CHAPTER 4
SELECTION OF PILOT PROVINCES

4.1 SELECTION CRITERIA

Three (3) pilot provinces shall be selected. The criteria for selection of the pilot provinces were established as follows:

- In Chapter 3, provinces were classified according to disaster potential into three categories: low, medium, and high, and according to topography into three categories: mountainous, mountainous and flat combined, and flat. In connection with the classification of province, the following considerations were given in selecting provinces:

  - Provinces ranked high disaster potential should be given precedence.

  - A variety of topography should be covered by the selected provinces as a whole.

  From these points of view, the criterion was established as follows:

  (1) One province each shall be selected from Group H-M (high disaster potential, mountainous), Group H-MF (high disaster potential, mountainous and flat combined), and Group H-F (high disaster potential, flat).

- Considering that provinces with many disasters in recent years are suitable for pilot provinces, the following criteria were established:

  (2) Any selected province shall have more than 75 million pesos damage for 10 years (1980 to 1989).

  (3) Three selected provinces as a whole shall have at least 10 spots each of road damage, bridge damage and slope damage for 2 years (1988 to 1989).

- In consideration of distribution of selected provinces over the country, the following criteria were established:

  (4) Not more than one province shall be selected from one region.

  (5) At least one and not all provinces shall be selected from Luzon Island.

- Both economically developed and undeveloped provinces should be included so that feasibility study results may be widely applicable to other provinces. Incidence of poverty is used as indicator for economic development level. Provinces are divided into two; more than and less than the country average in incidence of poverty. Provinces should be selected from both groups. Thus:

(6) At least one and not all provinces shall be above the average in incidence of poverty.

- In view of the importance of access roads to the Pan-Philippine Highway to be studied:

(7) At least one province shall be located along the Pan- Philippine Highway.

- For the execution of the study in safety:

(8) Any selected province shall have no or less problem on peace and order.

4.2 SELECTION OF PILOT PROVINCES

In accordance with criteria (2) above, qualified provinces are selected as follows:

Group H-M	Benguet Mountain Province
Group H-MF	Zambales Ilocos Sur Ilocos Norte Albay Oriental Mindoro Isabela Batangas
Group H-F	Camarines Sur Leyte Bataan Nueva Ecija Sorsogon Pangasinan

In accordance with all criteria except (8), possible combinations of pilot provinces are as follows:

• (CAR) Benguet	(3) Zambales	(8) Leyte
• (CAR) Benguet	(5) Albay	(8) Leyte
• (CAR) Benguet	(4) Oriental Mindoro	(5) Camarines Sur
• (CAR) Benguet	(4) Oriental Mindoro	(8) Leyte
• (CAR) Benguet	(4) Oriental Mindoro	(3) Nueva Ecija
• (CAR) Benguet	(4) Oriental Mindoro	(5) Sorsogon
• (CAR) Benguet	(2) Isabela	(8) Leyte
• (CAR) Benguet	(4) Batangas	(8) Leyte
• (CAR) Mt. Province	(3) Zambales	(8) Leyte
• (CAR) Mt. Province	(5) Albay	(8) Leyte
• (CAR) Mt. Province	(4) Oriental Mindoro	(8) Leyte
• (CAR) Mt. Province	(2) Isabela	(8) Leyte
• (CAR) Mt. Province	(4) Batangas	(8) Leyte

Further, in consideration of wide distribution over the country and peace and order situation, the following three (3) provinces were finally selected as pilot provinces:

(CAR) Benguet
(4) Batangas
(8) Leyte

CHAPTER 5
PROFILE OF PILOT PROVINCES

5.1 PROFILE OF BENGUET PROVINCE

5.1.1 General

The Province of Benguet was selected as one of the pilot provinces which represents the provinces of high disaster potential and mountainous topography.

The province is located in the Northern Luzon and bounded on the south by Pangasinan, on the east by Nueva Vizcaya and Ifugao, on the north by Mountain Province and on the west by La Union and Ilocos Sur.

The province is composed of one (1) Chartered City (Baguio City) and 13 municicilipalities. The provincial capital is located at La Trinidad.

5.1.2 Physical Profile

1) Topography

Figure 5.1-1 shows the slope classification map.

Benguet has a land area of 2,655 km^2 representing 0.9 % of the total land area of the Philippines, and has mountainous slopes that are so steep that landslides often occur. The highest peaks of Luzon are found the eastern boarder of the province. The highest point is on Mt. Pulog with 2,930 m elevation in the southeast of Baguio, and following to Mt. Sto. Tomas (2,252 m) in the west, Mt. Mirado (1,583 m) located in Baguio City. Due to its high level elevation which ranges from 900 to 1,650 m. above sea level, it experiences a balmy climate all the year round.

Benguet Province straddle the southern section of Central Cordillera Mountain Range which has a rugged, irregularly patterned relief of ridges, canyons and peaks, many above 2,400 m in elevation. The lowest elevation is about 500 m at the southern boundary of the province and the highest rises to more than 2800 m at the northeast portion. There are a few local intermontane valleys and uplands, the best known is the rolling upland of Baguio City and Trinidad Valley.

The main drainages of the province are the Agno and Bued Rivers. Agno River traverses almost the entire length of the province while Bued River drains the southern part in the vicinity of Baguio. Several tributaries of Amburrayan Rivers drain the western boundary of the province. Agno and Bued Rivers flow southward into Lingayen Gulf.

Area Coverage

1	0 - 8%	0
2	8 - 18%	32.4 km² (1.2%)
3	18 - 30%	55.5 km² (2.1%)
4	30 - 50%	732.1 km² (27.6%)
5	50% & above	1,835.4 km² (69.1%)
	T o t a l	2,655.4 km² (100.0%)

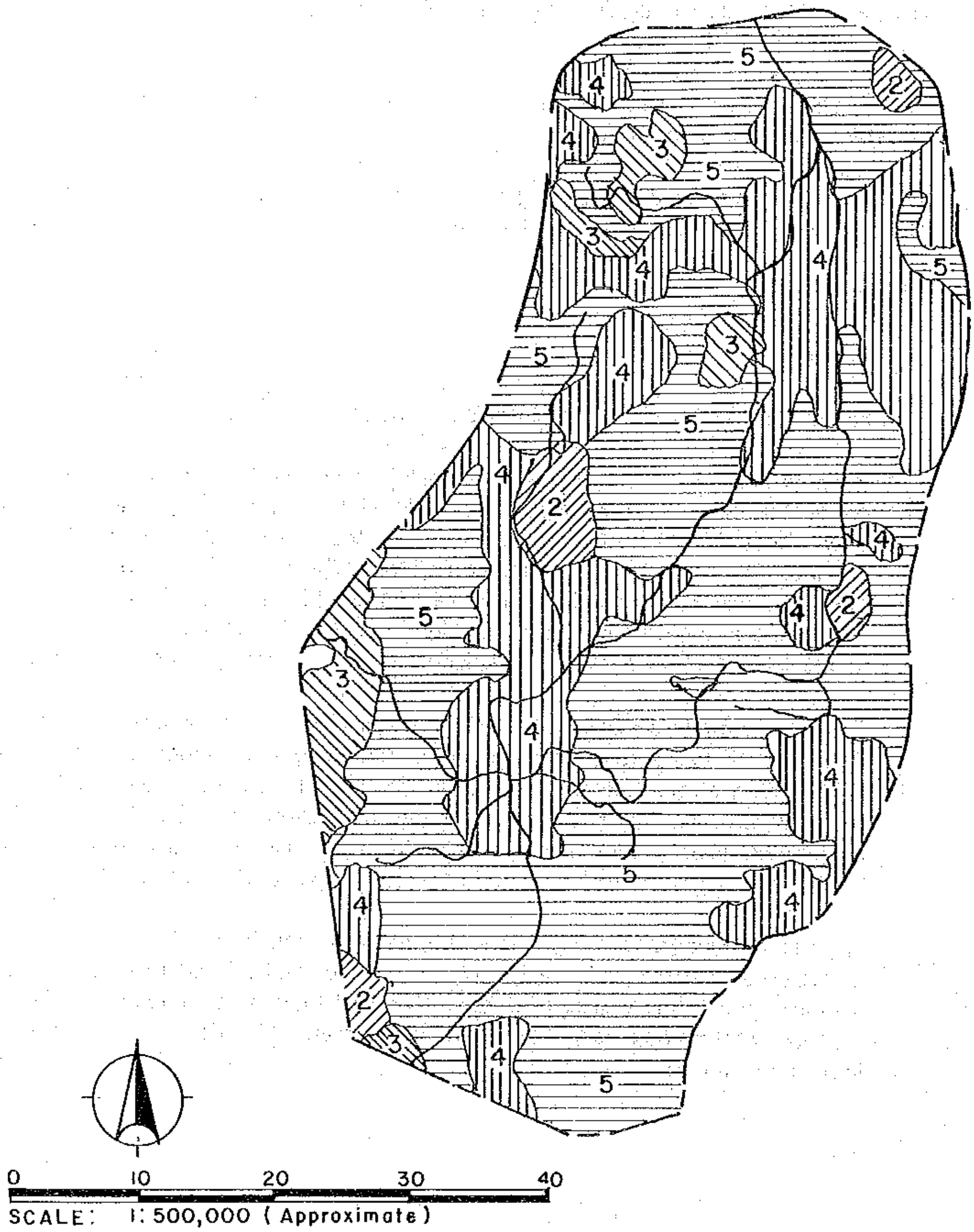


FIGURE 5.1-1 SLOPE CLASSIFICATION MAP OF BENGUET PROVINCE

2) Geology

Formations

The major rock formations in the province range in age from probable early Cretaceous to Pliocene (Figure 5.1-2). The youngest rock is the Quaternary Volcanic (QV) randomly observed as isolated knobs or peaks. The following time-rock units listed in the order of decreasing age underlie the province of Benguet: Undifferentiated Volcanics (UV); Early to Middle Miocene Sedimentary Rocks (N_1); Neogene Intrusive (NI); Upper Miocene to Pliocene Sedimentary Rocks (N_2); and Quaternary Volcanics (QV).

– Undifferentiated Volcanics (UV)

The rock assemblage constitutes the oldest rock formation in the province and forms a north-south belted pattern that underlies the axial zone of the Central Cordillera Mountain. The assemblage consists of altered basalt-spilite andesite-keratophyre, dacite and diabase and is locally intercalated at the upper stratigraphic section with the altered Eocene clastic sedimentary rocks. The andesite and basalt occur together as successive flow and both are altered to greenstones.

– Early to Middle Miocene Sedimentary Rocks (N_1)

The rock assemblage constituting the most extensive rocks fringes the eastern and western flank of the Central Cordillera along its entire extent. The rocks unconformably overlie the Cretaceous and Palaeogene rocks. Some of the rock formations represented in the province by this time rock unit are the Zigzag Series, Balili Sediments, Twin Peaks Formation and Kennon Limestone.

The Zigzag Series, Balili Sediments and Twin Peaks Formation all consist of a thick sequence of sedimentary rocks, conglomerate, calcareous and arkosic sandstone, wacke and siltstone-shale sequence. The Zigzag Series is intercalated with volcanic flow with minor interbeds of tuff, agglomerates and pyroclastics.

The limestone member of this time rock unit occurs either as lenticular interbed or as the upper unit of the various rock formations. The limestone in some instances becomes the host rock of sulphide deposition.

– Neogene Intrusive (NI)

The rock is a batholitic mass which appears to be the core of the Central Cordillera Mountains. It intrudes the KP and the early to Middle Miocene rocks. The intrusive rock is a composite intrusive consisting of quartz diorite, granodiorite, hornblende diorite, pyroxene diorite and related andesite-dacite porphyries which are sporadically distributed along the borders or margin of the pluton.

In the Baguio Mineral District, previous wokers and investigators recognized the various diorites within the plutonic complext which are represented by type and locality names that include Antamok diorite, Virac granodiorite, augite diorite, Itogon quartz diorite, generally referred to as the Agno Batholith, and and th Bagon Intrusive of the Lepanto Mine. The Virac granodiorite is the principal host rock of Balatoc and Agno Batholith is reported to be the mother magma of the mineral deposits of the Baguio Mineral District. Numerous mines and prospects are located within and near the periphery of border of the Agno Batholith.

– Upper Miocene to Pliocene Sedimentary Rocks (N_2)

The rock formation is a thick sequence of poortly sorted conglomerate associated with thin interbeds of tuffaceous wacke, claystone and carbonaceous siltstone, represented in the Baguio Mineral District by the Klondyke conglomerate. In other parts of the province particularly towards the Ilocos Sur - La Union boundary, the rock assemblage is represented by Rosario Formation, a largely tuffaceous shale - claystone-siltstone wacke sequence with some fairly compacted but poorly sorted pebbly conglomerate lenses and some coralline limestone.

The limestone unit of this assemblage is represented by Mirador Limestone located at Mt. Mirador, Baguio City. It rests with angular unconformity upon the Zigzag Series and exhibits nearly flat bedding.

In Lepanto mine area, at Mankayan, this time rock unit is represented by dacite flow, agglomerate and pyroclastics of Late Miocene age. The rocks unconformably overlie the KP rocks and served as cap rocks for the copper mineralization at Lepanto.

– Quaternary Volcanics (QV)

The rocks occur as isolated cone shaped plugs of andesite to dacitic composition in the northwest and northeast part of the province. Widespread occurrence of this rock type was reported at the flank of Central Cordillera, outside of the area under consideration.

<u>Geologic Structure</u>

Sedimentary rocks of the western periphery are folded into north and northeast structures whereas those of the southwestern portions are controlled by the northeasterly-aligned faults. These rocks units generally dip to the north following roughly the slope of the Cordillera Mountains as homocline in the northwestern part. The orientation and distribution of these units are produced by the north trending faults or controlled by northwesterly tectonic lines.

The uplift and subsidence movements, faulting and other geological processes acting on the earth crust greatly influence the geologic formation of the area. Older rocks occur at higher elevation, but the stratigraphic series is neither overtuned nor folded due to the predominant influence of tectonic forces during sedimentation.

The major faults in the area are located in the southern part of the province along the Agno River while another is located in the northern portion of the province. These faults are northwest in direction. Numerous smaller tensional splays are conspicuous with northeast direction. Generally, the area is a part of the Philippine Fault Zone.

Diastrophism along major tracts constantly uplifted the whole area which is the part of the Phillppine Cordillera thus exposing the older formations. Tectonic forces exposed some portions which are severally weathered and eroded furnishing clastic materials to younger formation and usually deposited in the lowland. Most physiographic features of the area are the fault of geological structure that expresses the operation of subsequent forces.

3) Meteorology

The Province of Benguet has one synoptic station in Baguio. The climatological normals of the Baguio Station are shown in Table 5.1-1.

- Temperature

  Mean annual temperature is 19.3C, which is the lowest in the country due to the high elevation of the province.

- Relative Humidity

  Mean annual relative humidity is 84%, which is higher than that in most of the other provinces.

- Prevailing Wind

  Southeast wind prevails all the year round except for September when northwest wind prevails.

- Rainfall

  Mean annual rainfall is 3,563 mm, which is considerably high comparing with that in other provinces.

- Climate Type

  Climate type in Benguet belongs to Type I.

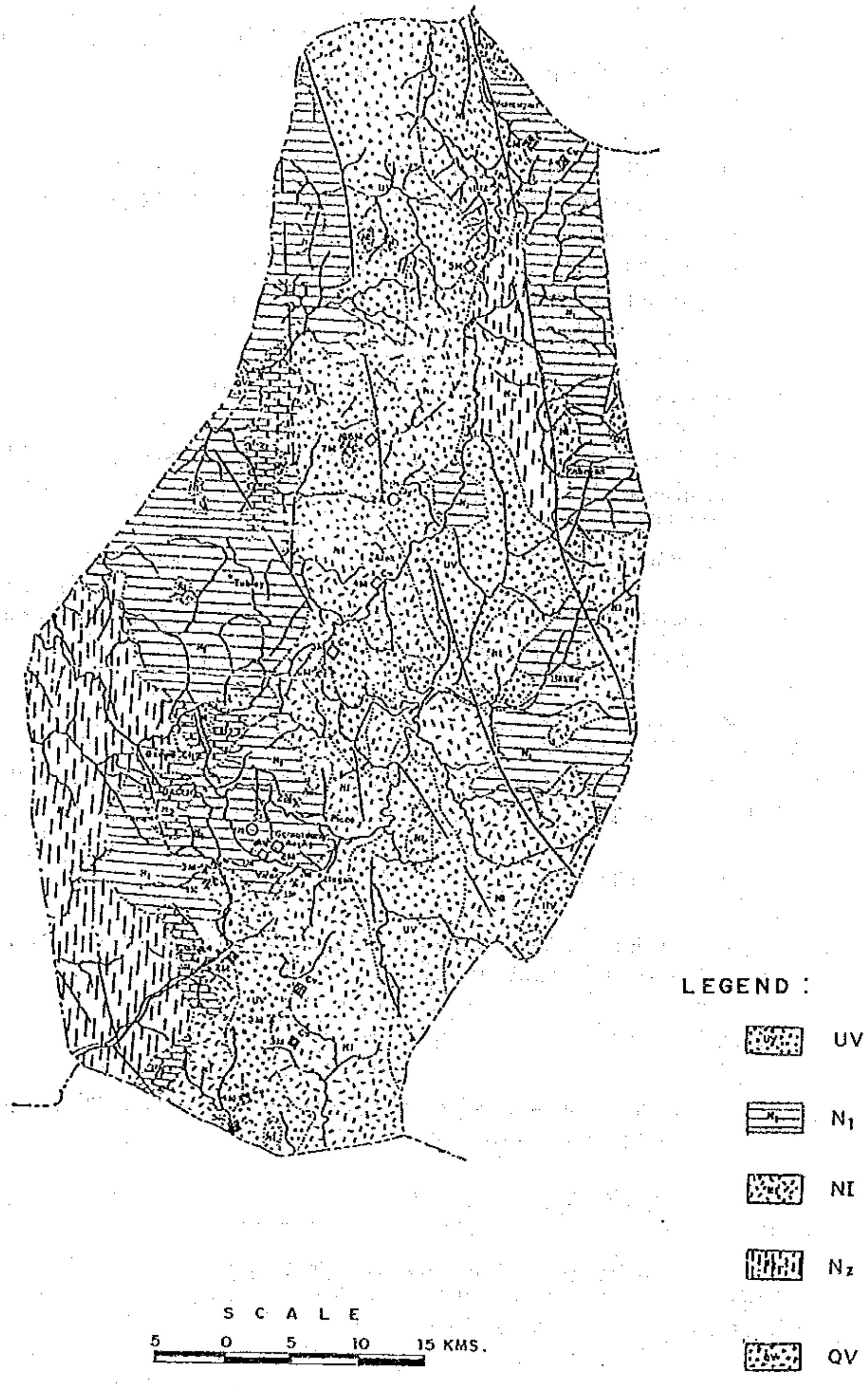


FIGURE 5.1-2 GEOLOGICAL MAP OF BENGUET PROVINCE

TABLE 5.1-1 CLIMATOLOGICAL NORMALS OF BAGUIO STATION

Station : Baguio
Coordinate: 16°25'N 120°36'E

Period of Records: 1951 - 1985

Month	Rain-fall (mm)	No. of Rainy Days	Temperature (deg. C)						Rel. Humidity (%)	Mean Sea Level Pressure (mbs)	Prevailing Wind		Cloudiness (OKTA)	No. of Days with	
			Maximum	Minimum	Mean	Dry Bulb	Wet Bulb	Dew Point			Direction	Speed (mps)		Thunder Storm	Lightning
Jan.	12.1	4	22.6	12.9	17.8	16.6	14.5	13	80	1012.1	SE	2	4	0	0
Feb.	35.8	2	23.6	13.1	18.4	17.2	14.8	13	78	1011.6	SE	2	4	1	0
Mar.	55.9	4	24.7	14.3	19.6	18.4	16.0	15	78	1010.8	SE	2	4	2	1
Apr.	102.9	9	25.4	15.5	20.4	19.4	17.2	16	80	1009.4	SE	2	5	9	3
May	331.1	19	24.6	16.2	20.5	19.4	17.8	17	86	1007.9	SE	2	6	18	10
Jun.	480.6	22	23.6	16.2	20.0	19.0	17.7	17	88	1007.3	SE	3	6	15	8
Jul.	670.8	26	23.0	16.0	19.6	18.6	17.5	17	90	1006.6	SE	3	7	14	6
Aug.	847.9	27	22.0	15.9	18.9	18.2	17.4	17	92	1006.2	SE	3	8	11	4
Sep.	582.3	25	22.9	15.7	19.3	18.5	17.4	17	90	1007.1	NW	2	7	13	5
Oct.	262.4	17	23.5	15.4	19.5	18.6	17.2	17	87	1008.1	SE	3	6	8	5
Nov.	152.3	9	23.2	14.8	19.0	18.1	16.3	15	83	1009.5	SE	3	5	2	1
Dec.	28.8	5	22.8	14.0	18.4	17.4	15.3	14	80	1010.9	SE	2	4	1	0
Annual	3562.9	169	23.5	15.0	19.3	18.3	16.6	16	84	1009.0	SE	2	6	94	43

5.1.3 Socio-Economic Profile

1) Population

Population, annual growth rate and population density by city/municipal are presented in Table 5.1-2. Distribution of city and municipal towns is shown in Figure 5.1-3 together with population. Major population concentration is observed only in Baguio City and its surrounding areas.

TABLE 5.1-2 POPULATION, LAND AREA AND DENSITY (1990) PROVINCE OF BENGUET

City/Municipality	Population 1990	Growth Rate (%) 1980-1990	Land Area km^2	Population Density (P/km^2)
1. Atok	13,853	-0.9	137.0	101.1
2. Baguio City	183,102	4.3	48.9	3,744.4
3. Bakun	10,817	1.9	237.4	45.6
4. Bukod	11,474	-0.9	425.3	27.0
5. Buguias	25,236	3.6	193.1	130.7
6. Itogon	61,773	2.6	423.7	145.8
7. Kabayan	10,306	1.2	177.5	58.1
8. Kapangan	15,537	1.4	136.4	113.9
9. Kibungan	12,753	1.9	192.1	66.4
10. La Trinidad	48,252	5.2	61.4	785.9
11. Mankayan	32,889	2.4	131.7	249.7
12. Sablan	8,440	0.6	91.6	92.1
13. Tuba	39,635	2.5	314.4	125.2
14. Tublay	11,479	1.6	84.9	135.2
Total	485,546	3.1	2,655.4	182.9

Source: 1990 Population Census

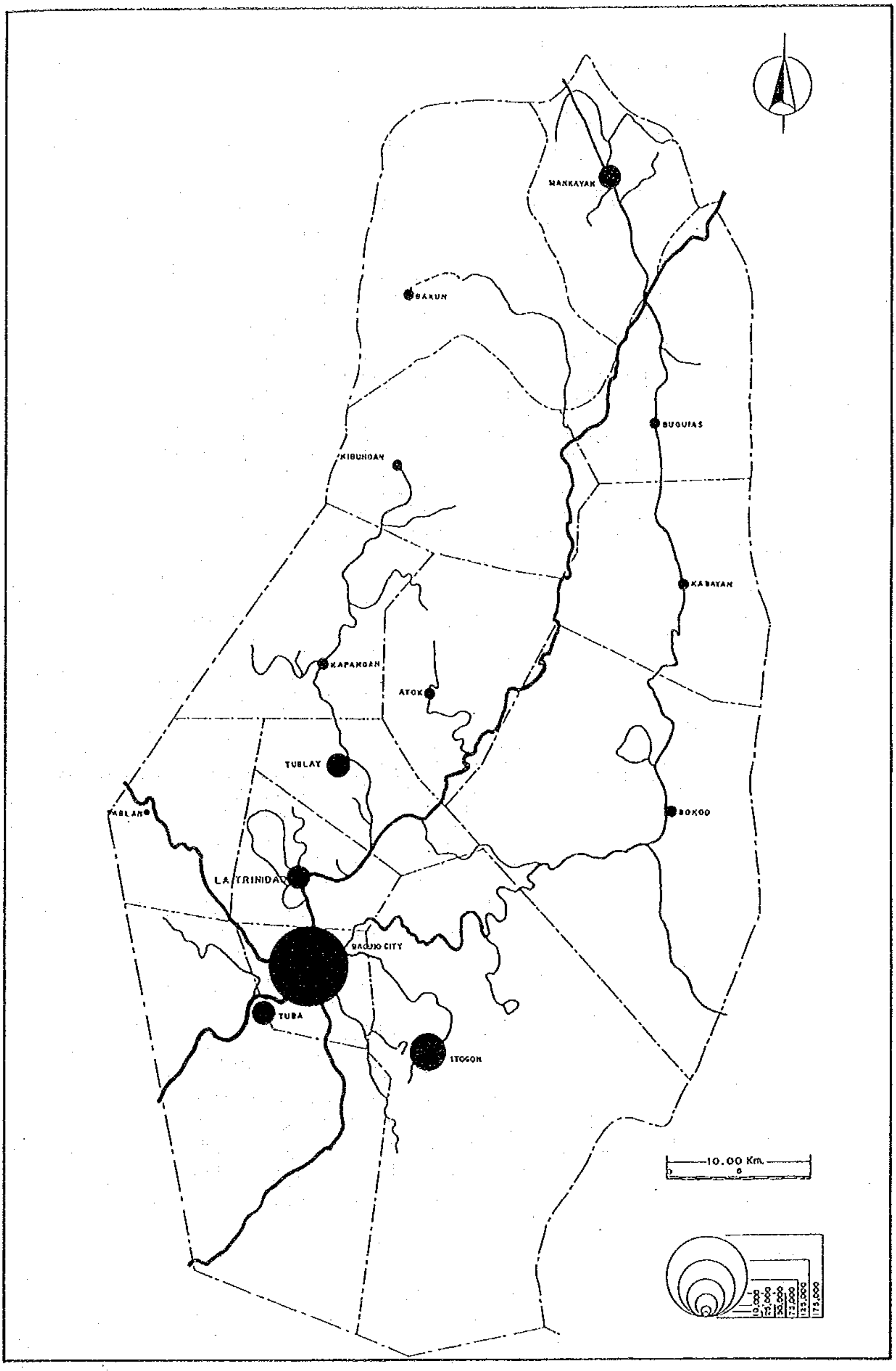


FIGURE 5.1-3 POPULATION BY MUNICIPALITY (1990)

2) Land Use

Benguet has a total land area of 2,655.4 square kilometers, representing 0.9% of the total land area of the country. Table 5.1-3 shows general land use of the province.

TABLE 5.1-3 LAND USE OF BENGUET

Land Use	Area in Sq. Km.	%
Agricultural Land	281.5	10.6
Forest	993.1	37.4
Grassland/Shrubland	1,327.7	50.0
Built-up Areas	34.5	1.3
Miscellaneous Use	18.6	0.7
Total	2,655.4	100.0

Source: Physical Land Resources, Bureau of Soils

3) Economy

Table 5.1-4 shows major socio-economic data of the province in comparison with the national value.

TABLE 5.1-4 MAJOR SOCIO-ECONOMIC DATA OF PROVINCE OF BENGUET

	Benguet (A)	Philippines (B)	(A)/(B)
1. Total Land Area (km^2)	2,655	300,000	0.009
2. Population in 1990 (1,000 persons)	486	60,685	0.008
3. Population Density (persons/km^2)	183	202	0.91
4. GRDP in 1987 (Million ₱ at current prices)	4,008	705,467	0.006
5. Per Capita Income in 1985 (₱/person)	9,216	5,593	1.65
6. Number of Workers by Industrial Sector in 1980 (1,000 persons)			
* Agricultural	49.1 (43%)	7,303 (51%)	0.007
* Industry	28.3 (25%)	2,177 (15%)	0.013
* Service	37.1 (32%)	4,552 (32%)	0.008
* Total[1)]	114.7 (100%)	14,197 (100%)	0.008
7. Incidence of Poverty in 1985 (%)	36.1	59.3	0.61
8. Unemployment Rate in 1988 (%)	2.7	8.3	0.33
9. Underemployment Rate in 1988 (%)	3.3	11.6	0.28

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

- Agriculture

Agriculture is one of the major industries of the province, sharing 43% in terms of number of workers.

Table 5.1-5 shows major crops produced in the province. Five (5) major crops of the province are palay, cabbage, camote, white potato and mustard. Favored by climate, the province produces various kinds of vegetables which are mostly consumed in Metro Manila.

TABLE 5.1-5 MAJOR CROPS OF BENGUET

Crops	Area Utilized (ha.)		Production (M.T.)	
	1985	1986	1985	1986
Palay	5,660	5,610	9,810	10,605
Cabbage	3,225	3,460	45,060	49,201
Camote	3,850	3,400	44,016	42,560
White Potato	2,960	3,250	34,841	39,740
Mustard	1,200	1,580	18,450	24,486

- Livestock

An increase in livestock population characterized the five-year performance of the sector. Hog population grew by an annual average of a little less than 1% from 39,500 heads in 1978 to 40,820 heads in 1982. Backyard farms registered an annual growth of 3% while commercial farms dropped by 16%.

Cattle population grew from 14,350 heads in 1978 to 15,480 heads in 1982 while carabao population grew from 10,320 to 10,530 heads during the same years. Commercial farms grew faster than the backyard farms.

