and wet the rest of the year. Rainfall is more or less evenly distributed throughout the year under Type 4 climate.

A map and charts showing the climatological factors in Luzon and Visayas areas related to the Project are shown in Figure 3.1. The climate in most of the Project Area is predominantly Type 1. However, almost entire Capiz, a portion of Aklan and about half of Iloilo in the northeastern part of Panay island fall under the Type 3 climate. In some years, Panay island had prolonged rainy seasons extending up to the month of December.

Annual rainfall is greatly influenced by the frequency of typhoons in this country. In Panay island, the mean annual rainfall varies from 1,938 mm at Iloilo City to 3,971 mm at Culasi, Antique. The northern Luzon provinces have relatively evenly distributed rainfall of 2,000 to 2,500 mm/year in areas along the coast. Rainfall is enhanced by the condensation effects in mountain ranges forming the eastern boundary of the northern Luzon provinces. The maximum monthly rainfall at Roxas City which was recorded in October 1970 amounted to 759 mm; at Iloilo City this occurred in July 1972 with a recorded depth of 767 mm. Dry season is more pronounced in northern Luzon than in Panay island.

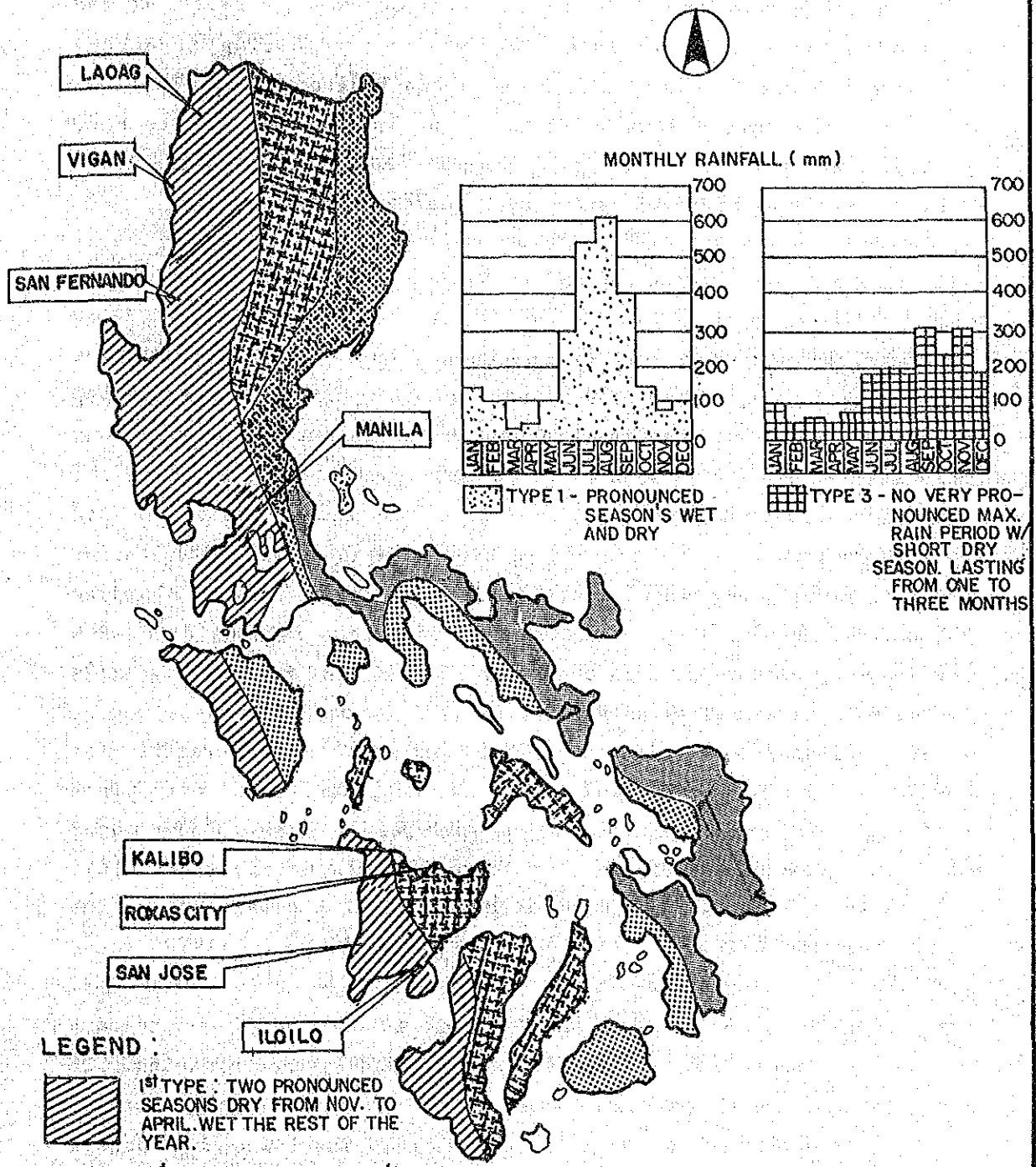
Temperature does not vary appreciably throughout the entire country. Diurnal and annual ranges of temperature in the Project Area are likewise minimal. The mean annual temperature is 27.9 degrees centigrade at Kalibo, Aklan and 26.8 degrees centigrade in Laoag, Ilocos Norte, which are the maximum and the minimum among the provinces of the Project Area.

The country is humid throughout the year. In Ilocos Sur, for instance, the mean monthly relative humidity ranges from 71.4 percent to 85.3 percent.

3.2.2 Topography and Geology

The Philippine archipelago is situated in the West Pacific Ocean, lying in the eastern end of the Eurasian Plate. The islands were uplifted in the Mesozoic era chiefly by the forces caused by the

FIG. 3.1 CLIMATE IN LUZON & VISAYAS AREAS



SOURCE : 1972 NATIONAL ECONOMIC ATLAS

west-ward movement of the Pacific Plate. The major faults extend in the directions of north-south and northwest-southeast parallel to the axes of major folds, following the trend of bordering trenches. Volcanic activities had taken place in the faulted zones. The lowlands and the depressions were buried by Tertiary and Quaternary sediments and pyroclastic brought by water and/or air. Reefal limestone is also seen intermittently near the coastlines.

(1) Ilocos Norte, Ilocos Sur and La Union

Ilocos highlands is a part of the Luzon Central Cordillera which forms rugged topography. The highest peak in the area is Mt. Pulog (2,929 m), which is also the highest in the island of Luzon. Four main rivers, the Agno, Laoag, Chico-Amburayan and Abra, drain the Cordillera and empty into the China Sea. The ridges are structured by intermediate to mafic plutonic masses with intercalated volcanics and meta sediments. The foothills are mainly comprised by Klondyke Formation composed of conglomerate and sandstone intercalated with lava flows, volcanic breccia and pyroclastics. The low rolling hills are mainly comprised by Rosario Formation composed of a sequence of interbedded sandstone, siltstone, shale and minor conglomerate in the lower portion, and tuffaceous sandstone and conglomerate with minor siltstone, shale, reefal limestone and basalt flow in the upper portion. Quaternary alluvium, of which main compositions are clay, silt, sand, gravel and boulders, is deposited in the valleys and the narrow coastal plains.

The Ilocos Lowlands lie along northwestern Luzon bounded on the east by the Luzon Central Cordillera and on the west by the China Sea. It measures about 95 km long and 35 km at its widest, extending south of Vigan, Ilocos Sur to Pasaleng, Ilocos Norte. The lowland consists of low rolling hills and a narrow plain along the coastline. Alluvial fans are formed in the upper Laoag River. The predominant geological formations are Baruyen Formation, Bojeador Formation, Pasuquin Lime-stone and Laoag Formation. The Baruyen Formation dated Cretaceous - Paleogene is outcropped in the southern part of Nueva Era and all parts of Dumanlig, Ilocos Norte. This formation is composed of chert interbedded with basic volcanics and sediments, which are partly metamorphosed into schist and serpentine. The Bojeador forma-

tion dated early to middle Miocene is outcropped in the Vintar area. This formation includes agglomerate, sedimentary rocks, volcanic flows and other pyroclastics. The rocks are folded, faulted and peneplaned before the deposition of Pasuquin Limestone. In the Burgos-Pasuquin area, the Pasuquin Limestone dated middle to late Miocene lies unconformably over the Bojeador Formation. In coastal plains and foothills in Laoag, the Laoag Formation dated Pliocene-Pleistocene forms rolling hills composing of sandstones and shales.

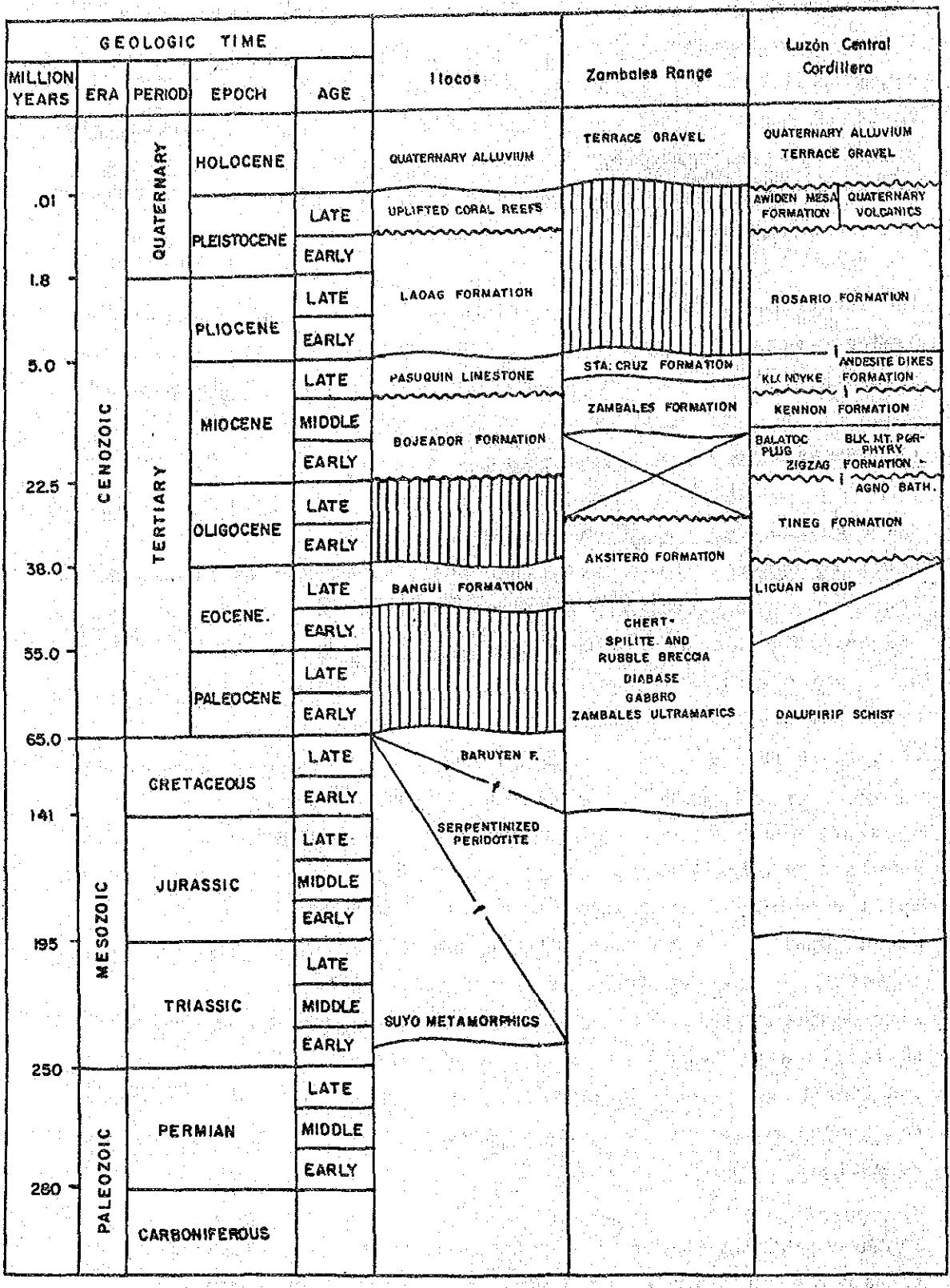
The stratigraphy in the Ilocos provinces is summarized in Figure 3.2. Geologic maps of Ilocos Norte, Ilocos Sur and La Union are shown in Figure 3.3, Figure 3.4, and Figure 3.5, respectively.

(2) Pangasinan

Zambales Range extends from the western part of Lingayen Gulf on the north to Bataan Peninsula on the south. It measures about 220 km long and 40 km wide. The range consists of high peaks and rugged ridges. The northern part of the range is bordered by low rolling hills which merge with small coastal plains. Short and rapid streams drain the western slopes and form small plains interrupting the rocky western shoreline. The geology is made up largely of mafic-ultramafic rocks called Zambales Ultramafic Complex. The rocks are part of a complete ophiolite sequence consisting of metamorphic peridotite, cumulate peridotite, layered gabbro, diabase dike swarms and chert-spilite overlain by pelagic sediments, known as Aksitero Formation dated upper Eocene to lower Oliqocene. On the western and northern foothills of Zambales Range is Zambales Formation which unconformably lies on the Aksitero Formation. The formation consists of tuffaceous shale (locally called Adobe) and sandstone with minor conglomerate and limestone. Along the western and northern flanks of the range is the bedded to massive reefal limestone of the late Miocene Sta. Cruz Formation.

In the eastern flank of the range, some places are intruded by Quaternary volcanic plugs mainly of dacite composition. Terrace gravel is dominant along the valleys in the western Pangasinan.
The stratigraphy in Pangasinan is summarized also in Figure 3.2 while the geologic map of the province is in Figure 3.6.

