INDUSTRIAL ESTATES DEVELOPMENT

IN THAILAND

REPORT

Prepared for

Overseas Technical Cooperation Agency

Government of Japan

by Japanese Survey Team for

Industrial Estates Development

in Thailand

March 1970

P R E F A C E

Industrial development alongside agricultural growth is contemplated to be one of the most important strategies for Thailand with a view to increasing the living-standards and stabilizing the national life.

In order to attain this objective, a way of maximum possible utilization of the resources existing in the country has to be studied first of all and then a plan of industrial development conformed with the characteristics of each region should be drawn out.

From the above point of view, our Survey Team for Industrial Estates Development in Thailand, led by Dr. Sadakazu Iijima, Executive Director of Japan Industrial Location Center, was organized at the request of the Royal Thai Government to investigate into the technical, economic and social conditions for industrial location of selected sites and to suggest a basic course towards the industrial development in the region involved, and ultimately to show an industrial estates development plan as a step for the acceleration of industrialization in Thailand.

The recent report is the outcome of the study based upon the field investigation carried out by the team during November 5, 1969 - December 4, 1969.

I firmly believe that it will be equal enough to careful study on the part of the Government of Thailand, and be contributed to further economic growth in this country.

Finally, I take this opportunity to express my hearty gratitude to officials of the Royal Thai Government, especially the Ministry of Industry as well as to other people of Thailand concerned for their cordial cooperation and assistance extended to the team without which the survey works could not be performed successfully, and at the same time my deep appreciation goes to the Japanese Embassy in Thailand, the Japan Consulting Institute and other organizations concerned.

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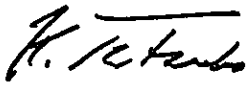

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Chapter I Necessity of the Industrial Development Policy; Significance of the Development of Industrial Estates

1.1 Necessity of the industrial development and its background

Those countries of Southeast Asia, which have attained independence one after another after World War II, hitherto have formulated their various policies and concentrated their efforts to become independent economically, but unfortunately the results obtained so far have not been satisfactory enough.

However, these countries have finally begun to take the course of general economic growth since the latter part of 1960's when the political situation headed toward stabilization.

It could be said that those countries located west of the Malay Peninsula, being favored by the special procurement boom of the Vietnam war and their policy of developing highly the industrial structure called 'industrialization' now on the right track, have established their foundation necessary for the smooth economic growth and expansion.

During the period of the First Stage Economic Development Program (1961 - 1966), Thailand continued to enjoy the annual growth rate of 7.2% which was quite a high rate compared with that of other countries. It seemed that Thailand would soon take off to take the course of a country of modern economy, but when the country entered the Second National Economic & Social Development Plan (1967 - 1971) the country was affected adversely by decreased production of agricultural products caused by bad weather conditions, and also affected by the external factor called 'stagnation' in the export of the primary products resulting from the drop in the international prices. Consequently, the expected annual economic growth rate of 8.5% was not attained, and the mark set was forced to be changed.

The Second Plan (1967 - 1971) has been aimed at the elevation of the living standards of the general people of Thailand, and the Government, instead of directly intervening in the field of production, has concentrated efforts to foster, assist and grant subsidy for the purpose of increasing the productivity through the efforts of the private enterprises.

Emphasis of the Government's policies is being placed on the development and readjustment of the economic foundation such as the construction of irrigation facilities, readjustment and replenishment of roads and other transportation facilities, supply of electricity at low cost, and etc.

Attaching importance to modernization of agriculture, the Government is encouraging diversification of agriculture, and is positively promoting the policies for the improvement of the agricultural structure providing chances to the farming population to learn farming techniques and receiving training. Beside this, the Government is planning to gradually carry the policies for industrialization by encouraging private savings and industrial investment.

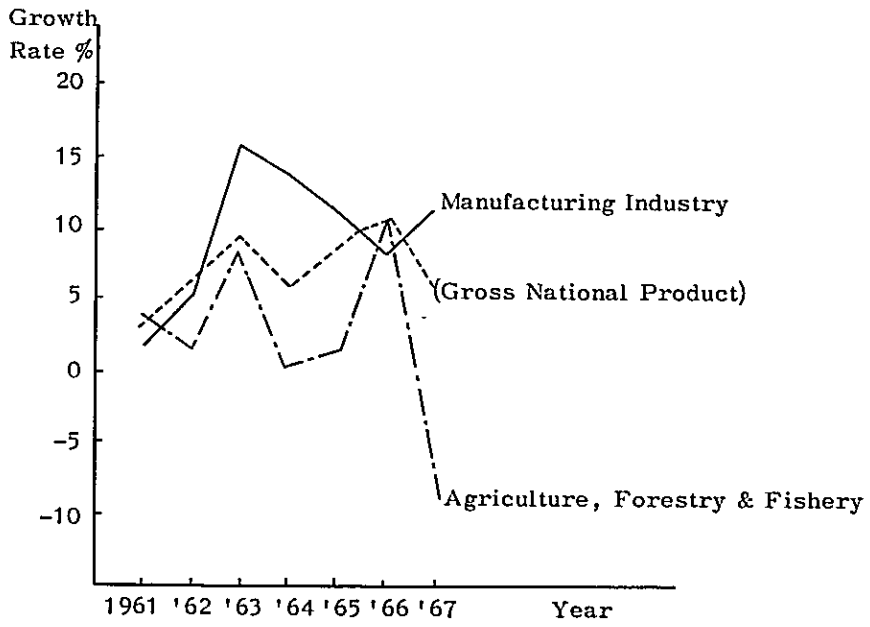
The foundation of these policies is based on the promotion of agriculture, and it could be said that the Government is intending to promote the industrilization policies on this foundation.

As the purpose of this report is to formulate a plan for the development of industrial estates for the promotion of the industrialization policies, it would be worth tracing the records of industrialization in Thailand and probing into the concrete development policies enforced so far and the results, and thereby find out the direction in which the development policies should be enforced hereafter.

As mentioned before, Thai Government's industrialization policy is based on the fundamental idea of developing manufacturing industries in which the private enterprises take the initiative, and the Government is trying to avoid competition between the governmental enterprises and the private enterprises as reflected in the law concerning promotion of industrial investment and the policy of importation of foreign capital. This policy, when watched from the macroscopic viewpoint, has been quite successful.

As shown in the following graph, the manufacturing industry since 1963 has recorded high growth rate constantly, compared with the growth rate of the gross national product.

Fig. 1-1-1 Growth Rate of Gross National Product



Data obtaind from: National Income of Thailand (1966)

As regards the policy for the industrial development, emphasis is being placed on the development of the industry which utilizes the natural resources and of the industry which manufactures substitutes for imported goods. Again, the government is positively encouraging the industrial investment and carrying out the policy of importation of foreign capital in order to cover the shortage of funds. As to the former, no conspicuous results have yet been obtained, but concerning the latter, the policy has been quite successful, and many countries like Japan, USA and the countries in Europe and some countries in Southeast Asia have made capital investment in Thailand.

The development of the industry which utilizes the natural resources and of the industry which manufactures substitutes for imported goods, as pointed out in the paragraphs on points of issue of Thai economy, is absolutely necessary in carrying out the economic policies called the drastic improvement of the structure of agriculture and foreign trade.

In other words, modernization and rationalization of agriculture can be attained only by means of enhancing the productivity of agricultural products, and such will exert much influence on the manufacturing industry in the stage of carrying out such modernization and rationalization of agriculture.

For the adjustment of the foundation of agricultural production, machinery for civil engineering and construction is required; farming machines will be required for mechanization of farming operations as a means of enhancing productivity; and there will be a demand for huge quantities of chemical fertilizers for increased production. Diversification of processing of farm products, effective use of human resources such as the shifting of surplus farm workers to other industries through betterment of labor productivity, all these could be called the big potentials which will serve to promote industrialization.

Development of primary products of mineral products or forest products will also stimulate industrialization.

Digging machines, vehicles for transportation, and explosives will become necessary for the development of natural resources. Smelting of tin ore, and iron manufacturing using iron ore and fluorite as raw materials in Thailand may be taken into consideration depending on deposits and the scale of the development projects. As to forest products, the industrial development will be considered in in connection with the development of the resources of rubber.

Domestic production of goods which are now being imported is the thing which should be carried out first of all to establish a firm foundation for industrialization.

The following Table shows the goods imported during the period of 1961 to 1968 classified into consumer goods, raw materials, capital goods etc. and the ratio of each goods to the total amount of import.

Table 1-1-1 Composition of Imported Materials

Unit: Million Bahts

	Consumer goods		Raw materials		Capital goods		Others		Total	
	Amount	Ratio	Amount	Ratio	Amount	Ratio	Amount	Ratio	Amount	Ratio
1961	3,974	38.6	1,616	15.7	2,548	24.7	2,149	209	10,287	100.0
1962	3,973	34.5	1,661	14.4	3,248	283	2,622	22.8	11,504	100.0
1963	4,017	313	1,859	14.5	4,056	31.6	2,870	22.6	12,802	100.0
1964	4,377	307	2,342	16.4	4,242	29.7	3,293	23.2	14,254	1000
1965	4,615	29.9	2,758	17.8	4,775	309	3,285	21.4	15,433	100.0
1966	5,238	283	3,417	18.4	5,701	308	4,148	22.5	18,504	1000
1967	5,907	26.6	4,165	187	7,542	339	4,574	208	22,188	100.0
1968	6,769	27.2	4,390	17.6	8,386	33.7	5,334	21.5	24,829	100.0

Data obtained from Customs Bureau.

The general trend is that the amount of import has increased rather quickly in the past years. Not much difference has been seen in the types of goods imported.

Machinery, manufactured goods, chemical products, lubricants, and foodstuff etc. comprised the most part of the import.

The policy of development of the manufacturing industry for manufacturing such items to substitute for the imported items carried out hitherto has created various kinds of industries which have made possible the self-supply of such items, but there still are many more types of industry which can be promoted domestically. The next chapter deals with the types of industry which should be started domestically.

As has been pointed out in the paragraphs on modernization of agriculture and the improvement of the structure of foreign trade and the general economic problems, it would be necessary to study from a different viewpoint the development of the types of industries in which diversification and quality-up of manufactured goods will be required on the phase of increasing the income of the consumers for the purpose of elevating the living standards of the consumers by further stimulating the consumption boom and diversification of the consumer goods. It is also necessary to consider upon studying the economic and physical conditions for the introduction of heavy chemical industry which is the industry for manufacturing material s, the demand for which will increase largely hereafter in the industrial sector and the construction sector.

The necessity of establishing the overall policy in connection with the industrialization policy and the overall economic policy has already been explained. Together with the modernization of the primary industry such as agriculture and also as a means of carrying out the important industrial development policies, what will be required are the development of the sources of energy (mainly electric power), improvement and replenishment of roads, transportation facilities and facilities related to industries, overall and multipurpose development of water resources and preparation of the master plan for such development, expansion of financing for development, measures for the effective use of energy, and the improvement of administrative system for the promotion of the development sponsored by private enterprises.

What should be taken into consideration are the various unfavorable conditions found in the capital city zone accompanying urbanization (traffic congestion, public hazards, residences and factories sharing the same area) which will obstruct the industrial development and may even develop into serious social problems.

Therefore, it is necessary that the policy of industrial development should be based not merely on economic conditions but should be carried out systematically keeping harmony with the phenomenon called 'urbanization'.

As regards the built-up area in the capital city zone where overcrowding is becoming more and more conspicuous, it would be necessary that the integrated policy of rearrangement of factories, which includes systematic dispersion of factories and unification of the residential area, should be carried out. In this sense, the policy of industrial estates development could well be an effective means of promoting the development projects.

The following paragraphs will touch upon the abovementioned points.

2.2 Significance of Construction of Industrial Estates

Industrial estates were used as a means of regional development and urbanization when they were first established in England, but it was in USA after World War II that a large number of industrial estates were constructed on a full scale.

The main causes of this could be mentioned as follows:

(1) The increased demand for industrial estates due to the rapid progress made in the industrial production.

(2) Shortage of sites for built-up industrial cities (most of them have developed into industrial cities as a natural consequence).

(3) Aggravation of geographical conditions of large cities due to unfavorable traffic conditions.

(4) Scale-up of the factories

(5) Rapid increase of parking space as the result of motorization

(6) Tree-planting to provide comfortable environment for factories. Then, what is an industrial estate like? It could be defined as follows:-

"An industrial estate is an estate developed for an industrial group according to an extensive and comprehensive plan, divided into blocks and equipped with roads, railways, water supply, sewerage, power supply, and the developer regulates the use of the land and buildings."

In England the industrial estate is called "industrial estate" while in America it is called "planned industrial district", or "organized industrial district" or "industrial park".

In USA and Japan the sale of land is common, but in England lease system is being used. Many industrial estates have been developed recently in Southeast Asia. Some examples of the industrial estates are given in the end of this chapter as reference.

The effects and the points of issue of the development of industrial estates are given later in more details.

Generally the development of industrial estates is carried out as a means of of regional development - most of which are the industrial development in underdeveloped areas - under which are created such conditions of receiving industries to attract the enterprises to the estate and thereby increase the income of the area. The main object of introduction of industry originally was the benefit of promoting the regional economy directly and indirectly, such as the benefit of increased income resulting from the absorption of labor power, benefit of tax revenue such as tax on fixed assets and business tax, benefit of increased demand for construction work and the benefit of increased consumers, purchasing power and similar indirect benefits, but it is also possible to expect benefits on the phase of construction of ideal towns and cities based on efficient use of land, systematic reformation of urban area and creation of such conditions which would improve the environment of the urban area.

The merits of development of industrial estates which the enterprises utilizing such industrial estates can enjoy could be mentioned as follows. Firstly, they do not require to go through complicated procedures for the acquisition of industrial land. Secondly, land can be acquired at comparatively low cost, and they can enjoy indirectly the profit from accumulation of the factories at the time of constructing the factories and when operating such factories. Thirdly, they can use facilities such as roads, railways, water supply, sewerage, and power supply, and also enjoy the benefits of the external economy. Fourthly, they can design the layout of the factories systematically, which is directly useful for rationalization.

The merits which the area to be developed can enjoy are the followings. Firstly, it is the indirect benefit on the phase of income resulting from the introduction of factories. Secondly, construction of new towns can be done systematically and comprehensively. Thirdly, the introduction of new industries will stimulate the regional industries and give them a chance for modernization.

Again, from the viewpoint of the economy of a country, the introduction of the manufacturing industry to the underdeveloped areas will be useful for stabilization of the people's livelihood through revision of the areal difference of income.

Thus, the systematic development of industrial estates could be the most effective and strategic means of reforming the economic and social structure of each area.

It would be worth introducing here how industrial estates are being developed in the countries of Southeast Asia except Japan. Table 1-2-1 gives the summary of the scale of the industrial estates, types of industries, and the contents of the facilities in the industrial estates classified by country.

Among these countries, the Republic of Korea is the country which is developing the industrial estates most of all. Industrial estates with heavy chemical industry as the main industry have been developed in the coastal area, and the scale of development projects is large compared with that of other countries. It is notable that the facilities of water supply are perfect.

In Singapore, the new town system (method of developing industrial estate in a set which includes the industrial area, residential area and the area with various related facilities) is being employed, and Jurong Industrial Estate is characteristic of this system. Most of the industries are heavy industry, chemical industry and machine industry financed by foreign capitals, and this industrial estate has been commented on as highly successful.

In Malaysia, the policy of establishing industrial estates all over the country is being enforced, but the coastal areas and areas comparatively close to seashores are being selected for development.

It is characteristic of Taiwan that processing centers of export items (free zones) have been established in Kaohsing Area and Tsing-Shui area.

Special measures of taxation system have been enforced on imported raw materials and the export of manufactured goods in these free zones, and the government has been successful in promoting positive importation of foreign

capital. The main object of establishment of the free zone was to seek the benefit from absorption of labor power.

We would like to touch upon some of the policies of development of industrial estates in Japan.

Japan's policies of regional development and praticularly those of industrial development can be divided into three categories. The first category includes such policies carried out as a means of redevelopment of the areas in depression in the form of quality-up of the industrial structure and the switch-over of the sources of energy.

In such a case, special measures for taxation system and financing are being taken in the meaning of carrying out the social policy. There are 61 industrial estates (total area is 720 ha) of this category developed in Japan, and the number of enterprises involved is . . . .

Industrial estates belonging to the second category are the industrial estates developed for the purpose of correcting the difference in the income between the area of high income level and the area of low income level. The furious stream of urbanization causes intense concentration of population and industries in the main local cities, while those areas from which the population flows out lose not only their economic foundation but also the social foundation (educational and medical facilities), and this causes a wide difference in the income of the areas of high income level and the areas of low income level.

Industrial estates of the second category are the industrial estates which are developed in the underdeveloped areas for the purposes of eliminating the areal difference mentioned above, and of preventing such harmful influence (overcrowding in cities) which usually follows concentration of population and industries.

For such areas, special legislative measures will be taken, and special consideration will be given on the phases of taxation system and financing. Because of the geographical conditions of the main islands of Japan, these areas extend over quite a wide sphere, and the structure of each area differs from one another. Naturally, there are many areas in which the expected object of development of industrial estates cannot be attained because of their unfavourable industrial geographical conditions. On the contrary, there are quite a number of places where big projects have been successful in the form of development of large industrial positions. Such areas are mostly the seaside area.

Industrial estates of the third category are the industrial estates to be constructed for the purpose of redevelopment of factories in the built-up industrial areas in large cities. Concentration of population and industries in large cities will bring about the accumulative economic benefit of accumulative profit based on the theory of geographical conditions, but excessive accumulation would give rise to various problems. In other words, such would aggravate the environment of each area due to retarded traffic and sharing of same area by residences and factories resulting from slow consolidation of the social overhead capital. If rearrangement of the industry (dispersion and rearrangement of local factories) or the rearrangement of factories through reformation of the industrial areas in cities is not carried out, such harmful influence mentioned above will invite stagnation of the production activities and aggravation of life environment.

In large city areas, such harmful influence has already been revealed, and dispersion of industries is being carried out earnestly. However, if each enterprise is allowed to choose freely its own geographical conditions, overcrowding will again be seen in the suburbs of the large cities. As a measure of preventing this, the construction of industrial estates equipped with the traffic network joining large cities with industrial estates will become necessary.

It is desirable that these industrial estates will be developed into integrated industrial estates which will accommodate not only the manufacturing industry but also the distribution industry which is being affected adversely by the phenomenon of overcrowding.

Further, the new town system based on the method of development in a set is being employed to include group housing area in the industrial estate to solve the problem of shortage of residential areas. There are many cases of development of such industrial estates in the capital zone.

As mentioned above, industrial development is being promoted vigorously in advanced countries of course and also in the countries of Southeast Asia as a part of the policy for quality-up of the industrial structure, and it would not be wrong to say that this measure is beginning to take effect though gradually, It is almost impossible to make a detailed study of the present condition due to shortage of data and gathering of information has not been conducted. However, the examples of the Japanese industrial estates clearly prove the significance of the development of industrial estates as a means of industrial development.

Table 1-2-1 MAIN INDUSTRIAL ESTATES IN THE COUNTRIES OF SOUTHEAST ASIA

Name of Country	Name of Industrial Estate	Acreage	Types of Industries	Facilities
SINGAPORE	Alexander Industrial State	No. 1 District 13000--3000f^2 58 blocks No. 2 District 6000--12000f^2 26 blocks	Minor industries	
	Redhill Industrial Estate (2 miles from the center of Singapore City)	Total acerage 60 acres No. 1 District 23 acres No. 2 District 37 acres		Factory facilities: Provided with standard factory facilities Each has a floor space of 3750f^2. Sold on the terms of yearly instalment of over 15 years One unit: 7000--13000f^2 including building and site.
	Bukit Timah Industrial Estate (8 miles from the center of Singapore City, on the main highway joining Singapore with Malaysia)	No. 1 District 1--7 acres 9 blocks No. 2 District 1--2 acres 10 blocks		
	Jurong Industrial Estate	Total acerage: 17000 acres *Industrial Dist. 6000 acres *Town Center & public facilities 5700 acres *Residential Dist. 4000 acres *Communication facilities Reservoir or industrial water 1300 acres	*Iron and steel, shipbuilding, textile, chemical, metal processing, rubber, wood processing, cables, automobile, tannery, suger refinery, paper manufacturing *Fertilizer factories and integrated textile factories using raw materials are now under construction *Most industries are under joint venture with foreign enterprises in Hong Kong, Taiwan, Japan, Philippines, Britain, USA & Australia *Jurong Shipyard is the typical joint venture company of a Japanese enterprise. *As of March 1968, 280 medium & small enterprises were in operation, and 99 enterprises were consutructing their factories.	Railway: There is a railway covering a distance of 12 miles and connected with the main railway line running through the western part of Malaysia. Roads Roads connecting the industrial estates and the port have been completed Fully equipped highways to the center of the city and roads between industrial estates have also been completed Electric Power: Electric power is being supplied through three 66kV sub-stations located at Pasir Panjang B and Jurong. A power station having the capacity of 480 MW is now under construction A 66 kV sub-station will be constructed at Sudland, and power demand of the industrial estates will be satisfied upon completion of this substation. Drinking water: A supply of 30,000,000 gallons/day of drinking water will become possible upon completion of the water-supply works using new 48-inch diameter pipes drawing water from Johore Industrial water: Supplied to large consumers at the rate of 20 Singapore cents per 1000 gallons. Water of good quality is being supplied at the rate of 10,000,000 gallons/day. More water will be made available upon completion of the Second Stage Industrial Water Project. Existing factories and buildings: There are factories and buildings having sites ranging between 936 f^2 -- 3500 f^2. The number of buildings as of March 1968 was 94. More buildings are being constructed Some of the buildings are being leased by the Jurong Town Corporation
MALAYSIA	Tanpoi Industrial Estate (southern part of Johore State)	Total acreage: 148 acres 55 blocks Period of Lease: 60 years		Roads joining the blocks are well equipped. Water-supply and railway transportation are perfect. Power is being supplied from the completed part of the power station now under construction at Johore Bahru.
	Ipoh Industrial Estate (140 miles north of Kuala Lumpur. Ipon City is in the middle of tin mining area. Forms an important junction of highway, railway, and by-pass running from Singapore to Thailand).	*Tasek Ind. Estate 379 acres Lease period: 99 years *Menglemba Ind. Estate (under construction)	Some enterprises have already moved into Tasek Ind. Estate. The largest cement manufacturer Pan Malaysia Cement is located here.	
	Petalinja Industrial Estate (Selangor State)		263 enterprises have moved into this estate by the end of 1966. 43 of these are the new industries authorized by the Government. All types of industies Sanyo Electric Co., Ltd. and Hayakawa Electric Co. Ltd. of Japan have their factories.	
	Penang State Industrial Estate (Including the state on the west coast, Penang Island and its opposite coast)			
	Makmandin Ind. Estate (west Malaysia)	Total acreage: 140 acres		A series of overall plans including schools, commercial areas, and workers' living quarters is being promoted the project of developing the residential area for the workers.

Name of Country	Name of Industrial Estate	Acreage	Types of Industries	Facilities
MALAYSIA	Penang Industrial Estate (near Georgetown, capital of the state)	*Makloom Road Area (2.5 miles from Port Swettenham and 1 mile from Sungei Penang Industrial Estate) One district 8000--14000 f^2 17 blocks (Now being expanded) *Sungei Penang (2 miles from Port Penang) Total acreage: 5.8 acres 1 District 16000--39700 f^2 8 blocks *Weld Quay Total acreage 14 acres (Under development)		
	Pulai Industrial Estate (west Malaysia)	Total acreage 2500 acres Many blocks of unit area of 1 acre.	*Malayawata Steel as the joint venture of Yawata Steel of Japan *Steel mill using charcoal furnace (using old rubber trees for making charcoal) is in operation. *Malayan Sugar is doing good business	Has port facilities for shipping out tin ore and iron ore.
	Batu Tiga Industrial Estate (In Selangor State. Located inbetween Kuala Lumpur and Port Swettenham. 10 miles from the New International Airport)	Total acreage 1200 acres Lease period 99 yrs.	*Japan's Matsushita Electric, Yamaha, Toshiba, Toyota *Manufacturers of automobiles and electrical apparatus and such durable consumer goods. *Types of industry are rather limited.	Electric Power: Main power station of National Electricity Board is close by. Telephone: 150 circuits. Directly connected with Kuala Lumper, Kran, and Swettenham Kran is the relay station for international telephone service. Facilities are being made for the use of telex. Municipal water supply: Water supply works have been completed on most of the districts along the main roads by Selangor State Development Corporation.
TAIWAN	Kaohsiung Industrial Estate (In the area which includes Kaohsiung Port)	Consisting of 5 development areas No. 1: Having 7 industrial areas 1080 ha. 69 ha. for free zones 63 ha. sold to private enterprises as industrial area No. 2: Scheduled for Chung-tao district Nos. 3 & 4: 4 projects for development of fishing ports Total. 138 ha. No. 4: Project of development of port for exclusive use by petroleum industry No 5. Free Zone 69 ha In the central part of Chung-tao.	*Many big projects such as 2 million tons/year capacity steel mills, oil refinery, industry. *Export enterprises allowed to use the free zones such as precision machinery industry, machine industry, electric industry, optical instrument industry, metal industry, plastic industry, furnitures, handicrafts, electrical parts, chemical products, printing, leather goods industry except tannery, manufacturing of paper containers, manufacturing of toys, manufacturing of yachts, hosiery, manufacturing of knitting machines, manufacturing of clothings, etc. Conditions for the use of the industrial estates are:- (a) Enterprises for new investment, (b) enterprises which do not exert influence over the existing domestic industries, (c) enterprises in which the inspection and control of raw materials and semi-finished goods can be done easily, (d) the process of manufacure is safe and sanitary. No. 1 Free Zone is fully occupied, and the development of No. 2 Free Zone is being expedited. There are 52 Japanese enterprises, of which 48 are joint-venture enterprises.	Free Zone Land is leased at ¥1/f^2, and electric power, industrial water, roads, transportation facilities, warehouses, and water supply and such public facilities are being provided by the government. Port facilities: Under the new port development project, the port will have an acreage of 51 ha. 775,000-ton class will be able to enter the port. Such will bring about tremendous benefits on the phase of economy together with increased capacity for cargo handling *The fishing port of Chien Cheng is almost complete. When all four projects are completed, Kaohsing Port will become a commercial port, industrial port, and port for large ocean going fishing boats *The oil terminal of Kaohsiung Port now located at Linya (suburbs of Kaohsiung City) will be moved to the east end of Kaohsiung Port near Ta-Lin-Pu, and new facilities will be constructed on 90 ha.

Name of Cohntry	Name of Industrial Estate	Acreage	Types of Industries	Facilities
TAIWAN	Lioutu Industrial Estate (8 km from Keelung and 20 km from Taipei) (First industrial estate in Tailwn completed in June 1963)	5,95 ha. Details: Site for factory 39.6 ha Embankment 6 8 ha. Roads 4,3 ha. Sewage treatment facilities 3,0 ha		Water supply: 8000 m^3/day Capacity of sewage treatment: 3,800 m^3/day Transformer substation: 12,500 kW Roads: Main . . .20 m wide x 2,200 m long Subsidiary. . 10 m wide x 800 m long Drainage facilities: 3,500 m Embankment: 2,080 m
	Kanting Industrial Estate (In the surbs of Taipei City)	13,5 ha. Sites for buildings and structures 12,1 ha. Roads and drainage 1,4 ha. Irrigation 0,1 ha	Minor industries from low areas have moved in.	Standard building Drainage
	Kueishan Industrial Estate (24 km from Taipei)	28,8 ha. Sites for buildings and structure 26,8 ha Roads & drainage 2,0 ha;		Drainage system
	Chungli Industrial Estate (35 km from Taipei, close to Kueishan ndustrial Estate)	43 ha. Sites for buildings and structures 36,34 ha. Roads 4,62 ha. Service Center 0,95 ha.		Sewage treatment facilities Service Center Drainage system
	Kueishan Enlarged Industrial Estate (new)	94 ha. Sites for factory buildings 73,6 ha. Roads 11,4 ha. Reserved land for express highway 4,0 ha. Service Center 1,6 ha.		Drainage system Sewage treatment facilities Service Center
	Nantzue Free Zone	115 ha. Factory buildings 62 73 ha. Residences 26,27 ha. Roads, green belt 20,67 ha. Control office 5,00 ha.	Two methods will be employed. (1) Government builds standard factories and lease. (2) Enterprises build their own factories	Public facilities Administration Office Standard factory 6-story building (light industry) 1-story building (heavy industry)
	Tantzue Free Zone (Between Taipei and	23,63 ha. Sites for factory and buildings 15 69 ha. Roads & stations 4,26 ha. Service Center 1,23 ha Warehouses 0,97 ha.	Export enterprises 50 firms	23,63 ha. is divided into 8 blocks. 1 block is for the administration office, 2 blocks for factories owned by the enterprises, and other blocks for standard factories. Roads: 22-m wide and 15-m wide main roads. 9,5-m wide loop road.
REPUBLIC OF KOREA	Pohang (in Kyong-sang pukto)	Present: 1052 ha. Future: 1068 ha.	General industries (iron manufacturing etc.)	Water supply: 100,000 m^3/day (present) 200,000 m^3/day (future) Cost 6,35 Site: $4300 Harbor: 80,000 tons (plan) Electric power: 154 kV Others: Steel manufacturing 600,000--3,000,000 tons
	Masan (in Kyongsang namdo)	Present: 61 ha. Future: 244 ha.	Free export area (special)	Water supply: 45,000 m^3/day (present) 300,000 m^3/day (future) Cost 5,60 Harbor: 5,000 t (present) 20,000 t (plan) Others: Specified as free export area
	Ulsan (in Kyongsang namdo)	Present: 2440 ha. Future. 2532 ha.	Petroleum enterprising group (combinat)	Water supply: 170,000 m^3/day (present) 520,000 m^3/day (future) Cost 7,30
	Yosu (in Cholla-namdo)	Present: 1373 ha. Future: 1525 ha.		Water supply: 25,000 m /day (present) 600,000 m /day (future) Cost 8,30 (present 5,60) Site: ¥3000 Harbor: 5,000 t (present) 30,000 t (future) Electric power: 154 kV
	Mokpo (in Cholla-namdo)	Present 95 ha. Future. 1830 ha.		Water supply 10,000 m^3/day (present) 300,000 m^3/day (future) Cost 2,30 Site: ¥3,500 Harbor: 10,000 t (present) 20,000 t (plan) Electric power 6,6 kV

Name of Country	Name of Industrial Estate	Acreage	Types of Industries	Facilities
REPUBLIC OF KOREA	Yong Dok	Future: 2135 ha.		Water supply: 300,000 m^3/day (future) Cost 3.50 Site: ¥300 Reclaimed land: ¥4,500 Harbor: 20,000 t (plan)
	Chunchon (Kanwon)	Present: 43 ha.		Water supply: 130,000 m^3/day (future) Site: ¥400 (Vegetable field) Electric power: 154 kV
	Wonju (Kanwon)	Present: 37 ha. Future: 275 ha.		Water supply: 60,000 m^3/day (present) 133,000 m^3/day (future) Cost 4.80 Site: ¥800 Electric power: 154 kV
	Chongju (Chungchong-pukto)	Present. 37 ha. Future- 1464 ha.	25 factories already have moved in.	Water supply: 8,000 m^3/day (present) 200,000 m^3/day (future) Cost 4.60 Site: ¥800 Electric power: 6.6 kV
	Iri (in Cholla-pukto)	Present: 122 ha.		Water supply: 18,000 m^3/day Site: ¥700 Electric power: 3.3 kV
	Kumi (in Kyongsang-pukto)	Present: 366 ha. Future: 488 ha.	Foreign enterprises	Water supply: 55,000 m^3/day (present) Site: 110,000 m^3/day (future) Cost 3.20
	Taegu (in Kyongsang-pukto)	Present: 320 ha. Future: 1144 ha.	Textile, chemical and metal	Water supply: 42,000 m^3/day (present) 380,000 m^3/day (future) Cost 4.80
	Kwangju (in Cholla-namdo)	Present: 226 ha.	Automobile, machine and textile	Water supply: 13,000 m^3/day (present) 80,000 m^3/day (future) Cost 6.50 Site: ¥1,500 Electric power: 6.6 kV

Chapter II Basic Direction of Industrial Development Classified by Area

In the preceding chapter we have pointed out the effectiveness of industrial development policies for building a high-degree industrial structure and renovation of trade structure and have also clarified that as a "tool" the development of industrial estates could become a strategic means of achieving such goals.

We have also pointed out in the same chapter that the development and consolication of industrial estates will have a multi-facade, multi-purpose significance having much bearing not only on technological promotion measures but also industrial and social policies regarding consolidation of towns and cities, modernization of distribution activities, and renovation of local environments.

However, in pushing the industrial development ahead, ways and means to be employed are different in respective areas.

In an interim report submitted in December 1969, this survey team has already picked prospective locations for industrial development and presented from a broader point of view lines of operations to be developed in respective areas and various circumstances surrounding the locations.

In the current report we will attempt to look into the peculiarities of area structures and geographical conditions around the prospective locations thereby setting the fundamental courses for industrial development in respective areas.

Geographically, Thailand is divided into Central, Northern, North-Eastern and Southern areas, with marked differences in natural conditions and industrial structures in each area.

Comprising a vast alluvial plain along the Maenam and numerous other rivers of all sizes and lengths, the Central area has been noted as a rice-producing area turning out approximately 50% of rice of the entire nation. Holding Bangkok, the nation's capital, and Thonburi adjacent to it, the area forms the backbone of politics, economy and culture of the country.

The Northern area is generally mountainous and borders Burma. There is relatively little rain with low temperatures in the dry season and natural conditions are favorable. Agriculture is undertaken sporadically in the mountain areas. While the lands owned by farmers are generally small, some of them are engaged in diversified agriculture. Ancient city of Chien Mai is the center of the area and abounds in cultural and scenic spots.

The North-eastern area is formed largely by plateaus, typical of which is the Kolat Heights. It borders Laos by the Mekong on the north, and Cambodia by a mountain ranges on the east.

Although lands owned by farmers are generally spacious, little rain and poor soil do not yield much rice.

Most of the Southern area extends into the Malay Peninsula and is the principal rubber and coconut producing area with abundant rain and thriving forests. Besides rice which comes from the plains along the rivers, and tin is produced in large quantities and fishing is active being favoured by a long shore line.

As a brief survey shows there are marked differences in each area in natural conditions and industrial structures, but the Central area is well ahead of the others in terms of natural conditions, economic and social conditions, thus requiring a study of ways and means to be used for industrial development from quite a different angle.

Even in the Central area the ways and means to be employed for development of the capital zone with Bangkok and Thonburi as major cities are naturally different from those intended for other areas.

In reality, however, the survey team found it very difficult to grasp the real conditions of each area due to lack of area-by-area and city-by-city data necessary for such investigations in a limited time. As the result, a study of each area will have to be based on what little data we could obtain, impressions gained by the team members and other information from the dignitaries, governmental or otherwise, who have visited the areas concerned.

2.1 Fundamental Direction for Industrial Development in the Central Area

The Central area forms the principal section of Thailand, geographically, economically and socially and Chanwat Phrankhon with Bangkok as a center and Chanwat Thonburi holding Thonburi are the centers of politics and economy, forming a large city zone together with Chanwat in the adjacent area.

The population of Bangkok together with neighboring Thonburi recorded 2,200,000 in 1960 and it is the administrative center of the country. The recent indications show that the city is getting more and more overcrowded with the concentration of industries and people coupled with backwardness in consolidation of the social overhead capital. As a result, the urbanization radiates out of the city along the major routes in the eastern, southern and northern sections of the city. Same as elsewhere, urbanization in this area is characterized by shops of all kinds along the principal routes and residential area in the hinterland. While minor-sized factories are huddled together with the shops along the main routes, others of medium size are concentrated in the outlying areas of Bangkok City.

Attached Table 2-1-1 shows the number of principal factories classified by province and year.

As shown in the table, there are more factories in Chanwat Phranakhon than in any other areas and not much change is foreseeable in terms of time. The table also indicates that more and more factories are scattered in the outlying areas of the city away from the overpopulated sections of the city. This is noticeable especially in the northern and south-eastern areas of Bangkok. In Chanwat Thonburi the industries have a way of proceeding south along the Maenam River toward its mouth.

In Chanwat Samut Prakan, located south-east of Bangkok City, the factories increased by leap and bound since 1961 and most of them are located along the Maenam River.

