4.2.3 Tourism Promotion

1) Marketing

In spite of the role of tourism as a major income making industry of Phatthaya, the budget and the staff of the tourism promotion division of City Gov. are very limited (annual budget was 300,000- Baht in 1989 and 2 persons in the division). In order to promote more initiative of the city, following measures shall be taken.

(1) Increase of budget and staff of the city.

(2) Improvement of the image of Phatthaya

Beach resort and night entertainment have been major tourism attraction of Phatthaya. But since the Phatthaya directs to the international resort and regional centre, it is required to improve its image of the development direction to be a multi-function city.

In order to invite the family resort visitors for a healthy resort, it is required to promote;

- Tourism exhibition to emphasize the improvement of regional image and possibility to the overseas market. The exhibitions shall be supported by TAT, airlines, travel agencies union, newspaper and hotels to promote another image of Phatthaya.

- For the domestic market, the mas-media such as television, newspaper and magazine, TAT and airline will be the major supporting bodies.

2) Development of Tourism Attractiveness

(1) Increase the choice of Tourism Attractions

At present, night entertainment is only the after dark tourism attractions in Phatthaya. The limited tourism resources structure is insufficient to satisfy the requirements of various international guests.

According to the world tendency of the active resort style, the performance of arts and culture will attract the international visitors. Concert, ballet, theater, operetta, exhibitions, lecture, symposium,

international meeting etc. will broaden the choice of demands of the visitors.

(2) Support to the private tourism enterprises.

In Phatthaya, Nong Nooch Village, Mini Siam, Phatthaya Circuit, Elephant Farm etc. are operated by the private enterprises. Expansion of family resort will increase the role of those tourism resources. Support for advertising, promotion and financial preference will encourage the operation to attract the visitors. It is also effective to increase visitors during low season.

(3) Promotion of the convention and events.

Convention and events will bring the incomes from outside of region and contribute to the economy of Phatthaya. The conventions will also appeal the change of image of Phatthaya.

At present, Phatthaya is 3rd popular convention place in Thailand followed to Bangkok and Chiang Mai. In 1987, the big events for visit Thailand year performed in Phatthaya invited 2.2 times more visitors than 1986.

In order to promote the conventions and events, it is required to establish the Execution Committee with permanent staff. The head of the committee must be an influential persons to Phatthaya council, changwat administration and central government. The duty of the committee is to make the plan promotion arrangement of the facilities to invite the visitors, arrange the finance source, conduct the conventions and events in successfully.

Advertising to the international market shall be responsibility of Association of Incentive and Conventions of Thailand. Promotion to the domestic market shall be supported by the Government and private sector.

3) Upgrading of the Regional Tourism

The regional tourism centred in Phatthaya is already started. The function as the tourism sub-centre is being actualized. The destinations from Phatthaya are covering almost of the popular destinations in Thailand such as Chiang Mai,

Golden Triangle, Kanchanaburi, Phuket and Song Kla. The frequent direct bus service to Don Muang Airport is already being operated.

According to the open to the private use of U-Tapao airport for charter flights, difficulties of accommodation and transport in Bangkok the weight of Phatthaya as tourist sub-centre. The regular flight to Chiang Mai and Phuket is being expected from next year.

(1) Reinforcement of information functions

In order to further upgrading of the function of Phatthaya as a tourism sub-centre, it is required to improve the domestic and international telecommunication system. The expansion of the tourism and conventions will require more service of the information functions such as telephone, faximile and data communication. Growth of business function shall require more sophisticated communication system network with all the areas of the world.

Computer on-line system will contribute to the tourist services and financial market of Phatthaya. Reservation and ticketing of transportation, hotel, conventions and performance which will be held in all of the major cities in Thailand shall be required. Other necessary information for the tourists such as event schedule, hotel list, time schedule, exchange rate, price list and tourism news shall be available.

4) Security Improvement

(1) Security

Security of the tourists is the basic requirement of the tourism. At present, the security of Phatthaya depends on 4 differently security agencies, such as police officer, and marine police controlled by MOI, tourist police by TAT and security officer by Phatthaya city.

In comparison with the population, including tourists, and the number of cars, jet scouters, boats, the number of the police and security officers are not enough to protect the residents and tourist.

It is recommended to increase the number of officers to upgrade the security in Phatthaya.

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In comparison with the population, including tourists, and the number of cars, jet scouters, boats, the number of the police and security officers are not enough to protect the residents and tourist.

Improvement and increase of the traffic safety devices, medical facilities and communication are also the requirements for the security.

5) Manpower Development

(1) Background

Development of human resource is an essential requirements of the establishments in Phatthaya to maintain the workforce and its quality. The major industries in Phatthaya, such as tourism and commerce are supported by the continuous manpower supply to keep its quality level of their services. The reputation of Phatthaya as an international resort area is deeply depends on the quality of services and efficiency of the tourism related industries.

Therefore, continuous effort to keep the well trained personnel for maintaining the quality level of services and facilities are fundamental requirements for the prosperity of tourism in Phatthaya.

According to this point of view, it is strongly recommended to establish an appropriate training facility to satisfy the fundamental requirement in Phatthaya.

The vocational training school majoring the tourism and business, named "Phatthaya School of Tourism and Business", will be established in Phatthaya. The candidate location of the school will be proposed at Business Core which is planned near the crossing point of North Phatthaya Road and Sukhumvit Highway.

(2) Establishment of the Training School

① The establishment of the training school

The existing organization, "The Committee of Tourism Promotion of Phatthaya should promote the establishment of the training school. It is headed by the Vice President of TAT as the Chairman with members comprising of chiefs of government agencies, state enterprises of Chonburi, PCG, representatives of private organizations including Phatthaya Chapters of Thai Hotels Association, Small Hotels Association, Restaurants and Food Shops Association of Phatthaya etc.

The role of the Committee is to prepare the establishment of the school. The coordination of the government agencies and financial arrangement are the major requirements for the establishment.

The license system is also required to certify the results of the training program. The licence issued by the Committee will be recognized by tourism and business establishments in all of Thailand as a certification of abilities and experience of the graduates. The official guarantee for the recruitment with the licence will be a good motivation for the trainees and good policy for the school to invite good students to the training program.

② Training program

According to the demands of local labour market, the Committee must prepare the most appropriate training program. The program should be prepared in wide variety of the subjects and arranged to obtain the licence as a result of training.

The program aimed to train the middle managing personnel to upgrade the general quality of the personnel. It is also required to train the skilled manual working staff for maintenance works.

- The program for middle management course consists of the following subjects :
  - General view of the tourism industry
  - Hotel and restaurant management
  - Travel agent management
  - Tourism development planning
  - Marketing and promotion
  - Accounting and general affairs
  - Trading and commerce

- Staff training course include the following subjects
  - Secretarial technique
  - Computer technique
  - Service technique
    (housekeeping, reception, restaurant and banquet)
  - First aid

- Maintenance technique for electricity, mechanic and carpentry

- The following subjects will be given in accordance with the necessity
  - Language
  - Psychology
  - Socio-economy
  - Art, culture and history
  - Environment management

- The senior course to train the instructor shall be included to grow the teaching staff of the school. Special lectures by overseas experts and experienced member of the Committee will be provided to the school by arrangement of the committee and supporting association.

③ Establishment of the training school

- The "Phatthaya School of tourism and Business" will be located at the proposed business core near the crossing of North Phatthaya Road and Sukhumvit Highway.

- Establishment of the school is expected as early as possible by the strong initiatives of the Committee. Arrangement of the financial source shall be conducted. Subsidy from TAT and contribution from members will be major part of the source. In order to secure the financial background of the school management, it is recommended to establish the back up organization such as school foundation which collect the necessary fund with the contribution by the establishments who intend to recruit the graduates or to send their staff for upgrading.

- Cooperation with the private sector

  The training program shall include the intensive practice training on the job site. The practic experience in administration, accounting, reception, banquet and restaurant management, catering, maintenance etc. shall be conducted in cooperation with the private sector. The members of the

Committee must offer those opportunity for the students. This program is also advantageous for the hotels and restaurants for recruitment of the graduates.

The lecture by the expert who is rich in practic experience will be very helpful for the students. The cooperation by the members of the committee to send their experienced staff for the lecture is a very helpful opportunity for the students.

(3) Establishment of "Human Resource Data Bank"

In order to promote the recruitment of the graduates, establishment of "Human Resource Data Bank" is recommended. The data-base of the graduates and candidates will be registered at the data bank. It will be used as the information exchange bank for the employer and employment candidates. They may refer the conditions each other. It will contribute to improve the labour environment.

The financial source of Data Bank will be following three, the Registration and membership fee, charge of the recruitment commission and own business.

① Data Bank is operated with membership system by the establishments who intend to recruit the personnel with good quality. Only the members can refer the data of the registered manpower.

② The charge to the recruitment commission is paid by the employers. The candidates can register their data in free of charge. When the employment contract was made, the employer shall pay the commission.

③ Other business will be undertaken by the accumulation of rich information of human resource. Provision of the temporary staff for secretary, operator of computer and OA equipments, will be requested in accordance with further development of business and commerce and generate the additional incomes. Translation, advertising, publishing and planning will increase own further business opportunities.

4.2.4 Tourism Facilities

Development plan of tourism facilities consists of the following three proposals.

- Reinforcement of accommodation
- Reinforcement of tourism attractions
- Introduction of new tourism function

1) Reinforcement of Accommodation

(1) Necessity of new Accommodation

New development of accommodation is required according to the projected increase in tourist demand.

Based on the future tourist projection, 11,600 hotel rooms and 8,700 condominium units will be additionally needed in the year of 2006 as shown in Table 4.2.4. Since the existing facilities are 6,700 hotel rooms and 9,100 condominium units respectively in the study area, 4,900 hotel rooms will be newly required by 2006.

(2) Distribution of New Development

Future distribution of accommodation is shown in Table 4.2.5.

Considering that Jomtien has enough vacant land of 290 ha in sea front and its hinter land as shown in Table 4.2.6, new hotel developments in addition to existing development are mainly (70%) distributed in Jomtien area. With a realization of new hotel development Jomtien area will become a new core of accommodation in Phatthaya resort.

Although Sattahip, Tha Farang and Ko Lan area still have a beach front, they are excluded as hotel development areas because of their desired nature oriented development.

2) Reinforcement of Tourism Attractions

(1) Development of Reclamation Land in South Phatthaya

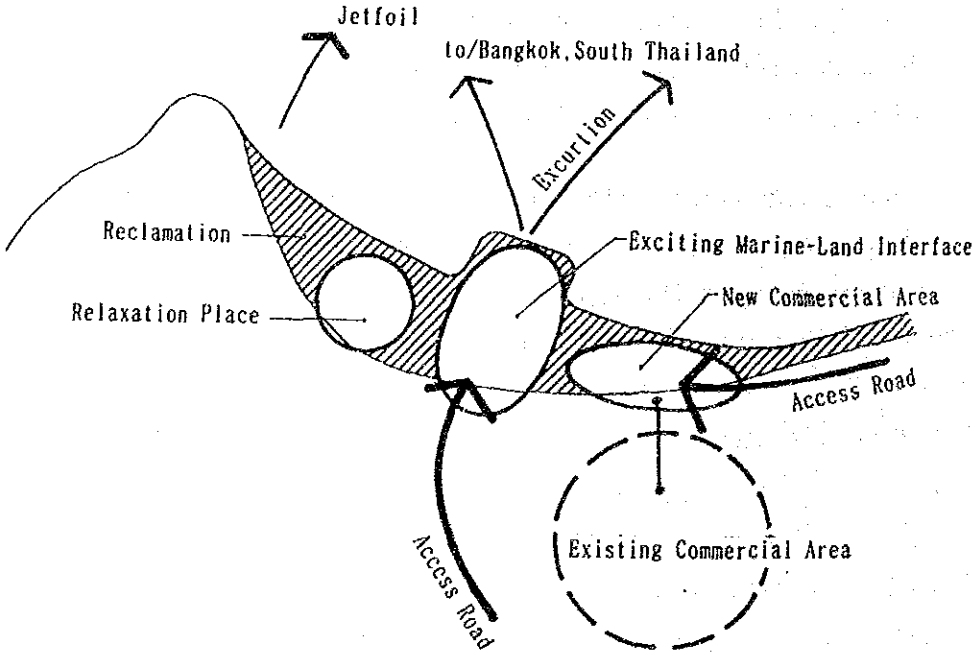
Background and Necessity

- New tourism function as for event and culture can be developed.
- A large park and/or open space, developing level of which is very low in Phatthaya City is eagerly required to fulfill the requirement of tourists and citizens.
- Renewal of illegal shops and restaurants in water front can be realized with utilization of a part of reclaimed land.
- Land transportation facilities such as car parking and bus terminal for excursion tourist should be installed.

