

CHAPTER 2
OUTLINE OF THE REGION

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2.1 LAND AND CLIMATE

The Kingdom of Thailand with an area of 514,000 km² is situated in the center of the Southeast Asian mainland between latitude 5° and 20° north and longitude 97° and 105° east. The area of the Central Region (the Region) of 104,000 km² including Bangkok's 1,600 km² occupies 20% of the whole area of Thailand. The Region which faces the Gulf of Thailand spreads over a wide plain of the largest grain producing area along the Chao Phya River. The Region is bordered on the north by the Northern Region with low highlands, on the south by the Southern Region, a part of the Malay Peninsula, on the east by the Northeastern Region with the Khorat Plateau and the Cambodian border, and on the west by the Burmese border.

Temperatures in Thailand are high in April and May, and low in December and January. In the Region, the average highest temperature is about 31°C recorded in April and the average lowest is about 25°C in January.

Annual average rainfall in the Region varies from 800 mm to 1,800 mm. About 90% of the annual rainfall is concentrated in the rainy season during the period May through October.

2.2 SOCIAL CONDITIONS

2.2.1 Administration

For regional administration, Thailand is divided into Changwats, which are further subdivided into Amphoes, Tambons and Bans. The governors of Changwats and Amphoes are appointed by the central government, while the heads of Tambons and Bans are elected.

Of Thailand's 73 Changwats, the following 25 Changwats in the Region and two Changwats, Nakhon Sawan and Uthai Thani, in the Northern Region are included in the study area:

Chai Nat, Sing Buri, Lop Buri, Ang Thong, Saraburi, Suphan Buri, Ayutthaya, Nakhon Nayok, Kanchanaburi, Pathum Thani, Prachinburi, Nakhon Pathom, Nonthaburi, Chachoengsao, Samut Prakan, Samut Sakhon, Ratchaburi, Samut Songkhram, Chon Buri, Rayong, Chanthaburi, Trat, Petchaburi, Prachuap Khiri Khan and Bangkok.

2.2.2 Population

Thailand had a total population of 52,969,000 or 103 persons per km² as of 1986. The average annual growth rate during the period 1981-1986 was 2.0%. The Central Region had a population of 17,319,000 thousand persons or 167 persons per km² and 32.7% of the total population. The average annual growth rate was 1.8% during the same period. Population by region is shown in the following table:

Table 2.2.1 POPULATION BY REGION IN 1986

| Region | Population (thousand persons) | Density (persons/ km ²) | Distribution (%) | Average Annual Growth Rate 1981- 1986 (% per annum) |
|---------------|-------------------------------------|---|---------------------|---|
| Whole Kingdom | 52,969 | 103 | 100 | 2.0 |
| Central | 17,319 | 167 | 32.7 | 1.8 |
| Northern | 10,490 | 62 | 19.8 | 1.6 |
| Northeastern | 18,552 | 110 | 35.0 | 2.5 |
| Southern | 6,608 | 93 | 12.5 | 2.2 |

Source: National Statistics Office (NSO)

Nakhon Sawan with a total population of 1,053,000 was the largest. Changwats showing both high population density and average annual growth rate are located around Bangkok, such as Nonthaburi, Pathum Thani, Samut Sakhon, and Samut Prakan.

Population by Changwat and Amphoe are shown in Table 2.2.2 and Appendix 2.2.1, respectively.

2.2.3 Social Facilities

Changwat and Amphoe centers play an important part in political, administrative, educational and economic activities.

The number of secondary schools and hospitals, which are key elements in social impact brought about by road development, are shown in Appendix 2.2.2.

2.3 ECONOMIC CONDITIONS

2.3.1 Gross Regional Product (GRP)

In 1985, the Gross Domestic Product (GDP) reached 1,047 billion Baht and 20,263 Baht per capita with an average annual growth rate of 5.0% during the period 1981–1985.

The Gross Regional Product (GRP) of the Region reached 663 billion Baht and 39,265 Baht per capita with an average annual growth rate of 5.1% during the same period and was 63% of GDP.

Manufacturing is the most productive sector and occupied 19.8% of the total GDP in 1986 followed by wholesaling and retailing with 18.2%, agriculture with 17.4% and the service sector with 11.0%.

They are shown in Tables 2.3.1 and 2.3.2.

Table 2.2.2 POPULATION BY CHANGWAT IN 1986

| Changwat | Population (thousand persons) | Density (persons/km ²) | Average Annual Growth Rate 1981-1986 (%) |
|---------------------|----------------------------------|---------------------------------------|--|
| Bangkok | 5,469 | 3,486 | 2.3 ¹ |
| Nakhon Sawan | 1,053 | 99 | 1.3 |
| Uthai Thani | 289 | 43 | 1.6 |
| Chai Nat | 343 | 130 | 0.7 |
| Nonthaburi | 525 | 845 | 5.4 |
| Pathum Thani | 402 | 263 | 3.9 |
| Ayutthaya | 664 | 261 | 1.2 |
| Lop Buri | 720 | 117 | 1.7 |
| Saraburi | 504 | 149 | 1.2 |
| Sing Buri | 219 | 267 | 1.4 |
| Ang Thong | 274 | 279 | 1.3 |
| Kanchanaburi | 634 | 33 | 3.1 |
| Nakhon Pathom | 618 | 284 | 1.6 |
| Prachuap Khiri Khan | 406 | 64 | 1.3 |
| Petchaburi | 412 | 65 | 2.1 |
| Ratchaburi | 691 | 135 | 1.1 |
| Samut Sakhon | 328 | 385 | 3.9 |
| Samut Songkhram | 205 | 495 | 0.8 |
| Suphan Buri | 797 | 149 | 2.2 |
| Chachoengsao | 541 | 100 | 1.7 |
| Chon Buri | 836 | 186 | 2.5 |
| Trat | 176 | 62 | 4.6 |
| Nakhon Nayok | 215 | 89 | 1.2 |
| Prachinburi | 816 | 69 | 4.7 |
| Rayong | 431 | 130 | 2.7 |
| Samut Prakan | 690 | 775 | 4.3 |
| Chanthaburi | 403 | 67 | 3.4 |

Note: ¹: 1985-1986

Source: NSO

Table 2.3.1 GRP IN 1985

| Region | GRP (billion Baht) | Average Annual Growth Rate 1981-1985 (%) | Distribution (%) | Per Capita GRP (Baht) |
|---------------|--------------------------|---|---------------------|-----------------------------|
| Whole Kingdom | 1,047 | 5.0 | 100.0 | 20,223 |
| Central | 663 | 5.1 | 63.3 | 39,265 |
| Northern | 136 | 4.9 | 13.0 | 13,089 |
| Northeastern | 146 | 5.6 | 14.0 | 8,083 |
| Southern | 102 | 3.8 | 9.7 | 16,171 |

Source: National Economic and Social Development Board (NESDB)

Table 2.3.2 GDP BY SECTOR IN 1985

(Unit: million Baht)

| Sector | GDP | Distribution (%) |
|------------------------------------|-------------|---------------------|
| Agriculture | 182,279.3 | 17.4 |
| Mining | 29,279.4 | 2.8 |
| Manufacturing | 207,418.4 | 19.8 |
| Construction | 53,758.1 | 5.1 |
| Electricity & Water Supply | 21,645.3 | 2.1 |
| Transportation | 96,253.8 | 9.2 |
| Wholesale & Retail Trade | 190,675.8 | 18.2 |
| Banking Insurance & Real Estate | 89,750.9 | 8.6 |
| Ownership of Dwellings | 13,706.1 | 1.3 |
| Public Administration & Defence | 47,058.1 | 4.5 |
| Service | 115,467.0 | 11.0 |
| Total | 1,047,292.2 | 100.0 |

Source: National Economic and Social Development Board (NESDB)

2.3.2 Gross Provincial Product (GPP)

The Gross Provincial Product (GPP) of related Changwats in 1985 is shown in Table 2.3.3. Except for Bangkok, Samut Prakan was the most productive Changwat at 39,896 million Baht and 62,827 Baht per capita with an average annual growth rate of 4.7%, followed by

Chon Buri at 36,714 million Baht and Pathum Thani at 17,451 million Baht. Details are shown in Appendix 2.3.1.

2.3.3 Average Income

Based on the Year Book of Labour Statistics 1985, the average monthly income of Bangkok was the highest at 4,589 Baht, followed by 4,191 Baht in 5 changwats (Samut Prakan, Samut Sakhon, Nakhon Pathom, Nonthaburi and Pathum Thani) 3,834 Baht in the Southern Region, 3,573 Baht in the Central Region, 3,193 Baht in the Northern Region and 2,875 Baht in the Northeastern Region.

In the Region, the Changwats showing a higher income than the average of the whole Kingdom are Nonthaburi, Pathum Thani, Chachoengsao, Saraburi, Sing Buri and Suphan Buri.

The average monthly income by Region is shown below and that by Changwat in Table 2.3.4.

AVERAGE MONTHLY INCOME BY REGION

| Region | Average Income (Baht) |
|----------------------------|--------------------------|
| Whole Kingdom | 4,084 |
| Bangkok | 4,589 |
| 5 Changwats around Bangkok | 4,191 |
| Central | 3,573 |
| Northern | 3,193 |
| Northeastern | 2,875 |
| Southern | 3,834 |

Source: Year Book of Labour Statistics 1985, Department of Labour,
Ministry of Interior

Table 2.3.3 GPP IN 1985

| Changwat | GPP (million Baht) | Average Annual Growth Rate 1981-1985 (%) | Per capita GPP (Baht) |
|---------------------|-----------------------|--|-----------------------------|
| Bangkok | 389,056.4 | 5.2 | 68,532 |
| Nakhon Sawan | 13,367.0 | 4.3 | 13,117 |
| Uthai Thani | 4,159.4 | 6.5 | 14,961 |
| Chai Nat | 5,204.6 | 2.2 | 15,629 |
| Nonthaburi | 8,392.8 | 4.6 | 17,857 |
| Pathum Thani | 17,450.5 | 13.1 | 47,809 |
| Ayutthaya | 8,199.5 | 5.6 | 12,872 |
| Lop Buri | 9,744.9 | 3.9 | 14,544 |
| Saraburi | 12,676.0 | 4.8 | 26,881 |
| Sing Buri | 3,505.6 | 5.5 | 16,773 |
| Ang Thong | 3,933.3 | 3.7 | 14,731 |
| Kanchanaburi | 15,929.7 | 2.6 | 26,373 |
| Nakhon Pathom | 12,105.8 | 4.5 | 20,345 |
| Prachuap Khiri Khan | 10,319.0 | 6.5 | 26,058 |
| Petchaburi | 8,425.7 | 6.0 | 20,959 |
| Ratchaburi | 15,289.9 | 4.4 | 22,719 |
| Samut Sakhon | 7,605.4 | 2.7 | 25,351 |
| Samut Songkhram | 2,383.0 | 2.9 | 11,915 |
| Suphan Buri | 11,364.1 | 2.7 | 15,111 |
| Chachoengsao | 13,828.7 | 1.1 | 27,168 |
| Chon Buri | 36,713.6 | 5.5 | 47,068 |
| Trat | 3,661.9 | 7.4 | 22,886 |
| Nakhon Nayok | 2,705.4 | 2.7 | 13,006 |
| Prachinburi | 8,776.6 | 7.0 | 11,844 |
| Rayong | 9,173.1 | 8.6 | 22,875 |
| Samut Prakan | 39,895.5 | 4.7 | 62,827 |
| Chanthaburi | 6,329.3 | 1.2 | 17,014 |

Source: NESDB

Table 2.3.4 AVERAGE MONTHLY INCOME BY CHANGWAT IN 1985

| Changwat | Average Income (Baht) | Changwat |
|---------------------|-----------------------------|----------------------|
| | | Whole Kingdom (%) |
| Whole Kingdom | 4,084 | (100) |
| Bangkok | 4,589 | 112 |
| Nakhon Pathom | 2,684 | 66 |
| Nonthaburi | 4,956 | 121 |
| Pathum Thani | 4,296 | 105 |
| Samut Prakan | 3,913 | 96 |
| Samut Sakhon | 2,733 | 67 |
| Kanchanaburi | 3,241 | 79 |
| Chanthaburi | 2,615 | 64 |
| Chachoengsao | 4,433 | 109 |
| Chon Buri | 3,575 | 88 |
| Chai Nat | 3,258 | 80 |
| Trat | 3,900 | 95 |
| Nakhon Nayok | 2,630 | 64 |
| Prachuap Khiri Khan | 2,575 | 63 |
| Prachinburi | 2,993 | 73 |
| Ayutthaya | 3,641 | 89 |
| Petchaburi | 2,718 | 67 |
| Rayong | 2,638 | 65 |
| Ratchaburi | 2,916 | 71 |
| Lop Buri | 2,735 | 67 |
| Samut Songkhram | 3,022 | 74 |
| Saraburi | 4,754 | 116 |
| Sing Buri | 4,705 | 115 |
| Suphan Buri | 4,980 | 122 |
| Ang Thong | 3,494 | 86 |
| Nakhon Sawan | 3,977 | 97 |
| Uthai Thani | 3,402 | 83 |

Source: Year Book of Labour Statistics 1985, Department of Labour, Ministry of Interior

2.3.4 Industry

(1) Employed Persons

Based on the Year Book of Labour Statistics, employed persons in the whole Kingdom in 1986 was 21,494,000. In the Region, employed persons amounted to 33.6% of the national total or 7,213,900 persons.

EMPLOYED PERSONS BY REGION IN 1986

| Region | Employed Persons | Distribution (%) |
|---------------|------------------|------------------|
| Whole Kingdom | 21,494,000 | 100.0 |
| Central | 7,213,900 | 33.6 |
| Northern | 4,852,600 | 22.6 |
| Northeastern | 7,058,200 | 32.8 |
| Southern | 2,369,300 | 11.0 |

Source: Year Book of Labour Statistics, Department of Labour, Ministry of Interior

Of the total employed persons in 1986, the sectors involving agriculture, forestry, hunting and fishing occupied 58.9%, followed by services with 11.5%, manufacturing with 10.9% and commerce with 10.7%.

EMPLOYED PERSONS BY INDUSTRY IN 1986

| Industry | (%) |
|---|-------|
| Total | 100.0 |
| Agriculture, Forestry, Hunting and Fishing | 58.9 |
| Mining and Quarrying | 0.5 |
| Manufacturing | 10.9 |
| Construction, Repair and Demolition | 3.5 |
| Electricity, Gas, Water and Sanitary Services | 0.6 |
| Commerce | 10.7 |
| Transport, Storage and Communication | 3.4 |
| Services | 11.5 |

Source: Year Book of Labour Statistics, Department of Labour, Ministry of Interior

(2) Land use

Of the total land in 1984, there was forest land of about 94,695 thousand Rai or 29.5% of the whole area, farm holding land of about 125,314 thousand Rai or 39.1% and unclassified

land of about 100,688 thousand Rai or 31.4%.

