

Per capita GPP in the Study Area in 1988 was estimated at about 50,642 Baht on the average, or 1.8 times more than the country average. Of the provinces, Bangkok, Samut Prakarn, Pathum Thani and Samut Sakhon showed a high GPP capita of 104,475 Baht, 92,555 Baht 60,931 Baht and 48,224 Baht, respectively (refer to Table 4.3.10).

(3) Government Budget

The economy of Thailand grew very rapidly at an average rate of 10.5% per year, and the Government revenue collection had been significantly higher than the estimates, having a 15.1% (1986) to 19.7% (1990) increase in GDP. Nevertheless, the public finance of Thailand during the past two decades was yearly in the red. However, this financial deficit has shown a decreasing tendency since 1987, and during the period 1988 - 1990 the revenue grew against expenditure as shown in Table 4.3.11.

In 1990, the public revenue was 394,514 million Baht against a public expenditure of 336,508 million Baht, and a profit of 58,006 million Baht (refer to Table 4.3.12).

Majority of the revenue were accounted for by taxes and duties amounting to 348,591 million Baht or 88% of the total revenue.

As for expenditures, the debt service payment in 1990 showed the highest among expenditure items: 69,547 million Baht. The expenditures on other items in the order of amount were 68,996 million Baht for economic services, 59,962 million Baht for education, 54,758 million Baht for defence, 42,507 million Baht for public health and utilities, and 14,889 million Baht for internal security.

(4) Household Income

According to the National Statistics Office, the average monthly income per household in the country was 5,621 Baht in 1990. On the household income by regions, Bangkok Metropolis was reported to have the highest income of 11,344 Baht per month. Following were the Central Region, the Southern Region and the Northern Region with 6,060 Baht, 5,023 Baht and 4,553 Baht, respectively. The Northeastern Region was reported to have the lowest average income of 3,563 Baht.

The average household income of Thailand in 1990 increased by 66.4% compared with that in 1981. Among regions, the highest increase rate of 91.9% was observed in Bangkok Metropolitan Area, followed by the Central Region, Northern Region, Southern Region and the Northeastern Region, with 65.3%, 57.8%, 54.3%, 41.8 percent, respectively.

Table 4.3.13 shows the average monthly income per household and increase rate by regions.

4.3.3 Population and Household

(1) Population

The population estimates presented in this Chapter were obtained from the National Statistical Office (NSO) and the Department of Local Administration under the Ministry of Interior.

The population census of Thailand has been conducted every 10 years since 1960, and the population was 26.568 million in 1960, 34.397 million in 1970 and 44.825 in 1980. The population in 1990 amounted to 56.303 million according to the National Statistical Office (refer to Table 4.3.14).

Like other Asian countries, Thailand went through a period of high population growth (1960-1970) where an annual growth rate of 2.74% was observed. With an intensive family planning campaign, the population growth rate was reduced to 2.68% and 2.31% during the 1970-1980 and 1980-1990 periods, respectively, and still continues to do so (refer to Table 4.3.14).

As for population by region, Bangkok Metropolis is noted to have had a remarkable growth rate of 3.72% (1960-1970) and 4.32% (1970-1980) mainly due to increase in migrants from rural areas and high birth rate. The ratio was observed to have gradually decreased, however, in 1980-1990 due to decrease in number of migrants, which probably resulted from the effects of rapid urbanization such as congestion and high cost of land.

According to the National Statistical Office and the Department of Local Administration, the population of Bangkok metropolis in 1991 was nearly 5.6 million, about 68.6% of the total Study Area population (Table 4.3.17 and Figures 4.3.1 and 4.3.2), and the growth rate was 1.65% per annum during the 1980-1991 period (Table 4.3.15).

The population in the Study Area rose from 6.27 million in 1980 to 8.2 million in 1991 (refer to Table 4.3.16 and Figure 4.3.1). The Study Area accounted for about 40% of the total population of the whole provinces within the area, and during the 1980-1991 period, the population growth rate was 2.47% per annum.

Among the seven (7) provinces (excluding Bangkok) in the Study Area, four (4), Nonthaburi, Pathum Thani, Samut Prakarn and Samut Sakhon showed high annual growth rates of 6.02%, 3.48%, 5.59% and 3.61%, respectively, within the same period.

The population growth in the provinces located in the Bangkok Metropolitan area is very much influenced by the increase in the number of migrants from rural areas.

The population density in 1991 was estimated at an average of 111 persons per square kilometer in whole country and 1,289 persons per square kilometer in the Study Area.

In the same year, Bangkok was the most densely populated area (3,583 persons per square kilometer) of the provinces within the Study Area. It is followed by the three provinces, Nonthaburi, Samut Prakan and Samut Sakhon, which comparatively showed high average population densities of 1130, 879 and 706 persons per square kilometer, respectively (refer to Table 4.3.17).

The population density (1991) by districts is shown in Figure 4.3.3. Of the districts comprising the Metropolitan Area and its vicinities, the most densely populated areas (persons per square kilometer) were Pom Prap Sattru Phai (44,742), Samphanthawong (32,684), Thon Buri (30,065), Khlong San (20,126). The least densely populated were found in districts of Ayutthaya, Pathum Thani, Nakhon Pathom and Chachoengsao (160 average).

Details on the population of every district in the Study Area are shown in Tables 4.3.18, 4.3.19, 4.3.20, 4.3.21, 4.3.22, 4.3.22A, 4.3.23, 4.3.23A, 4.3.24, 4.3.24A, 4.3.25 and 4.3.25A.

(2) Household

According to the National Statistical Office, Thailand has about 11.72 million households in 1991 with an average rate of 4.9 persons per household, and in the Study Area the number of households has reached about 1.857 million (15.85% of the nationwide ratio) with a rate of 4.4% persons per household.

In the Study Area, the provinces of Ayutthaya and Chachoengsao had an average of over 5 persons per household, followed by Bangkok, Nonthaburi, Pathum Thani, Samut prakan and Nakhon Pathom with an average of about 4.3 persons per household. The least populated household is in Samut Sakhon, with only 3.7 persons per household (refer to Table 4.3.17).

(3) Population Projections up to Year 2017

The population projections are used as basic data for development planning and estimation of future water demand for the management of groundwater and land subsidence in the Bangkok Metropolitan Area and its Vicinity.

These population projections were based on NSO census data and the results of the regional population projections prepared by NESDB.

The projections for provinces inside the Study Area are given in Table 4.3.26, 4.3.26A, Figures 4.3.4 and 4.3.5, and the growth rates in Table 4.3.27.

According to Table 4.3.26, it is noted that the 1990 population of Bangkok and the rest of the provinces in the Study Area represents 69% and 31%, respectively, of the total population. However, by the year 2000 these differences are expected to be slightly reduced to 66% percent for Bangkok and 34% for the rest of the provinces, and more at about 60% and 40%, respectively, by the year 2017.

According to Table 4.3.27, the population growth rate of the Study Area will reach the rate of 2.05% in the 1990-1995 period. Based on the NESDB data, the population growth rate is expected to slow down to 1.56% during the 2015-2017 period.

Given these growth rates, the population of the Study Area is expected to increase to 1.6 times the present population between 1990 and 2017.

Table 4.3.1 Growth of Real GDP and Per Capita GNP

Year	Real GDP	Agriculture	Industry	Services	Real per Capita GNP
60 - 65	7.2	4.8	11.5	7.2	-
65 - 70	8.6	6.0	10.4	9.5	-
70 - 75	5.6	3.8	7.3	5.6	2.9
75 - 80	7.9	4.0	10.6	8.2	5.3
80 - 85	5.6	4.9	5.0	6.3	3.5
86	4.5	0.2	7.1	4.6	2.6
87	9.5	-0.2	12.8	11.1	7.7
88	13.2	10.2	17.4	11.6	11.4
89	12.0	6.6	16.2	11.1	10.5
90	10.0	-1.8	15.8	10.0	8.5

Source : National Economic and Social Development Board (NESDB)

Table 4.3.2 MAJOR DEVELOPMENT TARGETS OF ECONOMIC AND SOCIAL DEVELOPMENT DURING THE SEVENTH PLAN (1992-1996)

	Sixth Plan (1987-1991)	Seventh Plan targets (1992-1996)
1. Economic growth (% per year at constant prices)	10.5	8.2
1.1 Agriculture sector	3.4	3.4
1.2 Non-agriculture sector	12.1	8.6
- Industry	13.7	9.5
- Construction	18.7	8.9
- Services and others	11.0	8.1
2. Per capita income (baht/year) 1/	41,000	71,000
3. Expenditures (% per year at constant prices)		
3.1 Private sector		
- Consumption	9.1	5.7
- Investment	26.0	8.8
3.2 Public sector		
- Consumption	2.0	3.3
- Investment	6.5	8.5
4. Export of goods		
4.1 Average (billion baht)	496.0	1,063.0
4.2 Aver. growth rate per year (%)	24.5	14.7
5. Import of goods		
5.1 Average value (billion baht)	664.3	1,358.0
5.2 Aver. growth rate per year (%)	32.6	11.4
6. Trade balance		
6.1 Average value	(168.0)	(313.0)
6.2 Trade balance/GDP (%)	(8.4)	(9.4)
7. Current account balance		
7.1 Average Value (billion baht)	(99.0)	(170.3)
7.2 Current account balance/GDP (%)	(4.9)	(5.2)
8. Inflation (%)	4.7	5.6
9. Number of population (million)	56.9	61.0
Population growth rate (%)	1.4	1.2
10. Employment (million persons)	32.0	34.9
Unemployment rate (%)	0.6	0.5
11. Proportion of people under poverty line (%)	23.7	20
12. Reserve forest (% of total)	18.4	25

Source : The Seventh National Economic and Social Development Plan (1992 - 1996)
National Economic and Social Development Board

Table 4.3.3 GROSS DOMESTIC PRODUCT AND GROSS NATIONAL PRODUCT AT CURRENT MARKET PRICES
(1986-1990)
(Unit : Million Baht)

INDUSTRIAL ORIGIN	1986	1987	1988	1989	1990
Agriculture	178,140	205,592	250,384	266,379	254,523
Mining and Quarrying	34,607	38,491	47,657	60,648	73,500
Manufacturing	258,644	299,327	373,326	453,258	535,396
Construction	56,572	66,097	84,791	112,283	146,817
Electricity and Water Supply	27,300	31,266	34,315	41,499	47,367
Transportation and Communication	85,368	92,943	106,696	123,047	138,752
Wholesale and Retail Trade	171,035	195,696	240,080	272,748	312,738
Banking, Insurance and Real Estate	37,208	50,366	64,979	87,845	124,527
Ownership of Dwellings	44,842	48,802	52,697	58,430	64,355
Public Administration and Defense	50,580	52,700	56,397	64,326	74,603
Services	151,072	171,867	195,655	235,515	278,630
GROSS DOMESTIC PRODUCT (GDP)	1,095,368	1,253,147	1,506,977	1,775,978	2,051,208
Plus: Net Factor Income Payment from the Rest of the World	(22,437)	(22,394)	(24,770)	(23,404)	(21,144)
GROSS NATIONAL PRODUCT (GNP)	1,072,931	1,230,753	1,482,207	1,752,574	2,030,064
National Income (NNP)	852,451	977,857	1,160,715	1,372,921	1,574,649
PER CAPITA GNP (Baht)	20,377	22,960	27,179	31,608	36,032

Source: National Income of Thailand, 1990,
Office of the National Economic and Social Development Board

Table 4.3.4 CONTRIBUTION OF INDUSTRIAL SECTOR TO GDP (1986.1990)
(Unit : Percent)

INDUSTRIAL ORIGIN	1986	1987	1988	1989	1990
Agriculture	16.26	16.41	16.61	15.00	12.41
Mining and Quarrying	3.16	3.07	3.16	3.42	3.58
Manufacturing	23.61	23.89	24.77	25.52	26.10
Construction	5.16	5.27	5.63	6.32	7.16
Electricity and Water Supply	2.49	2.49	2.28	2.34	2.31
Transportation and Communication	7.79	7.42	7.08	6.93	6.76
Wholesale and Retail Trade	15.61	15.62	15.93	15.36	15.25
Banking, Insurance and Real Estate	3.40	4.02	4.31	4.95	6.07
Ownership of Dwellings	4.09	3.89	3.50	3.29	3.14
Public Administration and Defense	4.62	4.21	3.74	3.62	3.64
Services	13.79	13.71	12.96	13.26	13.58
GROSS DOMESTIC PRODUCT (GDP)	100.00	100.00	100.00	100.00	100.00

Source: National Income of Thailand, 1990
Office of the National Economic and Social Development Board
Percentages, arranged by the Study Team

Table 4.3.5 GNP, GDP AND PER CAPITA GNP AT THE 1972 PRICES BY INDUSTRIAL ORIGIN
(Unit : Million Baht)

ORIGIN	YEAR				AVER. ANNUAL GROWTH RATE 1986-1990 (%)
	1986	1987	1988	1989	
GROSS DOMESTIC PRODUCT	413,489	452,635	512,467	574,195	11.17
GROSS NATIONAL PRODUCT	406,935	446,249	505,756	568,470	11.41
PER CAPITA GNP (Baht)	7,728	8,325	9,274	10,252	9.54
					11,128
					631,610
					626,970

Source: National Income of Thailand, 1990
Office of the National Economic and Social Development Board

Table 4.3.6 ANNUAL GROWTH RATES OF GDP, GNP AND PER CAPITA GNP (1986-1990)
(Unit : Percent)

ORIGIN	YEAR				1990
	1986	1987	1988	1989	
GROSS DOMESTIC PRODUCT	-	9.48	13.22	12.04	10.00
GROSS NATIONAL PRODUCT	-	9.66	13.33	12.40	10.29
PER CAPITA GNP	-	7.72	11.40	10.54	8.54

Source : National Income of Thailand, 1990
Office of the National Economic and Social Development Board

Table 4.3.7 GROSS REGIONAL PRODUCT (GRP) AT CURRENT MARKET PRICES
AND AVERAGE ANNUAL GROWTH RATE BY REGION (1986-1988)

REGION	CURRENT MARKET PRICES (Million Baht)			AV. ANNUAL GROWTH RATE (%) 86-88
	1986	1987	1988	
Whole Kingdom	1,095,368	1,253,148	1,506,977	17.3
Bangkok Metropolitan and Vicinity	509,033	611,496	754,651	21.8
Bangkok Metropolis	414,075	495,107	609,924	21.4
Central Region	48,927	53,566	64,984	15.2
Eastern Region	100,023	103,542	67,719	-17.7
Western Region	57,497	63,991	72,132	12.0
Northeastern Region	143,407	152,842	179,500	11.9
Northern Region	126,196	141,618	171,799	16.7
Southern Region	110,285	126,095	146,196	15.1

Source : Statistical Yearbook, Thailand, 1991
National Statistical Office

Table 4.3.8 PER CAPITA (GRP) AT CURRENT MARKET PRICES AND AVERAGE
GROWTH RATE BY REGION (1986-1988)

REGION	PER CAPITA (in Baht)			AV. ANNUAL GROWTH RATE (%) 86-88
	1986	1987	1988	
Whole Kingdom	20,803	23,377	27,632	15.3
Bangkok Metropolitan and Vicinity	61,544	72,315	87,032	18.9
Bangkok Metropolis	71,074	82,905	104,475	21.2
Central Region	18,724	20,275	24,412	14.2
Eastern Region	30,700	32,037	20,558	-18.2
Western Region	18,988	20,192	22,499	8.9
Northeastern Region	7,825	8,208	9,494	10.1
Northern Region	12,210	13,503	16,156	15.0
Southern Region	16,168	18,024	20,381	12.3

Source : Statistical Yearbook, Thailand, 1991
National Statistical Office

Table 4.3.9 GROSS PROVINCIAL PRODUCT (GPP) AT CURRENT MARKET PRICES
BY PROVINCES IN THE STUDY AREA (1986-1988)

PROVINCE	CURRENT MARKET PRICES (Million Baht)			AV. ANNUAL GROWTH RATE (%) 86-88
	1986	1987	1988	
Bangkok Metropolis	414,075	495,107	609,924	21.4
Nakhon Pathom	10,505	11,827	13,604	13.8
Nonthaburi	8,776	10,409	13,565	24.3
Pathum Thani	19,228	23,842	26,688	17.8
Samut Prakarn	44,989	57,062	74,136	28.4
Samut Sakhon	11,460	13,249	16,734	20.8
P. N. Si Ayutthaya	9,738	9,976	11,697	9.6
Chachoengsao	14,602	16,478	19,538	15.7
TOTAL	533,373	637,950	785,886	21.4

Source : Statistical Yearbook, Thailand, 1991
National Statistical Office

Table 4.3.10 PER CAPITA (GPP) AT CURRENT MARKET PRICES BY PROVINCES
IN THE STUDY AREA (1986-1988)

PROVINCE	PER CAPITA (in Baht)			AV. ANNUAL GROWTH RATE (%) 86-88
	1986	1987	1988	
Bangkok Metropolis	71,074	82,905	104,475	21.2
Nakhon Pathom	17,655	20,183	21,091	9.3
Nonthaburi	17,552	20,018	22,533	13.3
Pathum Thani	50,335	61,608	60,931	10.0
Samut Prakarn	68,581	84,162	92,555	16.2
Samut Sakhon	36,732	42,328	48,224	14.6
P. N. Si Ayutthaya	15,239	15,467	17,967	8.6
Chachoengsao	28,244	32,246	37,357	15.0

Source : Statistical Yearbook, Thailand, 1991
National Statistical Office

Table 4.3.11 GOVERNMENT ACTUAL REVENUE AND EXPENDITURE
(1981-1990) (Thousands Baht)

Fiscal year	Actual revenue (1)	Budget expendit. (2)	Difference (1) - (2)
1981	110,391,930	140,000,000	-29,608,070
1982	113,847,788	161,000,000	-47,152,212
1983	136,607,836	177,000,000	-40,392,164
1984	147,871,822	192,000,000	-44,128,178
1985	159,199,939	209,000,000	-49,800,061
1986	166,123,227	211,650,000	-45,526,773
1987	193,524,953	225,032,058	-31,507,105
1988	245,031,256	243,500,000	1,531,256
1989	309,534,113	285,500,000	24,034,113
1990	394,514,362	336,507,500	58,006,862

Source: Statistical Yearbook Thailand, 1991
National Statistical Office

Table 4.3.12 BREAKDOWN OF THE GOVERNMENT FINANCE: FISCAL YEARS 1987-1990
(Thousands Baht)

ITEM	1987	1988	1989	1990
REVENUE				
Taxes and duties	193,524,953	245,031,256	309,534,113	394,514,362
Direct taxes	171,313,785	219,403,979	273,325,778	348,591,497
General sales tax	36,553,718	50,144,074	65,713,773	98,078,680
Specific sales tax	34,249,295	48,947,336	65,636,657	87,545,238
Consumption goods tax	56,834,206	59,900,438	69,492,165	69,961,037
Natural resource tax	54,886,270	57,362,155	66,648,212	67,107,923
Import - export duties	1,947,936	2,538,283	2,843,953	2,853,114
Fees and permits	38,429,722	55,211,189	68,079,725	87,906,586
Other taxes and duties	5,246,291	5,200,119	4,402,826	5,099,956
Other taxes and duties		823	642	
Sales of goods and services	5,808,872	9,082,589	11,958,749	18,104,514
State enterprises	9,504,478	10,227,386	13,585,337	18,620,416
Miscellaneous	6,897,818	6,317,302	10,664,239	9,197,936
BUDGET EXPENDITURE	227,500,000	243,500,000	285,500,000	336,507,500
Economic services	35,902,000	38,088,500	46,292,600	68,966,000
Education	41,111,000	43,860,700	47,358,100	59,962,100
Public health and utilities	24,405,000	25,334,500	31,238,300	42,506,800
Defence	41,057,700	42,985,100	46,427,400	54,758,900
Internal security	10,922,200	11,634,900	12,500,000	14,889,000
General administration	6,208,300	6,693,200	8,053,100	11,038,800
Debt services	56,097,200	59,746,700	66,500,800	69,574,200
Others	11,796,600	13,156,400	27,129,700	14,811,700

