 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.

3) Traffic Benefits in Development Projects

No diverted traffic is expected in most development projects. The benefits from normal traffic and 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 distance 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.

9.5.5 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 harvests 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:

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

where,
- PRODw = Production in metric tons, with
- PRODw/o = Production in metric tones, 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.

9.5.6 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 2) 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.

1) 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 ₱14,745/km times the EMK factor as shown in Table 9.5-6.

TABLE 9.5-6 EMK FACTOR FOR DIFFERENT SURFACING AND AADT

Surface Type \ AADT	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

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

2) 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 9.5-7.

TABLE 9.5-7 ESTIMATE OF ROUTINE MAINTENANCE COSTS

Surface Type	Operation	Annual Cost (peso/km)
Gravel	Vegetation Control	1,000
	Ditch Cleaning Grading Pothole Repair	4.0 m Gravel: 2,300 + 35 AADT 6.0 m Gravel: 2,600 + 40 AADT
	Total	4.0 m Gravel: 3,300 + 35 AADT 6.0 m Gravel: 3,600 + 40 AADT
BMP	Vegetation Control	1,000
	Ditch Cleaning	950
	Shoulder Repair	1,850
	Patching	6,700 + 6.3 AADT
	Regravelling Shoulder	7,500
	Total	18,000 + 6.3 AADT
AC	Vegetation Control	1,000
	Ditch Cleaning	950
	Shoulder Repair	1,850
	Patching	7,700
	Regravelling Shoulder	7,500
	Total	19,000
PCC	Vegetation Control	1,000
	Ditch Cleaning	950
	Shoulder Repair	1,850
	Crack and Joint Sealing	4,700
	Regravelling Shoulder	7,500
	Total	16,000

CHAPTER 10

PROJECT EVALUATION IN PROVINCE OF CAVITE

10.1 PROFILE OF CAVITE

10.1.1 General

Cavite lies immediately at the southern entrance of Manila Bay across from the Bataan Peninsula. It extends eastward along the shoreline north up to the historic Zapote Bridge and inland in the south to Carmona. It is bounded on the east by Metro Manila and Laguna, on the south by Batangas, on the west by the South China Sea and on the north by Manila Bay.

Cavite is composed of twenty (20) municipalities and three (3) chartered cities. The provincial government is seated in Trece Martires City.

10.1.2 Topography and Climate

The province is divided into three (3) physiographical areas. First is the lowland area with a slope ranging from 0-3% and composed of Guadalupe and clay loam which are suited to lowland rice and corn production. Second the central or transition area with a slope of 3-8% and principally consists of Magallanes loam with streaks of Magallanes clay loam steep phase which is recommended for diversified farming such as upland rice, corn, sugarcane, vegetables, coconut, mangoes and other fruit trees. Third the upland area in the south which is hilly and mountainous with slopes of 15% to more than 40% and principally consists of Tagaytay loam and Tagaytay sandy loam with undifferentiated mountain soil which is suited to upland crops (refer to Figure 10.1-1).

The climate is characterized by two pronounced seasons, dry from November to May, wet during the rest of the year. Average annual rainfall (1982-86) is about 1,750 mm, and the average annual temperature lies within the range of 27-28 °C.

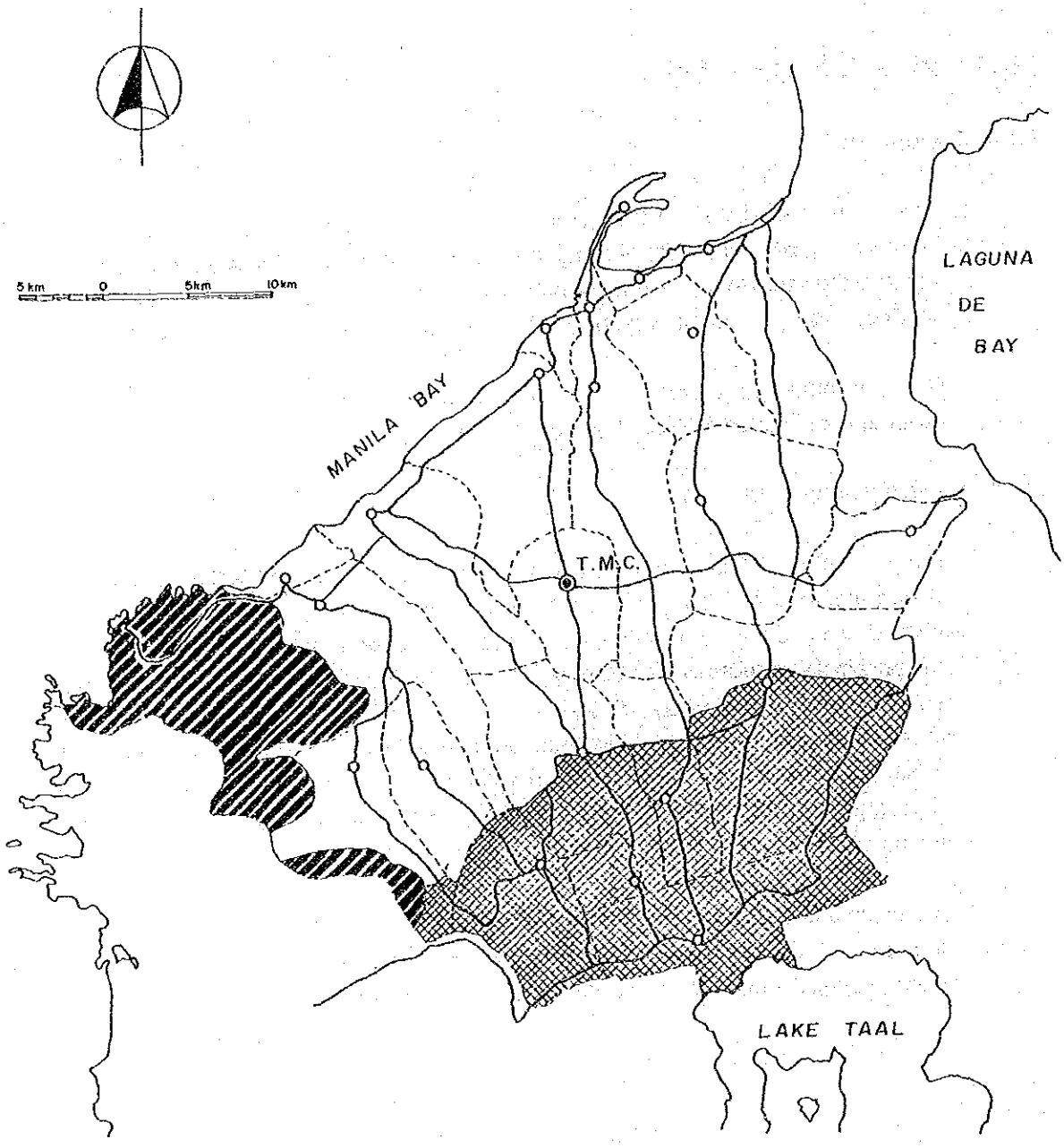


FIGURE 10.1-1 SLOPE MAP

10.1.3 Population

In 1988, the province has a total population of 999,804 within an area of 1,287.6 square kilometers, resulting in a population density of 811 persons per square kilometer (see Table 10.1-1).