Project Outline

Following four elements are essential and should be incorporated in the development of reclamation area.

a. Crowded and "marine-land interface" of many excursion tourist.
b. Commercial area with various restaurants, shops and other amusement facilities where tourists can enjoy shopping.
c. Relaxation place in water front for the citizen and tourist.
d. Supporting infrastructure, especially traffic facilities.



Following facilities are proposed into the reclaimed land. Detail land use and facility distribution are studied in Part II, Chapter 6.

Function	Facilities	
① Marine-land interface	① Event facility	Event square, Conference center, Trade fair center, Fashion show stage
	② Tourism terminal ..	Boat control, Information, Travel agency,Restaurants
② Reinforcement of commercial function	① Restaurant	
	② Shopping plaza	Duty free shop, International shop, Sea food market, Art center, Craft center, Restaurant
	③ Entertainment	Movie theater (wide screen), Concert hall
③ Relaxation place for citizen and tourist	① Avenue, Promenade	
	② Park	Carving park, Orchid park, Lawn park, Fountain, Children club, Water front park Water stream
	③ Athletic	Jogging trail, Tennis court, Fitness park
	④ Culture	Concert hall, Theater, Library
④ Supporting Infrastructure	① Traffic	Access road, Car parking, Bus terminal
	② Safety guard	Police, Fire station First aid
	③ Others	Bank Clinic, Telecommunication,

(2) Restoration of Phatthaya - Beach

Phatthaya beach has very limited beach width and its sea bed seems to be covered by polluted mud. Artificial beach construction is proposed for beach widening and restoration of seabed at the same time.

Construction of an artificial beach made by sand fill seems technically not difficult because of shallow water and gentle wave. Concept of an artificial beach is shown in former section 4.2.2 detailedly.

Beach promenade restoration is also proposed in order to create the shopping street in front of shops and hotels as shown in Fig. 4.2.8.

(3) Development of Jomtien Beach

Although Jomtien beach faces clean sea water suitable for swimming and gentle wave with proper wind attracts a lot of marine sports lovers, undeveloped infrastructure threaten to occur the deterioration of

popular beach when the drastic tourism developments were disorderly realized in Jomtien beach area.

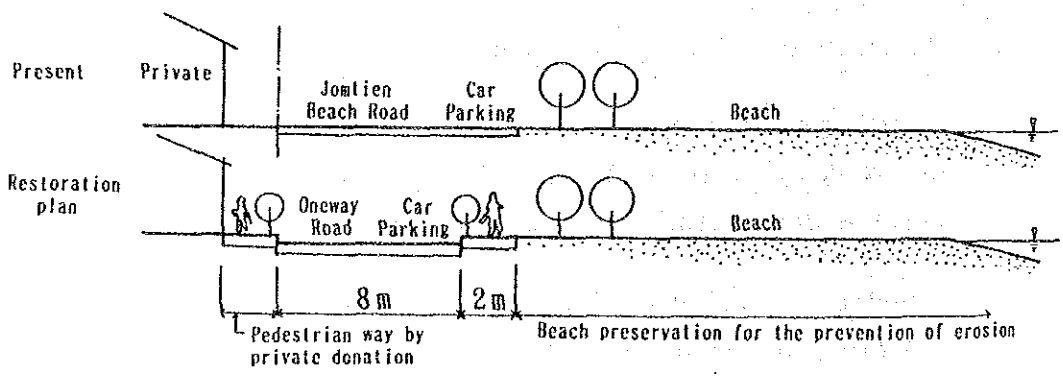
To protect Jomtien Beach from the deterioration by disorderly development and, following developments and restorations are proposed in Jomtien beach area as long-list projects.

① Restoration of Beach Road

Most desirable plan for beach road restoration is the construction of second beach road and the change of existing beach road as a pedestrian mall and/or a promenade.

However, if the existing land use and land tenure would not allow above restoration, the second best is a construction of the pedestrian way as a minimum development along the seashore as shown below figure.

In the case of construction of pedestrian way, existing green zone must be reserved and due attention should be paid to the creation of comfortable landscape.



② Introduction of Beach Center

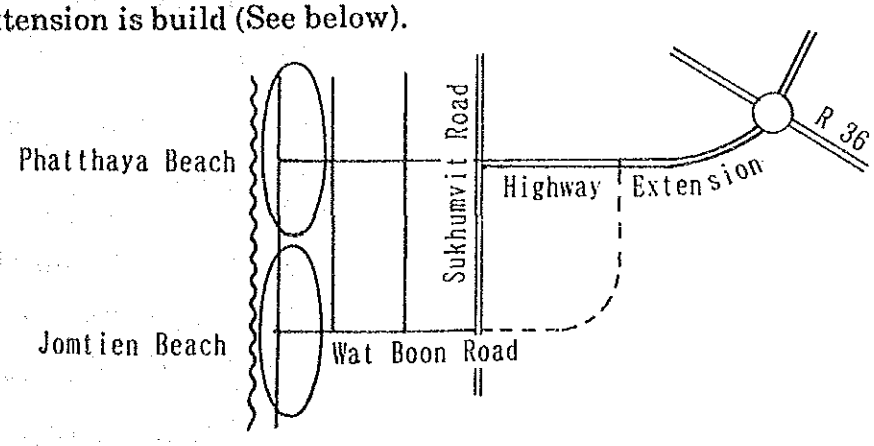
Functions

- Traffic terminal .... Bus terminal, car parking, taxi pool etc.
- Information center . Tourism information, reservation
- Head office for events management
- Accommodation for the youth training ... Economy class hotel, lodge, villa
- Commercial outlets
- Public safety ..... Marine police, Tourist police, Rescue, Security officer etc.

Location

A site at the junction of Jomtien Beach Road and Wat Boon Road as shown in the following figure was chosen considering the following advantages.

- It is located at the center of Jomtien Beach.
- The site of Wat Boon, which illegally occupies on area of 1.5 ha (9.4 Rai), could be utilized as a core site of the Jomtien Beach Center.
- Wat Boon Road will be the main access to Jomtien area, when and then direct access to Chonburi - Phatthaya Highway Extension is build (See below).



Scale and Facilities

Jomtien Beach would receive 45,000 tourist (including 27,000 daytrippers) per peak day in 2006 as described in Section 4.2.2 beach capacity & demand.

In order to deal with such a large number of tourist, transportation facilities such as car parking and bus terminal should be amply installed and an information center in which all kind of tourism informations are easily available for tourists should be introduced as a main tourism facility.

In addition, an event facility, commercial facility and accommodations that could contribute to be financial condition of the project are also proposed in proper scale.

③ Car parking Development

Car parking facilities should be developed for the day trippers. Detail study is shown in 4.2.9.

④ Well Regulated Introduction of New Accommodation and Commercial Facility

To prevent a disorderly development of accommodation and commercial facility, special zone for them must be supplied in line with the comprehensive land use plan for Jomtien beach area. Enough area for new accommodation could be found in sea front and hinterland along planned 2nd beach road in Jomtien beach to meet the land demand in the year of 2006. As for the commercial facility, shopping center are under construction in the north head area and in the central area of Jomtien beach. They could be seeds of advanced development in the future.

⑤ Introduction of Theme Park

A success of introduction of a theme park would drastically increase the attractiveness of Phatthaya resort. Swimming pool complex, animal show and large scale playing devices characterized by each theme could be the elements of the theme park.

Theme park is proposed to be developed next to the central commercial zone.

(4) Inland Tourism Development

Although there are already some tourism facilities in inland area, more of them are heeded as sightseeing is a major activity as well as beach recreation according to the tourist survey conducted by JICA Team. Family type facility and sports oriented facility are especially desirable to be augumented as in Table 4.2.7.

(5) Strengthening of Information Centers

TAT Phatthaya and the tourism promotion division of Phatthaya City Hall are being operated as a sort of information center for the visitors. Due to the manpower and budget limitations, however, their efforts are not so successful. A new and effective information center must be set up in Phatthaya.

(Tasks of Information Center)

- Guidance and arrangement for accommodation to the tourist
- Explanation of history and events of Phatthaya City
- Ticket handling of transportation (Bus, Excursion boat, Jet foil etc.)
- Reservation of restaurants and other entertainments
- Introduction of tourist guide
- Communication with the other tourism area in the whole Kingdom
- Others (stray child care, grievance machinery etc.)

3) Introduction of New Tourism Functions

In order to compete with other tourism resorts especially in Asean countries which endeavor to introduce new tourism facilities, Phatthaya should better have advanced tourism devices.

(1) Sky Sports

Sky sports, rapidly getting popular as a new leisure activity, are desirable to be introduced in addition to marine sports in Phatthaya.

Sky sports are divided into two types: one is somewhat special sports such as balloon, glider, parachute and hang glider which have worldwide competition shown in the following table, the other is handy sports such as paraglider, flying boat, gyroplane as shown in Fig. 4.2.9. Boat towing

paraglider and flying boat are very suitable for Phatthaya and likely to become popular.

For special sky sports such as glider, Utapao airport located within one hour drive distance from Phatthaya downtown may be utilized as a training center.

WORLD CHAMPIONSHIP OF SKY SPORTS

Year	1984	1985	1986	1987	1988
Balloon					
Hot Balloon	-	USA Battlecreek (July 12 ~ 12)	-	Australia sealion (Sep. 5 ~ 11)	-
Gas Balloon					West Germany Augsburg (Sep. 23 ~ 10)
Glider	-	Italy Lieti (June 28 ~ July 12)	-	Australia Benalla (Jan. 15 ~ 31)	-
Parachute	France Visie (Aug. 29~Sep. 9)	Ugoslavia Mau Losinj (Sep.16~28)	Turkey Ankara (Sep. 2~13)	Brazil Rio de Janeiro (Oct. 1~11)	Sweden Scopin (July 25~Aug. 7)
Hang Glider	-	Australia Cossen (May 25 ~ June 9)	-	-	Australia Victoria State (Jan. 22 ~ Feb. 13)

Source: Ministry of Transportation of Japan

(2) Theme Park (Large Scale Amusement Park)

Introduction of an attractive large amusement park typically represented by Disneyland in USA would increase the tourism potential of Phatthaya dramatically and is worth consideration. Small scale playgrounds such as Ocean world (Bang Saen) and Mini Siam (Phatthaya) were already developed by private sector. However, the first development of large scale amusement park is proposed in Phatthaya as a top resort in Thailand.

Existing theme parks in Japan and USA are shown in the following table.

Location		Guest No. per year (1987)	Remarks
Walt Disney World	Frolida USA	26.0 million	2,024 ha
Disneyland	California USA	13.5	
Frolida Sea World	Frolida USA	4.8	
Bush Garden	- ditto -	3.1	Giant Panda
Sider Point	Ohio USA	3.1	Water Park
Disneyland	Tokyo Japan	12.0	100 ha
Nagasaki Holland	Nagasaki Japan Village	1.7	

Remark: Major parks only

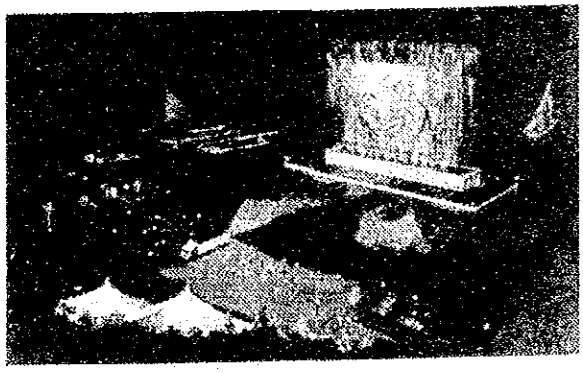
Theme park in Phatthaya will include fresh water pool complex, a show of sea mammal and large scale playing devices. Suitable location of the site is proposed in sea front of Jomtien Beach or inland area where cooperation with inland tourism facilities as mentioned earlier could be expected.

(3) Daily Events

Parade, beauty contest and other attractions in the Phatthaya Festival attract numerous tourists in every April. This effective event is proposed to be conducted more often in order to attract more tourists.

Although large scale event is to be limited once or twice per year, of course, small scale event and/or festival held daily in Phatthaya downtown can captivate tourists who can only stay two or three nights in Phatthaya.

Parade of musical band along the beach promenade in twilight time and water vision at night for instance are proposed.