Source: Statistical Yearbook Thailand, 1991
National Statistical Office

Table 4.3.13 AVERAGE MONTHLY INCOME PER HOUSEHOLD AND INCREASE RATE
BY REGION 1981-1990

REGION	AVERAGE MONTHLY HOUSEHOLD INCOME			INCREASE RATE (%)		
	1981 (2)	1988	1990	1981-88	1988-90	1981-90
WHOLE KINGDOM	3,378	4,106	5,621	21.6	36.9	66.4
Bangkok Metropolitan Area	5,912	7,877	11,344	33.2	44.0	91.9
Central (1)	3,665	4,220	6,060	15.1	43.6	65.3
Southern	3,256	3,959	5,023	21.6	26.9	54.3
Northern	2,886	3,400	4,553	17.8	33.9	57.8
Northeastern	2,512	3,067	3,563	22.1	16.2	41.8

(1) Excludes Bangkok Metropolitan, Nonthaburi, Pathum Thani and Samut Prakarn

Source: (2) Report of 1981 Socio-Economic Survey, Whole Kingdom
National Statistical Office
Statistical Handbook of Thailand 1992
National Statistical Office

Table 4.3.14 POPULATION AND GROWTH RATE BY REGION : 1960, 1970, 1980, 1990

REGION	POPULATION				AVERAGE ANNUAL GROWTH RATE (%)		
	1960	1970	1980	1990	1960-1970	1970-1980	1980-1990
WHOLE KINGDOM	26,257,916	34,397,374	44,824,540	56,303,273	2.74	2.68	2.31
BANGKOK METROPOLIS	2,136,435	3,077,361	4,697,071	5,546,937	3.72	4.32	1.68
CENTRAL /1	2,101,492	2,465,932	3,069,408	4,511,841	1.61	2.21	3.93
EASTERN	1,809,808	2,373,600	3,181,565	4,182,000	2.75	2.97	2.77
WESTERN	2,223,567	2,694,984	3,475,299	4,127,000	1.94	2.58	1.73
NORTHEASTERN	8,991,543	12,025,140	15,698,878	19,828,941	2.95	2.70	2.36
NORTHERN	5,723,106	7,488,683	9,074,103	10,993,792	2.73	1.94	1.94
SOUTHERN	3,271,965	4,271,674	5,628,216	7,112,762	2.70	2.80	2.37

Note : /1 Excluding Bangkok Metropolis
Source : 1960 Population Census and 1970, 1980 and 1990 Population
and Housing Census
National Statistical Office
Department of Local Administration

Table 4.3.15 NUMBER OF POPULATION BY PROVINCE 1980-1991

PROVINCE	1980	1981	1982	1983	1984	1985	Av. Annual Growth Rate 1980-1991
WHOLE KINGDOM	44,824,540	47,875,002	48,846,927	49,515,094	50,583,105	51,795,651	
Bangkok	4,697,071	5,331,402	5,468,286	5,018,327	5,174,682	5,363,378	
Nonthaburi	369,777	403,809	422,392	456,588	478,199	504,424	
Pathum Thani	319,674	332,111	341,336	357,809	366,767	384,713	
Samut Prakarn	484,829	557,292	585,320	623,514	640,316	662,612	
Samut Sakhon	247,168	270,744	278,949	296,714	301,631	315,373	
Ayutthaya	602,021	626,590	631,285	630,799	637,845	652,977	
Nakhon Pathom	525,906	569,649	590,588	585,931	596,257	609,316	
Chachoengsao	445,000	498,092	507,422	503,184	510,308	525,717	
TOTAL	7,691,446	8,589,689	8,825,578	8,472,866	8,706,005	9,018,510	
PROVINCE	1986	1987	1988	1989	1990	1991	
WHOLE KINGDOM	52,969,204	53,873,172	54,960,917	55,888,393	56,303,273	56,961,030	2.20
Bangkok	5,468,915	5,609,352	5,716,779	5,832,843	5,546,937	5,620,591	1.65
Nonthaburi	525,475	571,871	596,381	627,667	668,760	703,187	6.02
Pathum Thani	402,080	415,193	435,409	441,930	452,693	465,968	3.48
Samut Prakarn	689,631	741,905	789,060	829,412	854,883	882,164	5.59
Samut Sakhon	327,677	334,170	340,952	349,680	358,155	365,274	3.61
Ayutthaya	664,245	668,611	677,626	680,100	685,394	691,075	1.26
Nakhon Pathom	617,596	619,518	630,805	646,803	657,182	664,190	2.14
Chachoengsao	540,864	550,787	569,411	575,731	582,783	589,829	2.59
TOTAL	9,236,483	9,511,407	9,756,423	9,984,166	9,806,787	9,982,278	2.40

Source : Department of Local Administration

Table 4.3.16 NUMBER OF POPULATION OF THE STUDY AREA 1980-1991

PROVINCE	1980	1981	1982	1983	1984	1985	
Bangkok	4,697,071	5,331,402	5,468,286	5,018,327	5,174,682	5,363,378	
Nonthaburi	369,777	403,809	422,392	456,588	478,199	504,424	
Pathum Thani	319,674	332,111	341,336	357,809	366,767	384,713	
Samut Prakarn	484,829	557,292	585,320	623,514	640,316	652,612	
Samut Sakhon	148,860	163,059	168,001	178,700	181,661	189,937	
Ayutthaya	85,710	89,208	89,877	89,807	90,811	92,965	
Nakhon Pathom	69,830	75,639	78,419	77,801	79,172	80,906	
Chachoengsao	89,764	100,473	102,355	101,500	102,937	106,046	
TOTAL	6,265,515	7,052,993	7,255,986	6,904,046	7,114,545	7,384,981	
PROVINCE	1986	1987	1988	1989	1990	1991	Av. Annual Grow. Rate 1980, 1991
Bangkok	5,468,915	5,609,352	5,716,779	5,832,843	5,546,937	5,620,591	1.65
Nonthaburi	525,475	571,871	596,381	627,667	668,760	703,187	6.02
Pathum Thani	402,080	415,193	435,409	441,930	452,693	465,968	3.48
Samut Prakarn	689,631	741,905	789,060	829,412	854,883	882,164	5.59
Samut Sakhon	197,348	201,258	205,343	210,599	215,703	219,991	3.61
Ayutthaya	94,569	95,191	96,474	96,826	97,580	98,389	1.26
Nakhon Pathom	82,005	82,260	83,759	85,883	87,261	88,192	2.14
Chachoengsao	109,101	111,103	114,859	116,134	117,557	118,978	2.59
TOTAL	7,569,124	7,828,133	8,038,064	8,241,294	8,041,374	8,197,460	2.47

Source : Department of Local Administration

Table 4.3.17 STUDY AREA POPULATION, HOUSEHOLD, DENSITY, 1991

PROVINCE	AREA (km ²)	POPULATION	HOUSEHOLD	DENSITY (pers/km ²)	Person per household
Bangkok	1,568.737	5,620,591	1,239,475	3,583	4.5
Nonthaburi	622.303	703,187	165,229	1,130	4.3
Pathum Thani	1,525.856	465,968	110,927	305	4.2
Samut Prakarn	1,004.092	882,164	223,044	879	4.0
Samut Sakhon /1	311.800	219,991	60,124	706	3.7
Ayutthaya /1	477.500	98,389	18,224	206	5.4
Nakhon Pathom /1	282.350	88,192	20,053	312	4.4
Chachoengsao /1	527.000	118,978	20,356	226	5.8
Gulf	38.862			0	0.0
TOTAL	6,358.500	8,197,460	1,857,432	1,289	4.4

Source: Department of Local Administration
National Statistical Office
/1 by the Study Team based on DLA & NSO data

Table 4.3.18 NUMBER OF POPULATION, HOUSEHOLD, DENSITY OF BANGKOK METROPOLIS BY DISTRICT (1990)

No.	DISTRICT	LAND AREA (km ²)	POPULATION	HOUSEHOLD	DENSITY (Pers/km ²)
1	Phra Nakhon	5.536	90,522	21,571	16,352
2	Pom Prap Sattru Phai	1.931	86,397	17,044	44,742
3	Samphanthawong	1.416	46,281	14,571	32,684
4	Pathum Wan	8.369	138,071	26,446	16,498
5	Bang Rak	5.536	85,421	21,999	15,430
6	Yan Nawa	16.662	110,139	24,532	6,610
7	Sathon	9.326	142,095	27,195	15,236
8	Bang Kho Laem	10.921	150,288	25,743	13,761
9	Dusit	10.665	175,663	25,363	16,471
10	Bang Su	11.545	189,873	38,694	16,446
11	Phaya Thai	10.265	201,261	24,665	19,607
12	Ratchathewi	7.164	95,175	21,644	13,285
13	Huai Khwang	22.679	266,604	51,671	11,756
14	Phra Khanong	33.887	209,461	52,581	6,181
15	Khlong Toei	27.193	251,431	72,217	9,246
16	Prawet	82.479	205,906	46,691	2,496
17	Bang Khen	76.613	221,274	53,235	2,888
18	Don Muang	59.789	235,155	51,514	3,933
19	Chatuchak	32.908	207,239	41,351	6,298
20	Bang Kapi	48.904	235,494	62,445	4,815
21	Lat Phrao	30.476	120,732	32,754	3,962
22	Bung Kum	69.903	188,789	46,054	2,701
23	Nong Chok	236.261	61,682	9,989	261
24	Min Buri	174.331	100,618	20,538	577
25	Lat Krabang	123.859	68,926	17,756	556
26	Thon Buri	8.626	259,345	38,962	30,065
27	Khlong San	6.051	121,780	24,608	20,126
28	Bangkok Noi	11.944	160,168	31,325	13,410
29	Bang Phlat	11.360	143,567	39,734	12,638
30	Bang Yai	6.180	102,600	22,381	16,602
31	Phasi Charoen	53.947	261,432	65,907	4,846
32	Bang Khun Thian	155.432	130,546	35,363	840
33	Chom Thong	25.724	174,976	38,787	6,802
34	Taling Chan	79.698	126,205	29,285	1,584
35	Rat Burana	42.874	169,036	36,829	3,943
36	Nong Khaem	48.283	86,439	28,031	1,790
	TOTAL	1,568.737	5,620,591	1,239,475	3,583

Source : Department of Local Administration
National Statistical Office

Table 4.3.19 NUMBER OF POPULATION, HOUSEHOLD, DENSITY OF NONTHABURI BY DISTRICT (1991)

District	Land Area (km ²)	Population	Household	Density (pers/km ²)
Muang Nonthaburi	77.018	314,000	69,572	4,077
Bang Kruai	57.408	80,053	18,587	1,394
Bang Yai	96.398	41,914	9,478	435
Bang Bua Thong	116.439	71,934	22,833	618
Pak Kret	89.023	161,133	38,992	1,810
Sai Noi	186.017	34,153	5,767	184
Total	622.303	703,187	165,229	1,130

Source: Department of Local Administration

Table 4.3.20 NUMBER OF POPULATION, HOUSEHOLD, DENSITY OF PATHUM THANI BY DISTRICT (1991)

District	Land Area (km ²)	Population	Household	Density (pers/km ²)
Muang Pathum Thani	120.151	94,604	28,405	787
Sam Khok	94.967	39,250	7,779	413
Lat Lum Kaeo	188.120	35,393	6,714	188
Thanyaburi	112.124	84,916	17,248	757
Lam Luk Ka	297.710	89,235	20,544	300
Khlong Luang	299.152	82,080	22,055	274
Nong Sua	413.632	40,490	8,182	98
Total	1,525.856	465,968	110,927	305

Source: Department of Local Administration

Table 4.3.21 NUMBER OF POPULATION HOUSEHOLD DENSITY OF SAMUT
 PRAKARN BY DISTRICT (1991)

District	Land Area (km ²)	Population	Household	Density (pers/km ²)
Muang District	190.557	354,482	105,010	1,860
Phra Pradaeng	73.368	203,322	52,890	2,771
Bang Phli	374.782	158,694	35,175	423
Bang Bo	245.007	86,450	14,220	353
Phra Samut Chedi	120.378	79,216	15,749	658
Total	1004.092	882,164	223,044	879

Source: Department of Local Administration

Table 4.3.22 NUMBER OF POPULATION, HOUSEHOLD, DENSITY OF SAMUT SAKHON BY DISTRICT (1991)

District	Land Area (km ²)	Population	Household	Density (pers/km ²)
Muang Samut Sakhon	492.040	182,514	42,500	371
Krathum Baen	135.276	96,163	32,496	711
Ban Phaeo	245.031	86,597	14,577	353
Total	872.347	365,274	89,573	419

Source: Department of Local Administration

Table 4.3.22a SAMUT SAKHON, STUDY AREA POPULATION, (1991)

District	Land Area (km ²)	Population	Household	Density (pers/km ²)
Muang Samut Sakhon	204.000	131,193	30,236	643
Krathum Baen	107.800	88,798	29,888	824
Total	311.800	219,991	60,124	706

Source: Study Team

Table 4.3.23 NUMBER OF POPULATION, HOUSEHOLD, DENSITY OF PHRA NAKHOM SI AYUTTHAYA BY DISTRICT (1991)

District	Land Area (km ²)	Population	Household	Density (pers/km ²)
Phra Nakhom Si Ayutthaya	130.579	121,435	20,811	930
Tha Rua	106.189	51,904	11,281	489
Nakhon Luang	198.919	33,088	6,708	166
Bang Sai	219.679	44,460	7,999	202
Bang Ban	135.305	34,980	7,733	259
Bang Pa In	229.098	64,543	11,228	282
Bang Pahan	121.865	36,759	7,445	302
Phak Hai	189.008	45,675	9,233	242
Phachi	104.508	29,684	4,940	284
Lat Bua Luang	199.928	33,354	6,328	167
Wang Noi	219.191	43,655	8,410	199
Sena	205.567	60,793	12,550	296
Bang Sai (Left)	150.756	19,889	4,327	132
Uthai	186.802	37,885	7,536	203
Maha Rat	120.159	23,493	4,763	196
Ban Phraek	39.087	9,478	2,140	242
Total	2,556.640	691,075	133,432	270

Source : Department of Local Administration

Table 4.3.23a PHRA NAKHOM SI AYUTTHAYA, STUDY AREA POPULATION (1991)

District	Land Area (km ²)	Population	Household	Density (pers/km ²)
Bang Sai	111.500	22,523	4,052	202
Bang Pa In	83.500	23,547	4,096	282
Lat Bua Luang	187.000	31,229	5,925	167
Wang Noi	74.000	14,726	2,837	199
Sena	21.500	6,364	1,314	296
Total	477.500	98,389	18,224	206

Source : Department of Local Administration

Table 4.3.24 NUMBER OF POPULATION, HOUSEHOLD, DENSITY OF NAKHON PATHOM BY DISTRICT (1991)

District	Land Area (km ²)	Population	Household	Density (pers/km ²)
Muang Nakhon Pathom	417.440	229,935	47,897	551
Sam Phran	249.347	107,479	30,731	431
Nakhon Chaisi	284.031	84,866	16,152	299
Bang Len	588.836	82,965	15,747	141
Kamphaeng Saen	405.019	104,732	17,250	259
Don Tum	171.354	38,618	6,275	225
Buddha Monton (subd.)	52.300	15,595	2,727	298
Total	2,168.327	664,190	136,779	306

Source: Department of Local Administration

Table 4.3.24a NAKHON PATHOM, STUDY AREA POPULATION (1991)

District	Land Area (km ²)	Population	Household	Density (pers/km ²)
Sam Phran	133.850	57,689	16,495	431
Nakhon Chaisi	8.500	2,542	484	299
Bang Len	87.700	12,366	2,347	141
Buddha Monton	52.300	15,595	2,727	298
Total	282.350	88,192	22,053	312

Source: Study Team

Table 4.3.25 NUMBER OF POPULATION, HOUSEHOLD, DENSITY OF CHACHOENGSAO BY DISTRICT (1991)

DISTRICT	LAND AREA (km ²)	POPULATION	HOUSEHOLD	DENSITY (pers/km ²)
Muang Chachoengsao	378.663	132,062	27,716	349
Bang Pakong	257.893	74,724	15,667	290
Bang Khla	355.290	61,131	12,418	172
Ban Pho	217.593	45,449	8,298	209
Bang Nam Prieo	498.659	73,519	15,246	147
Phanom Sarakham	550.000	74,601	16,864	136
Plaeng Yao	237.230	31,308	6,878	132
Sanam Chai Khet	1,666.000	56,306	10,807	34
Ratchasan	134.900	12,372	2,384	92
Tha Takiap	1,054.772	28,357	6,742	27
TOTAL	5,351.000	589,829	123,020	110

Source: Department of Local Administration

Table 4.3.25a CHACHOENGSAO, STUDY AREA POPULATION (1991)

DISTRICT	LAND AREA (km ²)	POPULATION	HOUSEHOLD	DENSITY (pers/km ²)
Muang Chachoengsao	160.500	56,015	7,323	349
Bang Nam Prieo	107.000	15,729	3,262	147
Ban Pho	19.500	4,076	744	209
Bang Pakong	127.000	36,830	7,722	290
North Side	113.00	6328.00	1,305	56
TOTAL	527.000	118,978	20,356	226

Source: Study Team

Table 4.3.26 POPULATION PROJECTIONS FOR SELECTED YEARS WITHIN THE STUDY AREA (1990-2017)

PROVINCE	1990	1995	2000	2005	2010	2015	2017
Bangkok	5,546,937	6,012,332	6,435,419	6,820,698	7,180,772	7,547,064	7,698,760
Nonthaburi	668,760	798,127	937,360	1,086,657	1,259,733	1,460,376	1,549,313
Pathum Thani	452,693	522,496	595,379	667,070	747,394	837,390	876,353
Samut Prakarn	854,883	993,628	1,140,911	1,290,836	1,460,463	1,652,379	1,736,031
Samut Sakhon	215,703	240,815	267,214	295,026	325,732	359,635	374,164
Ayutthaya	97,580	106,006	114,568	122,211	130,364	139,061	142,700
Nakhon Pathom	87,261	95,270	103,420	110,865	118,846	127,401	130,994
Chachoengsao	117,557	132,992	149,695	166,087	184,274	204,453	213,130
Total	8,041,374	8,901,666	9,743,966	10,559,451	11,407,579	12,327,761	12,721,446

Source : 1990, Census Data of N.S.O.
 1995-2000, arranged by the Study Team based on Population Projections for Thailand
 1980-2015, N.E.S.D.B.
 2005-2017, arranged by the Study Team