Chicken population, on the other hand, registered an average annual decrease of 1%. Commercial farms dropped by an average of 4% annually while backyard farm less than 1%.

- Tourism

Benguet has a cool climate year-round. It has varied tourist attractions, among which are the La Trinidad Valley, the country's salad bowl; the majestic Mt. Pulog, the second highest mountain in the country rising at 2,930 m above sea level; the Banawe Rice Terraces considered as one of ten wonders of the world; and the six waterfalls in the sacred Mount Kabunian, named after the Kankaney pagan god. Benguet also offers elegant hotels with 1,810 rooms and several resort facilities.

5.1.4 Road Network

Benguet Province has a total of 1,757 km of roads in 1987, comprising the following:

National Road	467.1 km.	(26.6%)
Provincial Road	321.1 km.	(18.3%)
City Road	142.2 km.	(8.1%)
Municipal Road	35.6 km.	(2.0%)
Barangay Road	791.2 km.	(45.0%)
Total	1,757.2 km	(100.0%)

Pavement ratio of each class of roads in comparison with the national value is as follows:

TABLE 5.1-6 PAVEMENT RATIO

	Length in Km By Surface Type		Pavement Ratio A/(A + B) x 100	
	PCC and AC (A)	Gravel and Earth (B)	Benguet	Philippines
National Road	230.0 km	237.1 km	49.2%	45.9%
Provincial Road	40.3 km	280.8 km	12.6%	11.4%
City Road *	142.2 km	0.0 km	100.0%	66.6%
Municipal Road	1.1 km	34.5 km	3.1%	25.5%
Barangay Road	41.0 km	750.2 km	5.2%	1.0%
T o t a l	454.6 km	1,302.6 km	25.9%	14.0%

Both national and provincial roads have almost the same pavement ratios as the national average.

Figure 5.1-4 shows existing national and provincial roads. All city and municipal towns except Bakun are linked with either national or provincial roads, thus a basic road network is almost formed. Due to topographical constraints, road network is scarce and fishbone type of networkis formed. Interlinkage between national roads is not achieved yet.

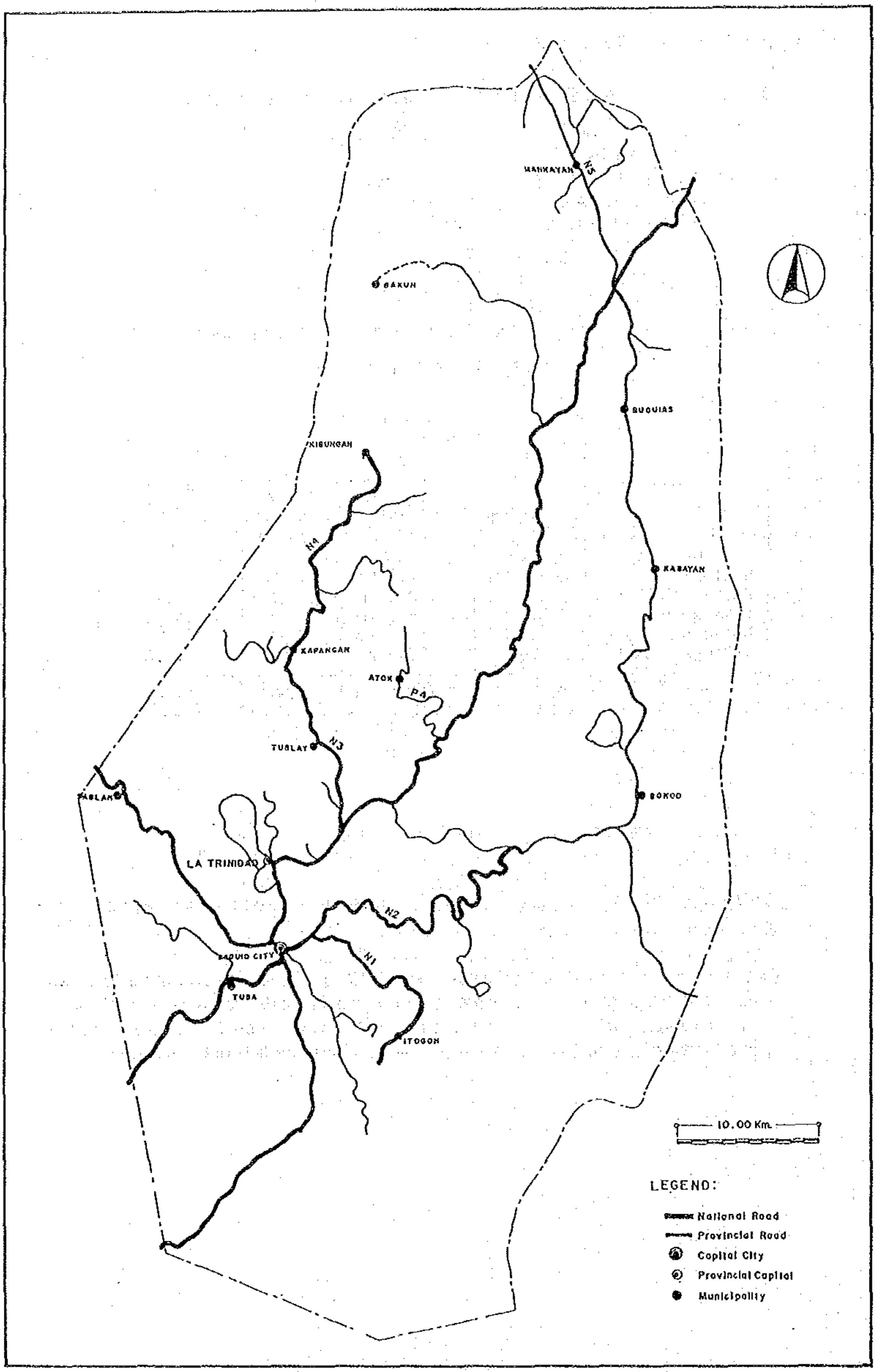


FIGURE 5.1-4 ROAD NETWORK MAP (BENGUET PROVINCE)

5.2 PROFILE OF BATANGAS PROVINCE

5.2.1 General

The Province of Batangas was selected as one of the pilot provinces which represents provinces of high disaster potential volcanic geology and flat/mountainous topography.

The province is located in the central part of Luzon Island or in the midst of Tagalog Region. It is bounded on the north by the province of Cavite, on the east by the provinces of Laguna and Quezon, on the south by Verde Island Passage and on the west by China Sea.

The province is composed of two (2) cities and 32 municipalities. The provincial capital is located at Batangas City.

5.2.2 Physical Profile

1) Topography

Figure 5.2-1 shows the slope classification map.

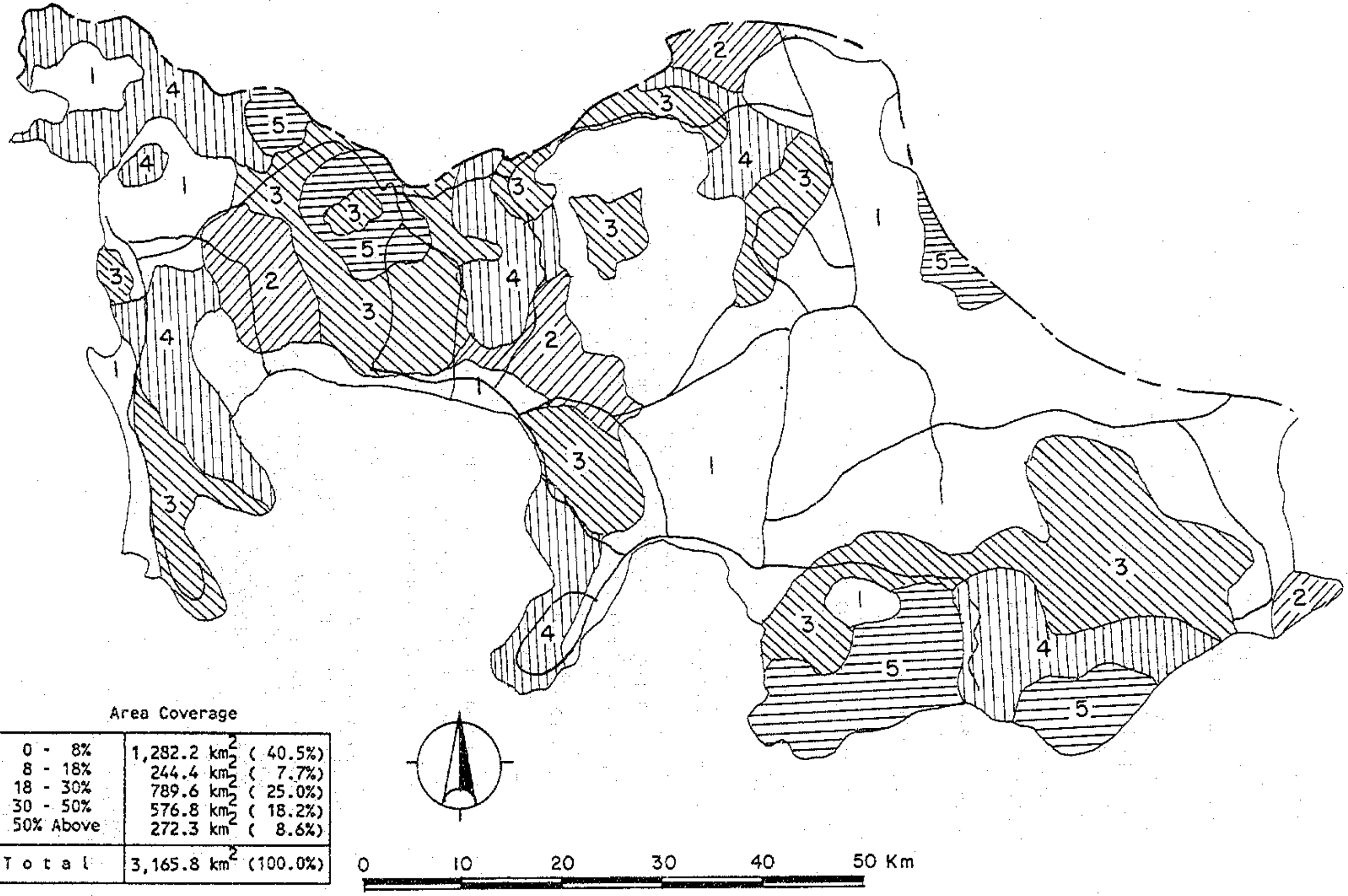
The province is a part of the volcanic region in Southern Luzon where violent eruptions of Taal Volcano formed the Taal Lake and blanked the whole province.

Taal Lake has an area of approximately 359 square kilometers. It is drained by Pansipit River which flows in south and into Balayan Bay. The Taal Lake Basin covers almost the whole area of the province. The Tagaytay Ridge and other topographic barriers in the heart of the basins empty into the Taal Lake.

Topography is relatively flat and occasionally dispersed by mountains whose average elevation is approximate 300 meters.

There are two prominent mountains, Mount Makiling (1,096 m) and Mount Malaraya (963 m), separating the province from Laguna and Quezon. The Tagaytay Ridge separates Batangas from Cavite Province.

The irregular coastline of the study area is generally rocky with occasionally limited stretches of sandy or gravelly beaches. The coastal profile usually descends abruptly seaward but in some places coral reefs and mangroves swamps with tortuous tidal channels may border the coast. Along the coast, several embayments are gradually being filled up with alluvial materials producing small tracts of coastal plains.



Area Coverage

1	0 - 8%	1,282.2 km^2 (40.5%)
2	8 - 18%	244.4 km^2 (7.7%)
3	18 - 30%	789.6 km^2 (25.0%)
4	30 - 50%	576.8 km^2 (18.2%)
5	50% Above	272.3 km^2 (8.6%)
	Total	3,165.8 km^2 (100.0%)

FIGURE 5.2-1 SLOPE CLASSIFICATION MAP OF BATANGAS PROVINCE

2) Geology

Formations

The geologic formation of the province of Batangas is dominantly of Recent origin of alluvium, beach deposits, etc., and a host of other formations of sedimentary, volcanic, and metamorphic rocks (Figure 5.2-2).

- Recent Alluvium (R)

  Alluvium, fluviatile, beach deposits, raised coral reefs, stones and beach rocks.

  Recent alluvium is concentrated on floodplains, river beds and banks, swampy and coastal areas, abandoned segments of meander cutoffs and lacustrine plains. It consists of fluviatile sediments of unsorted and unconsolidated clay, silt, sand, gravel, reworked pyroclastics and volcanic rock fragments.

  The littoral and alluvial deposits occur in some parts of San Juan, along the coasts between Batangas and Bauan, between Taal and Balayan and also in Lian and Nasugbu. Karst plain is located in vicinity of San Juan and Calatagan. Lacustrine plain is located in Talisay, Laurel, San Nicolas and Balete within Taal Lake.

  Most of the alluvium in the province is generally covered with volcanic tuff.

- Pliocene-Pleistocene ($N_3 + Q_1$)

  Marine and terrestial sediments (molasses). Associated with extensive reef limestone. Predominantly marl and reworked tuff in places. Sporadic terrace gravel deposits in some coastal and fluvial tracts. Plateau red earths and/or laterites in some elevated flat land surface.

- Oligocene-Miocene (N_1)

  Thick, extensive, transgressive mixed shelf, marine deposits, largely wackes, shales, and reef limestone. Underlain by conglomerate and/or associated with paralic coal measures in places. Sometimes associated with basic and intermediate flows and pyroclastics. Largely arkosic and quartzitic clastics, generally well indurated. Folded and locally intruded by quartz diorite.

- Upper Miocene-Pliocene (N_2S)

  Largely marine clastics (molasses) overlain by extensive, locally transgressive pyroclastics and tuffacious sedimentary rocks. Associated with calcarenite and/or silty limestone.

- Basement Complex (BC)

  Undifferentiated amphibolite, quartz of feldspathic mica schist and phyllites-slates frequently associated with marble and quartzite. Broadly folded; some narrow zones of close folding broken up by thrusts.

- Late Miocene-Pliocene (N_2V)

  Andesite basalt dacite vesicular and amygdaloidal lava and breccia flows, interbedded tuffs and agglomerates, intrusive dikes and sills.

- Undifferentiated (UV)

  Largely graywackes and metamorphosed shale interbedded and/or intercalated with spilitic, basic and intermediate flows, and/or pyroclastics.

- Pliocene-Quaternary (QV)

  Non-active cones (generally pyroxene andesite) also dacitic and/or andesitic plugs.

- Pliocene-Quaternary (QVP)

  Volcanic plain or volcanic piedmont deposits. Chiefly pyroclastics and/or volcanic debris at foot of volcanoes.

- Quaternary (QAV)

  Active volcanoes (with eruptions and/or activity since 1616) such as Didicas, Taal, Mayon, Bulusan, Canlaon, Camiguin, Makaturin, Ragang and Calayo.

Geologic Structures

Frequent tectonic and volcanic events have affected the area. In one way or another, many of the most important physical features can be linked to diastrophism.

Violent volcanic eruptions developed the volcanic region in the province. The ejected materials were found to be an Upper Miocene and Quaternary in age. Tectonic structures observed in the southeastern, eastern, and western portions are trending in all directions.

The southeastern and western parts of the province must have been affected by wide spread tectonic disturbances as evidenced by the preponderance of faults of various age and nature.

The tectonic lines that traversed the sedimentary and some volcanic formations in the western parts are N, NW and NE directions.

In the southeastern part of the province, the Laiya Fault is the most prominent structure. It is a normal fault that strikes west- northwest separating the younger volcanics in the topographically low areas. It is readily recognized in the vicinity of Laiya, San Juan and Lobo River. Its northern extent is not traceable due to the presence of the thick volcanic tuff covering the area.

Minor structure in the eastern part of Batangas City that traversed along Mount Banoy are NE trending gravity faults are associated with shears and joints. Near Laiya Fault, NW striking faults are separating the metamorphic rocks from the relatively younger tuff, they cut across both the metamorphic rocks sequence and the diorite intrusive.

Localized folding of the younger clastic along Calumpit River is manifested by a synclinical structure with axis striking NW and limbs dipping moderately towards the NE and SE. The clastics at upper Pinamucan area are characterized by homoclinal beds that strike NE and dip gently to the NW. The clastics in the western part of the province have the same characteristics.

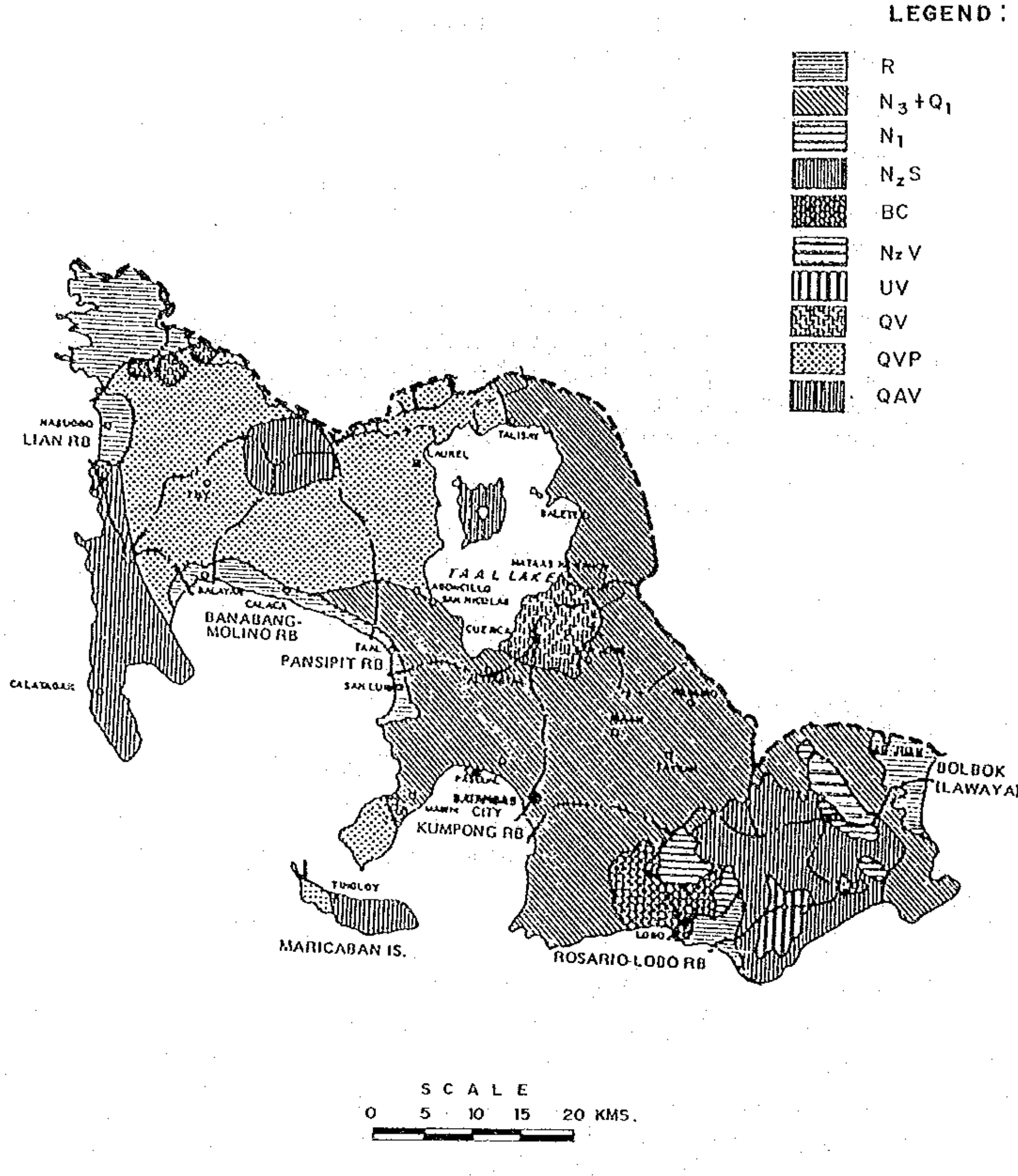


FIGURE 5.2-2 GEOLOGICAL MAP OF BATANGAS PROVINCE

3) Meteorology

The Province of Batangas has one synoptic station at Ambulong, Tanauan Municipality. The climatological normals of the Ambulong Station are shown in Table 5.2-1.

- Temperature

  Mean annual temperature is 27.5C, which is a little higher than average in Luzon area except Baguio.

- Relative Humidity

  Mean annual relative humidity is 78%, which is lower than average in the Philippines.

- Prevailing Wind

  Northeast wind prevails in dry season, while southwest wind in rainy season.

- Rainfall

  Mean annual rainfall is 1,790 mm, which is considerably lower than average in the Philippines.

- Climate Type

  Climate type in Batangas belongs to Type I.

TABLE 5.2-1 CLIMATOLOGICAL NORMALS OF AMBULOG STATION

Station : AMBULOG, BATANGAS
Coordinate: 14°05'N 121°04'E

Period of Records: 1951 - 1985

Month	Rainfall (mm)	No. of Rainy Days	Temperature (deg. C) Maximum	Minimum	Mean	Dry Bulb	Wet Bulb	Dew Point	Rel. Humidity (%)	Mean Sea Level Pressure (mbs)	Prevailing Wind Direction	Speed (mps)	Cloudiness (OKTA)	No. of Days with Thunder Storm	Lightning
Jan.	22.1	5	30.5	21.5	26.0	25.3	22.2	21	76	1013.1	NE	2	4	0	0
Feb.	9.9	3	31.7	21.4	26.6	25.8	22.2	21	73	1012.9	NE	2	4	0	0
Mar.	16.3	3	33.5	22.2	27.9	27.2	22.9	21	69	1012.4	NE	2	3	1	1
Apr.	37.4	5	34.8	23.4	29.2	28.6	24.2	23	69	1010.8	NE	2	3	4	6
May	105.3	10	34.3	23.9	29.2	28.8	25.0	24	73	1009.3	SW	2	4	12	18
Jun.	237.5	16	31.6	24.0	27.9	27.9	25.2	24	80	1008.7	SW	2	6	14	16
Jul.	289.9	19	31.4	23.6	27.5	27.2	24.9	24	83	1008.4	SW	2	6	16	16
Aug.	323.7	19	30.8	23.8	27.3	27.1	24.8	24	83	1008.2	SW	2	6	9	9
Sep.	259.7	18	31.3	23.4	27.3	26.9	24.8	24	84	1009.1	SW	2	6	14	16
Oct.	234.1	16	31.5	23.0	27.3	26.7	24.4	24	83	1009.7	NE	2	5	8	12
Nov.	156.6	13	31.1	22.8	27.0	26.5	23.8	23	80	1010.6	NE	2	5	3	6
Dec.	97.6	10	30.0	22.2	26.2	26.5	22.9	22	79	1012.1	NE	2	5	1	2
Annual	1790.1	137	31.9	22.9	27.5	27.0	23.9	23	78	1010.4	NE	2	5	82	102

5.2.3 Socio-Economic Profile

1) Population

Population, annual growth rate and population density by city/municipality are presented in Table 5.2-2. Distribution of cities and municipal towns is shown in Figure 5.2-3 together with population. Major concentration of population is observed along the Sto. Tomas - Lipa - Batangas corridor.

TABLE 5.2-2 POPULATION, LAND AREA AND DENSITY (1990) PROVINCE OF BATANGAS

City/Municipality	Population 1990	Growth Rate (%) 1980-1990	Land Area km2	Population Density (P/km2)
1. Agoncillo	20,227	2.3	54.7	369.8
2. Alitagtag	16,016	1.1	23.4	684.4
3. Balayan	53,870	2.2	108.7	495.6
4. Balete	11,678	3.1	25.0	467.1
5. Bauan	59,258	3.2	66.0	897.8
6. Calaca	45,377	2.3	100.3	452.4
7. Calatagan	35,543	2.6	112.0	317.3
8. Cuenca	20,176	1.7	40.4	499.4
9. Ibaan	31,220	2.0	99.0	315.3
10. Laurel	22,099	2.2	68.1	324.5
11. Lemery	53,932	2.4	101.6	530.8
12. Lian	31,296	1.9	76.8	407.5
13. Lobo	26,881	1.1	192.7	139.5
14. Mabini	30,474	2.6	43.0	708.7
15. Malvar	24,253	3.1	36.5	664.5
16. Mataas Na Kahoy	15,240	2.4	22.1	689.6
17. Nasugbu	75,515	2.5	263.0	287.1
18. Padre Garcia	25,958	2.9	93.7	277.0
19. Rosario	66,923	2.2	189.4	353.3
20. San Jose	38,680	3.1	49.5	781.4
21. Sab Juan	67,741	1.4	273.4	247.8
22. San Luis	22,143	2.2	39.2	564.9
23. San Nicolas	13,174	2.3	26.6	495.3
24. San Pascual	34,629	2.9	35.0	989.4
25. Sta. Teresita	12,605	1.3	12.5	1,008.4
26. Sto. Tomas	58,209	3.1	91.1	639.0
27. Taal	34,925	1.7	29.7	1,176.0
28. Talisay	23,159	1.8	28.2	821.2
29. Tanauan	92,754	2.3	107.2	113.1
30. Taysan	22,508	1.6	109.4	205.7
31. Tingloy	15,430	1.5	32.4	476.2
32. Tuy	30,409	2.0	122.4	248.4
33. Batangas City	184,970	2.6	283.0	653.6
34. Lipa City	160,117	2.9	209.4	764.6
Total	1,476,783	2.4	3,165.4	466.5

Source: Population Census

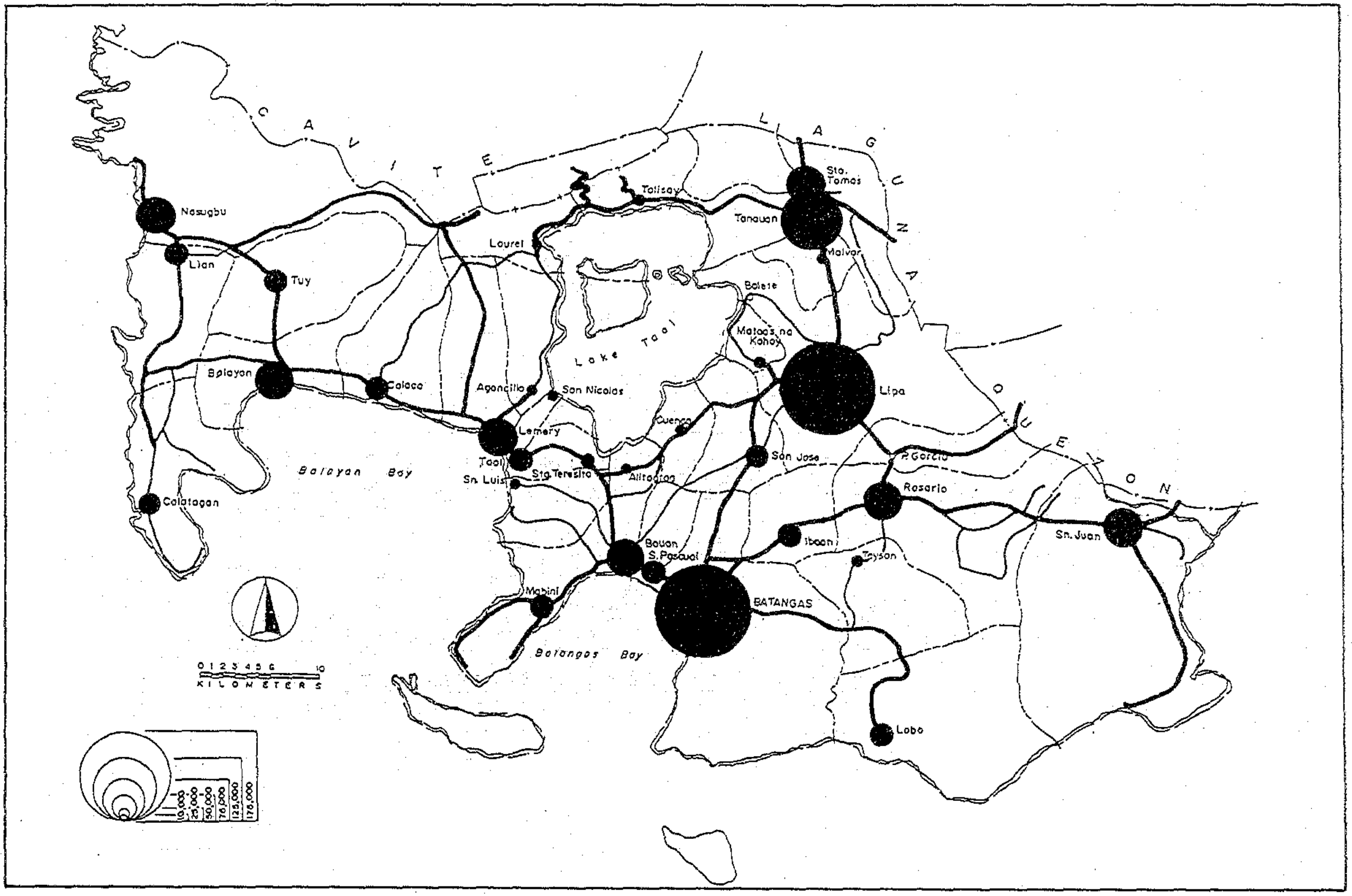


FIGURE 5.2-3 POPULATION BY MUNICIPALITY (1990)

2) Land Use

Batangas has a total land area of 3,165.8 square kilometers, representing 1.1% of the total land area of the Philippines. Table 5.2-3 shows general land use of the province.