Water Vision

(4) Spot Parks in Downtown

Inadequate number and space of parks in Phatthaya make tourist uncomfortable while strolling. Development of spot parks along beach and second beach road in Phatthaya and Jomtien would be desirable and effective. They are very realistic because of a small land requirement. A large park can be provided in the reclaimed land in South Phatthaya.

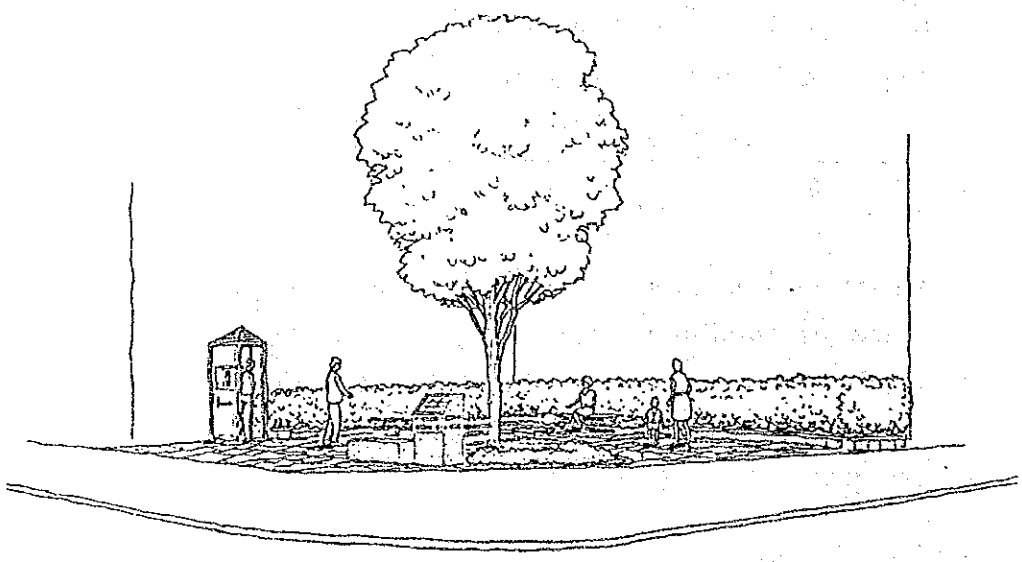


Table 4.2.4 REQUIRED NEW DEVELOPMENT OF ACCOMMODATION

① Guest Number Increase (person)	② Guest Number in Peak Day (person)	③ Guest Demand by Hotel Rank (person/day) /2 /3		④ Required Increase Number of Room (Rooms)	⑤ Existing Development Number (Rooms)	⑥ Required New Development (Rooms) ④−⑤	⑦ Density (Net) (Rooms/ha)	⑧ Required Area (ha) ⑤/⑦ /5	
(1989-2006)		Present	Future					Case II-1	Case II-2
96,000 × 17 year	1,632,000 × 0.02	H HL (50%) → (25%)	8,000	8,000/1.8 = 4,400	2,716	1,700	40	44	75
= 1,632,000	= 32,000	E HL (30%) → (30%)	9,600	9,600/1.8 = 5,350	3,549	1,800	100	18	31
		B (10%) → (10%)	3,200	3,200/1.8 = 1,800	400	1,400	20	70	119
				Sub-Total 11,550	Sub-Total 6,665				
		Cond (10%) → (35%)	11,200	11,200/3.6 × 7/2.5 (<4) = 8,700	9,083	−	70	−	−
		Total	32,000	Total 22,450	Total 15,748	Total 4,900		Total 132	225
(1989-1996)									
96,000 × 7 year	672,000 × 0.02	H HL (50%) → (40%)	5,200	5,200/1.8 = 2,900	2,716	200	40	5	-
= 672,000	= 13,000	E HL (30%) → (30%)	3,900	3,900/1.8 = 2,200	3,549	-	100	-	-
		B (10%) → (10%)	1,300	1,300/1.8 = 700	400	300	20	15	-
				Sub-Total 5,800	Sub-Total 6,665				
		Cond (10%) → (20%)	2,600	2,600/3.6 × 7/2.5 = 2,000	9,083	−	70	−	−
		Total	13,000	Total 7,800	Total 15,748	Total 500		Total 20	

Remarks: /1 H HL ... High Rank Hotel (4~5 Star HL)
E HL ... Economy Hotel (1~3 Star HL)
B ... Bungalow & Guest House
Cond ... Condominium

/2 Present guest percentage by the kind of accommodation is based on the existing number of rooms and units of accommodation and occupancy ratio by each rank.

/3 Ratio falls assuming part of hotel guests shift to condominium rooms.

/4 Units of condominium must be increased because of limited use of weekend (2.5 days in one week)

/5 Calculated by multiplying case II-1 figures by 1.7 (ratio of average annual increase of guest arrivals in case II-2 (163,000) to that of case II-1 (96,000)).

Table 4.2.5 FUTURE DISTRIBUTION OF ACCOMMODATION BY REGION

(Rooms, Units)

			Phatthaya	Naklua	Khao Phatthaya	Jomtien	Sattahip (Tha Farang)	Others	Total
Present Distribution	Hotel & Bungalow		10,410	2,504	1,839	1,076	3,296	56	19,181
	Condominium (Units)		69	361	639	194	205	–	1,468
Future Districution in 2006	Hotel & Bungalow	Total	12,249	3,004	2,514	7,367	4,656	556	30,746
		Existing	(10,410)	(2,504)	(1,839)	(1,076)	(3,296)	(56)	(19,181)
		ExistingDev.	(1,489)	(–)	(425)	(2,891)	(1,360)	(500)	(6,665)
		Additional Dev.	(750)	(500)	(250)	(3,400)	(–)	(–)	(4,900)
	Condominium	Total	3,038	1,368	3,310	1,672	1,163	–	10,551
		Existing	(69)	(361)	(639)	(194)	(205)	(–)	(1,468)
		Existing Dev.	(2,969)	(1,007)	(2,671)	(1,478)	(958)	(–)	(9,083)

Remark: Tourism demand is case II-1

Table 4.2.6 VACANT LAND IN JOMTIEN AREA

High Rank Hotel & Condominium	110 (ha)	Sea Front Vacant Land in Jomtien Beach, lot depth = 400 m
Economy Hotel, Bangalow, Guest House	180	Vacant land behind planned Jomtien 2nd Beach Road, lot depth = 200 m, lot front = 50 m
Total	290	

Remark: Assumed based on field reconnaisance

Table 4.2.7 DESIRABLE INLAND TOURISM FACILITIES

Type	Name of Facility	Facility Contents	Visitor	Remarks
① Family Type	a. Bird park	• Large Scale bird cage • Bird theater • Rapacious bird's cage • Flying mammals	• family tourist • Student • A part of foreigner	
	b. Fruit garden	• Self picking of tropical fruit • Spot sale of fruit	• Foreigner • Domestic • Family and group tourist	
	c. Botanical garden	• Large scale orchid garden • Cultivate and display precious pieces • Spot sale of orchid • Tropical forest garden	• Foreigner • Student	
② Sports Type	d. Athletic complex	• Multi purpose ground • Tennis court complex • Pool • Archery • Field athletic • Picnic trail/picnic park • Jogging course • Others	• Student • Foreigner (economy class) • Domestic	Cooperation with existing Panarak Park must be needed.
	e. Health center	• Kursaal • Athletic gym • Medical center • Aged people's sports complex	• Foreigner (economy class) • Domestic	
	f. Sky sports	• Hot baloon • Glider • Hang glider • Paraglider etc.	• Foreigner	Cooperation with existing horse-riding and/or elephant garden must be needed.
③ Access Road	Access road between inland tourism facility and Phatthaya downtown must be improved.			Existing road is bumpy latelite.

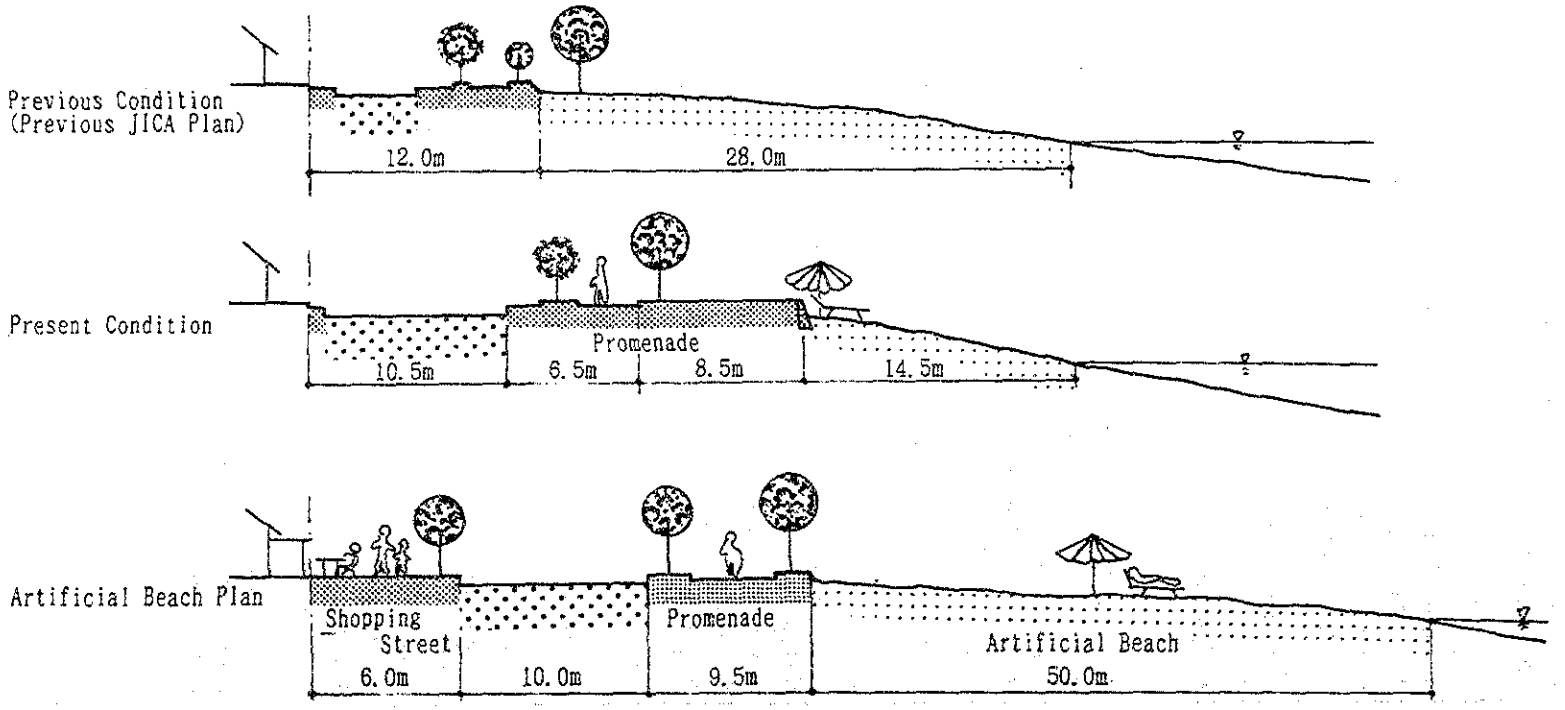


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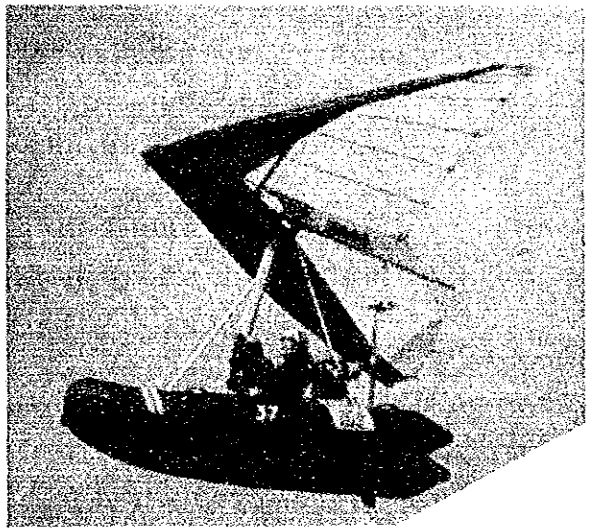
Fig. 4.2.8 Artificial Beach and Promenade Plan of Phatthaya Beach

Boat towing paraglider

(① Towed by boat, ② Release in a high altitude, ③ Control by itself)



Flying boat

Gyroplane

Fig. 4.2.9 Handy Sky Sports

4.2.5 Sewerage

1) Introduction and Sector Study Objective

Unprecedented rapid growth in the tourism industry in the Phatthaya area has considerably outpaced infrastructural development. As a result, environmental pollution arising from a lack of adequate wastewater management and control, has emerged as a serious problem, particularly in Phatthaya town and Na Klua and, potentially, in the Jomtien area. The need for determined efforts to resolve these problems is clear. Further growth in the area is foreseen and, the Government of Thailand, fully recognizing the needs to both, overcome the existing problems and to anticipate future demands, has initiated measures with this aim. The objective of this sector study is to develop a comprehensive wastewater management plan and implementation strategy that:-

- Rapidly address the existing and emerging wastewater pollution problems and secures tourist beaches and bathing waters against unacceptable contamination and health risks.
- Provides a flexible framework for future sewerage and sanitation development that anticipates the needs of long-term development planning proposals formulated by this study.