In the Region, farm holding land showed the highest share of about 44.0% or 28,600 thousand Rai, followed by forest land of 24.7% or 16,025 thousand Rai. Shares of farm holding land by type in the total were 59% for paddy, 24% for field crops and 10% for fruit trees and tree crops.

Kanchanaburi, Phetchaburi and Chanthaburi in the Region have a high percentage of forest land use. They were about 61%, 38% and 31%, respectively, in 1984.

LAND USE, 1984

| Item | (Unit: Rai and (%)) | |
|----------------------------------|---------------------|-------------------|
| | Whole Kingdom | Central |
| Total Land | 320,696,888 (100) | 64,938,253 (100) |
| Forest | 94,695,463 (29.5) | 16,024,966 (24.7) |
| Farm Holding | 125,313,764 (39.1) | 28,599,512 (44.0) |
| Housing Area | 2,772,354 (0.9) | , 654,659 (1.0) |
| Paddy Land | 73,909,386 (23.1) | 15,089,328 (23.2) |
| Under Field Crops | 30,032,711 (9.4) | 9,196,391 (14.2) |
| Under Fruit Trees and Tree Crops | 12,059,438 (3.8) | 2,369,019 (3.6) |
| Under Vegetables and Flowers | 410,066 (0.1) | , 168,559 (0.3) |
| Grass Land | 752,590 (0.2) | , 183,739 (0.3) |
| Idle Land | 3,652,602 (1.1) | , 450,221 (0.7) |
| Other Land | 1,724,617 (0.5) | , 487,596 (0.7) |
| Unclassified Land | 100,687,661 (31.4) | 20,313,775 (31.3) |

Source: Agricultural Statistics of Thailand Crop Year 1985/86, Center for Agricultural Statistics, Ministry of Agriculture & Co-operatives

Detailed land use by Changwat is given in Appendix 2.3.2.

(3) Agriculture

The planted area in the Region occupies the major portion of the whole Kingdom, amounting to 70% of the total planted area of the country in 1986. Paddy is the widest followed by maize, cassava, sugarcane, sorghum and groundnuts.

Crop productivity in the Region is comparatively high due to well developed irrigation.

PLANTED AREA AND PRODUCTION IN 1986

| Products | Whole Kingdom | | | | Central | | | |
|------------|----------------|------------------|-----------------|---------------|----------------|------------------|-----------------|---------------|
| | Planted Area | Harvest -ed Area | Product -ion | Yield per Rai | Planted Area | Harvest -ed Area | Product -ion | Yield per Rai |
| | (thousand Rai) | (thousand Rai) | (thousand tons) | (kg) | (thousand Rai) | (thousand Rai) | (thousand tons) | (kg) |
| Rice | 59,437 | 57,476 | 17,930 | 312 | 12,558 | 12,357 | 4,504 | 364 |
| Maize | 12,377 | 11,990 | 4,934 | 412 | 3,355 | 3,274 | 1,399 | 427 |
| Cassava | 7,748 | 7,528 | 15,255 | 2,026 | 2,576 | 2,530 | 5,505 | 2,176 |
| Sugarcane | 3,443 | 3,412 | 24,093 | 7,061 | 2,413 | 2,393 | 17,145 | 7,165 |
| Sorghum | 1,935 | 1,822 | 404 | 222 | 909 | 870 | 193 | 221 |
| Groundnuts | 779 | 756 | 171 | 227 | 123 | 121 | 29 | 240 |

Source: Agricultural Statistics of Thailand Crop Year 1985/86, Center for Agricultural Statistics, Ministry of Agriculture & Co-operatives

(4) Mining

Major minerals in the Region in 1985 were limestone with a total production volume of 8,356,000 tons, followed by glass sand with 152,000 tons, gemstones with 145,000 tons and lignite with 119,000 tons. Production volumes/values and locations of each mineral resource are shown in the following table:

PRODUCTION OF MAJOR MINERALS IN 1985

| Mineral | Whole Kingdom | | Central | Changwats |
|--------------|-------------------|----------------------|-------------------|-------------------------------|
| | Production (tons) | Value (million Baht) | Production (tons) | |
| Antimony | 2,917 | 64.7 | 838 | Chon Buri, Kanchanaburi |
| Feldspar | 92,620 | 114.1 | 12,303 | Ratchaburi |
| Fluorite | 263,059 | 449.3 | 59,401 | Kanchanaburi, Phetchaburi |
| Gemstones | 145,030 | — | 145,030 | Trat |
| Glass Sand | 152,133 | 52.4 | 152,133 | Rayong |
| Iron | 93,800 | 15.0 | 60,060 | Lopburi |
| Lead | 46,245 | 220.1 | 45,951 | Kanchanaburi |
| Lignite | 5,149,150 | 2,553.5 | 118,992 | Phetchaburi |
| Limestone | 9,844,610 | 428.1 | 8,356,286 | Saraburi, Phetchaburi |
| Marble | 21,479 | 41.9 | 13,614 | Saraburi, Prachuap Khiri Khan |
| Phosphate | 4,072 | 1.7 | 1,944 | Kanchanaburi |
| Pyrophyllite | 42,002 | 19.3 | 41,111 | Saraburi |
| Tin | 23,022 | 5,290.0 | 3,436 | Kanchanaburi |

Source: Mineral Statistics of Thailand, Department of Mineral Resources, Ministry of Industry

(5) Manufacturing

Industrial factories of the whole Kingdom numbered about 85,500 in 1986. Among them, rice mill factories were predominant and came to 55% of the total. In the Region, the total number of factories was about 33,000 in 1986 or 39% of the whole Kingdom. The share of rice mill factories was 17% for the Region, which was lower than the whole Kingdom. In addition, the number of other factories came to about 27,500 or 71% of the whole Kingdom.

NUMBER OF FACTORIES BY REGION

| Region | 1985 | | | 1986 | | |
|---------------|------------|--------|--------|------------|--------|--------|
| | Rice Mills | Others | Total | Rice Mills | Others | Total |
| Whole Kingdom | 47,245 | 37,810 | 85,055 | 46,945 | 38,535 | 85,480 |
| Central | 5,837 | 27,324 | 33,161 | 5,815 | 27,524 | 33,339 |
| Northeastern | 26,098 | 4,484 | 30,582 | 25,907 | 4,811 | 30,718 |
| Northern | 10,764 | 3,280 | 14,044 | 10,685 | 3,458 | 14,143 |
| Southern | 4,546 | 2,722 | 7,268 | 4,538 | 2,742 | 7,280 |

Source: Statistics of the Number of Industrial Factories, Department of Industrial Works, Ministry of Industry

The number of factories by Changwat in the study area is shown in Table 2.3.5.

According to the number of factories by Changwat, except for Samut Prakan, Samut Sakhon, Pathum Thani, Nonthaburi and Nakhon Pathom which constitute the Bangkok Metropolitan Region, and Chon Buri, the main type of factory in terms of number in the Region is agro-industry.

(6) Tourism

International tourist arrivals in Thailand in 1985 reached 2,438,270, an increase of 3.9% over the previous year.

Of all tourists, arrivals by air numbered 1,847,000 or 75.7%, 560,000 or 22.9% by land and 32,000 or 1.3% by sea, as shown in the following table:

INTERNATIONAL TOURIST ARRIVALS BY TRANSPORT MODE

| Year | 1983 | | 1984 | | 1985 | |
|-------|-----------|------------|-----------|------------|-----------|------------|
| | Arrivals | Change (%) | Arrivals | Change (%) | Arrivals | Change (%) |
| Total | 2,191,003 | -1.24 | 2,346,709 | +7.11 | 2,438,270 | +3.90 |
| Air | 1,588,128 | -1.00 | 1,710,584 | +7.71 | 1,846,917 | +7.97 |
| Land | 566,676 | -1.82 | 601,832 | +6.20 | 559,329 | -7.06 |
| Sea | 36,199 | -2.14 | 34,293 | -5.27 | 32,024 | -6.62 |

Source: Annual Statistical Report on Tourism in Thailand, Tourism Authority of Thailand

In 1985, Thailand earned 31,768 million Baht in the form of consumption expenditure from international tourism.

REVENUE FROM INTERNATIONAL TOURISM

| | |
|---------------------------------------|-----------|
| Number of Guest Arrivals (persons) | 2,438,270 |
| Average Length of Stay (days) | 6 |
| Average Expenditure (Baht/person-day) | 2,335 |
| Revenue (million Baht) | 31,768 |

Source: Annual Statistical Report on Tourism in Thailand, Tourism Authority of Thailand

In the Region, there are many famous tourist resources such as Pattaya, Hua Hin, Kan-
 chanaburi and Ayutthaya. According to the record of arrivals in Pattaya, the number of
 tourist arrivals was 790,000, of which 230,000 were Thais and 560,000 international tourists
 in 1985. The peak season is January and February and the off season is September and Oc-
 tober. The average annual growth rate of tourist arrivals in Pattaya during 1982-1985 was
 9.9%.

NUMBER OF GUEST ARRIVALS IN PATTAYA

| Category | 1982 | 1983 | 1984 | 1985 |
|-------------------------------|---------|---------|---------|---------|
| Number of Guest Arrivals | 599,535 | 593,554 | 682,419 | 796,047 |
| Average Length of Stay (days) | 4.73 | 3.99 | 4.02 | 4.10 |
| Average Occupancy Rate (%) | 53.23 | 48.18 | 50.92 | 53.07 |
| Number of Rooms | 7,642 | 8,647 | 9,720 | 10,504 |

Source: Annual Statistical Report on Tourism in Thailand, Tourism Authority of Thailand

Table 2.3.5 NUMBER OF FACTORIES BY CHANGWAT

| Changwat | 1985 | | | 1986 | | |
|---------------------|------------|--------|--------|------------|--------|--------|
| | Rice Mills | Others | Total | Rice Mills | Others | Total |
| Bangkok | 149 | 17,022 | 17,171 | 141 | 16,520 | 16,661 |
| Samut Prakan | 102 | 2,086 | 2,188 | 104 | 2,295 | 2,399 |
| Samut Sakhon | 47 | 658 | 705 | 46 | 733 | 779 |
| Pathum Thani | 131 | 358 | 489 | 132 | 399 | 531 |
| Nonthaburi | 71 | 518 | 589 | 73 | 550 | 623 |
| Kanchanaburi | 226 | 533 | 759 | 223 | 566 | 789 |
| Sing Buri | 130 | 59 | 189 | 130 | 50 | 180 |
| Ang Thong | 119 | 61 | 180 | 118 | 64 | 182 |
| Chai Nat | 369 | 73 | 442 | 374 | 62 | 436 |
| Ayutthaya | 281 | 244 | 525 | 272 | 268 | 540 |
| Uthai Thani | 277 | 18 | 295 | 285 | 17 | 302 |
| Nakhon Pathom | 276 | 516 | 792 | 276 | 575 | 851 |
| Nakhon Nayok | 95 | 32 | 127 | 96 | 38 | 134 |
| Prachuap Khiri Khan | 75 | 187 | 262 | 74 | 206 | 280 |
| Prachin Buri | 436 | 491 | 927 | 432 | 498 | 930 |
| Phetchaburi | 462 | 246 | 708 | 464 | 247 | 711 |
| Ratchaburi | 308 | 630 | 938 | 302 | 639 | 941 |
| Samut Songkhram | 12 | 97 | 109 | 12 | 94 | 106 |
| Lop Buri | 285 | 223 | 508 | 281 | 251 | 532 |
| Saraburi | 223 | 318 | 541 | 223 | 318 | 541 |
| Suphan Buri | 399 | 516 | 915 | 400 | 573 | 973 |
| Chanthaburi | 242 | 380 | 622 | 238 | 396 | 634 |
| Chachoengsao | 351 | 256 | 607 | 358 | 303 | 661 |
| Chon Buri | 314 | 1,012 | 1,326 | 305 | 1,053 | 1,358 |
| Trat | 220 | 192 | 412 | 219 | 193 | 412 |
| Rayong | 237 | 598 | 835 | 237 | 616 | 853 |
| Nakhon Sawan | 656 | 466 | 1,122 | 654 | 445 | 1,099 |

Source: Statistics of the Number of Industrial Factories, Department of Industrial Works, Ministry of Industry

2.4 TRANSPORTATION

The major transportation modes in the Region consist of highways, railways and inland waterways, while aviation is minor. Each transportation mode has been developed in such a manner to connect every part of the region and the country with Bangkok.

2.4.1 Highways

The major arterial highway network in the Region is formed by 11 primary highways and 38 secondary highways. Of the 11 primary highways, Routes 1, 2, 34/3 and 4 serve as important corridors which lead to other regions or areas from Bangkok.

Route 1, the most vital highway, which is reinforced by Routes 32 and 11, connects the Northern Region. Route 2, branching off from Route 1 at Saraburi, plays an important role as the sole gateway to the Northeastern Region. Routes 34 and 3 lead to Pattaya Beach and the Eastern Seaboard Area. Route 4 extends to the Southern Region via Nakhon Pathom where a junction with a highway to Kanchanaburi is located.

Secondary and provincial highways interwoven with primary highways have an indispensable role in the highway transportation in the Region. There also are a number of rural roads to supplement these arterial highways.

2.4.2 Railways

The railway network is shown in Appendix 2.4.1.

The State Railway of Thailand, owned by the Government, had a railway system radiating from Bangkok with a total length of 3,735 km as of the end of fiscal year 1985.

The railway line extends to Chiang Mai in the North, to Nong Khai and Ubon Ratchathani in the Northeast, to Kanchanaburi in the West, to Sungai Kolok in the South and to Aranyaprathet in the East.

In the Region, a new railway line between Chachoengsao and Sattahip has recently been constructed.

2.4.3 Waterways

Inland waterways have lost their importance compared with highways and railways. However, they still perform their part in freight transportation up to 500 km upstream from the sea on the Chao Phya River. Maintenance work of waterways and construction of an inland port at Nakhon Sawan are being carried out.

Shipping is of benefit especially to coastal areas. In the Region, except for Bangkok, there is a deep sea port at Sattahip and new ports are being constructed at Laem Chabang and at Map Ta Phut.

2.4.4 Aviation

Thai Airways International, owned by the Government, operates scheduled services radiating from Bangkok to all over the country. The average number of flights from Bangkok each day is 8.6. Aircraft employed are Airbus 310, Boeing 737, Avro 748, Short 330 and Short 360.