Forty-three percent (43%) of the total population of Cavite belongs to the northern area composed of five (5) municipalities and one (1) city: Bacoor, Imus, Kawit, Noveleta, Rosario and Cavite City. The average population density of these areas is 2,909 persons per square kilometer, while that of the remaining areas is 499 persons per square kilometer.

Population by municipality is shown in Figure 10.1-2.

TABLE 10.1-1 POPULATION, LAND AREA AND DENSITY (1988)
-- Province of Cavite --

	Municipality	Population	Growth Rate (%)	Land Area (km^2)	Density (P/km^2)
1	Trece Martires City	11,195	3.2	39.1	286.3
2	Cavite City	101,867	1.8	11.8	8,632.6
3	Tagaytay City	22,058	3.6	74.0	298.1
4	Alfonso	28,287	3.0	64.6	437.9
5	Amadeo	20,330	2.7	47.9	424.4
6	Bacoor	134,461	4.8	25.0	5,378.3
7	Carmona	23,906	4.4	30.2	791.0
8	Dasmarinas	36,479	4.6	82.3	443.2
9	Gen. e. Aguinaldo	11,290	2.0	51.0	221.4
10	Gen. M. Alvares	71,359	5.0	10.0	7,150.0
11	Gen. Trias	53,850	3.6	87.0	619.0
12	Imus	79,254	3.5	89.0	890.5
13	Indang	39,887	3.0	81.8	487.6
14	Kawit	52,212	3.4	13.4	3,896.3
15	Magallanes	13,164	3.7	78.6	167.5
16	Maragondon	24,211	3.5	139.8	173.2
17	Mendez Nunez	18,309	2.3	16.7	1,098.3
18	Naic	49,610	3.1	78.6	631.1
19	Noveleta	18,775	3.1	5.6	3,352.7
20	Rosario	45,150	3.7	3.6	12,541.3
21	Silang	70,553	3.6	141.7	497.9
22	Tanza	58,431	3.5	72.4	807.0
23	Ternate	15,166	5.4	43.5	348.6
	Total	999,804	3.6	1,287.6	776.5

Source : National Census and Statistics Office

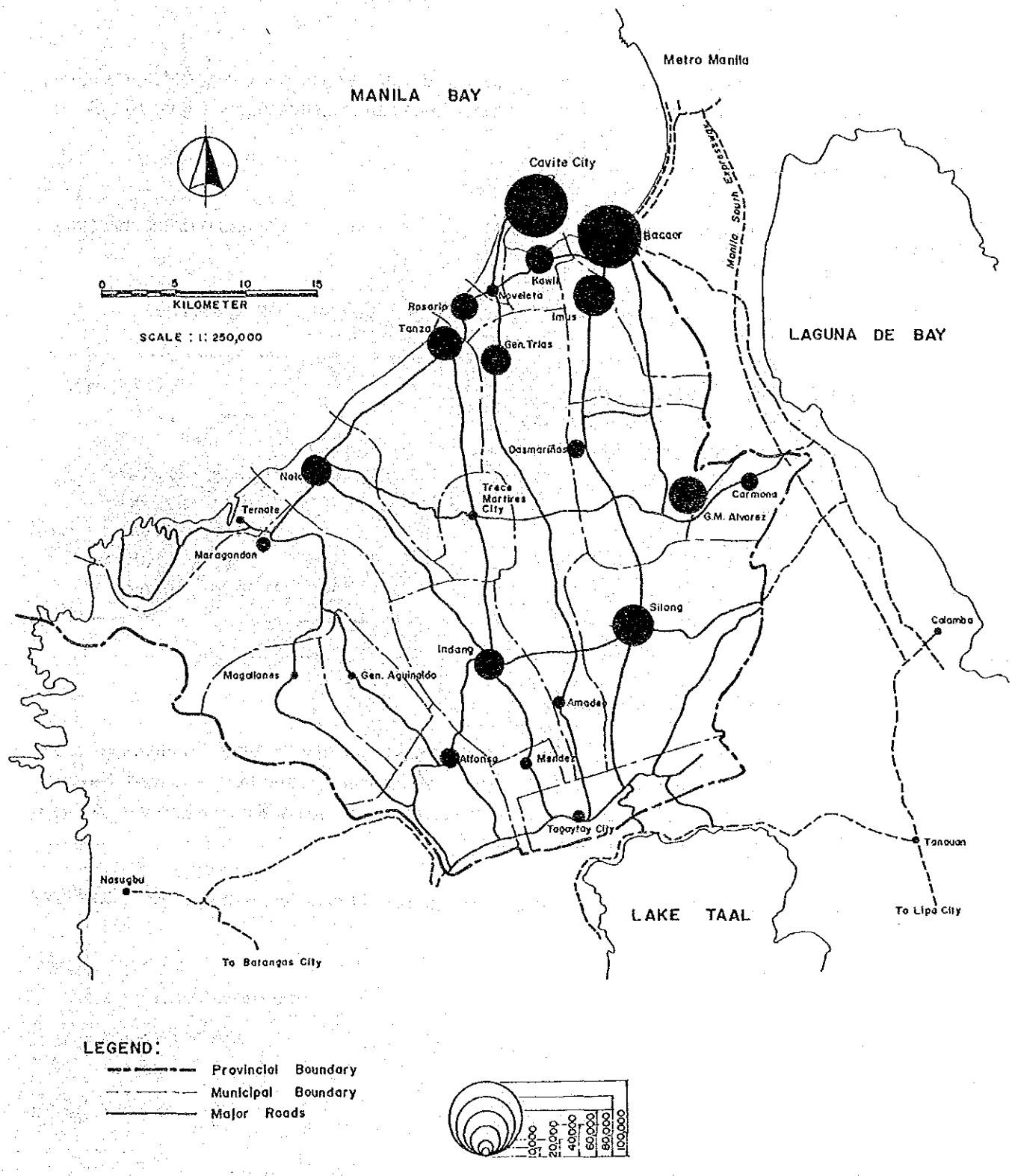


FIGURE 10.1-2 POPULATION BY MUNICIPALITY (1988)

10.1.4 Land Use

Cavite is basically an agricultural province since nearly 73% of the total land area is devoted to agriculture.

A great portion of these agricultural areas are devoted to rice, corn, vegetables, fruits, root crops and commercial crops such as coconut, coffee and sugarcane (see Figure 10.1-3)

10.1.5 Economy

Economic indicators are shown in Table 10.1-2. The number of workers is distributed almost equally among the three (3) industrial sectors.

TABLE 10.1-2 ECONOMIC INDICATORS OF CAVITE

Per Capita Income (1985)	7,157 pesos
Incidence of Poverty (1985)	31.4%
Number of Workers by Industrial Sector (1980)	
Primary Sector	78,138 (31.0%)
Secondary Sector	74,862 (29.7%)
Tertiary Sector	97,043 (38.5%)
Others	2,016 (0.8%)
Total	252,059(100.0%)

1) Agriculture

Table 10.1-3 shows the annual agricultural production in 1986. The leading crop in terms of production was fruits with 124.6 thousand metric tons produced. Next was rice with a total production of 81.8 thousand metric tons, while vegetables ranked third with a total of 48.6 thousand metric tons.

On the other hand, the leading crop in terms of harvested area was rice, followed by fruits and coffee.