The Plan shall be consistunt with the needs of an international tourist resort and shall reflect the aims of the Sixth National Economic and Social Development Plan. The ultimate goal is the provision of adequate and safe disposal of all wastewaters generated in the study area.

Full implementation of the plan can be expected to improve the general health and quality of life of the community at large and to assist towards securing the continued prosperity of the tourist industry and, by extension, the community in the area.

2) Major Factors Influencing Wastewater Planning

The major factors that influence planning for wastewater management and control include:-

- Natural characteristics of the area (topography, drainage watersheds, ground conditions, etc.)

- Existing status (development, water supply, sanitary practices, pollution problems, scope, adequacy and deficiencies of existing provisions, etc.)
- Spatial distribution of wastewater sources (population distribution, planning, zoning, etc.)
- Technical criteria (unit loads, performance standards, appropriate systems/processes, etc.)

Major factors that bear on both the development of wastewater planning concepts and on implementation strategy include:-

- Plan goals and policies
- Development planning proposals (land use, water supply, etc.)
- Legislative and regulatory provisions
- Priorities (urgency of problems, protection of public health and environment etc.)
- Land availability (location, cost, etc.)
- Practicalities (access, acquisition time frames, etc.)
- Resources (management, human, material, financial etc.)
- Costs (construction, operations etc.)

3) Overview of the Study Area

The development study area is a westerly facing coastal ribbon approximately 25 km long north to south. The majority of existing development and the population is located within two or three kilometers of the coast and mainly concentrated in Phatthaya town and Na Klua in the north and on the coastal strip of Jomtien and Tha Farang beaches to the south.

The area generally comprises a gently undulating alluvial plain to the east of a sandy coastal strip. The principal natural features of the area are the rocky quartzite outcrops of Phatthaya hill (100 m AMSL), Ko Lan approximately 8 km offshore, Loam Khon hill (240 m AMSL) west of Ban Sare and the natural drainage/river systems in Na Klua, Phatthaya, Jomtien, Ban Amphoe and Ban

Sare. There is a low hill south of Na Klua/north of Phatthaya town and the low lying areas behind the coastal strip are prone to swampy conditions.

Other features include the Sukhumvit highway and the railroad both running north to south approximately parallel to, and one to three kilometers from, the coastline.

For the purpose of wastewater management planning the area divides naturally into three principal zones/zone types: (See Figure 4.2.10)

- The largely urbanized areas of Phatthaya town and Na Klua to the north which further sub-divides into two principal drainage catchments of Phatthaya town and Na Klua.
- The coastal ribbon developments on the Jomtien and Tha Farang beaches culminating in the fishing village of Ban Sare in the south and
- The lightly developed and populated areas inland and on the island of Ko Lan

In assessing wastewater management needs emphasis is placed on the given priority of overcoming the existing pollution problems in Phatthaya town and Na Klua and the prevention of similar problems emerging at the rapidly developing beach area of Jomtien.

The climate is tropical with a dry season November-April and a wet season May-October with heaviest rainfall in September/October. Average temperature is 27°C and humidity is high all the year round.

Ground water levels are generally high eg 1.0 - 2.0 m below ground level.

4) Identified Inadequacies and Proposed Policies

The identified deficiencies of the existing provisions and of the present arrangements to cope with future needs are listed in Table 4.2.8 together with policies to address them.

5) Wastewater Management Plan

A management plan to implement these policies is proposed in Table 4.2.9. The plan comprises both non-investment programmes and capital works projects and provides the basis for rapid resolution of existing problems and a framework for phased and progressive development and improvement of sewerage and sanitation services and facilities throughout the area.

6) Analysis of Wastewater Generation in the Study Area

General

The quantity of wastewater generated is essentially a function of water supply volumes while its strength or characteristics are dependent on water supply quality and the use to which the water has been put. The main source of water in the study area is the piped supply from the Provincial Water Authority's (PWA) Mab Pracharn reservoir and treatment works. This supply is available to Na Klua, Phatthaya and the Jomtien areas. It serves virtually all hotels, public and commercial developments and approximately 50 percent of residential households in its service area which is essentially restricted to the Phatthaya City area but extends into Ban Lamung to the north of the study area. Rainwater collection and shallow wells are supplementary water sources, particularly in the less densely populated and rural parts of the Phatthaya City area and distribution by private tankers, usually sourced from shallow wells, is also available. The PWA expects the residential service connection ratio to increase to approximately 77% by the study horizon year of 2006. Current and future water demand estimations by PWA are:-

WATER DEMAND PROJECTIONS

Demand	Unit	1989	1996	2006
Domestic use	lcd	230	289	303
Public Facilities	-	15% of total domestic demand		
Tourist use	lcd	800	900	900
Commercial	-	52% of total tourist demand		
Industrial use	cu m/d	780	780	780

Water supply shortfalls in the PWA system,discussed elsewhere is this Report, are at present depressing unit consumption below estimated demand levels.

Water supply to Ban Amphoe, Tha Farang Beach, Ban Sare and other settlements, mostly located along Sukhumvit Highway, and to the island of Ko Lan is by rainwater collection and shallow wells supplemented by tanker distribution. A small water treatment works and reticulation system serves part of Ban Sare village but operation is intermittent. Tanker supply to Ko Lan is provided, at Phatthaya City request, by the Royal Thai Navy to a small reservoir, located at the fishing village, for standpipe collection by residents.

Wastewater Generation - Unit Loads:

Unit daily sewage volumes and strengths are assessed for five principal sources (as water user classification); domestic/residential, public, tourist (hotels and condominiums), commercial and industrial.

i) Domestic; The unit daily volume of sewage generated is assumed to be 80% of the water consumption to allow for water lost to garden watering, laundry drying, etc. For the purpose of sewer/sewage treatment works design the unit daily volume of sewage is assumed to be equal to the water consumption. This provides allowance for sewer infiltration (ground water levels are generally only 1 to 2 metes below ground level) and for background flows in the street drainage system from, groundwater, water supply network leakage and miscellaneous washing activities, etc. Domestic sewage strength (existing) is estimated at 150 mg/ℓ BOD_5 and 120 mg/ℓ S.S. (80% BOD). Estimate is based on existing sewage treatment works influent data and review of findings of NEB Report on Domestic Wastewaters and Pollution problems in Bangkok 1987. This is equivalent to a BOD_5 load of approximately 35 gm/cap/day (compare with TISTR 1986 assessment for Chonburi of 30 gms/cap/day). With improving living conditions and changing lifestyles the BOD_5 load/capita can be expected to increase by say 1 gm/cap/day/year with a corresponding increase in suspended solids. Domestic sewage strength at 1996 is therefore estimated at 166 mg/ℓ BOD_5 (133 mg/ℓ SS) and for 2006 at 170 mg/ℓ BOD_5 and 135 mg/ℓ SS. In fact the suspended solids (SS) loadings recorded in the sewage treatment works influent are somewhat lower than the above assumptions. This is assumed due to

partial pre-treatment of discharges from some hotels and a reduction in solids in flows connected via septic tanks. It is however expected that, when flows from the proposed modified combined sewer system/interceptor sewers are received at the works, the suspended solids loadings will increase. The sewage can be classified as a weak domestic sewage.

ii) Public; Existing and future sewage flows from public premises eg. schools, hospitals, police stations, etc., are assumed to be equal to water consumption volumes and to have the same characteristics as domestic sewage.

iii) Tourist; Wastewater generated by tourists is considered for two categories; per hotel room and per condominium unit (Ex. accommodation tourist flows are accounted for under commercial classification)

Hotel Rooms; The daily unit volume of sewage per occupied room is estimated as water supply/demand in litres per guest-day (from PWA) less allowance for swimming pool replenishment and air conditioning of 340 ℓ/guest-day with average room occupancy recorded at 1.78 guests per room (From this study). Sewage flows generated are therefore estimated at; 1989 – 800 ℓ/room/day and at 1996 and 2006 – 1000ℓ/room/day for occupied rooms. The 1989 estimate compares well with NEB Report for Bangkok hotels – 770 ℓ/room/day. The strength of hotel generated raw sewage is estimated at 200 mg/ℓ BOD_5 and 150 mg/ℓ S.S. (from Previous JICA Study and miscellaneous analyses) and this compares well with same NEB Report – 190 mg/ℓ BOD_5. It is noted that many hotels have sewage treatment facilities installed although not all operate satisfactorily all the time. Average performance is difficult to assess with the data available, however, estimated average strength of hotel treated effluent is around 160 mg/ℓ BOD_5 and 120 mg/ℓ SS. This is low efficiency but compares with NEB findings in Bangkok.

Condominium Units; The unit volume of sewage per tourist occupied condominium unit is assumed equal to water consumption which is taken as per domestic per capita demand with average unit occupancies of 1989 - 5 persons, 1996 - 4 persons and 2006 - 3.6 persons. Tourist occupied condominium unit volumes of sewage are therefore 1989 and

1996 - 1150 ℓ/unit/day and 2006 - 1100 ℓ/unit/day. The sewage is assumed to have the same characteristics as domestic sewage.

iv) Commercial; Existing and future sewage flows generated by commercial premises, eg. shops, business, restaurants, etc. are assumed to be equal to water consumption volumes and to have essentially the same characteristics as domestic sewage.

v) Industrial wastewaters;- The only industry generating substantial flows and pollution loads in the study area at present is tapioca starch processing. There are currently only two factories operating, one first grade and one second grade. The second grade factory is ceasing production now and it is not expected that the first grade factory will operate for more than another year or two. The flows and loads from the grade one factory, which is located outside the Phatthaya City boundary, discharge to the Na Klua river system after treatment in stabilization ponds. This flow assumed as 2400 m^3/day at 300 mg/ℓ BOD_5 and 200 mg/ℓ SS, is only considered for the existing situation and is discounted in assessments of future conditions. Other industrial premises in Phatthaya City area comprise small workshops and food factories spread throughout Na Klua (approximately 65%) and Phatthaya town (about 35%). Water supply to these users is recorded by PWA at 780 cum/day and the sewage generated is assumed equal to water consumption with loadings, 300 mg/ℓ BOD_5 and 200mg/ℓ SS. The fishing industry centered in Na Klua, Ban Sare and Ko Lan disposes the majority of its liquid and solid wastes directly to the sea or foreshore depositing a significant but unquantified pollution load in those immediate areas. The decline in the fishing industry in Na Klua in expected to continue as investment and employment prospects in tourism related industries generally offer more attractive returns. New sources of industrial wastewater of any significance are not expected to develop in the area.

The above assessments of unit volumes of sewage are determined on the basis of the PWA's demand forecasts. At present the PWA cannot meet these demands in the Phatthaya city area and water consumption is therefore depressed. Although some water users are supplementing their PWA supply from other sources there is a corresponding reduction in the volumes of sewage generated. This overall reduction is assessed at

approximately 25%. It is expected that the PWA will be able to fully meet demand effective end of 1991 and, it is assumed, thereafter.

Seasonal Variation in Wastewater Generation

The tourist industry is seasonal and the volumes of wastewater generated vary accordingly and with accommodation type. Table below shows assessments of Thai visitors utilizing hotel and condominium accommodation and their respective average day and peak day occupancy rates. These proportions and rates have been derived from TAT statistics, survey and tourist and accommodation projections by this study.