The same trend is noticeable in Chonburi on the eastern shore of the Bangkok Bay. In general, the situation concerning the factory locations may be summarized as in the following list.

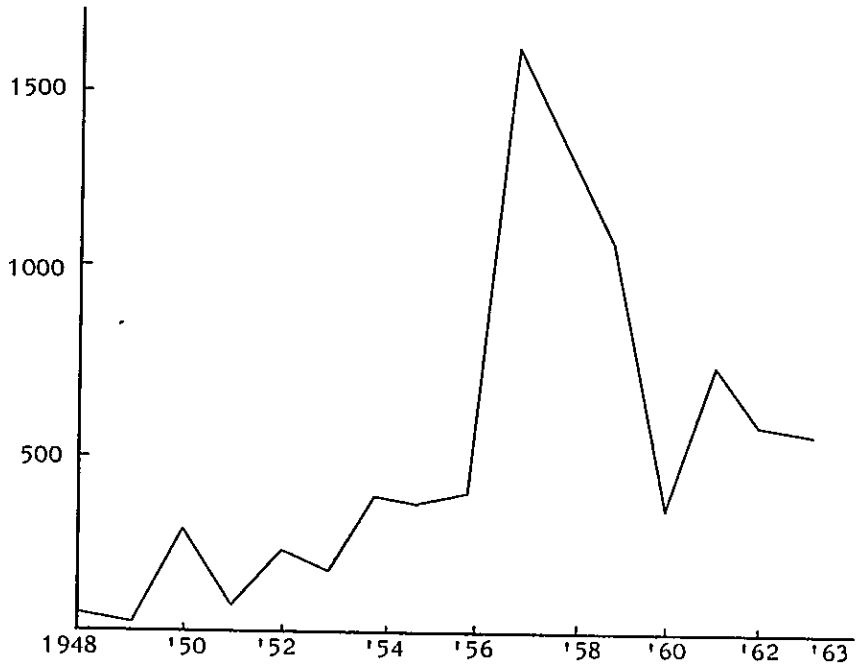
Table 2-1-1 Factory Locations Classified by Chanwat and Year

Chanwat	1957-1960	1961-1964	1965-1966	1967 & after	Total
Phra Nakhon	15	32	36	44	127
Thon Buri	4	2	9	5	20
Samut Sakorn	-	-	1	4	5
Samut Prakan	4	28	34	26	92
Chon Buri	4	3	4	7	18

A classification of factories in Bangkok and Thonburi shows that most of them are engaged in the similar types of operations, presenting similarity in industrial structures in both areas.

The following Fig. shows the number of factories registered over the years in accordance with FACTORY LAW.

Fig. 2-1-1 Number of Factories in Bangkok & Thonburi Classified by Year



The number of factory locations in both areas as shown in the above table showed a gradual increase in the late 1950's and increased suddenly in 1957 and gradually decreased in the 60's.

A hearing conducted in the Ministry of Technology has indicated that the number of industries which are not able to obtain necessary locations in the capital zone has reached 400 and the situation will grow even worse in future. Increased demand for lands, on the other hand, has resulted in the skyrocketing of land prices which are reportedly leaping at a rate of 25% a year.

Rapid urbanization and active industrialization have also resulted in traffic congestions and other public hazards including waste waters from the food processing, dying and sugar-refinery industries, making an overall review of city traffic facilities imperative in conjunction with other industries.

From the above our conclusion is that the overconcentration of industries in the capital zone is now becoming a social issue making it hard for the city to breathe. As a result, in this area, efforts should be directed toward redevelop - ment of industries and purchase of necessary lands for new industrial undertaking.

Concentration of industrial locations in such capital zone will inevitably give rise to traffic ongestion and environmental hazards. While traffic congestion in the city area of the capital zone --- center of industry and trade --- is bound to aggravate and yet this area is expected to see more and more locations used by industries because of its high potentials for lands. It is necessary for the area to be more prepared for that eventuality. Relocation of the existing industries is to be pushed, and a way, on the other hand, must be sought to purchase more locations needed for new industries.

In reality, however, redevelopment of industries in a city is a very difficult task. Depending on sizes and types, locations for industries could have different aspects. In principle, industry in a city is closely related to the ac- cumulative functions of a city.

The functions of a city include the central administrative organs, con- sumers' markets, related industries and traffic and communication network, ac- cumulation of which are observed in the old sectors of the capital zone with Bangkok and Thonburi as major cities. Industries in this area are heavily dependent upon consumers' markets and related industries. We could classify such industries in accordance with varying degrees of relations and dependence on cities.

While the built-up area of the capital zone is expected to maintain and increase its functions as the center of politics, trade, information, distribution and culture in future, a measure must be worked out whereby to preserve such functions.

At this point, it would be necessary to envisage an expansion in the following functions:

1. administrative centers of government agencies and home offices of business concerns
2. Various organs related to information
3. Various organs related to international communications (based mainly on personnel exchange)

4. Various organs related to physical distribution (physical distribution organs both for international and domestic transactions)

Since these organs are expected to be spread out in the principal locations in the capital zone, enough space must be preserved in anticipation of a gigantic expansion of such organs. Therefore, other functions of the city, especially industrial functions, must be relocated for the purpose of the utmost utilization of lands.

What should not be overlooked at this point is the tourist attractions Bangkok has. Being rich in religeous architectures and practices, Bangkok is one of the biggest tourist centers of the world. Since private housing is huddled together with tourist spots, a drastic measure must be worked out based on an overall city-planning so that the city can gain more in stature as a center of international tourism.

At present the city, under and overall city planning, is actively engaged in repairing roads and other facilities, but at the same time, a project must be studied with respect to relocation of industries.

From the above we recommend that the capital zone of Bangkok be classified as a city where relocation of industries is imperative and a concrete plan be worked out toward that end.

Meanwhile, high potentials of industrial locations, or energy for developing manufacturing industries are being dispersed and expanded in the outlying areas of the capital zone where traffic conditions are favorable, and free from traffic congestions and environmental hazards. Irregularities resulting from land utilization are observed in any other major countries of the world. This is because of inadequate restrictive measures concerning lands and haphazard selection of lands by individuals or corporations concerned.

In Thailand, with a view to developing urban areas in an orderly manners, surveys were made at 10 locations, and Bang Chan Industrial Estate Project was actually started as a forerunner of an overall development of industrial estates. At present numerous industries are applying for admission to the industrial estate. and this project has proved a success.

From what we have heard a population in the metropolitan area is increasing at the rate of 4-5% a year and about 2,000 enterprises are establishing their new locations. In order to cope with the growing population and concentration of industries, a strategic measure to be employed will be to plan and develop huge industrial estates and to induce at the same time various other functions out of the city.

Since the land in the capital zone is excellent both for farming and as residential land, a severe competition is almost inevitable in procuring the lands needed for industrial estates.

To solve this problem, it is necessary to purchase in advance necessary lands on the basis of a careful, long-range plan while making a study of the relations with transportation network in the area. Needless to say, rivers and creeks in the area will constitute vital factors in selecting locations. Procurement of the sources of industrial water supply and port facilities is absolutely necessary for some of the industries.

At this point we like to review the fundamental directions for industrial development dividing the capital zone into the inland and the sea-shore sections.

A. Industrial development of inland section

As we have explained in the interim report, we can envisage three categories of the industrial estates when planning a development project.

(1) estates intended only for industries (to include distribution)

(2) estates intended only for the housing area

(3) estates comprising industries, housing and commercial areas.

The industrial estate in Category One is of an ordinary kind but the traffic conditions will form the vital factor for selecting locations when the structure of the industries together with the capacity for the distribution facilities is taken into consideration. When we say distribution facilities, they mean the followings:

(1) junction of traffic (freight station, ports, air ports, truck terminals.)

(2) distribution of cargoes (transportation terminal facilities, central wholesale markets.)

(3) storage of materials (warehouses, both commercial and private.)

The locatipns of such facilities are dependent upon (a) trunk roads, (b) port facilities, (c) central wholesale markets, (d) central district of a city. Therefore, the substance of the industrial estates in the Inland Section of the capital zone will be formed by truck terminals, machine and metal wholesalers, machine servicing factories and warehouses for farm products and other materials intended for general consumers.

Besides these, such lines of operations as cargo-handling and packing, warehousing industrial products and cargo-transportation could be named.

The principal industries coming into the industrial estates are expected to be city-type manufacturing industries. By city-type industries are meant various lines of operations which are heavily dependent upon functions of a city as referred to elsewhere in the current report, and are of numerous kinds. When we take consumers' goods, for instance, they could be food processing, textile processing, wood products, paper products, leather products and sundries of daily use. And as for durable goods, they could be transporting equipment, electrical appliances for popular use and precision machineries. As for production goods, they are metal and machine industries and related industries.

The industrial estate as classified in Category Two is usually developed in combination with housing which is normally intended for use by industries coming into the estates. In case of minor industries, the space allocated is ususlly used both for operations and living.

While in the built-up area of the city a function for providing houses is well established comensurate with a demand, in a new town such a function is almost non-existent.

Whether it is industrial estate or housing area, the land prices around the newly-developed areas usually jump up to several times, meaning an extra financial burden on industries wishing to start operations in such areas. The types of industries coming in are usually city-type and are of small scale in management.

The industrial estate which falls under Category Three is a comprehensive industrial estate combining manufacturing, commerce and housing. This is designed more to be a "new town" rather than a mere industrial estate.

When the built-up area of the capital zone has grown too large in scale, affected by traffic congestion, and industries have reached such a point where mere diversification of partial functions is not enough to get the city going, several satellite cities are to be planned whereby to divert accumulated energy of a city into several nucleus. The new town such as this, apart from the special functions of large cities, is a large industrial estate having the functions of providing everything necessary for everyday life of the dwellers.

With respect to environmental hazards, the developers concerned must provide restrictive measures on factories and housing to be constructed. They can build model factories or houses in accordance with environmental hazard standards and lease them. This is entirely a new town where various facilities for education, medical treatment and recreation are provided besides the housing area in which various types of houses are built with ample green and open space.

The new town such as this is found in many other advanced countries of the world but it is not playing any decisive role in solving the problem of overpopulation of cities, serving only as the bed town of major cities. While a concept of a new town is an excellent way of building towns, it is not likely to attain its original objective should it lose by inadequate location of functions and unduly smallness of development its attraction such a town is supposed to offer. Therefore, such new town should be attractive with comfortable life environments and well-balanced on the phases of production, distribution and consumption.

Locations suitable for the development of the manufacturing industry in the Inland area will be dealt with in the next chapter by summarizing the results of several operations carried out.

What follows is the information with regard to the types of industries and the amount of water requirement of such industries.

B. Industrial Development in the Coastal Area

When we plan industrial development in the coastal area in Thailand, we must at the same time think of development of the areas along the rivers, especially in the area on both sides of the Maenam River near its mouth where industries are heavily concentrated, and the output of which contributes greatly to the total industrial production of the country.

Favoured by navigation canals, labor, and good drainage conditions, such lines of operations as chemical industries, light industries and iron industries are huddled together in this area.

Recently, factories of considerable sizes have started their operations in the area long the right bank of the Maenam River near its mouth. Since materials and people are readily transported by water, the principal factories hitherto have concentrated together along the Maenam River, especially in the area south of Bangkok.

Proximity of Bangkok port which holds the majority of the nation's foreign trade is one of the vital factors which has brought about the heavy concentration of industries in this area.

However, due mainly to soaring land prices and the ground too weak for ultra-heavy industries, there is little prospect for further development of large-scaled industrial areas.

The port of Bangkok is handling the cargo of 95% of export and 70% of import of the nation. The port is big enough to accommodate ships upto 12,000 DWT. The main weakness of the port is that it is located on the estuary of the river and a huge outlay of expenses is necessary to dredge the port to maintain a proper depth for ships coming in. Since 1960 the efficiency of cargo handling dropped largely, and this retarded the handling of cargos, and more ships are standing idle in the port.

What makes the situation even worse are the poor roads which join the port and the city area, and the poor efficiency due to traffic congestion. Although a plan is now under study for the expansion of the port further down the river, there is little prospect for realization. It is desired that a new port will serve as as part of the industrial facilities and not just as a mere commercial port.

When we think of raw materials to be imported and shipped in and manufactured goods exported and shipped out, there is not much point in separating a commercial port from an industrial port.

The coastal area with good port facilities is an ideal location for heavy chemical industries of modern scale. In order that such a location will grow into an industrial area, it must have spacious filled up land, port with proper depth, solid ground base and abundant supply of water of good quality. There is hardly any hope of finding such a location in the areas around Bangkok. Should there be such a location (area along the right bank of the Maenam River, for instance) the prospect is not rosy when viewed from the viewpoint of prevention of environmental hazards from industries.

From the above, the site of a new port will be selected somewhere quite far away from Bangkok.

Laem Krabang in Sriracha which is the proposed site of a new port has the following advantages:

a. Shore is sandy making dredging easy with little costs of construction.

b. Soil needed for construction is easily obtainable from weathered hills nearby.

c. Except for an area under south-westerly winds, waves offer promising condition for a new port.

d. Hinterland offers a good housing area.

e. The grouns is solid.

Industries related to petroleum industry, although on a small scale, are in operation now, and the Japanese Steel Survey Team has recently pointed out the high adaptability of the area for the steel industry.

The problem is how to secure the supply of industrial water. We will go into details on this subject later.

The industrial development of this area must be studied side by side with the development of a commercial port on a larger scale.

As for the manufacturing industries in this area, the collective enterprising group including oil refinery, petro chemical industry, and thermal power generation, and the steel manufacturing industry (integrated steel mill) and related lated industries will be the main industries. Ship-building and non-ferrous metal refinery (zinc refining, for instance) are also possible.

From the above we believe that this area is most suitable for the implementation of large-scaled industrial development project in Thailand with material industries as the main industries.

Then, what are the types of industries which will become the pioneers in the development project? The collective enterprising group including oil refinery and petro chemical industries and the thermal power generation which will supply electric power to such industries will formulate conditions for starting the development project.

As pointed out in the report on steel industry submitted by Iron & Steel Survey Team, industries capable of turning out one million tons of blister steel per annum will be in operation in the future. To repair and service ships transporting raw materials to the establishment, shipyards will naturally come into being. Steel-processing industries may also start operations. The related industries such as these do not have to be located in the filled up land facing the sea. They could be placed in heights somewhere in the Inland Area. If the costs are low for building such establishments, the possibility of development of an inland industrial estate should be probed into.

Next is the problem of how to develop Ban Ang Sila scheduled for the industrial estate for medium and minor-sized industries. Although much closer than Sriracha Area to Bangkok, the conditions as a port are not so favourable as Sriracha Area because temples, villas, graveyards and private housing area are close by. A careful screening of the types of industries to be admitted is recommended.

Since the area is marked as a prospective free zone in the future, it is advisable that the area be located as close as possible to the city area of Bangkok from the stand-point of the security of labor power and customs facilities if the area is to be designated at all as free zone in the not too distant future.

2.2 Fundamental Direction for Industrial Development in the Northern Area

Most of the Northern Area is mountainous, and in the northern-most Chieng Rai area, about 80% of the land is covered with forests. Although the temperature in the rainy season is about the same as in the Central Area, there is a sharp drop in the temperature especially at night in the dry season. The chief industry in this area is agriculture, and rice, vegetables and fruits are grown on the upland in the valleys. Rice cultivation is well advanced in the Lampang, Chieng Mai basin area where there are comparatively more plains.

Most of the industries are domestic and handicraft of silverware and silk processing are thriving.

Mineral resources of several kinds do exist, but the development of such resources is much behind because of economical problems.

Because of the unfavorable climatic and topographical conditions, diversified agriculture is being adopted, and emphasis of the development project is being placed on modernization of agriculture.

Inadequate transportation facilities in the past had retarded smooth distribution of farm products and obstructed the agricultural development.

Situation is being improved lately with the construction of roads, railways and air ports. With the completion of the railway and the national highway linking Lampang and Chieng Mai and the construction of an airport at Chieng Rai, air and land transportations are improving largely. A national highway shortly to be completed between Chieng Mai and Chieng Rai is expected to bring the two cities much closer. This highway together with others is expected to link Chieng Rai, Chieng Mai and Lampang, thus forming a large economic area.

A multi-purpose dam now under construction over the Cok River will make possible the supply of electric power to the Chieng Mai, Chieng Rai, Lampoon and Lampang areas, and power supply will be improved largely.

Installation of the irrigation facilities is being promoted in each area for the supply of irrigation water, and the development project is being promoted smoothly.

As for tourism in Chieng Mai, the city records 100,000 visitors each year and the number is on the increase. Expansion and improvement of transportation facilities, coupled with the projected construction of an international airport in the city, will certainly bring more tourists into this area.

Industries are mostly light industries including food processing, textile processing, ceramic industry, wood processing, some tabacco processing in Chieng Mai and Chieng Rai and other consumers' goods for daily use. (Attached is a list of industries classified by types.)

What would be the most appropriate ways of promoting the industrial development of the Norther area ?

Firstly, local resources must be fully utilized. Besides processing of farm products, silver-work of mineral products and tobacco processing which

are currently in operation, growing and processing high-class fruits would be promising. The outlets for the products must be sought in the foreign markets. Since the Northern area produces teak wood, promotion of reforestration and improvement of processing techniques will make this area the main producing area of high-class furnitures for export.

Consolidation of the capital of the local industry and facilities should be considered since rationalization through a joint-venture can be effected easily for the wood processing industry. Recently increased production of fluorite is being carried out in Northern Thailand, but there is no way at present of processing it locally.

Secondly, manufacture of silverware, silk and cotton textiles must be promoted. They are produced in considerable amount currently as souveniors but in view of the anticipated increased demand from visiting foreigners once a new airport is constructed, the quality of the products should be improved and products should have more varieties. A study is to be made of better designs and, pooling of manufacturing skills is necessary so that the products can find their way into foreign markets.

Thirdly, industries related to modernization of agriculture should be promoted. Currently, mechanization of farming operations and fertilization are not carried out in Thailand. However, as the national agricultural policy is based on modernization and increased productivity, labor-saving through introduction of machinery and increased production through fertilization will spread among the farming population hereafter.

If the principal industry of the Northern area is agriculture, more and more agricultural machineries and chemical fertilizers will naturally be introduced in large quantities. Repair and servicing such machineries plus production of necessary components will be possible locally.

If the use of agricultural machineries become more popular, assembling of such machineries will also become necessary. This will invite capital investments not only in the production of agricultural machineries but also in other industries which have a direct bearing on the peoples' living, bringing about an increased demand for construction machineries as a result. From the above it is necessary to pave a way toward promotion of machine and metal industries.

2.3 Fundamental Direction of Industrial Development in the North-eastern Area

Although the main industry in the North-eastern Area is agriculture as in the Northern Area, rice cultivation is not suitable because of little rain and saline soil. To supplement it, corn, jute, kenaf, cotton, and castor-oil plant are grown. Cattle-raising is also active at some places. With such climatic and topographical conditions, the living standard of farmers in this area is the lowest in the country. But the traffic conditions are good with the Friendship Highway linking Bangkok and the Northern Area. Khon Kaen is a vital junction along the way. Power development is being promoted in Nan Pong, Vbon, and Nam Pung using the multi-purpose dam, and power supply situation is improving. Industries are of minor size and are mainly food and textile-processing. As there is a U.S. air force base at Udon Thani in the northernmost area, machine and metal industries have been developed to quite an extent. (see attached Table of industries classified by types.)

Industrial development in this area should be based firstly on the promotion of farm products processing. Processing of kenaf, castor-oil plant and cattle will become the main industry in this area. Particularly in relation cattle-raising, further development of processing of milk, meat and feeds is desirable. Secondly, machine-metal industry is to be promoted in conjunction with the modernization of agriculture. Measures should be taken to further expand and foster the machine and metal processing industry in connection with the transportation facilities in the Udon Thani area.

As Nakhon Rachasima is located close to Bangkok and is a vantage point of traffic, it is advisable to build large-sized distribution centers such as stock centers for agricultural machineries and warehouses for farm products in this dred.

As mentioned in the preceding paragraphs, the Northern and the North-eastern areas are under-developed sections of the country, and for the successful industrial development of these areas, some political consideration should be added. There are examples of industrial developments such as the one carried out in southern Italy, the development of Puerto Rico carried out by America, and the development of underdeveloped areas carried out in Japan according to the law concerning promotion of development of underdeveloped areas. What must not be overlooked is the fact that it requires a huge amount of funds to be financed by respective country to promote the industrial development in the remote areas.

Should U.S.A. and Italy have any reason why they must make the pro jects successful, it is none other than that they are dealing with the special areas where racial problems are touchy and explosive.

2.4 Fundamental Direction of Industrial Development in the Southern Area

The Southern area which is mostly enveloped in the Malay Peninsula abounds in rivers and forest resources because of high temperatures and humidity. Tin ore is the main item of the mineral resources of this area. With the traffic network cutting through the entire length of the Malay Peninsula down to Singapore, land transportation is quite favorable, but the shoaly coastline offers poor conditions for port facilities.

Reportedly, a project is now under way to construct new ports at Songkhla on the east coast and at Phuket on the west coast respectively.

Although this survey team was not able to visit the sites and collect necessary data because of the limited time, attention should be given to the following points with respect to the industrial development of the Southern area of Thailand.

a. The area faces the Gulf of Thailand.

b. It has rich resources of tin and rubber.

c. The area is a vantage point of transportation by sea since it faces the Strait of Malacca which forms the boundary line between the Sumatra Island.

The industrial geographical conditions of Singapore are like those of the Southern area, and the success of the Jurong industrial estate in Singapore well indicates the possibility of the development of the Southern area.

We hope very much that an overall study will be made on the possibility of industrial development of this area.

2.5 Conclusion

We have attempted in the preceding chapters to set the fundamental directions for the industrial development in Thailand. Of all areas in this country, the one we should name first is the Central area where there are criss-crossing creeks, well-repaired roads and big markets. If any action is to be initiated, it will be in the capital zone, especially the Inland area on the outskirts of Bangkok. Next comes the coastal area in the capital zone. As for the industrial relocation of the built-up area of the capital city area, partial development rather than overall development should be carried out. It would be advisable to make the relocation plan by specifying the type of industry and the area.

In the Northern and North-eastern areas where agriculture is the principal industry, the development of industries related to agriculture will form the main part of the project, and the industrial development will be carried out with giving priority to the agricultural development.

In the Northern Area it is advisable that development should be promoted within the "triangle economic zone" joining Chieng Mai, Chieng Rai and Lampang. Its connection with the development of tourism and mineral resources must not be overlooked. The industrial development of the North-eastern Area should be promoted upon consideration of the regional relations with the Central and the Northern Areas.

The development of the Southern Area would be quite possible if its favorable geographical conditions and its proximity to seashore could be fully utilized. We hope that a survey would be carried out in the near future as to the feasibility of industrial development of this area.

Table 2-1-2 Industries Classified by Types

	PROVINCE	CHIENG MAI			CHIENG RAI			KHON KAEN			UDON THANI		
	Type of Industry	Number of manufacturing establishments			Number of manufacturing establishments			Number of manufacturing establishments			Number of manufacturing establishments		
		Total	with employees	with no employees	Total	with employees	with no employees	Total	with employees	with no employees	Total	with employees	with no employees
	Total	8,829	673	8,156	4,380	376	4,004	11,861	300	11,561	5,953	241	5,712
1	Slaughter	57	22	35	1	1	-	5	5	-	9	4	5
2	Preparative and preserving of meat	38	6	32	3	2	1				2	-	2
3	Ice cream	1	1	-				6	2	4	2	-	2
4	Preserving of fruits and vegetables	13	3	10				1	-	1			
5	Preserving of fish and seafood	4	1	3									
6	Manufacture of soy sance	1	1	-	1	1	1				1	-	1
7	Fishsoy sauce	1	1	-									
8	Food canning	1	-	1									
9	Rice mills	1,084	160	924	974	183	791	549	69	480	820	97	743
10	Flour mills	3	2	1	1	1	-	1	1	-			
11	Grain mills, not flour or rice	4	1	3									
12	Manufacture of bakery products and cakes	3	1	2	2	-	2						
13	Sugar mills and retineries	4	2	2				22	22	-	40	40	-
14	Manufacture of palm sugar and cane suger	2	1	1							2	-	2
15	Manufacture of confectioneries	8	1	7	2	2	-	4	-	4	3	1	2
16	Preparation of animal food	1	-	1									
17	Vermicelli and rice noodle manufacture	190	21	169	11	7	4	8	3	5	14	1	13
18	Margarine, compound cooking fats	3	-	3									
19	Ice factories	5	5	-	2	2	-	3	3	-	2	2	-
20	Manufacture of bean curd	1	-	1	1	-	1						
21	Miscellaneous food preparation	24	7	17	2	2	-	3	1	2	4	-	4
22	Distilleries - liquors	5	4	1	5	5	-						
23	Manufacture of non-alcoholic beverages	2	2	-									
24	Smoking chewing and chines tobacco factories	3	1	2									
25	Redrying tobacco leaf factories	50	50	-	19	16	3						
26	Fider spinning and pressing	10	-	10				6	5	1	3	3	-
27	Manufacture of cotton yarns	4	-	4	1	-	1	3	-	3			
28	Cotton textile factories	381	8	373	1,150	1	1,149	4,865	-	4,865	2,155	1	2,154
29	Dyeing factories	4	3	1				7	7	-	4	3	1
30	Spinning, weaving, dyeng finishing silk	8	7	1	2	-	2	1,729	1	1,728	199	1	198

	PROVINCE	CHIENG MAI			CHIENG RAI			KHON KAEN			UDON THANI		
	Type of Industry	Number of manufacturing establishments											
		Total	with employees	with no employees	Total	with employees	with no employees	Total	with employees	with no employees	Total	with employees	with no employees
31	Preparing spinning weaving of other yarns	4	-	4				1	-	1			
32	Manufacture of rope and twine from coir etc	126	-	126	1	-	1	3	-	3			
33	Manufacture of rope from other fibres	2	-	2				5	-	5			
34	Manufacture of other goods from fibres	15	-	15				8	-	8	11	-	11
35	Manufacture of mats from straw and fibers	293	2	291	483	-	483	1,004	2	1,002	327	-	327
36	Manufacture of repairing foot wear	16	4	12							2	1	1
37	Manufacture of outwear and underwear	1,104	55	1,049	188	33	155	217	54	163	565	31	534
38	Manufacture of hats	151	7	144				6	-	6	1	-	1
39	Umbrella making	151	-	151	1	-	1						
40	Manufacture of make-up textile goods	54	-	54	1	-	1	1	-	1	2	1	1
41	Saw mills and plywood factories	29	9	20	3	3	-	10	10	-	31	30	1
42	Wooden doors and windows	12	3	9	2	1	1	3	2	1			
43	Basketry	2,421	3	2,418	457	-	457	404	-	404	886	-	886
44	Wood carving	53	5	48	1	-	1				1	-	1
45	Manufacture of wood products	575	6	569	1	-	1	4	-	4			
46	Manufacture of wooden furniture and fixtures	115	25	90	51	6	45				21	7	14
47	Wickerwork making	3	1	2	1	-	1	6	-	6			
48	Manufacture of drinking straws	319	2	317									
49	Manufacture of paper products	8	7	1									
50	Newspaper and periodicals	4	4	-									
51	Printing of books	14	13	1	8	6	2				2	-	2
52	Photo engraving and etching	1	1	-				11	8	3			
53	Cure dress and steep animal hides	7	5	2	14	8	6	4	1	3	11	-	11
54	Leather tanning and finishing	4	4	-	14	6	8						
55	Manufacture of leather products	7	-	7	1	-	1						
56	Retreading tired	6	3	3	1	-	1	7	6	1	1	1	-
57	Manufacture of rubber and canvas footwear	2	1	1				1	-	1			
58	Manufacture of rubber products	3	-	3									
59	Manufacture of natural fertilizers	1	1	-				1	-	1			
60	Manufacture of dyes, dyestuff	1	1	-									

	PROVINCE	CHIENG MAI			CHIENG RAI			KHON KAEN			UDON THANI		
	Type of Industry	Number of Manufacturing Establishments											
		Total	with employees	with no employees	Total	with employees	with no employees	Total	with employees	with no employees	Total	with employees	with no employees
61	Manufacture of vegetables and anumalsoil	1	1	-									
62	Lacquer factories	2	2	-				1	1	-			
63	Manufacture of medicine and pharmaceuticals	2	2	-							2	-	2
64	Manufacture of medicine from plants	34	2	32				6	5	1	1	-	1
65	Manufacture of soaps and candles	14	-	14									
66	Manufacture of doss-sticks and chemical mosquite coils	1	-	1									
67	Manufacture of bricks	131	16	115	48	14	34	8	6	2	6	4	2
68	Manufacture of pottery and earthenware	629	14	615	388	3	385	144	2	142	132	1	131
69	Manufacture of cement, cement products	12	-	12	6	-	6				9	3	6
70	Stone crushing mills	9	-	9	1	1	-						
71	Manufacture of concrete products	90	62	28	43	14	29	30	12	18			
72	Manufacture of slaked lime	35	2	33	6	6	-	34	-	34			
73	Statuary manufacturing	3	3	-							1	-	1
74	Metal smelting not precious metal	1	1	-	5	-	5	2	-	2	4	1	3
75	Oxidizing, plating, polishing not precious metal	10	1	9	1	-	1	6	2	4			
76	Manufacture of galvanized iron	1	-	1									
77	Manufacture of aluminium tinware	19	-	19	12	-	12				4	-	4
78	Cutlery making	11	11	-	157	3	154				156	4	152
79	Manufacture of miscellaneous metal products	41	3	38	18	-	18				28	-	28
80	Machine shops	8	8	-	3	3	-						
81	Fitting and repairing machinery	2	-	2	7	2	5				4	3	1
82	Manufacture and repairing of wet and drycells	1	-	1							5	-	5
83	Assembling and repairing of electric machineries	4	1	3	6	2	4				1	-	1
84	Assembling and repairing of radios, television	11	-	11							7	1	6
85	Building motor vehicle bodies	1	1	-							19	11	8
86	Repairing motor vehicles	29	23	6	8	6	2						
87	Assembling and repairing motorcycles and bikes	135	10	125	39	2	37						
88	Manufacture and repairing of transport vehicles	16	6	11	3	1	2				9	-	9
89	Assembling and repairing of watches and clocks	10	-	10	3	-	3				5	-	5
90	Manufacture of gold ornaments	10	3	7	1	-	1				3	-	3

	PROVINCE	CHIENG MAI			CHIENG RAI			KHON KAEN			UDON THANI		
	Type of Industry	Number of manufacturing establishments											
		Total	with employees	with no employees	Total	with employees	with no employees	Total	with employees	with no employees	Total	with employees	with no employees
91	Making of golden sheet	8	-	8									
92	Silverware making	18	18	-	7	-	7				2	-	2
93	Making and repairing of musical instruments	2	-	2	1	-	1				7	-	7
94	Manufacture of plastic products	1	1	-							1	-	1
95	Doll making	2	-	2									
96	Charcoal making	88	3	85	30	7	23						
97	Manufacture industries not else where classified	21	8	15	35	1	34				1	-	1
98	Making paper by hand				1	-	1						
99	Retreading tyres				1	-	1						
100	Manufacture of ceramics				4	4	-						
101	Manufacture of stone products				155	-	155						
102	Manufacture of steel doors and windows				1	1	-						
103	Iron forging				1	1	-						
104	Ship and boat building and repairing				1	-	1				2	-	2
105	Silk combing				2	-	2	2,450	-	2,450	367	-	367
106	Manufacture of footwear, not rubber and fiber				5	-	5	3	2	1			
107	Manufacture of wooden altar				1	-	1						
108	Manufacture of milk and butter, etc.							3	-	3			
109	Print and bleach cotton textiles							1	-	1			
110	Knitting mills							3	-	3	2	-	2
111	Manufacture of textiles, not elsewhere classified							3	3	-			
112	Pranting mills and wood preserving							3	-	3			
113	Furniture and fixtures							3	-	3			
114	Lacquer ware							1	-	1			
115	Manufacture of furniture and fixtures not wood							10	10	-			
116	Fishsoy making										1	1	-
117	Planning mills and wood preserving										1	1	-
118	Manufacture of toilet preparations										1	-	1
119	Building motor vehicle bodies										1	1	-
120	Assembling and repairing of motorcycles and bicks										49	5	44

Chapter III A Study of Items Possible for Industrialization in Thailand

When we think of what items are to be industrialized in Thailand, it is necessary to make a study on the basis of the following four points:

Firstly, how the resources with which the country is endowed are to be industrialized.

Secondly, what are to be industrialized to attain a selfsustaining economy for the country.

Thirdly, how heavy and chemical industries can be promoted.

Lastly, how should the industries cope with the change in the demand structure.

As for the first, it is necessary to make a study from the following two standpoints. One is, what are those possible for industrialization among material resources such as agricultural products, forest products and mineral products? Another is how best man power can be utilized in diversified industries.

As for the second, what is needed is to look into those items which constitute a high ratio of imports or those items which are imported in large quantities, and find out which items among these can be produced domestically.

As for the third, it is to find out what industries can be developed into heavy and chemical industries considered from the physical and economic geographical conditions.

The last item requires a study from the three different standpoints. One is to study how the existing industries should deal with the fluctuations in the structure of demand and consumption within the country while another is to study how industries should react to development of new products.

The last one makes it necessary to study into what kind of manufacturing industries can be taken into consideration in their relations with the demand and consumption of other industries.

The following is the study made more in details on the basis of above-mentioned points of view in order.

3.1 Utilization of resources

(1) Utilization of natural resources

Of numerous material resources in Thailand, the primary products which can be utilized as raw materials in manufacturing industries are corn, tapioca, kenaf, castor bean, poultry and cattle in agriculture, while in forestry they are teak and rubber.

Of mineral resources which are of many kinds in the country, there are zinc ore, fluorite, lime, plaster, tungsten, manganese ore and many others. Although there are many others, these will be principal raw materials for manufacturing industries.

There is an increasing demand for corn as the materials for combined feeds on the international markets, and the principal outlet for Thailand's product is Japan. Though the domestic production has recorded an increase in the past several years, the annual increase rate has been small as 7-8%.

Despite this, the prospect for corn is bright since cattle raising industry in the country is expected to become more widespread and thriving as the result of the national policy based on the development of the cattle-raising industry.

Tapioca is currently exported to the U.S.A. and West Germany as raw materials for feeds for cattle while it is also used domestically for producing starch. Same as in the case of corn, the demand for tapioca as raw material for feeds will increase hereafter.

Kenaf is mainly used as raw material for making hemp bags but a way must be sought in the future for exporting processed goods.

Although castor bean is mostly exported as raw material, the demand is showing a decline throughout the world, hence there is not much chance for industrialization of this item.

Since poultry farming is becoming popular, industries based on eggs and broiler chicken would be possible of development.

Although the number of cattle raised has not shown any marked increase over the past several years, the development of meat processing industry can be promoted if the policy of promoting cattle-raising should spread itself and the scale of each farm is enlarged.

The production of teak is steadily on the increase. Although it requires many years for rearing forestry resources, the export of high class furniture could well be anticipated. The most effective use of limited teak resources is desired.

Iron ore, fluorite, tungsten and manganese ores are exported as raw materials for steel manufacturing and are also used domestically as raw materials to some extent. These resources constitute a vital element for the establishment of steel manufacturing industry.

Tin ore which abounds in the south is used domestically in the refining industry, which is expected to make a further growth since increased production seems possible. The future of plaster industry is bright since there is a growing demand for it as the raw material for producing cement and plaster boards. Production of plaster board as the raw material for interior decoration of buildings can be considered for industrialization since the demand for plaster board in overseas markets is increasing.

Of the items enumerated above, the most promising ones for industrialization are combined feeds, meat processing, high-class furniture and plaster board. Processing of special fruits is also promising as referred to in Chapter II.

(2) Utilization of manpower

Effective utilization of manpower means consolidation of the employment structure.

As shown in attached Table-3-1-1, 80% of the people in Thailand are engaged in the primary industry, indicating the highest ratio among the countries of Southeast Asia. However, a high ratio of employment in the primary industry does not necessarily mean a low per capital income.