FIG.3.2 STRATIGRAPHY IN ILOCOS PROVINCES AND PANGASINAN



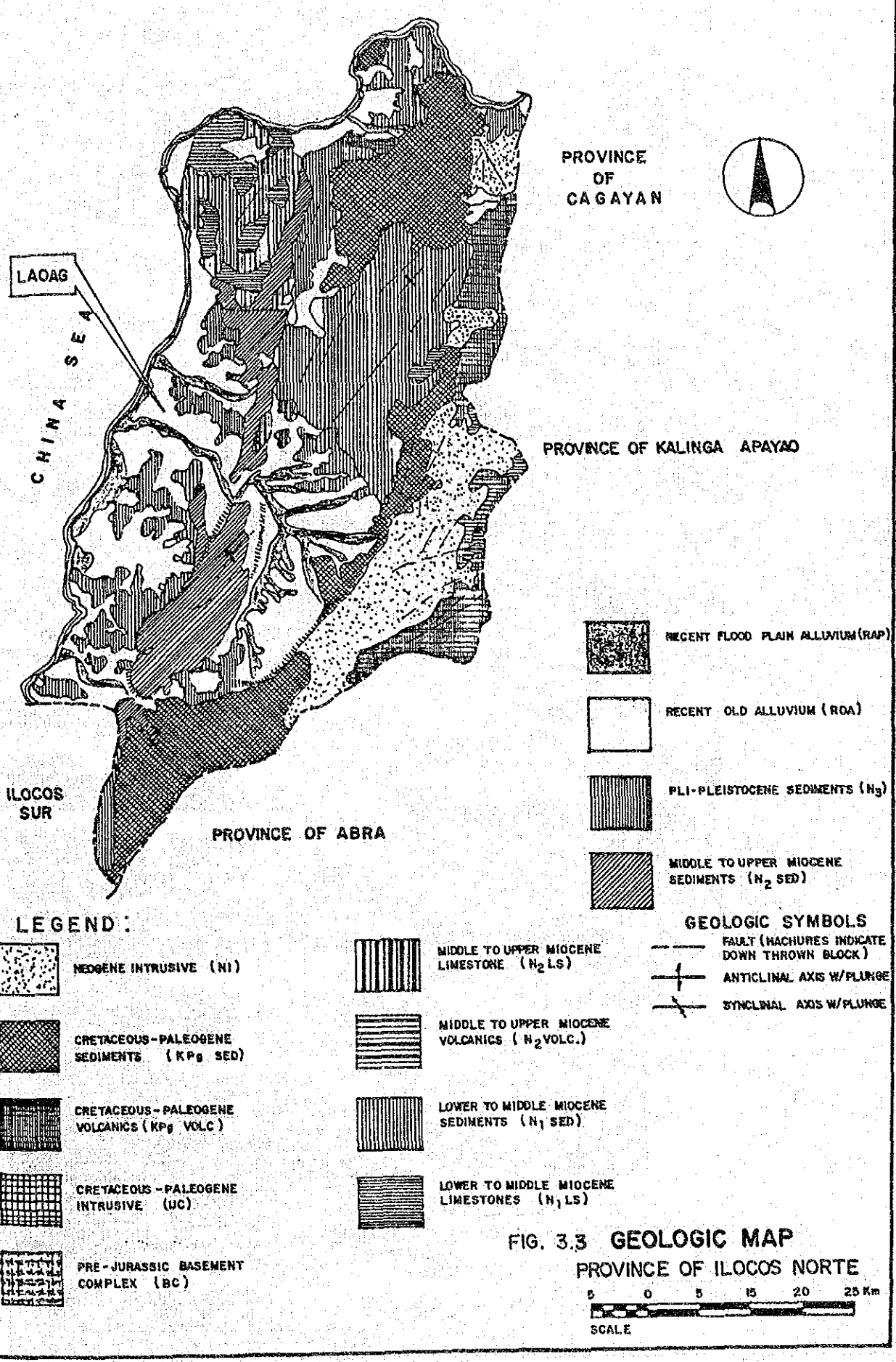


FIG. 3.3 GEOLOGIC MAP
PROVINCE OF ILOCOS NORTE

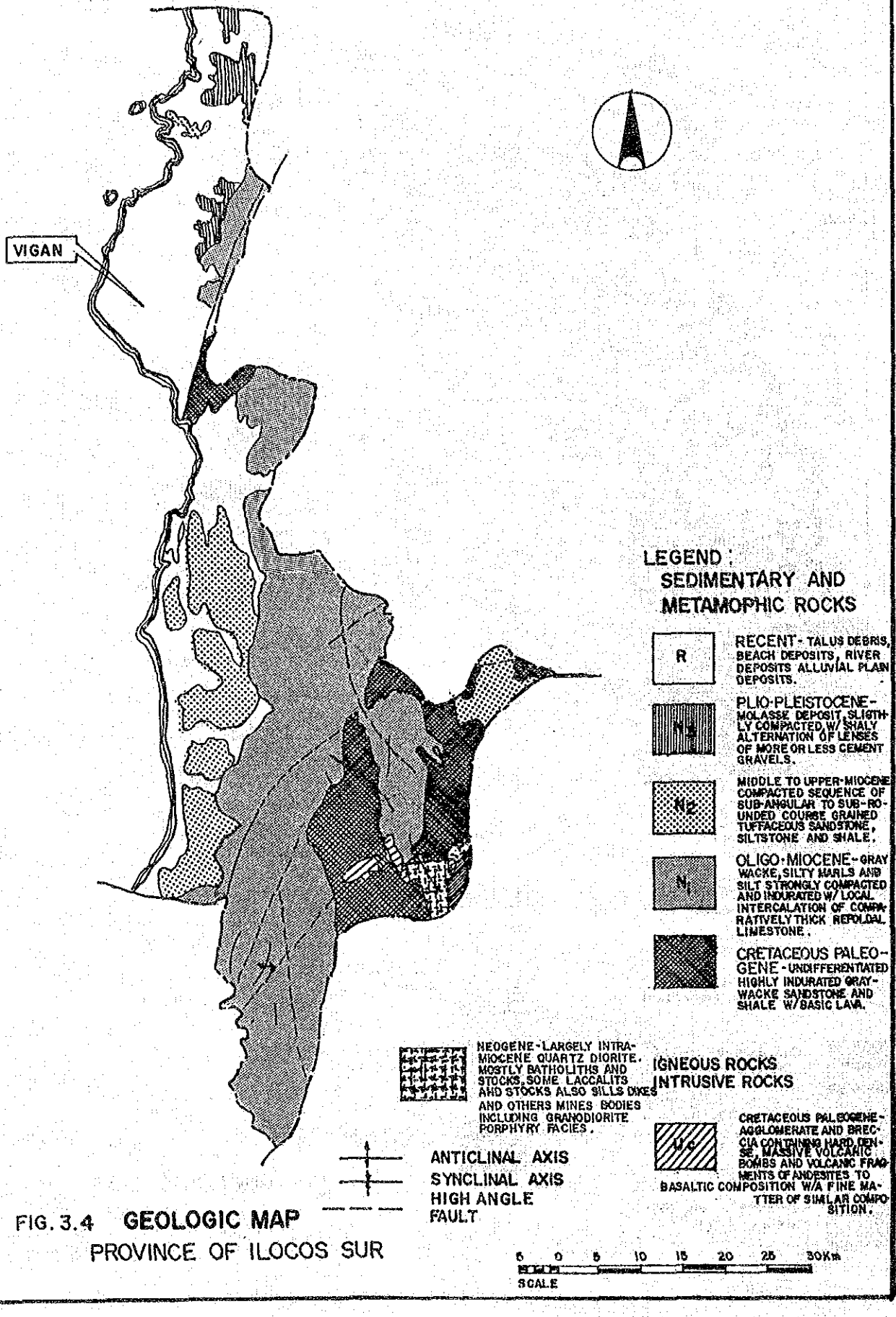


FIG. 3.4 **GEOLOGIC MAP**
PROVINCE OF ILOCOS SUR

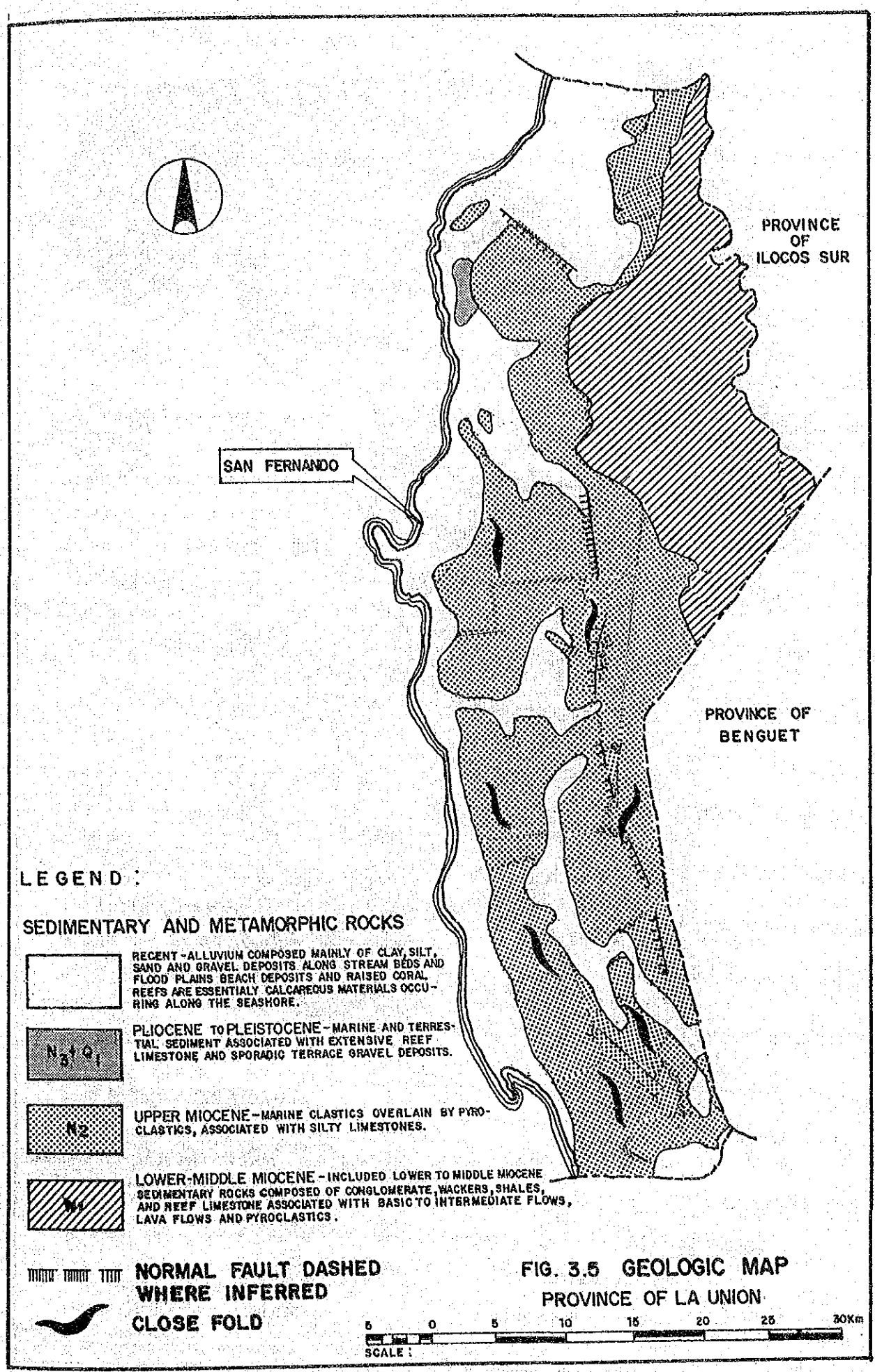


FIG. 3.5 GEOLOGIC MAP
PROVINCE OF LA UNION

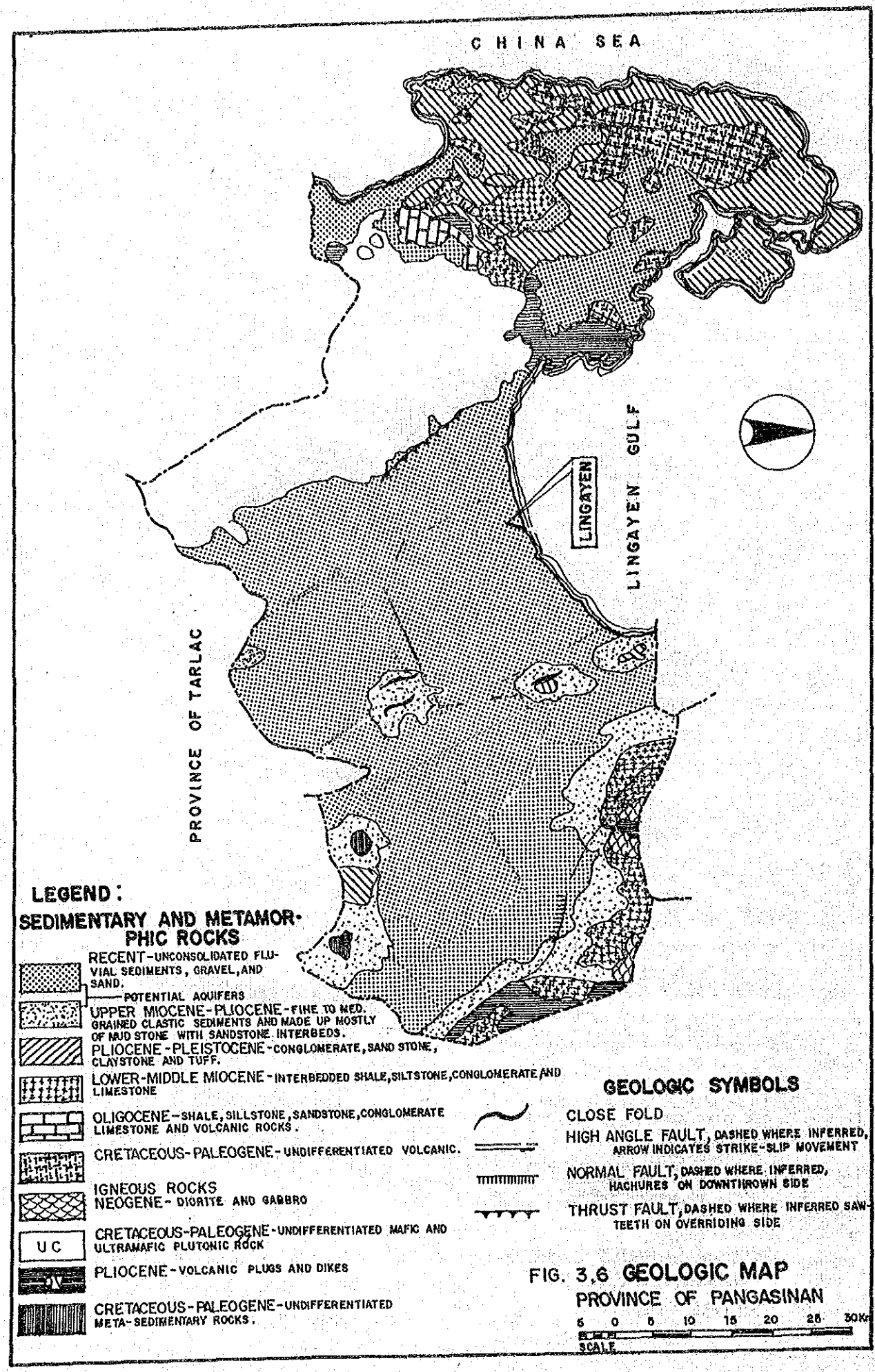


FIG. 3,6 GEOLOGIC MAP
PROVINCE OF PANGASINAN

Major topographic features of Pangasinan are an extensive alluvial plain on the central part and the mountain areas on the northeast and on the southeast. The relief is moderate on the northwest and northeast, flattening abruptly as it approaches the broad alluvial plain. The highest portion of the province is at the southwest where the northern tip of the Zambales mountain range is situated. Undulating hills make up the province's southeastern part.

Agno and Bued rivers comprise the major drainage system of Pangasinan. The former drains the southeastern half of central Cordillera at Benguet, flows south to the alluvial plain, hence west towards its discharge point at Lingayen Gulf in the town of Lingayen. The latter also drains the southeastern half of central Cordillera, flows across the northern portion of the alluvial plain and emerges at the Lingayen Gulf in San Fabian. The plain is composed of a sequence of clay, silt, sand, gravel and pyroclastic sediments (tuffaceous clay). In the downstream of Agno river, clay is deposited with thickness from 80 m to 120 m in most the area.

(3) Aklan, Capiz, Iloilo and Antique (Panay Island)

Panay island can be divided into three major physiographic areas, namely: Antique Range, Panay Central Plain and Eastern Panay.

Antique Range is situated along the western part of Panay. The range is approximately 200 km long extending from Ibajay, Aklan on the north to Anini-y, Antique on the south. It forms sharp ridges and deeply dissected valleys. It slopes westward rather steeply to the sea, the Cuyo East Pass. Eastward, the range slopes gradually and forms a wide belt of foothills that merge with Aklan river and Panay Central Plain. Elevations of the range reach more than 900 metres. The highest peak is Mt. Nangtud (2,049 m) at the center, which is also the highest in Panay island.

The ridges are structured by the Antique Ophiolite and the Bongbongan Series. The Antique Ophiolite consists of ultramafics, gabbro-diorites cumulates. The Bongbongan Series consists of basalt flows with characteristic pillow structures, bedded chert and green ferruginous sediments.

Different Tertiary formations are present in the northern part and in the southern part. In the southern part, the Igsawa Pyroclastics is deposited around Laua-an, Bugasong and Valderrama, Antique. This formation is composed of andesite flow breccia, tuff, wacke, conglomerate and calcirudite. The Sewaragan Formation, exposed in San Joaquin, Iloilo, is composed of basaltic wacke overlain by mudstone, wacke, thin basalt breccia and local limestone. The age of the formations are considered Early Miocene.

Middle Miocene age is the Lagdo Formation exposed in San Jose, Tobias Fornier and Anini-y, Antique. The Lagdo Formation consists of basal conglomerate overlain by siltstone, mudstone, tuff, wacke and minor conglomerate. The Pliocene Apdo Formation overlies unconformably the Lagdo Formation and forms low rolling hills. The Apdo Formation consists of marl and mudstone.

In the northern part, the Fragante Formation occurs as a continuous mass of basaltic lava flows intercalated with conglomerate, sandstone and limestone. The age of the formation is considered Early Miocene.

The Makato Formation lies over the Fragante Formation. The Makato consists of interbedded sandstone and shale exposed near Makato and in Agpa Point, north of Tangalan, Aklan. The age of the formation is considered Middle Miocene. Recent alluvial deposits occur along river channels, flood plains, and deltaic plains.

The Central Plain is formed by the coalescing of three major alluvial plains. Aklan river flowing north forms an alluvial plain in Kalibo, Numancia and Lezo. Panay river flowing northeast forms a deltaic plain in Roxas city and Panay, and an alluvial basin in Mambusao, Sigma and Dao, Capiz. The other is Jalaur River flowing south, which forms a broad alluvial plain in the western half of Iloilo province. Headwaters of the rivers are in the Antique Range.