TABLE 5.2-3 LAND USE OF BATANGAS

Land Use	Area in Sq. Km.	%
Agricultural Land	2,008.5	63.4
Forest	188.2	5.9
Grass/pasture Land	348.3	11.0
Shrubland	508.6	16.1
Wetland	24.4	0.8
Built-up Area and other Misc. Use	87.8	2.8
Total	3,165.8	100.0
Taal Lake	223.8	

Source: Physical Land Resources, Bureau of Soils

3) Economy

Table 5.2-4 shows major socio-economic data of the province in comparison with the national value.

TABLE 5.2-4 MAJOR SOCIO-ECONOMIC DATA OF PROVINCE OF BATANGAS

	Batangas (A)	Philippines (B)	(A)/(B)
1. Total Land Area (km^2)	3,165	300,000	0.011
2. Population in 1990 (1,000 persons)	1,477	60,685	0.024
3. Population Density (persons/km^2)	467	202	2.310
4. GRDP in 1987 (Million ₱ at current prices)	21,261	705,467	0.030
5. Per Capita Income in 1985 (₱/Person)	5,431	5,593	0.970
6. Number of Workers by Industrial Sector in 1980 (1,000 persons)			
* Agricultural	162.5 (45%)	7,303 (51%)	0.022
* Industry	78.8 (22%)	2,177 (15%)	0.036
* Service	119.0 (33%)	4,552 (32%)	0.026
* Total[1)]	362.5 (100%)	14,197 (100%)	0.026
7. Incidence of Poverty in 1985 (%)	52.4	59.3	0.880
8. Unemployment Rate in 1988 (%)	11.4	8.3	1.370
9. Underemployment Rate in 1988 (%)	19.8	11.6	1.710

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

- Agriculture

Agriculture is one of the major industries in the province sharing 45% in terms of number of workers.

Table 5.2-5 shows major crops produced in the province.

TABLE 5.2-5 MAJOR CROPS OF BATANGAS

Crops	Area Utilized (ha.)		Production (M.T.)	
	1985	1986	1985	1986
Corn	162,420	163,660	128,470	135,690
Palay	34,200	34,450	52,620	61,290
Sugarcane	27,131	27,242	1,256	1,436
Coconut	-	23,561	-	27,092
Coffee	4,150	4,150	2,701	2,129

Source: Provincial Profiles, Department of Agriculture

- Livestock and Poulty

The province is considered one of the major cattle producers in the region. There was a total of 169,139 heads of cattle and an estimated meat production of 23,741,617 kilograms. On the other hand, a total of 242,567 heads of goats was raised in the year 1987 and an estimated meat production of 3,638,505 kilograms.

The poulty production industry of the province raised 3,379,337 heads of backyard chicken and 15,104,248 heads in commercial farms, obtaining an estimated total meat production of 17,744,241 kilograms in 1987.

- Fisheries

Batangas has 127 kilometers coast line which is adjacent to vast fishing grounds namely, from the southeast to the northwest, Tayabas Bay, Verde Island Passage, Batangas Bay, Janao-Janao Bay, Balayan Bay and the China Sea.

The province has fifty-seven (57) rivers that were stocked with fish fingerlings. Fish production in 1987 was 52,850 metric tons. Highest producer was the municipality of Balayan with 10,433 metric tons followed by Calatagan and Calaca with a catch of 9,344 metric tons and 6,352 metric tons respectively.

- Tourism

There are various tourist spots in this province which are mostly located along the coastal areas. Tourism in Batangas is another income earner of the province.

5.2.4 Road Network

Batangas Province has a total of 3,653.7 kms of roads in 1987, comprising the following:

National Road	507.5 km	(13.9%)
Provincial Road	637.0 km	(17.4%)
City Road	37.3 km	(1.0%)
Municipal Road	237.1 km	(6.5%)
Barangay Road	2,234.7 km	(61.2%)
Total	3,653.6 km	(100.0%)

Pavement ratio of each class of roads in comparison with the national value is as follows:

TABLE 5.2-6 PAVEMENT RATIO

	Length in Km By Surface Type		Pavement Ratio A/(A + B) x 100	
	PCC and AC (A)	Gravel and Earth (B)	Batangas	Philippines
National Road	419.5 km	88.0 km	82.7%	45.9%
Provincial Road	252.9 km	384.1 km	39.7%	11.4%
City Road	33.6 km	3.7 km	90.1%	66.6%
Municipal Road	128.0 km	109.1 km	54.0%	25.3%
Barangay Road	148.8 km	2,085.9 km	6.7%	1.0%
Total	982.8 km	2,670.8 km	26.9%	14.0%

Paving of national roads with PCC or AC in Batangas has progressed, and pavement ratio of national roads shows much higher level than the national average. Pavement ratio of provincial roads in Batangas shows also higher level than the national average.

Figure 5.2-4 shows existing national and provincial roads. All cities and municipal towns are connected with either national or provincial roads, thus a basic road network is considered formed. The Sto. Tomas - Lipa - Batangas corridor has a dense network. Interlinkages between national roads are basically achieved.

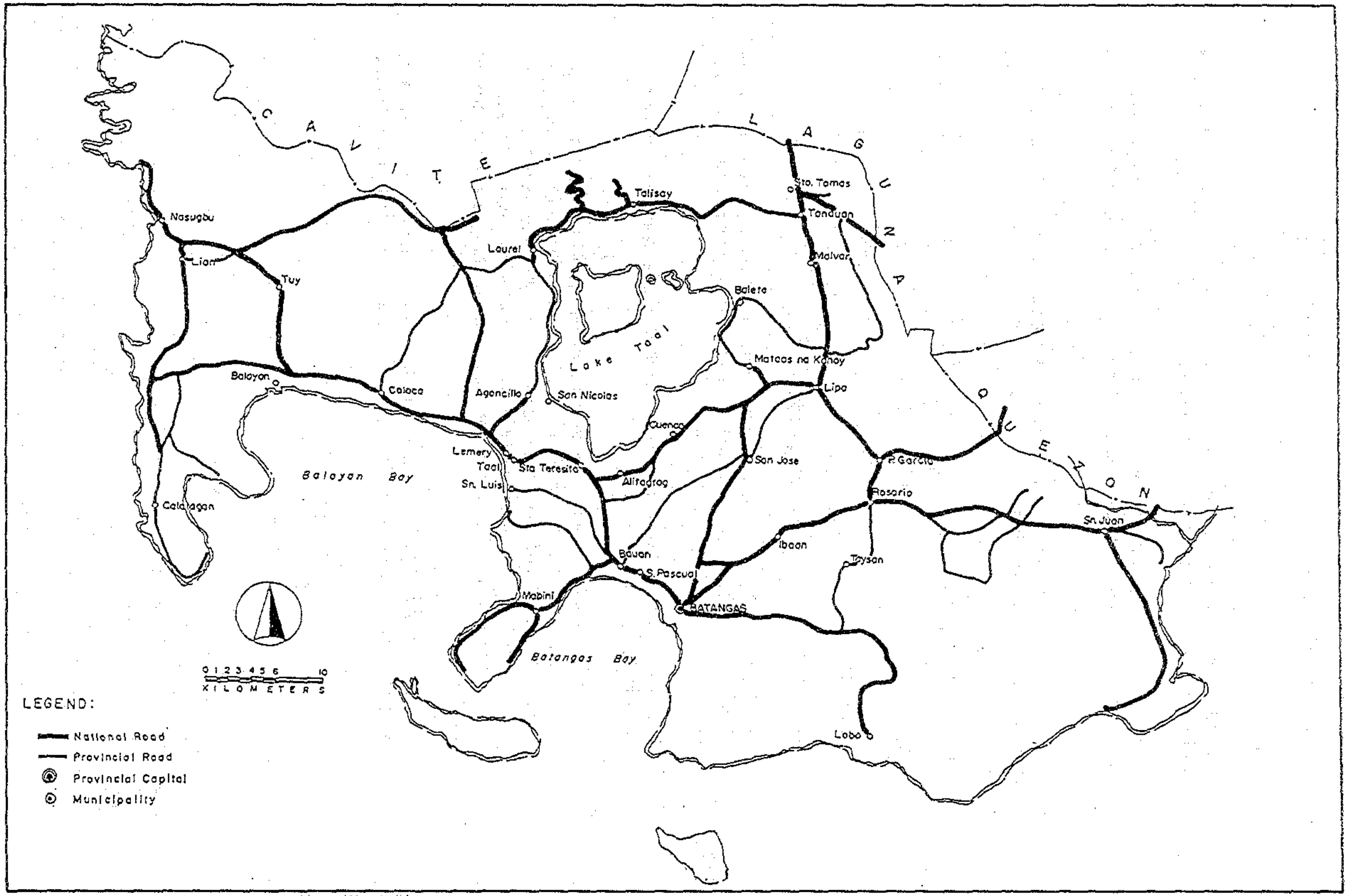


FIGURE 5.2-4 ROAD NETWORK MAP (BATANGAS PROVINCE)

5.3 PROFILE OF LEYTE PROVINCE

5.3.1 General

The Province of Leyte was selected as one of the pilot provinces which represents the provinces of high disaster potential and flat topography.

The province is located in the northern and central portions of Leyte Island which is composed of the provinces of Leyte and Southern Leyte. Leyte shares 78% of land area of the island.

The province is composed of two (2) cities and 49 municipalities. Provincial Capital is located at Tacloban City which is also the center for business and commercial activities of Region VIII.

The subprovince of Biliran is included in the Study.

5.3.2 Physical Profile

1) Topography

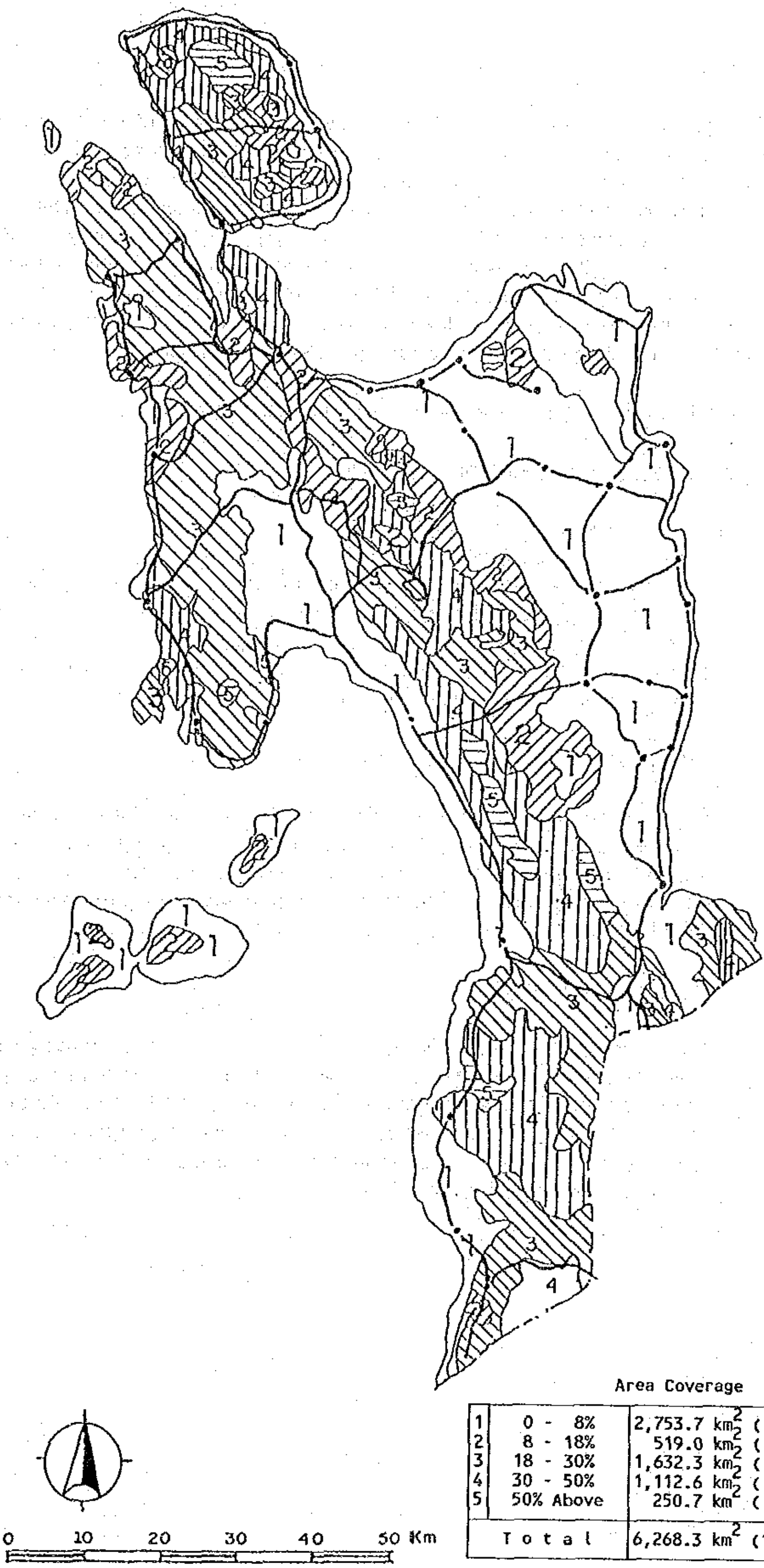
Figure 5.3-1 shows the slope classification map.

The Province of Leyte having a total land area of 6,268.3 sq. km. is consist of main island, Leyte; Biliran Island in the north; Pana-on Island in the south; and the Poro Island group in the midwest.

The smaller islands are predominantly from rolling to mountainous terrain with flat areas along the coasts.

In Leyte Island, the northern and southern portions exhibit topographic variation. In the northern portion there are extensive flat areas stretching from Abuyog to Barugo in the northeast and also in the vicinity of Ormoc city, there is a smaller extent along the northwestern coastal areas. The southern portion of the island is predominantly mountainous with flat areas limited along a narrow strip of coastline.

The characteristics island topography of the province forms numerous independent waterways and river basin, the largest watershed is less than 500 square kilometers.



Area Coverage

1	0 - 8%	2,753.7 km^2 (43.9%)
2	8 - 18%	519.0 km^2 (8.3%)
3	18 - 30%	1,632.3 km^2 (26.0%)
4	30 - 50%	1,112.6 km^2 (17.8%)
5	50% Above	250.7 km^2 (4.0%)
	T o t a l	6,268.3 km^2 (100.0%)

FIGURE 5.3-1 SLOPE CLASSIFICATION MAP OF LEYTE PROVINCE

2) Geology

The geological structure of Leyte consists of a basement of chiefly pre-tertiary basic igneous and metamorphic rocks exposed discontinuously in several parallel high belts (Figure 5.3-2). A thick accumulation of andesitic volcanics, ranging in age from Miocene to Recent, forms the central mountain range. Thick, folded Miocene and Pliocene marine sedimentary rocks are exposed west of the volcanics. Most of the sedimentary rocks are characterized by poor sortings and extreme variations in thickness and lithology within short distance. Uplifted coral reefs of Quaternary age fringe the northwestern part of Leyte. Wide alluvial plains are present both on the north eastern and northwestern portions of the island.

The different geologic formations of Leyte are as follows:

<u>Sedimentary and Metamorphic Rocks</u>

- Pliocene-Pleistocene ($N_3 + Q_1$)

  These are marine and terrestial sediments (molasses). Associated with extensive reef limestone. Predominantly marl and reworked tuff in places. Sporadic terrace gravel deposits in some coastal and fluvial tracts. Plateau red earths and/or laterists in some elevated flat land surfaces. Deformation limited to gentle warping and vertical dislocation.

- Upper Miocene-Pliocene (N_2)

  Largely marine clastics (molasses) overlain by extensive, locally transgressive pyroclastics (chiefly tuff, tuffities) and tuffaceous sedimentary rocks. Associated with calcarenite and/or silty limestone. Reef limestone lenses interrelated with dacite and andesite flows. Laterite deposits in some elevated nearpeneplaned surfaces.

- Oligocene-Miocene (N_i)

  Thick, extensive, transgressive mixed shelf marine deposits, largely wackers, shales, and reef limestone. Underlain by conglomerate and/or associated with paralic coal measures in places. Sometimes associated with basic and intermediate flows and pyroclastics. Largely arkosic and quartzitic clastics. Generally well indurated. Folded and locally intruded by quartz diorite, the epidermal cover of many folded mountains.

- Pre-Jurassic Basement Complex (BC)

  Undifferentiated amphibolite, quartz of feldspathic mica schist, and phyllites-slates frequently associated with marble and quartzite. Broadly folded; some narrow zones of close folding broken up by thrusts.

<u>**Igneous Rocks (Intrusive)**</u>

- Neogene (NI)

  Largely intra-miocene quartz diorite. Mostly betholith and stocks some laccoliths, also sills, dikes and other minor bodies. Includes granodiorite porphyry facies and late miocene dacite. Pervasive in Palaeogene and Mesozoic, less widespread in early Miocene rock sequences.

- Cretaceous - Palaeogene (UC)

  Undifferentiated ultramafic and mafic plutonic rocks. Predominantly peridotite associated with late gabbro and/or diabase dikes. Complex layered type. Generally thrusted or upfaulted into Tertiary and older rock formations. Most bodies probably late Mesozoic to early Tertiary.

- Pliocene - Quaternary (QV)

  Non-active cones (generally pyroxene andesite); also dacitic and/or andesite plugs. Basaltic dikes.

- Oligocene - Miocene (N_1V)

  Mostly submarine andesite and/or basalt flows. Intercalated with pyroclastics and clastic sedimentary rocks and/or reef limestone lenses.

- Cretaceous - Palaeocene (K)

  Essentially spilitic and basic flows. Usually intercalated with gray-wackes. Transgressive on "basement" rocks. Some are included with Cretaceous sedimentary rocks.

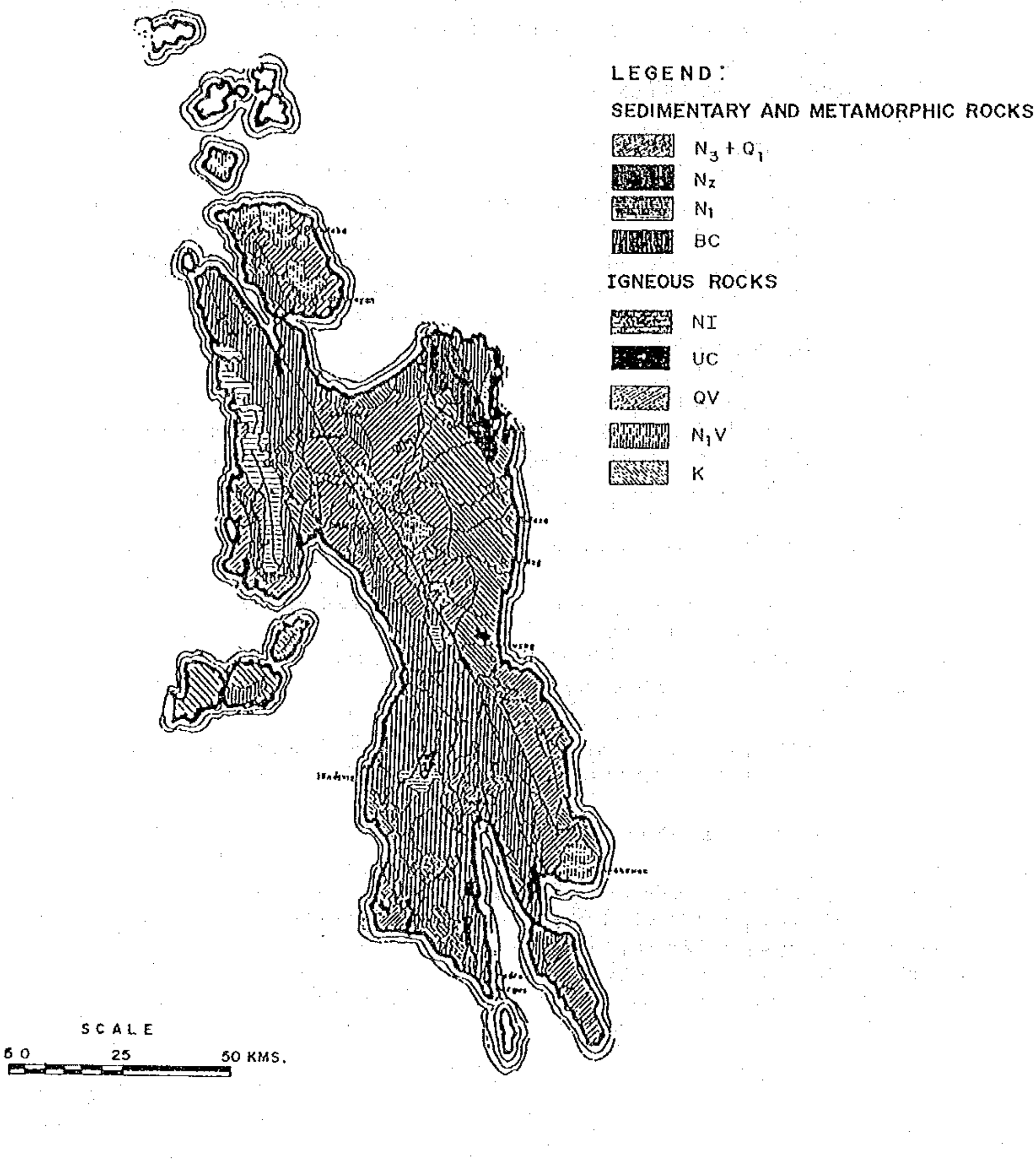


FIGURE 5.3-2 GEOLOGICAL MAP OF LEYTE PROVINCE

3) Meteorology

The Province of Leyte has one synoptic station in Tacloban.

The climatological normals of the Tacloban Station are shown in Table 5.3-1.

- Temperature

  Mean annual temperature is 27.2C, which is almost same as average in Visayas area.

- Relative Humidity

  Mean annual relative humidity is 82%, which is almost average in the Philippines.

- Prevailing Wind

  Northwest wind prevails all the year round except for May and June when southeast wind prevails.

- Rainfall

  Mean annual rainfall is 2,216 mm, which is a little lower than average in the Philippines.

- Climatic Type

  Climatic type in Leyte belongs to Type III.

TABLE 5.3-1 CLIMATOLOGICAL NORMAL OF TACLOBAN STATION

Station : TACLOBAN CITY
Coordinate: 11°15'N 125°00'E

Period of Records: 1951 - 1985

Month	Rain-fall (mm)	No. of Rainy Days	Temperature (deg. C) Maxi-mum	Mini-mum	Mean	Dry Bulb	Wet Bulb	Dew Point	Rel. Humi dity (%)	Mean Sea Level Pressure (mbs)	Prevailing Wind Direction	Speed (mps)	Cloudi-ness (OKTA)	No. of Days with Thun-der Storm	Light ning
Jan.	261.8	20	28.8	22.8	25.8	25.3	23.2	22	84	1011.9	NW	3	6	1	1
Feb.	205.2	18	29.1	22.7	25.9	25.4	23.1	22	82	1012.0	NW	3	6	1	1
Mar.	137.6	16	30.0	23.2	26.6	26.0	23.6	23	82	1012.0	NW	3	5	2	1
Apr.	121.2	15	30.8	24.1	27.4	27.0	24.5	24	81	1010.8	NW	3	5	6	6
May	146.1	15	31.1	24.8	27.9	27.7	25.1	24	81	1009.6	SE	3	5	13	15
Jun.	154.7	16	31.2	24.6	27.9	27.5	25.1	24	82	1009.3	SE/SSE	3	6	15	19
Jul.	167.0	17	31.1	24.4	27.7	27.3	24.8	24	82	1008.7	NW	3	6	16	19
Aug.	129.0	15	31.4	24.5	27.9	27.5	24.8	24	80	1008.5	NW	3	6	15	15
Sep.	146.8	16	31.3	24.5	27.9	27.4	24.8	24	81	1008.9	NW	3	6	15	19
Oct.	184.4	19	31.0	24.2	27.6	27.0	24.7	24	83	1009.2	NW	3	6	16	19
Nov.	244.8	20	30.3	23.9	27.1	26.5	24.4	24	84	1009.3	NW	3	6	10	11
Dec.	316.9	23	29.5	23.4	26.5	25.8	23.9	23	85	1010.7	NW	3	6	6	5
Annual	2215.6	210	30.5	23.9	27.2	26.7	24.3	24	82	1010.1	NW	3	6	116	131

5.3.3 Socio-Economic Profile

1) Population

Population, annual growth rate and population density by city/municipality are presented in Table 5.3-2. Distribution of cities and municipal towns is shown in Figure 5.3-3 together with population. Cities and municipal towns are widely distributed in the province except mountainous areas which run from the north to the south in the central part of the province.

TABLE 5.3-2 POPULATION, LAND AREA AND DENSITY (1990) PROVINCE OF LEYTE

City/Municipality	Population 1990	Growth Rate 1980-1990	Land Area km^2	Population Density (P/km^2)
1. Tacloban City	137,190	3.5	100.9	1,359.7
2. Ormoc City	129,456	2.1	464.3	278.8
3. Abuyog City	47,265	1.2	294.7	160.4
4. Alangalang	33,375	1.2	150.5	221.8
5. Albuera	32,395	1.6	181.2	178.8
6. Babatngon	17,795	0.8	137.8	129.1
7. Barugo	23,817	0.7	78.5	303.4
8. Bato	28,197	1.4	87.1	323.7
9. Baybay	82,281	1.0	410.5	200.4
10. Burauen	46,029	-0.9	178.0	158.6
11. Calubian	25,968	-0.9	137.0	189.5
12. Capoocan	23,687	1.3	185.4	127.8
13. Carigara	38,863	1.2	94.9	409.5
14. Dagami	25,606	1.5	160.0	160.0
15. Dulag	33,020	1.6	39.0	846.7
16. Hilongos	48,617	1.0	136.9	355.1
17. Hindang	16,272	0.05	127.4	127.7
18. Inopocan	16,894	0.6	182.4	92.6
19. Isabel	33,389	7.6	97.5	342.4
20. Jaro	31,727	0.6	148.7	213.4
21. Javier	18,658	0.7	141.8	131.6
22. Julita	9,944	0.2	53.3	186.6
23. Kananga	36,288	2.4	144.2	251.6
24. La Paz	14,311	-0.9	171.5	83.4
25. Leyte	32,575	1.0	238.3	136.7
26. MacArthur	13,159	0.3	48.6	270.8
27. Mahaplag	22,673	1.0	172.0	131.8
28. Matag-ob	15,474	-0.9	31.7	488.1
29. Matalom	28,291	0.8	75.4	375.2
30. Mayorga	10,530	0.8	61.6	170.9
31. Merida	22,345	1.7	122.7	182.1
32. Palo	38,100	2.0	67.6	563.6
33. Palompon	45,745	1.3	104.0	439.8
34. Pastrana	12,565	1.4	79.3	158.4
35. San Isidro	24,442	0.9	109.2	223.8
36. San Miguel	13,438	1.3	120.1	111.9
37. Santa Fe	12,119	2.2	81.9	148.0
38. Tabango	29,743	0.1	129.2	230.2
39. Tabon-Tabon	7,183	1.0	23.9	300.5
40. Tanauan	38,033	1.9	68.1	558.5
41. Tolosa	13,299	2.0	31.7	419.5
42. Tunga	5,413	0.8	38.2	141.7
43. Villaba	32,339	0.4	126.0	256.6
44. Almeria	12,013	1.4	65.5	183.7
45. Biliran	11,531	0.5	86.3	133.6
46. Cabucgayan	15,240	1.6	49.4	308.5
47. Caibiran	17,596	0.3	75.4	233.4
48. Culaba	9,822	-0.9	95.4	103.0
49. Kawayan	15,056	-0.9	44.7	336.8
50. Naval	29,811	1.2	107.1	278.3
51. Maripipi	6,943	-0.9	31.7	219.0
Total	1,486,522	1.3	6,188.5	240.2

Source: 1990 Population Census

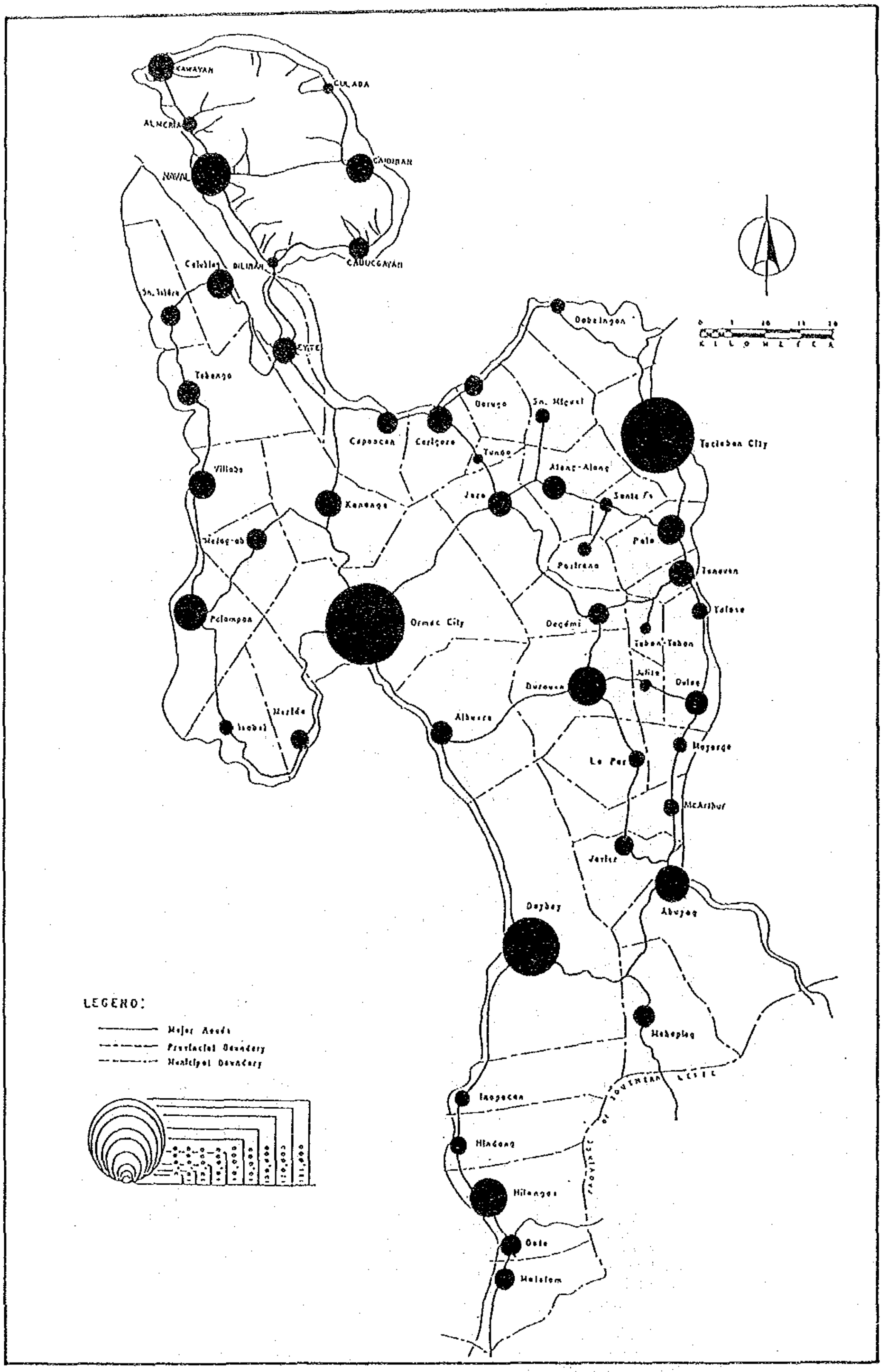


FIGURE 5.3-3 POPULATION BY MUNICIPALITY (1990)

2) Land Use

Leyte has a total land area of 6,188.5 square kilometers, representing 2.1% of the total land area of the Philippines. Table 5.3-3 shows general land use of the province.