Table 3-1-1 Ratio of Employment in Primary Industry and Per Capital Income in Southeast Asian Countries

Country	In Primary Industry		Per Capital Income ($)	
Thailand	1966	79.8%	1967	127
India	1961	72.9	1966	64
Pakistan	1964	68.8	1967	115
Indonesia	1961	68.0	1966	91
Burma	1965	66.5	1967	59
Philippines	1965	52.7	1967	157
S. Korea	1967	51.8	1967	137
Malaysia	1962	51.9	1966	254
Taiwan	1966	44.0	1967	220

In the case of Thailand, productivity of the primary industry must be increased. Introduction of machineries for this purpose will greatly enhance the labor productivity and at the same time create latent surplus labor force. Various policies for promoting industrialization are only possible by the utilization of latent labor force in the low tertiary industries. Locations of industries which require large labor force, in other words, the labor intensive industries, can be chosen in such areas where the latent labor power is abundant and readily available.

Attached Table 3-1-2 shows the number of employees used for the unit production of one hundred million yen classified by the types of manufacturing industries in Japan.

In general, textile, wood and ceramics, especially textile processing, furniture and precision machinery are the industries most representative of the labor intensive type. In such industries, abundance of labor is the vital factor of the geographical conditions. These are the industries which should be given priority in the industrialization of the area where there is abundant labor force.

Table 3-1-2 Classification of Labor Intensive Industries
(Personnel used per unit of produced amount)

No. of employees per 100 million yen	Less than 5	6 - 10	11 - 20	21 - 30	31 - 40	41 - 60	Over 61
Type of industry							
Food production (19 .... employees/factory)	Beer	Floor & sugar producing		Refreshment		Canned marine products	
Textile industries (36)				Wool spining & weaving cotton & linen textile machine, dyeing & finishing	Cotton spinning & weaving chemical fiber spinning & weaving synthetic fiber textile machine, dyeing & finishing	Cotton staple fiber, raw & artificial silk textile lateral knitted wear artificial silk textile machine, dyeing finishing thread dyeing	
Clothing & other textile products (54)					Bedding	Making fatigue & under wear	Making suits for men
Timber & wood products			Processing timber by chemicals	Making plywood	Veneer		
Furniture & other fitting (41)				Making metal furniture		Making furniture & other fittings	
Pulp, paper & paper products (21)			Making dissolved pulp, making paper with plant capable of producing pulp making paper board with plant capable of producing pulp making cellophane	Making paper for stationery cardboard box			
Publishing & printing & related industries (30)				Newspaper publishing		Printing	
Chemical industries(15)	Making vegetable oil	Acethylene & derivatives	Ammonium fertilizer production, soda, dye & medical drug derivative synthetic dyes & facial cosmetics acetate production	Electric furnace Rayon production			

			synthetic fiber products soap surface active agents, paints, printing ink medical drugs perfume, cosmetics & others photographic materials			
Petroleum products, coal products (3)	Oil refining	Secondary coal products				
Rubber products (3)			Making tires, tubes, hoses & other rubber for industrial use, rubber belts for industrial use			
Leather & leather products (35)				Making		Leathe footwear
Ceramics & earthernware			Making plate glass & cement	Processing glass products	Making optical glass & concrete products	Making fire-proof brick
Iron & steel (15)		Cold rolling	Copper producing & rolling & iron producing by high furnace making ferroalloy steel production by flat furnace & rolling copper production & rolling by electric furnace high temperature rolling steel rod & moulded steel			
Non-ferrous metal	Primary refining of copper	Primary smelting of aluminum copper rolling, wire, alloy	Primary smelting of zinc ore, aluminum rolling, wire & alloy	Non-ferrous diecast		

Metal products			Tin can & other plating	Metal products for construction, metal ornaments for construction	Punching & pressing, aluminum alloy
Machine (31)			Making boilers steam engine, turbines, hydraulic turbines, construction & mining machineries, pump & other attachments, elevators, escalators, cargo handling facilities, chemical machines	Making metal machine tools, dewing machine, ball & roller bearings	
Electric machinery		Radio & TV sets	Electric appliances for popular use, wireless apparatus, electric sound system	Generators, power-driven machines & revolving machines	Electric measuring instrument
Transporting machinery	Making automobiles	Making & repair steel vessel	Making car chassis & trailers	Rolling stock & components	
Precision machinery (40)				Making camera & attachment, watches & parts	Automatic measuring machine, land-surveying-instrument
Others (32)			Plastic products unable to classify		

3.2 Encouragement of Home Production

Although various policies intended for realization of a self-sustaining economy have been enforced with obtaining reasonably good results, the trade balance is still in the red, and the ratio of imported consumer goods, despite the recent decrease, is sitll quite high.

The materials which are now produced within the country on a self-sustaining basis are cotton textiles, hemp bags, sugar, steel sheets, zinc plates, nails, paper of medium quality, chemical seasoning, sulfuric acid, glass bottles, zinc refinery products, blankets, light bulbs, dry batteries, plywood, tires, tubes, and electric wire. The items imported, according to the available statistics, in the other of the size of expenditure are milk, petroleum products, chemical drugs, paints, medicines, paper products, textile products, metal products, aluminum products, construction machineries, agricultural machineries, and equipment, rolling stock, ships, optical and medical instruments and sundries. Domestic production of these materials must be promoted and encouraged.

3.3 Heavy Chemical Industrialization

An attached table shows composition of industries in Southeast Asian countries. Being old, the Table may not give the exact comparison with other countries, but the ratio of heavy industries of Thailand is very low when compared with those of the Southeast Asian countries other than Japan.

Table 3-3-1 Ratio of Industrial Composition of the Southeast Asian Countries

Country	Year	Ratio of light industry	Ratio of Heavy industry
India	1960-1963	65.4%	34.6%
Pakistan	1962-1963	85.5	14.5
Ceylon	1963	62.9	37.1
Indonesia	1960	76.5	23.5
Malaysia	1963	71.2	28.8
Singapore	1964	56.5	43.5
Philippines	1962	66.3	33.7
Thailand	1963	83.3	16.7
Burma	1961	60.4	39.6
Taiwan	1961	68.6	31.4
ROK	1963	75.5	24.5
Japan	1963	43.9	56.1

(From U.N. Economic Survey of Asia and the Far East, 1967)

Heavy industry is the comprehensive terminology of chemical, metal and machine industries. These are divided into process and machine industries. Process industry is the one that produces fundamental and intermediate goods (for instance, high-blast furnace, oil refinery, basic chemistry, pulp, and synthetic fibers) and is usually located in the coastal area.

Machine industry produces industrial, electric, transportation and precision machineries, and except for shipbuilding and heavy machineries, is located in the inland area. Since so much space has been devoted to machine industries, the current report, omitting them, will go straight into the processing industry in the coastal area.

The term "coastal processing industry" is used in contrast to "inland machine industry", and means material industry which transports raw materials and finished products by using port facilities located in the vicinity. The factories under this category usually have piers of their own for cargo-handling and they also use public or jointly owned piers. Hitherto, the most representative form of material industry was that the factories were located in the vicinity of the resources of raw materials and they transported finished products to the markets. Since raw materials were in inland areas, so were the factories. Cement industry, natural gas, fertilizer, electric iron refinery and steel manufacturing are the main lines of operations under this category. Being heavily dependent

upon locations of raw materials, the industry is called material-oriented industry. Another type of industry which corresponds to material-oriented industry is consumers' area type industry. From formula in the footnote, Material Index larger than 1 is signified as material-oriented industry while Material Index smaller than 1 consumers' area type industry.

Note:

$$\text{Material Index} = \frac{\text{Grand total weight of local materials}}{\text{Unit of product weight}} \gtrless 1$$

As the result of a drastic increase in the demand, gigantic enlargement of facilities and shifts in energies, source of power and means of transportations, modern industries are gradually changing into consumers' area type from material-oriented type. For ready transportation in and out of port facilities, more and more locations of establishments are found on the coastal area. The principal lines of operations are steel and oil refining, petroleum chemical, non-ferrous metal refining, chemical fertilizers, plate glass and paper pulp. Industries such as these require spacious lands, huge water requirement (large quantity of waste water as a result), ports with a proper depth, abundant electric power and solid ground base. Attached Table 3-3-2 shows the basic unit of model plant representative of the coastal seashore processing industry.

Table 3-3-2 Basic Unit of Industrial Locations of Main Coastal Industries

Type	Scale of facilities	Land used for factories area m^2	Soil resistance t/m^2	Industrial water (freshwater) m^2/day	No. of men	Depth of port
Steel (exclusively steel)	Blister steel 2,500,000 tons year	3,300,000	50	126,000	11,500	13
	Blister steel 6,000,000 tons year	6,000,000	60	180,000	16,000	14
Oil refining	Crude oil processing capability 50,000 barrel	500,000	22	23,000	215	16
	100,000 "	920,000	40	60,000	230	16
	200,000 "	1,230,000	40	48,000	500	22
Petroleum chemical	Converted into ethylene (year) 100,000 tons	990,000	30	66,000	1,100	12
	200,000 "	1,300,000	40	82,000	1,370	12
Paper pulp	Foreign paper 100 tons (day)	9,000	25	10,000	250	12
	430 " "	15,000	25	25,400	2,900	12
Aluminum	Aluminum 40,000 tons (year)	150,000	30	17,000	850	10
	60,000 " "	700,000	30	27,000	1,200	10
Ammonium fertilizer	Ammonia 70,000 tons (year)	450,000	20	7,000	850	10
	100,000 " "	760,000	20	10,000	1,500	10
Shipbuilding	Steel ship 200,000 gross tons (year)	80,000	20		1,200	7-8
	500,000 " " "	200,000	20		2,700	"
	890,000 " " "	300,000	20		3,600	9-10

The following is the detailed study of principal industries in the coastal area.

(1) Steel manufacturing

Steel is being used extensively as the basic material of production in every field of industry and its output has doubled in the past ten years throughout the world. While consumption of steel marks a high standard in the industrial-advanced nations of the world, it maintains an extremely low level in the developing countries. Attached Table 3-3-3 shows a per capita consumption of steel in the leading countries of the world.

Table 3-3-3 Per Capita Consumption of Steel in the Leading Countries of the World (1966)

Country	Per capita consumption (kg)
U.S.A.	667
Sweden	648
Japan	369
Netherland	321
Turkey	31
Iran	29
Thailand	26
Philippines	24
Pakistan	5

As the Table shows, per capita consumption of steel in Thailand is 26 kgs and is on a par with other countries of Southeast Asia but as low as 1/10 - 1/20 of the advanced nations. According to a survey made by the JETRO on the long-range consumption of blister steel in Thailand, the country is to need 1,003 tons in 1970 and 3,156 tons in 1985. The survey further estimates a threefold growth in the demand in coming 15 years and places per capita consumption at 20 kgs in 1970 and 66.5 kgs in 1985.

The total current demand for steel comprises of 33% for steel plates, 26% for structural steel, 11% for steel pipes and others, and the principal products are galvanized iron steel, tin plate, round steel bars for construction use and steel pipes.

The raw materials for these products come mainly from Japan and very little scrap is supplied domestically dependent heavily upon imports.

While there are a considerable number of manufacturers engaged in steel production, rolling and producing steel bars, pipes, galvanized iron plate and tin plate, there is only one steel mill which is continuing integrated work. Using iron ore supplied domestically, this steel mill is turning out 2,000 tons of cast iron yearly by means of small furnaces and is reportedly working on a plan now whereby to expand the present facilities comparable to a modern factory.

A Japanese Steel Survey Team dispatched to Southeast Asian countries emphasizes in its report on the basis of a long-range prospects for demands for steel in Thailand, Singapore, Malaysia and Indonesia a need of establishing integrated steel mills in Thailand where the demand holds a large percentage.

Thailand is also rich with iron ore, coal, lime stone, tungsten ore, manganese and fluorite, all of which are fine materials for producing iron.

Attached Table 3-3-4 shows the production of such materials classified by the year. It shows a marked increase in production especially of fluorite and manganese ore.

From the above, establishment of steel manufacturing industry (integrated steel mills for continuous operation) is promising in future in this country.

Table 3-3-4 Production of Mineral Resources by the Year

(unit 1,000 tons)

Year / Kinds	1961	1962	1963	1964	1965	1966	1967
Iron ore	56	45	16	191	751	692	549
Fluorite	4.8	11.0	29.2	63.5	51.8	48.0	133.2
Manganese	0.5	2.9	6.6	11.1	33.4	70.6	79.1
Tungsten	0.5	0.4	0.2	0.4	0.5	0.5	0.8

(2) Copper refining

With an increased demand for copper for use in manufacturing electric wire, electric machineries and equipment and the insufficient supply of original materials, the world-wide supply and demand situation of copper is getting very tight. This is due to maldistribution of rich deposits throughout the world and almost none at all in others and also due to the high market share held almost exclusively by huge international capitals. Hence development of copper refining industries cannot be expected in those countries where the resources of copper ore are poor. Thailand unfortunately is one of those countries having poor resources of copper ore, and therefore industrialization of copper industry seems very difficult.

(3) Aluminum industry

With aluminum being used more extensively than ever before in diversified fields, its related industries are showing a remarkable growth and expansion. However, because of the high cost of aluminum compared with other metals, the consumption of aluminium in the countries other than those in the advanced nations of the West is low. Aluminium industry is a kind of industry which consumes much electric power (comprising some 30% of production costs) and is most suitable for such areas where electric power is cheap and readily available. The main materials to be used are bauxite and caustic soda. A plan is reportedly under way for establishing an aluminium smelting plant in Sumatra Island, Indonesia, where thermal power and bauxite are available.

In the case of Thailand, a prospect for aluminum industry is hopeless since the country yields very little bauxite and electric power is not readily available at low cost.

(4) Oil refining

The world-wide tendency is that the source of energy is gradually shifting from coal to petroleum. With this transition in the background, the production of crude oil is steadily on the increase. With an improvement in techniques in the ocean development, more crude oil is being found in diversified areas of the world. As attached Table 3-3-5 of per capita consumption of energy in Southeast Asian countries shows, consumption per head in Thailand is much lower than in Japan and the Republic of Korea.

Table 3-3-5 Per Capita Consumption of Energy in Southeast Asian Countries 1966

Country	Consumption (kg) (in terms of coal)
Japan	1,954
Formosa	706
ROK	510
W. Malaysia	400
Philippines	207
Thailand	183
Pakistan	87
Indonesia	85

However, a demand for various petroleum products in Thailand is bound to increase in future since more thermal power stations will come into being, with a view to promoting industries and stabilizing popular life and motorization cecomes more widespread and an increasing demand is anticipated for raw materials for petrochemical industries.

At present there are two refineries, both of which are small in scale--one along the Maenam River in Bangkok and another in the Sriracha Area. As for the first one which is located close to the city area having little space for expansion and overcrowded with harbor facilities, dispersion and intensification of the refinery are desirable.

A plan to develop undersea oil fields in the Siam Bay presents a bright picture in the future production of oil in this country.

With an anticipated increase in the demand for oil, various advantages on the phase of the supply of raw materials and the pursue of the merit of the industrial complex, the construction of oil refineries of quite a large scale in Thailand could well be anticipated.

(5) Petro-chemical industry

Petro-chemical industry leads the modern industries by placing on the market new products one after another. Besides producing naphtha (crude gasoline) various plastic products, synthetic fibers and synthetic rubber products, it is finding its way to paper, wood and food industries as an overall industry.

In reality, however, the industrialization of this industry has been promoted only in those highly advanced countries of the world since it requires large quantities of raw materials, diversified markets and huge equipment fund.

However, in the case of Thailand, the demand for plastic materials is growing at the rate of 25-37% a year, and it is expected that the total domestic consumption will reach the level of 135 tons in 1971. At present there are 320 manufacturers of plastic products throughout the country. Some of the companies in operation are planning to industrialize low-density polyethylene, vinyl chrolide and polyvinyl-acetate. The advancement of the Japanese enterprises in this field is also being discussed.

In any event, the demand for petro-chemical products with various kinds of plastic products as the main products is expected to mark a substantial increase in the not too distant future.

As well known, petro-chemical industry involves complicated and diversified processes from the stage of raw materials to the stage of finished pro-products. Naphtha is dissolved into various intermediate materials (ethylene, propyline and butane, etc.) which in turn will go into the making of various derivatives. Therefore, production process is linked with a connecting pipe from raw materials to finished products and manufacturing plants are located in combination in accordance with the specific items to be produced. As the products which come out from such complicated process are goods of all kinds, naturally require such diversified markets.

The fact that petro-chemical complexes are established signifies none other than the pursuit of merit resulting from the accumulated industries.

In the Sriracha area, establishment of a petro-chemical complex is highly prospective in relation to the oil refinery.

(6) Chemical fertilizers

Chemical fertilizers include nitrogenous fertilizers, phosphatic fertilizers and kali fertilizer of which netrogenous products constitute most of the chemical fertilizers. Nitrogenous fertilizers are classified into ammonia and lime fertilizers, of which the former constitutes the major proportion.

Recently with the improvement made in the petro-chemical industry, crude oil and waste gas from naphtha are replacing gases from coke furnaces and natural gases as materials for ammonia fertilizers (ammonium sulphate and urea, etc.). Although chemical fertilizers in Thailand presently are used in limited fields, the latent demand for such fertilizers is tremendous in an agricultural state like Thailand as long as the use of fertilizers is the minimum requirement for increasing productivity. Attached Table-3-3-6 shows the rapid increase in the amount of fertilizers imported in recent years.

Table 3-3-6 Fertilizers Imported into Thailand (unit: 1,000 tons)

Year	Nitrogenous f.	Phosphatic f.	Kali f.	Others	Total
1960	32	9	1.1	10	52.1
1961	33	12	0.4	9	54.4
1962	33	21	1.6	10	65.6
1963	47	30	2.0	18	97.0
1964	39	38	0.8	30	107.8
1965	33	24	2.2	29	88.2
1966	51	49	2.1	39	141.1

According to the statistics prepared by FAO, the amount of fertilizers used in 1966 was 3.2 kgs of nitrogen, 1.6 kgs of sulphate and 0.4 kgs of kali per one hectare respectively as against 144 kgs, 107 kgs and 108 kgs respectively in the case of Japan.

Since the Thai Government is encouraging the use of 15 kgs of fertilizers per one rai (0.16 hectare), the total amount of fertilizers needed for the total cultivated acreage of 56,470,000 rais will come to 847,000 tons. With this as potential, fertilizer industry could be called as one of the growing industries in Thailand. Ammonia fertilizer industry is to be promoted and located in combination with oil refining and petro-chemical industries with which it is closely related.

(7) Other coastal area industries

Besides the above-mentioned items, there are soda, plate glass, cement, paper pulp, plywood, shipbuilding, edible oil, thermal power generation and atomic power generation for possible industrialization. While Japanese enterprises are engaged in manufacturing soda and plate glass, the state-owned factories are producing cement, paper, and plywood, and each of these industries has established its set-up for self-sufficiency.

As for the production of paper pulp, a study is recommended along the line of relocating the existing factories on the coastal area and intensifying them since the present facilities are small in scale, located in the inland area and are capable of only turning out paper of medium quality. The factories to be set up in future should be large-scaled integrated factories located in the coastal area.

As for the plywood industry, it is also advisable that the related factories and establishments be located in the coastal area and intensified so that the materials imported are readily obtainable and finished products conveniently shipped out.

With respect to shipbuilding, at present there are only a few minor factories and none big enough to repair ocean-going steel vessels. But a day will not be too distant in future when a ship-yard large enough to service big steel ships becomes necessary with the progress of development of industrial estates for heavy chemical industries in the coastal area, and when more vessels of larger sizes beginning to enter the port.

Plywood and shipbuilding industries require intensive labor, and it is necessary that these industries should be promoted in this country as a means of absorbing the large labor force Thailand has.

The thermal power generation is a line of operation which accompanies the establishment of a large-scaled coastal industrial area because it must receive fuel necessary for operations from the petroleum complex in the industrial area and at the same time supply power to the coastal industrial area.

Although the Sriracha Area is scheduled for the prospective site of atomic power generation, thermal power will be the principal source of energy for the industrial area in the vicinity. As for the location of the atomic power station, a further study is necessary since the area selected is much too close to the industrial area for heavy chemical industries. This is not to say that the atomic power issue could be left unattended. On the contrary, the atomic power will be indispensable in future to desalination of seawater and producing salts for industrial use, both of which are vital to the industrial development of the coastal area.

These are item-by-item study of industries prospective of future development on the coastal area but the related industries are not touched upon because of their diversity and infinite number.

In general, once a main material or energy industry is set up, numerous related industries will gather around it. For instance, steel industry will give rise to industries such as the manufacture of zinc iron plate, print steel plate, drums, large bridges, structures for ocean use, steel processing centers, specialized steel, cast iron, forged steel, fire-proof brick, cokes, and oxygen centers. The industries related to aluminium production are aluminium rolling, aluminium wire, aluminium casting, aluminium foil, aluminium electric wire, aluminium construction materials, and caustic soda.

Petroleum complex is related to such industries as synthetic fibers, synthetic rubber, synthetic paper, synthetic wood, petroleum protein, synthetic resins processing, synthetic drugs and paints.

Related industries to paper production are cardboard, tissue paper and toilet paper. It is recommended that these industries mentioned above be located close to material-supplying facilities because the finished products are to be distributed by pipe if they are in liquid form or by train or barges if they are solid objects.

(8) Related distribution industries

Lastly, it would be worthwhile touching upon the geographical conditions of the distribution facilities having relations with manufacturing industries. As reported in Chapter II those distribution facilities dependent upon port facilities will be located in the vicinity of industrial port or commercial port if constructed. Such facilities include container yard, truck terminal, fresh food distribution center (to include processing facilities) machinery stock yard (to include assembly facilities) and warehouses. As distribution processing facilities, there are refrigerating plants, packing material plants,and large rice-cleaning mills.

3.4 How Should the Industries Deal with Fluctuations in Demand and Consumption

With an increase in income, the demand structure of consumers' goods will become more diversified and shift toward better and higher quality products.

To cope with the increasing and diversified demand of the public, more food, clothings and sundries will have to be supplied. Clothing is a typical example. The workmanship of spinning, dyeing and design is the key point which decides the marketability of the products.

Concerning foodstuff, importance should be attached to its relations with the fields of distribution such as packing, storage, control, transportation etc. with the growth of the market.

As to sundries, an increased demand is anticipated for musical instruments, sports goods and other products related to people's recreation. The tendency of plastic replacing other materials will become more and more conspicuous.

As for the durable goods, more new products will appear on the market. Attached Table 3-4-1 shows the diffusion rates of durable goods in Japan in the past several years. Electric refrigerator and vacuum cleaner which recorded only 10 - 19% and 9% diffusion rates respectively in 1960 now record more than 70%.

In Thailand too, more durable goods such as electrical machinery and appliances for home use and furniture will be used by the people.

As the result of expansion of administrative organs, the demand for printing, metal construction materials, and office machines and appliances will further increase.

Attached Table 3-4-2 shows detailed classification of the industries related to the production of durable goods. These will be located in the future where various organs vital to a city function are concentrated.

Table 3-4-1 Diffusion of Durable Goods in Japan

	1960	1965	1969
70%	radio	radio, ,wardrobe, sewing machine, electric washer, electric foot-warmer, electric fan, oil oil stove	sewing machine, TV set, radio, electric washer, electric refrigerator, electric fan, electric foot-warmer, oil stove, wardrobe, electric cleaner
50-60	wardrobe, sewing machine, bicycle	transistor radio, camera, bicycle, electric rice-cooker, electric refrigerator	camera, bicycle

40-49	camera, electric washer, TV set	electric cleaner, oil stove	stainless sink
30-39	electric ricecooker, electic fan, mattresses	gas range, telephone, mattress	knitting machine, stereophonic record player, tape recorder, gas kettle
20-29		stereophonic record player, tape recorder, gas stove, stainless sink	vent fan, blanket, gas stove, organ, furniture for guests, dining room furniture, bed
10-19	scooter, motorcycle, electric refrigerator, gas stove, guest receiving set, transistor radio	organ, scooter, motorcycle, cars, electric stove, guest receiving set, dining room furniture	color TV.set, car, motorcycle, scooter
9	piano, organ, camera, electric electric cleaner	piano, air conditioner, vent fan	air conditioner, piano, golf set

Table 3-4-2 A List of Industries Related to Durable Goods

Medium Classification	Detailed Classification
food	meat product, milk product, canned marine product, canned farm product, seasoning, flour mill, confectionery, refreshment, beer, spirits, food oil
textile goods	knitted goods, socks, ready-made suits, suits for women and children, fatigues, underwear, caps, fur products
wood products	furniture, bedding
paper products	paper products of all kinds, paper containers
rubber products	rubber foot-wear, medical and sanitary rubber goods
leather goods	leather products of all kinds
ceramics	food utensils
metal	cutlery, sharp instruments, utensils for kitchen use, metal products for construction of steel furniture
machinery	electric bulbs, dry batteries, electrical machinery and appliances for home use, their components, measuring instruments

sundries	sundries made of precious metals, musical instrument, toys, sports goods, stationeries, personal ornaments, plastic sundries
chemical	medical drugs, cosmetics

In conclusion, a brief survey is worth making on how the structural changes in the demand and consumption will affect each industrial sector. There are many industries which are highly connected with the manufacturing industry. They are forestry, fishery, mining, energy industries, construction, transportation, warehousing and tourism. Here a study will be devoted to agriculture which is closely related to the industrialization in Thailand.

As pointed out elsewhere, promotion of agriculture will exert much influence on the manufacturing industries.

The items which will be directly affected are fertilizers, agricultural chemicals, feeds, farming machineries and tools. Agricultural chemicals are used for pest control to prevent plant diseases and insects. Records show that the agricultural chemicals imported in 1966 reached 9,006 tons as against 476 tons of 1950. Same as in the case of fertilizers, most of the agricultural chemicals are imported. Most of the agricultural chemicals now being used are inorganic, but organic agricultural chemicals such as BHC and DDT are also being used in large quantities, replacing those of vegetable nature. Since increased use of fertilizers will give rise to the outbreak of diseases and insects, the demand for agricultural chemicals is bound to increase.

In Thailand, farm machines and tools are not in popular use with the exception of small pumps, and tractors which are used mainly by farmers with large holdings in the limited areas. The number of tractors in use in the country is said to be around 15,000 and this increase in the number is reportedly caused by a boost in corn production. Farm machines include tilling machines, sprinklers, spraying machines, and threshers. In some of the advanced countries rice-planting machines, grass-cutting machines and harvesters are already in use.

In any event it will become necessary for Thailand to induce farm machines in larger quantities and this is a line of operation that must be promoted ahead of all others in the machine industry.

Attached Table 3-4-3 shows the basic unit industrial water requirement classified by the types of industries. (on separate sheet)

Table 3-4-3 Basic Unit of Industrial Water

Type of Industry	Amount of Fresh Water Used (1000 m3/m2)
food production	65.3
canned marine products	94.6
flour production	16.6
sugar production	90.5
refreshment	51.3

beer production	62.3
textile industry	42.2
cotton weaving	47.4
chemical fibers spinning	56.8
wool spinning	39.3
cotton synthetic fiber	18.9
raw silk & artificial silk	24.8
wool textile	14.2
lateral knit wear	10.2
cotton and linen dyeing & finishing	127.3
servicing & dyeing spinning machines for raw & artificial silk	87.0
dyeing & servicing spinning machines for synthetic fibers	103.0
thread dyeing	141.6
clothing & other textiles	3.9
making men's suits	3.7
making fatigues	3.5
making underwear	4.4
making beddings	2.1
producing wood & wood products	2.1
producing plywood	4.9
producing veneer	5.6
processing wood with chemicals	0.5
furniture & fittings	3.2
producing furniture	2.3
producing metal furniture	7.0
producing fittings	1.7
processing pulp, paper, paper products	259.0
producing dissolved pulp	252.3
producing pulp for paper	267.9
producing paper with plant capable of producing pulp	372.6
producing cardboard with plant capable of producing pulp	174.6
producing corrugated paper	33.7
producing paper for stationery	10.5
producing cardboard box	12.5

producing cellophane	248.9
printing & related industries (publishing)	26.9
newspaper printing (print & publish by using roll print)	136.1
printing (excepting mimeograph pringing)	20.8
chemical industry	140.9
producing ammonia fertilizer	280.7
soda industry	120.1
electric furnace industry	76.7
producing dyes, derivatives, synthetic dye, organic cosmetics	69.5
acetylene derivative, ethylene derivative methanol	301.3
producing methanol derivative, synthetic resin, plastic	301.6
producing rayon	229.6
producing acetate	129.8
producing synthetic fiber	148.8
producing vegetable oil	101.3
producing soap	196.1
producing surfactants	76.7
producing paint	35.9
producing printing ink	29.9
producing medical drugs	83.9
producing perfume & other cosmetics	104.9
producing photographic plates	166.4
petroleum & coal products	39.6
oil refining	39.0
producing cokes & its secondary products	99.5
rubber products	48.4
tires, tubes	70.9
rubber belt for industrial use, rubber hose, other rubber products for industrial use	42.1
leather products for industrial use	20.2
leather producing	41.0
producing leather footwear	4.7
producing ceramics	27.5

producing plate glass	103.0
producing optical glass	7.4
processing glass products	31.0
cement production	95.6
producing fire-proof brick	3.9
producing cement products	12.8
iron and steel	75.1
steel industry using high furnace for steel rolling	114.9
iron casting by electric furnace	54.8
producing ferroalloy	89.8
steel producing & rolling by flat furnace	73.9
steel production & rolling by electric furnace	68.0
high temperature rolling	13.0
cold temperature rolling	84.5
producing jointless steel pipe	31.0
producing welded steel pipe	14.3
steel rods & moulded steel	25.2
non-ferrous metal	25.9
primary refining & refining of copper	8.8
primary refining & refining of zinc	72.3
primary smelting & smelting aluminium	39.9
copper rolling, extended copper wire and alloying copper	19.3
aluminium rolling, wire, alloying	74.1
producing diecast	28.5
producing electric wire	27.6
metal products	13.1
tin and other plating	11.6
producing metal ornaments for construction use	15.8
punching, pressing and producing aluminium alloy products	36.8
machinery	8.6
producing boilers	5.1
producing steam engines, turbine water power turbine	10.2

producing construction & mining machines	5.5
producing metal processing machines	7.2
producing elevators, escalators	3.5
producing pumps & attachments	17.5
producing facilities for cargo handling	5.0
producing chemical machineries	8.4
producing sewing machines	7.7
producing ball bearings, roller bearing	16.3
electric machineries	16.6
producing generators, power-driven machineries & other revolving machines	16.2
producing electric appliances for popular use	18.4
producing wireless machines & equipment	13.5
producing radio, TV sets	14.4
producing electric sound machines	10.7
electric measuring instruments	6.6
transportating machineries	19.9
producing automobiles	43.5
producing automobile bodies & attachments	13.5
producing rolling stock & components	8.6
producing rolling stock and components	8.6
producing steel ships, & repairs	7.4
precision machines	12.6
producing measuring instruments	12.9
producing land-surveying instruments	11.6
producing cameras & attachments	12.9
producing watches & components	13.5
others	21.4
plastic products unable to classify	23.1

Chapter IV Project for Industrial Estate Development

4.1 A study of suitable locations all over the country for industrial development

1) How to select suitable locations from the national viewpoint:

The study of the feasibility of industrial estate development in each area centering around the major cities is to first select the suitable area according to the fundamental conditions for development concerning all over the country, and then choose the localities in each of the prospective areas suitable for industrial estate development. The unit of the areal classification used here is 'chanwat' (prefecture). There are two phases of the basic conditions which should be grasped all over the country. One is the natural phase of Thailand, and the other is the socio-economic phase which should become the background of the industrial development. Here, only such major conditions have been taken up which clearly indicate the areal characteristics. In other words, they are the present conditions throughout the country relative to topography, population, traffic, facilities, etc.

The summary of the present condition and industrial conditions of location is as given below and also shown on maps Nos. 1-15. Map No. 16 indicates the general findings of the study and at the same time shows the areas feasible of industrial development all over the country.

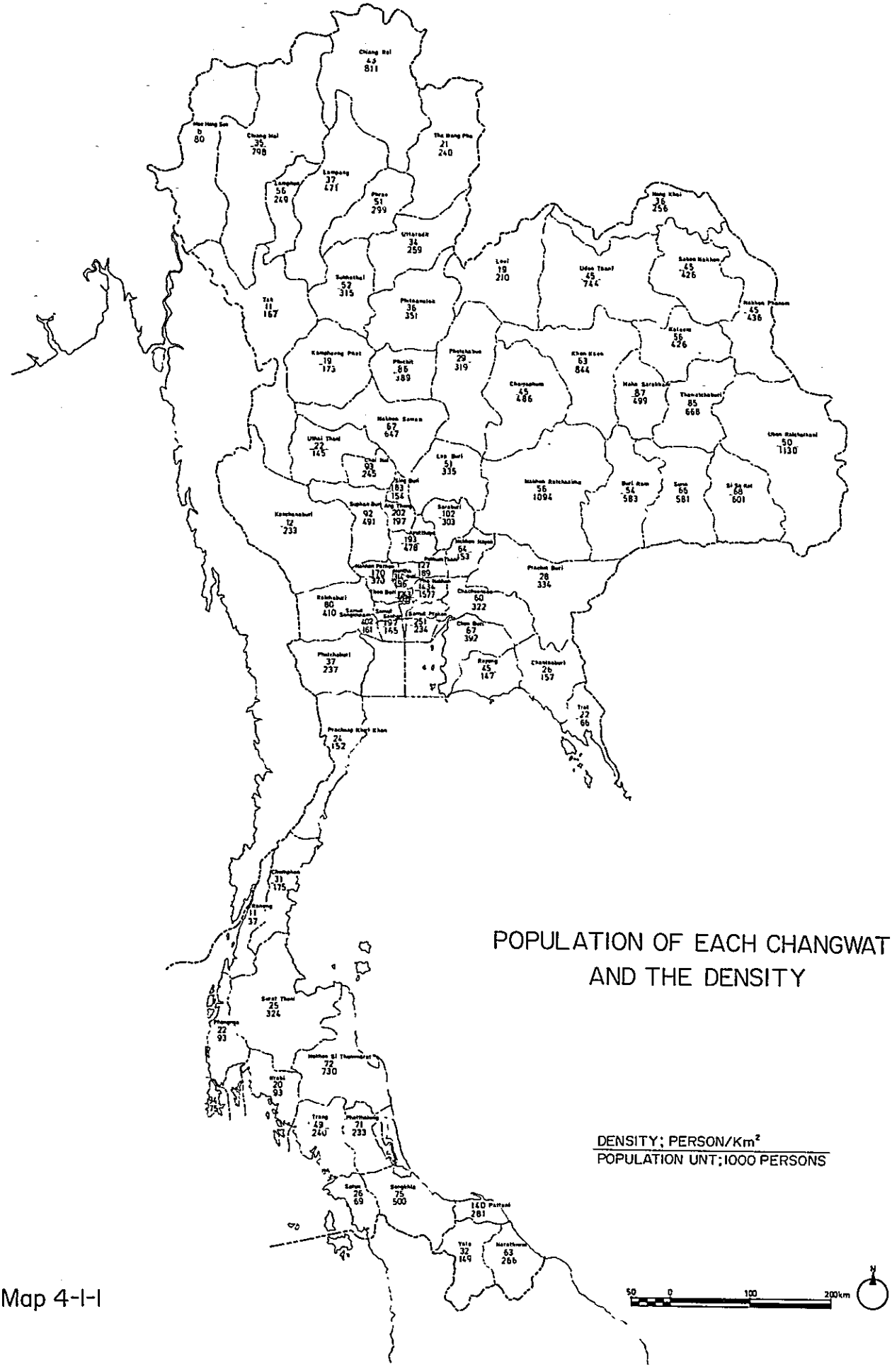
2) Grasping the present condition and the conditions of location of each area.

Data on the basic conditions of location for industrial development obtained, and the points aimed at within the possibility of making a decision in accordance with the said data are as shown below. The data used are "Thailand Resources Atlas".