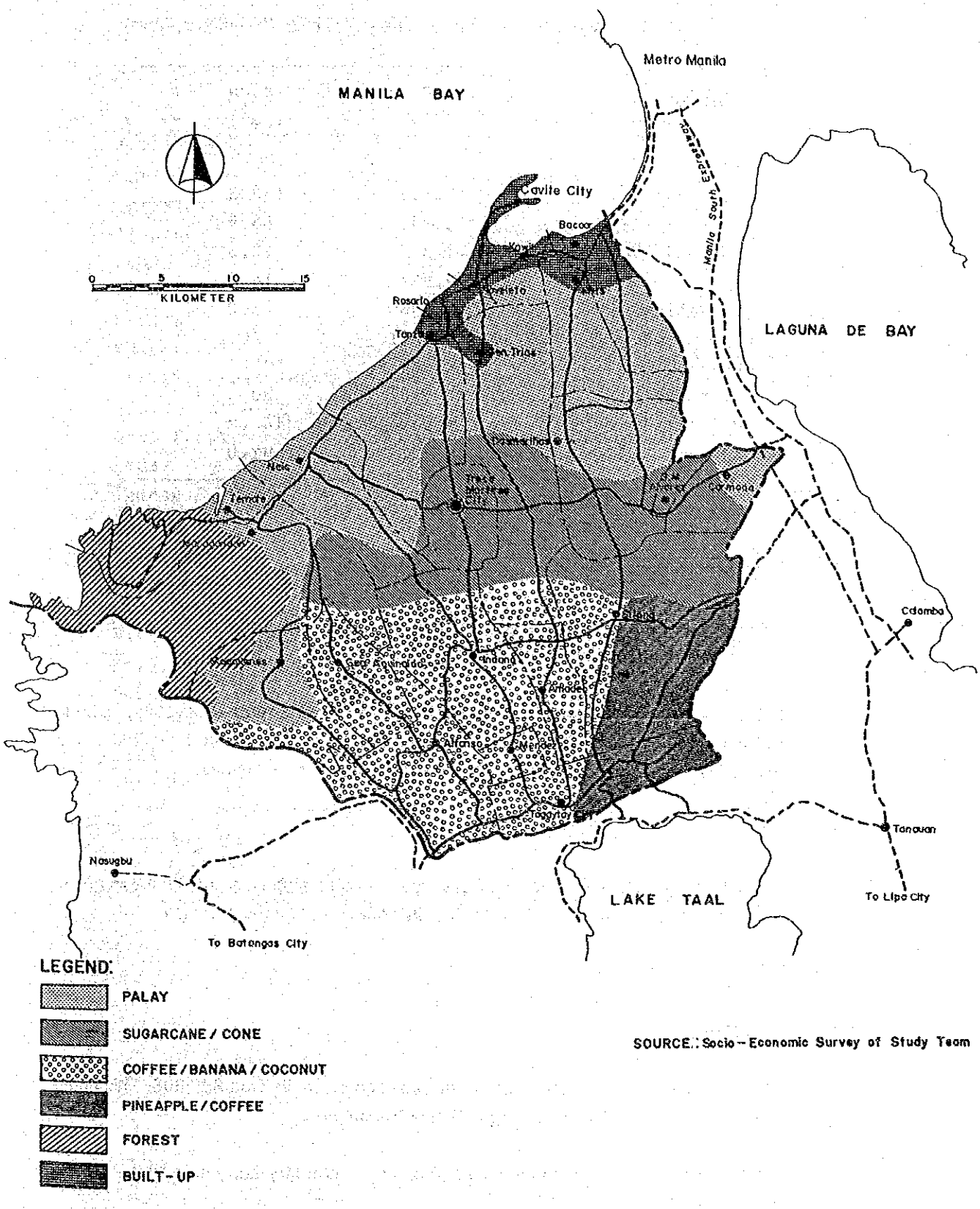


FIGURE 10.1-3 AGRICULTURAL LAND USE

TABLE 10.1-3 ANNUAL AGRICULTURAL PRODUCTION (1986)

Crops	Production (MT)	Harvested Area (km^2)
Rice		
Irrigated	49,064	153.3
Unirrigated	14,951	58.5
Upland	17,817	75.5
Corn	9,932	16.6
Vegetables	48,608	43.0
Root Crops	19,221	26.2
Fruits	124,605	171.1
Sugarcane	47,946	30.3
Coffee	16,549	163.2
Coconut	25,782	92.0

Source: Cavite Provincial Profile 1986

2) Industry

Although the economy of the province relies greatly on agriculture, the share of industry has been rapidly increasing.

There are some new industrial sites such as the Cavite Export Processing Zone in Rosario, People's Technology Complex in Carmona and New Cavite Industrial City in Gen. Trias. These are enticements for the establishment of industries.

3) Tourism

There are various tourist spots which are mostly located along the coastal areas and in Tagaytay City. Tourism in Cavite is another income earner for the province.

10.1.6 Social Service Facilities

1) Education

In 1985, the school age population in the province of Cavite was 330,208. This figure represented 32.6% of the total population of the province.

The province had 343 elementary schools, 77 secondary schools and 13 tertiary schools.

Table 10.1-4 shows the number of educational facilities by municipality.

TABLE 10.1-4 NUMBER OF SCHOOLS BY MUNICIPALITY (1985)

	Elementary	Secondary	Tertiary	Total
Trece Martires C.	7	1	-	8
Cavite City	15	4	3	22
Tagaytay City	14	3	-	17
Alfonso	17	5	-	22
Amadeo	10	5	-	15
Bacoor	31	6	-	37
Carmona	7	1	-	8
Dasmarinas	22	3	4	25
Gen. E. Aguinaldo	10	2	-	12
Gen. M. Alvarez	5	1	-	6
Gen. Trias	19	2	-	21
Imus	23	3	1	27
Indang	22	5	1	28
Kawit	11	2	-	13
Magallanes	11	3	-	14
Maragondon	15	3	-	18
Mendez Nunez	8	4	-	12
Naic	16	4	2	22
Noveleta	6	1	-	7
Rosario	9	6	1	16
Silang	44	8	1	53
Tanza	15	4	-	19
Ternate	5	1	-	6
Total	343	77	13	433

Source: Department of Education, Culture and Sports

2) Health

In 1985, there were 28 hospitals in Cavite, 10 of which were government hospitals, while 18 were private with varying capacities that provide health care services to the total population. There were also 27 rural health units and 242 barangay health stations (see Table 10.1-5).

TABLE 10.1-5 NUMBER OF HOSPITALS, RURAL HEALTH UNITS AND BARANGAY HEALTH STATIONS (1985)

	Hospital	R.H.U.	B.H.S.	Total
Trece Martires C.	2	1	7	10
Cavite City	4	2	5	11
Tagaytay City	1	1	12	14
Alfonso	1	1	6	8
Amadeo	-	1	9	10
Bacoor	-	2	18	20
Carmona	-	1	9	10
Dasmarinas	3	2	26	31
Gen. E. Aguinaldo	-	1	4	5
Gen. M. Alvarez	1	2	8	11
Gen. Trias	1	1	17	19
Imus	1	1	16	18
Indang	-	1	10	11
Kawit	-	1	12	13
Magallanes	-	1	6	7
Maragondon	2	1	7	10
Mendez Nunez	-	1	5	6
Naic	1	1	18	20
Noveleta	-	1	4	5
Rosario	6	1	8	15
Silang	4	1	13	18
Tanza	1	1	20	22
Ternate	-	1	2	3
Total	28	27	242	297

Source: Provincial Health Office, Cavite

10.2 ROAD NETWORK

10.2.1 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 10.2-1 shows the present level of road development and Figure 10.2-1 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 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% being rated good or fair. Improvement of surface conditions is the major priority of provincial roads.
- Most barangay roads have still gravel or earth surfaces.