The oldest rocks considered as the basement, consist of an assemblage of igneous and metamorphic rocks. The igneous rocks are predominantly basic and include fine grained, porphyritic and amygdaloidal basalts, volcanic breccias, agglomerates and coarse tuffs. The metamorphic rocks are greenstones, serpentines and quartzites.

Unconformably overlying or in fault contact is a sequence of Oligocene to Miocene conglomerate, sandstone, shale and reefal limestone designated as the Singit Formation. This formation include the Sewaragan Complex which is equivalent to the Sewaragan formation in the Antique range. Conformable on the Singit is the Tarao Formation which is subdivided into two distinct members based on lithologic characters: the Late Miocene Tubungan Siltstone and the Lower Pliocene Guimba Mudstone. Overlying the Tarao is the Iday Formation, a Pliocene sequence of conglomerate, sandstone and claystone.

The Late Pliocene Ulian Formation consists mostly of claystone or mudstone. The youngest formational unit is the Pleistocene Cabatuan Formation which is subdivided into three members: the Balic Clay, Sta. Barbara Silt and Maragat Sandstone. The Sta. Barbara Silt is bedded as thick as 100 metres in Sta. Barbara. Alluvium covers flood plains of Aklan, Panay, Jaro, Jalaur rivers. The Lambuano and Janiuay plateaus are capped by loosely consolidated gravels.

Eastern Panay consists of highlands and dissected valleys formed by short, rapid streams. The area is bounded by the Panay river basin and the Jalaur river basin on the west and the Sibuyan Sea on the north, and the Visayan Sea on the east.

The oldest formations are Masonson Schist and the Sibala Formation dated Cretaceous to Paleocene. The Sibala Formation consists of basic clastic sediments with intercalated volcanics. The Sara Diorite intrudes both the Masonson Schist and the Sibala Formation. The diorite is considered Paleocene. The Middle Miocene Passi Formation is divided into the Salngan and the Assissig members. The Salngan member is much indurated and altered by the Bayuso Volcanics. The Anilao Shale and the Pilar limestone are considered as extensions of the Passi Formation.

Overlying the Passi Formation is the Late Miocene to Early Pliocene Dingle Formation, consisting of interbedded reefal limestone, marl, sandstone and claystone. The Pliocene Ulian Formation consists of slightly to highly calcareous mudstone. This formation is overlain by shallow water deposits of the Maraget Sandstone member of the Cabatuan Formation. Quaternary Alluvium is thin in this area, less

than 20 m thick in most the plains.

The stratigraphy and geologic structural conditions in Panay Island is summarized in Figure 3.7 and 3.8, respectively. The geologic map of Panay river basin is depicted in Figure 3.9 while the geologic map of Antique is shown in Figure 3.10.

3.2.3 Hydrogeology and Groundwater

Hydrogeological evaluation to determine if a specific geological formation is a good aquifer, a poor aquifer or an aquiclude, requires a knowledge of the formation's permeability, thickness and geological structure. It is also important for good aquifers to have contiguity to recharge areas. Permeability varies with the lithology of the geological formation. Degree of permeability and infiltration capacity is increased if the consolidated rocks are fissured. Lithological units existing in the Project Area together with their respective permeability and infiltration capacity are listed in Table 3.1 for reference.

Hydrogeological features and groundwater information by province are discussed in the following paragraphs. Groundwater map and selected well logs in each province are compiled in Appendix A.1.

(1) Ilocos Norte

The potential aquifers occur in the recent alluvial deposits, and the Plio-Pleistocene sediments composed of medium to coarse grained tuffaceous sandstone where groundwater is confined as indicated by several artesian wells from Badoc to Batac.

The towns of Solsona, Marcos, Currimao, Paoay, Dingras, Bacarra and Burgos have been identified to have high groundwater potentials. The major aquifers lie at shallow depths in the above towns as indicated by the georesistivity survey results reported in the NWRC Framework Plan. Specific yields of permeable aquifers and semi-permeable aquifers were estimated at five percent and three percent, respectively, based on the performance of existing Bureau of Public Works (BPW) wells. Saltwater intrusion affects shallow aquifers along the