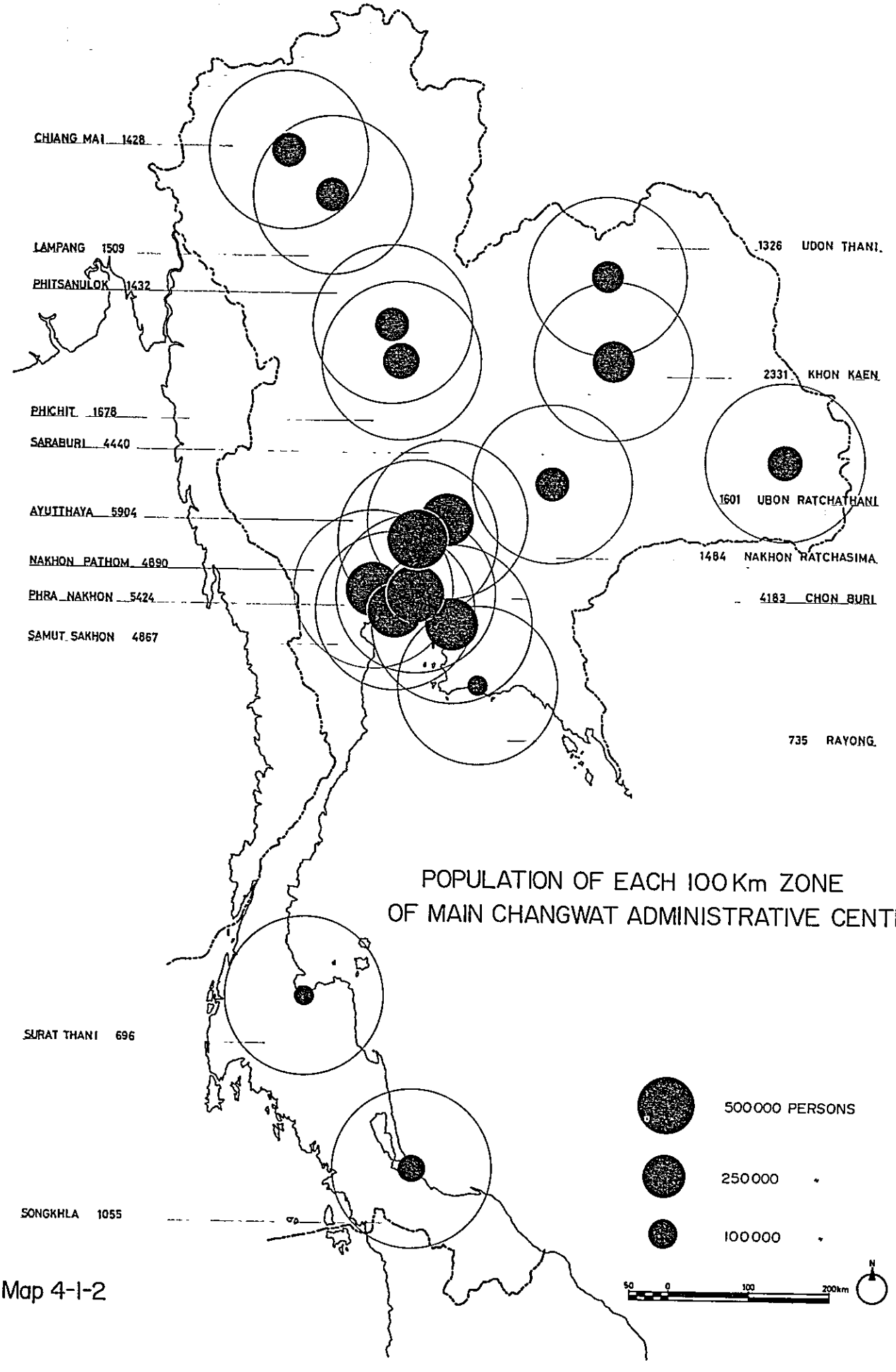
Conditions of Location and Data for making Decision of Location	Visual Point
A. Land and Water Sources	
1. Type of Forests & National Parks	Topographical condition Pick up the mountainous area Condition of land surface Take up from among forests, glassland and national parks and such areas where there is little possibility of using as industrial estates.
2. Water Resources Development	Distribution of usable industrial water Grasp the areal distribution on each stage of volume and scale and find out the area which can be used.

3. Cadastral Map of Thailand	Calculation of the usable acreage of each area (9 areas) which can be used.
4. General Soil Condition	Condition of distribution of alluvial plain and low table-land Condition of distribution of high table-land and low table-land Condition of distribution of hills and mountainous area
B. Labor Power	
5. Administrative Division by Changwat Amphoe and King Amphoe	Distribution of Population Check the unity of the population scale of 100 km zone of city areas
C. Transportation	
6. National Highways Railways, and Domestic Airlines	Map showing the network of main roads Pick up the area possible for use as industrial estate from the viewpoint of traffic condition Map showing the railway network Pick up the area possible for use as industrial estate from the viewpoint of railway transportation.
7. Inland Waterways	1. Number of transport ships on inland waterways Power driven ships Boats with overboad engines Non-powered ships 2. No. of ocean-going vessels belonging to domestic ports Power driven ships Sailing ships Non-powered ships (To find out the capacity of each port from the above) 3. Amount of freight handled at each port classified by city (To check the scale of each port)
D. Energy	
8. Existing Power System in Thailand	Distribution of the areas where the use of power is possible Check from the present condition of power stations, substations and transmission lines.

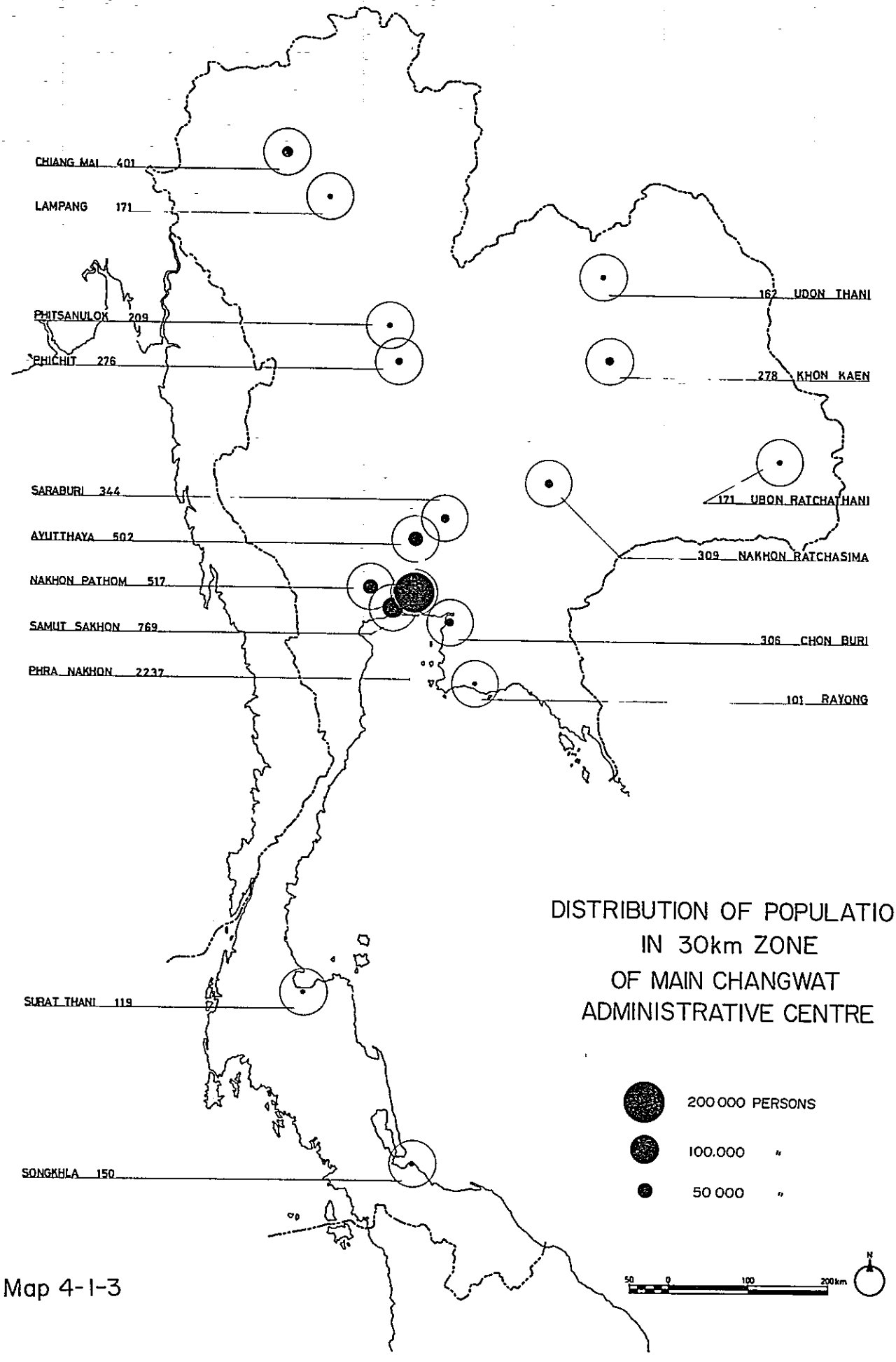
	As diesel power plant is being used to quite an extent, it is possible to construct a power station depending on the condition of each area. This point should be taken into consideration. (Thermal power station also exists.)
9. Mineral Resources of Thailand	Distribution of energy Distribution of resources of coal and petroleum, estimated deposits and scale Location of oil refinery Distribution of mineral resources Check the distribution of mineral resources having large deposits
E. Market	
Same as 5.	Distribution of population Check the population by changwat to find out the density
F. Others	
Same as 6.	Location of airports Pick up as an area where close exchange of information is possible
10. Telecommunications	Telephone facilities Check the areas where there are long distance telephone facilities Check the scale of the facilities


POPULATION OF EACH CHANGWAT
AND THE DENSITY
DENSITY; PERSON/Km²
POPULATION UNT;1000 PERSONS
50 0 100 200km
N

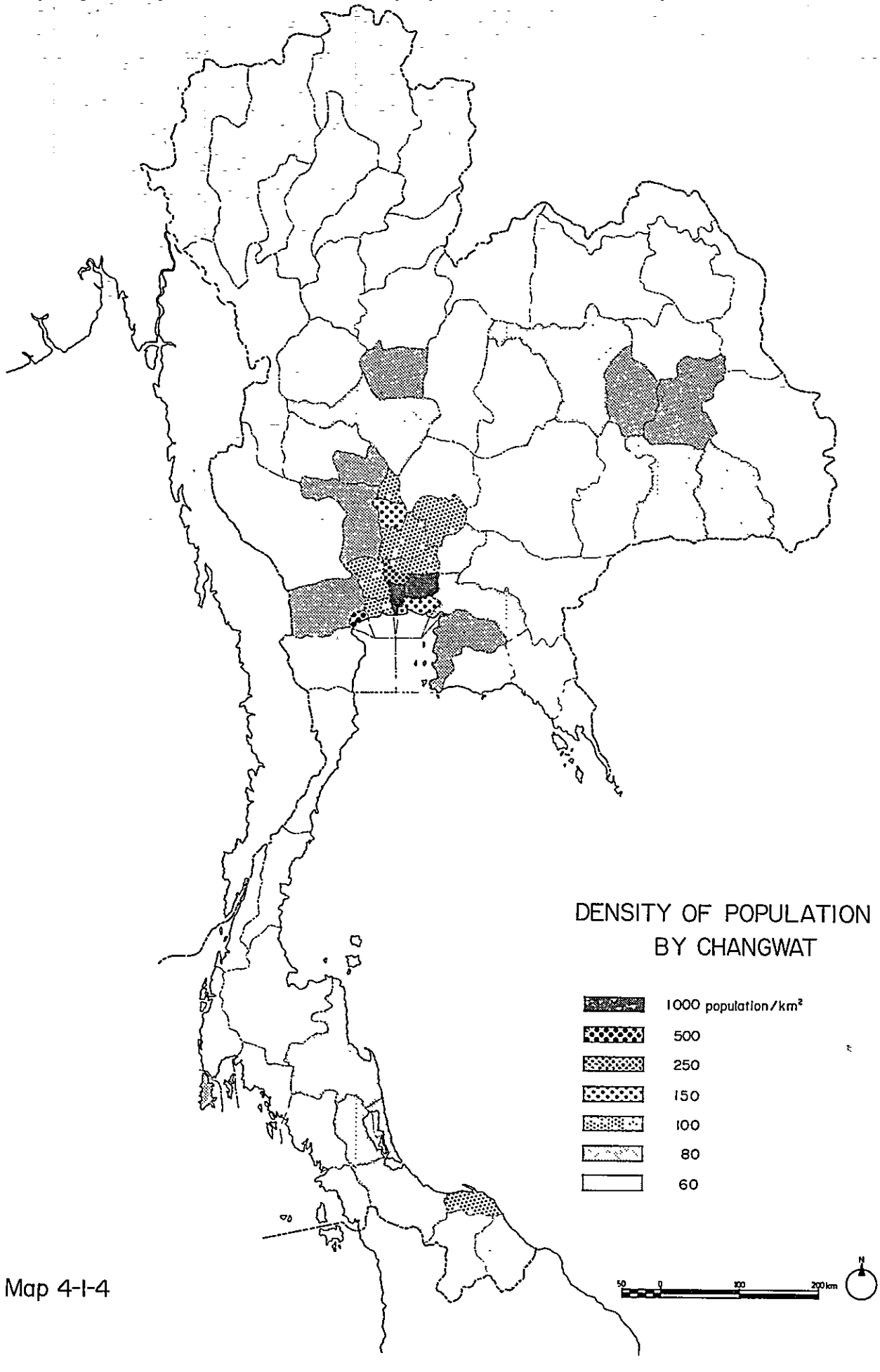
Map 4-1-1


CHIANG MAI 1428
LAMPANG 1509
PHITSANULOK 1432
PHICHIT 1678
SARABURI 4440
AYUTTHAYA 5904
NAKHON PATHOM 4890
PHRA NAKHON 5424
SAMUT SAKHON 4867
SURAT THANI 696
SONGKHLA 1055
1326 UDON THANI
2331 KHON KAEN
1601 UBON RATCHATHANI
1484 NAKHON RATCHASIMA
4183 CHON BURI
735 RAYONG
POPULATION OF EACH 100 Km ZONE
OF MAIN CHANGWAT ADMINISTRATIVE CENTRE
500000 PERSONS
250000
100000
50 0 100 200km
N

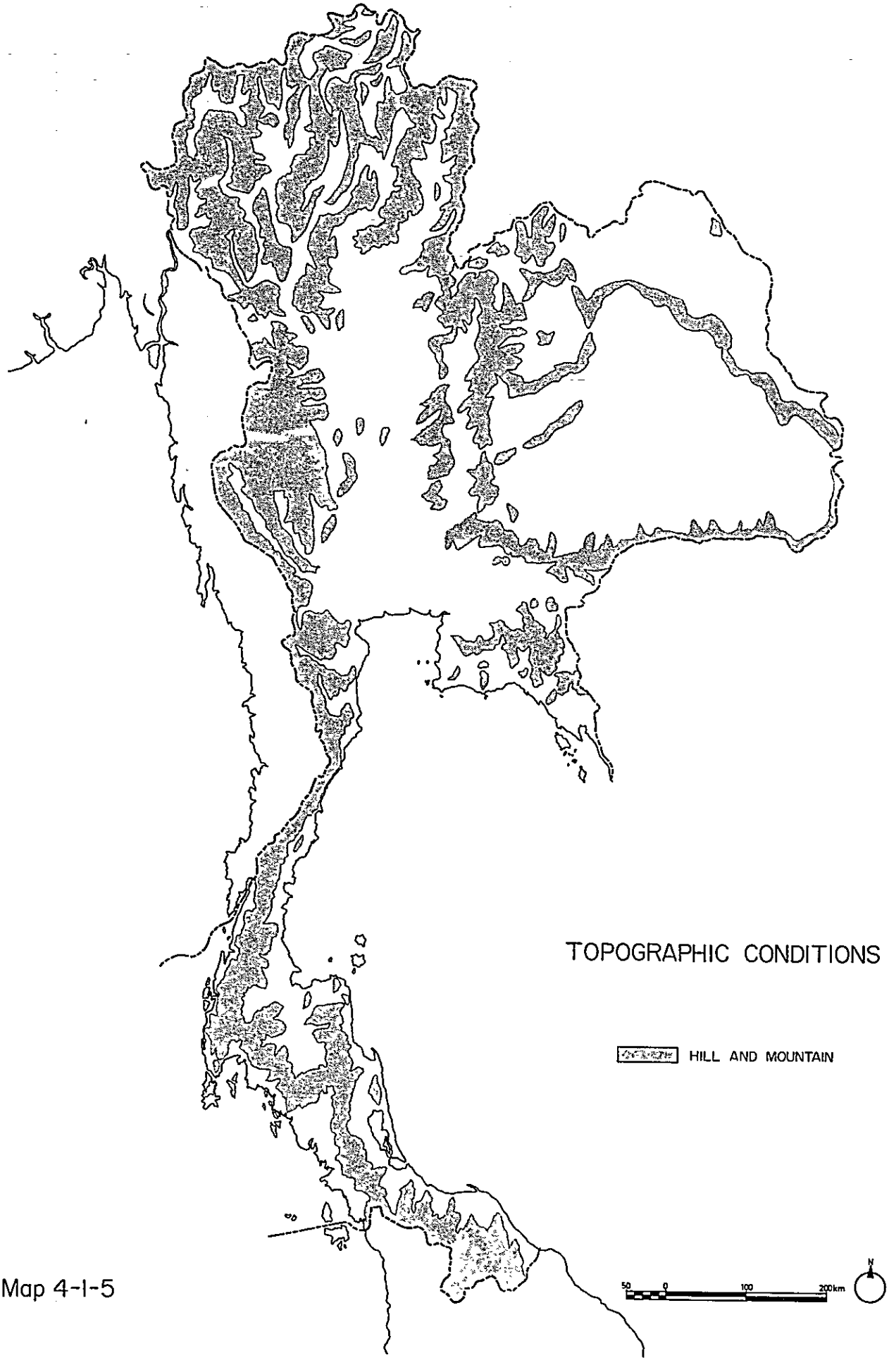
Map 4-1-2


CHIANG MAI 401
LAMPANG 171
PHITSANULOK 209
PHICHIT 276
SARABURI 344
AYUTTHAYA 502
NAKHON PATHOM 517
SAMUT SAKHON 769
PHRA NAKHON 2237
SURAT THANI 119
SONGKHLA 150
162 UDON THANI
278 KHON KAEN
171 UBON RATCHATHANI
309 NAKHON RATCHASIMA
306 CHON BURI
101 RAYONG
DISTRIBUTION OF POPULATION
IN 30km ZONE
OF MAIN CHANGWAT
ADMINISTRATIVE CENTRE
200 000 PERSONS
100.000 "
50 000 "
50 0 100 200km
N

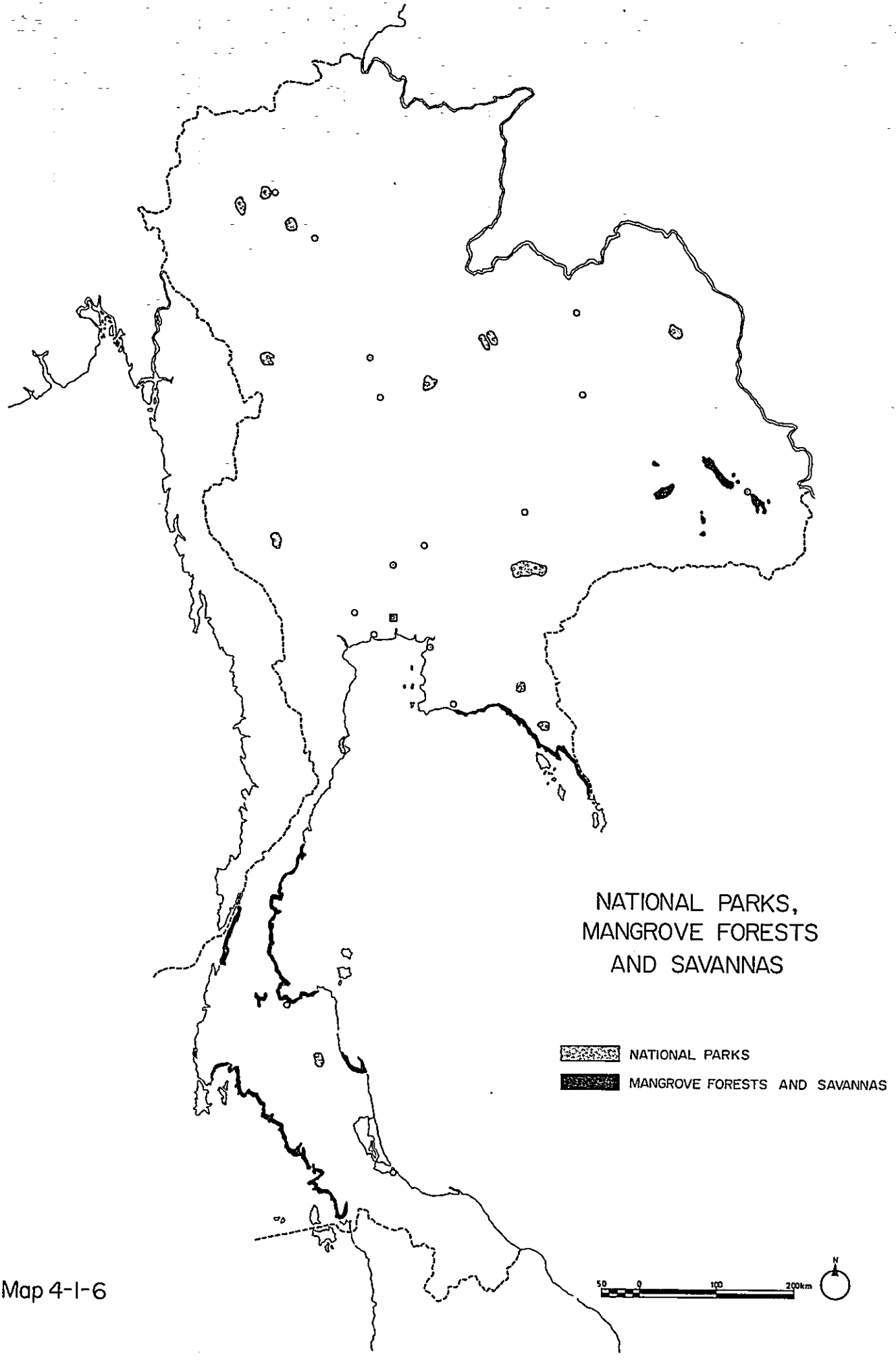
Map 4-1-3


DENSITY OF POPULATION
BY CHANGWAT
1000 population/km²
500
250
150
100
80
60
50
0
100
200km
N

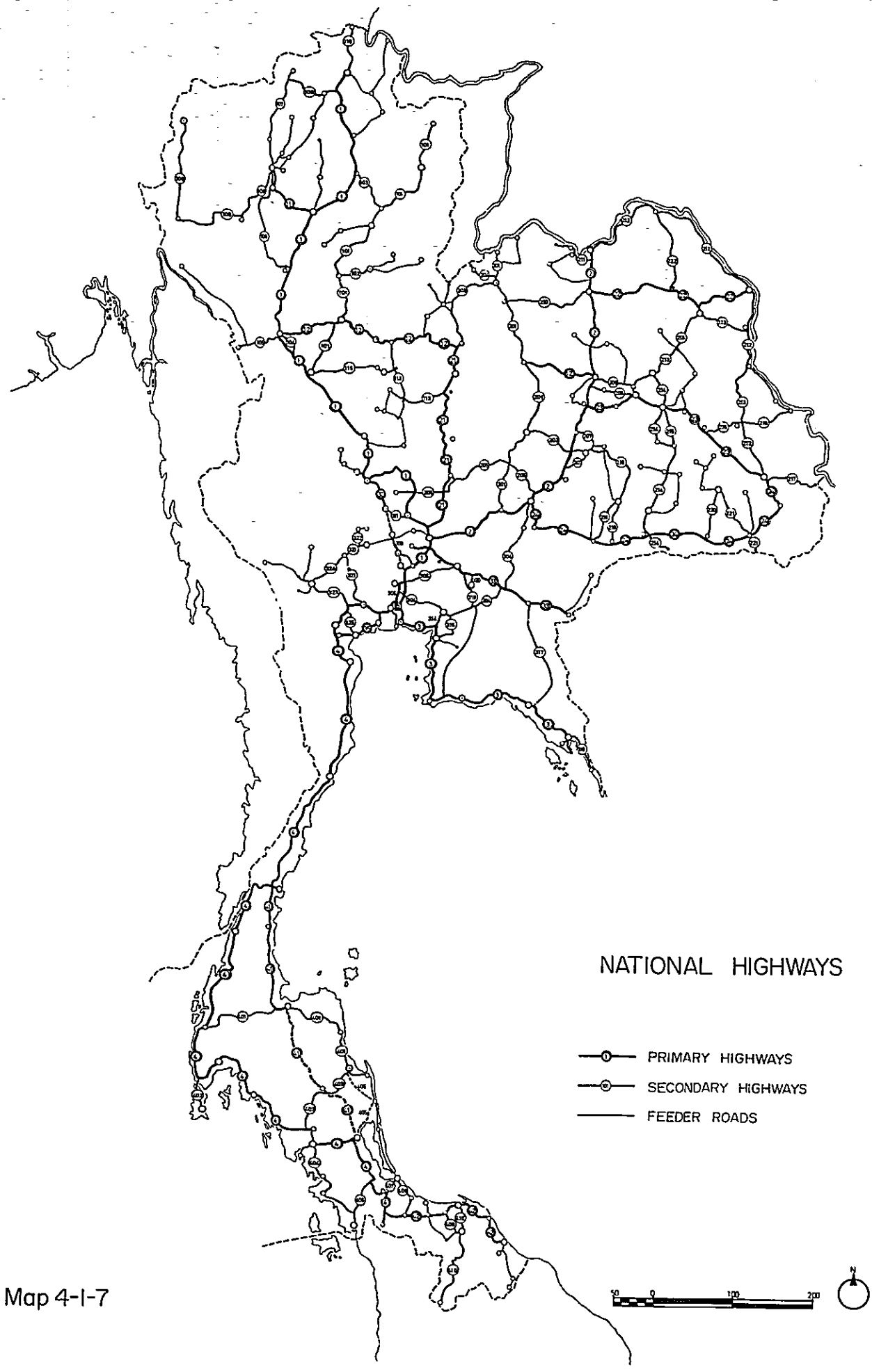
Map 4-I-4



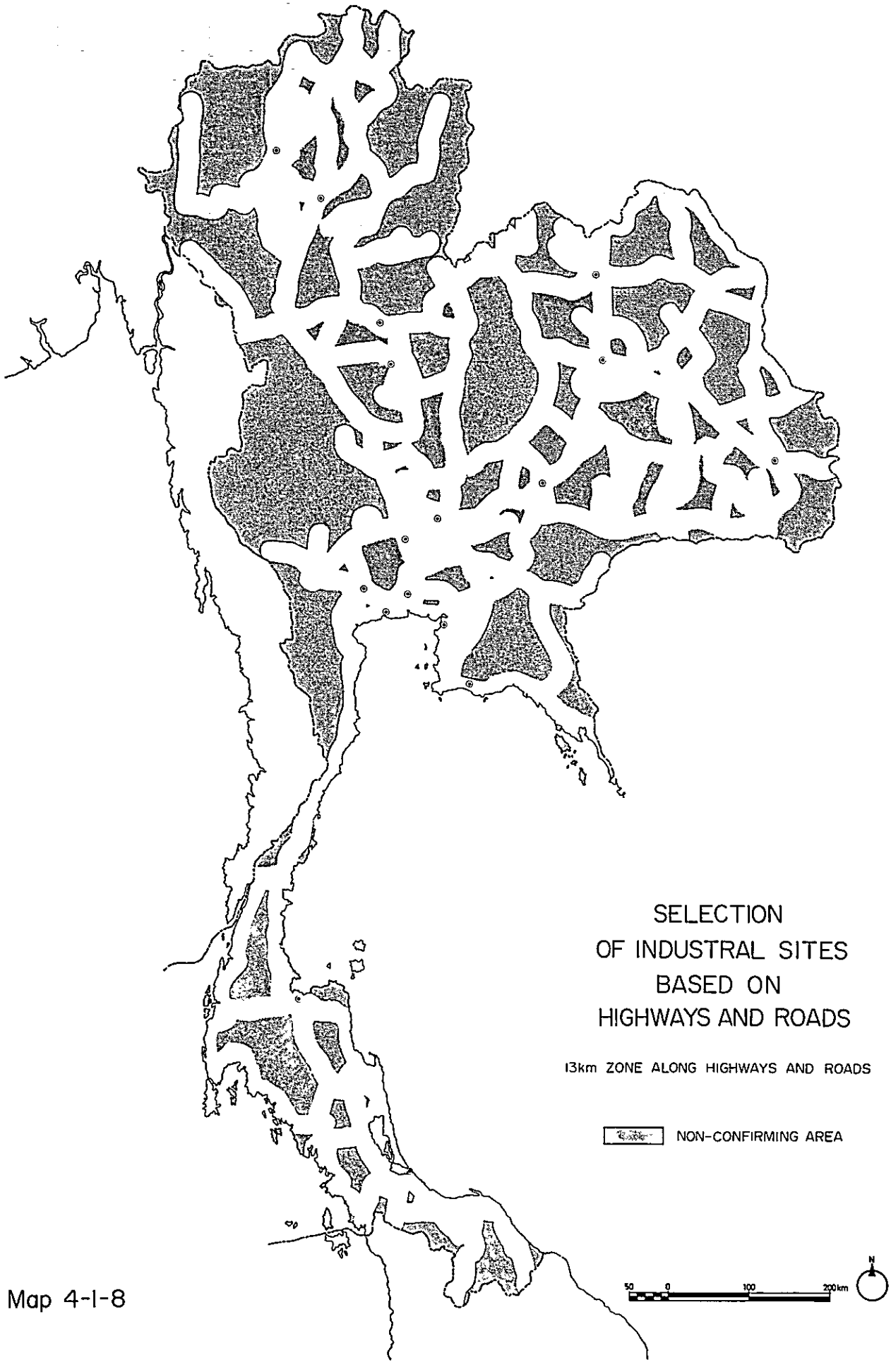
Map 4-1-5


NATIONAL PARKS,
MANGROVE FORESTS
AND SAVANNAS
NATIONAL PARKS
MANGROVE FORESTS AND SAVANNAS
50
0
100
200km
N

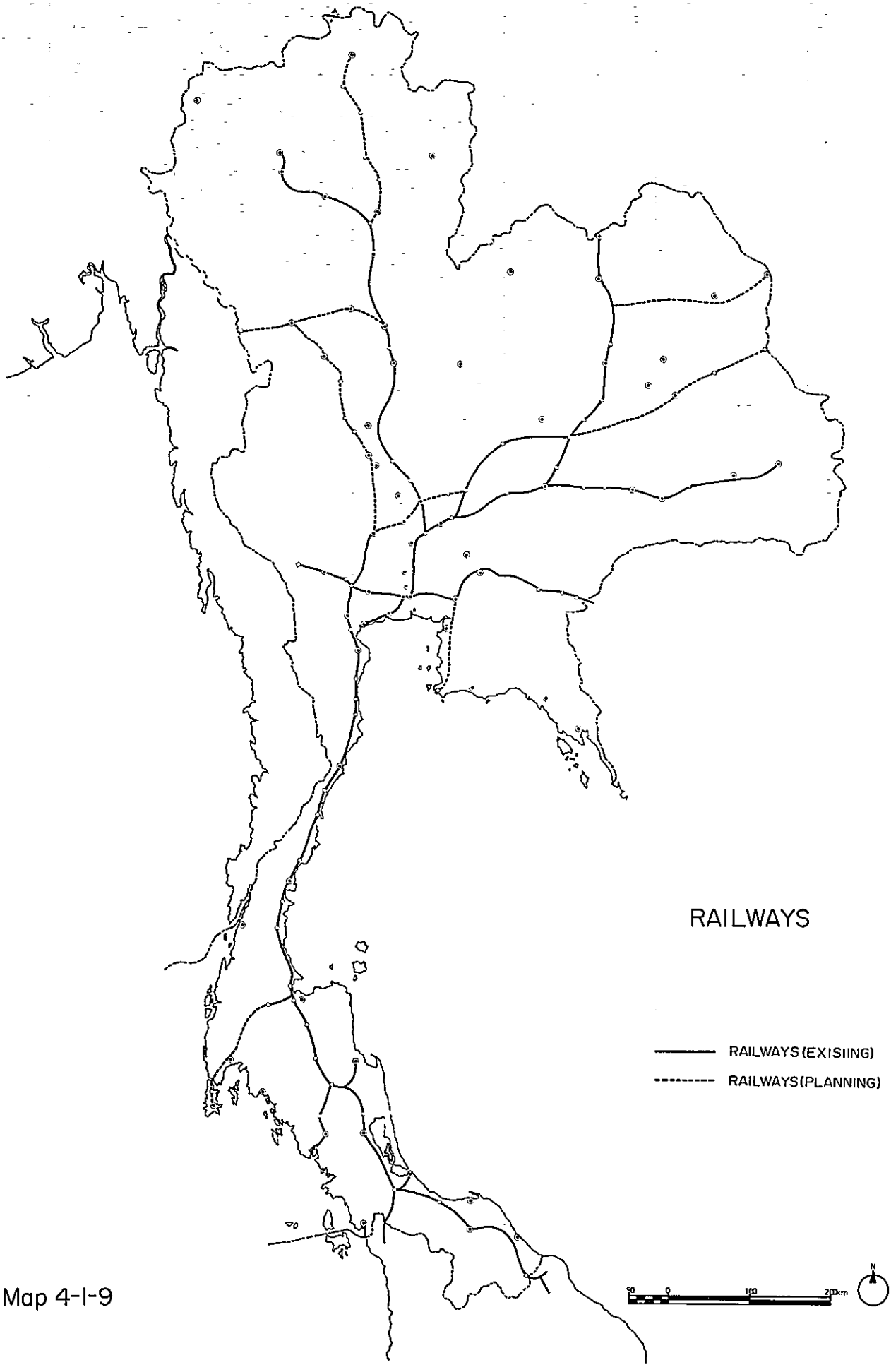
Map 4-1-6


NATIONAL HIGHWAYS
PRIMARY HIGHWAYS
SECONDARY HIGHWAYS
FEEDER ROADS
0
100
200
N

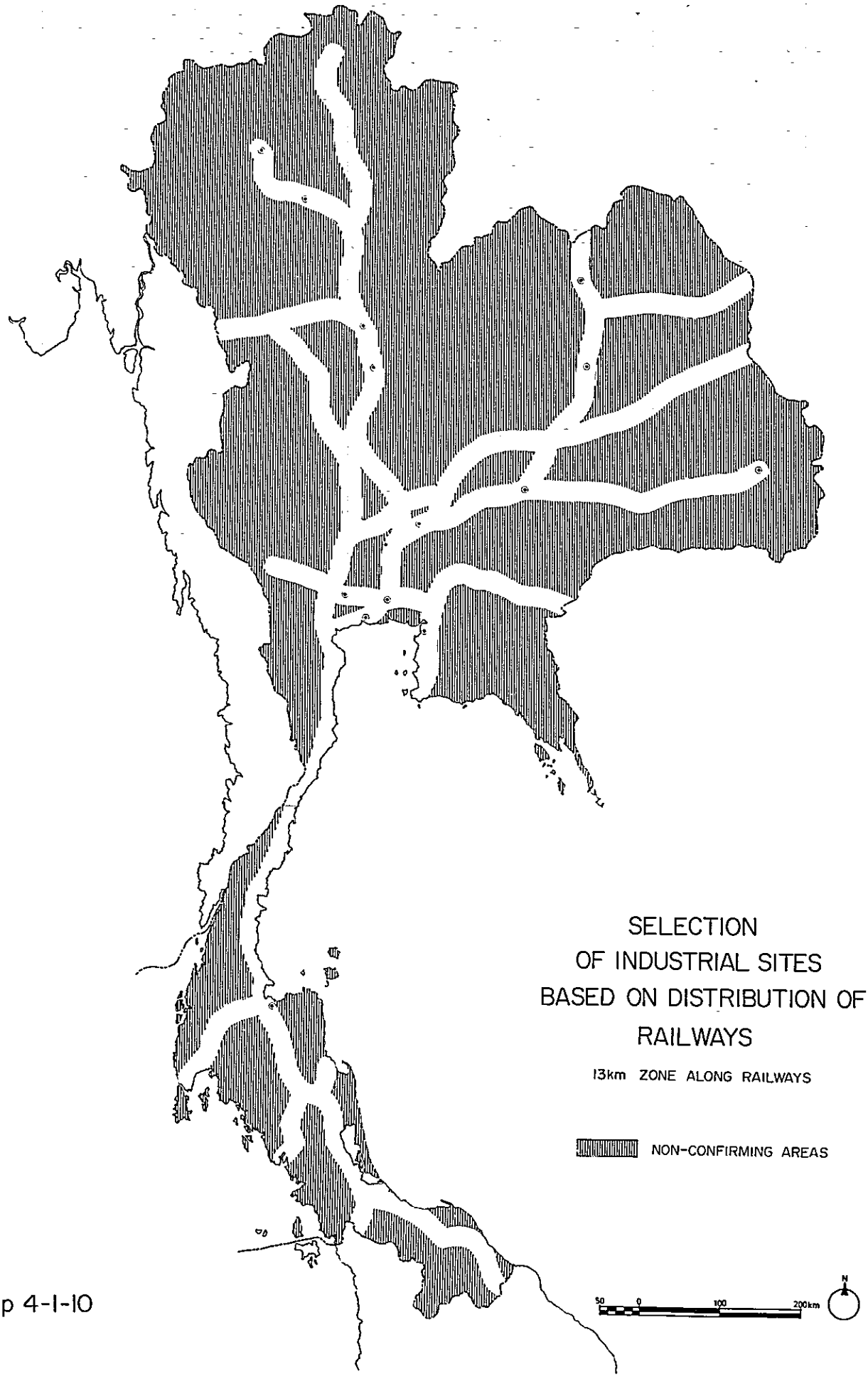
Map 4-1-7


SELECTION
OF INDUSTRAL SITES
BASED ON
HIGHWAYS AND ROADS
13km ZONE ALONG HIGHWAYS AND ROADS
NON-CONFIRMING AREA
50
0
100
200km
N