Table 4.3.26a POPULATION PROJECTION OF THE STUDY AREA, 1990-2017

YEAR	TOTAL	BANGKOK	NONTHABURI	PATHUM THANI	SAMUT PRAKARN	SAMUT SAKHON	AYUTTHAYA	NAKHON PATHOM	CHACHO-ENGSAO
1990	8,041,374	5,546,937	668,760	452,693	854,883	215,703	97,580	87,261	117,557
1991	8,197,460	5,620,591	703,187	465,968	882,164	219,991	98,389	88,192	118,978
1992	8,384,047	5,734,175	719,191	480,409	909,314	226,005	100,842	90,633	123,477
1993	8,550,022	5,824,194	744,407	493,754	935,995	230,512	102,473	92,039	126,649
1994	8,726,802	5,917,813	770,718	509,151	964,812	236,307	104,103	93,865	130,032
1995	8,901,666	6,012,332	798,127	522,496	993,628	240,815	106,006	95,270	132,992
1996	9,073,393	6,097,850	826,631	537,894	1,023,512	246,610	107,637	97,097	136,163
1997	9,242,637	6,183,367	854,039	552,265	1,053,395	251,761	109,268	98,783	139,758
1998	9,403,805	6,265,284	880,351	565,610	1,081,144	256,912	111,035	100,329	143,140
1999	9,574,015	6,349,001	908,856	581,007	1,112,095	262,063	112,665	102,015	146,312
2000	9,743,967	6,435,419	937,360	595,379	1,140,911	267,214	114,568	103,420	149,695
2001	9,901,344	6,511,035	965,481	609,073	1,169,434	272,558	116,057	104,868	152,839
2002	10,065,307	6,591,151	994,445	623,081	1,198,670	278,009	117,566	106,336	156,048
2003	10,226,008	6,665,866	1,024,279	637,412	1,228,636	283,570	119,094	107,825	159,325
2004	10,391,603	6,743,282	1,055,007	652,073	1,259,352	289,241	120,643	109,334	162,671
2005	10,559,451	6,820,698	1,086,657	667,070	1,290,836	295,026	122,211	110,865	166,087
2006	10,726,008	6,894,513	1,119,257	682,413	1,323,107	300,926	123,800	112,417	169,575
2007	10,892,237	6,965,628	1,152,835	698,109	1,356,185	306,945	125,409	113,991	173,136
2008	11,060,898	7,036,742	1,187,420	714,165	1,390,089	313,084	127,040	115,587	176,772
2009	11,230,257	7,106,057	1,223,042	730,591	1,424,841	319,345	128,691	117,205	180,484
2010	11,407,579	7,180,772	1,259,733	747,394	1,460,463	325,732	130,364	118,846	184,274
2011	11,584,623	7,252,580	1,297,525	764,584	1,496,974	332,247	132,059	120,510	188,144
2012	11,765,085	7,325,106	1,336,451	782,170	1,534,398	338,892	133,776	122,197	192,095
2013	11,949,041	7,398,357	1,376,545	800,160	1,572,758	345,670	135,515	123,908	196,129
2014	12,136,572	7,472,341	1,417,841	818,564	1,612,077	352,583	137,276	125,642	200,248
2015	12,327,761	7,547,064	1,460,376	837,390	1,652,379	359,635	139,061	127,401	204,453
2016	12,522,689	7,622,535	1,504,188	856,650	1,693,689	366,828	140,869	129,185	208,746
2017	12,721,446	7,698,760	1,549,313	876,353	1,736,031	374,164	142,700	130,994	213,130

Source : 1990-1992, National Statistical Office
 1993-2000, arranged by the Study Team based on Population Projections for Thailand
 1980-2015, NESDB
 2001-2017, arranged by the Study Team

Table 4.3.27 POPULATION GROWTH RATE OF THE STUDY AREA

PROVINCE	1995/1990	2000/1995	2005/2000	2010/2005	2015/2010	2017/2015
Bangkok	1.62	1.37	1.17	1.03	1.00	1.00
Nonthaburi	3.60	3.27	3.00	3.00	3.00	3.00
Pathum Thani	2.91	2.65	2.30	2.30	2.30	2.30
Samut Prakarn	3.05	2.80	2.50	2.50	2.50	2.50
Samut Sakhon	2.23	2.10	2.00	2.00	2.00	2.00
Ayutthaya	1.67	1.57	1.30	1.30	1.30	1.30
Nakhon Pathom	1.77	1.66	1.40	1.40	1.40	1.40
Chachoengsao	2.50	2.39	2.10	2.10	2.10	2.10
Total	2.05	1.82	1.62	1.56	1.56	1.56

Source : 1990-2000, NESDB
2000-2017, Study Team

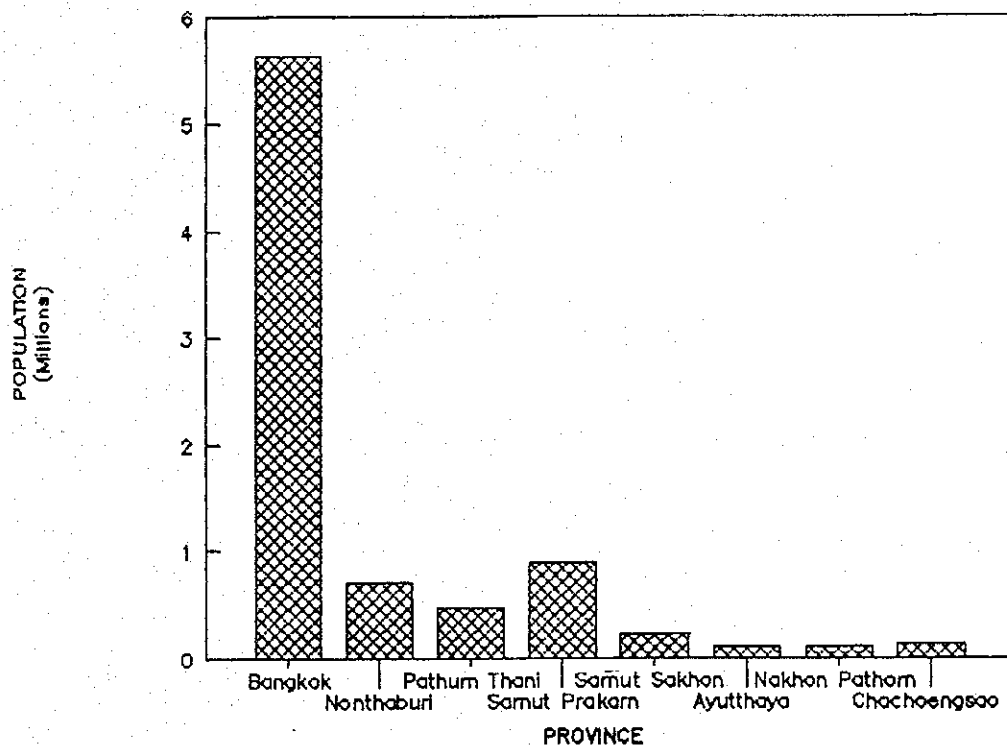


Figure 4.3.1 STUDY AREA POPULATION, 1991

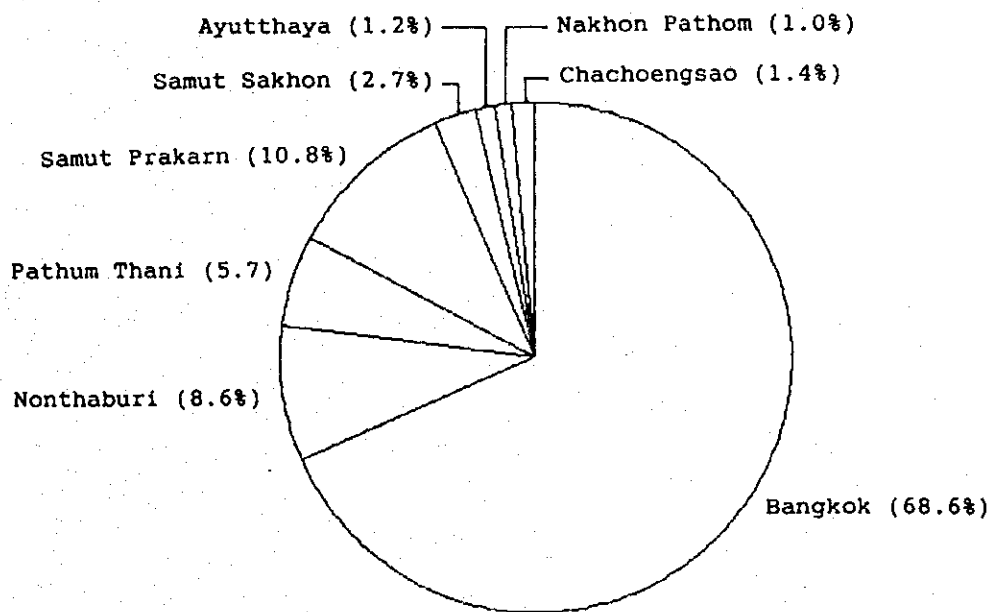


Figure 4.3.2 STUDY AREA POPULATION BY PERCENTAGE, 1991

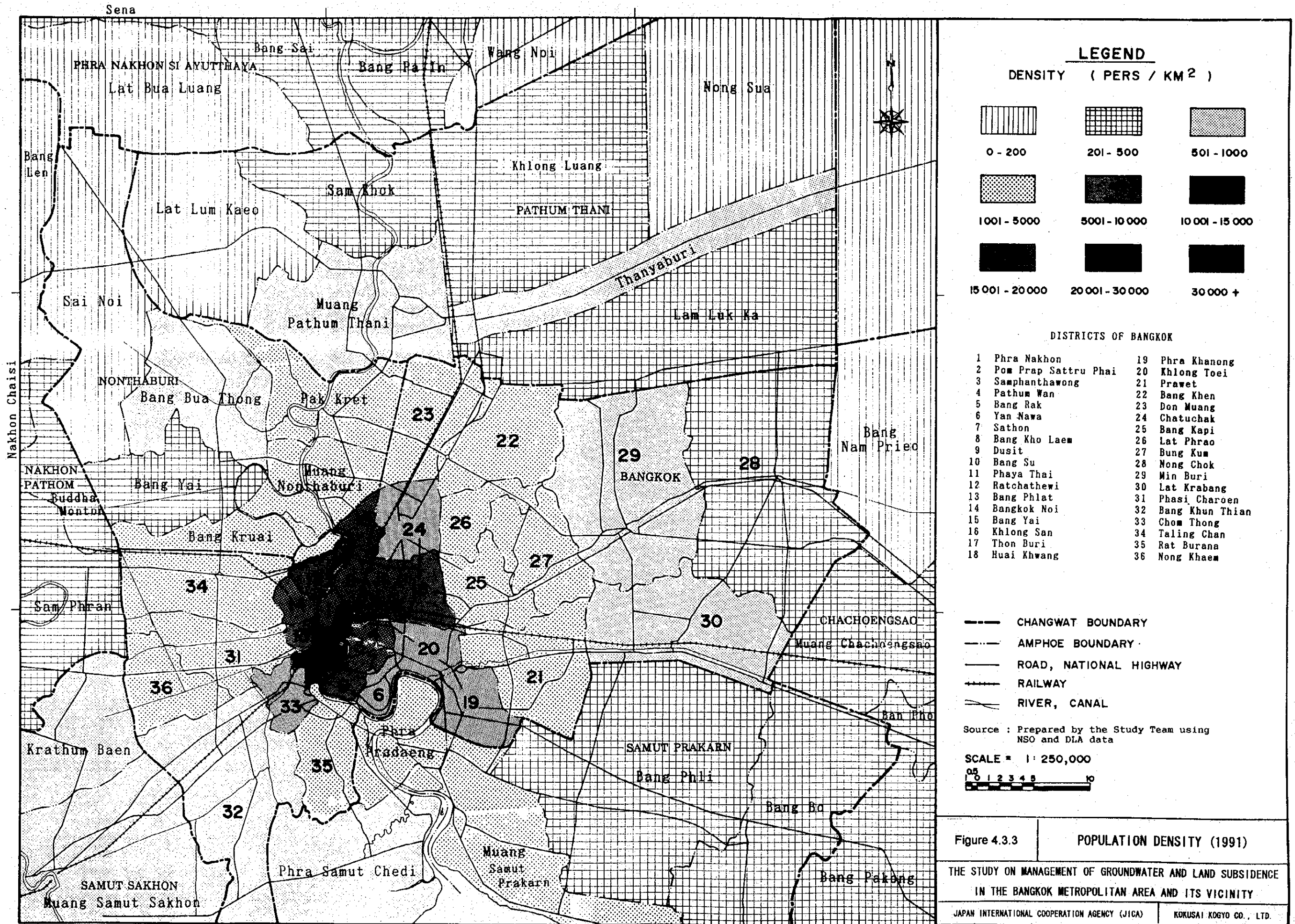


Figure 4.3.3 POPULATION DENSITY (1991)

THE STUDY ON MANAGEMENT OF GROUNDWATER AND LAND SUBSIDENCE
IN THE BANGKOK METROPOLITAN AREA AND ITS VICINITY

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) KOKUSAI KOGYO CO., LTD.

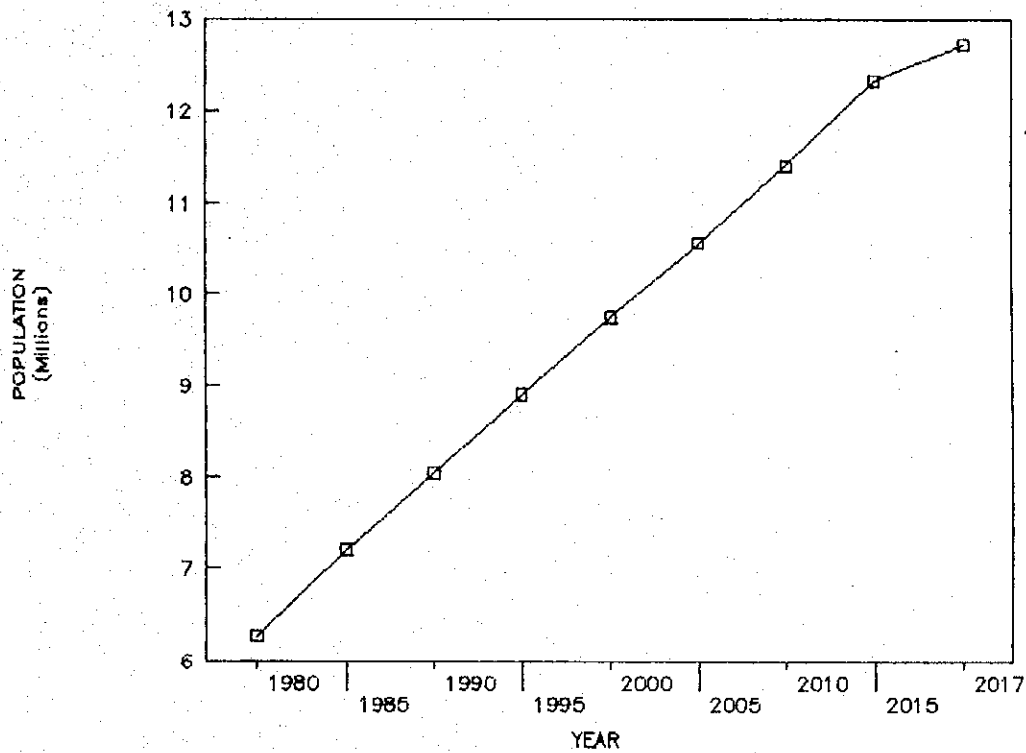


Figure 4.3.4 POPULATION PROJECTION OF THE STUDY AREA

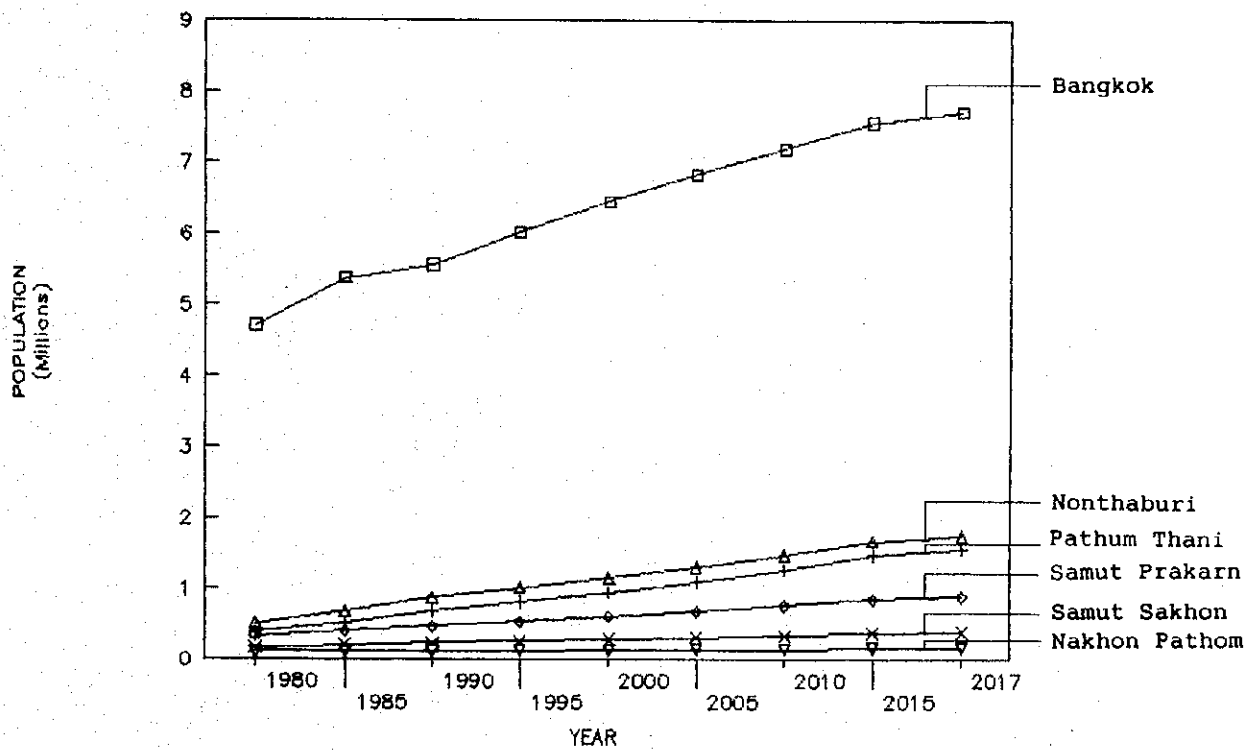


Figure 4.3.5 POPULATION PROJECTION BY DISTRICTS

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4.4 Infrastructure

4.4.1 Transportation

(1) Road Network

The transportation network in Thailand is mainly characterized by highway roads. Highways and roads in the country are classified into seven (7) categories: special highway, national highway, provincial highway, concessioned highway, rural road, municipal road and sanitary road. The first four types of highways are administered by the Department of Highways, while the remaining other categories are under the control of the respective provincial administrative organizations under the Municipal Public Works.

Table 4.4.1 shows the length of national (including special highways) and provincial highways. According to the Table, the total length increased from 15,218 km in 1985 to 17,920 km in 1991 for the national highways, and from 21,017 km in 1985 to 28,127 km in 1991 for the provincial highways, showing annual increase rates of 2.76% and 4.98%, respectively.

Among the highways, it is observed that the provincial highway grew considerably in length during the same period. In the Study Area the major road network is as shown in Figure 4.4.1. The major roads connecting Bangkok to different directions within the study area are:

- National road 1, to the northern and the northeastern part.
- National roads 3 and 34, to the eastern part.
- National roads 4 and 35, to the southern and western parts.