FIG. 3.7 STRATIGRAPHY IN THE PANAY ISLAND

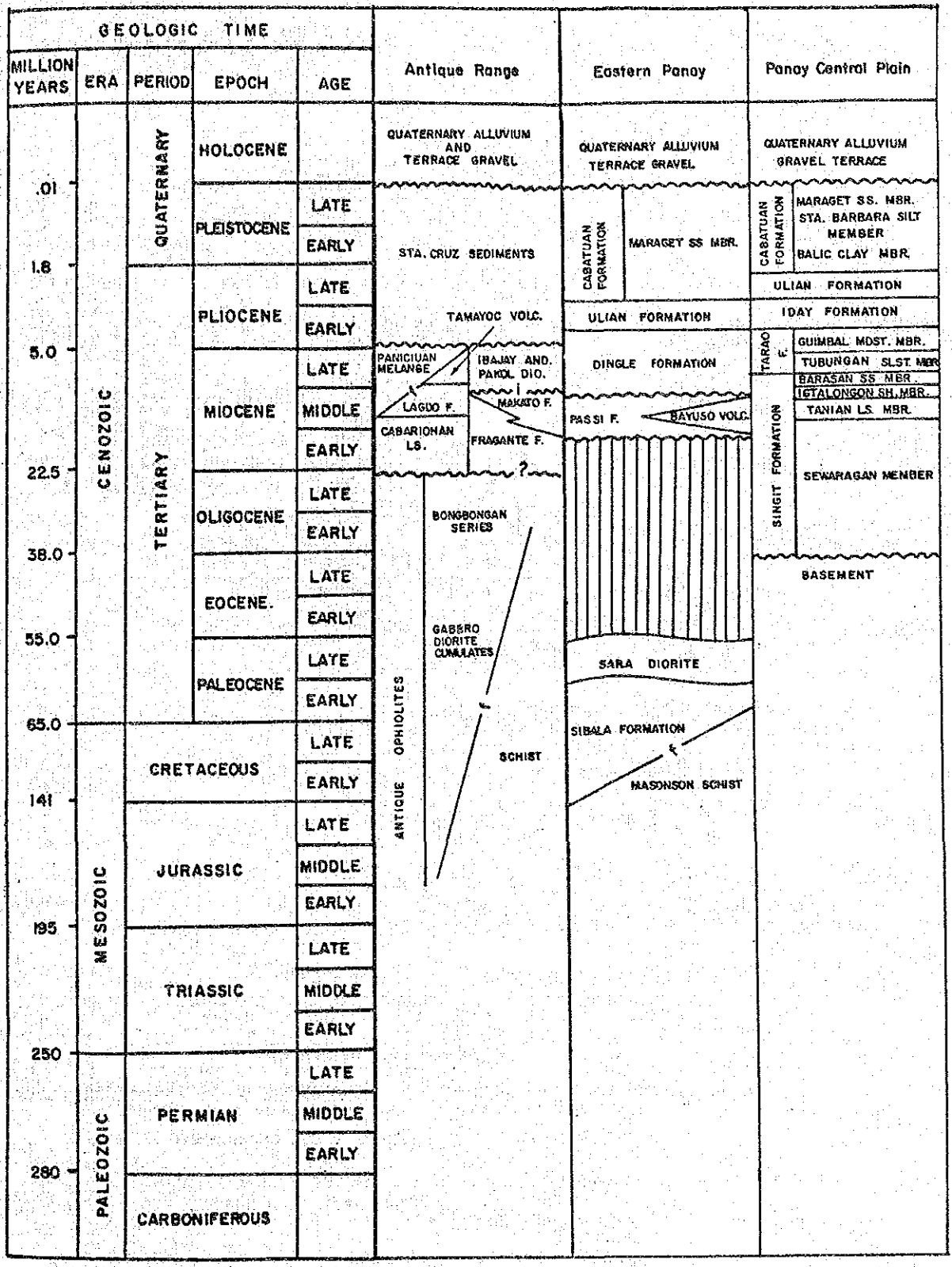
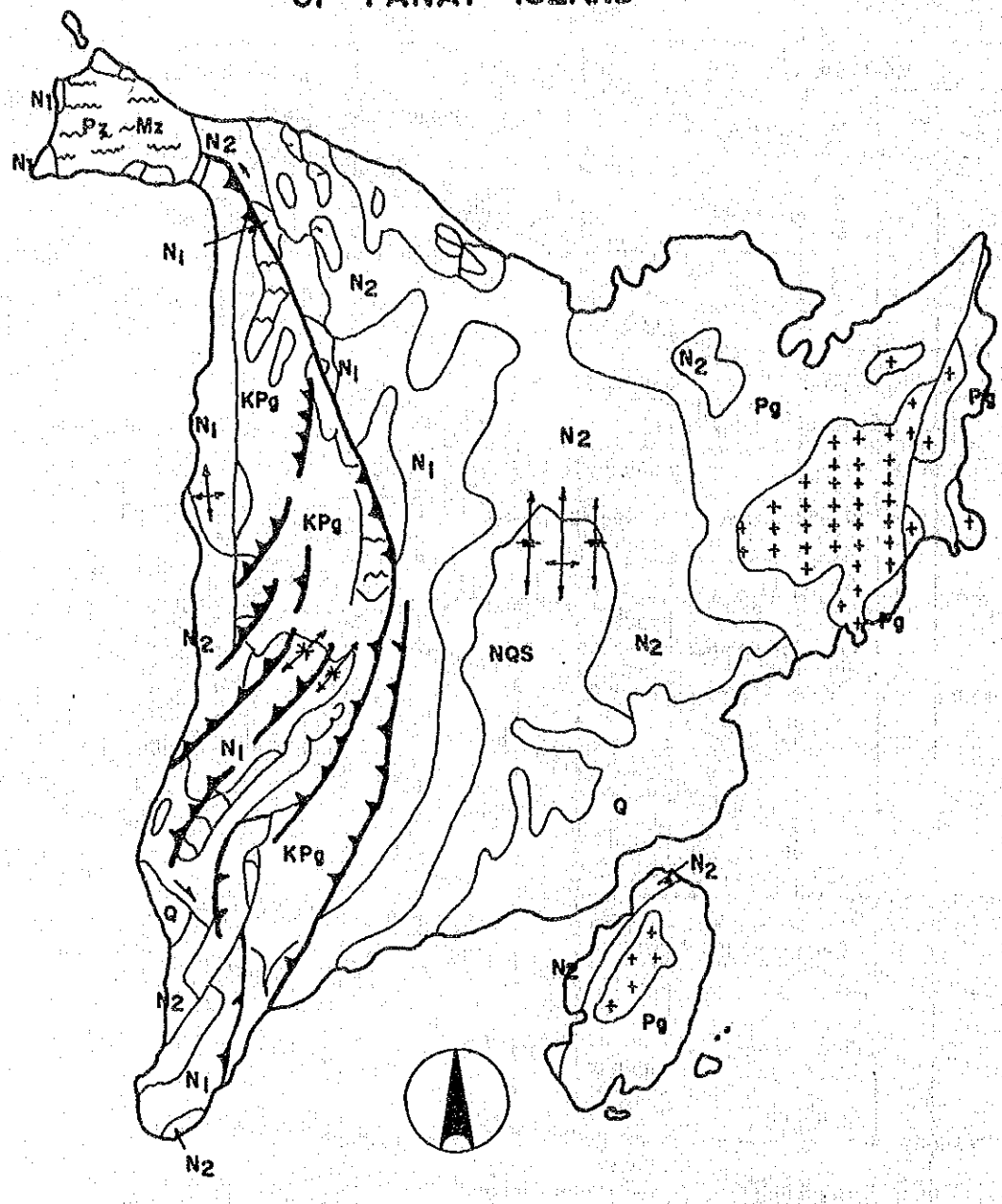


FIG.3.8 GEOLOGIC STRUCTURAL MAP OF PANAY ISLAND



STRUCTURAL SYMBOLS

HIGH-ANGLE FAULT, ARROW SHOWS RELATIVE DIRECTION OF STRIKE-SLIP MOVEMENT

NORMAL FAULT, HACHURES ON DOWNTHROWN SIDE, DASHED WHERE INFERRED

THRUST FAULT, SAW-TEETH ON OVERRIDING SIDE, DASHED WHERE INFERRED

BOUNDARY OF LITHOLOGIC UNIT

ANTICLINAL AXIS WITH PLUNGE

OVERTURNED ANTICLINE

SYNCLINAL AXIS WITH PLUNGE

OVERTURNED SYNCLINE

QUATERNARY VOLCANIC CENTER

NOTE :

REFERENCE FOR GEOLOGICAL CONDITIONS IN AKLAN AND ILOILO PROVINCES.

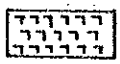
LEGEND :

STRATIGRAPHY OF PANAY ISLAND

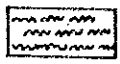
STRATIFIED ROCKS :

Q	QUATERNARY ALLUVIAL, LACUSTRINE, BEACH AND RESIDUAL DEPOSITS.
NQV	PLIOCENE, PLEISTOCENE AND RECENT VOLCANIC DEPOSITS; MOSTLY ANDESITES AND BASALTS W/ASSOCIATED DACITES AND RHYODACITES IN PLACES, OCCURING MAINLY AS LAVA FLOWS IN VOLCANIC CENTERS AND PYROCLASTICS IN THEIR APRONS; OLIVINE-PYROXENE BASALTS CONTITUTE LARGELY THE LANAO-BUKID NON-VOL. PLATEAU.
NQS	PLIOCENE TO PLEISTOCENE SEDIMENTS BOTH MARINE AND TERRESTRIAL INCLUDES EXTENSIVE REEF LIMESTONE AND WATER-LAID PYROCLASTICS, ALSO LOCALIZE GRAVEL DEPOSITS.
N_2	UPPER MIOCENE SEDIMENTS AND VOLCANICS; LARGELY MARINE CLASTICS, REEF LIMESTONE, AND ANDESITIC BASALTIC PYROCLASTICS AND LAVAS.
N_1	LATE OLIGOCENE TO MIDDLE MIOCENE SEDIMENTS AND VOLCANICS, MAINLY MARINE SANDSTONE, SHALE AND REEF LIMESTONE; SOME CONGLOMERATE, COAL MEASURE AND MARINE ANDESITIC-BASALTIC PYROCLASTICS AND LAVAS.
Pg	PALEOCENE TO OLIGOCENE SEDIMENTS AND VOLCANICS; MAINLY MARINE SANDSTONE, SHALE AND LIMESTONE; DACITE AND ADESITE LAVAS AND PYROCLASTICS IN CATANDUANES, SOUTHERN SIERRA MADRE AND EASTERN MINDANAO; MAINLY ARKOSIC AND QUARTZITIC SHALE AND SANDSTONE IN MINDORO AND PALAWAN.
KPg	UNDIFFERENTIATED CRETACEOUS TO PALEOGENE STRATA; COMMONLY MAPPED AS METAVOLCANICS AND METASEDIMENTS CONSISTING MAINLY OF SPILITES CHERT, PEGALIC TO HEMIPEGALIC SEDIMENTS AND TURBIDITES.
K	CRETACEOUS SEDIMENTS AND VOLCANICS; MAINLY UPPER CRETACEOUS SPILITIC TO NON-SPILITIC BASALT, ANDESITE, CHERT, PELAGIC TO HEMIPELAGIC SEDIMENTS, TURBIDITES, LIMESTONE, SANDSTONE AND SHALE; LOWER CRETACEOUS CONSTITUTE THE BULK OF THE CRETACEOUS IN CEBU BUT HAS NOT BEEN REPORTED IN OTHER AREAS.
J	MIDDLE TO UPPER JURASSIC ARKOSE, SUBGRAYWACKE, MUDSTONE AND CONGLOMERATE IDENTIFIED ONLY IN MINDORO (MANSALAY FORMATION).
Pz-Mz	CARBONIFEROUS TO MIDDLE JURASSIC RADIOLARITE, SANDSTONE, SHALE, LIMESTONE AND CONGLOMERATE REGIONALLY METAMORPHOSED TO QUARTZITE, SLATE, PHYLLITE, MARBLE AND MICA SCHIST; LIMITED TO MINDORO, ROMBLON ISLAND GROUP, BURUANGA PENINSULA, CUYO ISLAND, BURUANGA ISLAND GROUP, NORTERN PALAWAN AND PROBABLY ZAMBOANGA PENINSULA.

INTRUSIVE AND PSEUDOSTRATIFIED ROCKS :

	INTERMEDIATE TO ACID; MAINLY DIORITE, GRANODIORITE, QUARTS DIORITE AND MONZONITE; TONALITE, ADAMELLITE, GABBRO, SYENITE AND GRANITE ARE LOCALIZED FACIES.
	BASIC AND ULTRABASIC; MAINLY PERIDOTITE, DUNITE AND LAYERED GABBRO; PERIDOTITE AND DUNITE ARE GENERALLY SERPENTINIZED; TROCTOLITE, NORITE, TRONDJHEMITE.

METAMORPHIC ROCKS :

	SCHIST, PHYLLITE, GNEISS; MARBLE AND QUARTZITE RANGING FROM THE GREENSCHIST PYROXENITE (COLOR FOLLOWS AGE OF ORIGINAL ROCK.)