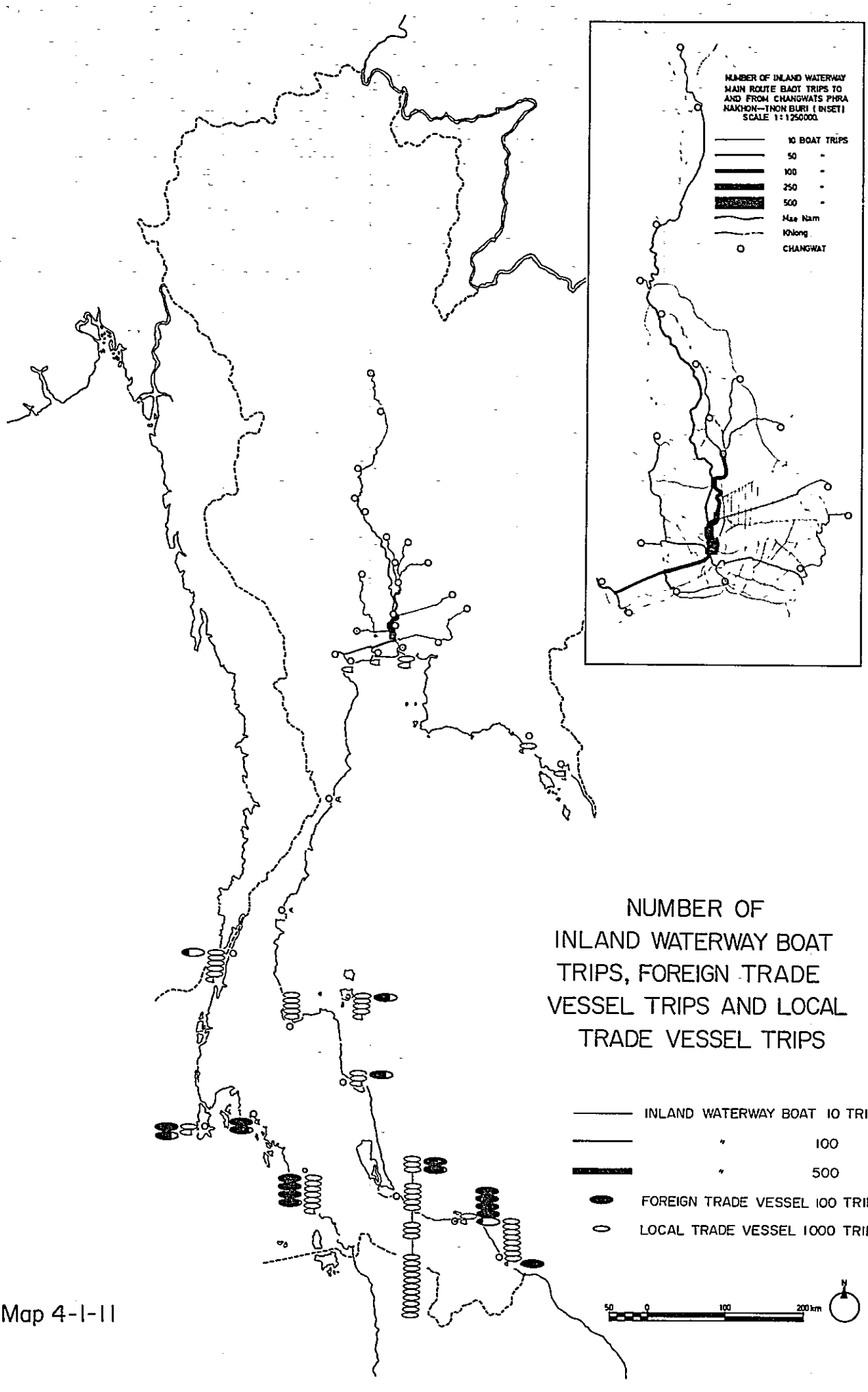
Map 4-1-8


RAILWAYS
RAILWAYS (EXISIING)
RAILWAYS (PLANNING)
50 0 100 200km
N

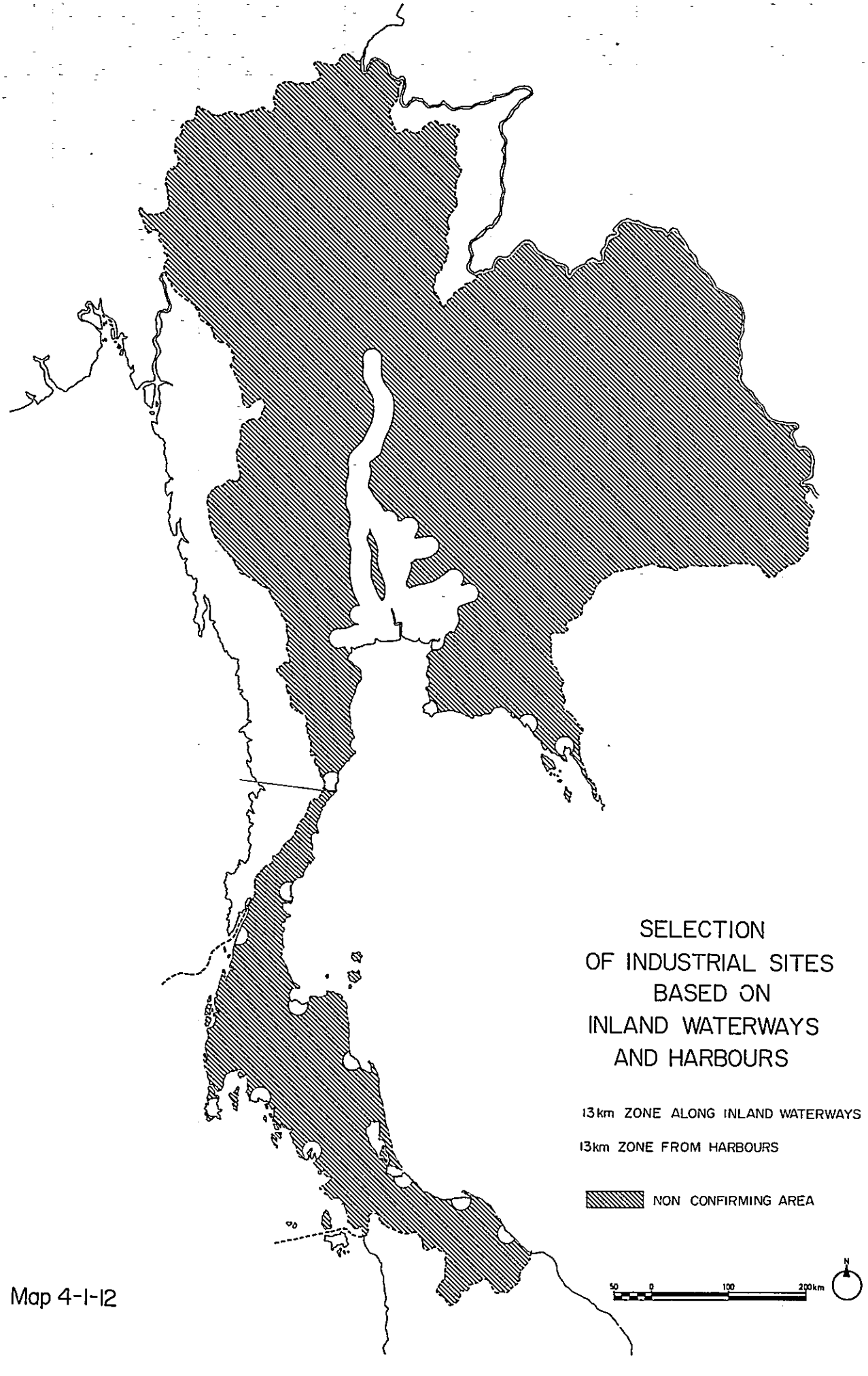
Map 4-1-9


SELECTION
OF INDUSTRIAL SITES
BASED ON DISTRIBUTION OF
RAILWAYS
13km ZONE ALONG RAILWAYS
NON-CONFIRMING AREAS
50 0 100 200km
N

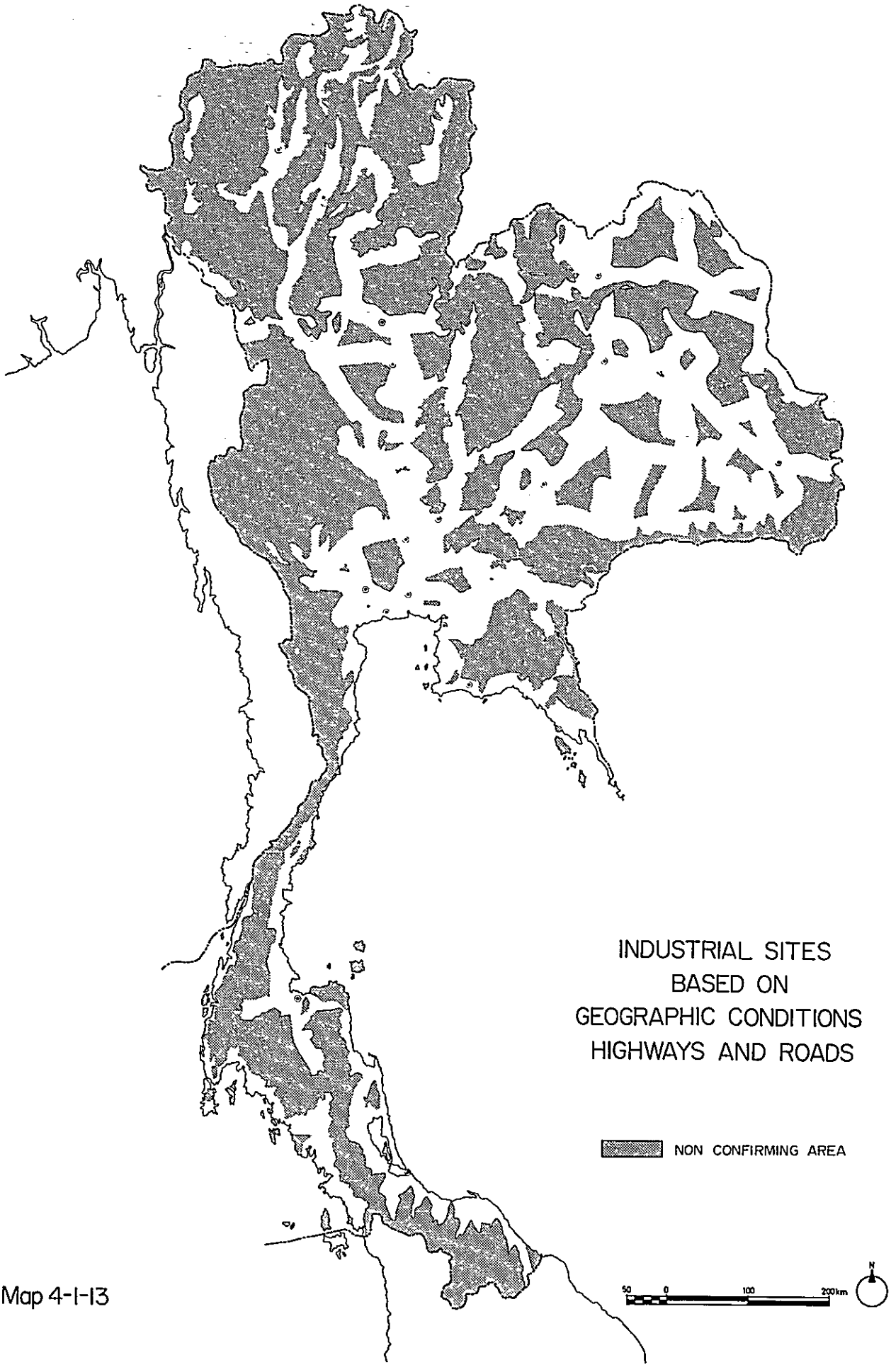
Map 4-1-10


NUMBER OF INLAND WATERWAY MAIN ROUTE BAOT TRIPS TO AND FROM CHANGWATS PHRA NAKHON—THON BURI (INSET)
SCALE 1:1250000
10 BOAT TRIPS
50 "
100 "
250 "
500 "
Mae Nam
Khlong
CHANGWAT
NUMBER OF INLAND WATERWAY BOAT TRIPS, FOREIGN TRADE VESSEL TRIPS AND LOCAL TRADE VESSEL TRIPS
INLAND WATERWAY BOAT 10 TRIPS
" 100
" 500
FOREIGN TRADE VESSEL 100 TRIPS
LOCAL TRADE VESSEL 1000 TRIPS
50 0 100 200 km
N

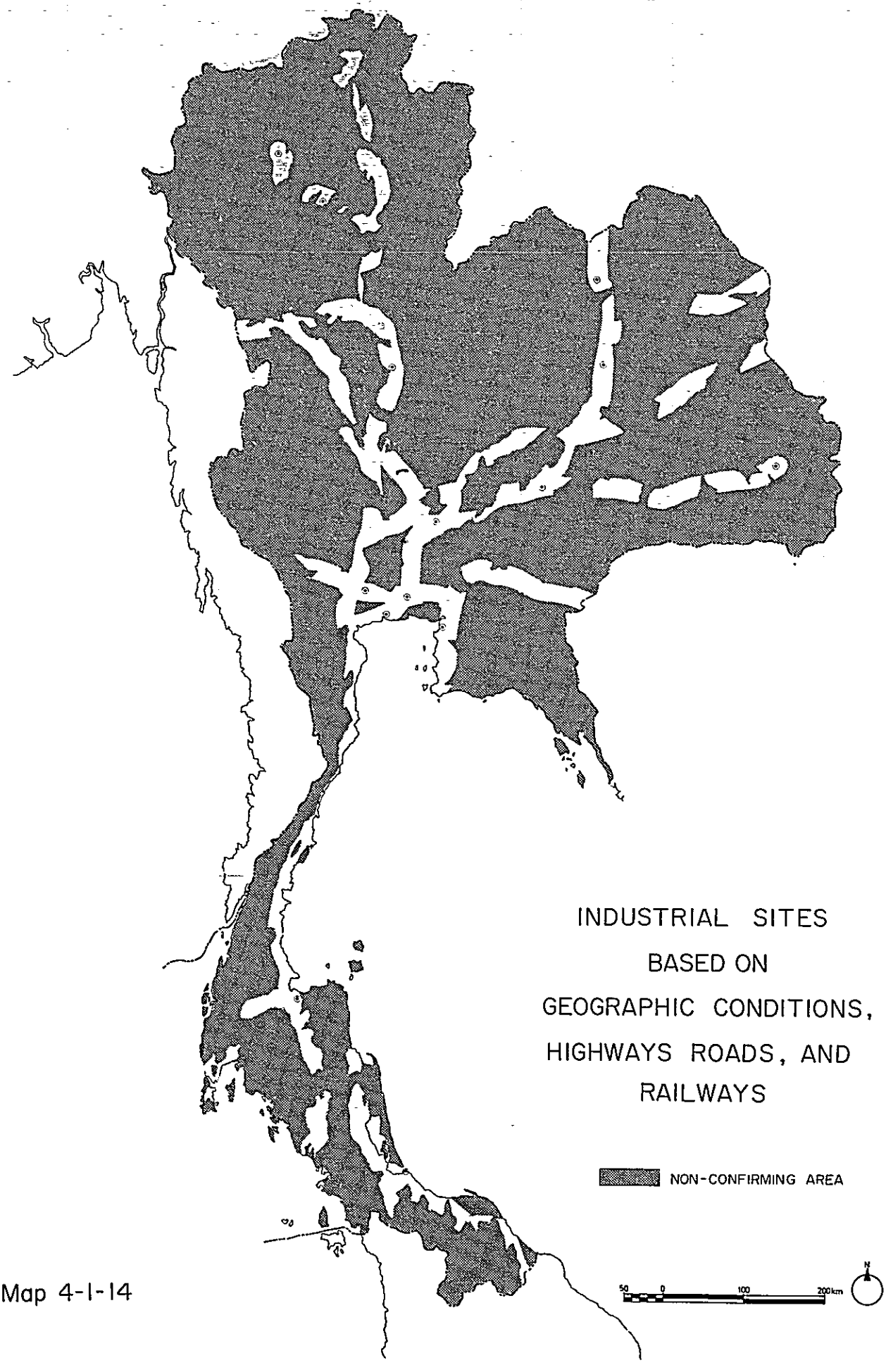
Map 4-1-11


SELECTION
OF INDUSTRIAL SITES
BASED ON
INLAND WATERWAYS
AND HARBOURS
13km ZONE ALONG INLAND WATERWAYS
13km ZONE FROM HARBOURS
NON CONFIRMING AREA
50
0
100
200km
N

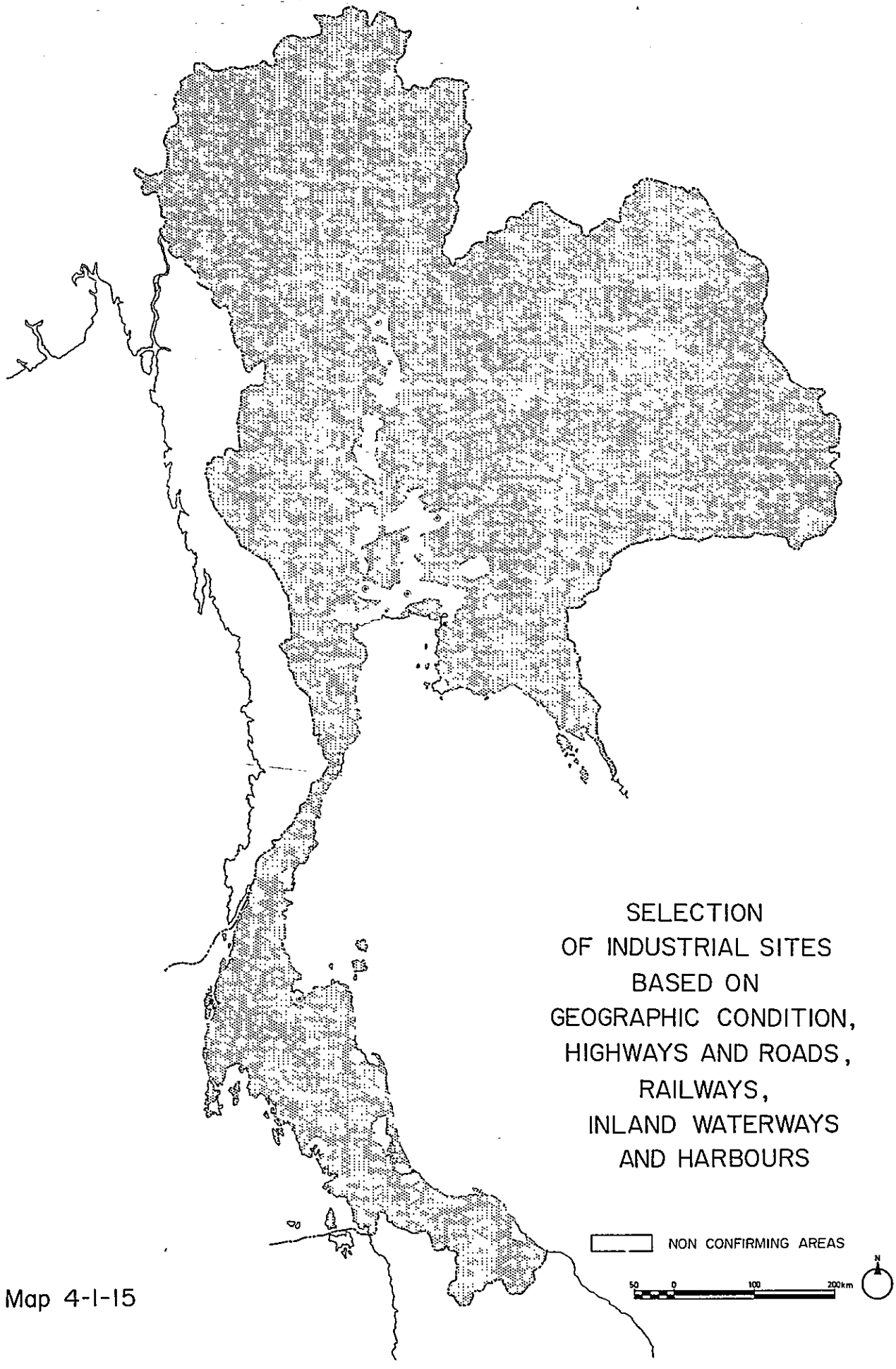
Map 4-1-12


INDUSTRIAL SITES
BASED ON
GEOGRAPHIC CONDITIONS
HIGHWAYS AND ROADS
NON CONFIRMING AREA
50
0
100
200km
N

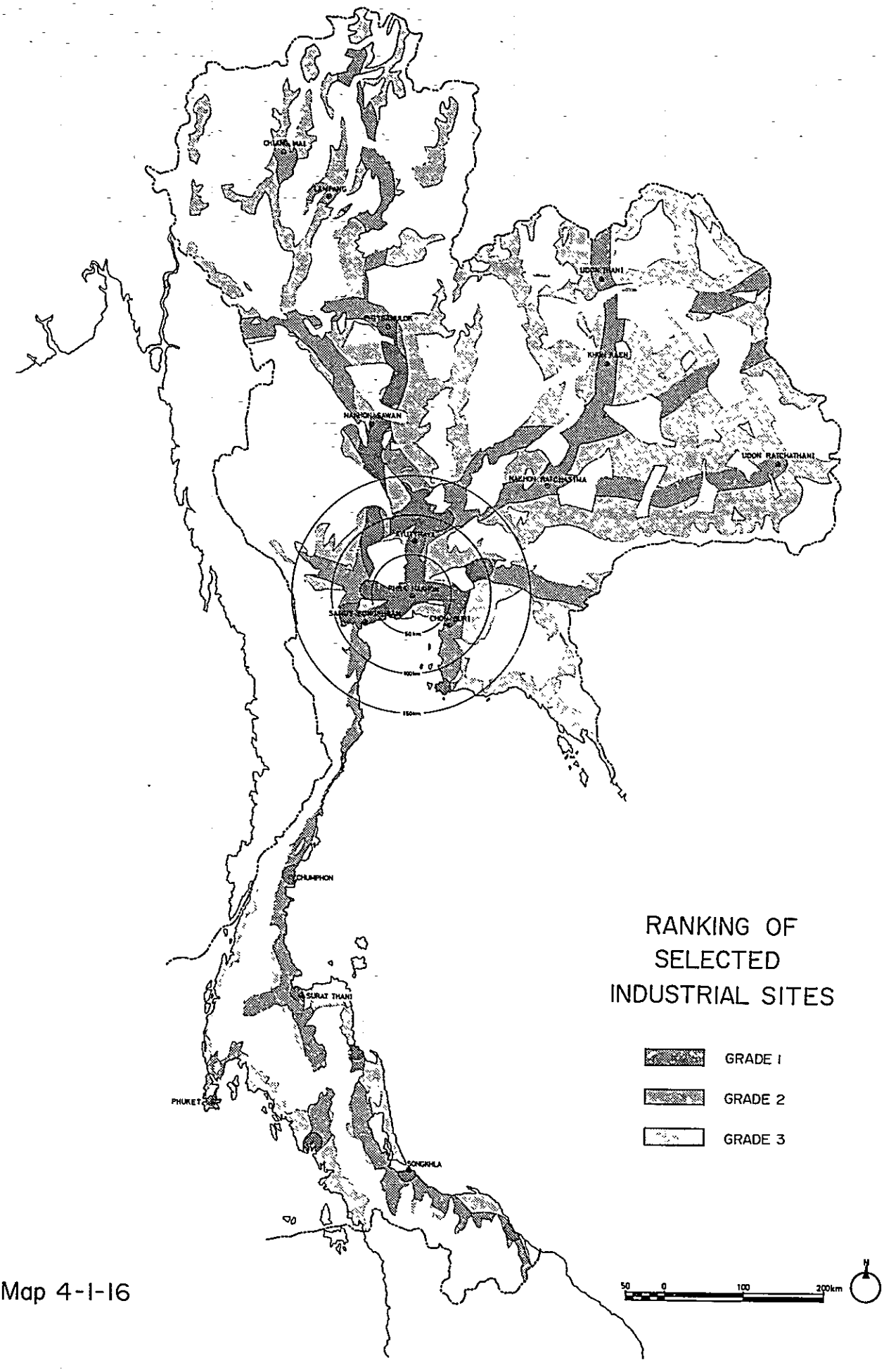
Map 4-1-13


INDUSTRIAL SITES
BASED ON
GEOGRAPHIC CONDITIONS,
HIGHWAYS ROADS, AND
RAILWAYS
NON-CONFIRMING AREA
50
0
100
200km
N

Map 4-1-14


SELECTION
OF INDUSTRIAL SITES
BASED ON
GEOGRAPHIC CONDITION,
HIGHWAYS AND ROADS,
RAILWAYS,
INLAND WATERWAYS
AND HARBOURS
NON CONFIRMING AREAS
50 0 100 200km
N

Map 4-1-15


CHIANG MAI
LAMPANG
UDON THANI
PHITSANULOK
KHON KAEN
NAKHON SAWAN
UDON RATCHATHANI
NAKHON RATCHASIMA
AYUTTHAYA
SARABURI
CHOLBURI
50km
100km
150km
CHUMPHON
SURAT THANI
PHUKET
SONGKHLA
RANKING OF
SELECTED
INDUSTRIAL SITES
GRADE I
GRADE 2
GRADE 3
50
0
100
200km
N

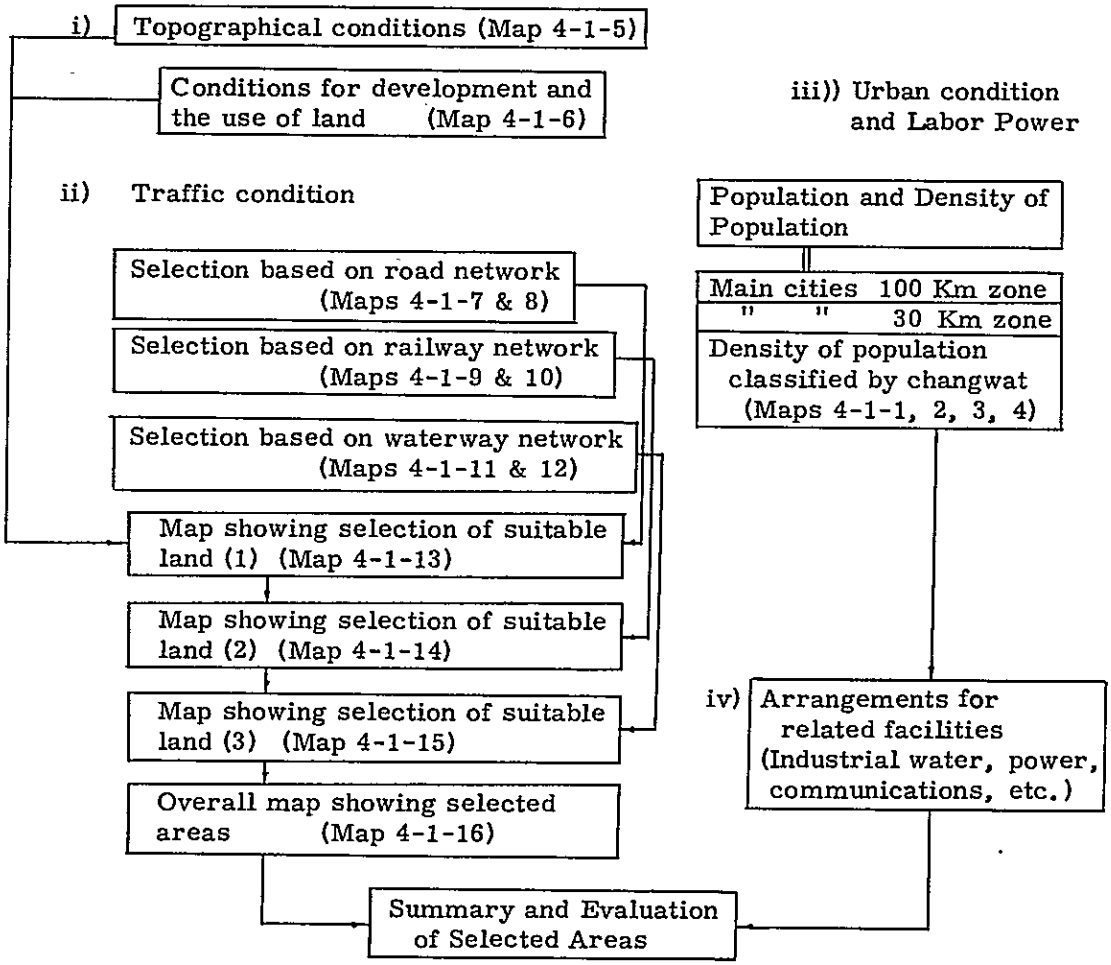
Map 4-1-16

3) Site selection for development

The first step of the site selection for industrial development is to look for an area which has certain conditions suitable for development rather than its location. This implies preliminary selection for establishing the position for concrete estate development, and at the same time, will provide a foundation when studying the national plan of distribution of the positions of industrial development and the priority of development of each area.

Steps to be taken when selecting a suitable area as shown on the diagram given below.

Diagram for Selection of Suitable Land



i) Topographical Conditions ..... Pick up the plains suitable for large-scaled development by checking the topographical conditions such as mountainous areas, highlands, rivers and lakes and ponds, and demarcate such areas. Exclude such areas which are not suitable from the viewpoint of restrictive conditions such as the protection of natural scenery (such as national parks) and such unsuitable areas (forests and wet land) due to unfavorable natural conditions.

ii) Traffic Condition..... Pick up the areas which may be benefited by by roads, railways and waterways in the order as mentioned on the phases of commuting and freight transportation. Areas possible of development along the main highways by constructing branch roads of about 10 Km have been assumed.

iii) Urban Condition and Labor Power..... Population and the population density in 100 Km zone and 30 Km zone of main cities have been used as guide to evaluate the scale of the existing cities and the distribution of labor power from the population and the population density.

iv) Arrangements for Related Facilities ..... Evaluate the areas selected according to the abovementioned condition and find out if the geographical conditions of the areas are suitable on the phase of industrial water, power and communications, etc.

The areas for development have been selected according to the above-mentioned four visual points. The selected areas are 17 areas centering around the main cities, and the following table 4-1-1 gives the results of the comparative study of these areas.

Conditions for selection mentioned in the diagram have been simplified because only those conditions which can be grasped with the same accuracy have been taken up in order to make possible the comparison of the areas all over the country.

As regards i), it could be considered that there are quite a number of areas which should be excluded which may be affected by farmland reform and the strategic use of the land.

Concerning ii), iii), and iv), the superiority of the nature and geographical conditions of each area should be studied in more details from the viewpoints of the possibility of the use of various facilities, future equipment plan, population increase and employment structure, the movement of population, and commuting distance, etc.

4) Selected Areas and their evaluation

The results of the evaluation of each of the selected areas based on the available data are as shown on the following table 4-1-1. This table was made for the purpose of comparing the prefectures (changwats) centering around the major 17 cities, and the order of superiority was decided on the basis of the population in the zone, traffic condition and nautral conditions and conditions relative to facilities.

Phrana Korn which includes Bangkok ranks top, and those urban areas centering around the capital city within the 100 km zone rank second to fifth. They are Ayutthaya and Saraburi on the northern part and Nakhon Pathom and Samut Sakorn on the western part.

Those areas which rank sixth to tenth are the urban areas within the 300 km zone. They are Khonken and Khorat on the northeastern part, Chonburi to the west of the capital city, and Phichit and Phitsanuloke on the northern part.

In view of the structure of the selected areas, the industrial development can be classified into the following three types.

(1) Development of the 100 km zone which includes those urban areas centering around the capital city.

(2) Concentrated development with Khonken on the northeastern part as the center of the areas.

(3) Diversified development by developing each area around the cities on the northern part such as Lampang, Cheing Mai andCheingRai and connect each other with the main traffic lines.

Selection of suitable land for concrete industrial estate development of the areas around Bangkok and its neighboring cities will be taken up in the next paragraph.