2.4.5 Modal Split

1) Passenger

The modal split for passenger transport is shown below. In 1978, highway transport took 85% of passenger-km in the whole nation, and railway transport 14%, while the share of air transport was less than 1%.

In 1984, total passenger-km increased to 124 billion from 43 billion in 1978. The share of highways reached 92%, indicating the increasing importance of highways. In addition, the shares of railways and air were 7.8% and 0.4%, respectively.

MODAL SPLIT FOR PASSENGER TRANSPORT

(Unit: billion passenger-km)

| Year | Road | Rail | Air | Total |
|------|-------------------|-----------------|--------------|--------------------|
| 1978 | 37,000 (85.5) | 6,039 (14.1) | 205 (0.5) | 43,243 (100.0) |
| 1984 | 113,604 (91.8) | 9,643 (7.8) | 548 (0.4) | 123,795 (100.0) |

Note: Percentage in ()

Source: Annual Transport Statistics, Ministry of Communications

2) Freight

The modal split for freight transportation in 1984 is shown below. In freight transportation, highways played a vital role and their share reached 88% of the total ton-km in the whole country. Railways are of secondary importance, with a share of only 12%. The share of inland waterways was not available but is considered insignificant.

MODAL SPLIT FOR FREIGHT TRANSPORT

(Unit: billion ton-km)

| Year | Road | Rail | Waterways | Air | Total |
|------|------------------|-----------------|---------------|--------------|-------------------|
| 1984 | 18,920 (87.8) | 2,618 (12.2) | N.A. (-) | 1.8 (0.0) | 21,540 (100.0) |

Note: Percent in ()

Source: Annual Transport Statistics, Ministry of Communications

Commodity flow diagrams in and out of Bangkok by highway, railway and waterway are shown in Appendices 2.4.2, 2.4.3 and 2.4.4, respectively.

CHAPTER 3
DEVELOPMENT PLANS AND SOCIO-ECONOMIC
FRAMEWORK

CHAPTER 3

DEVELOPMENT PLANS AND SOCIO-ECONOMIC FRAMEWORK

3.1 SIXTH NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT PLAN

The main issue of the Sixth National Economic and Social Development Plan (hereinafter referred to as the Sixth Plan) is how to raise the country's level of development so that the Thai economy will expand at a higher rate than during the Fifth Plan period.

The Sixth Plan has the following two major objectives:

- to maintain at least 5% economic growth so as to absorb new labor of not less than 3.9 million persons. Emphasis will be given to a pattern of growth which will ensure economic stability and assist in solving the various economic problems that occurred during the Fifth Plan.

- to promote the improvement of quality and equality in human life through social development.

In order to achieve the aforementioned objectives, the following strategies and programs are set forth:

- a) To increase the country's efficiency in development.
 - Overall economic development program.
 - Human and social development program.
 - Natural resources and environmental development program.
 - Science and technology development program.
 - Program to improve management and review the role of the state in development.
 - State enterprise development program.

- b) To improve the production structures and raise the quality of basic services.
 - Production, marketing, and employment development program.

- Basic services of infrastructures.

c) To distribute prosperity and create equity.

- Urban and specific zones development program.

- Rural development program.

Target socio-economic indexes set up in the Sixth Plan are shown in Table 3.1.1 together with the achievements during the Fifth Plan period. Aided by a favorable external economic environment, Thailand's actual performance in 1987 and 1988 for outstripped the targets specified in the Sixth Plan. It is expected that the economic growth of Thailand during the Sixth Plan period will be significantly higher than the targets shown in the original Plan.

Table 3.1.1 SOCIO-ECONOMIC INDEXES OF THE DEVELOPMENT PLAN

(Unit: % per annum)

| Items | Fifth Plan 1982-1986 | Sixth Plan 1987-1991 |
|------------------------|-------------------------|-------------------------|
| Economic Growth | 4.4 | 5.0 |
| Agriculture | 2.9 | 2.9 |
| Non-Agriculture | 5.5 | 5.7 |
| Manufacturing | 5.6 | 6.6 |
| Mining | 6.5 | 6.4 |
| Electricity/Water | 8.0 | 6.1 |
| Construction | 3.6 | 5.1 |
| Services | 5.6 | 5.3 |
| Consumer Price Index | 2.7 | 2.3 |
| Population Growth Rate | 1.7 | 1.3 |
| Municipal Area | 2.7 | 2.5 |
| Sanitary Area | 2.1 | 2.4 |
| Village | 1.4 | 0.8 |

Source: NESDB

3.2 REGIONAL DEVELOPMENT PLAN

The Sixth Plan sets a strategy to disperse socio-economic activities concentrated in Bangkok to new economic zones in different parts of the country. In the study area, Chon Buri is designated as one of the five growth poles with Chiang Mai, Khon Kaen, Nakhon Ratchasima and Songkhla in other regions. Nakhon Sawan, Saraburi, Kanchanaburi, Ratchaburi, Phetchaburi, Chachoengsao and Rayong are also included in the 19 designated growth centers.

According to the regional development plans formulated by Department of Town and Country Planning, Ministry of Interior, urbanization outside of Bangkok is encouraged aiming at changing the present economic structures and pattern of industrialization in Thailand. In-

dustrial areas are planned at Chon Buri, Rayong, Samut Prakan, Samut Sakhon, Chachoengsao, Ratchaburi, Petchaburi, Saraburi, Kanchanaburi and Nakhon Sawan in the study area.

3.3 EASTERN SEABOARD DEVELOPMENT PROGRAM

The Eastern Seaboard Development Program is a development plan to which the highest priority is given over the Fifth and the Sixth Plans (see Figure 3.3.1). The program aims are as follows:

- to develop light, labor-intensive industries at Laem Chabang and Chon Buri and natural gas related industries at Map Ta Phut and Rayong.
- to provide jobs and facilities which will encourage urbanization outside of Bangkok.

The Eastern Seaboard covers three Changwats: Chon Buri, Chachoengsao and Rayong, with a total area of about 13,215 km² and a total population of about 1.8 million people.

1) Laem Chabang Industrial Complex (see Figure 3.3.2)

The Laem Chabang Industrial Complex is located 125 km southeast of Bangkok and 10 km north of the international resort city of Pattaya. It is planned to have a commercial deep-sea port, an industrial estate and an export processing zone backed up by a complete urban center and essential infrastructure. The planned industries are mainly clean, labor-intensive, export-oriented and light ones as well as agro-processing.

Construction of the deep-sea port has already started. After completion, it will be a primary gateway for containerized and break-bulk cargo to and from Thailand. The shipping volume will reach 4 million tons per year by 1995, which will be transported by up to 2,000 TEU container vessels and up to 120,000 DWT dry bulk carriers. An area for a General Industrial Estate (GIE) and a Export Processing Zone (EPZ), which will occupy most of the total planned area of 448 ha, has already been acquired by the Industrial Estate Authority of Thailand. While the detailed plan for a new urban area related to the port and industrial estate has not yet been authorized, a rail spur from the new Chachoengsao-Sattahip line to the port and industrial estate areas and the improvement of the road network concerned are also being planned.

2) Map Ta Phut Industrial Complex (see Figure 3.3.3)

The Map Ta Phut Industrial Complex is located to the west of Rayong and 180 km southeast

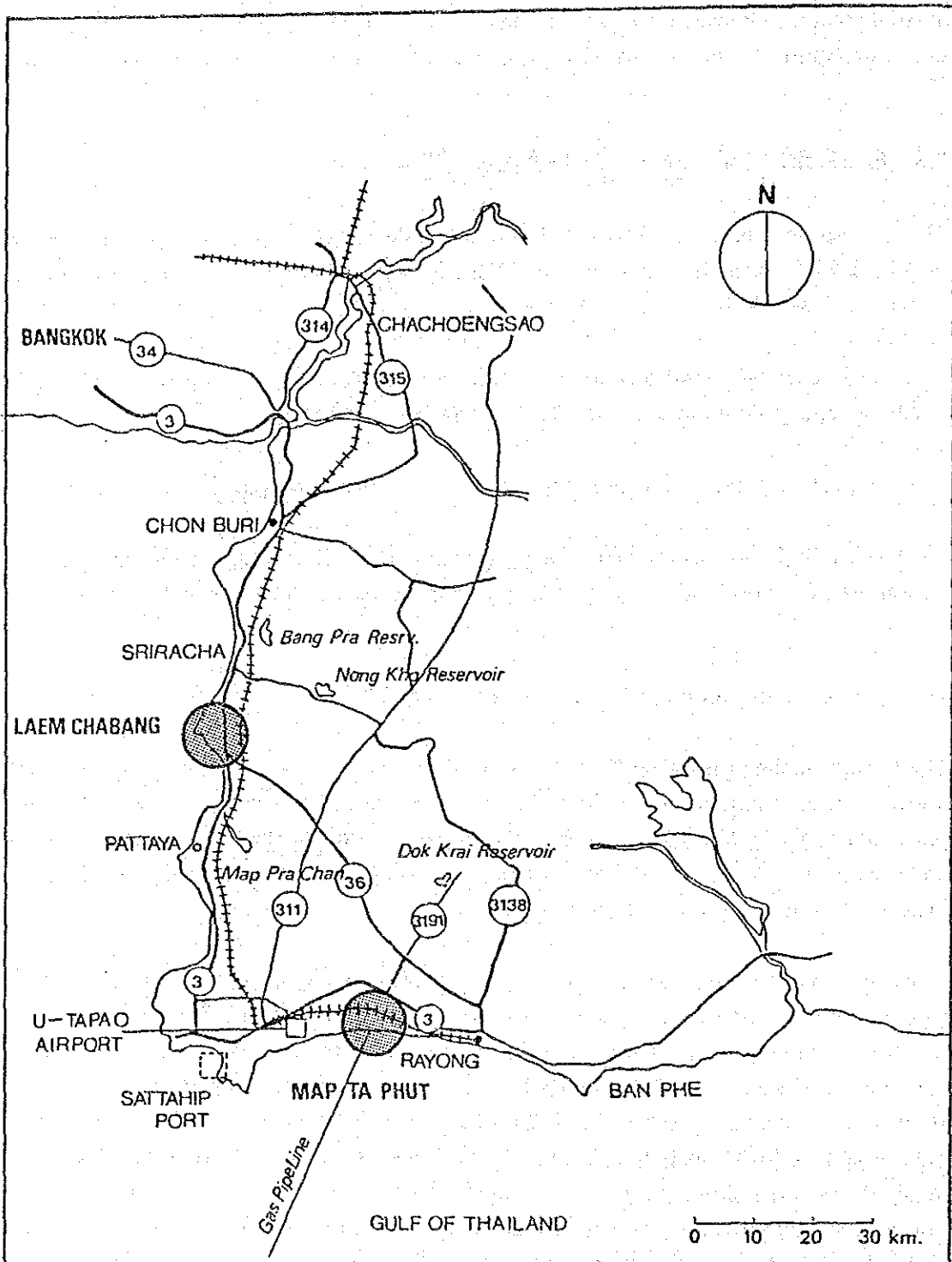
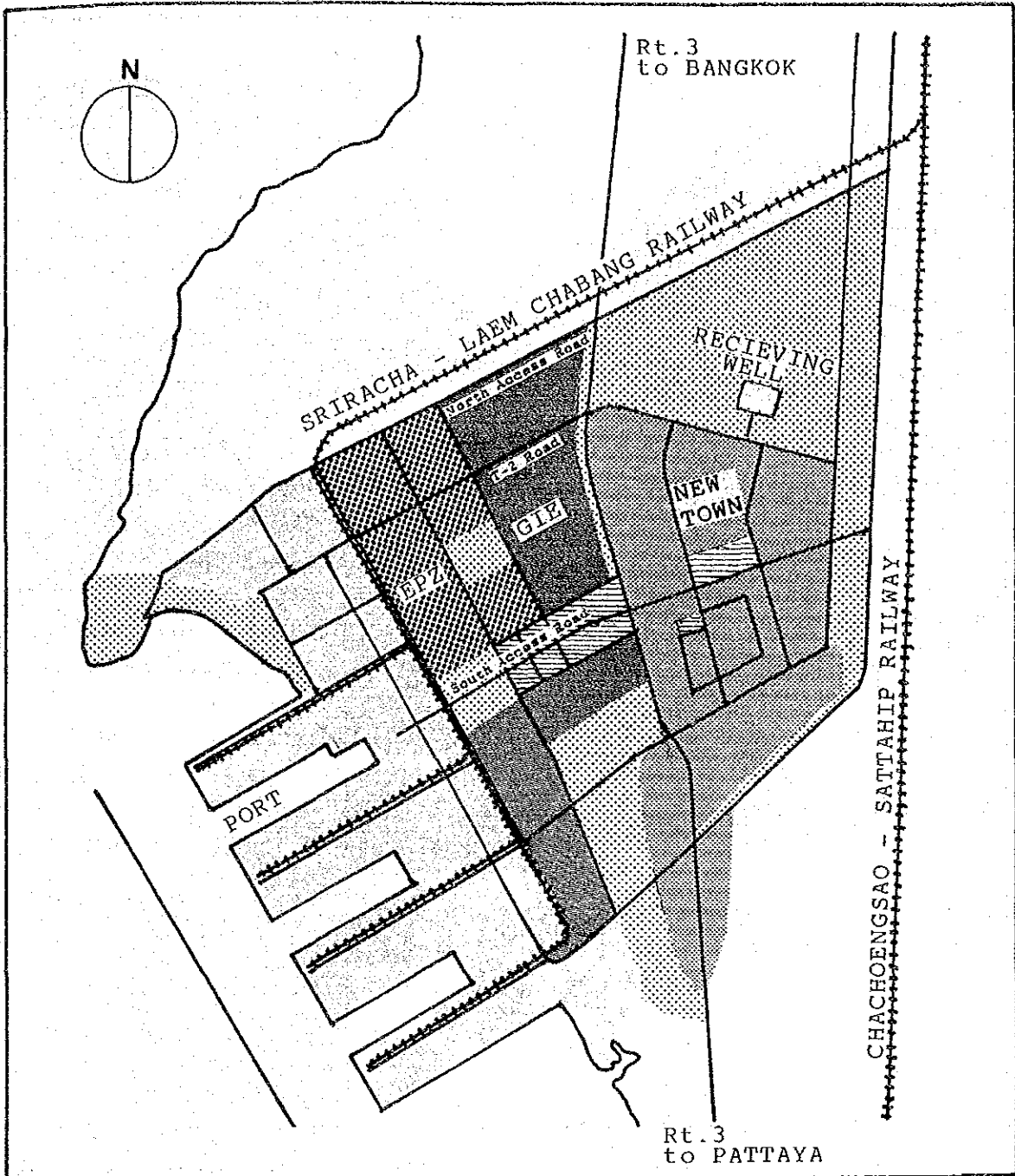