(2) Railway

Railway transport is less consolidated than the road network, and the operation length of the State Railway of Thailand as of 1982 is 3,735 km. New lines have not been constructed since 1970.

The railway networks are radially constructed from Bangkok leading off to the north (railway line to Chiang Mai), northeast (to Ayutthaya and other connecting lines), east (to Prachin Buri) and south (to Suhai Kolok) directions.

(3) Inland Water Transportation

The inland water transportation serves a distance of about 3,000 km, and the canal networks of the Chao Phraya River, the original means of transportation of Bangkok and vicinity, are the largest in the country. These canal networks have been used for the transportation of gravel, cement, maize, etc., however, all year round navigation is impossible due to fluctuating water depths and high costs involved in canal dredging.

4.4.2 Water Supply

Water supply in Bangkok and vicinity is under the responsibility of the Metropolitan Waterworks Authority (MWA), the Provincial Waterworks Authority (PWA), and the municipal offices. These agencies serve 60% of the total population of the area of their jurisdiction.

Bangkok and its vicinity have undergone tremendous growth, but basic infrastructural conditions have not expanded to meet the demands. Furthermore, construction projects are unregulated thus infrastructures cannot be planned ahead.

MWA has completed three water supply improvement projects that contribute in meeting customers' demands. A major plan is also being implemented and further urgent projects are being carried out to alleviate water shortage in some areas, especially Thonburi and Nonthaburi on the west bank of the Chao Phraya River, which have high growth rates. Shortage in tap water on the other hand, has prompted users to pump groundwater, inadvertently causing ground subsidence.

Accordingly, the Government has had to issue a decree restricting the excessive pumping of groundwater by both the private sector and MWA.

Table 4.4.2 shows that the major source of water supply of the private households in 1991, were public and private wells (58.3%), followed by taps or faucets inside and outside households (29.7%). Most of the private households in municipal areas reported taps or faucets as major sources of water supply (84.6%), while public and private wells were reported as major sources of water supply in non-municipal areas (69.3%).

Wells (public and private) are the major source of water supply for all regions, except for the Bangkok Metropolis where taps or faucets are the top leading sources of water supply (92.1%).

4.4.3 Lighting

The two agencies responsible for the electricity in Bangkok and its vicinity are the Metropolitan Electric Authority (MEA) and the Provincial Electric Authority (PEA). Both agencies are supplied by the Electricity Generating Authority of Thailand (EGAT) and distributes electricity to the designated areas. MEA is responsible for Bangkok, Nonthaburi, Samut Prakarn and some parts of Pathum Thani, while PEA is responsible for Nakhon Pathom, Samut Sakhon and Pathum Thani.

About 10,919,500 private households or about 89.3% of the private households have electricity. In municipal areas, 2,295,100 private households or 98.6% use electricity. In non-municipal areas, however, about 8,624,400 private households or 87.2% of private households were reportedly using electricity for lighting, while only 12.8% do not.

Electricity was found to be widely used in Bangkok Metropolis (99.4%), followed by the Central Region (92.6%), the Northeast area (87.9%), the Northern area (85.7%), and the Southern area (84.4%).

Table 4.4.1 LENGTH OF HIGHWAYS AND ROADS IN THAILAND
(unit: Km)

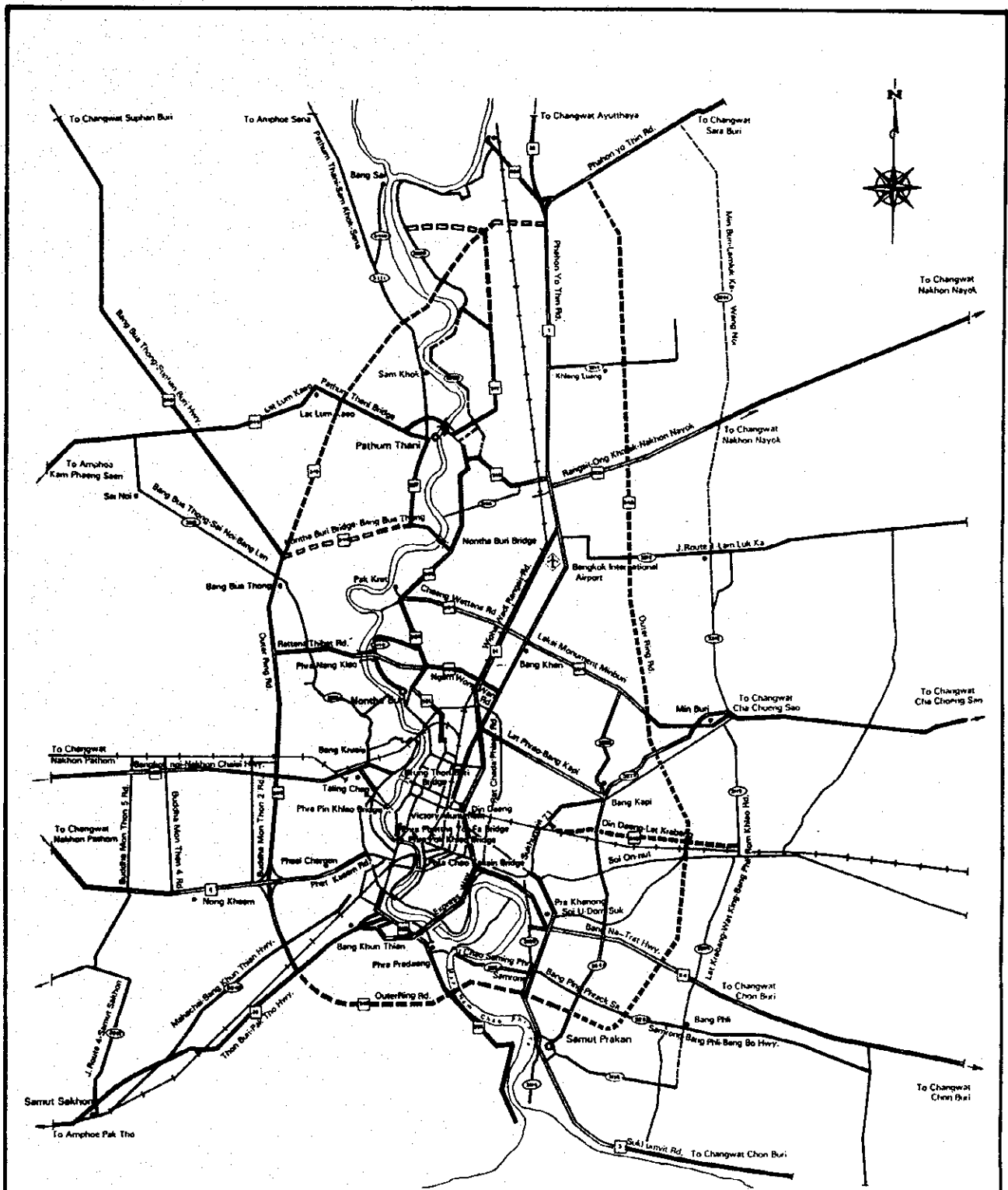
Category	1985	1987	1988	1989	1990	1991	1985-90 (%)
National Highway	15,218	15,664	15,899	16,815	17,482	17,920	2.76
Primary	7,305	7,278	7,314	7,323	7,536	7,802	1.10
Secondary	7,913	8,386	8,585	9,492	9,950	10,118	4.18
Provincial Highway	21,017	24,500	25,895	27,595	27,959	28,127	4.98
Total	51,453	55,828	57,693	61,225	62,927	63,967	3.69

Source: Statistical Yearbook, Thailand, 1991
 Statistical Handbook of Thailand, 1992
 National Statistical Office

Table 4.4.2 PERCENTAGE OF PRIVATE HOUSEHOLD BY SOURCE OF WATER SUPPLY AND LIGHTING

WATER SUPPLY LIGHTING	WHOLE KINGDOM			REGION				
	TOTAL	MUNIC. AREA	NON- MUNIC. AREA	Bangkok Metrop.	Central Region (Excl. Bangkok Metrop.)	Northern Region	North- eastern Region	Southern Region
WATER SUPPLY								
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Tap Water	29.6	84.6	16.8	92.1	35.3	22.9	14.2	17.9
Well Water	58.3	11.4	69.3	3.4	39.8	67.9	76.3	75.8
Rain Water	1.7	0.4	2	0.4	2.9	1	1.6	2.1
River, Canal, Stream,								
Waterfall	9.7	3.1	11.2	3.7	21.2	7.5	7.3	3.5
Others	0.4	0.3	0.4	0.3	0.5	0.3	0.3	0.4
Unknown	0.3	0.2	0.3	0.1	0.3	0.4	0.3	0.3
LIGHTING								
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Electricity	89.3	98.6	87.2	99.4	92.6	85.7	87.9	84.4
Pressure Lamp	0.4	0.2	0.4	0.1	0.5	0.4	0.4	0.5
Oil Lamp	9.4	0.9	11.4	0.3	6	12.6	10.9	14.3
Others	0.5	0.1	0.6	0.1	0.5	0.9	0.4	0.5
Unknown	0.4	0.2	0.4	0.1	0.4	0.4	0.4	0.3

Source : National Statistical Office



Source : Department of Highway

LEGEND	Paved Divided Highway	
	Paved Highway	
	Unpaved Highway	
	Under Construction Highway	
	Proposed Highway	
	Expressway	

Figure 4.4.1

ROAD NETWORK MAP

**THE STUDY ON MANAGEMENT OF GROUNDWATER AND LAND SUBSIDENCE
IN THE BANGKOK METROPOLITAN AREA AND ITS VICINITY**

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

KOKUSAI KOGYO CO., LTD.

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4.5 Present Situation

4.5.1 Basic Urban Statistics and Other Basic Information

(1) Population

The population projections are the basic data for development, planning and estimation of future demand for the management of groundwater in the Bangkok Metropolitan Area and its Vicinity. Therefore, population estimates shown in this Section were reviewed from the previous population information presented in the Interim Report (2), and up-dated with complementary data provided by the National Statistical Office (NSO), the National Economic and Social Development Board (NESDB), and the Department of Local Administration (DLA).

The up-dated population information was used as the basis for extrapolation to project the future population by province and by district in the Study Area as shown in Table 4.5.1 and Tables 4.5.2a to 4.5.2h.

The growth rates used to project the future population (1992-2010) in the Study Area were estimated on the basis of the 1990, 1991 and 1992 population data provided by NSO and DLA, and the population projection data (Population Growth Study 1994) provided by NESDB. For the population projections from 2010 to 2017 were assumed the same growth rates of the 2005-2010 period.

According to the growth rates given in the tables, the population of the Study Area is expected to increase 1.2 times the present population in 2,000, and 1.6 times in 2017 reaching a total population of 13.2 million inhabitants.

Among the 8 provinces shown in the tables, high growth rates are observed in Nonthaburi, Samut Prakarn, Pathum Thani and Chachoengsao, and slower rates in Ayutthaya. At the same time a slight decline is observed in some districts of Bangkok because of the effects of the policy to decentralize economic activities and due to the land expropriation and move to peripheral areas forced by road expansion projects, expressways and large building complex constructions around the Bangkok Metropolitan area.

Population density in 1991 was estimated at an average of 1,289 persons per square kilometer in the Study Area. By district, the most densely populated areas (persons per square kilometer) were Pom Prap Sattru Phai (44,742), Samphanthawong (32,684), Thonburi (30,065), Khlong San (20,126). The least densely populated were found in districts of Ayutthaya, Pathum Thani, Nakhon Pathom and Chachoengsao (160 average). Distribution of population density by district is shown in Figure 4.3.3.

(2) Transportation

Transportation network is characterized mainly by highways and roads. These highways and roads are classified into seven (7) categories: Special, National, Provincial, and Concession highways; and Rural, Municipal and Sanitary roads. The first four categories of highways are administered by the Department of Highways, while the remaining three categories of roads are managed by the respective provincial administrative organizations through the Municipal Public Works and by other government Agencies described below.

The Department of Highways (DOH) is responsible for construction and maintenance of Special, National, Provincial and Concession Highways. Municipalities and Sanitaries are responsible for construction and maintenance of roads in their areas.

Public Works Department (PWD), Provincial Administration Organization (PAO), Rural Accelerated Development Bureau (RADB), the Community Development Department (CDD) are all responsible for construction and maintenance of rural roads.

The Expressway and Rapid Transit Authority of Thailand (ETA) is responsible for construction and maintenance of expressway. Moreover, there are highways for special purposes constructed by other government Agencies such as the Forestry Department, the Royal Irrigation Department, and the National Security Command.

The rapid growth resulted from high investment by private sector and from the growth of exports, the transport infrastructure was not meeting the demand being placed on it by exports and tourism.

In the Study Area the major road network is as shown in Figure 4.4.1. The major roads connecting Bangkok to different directions are :

- National Road No.1, to the northern and northeastern part
- National Road No.3 and No.34, to the eastern part
- National Road No.4 and no.35, to the southern and western parts

(3) Industry

In terms of production process, the industrial sector made considerable progress both in terms of types of production and quality of products. Industrial production has become increasingly sophisticated and generated more linkages with related industries. Industrial factories are also more modern, utilizing higher technology, and larger amount of investment. These changes have been brought about largely because of the development of industrial exports, which need to compete in the world market, and through joint ventures with foreign investors.

Despite the rapid industrial growth, the majority of industrial factories continue to be concentrated in and around Bangkok Metropolis. Some factories are being dispersed to the outer ring in the central and eastern regions. In the remoter regions, no significant number of industrial factories have been located. As a result, the number of factories located in and around Bangkok Metropolis account for 52% of the total nationwide. The following Table 4.5.3 shows the number of factories in the Study Area.

(4) Urban Development Evolution of Bangkok Metropolitan Area and its Vicinity

Bangkok Metropolis, the seat of administration, center of commerce and trade was originally built on the banks of Chao Phraya River in 1782, and was developed out of a regular and compact structure, covering only 4.14 km² at that time.

Table 4.5.3 Number of Industry

Province	1987	1988	1989	1990	1991	1992
BMA	17,056	17,465	18,689	19,892	20,378	20,978
Samut Prakarn	2,631	2,867	3,156	3,443	3,822	4,155
Samut Sakhon	813	897	1,006	1,154	1,364	1,534
Nonthaburi	686	755	796	887	954	1,008
Pathum Thani	597	648	733	825	929	983
Nakhon Pathum	887	932	1,026	1,179	1,375	1,449
Total	22,670	23,564	25,406	27,380	28,822	30,067

Source: Factory Control Division, Ministry of Industry

The geographical spread of the metropolis has increased from 25 km² in 1930 to some 100 km² in 1960. During 1960 to 1980, the population of the metropolitan area increased from 2 millions to 4.7 millions and the urban area was increased from 100 km² to 500 km². In 1991, Bangkok Metropolitan area and its Vicinity covers an total area of 6,300 km², with an urban area of about 650 km² or 10% of the total area and a population of 8 millions or 14.4% of the total population of Thailand.

From the above figures, it can be noticed that Bangkok Metropolitan area and its Vicinity has expanded both in area and population along the main routes, especially to the northern and eastern corridors.

The present trend indicates a continuous increase of the urban areas along the major roads, especially to the northern and eastern corridors, as shown in Figure 4.5.1.

(5) Present Land Use

The present land use map was prepared based on information from DTCP, the existing JICA's report and field survey by the Study Team. Considering the unavailability of land use information at provincial level (Chachoengsao, Ayutthaya, and parts of Pathum Thani, Nakhon Pathom and Samut Sakhon), the present land use map was prepared mainly for Bangkok and the eastern part of the Study Area. This map is shown in Figure 4.5.2.

a) Classification of Land Use

The land use is classified into the following categories:

- Residential area
- Commercial area
- Industrial area
- Institutional area

- Park and recreational area
- Agricultural and vacant areas

The category residential area is classified into low, middle and high density areas:

- Low density : consist of low rise detached houses and isolated high rise condominiums
- Middle density: consist of town houses, condominiums and NHA housing
- High density : consist of low rise slums and squatters

The category commercial area is composed of shophouses, markets, commercial and business buildings.

The category industrial area is composed of factories, warehouses, shophouses used as factory, etc.

The category institutional consist of educational, religious and public facilities buildings.

Park and recreational consist of parks, recreational areas, forest, etc.

Agricultural and vacant areas is composed of agricultural, vacant land and open spaces.

b) Growth of Urban Areas

The urban areas of Bangkok and its vicinity has been increased two times from 1968 to 1980, from 248.94 km² to 500.05 km² respectively. Among the provinces, Bangkok has the biggest increase of about 160.13 km² or 63.8% of the total urban area increase. The second was Nonthaburi with a increase of 37.91 km² or 15.1%, followed by Samut Prakarn with 21.64 km² increase or 8.6%, and the less increased province was Samut Sakhon with only 5.53% increase or 2.2% of the total urban increase.

Table 4.5.4 Growth of Urban Area (1968-1980)

Province	Urban Area 1968 (km ²)	Urban Area 1980 (km ²)	Area Increase 1968-1980 (Difference)	% of Total Growth	Average Increase per Year (%)
Bangkok	183.87	344.00	160.13	63.8	7.3
Nonthaburi	21.04	58.95	37.91	15.1	15.0
Pathum Thani	6.22	24.79	18.57	7.4	24.9
Samut Prakarn	24.23	45.87	21.64	8.6	7.4
Samut Sakhon	7.72	13.25	5.53	2.2	7.0
Nakhon Pathom	5.86	13.20	7.34	2.9	10.4
Total	248.94	500.06	250.47	100.0	8.4

Source: Department of Town and City Planning (DTCP)

(6) Concerned Organization Agencies

The organizations involved in urban development plans are BMA and DTCP, among others.

a) Bangkok Metropolitan Administration (BMA)

The BMA is a combined provincial and municipal authority for Bangkok Metropolis under an elected governor and council.

The Department of Policy and Planning is responsible for the work relating to policy and planning of Bangkok Metropolitan Administration. It collects statistical data and other technical documents in order to formulate the BMA master plan and design the beneficial projects. It works as coordinator to seek and loans and grants form foreign countries and some international agencies.

The Department of Public Works is responsible for the public works in Bangkok Metropolis including the building control, construction and maintenance of roads, flyovers and pedestrian overpasses.

The Department of Communication Development is responsible for planning the slum improvement, housing management, occupation training and employment promotion.

b) Department of Town and Country Planning (DTCP)

This Department is responsible for the preparation of urban and rural land use plans and preparation of structure plan for Greater Bangkok Area and comprehensive plans for the Bangkok Metropolitan area and the adjacent provinces. DTCP has been in charge of updating and revising the Greater Bangkok Plan, the most important tool for zoning regulation since 1960.

c) Other Organizations

National Housing Authority (NHA)

NHA is responsible for development and sale of housing, and administration of public rental housing. Development of new town projects. Implementation of slum upgrading program.

Industrial Estate Authority of Thailand (IEAT)

IEAT is responsible for the development and management of industrial estates with sites and factories for lease and sale.

In the Bangkok Metropolitan area, BMA and the vicinity municipalities are making the Specific Plans. At present, however, it is considered difficult for municipalities in general including DTCP, to make the plans, because of the manpower shortage.