SEASONAL VARIATION IN TOURIST ACCOMMODATION OCCUPANCY RATES FOR PHATTHAYA CITY AREA

	Average day		Peak day	
	Hotel Room	Condo Unit	Hotel Room	Condo Unit
Distribution of Thai Visitors				
1989	68%	32%	60%	40%
1996	52%	48%	40%	60%
2006	47%	53%	30%	70%
Derived Occupancy Rates				
1989	59%	14%	100%	63%
1996	55%	6%	94%	28%
2006	61%	15%	100%	57%

Remarks: Hotel Room Occupancy Rates include foreign and Thai visitors.

Population and Accommodation Distribution

Population and accommodation distributions are derived from the DTCP planning zones and survey of 1987 adjusted for 1989 and on survey conducted by this study. Population and accommodation projections are based on the recommended development plan, Plan C with moderate growth Case II-1.

Tables 4.2.10 and 4.2.11 show population and tourist accommodation distribution for 1989, 1996 and 2006 by DTCP zone and by sewerage catchment.

Table below shows population and tourist accommodation data for 1989 and 2006 for the Tha Farang Beach and Ban Sare areas.

POPULATION AND TOURIST ACCOMMODATION DATA FOR THA FARANG BEACH AND BAN SARE

	Total Population	Tourist Accommodation	
		Hotel Rooms	Condo Units
Tha Farang Beach			
1989	7,100	3,296	30
2006	8,000	4,656	1,893
Ban Sare			
1989	12,200	72	175
2006	12,000	72	175

Total Wastewater Generation

Estimates of existing and future wastewater generation are based on the existing and projected distributions of population and tourist accommodation and the unit loads development above. Table 4.2.12 shows estimates and projections of the total daily quantities of wastewater generated in the principal sewerage catchment areas of Na Klua, Phatthaya town and Jomtien on average and peak season days, for 1989, 1996 and 2006. Figures 4.2.11 and 4.2.12 summarize the projections made. Table 4.2.13 shows total daily quantities of wastewater generated in the Tha Farang Beach and Ban Sare areas for 1989 and year 2006.

7) Existing Wastewater Disposal Arrangements and the Need for Sewerage

The existing wastewater disposal arrangements comprise.

- to septic tank (or pre-treatment) and soakaway or irrigation

- to septic tank/soakaway and overflow or connection to the drainage system, rivers or sea
- to existing and already planned (89-90) sewerage and sewage treatment works (Phatthaya town only).

The proportion and volumes of wastewater being disposal via each of these systems has been assessed for peak season days. Figure 4.2.13 illustrates the findings for the principal catchments of Na Klua, Phatthaya town and Jomtien, it also shows projections for the year 2006 on the assumption that no further development of the municipal sewerage and sewage treatment facilities is implemented.

The need for formal sewerage and sewerage treatment and safe disposal to remedy the existing and foreseen pollution problems in Na Klua is clear. It is also clear that unless a sewerage/sewage treatment/disposal scheme is implemented in the Jomtien area, in the immediate future, rapidly increasing and substantial volumes of raw sewage will be discharged via drainage systems to the beach and bathing waters. The volumes of sewage discharging in this way are foreseen to increase to about 13,500 cu m/day in 2006. This is approximately 30% higher than the volume estimated as being discharged to Phatthaya beach and bay today and similar environmental degradation could be expected to occur.

For Phatthaya town it can be seen that the sewerage and sewage treatment works extensions being implemented now will intercept the majority of the sewage that is currently discharging directly or indirectly to the sea. It is noted that in the peak tourist season (1990) approximately 15,000 cu m/day will discharge to the treatment facilities, this is 2,000 cu m/day greater than the designed average flow rate of 13,000 cu m/day of the works, but within its hydraulic capacity. At times of daily peak flow and in the rainy season a limited amount of sewage can be expected to overflow to the drainage system. The projection for year 2006 illustrates the need for further major expansion of the sewerage system and a considerable increase in sewage treatment works capacity. Failure to implement further sewerage extension can be expected to result in the volumes and pollution loads discharging to the beach and sea to increase to almost twice their existing levels. This would have an immense environmental impact and it is therefore essential that further extensions of the sewerage/sewage treatment works be initiated now.

8) Demand for Sewerage and Sewage Treatment

The demand for sewerage and sewage treatment capacity in the catchments of Na Klua, Phatthaya town, Jomtien, Tha Farang Beach and Ban Sare has been assessed. The demand in the principal catchment of Na Klua, Phatthaya town and Jomtien has been determined for the years 1996 and 2006 on the basis that:

- All wastewaters that would be unacceptably discharged via the drainage system to natural watercourses and sea shall be intercepted and conveyed to treatment and safe disposal. (Priority 1)
- That settlements inland and along the Sukhumvit Highway with locally high population densities will be connected to the system. (Priority 2)
- That all properties, hotels, work establishments, etc, within the catchment area of the sewage treatment works, i.e. adjoining sewers or street drains to which discharges are authorized, will be encouraged to connect to the system and will ultimately be expected to. (Progressive programme)

The above policy will result in the majority of the urbanized areas having connection to some form of sewerage system including virtually all hotels, condominiums, commercial and public facilities and will achieve a domestic service connection rate of 50% - 60%. The balance of the population and other facilities shall continue to use on-site disposal systems. Provision of sewerage systems will generate some additional demand (over the need previously assessed) due to connection of properties within the service area of the sewage treatment works which, without a system, would have satisfactorily disposed their wastewater on-site.

Table 4.2.14 summarizes the demand assessments for Na Klua, Phatthaya town and Jomtien sewerage catchments for 1989/90, 1996 and 2006. Figure 4.2.14 shows the rate of growth of sewage treatment capacity demand and the recommended phasing for provision of the average flow capacity.

Sewage treatment demand for the Tha Farang Beach and Ban Sare areas is summarized in Table 4.2.15. Provision of sewerage to Tha Farang Beach area should be coordinated with installation of piped water supply. In Ban Sare sewerage provision could preceed improved water supply but should be designed for future flows.

9) Wastewater Management Plan - Plan Elements

The non-investment programmes listed previously (Table 4.2.9) and required for full and successful implementation of the wastewater management plan are described below.

Improvement of On-Site Sanitation

The need to improve standards of on-site sanitation provision and operation has been identified. To achieve the required improvement, it is proposed that the authorities draw up comprehensive guidelines for the selection, design, construction and operation of on-site sanitation facilities such as septic tank and leaching pit systems. These guidelines should be freely accessible to the community together with advice on their implementation and use. In rural settlements outside the practical or economic reach of sewerage arrangements, households should be encouraged to improve and upgrade their facilities where necessary and new developments should be expected to comply with the guidelines. In urban and more densely populated areas, principally the Phatthaya City area, the need for better supervision and management of on-site facilities is more pronounced and it is therefore proposed that such guidelines be enacted as local regulations and that all new developments should be obliged to comply. It is also proposed that the city require all such facilities to be registered with the city and a progressive programme of inspection be undertaken. The inspection shall identify less than satisfactory arrangements, register them as temporary and oblige the owners to improve or upgrade them within a set period of time eg one year. Enforcement provisions should be included within the local legislation to empower the city to levy fines or in the case of commercial premises etc to cancel or not renew operating licences. Such legislation should include for improved supervision of grease traps etc at restaurants etc. A five year period from enactment of the regulations is suggested us a reasonable period for overall coverage.

To support the above programme it is essential that improved and properly managed septage services are made available. It is proposed that regulation for the safe handling and disposal/utilization of septage be drawn up and enacted by local by-law. Regulations should proscribe criteria for disposal site designation and disposal method approval. Safe disposal may be effected

either by discharge to a designated site and treatment in stabilization ponds, discharge to municipal sewage treatment works for treatment, (in which case provision must be made in the works design for the heavy biological and solids loadings,) to approved land disposal where access is restricted and leaching will not pollute watercourses or water supply wells, or to solid waste land fill/disposal sites where septage can be applied after scavenging and immediately before covering with earth. The gross volumes per capita of septage are minimal compared to solid waste and significant additional area would not be required, however, leachates must not pollute watercourses or water supply wells.

The regulation should also provide for the licensing and control of private septage tanker services and the prohibition of unlicenced operators. Licences should be issued conditional upon observance of handling and disposal regulations and municipally fixed fair charge scales which should be reviewed annually.

To implement all the above proposals to a satisfactory timetable the Government may consider the opportunities for a Technical Assistance Project.

Strengthening of Existing Regulations and Enforcement

To improve the performance of private wastewater treatment facilities at hotels etc, it is proposed that the performance monitoring provisions of the existing regulation be strengthened to include for more locally based monitoring and supervision, powers for inspection and checking and more rigorous application of enforcement provisions. It is also recommend that the existing regulations be extended to include a greater range of developments eg hotels from 25 rooms up instead of the 80 rooms at present.

Planning restrictions on stilted properties on rivers and the waterfronts should be strengthened and more positively enforced. Owners should be obliged to install and use on land on site sanitation facilities. The provision of communal facilities should be considered in special circumstances.

The existing regulations for connection to foul sewers in the Phatthaya beach area and the prohibition of surface water drainage connections to these sewers should be more strenuously applied. This can be effected through a short inspection programme and if necessary enforcement.

Enforcement is no substitute for voluntary co-operation and compliance and it is recommended that Phatthaya City mount a public relations/publicity campaign spelling out the efforts that the government and the city are making and bringing home to the community at large its responsibility to contribute to these efforts. Success of such a campaign will rely on the government and the city leading the way and confirming their commitment to the Plan goals through implementation of the Capital Works Projects proposed by this study.

One immediate measure that would demonstrate that a start is being made is an increase in the maintenance and cleansing of urban drains and khlongs/river banks in the Phatthaya town and Na Klua areas.

Capital Works Projects

The capital works projects identified previously (Table 4.2.9) and required to achieve the set plan goals are described below. These required projects are categorised as long-list projects ie all identified projects. Within this listing, three projects are classified as priority projects which must be implemented to an accelerated sewerage programme if the particular goal of eliminating wastewater pollution problems in Na Klua and Phatthaya town and preventing similar problems from emerging in Jomtien, is to be realized. These three priority projects are:

- Na Klua area - Sewerage and Sewage Treatment Project
- Phatthaya town - Sewerage and Sewage Treatment Project
- Jomtien area - Sewerage and Sewage Treatment Project

Full details of these three projects and recommendation for their implementation are elaborated in Chapter 6 of this Report.

Tha Farang Beach - Sewerage and Sewage Treatment Project

There is presently no serious problem with wastewater pollution in the Tha Farang Beach and Ban Amphoe village area. The expected rapid development of hotels and condominiums, together with the service industries and communities they generate, may over the next two to three years lead to such problems particularly when volumes of wastewater increase with improvements to the water supply.

It is proposed therefore that in coordination with the improvement of water supply to the area, a basic sewerage and sewage treatment/disposal system be implemented. The system should be least-cost and simple to operate and manage.

The main elements of the scheme shall be:-

- Progressive improvement and upgrading of septic tank/leaching pit and septage disposal services throughout the area.
- Improvement of the performance monitoring of sewage treatment facilities installed by hotel and condominium developments and better enforcement of standards.
- Progressive provision of a basic sewerage system to serve settlements of Ban Amphoe and along the Sukhumvit highway and to convey partially treated effluents from large developments for final treatment and disposal.
- Provision of a simple to operate sewage treatment works to render the collected wastewaters suitable for disposal to natural drainage (watercourse).

The sewerage system shall comprise progressively extendable collection sewers or covered wastewater drains along Sukhumvit Highway north and south of Ban Amphoe. Wastewater flows in the drains in Ban Amphoe shall also be intercepted where possible. A small pumping station will be required to transfer flows from the north of Ban Amphoe river to the south and a further pumping station to deliver all flows to sewage treatment shall also (most likely, depending or site for treatment works) be required.

The treatment works should comprise stabilization ponds designed for a future capacity of 5,000 cu m/day and to achieve a discharge standard of 20 mg/ℓ BOD_5 and 30 mg/ℓ SS. The site shall be to the south of and adjacent to the river at Ban Amphoe to which it will discharge treated effluent. The works may be developed in phases but land should be acquired and reserved for the future flows. The land requirement for stabilization pond construction will be 9 Ha (54 Rai).

Fig. 4.2.15 shows outline details of the scheme. The next step is for the Government/Sanitary District to identify and acquire a suitable plot of land and reserve it for treatment works construction.

Ban Sare - Sewage and Sewage Treatment Project

Uncontrolled discharges of solid waste and wastewaters on the waterfront at Ban Sare is causing serious pollution problems. It is anticipated that these problems will become worse particularly when the water supply is improved and with the development of income generating tourist facilities such as waterfront restaurants etc.