TABLE 5.3-3 LAND USE OF LEYTE

Land Use	Area in Sq. Km.	%
Agricultural Land	3,735.8	60.4
Forest	1,656.8	26.8
Bushland	233.5	3.8
Cogon/Openland	199.9	3.2
Marsh/Swamp	81.4	1.3
Built-up Area and other Misc. Use	281.1	4.5
T o t a l	6,188.5	100.0

Source: Physical Lan Resources, Bureau of Soils

3) Economy

Table 5.3-4 shows major socio-economic data of the province in comparison with the national value.

TABLE 5.3-4 MAJOR SOCIO-ECONOMIC DATA OF PROVINCE OF LEYTE

	Leyte (A)	Philippines (B)	(A)/(B)
1. Total Land Area (km^2)	6,189	300,000	0.021
2. Population in 1990 (1,000 persons)	1,487	60,685	0.025
3. Population Density (persons/km^2)	240	202	1.190
4. GRDP in 1987 (Million ₱ at current prices)	9,068	705,467	0.013
5. Per Capita Income in 1985 (₱/person)	3,456	5,593	0.620
6. Number of Workers by Industrial Sector in 1980 (1,000 persons)			
* Agricultural	254.3 (68%)	7,303 (51%)	0.035
* Industry	30.1 (8%)	2,177 (15%)	0.014
* Service	84.8 (23%)	4,552 (32%)	0.019
* Total [1]	373.7 (100%)	14,197 (100%)	0.026
7. Incidence of Poverty in 1985 (%)	68.0	59.3	1.150
8. Unemployment Rate in 1988 (%)	5.5	8.3	0.660
9. Underemployment Rate in 1988 (%)	17.3	11.6	1.490

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

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

- Agriculture

Agriculture is the predominant industry of the province sharing 68% in terms of number of workers.

Table 5.3-5 shows major crops produced in the province. Five (5) major crops of the province are corn, palay, coconut, abaca and camote. The province substantially accounts for Region VIII's output of corn (60%), palay (61%), coconut (80%) and abaca (65%).

TABLE 5.3-5 MAJOR CROPS OF LEYTE

Crops	Area Utilized (ha.)		Production (M.T.)	
	1985	1986	1985	1986
Corn	160,810	164,950	163,760	142,040
Palay	120,990	123,750	289,320	284,810
Coconut	-	155,546	-	100,547
Abaca	16,800	16,808	13,856	13,871
Camote	15,777	16,107	56,655	57,148

- Livestock

In July 1984, total population of livestock and poulty was 1,687,846 heads. About 98 percent of this population were raised in backyard and the rest were raised for commercial purposes.

- Fisheries

There are 80 registered commercial fishing vessels in Leyte with an aggregate tonnage of 1,287.52 metric tons. Annually, there are 6,362 metric tons of commercial fishery averagely produced. There are about 1,384 hectares of fishpond areas both developed and undeveloped in Leyte and 173 fishpond operators. The average fishpond production is 1,917.50 metric tons annually. Other resources of about 1,581 hectares consist of lakes and dams.

- Mineral Resources

Leyte is rich in both metallic and non-metallic mineral deposits. Approximately 6.8 million metric tons have been determined by surveys conducted by the Bureau of Mines. About 698,407 metric tons and some undetermined volume of non-metallic mineral deposits can be found in certain areas of the province.

- Tourism

The tourism industry is one source of income of the province. Leyte has numerous tourist attractions or points of interest which are strategically located in the different cities and municipalities. They are natural attractions such as springs, lakes, falls, beaches, mountain trails, hills, and man made attractions like historical landsmarks and edifices, museum, old churches, national parks, and memorial markets. Some of these tourist spots are located in 20 municipalities and the rest are found just in the cities of Tacloban and Ormoc.

- Establishments

In June 1984, the province of Leyte has a total of 4,746 registered commercial establishments of which 83.2 percent are service oriented and 14.9 percent are in wholesaling and retailing. Most of these commercial establishments are located in trade centers like the cities of Tacloban and Ormoc and the municipalities of Abuyog, Palo and Naval. There are also 432 industrial firms which includes ten large scale industries engaged in the manufacture of various products. The rest are cottage, small and medium scale industries engaged in the manufacturing of products which use indigenous raw materials of the province and neighboring areas.

5.3.4 Road Network

Leyte Province has a total of 3,804.7 kms of roads in 1987, comprising the following:

National Road	959.0 km	(25.2%)
Provincial Road	520.6 km	(13.7%)
City Road	60.5 km	(1.6%)
Municipal Road	351.5 km	(9.2%)
Barangay Road	1,913.1 km	(50.3%)
Total	3,804.7 km	(100.0%)

Pavement ratio of each class of roads in comparison with the national value is as follows:

TABLE 5.3-6 PAVEMENT RATIO

	Length in Km By Surface Type		Pavement Ratio A/(A + B) x 100	
	PCC and AC (A)	Gravel and Earth (B)	Leyte	Philippines
National Road	351.8 km	607.2 km	36.7%	45.9%
Provincial Road	37.8 km	482.8 km	7.3%	11.4%
City Road	33.7 km	26.8 km	55.7%	66.6%
Municipal Road	111.3 km	240.2 km	31.7%	25.5%
Barangay Road	0.0 km	1,913.1 km	0	1.0%
Total	534.6 km	3,270.1 km	14.1%	14.0%

Both national and provincial roads in Leyte have lower pavement ratio than the national average.

Figure 5.3-4 shows existing national and provincial roads. All cities and municipal towns are connected with either national or provincial roads, thus a basic road network is considered formed. Eastern area has relatively fine road network, whereas western area has rather scarce road network.

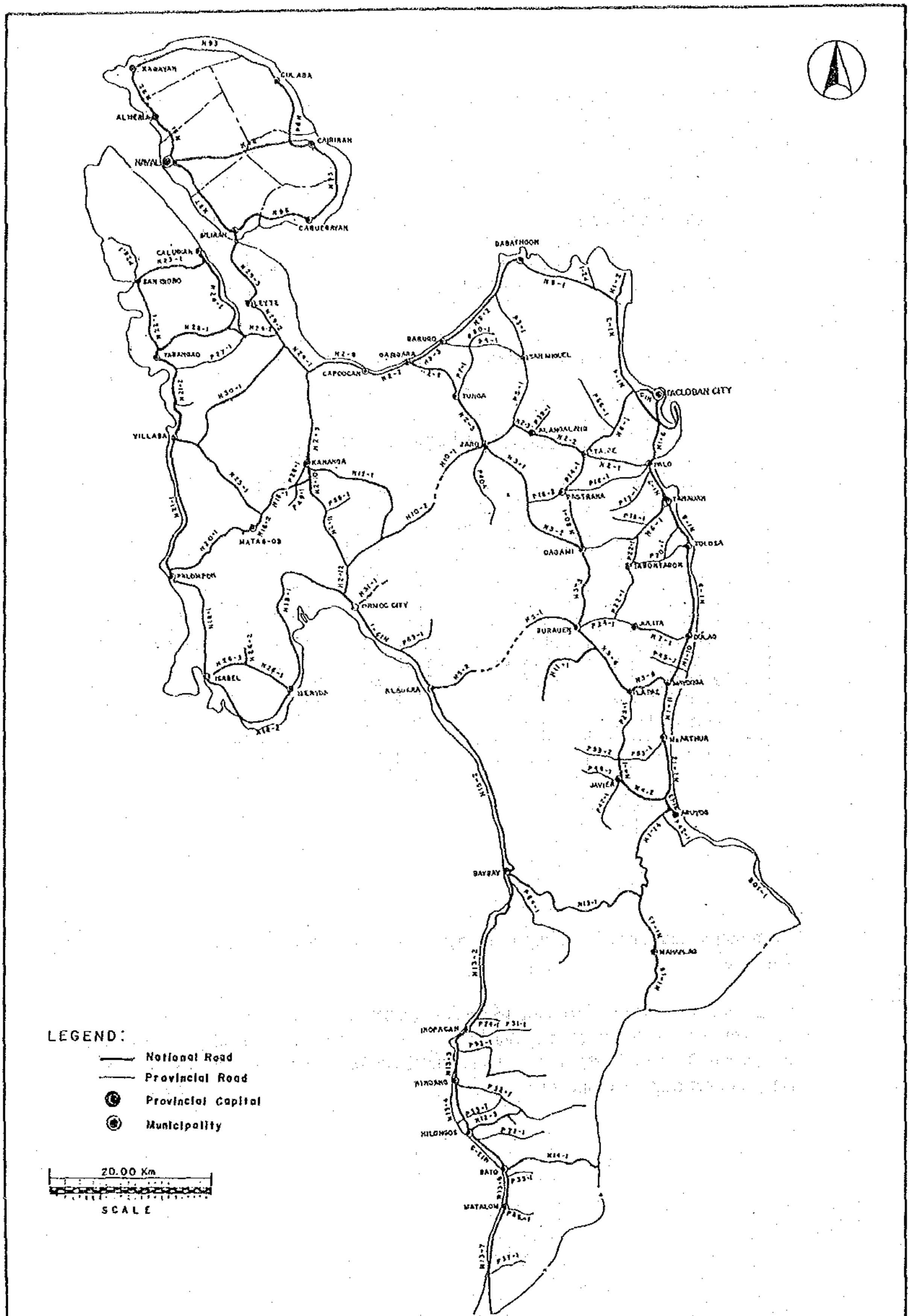


FIGURE 5.3-4 ROAD NETWORK MAP (LEYTE PROVINCE)

PART III

ROAD DISASTER IN PILOT PROVINCES

CHAPTER 6

CLASSIFICATION OF ROAD DISASTER

6.1 CLASSIFICATION OF ROAD DISASTER

Road disasters are broadly classified into six (6) categories based on the portion (or location) of roadway damaged or failed as follows:

I. Slope Damage
II. Debris Flow
III. Road Damage
IV. Bridge Damage
V. Culvert Damage
VI. Seawall Damage

Above mentioned are further classified into a total of 16 categories based on type of damage or failure as summarized in Table 6.1-1.

Definitions of respective categories of road disaster are presented in Table 6.1-2 (1) to 6.1-2 (16).

TABLE 3.1-1 CLASSIFICATION OF ROAD DISASTER

Classification by Portion of Roadway Damaged	Classification by Type of Damages or Failure	Abbreviation	Remarks
I. Slope Damage	1. Cut Slope Failure	C-F	Includes failures of cut slope and mountainside natural slope.
	2. Embankment Slope Failure	E-F	Includes failures of embankment slope and valley side natural slope.
	3. Rock Fall/Debris Fall	FALL	Includes rock fall and debris fall.
	4. Landslide	L-SL	
II. Debris Flow	5. Debris Flow	D-FL	Includes debris flow and mud flow.
III. Road Damage	6. Scour/Washout of Road-bed	Rd-D	Includes damages caused by river current or wave action.
	7. Flooded/Muddy Road Surface	FM-Rd	Includes flooded and/or muddy section during/after rainfall.
IV. Bridge Damage	8. Permanent Bridge Washout	PBr-W	
	9. Permanent Bridge Approach Washout	PBr-A	
	10. Permanent Bridge Other Damages	PBr-D	Includes scouring of abutment, piers and approaches, and all other damages related to permanent bridge.
	11. Temporary Bridge Washout	TBr-W	
	12. Temporary Bridge Approach Washout	TBr-A	
	13. Temporary Bridge Other Damages	TBr-D	Includes scouring of abutment, piers and approaches, and all other damages related to temporary bridge.
	14. Spillway Damage	SPW-D	Includes all kinds of damage related to a spillway or its approaches.
V. Culvert Damage	15. Culvert Damage	CLV-D	Includes culvert damage and other damages related to culvert such as embankment slope damage or flooding of road surface due to non-functioning culvert, etc.
VI. Seawall Damage	16. Seawall Damage	SW-D	Includes seawall washout or other damages and its related damages such as scouring of shoulders.

TABLE 6.1-2 (1) DEFINITION OF CUT SLOPE FAILURE (C-F)

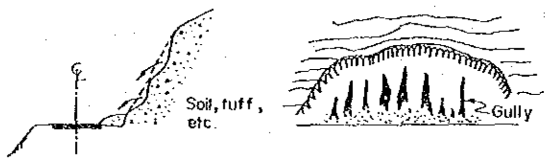
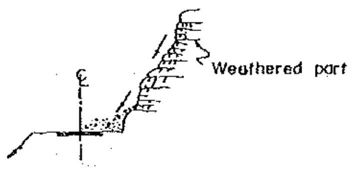
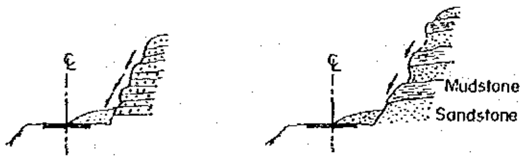
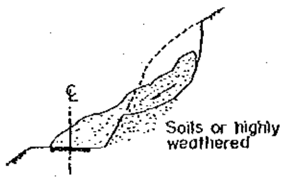
Sub-Classi-fication	Definition	Illustration	Soils/Rocks susceptible to Failure
Surface Failure	· Shallow failure of slope surface caused by erosion. · Erosion is due to heavy rainfall which often forms gullies on slope surface. · Erosion occurs mainly on bare slope without vegetation. · If left as is, may develop to large scale failure.		· Surface soils, volcanic ash soils, sand and gravel. · Volcaniclastic material, tuff, weathered shale and chert, agglomerate, etc.
	· Shallow failure of weathered surface of slope.		· Soft rocks, and easily weathered rocks. · Mudstone, tuff, weathered shale and and schist, etc.
	· Shallow failure caused by structural weakness, such as developed cracks, joints, bedding faults, and border planes in alternate strata of soft rocks.		· Schist, diabase, serpentinites, granite, andesite, quartz, porphyrites sandstones, etc. · Alternate strata of sandstone and mud-stone.
Deep Failure	· Deep failure caused by scouring. · Scouring is due to concentration of surface water on slope.		· Soil and all kinds of soft rocks.
	· Rotational failure · Failure occurs along circular slide plane of slope with weak shear strength.		· Sandy soil, clayey, soil, talus, and metamorphic rocks.

TABLE 6.1-2 (2) DEFINITION OF EMBANKMENT SLOPE FAILURE (E-F)

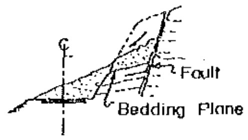
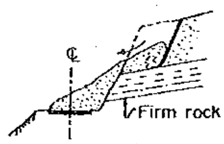
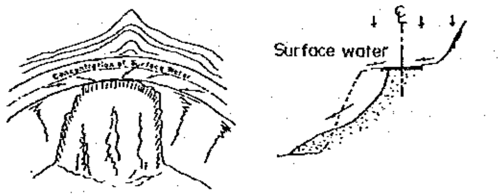
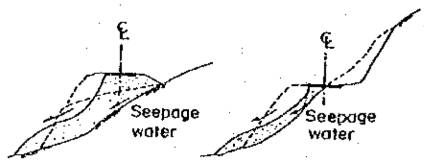
Sub-Classi-fication	Definition	Illustration	Soils/Rocks susceptible to Failure
Deep Failure	· Translational failure. · Failure occurs along the structural weakness of slope such as faults bedding planes, and border planes between firm bedrock and overlaying detritis or soil		· Sandstone, mudstone, slate, alternate strata of above rocks, granites, porphyry, etc.
			· Talus, sand and gravel, volcanic ash soil, etc. on bedrock.
Surface Failure	· Shallow failure due to erosion by surface water, which often forms gullies on slope surface.		· Sandy soil.
Deep Failure	· Deep failure caused by scouring or water saturation in embankment. · Scouring usually caused concentration of surface water at curved or sagged section.		
	· Deep failure caused by saturation of water due to seepage of surface or ground water into embankment. · Mainly occurs in embankment constructed on inclined ground or cut/embankment section.		

TABLE 6.1-2 (3) DEFINITION OF ROCK FALL/DEBRIS FALL (FALL)

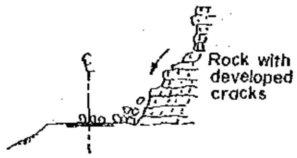
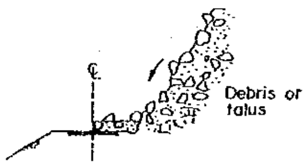
Sub-Classi-fication	Definition	Illustration	Soils/Rocks susceptible to Failure
Rock Fall	· Free fall of detached rocks from a surface of slope of bedrocks with developed cracks, joints, and beddings.		· All kinds of rocks with developed cracks, joints, and beddings.
Debris Fall	· Free fall of unsupported pebbles, cobbles and boulders from a surface of slope of debris or talus.		· Talus, volcaniclastic materials.

TABLE 6.1-2 (4) DEFINITION OF LANDSLIDE (L-SL)

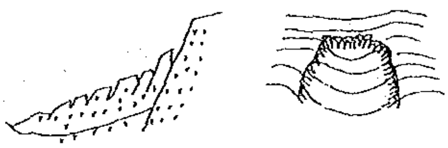
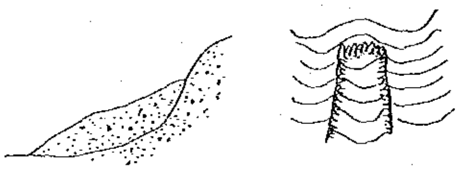
Sub-Classi-fication	Definition	Illustration	Soils/Rocks susceptible to Failure
Rock Landslide	· Movement of huge mass which occurs along structural weakness in rock or in weathered rock of weak shear strength. · Speed of movement is usually moderate and sometimes rapid in which case it is difficult to foresee. · Landslide in weathered rock shows intermittent movement.		· Neogene, crystalline, schist, etc. · Mainly in fault fracture zone.
Soil Landslide	· Movement of huge mass which occurs of colluvial soil and clayey soil or along border plane between firm rock and the said soils. · Speed of movement is slow and continuous.		· Colluvial soil, clayey soil, and said soils with gravel.

TABLE 6.1-2 (5) DEFINITION OF DEBRIS FLOW (D-FL)

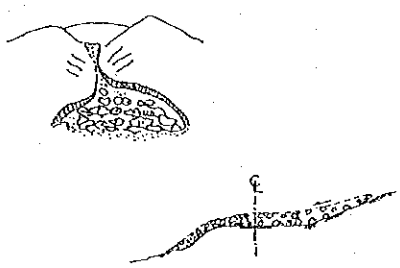
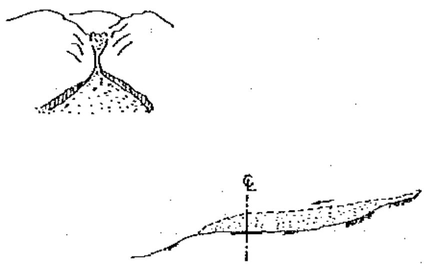
Sub-Classi-fication	Definition	Illustration	Soils/Rocks Susceptible to Failure
Debris Flow	· Flow movement of deposit with large stones on the stream bed. · Flow movement resembles those of viscous fluids in distribution of velocies.		· Fault fracture zone. · Neogene, weathered granite, volcaniclastic, etc.
Mud Flow	· Same as above except deposit materials which are soils and muds without large stones.		

TABLE 6.1-2 (6) DEFINITION OF SCOUR/WASHOUT OF ROADBED (Rd-D)

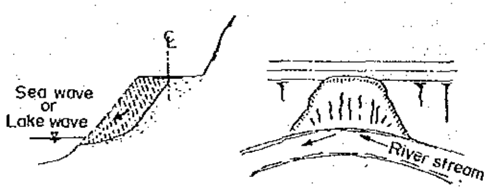
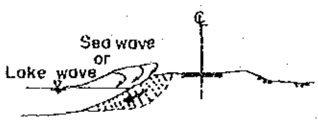
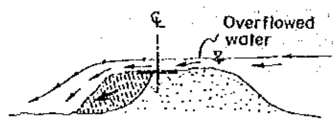
Sub-Classi-fication	Definition	Illustration
Scour or Washout of Roadbed	· Washout or scouring of roadbed due to effect of river stream, wave action or overflowing water.	
Scour or Washout of Shoulder	· Same as above, however, damage is extended only to shoulder.	

TABLE 6.1-2 (7) DEFINITION OF FLOODED/MUDDY ROAD SURFACE (FM-Rd)

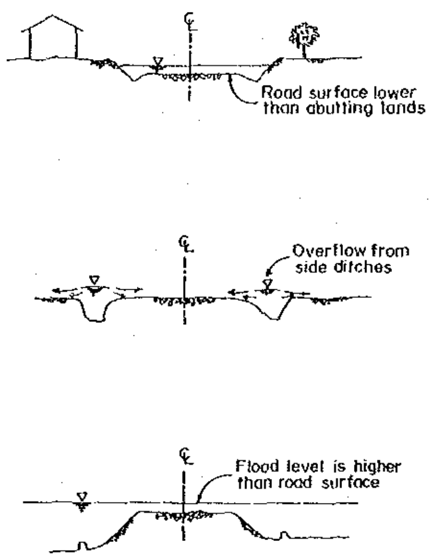
Sub-Classi-fication	Definition	Illustration
Flooded and/or Muddy Road Surface	• Road surface is flooded and/or muddy due to lower road surface than abutting lands or insufficient capacity of side ditches or lower road surface than flood level.	

TABLE 6.1-2 (8) DEFINITION OF PERMANENT BRIDGE WASHOUT (PBr-W)

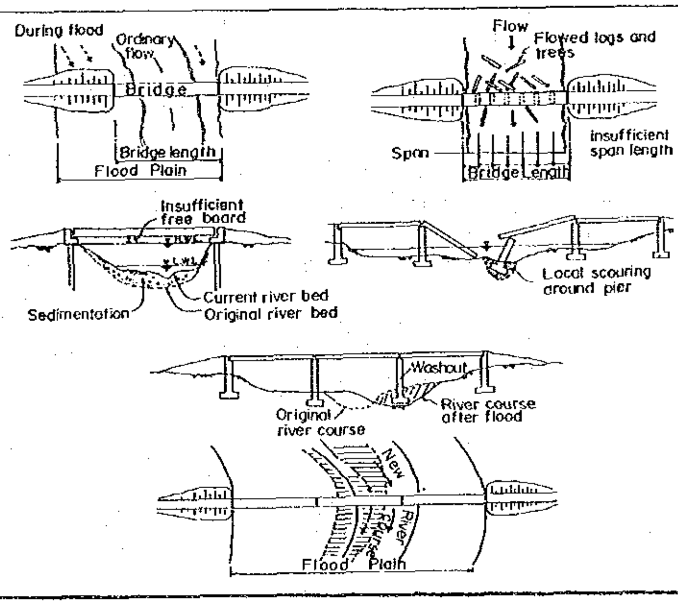
Sub-Classi-fication	Definition	Illustration
Permanent Bridge Washout	• Washout of permanent bridge due to insufficient length of bridge, too short span length between piers, insufficient free board, collapse of piers due to scouring, changed river course, etc.	

TABLE 6.1-2 (9) DEFINITION OF PERMANENT BRIDGE APPROACH WASHOUT (PBr-A)

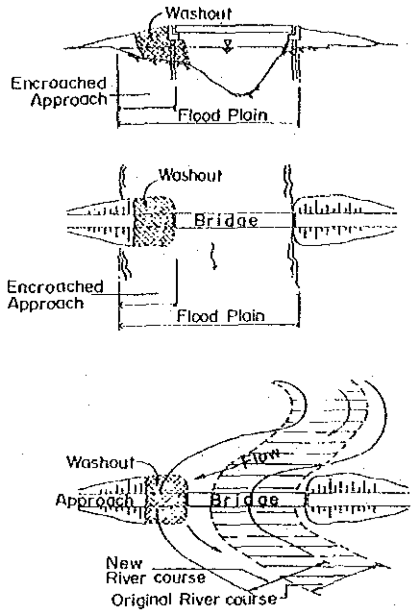
Sub-Classi-fication	Definition	Illustration
Permanent Bridge Approach Washout	· Partial or total wash-out of approach of permanent bridge due to encroachment of approach on the flood plain, meandering of stream, washout of rivetment or riprap around abutment due to scouring, etc.	

TABLE 6.1-2 (10) DEFINITION OF PERMANENT BRIDGE OTHER DAMAGES (PBr-D)

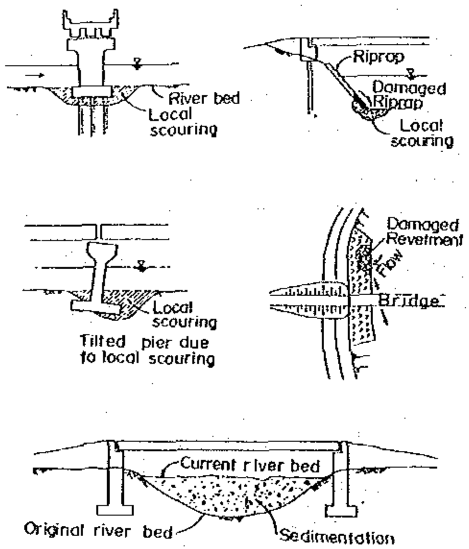
Sub-Classi-fication	Definition	Illustration
Permanent Bridge Other Damages	· Other damages include local scouring at pier, local scouring and damages of riprap or stone masonry around abutment, tilting of pier, local scouring of rivetment near abutment raising of river bed elevation due to sedimentation, etc.	