Figure 3.3.1 EASTERN SEABOARD DEVELOPMENT PROGRAM



LEGEND







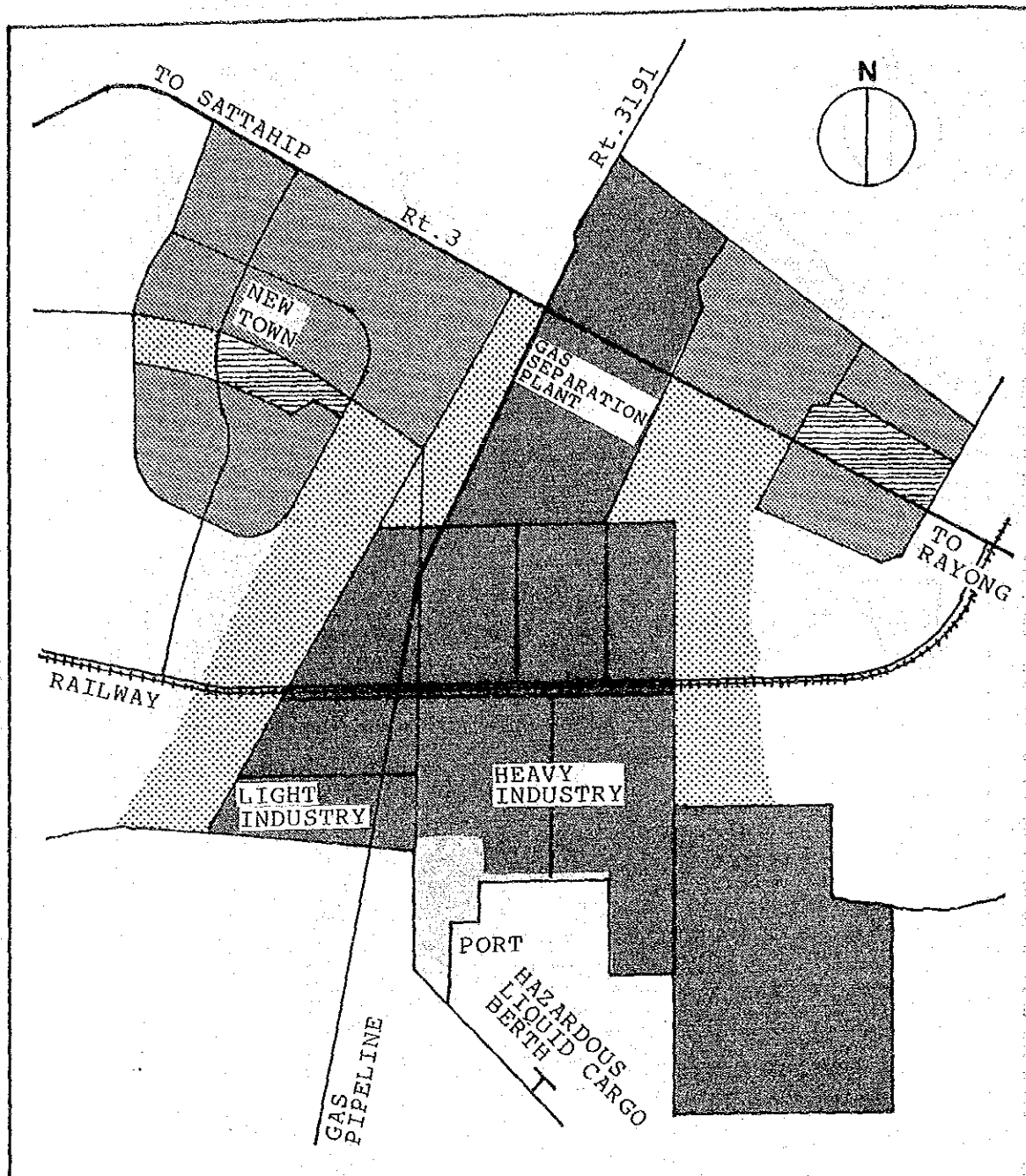
- | | | | |
|---|-----------------------------------|---|------------|
|  | GENERAL INDUSTRIAL ESTATE (GIE) |  | PORT AREA |
|  | EXPORT PROCESSING ZONE (EPZ) |  | URBAN AREA |
|  | BUSINESS AND COMMERCIAL AREA (BC) |  | GREEN AREA |

Figure 3.3.2 LAEM CHABANG INDUSTRIAL COMPLEX



LEGEND






- | | | | |
|---|------------------------------|---|------------|
|  | INDUSTRIAL ESTATE |  | URBAN AREA |
|  | BUSINESS AND COMMERCIAL AREA |  | GREEN AREA |
|  | PORT AREA | | |

Figure 3.3.3 MAP TA PHUT INDUSTRIAL COMPLEX

of Bangkok. The complex will house natural gas and petrochemical based and heavy industries served by its own industrial deep-sea port.

The Natural Gas Separation Plant has been operating successfully since January 1985. It processes 350 million cubic feet per day of natural gas from the Gulf of Thailand and is producing LPG, methane and ethane.

An industrial estate of 870 ha in total is planned for mainly petrochemical and its downstream industries in the first stage. The master plan, however, includes heavy industries as well.

The port is planned to bring in industrial raw materials and take away finished products from the heavy industries. The shipping volume will reach 2.5 million tons per year by 1995 to be carried by 20,000 DWT vessels through multipurpose berths and by 8,000 DWT liquid cargo vessels through liquid berths. Construction, however, has not yet started.

A planned urban area to provide housing and other facilities for the new residents is now under construction.

The Map Ta Phut Industrial Complex area is already served by highways. A rail spur of 24 km to connect the complex with the new Chachoengsao-Sattahip line is under planning.

3) Pattaya

In order to change the city of Pattaya from a seasonal tourist city to a center of tourism and trade in the region, the organization and administration of the city and its finances are being reviewed in the Eastern Seaboard Development Program.

4) Sattahip

Improvement of Sattahip Port and U Tapao Airport, which will enable them to immediately serve the Eastern Seaboard Development area, is also being considered, but no concrete plan has yet been decided.

3.4 ESTABLISHMENT OF FUTURE FRAMEWORK

In order to forecast the future traffic volume, a future economic framework in the study area was established by referring to the present socio-economic conditions in the study area and the abovementioned national, regional and specific development plans. Population and GPP were selected as the major items of the framework, because they are closely related to traffic volume.

Population and GPP were estimated at 1993, 2000 and 2008, considering the expected project life.

Population was estimated by Amphoe according to the following steps:

- Population by Changwat was calculated based on the trend during five years (1981 – 1986). Changwat population thus predicted was modified by means of the population in the Region estimated by NESDB as the control total.
- Population by Amphoe was estimated in the same way regarding obtained Changwat population as the control total.

Gross Provincial Product (GPP) was estimated based on the trend during four years (1981–1985). The GPP thus predicted was modified by means of the Gross Regional Product (GRP) estimated by NESDB as the control total.

In the traffic forecast procedures to be described later, estimated GPP was allocated to each Amphoe in the Changwat in proportion to the population of the Amphoe.

The results of estimated population and GPP are shown in Appendices 3.4.1 and 3.4.2.

It should be noted that the Study could not incorporate the recent acceleration in economic growth due to the lack of concrete data. Therefore, GPP estimates and resulting traffic projections presented in this Report should be considered conservative.

CHAPTER 4
IDENTIFICATION OF ROAD NETWORK

CHAPTER 4

IDENTIFICATION OF ROAD NETWORK

4.1 EXISTING ROAD NETWORK

As a requisite of the study, the existing road network composed of national highways and provincial roads under DOH was identified based on DOH road map and road inventory data. The existing road network in the study area is shown in Figure 4.1.1.

The total of existing DOH roads in the study area is 11,736 km in length, of which national highways are 4,008 km and provincial roads 7,728 km.

The percentage of paved roads is high, about 100% of the national highways and even about 80% of the provincial roads.

4.2 SIXTH HIGHWAY PLAN

The Department of Highways has formulated the 6th Five-year Plan for construction and rehabilitation of highways (the 6th Highway Plan) following the policies of the Sixth National Economic and Social Development Plan (1987–1991).

Key strategies stated in the 6th Highway Plan are as follows:

- To emphasize maintenance and rehabilitation of existing highways to function effectively.
- To increase highway structure standards to meet traffic volume, especially on main highways.
- To make land transportation effective, convenient and smooth so as to support such development as exports, tourism and specific regional development.
- To strengthen required linkages between producing places, markets, transportation centers, etc. and to provide bypasses to reduce traffic congestion inside cities.

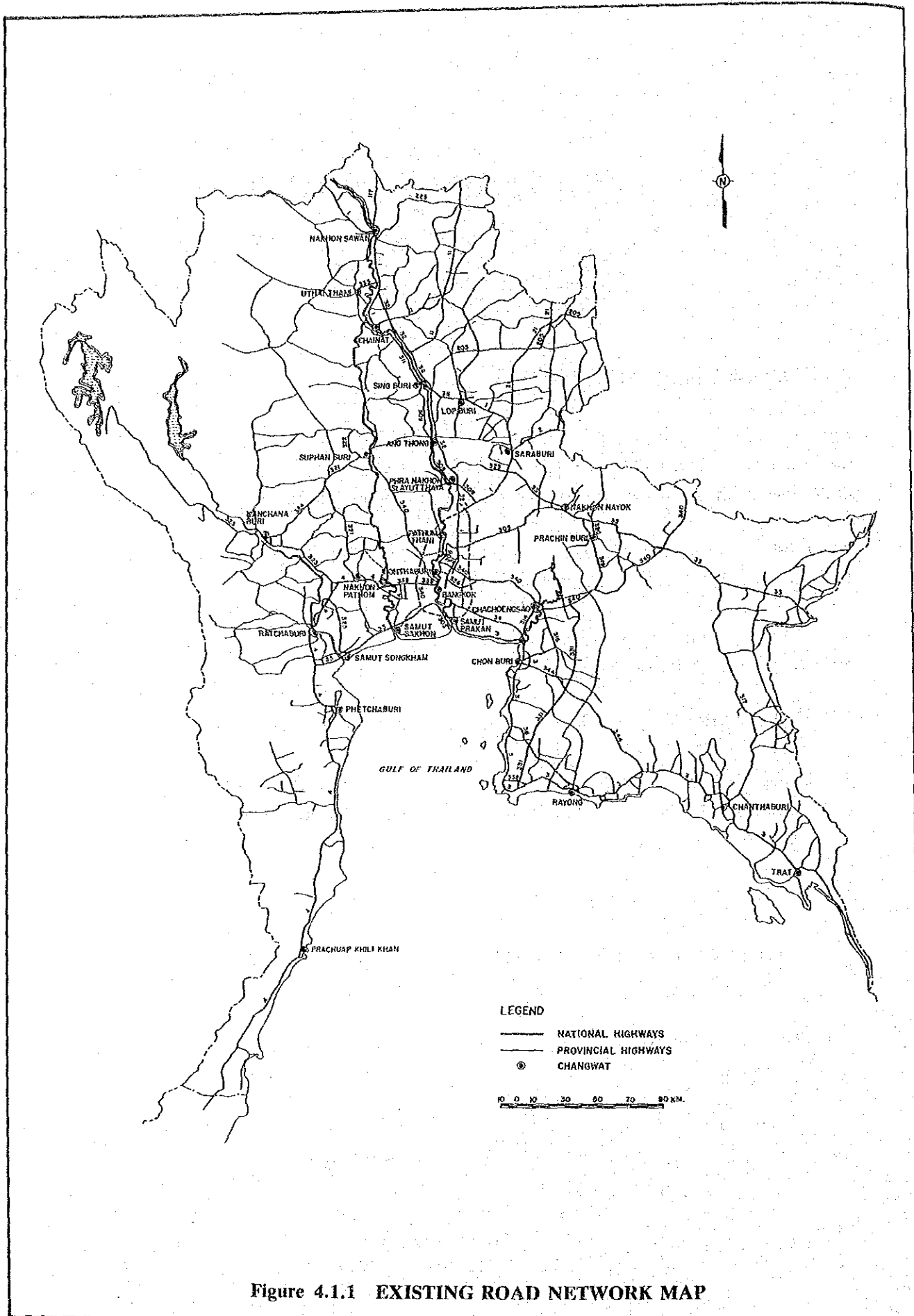


Figure 4.1.1 EXISTING ROAD NETWORK MAP

- To ease traffic congestion at important intersections.
- To prevent highway accidents.
- To invite private firms to participate in highway construction, maintenance and management in order not only to reduce the government burden, but also to work together in close cooperation.
- To increase toll roads for self-finance.
- To call for an amendment of the road user's tax which is inequitable.

In order to realize the above strategies, the following projects and financial countermeasures were taken up:

a) Projects

- Rehabilitation Projects
- Four-lane Road Construction Projects
(additional two lanes)
- Paved Road Construction Projects
- New Road Construction Projects
- Interchange and Long-span Bridge Construction Projects
- Highway Traffic Safety Projects

b) Financial countermeasures

- To privatize some highways
- To raise the toll gate fee
- To collect the road user tax

The scale of the projects planned in the 6th Highway Plan in the study area is as follows:

| | | |
|---|-----------|----------|
| Reconstruction/Rehabilitation | 58 links | 1,590 km |
| Four-lane Road Construction (additional two lanes) | 18 links | 461 km |
| Upgrading to Paved Road | 37 links | 870 km |
| New Road Construction | 5 links | 120 km |
| I.C./Long-span Bridge Construction | (6) | |
| | 118 links | 3,041 km |

Among them, the following projects were committed to early implementation within 1987 and 1988:

| | |
|--|--------|
| Reconstruction/Rehabilitation | 412 km |
| Four-lane Road Construction | 60 km |
| Another 240 km in total on Rts. 2, 32 and 35 was not yet committed at this time | |
| Upgrading to Paved Road | 430 km |
| New Road Construction | 18 km |
| | 920 km |

In addition to the above committed projects, the following projects are being constructed by the budget of the 5th Highway Plan (1982–1986):

| | | |
|-------------------------------|----------|----------|
| Reconstruction/Rehabilitation | 20 links | 520 km |
| Four-lane Road Construction | 1 link | 10 km |
| New Road Construction | 2 links | 10 km |
| Upgrading to Paved Road | 21 links | 556 km |
| | 44 links | 1,096 km |

4.3 BASE ROAD NETWORK MAP

In order to examine and select routes to be improved or newly constructed in the future, a study road network was drawn up on the assumption that ongoing and committed project roads have already been completed.