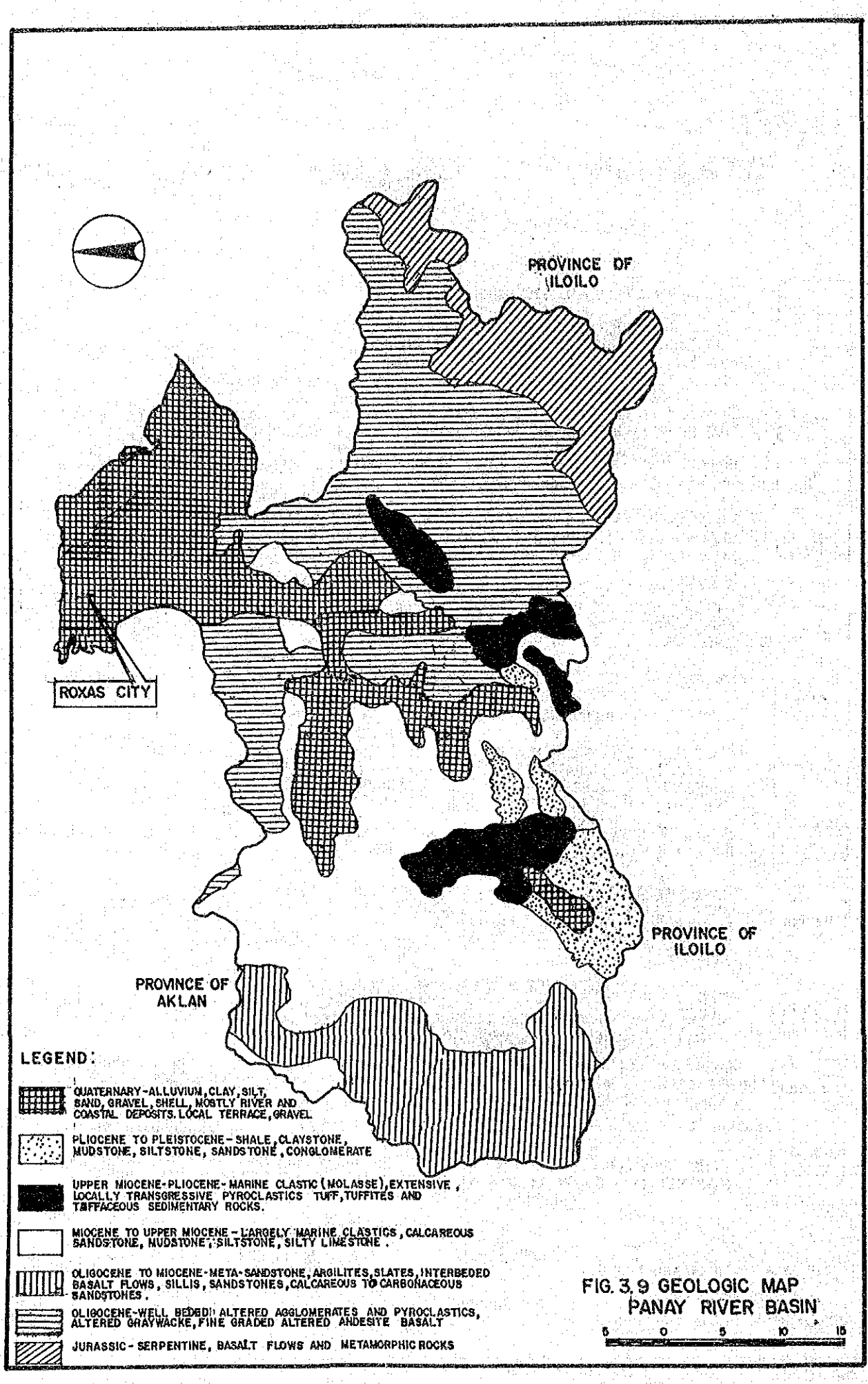


FIG. 3.9 GEOLOGIC MAP
PANAY RIVER BASIN

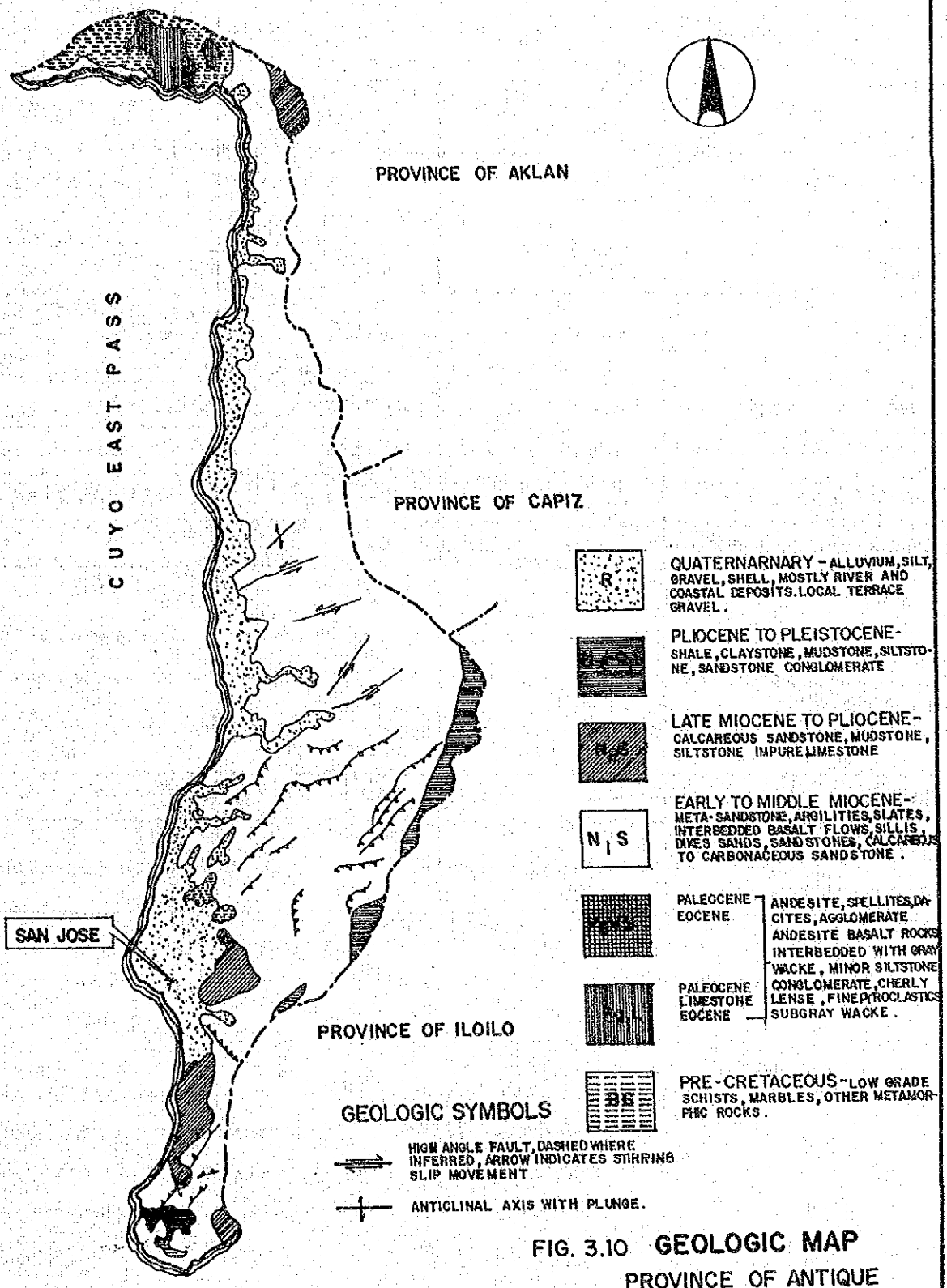


FIG. 3.10 **GEOLOGIC MAP**

PROVINCE OF ANTIQUE

TABLE 3.1 PERMEABILITY AND INFILTRATION CAPACITY BY LITHOLOGY

Lithology	Permeability	Infiltration Capacity	Remarks
Boulder	very high	very high	
Gravel	very high	very high	
Gravel with Boulder	very high	very high	
Sand and Gravel	high	high	
Sand	medium - high	medium - high	
Silt	low	low	
Clay	absent	absent	saturated with water
Clay with Gravel	absent	absent	-do-
Clay with Gravel	absent	absent	-do-
Tuffaceous clay	absent	absent	locally called adobe
Sandstone	low - medium	low	
Limestone	low - high	very low - low	permeability is high if solution cavities exist
Tuff	low	low	
Lava	very high	very high	
Basalt	low - medium	low	
Andesite	absent	absent	
Metamorphic rocks	absent	absent	

coastline from Badoc to Pasuquin, being most extensive at Laoag City and nearby areas caused by high tide intruding into the Laoag river.

According to NWRC Rapid Assessment of Water Supply Sources, the static water level in the province varies from 1.9 metres below ground surface (mbgs) at Solsona to 10.7 mbgs at Nueva Era. Specific capacity varies from 0.31 lps/m at Pinili to 2.08 lps/m at Laoag City, with most of the remaining areas in the range of 0.5-2.0 lps/m for 4 to 6 inch diameter wells.

(2) Ilocos Sur

The potential aquifers occur in the recent alluvial deposits, and semi-consolidated sedimentary and pyroclastic rocks which represent the shallow and deep aquifers, respectively. The shallow aquifers are composed of gravel and sand under confined or unconfined conditions while the deep aquifers consist mainly of semi-consolidated sandstone and tuff, and terrace gravel deposits.

The towns of Sto. Domingo, Cauayan, Narvacan, Sta. Maria and Santiago have been identified to have high groundwater potentials, where the major aquifers lie at 90 mbgs or deeper.

Salt water intrusion affects deep aquifers in coastal areas especially in the towns of Cauayan, Santa, Narvacan, Sta. Maria, San Esteban, Santiago, Candon and San Ildefonso, as shown by the groundwater map. The map also indicates the general movement of groundwater in the province reflecting the topographical features. In general, groundwater moves toward the China Sea which forms the western boundary of the province.

The static water level in the province ranges from 0.61 mbgs to 27.4 mbgs, being shallowest at San Vicente with an average of 2.77 mbgs. Specific capacity ranges widely from 0.01 lps/m to 21.00 lps/m for 4 to 6 inch diameter wells.

(3) La Union

The potential aquifers lie in the recent alluvial deposits and within the sedimentary formation of Miocene to Pleistocene deposits, being either under confined or unconfined condition.

The towns of Bangar, Balaoan, Bacnotan, San Juan, San Fernando, Bauang, Naguilian and Caba have been identified to have high groundwater potentials, where the major aquifers lie at 2 to 200 mbgs. Affected by saline intrusion are the towns of Luna, Bacnotan, San Gabriel, San Fernando, coastal areas of Bauang and Sto. Tomas, as shown by the groundwater map. The map also indicates the general movement of groundwater in the province reflecting the topographical features. In general, groundwater moves toward the China Sea which forms the western boundary of the province.

The static water level in the province ranges from 0.30 mbgs to 20.73 mbgs. The central and northwestern part of the province are characterized by shallow static water level, being shallowest at Bangar with an average of 2.26 mbgs. The specific capacity ranges from 0.04 lps/m to 3.10 lps/m for 4 to 6 inch diameter wells.

(4) Pangasinan

In the central area, potential aquifers lie in the recent alluvial deposits composed of sand and in the Pleistocene alluvial deposits composed of sand and gravel. In the east and the west, terrace gravel and alluvial fan deposits are prospective aquifers.

The towns in the Agno and the Bued river alluvial plains have been identified to have high groundwater potentials. The major aquifers cover mostly the alluvial plain. Deep confined aquifers lie at about 60 mbgs in Basista and the vicinity, and even deeper in areas downstream of the Agno river. A study made on 107 wells, the locations of which represent all municipalities, disclosed that 78.3 percent of the wells are within a depth of 143 m. Shallow unconfined aquifers are contaminated by salt water along the coastline, and by surface water inland. Dagupan City and the towns of Lingayen, Binmaley, Labrador, Sual, Bugallon are affected by salt water as shown by the

groundwater map. The said map also indicates that groundwater in the alluvial plain moves westward and gradually veers northward as it approaches the Lingayen Gulf.

Most of the wells have static water levels within 9 mbgs, since the aquifers are confined. Artesian wells are distributed in Binmaley, Mangaldan, and San Fabian. Specific capacity ranges from 0.14 lps/m to 2.45 lps/m for 4 to 6 inch diameter wells.

(5) Aklan

The potential aquifers occur in the recent alluvial deposits composed of sand and gravel with local terrace gravel as prospective aquifer. The towns of Kalibo, Lezo, Banga and Ibajay have been identified to have high groundwater potentials, where the major aquifers lie at 2 to 20 mbgs and even deeper in areas far from rivers.

The areas in the towns of New Washington, Numancia and Batan fronting the coastline and the Batan bay are affected by salt water intrusion as shown by the groundwater map. The map also indicates a general movement of groundwater with moderately steep gradient toward the Sibuyan Sea.

The static water level varies from 1.0 to 7.0 mbgs in most of the alluvial plains. Average static water levels are shallowest in the towns of Balete, Libacao and Malinao. Specific capacity ranges from 0.29 lps/m to 1.25 lps/m for 4 to 6 inch diameter wells.

(6) Capiz

The potential aquifers occur in the recent alluvial deposits, reefal limestone, Miocene-Pliocene sediments and Oligocene formation. The composition of aquifers is in the order of 70 percent sand and gravel, and 30 percent clay and silt.

Roxas City and the towns of Ivisan, Sapian, Pontevedra, Panitan, Maayon and Dumarao have been identified to have high groundwater potentials. The major aquifers which lie at depth ranging from 2 to 200 mbgs cover mostly the alluvial plains in these towns.

Saline water intrusion affects shallow aquifers as well as deep aquifers in the coastal areas of Roxas City as shown in the groundwater map. The map also shows groundwater movement at flat to steep gradient reflecting the general topography of the area. In the Panay river basin, groundwater is discharged to the river as lateral flow. Since the major aquifers are composed largely of clay and silt, the water is rich in minerals such as iron and manganese.

The static water level ranges from 1.0 to 60 m above mean sea level, which is 1 to 24 mbgs. The average static water level in the province is shallowest in the town of Dumarao. Specific capacity ranges from 0.22 lps/m to 0.87 lps/m for 4 to 6 inch diameter wells.

(7) Iloilo

The potential aquifers are sand deposits of Recent to Plio-Pleistocene age that range in size from very fine to very coarse with granules and pebbles. These aquifers are interbedded with or confined by layers of clay or clayey formations.

Iloilo City and the towns of Sta. Barbara, Cabatuan, Zarraga, Dingle, Banate and Barotac Viejo have been identified to have high groundwater potentials. Depth to the major aquifers varies from 2 to 200 mbgs in the said places.

Affected by saline intrusion are the towns of San Joaquin, Miagao, Guimbal, Igbaras, Tigbauan, Oton, Jaro, Dumangas, Banate and Iloilo City. Traces of salt water are detected as far as 10 km inland from the coastline in Iloilo City. Some wells/springs yield hard water like the Matagsing Spring I and Cali well in Dumangas.

The groundwater map also illustrates more or less the general pattern of groundwater movement in the province. The gradient of static water level is approximately 0.3 percent in the central basin with slight decrease in the Iloilo City vicinity wherein the gradient is only about 0.23 percent. The static water level in the province ranges from 1 to 26 mbgs, the average value being shallowest in the town of Lambunao. Specific capacity ranges from 0.02 lps/m to 1.38

lps/m for 4 to 6 inch diameter wells.

(8) Antique

There are no extensive or significantly large aquifers in the province. However, shallow aquifers consisting of sand with clay and gravel layers as well as coralline with shell fragments in coastal areas are laid at depths ranging approximately from 5 to 20 metres. The deeper aquifers consist of Pleistocene sedimentary formation, which are either unconfined, semi-confined or confined.

Only the town of San Jose has been identified to have high groundwater potentials. The towns of Pandan, Busong, Patanogon, Busong and Sibalom are expected to have good aquifers belonging to recent alluvium and Plio-Pleistocene sediments at varying depths.

The quality of groundwater varies considerably from place to place and is determined by its geological formation. Salt water intrusion in groundwater is limited to a few barangays in Anini-y, Igbobon, Patnongon, Belison and Hamtik.

The groundwater movement has moderate to steep gradient, reflecting the general topography of the area. The flow is reflected by the effluent and influent nature of rivers.

The static water level in the province ranges from 1 to 19 mbgs. On the average, the towns of Bugasong and Valderrama are shallowest in static water levels. Specific capacity ranges from 0.23 lps/m to 0.65 lps/m for 4 to 6 inch diameter wells.