TABLE 6.1-2 (11) DEFINITION OF TEMPORARY BRIDGE WASHOUT (TBr-W)

Sub-Classi-fication	Definition	Illustration
Temporary Bridge Washout	· Washout of temporary bridge due to reasons mentioned in Table 6.1-2 (8)	· Refer to Table 6.1-2 (8)

TABLE 6.1-2 (12) DEFINITION OF TEMPORARY BRIDGE APPROACH WASHOUT (TBr-A)

Sub-Classi-fication	Definition	Illustration
Temporary Bridge Approach Washout	· Washout of temporary bridge approach due to reasons mentioned in Table 6.1-2 (9).	· Refer to Table 6.1-2 (9)

TABLE 6.1-2 (13) DEFINITION OF TEMPORARY BRIDGE OTHER DAMAGE (TBr-D)

Sub-Classi-fication	Definition	Illustration
Temporary Bridge Other Damages	· Other damages include those mentioned in Table 6.1-2 (10).	· Refer to Table 6.1-2 (10)

TABLE 6.1-2 (14) DEFINITION OF SPILLWAY DAMAGE (SPW-D)

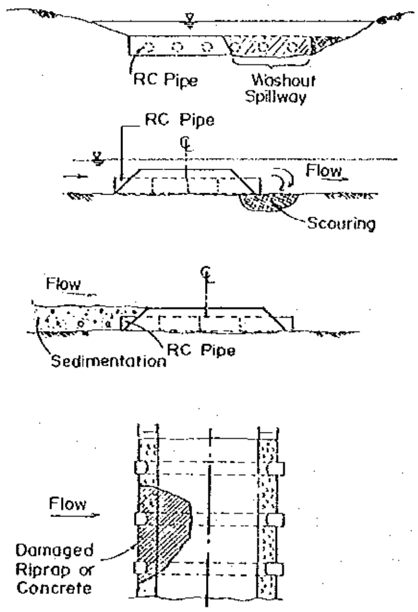
Sub-Classification	Definition	Illustration
Spillway Damage	• Washout of spillway due to scouring, collapse of riprap and/or surface concrete, washout of approach, clogged pipes, etc. • Damages include partial washout of spillway, damages of pipes and riprap, approach damages, etc.	

TABLE 6.1-2 (15) DEFINITION OF CULVERT DAMAGE (CLV-D)

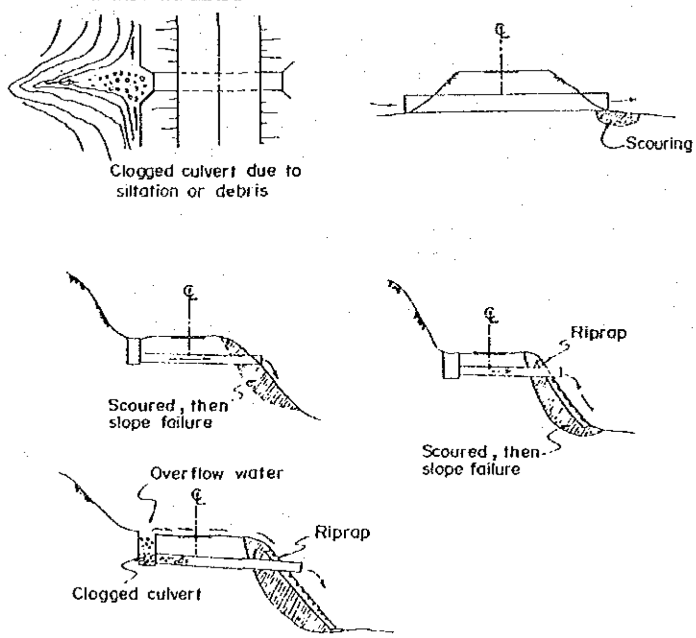
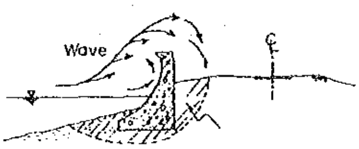
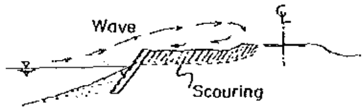
Sub-Classification	Definition	Illustration
Culvert Damage	• Culvert damage includes clogging of culvert due to siltation or debris, scouring at outlet, etc • Culvert related damages include embankment slope failure caused by scouring at culvert outlet, flooding of road surface due to non-functioning culvert etc.	

TABLE 6.1-2 (16) DEFINITION OF SEAWALL DAMAGE (SW-D)

Sub-Classi-fication	Definition	Illustration
Seawall Damage	· Seawall washout or damages due to wave action. · Damage includes scouring of shoulder due to wave action.	 

CHAPTER 7
IDENTIFICATION OF DISASTER SPOTS

Road disaster spots were identified in the three (3) pilot provinces, covering the following classes of roads:

- National secondary roads (national roads other than national primary roads defined in Executive Order No. 113)
- Provincial roads
- Major barangay roads

7.1 IDENTIFICATION PROCEDURE

1) Preparatory Works

Data Collection

The following data were collected:

- Road map (1:100,000)
- Topographic map (1:50,000)
- Geological map (1:1,000,000, 1:50,000)
- Available road disaster records
- On-going road project lists

Preparation of Field Inspection Sheet

Eight (8) forms of field inspection sheet were prepared. Their application is shown in Table 7.1-1. Inspection sheets are shown in Tables 7.1-2 (1) to 7.1-2 (8). Each inspection sheet is to be attached with a sketch and additional photographs in separate sheets.

Organization of Field Inspection Teams

Two (2) field inspection teams were organized. Each team was composed of the following members:

- 2 JICA Study Team Members
- 3 DPWH Counterpart Team Members
- 1 Engineer from respective District/City Engineering Office or Provincial Engineer's Office who guides the Study Team.

The field inspection schedule was set as follows:

Benguet	:	Nov. 8 - Nov. 20, 1990	(Team - A)
Batangas	:	Nov. 22 - Dec. 5, 1990	(Team - A)
Leyte	:	Nov. 8 - Nov. 25, 1990	(Team - B)

2) Field Inspection

Field inspection was undertaken in the following manner:

- Prior to visiting site, information on road disaster prone sections and latest road disasters was obtained from District/City Engineering Offices and Provincial Engineer's Office.

- In addition to those road sections, as many national secondary roads and provincial roads as possible were inspected by the field inspection team within the scheduled survey period.

- As for barangay roads, only road disaster spots suggested by local officials were visited by the team.

It is noted that as mentioned above, the field inspection team did not inspect all roads in the province and therefore, there may be other disaster spots than identified by the team.

The field inspection was completed on schedule.

TABLE 7.1-1 INSPECTION SHEETS AND THEIR APPLICATION

FORM NO. AND TITLE		TYPE OF ROAD DISASTER
Form-1:	Cut Slope Failure Inspection Sheet	Cut Slope Failure
Form-2:	Embankment Slope Failure Inspection Sheet	Embankment Slope Failure
Form-3:	Fall Inspection Sheet	Rock Fall/Debris Fall
Form-4:	Landslide Inspection Sheet	Landslide
Form-5:	Debris Flow Inspection Sheet	Debris Flow
Form-6:	Road Damage Inspection Sheet	Scour/Washout of Roadbed, Flooded/Muddy Road Surface, and Seawall Damage
Form-7:	Bridge Damage Inspection Sheet	Permanent Bridge Washout, Permanent Bridge Approach Washout, Permanent Bridge Other Damage, Temporary Bridge Washout, Temporary Bridge Approach Washout, Temporary Bridge Other Damage, and Spillway Damage
Form-8:	Culvert Damage Inspection Sheet	Culvert Damage

TABLE 7.1-2 (1) FIELD INSPECTION SHEET, FORM-1

CUT SLOPE FAILURE
INSPECTION SHEET

SPOT NO.	
NAME OF PROVINCE	

NAME OF ROAD (Road No.)			
CLASSIFICATION OF ROAD			(1) NATIONAL ROAD (2) PROVINCIAL ROAD (3) BARANGAY ROAD
LOCATION OF SPOT			
NO. OF LANES AND ROADWAY WIDTH			(1)1-LANE (2)2-LANE TOTAL WIDTH: PAVE.WIDTH:
SURFACE TYPE			(1)PCC (2)AC (3)GRAVEL (4)EARTH
EVIDENCE OF FAILURE	1	TYPE OF SLOPE	(1)CUT SLOPE (2)NATURAL SLOPE (3)( )
	2	KIND OF FAILURE	(1)SURFACE FAILURE (2)DEEP FAILURE (3)( )
	3	SIZE OF FAILURE	(1)WIDTH(m): (2)HEIGHT(m):
	4	DATE OCCURED	/ / 19 __
	5	TRAFFIC INTERRUPTION PERIOD	(1)1 DAY > (2)1 DAY - 7 DAYS (3)7 DAYS <
	6	COUNTERMEASURE	(1)STRUCTURE( )(2)REMOVAL OF SLIDE MATERIALS (3)
	7	RAINFALL INTENSITY (mm/day)	(1)100 > (2)100-200 (3)200-300 (4)300 <
EXISTING SLOPE CONDITION	8	HEIGHT	(1)10 m > (2)10-30 m (3)30-50 m (4)50 m <
	9	GRADIENT	(1) 45°> (2)45°-60° (3)60°< (4)OVERHANG
	10	BERM	(1)NONE (2)EXISTING NUMBER( )(3)WIDTH( )
	11	PROTECTION	(1)NONE (2)VEGETATION (3)STRUCTURE( )
GEOLOGICAL CONDITION — ROCK	12	HARDNESS	(1)HARD ROCK (2)SOFT ROCK (3)( )
	13	ROCK NAME (INDICATE SAMPLE NO. IF ANY)	(1)GRANITE (2)DIORITE (3)DIABASE (4)ANDESITE (5)DIACITE (6)SCHIST (7)SIATE (8)LIMESTONE (9)SCHALTEN (10)TUFF (11)TUFFBRECCIA (12)SANDSTONE (13)SHALE (14)MUDSTONE (15)CONGLOMERATE (16)MASS (17)VOLCANICLATIOS SAMPLE NO.
	14	WEATHERING CONDITION	(1)FRESH (2)SLIGHTLY WEATHERED (3)HIGHLY WEATHERED (4)NEARLY SOIL
	15	CONDITION OF CRACK	(1)SPARSE (2)REGULAR (3)DEVELOPED (4)OPENING CRACK
	16	DIRECTION OF CRACK	(1)INCLINED TO MOUNTAIN (2)INCLINED TO SLOPE (3)IRREGULAR INCLINATION
GEOLOGICAL CONDITION — SOIL	17	THICKNESS	(1)1 m (2)1-5 m (3)5-10 m (4)10-20 m (5)20 m <
	18	COMPACTNESS	(1)TIGHT (2)SLIGHTLY LOOSE (3)LOOSE
WATER CONDITION	19	DEGREE OF SATURATION	(1)DRY (2)WET (3)SEEPAGE (4)SPRING
	20	SURFACE WATER CONCENTRATION	(1)NONE (2)LOW (3)HIGH
	21	DRAINAGE FACILITIES	(1)EXISTING( ) (2)NOTHING
ENGINEERING JUDGEMENT	22	IMPACT TO ROAD	(1)LOW (2)MEDIUM (3)HIGH
	23	CAUSE OF DAMAGE	(1)SEEPAGE WATER (2)SEISMIC (3)( )
	24	COUNTERMEASURE	
	25	DETOUR ROAD	(1)NONE (2)AVAILABLE

DATE OF INSPECTION		INSPECTOR	

TABLE 7.1-2 (2) FIELD INSPECTION SHEET, FORM-2

EMBANKMENT SLOPE FAILURE
INSPECTION SHEET

SPOT NO.	
NAME OF PROVINCE	

NAME OF ROAD (Road No.)			
CLASSIFICATION OF ROAD			(1) NATIONAL ROAD (2) PROVINCIAL ROAD (3) BARANGAY ROAD
LOCATION OF SPOT			
NO. OF LANES AND ROADWAY WIDTH			(1)1-LANE (2)2-LANE | TOTAL WIDTH: | PAVE.WIDTH:
SURFACE TYPE			(1)PCC (2)AC (3)GRAVEL (4)EARTH
EVIDENCE OF FAILURE	1	TYPE OF SLOPE	(1)EMBANKMENT (2)NATURAL (3)BRIDGE APPROACH
	2	LOCATION	(1)INSIDE OF CURVE (2)ADJACENT TO RIVER/SEA (3)BRIDGE APPROACH (4)( )
	3	SIZE OF FAILURE	(1)WIDTH(m): (2)HEIGHT(m):
	4	DATE OCCURED	/ / 19 ___
	5	TRAFFIC INTERRUPTION PERIOD	(1)1 DAY > (2)1 DAY - 7 DAYS (3)7 DAYS <
	6	COUNTERMEASURE	(1)ONLY FILL (2)RIPRAP (3)STRUCTURE ( ) (4) ( )
	7	RAINFALL INTENSITY (mm/day)	(1)100 > (2)100-200 (3)200-300 (4)300 <
EXISTING SLOPE CONDITION	8	HEIGHT	(1) 5 m > (2) 5-10 m (3)10 m <
	9	GRADIENT	(1) 45°> (2)45°-60° (3)60°<
	10	PROTECTION	(1)NONE (2)VEGETATION (3)RIPRAP (4)STRUCTURE( )
	11	SURFACE WATER CONCENTRATION	(1)NONE (2)LOW (3)HIGH ( ))
	12	DRAINAGE FACILITIES	(1)EXISTING ( ) (2)NOTHING
ENGINEERING JUDGEMENT	13	IMPACT TO ROAD	(1)LOW (2)MEDIUM (3)HIGH
	14	CAUSE OF DAMAGE	(1)CONCENTRATION OF SURFACE WATER (2)RIVER STREAM (3)SEA WAVE (4)( )
	15	COUNTERMEASURE	
	16	DETOUR ROAD	(1)NONE (2)AVAILABLE

DATE OF INSPECTION		INSPECTOR	

TABLE 7.1-2 (3) FIELD INSPECTION SHEET, FORM-3

FALL INSPECTION SHEET

SPOT NO.	
NAME OF PROVINCE	

NAME OF ROAD (Road No.)				
CLASSIFICATION OF ROAD				(1) NATIONAL ROAD (2) PROVINCIAL ROAD (3) BARANGAY ROAD
LOCATION OF SPOT				
NO. OF LANES AND ROADWAY WIDTH				(1)1-LANE (2)2-LANE TOTAL WIDTH: PAVE.WIDTH:
SURFACE TYPE				(1)PCC (2)AC (3)GRAVEL (4)EARTH
EVIDENCE OF FALL		1	TYPE OF SLOPE	(1)CUT SLOPE (2)NATURAL SLOPE (3)( )
		2	TYPE OF FALL	(1)DEBRIS FALL (2)ROCK FALL (3)( )
		3	FALLEN ROCK SIZE	(1)20(cm)> (20-50(cm) (3)50(cm)
		4	DATE OCCURED	/ / 19 ___
		5	TRAFFIC INTERRUPTION PERIOD	(1)1 DAY > (2)1 DAY - 7 DAYS (3)7 DAYS <
		6	COUNTERMEASURE	(1)STRUCTURE( )(2)REMOVAL OF FALLEN ROCK (3)( )
		7	RAINFALL INTENSITY (mm/day)	(1)100 > (2)100-200 (3)200-300 (4)300 <
EXISTING SLOPE CONDITION		8	HEIGHT	(1)10 m > (2)10-30 m (3)30-50 m (4)50 m <
		9	GRADIENT	(1) 45°> (2)45°-60° (3)60°< (4)OVERHANG
		10	DEGREE OF SATURATION	(1)DRY (2)WET (3)SEEPAGE (4)SPRING
		11	SURFACE WATER CONCENTRATION	(1)NONE (2)LOW (3)HIGH))
		12	BERM	(1)NONE (2)EXISTING NUMBER ( ) WIDTH ( )
		13	SLOPE PROTECTION	(1)NONE (2)VEGETATION (3)STRUCTURE ( )
		14	DRAINAGE FACILITIES	(1)NONE (2)EXISTING ( )
GEOLOGICAL CONDITION	DEBRIS FALL	15	MATRIX CONDITION	(1)HARD (2)SOFT (3)LOOSE (4)LOOSE WITH DETACHED COBBLE
		16	GULLY	(1)RARE (2)COMMON (3)FREQUENTLY
		17	DETACHED ROCK & COBBLE	(1)NOTHING (2)SUPPORTED STABLY (3)SUPPORTED UNSTABLY
	ROCK FALL	18	ROCK NAME	(1)GRANITE (2)DIORITE (3)DIABASE (4)ANDESITE (5)DICITE (6)SCHIST (7)SLATE (8)LIMESTONE (9)SCHALSTONE (10)TUFF (11)TUFFBRECCIA (12)SANDSTONE (13)SHALE (14)MUDSTONE (15)CONGLOMERATE (16)MASA (17)VOLCANICLASTIES
		19	WEATHERING CONDITION	(1)FRESH (2)SLIGHTLY WEATHERED (3)HIGHLY WEATHERED
		20	CONDITION OF CRACK	(1)SPARSE (2)REGULAR (3)DEVELOPED
		21	DIRECTION OF CRACK	(1)INCLINED MOUNTAIN (2)IRREGULAR INCLINATION (3)INCLINED SLOPE
ENGINEERING JUDGEMENT		22	IMPACT TO ROAD	(1)LOW (2)MEDIUM (3)HIGH
		23	CAUSE OF FALL	
		24	COUNTERMEASURE	
		25	DETOUR ROAD	(1)NONE (2)AVAILABLE

DATE OF INSPECTION		INSPECTOR	

TABLE 7.1-2 (4) FIELD INSPECTION SHEET, FORM-4

LANDSLIDE INSPECTION SHEET

SPOT NO.	
NAME OF PROVINCE	

NAME OF ROAD (Road No.)			
CLASSIFICATION OF ROAD			(1) NATIONAL ROAD (2) PROVINCIAL ROAD (3) BARANGAY ROAD
LOCATION OF SPOT			
NO. OF LANES AND ROADWAY WIDTH			(1)1-LANE (2)2-LANE | TOTAL WIDTH: | PAVE.WIDTH:
SURFACE TYPE			(1)PCC (2)AC (3)GRAVEL (4)EARTH
EVIDENCE OF FAILURE	1	TYPE OF SLOPE	(1)CUT SLOPE (2)NATURAL SLOPE
	2	TYPE OF LANDSLIDE	(1)ROCK (2)TALUS (3)SOIL
	3	SIZE OF LANDSLIDE	(1)WIDTH ( ) (2)HEIGHT ( )
	4	DATE OCCURED	/ / 19 ___
	5	TRAFFIC INTERRUPTION PERIOD	(1)1 DAY > (2)1 DAY - 7 DAYS (3)7 DAYS <
	6	RAINFALL INTENSITY (mm/day)	(1)100 > (2)100-200 (3)200-300 (4)300 <
TOPO-GRAPHICAL AND GEOLOGICAL CONDITION	7	EXISTING OF IRREGULAR SURFACE WITH STEPS, SHARP CLIFF AND PUDDLES	(1)UNNOTICED (2)MEDIUM (3)REMARKABLE (4)( )
	8	GEOLOGY	(1)SEDIMENTARY ROCK (2)HIGHLY WEATHERED SEDIMENTARY ROCK OR TALUS OR SOIL (3)OTHERS
OTHER CONDITION	9	DEGREE OF SATURATION	(1)DRY (2)WET (3)SEEPAGE (4)SPRING
	10	GRADIENT OF SLIDE PLAN	(1)10°> (2)10°-20° (3)20°<
	11	CONTINUITY OF SLIDE MOVEMENT	(1)UNNOTICED (2)MEDIUM (3)REMARKABLE
ENGINEERING JUDGEMENT	12	IMPACT TO ROAD	(1)LOW (2)MEDIUM (3)HIGH
	13	CAUSE OF LANDSLIDE	
	14	COUNTERMEASURE	
	15	DETOUR ROAD	(1)NONE (2)AVAILABLE

DATE OF INSPECTION		INSPECTOR	

TABLE 7.1-2 (5) FIELD INSPECTION SHEET, FORM-5

DEBRIS FLOW INSPECTION SHEET

SPOT NO.	
NAME OF PROVINCE	

NAME OF ROAD (Road No.)			
CLASSIFICATION OF ROAD			(1) NATIONAL ROAD (2) PROVINCIAL ROAD (3) BARANGAY ROAD
LOCATION OF SPOT			
NO. OF LANES AND ROADWAY WIDTH			(1)1-LANE (2)2-LANE | TOTAL WIDTH: | PAVE.WIDTH:
SURFACE TYPE			(1)PCC (2)AC (3)GRAVEL (4)EARTH
EVIDENCE OF DEBRIS FLOW	1	EXISTING OF DEPOSITIONAL TOE	(1)EXISTING (2)NOTHING (3) ( )
	2	SIZE OF DAMAGE	(1)WIDTH( ) (2)LENGTH ( )
	3	DATE OCCURED	/ / 19 ___
	4	TRAFFIC INTERRUPTION PERIOD	(1)1 DAY > (2)1 DAY - 7 DAYS (3)7 DAYS <
	5	RAINFALL INTENSITY (mm/day)	(1)100 > (2)100-200 (3)200-300 (4)300 <
EXISTING FLOW CONDITION	7	AVERAGE GRADIENT	(1)20°> (2)20°-30° (3)30°<
	8	AREA OF BASIN	(1)50000m2 (2)50000-200000m2 (3)200000m2 <
	9	DEPOSIT ON RIVERBED	(1)NONE (2)RARE (3)ABUNDANCE
	10	VEGETATION	(1)COVERING RATE OF BARE LAND OR THIN FOREST: 50% > OR 50<
ENGINEERING JUDGEMENT	11	IMPACT TO TRAFFIC	(1)LOW (2)MEDIUM (3)HIGH
	12	CAUSE OF DAMAGE	
	13	COUNTERMEASURE	
	14	DETOUR ROAD	(1)NONE (2)AVAILABLE

TYPICAL PHOTO

DATE OF INSPECTION		INSPECTOR	

TABLE 7.1-2 (6) FIELD INSPECTION SHEET, FORM-6

ROAD DAMAGE INSPECTION SHEET

SPOT NO.	
NAME OF PROVINCE	

NAME OF ROAD (Road No.)			
CLASSIFICATION OF ROAD			(1) NATIONAL ROAD (2) PROVINCIAL ROAD (3) BARANGAY ROAD
LOCATION OF SPOT			
NO. OF LANES AND ROADWAY WIDTH			(1)1-LANE (2)2-LANE | TOTAL WIDTH: | PAVE.WIDTH:
SURFACE TYPE			(1)PCC (2)AC (3)GRAVEL (4)EARTH
GENERAL INFORMATION	1	TERRAIN	(1)FLAT (2)ROLLING (3)MOUNTAINOUS
	2	CROSS-SECTION	(1)FILL (2)CUT (3)CUT/FILL (4)FLAT
	3	ROADBED MATERIAL	(1)GRAINED (2)GRAVEL (3)COMMON (4)
EVIDENCE OF DAMAGE	4	TYPE OF DAMAGE	(1)WASHOUT/SCOURING OF ROADBED (2)SCOURING OF SHOULDER (3)FLOODING/MUDDY SURFACE (4)SEAWALL DAMAGE/WASHOUT
	5	LENGTH OF DAMAGE	
	6	DATE OCCURED	/ / 19__
	7	TRAFFIC INTERRUPTION PERIOD	(1)1 DAY > (2)1 DAY - 7 DAYS (3)7 DAYS <
	8	RAINFALL INTENSITY (mm/day)	(1)100 > (2)100-200 (3)200-300 (4)300 <
	9	COUNTERMEASURE	
EXISTING ROAD CONDITION	10	SURFACE CONDITION	(1)FAIR (2)BAD (3)VERY BAD (4)IMPASSABLE
	11	DRAINAGE FACILITIES	(1)EXISTING ( ) (2)NONE
	12	DRAINAGE CONDITOIN	
ENGINEERING JUDGEMENT	13	IMPACT TO TRAFFIC	(1)LOW (2)MEDIUM (3)HIGH
	14	CAUSE OF DAMAGE	(1)CONCENTRATION OF SURFACE WATER (2)FLOOD (3)RIVER STREAM (4)SEA WAVE (5)
	15	COUNTERMEASURE	
	16	DETOUR ROAD	(1)NONE (2)AVAILABLE

TYPICAL PHOTO

DATE OF INSPECTION		INSPECTOR	

TABLE 7.1-2 (7) FIELD INSPECTION SHEET, FORM-7

BRIDGE DAMAGE INSPECTION SHEET

SPOT NO.	
NAME OF PROVINCE	

NAME OF ROAD (Road No.)					
CLASSIFICATION OF ROAD			(1) NATIONAL ROAD	(2) PROVINCIAL ROAD	(3) BARANGAY ROAD
LOCATION OF SPOT					
NAME OF BRIDGE					
NO. OF LANES AND ROADWAY WIDTH			(1)1-LANE (2)2-LANE	TOTAL WIDTH:	PAVE.WIDTH:
SURFACE TYPE			(1)PCC (2)AC	(3)GRAVEL	(4)EARTH
TYPE OF BRIDGE			(1)PERMANENT	(2)TEMPORARY	(3)SPILLWAY
GENERAL INFORMATION	1	BRIDGE LENGTH (SPAN LENGTH) (m)			
	2	BRIDGE WIDTH (m)			
	3	TYPE OF SUPERSTRUCTURE			
	4	TYPE OF ABUTMENT			
	5	TYPE OF PIER			
	6	TYPE OF FOUNDATION			
DAMAGE	7	SUPERSTRUCTURE			
	8	SUB-STRUCTURE: ABUTMENT			
	9	SUB-STRUCTURE: PIER			
	10	SUB-STRUCTURE: OTHERS			
	11	MOVEMENT	(1)SCOUR (2)TILTING	(3)SETTLEMENT (4)SLIDING	(5) ( )
	12	APPROACH ROAD			
	13	RIVER CONDITION			
	14	DATE OCCURED	/	/ 19__	
	15	TRAFFIC INTERRUPTION PERIOD	(1)1 DAY >	(2)1 DAY - 7 DAYS	(3)7 DAYS <
ENGINEERING JUDGEMENT	16	IMPACT TO ROAD	(1)LOW	(2)MEDIUM	(3)HIGH
	17	CAUSE OF DAMAGE			
	18	COUNTERMEASURE			
	19	DETOUR ROAD	(1)NONE	(2)AVAILABLE	

TYPICAL PHOTO

DATE OF INSPECTION		INSPECTOR	

TABLE 7.1-2 (8) FIELD INSPECTION SHEET, FORM-8

CULVERT AND ITS RELATED DAMAGE
INSPECTION SHEET

SPOT NO.	
NAME OF PROVINCE	

NAME OF ROAD (Road No.)			
CLASSIFICATION OF ROAD			(1) NATIONAL ROAD (2) PROVINCIAL ROAD (3) BARANGAY ROAD
LOCATION OF SPOT			
NO. OF LANES AND ROADWAY WIDTH			(1)1-LANE (2)2-LANE TOTAL WIDTH: PAVE.WIDTH:
SURFACE TYPE			(1)PCC (2)AC (3)GRAVEL (4)EARTH
GENERAL INFORMATION	1	TERRAIN	(1)FLAT (2)ROLLING (3)MOUNTAINOUS
	2	CROSS-SECTION	(1)FILL (2)CUT (3)CUT/FILL (4)FLAT
	3	LOATION	(1)TANGENT SECTION (2)CURVED SECTION
	4	TYPE AND DIMENSION	(1)PIPE CULVERT (ϕ) (2)BOX CULVERT (m. x m)
CULVERT DAMAGE	5	SILTED/BLOCKED	
	6	SCOUR	
	7	STRUCTURAL DAMAGE	
	8	OTHERS	
	9	DATE OCCURED	/ / 19___
RELATED DAMAGE	10	DAMAGED PORTION	(1)EMBANKMENT SLOPE (2)CUT SLOPE (3)
	11	CAUSES OF DAMAGE	
	12	DATE OCCURED	/ / 19___
	13	TRAFFIC INTERRUPTION PERIOD	(1)1 DAY > (2)1 DAY - 7 DAYS (3)7 DAYS <
ENGINEERING JUDGEMENT	14	IMPACT TO ROAD	(1)LOW (2)MEDIUM (3)HIGH
	15	CAUSE OF DAMAGE	
	16	COUNTERMEASURE	
	17	DETOUR ROAD	(1)NONE (2)AVAILABLE

TYPICAL PHOTO

DATE OF INSPECTION		INSPECTOR	

7.2 IDENTIFICATION OF DISASTER SPOTS

7.2.1 Identification of Disaster Spots

A total of 226 road disaster spots were identified as follows:

Benguet	70
Batangas	66
Leyte	90
Total	226

Field inspection sheets are compiled in separate volumes. List of spots is attached in Appendix 7-1.

Number of spots by portion of roadway damaged and by province is summarized in Table 7.2-1. Number of spots by type of damage and by province is summarized in Table 7.2-2. Locations of identified spots in Benguet, Batangas and Leyte are presented in Figures 7.2-1, 7.2-2 and 7.2-3, respectively.