Road Network Formation

- Basically, 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 a 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 10.2-1 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]	303.9	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

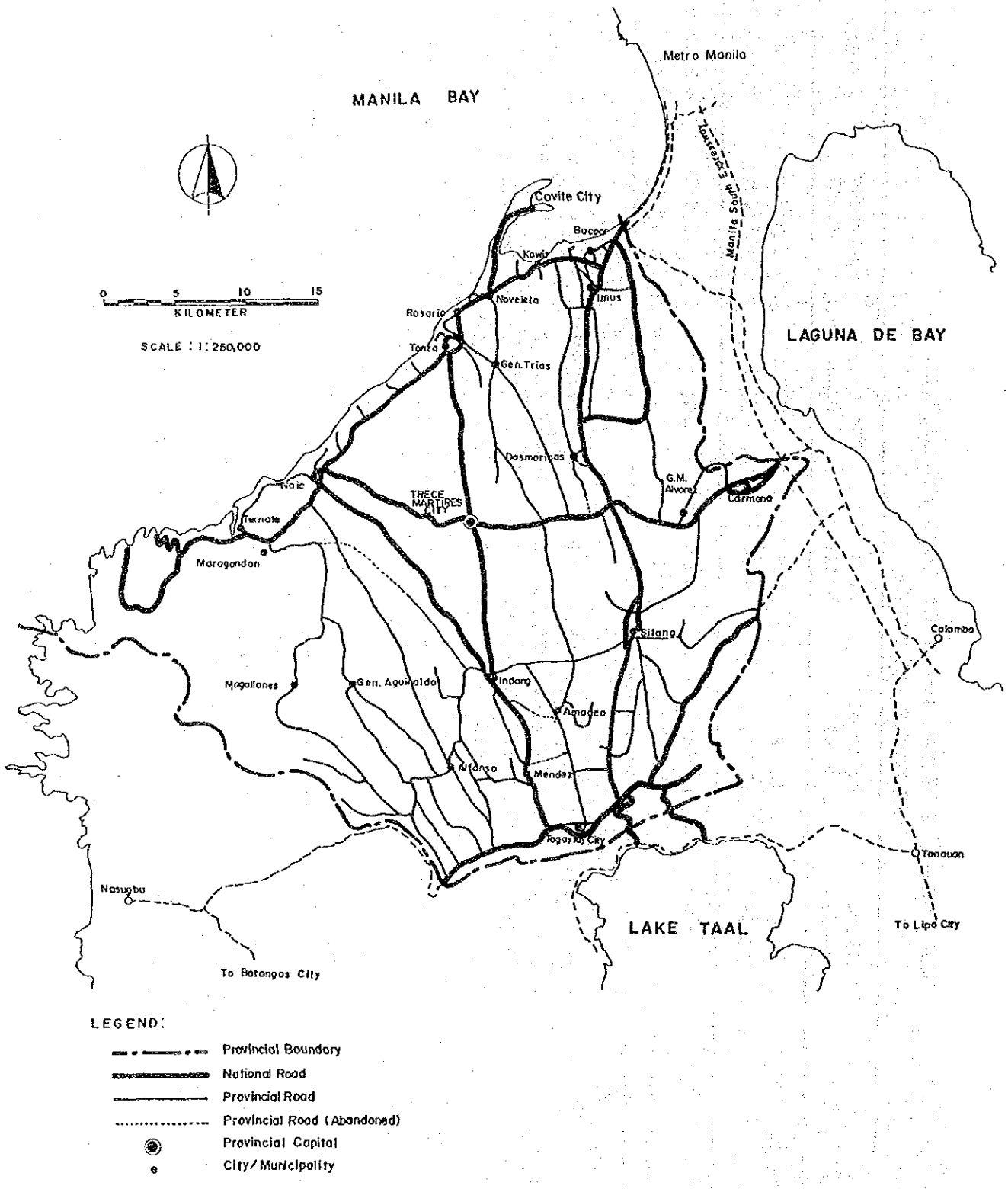


FIGURE 10.2-1 EXISTING ROAD MAP

10.2.2 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 Cavite was proposed as shown in Figure 10.2-2. 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 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.