It is proposed that, in coordination with the improvement of water supply to the village, a basic sewage and sewage treatment/disposal system be established. It is essential that this system be the least cost and simplest to operate and manage solution for it to be within the community resources available..

The main elements of the scheme shall therefore be:-

- Progressive improvement and upgrading of septic tanks/leaching pits and septage disposal services for all properties in the inland areas of the village
- Provision of a basic modified combined sewerage system to serve the densely populated waterfront area extending back to the watershed on Ban Sare road 2. together with improvement and upgrading of associated drains.
- Provision of a simple to operate treatment works to render the intercepted wastewaters suitable for discharge to the Ban Sare river.

The sewerage system shall comprise an interceptor sewer in Ban Sare road 1 parallel to the waterfront. All properties adjacent to the sewer will connect their discharges to it and all wastewaters in the drainage system between Ban Sare roads 1 and 2 shall be intercepted. A small pumping station (BS/PS 1) shall be provided at a suitable low point on Ban Sare road 1 shall convey all flows to treatment. An second small pumping station (BS/PS 2) shall collect wastewater flows from the drainage system serving the northern part of the village and forward these flows to the interceptor sewer. The street

drains connected to the interceptor sewers shall be progressively improved and upgraded.

The sewage treatment works should comprise stabilization ponds designed for a capacity of 1,750 cu m/day average flow and to achieve a discharge standard of 20 mg/ℓ BOD_5 and 30mg/ℓ SS. The works shall be sited adjacent to, and discharge its treated effluent to the Ban Sare river. The area of land required for stabilization pond construction will be 3Ha (19 Rai).

Fig. 4.2.16 shows outline details of the scheme and indicates suitable areas for locating the sewage treatment works. The works could if necessary be sited on the other side of the river.

The next step is for the Government/Sanitary District to identify and acquire a suitable plot of land and reserve it for treatment works construction. If land acquisition is found to be a serious problem consideration could be given to construction of oxidation ditches (land requirement approximately 0.3 Ha/2 Rai) or provision of a package sewage treatment plant based on the aeration or RBC processes (land requirement approximately 0.175 Ha/1 Rai). It is noted however that these plants would also require chlorination of treated effluent and a power. supply. They would be more expansive to operate and maintain and the skills required for operation and maintenance are not generally available within the community.

Phatthaya Town and Na Klua - Street Drainage Improvements

All street drains designated as part of the foul sewage collection system shall be inspected and improved and upgraded where necessary. Upgrading and improvement shall be aimed at ensuring the best flow conditions that can be achieved and shall include:-

- covering of all drains to exclude as much extraneous solid waste, grit etc. as possible
- provision of solids traps at suitable spacings
- removal of restrictions, bottlenecks etc and improvement of gradients where necessary and possible, to improve flow velocities to the interceptor sewer.

The project should be implemented by Phatthaya City administration and should be progressively extended throughout the treatment works designated catchment areas. A progressive programme of wastewater discharge connection to the designated drains should be run in parallel with but just behind the improvement programme. In Na Klua, project implementation should be coordinated with the commissioning of the treatment works and trunk interceptor sewerage project. In Phatthaya Town the project should be initiated during 1991 - 92 in the areas designated as the catchments to the extended Soi Kazem Suwan and the Soi 17 sewage treatment works. Its further expansion should be coordinated with the implementation of the Sewerage and Sewage Treatment Works Project proposed for Phatthaya Town by this study.

Phatthaya town, Jomtien and Ko Lan - Public Toilets at Tourist Beaches

The provision of public toilets at tourist beaches is proposed. Such a project would have two principal functions:-

- To provide a convenience to tourists, particularly day trip visitors, and safeguard beaches and bathing water against fouling by visitors/vendors etc.

- As part of a public relations campaign confirming Phatthaya Cities determination to tackle wastewater pollution problems and safeguard public health.

The facilities should be at suitable centers and locations along the main tourist beaches of Phatthaya town, Jomtien and Ko Lan. They should be attractive but robust with separate western style wc/urinal facilities for male and female users. At Phatthaya and Jomtien beaches where a piped sewerage system is available the toilets facilities should connected to the sewers. At Ko Lan properly designed septic tanks and leaching pits will be necessary and the toilets will have to be set back from the beach. All public toilets should be clearly signed and advertised for use. Ideally they should have full time attendants during seasonal daylight hours to ensure cleanliness and to protect against misuse (Phatthaya and Jomtien particularly). In Phatthaya and Jomtien where a piped water supply is available consideration should be given to providing beach showering facilities - these should be open air and should not discharge to the sewers - and a limited numbers of changing cubicles. At Ko Lan where piped water is

not available a supply must be provided at all times by regular manhandleable bowses supplemented by rainwater collection.

The project should be implemented by Phatthaya City. In Phatthaya town it should be implemented during 1990 - 91 and progressively extended. In Jomtien implementation should be coordinated with the provision of sewerage facilities (1991-92) and in Ko Lan implementation could commence in 1991-92. All tourist beaches should be adequately served by end 1994.

Improvement of Sanitation at Public Facilities

This project can also be viewed as part of a public relations campaign to confirm the Authorities commitment to the elimination of pollution and improved sanitation. Further, if as proposed under the non-investment sanitation programmes, the community at large is to be expected to improve, upgrade and properly service on-site sanitation facilities, it is essential that the authorities lead the way by setting an example.

It is proposed therefore that Phatthaya City and Sanitary Districts inspect all sanitation facilities to public premises under their jurisdiction. The inspection should identify less than satisfactory arrangements and register them as temporary. A progressive programme of improvement and upgrading, or where appropriate connection to the sewerage system or designated drains, should be initiated. The inspection programme should be initiated forthwith, particularly in the Phatthaya City area, with a view to allocating funds in the 1990-91 budget for commencing a progressive implementation programme,. A target programme period of two three years to completion should be adopted.

Table 4.2.8 (1)

Recommended policies to overcome inadequacies of the present sanitation and sewerage arrangements (1/3)

Inadequacy		Policy Proposed	
1	Public health-particularly in rural areas	1.1	Improve awareness of domestic sanitation needs by community training (existing policy)
		1.2	Provision of safe and adequate water supplies (existing policy) Not this sector.
2	Contamination of well water by sewage	2.1	Installation of piped water supply where ground (soil) conditions and housing density does not allow sufficient distance between wells and leaching pits. - Not this sector.
3	Need for more and better domestic sanitation facilities	3.1	Mandatory requirements for design and operation of septic tanks
		3.2	Installation of community sanitation facilities in particular circumstance.
		3.3	Extend EIS legislation to include smaller hotels (say 25 rooms up)
4	Sub-standard discharges from hotels large developments with or without approved EIS.	4.1	Better monitoring of performance and better enforcement. To include more involvement of local administration eg. use of spot checks and analysis by Phatthaya City laboratory
5	Pollution of rivers by direct disposal eg. stilted premises on Na Klua river.	5.1	Insistence on installation of on-site excreta disposal facilities on land or provision of communal facilities including laundry and washing facilities where water supply available.(Discharge to interceptor sewers when/where available).

Table 4.2.8 (2)

Recommended policies to overcome inadequacies of the present sanitation and sewerage arrangements (2/3)

Inadequacy		Policy Proposed	
5	(Continued)	5.2	Better enforcement of existing legislation by Harbour Department
		5.3	Planning controls to limit stilted properties and activities in them.
6	Pollution of rivers by wastewaters from drainage system	6.1	Installation of interceptor sewers to separate wastewaters and convey to treatment and disposal. Co-ordinate with drainage sector
7	Wastewater pollution of seashore/sea by direct disposal e.g. Na Klua, South Phatthaya, Ban Sare	7.1	Insistence or installation of on-site disposal facilities on land or provision of communal facilities - May discharge to interceptor sewers where/when provided.
		7.2	Better enforcement of existing legislation by Harbour Department
		7.3	Planning controls (and enforcement) to limit stilted premises and activities in them.
		7.4	Provide public toilets at tourist beaches of Phatthaya, Jomtien and Ko Lan.
8	Wastewater pollution of sea shore/sea from polluted drainage system (Particularly Phatthaya town)	8.1	Installation of interceptor sewers to separate wastewaters and convey them to treatment and disposal. Co-ordinate with drainage sector.
		8.2	Insistence on connection to wastewater sewers where available.

Table 4.2.8 (3)

Recommended policies to overcome inadequacies of the present sanitation and sewerage arrangements (3/3)

Inadequacy		Policy Proposed	
9	Urban pollution from wastewater	9.1	Better maintenance of urban drains and khlongs/rivers
		9.2	Improvements to urban drains carrying wastewaters particularly those discharging to interceptor sewers, including, lining, covering and improving profiles (gradients) where desirable and possible.
10	Hydraulic overloading of parts of existing sewerage system and sewage treatment works at Soi Kazem Suwan, Phatthaya.	10.1	Expand and improve sewerage and sewage treatment facilities to meet identified demands and provide a service constant with the needs of an international tourist resort.
11	Haphazard septage disposal	11.1	Designate sites for septage treatment and/or disposal
		11.2	Licence and regulate private septage tanker services and insist on disposal to designated sites
12	Wastewater pollution at Slaughterhouse site.	12.1	Install wastewater drainage and treatment facilities at slaughterhouses. Dependent on the site determined for new slaughterhouse and sewage treatment works at Na Klua it may be viable to pump or tanker wastewaters to treatment works.
13	Lack of provision for public utilities, sewage treatment works, etc. in urban planning.	13.1	Reserve sufficient land for future sewerage, drainage works, interceptor sewers and sewage treatment facilities.

Table 4.2.9 (1)

RECOMMENDED WASTEWATER MANAGEMENT PLAN (1/3)

	Task	Institution	Implementation
1	Non-Investment Programmes		
1.1	Design and operation guidelines for septic tank/leaching pit systems in rural areas	PWD	As soon as practicable before end 1991
1.2	Design and operation regulations for septic tank/leaching pit systems in urban areas	PWD and Phatthaya City	As soon as practicable. before end 1991
1.3	Registration of all domestic sanitation facilities in urban areas and registering less satisfactory systems as temporary arrangements.	Phatthaya City and Sanitary Districts	Phatthaya City commence now. Sanitary districts commence on completion of 1.1/1.2
1.4	Prepare regulations for safe handling and disposal/utilization of septage and acquire/designate sites for treatment and/or disposal/utilization	PWD/ONEB and Phatthaya City	As soon as practicable. Target operational before end Sixth National Plan
1.5	Register, licence and regulate private septage tanker services	Phatthaya City and Sanitary Districts	Effect on completion of 1.4.
1.6	Increase performance monitoring of wastewater treatment facilities at hotels and enforce requirements properly. Extend EIS legislation to include smaller hotels (Say 25 rooms up).	ONEB and Phatthaya City	Introduce as soon as practicable. Amend requirements on permit renewal. Seek advance cooperation locally.
1.7	Strengthen and enforce planning restriction including wastewater disposal regulations on stilted developments on rivers and waterfronts.	Phatthaya City Ban Sare Sanitary District	Introduce by -laws 1991/92

Table 4.2.9 (2)

RECOMMENDED WASTEWATER MANAGEMENT PLAN (2/3)

	Task	Institution	Implementation
1.8	Insist on connection to wastewater sewers within designated areas (when available) and insist on disconnection of surface water drainage from foul sewers in Phatthaya.	Phatthaya City	Commence as soon as treatment works extensions complete-end 1990 Commence surface water disconnection now.
1.9	Increase and improve maintenance of urban drains, khlongs/rivers.	Phatthaya City and Sanitary Districts	Allocate increased budget 1990-91
2.	Capital Works Projects		
2.1 *	Na Klua area - Sewerage, and Sewage Treatment Project	PWD and Phatthaya City	Identify and acquire site for treatment works now. Implement 1st phase 1991-93.
2.2 *	Jomtien area - Sewerage and Sewage Treatment Project	PWD and Phatthaya City	Implement 1st phase 1990-92.
2.3 *	Phatthaya town - Sewerage and Sewage Treatment Expansion Project	PWD and Phatthaya City	Identify and acquire site for sewage treatment works now. Target implementation 1991-93.
2.4	Tha Farang Beach/Ban Amphoe - Sewerage and Sewage Treatment Project	PWD and Sanitary District	Acquire/reserve site for treatment works
2.5	Ban Sare - Sewerage and Sewerage Treatment Project	PWD and Sanitary District	Acquire/reserve site for treatment works
2.6	Phatthaya town and Na Klua - Street drainage improvements	Phatthaya City	Continuous - coordinate with 2.1 and 2.3 above