Map 4 - 1 - 17

The Selected Urban Areas Ranking First to Tenth for Industrial Estate Development

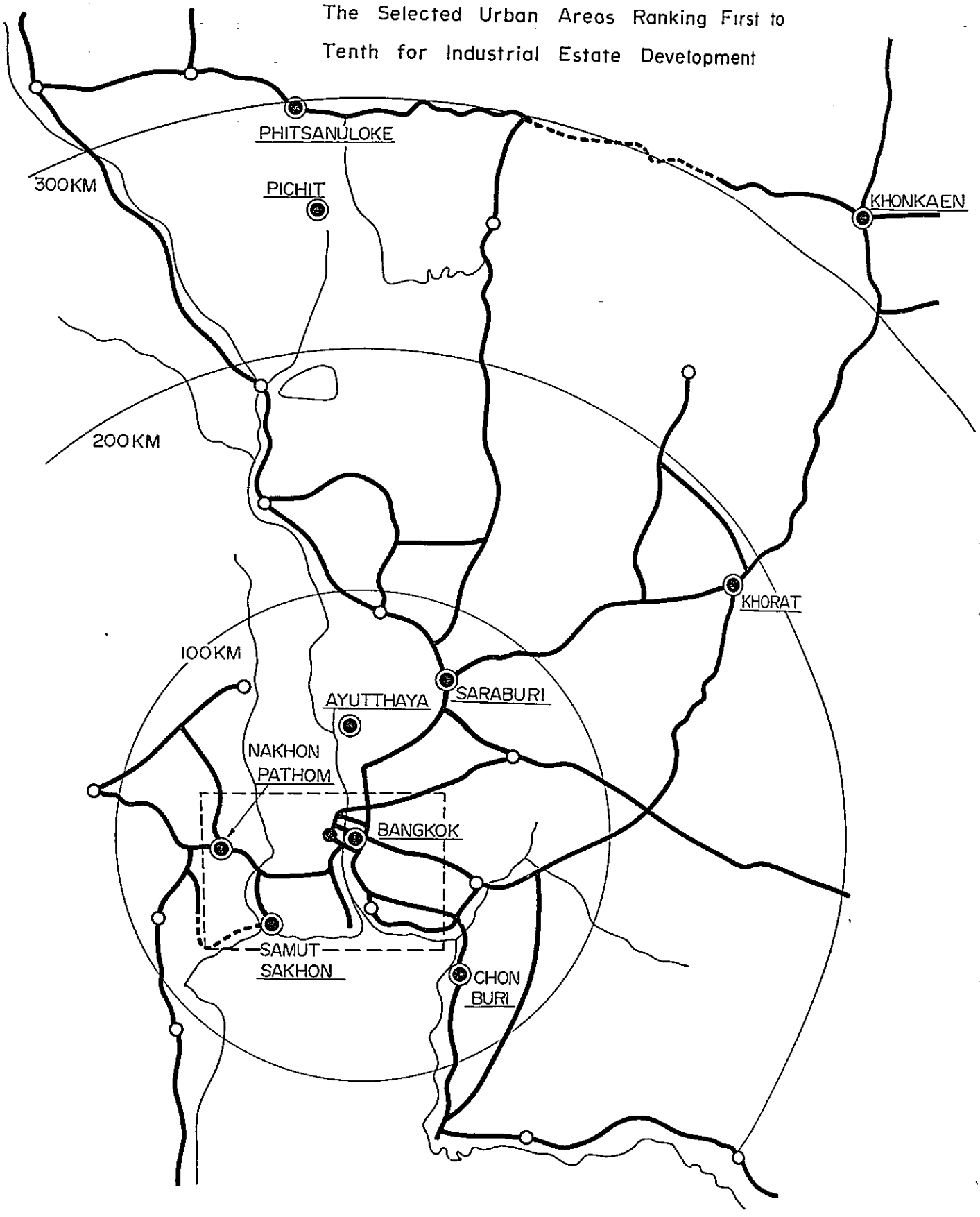


Table 4-1-1 Selection of Sites Suitable for Industrial Development

Factor	Population			Traffic Condition			Natural Features			Facilities			
Item	1) Population 100 km zone (1000 persons)	2) Population 30 km zone (1000 persons)	3) Population density (person/km^2)	4) Possibility of using roads	5) Possibility of using railways	6) Possibility of using water ways	7) Geographic conditions in 30 km zone	8) Closeness to National Park & Forest	9) Industrial water (mill m^3)	10) Available electric power (K.V.)	11) Number of telephone service	12) Airport	13) Order
Chieng Mai	143	40	35	yes	yes	no	L.T. 3/10 A.P. 1/10	National Park	Ton-Nam Mae kuan	69	2,000	Existing	(12)
Lampang	151	17	37	yes	yes	no	L.T. 3/10	-	Kiv Lom (100)	69	1,000	Existing	(11)
Phitsanuloke	143	21	36	yes	yes	yes	L.T. 4/10 A.P. 5/10	-	-	115	200	Existing	(8)
Phichit	168	28	86	yes	yes	yes	L.T. 5/10 A.P. 3/10	-	-	115	400	-	(10)
Saraburi	444	34	102	yes	yes	yes	L.T. 5/10 A.P. 1/10	-	Pa Sak	69	1,000	-	(3)
Ayutthaya	590	50	193	yes	yes	yes	L.T. 1/10 A.P. 9/10	-	-	230	600	-	(2)
Phra Nakhon	542	223	1434	yes	yes	yes	A.P. 10/10	-	-	230	5,000	Existing	(1)
Samut Sakhon	487	77	197	yes	yes	yes	A.P. 5/10	-	-	69	200	-	(5)
Nakhon Pathom	489	52	170	yes	yes	yes	L.T. 2/10 A.P. 8/10	-	-	115	1,000	-	(4)
Chon Buri	418	31	87	yes	yes	no	L.T. 2/10 A.P. 3/10	-	Bang Phra (22)	115	2,000	-	(7)
Nakhon Ratchasima (Khorat)	148	31	56	yes	yes	no	L.T. 4/10 A.P. 3/10	-	Lam chamwak(23) Lam Sam Lai(26) Lam Phra Plong(152) Lam Takhong(220) Ubonrat	115	2,000	-	(9)
Khon Kaen	233	28	63	yes	yes	no	L.T. 6/10 A.P. 3/10	-	-	115	1,600	Existing	(6)
Udon Thani	133	16	45	yes	yes	no	L.T. 5/10	-	-	115	1,600	Existing	(16)
Ubon Ratchathani	160	17	50	yes	yes	no	L.T. 7/10 A.P. 2/10	Savanna	Huaipladaek (15)	none	1,000	Existing	(12)
Rayong	74	10	45	yes	no	yes	A.P. 1/10	Mangrove Forest	-	115	600	-	(17)
Surat Thani	70	12	25	yes	yes	yes	L.T. 2/10 A.P. 4/10	Mangrove Forest	-	115	800	-	(14)
Sohgkhla	106	15	75	yes	yes	yes	L.T. 1/10 A.P. 1/10	-	-	none	600	Existing	(15)

L.T = Lower Terrace A.P. = Alluvial Plain

5) Scale of Development

In order to select the sites for industrial development, it is necessary, simultaneously with the establishment of a specified industrial estate, to take into consideration that new urban area will be formed, and to establish the acreage of the area for the entire development project including such new urban area. As a basic condition for the selection of development sites, the acreage of development project has been calculated roughly for each local city zone. The assumptions of the development scale shown in Table 4-1-2 has been calculated on the basis of the current population of each province and the following mechanism.

i) 30 km zones around the main cities have been considered the commuting zone, and the population in the community zone of each city has been estimated. Where more than two commuting zones overlap each other, adjustment has been made accordingly.

ii) 50% of the population of each commuting zone has been assumed to form the labor population, and it has been assumed that the labor power of other industries in the same zone would not be affected even if 10% of the abovementioned labor power should be absorbed by the future industrial development. In short, the number of employees in the industrial estate has been estimated to be 5% of the population of the commuting zones mentioned under i) above.

iii) Density of employment in the industrial estate has been estimated at gross 20 persons/ha, and the acreage of the industrial area has been calculated on this basis. In connection with this, land for residences, commercial area and urban facilities would become necessary, and so 50% of the entire project area has been appropriated for such city area and the industrial area.

Table 4-1-2 Estimation of Development Scale Classified by Changwat

Item Main Changwat	Population in 30 km zone (1000 persons) ( ); adjusted for overlapped areas		Estimated Labor power (1000 persons)	Estimated number of Employees in Industrial Estates (person)	Estimated Scale of Industrial Estates (ha)	Estimated Acreage of Development areas (ha)
Chieng Mai	40	(40)	20	10,000	500	1,000
Lampang	17	(17)	8	4,000	200	400
Phitsanuloke	21	(18)	9	4,500	225	450
Phichit	28	(26)	13	6,500	325	650
Saraburi	34	(30)	15	7,500	375	750
Ayutthaya	50	(46)	23	11,500	575	1,150
Phra Nakhon	223	(180)	90	45,000	2,250	4,500
Samut Sakhon	77	(46)	23	11,500	575	1,150
Nokhon Pathon	52	(46)	23	11,500	575	1,150
Chon Buri	31	(31)	15	7,500	375	750
Nakhon Ratchasima (Khorat)	31	(31)	15	7,500	375	750
Khon Kaen	28	(28)	14	7,000	350	700
Udon Thani	16	(16)	8	4,000	200	400
Uban Ratchathani	17	(17)	8	4,000	200	400
Rayong	10	(10)	5	2,500	125	250
Surat Thani	12	(12)	6	3,000	150	300
Songkhla	15	(15)	7	3,500	175	350
		(a)	b:a x $\frac{50}{100}$	c:b x $\frac{50}{100}$	d:20 person/ha	e:d x $\frac{200}{100}$

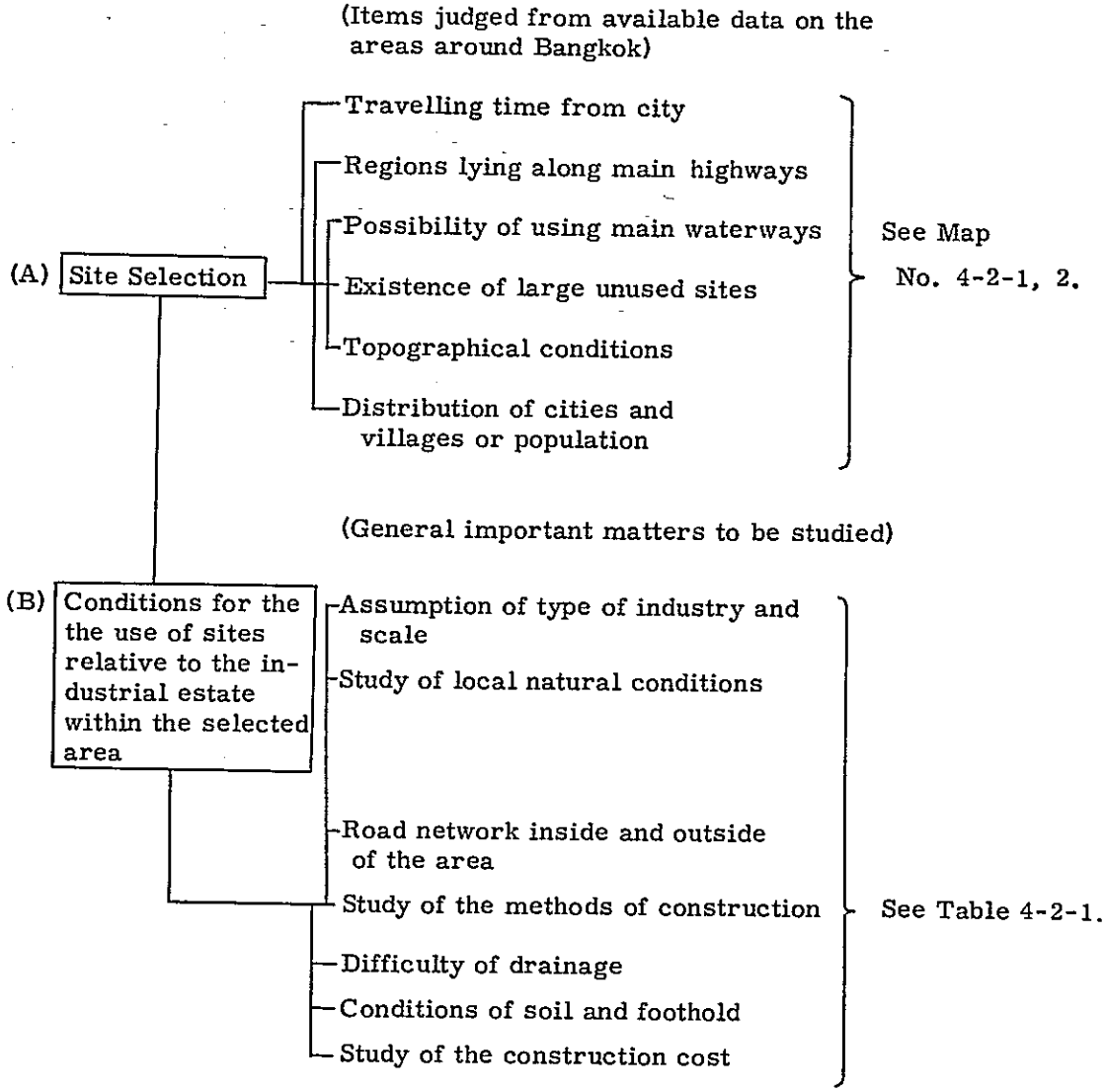
4.2 Site selection for Industrial Estates in Greater Bangkok Region and its fringe areas

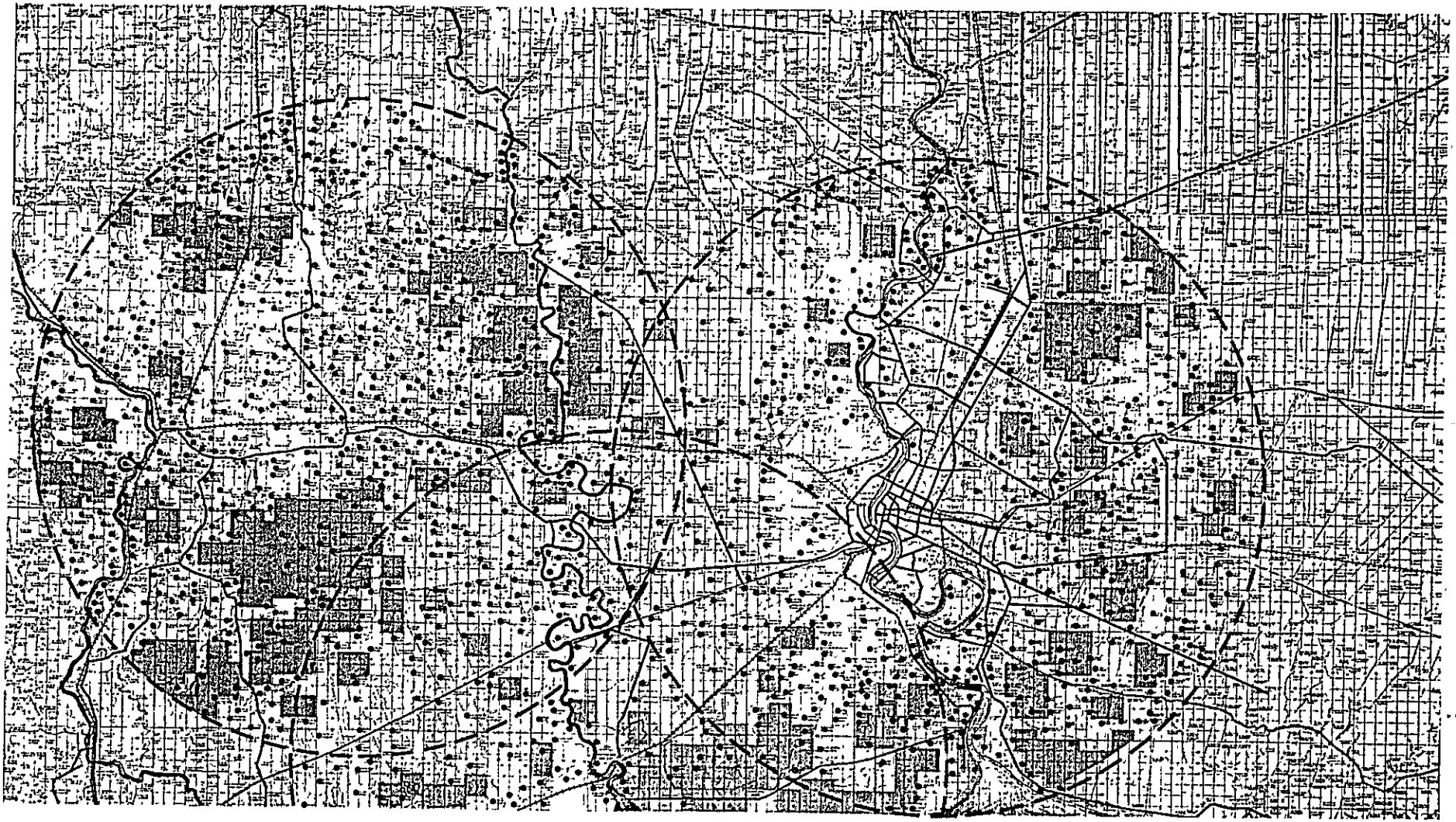
When conducting site selection in Greater Bangkok Region, it would be most appropriate to consider the area which is within 15--30 km zone from the center of the capital city and its outer regions. The "Greater Bangkok Plan" which is a comprehensive plan of developing the capital zone with the aim of completing the project in 1990 has taken up the 15 km zone. The finger type urbanization indicated in this plan tends to become more popular, and the finger which extends from Changwat Nonthaburi to Pathumthani on the north and to Samut Prakarn on the south seems to pass the 15 km zone. The distribution of the manufacturing industry in the area with Bangkok as its center will invite concentration of population in the capital city due to shorter travelling time as the result of improved means of road transportation, and the prices of land will rise as the result of urbanization of the areas lying between the fingers. It would become necessary to make a study of the 30 km zone and also to establish the long-term development positions in connection with those suburban cities located outside of the 30 km zone.

The steps to be taken for the site selection can be roughly classified into the following two, (A) selection of suitable area, and (B) evaluation of conditions for the use of the site and geographical conditions. In practice, the study of (A) and (B) are fed back, and the sites are selected on the map which shows the nature and the characteristics of the areas.

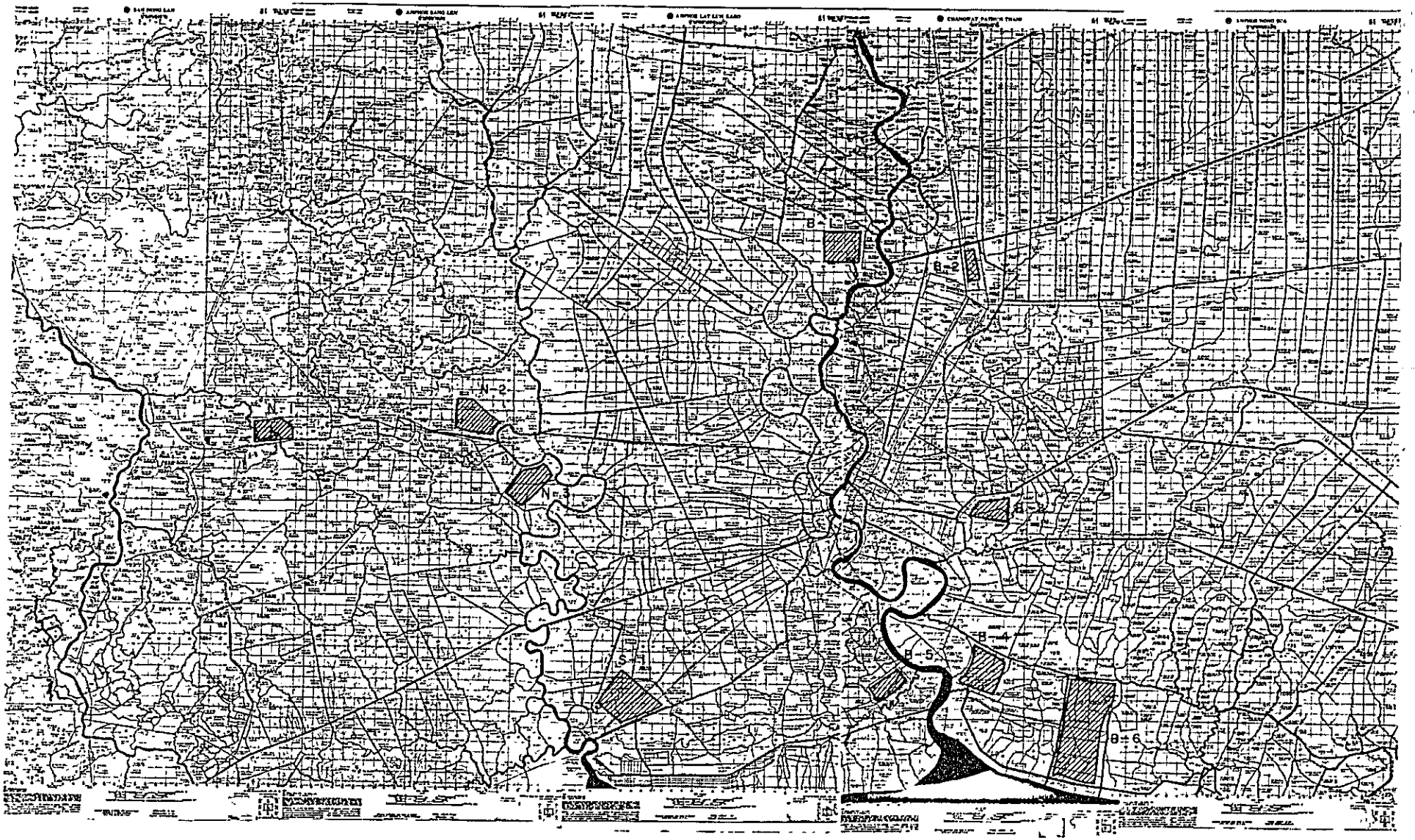
This, together with the important points for study, is as shown on the following diagram. Site selection (A) is to find out the limit of the area suitable as industrial area from industrial geographical conditions such as land, infrastructure, urban facilities, population and conditions for transportation. This applies not only to the development of the sites for factories but also to the development of an area possible for a large-scaled housing project. The latter which is (B) is to concretely grasp various conditions in as much detail as possible and evaluate the geographical conditions.

Several points to be studied concerning (A) are as shown on Map No. 4-2-1, 2. Concerning (B), conditions for the construction of an industrial estate judged from the available data are as shown on Table 4-2-1.


(Items judged from available data on the areas around Bangkok)
Travelling time from city
Regions lying along main highways
Possibility of using main waterways
Existence of large unused sites
Topographical conditions
Distribution of cities and villages or population
See Map No. 4-2-1, 2.
(A) Site Selection
(General important matters to be studied)
(B) Conditions for the the use of sites relative to the industrial estate within the selected area
Assumption of type of industry and scale
Study of local natural conditions
Road network inside and outside of the area
Study of the methods of construction
Difficulty of drainage
Conditions of soil and foothold
Study of the construction cost
See Table 4-2-1.



Map 4-2-1 Distribution of Villages
and un-used Land(Not built-up area)
in 30Km Zone of Main Cities



Existing waterways

Sites for development

Map 4-2-2 Distribution of Water ways

A Sites; areas indicated at the beginning

B Sites; areas proposed by the survey team

Map 4-2-3 Suitable Sites for Development

Again, the selection of the industrial sites mentioned before was made with paying full respect to a number of proposed industrial sites (hereinafter called 'A Sites') indicated by the Ministry of Industry of the Thai Government at the beginning of the survey. Consequently, there are many cases in which large-scaled industrial sites (hereinafter called 'B Sites') can be selected newly in the neighboring sites of A sites in the Bangkok Capital City Zone.

The locations of A sites and B sites do not necessarily agree for the following reasons. i), there are some areas in A sites where urbanization is progressing or other projects are being planned, and such areas were excluded when selecting B sites, and ii), large-scaled overall development was considered for B sites, and so the areas having vast unused land were selected as B sites.

As the industrial geographical conditions of A sites are quite favorable, they can be specified as industrial area by 'zoning', or the establishment of small scaled industrial estates through establishment of urban facilities including commercial, housing distribution facilities is considered possible.

Table 4-2-1 A Study of the Proposed Sites for Industrial Estates

Item	(1) Labor Power x Number of Bans in 5 km	(2) Present condition condition of site x Main land sort Land Water surface	(3) Present elevation x Elevation x Drainage Farmland Built-up area	(4) Preservation of environments x Closeness of the built up area
Site;				
B-1 (approximately) (1,000 ha)	20 2/100 ha. (approximately)	Paddy field (No villages)	+ 3 m Discharge into Main stream of Menam River	None
B-2 (" 670 ha)	40 6/100 ha.	Paddy field (No villages)	+ 3 -- 2 m Main stream of Menam River	City area near airport
B-3 (" 800 ha)	30 4/100 ha.	Paddy field 1 Ban inside the site	+ 2 m Discharge into main stream of Maenam River	Suburbs to the east of city area of Bangkok Center of Amphoe Bang Kapi
B-4 (" 1300 ha.)	40 3/100 ha.	Paddy field 3 Bans inside the site	Less than + 2m Discharge into estuary of Maenam River (through canal)	City area of Samut Prakan District
B-5 (" 1100 ha.)	50 4/100 ha.	Paddy field & orchard (No villages)	Less than + 1 m	No ordinary city area Villages along two main canals (Large military facilities (5Km))
B-6 (" 5000 ha.)	35 0.7/100 ha.	Paddy field & swamps (No villages)	Less than + 1 m Fishing village	None
S-1 (" 1600 ha.)	20 1/100 ha.	Woods or brushwoods (No villages)	+ 2 m Discharge through canal	Samut Sakorn
N-3 (" 1300 ha)	45 3/100 ha.	Paddy field 7 Bans	+ 3 m into Nakhon Chai Si	None
N-2 (" 100 ha.)	60 6/100 ha.	Paddy field 1 Ban	+ 2 - 4 m Into main stream of Nakhon Chai Si	Villages along the river banks
N-1 (" 750 ha.)	70 6/100 ha.	Paddy field 3 Bans	+ 5 m Paddy field and villages	"

	(5) Convenience	Transportation (6) Road	(7) Waterway	(8) Railway	(9) Effect on neighboring facilities
	x Existence of built-up area, urbanization	x Access dist. of estate to main highway	x No. of main waterways between estate and city area x No. of waterways between estate and villages x Ferry facilities	x Closeness to r. sta. x Possibility of sidelines	x Removal of existing facilities in and outside estate x Access road & problem of removal
B-1	None	Connected with No. 503 Along the road	None Main stream of Maenam River & 3 branches	None	No removal
B-2	From airport to city center (district where urbanization is in progress)	Along No. 3	Two main waterways	Sideline possible (There is r. station)	Readjustment of the area around airport (Urbanization along the road restricted)
B-3	District where urbanization is in progress. Point between Ban Chan and Bangkok	(1) From Ban Chan (2) From airport (3) From city center (4) From port (area behind port needs improvement)	Main commuting canals 3	Sideline possible (r. sta.)	Partial removal of one Ban Unify with center of Amphore
B-4	Samut Prakan's center Ferry	1 km-4 km from No. 112 (access road necessary)	3 main waterways (Khlong Samlong)	None	Removal of 7 Bans. Improvement of sprawl district. Expansion of Samut Prakan due to by-pass
B-5	None	Along No. 503 main highway	2 main waterways 3 secondary " Kl. Bang Pla Kot Kl. Samphasamit	None	No removal
B-6	None	No. 112 main highway	2 main waterways	None	No removal
S-1	Samut Sakorn Ferry	1 km from main highway	Main waterway (1)	Sideline possible	No removal
N-3	None	No. 3 -112 (roadside)	Main stream of Nakhon Chai Si 2 small waterways		No removal
N-2	Nakhon Chaisi	2 km from main highway	2 small waterways from the main stream of Nakhon Cha Si	Sideline possible (r. sta.)	1 Ban (partial)
N-1	Changwat Nakhon Pathom	No. 3-112 (roadside)	1 small waterway connecting villages	"	

	(10) Difficulty of establishing estate	(11) Construction of approach roads	(12) Sewerage	(13) Construction of waterways
	x Will be decided when making layout	Extend from	x Present condition of discharge Farmland Villages City area	x Pier x Repair of waterway 10-50 m wide Capacity as pondage
B-1	Easy	Entrance road only	Upper reach of Maenam River (Unsuitable for discharging treated water)	Not required
B-2	Easy	Entrance road only	Exerts influence over city area near airport and water source on upper reach	Easy
B-3	Easy	Grade crossing with railway	To port area (Required to be separated from the main waterway	Easy Has small waterways
B-4	Land formation in low area Slightly difficult	Construction of bypass from No. 112 and access road	City area (has irrigation canal to be separated.)	Repair of waterway to main stream of the river difficult (waterway inside city area)
B-5	Slightly difficult	Entrance road only	Villages along the waterways (Sewerage to main stream needed)	Establishment of main waterway
B-6	Difficult	"	Fishing village Swamp	Establishment of main waterway
S-1	Easy	"	Fishing port, ferry, main waterway	"
N-3	Easy	"	Upper reach of main stream	Not needed
N-2	Easy	Access road 2 km needed (Grade crossing with railway	Large villages along the river banks Upstream of main stream of Nakhon ChaiSi	Not needed
N-1	Easy	Entrance road	Densely inhabited area	Not needed

4.3 Proposed Plan for Industrial Estates

1) Assumptions of the Plan

While promoting the industrialization of various areas, the most im portant thing in this project is how we think about the role to be played by the estate development. From this viewpoint, the type and the scale of the industrial estate which should be developed will be decided, and also by whom and how such development will be actualized.

In the process of from planning to actualization of construction, it is necessary that the abovementioned points concerning the estate development should be made clear first of all.

For the purpose of proposing a physical plan in the first stage of the project, the plan should be studied on the basis of at least the following points as assumptions.

(1) The plan should be formulated by distinguishing clearly the development of the industrial estate from the zoning of the industrial district.

By the latter it is possible to carry out the induction and regulation of the manufacturing industry based on the plan of land use, and again, the land use, which is the object of such zoning of an industrial district, can generally be actualized. On the contrary, the former has to be developed with a certain objective, and characterized intentionally. Whether the estate development is going to be a government project or a project in which a local public body is going to participate in, the goal of industrialization can be decided, and the effect of development can be expected and evaluated only when a public organ take the lead and construct such industrial estate.

(2) Combine industrial development and community development

Comprehensive planning is necessary for this purpose, and assignment of responsibility for the construction of the estate and the responsibility for environmental improvement will be made according to this plan. When industrialization and urbanization make progress as the consequence of construction of the industrial estate, population, social and economic foundation, and the living of local society, etc. will change largely. Therefore, urban facilities will become necessary in the neighboring areas of the industrial estate physically and in correspondence with the construction of the industrial estate. In connection with this, it is necessary to estimate the demand for sites and facilities in each stage of construction of the industrial estate, and prepare a system concerning the limit of the related organs and the methods of participating in the planning, construction and operation.

(3) The stages of construction of an estate to be established in the comprehensive plan are not the division of the period of construction, but are of a long term which include at least the following three stages. (i) The stage in which the plan of industrial estate is made and construction work done; (ii) the stage in which the factories will be completed and start operation, and all facilities of the industrial estate will be completed; and (iii) when the factories in the industrial estate should have expanded their production and have exerted influence over the neighboring areas. Throughout all these stages, the problem of long term development should be studied according to the progress of the development, and counter policies should be worked out.

(4) Although it may vary depending on the objective of the plan, the purposes of development of industrial estate and its role in industrialization can be summarized as follows:-

(i) Will promote growth and development of local cities and undeveloped areas, and eliminate difference in standing; (ii) can be used as a means of rehabilitation of the conventional industries, and for the improvement of technical and managerial background of the small scaled manufacturing industries; (iii) Industrial estates are to be constructed from the viewpoint of counter-measures of large cities, and will accommodate those factories centering on cities in the external areas; (iv) Aim at preservation of healthy environment as a policy against those factories discharging waste lye, making noise and causing vibrations and air pollution; and (v) Development which agrees with the equipment of public facilities such as ports and express way, etc., and expansion of the manufacturing activities in that economic zone where the acquisition of the site is simple because the estate provides such sites.

2) A plan of development

In compliance with the abovementioned assumptions for the preparation of the plan, suitable estate development for the selected sites can be characterized as follows.

The estate development has been classified by site according to the following characteristics. (1), location seen from the traffic and transportation conditions, (2), scale of the block of industrial district,. (3), scale of the residential district and environmental facilities, and (4), importance of the countermeasures against public hazards.

I- Urban Fringe Allotment Type

Site	(1) Traffic & Transp. Conditions	(2) Scale of the block of indus. district	(3) Envir. facilities	(4) Importance of Counter measures against public hazards
B-2	Traffic position = Roads + railway + airport	Medium & small	Small; dependent on fringe areas and city center	Large; water pollution
B-3	Traffic position = Roads + railway + waterway + airport	Medium & small	Small; dependent on fringe areas and city center	Large

There is a tendency that the urban area adjacent to the city center is sprawling. B-2 and B-3 are the sites established in the fringe areas of the areas where urbanization is in progress. These are for the purpose of actualizing systematic land use and build up urban area avoiding confused land use so that they will not become the expanded portion of the future city district which would hinder the function of the city center, city environment and development of the neighboring areas.

Both B-2 and B-3 are on the important traffic points between the areas outside of the capital city zone, and are conveniently located for commuting, communication and transportation of materials to and from the city center. This could be called the distribution center development type directly connected with the city center.

As urbanization will further progress with the development of the industrial estate, the rate of the industrial estate's dependence on the urban areas outside of the industrial estate for urban facilities (residences and shopping center) will be comparatively high. Emphasis will be placed on the equipment of the inside of the industrial estate with the facilities of the manufacturing industry and distribution relations, and the adjustment of such equipment accordingly with the plan of construction of public facilities (roads, municipal supply, sewerage, etc.) of the neighboring urban areas will become an important problem to be solved.

As it is anticipated that land price will rise rapidly in these sites, the industries moving into such sites will be limited to quite an extent. In other words, it is necessary to consider those manufacturing industries which require to be concentrated in large cities and particularly those industries having the capacity of bearing the burden of high land price. Food processing and printing industries which have their markets in the capital zone where population is dense and crowded with offices are the representative industries, but circulation and processing of construction materials and consumer goods, and machine, electronics, precision machinery relations which require advanced techniques and information can also be be taken into consideration.

II Industrial Community Type

Site	(1) Traffic & transportation conditions	(2) Scale of the block of the industrial	(3) Environmental facilities	(4) Importance of counter measures against public hazards
B-1	Development of the area along the main highways	Medium and small	Large-scaled (newly developed)	Large Water pollution
B-4	Roads & waterways	Large, medium and small	Large (Expansion of built-up city area)	Little (Drainage is possible)
B-5	Roads and waterways	Large, medium and small	Large (Expansion of built-up city area)	Little (Drainage is possible)

This type is to provide residential land, commercial area, some office area and distribution facilities when developing an industrial estate to establish a new living zone. This will be the area for new comprehensive development.

The main aim of this development is to build cities in the suburbs as a counter measure against overcrowding in large cities, and will promote formation

of small scaled new city areas equipped with facilities of workshop and residence as a set.

Urbanization in B-1, B-4 and B-5 areas is behind at present, but some factories in the capital city zone have already moved to the areas adjacent to these areas. These areas are within the 20 km zone and it is expected that these areas will develop into promising areas in the suburbs of the capital city.

By carrying out the repair of roads and waterways, this development can be started as the development along the route of the main highway extending from Bangkok, and will take the cluster like form connected with the main routes.

The percentage of the industrial land in these sites (areas) is smaller when compared with other types of sites, but the industrial land will be established as the main part of the entire plan of the area. This type of an industrial estate is possible to accommodate diversified types and scales of the manufacturing industry.

As B-1 site is located on the upper reaches of Maenam Chaophraya close to the source of municipal water supply of the capital city, factories which would contaminate this water source are not suitable.

III Large-scaled overall development type (self-contained type)

Site	(1) Traffic	(2) Scale	(3) Environmental	(4) Importance of counter measures against public hazards
B-6	Roads & waterways	Huge, large	Large (To be developed newly)	Little

As a part of the countermeasure for large cities, this type of development may be included in the long-range plan when carrying out a large-scaled development newly. Such development will establish a large position which would form the expanded future capital city zone, and unused land of largest scale will be selected for such type of development. As to the scale of the industry, large-sized industry which requires to be separated from the city area will also be adopted. and the plan will include establishment of vast buffer green belts in the environs.

Assuming that the entire project area is 5,000 ha and which is large enough to accommodate a population of approximately two hundred thousand, this project area should be assigned for the future study of a suitable area for a set of new town which will have in combination all such urban functions such as manufacturing industry, housing, commerce and other business activities, distribution, recreation, etc. Again, the development of this area can only be materialized by land formation to be carried out in the paddy field area lying between to major Bangkok-Chonburi highways (old and new).

Consequently, such a development project, which requires improvements and construction of a large-scaled waterway network, must be planned as a part of a long range master plan of the overall development.

IV Outer cities development type

Site	(1) Traffic	(2) Industrial land	(3) Environmental facilities	(4) Importance of counter measures against public hazards
S-1	Roads + waterways + railway	Large -- small	Large (Expansion of existing facilities)	Little (Treatment of drainage works)
N-1	Roads + waterways	"	Large (newly developed)	Large (Drainage particularly)
N-2	Roads + waterways + railway	"	Large (to be developed newly)	Large (Drainage particularly)
N-3	Roads	"	Large (to be developed newly)	Large

This type of development will promote development of outer cities (Nakorn Phatom and Samutsakorn) of the capital city, and intensify their functions. Will be located outside of the commuting area of the capital city. Locations having local center and many villages and densely inhabited areas within the commuting zone of the industrial estate are desirable. This type of development will be promoted within the commuting zone of the outer cities, and the area to be developed will be arranged along the main highways and the railways radiating from the local center. The manufacturing industry will be the inland labor intensive type, and as it will exert much influence over the inland waterways, factories which may cause public hazards from drainage should be avoided.

3) Scale of the development area and the land use

The following table shows the scale of the industrial estate estimated from the population of the 30 km zone (assumed to be the commuting zone) around the industrial estate.

Concerning the selected sites mentioned in the foregoing paragraph, concrete plan of each area will be studied with the scale of A and B industrial estates as assumptions.

(Estimated scale)

A. Industrial estates in the Greater Bangkok Region

200 -- 1000 ha/unit

B. Industrial estates in outer cities of capital city zone

100 -- 300 ha/unit

C. Industrial estates in the areas around local cities

100 ha. and less

Estimated scale of industrial estate	Working population in the industrial estate	Labor power in the environs.	Population of 30 km zone
A 300--100 ha	6000--20000	12000--40000	120--400 thousand
B 100--300 ha	2000 -6000	4000--12000	40--120 thousand
C 100 ha or less	2000 or less	4000 or less	40000

(Estimated land use)

Proposed area	Industrial land (gross) ha.	Residential land (gross)	Commerce, business, city area	Educational facilities	Recreation facilities, parks, etc.	Waterway surface	Acreage of planned area
Type I							
B-3	650	100	20	-	(100)	-	870 ha
Type II							
B-1	500	200	30	20	75	75	900 ha
B-4	800 (Large & medium 750 small 50)	200 (Outside estate 600)	75 (Com. 50 city area 25)	25	100	200	1,400 ha
B-5	600	200 (Outside estate 400)	120	20	60	100	1,100 ha
Type IV							
N-2	700	200	50	20	50	30	1,050 ha

An open space in the development site will be required for the purpose of providing urban service facilities for the residential land, and also for improving the environments and for preventing disasters and to provide recreation facilities for the industrial land.