TABLE 7.2-1 NUMBER OF ROAD DISASTER SPOTS BY PORTION OF ROADWAY DAMAGED

Portion of Roadway Damaged	Benguet	Batangas	Leyte	Total
I. Slope Damage	49	19	64	132
II. Debris Flow	7	0	0	7
III. Road Damage	1	17	2	20
IV. Bridge Damage	5	20	22	47
V. Culvert Damage	8	8	2	18
VI. Seawall Damage	0	2	0	2
TOTAL	70	66	90	226

TABLE 7.2-2 NUMBER OF ROAD DISASTER SPOTS BY TYPE OF DAMAGE

Type of Damage		Benguet National Road	Benguet Provincial Road	Benguet Barangay Road	Benguet Total	Batangas National Road	Batangas Provincial Road	Batangas Barangay Road	Batangas Total	Leyte National Road	Leyte Provincial Road	Leyte Barangay Road	Leyte Total	Total National Road	Total Provincial Road	Total Barangay Road	Total Total
I. Slope Damage	1. Cut Slope Failure	31	3	-	34	3	0	-	3	24	2	4	30	58	5	4	67
	2. Embankment Slope Failure	10	1	-	11	11	0	-	11	14	0	1	15	35	1	1	37
	3. Rock Fall/Debris Fall	2	1	-	3	5	0	-	5	15	0	1	15	22	1	1	24
	4. Landslide	1	0	-	1	0	0	-	0	4	0	0	4	5	0	0	5
II. Debris Flow	5. Debris Flow	7	0	-	7	0	0	-	0	0	0	0	0	7	0	0	7
III. Road Damage	6. Scour/Washout of Roadbed	1	0	-	1	1	2	-	3	0	0	0	0	2	2	0	4
	7. Flooded and Muddy Road Surface	0	0	-	0	1	13	-	14	2	0	0	2	3	13	0	16
IV. Bridge Damage	8. Permanent Bridge Washout	1	0	-	1	0	0	-	0	0	0	0	0	1	0	0	1
	9. Permanent Bridge Approach Washout	1	0	-	1	1	0	-	1	1	0	0	1	3	0	0	3
	10. Permanent Bridge Other Damages	2	0	-	2	9	2	-	11	0	0	0	0	11	2	0	13
	11. Temporary Bridge Washout	0	0	-	0	0	0	-	0	8	4	1	13	8	4	1	13
	12. Temporary Bridge Approach Washout	0	0	-	0	0	1	-	1	3	0	0	3	3	1	0	4
	13. Temporary Bridge Other Damages	0	0	-	0	0	1	-	1	1	0	0	1	1	1	0	2
	14. Spillway Damages	0	1	-	1	4	2	-	6	2	2	0	4	6	5	0	11
V. Culvert Damage	15. Culvert Damages	7	1	-	8	8	0	-	8	0	1	0	1	5	2	0	17
VI. Seawall Damage	16. Seawall Damage	0	0	-	0	1	1	-	2	0	0	0	0	1	1	0	2
Total		63	7	-	70	44	22	-	66	74	9	7	90	131	38	7	226

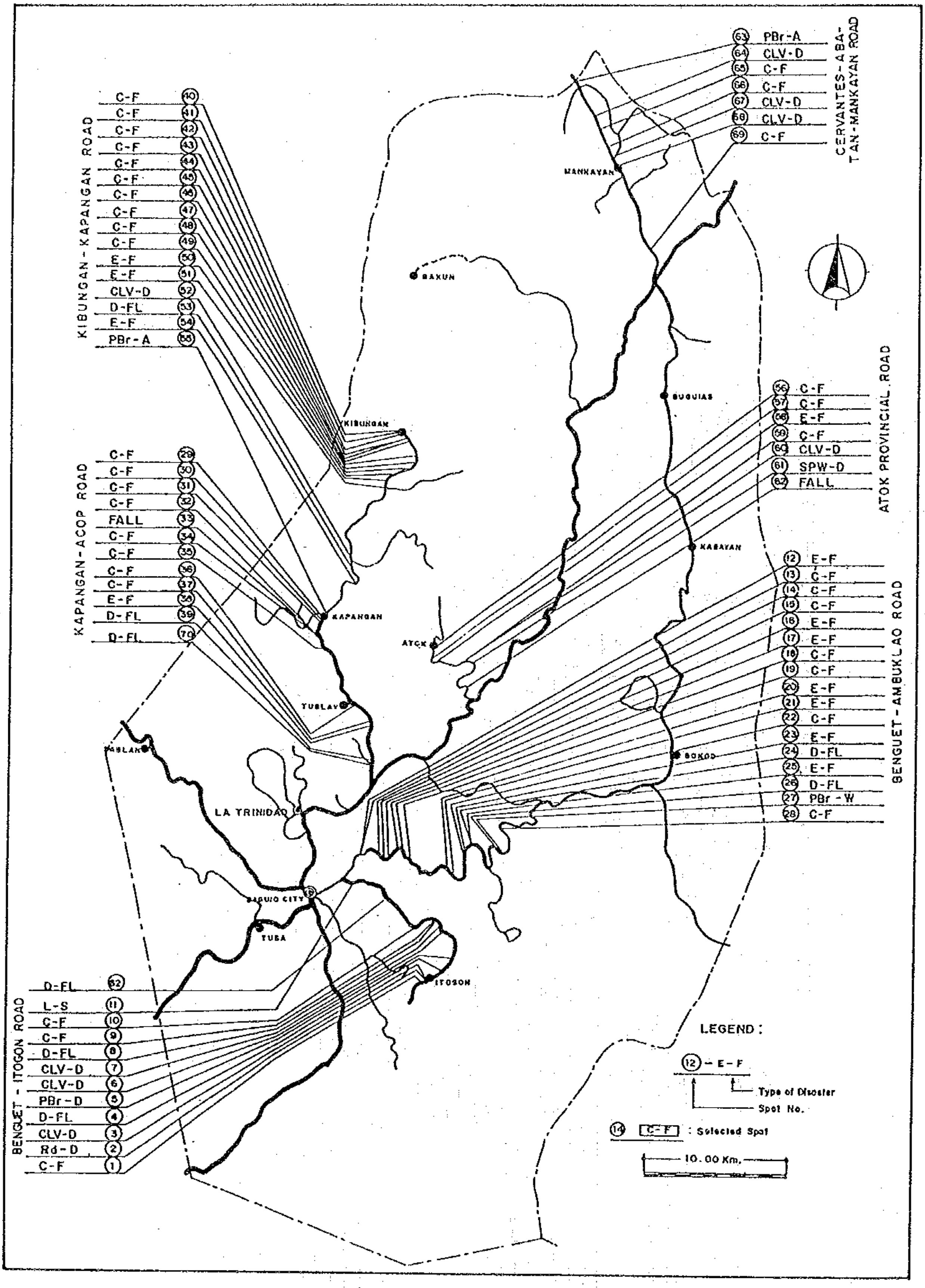


FIGURE 7.2-1 LOCATION OF IDENTIFIED SPOTS (BENGUET)

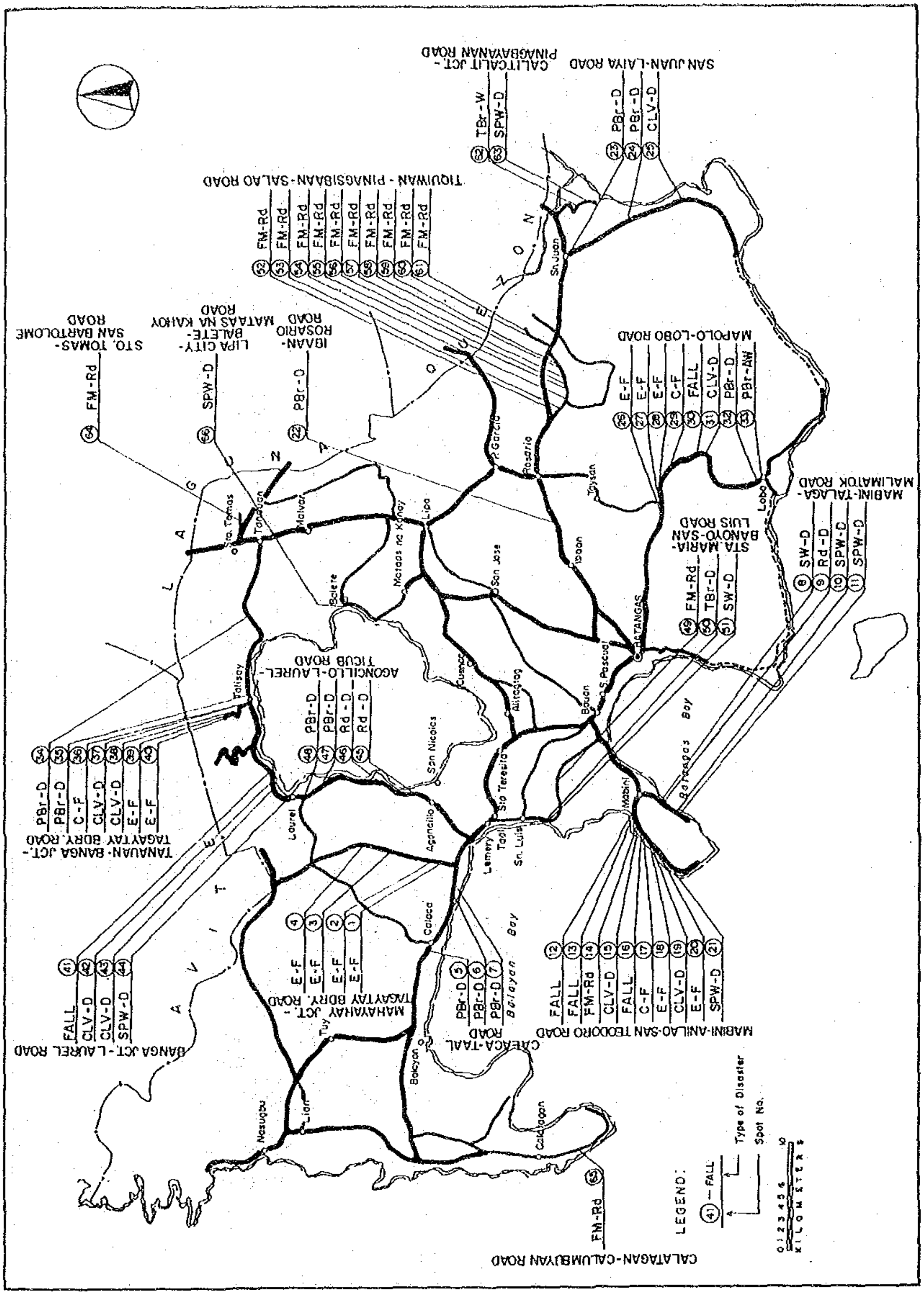


FIGURE 7.2-2 LOCATION OF IDENTIFIED SPOTS (BATANGAS)

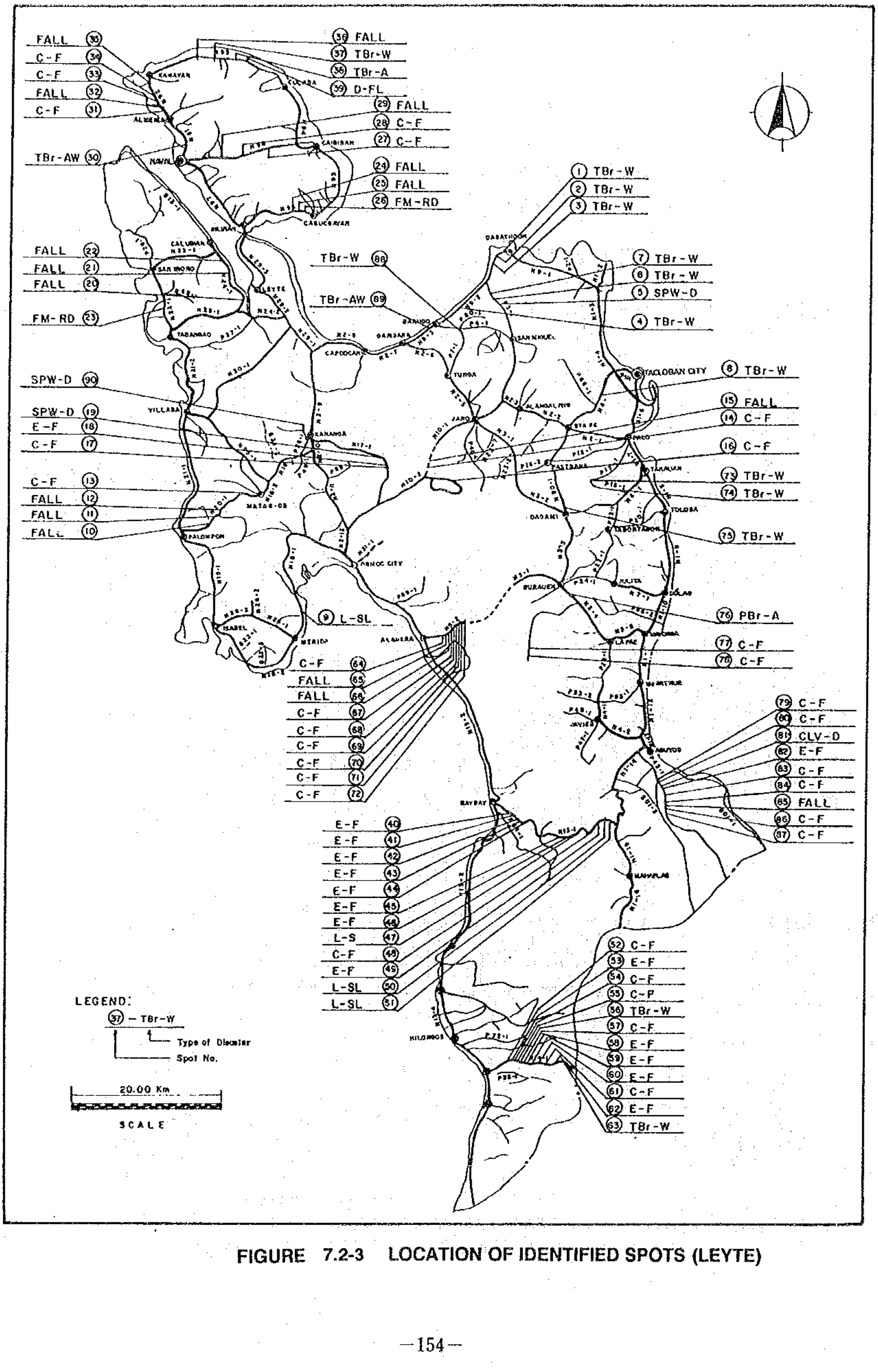


FIGURE 7.2-3 LOCATION OF IDENTIFIED SPOTS (LEYTE)

7.2.2 Characteristics of Road Disaster in Pilot Provinces

Since the field inspection was conducted mainly based on the information provided by local officials, all existing disaster spots may not be covered. Number of spots identified by this Study does not completely reflect overall features of road disasters in the province, however, characteristics of road disasters can be understood to a certain extent.

Based on the number of road disaster spots by type of damage shown in Table 7.2-2, the following are observed:

Benguet Province

Due to topographical, geological and meteorological characteristics of the province, most roads were constructed:

- on very steep and high mountain slopes,
- in the geological fractured zones, and
- in the areas with high rainfall intensity

As a result, road disasters commonly observed were in the following order:

- Cut slope failure (49%)
- Embankment slope failure (16%)
- Culvert damages (11%)
- Debris Flow (10%)
- Others (14%)

(Note: % is based on number of identified disaster spot.)

Batangas Province

Roads in this province mostly pass through flat or rolling terrains, therefore, road disasters common to these terrains such as embankment slope failures and flooded/muddy road surface were frequently observed. Cut slope failure and fall peculiar to volcanic rocks were also observed. Although many temporary bridges were replaced with permanent bridges, river control works were not simultaneously implemented, thus many permanent bridges damaged were observed.

Road disasters commonly observed in this province were in the following order:

- Flooded and muddy road surface (21%)
- Embankment slope failure (17%)
- Permanent bridge other damage (17%)
- Culvert damage (12%)
- Others (33%)

(Note: % is based on number of identified disaster spots.)

Leyte Province

Roads in this province pass through flat and rolling terrains as well as mountainous terrain, therefore, various types of road disaster were observed. In mountainous terrain, road disaster common to Benguet Province were observed, however, magnitudes of damage were smaller than those in Benguet Province. In flat and rolling terrains, road disasters common to Batangas Province were observed, with a difference which is that many temporary bridges still exist in Leyte Province and many of these were washed out.

Road disasters commonly observed in this province were in the following order:

- Cut slope failure (33%)
- Fall (17%)
- Embankment slope failure (17%)
- Temporary bridge washout (14%)
- Others (19%)

(Note: % is based on number of identified disaster spots.)

CHAPTER 8

SELECTION OF DISASTER SPOTS FOR FEASIBILITY STUDY

8.1 SELECTION PROCEDURE

About 60 typical disaster spots are to be selected from 226 disaster spots identified. Typical disaster spots selected are subjected to feasibility studies in Part IV.

Selection procedure of typical disaster spots for feasibility study is shown in Figure 8.1-1. Firstly disaster spots are assessed in terms of the following:

- Importance of road where a spot is located
- Magnitude of damage
- Impact on socio-economic activity

Based on the results of above assessment, disaster spots are classified as shown in Figure 8.1-2.

Typical disaster spots are selected in accordance with selection criteria.

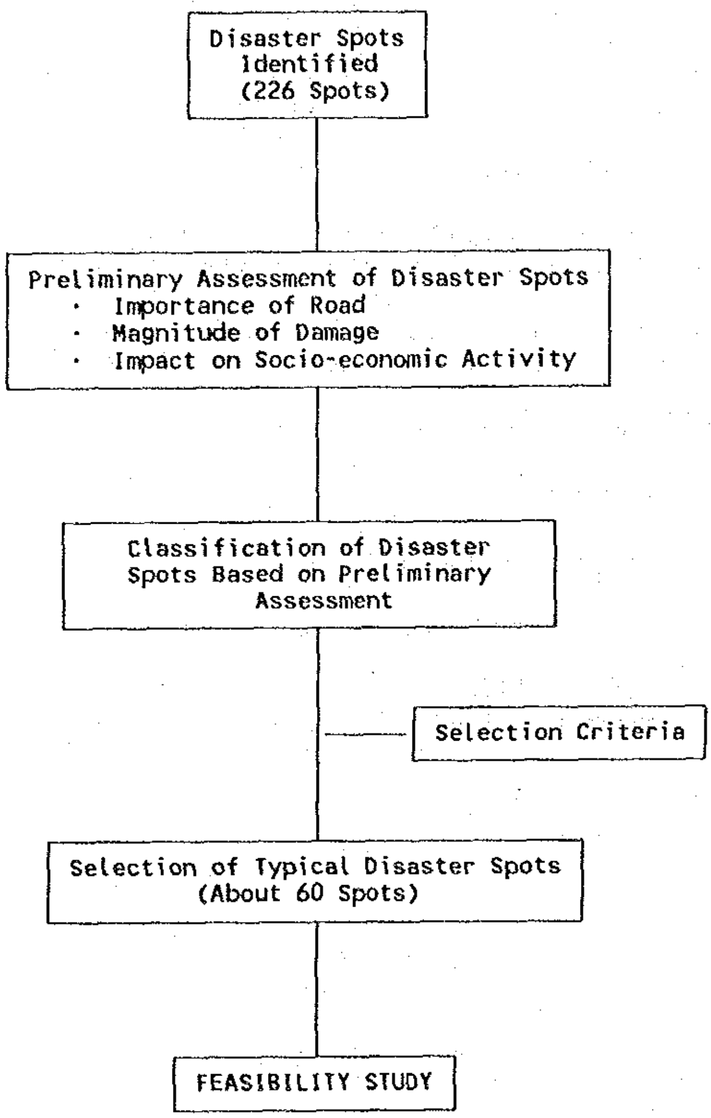


FIGURE 8.1-1 SELECTION PROCEDURE OF DISASTER SPOTS FOR FEASIBILITY STUDY

PROVINCE OF LEYTE

PROVINCE OF BATANGAS

PROVINCE OF BENGUET

Type of Road Disaster	Magnitude of Damage	Impact on Socio-Economic Activity	Importance of Road		
			National Road	Provincial Road	Barangay Road
1. Cut Slope Failure	Class A	Very High	6, 8,	2	31
		High	4		
	Class B	Medium			
	Class C	Low			43
2. Embankment Slope Failure	Class A	Very High			
		High			
	Class B	Medium	23		
	Class C	Low			
3. Rock Fall / Debris Fall	Class A	Very High		28	
		High			
	Class B	Medium			
	Class C	Low			
4. Landslide	Class A	Very High	45		
		High			
	Class B	Medium			

Spot number is entered

FIGURE 8.1-2 CLASSIFICATION OF SPOTS BASED ON PRELIMINARY ASSESSMENT

8.2 PRELIMINARY ASSESSMENT OF DISASTER SPOTS

For the purpose of selecting typical disaster spots for feasibility study, disaster spots were assessed in terms of the following:

- Importance of road where a spot is located
- Magnitude of damage
- Impact on socio-economic activities

Detailed engineering evaluation of selected disaster spots are undertaken in Part IV.

8.2.1 Importance of Road

Present administrative road classification indicates, in general importance of a road as follows:

National Road	:	Forms trunk road network system in the country and provide linkage between major urban centers and terminals of other major transport facilities.
Provincial Road	:	Forms primary road network system in a province connects municipal towns each other and provide linkage to national roads.
Barangay Road	:	Is rural road located outside urban areas and functions as feeder or farm-to-market road.

In this stage of the Study, importance of road was simply assessed by the present administrative road classification, namely:

- National Road
- Provincial Road
- Barangay Road

8.2.2 Magnitude of Damage

As an assessment criterion commonly applicable to all types of road disaster, magnitude of damage was assessed on the following basis:

Class A :	The most critical damage. Full carriageway is damaged or cut or covered by mass of soils/rocks/debris. The road section becomes impassable. Traffic function is totally paralyzed.
Class B :	One lane of the carriageway is damaged or covered by mass of soils/rocks/debris, but one lane is secured for traffic.
Class C :	The carriageway is not damaged or affected. Damage or fallen mass of soils/rocks/debris extends only within the shoulder. Traffic function is slightly affected.

In case of a one-lane road, magnitude of damage is classified as either Class A or Class C.

8.2.3 Impact on Socio-Economic Activities

When a road is cut or damaged and traffic function of the road is affected to some extent, socio-economic activities of the affected areas are damaged. Impact of a road disaster on socio- economic activities of the affected areas was assessed based on the duration of traffic function affected as follows:

Very High	:	Damage of a spot makes the road section impassable for more than one (1) week, and no detour road is available. Affected area is totally isolated and socio-economic activities are greatly affected.
High	:	Damage of a spot makes the road section impassable for seven (7) days or less, or the section becomes impassable for more than one (1) week but a detour road is available. Affected areas have access problems and socio-economic activities are accordingly affected.
Medium	:	Although a road section is damaged, one (1) lane can be secured for traffic. Socio-economic activities in the affected areas are slightly affected.
Low	:	Two-lane traffic operation can be maintained, though vehicle driving speed may be reduced. Traffic safety problems may remain. Normal socio-economic activities can be more or less maintained in the affected areas.

8.2.4 Classification of Disaster Spots Based on Preliminary Assessment

Each spot was assessed in accordance with above criteria and summarized in the form shown in Figure 8.1-2 (Tables 8.3-2 to 8.3-4).

8.3 SELECTION OF DISASTER SPOTS FOR FEASIBILITY STUDY

8.3.1 Selection Criteria

Criteria for selecting typical disaster spots for feasibility study were established as follows:

- At least one (1) spot shall be selected from each type of disaster.
- Spots shall be selected so as to cover different classes of road, different magnitudes of damage and different impacts on socio-economic activities.
- When there are several candidate spots in a certain category, only one (1) spot which is considered typical shall be basically selected.
- Even when there is only one (1) spot in a certain category but it is not judged typical, it may be omitted.

8.3.2 Selected Typical Spots

In accordance with selection criteria, a total of 62 spots were selected from 226 spots. Selected spots by province are as follows:

Province	No. of Spots Identified	No. of Selected Spots
Benguet	70	21
Batangas	66	18
Leyte	90	23
T o t a l	226	62

Selected spots by type of disaster are shown in Table 8.3-1. As shown in the table, all types of disaster were covered except "Permanent Bridge Washout". Under the said classification, only one (1) spot was identified in Benguet. The bridge was damaged by the July 1990 earthquake and then washed out by succeeding typhoons. This case was not considered typical, therefore, the spot was not selected.

Table 8.3-2 and Figure 8.3-1 show selected spots in Benguet, Table 8.3-3 and Figure 8.3-2 in Batangas, and Table 8.3-4 and Figure 8.3-3 in Leyte. Table 8.3-5 shows summary of selected spots in three (3) pilot provinces.

TABLE 8.3-1 NUMBER OF SELECTED SPOTS

Type of Damage		Number of Spots Identified				Number of Selected Spots for F/S			
		Benguet	Batangas	Leyte	Total	Benguet	Batangas	Leyte	Total
I. Slope Damage	1. Cut Slope Failure	34	3	30	67	5	1	6	12
	2. Embankment Slope Failure	11	11	15	37	5	2	2	9
	3. Rock Fall/Debris Fall	3	5	16	24	1	2	2	5
	4. Landslide	1	0	4	5	1	0	2	3
II. Debris Flow	5. Debris Flow	7	0	-	7	4	0	1	5
III. Road Damage	6. Scour/Washout of Roadbed	1	3	0	4	1	1	0	2
	7. Flooded/Muddy Road Surface	0	14	2	16	0	2	2	4
IV. Bridge Damage	8. Permanent Bridge Washout	1	0	0	1	0	0	0	0
	9. Permanent Bridge Approach Washout	1	1	1	3	2	1	1	4
	10. Permanent Bridge Other Damage	2	11	0	13	0	2	0	2
	11. Temporary Bridge Washout	0	0	13	13	0	0	2	2
	12. Temporary Bridge Approach Washout	0	1	3	4	0	1	1	2
	13. Temporary Bridge Other Damage	0	1	1	2	0	1	0	1
	14. Spillway Damage	1	6	4	11	0	1	2	3
V. Culvert Damage	15. Culvert Damage	8	8	1	17	2	2	2	6
VI. Seawall Damage	16. Seawall Damage	0	2	0	2	0	2	0	2
TOTAL		70	66	90	226	21	18	23	62