3.3 Socio-Economic Conditions Including Basic Infrastructures

Socio-economic data relevant to the Project, and information on basic infrastructures by province are presented in the Table 3.2. The items cover both the essential infrastructures like roads, electric power supply, communication facilities, transportation facilities, industrial/business/commercial establishments, and education and health facilities. The socio-economic data also comprises labor and employment, and family income and expenditure. All the information is

TABLE 3.2 DATA ON SOCIO-ECONOMIC CONDITIONS AND BASIC INFRASTRUCTURE

ITEM	UNIT	REGION I				REGION VI			
		ILOCOS NORTE	ILOCOS SUR	LA UNION	PANGASINAN	AKLAN	CAPIZ	ILOILO	ANTIQUE
(1) ROADS									
(a) TOTAL LENGTH	Km	3,533	2,847	1,745	4,700	1,237	1,568	3,653	1,373
(b) BARANGAY ROADS	PERCENT	69	70	67	64	58	47	53	57
(2) ELECTRICITY AVAILABILITY AT :									
(a) MUNICIPAL LEVEL	PERCENT	100	82	100	100	100	100	100	94
(b) BARANGAY LEVEL	PERCENT	95	86	78.6	87	70	51.1	72.0	-
(c) HOUSEHOLD LEVEL	PERCENT	96	76	60.9	70.7	38	28	42.8	-
(3) TELECOMMUNICATION									
(a) AVAILABILITY AT MUNICIPAL LEVEL	PERCENT	86A	47	95	100	70	100	87	22
(b) TELEGRAPH STATIONS	NUMBER	19	29	24	47	12	17	40	4
(c) TELEPHONE EXCHANGES	NUMBER	-	-	-	-	-	-	-	-
(4) POSTAL SERVICES									
(a) POST OFFICE / POSTAL STATIONS	NUMBER	28	40	24	47	12	17	46	18
(5) TRANSPORTATION	-	LAOG INTERNATIONAL AIRPORT, BUS LINES	TWO SMALL SEA-PORTS, FEEDER AIR-PORT, BUS LINES	FEEDER AIRPORT, SEAPORT, BUS LINES	TWO SEAPORTS, TWO FEEDER AIR-PORTS, BUS LINES	ONE MAJOR AIRPORT, 3 MAJOR PORTS, BUS LINES, MINI-BUS, JEEP	ONE MAJOR AIR-PORT, SEAPORTS, BUS LINES, MINI-BUS, JEEP	ONE MAJOR AIR-PORT, SEAPORT, PUBLIC UTILITY VEHICLES	ONE SEAPORT, 2 FEEDER AIRPORTS BUS LINES, JEEP
(6) BANKING FACILITIES	-	PNB, DBP AND 45 RURAL, COMMERCIAL AND THIFT BANKS	ABOUT 30 RURAL AND COMMERCIAL BANKS	15 LARGE BANK-ING INSTITUTIONS	ABOUT 70 RURAL AND COMMERCIAL BANKS	PNB, DBP, BPI, METRO BANK, ALLIED BANK, OTHER	29 BANKS INCLU-DING PNB & DBP	67 COMMERCIAL AND RURAL BANKS	PNB, DBP, 2 OTHER COMMERCIAL BANKS, 9 RURAL BANKS
(7) INDUSTRIAL/ BUSINESS/ COMMERCIAL ESTABLISHMENTS	NUMBER	5,618	4,317	5,492	14,382	970	1,086	MANY BUT NUMBER NOT SPECIFIED	4,495
(8) TOURISM FACILITIES (HOTEL, RESORT, LODGING HOUSE INN, RESTAURANT, RECREATIONAL FACILITY, ETC.	NUMBER	346	455	710	969	24	18	ABOUT 800 ROOMS AT HOTEL & OTHER LODGING FACILITY, 35 RESTAURANTS	13

ITEM	UNIT	REGION I				REGION VI			
		ILOCOS NORTE	ILOCOS SUR	LA UNION	PANGASINAN	AKLAN	CAPIZ	ILOILO	ANTIQUE
(9) SCHOOLS									
(a) ELEMENTARY LEVEL	NUMBER	311				180	161	890	221
(b) SECONDARY LEVEL	NUMBER	42	(582)	(90)	(1663)	42	38	119	55
(c) TERTIARY LEVEL	NUMBER	8				8	7	48	8
(10) HEALTH FACILITIES									
(a) HOSPITALS/CLINICS	NUMBER	10	15	40	47	9	8	20	9
(b) MAIN HEALTH CENTERS/RURAL HEALTH UNITS/BARANGAY HEALTH CENTERS/BARANGAY HEALTH STATIONS, ETC.	NUMBER	22	154	115	406	130	108	364	203
(11) LABOR									
(a) LABOR FORCE PARTICIPATION RATE	PERCENT	69.7	65.5	62.5	59.9	90.0	72.6	62.8	56.8
(b) EMPLOYMENT RATE	PERCENT	96.8	96.8	96.8	96.0	96.0	95.6	93.0	86.4
(12) FAMILY INCOME AND EXPENDITURE									
(a) MONTHLY INCOME	P	3,360	1,920	3,000	2,440	1,200	2,070	1,500	1,460
(b) MONTHLY EXPENDITURE	P	2,899	1,880	2,830	1,950	-	1,860	-	1,270

SOURCE: 1987 OR 1989 SOCIO-ECONOMIC PROFILE, PROVINCIAL PLANNING AND DEVELOPMENT OFFICE, RESPECTIVE PROVINCE

TABLE 3.2 (2 OF 2)

based on 1987 or 1988 statistics, except for the family income and expenditure which are based on 1983 or 1985 data.

Significant information provided by the tabulated socio-economic and basic infrastructure data are:

- Barangays in the Region I provinces seem to be more accessible by roads compared to Region VI provinces based on the ratio of the length of barangay roads to the total. This ratio is more than 60 percent in the former and less than 60 percent in the latter region.

- Electricity is available in all municipalities except in Ilocos Sur where only 82 percent of towns are electrified. In the barangay level, coverage ranges from 51 percent in Capiz to 95 percent in Ilocos Norte. Only 28 percent of households in Capiz have electricity while 96 percent enjoy this benefit in Ilocos Norte.

- Telecommunication facilities in all provinces are provided by telegraph stations of the Bureau of Telecommunications (BUTEL) supplemented by private telephone/telegraph offices in some provinces.

- Postal services are provided by the Bureau of Posts in all provinces, although no data on the number of postal stations is available for some areas.

- Transportation facilities in Region I are mostly land-based except in Laoag where air passenger transport is available. There are also several seaports and feeder airports for emergency. In Region VI, major airports exist in the capital city/town of Aklan, Capiz and Iloilo. Land travel within Panay island is provided by bus, jeepney, etc., although access to a number of barangays in Antique and Aklan is difficult. Regular boat trips between Manila and the provincial capitals are available.

- Labor force participation rate of persons 15 years old and over is highest in Capiz with 72.6 percent and lowest in Antique with 56.8

percent. Range of employment rate is 86.4 percent in Antique to 96.8 percent in Ilocos Norte.

- Aklan has the lowest average monthly household income with ₱1,200 while Ilocos Norte seems to be the most affluent with ₱3,360. In terms of average monthly household expenditure, Ilocos Norte is highest with ₱2,899, Aklan probably the lowest (the figure is not given), and Antique coming in the second lowest with ₱1,270.

Data/information that pertain to water supply and sanitation conditions are described separately in the succeeding section.

3.4 Present Situation of the Related Sectors in the Areas

3.4.1 Health and Sanitation Conditions

Based on 1986 sanitation facilities information, 73.6 percent of households in the Project Area had sanitary type toilets. Households with only insanitary toilets constituted 12.9 percent and those households without any toilet facilities comprised the remaining 13.5 percent. Regional and provincial breakdowns of the sanitation facilities status are shown in Table 3.3.

The DOH has implemented the World Bank-assisted First Rural Water Supply and Sanitation Project (FRWSSP) which spanned a 3-year period starting 1984. In this said project, a total of 750,000 plastic bowls were distributed to rural households in an effort to increase sanitary toilet facilities coverage. Follow-up/monitoring of this work is currently on-going. To provide guidance and motivation on proper sanitation practices to the beneficiaries, the DOH has fielded sanitary inspectors nationwide.

Field visits to elementary schools conducted by the Study Team reveal that, generally, the number of existing toilet units does not suit the number of pupils. As a rule, operation and maintenance is deterred if the facility is dilapidated. Sanitary practices are properly observed in schools with water supply system, but most school visited do not have such facilities for toilet use.

An overview of Project-associated health conditions is reflected in

TABLE 3.3 STATUS OF SANITATION FACILITIES
AS OF 1986

Region/ Province	Total Number of Households	Households with Sanitary Toilet		Households with Insanitary Toilet		Households without Toilet	
		Number	Percent	Number	Percent	Number	Percent
Region I							
Ilocos Norte	73,986	52,503	71.0	7,477	10.1	14,006	18.9
Ilocos Sur	84,712	68,946	81.4	1,491	1.8	14,275	16.8
La Union	82,807	59,787	72.2	17,920	21.6	5,100	6.2
Pangasinan	307,883	231,253	75.1	15,196	4.9	61,434	20.0
Total/Average for Region I	549,388	412,489	75.1	42,084	7.7	94,815	17.2
Region VI							
Aklan	66,504	48,302	72.6	9,669	14.6	8,533	12.8
Capiz	84,363	55,080	65.3	21,362	25.3	7,921	9.4
Iloilo	223,960	171,016	76.4	31,766	14.2	21,178	9.4
Antique	74,566	48,580	65.2	23,601	31.6	2,385	3.2
Total/Average for Region VI	449,393	322,978	71.9	86,398	19.2	40,017	8.9
Grand Total/Average	998,781	735,467	73.6	128,482	12.9	134,832	13.5

Source: DPWH/DOH, July 1989

Table 3.4 which shows the number of cases and incidence rates of waterborne and water-related diseases.

3.4.2 Water Service Situation

As of 1987, 67.3 percent of the population in the Project Area were served by public water supply systems. The remaining 32.7 percent drew their domestic water from open dug wells, unprotected springs, lakes and streams; ill-maintained and untreated rainwater cisterns, rainwater collectors and other sources which are in most cases unsafe. Regional and provincial breakdowns of the public water supply service status are shown in Table 3.5.

Additional information on water service situation as gathered from the field survey of the Study Team are as follows:

- Level III systems are provided by Water Districts (WD) in most provincial capitals and/or neighboring municipalities except in Antique. The WDs in some areas, notably Ilocos Sur, Aklan and Capiz, have on-going or planned expansion/improvement projects. In Poblacion Ibajay, Aklan, a Level III system has been constructed under the BWP but its deep well source is affected by saltwater intrusion. Some Level III systems that are deteriorated and need to be repaired exist in Ilocos Sur. The transmission line of the Level III system in Ivisan, Capiz, which has been in use for 40 years is deteriorated and leaks excessively.

- There are 128 Level II systems in Antique and 8 Level II systems servicing for 15 municipalities in Iloilo. Several systems of this level also exist in other provinces. In Ilocos Norte, Level II systems are small in size; in Ilocos Sur and Sara, Iloilo, facilities are deteriorated and need repair. The distribution pipeline of the Level II system in Poblacion Banga, Aklan, has excessive leakage and is not being used.

- Level I systems are predominant in all provinces. Common sources for these systems are shallow drilled wells, springs, dug wells, and some deep wells. In Capiz and Iloilo, these sources are supplemented by rainwater collectors. Surface water is being tapped for domestic use in some parts of Antique. About 30 percent of public wells in Ilocos Norte are not functioning or are not used either because their pumps are out of order and/or their

TABLE 3.4 REPORTED CASES AND DEATHS OF NOTIFIABLE WATERBORNE AND WATER-RELATED DISEASES

PROVINCE/ REGION	CHOLERA				TYPHOID				DIARRHEA				MALARIA				INFECTIOUS HEPATITIS				SCHISTOSOMIASIS				POLIOMYLITIS				H-FEVER				T.B.			
	MORBIDITY		MORTALITY		MORBIDITY		MORTALITY		MORBIDITY		MORTALITY		MORBIDITY		MORTALITY		MORBIDITY		MORTALITY		MORBIDITY		MORTALITY		MORBIDITY		MORTALITY		MORBIDITY		MORTA-LITY		MORBIDITY		MORTA-LITY	
	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R
REGION I																																				
I LOCOS NORTE	-	-	-	-	338	100	11	3.3	10,776	3189.4	59	17.5	124	36.7	0	0	252	74.6	3	0.9	3	0.9	1	0.3	3	2.4	0	-	16	4.7	0	0	3,942	574.8	207	61.3
ILOCOS SUR	7	1.5	1	0.6	37	7.9	7	1.5	4,461	950.4	71	15.1	110	23.4	0	-	157	33.4	8	1.7	0	-	0	-	0	-	0	-	0	-	0	-	885	289.3	278	59.2
LA UNION	15	3.1	13	2.7	297	60.7	32	4.3	8,153	1667.3	109	22.3	49	10	3	0.2	441	90.2	7	1.4	0	-	0	-	3	0.6	0	-	8	1.6	0	-	2,284	467.1	256	60.5
PANGASINAN	71	4.7	13	0.9	156	10.2	19	1.2	8,896	373.7	398	26.1	102	6.7	2	0.1	163	10.7	19	1.2	5	0.3	1	0.09	10	0.7	4	0.3	1	0.07	0	-	3,339	319	963	63.2
REGION VI																																				
AKLAN	6	1.7	3	0.8	3	0.8	3	0.6	3,227	914.6	82	23.4	6	1.7	0	-	89	25.2	6	1.7	4	1.1	1	0.3	3	0.8	2	0.6	0	-	0	-	937	265.6	260	73.7
CAPIZ	0	-	0	-	21	4.7	3	0.7	3,565	792.1	69	15.3	0	-	0	-	58	12.9	2	0.4	0	-	0	-	3	0.7	2	0.4	0	-	0	-	833	185	220	48.9
ILOILO	15	1.2	3	0.2	102	7.9	19	1.5	7,207	548.7	152	12.5	13	1	1	1	20	1.7	11	0.8	3	0.2	1	0.1	2	0.1	0	-	20	1.5	1	0.1	3,395	262	958	73.7
ANTIQUE	3	0.8	1	0.3	39	10.3	3	0.6	7,762	1055.7	104	25.5	0	0	0	0	219	58	6	1.6	2	0.5	0	-	3	0.8	2	0.6	0	-	0	-	2,395	607.3	407	107.8

SOURCE: DPWH, DOH, JULY 1989

NOTE: C = No. OF CASES
R = RATE / 100,000

TABLE 3.5 WATER SUPPLY SERVICE COVERAGE STATUS
AS OF 1987

Region/ Province	Total Population	Population Served by Public Facilities		Population Unserved by Public Facilities	
		Number	Percent	Number	Percent
Region I					
Ilocos Norte	314,445	227,312	72.3	87,133	27.7
Ilocos Sur	413,839	368,027	88.9	45,812	11.1
La Union	429,818	225,482	52.5	204,336	47.5
Pangasinan	1,249,878	899,037	71.9	350,841	28.1
Total/Average for Region I	2,407,980	1,719,858	71.4	688,122	28.6
Region VI					
Aklan	327,688	124,128	37.9	203,560	62.1
Capiz	497,149	255,137	51.3	242,012	48.7
Iloilo	1,059,443	808,037	76.3	251,406	23.7
Antique	315,479	195,818	62.1	119,661	37.9
Total/Average for Region VI	2,199,759	1,383,120	62.9	816,639	37.1
Grand/Average Total	4,607,739	3,102,978	67.3	1,504,761	32.7

Source: DPWH/DOH, July 1989

water level is lowered especially during the dry season. As a result, people are forced to use private driven wells and dug wells, and therefore are exposed to the danger of waterborne and water-related diseases. As another problem, wells located in the plains of Pangasinan experience frequent flooding during the rainy season, making them prone to unsanitary conditions.