The following table shows the assumptions of the land required for the main facilities comprising 40--50% of the entire development site excluding the industrial land.

Site for facilities	Standard (assumption)	
1. Residential land	100 persons/ha (gross)	As an average value of a block of residential land
2. Open space		
(1) Parks	3--5 ha per 10,000 persons	To be established at an interval of 200--300 m (for pedestrians)
(2) Open space, lateral roads	1500-3000 m^2	To be established as shopping center
(3) Park of the district	About 50 ha	Including sports park of 5--6 ha. (To be established adjacent to waterway and on the side facing the main highway. Will be buffer green belts)*
3. Urban area	About 3% of the project area	Commercial and business area of the center of the development site

* Waterways and the green belts on the waterside . . .

Reassess the importance of the waterways

(1) Importance as a means of transportation
(2) Buffer belts as green belts to prevent disasters
(3) Flood control area
(4) As a reservoir

(Necessary facilities of the industrial estate)

The development of the industrial estate is basically different from the specification of an industrial area, and it is considered quite proper to establish regulations concerning land use, use of sites by factories, use of buildings, and construction by the estate itself for the purpose of attaining the objective of the project, but the management of the estate must be well controlled for the convenience of the factories coming to the estate (including necessary facilities for the employees), and also for the purpose of constructing the estate in the form of responding to the requests of the neighboring local communities.

Composition of the necessary facilities varies according to the type of development, but the main facilities which should be taken into consideration at the time of planning the estate are as shown below.

i) Facilities for living ... To be established on residential land and shopping area

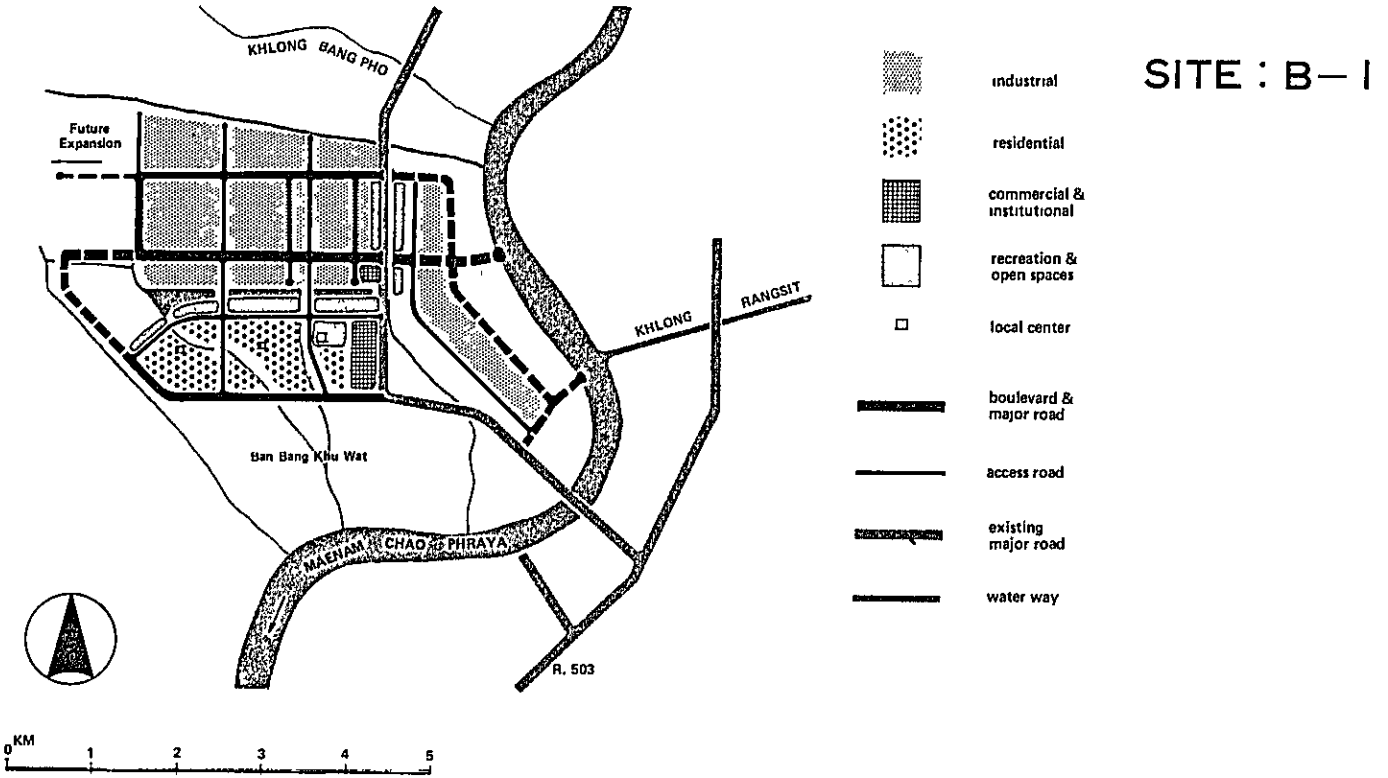
(1) Residences
(2) School, educational facilities, temples,
(3) Parks and open space
(4) Recreation facilities (Outdoor stadium, indoor hall)
(5) Shopping center (shops, restaurants, markets, etc.)

ii) Facilities of circulation relations ... To be established in industrial land and business area

(1) Roads (access roads, major roads), parking area, car service facilities
(2) Railways, railway siding
(3) Waterway, wharf
(4) Warehouse, open storage
(5) Industrial water, power supply, communication system
(6) Facilities for disposal of waste matters and sewerage

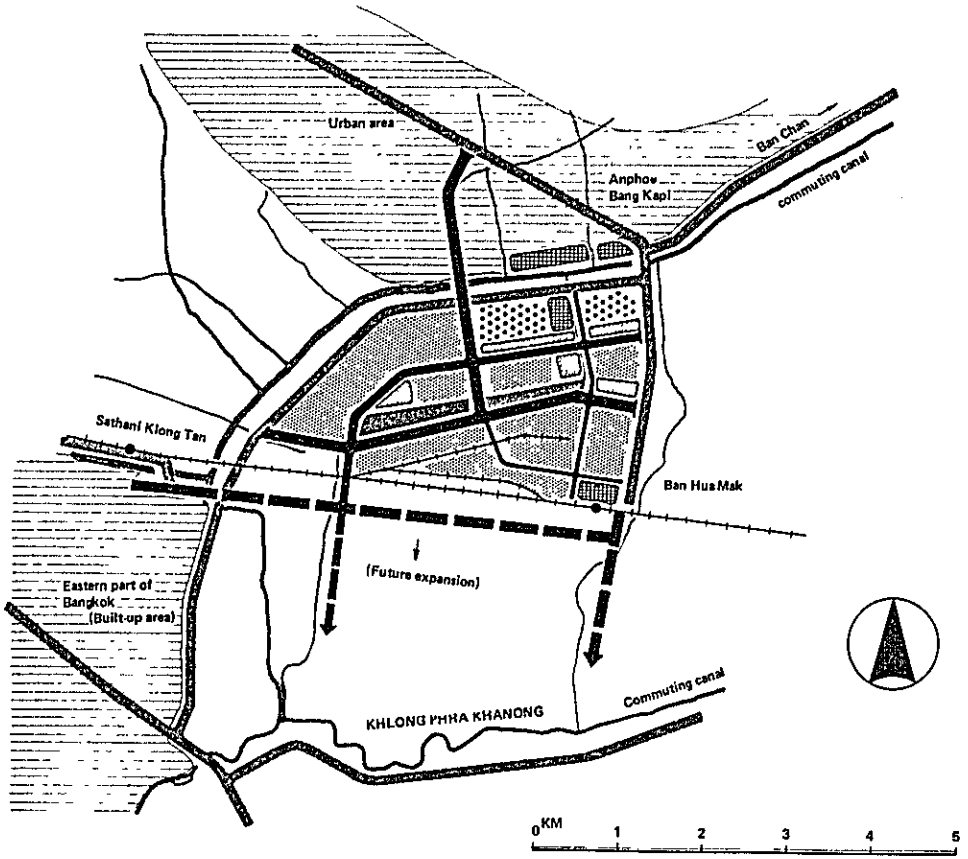
iii) Administrative facilities ... To be established mainly at the central district (commercial and business areas)

(1) Facilities for administration of the entire project site (construction of public and private offices)
(2) Facilities for prevention of disasters (Fire station, police station, hospital)
(3) Joint factory, facilities for technical training, facilities for testing and research

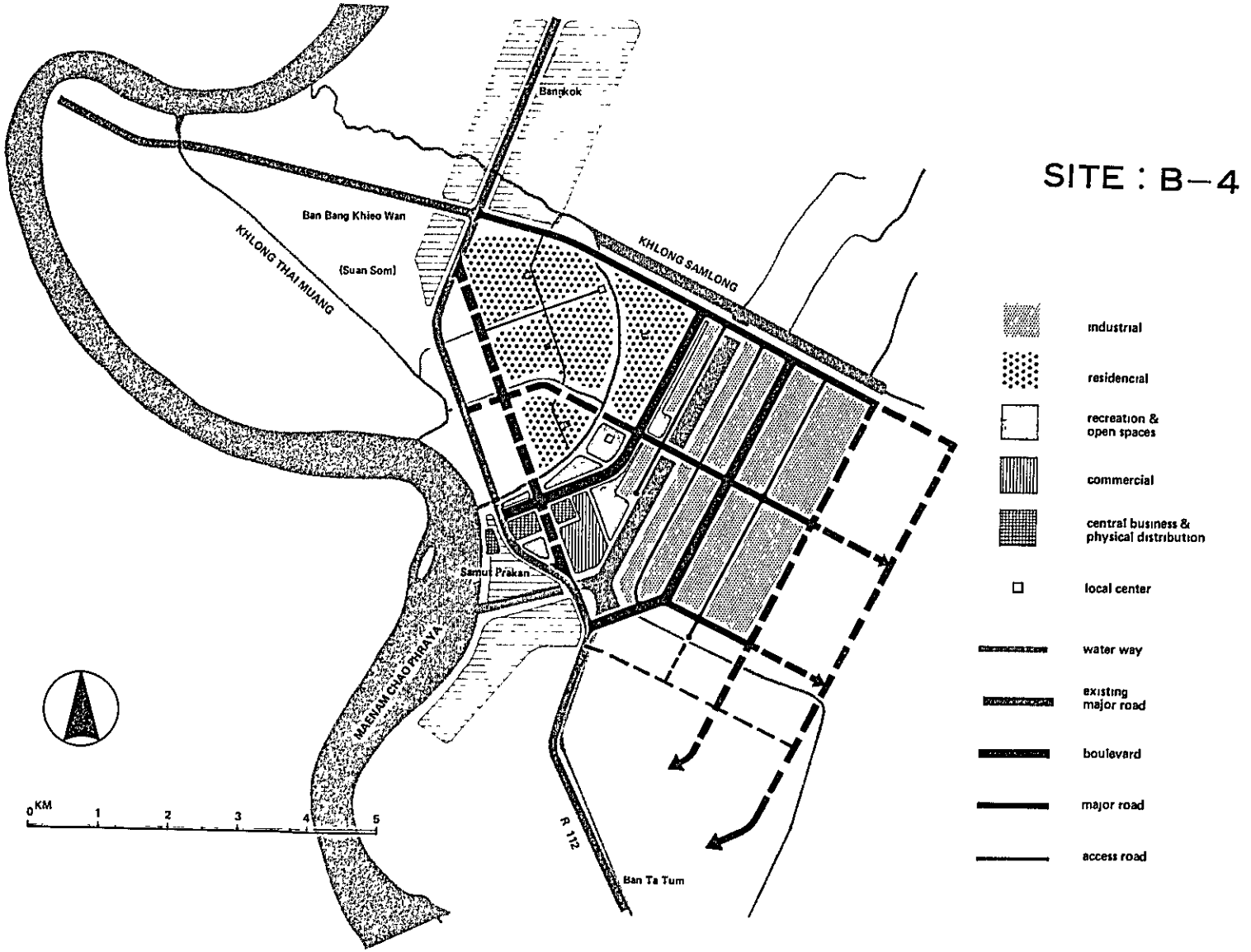

KHLONG BANG PHO
Future Expansion
KHLONG RANGSIT
San Bang Khu Wat
MAENAM CHAO PHRAYA
R. 503
0 KM 1 2 3 4 5
industrial
residential
commercial & institutional
recreation & open spaces
local center
boulevard & major road
access road
existing major road
water way
SITE : B – I

Map 4-3-1

SITE : B-3

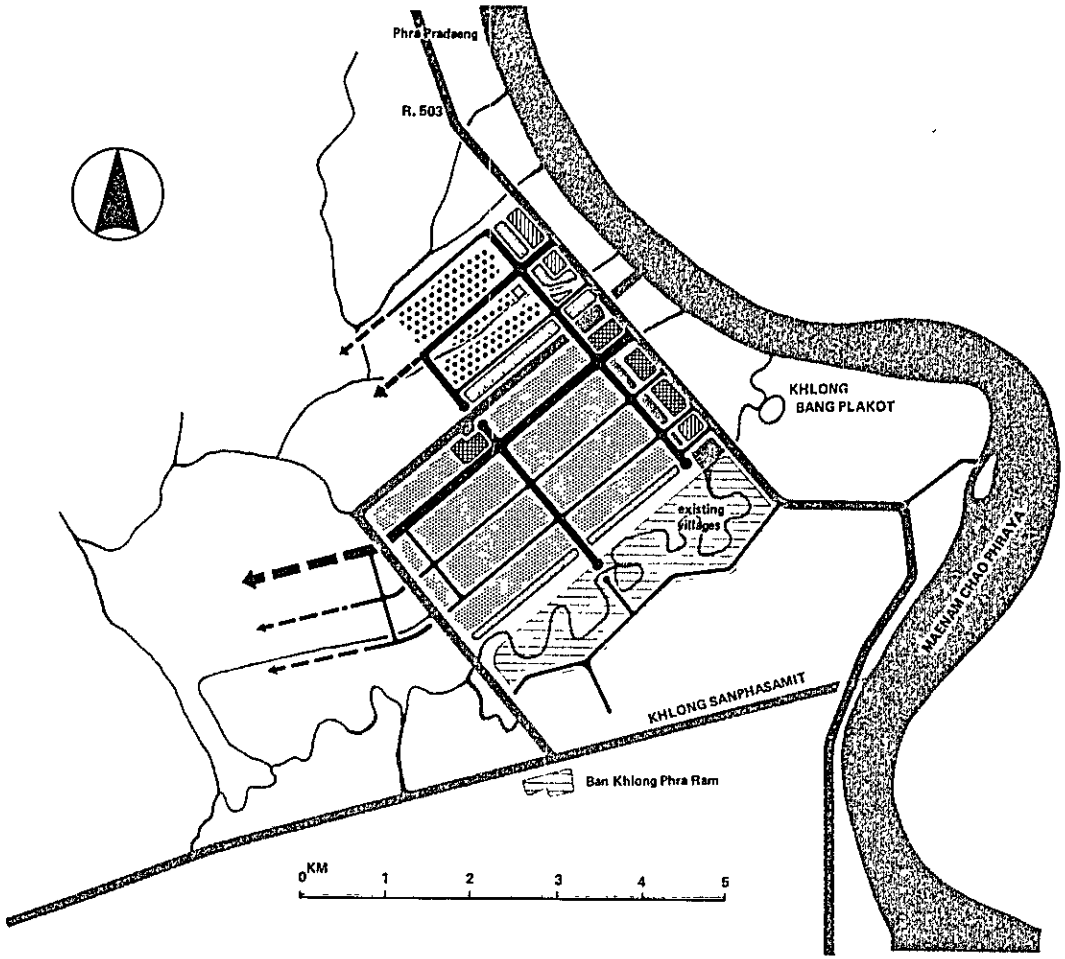


Map 4-3-2


SITE : B-4
Bangkok
Ban Bang Khieo Wan
(Suan Som)
KHLONG THAI MUANG
KHLONG SAMLONG
Samut Prakan
MAENAM CHAO PHRAYA
R 112
Ban Ta Tum
0 KM 1 2 3 4 5
industrial
residencial
recreation & open spaces
commercial
central business & physical distribution
local center
water way
existing major road
boulevard
major road
access road

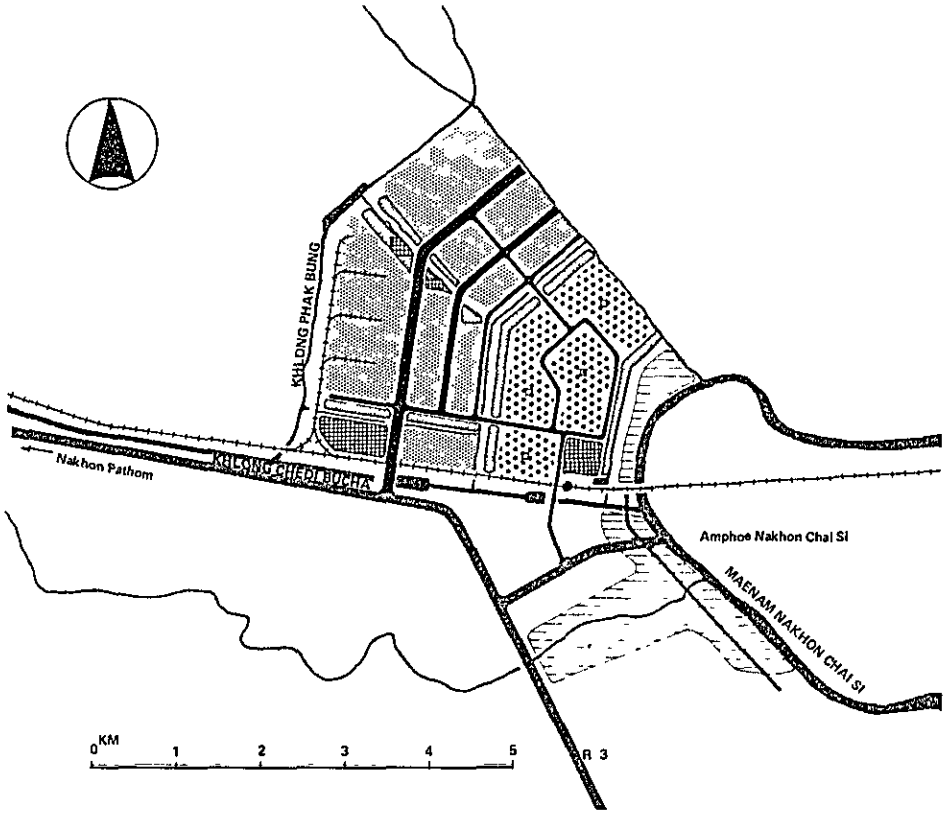
Map 4-3-3

SITE : B-5



Map 4-3-4

SITE : N-2



Map 4-3-5

4.4 Important subjects to be studied hereafter concerning preparation of the plan of construction of an industrial estate

In Chapter IV, the main subject was the planning of an industrial estate development project in the inland part of the country. Selection of suitable sites was made according to the basic characteristics such as the natural conditions of the country, distribution of population classified by the city zone, and the development sites in large city zones, and the plan of development was sketched roughly. There still are many more points which require to be studied before actually deciding the development sites and commencing the construction work.

Coordination of the specific conditions, types and scale of the manufacturing industries and enterprises advancing into each development area with the development plan of large city zone, and coordination with the plan of development of areal communities and regional city zones around the industrial estate and the general schedule of execution of the construction plan will become the important problems.

Basic things particularly necessary for the planning of the estate construction plan of the industrial estate are as shown below.

i) Natural conditions of the proposed development sites

A. Topography: Selection of suitable sites is based on the macroscopic observation in which a topographical map of 1/50,000 scale was used, but to study in more details the vast selected areas it is advisable to use the recent air photographs. Usually vast plains are selected as suitable sites, and it is necessary from the microscopic point of view to be specially careful as to the methods of drainage of rain water and industrial waste water after constructing the estate. Moreover, to study the land use and distribution of cities in the neighboring areas, it is necessary to topographical maps in 1/200,000 1/500,000 and other scales.

B. Geology: It is necessary to make a geological survey previously because the geology exerts much influence upon land preparation, its cost, and the foundation work of the structures. Since much construction work is being carried out in various places, it is desirable that more data such as the results of boring concerning as many points as possible are gathered.

C. Meteorological conditions: Changes in the wind direction, temperature and humidity of a year exert much influence upon the production activities of the factory. It is particularly necessary to be careful about air pollution since the influence it exerts upon the neighboring areas varies accordingly with the wind direction.

D. Water source: It is necessary to check previously the quantity of water, water quality and the condition of groundwater and the surface water of the rivers.

ii) Socio-economic conditions

A. Land: As to the land price, it is necessary to grasp accurately the actual transactions and the changes in the assessed value of land in various areas. It is also necessary to study the relative difficulty of buying up the land, possibility of future growth of the area, scale of the project, and also how they will vary accordingly with the methods of buying up the land.

B. Transport condition: How to decide the routes for the transportation of materials to and from the factories, routes in the entire project area, and the routes connecting with other estates. It is necessary that these routes coordinate with the plan of traffic network of the neighboring areas of the industrial estate including the means of transportation for the commuters.

C. Relationship between the residents in the area and the industrial estate: There still are many more things to be studied in order to materialize the plan of establishment of an industrial estate which will not disturb the living environments of the neighboring communities and will be established on the basis of cooperation and understanding of the residents in such areas.

D. Relationship between the function of the neighboring cities: Make clear the limit of the industrial estate's dependence on the function of the neighboring cities. Make a study on consideration to be given to the manufacturing industry and particularly to the existing small-scaled manufacturing industries, and on how the industrial estate will depend on those neighboring cities on the phases of commerce, transportation, communication, financing, recreation, culture and administration, or on whether the industrial estate will establish voluntarily its own urbanized area.

E. Relationship with the areal economic zone: This is an important condition when deciding the location of the industrial estate. Distribution of related industries classified by the type of industry, trading firms, related traders, movement and the commuting zone of the labor power, zone for utilization of freight stations, port and other facilities must be studied fully.

F. Relationship with the areal plan: Coordination with the planning of overall development of the entire area around the industrial estate should be studied. It is also necessary to study the financing plan and the mechanism of the industrial estate as a public enterprise when planning, constructing and managing the industrial estate.

iii) Contents of the Master Plan of the industrial estate:

Preparation of the basic planning for the construction of an industrial estate will be commenced practically after the location, scale and the prospective industries occupying the estate have been decided. The following shows the basic plan of an industrial estate.

a) A study of the policy for planning:

(1) Characteristics of the district related to the industrial development; the role of the industrial estate concerned

(2) Suitability and necessity of precedent construction of the industrial estate concerned

(3) Make a study of and keep in order the geographical conditions particularly concerning the industrial land, water source, roads, railways, labor power, meteorological conditions, geology, foundation, related sub-contracting enterprises, power supply, etc. regarding the recent tendency of industrial location.

b) Preparation of the map showing the general condition of the project area.

(1) Map showing the general condition:

Prepare the map showing the position of the industrial estate and show the locations of the existing enterprises, medium and small enterprises and other industries and the urban facilities.

Write down the general outline of the location and land use (relations with the measures for the development of agriculture, and the direction of the growth of the cities in the neighborhood of the industrial estate) of the industrial estate concerned. At the same time, investigate into the land category, acreage, owner of the land and the precedents of acquisition of industrial land, etc.

(2) General outline of the related facilities (attach a map of approximately 1/3000 scale)

Investigate into the present condition and bottlenecks relative to railway, roads, water supply, sewerage, industrial water supply, housing facilities and other facilities related to the industrial estate, and the future plan of expansion, and make the general outline.

c) Selection of the scale of suitable industries

Select the suitable industries and the scale according to the shape of the industrial estate, location, other geographical conditions, relations with the existing enterprises, distance from built-up large cities or from the main cities in the area concerned, relations with other industries in the neighboring cities, amount of water to be drawn in, and geographical conditions of each industry, and investigate into the enterprises located in the neighboring districts.

d) Plan of construction of an estate

(1) Land plotting of an estate

A. Basic plan of construction of an estate

Formulate the basic plan of land plotting of an estate, distribution of the central area of the estate, green belts in the estate, public open space, and for planning of plotted area and roads, etc.

B. Plan of land use

Prepare the plan of land use with the estate concerned as the center with fully taking into consideration the topography, roads, residential land, and relationships with the neighboring districts. (A map of 1/30,000 scale showing the land use).

C. Land plotting of the estate

Carry out rational land plotting of the estate so that large, medium and small enterprises of suitable industries can be located on the land of the acreage they desire. In this case, land plotting should be carried out upon consideration of the distribution seen from the viewpoint of entry and departure of the estimated number of trucks for bringing in materials and taking out manufactured goods and the relations between the large enterprises and the minor enterprises, and at the same time, taking into consideration the organization of groups classified by the scale of the enterprises.

Select the standard lot, or prepare the map showing the plotted lots and the map showing the land plotting, or make three plans in the beginning and choose one type out of these. (Attach a map showing the land plotting of the industrial estate of approximately 1/2000 scale).

D. Sites for public facilities and jointly owned facilities

Study the general outline of the facilities in the sites such as the public facilities (parks, green belts, transformer substation, etc.) and jointly owned facilities (feeding facilities, gathering places, car park, etc.) necessary for the industrial estate concerned. (Attach a map of 1/1000 scale).

(2) Planning of Roads

A. Policy for the planning of roads

Grasp accurately the condition and points of issue of the roads in the neighborhood of the industrial estate, and establish the policy for road planning.

B. Traffic volume and the traffic growth of the roads inside the industrial estate.

Estimate the future traffic volume of the main roads in the industrial estate, and study the width of roads and the smooth transportation inside the industrial estate.

C. Standard section of roads, etc.

Design linear details, width of roads, facilities on roads, gutters, and prepare the map showing the roads to be constructed, and the standard sections of roads. (Prepare a plan of 1/1000 scale.)

(3) Industrial Water

A. Quantity of industrial water required

Estimate the quantity of industrial water required by the prospective enterprises stating each source of the industrial water, sutdy the relations between the scale of the project and the quantity of water possible to be drawn, and use this as reference for the study of the quantity of water to be drawn by the enterprises around the industrial estate, depth at which the water is drawn, pumping capacity and water quality, etc.

B. Possibility of drawing water from rivers, lakes and ponds, and groundwater

Study the present condition of river water, lakes and ponds, and groundwater, and look for water in reserve.

C. Plan of waterworks for the supply of industrial water

Study the general outline of the plan of facilities, methods of water supply and distribution, and the contents of the facilities. (Attach a plan of waterworks for the supply of industrial water.)

(4) Plan of waterworks

Study the quantity required, general outline of the plan of installation of facilities, and design volume of water. (Attach a plan of waterworks of 1/2000 scale.)

(5) Drainage Plan

A. Drainage for factories

Study the quality and quantity of the waste water to be discharged from the factories of the prospective industries together with the condition of the rivers to which such waste water will be discharged.

B. Drainage for rain water

Calculate the intensity of rainfall and the amount of rain water and write down the estimated quantity.

C. Plan of facilities

Study the drainage system, distribution of the main drainage canals, method of drainage, contents of the purification plants, etc. upon consideration of the topography outside of the industrial estate, city drainage, agricultural drainage, etc. (Plan of drainage system of 1/2000 scale).

(6) Plan of facilities for power supply

As it is necessary to supply electric power to the factories in the industrial estate, the capacity of the main supply line and the transformer sub-station should be studied. Land plotting in the industrial estate and the width of the roads are closely related to the economical method of transmitting electric power to the industrial estate, and so make a plan with keeping close contact with the authorities concerned. (Attach a plan of facilities for power supply.)

e) Design of works

Based on the above plan and calculate the quantity of soil to be moved by using the 1/3000--1/1000 scale plan. Design the works of land preparation, roads and drainage system and other related facilities and write down the outline of the plan, and at the same time, calculate the acreage of drainage canals and the construction cost. As regards land preparation, there will be some difference in the cost depending on the removal of the existing facilities, felling of trees, and the nature of soil, etc. This point should be studied.

Chapter V The Development Plan of the Coastal Industrial Area

5.1 Conditions to be considered for selecting locations for development in the coastal industrial area

As pointed out in the interim report, the world-wide tendency when inducing heavy chemical industries on modern scale is to establish complex-type factories, and this is most reasonable and effective.

Although there are some differences depending on the types of industries, the following are the general conditions which are vital to selection of sites in the coastal industrial area from the standpoint of business enterprises:

(1) land prices are relatively low and large lots can be procured.
(2) the ground foundation is favorable.
(3) they are close to general commercial ports.
(4) they are close to the consuming areas for the products.
(5) industrial water is plentiful.
(6) power is readily available.
(7) labor is easily and conveniently obtainable.
(8) overland transportations such as railways and roads are conveniently located.
(9) compensations for possible damages to fishing activities are not difficult.

As the ways of constructing such coastal area, there are;

(1) a fill-in system which calls for reclaiming the sea.

(2) a dig-in system which calls for opening up waterways in areas close to the sea with a relatively low productivity to link with the outlying sea.

(3) a combination of above-mentioned (1) and (2).

The following are the basic policies for planning industrial port:

(1) large vessels can come in speedily and safely and be moored by the edge of the water right by the factories to make the cargo-handling easier.

(2) factories must be located in such a way as to be surrounded with a line of water equally and such a line is to be extended as much as possible for best possible utilization.

(3) waters adjacent to the factories must be calm so that not only berthing and mooring of the ships is safe but also the factories themselves may not be inundated by high waves.

(4) the communication with the commercial port in the neighboring area should be improved.

(5) communications by means of inland transportation are to be improved with major cities and hinterland (railways and industrial roads)

(6) a close contact is to be maintained with an overall city-planning of cities and towns.

Although these are the fundamental policies with regard to the planning of industrial port, there is a need for studying how the various sizes of ships coming and going are to be handled while planning port and related facilities. The following table is an example of such a study:

Table 5-1-1

		Length of ships	Berth	Depth of water
Tanker	200,000 t	342 m	380 m	19 m
"	100,000	285	315	16
Orecarrier	100,000	-	310	16
Freighter	20,000	180	195	11
Steam-and-sail boat	300	32	40	4
Barge	200	23	30	2

If the type and the scale of the factories to be located are known in advance, lands can be spaced out and waterways arranged properly, but if not, it is advisable that the main waterways be spaced out first, leaving the secondary ones for the later days. The width of waterways in such case will be as follows:

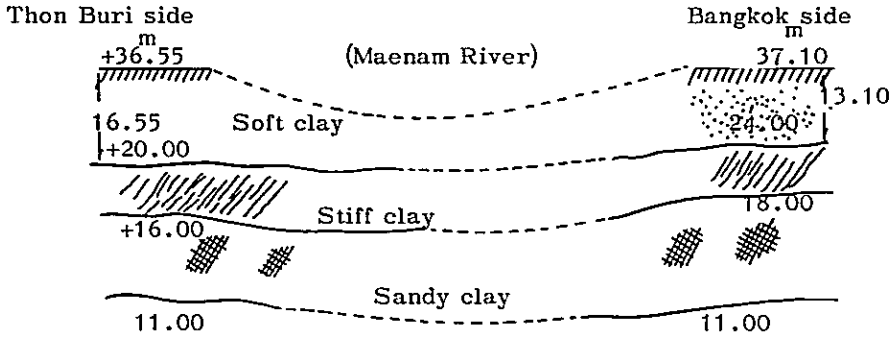
Main waterways	300 - 600 m
Secondary waterways	200 - 300 m
Small ships and barges	50 - 80 m

These are the general considerations for selecting suitable sites in the coastal industrial area. The following are area-by-area study of the geographical conditions of the sites currently under consideration for development as the coastal industrial area and the methods of constructing such areas:

5.2 Geographical conditions of the selected sites for development and the methods of construction

1) Areas along the Maenam Chao Phraya

Several sites have already been selected in the areas along the Maenam on the downstream from the port of Bangkok, and in some areas numerous factories are already in operation while some others are presently under construction. This central plan in Thailand around the estuary of the Maenam is the area facing either the sea or the river with a long shore line but it is shallow, as a sea chart shows, requiring a minimum distance of 10 kms to attain a depth of 10 meters. Formed by the sedimentation runoff, particularly of fine clayey nature, which washed down the river in a duration of many years, the sea bed is extremely weak and does not resist much against pressures. The data prepared by OTCA (Overseas Technical Cooperation Agency) when the preliminary survey for the Bangkok Thon Buri Bridge was carried out in 1968 well support this fact.



At points where the survey was conducted,

(1) the surface soil is relatively strong down to 3 meters, but soil is soft further down due to dry and moist climate of the area.

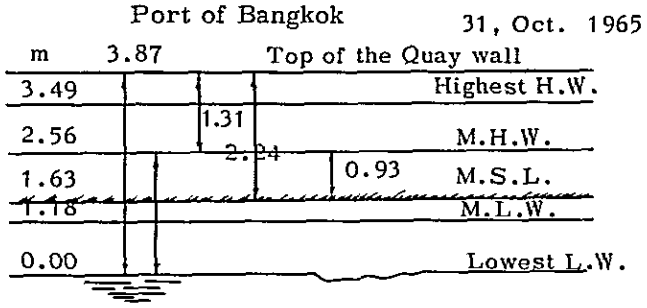
(2) a clayey layer reaches down to 20 metersffrom the surface. This is formed by the weathered laterite which has settled and accumulated. The ground further down is formed by the alternating layers of clay and sand.

(3) the level of underground water is (-) 1 m - (-) 1.5 m.

As for dredging of sea routes, it is extremely difficult under the present condition of Bangkok Port to secure sea routes deep enough to make the passage of large vessels possible. But it is possible to branch off several routes, each 2 to 3 meters deep, from the principal route in the port, enabling small ships to come alongside the pier if it is constructed at the immediate edge of the water of the factories.

Utilization of high tide which rises on an average of 0.9 m will make the passage of larger steam-and-sail boats possible.

Although there are not many commendable merits with respect to the firmness of the ground for use as factory sites and the sea routes, the area offers favorable conditions for locating medium and minor industries since it is close to Bangkok, the capital of Thailand, and the largest consumers' market in the vicinity.



2) Ang Sila area

There is a plan under way of establishing an industrial estate in this area by reclaiming part of the sea, but this involves the following problems:

(1) the water immediately adjacent to the area to be filled in is only about 2 meters deep and it is difficult for ships to come directly alongside the shore to handle cargoes.

(2) by constructing a jetty 2,000 m x 8 m, it is possible to reach the depth of 8 meters where a dolphine is planned to be built, but still it is not deep enough to handle cargoes in large amounts not to mention of bringing large ships alongside the pier.

(3) a jetty 8 meters wide is subjected to splashes of sea water and it would be dangerous to carry on cargo-handling under such circumstances. Since there are no data availabe to support this point, clear-cut assertions are reserved, but it is very likely that cargoes may get wet by splashes.

As for the plan of land-formation by reclamation:

(1) the drainage from the hinterland is to be directed toward the present standby area for ships and the waterway on the southern side is to be closed. This way, more land can be formed economically.

(2) when stone for construction use is quarried from the highland in Laem Sammuk, it would be more effective on the phase of execution of the construction work to close up the waterway.

(3) in the case of (1), a further study is necessary with respect to the location of the standby area for ships and the communication between the south-western area and the north-eastern area.

3) South-Eastern Coastal Area (Sriracha area)

As referred to in Chapter Two and in this paragraph, this area has the fundamental geographical conditions required for an area to be developed into the coastal industrial area. Despite repetition, these conditions are as given below:

(1) the sea is deep.
(2) the quality of soil on the sea bed is considered to be good.
(3) land-formation on a large scale is possible.
(4) the sources of industrial water can be sought for in the immediate vicinity.
(5) there is a plan of constructing the second Bangkok Port. In the event of implementation of such a plan, this area will have a commercial port adjacent to it.
(6) the Japanese survey team for steel plan locations has selected the area as a possible site for a steel mill.
(7) simultaneously with (5), a new plan is under way of building a thermal power station here.

A major problem in connection with the geographical location is the supply of industrial water. If the demand for industrial water in the area is estimated at 200,000 - 300,000 m^3 a day, the following three are considered as possible sources of water:

(1) increase the volume of Bang Phra Reservoir and use as water source.
(2) draw water from the Bang Pahong River.
(3) make another reservoir.