A road list was prepared for this purpose by each DOH district office included in the study area, in which the ongoing and committed project roads described in Section 4.2 are included to the existing roads.

The total length of the listed roads is 11,764 km as summarized in Table 4.3.1. Of the total length, national highways make up 4,018 km and provincial highways 7,746 km. There is

very little difference between the above length and that of the existing roads, only 28 km. This indicates that most of the ongoing and committed projects involve rehabilitation, upgrading to paved road, four-lane road construction, etc., which do not affect the road length. The detailed road lists are given in Appendix 4.3.1.

Applying the road list mentioned above, a base road network map, in which only paved roads were included, was made to be used as a basic road network for the study. This is shown in Figure 4.3.1.

Table 4.3.1 ROAD LENGTH BY DOH DISTRICT OFFICE

| District | National Highway | | | Provincial Road | | | Total |
|--------------|------------------|-----------|-------------|-----------------|-------------|-------------|--------------|
| | Paved | Unpaved | Total | Paved | Unpaved | Total | |
| 411 | 104 | — | 104 | 121 | — | 121 | 225 |
| 412 | 293 | — | 293 | 389 | 43 | 432 | 725 |
| 413 | 148 | — | 148 | 210 | 22 | 232 | 380 |
| 414 | 154 | — | 154 | 541 | 61 | 602 | 756 |
| 415 | 201 | — | 201 | 288 | 16 | 304 | 505 |
| 416 | 132 | — | 132 | 104 | 15 | 119 | 251 |
| 421 | 260 | — | 260 | 339 | 36 | 375 | 635 |
| 422 | 291 | — | 291 | 283 | 18 | 301 | 592 |
| 423 | 135 | — | 135 | 375 | 98 | 473 | 608 |
| 424 | 208 | 17 | 225 | 145 | 59 | 204 | 429 |
| 425 | 132 | 7 | 139 | 198 | 82 | 280 | 419 |
| 426 | 184 | — | 184 | 264 | 63 | 327 | 511 |
| 427 | 144 | — | 144 | 306 | 207 | 513 | 657 |
| 431 | 181 | — | 181 | 313 | 95 | 408 | 589 |
| 432 | 185 | — | 185 | 317 | 172 | 489 | 674 |
| 433 | 265 | — | 265 | 257 | 105 | 362 | 627 |
| 435 | 195 | — | 195 | 193 | 127 | 320 | 515 |
| 436 | 30 | — | 30 | 505 | 37 | 542 | 572 |
| 437 | 290 | — | 290 | 404 | 102 | 506 | 796 |
| 332 | 86 | — | 86 | 14 | 27 | 41 | 127 |
| 333 | 207 | — | 207 | 201 | 131 | 332 | 539 |
| 335 | 169 | — | 169 | 405 | 58 | 463 | 632 |
| Total | 3994 | 24 | 4018 | 6172 | 1574 | 7746 | 11764 |
| 411 | Bangkok | | 412 | Ban Pong | | 413 | Ayutthaya |
| 414 | Suphan Buri | | 415 | Thon Buri | | 416 | Pathum Thani |
| 421 | Chachoengsao | | 422 | Chon Buri | | 423 | Chanthaburi |
| 424 | Prachinburi | | 425 | Trat | | 426 | Rayong |
| 427 | Wat Thana Nakhon | | 431 | Lop Buri | | 432 | Saraburi |
| 433 | Chai Nat | | 435 | Lam Na Rai | | 436 | Uthai Thani |
| 437 | Nakhon Sawan | | 332 | Chumphon | | 333 | Hua Hin |
| 335 | Ratchaburi | | | | | | |

Note: Appendix 4.3.1 includes DOH roads of 36 links with 371 km in total inside the Outer Ring Road which are excluded in the study area.

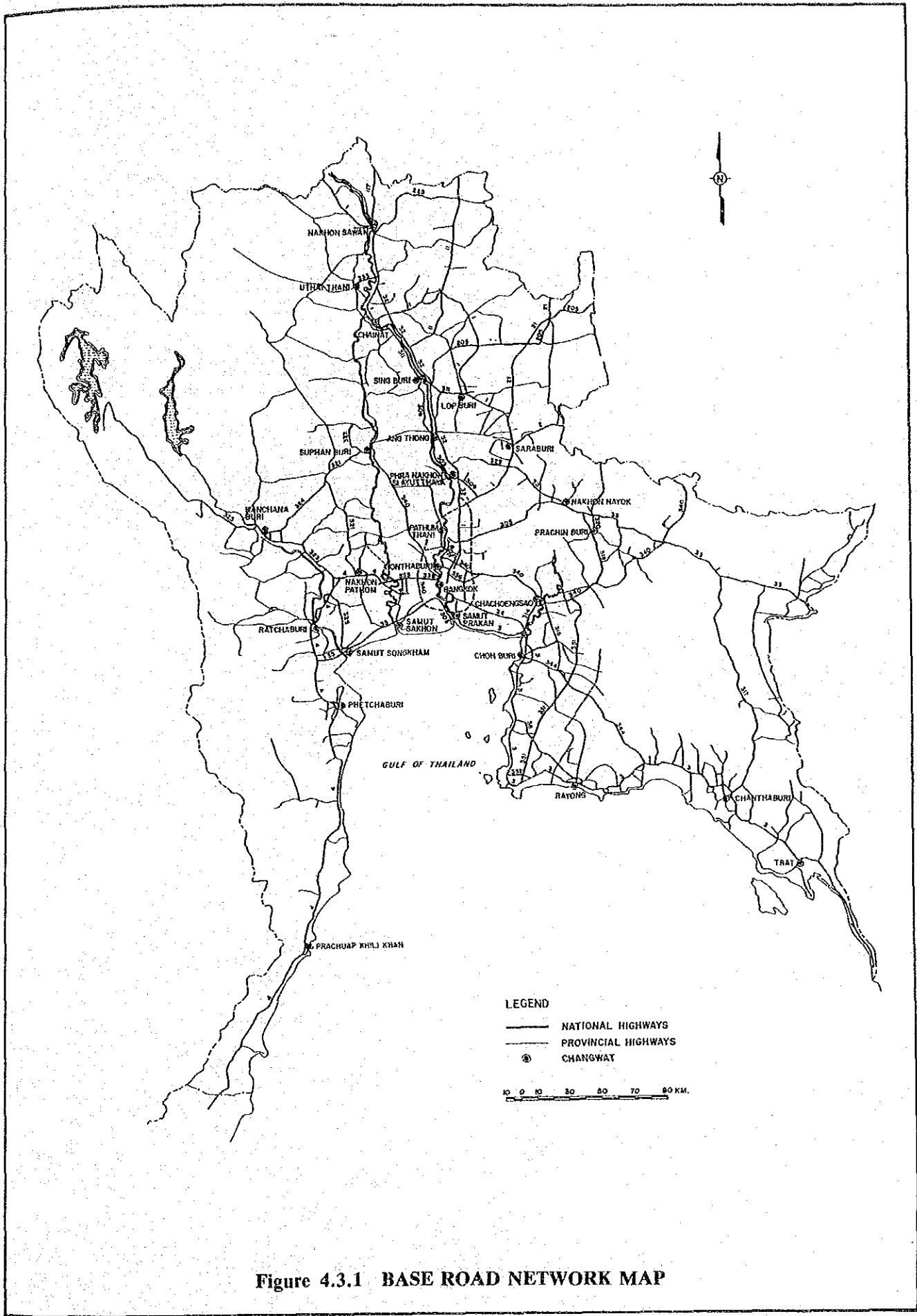


Figure 4.3.1 BASE ROAD NETWORK MAP

CHAPTER 5
TRAFFIC SURVEYS AND FORECAST

CHAPTER 5

TRAFFIC SURVEYS AND FORECAST

5.1 PRESENT TRAFFIC CONDITIONS

The study area is the most active area in Thailand with Bangkok as the major city in the country where activities of all fields are concentrated. Almost all arterial highways originate in Bangkok and radiate to the whole country. Therefore, traffic volumes on highways in this area are extremely higher than in the other regions.

A traffic flow map of 1986 prepared based on DOH traffic count data is shown in Figure 5.1.1. Traffic volumes on primary national highways range from 15,000 to 57,000 ADT and high traffic volumes are seen on Routes 1, 3, 4 and 34.

On the other hand, traffic volumes on secondary national highways are lower than on primary highways ranging from 600 to 47,000 ADT, while those on provincial highways range from 100 to 20,000 ADT.

5.2 TRAFFIC SURVEYS

Traffic surveys composed of O/D surveys, manual traffic counts and automatic traffic counts were carried out to obtain general conditions of O/D patterns and traffic characteristics in the study area.

Prior to the traffic surveys, a field reconnaissance was carried out and 10 survey points were set up mainly along trunk highways as shown in Appendix 5.2.1.

Survey duration periods for O/D surveys and manual traffic counts were 12 hours and for automatic counts 24 hours.

Question items of C/D surveys in roadside interviews of drivers were as follows:

- Origin/destination of trip
- Vehicle characteristics

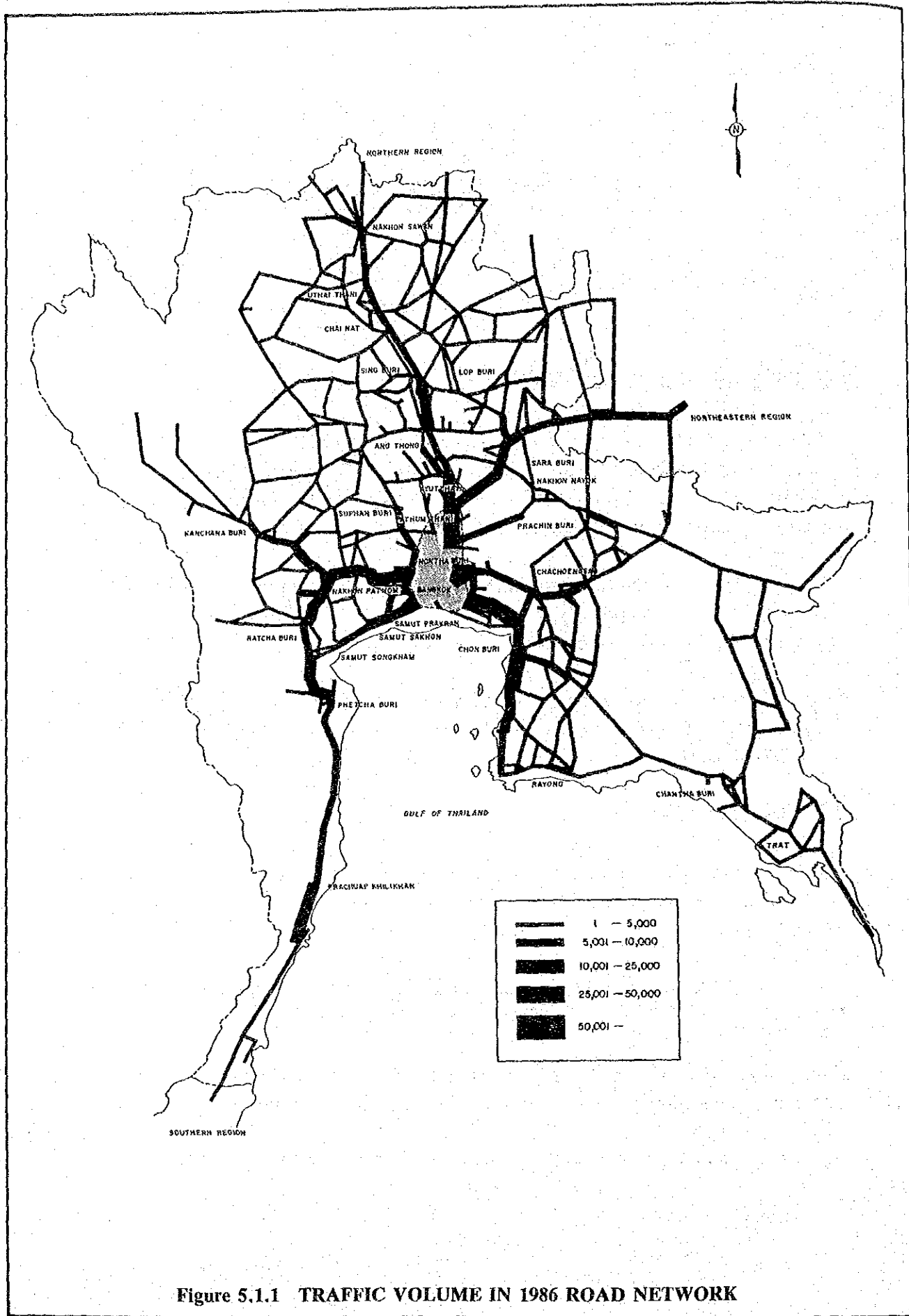


Figure 5.1.1 TRAFFIC VOLUME IN 1986 ROAD NETWORK

- Vehicle usage
- Freight movement

Survey items are listed in Appendix 5.2.2, and survey forms are shown in Appendices 5.2.3(1) through 5.2.3(3).

1) Traffic Counts

Results of 12 hour manual traffic counts by station and vehicle type are shown in Appendix 5.2.4.

2) Number of Samples

The total effective number of samples for the roadside interview was 16,055. This is shown in Appendix 5.2.5 by survey station and vehicle type. The average sampling rate for all vehicles of all survey stations was 0.17 and that by vehicle type varied from 0.07 to 0.60 as given in Appendix 5.2.6.

3) Expansion Factor

Twelve hour manual traffic counts were expanded to 24 hour data based on the result of automatic traffic counts. The automatic count data and calculated expansion factors are shown in Appendix 5.2.7.

4) Seasonal and Weekly Fluctuations

Seasonal and weekly fluctuations were estimated based on the relationship between traffic counts conducted by the study team and existing DOH data. Appendix 5.2.8 shows the estimated adjustment factors for seasonal and weekly fluctuations by survey station.

5) Characteristics of Vehicles

The following characteristics of vehicles were revealed by the O/D surveys:

- Average permitted capacity: Appendix 5.2.9(1)
- Average actual payload : Appendix 5.2.9(2)
- Empty vehicle ratio : Appendix 5.2.9(3)
- Engine capacity : Appendix 5.2.9(4)

- Age of vehicle : Appendix 5.2.9(5)
- Number of assistants : Appendix 5.2.9(6)
- Average trip frequency : Appendix 5.2.9(7)
- Vehicle ownership : Appendix 5.2.9(8)
- Fuel type : Appendix 5.2.9(9)
- Trip purpose : Appendix 5.2.9(10)
- Commodity flow : Appendix 5.2.9(11) to (14)

5.3 TRAFFIC FORECAST

Traffic forecast was done based on a gravity model made up of following two variables:

- Number of registered vehicles
- Travel time

The procedures were as follows:

- Traffic zoning and preparation of road networks
- Estimation of number of registered vehicles by traffic zone
- Formulation of a gravity model
- Preparation of present O/D tables as of 1986
- Preparation of future O/D tables
- Traffic assignment

Detailed procedures are shown in Figure 5.3.1.