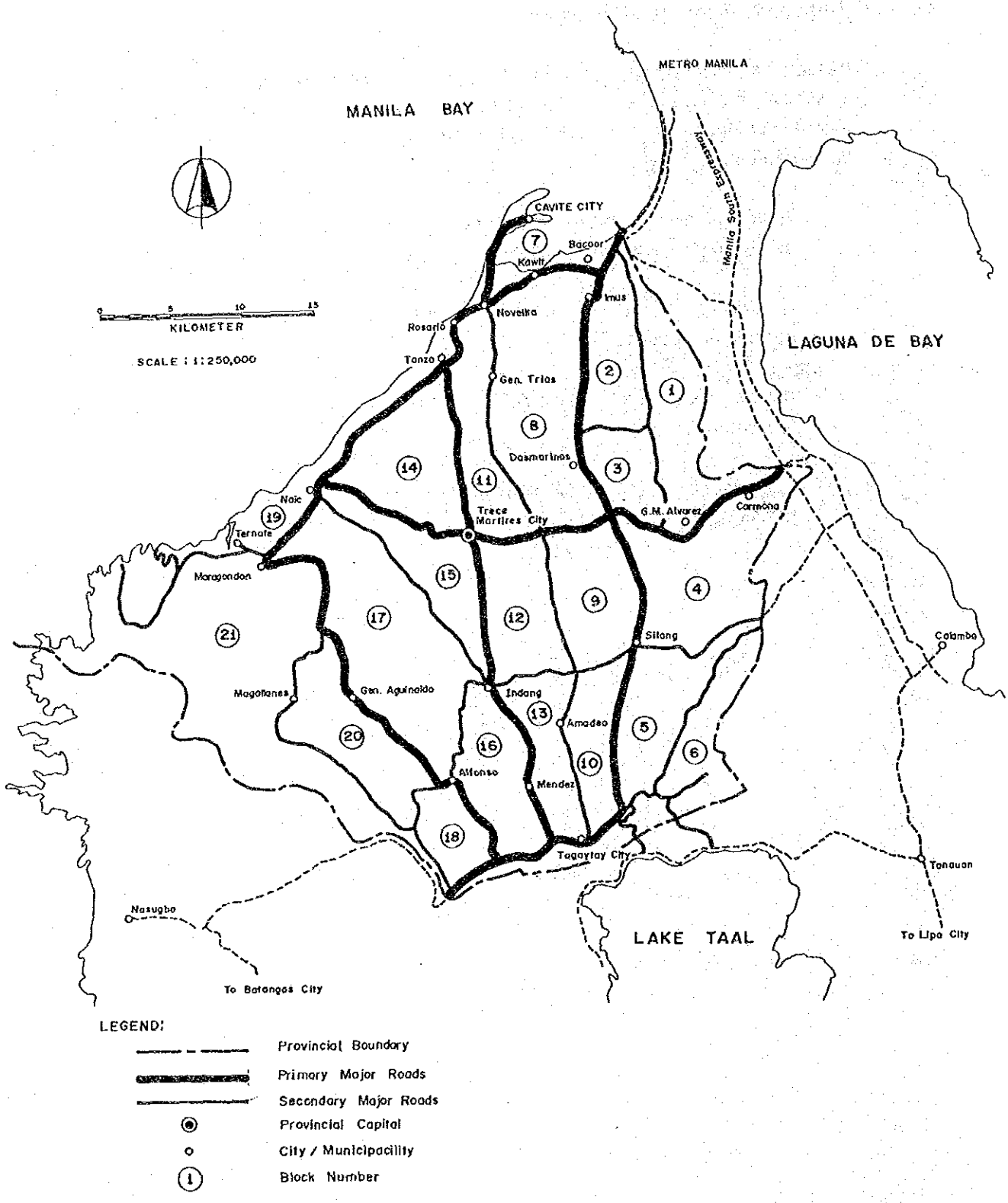


FIGURE 10.2-2 PROPOSED MAJOR ROAD NETWORK

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 10.2-2.

Table 10.2-3 shows network value and accessibility defined in Section 7.3.2 4), 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 10.2-2 COMPOSITION OF MAJOR AND MINOR ROADS (KM)

	Major Roads	Minor Roads 1)	Total
National Roads	224.5	79.4	303.5
Provincial/City Roads	144.8	376.3	521.1
Barangay Roads	-	746.7	746.7
Total	369.3(23.5%)	1,202.4(76.5%)	1,571.3(100%)

Note: 1) Based on 1985 road length

TABLE 10.2-3 NETWORK VALUE/ACCESSIBILITY (Cavite)

Block No.	Population	Land Area (km^2)	Road (km)	Network Value	Access (P*km)	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

10.3 TRAFFIC

10.3.1 Traffic Survey Results

Figure 10.3-1 shows the location of traffic count stations. Traffic survey results are summarized in Table 10.3-1.

TABLE 10.3-1 SUMMARY OF TRAFFIC SURVEY RESULTS

(ADT as of June, 1988)

Sta.	Car	Jeep	Van	Jeepney	Bus	Truck	Total	Motor-Tricle	Motor-Cycle	Animal
1	142	136	290	3141	75	41	3825	464	92	6
2	21	68	44	641	0	32	806	60	37	1
3	144	152	177	405	3	61	942	99	59	1
4	73	185	140	434	0	65	897	25	81	12
5	61	90	103	1344	26	39	1663	87	24	12
6	531	394	539	429	133	148	2174	24	83	0
7	346	340	246	306	412	214	1864	96	86	4
8	1886	1019	596	1986	519	437	6443	11	55	0
9	81	167	61	518	2	28	857	7	7	3
10	137	250	158	335	115	57	1052	14	65	0
11	268	215	211	356	109	179	1338	1104	137	0
12	5	15	37	73	0	14	144	8	7	32
13	3	22	18	51	1	4	99	92	21	6
14	0	12	3	30	0	2	47	3	5	0
15	36	76	47	381	28	22	590	29	43	0
16	3	18	18	83	0	1	123	2	12	4
17	7	70	96	72	11	12	268	130	16	0
18	4	34	8	137	0	52	235	3	5	0
19	23	81	69	372	97	26	668	8	40	4
20	47	116	57	261	5	22	508	35	16	8
21	434	239	626	377	162	270	2108	10	43	0
22	52	177	96	306	104	25	760	13	31	2
23	2	101	45	149	0	2	299	1	2	12
24	85	74	89	297	0	32	577	0	17	11
25	121	111	328	271	6	7	844	93	32	3
26	1	1	5	46	0	1	54	0	0	1

Source: Traffic Survey by Study Team (June, 1988)

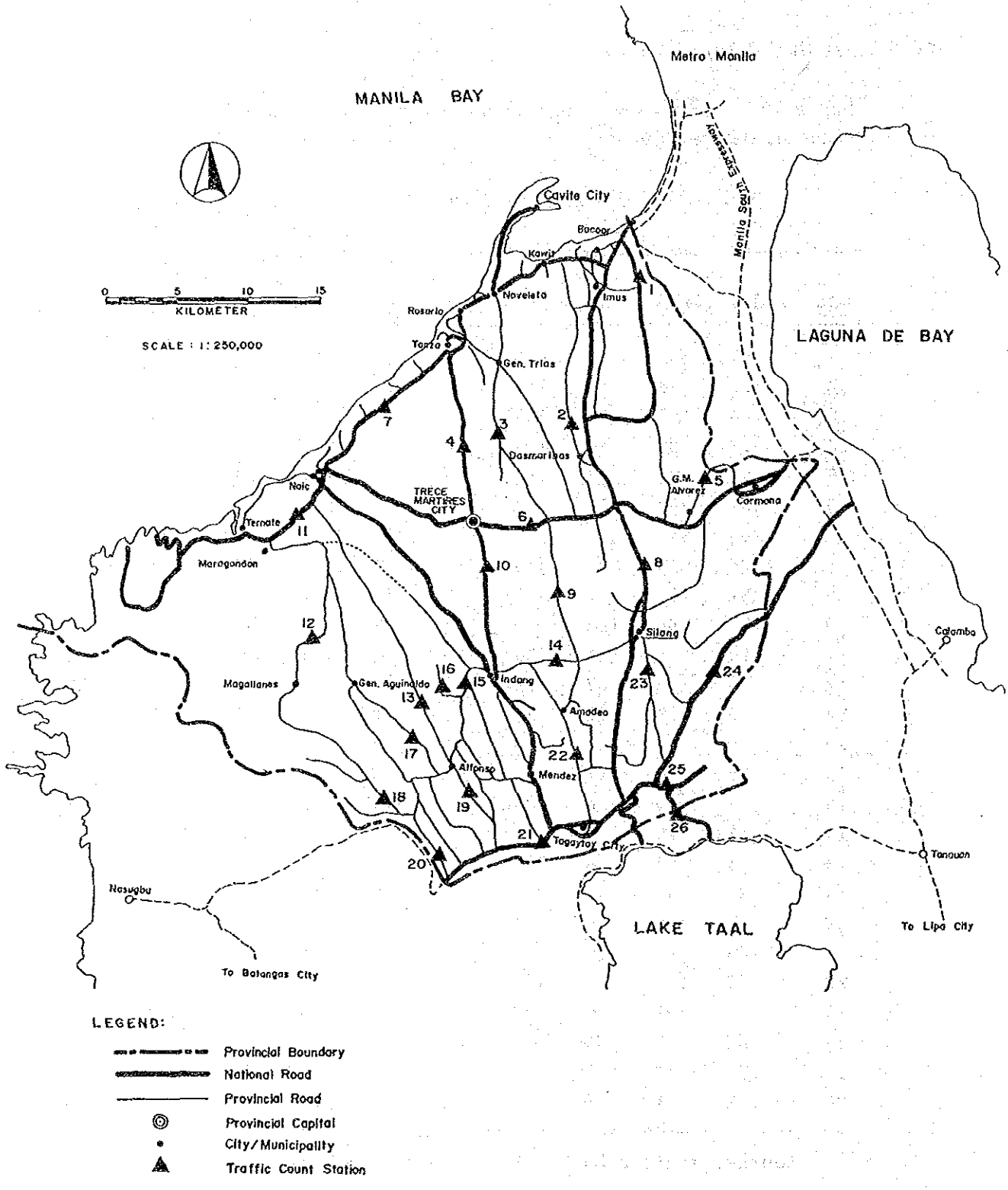


FIGURE 10.3-1 TRAFFIC COUNT STATIONS

10.3.2 Traffic Volume on the Study Roads

The present and future traffic volume on the study roads were forecasted in accordance with the procedure described in Section 9.3.