Of the above plans, realization of (2) is difficult for reasons of high costs involved because the sea water flows backward into the river as far as 50 kms upstream from the estuary and if water is to be induced from the river to the proposed site, it requires driving channels as long as 100 kms.

Incidentally, the Electric Power Development Co., Ltd. is now studying the Sai Gai power-generation project in the upper stream area of the river. In the event of completion in 1975, the amount of water to be supplied in the drought season, excepting the irrigation water, is estimated at 400,000 m^3 a day.

As for (3), it is necessary to study those areas for possible site of a new reservoir along the tributaries of, or in the vicinity of the Bang Pakong River, and particularly the eastern Chombori area where an irrigation reservoir is planned. From the above, (1) offers a prospect more promising than the others for the time being.

The outline of Bang Phra Reservoir is as follows:

Total acreage of catchment area	130 km^2
N.W.L.	22 m
L.W.L.	18 m
Storage capacity	21,700,000 m^3
Effective storage capacity	17,700,000 m^3
Type of dam	Earth dam
Length	1,400 m
Height	9 m
Crown width	6 m
El. of Crown	23.5 m above sea level
Total construction cost	21,000,000 Bahts

Condition of water use

Agriculture	20,000--75,000 m^3/day (To irrigate 1300 ha)
Waterworks	17,100 m^3/day
Industrial water	5,500 m^3/day
Total	43,000--98,000 m^3/day (Average 70,000 m^3/day)

Breakdown of industrial water by types of industries:

Thai Oil Co.	2,850 m^3/day
Tapioca factories	2,000 m^3/day
Plywood factories	170 m^3/day
Red Cross hospitals	360 m^3/day
Golf course	150 m^3/day
Total	5,530 m^3/day

Monthly average water level throughout a year from 1968 to 1969 (until October) is 20.5 - 22.0 meters and in September and October water overflows. Although the water level in April in the late dry season drops to the neighborhood of L.W.L., enough water is considered to be still left in storage for supply. It the reservoir is used for five months in the dry season between November and March, it is possible to supply 110,000 m^3/day of water. If the average discharge during the dry season is estimated at 30,000 m^3 a day (if the average daily discharge throughout a year is estimated at 300,000 m^3 a day, the amount of rainfall at 1,200 mm, and the runoff ratio at 70%), the reservoir is believed to be capable of supplying a surplus of 70,000 m^3/day.

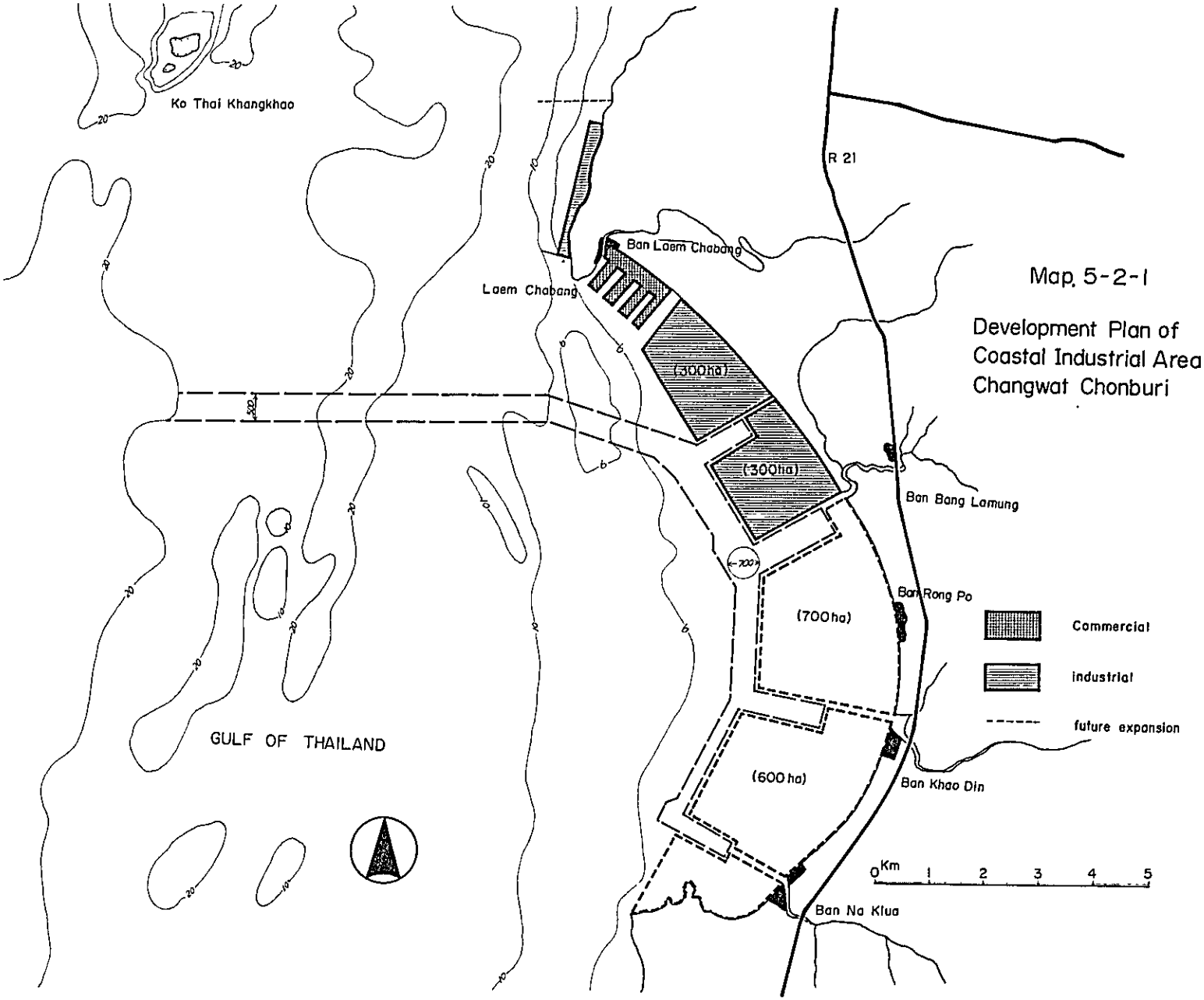
Dam raising by one meter will increase the storage capacity by 10,000,000 m^3 of water. If it is raised by 2 meters, the storage capacity will increase by 20,000,000 m , making it possible to supply an average of 130,000 m^3/day for five months during the dry season. Combined with the surplus water now available, the supply of 200,000 m^3/day will become possible.

As to the feasibility of dam raising, a closer on-the-spot survey including a geological study is necessary, but a topographic map of 1/50,000 scale indicates the feasibility as far as the elevation above sea level is concerned.

At the same time, utilization of underground water by means of deep wells must be looked into. If this water source can be used, it will greatly add to amount of water to be supplied.

For the planning of port and related facilities, it is necessary to obtain data on meteorological conditions of the areas in question, what the survey team obtained during the limited period of the field survey were the data from a nearby weather station on winds and the level of tides.

An attached figure was prepared on the basis of the data on velocity of winds obtained from the weather station from which only strong winds of velocity of over 17 knots per hour which would exert much influence over the construction works of a port and manuvering of ships in the port.

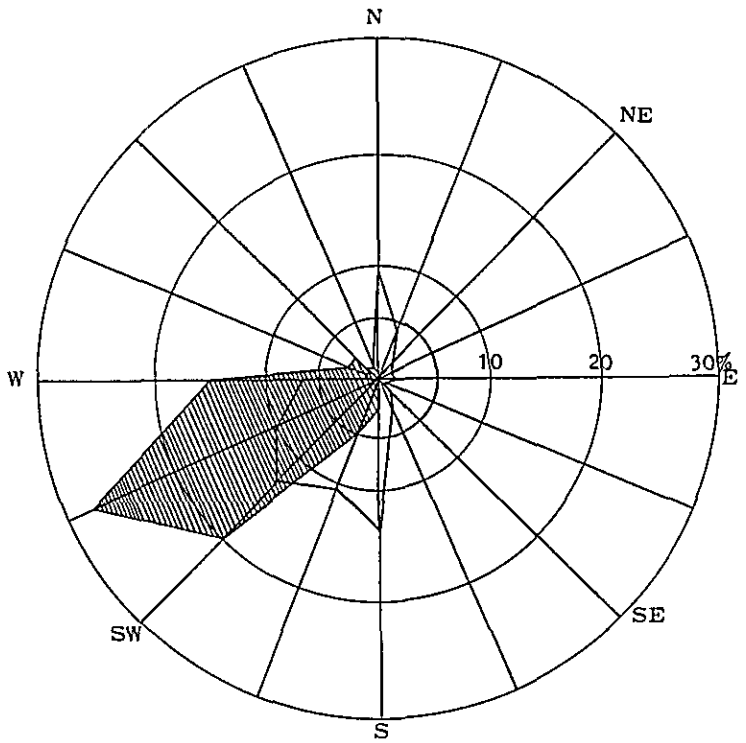


Map. 5-2-1

Development Plan of
Coastal Industrial Area
Changwat Chonburi

Fig. 5-2-1 Frequency of wind (%) >17 knots

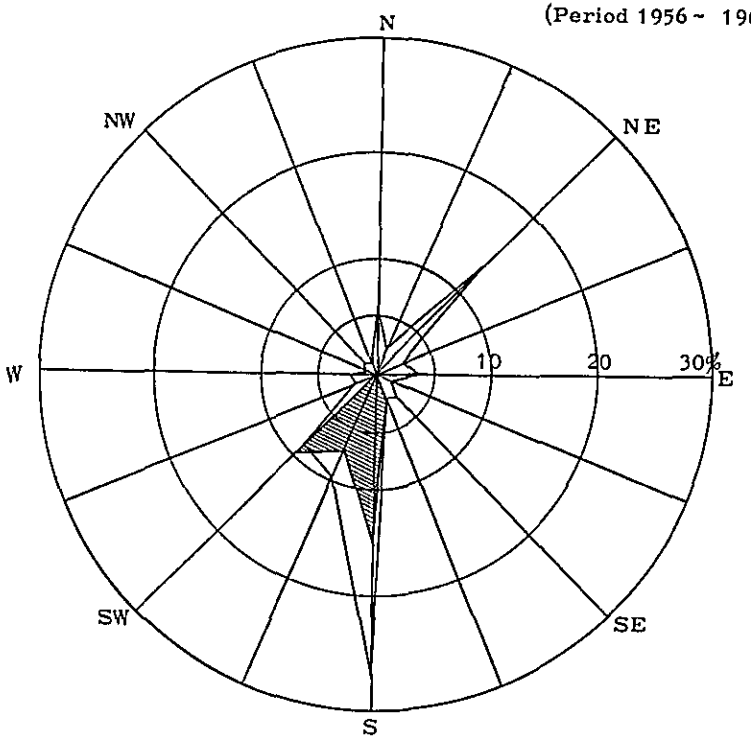
SATTAHIP STATION



Frequency of wind (%) >17 knots

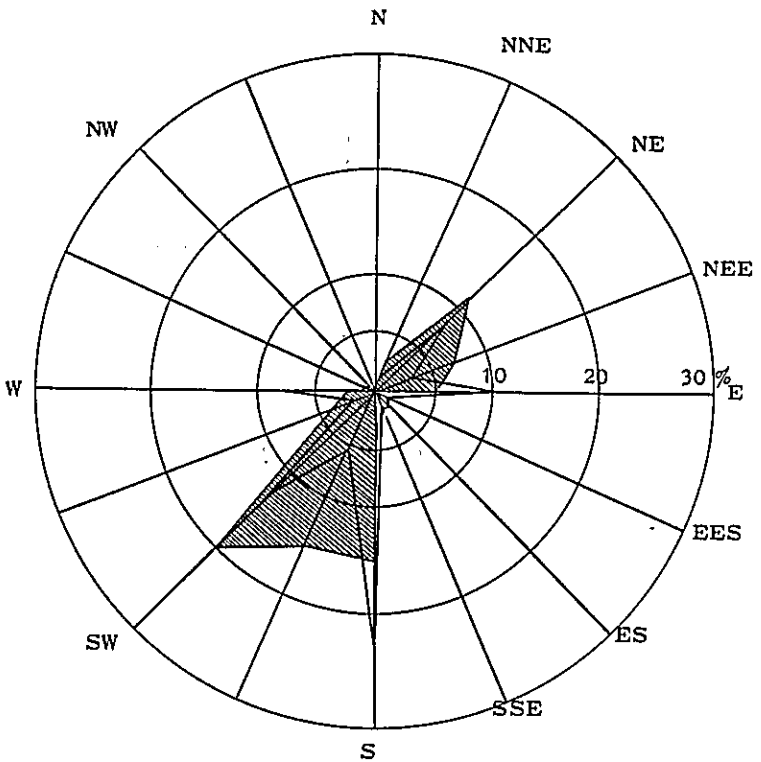
POM PRACHUN STATION

(Period 1956 ~ 1965)



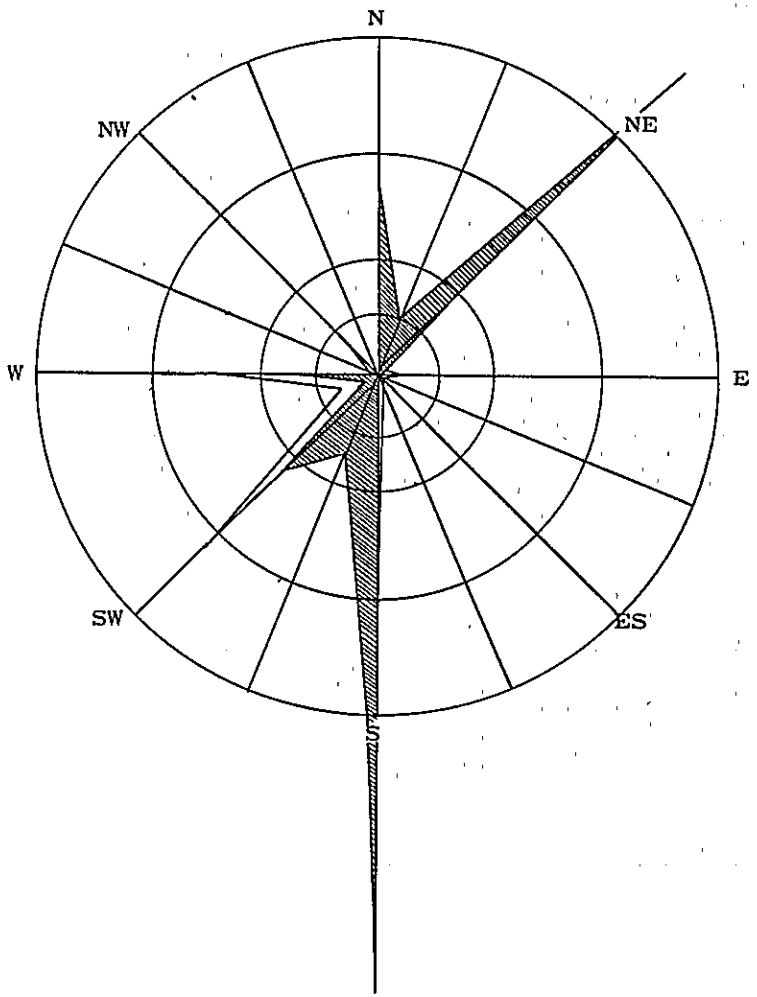
Frequency of wind (%) (1951 ~ 1965)

CHON BURI STATION



Frequency of wind (%) >17 knots

KOH SICHANG



From the abovementioned data on wind velocity, the sizes of the waves which will affect the construction works of a port most can be figured out indirectly, but it is necessary to make an additional survey prior to the commencement of the construction works on the blowing time, distance, direction and velocity of the winds. (can be figured out by using a sea chart.) From the above, the necessity of constructing a jetty, its direction, extension, height of embankment, size and a level of foundation of filled-in land will be decided.

With respect to the plan of construction of a commercial port, since the port facilities are to be arranged in water space 1,400 meters south of a cape in Laem Chabang, 20,000,000 m^3 of land can be reclaimed by filling in the southern sea area up to a depth of 3 meters. By using earth and sand dredged from the sea routes approaching this area, both sea routes and reclaimed lands can be completed at the same time.

The performances of large pump-type dredging ships in our country show that they are capable of transferring earth and sand over a distance of about 3,000 meters in case of ordinary earth and sand, and one such ship turns out 3,000,000 - 3,500,000 m^3 of earth and sand a year.

The number of such ships to be employed for the work can be decided on the basis of the date scheduled for completion or the construction period.

As to the northern area of the commercial port, land reclamation on a large scale is difficult because of the low, hilly area which is immediately adjacent to the sea, yet a ground in the vicinity of 500,000 m^3 in area can be reclaimed by filling in the shallow shore area with earth and sand dug out from the hilly areas.

Naturally, the industrial port must be studied in conjunction with the commercial port under an effective plan so that each one will not get into each other's way.

For sea routes and mooring points for this area, a depth has been tentatively set at 20 meters.

As for land reclamation, it is hoped that the government, taking into account locations of advancing enterprises, will embark on it at the actual costs, and at the same time, have the businessmen who are interested in the project defray the necessary expenses for construction works except in the case of public facilities.

Chapter VI Several Problems Concerning Industrial Development; and the Conclusion

Explanations have been given in the foregoing chapters on the present condition of industrial development in Thailand and on the feasible development sites. This chapter deals with the several problems concerning the industrial development and the conclusion.

Being given full cooperation by the Ministry of the Thai Government, the Japanese Embassy and the Japan Plant Association, the Japanese Survey Team for Industrial Estates Development in Thailand conducted a field survey for a period of one month from November 5, 1969 to December 4, 1969 concerning the proposed sites for industrial development, zoning in the city planning of each city, present condition of the areal development in each province, and how the industrial development should be carried out in Thailand.

The officials of the Ministry of Industry cooperated with the survey team and provided facilities and much information necessary for the survey. We would like to fully understand the social conditions of Thailand and formulate a plan which is really feasible and at the same time fully reflects the Thai Government's intention. The plan can be a perfect one only when our experiences in industrial development and Thai Government's knowledge of actual condition of the sites agree.

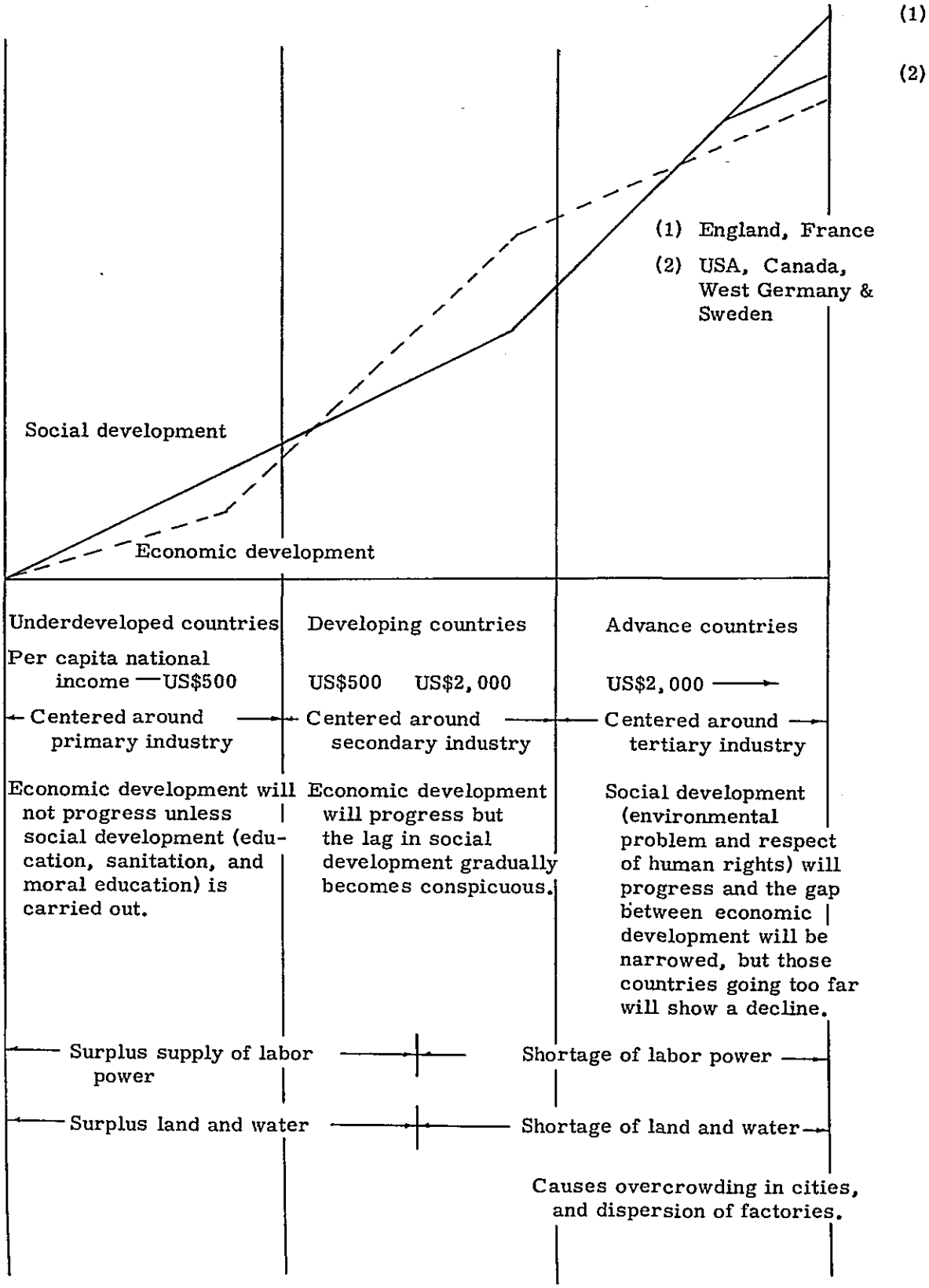
We have realized that Thailand's manufacturing industry is making a steady growth, and we believe that many investors hereafter will establish their factories in Thailand without any anxiety because the country is politically stable and the people faithful and pious. Government's full understanding of the manufacturing industry and its aid for further development are much desired.

6.1 Industrial development and the prosperity of the country

In view of the high rate of population growth and the level of national income per capita, industrialization is considered absolutely necessary for the purpose of making rich the county economically, promoting the social development, and strengthening the national defense.

We would like to consider the stages of national growth by showing a figure. We cannot definitely say that what has been shown in the Fig. 6-1-1 applies to all countries equally because of the difference in the social conditions and other circumstances, but we believe it serves as general consideration.

Fig. 6-1-1 National Growth and Development



In the stages of national growth, the stage of social development is first required, and the contents of such social development are diffusion of education, improvement of sanitary condition, and elevation of moral standard. Without these, no economic development can be expected. Unreasonable industrialization ends in a failure because this important stage is disregarded.

With the primary progress of the social development the primary industry is developed, then follows the stage of industrialization. To advance highly the industrialization it is necessary to further elevate the level of education. The manufacturing industry begins with the manufacturing of consumer goods such as textile and sundry goods, followed by the manufacturing of basic producers' goods, and then advances to the manufacture of durable consumer goods of high quality.

Up to this stage, the economic development will progress under the surplus labor power type economy, but the economic development precedes social and public investments, and the lag of social development becomes more and more conspicuous.

From about the time when the national income per capita reaches the level of US$1,500, the necessity of investment in social development will be advocated. There will be shortage of labor power, and the policy of precedence of human life will be advocated.

This type of development is applicable to a country or a region as a unit. Even in one same country, the difference as shown in the Figure can be seen between an advanced area and undeveloped area. What is most important when establishing the policy of development is to judge properly what should be done at each stage of the national growth.

Thailand has sufficient national power to promote the industrial development.

6.2 Selection of the sites for industrial development

As regards the sites for industrial development in Thailand, the following three categories can be thought of.

(1) Site for the development of coastal heavy-chemical industry.

(2) Sites for development of inland light and machine industries:

a. Site for proper distribution of the respective industry according to the zoning of the city planning and the factory law.

b. Site for establishing the industrial estate to promote development positively as a government enterprise

(3) Site for establishment of a free zone to promote development through the processing industry

The location of industry tends to expand toward the areas centering around Bangkok city. As the land price is soaring, new industries have been established in the areas 20 to 30 km away from Bangkok, and this distance is getting larger. The following table shows the classification of 1) Bangkok area where the factories are established most, 2) coastal area on the eastern part, and 3) underdeveloped areas on northern, northeastern and southern parts, into the abovementioned three categories. Our report has been prepared along with this way of thinking.

Table 6-2-1 Classification of Areas

Category	Coastal Area around Bangkok	Inland Area around Bangkok	Eastern coastal area	Northern & northeastern areas
1			◎	
2 a		○		◎
b	◎	◎	○	○
3	◎		○	

6.3 Waterways and creeks as geographical conditions of industry

Although there are various geographical conditions of industry, rivers, irrigation canals, creeks, etc. are playing an important role, and the importance of these will remain unchanged hereafter. However, when planning an industrial estate, some of these waterways may have to be filled up or altered. Again, it is considered necessary to fully grasp the present condition of the canals and secure the most reasonable land for industrial development in order to minimize the public hazards which might be caused by the discharge of waste water from the factories.

6.4 Coastal industrial area

It is now an international trend to adopt the form of industrial complex when inducing heavy chemical industry of the most modern scale, and it is most rational at the same time. For this purpose, vast reclaimed land, deep water harbors, firm foundation, ample supply of industrial water, low-priced land, and many other conditions must be satisfied. As the area along Chao Phraya River is close to the center of the capital city and may give rise to the problem of public hazards, and also it is difficult to satisfy the abovementioned conditions, it is necessary to consider a new coastal industrial area.

As the proposed site of a new coastal indsutrial area, Laem Krabang in Sriracha would be the most appropriate site. This is the proposed site for the construction of No. 2 Bangkok Port, and the Japanese Survey Team for Steel Plant Locationsis also of the opinion that this is the most appropriate location. Although more detailed scientific survey should be conducted in the future to substantiate the opinion of the abovementioned survey team, some of the favorable conditions can be mentioned as follows:

(1) Sandy coast makes possible the reclamation of land at low cost by means of dredging

(2) Weathered hills are close by and earth can be supplied from those hills

(3) As the marine condition is close to that of deep sea (- 20m) and there is an island in front, the weather conditions are favorable

(4) Road conditions are good

(5) Suitable residential land in the hinterland

(6) Good foundation

An oil refining plant has already been established in this area, and it will soon develop into the petro-chemical industry. The formation of a Complex with the establishment of power plants and steel mills can be valued highly as the benefit of aggromeration. The development of No. 2 Bangkok Port in the form of consolidation of a commercial port and an industrial port for the new coastal industrial area having compound functions as much as possible will help promote the development of this area.

As the shape of the reclaimed land will vary depending on the types of industries and enterprises, it is advisable that the government decide the shape of the reclaimed land and the scale of the port according to the demands of the factories before commencing the construction of the coastal industrial area. It is desired that the government carry out the construction of the industrial area.

6.5 Industrial water supply

The only problem encountered with concerning the construction of the eastern coastal industrial area including Laem Krabang Area is the supply of industrial water. In case the development of the industrial area should be decided in such a way that 6,000,000 m^2 will be developed in the first stage and 13,000,000 m^2 in second stage as mentioned in Chapter V, more than 200,000 m^3/day of industrial water will be required in the first stage, and this will be covered by dam raising of the Ban Phra Reservoir. Industrial water required in the second stage will be supplied by drawing fresh water from the rivers to the factories using a waterway specially provided for that purpose. This method is being used in many countries of the world. The use of ground water should be confined to the supply of municipal water to the citizens, and the feasibility of construction of exclusive waterworks for industrial use should be studied when constructing a modern coastal industrial area. Dam raising of Bang Phra Reservoir for the supply of industrial water in the first stage and drawing water from Bang Pakong River in the second stage will have to be considered as mentioned before, and it is also necessary to make a concrete study of the cost of such construction works.

6.6 Free Zone

The method of promoting industrialization by establishing a free zone in the coastal area has been actualized in Kaohsing in Taiwan, but this requires powerful government support. The manufacturing industry to be located in the free zone consists of medium and small enterprises, and in case of Thailand, the area near the estuary on the right bank of Chao Phraya River close to Bangkok would be the most appropriate location in view of the availability of cheap labor power, customs facilities and other conditions. It is advisable to study the coastal area on the eastern part in the next stage.

6.7 Inland industrial development

There are two methods of promoting inland industrial development, one is to help the enterprises decide the locations according to the zoning and the factory law, and the other is to positively establish the industrial estate to encourage the investors to establish their factories in such industrial estates. In view of the current demand and supply situation of land, it is believed that the enterprises are strongly inclined to move to the industrial estates where the land price is stable and all accessory facilities readily available.

There are three types of industrial estates, and all of them vary accordingly with the location and the scale of each.

(1) Industrial estate exclusively for the manufacturing (including circulation) industry

(2) Industrial estate for the manufacturing industry including residential area

(3) Industrial estate in the form of a new town including the manufacturing industry, residences, business and commercial area

As mentioned in Chapter IV, our way of thinking concerning the areas around Bangkok is based on the abovementioned classification.

The proposed new coastal industrial area on the eastern part is connected with Bangkok by a new highway, and the areas along the old highway at present could be called the sites suitable for industrial estates development.

The establishment of an industrial estate at the intermediate point along the old highway between the port of Laem Krabang, the coastal heavy and chemical industry area and Bangkok certainly is desirable from the viewpoint of physical distribution of commodities. As there exists no cities in this area, it is possible to plan several new towns, and the transportation situation will be much improved if the plan of constructing roads joining with the new highway is included in the plan.

The government must exercise prudence because the announcement of the estate development may become the cause of soaring of land price and interruption by the investors.

6.8 Several Points of Issue

(1) The problem of location of industry is related to a wide sphere, and it is necessary that the government secure inter-ministerial cooperation and contact. This project particularly has close relations with the zoning of the city planning, and we feel assured by the encouraging news released by the City Planning Bureau of the Ministry of Internal Affairs of the Thai Government that it would give us full cooperation accordingly with the findings of our survey. We must also maintain harmony with the authorities concerned in irrigation, agriculture and roads.

(2) The establishment of the industrial estate in the present stage is the work of the state, and it should be promoted powerfully by the state. There are many countries in which the development project is entrusted to the private developers, but such would usually involve much trouble on the phase of procurement of land and on other phases of administration. Development of the industrial estates may be entrusted to the private developers after the government has procured the land. However, it is advisable that this project should be carried out by the government as its own enterprise for some time to come.

(3) Even if the land price at the time of purchase is considered high, the land price of the land in the neighborhood of the industrial estate will further rise when the estate is constructed, industrial orientation such as power distribution facilities and roads, etc. are installed and the factories occupy the estate. The constant possession of the industrial estates by the government will help stabilize the land price.

(4) There is a fear that the heavy chemical industry in the coastal area may give rise to the problem of public hazards due to air pollution. Measures for prevention of SO_2, F, dust and smoke etc. should be established, and rational land use should be considered upon careful study of the direction of the wind and meteorological conditions. The coastal manufacturing industry should be located at the land reclaimed beyond the coastline, and in case the factories have to be built on the inland portion of the site, the position of the buildings and their distance from the residential land must be taken into full consideration.

(5) Manufacturing industries which have the fear of contaminating the atmosphere or emitting offensive smell, or may give rise to the problem of sewerage should not be located inside the inland industrial estates. Only clean manufacturing industries should be allowed to occupy the industrial estate. As regards noise, it can be prevented by locating the factories concentratedly in the center of the industrial area or locating them in the area farthest from the residential land.

Concentration of the foundries in the coastal reclaimed land having firm foundation will help prevent the public hazard due to vibration.

(6) Miscellaneous

(i) It is necessary to establish an office which handles information and planning concerning industrial orientation. Investors and the people from the local self-governing bodies may get information and guidance at this office.

(ii) It would be convenient to gather information on the acreage of land,

floor space, amount of use of industrial water, means of obtaining water, uses, and the methods of drainage etc. by sending a questionnaire to the factories.

(iii) As the effective combination of road network and the waterways will be very useful for the industrial development of Thailand, good results can be obtained by planning the construction of roads and the estate development integratedly.

APPENDICES

1. DEPARTMENT OF INDUSTRIAL WORKS MINISTRY OF INDUSTRY (THAI GOVERNMENT)

Principal Thai Officials who participated in the Industrial Estate Development Survey

Mr. Udomsakdi Bhasavanich
(Director General)

Mr. Vira Susangkarakarn
(Deputy Director General)

Counterpart Officers

Mr. Ta-Noo Vicharangsan

Mr. Somsakdi Sriyakorn

Mr. Songsilpa Poungdokmai

Mr. Annop Bunyasiri

2. JAPANESE SURVEY TEAM FOR INDUSTRIAL ESTATES DEVELOPMENT IN THAILAND

Dr. Sadakazu Iijima
(Chief of the Team)
Executive Director
Japan Industrial Location Center

Mr. Shinji Mimura
(Port and Harbour)
Inspector
Mitsui Harbour Development Co., Ltd.

Dr. Akira Konno
(City Planning)
Counsellor
Japan Industrial Location Center

Mr. Kenichi Itoh
(Public Nuisance, Power and Water)
Technical Official
Industrial Location and Public Nuisance Division
Enterprise Bureau
Ministry of International Trade and Industry

Mr. Shigeichi Mogi
(Economy and Trade)
Official
Economic Cooperation Division
Trade and Development Bureau
Ministry of International Trade and Industry

Mr. Sueo Miki
(Location of Industry)
Researcher
Japan Industrial Location Center

Mr. Jiro Watanabe
(Land Development)
Researcher
Japan Industrial Location Center

Mr. Yasushi Hirotani
(Coordination)
Official
Development Survey Division
Overseas Technical Cooperation Agency

Mr. Kiichi Takahashi
(Coordination)
Superintendent
Japan Consulting Institute in Bangkok

3. Itinerary of the Surve Team

Date	Description
Nov. 5, 1969 (Wed.)	Arrived in Bangkok
" 6, (Thu.)	Briefed by officials at Ministry of Industry. Briefed by officials at National Economic Development Board. Briefed by officials at Office of Town Planning. Met with staff of the Japanese Embassy and had informal discussions.
" 7, (Fri.)	Exchanged views with officials at Ministry of Industry.
" 8, (Sat.)	Toured SAMUT-PRAKARN, CHON-BURI districts.
" 9, (Sun.)	Toured CHON-BURI, RAYONG districts.
" 10, (Mon.)	Briefed by officials at Board of Investment.
" 11, (Tue.)	Toured SAMUT-SAKORN districts. Toured Thai Towel Manufacturing Plant.
" 12, (Wed.)	Obtained information and data at Ministry of Industry. Exchanged views with staff dispatched from JETRO and Ministry of International Trade and Industry of Japanese Government.
" 13, (Thu.)	Toured NAKHORN-PATHOM district.
" 14, (Fri.)	Toured KHON-KAEN district.
" 15, (Sat.)	Briefed by staff at Province Electricity Office. Inspected Nam Pong Dam.
" 16, (Sun.)	Toured NAKHON-RATSHASIMA, SARABURI districts.
" 17, (Mon.)	Briefed by officials at Bangkok Port Authorities.
" 18, (Tue.)	Inspected the basin of the Maenam River.
" 19, (Wed.)	Toured NONBURI, PATUM -TANI districts.
" 20, (Thu.)	Summarization of data at Ministry of Industry.
" 21, (Fri.)	Toured CHIENG-MAI district.
" 22, (Sat.)	Toured RAMPANG district.
" 23, (Sun.)	Holiday
" 24, (Mon.)	Toured CHIENG RAI district.
" 25, (Tue.)	"
" 26, (Wed.)	Left CHIENG-RAI and arrived in Bangkok.
" 27, (Thu.)	Briefed by officials at Hydrographic Department.

Date	Description
Nov. 28, 1969(Fri.)	Briefed by officials at Royal Irrigation Office. Toured Isuzu Automobile factory.
" 29, (Sat.)	Preparation of interim report.
" 30, (Sun.)	Same as above
Dec. 1, (Mon.)	Met with staff of the Japanese Embassy for briefing on the interim report. Toured BANG CHAN industrial estate.
" 2, (Tue.)	Submitted on interim report to Ministry of Industry of the Thai Government, and had discussions with officials.
" 3, (Wed.)	Preparation for departure. Attended a party given by Ministry of Industry..
" 4, (Thu.)	Left Bangkok.