4.5.2 Urbanization Problems of Bangkok Metropolitan Area and it's Vicinity

(1) Major Urban Problems

As Thailand is developing to become Newly Industrialized Country (NIC), there has been a rapid expansion of export, investment and tourism. As a result of the economic growth, it caused a rapid expansion of towns in Bangkok Metropolis and it's vicinity and an expansion of a new

economic area at seaboard and communities in central region. However, the lack of town and country planning, and lack of public facilities as well as lack of necessary infrastructure in big cities, caused the problems in communication and transportation within Bangkok Metropolis and its contiguous provinces.

The major problems marked by the above economic growth are:

a) Income Disparities and Centralization

Although the high economic growth has had significant beneficial effects on the overall economy, the pattern of growth has led to structural imbalances and is not distributed to other cities as well. Urban centers, while containing only 28% of the population, produce more than 80% of GDP and account for nearly all of the net generation of employment. The sub-urban settlements around Bangkok are the most rapidly growing areas in the country, not only in population but also in capital investment and employment. The population of the Bangkok Metropolitan Area is currently growing at twice the national average. Furthermore, regional demographic trends and the major discrepancy in urban and rural incomes indicate that migration towards urban areas is likely to continue well into the future and probably accelerate. Recent in-migrants to urban areas in Thailand have a relatively low unemployment rate, although there is concern over the resulting over-burdening of urban infrastructure.

b) Physical Development

The rapid development of Bangkok brought about conflicting land use and other problems, such as traffic congestion and basic infrastructure services (sewerage, drainage, flood control and public cleansing).

c) Population and Society

The migration of a considerable number of people from the rural area to Bangkok in search of jobs brought about increase in unemployment rate, growth of slum and squatters areas, shortage in infrastructure and public utilities.

d) Transportation

The network of services is still incomplete and inadequate and unable to offer efficient, convenient and rapid service. Particularly serious is the problem of heavy traffic congestion. Although a number of crucial infrastructure projects have been started, such as outer ring road around Bangkok Metropolis, the second stage expressway, and elevated tollway, etc., their implementation takes a great deal of time. A number of these projects have been facing delays at various stages of implementation, particularly the increasing private sector role in the provision of infrastructure services.

e) Environment

The rapid development of Bangkok Metropolis brought about environmental pollution due to the absence of proper measures, such as overcrowding, poor housing condition in suburban areas, traffic congestion, water and air pollution from domestic and industrial sources, and hazardous wastes from industry. Industrialization, urbanization, and energy consumption are

closely related. Industries are attracted to urban centers, especially Bangkok and its satellite provinces, because of the availability of infrastructure and services, and the proximity to markets and ports. The rural population is attracted to urban centers because of the availability of employment in industry and services. Since industry is far more energy intensive than agriculture, and urban centers more energy intensive than rural communities, industrialization and urbanization translates into greatly increased demand for energy and, by implication, greater generation of pollution. Industrial pollution is currently concentrated in the Bangkok Metropolitan Area and will continue to be so in the foreseeable future, but there are signs that some of the worst pollutes area moving out of the inner city districts into the satellite provinces of the Bangkok Metropolitan Area, which continue to receive by far the largest number of new industries. Bangkok Metropolitan Area, the most densely populated area in the country, accounts for over 50% of the factories and industrial estates in the country, and generates 75% of industrial waste.

Regarding to these problems, the Seventh Plan is a promising move towards more sustainable development, keeping a balance between growth and income distribution, industrialization and protection of environmental quality, urbanization and support for the rural population.

(2) Land Development Problems

The urbanization of Bangkok Metropolitan Area is influenced by housing development. Large subdivisions and land estates projects are developed along the highways and arterial roads, with only one access-exit road (abut road), and not distributor/collector roads are constructed, causing traffic congestion and bottlenecks.

Roads in urban areas are not only spaces for traffic, but also play important role for the construction of urban areas with safe and good environment, as the access, circulation, passages for exit when disaster happens. Insufficient space and abut roads is not only inconvenient for usual use, but also becomes obstacle for refuge and fire fighting when disaster happens. In the long run, traffic congestion can be reduced through enhanced land use planning and development of satellite urban centers.

Other problem aspects of the urban development are the ribbon development along major and new arterial roadways, lacking the open spaces and amenities for higher density areas, and the sinking of deep wells to supply water in most of the new housing and industrial estate projects which is causing land subsidence. Land readjustment could be used to reduce the extent of ribbon development along arterial roads and to provide land for the ponding of stormwater runoff. But the problem of subsidence and flooding due to the use of well waters in housing and industrial estates can only be solved by the agencies concerned in water projects.

One of the effective measures for solving these problems is the formulation of a General Plan for Bangkok and vicinity to implement proper land use. This General Plan will entail the decentralization of Bangkok to distribute economic activities to the outer ring area and to develop urban communities in the vicinity. This effects greater opportunities for development of vicinity areas and balancing population densities. The plan will also develop suitable area for industrial development, the establishment of proposed commercial centers, agricultural centers, education centers and housing development.

Table 4.5.1 Population Projection by Province in the Study Area (1991-2017)

YEAR	TOTAL	BANGKOK	NONTHABURI	PATHUM THANI	SAMUT PRAKARN	SAMUT SAKHON	AYUTTHAYA	NAKHON PATHOM	CHACHO-ENGAO
1991	8,288,334	5,820,933	593,719	465,968	882,164	219,991	98,389	88,192	118,978
1992	8,321,519	5,869,010	613,376	484,586	819,271	224,903	99,502	89,468	121,403
1993	8,524,806	5,996,170	633,696	504,560	845,182	229,925	100,628	90,767	123,878
1994	8,736,181	6,128,881	654,702	525,361	871,919	235,059	101,767	92,089	126,403
1995	9,039,174	6,350,581	676,417	547,025	899,507	240,309	102,919	93,436	128,980
1996	9,239,998	6,468,539	698,367	568,000	928,270	246,065	104,222	94,423	132,112
1997	9,447,286	6,590,254	721,042	589,784	957,963	251,960	105,543	95,420	135,320
1998	9,661,294	6,715,891	744,467	612,409	988,615	257,997	106,880	96,429	138,606
1999	9,882,296	6,845,626	768,667	635,908	1,020,259	264,179	108,235	97,450	141,972
2000	10,108,886	6,979,647	793,669	660,315	1,051,238	270,509	109,607	98,481	145,420
2001	10,336,520	7,118,153	816,311	682,770	1,082,137	276,227	111,103	100,909	148,910
2002	10,571,492	7,261,356	839,615	705,995	1,113,958	282,067	112,620	103,397	152,484
2003	10,814,105	7,409,482	863,599	730,017	1,146,728	288,031	114,158	105,947	156,143
2004	10,939,173	7,437,259	888,284	754,863	1,180,477	294,121	115,717	108,561	159,891
2005	11,063,731	7,465,036	913,692	780,562	1,211,836	300,340	117,297	111,240	163,728
2006	11,220,583	7,535,535	935,650	802,933	1,241,683	305,430	118,745	112,762	167,845
2007	11,380,583	7,607,010	958,153	825,953	1,272,279	310,607	120,210	114,305	172,066
2008	11,543,809	7,679,478	981,215	849,641	1,303,646	315,871	121,694	115,871	176,393
2009	11,710,329	7,752,953	1,004,850	874,016	1,335,802	321,225	123,196	117,458	180,829
2010	11,875,569	7,827,451	1,029,072	899,098	1,364,115	326,671	124,718	119,068	185,376
2011	12,048,761	7,902,988	1,053,883	924,908	1,397,776	332,209	126,258	120,700	190,039
2012	12,225,475	7,979,580	1,079,310	951,467	1,432,285	337,841	127,818	122,356	194,818
2013	12,405,796	8,057,244	1,105,370	978,798	1,467,664	343,569	129,398	124,035	199,718
2014	12,589,805	8,135,996	1,132,079	1,006,923	1,503,935	349,395	130,998	125,738	204,741
2015	12,777,588	8,215,853	1,159,454	1,035,866	1,541,122	355,320	132,617	127,465	209,891
2016	12,969,230	8,296,833	1,187,510	1,065,650	1,579,247	361,346	134,257	129,217	215,170
2017	13,164,824	8,378,953	1,216,267	1,096,300	1,618,336	367,475	135,918	130,993	220,582

Source: Arranged by the Study Team based on NSO and NESDB data

Table 4.5.2a (Continuation)

(P.2/2)

District	2,010	2,011	2,012	2,013	2,014	2,015	2,016	2,017
Phra Nakhon	86,876	86,638	86,401	86,164	85,928	85,692	85,458	85,223
Khlong Toei	355,331	358,089	360,849	363,671	366,494	369,339	372,207	375,096
Khlong San	162,796	163,263	163,732	164,202	164,673	165,146	165,621	166,097
Chatuchuk	270,803	273,227	275,672	278,140	280,629	283,141	285,675	288,232
Chom Thong	276,281	279,551	282,860	286,207	289,595	293,023	296,491	300,000
Don Muang	421,857	430,446	439,210	448,153	457,278	466,588	476,088	485,782
Dusit	281,760	281,938	282,116	282,294	282,472	282,650	282,828	283,007
Taling Chan	174,536	177,000	179,499	182,034	184,604	187,211	189,855	192,536
Thonburi	281,760	282,284	282,808	283,334	283,861	284,388	284,917	285,446
Bangkok Noi	188,623	189,487	190,355	191,227	192,103	192,982	193,866	194,754
Bangkok Yai	117,400	117,744	118,090	118,436	118,784	119,132	119,482	119,832
Bang Kapi	334,981	339,777	344,641	349,576	354,581	359,657	364,806	370,029
Bang Khun Thian	208,189	211,461	214,784	218,160	221,589	225,071	228,609	232,202
Bang Khen	321,676	326,022	330,426	334,889	339,413	343,999	348,646	353,355
Bang Kho Laem	174,536	176,419	178,308	179,201	179,098	179,000	179,907	180,818
Bang Sue	356,896	358,585	360,281	361,986	363,698	365,419	367,148	368,885
Bang Phiad	169,056	169,582	170,110	170,640	171,171	171,704	172,238	172,775
Bang Rak	84,528	84,665	84,802	84,939	85,075	85,212	85,349	85,486
Bang Kum	343,591	350,789	358,137	365,639	373,298	381,118	389,102	397,253
Pathum Wan	136,967	136,893	136,818	136,744	136,670	136,596	136,522	136,448
Pravet	332,633	337,244	341,920	346,660	351,466	356,338	361,278	366,286
Pom P. Satriu Phai	67,309	67,040	66,773	66,506	66,240	65,976	65,713	65,450
Phaya Thai	237,931	238,347	238,763	239,180	239,598	240,016	240,435	240,855
Phra Khanong	279,412	282,393	285,405	288,450	291,527	294,637	297,780	300,956
Phasi Charoen	335,764	338,650	341,560	344,495	347,456	350,442	353,453	356,491
Min Buri	151,056	153,461	155,906	158,389	160,912	163,476	166,080	168,725
Yannawa	176,100	178,096	180,115	182,157	184,222	186,311	188,423	190,559
Ratchatavee	108,791	108,754	108,717	108,681	108,644	108,607	108,571	108,534
Rat Burana	234,017	236,565	239,141	241,744	244,376	247,037	249,727	252,446
Lat Krabang	112,704	114,421	116,165	117,934	119,731	121,556	123,408	125,288
Lat Phrao	235,583	239,938	244,374	248,891	253,492	258,179	262,951	267,812
Somphanthawong	41,481	41,271	41,063	40,855	40,649	40,444	40,239	40,036
Sathon	172,969	173,838	174,712	175,590	176,472	177,359	178,250	179,146
Nong Khaem	134,619	137,036	139,497	142,002	144,552	147,148	149,790	152,480
Nong Chok	80,615	81,226	81,843	82,463	83,089	83,719	84,354	84,994
Huai Khwang	378,028	381,948	385,909	389,911	393,955	398,040	402,168	406,339
Total	7,827,451	7,902,988	7,979,580	8,057,244	8,135,996	8,215,853	8,296,833	8,378,953

Growth Rate (%)	1995/90	2000/95	2005/00	2010/05
Phra Nakhon	-0.62	-0.44	0.03	-0.27
Khlong Toei	1.61	1.42	1.18	0.78
Khlong San	3.65	0.69	0.80	0.29
Chatuchuk	1.60	1.74	1.29	0.90
Chom Thong	5.31	2.16	1.65	1.18
Don Muang	7.56	3.39	2.33	2.04
Dusit	0.66	8.21	0.84	0.06
Taling Chan	3.46	2.56	1.92	1.41
Thonburi	-0.48	0.42	0.56	0.19
Bangkok Noi	0.55	0.89	0.87	0.46
Bangkok Yai	2.43	0.57	0.71	0.29
Bang Kapi	3.36	2.28	1.65	1.43
Bang Khun Thian	1.00	2.77	1.99	1.67
Bang Khen	4.00	2.31	1.76	1.35
Bang Kho Laem	3.41	1.08	0.91	0.51
Bang Sue	1.10	0.93	0.88	0.47
Bang Phiad	-1.06	0.65	0.64	0.31
Bang Rak	0.50	0.19	0.48	0.04
Bang Kum	4.26	3.97	2.67	2.09
Pathum Wan	-2.04	-0.02	0.29	-0.06
Pravet	1.86	2.50	1.85	1.39
Pom P. Satriu Phai	-3.02	-2.49	-0.12	-0.40
Phaya Thai	0.39	0.48	0.54	0.17
Phra Khanong	2.66	1.97	1.47	1.07
Phasi Charoen	1.63	1.63	1.31	0.86
Min Buri	1.33	2.72	2.02	1.69
Yannawa	6.47	2.14	1.35	1.13
Ratchatavee	0.91	0.14	0.54	-0.03
Rat Burana	0.27	2.03	1.56	1.09
Lat Krabang	1.38	2.76	1.94	1.52
Lat Phrao	5.73	3.39	2.37	1.85
Somphanthawong	1.58	-0.54	0.32	-0.51
Sathon	3.35	0.99	0.91	0.50
Nong Khaem	2.41	3.15	2.11	1.80
Nong Chok	3.60	1.48	1.35	0.76
Huai Khwang	3.68	1.85	1.40	1.04
Bangkok	1.64	1.91	1.36	0.96

Source : Arranged by the Study Team based on NSO, NESDB and DLA data

Table 4.5.2b Population Projection by District in the Study Area (1990-2017)
NONTABURI

District	1.990	1.991	1.992	1.993	1.994	1.995	1.996	1.997	1.998	1.999
Muang Nonthaburi	256,588	265,357	274,426	283,805	293,505	303,536	313,686	324,176	335,015	346,217
Bang Krui	29,423	30,376	31,153	32,056	32,995	33,941	34,970	35,886	36,900	37,942
Bang Yai	66,200	67,594	69,530	71,412	73,238	75,112	76,979	78,832	80,852	82,862
Bang Bua Thong	54,057	55,837	57,876	59,576	61,538	63,565	65,612	67,724	69,905	72,156
Pak Kret	133,481	136,594	143,902	149,414	156,137	161,079	167,129	173,407	179,920	186,678
Sai Noi	34,953	35,761	36,588	37,433	38,299	39,184	40,061	40,958	41,875	42,813
Total	574,702	593,719	613,376	633,696	654,702	676,417	698,367	721,042	744,487	768,667
District	2.000	2.001	2.002	2.003	2.004	2.005	2.006	2.007	2.008	2.009
Muang Nonthaburi	357,794	368,320	379,155	390,309	401,792	413,612	423,880	434,404	445,138	456,240
Bang Krui	39,014	39,360	40,929	41,922	42,939	43,980	44,845	45,728	46,628	47,545
Bang Yai	84,921	86,693	88,502	90,348	92,234	94,158	96,094	97,254	98,841	100,453
Bang Bua Thong	74,479	76,578	78,736	80,955	83,236	85,582	87,891	89,668	91,784	93,950
Pak Kret	193,690	200,184	208,895	213,831	221,000	228,409	235,013	241,809	248,801	255,995
Sai Noi	43,771	44,577	45,397	46,233	47,084	47,951	48,616	49,290	49,973	50,666
Total	793,669	816,311	839,615	863,599	888,284	913,692	935,650	958,153	981,215	1,004,850
District	2.010	2.011	2.012	2.013	2.014	2.015	2.016	2.017		
Muang Nonthaburi	467,567	479,163	491,046	503,224	515,704	528,493	541,600	555,032		
Bang Krui	48,481	49,436	50,410	51,403	52,416	53,448	54,501	55,575		
Bang Yai	102,091	103,755	105,446	107,165	108,912	110,687	112,491	114,325		
Bang Bua Thong	96,167	98,437	100,768	103,138	105,572	108,069	110,613	113,224		
Pak Kret	263,397	271,009	278,841	286,900	295,191	303,722	312,500	321,531		
Sai Noi	51,359	52,083	52,807	53,541	54,285	55,040	55,805	56,581		
Total	1,029,072	1,053,883	1,079,310	1,105,370	1,132,079	1,159,454	1,187,510	1,216,267		

Source : Arranged by the Study Team based on NSO and NESDB data

Growth Rate (%) NONTABURI

District	1995/90	2000/95
Muang Nonthaburi	3.42	3.34
Bang Krui	2.90	2.83
Bang Yai	2.56	2.49
Bang Bua Thong	3.29	3.22
Pak Kret	3.83	3.76
Sai Noi	2.31	2.24
Nonthaburi	3.31	3.25
District	2005/00	2010/05
Muang Nonthaburi	2.94	2.48
Bang Krui	2.43	1.97
Bang Yai	2.09	1.63
Bang Bua Thong	2.62	2.36
Pak Kret	3.35	2.89
Sai Noi	1.84	1.39
Nonthaburi	2.86	2.41

Table 4.5.2c Population Projection by District in the Study Area (1990-2017)
PATHUM THANI

District	1.990	1.991	1.992	1.993	1.994	1.995	1.996	1.997	1.998	1.999
M. Pathum Thani	80,016	94,604	100,242	104,352	108,630	113,084	117,391	121,642	126,472	131,278
Sam Khok	30,751	39,250	38,072	40,255	41,689	43,173	44,581	46,034	47,535	49,084
Lat Lum Kaeo	30,089	35,393	37,118	38,505	39,946	41,440	42,866	44,340	45,868	47,444
Thanyaburi	76,219	84,916	89,280	93,182	97,254	101,504	105,836	109,934	114,408	119,065
Lam Luk Ka	75,604	89,235	93,503	97,716	102,113	106,708	111,254	115,993	120,935	126,086
Lam Luk Ka	86,375	82,080	84,232	87,723	91,233	95,009	98,531	102,288	106,134	110,124
Khlong Luang	33,353	40,490	41,274	42,626	44,436	46,107	47,702	49,353	51,060	52,827
Nong Sua										
Total	412,407	465,963	484,586	504,560	525,351	547,025	568,000	589,784	612,409	635,906
District	2.000	2.001	2.002	2.003	2.004	2.005	2.006	2.007	2.008	2.009
M. Pathum Thani	136,266	140,845	145,577	150,469	155,524	160,750	166,263	169,944	174,737	179,564
Sam Khok	50,684	52,114	53,583	55,094	56,648	58,245	59,873	60,932	62,321	63,742
Lat Lum Kaeo	48,076	50,548	52,064	53,626	55,235	56,892	58,297	59,737	61,213	62,725
Thanyaburi	123,911	128,409	133,070	137,900	142,906	148,094	152,670	157,387	162,251	167,264
Lam Luk Ka	131,458	136,479	141,693	147,106	152,725	158,559	163,760	169,131	174,679	180,408
Khlong Luang	114,285	118,070	122,002	126,064	130,262	134,600	138,355	142,215	146,183	150,262
Nong Sua	54,656	56,305	58,006	59,758	61,562	63,422	64,934	66,606	68,258	69,951
Total	660,315	682,770	705,995	730,017	754,863	780,562	802,333	825,953	849,641	874,016
District	2.010	2.011	2.012	2.013	2.014	2.015	2.016	2.017		
M. Pathum Thani	184,731	189,940	195,296	200,804	206,466	212,289	218,275	224,431		
Sam Khok	65,195	66,682	68,202	69,757	71,347	72,974	74,638	76,340		
Lat Lum Kaeo	64,274	65,852	67,463	69,155	70,864	72,614	74,407	76,245		
Thanyaburi	172,493	177,761	183,253	188,916	194,754	200,771	206,975	213,371		
Lam Luk Ka	186,326	192,437	198,749	205,268	212,001	218,954	226,136	233,553		
Khlong Luang	154,454	158,763	163,193	167,746	172,426	177,237	182,182	187,264		
Nong Sua	71,686	73,453	75,265	77,152	79,066	81,027	83,036	85,095		
Total	899,098	924,908	951,467	978,798	1,006,923	1,036,666	1,066,650	1,096,300		