Results of traffic projection for major roads and traffic volume on studied roads in 1992 are presented in Appendices 10-1 and 10-2, respectively.

The present traffic volume (1988) and "with project" case traffic volume (1992) on major roads are graphically shown in Figures 10.3-2 and 10.3-3, respectively.

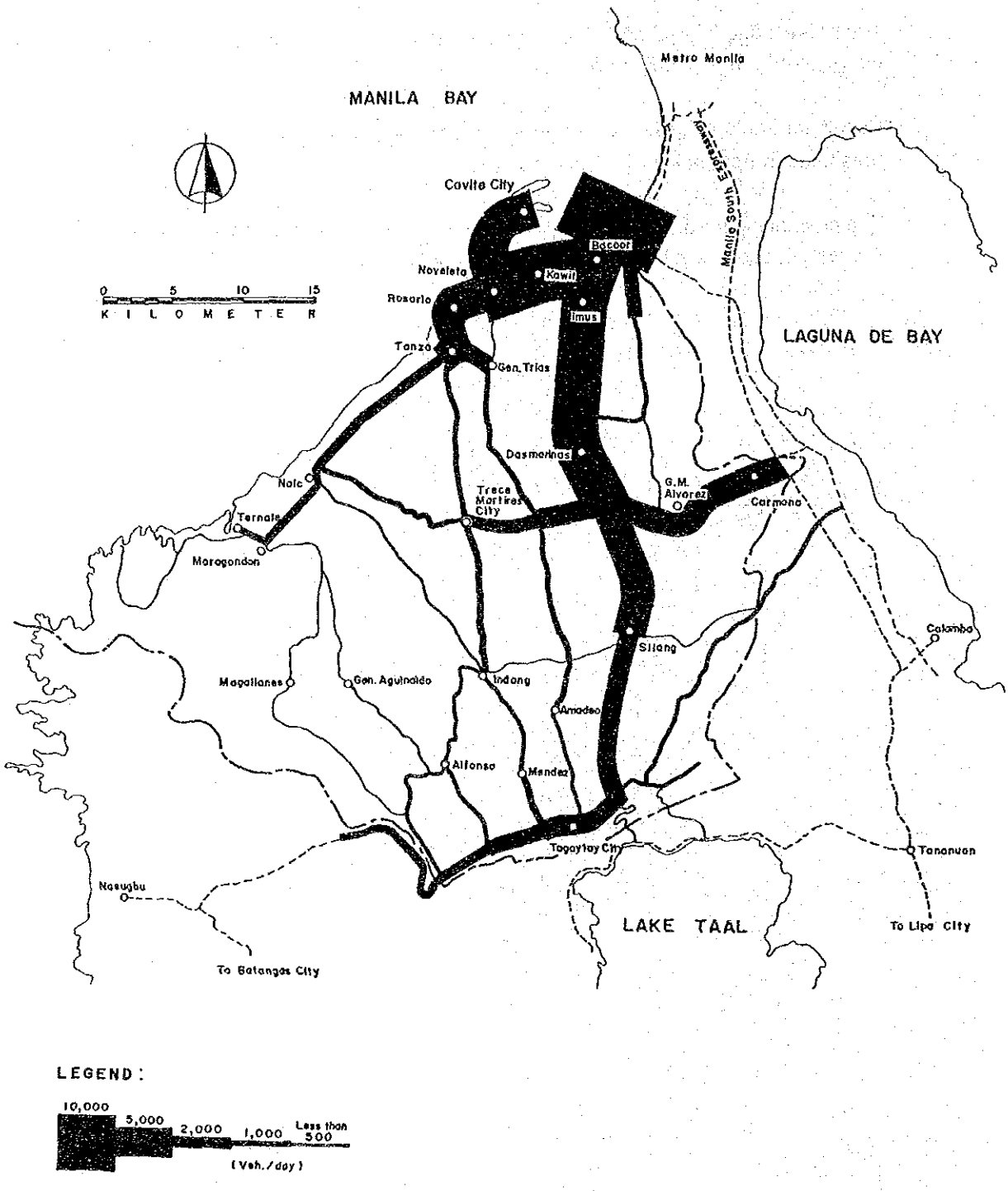


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FIGURE 10.3-2 ESTIMATED TRAFFIC VOLUME (1988)