Table 4.2.9 (3)

RECOMMENDED WASTEWATER MANAGEMENT PLAN (3/3)

	Task	Institution	Implementation
2.7	Phatthaya town, Jomtien and Ko Lan - Public toilets at tourist beaches	Phatthaya City	Phatthaya 1990-91. Jomtien coordinate with 2.2 above 1991-92 Ko Lan 1991-92 to include suitable on-site disposal
2.8	Improvement of Sanitation at Public facilities - All areas	Phatthaya City Sanitary Districts	Inspect Sanitation facilities at all public buildings. Upgrade or replace as necessary or connect to sewerage where available. Commence implementation 1990-91

* Accelerated Programme Project

Table No. 4.2.10 POPULATION DISTRIBUTION BY DTCP ZONE AND SEWERAGE CATCHMENT

Sewerage Catchment	DTCP Zone No.	Zone Population			% Population in Sewerage Catchment	Population in Catchment		
		1989	1996	2006		1989	1996	2006
NA KLUA	01	2,540	3,640	5,210	100	2,540	3,640	5,210
	02	3,976	5,278	7,136	100	3,976	5,278	7,136
	03	11,035	11,035	11,035	100	11,035	11,035	11,035
	04	3,529	4,596	6,119	100	3,529	4,596	6,119
	05	8,786	9,944	11,596	100	8,786	9,944	11,596
	06*	1,527	3,336	5,917	70	1,069	2,335	4,142
	07*	3,573	5,291	7,743	60	2,144	3,175	4,646
	08*	3,700	5,430	7,900	80	2,960	4,344	6,320
	Total					36,039	44,347	56,204
PHATTHAYA	06*	1,527	3,336	5,917	30	458	1,001	1,775
	07*	3,573	5,291	7,743	40	1,429	2,116	3,097
	08*	3,700	5,430	7,900	20	740	1,086	1,580
	09	4,020	8,692	15,360	100	4,020	8,692	15,360
	10	2,257	5,508	10,147	100	2,257	5,508	10,147
	11	3,092	3,805	4,822	100	3,092	3,805	4,822
	12	16,139	16,411	16,799	100	16,139	16,411	16,799
	13	7,327	9,869	13,497	100	7,327	9,869	13,497
	14**	3,036	5,042	7,906	75	2,125	3,857	6,325
	15**	5,024	5,399	5,934	90	4,522	4,859	5,341
	16**	5,629	7,532	10,249	95	5,348	7,155	9,737
	17**	6,030	8,757	12,650	95	5,728	8,319	12,018
	Total					53,185	72,678	100,498
JOMTIEN	14**	3,036	5,042	7,906	25	911	1,185	1,581
	15**	5,024	5,399	5,934	10	502	540	593
	16**	5,629	7,532	10,249	5	281	377	512
	17**	6,030	8,757	12,650	5	302	438	632
	18	1,923	2,384	3,043	100	1,923	2,384	3,043
	19	3,893	6,160	9,393	100	3,893	6,160	9,393
	20	889	4,182	8,879	100	889	4,182	8,879
	21	896	3,343	6,836	100	896	3,343	6,836
	22	659	1,903	3,679	100	659	1,903	3,679
	23	238	2,821	6,508	100	238	2,821	6,508
	24	282	842	1,642	100	282	842	1,642
	Total					10,776	24,175	43,298
Grand Total						100,000	141,200	200,000

Notes: *Part in Na Klua sewerage catchment part in Phatthaya town ** Part in Phatthaya town catchment part in Jomtien

Table No. 4.2.11 HOTEL ROOM AND CONDOMINIUM UNIT DISTRIBUTION BY DTCP PLANNING ZONE AND BY SEWERAGE CATCHMENT AREA

Sewerage Catchment	DTCP Zone	1989		1996		2006	
		Hotel Rooms	Condo Units	Hotel Room	Condo Units	Hotel Room	Condo Units
NA KLUA	01	-	-	-	-	-	-
	02	-	144	-	144	-	144
	03	-	-	-	-	-	-
	04	422	186	422	337	472	337
	05	-	-	-	-	100	-
	06*	274	-	274	820	524	820
	07*	404	-	404	-	454	-
	08*	-	-	-	-	-	-
	Total	1,100	330	1,100	1,301	1,550	1,301
PHATTHAYA	06*	1,029	31	1,029	67	1,029	67
	07*	375	-	375	-	425	-
	08*	-	-	-	-	-	-
	09	2,530	69	2,609	818	2,609	818
	10	706	-	706	269	706	269
	11	0	-	-	451	-	451
	12	4,708	-	6,118	684	6,118	684
	13	-	-	-	76	250	76
	14**	-	-	-	-	-	-
	15**	2,179	-	2,179	-	2,179	-
	16**	-	-	-	728	250	728
	17**	287	-	287	300	287	300
	Total	11,814	100	13,303	3,393	13,853	3,393
JOMTIEN	14**	-	-	-	-	-	-
	15**	676	-	676	1,849	926	1,849
	16**	-	-	-	-	-	-
	17**	-	-	-	-	-	-
	18	1,208	639	1,683	1,173	1,883	1,173
	19	670	111	2,273	111	2,973	111
	20	-	-	-	-	850	-
	21	157	-	1,745	470	2,445	470
	22	-	-	-	-	-	-
	23	204	83	204	1,091	1,054	1,091
	24	-	-	-	-	-	-
	Total	2,915	833	6,581	4,694	10,131	4,694
Grand Total		15,829	1,263	20,984	9,388	25,534	9,388

* Part in Na Klua sewerage catchment part in Phatthaya town

** Part in Phatthaya town sewerage catchment part in Jomtien.

Table No. 4.2.12 WASTEWATER VOLUMES AND LOADS GENERATED IN PHATTHAYA CITY AREA

	Population	Hotel Rooms No.	Condo Unit No.	Wastewater Volume cu m/day											Biological Load BOD_5 kg/day			
				Domestic	Public	Tourist Accommodation				Commercial		Industrial	Total		Average Flow Domestic + Public + Condo + Commercial	Average Load for Domestic, Public, Condo, Commercial	Average Load for Hotels	Average Load for Industry	Total Average Load
						Hotel		Condo		Average	Peak		Average	Peak					
				(a)	(b)	Average occupancy (c)	Peak occupancy (d)	Average occupancy (e)	Peak occupancy (f)	(g)	(h)	(i)							
1. 1989				230 ℓ/c/d	(a)×15%	800 ℓ/room/day 59%	100%	1,150 ℓ/unit/day 14%	63%	(c+e) × 52%	(d+f) × 52%		(a+b+c+e+g+i)	(a+b+d+f+h+i)	a+b+e+g	150 mg/ℓ	200 mg/ℓ	300 mg/ℓ	kg/day
NA KLUA	36,039	1,100	330	8,289	1,243	519	880	53	239	297	582	2,907	13,308	14,140	9,882	1,482	104	872	2,458
PHATTHAYA	53,185	11,814	100	12,233	1,835	5,576	9,451	16	72	2,908	4,923	273	22,841	28,787	16,992	2,549	1,115	82	3,746
JOMTIEN	10,776	2,915	833	2,478	372	1,376	2,332	134	604	785	1,527	-	5,145	7,313	3,769	565	275	-	840
	100,000	15,829	1,263	23,000	3,450	7,471	12,663	203	915	3,990	7,032	3,180	41,294	50,240	30,643	4,596	1,494	954	7,044
2. 1996				289 ℓ/c/d	(a)×15%	1,000 ℓ/room/day 55%	94%	1,150 ℓ/unit/day 6%	28%	(c+e) ×52%	(d+f) ×52%					166 mg/ℓ	200 mg/ℓ	300 mg/ℓ	—
NA KLUA	44,347	1,100	1,301	12,816	1,922	605	1,034	90	419	361	756	507	16,301	17,454	15,189	2,521	121	152	2,794
PHATTHAYA	72,678	13,303	3,393	21,004	3,151	7,316	12,504	234	1,093	3,926	7,070	273	35,904	45,095	28,315	4,700	1,463	82	6,245
JOMTIEN	24,175	6,581	4,694	6,986	1,048	3,620	6,187	324	1,512	2,051	4,003		14,029	19,736	10,409	1,728	724	-	2,452
	141,200	20,984	9,388	40,806	6,121	11,541	19,725	648	3,024	6,338	11,829	780	66,234	82,285	53,913	8,949	2,308	234	11,491
3. 2006				303 ℓ/c/d	(a)×15%	1,000 ℓ/room/day 61%	100%	1,100 ℓ/unit/day 15%	57%	(c+e) ×52%	(d+f) ×52%					170 mg/ℓ	200 mg/ℓ	300 mg/ℓ	
NA KLUA	56,204	1,550	1,301	17,030	2,555	946	1,550	215	816	604	1,230	507	21,857	23,688	20,404	3,469	189	152	3,810
PHATTHAYA	100,498	13,853	3,393	30,451	4,568	8,450	13,853	560	2,127	4,685	8,310	273	48,987	59,582	40,264	6,845	1,690	82	8,617
JOMTIEN	43,298	10,131	4,694	13,120	1,968	6,180	10,131	775	2,943	3,617	6,798	-	25,660	34,960	19,480	3,312	1,236	-	4,548
	200,000	25,534	9,388	60,601	9,091	15,576	25,534	1,550	5,886	8,906	16,338	780	96,504	118,230	80,148	13,626	3,115	234	16,975

*Note: Volumes of domestic wastewater are overestimated by

TABLE 4.2.13
WASTEWATER VOLUMES GENERATED
AT THA FARANG BEACH AND BAN SARE

	Domestic	Public	Tourist Accommodation				Commercial	Total	
			Hotel Rooms		Condo Unit				
			Average Occupancy	Peak day Occupancy	Average Occupancy	Peak day Occupancy		Average day	Average day
	(a)	(b)	(c)	(d)	(e)	(f)	(g)		
1989	230 ℓ/c/d	(a) × 15%	800 ℓ/room/d		1,150 ℓ/unit/d		(c)+(e) × 0.30	cu m/day	cu m/day
			59%	100%	14%	63%			
THA FARANG BEACH	1,633	245	1,555	2,637	5	22	468	3,907	5,005
BAN SARE	2,806	421		58		127	Say 100		3,512
2006	303 ℓ/c/d	(a) × 15%	1,000 ℓ/room/d		1,100 ℓ/unit/d		(c)+(e) × 0.30		
			61%	100%	15%	57%			
THA FARANG BEACH	2,424	364	2,840	4,656	312	1,187	946	6,886	9,577
BAN SARE	3,788	568		72		192	Say 200		4,820

Note: Commercial wastewater flows down assessed c.f. Phatthaya City
Ambassador City accounts for 3,572 cu m/day of 2006 peak flow. Balance is 6,005 cu m/day.