Source : Arranged by the Study Team Based on NSO and NESDB data

Growth Rate (%) PATHUM THANI

District	1995/90	2000/95
M. Pathum Thani	4.10	3.80
Sam Khok	3.56	3.26
Lat Lum Kaeo	3.74	3.44
Thanyaburi	4.37	4.07
Lam Luk Ka	4.50	4.26
Khlong Luang	4.07	3.76
Nong Sua	3.76	3.46
Pathum Thani	4.14	3.84
District	2005/00	2010/05
M. Pathum Thani	3.36	2.82
Sam Khok	2.82	2.28
Lat Lum Kaeo	3.00	2.47
Thanyaburi	3.63	3.09
Lam Luk Ka	3.82	3.28
Khlong Luang	3.33	2.79
Nong Sua	3.02	2.48
Pathum Thani	3.41	2.67

Table 4.5.2d Population Projection by District in the Study Area (1990-2017)
SAMUT PRAKARN

District	1.990	1.991	1.992	1.993	1.994	1.995	1.996	1.997	1.998	1.999
Muang District	306,347	354,452	325,317	335,237	345,461	355,995	366,454	378,043	389,574	401,456
Phra Pradaeng	181,586	203,322	192,872	198,775	204,680	211,129	217,582	224,253	231,118	238,193
Bang Phli	132,271	158,694	142,338	147,655	153,170	158,892	165,039	171,527	178,217	185,167
Bang Bo	79,593	86,450	84,334	86,885	89,463	92,116	94,879	97,725	100,658	103,677
Phra Samut Chedi	70,025	79,216	74,351	76,629	78,956	81,374	83,856	86,414	89,049	91,765
Total	769,822	862,154	819,271	845,182	871,919	899,507	928,270	957,963	986,615	1,020,259
District	2.000	2.001	2.002	2.003	2.004	2.005	2.006	2.007	2.008	2.009
Muang District	413,701	425,138	436,930	448,968	461,379	474,134	485,939	496,195	507,607	519,282
Phra Pradaeng	245,484	252,358	259,424	266,687	274,155	281,496	287,970	294,594	301,369	308,301
Bang Phli	190,876	197,938	205,262	212,857	220,733	226,138	233,974	240,842	248,549	256,503
Bang Bo	105,613	109,492	112,448	115,484	118,602	121,690	124,428	127,226	130,090	133,017
Phra Samut Chedi	94,564	97,212	99,934	102,732	105,608	108,378	110,871	113,421	116,029	118,696
Total	1,051,238	1,082,137	1,113,958	1,146,728	1,180,477	1,211,836	1,241,883	1,272,279	1,303,646	1,335,892
District	2.010	2.011	2.012	2.013	2.014	2.015	2.016	2.017		
Muang District	530,524	542,726	555,209	567,979	581,042	594,406	608,077	622,063		
Phra Pradaeng	315,145	322,393	329,808	337,394	345,154	353,093	361,214	369,522		
Bang Phli	211,568	209,938	278,576	287,491	296,690	306,184	315,962	326,094		
Bang Bo	135,610	138,661	141,781	144,971	148,233	151,568	154,979	158,456		
Phra Samut Chedi	121,268	124,057	126,910	129,829	132,815	135,870	138,995	142,192		
Total	1,364,115	1,397,776	1,432,265	1,467,664	1,503,935	1,541,122	1,579,247	1,618,336		

Source : Arranged by the Study Team based on NSO and NESDB data

Growth Rate (%) SAMUT PRAKARN

District	95/90	2000/95
Muang District	3.05	3.05
Phra Pradaeng	3.06	3.06
Bang Phli	3.74	3.90
Bang Bo	2.97	3.00
Phra Samut Chedi	3.05	3.05
Samut Prakarn	3.16	3.17
District	2005/00	2010/05
Muang District	2.76	2.30
Phra Pradaeng	2.80	2.30
Bang Phli	3.70	3.20
Bang Bo	2.70	2.25
Phra Samut Chedi	2.80	2.30
Samut Prakarn	2.88	2.40

Table 4.5.2e Population Projection by District in the Study Area (1991-2017)
SAMUT SAKHON

District	1.990	1.991	1.992	1.993	1.994	1.995	1.996	1.997	1.998	1.999
M. Samut Sakhon Krathum Baen	131.193 88.796	134.001 90.903	136.858 93.057	139.797 95.262	142.789 97.520	146.959 99.968	149.403 102.477	152.825 105.049	156.324 107.686	
Total	219.991	224.903	229.925	235.059	240.309	246.026	251.680	257.874	264.010	
District	2.000	2.001	2.002	2.003	2.004	2.005	2.006	2.007	2.008	2.009
M. Samut Sakhon Krathum Baen	159.904 110.389	163.134 112.662	166.430 115.390	169.791 117.974	173.221 120.517	176.720 123.319	182.385 127.823	185.285 130.137	188.231 132.492	
Total	270.293	275.996	281.819	287.766	293.838	300.039	310.208	315.422	320.723	
District	2.010	2.011	2.012	2.013	2.014	2.015	2.016	2.017		
M. Samut Sakhon Krathum Baen	191.224 134.891	194.264 137.332	197.353 139.818	200.491 142.348	203.679 144.925	206.917 147.548	213.549 152.938			
Total	326.114	331.595	337.171	342.839	348.604	354.465	360.426	366.487		

Growth Rate (%) SAMUT SAKHON

District	1995/90	2000/95
M. Samut Sakhon Krathum Baen	2.14 2.37	2.29 2.51
Samut Sakhon (SA)	2.23	2.38
District	2005/00	2010/05
M. Samut Sakhon Krathum Baen	2.02 2.24	1.59 1.81
Samut Sakhon (SA)	2.11	1.68

Source : Arranged by the Study Team based on NSO and NESDB data

Table 4.5.2f Population Projection by District in the Study Area (1991-2017)
 PHRA NAKHOM SI AYUTTHAYA

District	1.990	1.991	1.992	1.993	1.994	1.995	1.996	1.997	1.998	1.999
Bang Sai	22,523	22,714	22,908	23,102	23,299	23,532	23,767	24,005	24,245	24,485
Bang Pa In	23,547	23,853	24,163	24,477	24,796	25,143	25,495	25,852	26,214	26,576
Lat Bua Luang	31,229	31,989	32,300	32,665	33,079	33,500	33,925	34,355	34,790	35,220
Wang Noi	14,726	14,925	15,125	15,330	15,537	15,771	16,007	16,247	16,491	16,739
Sena	6,354	6,428	6,492	6,557	6,622	6,698	6,774	6,851	6,930	7,009
Total	98,389	99,502	100,628	101,767	102,919	104,222	105,543	106,880	108,235	109,605
District	2.000	2.001	2.002	2.003	2.004	2.005	2.006	2.007	2008	2009
Bang Sai	24,487	24,805	25,128	25,455	25,785	26,121	26,466	26,812	27,161	27,511
Bang Pa In	26,560	26,961	27,346	27,737	28,134	28,536	28,921	29,312	29,708	30,109
Lat Bua Luang	34,792	35,241	35,696	36,155	36,623	37,095	37,544	38,058	38,523	38,993
Wang Noi	16,738	17,086	17,478	17,865	18,235	18,611	18,993	19,349	19,733	20,119
Sena	7,009	7,090	7,172	7,255	7,339	7,425	7,505	7,586	7,668	7,751
Total	109,607	111,103	112,620	114,168	115,717	117,297	118,745	120,219	121,694	123,196
District	2.010	2.011	2.012	2.013	2.014	2.015	2.016	2.017		
Bang Sai	27,453	27,728	28,005	28,285	28,568	28,853	29,142	29,433		
Bang Pa In	30,515	30,927	31,345	31,768	32,197	32,631	33,072	33,518		
Lat Bua Luang	39,394	39,871	40,355	40,842	41,336	41,836	42,342	42,854		
Wang Noi	19,521	19,814	20,111	20,413	20,719	21,030	21,345	21,666		
Sena	7,634	7,919	8,004	8,091	8,178	8,267	8,355	8,446		
Total	124,716	126,258	127,816	129,398	130,998	132,617	134,257	135,916		

Growth Rate (%) AYUTTHAYA

District	1995/90	2000/95
Bang Sai	0.85	1.00
Bang Pa In	1.30	1.40
Lat Bua Luang	1.13	1.27
Wang Noi	1.35	1.50
Sena	1.00	1.14
Ayutthaya (S.A.)	1.13	1.27
District	2005/00	2010/05
Bang Sai	1.30	1.00
Bang Pa In	1.43	1.35
Lat Bua Luang	1.29	1.21
Wang Noi	1.60	1.58
Sena	1.16	1.08
Ayutthaya (S.A.)	1.37	1.23

Source : Arranged by the Study Team based on NSO and NESDB data

Table 4.5.2g Population Projection by District in the Study Area (1991-2017)
NAKHON PATHOM

District	1.990	1.991	1.992	1.993	1.994	1.995	1.996	1.997	1.998	1.999
Sam Phran		57,669	58,295	58,907	59,525	60,150	60,782	61,420	62,065	62,717
Nakhon Chaisi		2,542	2,575	2,609	2,643	2,678	2,712	2,747	2,781	2,816
Bang Len		12,366	12,532	12,700	12,870	13,042	13,119	13,197	13,274	13,353
Buddha Monton (subd.)		15,595	16,066	16,551	17,061	17,566	17,929	18,097	18,368	18,644
Total		88,192	89,468	90,767	92,039	93,436	94,423	95,420	96,429	97,450
District	2.000	2.001	2.002	2.003	2.004	2.005	2.006	2.007	2.008	2.009
Sam Phran	63,375	65,055	66,779	68,548	70,365	72,230	73,349	74,486	75,641	76,813
Nakhon Chaisi	2,751	2,809	2,869	2,930	2,992	3,055	3,086	3,118	3,150	3,182
Bang Len	13,432	13,720	14,015	14,317	14,624	14,939	15,096	15,254	15,414	15,576
Buddha Monton (subd.)	18,924	19,325	19,734	20,153	20,580	21,016	21,231	21,447	21,666	21,887
Total	98,481	100,909	103,397	105,947	108,561	111,240	112,762	114,305	115,871	117,468
District	2.010	2.011	2.012	2.013	2.014	2.015	2.016	2.017		
Sam Phran	76,004	79,213	80,440	81,687	82,953	84,239	85,545	86,871		
Nakhon Chaisi	3,214	3,247	3,280	3,314	3,347	3,381	3,416	3,451		
Bang Len	15,740	15,905	16,072	16,241	16,411	16,584	16,758	16,934		
Buddha Monton (subd.)	22,110	22,336	22,564	22,794	23,026	23,261	23,498	23,738		
Total	119,068	120,700	122,356	124,035	125,736	127,465	129,217	130,993		

Source: Arranged by the Study Team based on NSO and NESDB data

Growth Rate (%) NAKHON PATHOM

District	1995/90	2000/95
Sam Phran	1.05	1.05
Nakhon Chaisi	1.31	0.54
Bang Len	1.34	0.59
Buddha Monton (subd.)	3.02	1.50
Nakhon Pathom (S.A.)	1.45	1.06
District	2005/00	2010/05
Sam Phran	2.65	1.55
Nakhon Chaisi	2.12	1.02
Bang Len	2.15	1.05
Buddha Monton (subd.)	2.12	1.92
Nakhon Pathom (S.A.)	2.47	1.37

Table 4.5.2h Population Projection by District in the Study Area (1991-2017)
CHACHOENGSAO

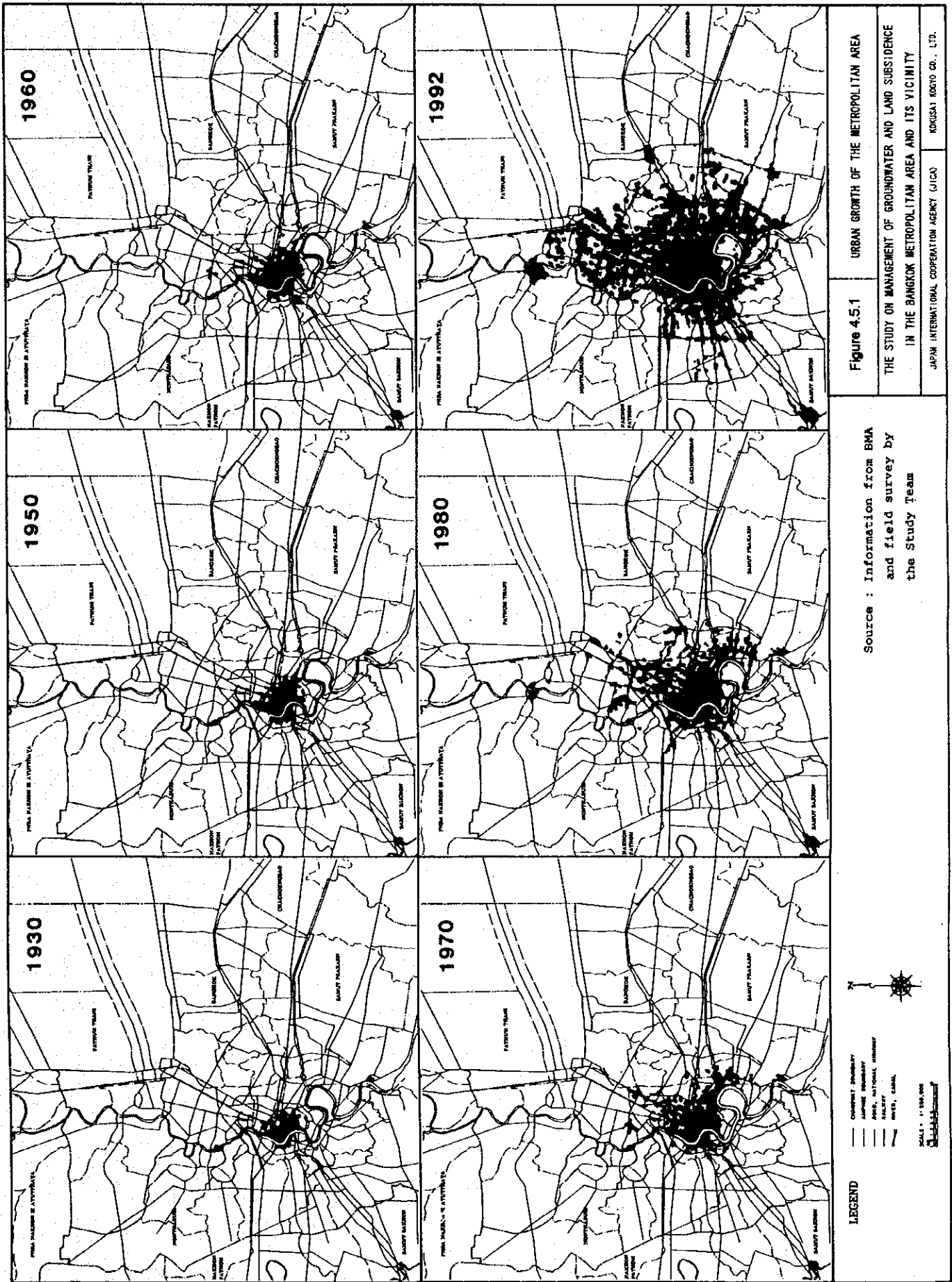
District	1.990	1.991	1.992	1.993	1.994	1.995	1.996	1.997	1.998	1.999
M. Chachoengsao		56,015	57,135	58,278	59,444	60,632	62,088	63,578	65,104	66,666
Bang Nam Prieo		15,729	16,051	16,380	16,716	17,059	17,475	17,902	18,338	18,786
Ban Pho		4,076	4,154	4,233	4,314	4,396	4,479	4,600	4,705	4,813
Bang Pakong		36,830	37,614	38,416	39,234	40,070	41,079	42,115	43,176	44,264
North Side		8,328	8,448	8,571	8,696	8,823	8,973	9,126	9,283	9,443
Total		118,978	121,403	123,878	126,403	128,980	132,112	135,320	138,606	141,972
District	2.000	2.001	2.002	2.003	2.004	2.005	2.006	2.007	2.008	2.009
M. Chachoengsao	68,266	69,904	71,562	73,300	75,059	76,861	78,757	80,720	82,722	84,774
Bang Nam Prieo	19,244	19,702	20,171	20,651	21,143	21,646	22,194	22,755	23,331	23,921
Ban Pho	4,923	5,033	5,145	5,260	5,378	5,497	5,628	5,762	5,899	6,040
Bang Pakong	48,379	48,496	47,839	48,811	50,012	51,242	52,580	53,962	55,360	56,805
North Side	7,607	7,774	7,945	8,120	8,299	8,481	8,677	8,876	9,080	9,289
Total	145,420	148,910	152,484	156,143	159,891	163,728	167,845	172,066	176,393	180,829
District	2.010	2.011	2.012	2.013	2.014	2.015	2.016	2.017		
M. Chachoengsao	86,876	89,031	91,239	93,501	95,820	98,196	100,632	103,127		
Bang Nam Prieo	24,528	25,147	25,783	26,435	27,104	27,790	28,493	29,214		
Ban Pho	6,184	6,331	6,481	6,636	6,794	6,955	7,121	7,290		
Bang Pakong	58,288	59,809	61,370	62,972	64,616	66,302	68,032	69,808		
North Side	9,503	9,721	9,945	10,174	10,408	10,647	10,892	11,142		
Total	185,376	190,039	194,818	199,718	204,741	209,891	215,170	220,582		