CHAPTER 4

THE PROJECT

CHAPTER 4 THE PROJECT

4.1 Objectives

The improvement of living standards of the rural population through the provision of basic social infrastructures especially in water supply and sanitation sectors, which has been identified by the GOP as one of the strategies for development and efforts towards this direction, is being vigorously exerted by concerned authorities.

In line with this policy, the GOP is currently implementing the so-called Accelerated Water Supply Program, to implement the planned components of the program, Phase II of the Rural Environmental Sanitation Project has been conceived to help further extend adequate and safe water supply systems, sanitary facilities and health education to the depressed countrysides.

It is also expected to motivate people to practice proper sanitation for the improvement of the living environment. In particular, this practice is introduced early to the school children, who in turn will influence their families as well as the whole community.

Furthermore, the Project is anticipated to promote the construction /installation of similar projects nationwide, applying methodologies developed under the Project.

4.2 Evaluation of the Requested Project

4.2.1 Needs and Appropriateness of the Project

Rationales for the Project as brought forth by the GOP and as confirmed and additionally perceived during the field survey are:

o Inadequacy of public water supply coverage and sanitation facilities.

As of end 1987, only 62 percent of the population in the rural areas is served by public water supply systems while 69 percent of households are provided with sanitary toilet facilities. In terms of

both water supply and sanitation facilities coverage, some of the subject provinces have even lower percentage than the national average. Water sources adaptable in the rural are groundwater, spring and properly treated rainwater, since treatment of surface water is costly and financially unaffordable to the rural communities. With respect to groundwater sources in the subject areas, two problems confront the delivery of water to meet basic human needs/minimum drinking requirements. One is related to water quality mainly in terms of high iron/manganese contents without provision of treatment facilities in the inland area and saltwater intrusion in the coastal

o Deterioration of the environment in places where sanitation facilities are inadequate

Improper sanitation practices largely brought about by the lack of sanitary toilet facilitiesfaeces contribute to the gradual deterioration of the living environment. Bodies of water which are used as direct disposal points for human faeces are convenient conduits for the spread of contagious waterborne and water-related diseases. Conditions are worse during the rainy season when flood brings faeces from pit privies and other unsanitary toilet facilities to the surface and contaminate unprotected and improperly constructed wells or other sources of drinking water.

o Prevalence of waterborne and water-related diseases

Because of the inadequacy of public water supply and sanitation facilities, waterborne and water-related diseases like gastroenteritis, cholera, diarrhea and infectious hepatitis, have consistently ranked high among the leading causes of morbidity and mortality. Based on the 1983 statistics of the DOH, subject provinces covered by the request had morbidity (reported cases) rates of more than 1,000 per 100,000 population caused by the diseases, the highest being more than 7,000 per 100,000 population in one province.

With the construction/provision of water supply and sanitation facilities and introduction of sanitary practices in the selected communities, it is expected that the deterioration of the environment will be checked and diseases reduced gradually even if not drastically.

The following conditions/circumstances make the requested project of the GOP appropriate for implementation under the Grant-Aid Program of the GOJ:

- The proposed project will cater to the needs of depressed areas where the prospective beneficiaries are unable to shoulder the construction cost of facilities but can afford the cost for their operation and maintenance. Project components and sites, there fore, are of the types that have low priority in terms of cost recovery but are categorized as urgent when the national policy of social amelioration is taken into account.

- The GOP has reaffirmed its strong support to rural water supply development because of its urgency and high priority in the national development program. In fact, the Accelerated Water Supply Program is currently under operation to provide for the immediate construction and rehabilitation of 100,000 LevelI systems or point sources covering all barangays in the Philippines until June 1991.

- The Phase II Project is expected to contribute not only in the form of facilities but also motivation in sanitation improvement under the aforementioned special program in line with the 1988-2000 Water Supply, Sewerage and Sanitation Master Plan of the Philippines.

- The proposed undertaking is an impact project, which means that it can be implemented within a relatively short span of time while its benefits can be realized almost immediately after completion.

Objectives established in Phase I Project have been, in general, successfully attained. Phase II Project being a reapplication of solutions to problems which had obtained in the communities covered by the pilot phase, is expected to have the same impact or effect on its selected project sites. However, modification of requested project components and physical targets may have to be made to meet permissible duration requirement for construction of facilities under the Grant-Aid Program.

In addition, strict site selection criteria must be established and followed. These criteria should, at least, take into consideration such factors as socio-economic conditions; applicability of technology especially with respect to water source type, capacity and location, and willingness of prospective beneficiaries to participate in the construction, operation and maintenance, and management of facilities. It is also imperative that the officials/authorities from the provincial and municipal levels be involved in the site selection, in cooperation with the DPWH and DOH. Selection of candidate sites for these projects was carried out employing the above criteria and requirements.

4.2.2 Implementation Arrangements

Government agencies/organizations involved in the implementation of rural water supply and sanitation projects are the DPWH, LWUA, DLG and its Local Government Units (LGU), DOH, Department of Education, Culture and Sports (DECS) and Rural Waterworks and Sanitation Associations/Barangay Waterworks and Sanitation Associations (RWSA/BWSA). Responsibilities of these agencies/organizations are defined in administrative issues, principal and most recent among which are:

- Resolution No. 5 dated March 8, 1989, of the National Economic and Development Authority Board.

- Memorandum of Agreement on the Implementation of Level I Water Supply Projects, executed by and between the DPWH and the DLG.

- Memorandum of Agreement executed by and between the DPWH, DOH and DECS, which pertains to the formation and organization of BWSAs in conjunction with the Accelerated Program. (A Steering Committee for the Rural Water Supply Institutional Development Program was created to ensure the effective implementation of the Accelerated Water Supply Program through responsive institutional development approaches).

For the post-construction stage which entails training of end users, operation and maintenance of the facilities, and monitoring and

evaluation of performance, institutional and budgetary arrangements in existence with regard to the implementation of the Project are given hereunder:

- For Level I project, training of LGUs and BWSAs in the operation, maintenance and management of water supply systems is the principal undertaking of the DLG and the DPWH which provides the technical outputs and infrastructure aspects. The DPWH appropriates funds to help defray expenses of the DLG in connection with the conduct of the training. Operation and maintenance are funded by beneficiary contributions and are undertaken by the beneficiaries themselves with some technical assistance from the DPWH. Completed projects are managed by the beneficiaries through the BWSAs at minimal or no compensation. Monitoring and evaluation of the performance of facilities and operation of BWSAs are responsibilities of the DPWH with the assistance of the DOH and the DECS, and the budget for administration/supervision allotted to the respective projects are utilized as source of funds to sustain these activities.

- For the Level II and Level III projects, training of the RWSAs in operation, maintenance and management is being carried out by the LWUA with the cooperation of the DPWH during the transition period, as the responsibility has been only recently delegated to the LWUA where before it was the responsibility of the DPWH. Operation and maintenance of the projects are funded by part of the water tariff collection from the user households and are undertaken by the beneficiaries themselves with some technical assistance from the LWUA. Constructed systems are managed by the beneficiaries through the RWSAs of which personnel are duly compensated from part of the amount of water tariff collection. Monitoring and evaluation of the performance of facilities and operation of RWSAs will eventually be fully handled by the LWUA. Funds for monitoring and performance evaluation may come from the budget for administration/supervision allotted to the respective projects.

- For sanitary facilities constructed in public elementary schools, information dissemination of their importance and proper use are being effected by the teachers to their pupils through the joint

health education program being implemented by the DOH and the DECS. During the period of performance monitoring and evaluation, the DOH is in-charge of their operation and maintenance including the provision of necessary expenses related to the said activities. When these sanitation facilities are finally turned over to the DECS after the performance monitoring and evaluation, operation and maintenance become its full responsibility in terms of administration and finance.

Generally, the current institutional and budgetary arrangements for the implementation of components included in Phase II Project appear to be adequate as the functions and responsibilities of all involved agencies are clearly defined and, most especially, the fund sources for post-construction activities are assured. To further ensure the effective and efficient implementation of the Project, the PCC will be created under a Joint Department Order by the DPWH and DOH. The Committee will be charged with the tasks of over-all coordination during construction work with JICA representatives and the Project Consultant, and effecting smooth transfer of responsibilities to the beneficiaries upon completion of the Projects.

4.2.3 Relationship with Similar Locally Funded and Foreign-Assisted Projects

There are a number of rural water supply and/or sanitation projects that are either on-going or are lined up for implementation up to the year 2000 which are included under the Master Plan and the Accelerated Water Supply Program. Not able among the existing and planned undertakings are the Rural Water Supply and Sanitation Project which is being administered by the DLG, the Rural Water Supply IV Project of the DPWH and the Rural Water Supply Improvement project of the LWUA, which are all foreign-assisted. The Accelerated Water Supply Program is planned to be financed from loans, grants and local funds.

The policy and criteria established by the GOP seem to adequately define priorities for project implementation in certain respects. However, since the conditions of urgency for providing safe and adequate water supply occur practically throughout the entire rural areas in the country, allotments of foreign assisted programs are not

distinctly differentiated as to areas or provinces covered. Because of this, there had been duplications/overlaps in project coverage in the provincial level, but not in the sub project areas or in the community level.

Major Grant-Aid programs being availed of by the GOP are those offered by the United States Government and the GOJ. The United States Agency for International Development (USAID) sponsored Barangay Water Program of the DLG provides water supply services in widely scattered areas throughout the country. On the other hand, the GOJ grants in this sector are localized in a limited number of closely-clustered provinces, considering the factors/conditions obtaining in the areas like water service coverage, income and inadequacy of water supply both in quantity and quality.

Project development/evolution in the DPWH normally involves the prepa-ration of annual project proposals by the Regional Director's Office (RDO) and/or the District Engineering Office (DEO) after careful study of the merits and urgency of the projects: submittal of these project proposals by the RDO/DEO to the DPWH Central Office for evaluation: and decision of the Central Office authorities on the projects to be implemented based principally on the submitted proposals. In the subject regions of the Study (Region I and Region VI) thereare already quite a considerable number of Level I and Level II water supply systems constructed in application of the above procedures.

During the past 7 years, Region I have been the recipient of many LevelI and Level II Water supply systems, particularly those under the OECF funded Rural Water Supply Project which has so far been implemented in 3 phases. However, the implementation of some Level II projects had to be canceled after the feasibility study and preliminary engineering stages because of problems associated with the prospective beneficiaries inability to meet financial requirements and the insufficiency of source to cope with the demand.

In Region VI, specifically in Panay Island, the GOJ has extended Technical Cooperation to the LWUA in the Groundwater Development Study for selected urban areas. Water Districts will consequently be

established and Level II/III systems will be constructed in these areas through the technical and financial assistance of the LWUA. In principle, the specific area coverage of the above-mentioned Technical Cooperation project and this Project is different even if they are located in the same island, since the former covers the urban area while the latter covers the rural area. As a result of these two GOJ-assisted projects, therefore, areas of the island are ultimately served.

Furthermore, projects that are covered by grants are usually low priority in terms of the beneficiaries capability to repay construction cost as well as operation and maintenance costs even if these are classified as urgent by the RDO/DEO in their request to the DPWH Central Office. The projects to be selected under this grant will therefore be those that are marginally not cost-effective but of which operation and maintenance costs are affordable to the prospective beneficiaries as proposed by the provincial and municipal officials.

4.2.4 Composition of the Project

The request of the GOP consists of water supply systems, sanitation facilities, and equipment and vehicles for a total of 15 provinces covering three regions. Being totally interrelated and complementary, these combination of components are regarded as essential elements in the attainment of Project objectives which focus on the improvement of health and sanitation conditions.

Evaluation was made on the proposed area coverage, components and physical targets considering mainly the policy of the Grant-Aid Program and such other factors as optimization of benefits, number of physical targets, and practicality of implementation. The following recommendations have been developed based on the said evaluation:

- Project Area coverage shall be limited to the provinces of Region I and Region VI. Region X had been excluded in order that the Project could be implemented within a limited duration under the Grant-Aid Program considering that the request included widely dispersed areas in Luzon, Visayas and Mindanao and has considera-

bly more project sites than the Phase I Project.

- Water supply systems to be constructed shall be limited to Level I and Level II as they are deemed adequate to provide minimum water requirement in consideration of the present urgent needs of rural communities.

- Sanitary facilities shall include only school toilets in consonance with the concept of extending services on a public/communal systems basis and optimization of their use.