Future traffic volumes were estimated for 1993, 2000 and 2008, considering expected project life.

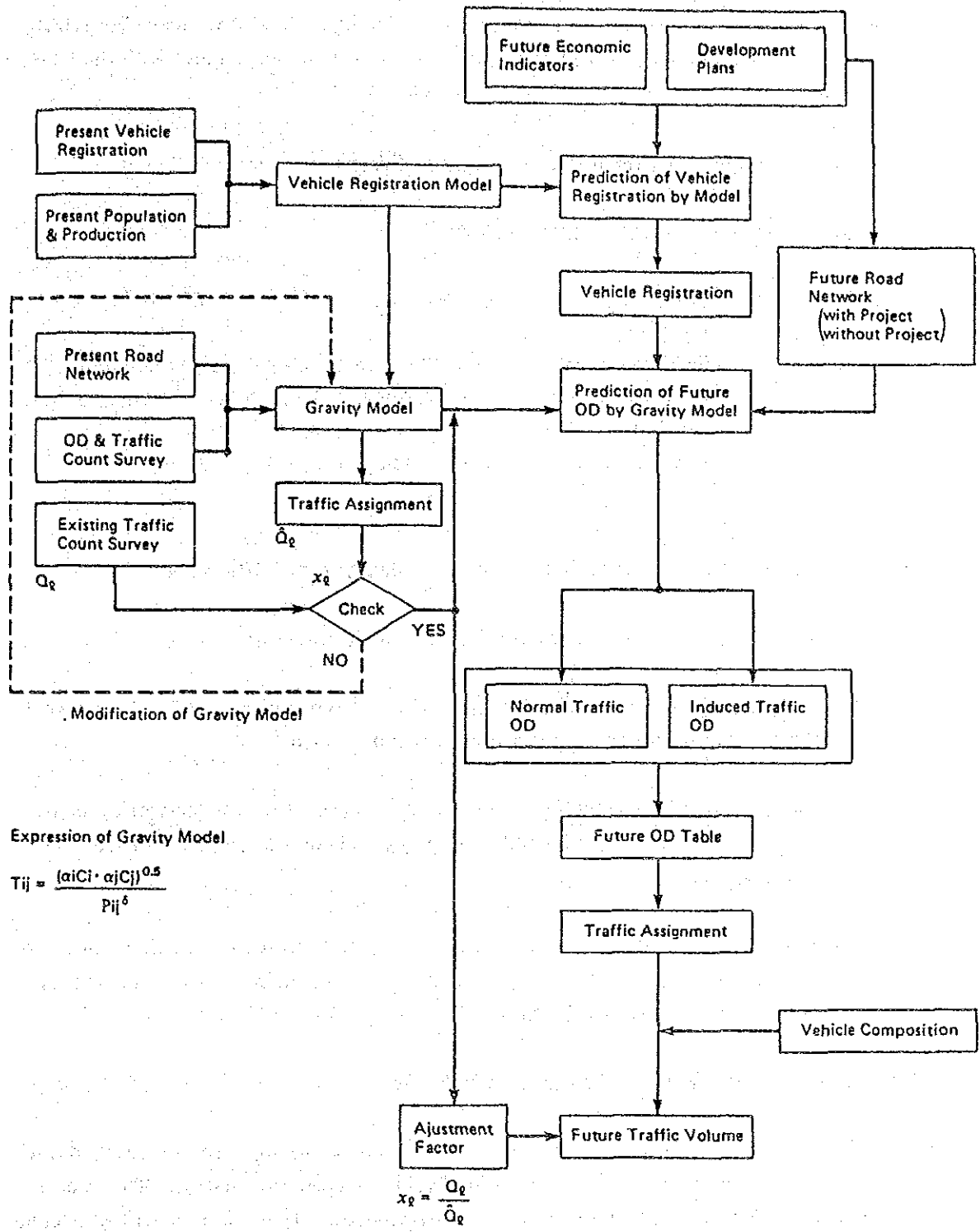


Figure 5.3.1 STUDY FLOW ON TRAFFIC FORECAST PROCESS

Vehicles were classified into six types: passenger car (P/C), light bus (L/B), heavy bus (H/B), light truck (4/T), medium truck (6/T) and heavy truck (10/T) in accordance with the DOH classification.

5.3.1 Traffic Zoning and Preparation of Road Networks

Traffic zones were established as shown below:

| | |
|-----------------------------------|------------------|
| Study area | 194 zones |
| Inside area of Outer Ring Road | 9 zones |
| Northern Region | 5 zones |
| Northeastern Region | 4 zones |
| Southern Region | 1 zone |
| Total | 213 zones |

In the study area, each Amphoe was basically regarded as one traffic zone.

The following two road networks were applied for traffic forecast:

- Existing road network: A present O/D table as of 1986 was prepared for this network to analyze the validity of the forecasting method applied.
- Base road network: Future traffic volumes were forecasted for this network prepared in Chapter 4, which was made by adding ongoing and committed project roads to the existing road network.

The routes involved in these road networks were divided into links for forecasting, considering topographic conditions, road classes, pavement types and surface conditions, etc. Applied link classifications are shown in Appendix 5.3.1.

5.3.2 Estimation of Number of Registered Vehicles

A formula for estimating future numbers of registered vehicles to apply to the gravity model was constructed assuming the number of registered vehicles is proportionate to GPP. A correlation analysis between GPPs by industrial sector (Appendix 2.3.1) and numbers of registered vehicles (Appendix 5.3.2) from 1981 to 1985 in the Changwats concerned was made.

For the formula, the number of registered vehicles was applied as a principal component score obtained by the following formula in order to avoid a negative coefficient in a direct application of multiple linear regression analysis:

$$Z_i = \alpha_1 \cdot G_{1i} + \alpha_2 \cdot G_{2i} + \alpha_3 \cdot G_{3i}$$

Z_i : First principal component score

G_{1i} , G_{2i} and G_{3i} : GPP (Sector 1, Sector 2 and Sector 3: 1000 Baht)

α_1 , α_2 and α_3 : Parameter

Parameter : $\alpha_1 = 0.09027$ $\alpha_2 = 0.5104$ $\alpha_3 = 0.8552$

Contribution ratio : 90.5%

Each factor loading : (G_1) 0.2994 (G_2) 0.9658 (G_3) 0.9977

A formulated vehicle registration formula and the result of multiple regression analysis are shown below: (Principal Component Score)

$$C_i = A (\alpha_1 \cdot 2G_{1i} + \alpha_2 \cdot 2G_{2i} + \alpha_3 \cdot 2G_{3i})^B$$

C_i : Number of registered vehicles (i : zone)

A and B: Parameter

| Vehicle Type | Parameter (T Value) | | Correlation Coefficient |
|---------------|---------------------|---------------------|-------------------------|
| | A | B | |
| Passenger Car | 0.36360 (3.2317) | 1.1210 (27.973) | 0.91644 |
| Bus | 0.75566 (1.0089) | 0.99613 (28.021) | 0.91670 |
| Van & Truck | 12.5724 (7.8750) | 0.86809 (20.347) | 0.85725 |

5.3.3 Formulation of Gravity Model

The applied gravity model is shown below with the result of multiple regression analysis:

$$T_{ij} = \frac{\alpha \cdot (C_i \cdot C_j)^{0.5}}{D_{ij}^\beta}$$

T_{ij} : Trips between zone i and j

C_i and C_j : Number of registered vehicles

D_{ij} : Travel time (minutes) between zone i and j

α and β : Parameter

| Vehicle Type | Parameter (T Value) | | Correlation Coefficient |
|----------------------|----------------------|---------------------|-------------------------|
| | α | β | |
| Passenger Car | 2.8400 (2.2871) | 1.0952 (11.260) | 0.4403 |
| Bus (light) | 3.517 (1.4215) | 1.1588 (5.8341) | 0.5663 |
| Bus (heavy) | 0.29008 (1.7343) | 0.71812 (4.7456) | 0.3472 |
| Van & Truck (light) | 0.82463 (0.95411) | 1.1312 (26.818) | 0.5747 |
| Van & Truck (medium) | 0.24020 (5.4754) | 0.95478 (17.186) | 0.5446 |
| Van & Truck (heavy) | 0.25307 (5.6188) | 0.87850 (17.268) | 0.4461 |

In the O/D table made based on a gravity model, there are cases that traffic is unexpectedly assigned to zone pairs on which no actual traffic exists. In order to omit such an error, a screening of O/D pairs by discriminant function analysis was carried out.

The applied formula is shown below with the result of discriminant function analysis:

$$Y_{ij} = \frac{a \cdot (C_i \cdot C_j)^b \cdot e^{c \cdot x_{ij}}}{D_{ij}^d} : Z$$

- Y_{ij} : Discriminant function value
 X_{ij} : If zone i-j pair is in the same Changwat = 1
 X_{ij} : in different Changwat = 0
a, b, c and d : Parameter
Z : Discriminant criteria

| Vehicle Type | Parameter | | | | Criteria |
|----------------------|-----------|---------|---------|---------|----------|
| | a | b | c | d | Z |
| Passenger Car | 0.18139 | 0.56378 | 0.70924 | 0.44019 | 0.45 |
| Bus (light) | 0.03608 | 0.88816 | 2.2585 | 0.64935 | 0.50 |
| Bus (heavy) | 0.00616 | 1.0098 | 2.4770 | 0.43524 | 0.37 |
| Van & Truck (light) | 0.57088 | 0.31201 | 0.76125 | 0.38167 | 0.55 |
| Van & Truck (medium) | 0.52065 | 0.50228 | 0.26944 | 0.67918 | 0.61 |
| Van & Truck (heavy) | 0.24162 | 0.39839 | 0.43790 | 0.33723 | 0.61 |

In reality, the gravity model was applied in a form modified by calibration so as to obtain traffic volumes approximate to actually measured ones.

5.3.4 Preparation of O/D Tables

O/D tables prepared by the above procedures were adjusted by applying Frater's Method so as to match attracted and generated traffic estimated beforehand from the number of registered vehicles.

Generated and attracted traffic for the Laem Chabang and Map Ta Phut Projects in the Eastern Seaboard Development Program were separately added to each concerned traffic zone.

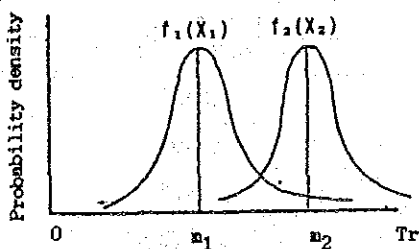
Diverted traffic from other transport modes were disregarded due to the following reasons:

- Volumes handled by railways have been small compared with highways, and cannot be expected to show a significant increase in the near future.
- Volumes by waterway and aviation have been negligibly small, and are not worthwhile considering.

5.3.5 Traffic Assignment

Procedures to assign traffic on links concerned from the O/D tables was as follows:

- Traffic volume for each O/D pair was divided by allotment ratios between the minimum travel time route and the second best route, and then assigned to the respective routes.
- The allotment ratio was estimated by the following formula on the assumption that the distribution of expected travel time would be as follows:

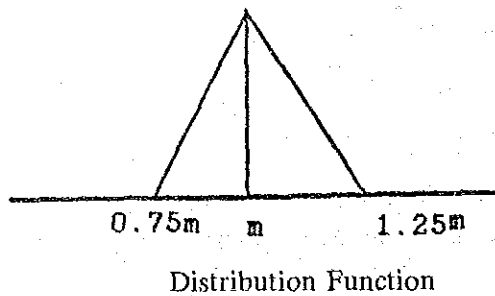


- m_1 : Expected travel time of first route
- m_2 : Expected travel time of second route

$$P_1 = \int_{-\infty}^{\infty} f_1(X_1) \int_{X_1}^{\infty} f_2(X_2) dX_2 dX_1 : \text{Allotment ratio of first route}$$

$$P_2 = 1 - P_1 : \text{Allotment ratio of second route}$$

In this study, the distribution function was assumed to be given as a simple triangular shape as shown below:



M : Average expected travel time

- Traffic volumes assigned on existing links through the above procedures were revised by adjustment factors which are ratios between traffic volumes assigned from the present O/D table and actually measured.

5.3.6 Analysis of Validity of Gravity Model

In order to analyze the validity of the applied gravity model, correlation coefficients between the following items were calculated:

- Attracted and generated traffic of the present O/D table and the number of registered vehicles in 1986 (Case I)
- Traffic volumes assigned on links from the present O/D table and traffic volumes actually measured in 1986 (Case II)

As seen below, the correlation coefficients calculated indicate that the gravity model is practically applicable.

| Vehicle Type | Correlation Coefficients of Case I | Correlation Coefficients of Case II |
|----------------------|------------------------------------|-------------------------------------|
| Passenger Car | 0.9342 | 0.8407 |
| Bus (light) | 0.7838 | 0.7497 |
| Bus (heavy) | 0.8353 | 0.7875 |
| Van & Truck (light) | 0.6935 | 0.7392 |
| Van & Truck (medium) | 0.5340 | 0.7715 |
| Van & Truck (heavy) | 0.5825 | 0.7655 |
| All Vehicle Types | 0.8763 | 0.8496 |

5.4 FUTURE TRAFFIC

5.4.1 Future Number of Registered Vehicles

The future number of registered vehicles was calculated for each traffic zone by the vehicle registration formula established in Section 5.3.2.