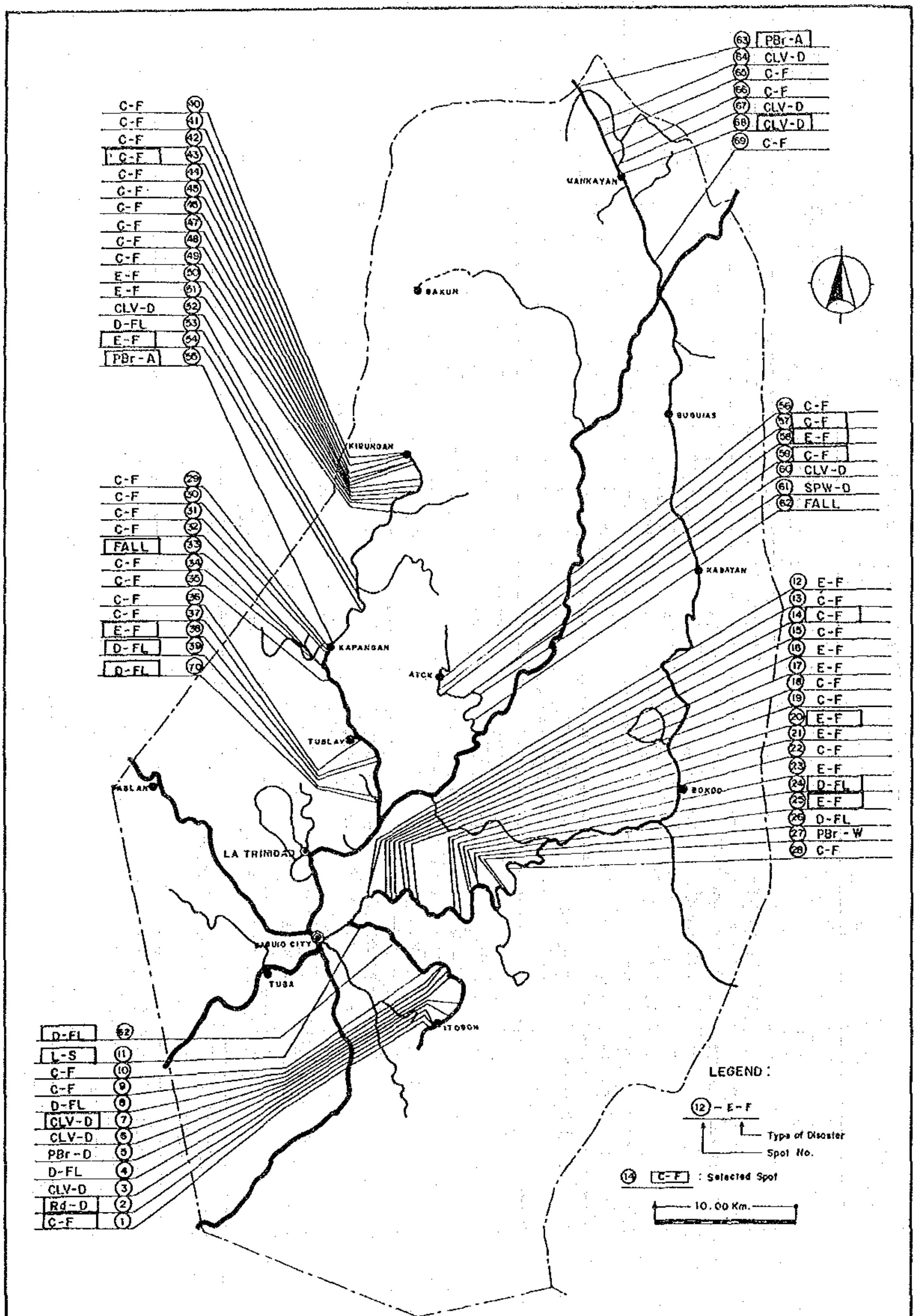


FIGURE 8.3-1 SELECTED SPOT IN BENGUET

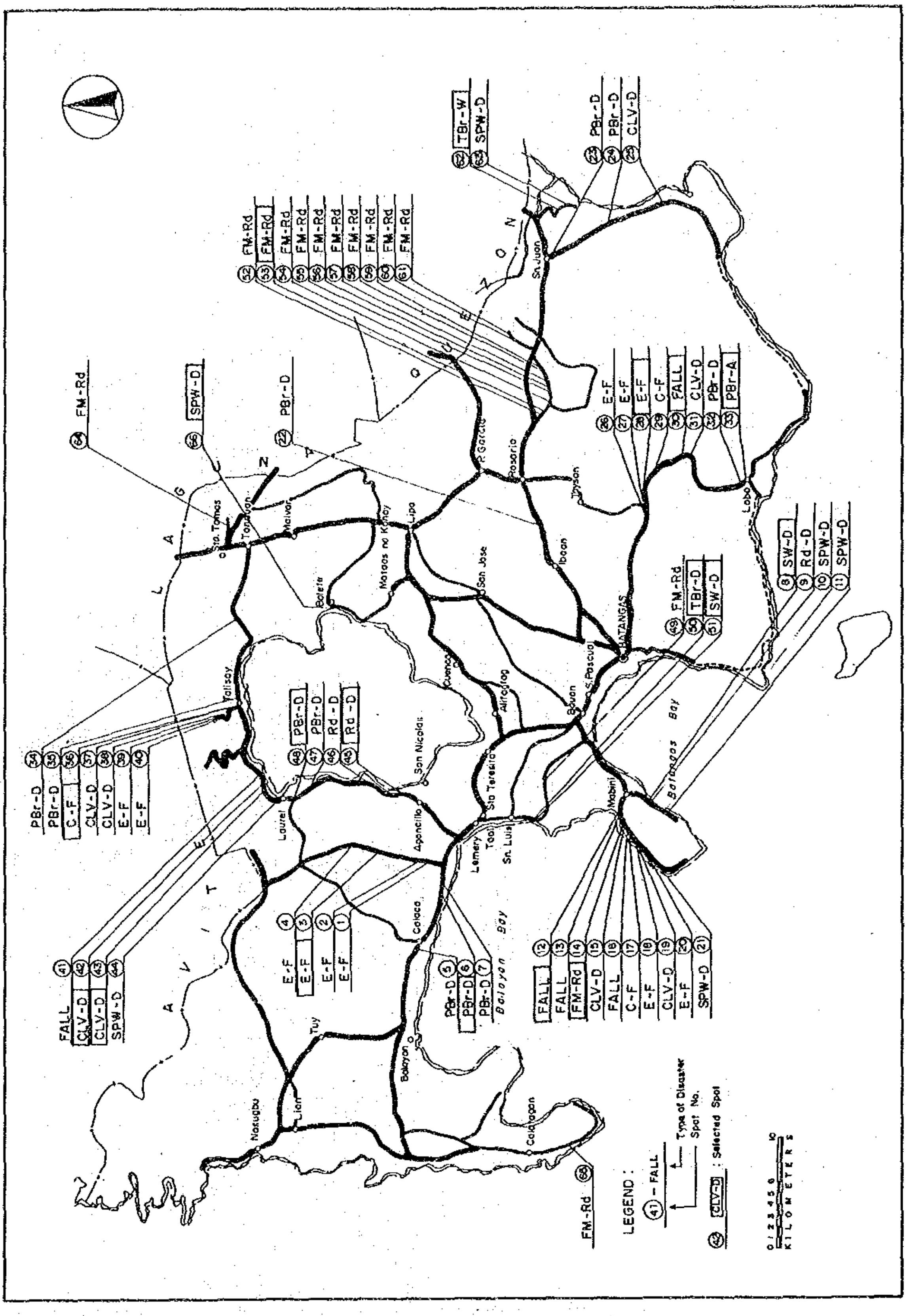


FIGURE 8.3-2 SELECTED SPOTS IN BATANGAS

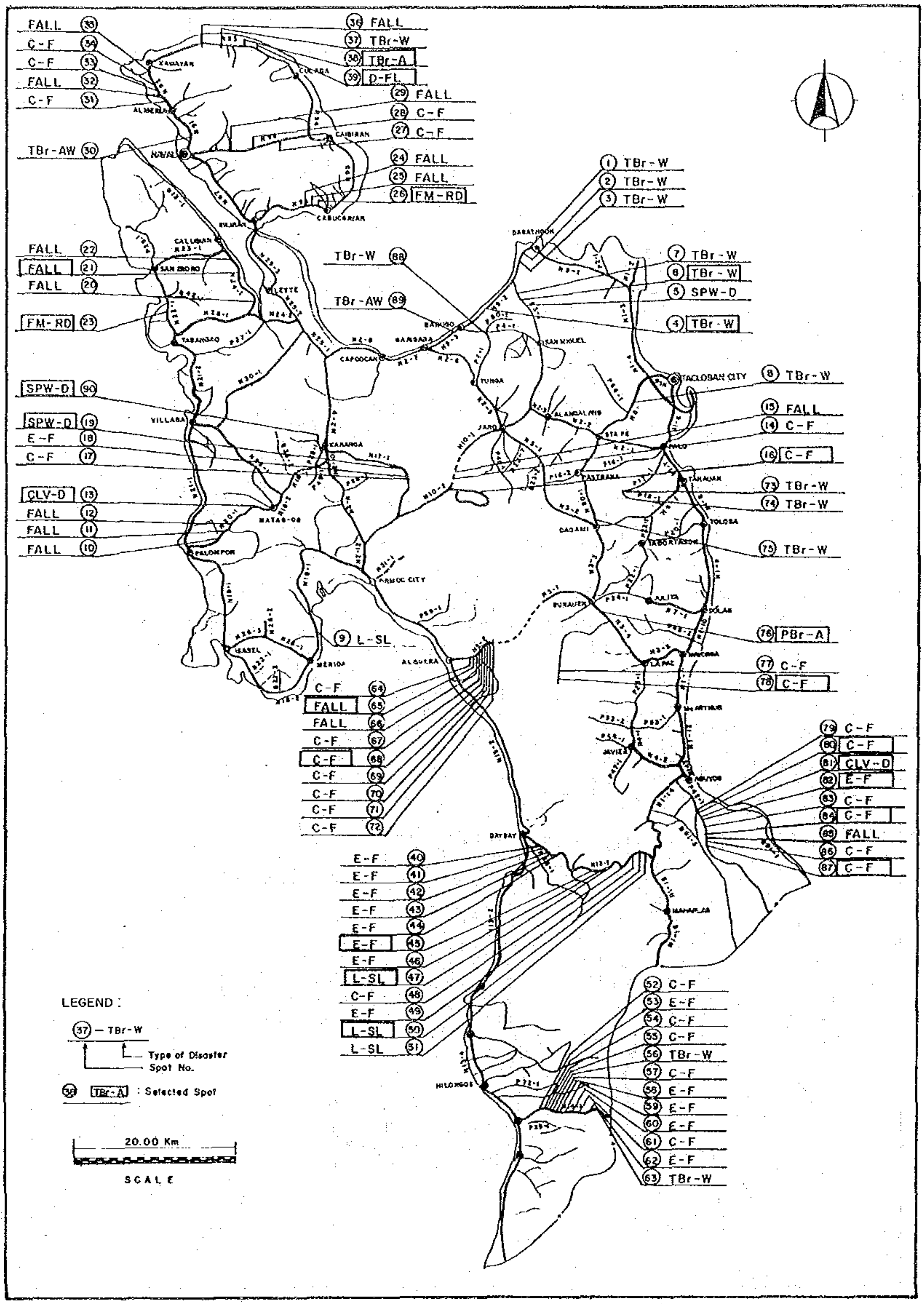


FIGURE 8.3-3 SELECTED SPOTS IN LEYTE

TABLE 8.3-2 SELECTED SPOTS IN BENGUET

TYPE OF ROAD DISASTER	MAGNITUDE OF DAMAGE	IMPACT ON SOCIO-ECO. ACTIVITIES	PROVINCE OF BENGUET: NATIONAL ROAD: SPOT NUMBER	NATIONAL ROAD: NO. OF SELECTED SPOTS	PROVINCIAL ROAD: SPOT NUMBER	PROVINCIAL ROAD: NO. OF SELECTED SPOTS	BARANGAY ROAD: SPOT NUMBER	BARANGAY ROAD: NO. OF SELECTED SPOTS
1. Cut Slope Failure	A	VH						
		H	(1),22,(25)	2	(59)	1		
	B	M	9,18,19,28,(43),45,46,47,48,49	1				
	C	L	10,13,(14),15,29,30,31,32,34,35,36,37,40,41,42,44,65,66,69	1	56,(57)	1		
2. Embankment Slope Failure	A	VH						
		H						
	B	M	(20),21	1				
	C	L	12,16,17,23,(38),50,51,(54)	2	(58)	1		
3. Rock Fall/ Debris Fall	A	VH						
		H						
	B	M						
	C	L	(33)	1				
4. Landslide	A	VH						
		H						
	B	M						
	C	L	(11)	1				
5. Debris Flow	A	VH						
		H	4,(24),26,53	1				
	B	M	8,(39),(70),(62)	3				
	C	L						
6. Scour/ Washout of Roadbed	A	VH						
		H						
	B	M						
	C	L	(2)	1				
7. Flooded/ Muddy Road Surface	A	VH						
		H						
	B	M						
	C	L						
8. Permanent Bridge Washout	A	VH	27					
		H						
	B	M						
	C	L						
9. Permanent Bridge Approach Washout.	A	VH						
		H	(63)	1				
	B	M						
	C	L						
10. Permanent Bridge Other Damage	A	VH						
		H						
	B	M	(55)	1				
	C	L	5					
11. Temporary Bridge Washout	A	VH						
		H						
	B	M						
	C	L						
12. Temporary Bridge Approach Washout	A	VH						
		H						
	B	M						
	C	L						
13. Temporary Bridge Other Damage	A	VH						
		H						
	B	M						
	C	L						
14. Spillway Damage	A	VH						
		H						
	B	M			61			
	C	L						
15. Culvert Damage	A	VH						
		H						
	B	M	(7)	1				
	C	L	3,6,52,64,67,(68)	1	60			
16. Seawall Damage	A	VH						
		H						
	B	M						
	C	L						
TOTAL				18		3		0

TABLE 8.3-3 SELECTED SPOTS IN BATANGAS

TYPE OF ROAD DISASTER	MAGNITUDE OF DAMAGE	IMPACT ON SOCIO-ECO. ACTIVITIES	PROVINCE OF BENGUET: NATIONAL ROAD — SPOT NUMBER	NO. OF SELECTED SPOTS	PROVINCIAL ROAD — SPOT NUMBER	NO. OF SELECTED SPOTS	BARANGAY ROAD — SPOT NUMBER	NO. OF SELECTED SPOTS
1. Cut Slope Failure	A	VH						
		H						
	B	M						
	C	L	17,29,(36)	1				
2. Embankment Slope Failure	A	VH						
		H						
	B	M	2,4,27,(28),39	1				
	C	L	1(3)18,20,26,40	1				
3. Rock Fall/ Debris Fall	A	VH						
		H						
	B	M	(12),16	1				
	C	L	13,41,(30)	1				
4. Landslide	A	VH						
		H						
	B	M						
	C	L						
5. Debris Flow	A	VH						
		H						
	B	M						
	C	L						
6. Scour/ Washout of Roadbed	A	VH			46			
		H						
	B	M			(45)	1		
	C	L	9					
7. Flooded/ Muddy Road Surface	A	VH						
		H	(14)	1	49,52,(53),54,55,56,57,58,59,60,61,65	1		
	B	M			64			
	C	L						
8. Permanent Bridge Washout	A	VH						
		H						
	B	M						
	C	L						
9. Permanent Bridge Approach Washout	A	VH	(33)	1				
		H						
	B	M						
	C	L						
10. Permanent Bridge Other Damage	A	VH						
		H	32					
	B	M	5(6)7,22,23,24,34,35	1	47,(48)	1		
	C	L						
11. Temporary Bridge Washout	A	VH						
		H						
	B	M						
	C	L						
12. Temporary Bridge Approach Washout	A	VH						
		H						
	B	M						
	C	L			(62)	1		
13. Temporary Bridge Other Damage	A	VH						
		H						
	B	M						
	C	L			(50)	1		
14. Spillway Damage	A	VH			63,(66)	1		
		H	44					
	B	M	10,21					
	C	L	11					
15. Culvert Damage	A	VH						
		H						
	B	M	19,(42)	1				
	C	L	15,25,31,37,38,(43)	1				
16. Seawall Damage	A	VH						
		H						
	B	M			(51)	1		
	C	L	(8)	1				
TOTAL				11		7		0

TABLE 8.3-4 SELECTED SPOTS IN LEYTE

TYPE OF ROAD DISASTER	MAGNITUDE OF DAMAGE	IMPACT ON SOCIO-ECO. ACTIVITIES	PROVINCE OF BENGUET: NATIONAL ROAD – SPOT NUMBER	NATIONAL ROAD – NO. OF SELECTED SPOTS	PROVINCIAL ROAD – SPOT NUMBER	PROVINCIAL ROAD – NO. OF SELECTED SPOTS	BARANGAY ROAD – SPOT NUMBER	BARANGAY ROAD – NO. OF SELECTED SPOTS
1. Cut Slope Failure	A	VH						
		H	(16),31,48	1				
	B	M	14,28,52,(68),70,78	2	79		(87),(80)	2
	C	L	13,17,27,33,34,54,55,57,61,64,67,69,71,72,77				(84),86,83	1
2. Embankment Slope Failure	A	VH						
		H	(45)	1				
	B	M	18,41,42,43,44,46,58,59,60				(82)	1
	C	L	40,49,53,62					
3. Rock Fall/ Debris Fall	A	VH						
		H						
	B	M	10,11,15,(65),66	1				
	C	L	12,20,(21),22,24,25,29,32,35,36	1				
4. Landslide	A	VH						
		H	9					
	B	M	(47)	1				
	C	L	(50),51	1				
5. Debris Flow	A	VH						
		H	(39)	1				
	B	M						
	C	L						
6. Scour/ Washout of Roadbed	A	VH						
		H						
	B	M						
	C	L						
7. Flooded// Muddy Road Surface	A	VH						
		H	(23)	1				
	B	M						
	C	L	26	1				
8. Permanent Bridge Washout	A	VH						
		H						
	B	M						
	C	L						
9. Permanent Bridge Approach Washout	A	VH	(76)	1				
		H						
	B	M						
	C	L						
10. Permanent Bridge Other Damage	A	VH						
		H						
	B	M						
	C	L						
11. Temporary Bridge Washout	A	VH	1,2,3,(4),37,56,63,75	1	(6),7,74,88	1	73	
		H						
	B	M						
	C	L						
12. Temporary Bridge Approach Washout	A	VH	30					
		H	(38),39	1				
	B	M						
	C	L						
13. Temporary Bridge Other Damage	A	VH	8					
		H						
	B	M						
	C	L						
14. Spillway Damage	A	VH	(19)	1	(90)	1		
		H						
	B	M						
	C	L			5			
15. Culvert Damage	A	VH						
		H						
	B	M						
	C	L	13	1			(81)	1
16. Seawall Damage	A	VH						
		H						
	B	M						
	C	L						
TOTAL				16		2		5

TABLE 8.3-5 SUMMARY OF SELECTED SPOTS IN THREE (3) PILOT PROVINCES

TYPE OF ROAD DISASTER	MAGNITUDE OF DAMAGE	IMPACT ON SOCIO-ECO. ACTIVITIES	NUMBER OF SPOTS															
			BENGUET				BATANGAS				LEYTE				TOTAL			
			N	P	B	T	N	P	B	T	N	P	B	T	N	P	B	T
1. Cut Slope Failure	A	VH																
		H	2	1		2					1			1	3	1		4
	B	M	1			1					2		2	4	3		2	5
	C	L	1	1		2	1			1			1	1	2	1	1	4
2. Embankment Slope Failure	A	VH																
		H									1		1	2	1		1	2
	B	M	1			1	1			1					2			2
	C	L	2	1		3	1			1					3	1		4
3. Rock Fall/ Debris Fall	A	VH																
		H				1												
	B	M				1	1			1	1			1	2			2
	C	L	1			1	1			1	1			1	3			3
4. Landslide	A	VH																
		H																
	B	M									1			1	1			1
	C	L	1			1					1			1	2			2
5. Debris Flow	A	VH																
		H	1			1					1			1	2			2
	B	M	3			3									3			3
	C	L																
6. Scour/ Washout of Roadbed	A	VH																
		H																
	B	M						1		1						1		1
	C	L	1			1									1			1
7. Flooded/Muddy Road Surface	A	VH																
		H					1	1		2	1			1	2	1		3
	B	M																
	C	L									1			1	1			1
8. Permanent Bridge Washout	A	VH																
		H																
	B	M																
	C	L																
9. Permanent Bridge Approach Washout	A	VH					1			1	1			1	2			2
		H	1			1									1			1
	B	M																
	C	L																
10. Permanent Bridge Other Damage	A	VH																
		H																
	B	M	1			1									1			1
	C	L					1	1		2					1	1		2
11. Temporary Bridge Washout	A	VH									1	1		2	1	1		2
		H																
	B	M																
	C	L																
12. Temporary Bridge Approach Washout	A	VH																
		H									1			1	1			1
	B	M																
	C	L						1		1						1		1
13. Temporary Bridge Other Damage	A	VH																
		H																
	B	M																
	C	L						1		1						1		1
14. Spillway Damage	A	VH						1		1	1	1		2	1	2		3
		H																
	B	M																
	C	L																
15. Culvert Damage	A	VH																
		H																
	B	M	1			1	1			1					2			2
	C	L	1			1	1			1	1		1	2	3		1	4
16. Seawall Damage	A	VH																
		H																
	B	M						1		1						1		1
	C	L					1			1					1			1
TOTAL			18	3	0	21	11	7	0	18	16	2	5	23	45	12	5	62

NOTE:
N : NATIONAL ROAD
P : PROVINCIAL ROAD
B : BARANGAY ROAD
T : TOTAL

PART IV

FEASIBILITY STUDY FOR SELECTED DISASTER SPOTS

CHAPTER 9
TRAFFIC FORECAST

9.1 APPROACH

The following two studies previously conducted with technical assistance from JICA are used as main references for some traffic related matters such as functional road classification, AADT prediction model and traffic growth rate:

- Pilot study for the Rural Road Network Development Project, 1989
- Feasibility Study on the Rural Road Network Development Project, 1990

The former is hereinafter referred to as RRNDP-I, and the latter as RRNDP-II, and collectively as RRNDP.

1) Road Classification

Rural roads are functionally classified into the following two categories:

- Major Roads
- Minor Roads

Major roads are inter-provincial or major intra-provincial roads linking municipal towns to the provincial capital or municipal towns each other, which form a skeleton road network of a province. Minor roads are feeder roads linking barangay centers to major roads or farm areas to barangay centers.

Traffic forecast is made in the different ways for major roads and minor roads.

Methodology for road classification is presented in Appendix 9-1.

2) Procedure of Traffic Forecast for Major Roads

The procedure of traffic forecast for major roads is shown in Figure 9.1-1.

Present Traffic

Present traffic was obtained from the result of the traffic survey, converting it into annual average daily traffic (AADT) applying monthly/daily/hourly variation factors based on the data obtained from the Nationwide Traffic Counts Program (NTCP) periodically conducted by DPWH.

Future Traffic

Traffic growth is related to various factors such as population growth, income growth, transport demand-income elasticity, growth in production and so on.

Future traffic was forecasted adopting a traffic growth rate expressed as follows:

$$TGR = [(1 + f/100)(1 + PGR/100) - 1] \times 100$$

where, TGR = traffic growth rate per annum in %
PGR = population growth rate per annum in %
f = comprehensive factor accounting for all other factors than population growth

f was determined by statistical analysis using the RRNDP data.

3) Procedure of Traffic Forecast for Minor Road

The procedure of traffic forecast for minor roads is shown in Figure 9.1-2.

Present Traffic

Traffic demand of minor road is difficult to be observed by one or two days survey because of big seasonal variation and sometimes physical obstacles thereon. In the RRNDP, traffic demand was estimated based on population and production within the road influence area (RIA) which was defined as area from which local traffic (whether vehicle, animal-drawn or pedestrian) using the road derives. Since close correlation was found between population and traffic demand, the AADT prediction model was developed by regression analysis using the population as a predictor variable, expressed as follows:

$$AADT = \beta_1 P + \beta_2 P^2 + \beta_3 P^3 + \beta_4 P^4$$

where, AADT = AADT (annual average daily traffic)
P = population within RIA
$\beta_1, \beta_2, \beta_3, \beta_4$ = coefficients obtained from regression analysis

This model was applied for estimating present traffic.

Future Traffic

The same procedure as in major roads was applied for forecasting future traffic on minor roads.

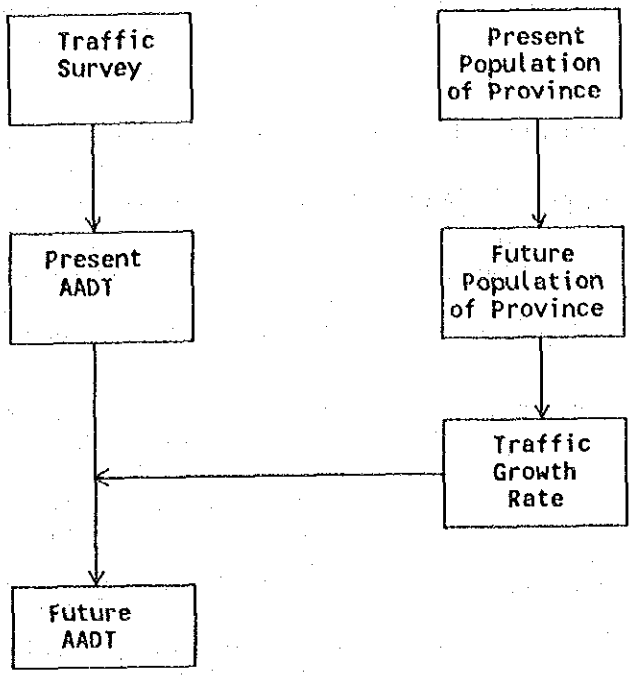


FIGURE 9.1-1 PROCEDURE OF TRAFFIC FORECAST FOR MAJOR ROADS

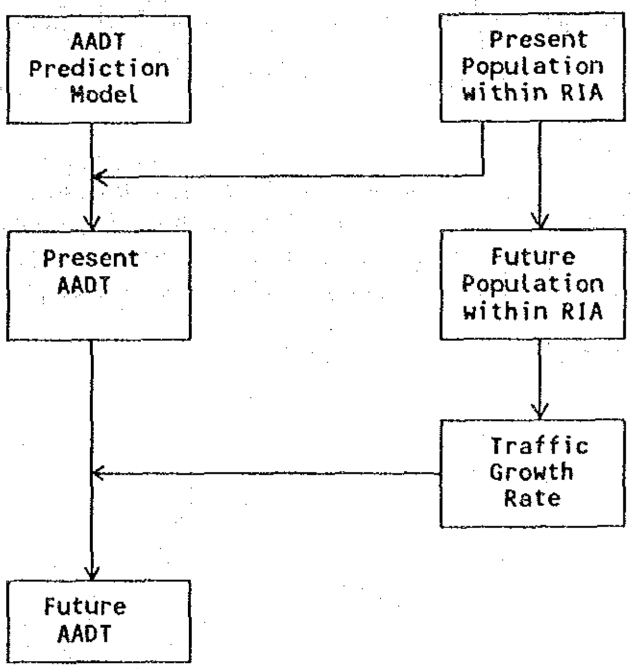


FIGURE 9.1-2 PROCEDURE OF TRAFFIC FORECAST FOR MINOR ROADS

9.2 TRAFFIC AND SOCIO-ECONOMIC SURVEY

9.2.1 Data Collection

Existing traffic data were collected from the following sources:

- DPWH Nationwide Traffic Counts Program (NTCP)
- RRNDP-II

In the NTCP, traffic counts are regularly conducted at the following stations on major national roads:

- 59 Seasonal Stations: consecutive 7 days (24 hours in one day and 12 hours in 6 days) every month
- 115 Control Stations: consecutive 7 days (24 hours in one day and 12 hours in 6 days), 4 times a year
- 1248 Coverage Stations: consecutive 7 days (12 hours), once a year

Traffic data in the pilot provinces obtained from the NTCP are presented in Appendix 9-2.

In Leyte which was included in the Study Provinces of the RRNDP- II, traffic counts were conducted at 28 stations on secondary national roads and provincial roads not covered by the NTCP. These data are presented in Appendix 9-3.

9.2.2 Traffic Survey

The traffic survey was conducted at 6 stations in Benguet and 11 stations in Batangas, while no survey was conducted in Leyte because of availability of the RRNDP-II data.

The survey stations were selected so as to cover all roads where the selected spots are located.

Traffic counts were carried out on one weekday for 12 hours from 6:00 AM to 6:00 PM. Number of vehicles was manually counted by direction and by vehicle type every hour. The vehicle type was classified into 12 types; car, jeep, van, pick-up, jeepney, mini- bus, large bus, 2-axle truck, 3-axle truck, truck combination, motorcycle and tricycle.

The survey data are presented in Appendix 9-3.

9.2.3 Socio-Economic Survey

The following data were collected for the pilot provinces:

- 1990 population by city/municipality
- 1990 population in the road influence area (RIA) for the selected minor roads

  The RIA was delineated considering topography, road network, rivers, mountain ranges, location of barangays and land use.
- Land use
- Major agricultural products
- Development plans

1990 population by city/municipality and the one in the RIA for the selected minor roads are presented in Appendix 9-4.

9.2.4 Establishment of Future Framework

Population was selected as a basic parameter for forecasting future traffic growth. Population projection was made as follows:

- Base year: 1990
- Target years: 2000, 2010 and 2020
- Projection method: using basically the NEDA Population Projection which was prepared based on data in and before 1980, and adjusting it by using 1990 population data.

Projected population by city/municipality and the one in the RIA for the selected minor roads are presented in Appendix 9-4.

9.3 TRAFFIC FORECAST

Vehicle types are combined in this Chapter into 6 types; car (including jeep, van and pick-up), jeepney, bus, truck, tricycle and motorcycle.

9.3.1 Traffic Forecast for Major Roads

1) Present Traffic

12 hours traffic obtained from the traffic survey was converted into annual average daily traffic (AADT) by applying the following adjustment factors which were derived from the nearest seasonal/control stations in the DPWH Nationwide Traffic Counts Program (NTCP):

- Expansion factor from 12 hours to 24 hours
- Daily factor for converting into monthly average daily traffic
- Seasonal factor for converting into AADT

2) Future Traffic

Future traffic was forecasted adopting the following growth rate:

$$TGR = [(1 + f/100)(1 + PGR/100) - 1] \times 100$$

where, TGR = traffic growth rate per annum, in %

PGR = population growth rate of the province per annum in %, obtained from Chapter 9.2.4.

f = comprehensive factor accounting for all other factors than population growth, obtained from the following table

	Benguet	Batangas	Leyte
Car	2.86	3.05	3.31
Jeepney	3.12	3.23	3.47
Bus	3.25	3.49	3.50
Truck	2.30	2.60	2.81
Tricycle	3.01	3.11	3.50
Motorcycle	3.37	3.44	3.50

The abovementioned f values were derived from statistical analysis using the RRNDP data.

9.3.2 Traffic Forecast for Minor Roads

1) Present Traffic

Present traffic on minor roads was estimated applying the AADT Prediction Model which is expressed as follows:

$$AADT = \beta_1 P + \beta_2 P^2 + \beta_3 P^3 + \beta_4 P^4$$

where, AADT = AADT

P = population within the road influence area (RIA), derived from Chapter 9.2.3.

$\beta_1, \beta_2, \beta_3, \beta_4$ = coefficients, obtained from Table 9.3.-1.

TABLE 9.3-1 COEFFICIENTS IN THE AADT PREDICTION MODEL

		Car	Jeepney	Bus	Truck	Tricycle	Motorcycle
Benguet	β_1	0.257×10^{-1}	0.105×10^{-1}	0	0.738×10^{-3}	0.140×10^{-1}	-0.279×10^{-3}
	β_2	-0.718×10^{-5}	0.113×10^{-5}	0	-0.124×10^{-6}	-0.509×10^{-6}	0.429×10^{-5}
	β_3	0.915×10^{-9}	0.109×10^{-9}	0	0.209×10^{-10}	0.367×10^{-9}	-0.751×10^{-9}
	β_4	-0.303×10^{-13}	-0.121×10^{-13}	0	-0.866×10^{-15}	-0.339×10^{-13}	0.461×10^{-13}
Batangas	β_1	0.368×10^{-2}	0.681×10^{-2}	0	0.214×10^{-3}	0.642×10^{-2}	0.535×10^{-2}
	β_2	-0.686×10^{-7}	0.423×10^{-6}	0	0.724×10^{-8}	0.217×10^{-6}	0.181×10^{-6}
	β_3	0	0	0	0	0	0
	β_4	0	0	0	0	0	0
Leyte	β_1	0.101×10^{-1}	0.496×10^{-2}	0	0.570×10^{-4}	0.604×10^{-2}	0.823×10^{-2}
	β_2	-0.542×10^{-6}	0.235×10^{-6}	0	0.130×10^{-6}	-0.712×10^{-7}	-0.260×10^{-6}
	β_3	0	0	0	0	0	0
	β_4	0	0	0	0	0	0

The above coefficients were derived from regression analysis using the RRNDP data.