- For the recommended Project Area, the respective total number of Level I and Level II water supply systems, and school toilets in the request shall be considered for the technical study.

- Except for the deletion of the vacuum trucks, all equipment and service vehicle items shall remain as per request. Vacuum trucks may be applied for a Grant-Aid Program separately from the materials and the equipment.

- Based on experience in the number of facilities constructed for the Phase I Project which took one year to complete, the proposed Phase II Project requires a two-stage implementation period.

4.2.5 Requirements for Facilities, Equipment and Service Vehicles

The following discussions all refer to the requirements of the recommended Project components.

Water source facilities requested for Level I systems consist of either deep wells (with handpump or engine driven pump) or spring intakes. In addition to deep well with electric/engine driven pump or spring intakes, Level II systems are provided with transmission facilities, storage facilities (ground level reservoir or elevated storage tank) and distribution facilities. The type of source may change based on the results of the technical study but total number of systems shall remain essentially the same.

Sanitation facilities comprise school toilets of several standard

types, complete with common urinal and toilet bowls. More than one unit of toilet facility may be provided to a school depending on the number of pupils.

Major equipment/service vehicle requirements are truck mounted rotary drilling rig and service pick-up. Other equipment needed include pumping test equipment, water level indicator and water quality analysis equipment. The drilling machines will be used for deep well construction and will be turned over to the GOP upon completion of the said work. Pumping test equipment, water level indicator and water quality test kit will be utilized during the construction of the water supply systems particularly in the source development stage as well as in rehabilitation and other maintenance works. Service pick-ups are essential to the DEOs and Provincial Health Offices (PHO) in carrying out operation and maintenance activities for this Project, considering present arrangements and needs of these local offices.

Results of the study on the equipment and service vehicles requested are summarized in the ensuing paragraphs.

(1) Well drilling rig

Two (2) units of truck-mounted rotary type drilling machine shall be provided to the Project particularly for use in deep well construction. Drilling requirements for the Project are the following:

- Bit diameter of 200 mm and 250 mm for the construction of Level I and Level II wells, respectively, to provide for open-hole drilling and gravel packing.

- Drilling depth of around 100 m, to provide for deeper wells of more than 10 nos.

- Drilling rig, appropriate for deeper well construction must be assured to cope with the limited construction period.

The following information reflects the conditions of the well construction field both in the government and private sectors in the Philippines and in the Project Area:

o As of 1988, the DPWH has the following type (with drilling capacity) and number of drilling rig:

TABLE 4.1 EXISTING DRILLING RIGS IN THE DPWH

Type of Drilling Rig	No. of Unit	Drilling Capacity/Use
Truck-mounted percussion	74	Deep well
Trailer-mounted percussion	22	Deep well
Portable/mechanized rotary	83	Shallow well
Truck-mounted rotary	5	Deep well
Trailer-mounted rotary	3	Shallow/deep well
Hand-feed type rotary	35	Shallow well

Source: DPWH Central Office

Allotment of these machines to the provinces covered by the Project is listed in Table 4.2, which significantly shows the minimal number of drilling rigs and the absence of truck-mounted rotary drilling rig.

o In the government, the principal agencies involved in rural water supply development and well construction are the DPWH and the LWUA.

LWUA, which is responsible for the development of Level II and Level III water sources, make contracts with on most of its well construction jobs. The DEOs of the DPWH, which are concerned with the construction of Level I systems, generally have a pair of drilling rig each one percussion and one rotary type. However, because of the creation of new DEOs this year, some DEOs are left without such rigs. In addition, the portable mechanized rigs, one of the common rigs assigned to many DEOs, are not used for drilling under hard strata conditions, hence its capability is limited to soft formations along coastal areas.

The existing drilling rigs, most of which are deteriorated because of long use and some are not functioning, are scheduled to be used for the Accelerated Water Supply Program. Available bit diameter of these rigs is up to 200 mm. Under these situations, only about 25 percent of drilling work in the DPWH is undertaken by force account. On the other hand, some of the contracted work are performed employing rented DPWH machine because of the general shortage of drilling

TABLE 4.2 DISTRIBUTION OF EXISTING DRILLING RIGS IN THE DEOs OF SUBJECT PROVINCES

Region/ Province	Percussion		Rotary			
	Truck	Trailer	Portable	Truck	Trailer	Handfeed
REGION I Ilocos Norte	1		1			1
Ilocos Sur I	1		1			
Ilocos Sur II		1			1	
La Union			1			
Pangasinan I	1		1			1
Pangasinan II	1		1			
Total	4	1	5	0	1	2
REGION VI Aklan		1	1			1
Capiz		1	1			1
Iloilo I	1		1			
Iloilo II			1			1
Antique	1		1			1
Total	2	2	5	0	0	4

Note: Some of the drilling machine are not functioning. Portable mechanized rotary rig is applicable only for shallow well construction under soft strata conditions/coastal areas. Handfeed type drilling machine was procured in 1989 to construct a huge number of shallow wells under OECF RWS III Project.

Source: DPWH, Central Office

o Private well drilling companies which are usually engaged by the DPWH are those that are locally based and with limited construction capability. About 10 to 20 of the bigger companies are all based in Manila and most of their work are in connection with the LWUA and National Irrigation Administration (NIA) projects. Based on an interview with an authority of a big drilling company in Manila, there are only less than 50 units of drillings rigs with 250 mm or larger diameter bit in the entire Philippines.

- Among the existing drilling rigs assigned to the subject provinces, only one rotary drilling rig capable of penetrating hard formation may be available for this Project, only if this Project is given priority over those scheduled under the Accelerated Water Supply Program. It will be, likewise, difficult and uncertain to make timely arrangements on the required drilling rig with the private sector.

In view of all the above conditions, two units of truck-mounted rotary drilling rigs, to enable mobilization in the distributed sites without the need for a towing vehicle, are required for the implementation of the Project. After completion of this Project, these rigs will also be utilized fully to help expedite the on-going Accelerated Water Supply Program.

Around 20 deep wells with depths in the range of more than 50 m will be constructed through these drilling rigs. Technology transfer to concerned DPWH and LWUA field personnel will also be carried out.

(2) Service vehicles

All DEOs and PHOs in the subject provinces shall be furnished with one service pick-up each.

The said vehicles will be used in the Project for the following purposes:

- Vehicles are required to provide mobility for technical assistance by the DEOs to individual RWSAs/BWSAs during the post-construction stage, considering that the project sites are remote (average of 20 to 30 km from DEO) and widely dispersed. The assistance work includes technical training, repair/rehabilitation of facilities, and monitoring. These activities are required at least once a month for each site, hence numerous round trips have to be made between the DEO and the sites to procure materials and to provide other assistance as may be needed.

- PHOs need the vehicles for the conduct of seminar/information

dissemination on sanitation improvement in relation to the proper use of school toilets. Monitoring activities covering 15 schools alloted to each province with average distance of 20 to 30 km from the respective PHO would likewise necessitate the use of vehicles.

The following information reflects the existing situation in the DEOs and PHOs with regard to service vehicles:

o Existing vehicles of the DEOs in the subject provinces, as of 1989, are listed in Table 4.3.

It can be gleamed from the said table that the number of service vehicles in each DEO is minimal or even insufficient. Moreover, most of these were procured at the beginning of 1980, which would clearly explain their functional status.

TABLE 4.3 EXISTING VEHICLES IN DEOs OF SUBJECT PROVINCES AS OF 1989

REGION	DEO	JEEP	PICK-UP		
		NO.	NO.	PROCURED YEAR	RELATED PROJECT
I	Ilocos Norte		1	1980	OECF 7TH
	Ilocos Sur I	1	1	1980	OECF 7TH
	Ilocos Sur II				
	La Union	1	1	1980	OECF 7TH
	Pangasinan I		1	1980	OECF 7TH
	Pangasinan II		1	1982	OECF 7TH
VI	Aklan	1	1	1980	PRIP - I
	Capiz	1	1	1980	PRIP - I
	Iloilo I		1	1980	OECF 7TH
	Iloilo II		1	1983	OECF 7TH
	Antique	1	1	1980	PRIP - I

Source: DPWH, Central Office

o Water supply sector represents only about 6 percent of the total investment cost in the past 3 years as per the Infrastructure Program of DPWH shown below.

TABLE 4.4 1987-1989 DPWH INFRASTRUCTURE PROGRAM

Category	Amount in Thousand Pesos		
	1987	1988	1989
1. Highways	4,796,962	5,577,559	8,105,033
2. Ports	327,743	413,830	712,550
3. Flood Control	917,324	933,913	1,390,705
4. Water Supply	486,321	506,516	800,000
5. School Bldg.	883,613	916,000	1,300,000
6. National Bldg.	14,000	16,000	36,000
7. Urban Infra.	217,921	232,652	376,000
8. Others	-	-	-
TOTAL	7,643,884	8,596,470	12,720,288

Source: DPWH Central Office

Under this situation, the use of existing service vehicles for water supply activities is curtailed, the priority being given to other sectors like highways, flood control, and school buildings which represent some 85 percent of the total expenditure for the infrastructures. The implementation of the Accelerated Water Supply Program has also given rise to the creation of a water supply section in many DEOs. These new sections in the DEOs have been staffed but are not provided with vehicles of their own, thus making it difficult for them to conduct field activities.

o The PHOs generally do not have service vehicles except for medical service cars (ambulance).

Considering the above critical needs for service vehicles, one pick-up for each DEO and PHO, are deemed imperative for follow-up and eventually ensure the successful implementation of the Project.

(3) Pumping test equipment, water quality analysis equipment and water level indicator

These are basic equipment which are essential not only in the construction of water source facilities but also in the monitoring of change in water quality and/or quantity of well sources. In principle, it is advisable to have one set of each equipment ready during a drilling operation. Present allocation of these equipment per subject region is given as follows based on DPWH information:

Equipment	Number	
	Region I	Region VI
Pumping test	1	2
Water quality analysis	5	14
Water level indicator	6	12

Source: DPWH Central Office

Shortage or need for these equipment is anticipated to arise with the huge number of well sources programmed for development, and the need for their effective use in this Project. One set of each equipment for every subject DEO would be required to fill in this shortage. Technology transfer to concerned field personnel shall be provided, not only in the use of these equipment during construction, but also in effective utilization of the data for the future in the post-construction stage.

4.2.6 Needs of the Technical Cooperation

Technical assistance in the field of water supply has been provided bya JICA specialist in the PMO-RWS after Phase I project. However it is further necessary to extend field assistance especially in the rural area.

Based on the study of the various aspects of the Project, problems and needs which can be possibly addressed by technical cooperation are the following:

- Promotion of the use of open-hole drilling and gravel packing as these construction methods are not still being adopted widely despite several training programs advocating such practice.

- Although apparently a factor which is being considered seriously by the GOP, operation and maintenance may emerge as a problem especially in the barangay beneficiary/operator level.

4.2.7 Conclusion and Basic Policy in Provision of Grant-Aid Program

Summary of the study made on the request of the GOP together with the conclusions drawn as a result of the evaluation are described hereunder:

- o The Project is deemed in line with the national policy of improvement of living standards of the rural population as it strives to extend the benefits of healthy and hygienic living including the reduction of waterborne and water-related diseases to the most needy or depressed areas of the countrysides. The Phase I Project carrying the same objectives as this Project had been successfully implemented, which fact attests to its appropriateness.

- o The present institutional and budgetary arrangements relevant to the implementation of the Project appear to be adequate as the functions and responsibilities of all involved agencies are clearly defined and, more importantly, the fund sources for post-construction activities are assured. To further ensure effective and efficient implementation, a committee will be created to handle over-all coordination with JICA representatives and the Project Consultants, and over-all direction in planning and execution.

- o The proposed Project is justified for inclusion under the Grant-Aid Program because it will serve communities which are unable to shoulder the construction cost of facilities but can otherwise afford the cost of operation and maintenance, making it principally a socially-oriented project.

- o Reductions in area coverage and components of the project are recommended after a careful study based mainly on the policy of the Grant-Aid Program. However, number of physical targets for each component item in the agreed areas has remained essentially the same as per request with the condition that facilities shall be constructed in two stages.

In view, therefore, of its effects and practicality as manifested by the likely benefits it would bring, the capability of the GOP to

implement post-construction activities, and its compatibility with the mechanism of a grant project, Phase II Project is recommended for implementation under the GOJ Grant-Aid Program. The planning and basic design study for the Project, on the assumption of its acceptance for grant-aid assistance, shall be carried out based on the modified area coverage, components and physical targets described above.

4.3 Project Description

4.3.1 Organization and Management for Implementation of the Project

Agencies/institutions involved and their respective functions as well the composition and responsibilities of the PCC for this particular project are given and discussed in preceding sections of this Report. Relevant information with regard to post-construction stage particularly in the operation and maintenance aspects are as follows:

- Operation, maintenance and management of water supply systems are taken care of by the RWSAs/BWSAs with the technical assistance of the DPWH and LWUA. For sanitation facilities, these activities are undertaken by the school personnel concerned with assistance from the DOH.

- Training in operation, maintenance and management is principally handled by DLG supported technically by the DPWH, LWUA and DOH for water supply, with the RWSAs/BWSAs as recipients of the training. Similar training activity for sanitation aspect is undertaken jointly by the DOH and DECS, with the beneficiaries/school children and concerned school personnel as recipients of the training.

- Performance monitoring of water supply systems is the responsibility of the DPWH and LWUA with the active participation of the DLG, LGUs, provincial/municipal councils. DOH, DECS and Non-Government Organizations (NGOs). Problems encountered in connection with the activity are acted upon by the DPWH and the LWUA. For the sanitation facilities, performance monitoring is carried out by the DOH and DECS.

Although specific functions of the PCC as contained in the creating