The summarized results are shown below:

SOCIO-ECONOMIC INDICATORS AND NUMBER OF REGISTERED VEHICLES

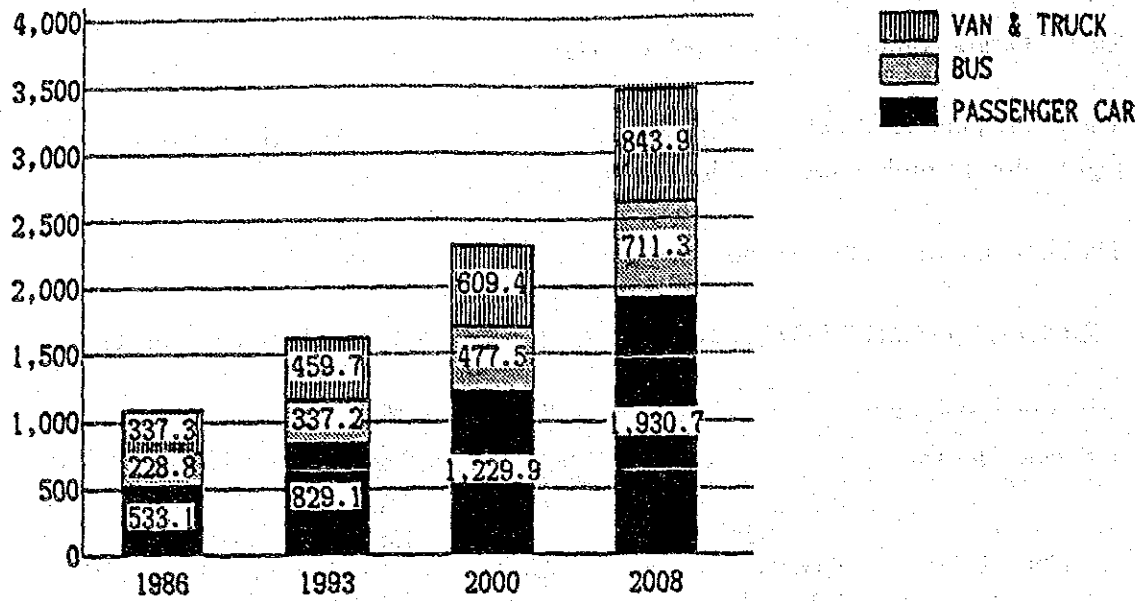
| Economic Indicators | | 1986 | 1993 | 2000 | 2008 |
|---------------------------------------|---------------|---------|---------|---------|---------|
| Population (thousand) | | 18,662 | 20,648 | 22,667 | 24,655 |
| G P P (billion Baht) | Primary | 34.2 | 41.0 | 49.3 | 60.7 |
| | Secondary | 92.4 | 135.1 | 197.2 | 303.4 |
| | Services | 133.3 | 198.8 | 280.3 | 415.1 |
| | Total | 259.9 | 374.9 | 526.8 | 779.2 |
| Vehicle Registration (thousand) | Passenger Car | 533.1 | 829.1 | 1,229.9 | 1,930.7 |
| | Bus | 228.8 | 337.2 | 477.5 | 711.3 |
| | Van & Truck | 337.3 | 459.7 | 609.4 | 843.9 |
| | Total | 1,099.2 | 1,626.0 | 2,316.8 | 3,485.9 |

The total population of 18,662,000 as of 1986 in the study area is expected to reach 22,667,000 in 2000 (1.21 times) and 24,665,000 in 2008 (1.32 times). The total GPP of 259.9 billion Baht as of 1986 is also expected to increase to 526.8 billion Baht in 2000 (2.03 times) and 779.2 billion Baht in 2008 (3.00 times)

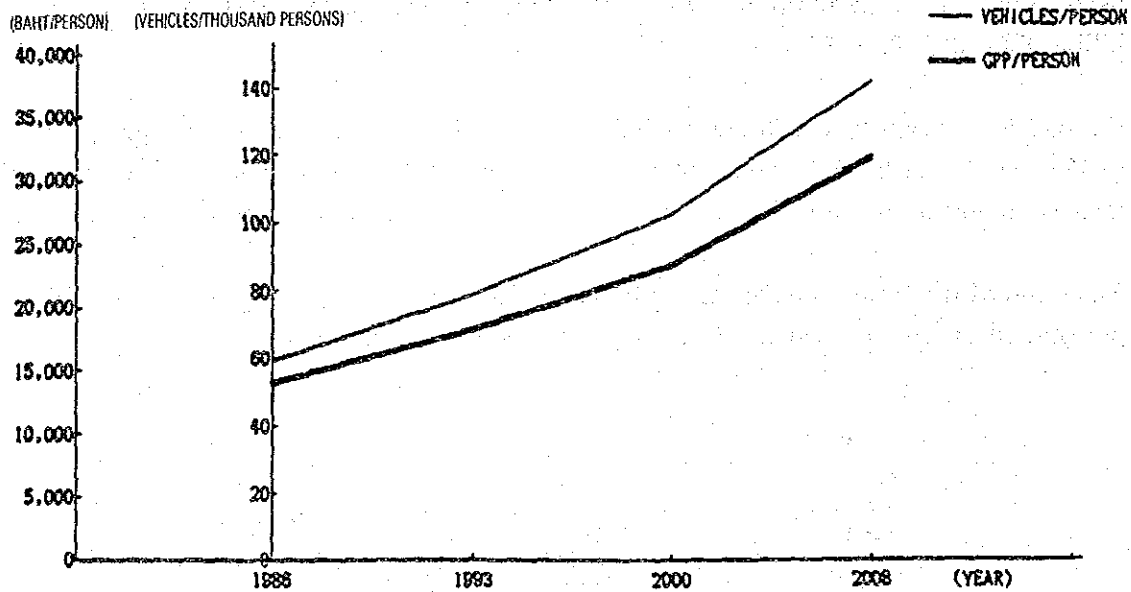
Re the future number of registered vehicles, it was estimated that the total of 1,099,000 as of 1986 would reach 2,317,000 in 2000 (2.11 times) and 3,486,000 in 2008 (3.17 times). The increase in the number of registered vehicles is likely to be somewhat higher than that of GPP.

The trend of the future number of registered vehicles and a comparison between GPP per person and number of registered vehicles per person are illustrated below.

(THOUSAND)



NUMBER OF REGISTERED VEHICLES



FUTURE GPP/PERSON AND VEHICLES/PERSON

The estimated future number of registered vehicles by Changwat are also shown in Table 5.4.1.

Table 5.4.1 FUTURE NUMBER OF REGISTERED VEHICLES

| No. | Changwat Name | 1986 | 1993 | 2000 | 2008 |
|-------|---------------------|-----------|-----------|-----------|-----------|
| 1 | Bangkok | 779,157 | 1,179,592 | 1,709,521 | 2,616,633 |
| 2 | Nakhon Sawan | 18,739 | 24,957 | 32,538 | 44,477 |
| 3 | Uthai Thani | 3,856 | 5,648 | 7,751 | 10,970 |
| 4 | Chai Nat | 4,102 | 5,254 | 6,664 | 8,940 |
| 5 | Nonthaburi | 22,469 | 35,138 | 51,688 | 79,634 |
| 6 | Pathum Thani | 4,748 | 8,066 | 12,544 | 20,067 |
| 7 | Ayutthaya | 8,595 | 12,439 | 17,346 | 25,415 |
| 8 | Lop Buri | 14,753 | 20,786 | 28,271 | 40,463 |
| 9 | Saraburi | 10,942 | 14,943 | 20,156 | 28,762 |
| 10 | Sing Buri | 5,308 | 7,621 | 10,545 | 15,335 |
| 11 | Ang Thong | 4,593 | 6,205 | 8,210 | 11,492 |
| 12 | Kanchanaburi | 16,739 | 22,714 | 30,409 | 43,095 |
| 13 | Nakhon Pathom | 28,547 | 36,758 | 47,372 | 64,938 |
| 14 | Prachuap Khiri khan | 10,535 | 14,301 | 18,925 | 26,252 |
| 15 | Phetchaburi | 11,023 | 15,711 | 21,555 | 30,997 |
| 16 | Ratchaburi | 15,245 | 20,081 | 26,397 | 36,854 |
| 17 | Samut Songkhram | 6,265 | 9,729 | 14,218 | 21,635 |
| 18 | Samut Songkhram | 3,840 | 5,569 | 7,725 | 11,245 |
| 19 | Suphan Buri | 17,312 | 23,399 | 30,885 | 42,911 |
| 20 | Chachoengsao | 8,935 | 13,802 | 19,965 | 30,130 |
| 21 | Chon Buri | 31,854 | 42,603 | 56,349 | 78,552 |
| 22 | Trat | 4,418 | 6,702 | 9,483 | 13,916 |
| 23 | Nakhon Nayok | 3,000 | 4,237 | 5,767 | 8,262 |
| 24 | Prachinburi | 10,699 | 15,265 | 20,870 | 28,135 |
| 25 | Rayong | 18,167 | 24,955 | 33,272 | 46,445 |
| 26 | Samut Prakan | 19,838 | 29,504 | 42,806 | 65,503 |
| 27 | Chanthaburi | 15,520 | 20,017 | 25,638 | 34,859 |
| TOTAL | | 1,099,199 | 1,625,996 | 2,316,870 | 3,485,917 |

5.4.2 O/D Tables

As described in Section 5.3.1, a total 213 of traffic zones was set up, so the number of O/D pairs dealt with reached 22,758 in total in one O/D table. Therefore, only attracted and generated traffic summarized by Changwat level are shown in Table 5.4.2 here. The details are given in Appendix 5.4.1 and traffic desire lines shown in Appendix 5.4.2.

**Table 5.4.2 ATTRACTED AND GENERATED TRAFFIC
(EXCLUDING TRAFFIC INSIDE ZONES)**

| No. Changwat Name | 1986 | 1993 | 2000 | 2008 |
|------------------------|----------------|----------------|------------------|------------------|
| 1 Bangkok | 212,270 | 327,552 | 477,870 | 734,662 |
| 2 Nakhon Sawan | 10,456 | 14,286 | 19,068 | 26,046 |
| 3 Uthai Thani | 4,216 | 6,190 | 8,494 | 11,810 |
| 4 Chai Nat | 1,894 | 2,556 | 3,274 | 4,278 |
| 5 Nonthaburi | 39,074 | 58,756 | 84,330 | 127,710 |
| 6 Pathum Thani | 20,930 | 37,100 | 58,680 | 95,626 |
| 7 Ayutthaya | 13,632 | 20,352 | 28,998 | 42,698 |
| 8 Lop Buri | 16,548 | 24,188 | 33,604 | 49,020 |
| 9 Saraburi | 13,720 | 19,052 | 26,104 | 37,534 |
| 10 Sing Buri | 2,646 | 3,974 | 5,630 | 8,094 |
| 11 Ang Thong | 5,510 | 7,626 | 10,148 | 14,164 |
| 12 Kanchanaburi | 19,878 | 27,082 | 36,190 | 50,474 |
| 13 Nakhon Pathom | 37,078 | 49,578 | 65,564 | 92,142 |
| 14 Prachuap Khiri Khan | 3,500 | 4,742 | 6,460 | 9,046 |
| 15 Phetchaburi | 7,588 | 10,702 | 14,890 | 21,546 |
| 16 Ratchaburi | 25,030 | 33,600 | 45,082 | 63,832 |
| 17 Samut Sakhon | 20,244 | 34,848 | 52,348 | 81,802 |
| 18 Samut Songkhram | 11,026 | 16,428 | 23,240 | 34,486 |
| 19 Suphan Buri | 15,788 | 22,876 | 30,886 | 43,646 |
| 20 Chachoengsao | 16,720 | 28,436 | 42,448 | 65,924 |
| 21 Chon Buri | 38,736 | 56,282 | 80,142 | 118,988 |
| 22 Trat | 5,308 | 8,004 | 11,374 | 16,706 |
| 23 Nakhon Nayok | 8,384 | 12,944 | 18,038 | 26,310 |
| 24 Prachinburi | 12,086 | 17,524 | 24,148 | 32,478 |
| 25 Rayong | 16,796 | 28,094 | 44,100 | 68,850 |
| 26 Samut Prakan | 48,480 | 73,512 | 107,488 | 165,292 |
| 27 Chanthaburi | 12,482 | 16,618 | 21,662 | 29,874 |
| Total | 640,020 | 962,902 | 1,380,260 | 2,073,038 |

Attracted and generated traffic induced by the Eastern Seaboard Development Program were estimated referring to the reports of the Master Plan and the detailed design of this program as shown in Table 5.4.3.

Table 5.4.3 ATTRACTED AND GENERATED TRAFFIC BY EASTERN SEABOARD DEVELOPMENT PROGRAM

| L A E M C H A B A N G | | | | | |
|-----------------------|---|-----------------|--------------------|----------------------------|----------------|
| Year | Freight Volume of Port (thousand tons/yr) | Modal Split | | Traffic Volume of Vehicles | (vehicles/day) |
| | | Transport Mode | (thousand tons/yr) | | |
| 1993 | 4,000 | Highway | 1,210 | P/C | 235 |
| | | Railway | 1,410 | M/T | 115 |
| | | Waterway | 780 | H/T | 355 |
| | | Empty Container | 600 | | |
| | | Total | 4,000 | Total | 705 |
| 2000 | 10,350 | Highway | 3,131 | P/C | 609 |
| | | Railway | 3,648 | M/T | 298 |
| | | Waterway | 2,018 | H/T | 920 |
| | | Empty Container | 1,553 | | |
| | | Total | 10,350 | Total | 1,827 |
| 2008 | 16,700 | Highway | 5,052 | P/C | 983 |
| | | Railway | 5,887 | M/T | 481 |
| | | Waterway | 3,257 | H/T | 1,484 |
| | | Empty Container | 2,505 | | |
| | | Total | 16,700 | Total | 2,948 |

M A P T A P H U T

| Year | Freight Volume of Port (thousand tons/yr) | Modal Split | | Traffic Volume of Vehicles (vehicles/day) | |
|------|---|----------------|--------------------|---|-------|
| | | Transport Mode | (thousand tons/yr) | | |
| 1993 | 2,500 | Highway | 559 | P/C | 93 |
| | | Railway | 402 | M/T | 45 |
| | | Waterway | 2,498 | H/T | 140 |
| | | Total | 3,459 | Total | 278 |
| 2000 | 12,750 | Highway | 2,851 | P/C | 472 |
| | | Railway | 2,051 | M/T | 231 |
| | | Waterway | 12,741 | H/T | 712 |
| | | Total | 17,643 | Total | 1,415 |
| 2008 | 23,000 | Highway | 5,143 | P/C | 851 |
| | | Railway | 3,700 | M/T | 416 |
| | | Waterway | 22,983 | H/T | 1,285 |
| | | Total | 31,826 | Total | 2,552 |

Note:

1. Traffic of surrounding area (25.7%) was excluded in the attracted and generated traffic.
2. Allotment ratio between medium and heavy trucks was estimated based on the result of O/D survey.
3. Average actual payload was also estimated based on the result of O/D survey.
4. Number of passenger cars was assumed to be 50% trucks.
5. Freight volumes of Map Ta Phut include freight other than port loadings.