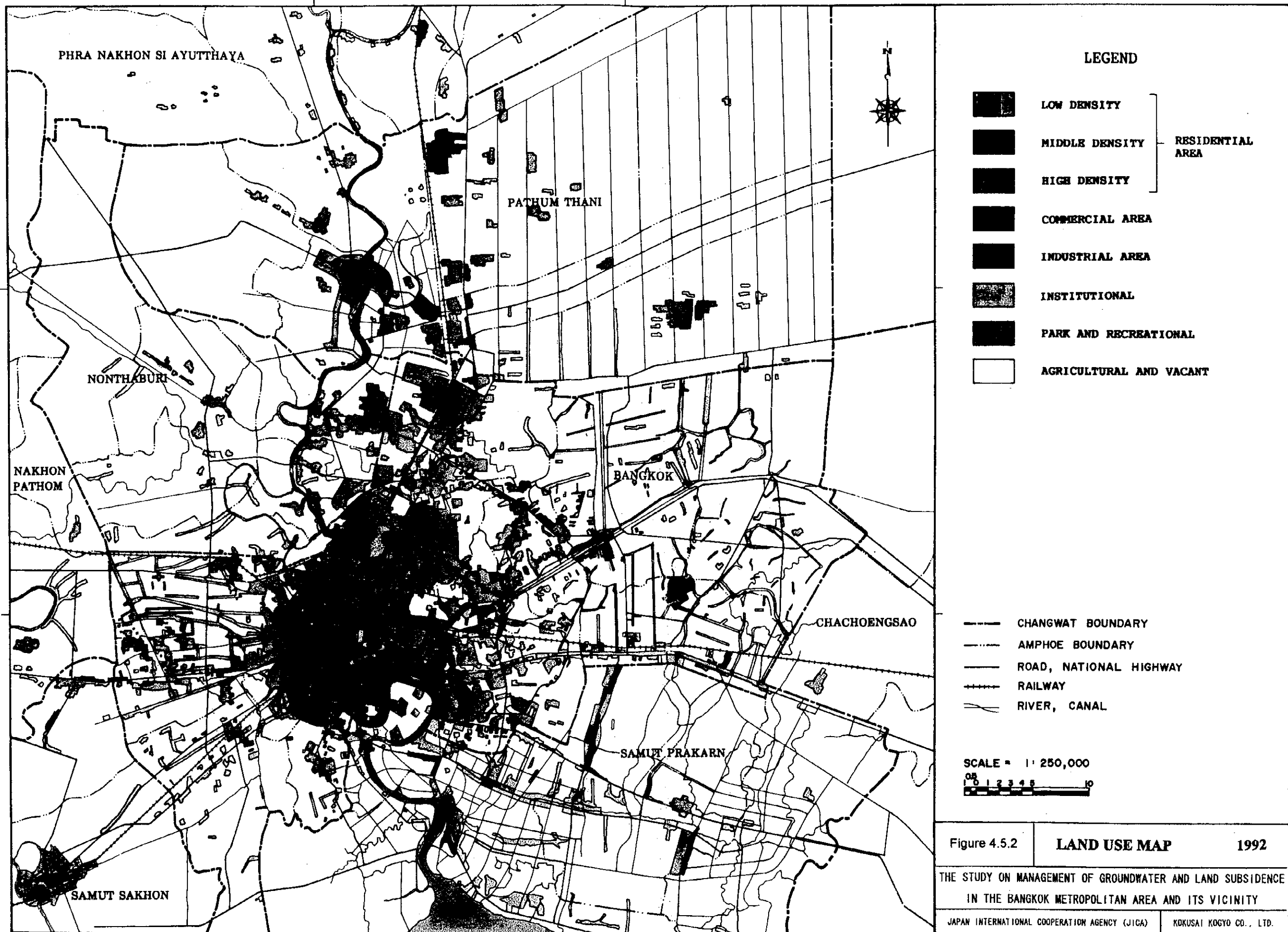
Source: Arranged by the Study Team based on NSO and NESDB data

Growth Rate (%) CHACHOENGSAO









District	1995/90	2000/95
M. Chachoengsao	2.00	2.40
Bang Nam Prieo	2.05	2.44
Ban Pho	1.91	2.29
Bang Pakong	2.13	2.52
North Side	1.90	2.20
Chachoengsao (SA)	2.04	2.43
District	2005/00	2010/05
M. Chachoengsao	2.40	2.48
Bang Nam Prieo	2.38	2.53
Ban Pho	2.23	2.38
Bang Pakong	2.46	2.61
North Side	2.20	2.30
Chachoengsao (SA)	2.40	2.51












LEGEND

-  LOW DENSITY
-  MIDDLE DENSITY
-  HIGH DENSITY
-  COMMERCIAL AREA
-  INDUSTRIAL AREA
-  INSTITUTIONAL
-  PARK AND RECREATIONAL
-  AGRICULTURAL AND VACANT

RESIDENTIAL AREA

-  CHANGWAT BOUNDARY
-  AMPHOE BOUNDARY
-  ROAD, NATIONAL HIGHWAY
-  RAILWAY
-  RIVER, CANAL


SCALE = 1:250,000


Figure 4.5.2 **LAND USE MAP** 1992

THE STUDY ON MANAGEMENT OF GROUNDWATER AND LAND SUBSIDENCE
 IN THE BANGKOK METROPOLITAN AREA AND ITS VICINITY

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) KOKUSAI KOGYO CO., LTD.

4.6 Urban Development Plan

4.6.1 Metropolitan Region Development Plan

Planned activities in the Metropolitan Region include development coordination guidelines for spatial development; increased urban systems integration; development of linkage, industrial and community infrastructure; and more effective land use planning mechanisms. The targets of the regional plans are: to decentralize economic activities from Bangkok to areas in the Metropolitan Region with high economic potential and to preserve and enhance the environment, to balance economic growth and urbanization within the Metropolitan Region.

In order to achieve the above targets in the Metropolitan Region, the following main measures and programs are formulated by NESDB as shown in Table 4.6.1.

4.6.2 On-going Projects

(1) Residential Area

According to "Investment and Property" report the residential development market is expected to experience rapid growth in recent years following an increase of over 200% (1994) in the number of units launched during the first quarter. Oversupply of townhouses could occur in 1994, particularly on the northern outskirts of Bangkok, while city condominiums are the new rising star in the market, mainly because of traffic congestion lengthening the time it takes to get to work.

Available data published by the Central Bank shows that in 1993, the number of new housing units in Bangkok and its vicinity totalled 134,086, a jump of 24.1% over the preceding year. Of these, new units in housing estates numbered 54,535, up 14.7%, new self-built houses 36,459, up 53.7%, and new flats and condominiums 43,092, up 17.3%. In January 1994 the number of new housing units up 22.8% over the preceding year. The fall in the growth rate affecting the housing sector is due mainly to a jump in land prices, discouraging people from buying land for their own houses. The report quoted that house building is unlikely to expand in metropolitan area. This is because land prices in Bangkok and surrounding provinces are mounting rapidly. Apart from this, there are fewer land plots available in the capital. The economic boom in the past has driven up land costs.

The National Housing Authority (NHA) has been implementing the Bang Plee New Town Project to be Bangkok Metropolitan satellite town in order to relieve the housing shortage in Bangkok; to encourage the proper and systematic growth of Bangkok; to relieve traffic congestion in Bangkok; to maximize land use in the project area; to create employment opportunities; and to relieve pressure on Bangkok's infrastructure by creating new urban infrastructure. The site of the new town is located in Bang Na-Trad Highway, Bang Sao subdistrict, Bang Plee district, Samut Prakarn province, 23 kms. east of Bangkok.

The project area, covering 715 hectares is divided into 2 phases:

- Phase 1 (266 ha.) 1980-1988
- Phase 2 (449 ha.) 1988-1999

After completion of the project, it is expected that there will be totally 25,000 households or approximately 120,000 people, and 40,000 labour force.

The new town is projected for residential area of different levels of income, and includes town facilities such as commercial area, sport center, education and government institutes, community center, central business district, etc.

Other on-going project is the Muang Thong Thani city, the largest private sector project in Thailand located in an area of 4,000 rai (640 ha). Muang Thong Thani project has divided into 25 phases of which 7 have been launched by Bangkok Land Ltd. It includes industrial condominiums, residential condominiums, mini-office villa projects, low-cost condominiums for teachers and retired civil servants. Also include business center, department stores, food center and movie halls.

There are also, several successful private on-going new town projects emphasizing housing as the principal use, and retail and office complexes have been developed largely on a site by site basis.

(2) Industrial Estate

To date, the industrial estates which have established have been largely successful and due to the rapid industrial growth around the Bangkok Metropolitan area, has prompted the Industrial Estate Authority of Thailand (IEAT) the governing body overseeing estate development, to plan several new projects in provinces far-removed from Bangkok.

Since IEAT began its essential role in setting the path for the country's industry, a number of problems have arisen, particularly during the past few years of rapid growth. The present administration has recognized the importance of industrial estates to the development of industry outside Bangkok. Decentralization of investment to the provinces is essential to the well-being of the people and the nation. IEAT plans to establish industrial towns in 25 more provinces: 15 southern towns, 5 northern towns and 5 northeastern towns.

At present, the industrial estates in operation and on-going in the Study Area are:

- In operation: Bang Chan I.E., Lat Krabang I.E., Bang Poo I.E., Bang Plee I.E.
- On-going : Samut Sakhon I.E., Bang Pa In I.E., Hitech I.E.

Some of the problems afflicting the management of IEAT surfaced in recent years when the numbers of foreign investors drastically decline. One notable example, the Eastern Seaboard project, now in existence over a decade, does not yet have satisfactory level of infrastructure. According to many industrialist there, the shortage of water is still a prime obstacle to their operation. Sales a estates on the East coast such as Bang Pakong I.E. have fallen off dramatically because of shortage of fresh water.

(3) Highway

The Government, through the Office of the National Economic and Social Development Board (NESDB), revised the national plan to cater for the unexpectedly fast growth. The revision also applied to the Highway Development Plan, with a number of major projects being added to the

original plan. These projects are designed to reduce traffic congestion in Bangkok and adjacent areas to support the development of the Eastern Seaboard. The projects involve newlink construction, widening and rehabilitation.

According to the national plan, the Department of Highway (DOH) is implementing programs to rehabilitate and upgrade the main highway routes connecting the provinces with Bangkok. The scope of the program will cover most of the main routes within a 250 kilometer radius of the Bangkok Metropolitan Area.

The important on-going projects under the responsibility of DOH within the Study Area are routes to the North and Northeast of Bangkok and projects supporting the Eastern Seaboard Development which consist of the following projects:

- Vibhavadi-Rangsit, Elevated Toll-way Project (under construction)
- Rangsit-Saraburi Rehabilitation Project
- Eastern Bangkok Outer Ring Road
- New Bangkok-Chonburi Highway Project
- Highway Route 34, Bang Na-Bang Pakong (widening project)
- Minburi-Chachoengsao (widening and rehabilitation project)
- Bang Pakong-Chachoengsao (widening and rehabilitation project)

In the past, the Expressway and Rapid Transit Authority of Thailand (ETA) had a plan to construct the expressway system in Bangkok and its vicinity including the provincial routes of 780 km length. However, due to the present traffic problem which has increased day by day, construction of the expressway system was considered as a top priority and the most urgent matter in Bangkok Metropolis and its vicinity by ETA. Plans for expressway in Bangkok and its vicinity has a total distance of about 300 km and will be completed within 5 years. At present, some stages of the expressway project has been operated such as the First Stage Expressway System and partial part of the Second Stage Expressway System which consist of 47.5 km.

Regarding to on-going projects on expressways within the Study Area, work on the second phase of the Second Stage Expressway System Project has resumed and is expected to be completed in 1995. It involves construction of collector and distributor roads and an extension north to Bangkok International Airport. This second phase of the Second Stage Expressway System will be constructed by private investment (100 km) and by the government (150 km).

The Third Stage Expressway System Project (Nonthaburi-Bangkapi-Min Buri Route and Bang Na-Samut Prakarn Route) will expand the expressway network in Bangkok and its vicinity while the fourth stage will extend the network from Bangkok to the 19 adjacent provinces and help the growing volume of freight transport.

The Ramindra-At Narong Expressway and the soon-to-be-completed Don Muang Tollway will help accommodate the rapid growth in the north and northeast of greater Bangkok and improve the service to Don Muang airport.

The major on-going projects are summarized in Table 4.6.2.

4.6.3 Proposed Projects

(1) New Town

The National Housing Authority (NHA) has analyzed the suitable location for development of Bangkok Metropolitan's Satellite Towns in 5 areas within 50 kms from Bangkok as shown in Table 4.6.3.

Within the suitable location for new town development around Bangkok Metropolis, the eastern area is taken into consideration as the study case by NHA. The area is located in Tambon Khlong Luang Paeng, Amphoe Muang in Chachoengsao province, covering 1,520 hectares. This area will be developed to be self-contained satellite town of Bangkok Metropolis and will be completed in 10 years. It is planned to accommodate a population of 54,000 families or about 270,000 people in accordance with the eastern subregion development set up in the Bangkok Metropolitan Region Development Plan.

The town consists of the following urban facilities: 54,000 housing units, civic center, commercial and business area, inland container depot, eastern truck terminal, industrial complex serving 20,000 labours, etc. In addition, there will be other land use components such as educational institution, police station, fire brigade, sport complex, park, flood protection, inner town mass transit system and circulation area.

(2) New Metropolitan Center

BMA proposed 11 metropolitan centers spaced along the Outer Ring Road (see Figure 4.6.1). Several of these locations would involve the planned expansion of existing towns or new centers which have already begun to form, while a majority of them involve new planned developments on lands currently used for agriculture or other purposes. The centers will vary in size and composition, depending upon their location. The metropolitan centers are envisioned as a planned area where employment, shopping, services, institutions and higher density are located within walking distance. The proposed plan are intended to create new suburban cities rather than sprawling, disorganized, faceless suburbs. According to recent Strategic Planning for Metropolitan Bangkok report of BMA the creation of these metropolitan centers is less costly and easier strategy than that of creating new cities distant from Bangkok based on government employment.

Among the 11 proposed metropolitan centers, 3 centers are selected by BMA (New Lat Krabang Center, the Expanded Minburi Center and New Taling Chan on the western side of the Chao Phraya River) and one (Lat Krabang area) is recommended by the BMA Consultants Team as the greatest potential today. If this new center is successfully begun, Taling Chan area is recommended as a second center. The expanded Minburi center, which involves scaling up the existing settlement in a planned manner might be accomplished through a gradual process, focusing some of the growth that would otherwise continue in that area.

According to the BMA Consultants Team, several factors will make the Lat Krabang area one of the most promising areas for the creation of a new metropolitan center. These factors are: the development of the Eastern Seaboard, with its new port and industrial facilities development; construction of the Chonburi Highway as the new connection from Bangkok to the Eastern Seaboard; the Outer Ring Road as a complementary road by allowing travel to the new city and

industrial concentration in the region without passing through the center of Bangkok; the planned extension of the Hopewell alignment for mass transit and the high speed rail to the Eastern Seaboard under discussion; and the most important, the construction of the SBIA, which add a huge economic magnet to the area.

(3) Highway

Based on the government policies in achieving the alleviation of traffic congestion in Bangkok Metropolis, ETA has planned the following projects: the Fourth Stage Expressway System Project, linking greater Bangkok with the neighbouring provinces, the extension project of the Second Stage Expressway System, the Bang Na-Chonburi Expressway Project, the additional On-off Ramp Project on the First Stage Expressway System, the Mass Rapid Transit System Project Part II Stage I, including the study project to solve the traffic problem in main cities.

The fourth stage, scheduled for completion in 1999, will involve two components: a Bangkok and vicinity network of 103 kms and an intercity network of 768 kms.

In order to decentralize economic activities to outlying regions, most inter-provincial highway will be widened and upgraded and new highway constructed. One will link Nakhon Ratchasima to the Eastern Seaboard and another Bangkok to Chon Buri and Nakhon Ratchasima.

Planned expressway projects are summarized in Table 4.6.4.

(4) Mass Transportation System

The three major projects of an elevated mass transport system (Bangkok Transit System) was delayed due to Cabinet's decision on May 1994 that those systems planned for 25 km² of central Bangkok must go underground. The decision was based on the recommendations of a study commissioned by the authorities. According to this decision, Hopewell will be asked to put 7.2 kms of its 60 km long urban highway and mass transit systems beneath the ground. Bangkok Transit System Corporation (BTSC) and Bangkok Land, which have 21.6 kms and 20 kms in total route lengths respectively, will be asked to built 10.8 kms and 11.3 kms as subways. The change by the government requires restudies of engineering and technical aspects of the projects by all developers concerned, delaying the project implementation.

Furthermore, to solve the traffic problem in Bangkok, ETA has a plan to construct electric train system over the road and mass transport system over San Saeb canal covering a distance of about 50 km. to be constructed within 10 years. All the above projects are expected to complete by the year 1999.

Concerning to the Mass Rapid Transit System Project, ETA had conducted the engineering detailed design since 1981 and forwarded the report to the government for further consideration. But at that time the government was facing financial problem and could not support the high cost of MRTS. To make the project viable, ETA considered to implement half of the project which was called the Mass Rapid Transit System Project Part I Stage I consisting of two routes: Phra Khanong-Hua Lumpong-Bang Sue and Sathorn-Lad Phrao, with the length of 23 km and 11 km respectively. According to the work plan, the construction of the first phase and the second phase will be completed and can be opened to traffic in 1995 and 1997 respectively.

(5) Airport

On May 1991, the Second Bangkok International Airport (SBIA) project was approved by the Government and the Airport Authority of Thailand (AAT) has been authorized to handle the project. According to the plan, the work schedule is 7 years and 6 months divided into 3 phases:

- Phase 1: Master Planning and Schematic Design (May 1993-April 1994)
- Phase 2: Supervision of Engineering Design (May 1994-October 1996)
- Phase 3: Project Construction (Nov. 1996-October 2000)

The project had gone through consideration of different governments and was delayed because BIA at Don Muang has not reached its full capacity yet. But with the presently increasing demand, the SBIA project becomes vital now. During the period 1987-1991, the number of air traffic using Bangkok International Airport (BIA) has been increased at a high rate.

According to the forecast of air traffic in the next coming decades which is projected by AAT, the number of passengers will rise from 35 million in the year 2,000 to 55 million in 2010. Therefore, the SBIA is projected to meet the rising volume of air traffic as well as to support and promote Thailand aviation hub in the region.

Under the two airports concept, one will serve as a major airport and another will supplement the major one for being a hub like those in big cities of which population are over 20 million. Due to the development limitation of BIA, SBIA will be a major hub airport while BIA is planned to be a supplementary one. SBIA has to provide scheduled intercontinental flight service and flight to major cities in the region. BIA will serve strong local (origin-destination) aviation market, domestic flights and chartered flights. Besides, all airlines operating at BIA will provide service at SBIA as well.

Having taken into consideration the above increasing demand, a land of about 3,100 hectares in Nong Ngu Hao (Cobra Swamp) in the area of Bang Chalong, Raja Teva and Nong Prue sub-districts in Bang Phli District, Samut Prakarn Province, located approximately 30 kms. east of Bangkok, was selected to be the construction site of the new airport.

Since the projected site is a low land along the coast line, the soil in that area is soft compressible soil which may cause difficulty for airport construction. AAT therefore has to work on ground improvement, establishment of flood protection system and polder system, and taken into consideration the environmental impact to the surrounding areas. The SBIA site is relatively flat and its elevation is near sea level, it seems like a big basin for the floodwater from Bangkok. AAT has adopted a polder system to provide flood protection and drainage for airport site. However, also protection measures should be taken into consideration for the surrounding areas where will affected by airport construction.

Proposed future projects are shown in Figure 4.6.2.