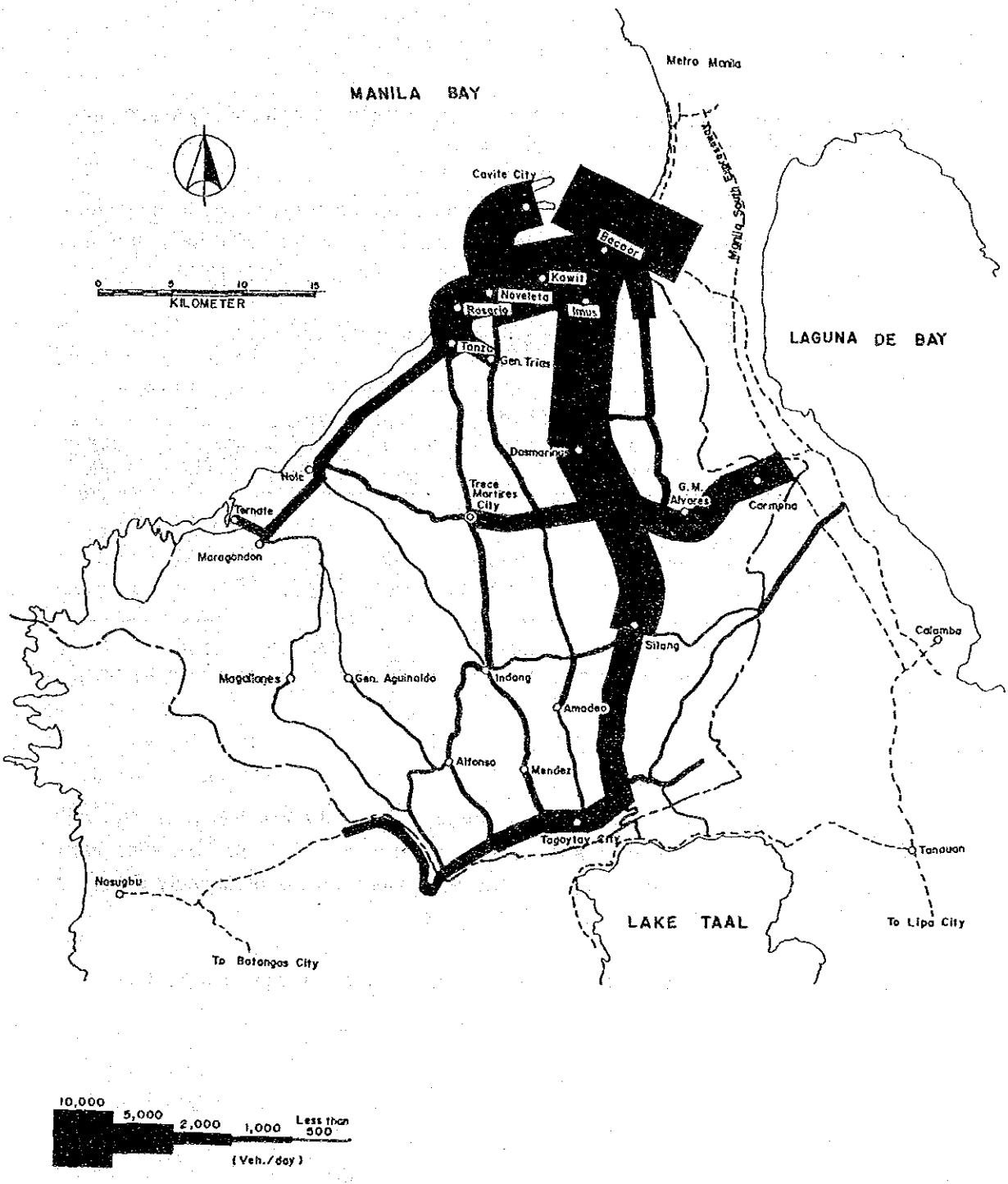

FIGURE 10.3-3 ESTIMATED TRAFFIC VOLUME (1992), "WITH PROJECT" CASE

10.4 PROJECT EVALUATION

10.4.1 Roads Subjected to Feasibility Study

In the project identification and screening stage, the road projects for feasibility studies were selected as described in Chapter 8.

At this stage, some road links were integrated and some adjacent links were joined to form a more appropriate project for evaluation purposes. As a result of this adjustment, the road projects subjected to feasibility studies were assembled as shown in Table 10.4-1.

TABLE 10.4-1 ROADS SUBJECTED TO F/S

	Major Road		Minor Road		Total	
	No. of Links	length (km)	No. of Links	Length (km)	No. of Links	Length (km)
National Roads	8	86.0	2	11.2	10	97.2
Provincial/City Roads	14	121.1	39	230.3	53	351.4
Barangay Roads	0	0	75	216.8	75	216.8
Total	22	207.1	116	458.3	138	665.4

10.4.2 Preliminary Design

On the basis of the findings of the road inventory survey, the preliminary design was conducted as summarized by type of improvement in Tables 10.4-2 and 10.4-3 for major roads and minor roads, respectively. Detailed information on the preliminary design is presented in Appendix 10-3 and Volume IV, Drawings.

Quantities by construction item and construction costs are shown in Appendix 10-4.

TABLE 10.4-2 SUMMARY OF PRELIMINARY DESIGN:
PROVINCE OF CAVITE
- MAJOR ROADS -

	Type of Improvement			
	Rehabilitation/ Improvement-1	Improvement-2/ Widening	New Construction	Total
Primary Major Roads				
1. No. of Links	5	-	-	5
2. Total Length (km)	44.2	-	-	44.2
3. Improvement Length (km)	30.6	-	-	30.6
4. Construction Cost (million ₱)	63.5	-	-	63.5
5. Const. Cost/Imp. Length(M₱/km)	2.08	-	-	2.08
Secondary Major Roads				
1. No. of Links	16	1	-	17
2. Total Length (km)	156.4	6.5	-	162.9
3. Improvement Length (km)	124.0	5.1	-	129.1
4. Construction Cost (million ₱)	317.7	8.4	-	326.1
5. Const. Cost/Imp. Length(M₱/km)	2.56	1.65	-	2.53
Major Road Total				
1. No. of Links	21	1	-	22
2. Total Length (km)	200.6	6.5	-	207.1
3. Improvement Length (km)	154.6	5.1	-	159.7
4. Construction Cost (million ₱)	381.2	8.4	-	389.6
5. Const. Cost/Imp. Length (M₱/km)	2.47	1.65	-	2.44

TABLE 10.4-3 SUMMARY OF PRELIMINARY DESIGN:
PROVINCE OF CAVITE
- MINOR ROADS -

	Type of Improvement		
	Rehabilitation/ Improvement-1	New Construction	Total
Minor Roads (National/Provincial/City)			
1. No. of Links	41	-	41
2. Total Length (km)	241.5	-	241.5
3. Improvement Length (km)	207.7	-	207.7
4. Construction Cost (million ₱)	303.5	-	303.5
5. Const. Cost/Imp. Length (M₱/km)	1.46	-	1.46
Minor Roads (Barangay)			
1. No. of Links	68	7	75
2. Total Length (km)	197.7	19.1	216.8
3. Improvement Length (km)	185.5	19.1	204.6
4. Construction Cost (million ₱)	95.2	9.0	104.2
5. Const. Cost/Imp. Length (M₱/km)	0.51	0.47	0.51
Minor Road Total			
1. No. of Links	109	7	116
2. Total Length (km)	439.2	19.1	458.3
3. Improvement Length (km)	393.2	19.1	412.3
4. Construction Cost (million ₱)	398.7	9.0	407.7
5. Const. Cost/Imp. Length (M₱/km)	1.01	0.47	0.99

10.4.3 Economic Evaluation

Economic evaluation was conducted in accordance with the procedure described in Section 9.5.

Demographic and agricultural data which were used for evaluation of development projects are summarized in Appendix 10-5 and results of economic evaluation for each road link are presented in Appendix 10-6.

The project roads were categorized according to class of road, IRR and type of improvement. In the case of the road link which is divided into subsections with different types of improvement, the categorization was made based on the type of improvement covering the longest part. Table 10.4-4 presents the number of road links, length and costs by category.

Figure 10.4-1 shows the location map of the project roads.

TABLE 10.4-4 ROAD LENGTH AND CONSTRUCTION COST BY CATEGORY (CAVITE)