The estimated total number of trips between traffic zones including trips from/to areas outside of the study area shown below:

**ESTIMATED TOTAL NUMBER OF TRIPS
(EXCLUDING TRIPS INSIDE ZONES)**

| Year | PASSENGER | BUS(L) | BUS(H) | TRUCK(L) | TRUCK(M) | TRUCK(H) | Total |
|------|-----------|---------|--------|----------|----------|----------|-----------|
| 1986 | 149,800 | 39,500 | 23,800 | 64,500 | 33,900 | 36,100 | 347,600 |
| 1993 | 237,200 | 59,900 | 35,400 | 89,600 | 47,500 | 50,300 | 519,900 |
| 2000 | 354,200 | 85,800 | 50,400 | 120,100 | 64,100 | 67,800 | 742,400 |
| 2008 | 558,300 | 128,600 | 74,300 | 166,700 | 89,000 | 93,700 | 1,110,600 |

Note: L: Light, M: Medium, H: Heavy

Growth rates of the total number of trips with 1986 figures as the base are shown below:

**GROWTH RATES FOR TOTAL NUMBER OF TRIPS
(BASE YEAR 1986)**

| Year | PASSENGER | BUS(L) | BUS(H) | TRUCK(L) | TRUCK(M) | TRUCK(H) | Total |
|------|-----------|--------|--------|----------|----------|----------|-------|
| 1986 | 1. | 1. | 1. | 1. | 1. | 1. | 1. |
| 1993 | 1.583 | 1.516 | 1.487 | 1.389 | 1.401 | 1.393 | 1.496 |
| 2000 | 2.364 | 2.172 | 2.118 | 1.862 | 1.891 | 1.878 | 2.136 |
| 2008 | 3.727 | 3.256 | 3.122 | 2.584 | 2.625 | 2.596 | 3.195 |

5.4.3 Future Traffic Volume

Future traffic volumes forecasted through the procedures described previously in 1986, 2000 and 2008 are shown in Figures 5.1.1, 5.4.1 and 5.4.2, respectively.

Based on this result, traffic volumes on links adjacent to Bangkok were summed up for each of the four main directions: north, northeast, east and west. Traffic volumes summed up by direction are as follows:

FUTURE TRAFFIC FLOW IN AND OUT OF BANGKOK

(Unit: ADT)

| Direction | Item | 1986 | 1993 | 2000 | 2008 |
|-----------|----------------|---------|---------|---------|---------|
| North | Traffic Volume | 20,200 | 29,400 | 42,200 | 62,300 |
| | Growth Rate | 1. | 1.455 | 2.089 | 3.084 |
| Northeast | Traffic Volume | 25,900 | 40,900 | 57,500 | 83,500 |
| | Growth Rate | 1. | 1.579 | 2.22 | 3.224 |
| East | Traffic Volume | 34,400 | 49,600 | 74,700 | 114,800 |
| | Growth Rate | 1. | 1.442 | 2.172 | 3.337 |
| West | Traffic Volume | 54,700 | 76,800 | 106,800 | 155,200 |
| | Growth Rate | 1. | 1.404 | 1.952 | 2.837 |
| Total | Traffic Volume | 135,200 | 196,700 | 281,200 | 415,800 |
| | Growth Rate | 1. | 1.455 | 2.08 | 3.075 |

Note: North : Routes 1 and 340
 Northeast : Routes 2 and 305
 East : Routes 3, 34 and 304
 West : Routes 4, 35, 338 and 3035

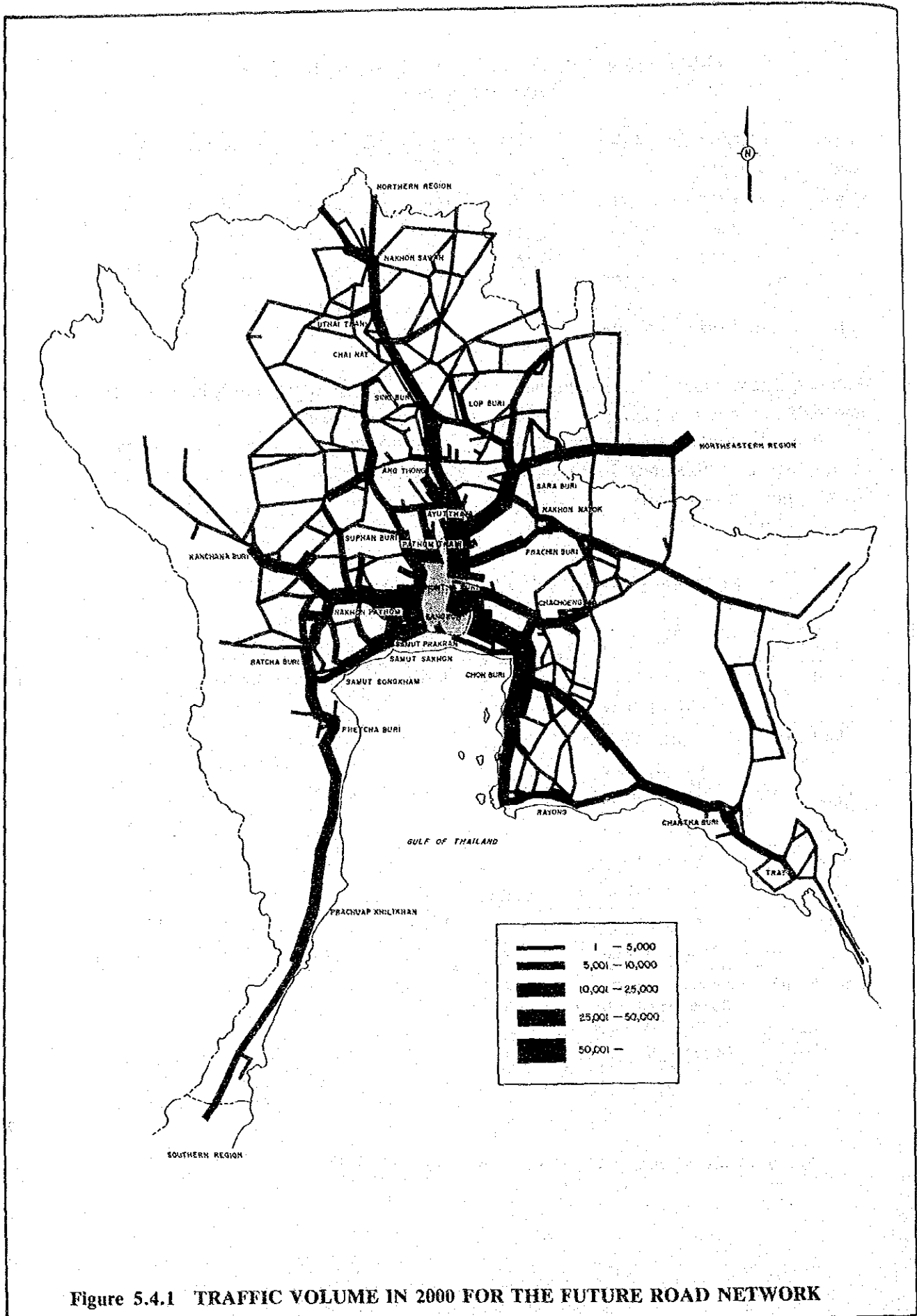


Figure 5.4.1 TRAFFIC VOLUME IN 2000 FOR THE FUTURE ROAD NETWORK

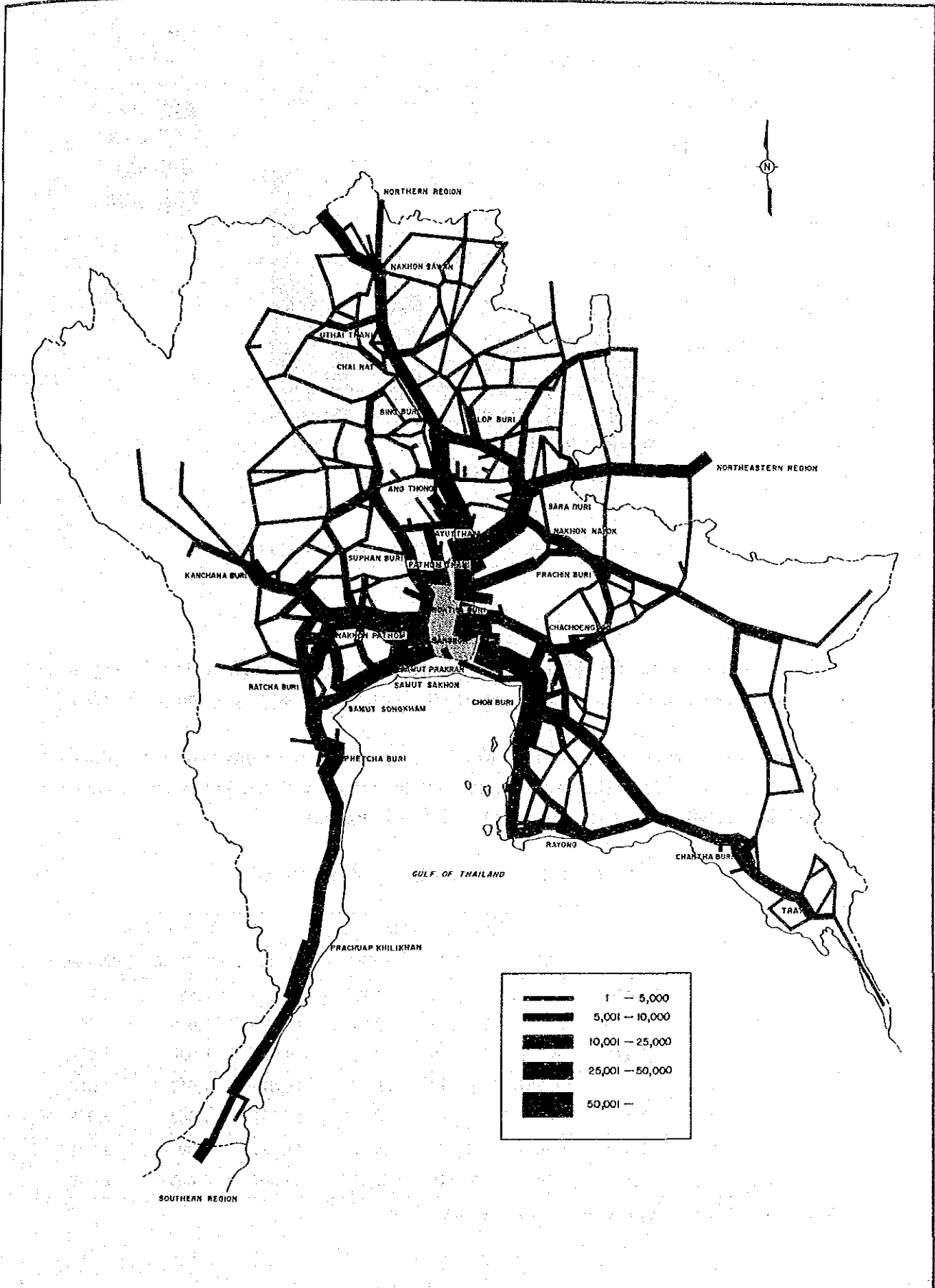
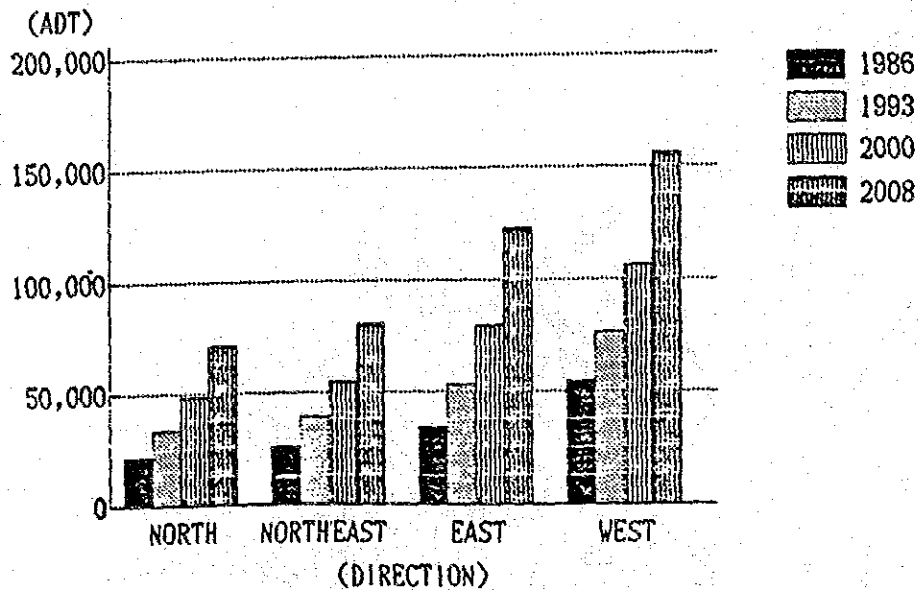


Figure 5.4.2 TRAFFIC VOLUME IN 2008 FOR THE FUTURE ROAD NETWORK



TRAFFIC FLOW IN AND OUT OF BANGKOK

As seen in this result, the traffic volume in the west section is the highest, but the highest growth rate appeared in the east section related to the Eastern Seaboard Development Program.

For comparison between the results of traffic forecast made in the Study and those estimated by DOH, future traffic volumes on some trunk highways near Bangkok were calculated by applying growth rates determined by DOH as given below:

TRAFFIC FLOW IN AND OUT OF BANGKOK

| Direction | Route | Traffic (vehicles/day) | | | | | Growth Rate | |
|-----------|-------|------------------------|--------|--------|--------|--------|-------------|-----------|
| | | 1977 | 1982 | 1986 | 1994 | 2002 | 1994/1986 | 2002/1986 |
| North | 1 | 26,478 | 28,662 | 41,714 | 64,868 | 92,594 | 1.555 | 2.22 |
| | 340 | | | 5,569 | 9,329 | 14,476 | 1.675 | 2.599 |
| | 305 | 4,491 | 6,148 | 7,918 | 12,967 | 19,668 | 1.638 | 2.484 |
| East | 34 | 13,777 | 16,787 | 25,110 | 48,144 | 75,679 | 1.917 | 3.014 |
| | 304 | 2,435 | 4,808 | 6,583 | 8,972 | 13,531 | 1.363 | 2.055 |
| West | 4 | 11,600 | 12,689 | 18,956 | 35,963 | 51,587 | 1.897 | 2.721 |
| | 35 | 6,756 | 8,619 | 14,116 | 22,703 | 34,567 | 1.608 | 2.449 |

Note: Future traffic growth rates from DOH materials

As seen in this table, the ratio between traffic volumes in 1986 and 2002 ranges from 2.0 to 3.0, almost the same as estimated by the Study.