Table 4.6.1 NESDB MAIN MEASURES AND PROGRAMS

MAJOR DEVELOPMENT	NP8	NP9	Long Term
1. Key Infrastructure Development > Expressway Projects > Express Train Projects > Second Bangkok International Airport and Environs > High Speed Train	----- ===== ===== -----	----- ----- ----- -----	
2. Rehabilitation of Bangkok Metropolitan Region > Speed up implementation of mass transit systems and additions to the secondary road network > Develop major metropolitan sub-centres within the BMA and rehabilitate inner areas of Bangkok > Decentralize economic activities and public administrative offices to the new economic zones of the Metropolitan Region > Promote the use of Laem Chabang and Map Ta Put ports instead of Bangkok port	----- ----- ----- -----	----- ----- ----- -----	
3. Develop the New Economic Zones of the Eastern Seaboard and the Upper Central Subregion > Accelerate the development of the infrastructure network and expand it to hinterland areas > Develop Saraburi to be a research and technology centre for industry and export, and upgrade basic amenities > Build a New Town near Chachoengsao, coordinated by the National Housing Authority	----- ----- -----	----- ----- -----	
4. Manage Natural Resources and Improve the Quality of the Environment > Establish an environmental action plan for inner Bangkok areas and key urban centers in the Metropolitan Region > Expand water supply, especially to the eastern side of the Chao Praya river, and to key urban centres in the Metropolitan Region	----- -----	----- -----	

----- preparation ----- implementation
 NP 8 - The 8th National Plan (1997-2002) NP 9 - The 9th National Plan (2003-2008)

Source : National Economic and Social Development Board (NESDB)

Table 4.6.2 ON-GOING HIGHWAY PROJECTS

Project Type	Project Name	Dist. (km)	Project Period	Situation of the Project	Respos. Agency
HIGHWAY	Vibhavadi-Rangsit (Elevated Toll-way Project)		-1993	Under const.	DOH
	Rangsit-Saraburi Rehabilit. Project		-1994	Under const.	DOH
	Thon Buri-Pak Tho Highway			Widening	DOH
	Minburi-Chachoengsao-Phanom Sarakham	100.0	-1994	Widening & rehabilit.	DOH
	Outer Ring Road (West)	33.0	-1995	Under const.	DOH
	Outer Ring Road (East)	62.0	-1996	Contract	DOH
	Ding Dang-Don Muang (Elevated Highway)	16.0		Under const.	DOH
EXPRESSWAY	Second Stage Expressway System				ETA
	-Line B (Phayathai-Bang Khlo)	9.4	1994-1995	Under const.	
	-Line D (Rama 9-Srinakarin)	8.0	1994-1997	F/S	
	(Srinakarin-Bang Na)	8.0	1994-1998	F/S	
	Rawindra & At Narong Expressway	18.7	1994-1996	Under const.	ETA
	Bang Na-Bang Phli & Bang Pakong	56.0	1994-1998	Under const.	ETA
	Third Stage Expressway System				ETA
	- North Route	23.0	1994-1998	Under const.	
- South Route	9.5	1994-1997	Under const.		
- At Narong-Bang Poo	16.5	1994-1998	Under const.		

Table 4.6.3 PROPOSED LOCATIONS OF SATELLITE TOWN DEVELOPMENTS (NHA)

Area	District	Province	Development Potential
Area A1 (Northeast)	Khet Nong Chok Lam Luk Ka Bang Nam Prieo Ongkharak	Bangkok Pathum Thani Chachoengsao Nakhon Nayok	
Area A2 (Northwest)	Bang Bua Thong Bang Yai Sai Noi Lat Lum Kaeo	Nonthaburi Nonthaburi Nonthaburi Pathum Thani	
Area B1 (North)	Khlong Luang Nong Sua Thanyaburi Wang Noi Bang Pa-in Bang Sai Uthai	Pathum Thani Pathum Thani Pathum Thani Ayutthaya Ayutthaya Ayutthaya Ayutthaya	Bangkok Outer Ring Road will run the eastward of the site. Can be developed as a residential town or a civic centre town.
Area B2 (East)	Muang Chachoengsao Bang Nam Prieo Bang Pakong Ban Pho Bang Bo Lat Krabang	Chachoengsao Chachoengsao Chachoengsao Chachoengsao Samut Prakarn Bangkok	The potentiality for development will be high: Railway line and high speed rail system is to be developed making a rapid commuting connection to Bangkok. Able to construct roads connecting to Bangkok-Chonburi New Highway Project. Availability of job opportunities.
Area B3 (West)	Muang Nakhon Pathom Sam Phran Nakhon Chaisi Krathum Baen Ban Phaeo	Nakhon Pathom Nakhon Pathom Nakhon Pathom Samut Sakhon Samut Sakhon	Inconvenience transportation network This makes the area less advantages than other areas. However, the advantage is that the western area can be provided for water supply better than in the eastward.

Note : Khet means District

Source : National Housing Authority

SUITABLE LOCATION FOR NEW TOWN DEVELOPMENT AROUND BANGKOK METROPOLIS

- A Semi-self contained New Town & semi-contained New Town (Dormitory Town)
- B Semi-contained New Town

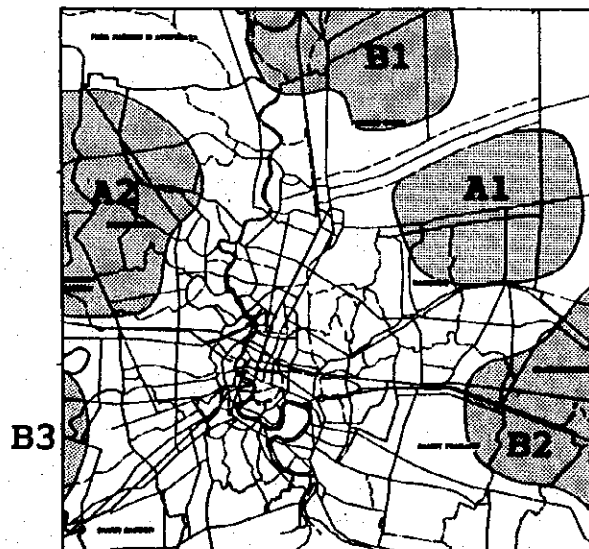
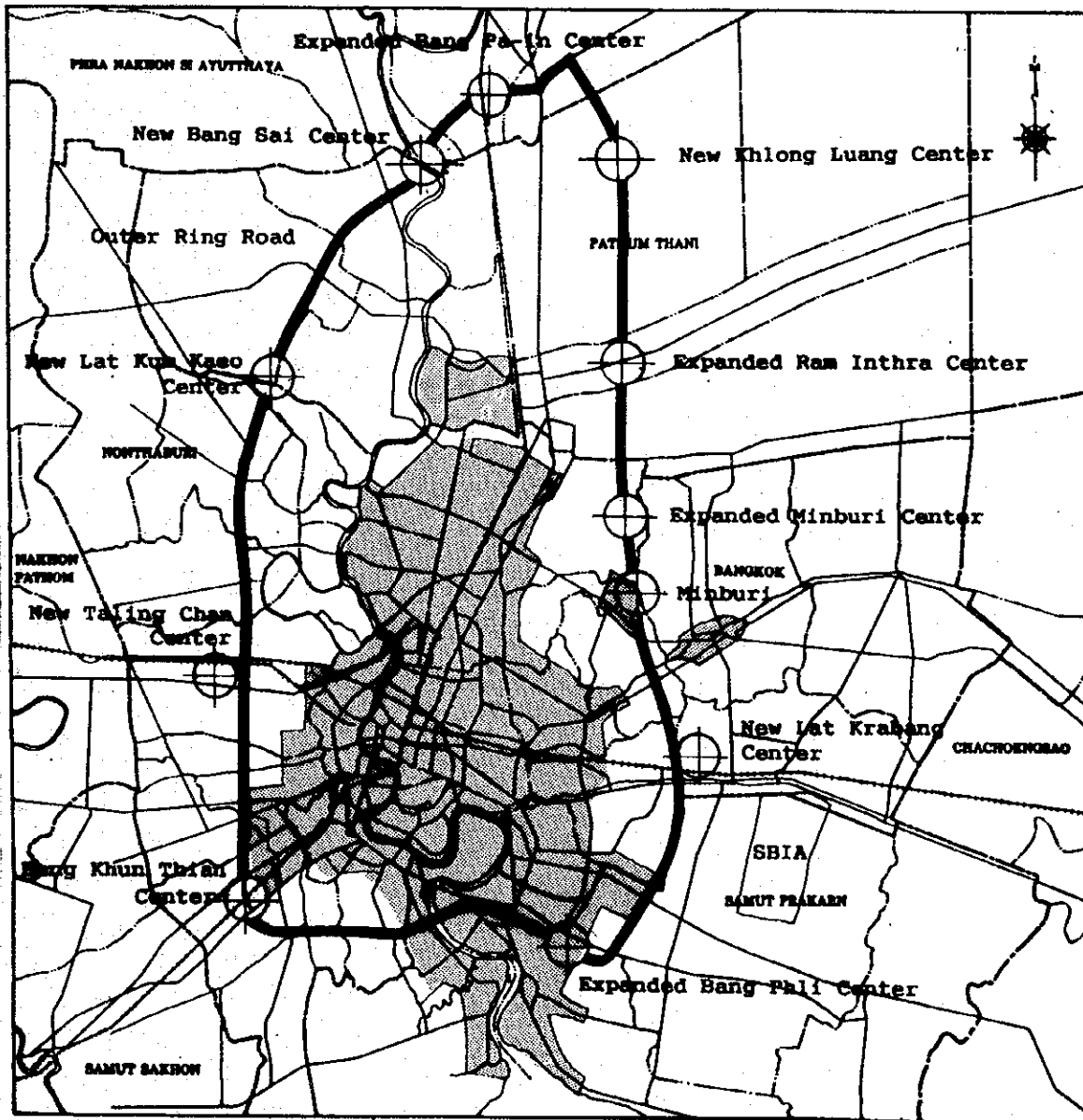


Table 4.6.4 PLANNED HIGHWAY PROJECTS

Project Type	Project Name	Dist. (km)	Project Period	Situation of the Project	Respos. Agency
HIGHWAY	New Bangkok-Chonburi Highway	83.0		Design	DOH
EXPRESSWAY	Second Stage Expressway System (Extension Project) - Phayathai-Buddhamontol Nakhon Pathom - Chaeng Wattana-Bangpoor Bang Sai	40.0	1995-1998		ETA
	Dao Karong-Bang Khurtien & Samut Sakhon	30.0	1995-1998		ETA
	Bang Na-Chonburi Expressway	20.4	1995-1999	Under F/S	ETA
	Fourth Stage Expressway System Project		1996-1998		ETA
EXPRESSWAY & MTS	Expressway and Mass Transport over Ban Saeb Canal	18.4	1995-1999	Under F/S	ETA
MST	Mass Transport over the Expressway Project	38.0	1994-1998		ETA



LEGEND




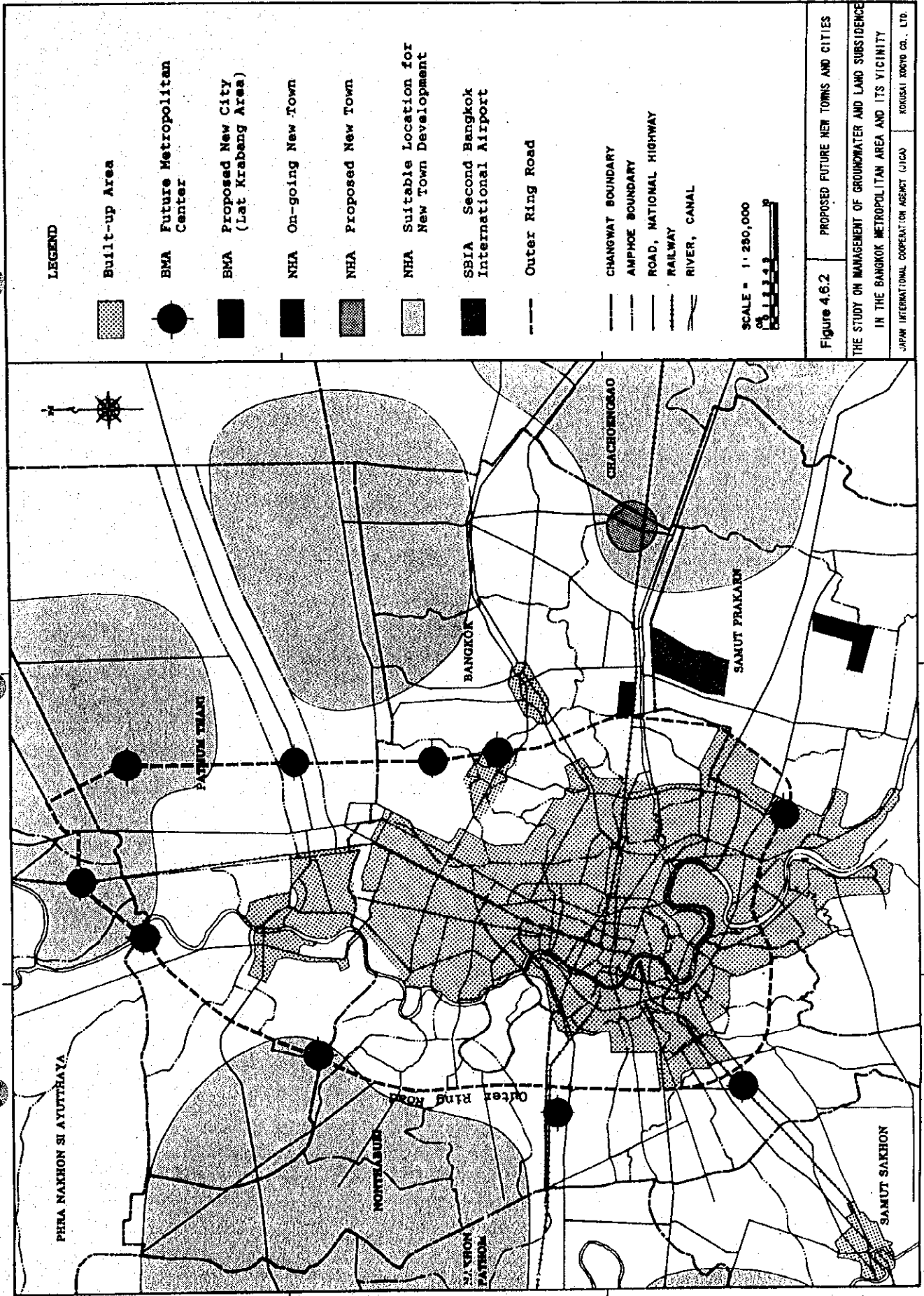
-  Proposed Future Metropolitan Center
-  Second Bangkok International Airport
-  Outer Ring Road

Figure 4.6.1	PROPOSED METROPOLITAN CENTERS BY BMA
THE STUDY ON MANAGEMENT OF GROUNDWATER AND LAND SUBSIDENCE IN THE BANGKOK METROPOLITAN AREA AND ITS VICINITY	
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LEGEND

- Built-up Area
- BMA Future Metropolitan Center
- BMA Proposed New City (Lat Krabang Area)
- NHA On-going New Town
- NHA Proposed New Town
- NHA Suitable Location for New Town Development
- SBIA Second Bangkok International Airport
- Outer Ring Road
- CHANGWAT BOUNDARY
- AMPHOE BOUNDARY
- ROAD, NATIONAL HIGHWAY
- RAILWAY
- RIVER, CANAL

SCALE = 1:250,000

Figure 4.6.2 PROPOSED FUTURE NEW TOWNS AND CITIES

THE STUDY ON MANAGEMENT OF GROUNDWATER AND LAND SUBSIDENCE
 IN THE BANGKOK METROPOLITAN AREA AND ITS VICINITY
 JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) KOKUSAI KOGYO CO., LTD.



4.7 Future Trend of Development

4.7.1 Population Growth Trends and Metropolitan Regional Structure Plan

It is expected that the urban population growth of Bangkok Metropolis and its vicinity towns will continue to increase, but at a slower rate because of the effects of the policy to decentralize economic activities and benefits to the regions. According to the population studies, growth rates increase may be expected in the eastern districts of Bangkok and western part of Chachoengsao because of the future development towards the eastern corridor. It is also estimated that the share of Bangkok in the country's total population will decline from 42% to 34% of the total within the next 20 years. Similarly and as described above, the future direction of Bangkok growth is likely to be more closely integrated with the development of the Eastern Seaboard, expecting to become a greater metropolitan region next to the Seaboard.

Recommendations and main components of the structural plan for the Metropolitan Region are:

a) Bangkok Metropolitan Region

Bangkok: as a leading finance center, other high level services, national and international administration, and cultural activities. In order to decentralize activities from central Bangkok a new metropolitan center at Lat Krabang area and a Second Bangkok International Airport (SBIA) are proposed.

b) Eastern Seaboard Subregion

Chachoengsao: as a new public administration center and a key center for services associated with the Second Bangkok International Airport, and in accommodating decentralize activities from Bangkok;

Rayong-Map Ta Put-U Taphao: as a center of heavy industry and international trade;

Chonburi-Laem Chabang: as a center for services as well as a new international port.

c) Upper Central Sub-region

Saraburi-Kaeng Khoi: as a new industrial center to accommodate industrial decentralization from Bangkok.

d) Western Seaboard

Nakhon Pathom: as an administrative and service center, acting as a gateway to the Western Seaboard and the south.

Ratchaburi-Bang Pong: as a Western Seaboard's industrial center, accommodating industrial decentralization from Bangkok.

4.7.2 Urbanization Trend of the Metropolitan Area

Bangkok Metropolitan Area, one of the fastest developing cities in Southeast Asia, and the primary urban concentration in the country is characterized by rapid urbanization leading to serious problems such as overcrowding, poor housing conditions, traffic congestion, water and air pollution, etc. This rapid urbanization is influenced by the housing development, industrialization and increasing of number of slum locations.

The present trend indicates a continuous increase of the urban areas along the major routes, especially to the northern and eastern corridors involving Bangkok (northern districts), the municipal area of Nonthaburi and Samut Prakarn (western districts), and urban spot locations along route 35 and routes 306-307 in Samut Sakhon and Pathum Thani provinces respectively.

However, the future direction of Bangkok Metropolis growth is likely to be more closely integrated with the development of Eastern Seaboard, thus becoming a greater metropolitan region, next to the Seaboard, serving as a base for basic industrial development and as a new gateway of Thailand's economic development. Therefore, there must be promotional measures to speed up development of this metropolitan region to serve as a center of economic, trade and financial, thereby contributing to the internationalization of the Thailand's economy (Figure 4.7.1).

(1) Housing Development

Real estate began booming since 1960, and reached a peak in 1989 at a growth rate of 50% per annum. This was partly the result of land speculation which caused land prices to triple in 1990. The cost of housing projects continued to rise especially those in Bangkok area. Although increases in residential use occurred in all direction, the main thrust of expansion was in the direction of Bang Kapi Band Khen and Min Buri in the north, Muang Samut Prakarn and Phra Khanong to the south and east, and to the west of Chao Phraya River at Buddha Monton and outer ring road. The development pattern has been virtually unplanned although the construction of roads has been the most important determination of the spatial orientation of development and induced an ribbon development and vacant areas remain among the thin ribbon along the major roads.

During the last 5 years (1987-1992), the numbers of the high rised or large sized buildings has increased considerably, because of the boom of the building industry, standing on the economic condition of Thailand. Although construction in 1992 slowed down considerably due to the decline in the economic situation and high interest rate, the demand for housing, which constitutes one of the basic needs, is still high.

In the sub-urban areas, there are many low rised buildings (dwellings). Physically, the small lot size makes the area high dense and there are not efficient vacant space among each building for a good environment.

Residential projects now lead towards condominiums rather than single houses or townhouses as people adjust their way of life to suit of the boom of the building industry, standing on the economic condition of Thailand.