Class of Road	Range of IRR	Rehabilitation/Improvement-1						Improvement-2/Widening						New Construction						Total					
		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	No.	Total Length	Improv Length	Road Cost	Bridge Cost	Total Cost
Primary Major	15<	5	44.2	30.6	58.0	5.5	63.5	-	-	-	-	-	-	-	-	-	-	-	-	5	44.2	30.6	58.0	5.5	63.5
	10-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7.5-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	5	44.2	30.6	58.0	5.5	63.5	-	-	-	-	-	-	-	-	-	-	-	-	5	44.2	30.6	58.0	5.5	63.5
Second'y Major	15<	16	146.2	113.2	250.5	39.5	290.0	1	6.5	5.1	8.4	-	8.4	-	-	-	-	-	-	16	151.7	118.3	258.9	39.5	298.4
	10-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7.5-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	1	11.2	10.8	27.7	-	27.7	-	-	-	-	-	-	-	-	-	-	-	-	1	11.2	10.8	27.7	-	27.7
	Total	17	156.4	124.0	278.2	39.5	317.7	1	6.5	5.1	8.4	-	8.4	-	-	-	-	-	-	17	162.9	129.1	286.6	39.5	326.1
Minor (Nat'l/ Prov'l)	15<	15	113.7	94.0	143.4	19.8	163.1	-	-	-	-	-	-	-	-	-	-	-	-	15	113.7	94.0	143.4	19.8	163.1
	10-15	8	48.1	42.0	46.2	4.0	50.2	-	-	-	-	-	-	-	-	-	-	-	-	8	48.1	42.0	46.2	4.0	50.2
	7.5-10	3	13.6	13.6	17.6	-	17.6	-	-	-	-	-	-	-	-	-	-	-	-	3	13.6	13.6	17.6	-	17.6
	<7.5	15	66.1	58.1	65.3	7.3	72.6	-	-	-	-	-	-	-	-	-	-	-	-	15	66.1	58.1	65.3	7.3	72.6
	Total	41	241.5	207.7	272.5	31.1	303.5	-	-	-	-	-	-	-	-	-	-	-	-	41	241.5	207.7	272.5	31.1	303.5
Minor (Baran-gay)	15<	21	56.5	53.7	25.4	.6	26.0	-	-	-	-	-	-	2	9.8	9.8	4.7	-	4.7	23	66.3	63.5	30.2	.6	30.8
	10-15	10	33.6	32.2	15.1	-	15.1	-	-	-	-	-	-	-	-	-	-	-	-	10	33.6	32.2	15.1	-	15.1
	7.5-10	8	20.9	18.9	10.8	2.3	13.1	-	-	-	-	-	-	3	6.9	6.9	3.0	-	3.0	11	27.8	25.8	13.9	2.3	16.2
	<7.5	29	86.8	80.7	39.7	1.3	41.0	-	-	-	-	-	-	2	2.4	2.4	1.2	-	1.2	31	89.2	83.1	40.9	1.3	42.2
	Total	68	197.7	185.5	91.0	4.2	95.2	-	-	-	-	-	-	7	19.1	19.1	9.0	-	9.0	75	216.8	204.6	100.0	4.2	104.2
Total	15<	56	359.6	291.5	477.3	65.4	542.7	1	6.5	5.1	8.4	-	8.4	2	9.8	9.8	4.7	-	4.7	59	375.9	306.4	490.4	65.4	555.8
	10-15	18	81.6	74.2	61.3	4.0	65.2	-	-	-	-	-	-	-	-	-	-	-	-	18	81.6	74.2	61.3	4.0	65.2
	7.5-10	11	34.5	32.5	28.4	2.3	30.7	-	-	-	-	-	-	3	6.9	6.9	3.0	-	3.0	14	41.4	39.4	31.5	2.3	33.8
	<7.5	45	154.1	149.6	132.7	8.6	141.3	-	-	-	-	-	-	2	2.4	2.4	1.2	-	1.2	47	156.5	152.0	133.9	8.6	142.5
	Total	130	639.8	547.8	699.7	80.2	780.0	1	6.5	5.1	8.4	-	8.4	7	19.1	19.1	9.0	-	9.0	138	665.4	572.0	717.1	80.2	797.3

PROVINCE OF CAVITE

LEGEND:

- NATIONAL ROAD
- PROVINCIAL ROAD
- BARANGAY ROAD
- ABANDONED ROAD
- PROVINCIAL BOUNDARY
- PROVINCIAL CAPITAL
- CITY / MUNICIPALITY
- ROADS SUBJECTED TO F/S
- IRR ≥ 15%
- 15% > IRR ≥ 7.5%
- ROADS IN GOOD/FAIR CONDITION

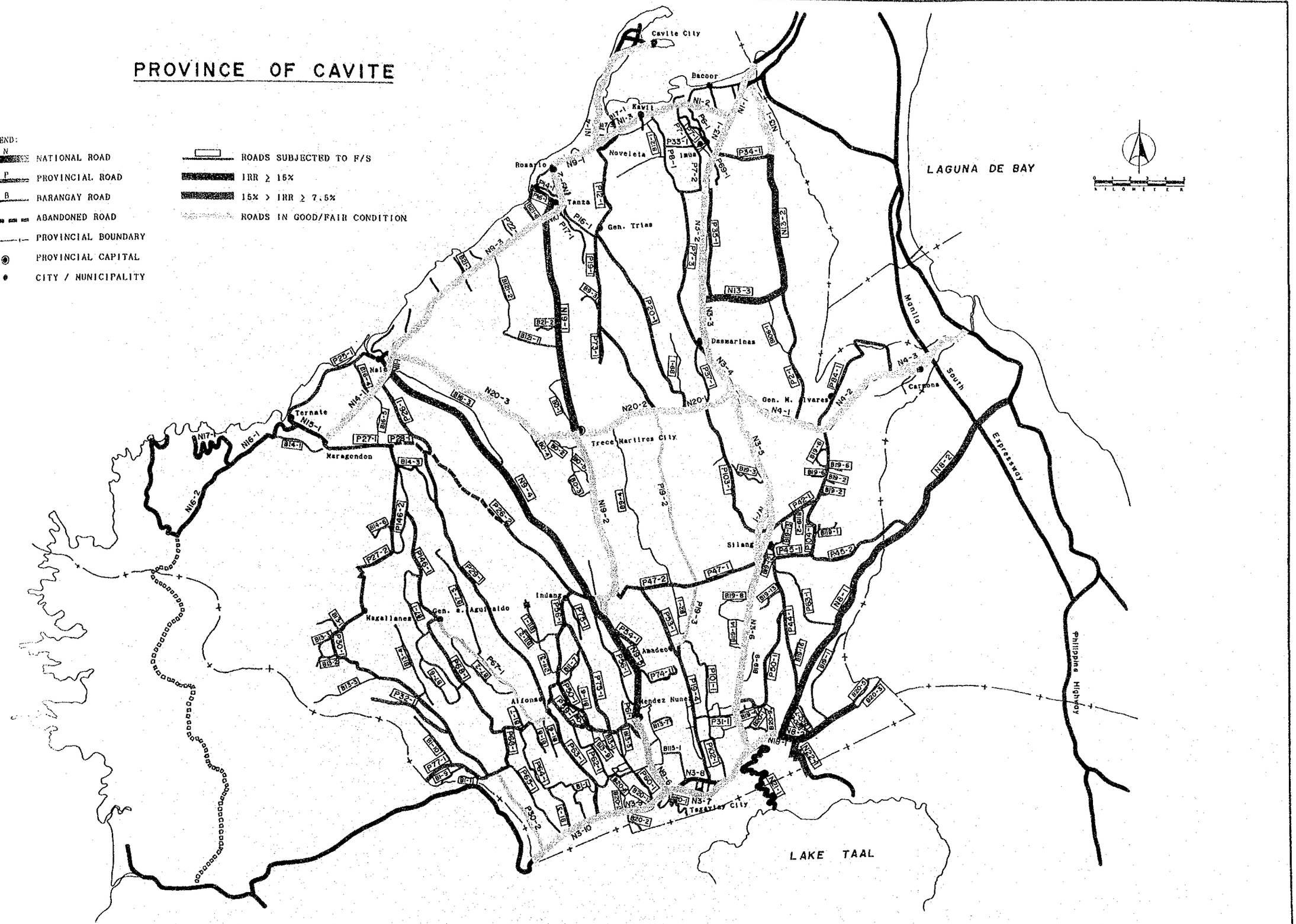

FIGURE 10.4-1 PROJECT ROADS