The chart for predicting AADT based on the population within the RIA was prepared as shown in Figure 9.3-1.

2) Future Traffic

Future traffic was forecasted adopting the following growth rate:

$$TGR = [(1 + f/100)(1 + PGR/100) - 1] \times 100$$

where, TGR = traffic growth rate per annum, in %

PGR = growth rate of population within RIA per annum in percent, obtained from Chapter 9.2.4.

f = comprehensive factor accounting for all other factors than population growth, obtained from the following table

	Benguet	Batangas	Leyte
Car	2.57	1.73	2.82
Jeepney	2.85	2.47	2.65
Bus	-	-	-
Truck	0.42	0.13	1.21
Tricycle	2.87	2.47	2.60
Motorcycle	2.99	3.05	2.98

9.3.3 Result of Traffic Forecast

Figures 9.3-2, 9.3-3 and 9.3-4 show 1991, 2000, 2010 and 2020 traffic on the roads covering the selected disaster spots in Benguet, Batangas and Leyte, respectively, together with road classification, number of lanes and general surface type and condition.

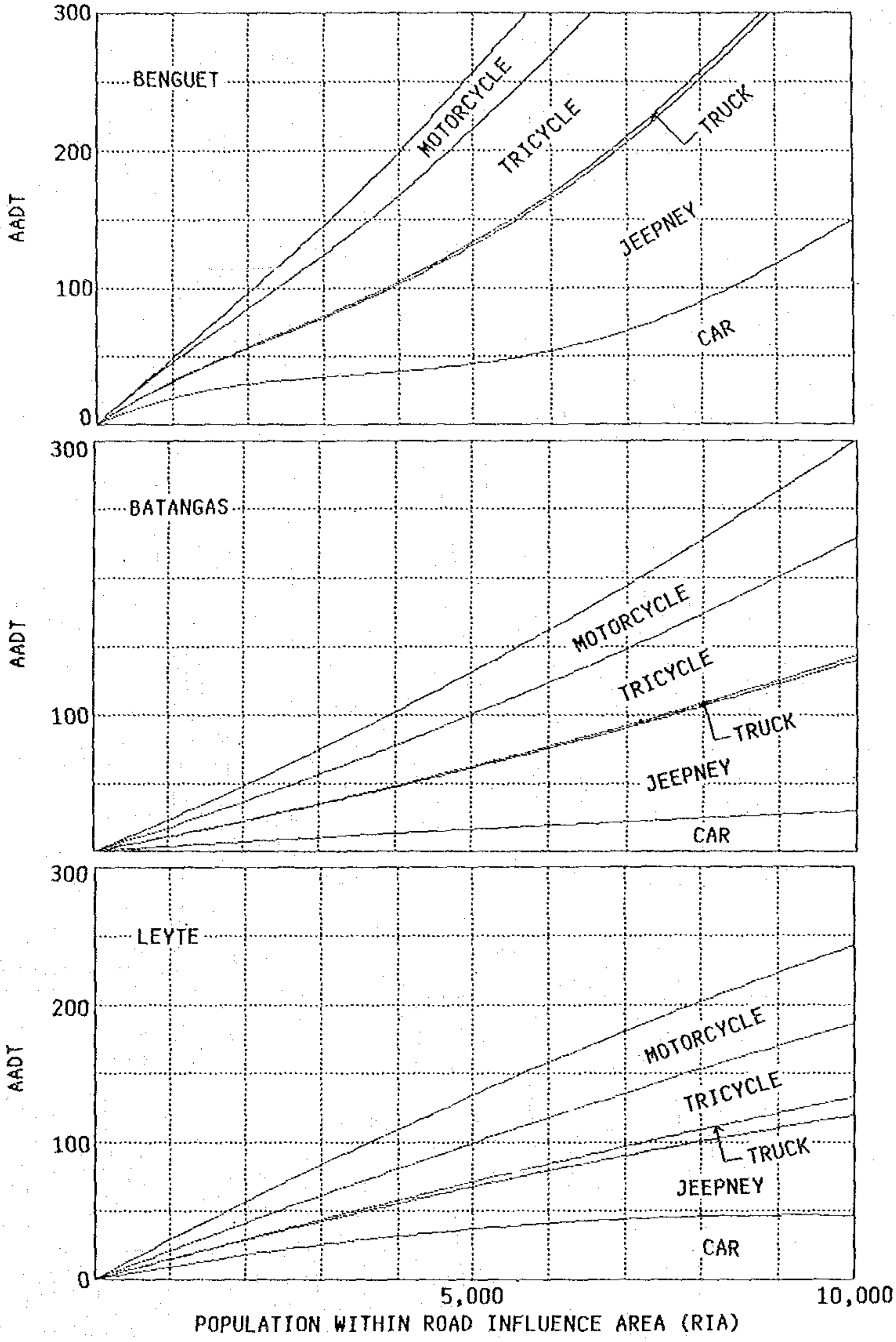
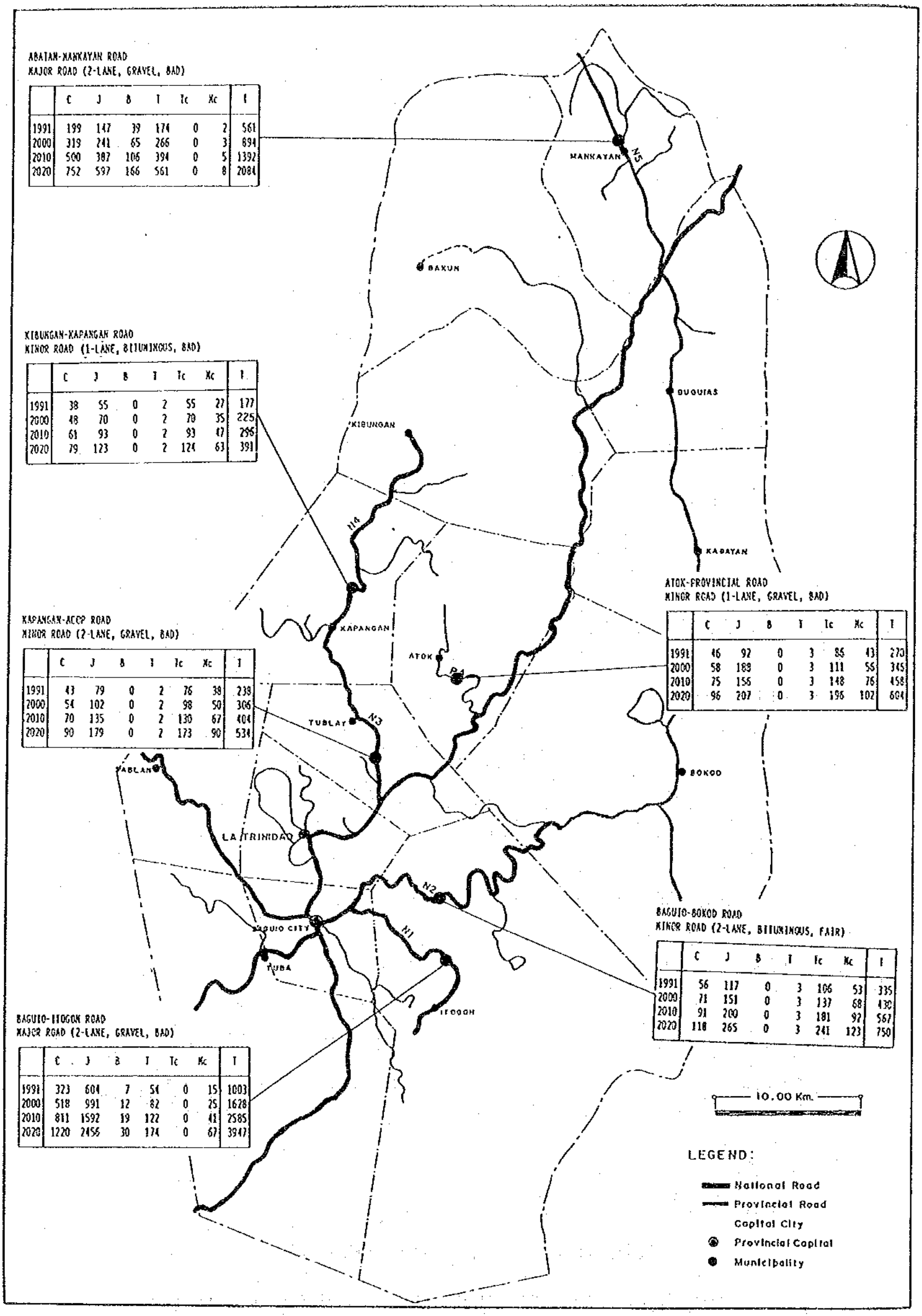


FIGURE 9.3-1 CHART FOR ESTIMATING AADT BASED ON POPULATION WITHIN ROAD INFLUENCE AREA



ABATAN-MANKAYAN ROAD
MAJOR ROAD (2-LANE, GRAVEL, BAD)

	C	J	B	T	Tc	Xc	T
1991	199	147	39	174	0	2	561
2000	319	241	65	266	0	3	894
2010	500	387	106	394	0	5	1392
2020	752	597	166	561	0	8	2084

KIBUNGAN-KAPANGAN ROAD
MINOR ROAD (1-LANE, BITUMINOUS, BAD)

	C	J	B	T	Tc	Xc	T
1991	38	55	0	2	55	27	177
2000	48	70	0	2	70	35	225
2010	61	93	0	2	93	47	295
2020	79	123	0	2	124	63	391

KAPANGAN-ACOP ROAD
MINOR ROAD (2-LANE, GRAVEL, BAD)

	C	J	B	T	Tc	Xc	T
1991	43	79	0	2	76	38	238
2000	54	102	0	2	98	50	306
2010	70	135	0	2	130	67	404
2020	90	179	0	2	173	90	534

ATOK-PROVINCIAL ROAD
MINOR ROAD (1-LANE, GRAVEL, BAD)

	C	J	B	T	Tc	Xc	T
1991	46	92	0	3	86	43	270
2000	58	188	0	3	111	56	345
2010	75	156	0	3	148	76	458
2020	96	207	0	3	196	102	604

BAGUIO-BOKOD ROAD
MINOR ROAD (2-LANE, BITUMINOUS, FAIR)

	C	J	B	T	Tc	Xc	T
1991	56	117	0	3	106	53	335
2000	71	151	0	3	137	68	430
2010	91	200	0	3	181	92	567
2020	118	265	0	3	241	123	750

BAGUIO-ITOGON ROAD
MAJOR ROAD (2-LANE, GRAVEL, BAD)

	C	J	B	T	Tc	Xc	T
1991	323	604	7	54	0	15	1003
2000	518	991	12	82	0	25	1628
2010	811	1592	19	122	0	41	2585
2020	1220	2456	30	174	0	67	3947

FIGURE 9.3-2 TRAFFIC VOLUME ON THE STUDY ROADS (BENGUET PROVINCE)

MATINGAIN-TABLA ROAD
MAJOR ROAD (2-LANE, BITUMINOUS, FAIR)

	C	J	B	T	Tc	Mc	T
1991	298	143	1	50	33	35	552
2000	450	225	2	75	51	56	859
2010	694	353	3	111	79	90	1330
2020	1032	534	5	158	118	139	1985

LAUREL-TALISAY ROAD
MAJOR ROAD (2-LANE, BITUMINOUS, GOOD)

	C	J	B	T	Tc	Mc	T
1991	191	87	0	100	50	40	468
2000	296	137	0	149	78	64	724
2010	457	215	0	220	121	103	1116
2020	680	325	0	313	181	159	1659

TALISAY-CANLUBANG ROAD
MAJOR ROAD (2-LANE, BITUMINOUS, FAIR)

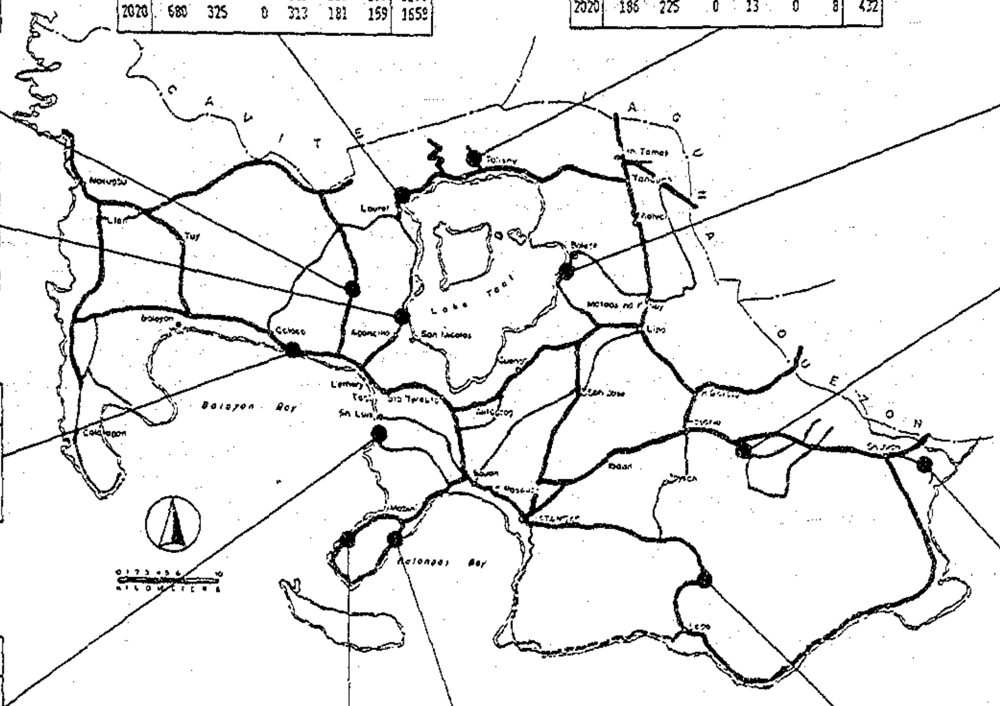
	C	J	B	T	Tc	Mc	T
1991	52	60	0	4	0	2	118
2000	81	95	0	6	0	3	185
2010	125	149	0	9	0	5	288
2020	186	225	0	13	0	8	432

LIPA-BALETE ROAD
MINOR ROAD (2-LANE, GRAVEL, VERY BAD)

	C	J	B	T	Tc	Mc	T
1991	23	74	0	2	59	50	208
2000	27	92	0	2	74	66	261
2010	32	117	0	2	94	89	334
2020	38	150	0	2	121	121	432

TUBIG-AGONCILLO ROAD
MINOR ROAD (2-LANE, PCC, FAIR)

	C	J	B	T	Tc	Mc	T
1991	104	284	1	12	36	36	473
2000	136	378	1	15	47	49	626
2010	184	520	2	20	64	68	858
2020	249	714	3	25	88	94	1173



BAYABAYIN ROAD
MINOR ROAD (2-LANE, GRAVEL, BAD)

	C	J	B	T	Tc	Mc	T
1991	13	33	0	1	28	24	99
2000	15	41	0	1	34	31	122
2010	18	52	0	1	44	42	157
2020	22	66	0	2	56	57	202

CALACA-SINISIAN ROAD
MAJOR ROAD (2-LANE, BITUMINOUS, GOOD)

	C	J	B	T	Tc	Mc	T
1991	1229	917	14	1777	159	186	4282
2000	1907	1445	23	2650	248	298	6571
2010	2942	2268	37	3911	395	478	10021
2020	4376	3159	57	5565	576	738	14471

PINAGBAYANAN ROAD
MINOR ROAD (2-LANE, GRAVEL, VERY BAD)

	C	J	B	T	Tc	Mc	T
1991	24	81	0	2	65	55	227
2000	28	101	0	2	80	72	283
2010	34	129	0	2	103	97	365
2020	40	164	0	2	131	130	467

SAN LUIS-BATO ROAD
MAJOR ROAD (2-LANE, BITUMINOUS, VERY BAD)

	C	J	B	T	Tc	Mc	T
1991	51	316	19	28	3	3	420
2000	27	421	26	35	4	4	559
2010	90	578	36	46	5	6	761
2020	122	794	51	59	7	8	1041

MABINI-SOLO ROAD
MAJOR ROAD (2-LANE, GRAVEL, BAD)

	C	J	B	T	Tc	Mc	T
1991	85	62	0	14	12	17	190
2000	132	98	0	21	19	27	297
2010	204	154	0	31	29	43	461
2020	303	233	0	44	4	66	650

MABINI-SAGUING ROAD
MAJOR ROAD (2-LANE, BITUMINOUS, VERY BAD)

	C	J	B	T	Tc	Mc	T
1991	322	486	3	130	132	22	1095
2000	499	766	5	194	206	35	1705
2010	770	1202	8	285	320	56	2642
2020	1145	1819	12	407	479	85	3948

BATANGAS-LOBO ROAD
MAJOR ROAD (2-LANE, BITUMINOUS, VERY BAD)

	C	J	B	T	Tc	Mc	T
1991	425	410	121	338	172	28	1494
2000	555	546	165	425	259	45	2006
2010	751	750	232	550	419	73	2775
2020	1015	1030	327	711	627	112	3822

FIGURE 9.3-3 TRAFFIC VOLUME ON THE STUDY ROADS (BATANGAS PROVINCE)

CALUBIAN ROAD
MAJOR ROAD (2-LANE, GRAVEL, BAD)

	C	J	B	T	Tc	Mc	T
1991	76	28	32	22	18	10	186
2000	113	42	48	31	25	14	273
2010	170	64	74	44	35	19	406
2020	252	96	112	62	49	27	598

CULABA-KAWAYAN ROAD
MAJOR ROAD (2-LANE, GRAVEL, FAIR)

	C	J	B	T	Tc	Mc	T
1991	44	26	17	39	40	45	211
2000	65	39	26	55	55	61	301
2010	98	60	40	79	77	87	441
2020	145	90	60	112	108	122	637

CABUGCAYAN ROAD
MAJOR ROAD (2-LANE, GRAVEL, FAIR)

	C	J	B	T	Tc	Mc	T
1991	57	56	52	54	35	72	326
2000	85	84	78	77	48	98	470
2010	128	128	120	110	67	138	691
2020	190	193	181	156	95	195	1010

SAN ISIDRO-TABANGO ROAD
MAJOR ROAD (2-LANE, GRAVEL, VERY BAD)

	C	J	B	T	Tc	Mc	T
1991	61	44	12	17	42	11	187
2000	91	66	18	24	57	17	273
2010	137	101	28	34	81	26	407
2020	203	152	42	48	114	39	598

BARUGO-BAGACAY ROAD
MINOR ROAD (1-LANE, EARTH, BAD)

	C	J	B	T	Tc	Mc	T
1991	39	34	0	4	31	37	145
2000	50	43	0	5	39	48	185
2010	66	56	0	5	50	65	242
2020	88	72	0	6	65	87	318

ORMOC-LAKE DANAO ROAD
MINOR ROAD (2-LANE, GRAVEL, FAIR)

	C	J	B	T	Tc	Mc	T
1991	30	21	0	2	21	27	101
2000	38	26	0	2	26	35	127
2010	51	34	0	3	33	47	168
2020	67	44	0	3	43	63	220

BABATOGON-STA. CRUZ ROAD
MINOR ROAD (1-LANE, EARTH, VERY BAD)

	C	J	B	T	Tc	Mc	T
1991	21	12	0	1	13	17	64
2000	26	16	0	1	17	23	83
2010	35	20	0	1	22	31	109
2020	46	26	0	1	28	41	142

BARAUEN-LAPAZ ROAD
MAJOR ROAD (2-LANE, GRAVEL, FAIR)

	C	J	B	T	Tc	Mc	T
1991	55	11	7	30	48	90	241
2000	82	17	11	43	65	136	354
2010	123	26	17	62	92	209	529
2020	183	39	26	88	130	315	782

PALOMPON-MATOGOB ROAD
MAJOR ROAD (2-LANE, GRAVEL, FAIR)

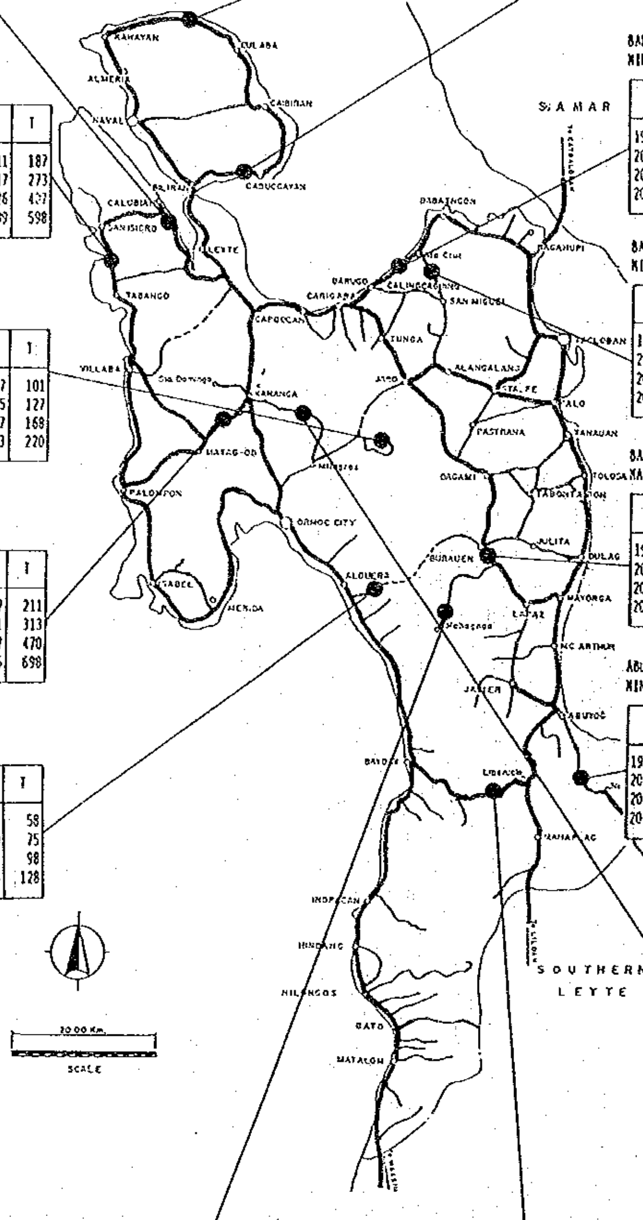
	C	J	B	T	Tc	Mc	T
1991	82	76	11	25	10	7	211
2000	122	114	17	35	14	11	313
2010	184	174	26	50	19	17	470
2020	273	262	39	71	27	26	698

ABUYOG-NEBGA ROAD
MINOR ROAD (2-LANE, GRAVEL, BAD)

	C	J	B	T	Tc	Mc	T
1991	45	46	0	6	39	45	181
2000	58	58	0	7	49	59	231
2010	77	74	0	8	63	79	301
2020	101	97	0	9	82	106	395

ALBUERA-BURAUEN ROAD
MINOR ROAD (2-LANE, GRAVEL, BAD)

	C	J	B	T	Tc	Mc	T
1991	19	11	0	1	12	15	58
2000	24	14	0	1	16	20	75
2010	31	19	0	1	20	27	98
2020	41	24	0	1	26	36	128



MAHAGNAO ROAD
MINOR ROAD (2-LANE, GRAVEL, FAIR)

	C	J	B	T	Tc	Mc	T
1991	35	28	0	3	27	33	126
2000	45	35	0	3	34	43	160
2010	59	46	0	4	43	58	210
2020	78	59	0	4	56	77	274

BAYBAY-LIBERACIO ROAD
MAJOR ROAD (2-LANE, PCC, GOOD)

	C	J	B	T	Tc	Mc	T
1991	145	110	60	77	15	21	428
2000	215	166	91	109	20	32	633
2010	324	254	140	156	29	49	952
2020	481	383	212	221	41	74	1412

KANANGA-MILAGROS ROAD
MINOR ROAD (2-LANE, GRAVEL, BAD)

	C	J	B	T	Tc	Mc	T
1991	45	48	0	7	40	46	186
2000	58	61	0	8	50	60	237
2010	77	79	0	9	65	81	311
2020	101	103	0	10	84	109	407

FIGURE 9.3-4 TRAFFIC VOLUME ON THE STUDY ROADS (LEYTE PROVINCE)

CHAPTER 10
ENGINEERING SURVEY

10.1 OUTLINE OF ENGINEERING SURVEY

The Engineering Survey was composed of the following:

- Topographic Survey
- Geotechnical Survey
- Disaster Survey

Number of spots covered by each survey was as follows:

Province	F/S Spots	Topographic Survey	Geotechnical Survey	Disaster Survey
Benguet	21	9	2	21
Batangas	18	11	2	18
Leyte	23	11	2	23
Total	62	31	6	62

Location maps of the selected spots for survey in Benguet, Batangas and Leyte are shown in Figures 10.1-1, 10.1-2 and 10.1- 3, respectively.

Topographic survey and geotechnical survey were subcontracted to the local contractors, while disaster survey was conducted by the Study Team. For those spots where the topographic survey was not undertaken, rough plans and cross sections were prepared by observing the topography and measuring the major length/height/gradient by the Study Team.

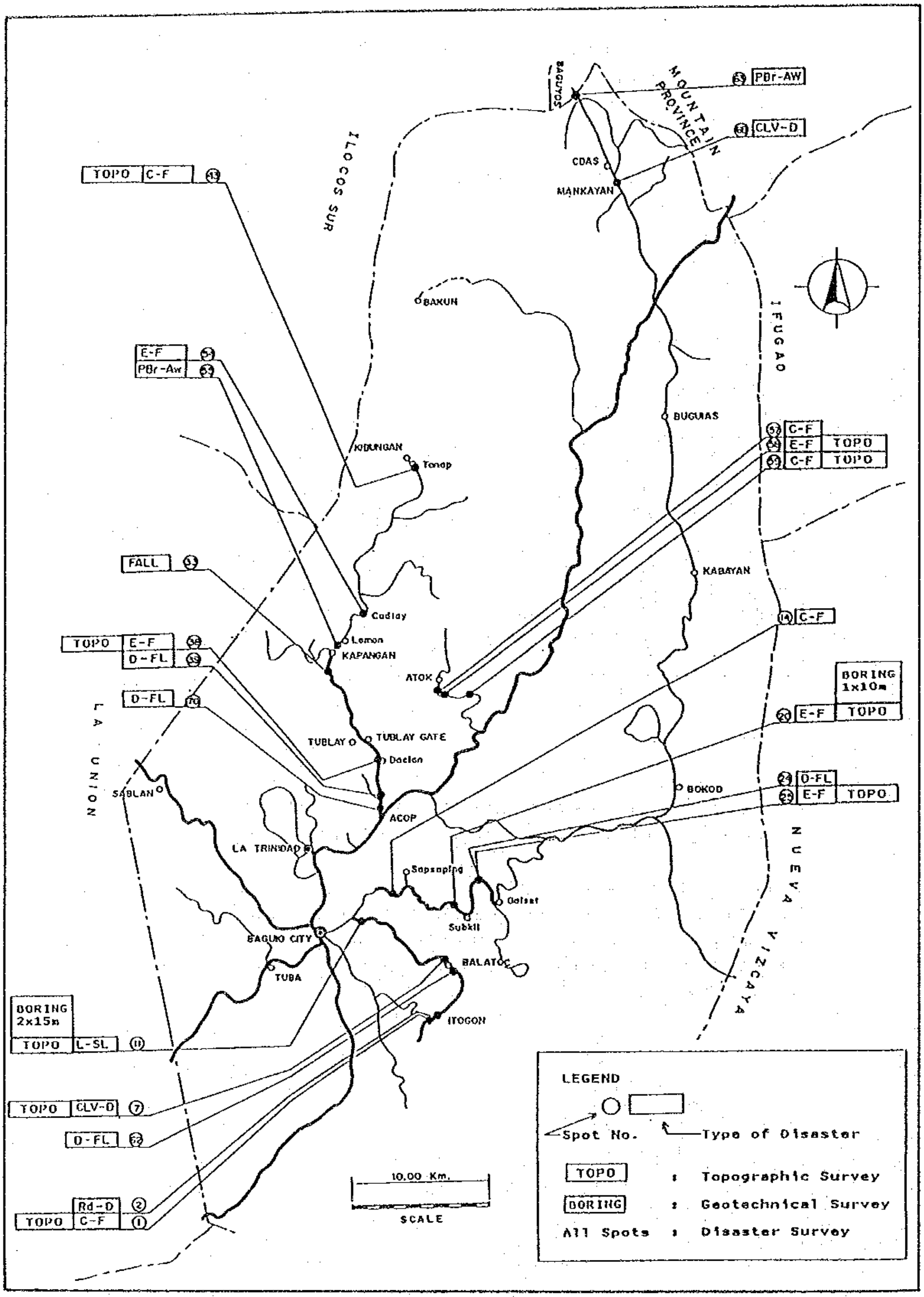


FIGURE 10.1-1 LOCATION MAP OF SPOTS FOR ENGINEERING SURVEY (BENGUET)