Table 4.2.14 DEMAND FOR SEWAGE TREATMENT IN NA KLUA PHATTHAYA TOWN AND JOMTIEN

Catchment area	Wastewater	Wastewater volumes cu m/day average flow peak season		
		1989	1996	2006
Na Klua	Total Generated	14,140	17,459	23,688
	On-site disposal	6,321	7,475	9,766
	To Treatment	7,819	9,984	13,922
Phatthaya town	Total Generated	28,787	45,095	59,582
	On-site disposal	12,503	17,641	19,402
	To Treatment	16,284	27,454	40,180
Jomtien	Total Generated	7,313	19,736	34,960
	On-site disposal	6,799	9,756	14,211
	To Treatment	514	9,980	20,749

Table 4.2.15 SEWAGE TREATMENT IN THA FARANG BEACH AND BAN SARE

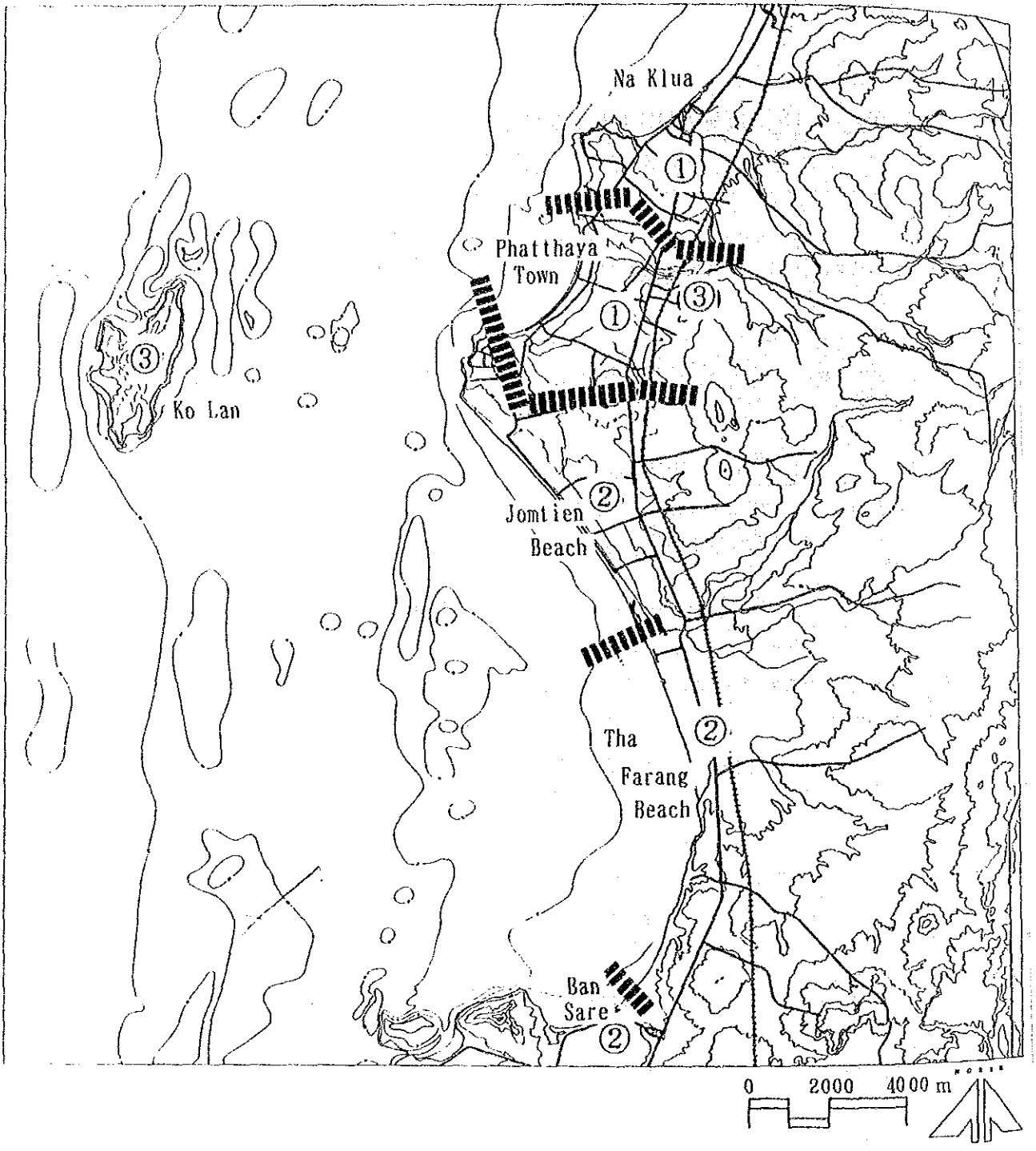
Catchment area	Wastewater	Wastewater volumes cu m/day average flow peak season*	
		1989	2006
Tha Farang Beach	Total Generated	5,002	9,477
	On-site disposal	5,002	4,572
	To Treatment	-	5,000
Ban Sare	Total Generated	3,512	4,820
	On-site disposal		
	To Treatment	1,200**	1,750

* Flows in Ban Sare are not seasonal ** to drains/river sea.

Assumptions : 1 Both Tha Farang Beach and Ban Sare are provided with piped water supply system

: 2 Sewerage in Ban Sare will only serve immediate village area, that is draining to the waterfront. i.e. Tambons 2 and 4 only.

: 3 Sewerage in Tha Farang Beach will only serve parts of Tambons 1, 2, 4 and 9 which shall include Ban Amphoe.



Principal Watersheds

② Zones/Zone types

Fig. 4.2.10 Wastewater Planning Zones and Principal Watersheds

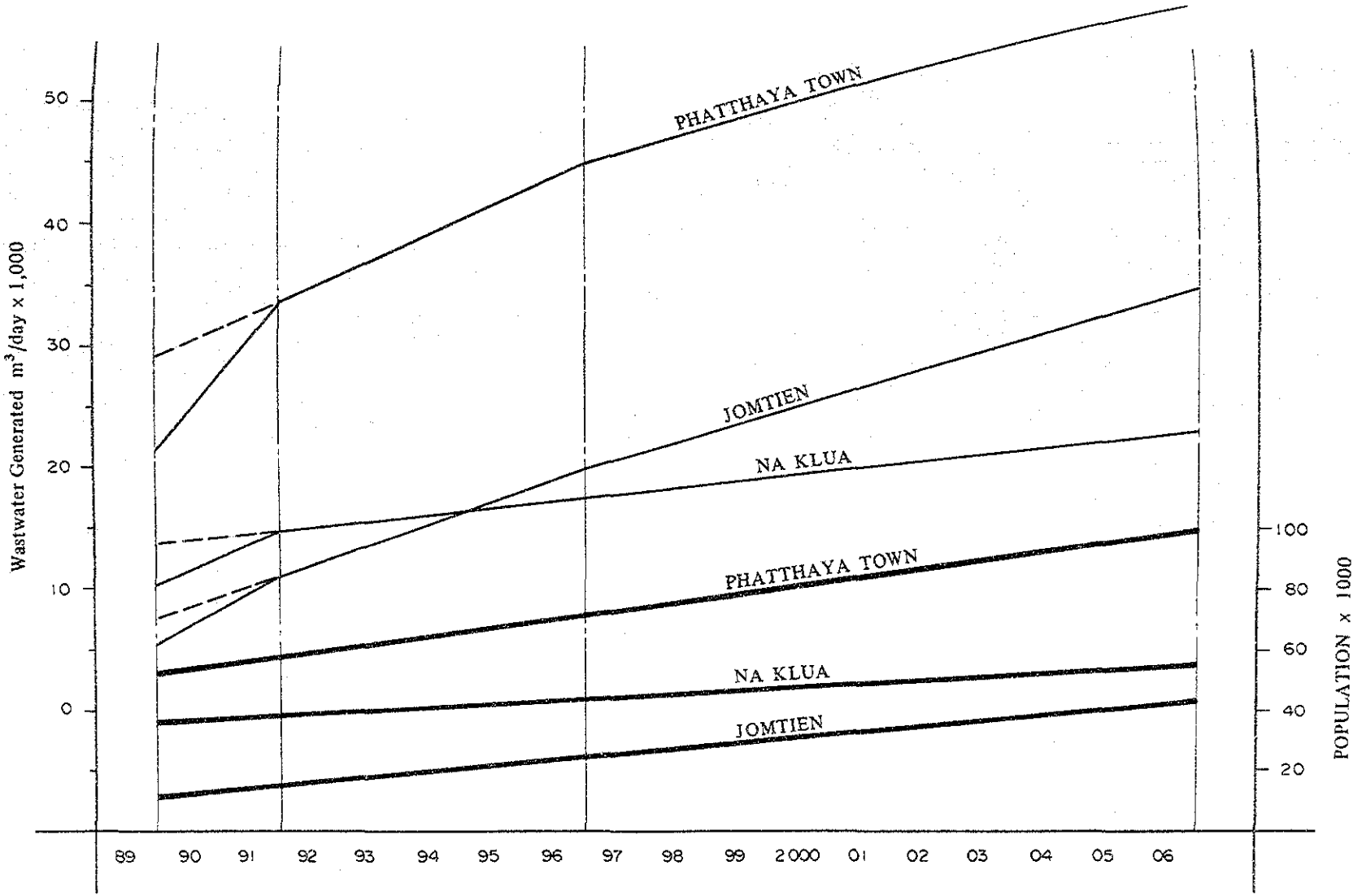
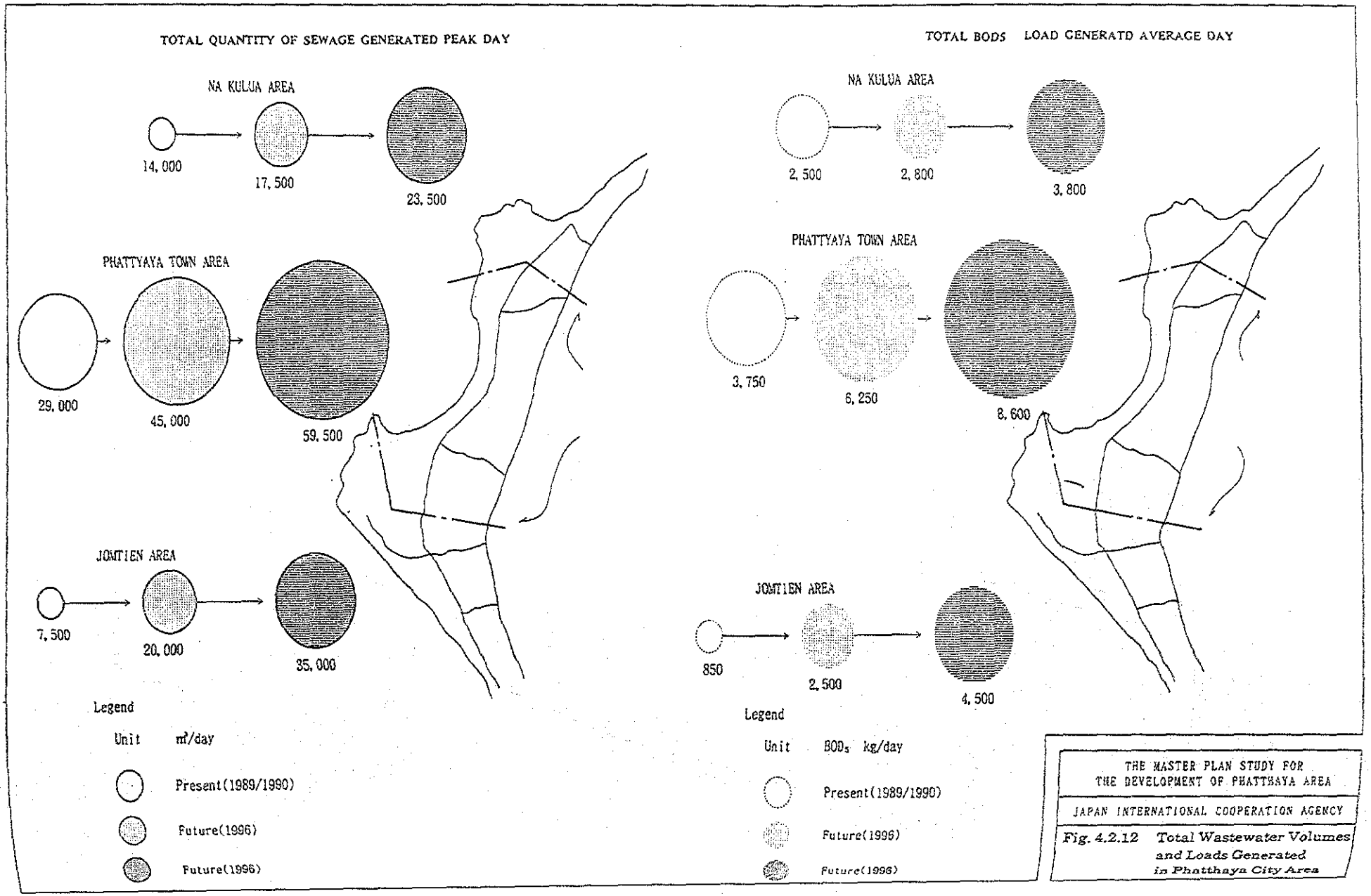


Fig. 4.2.11 Polulation and Wastewater Generation Projections



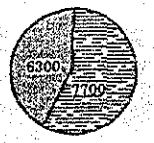
THE MASTER PLAN STUDY FOR
THE DEVELOPMENT OF PHATTHAYA AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 4.2.12 Total Wastewater Volumes and Loads Generated in Phatthaya City Area

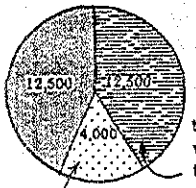
NA KLUA CATCHMENT 1989

Total Sewage Generated
14,000 cu m/day (peak day)



PHATTHAYA TOWN CATCHMENT 1989/90

a) With Existing Sewerage (1989)



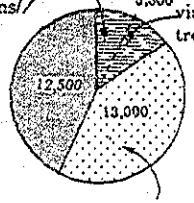
to drum/river/sea via sewer/sewage treatment overflow

effective sewage treatment capacity (peak rate of flow 6,000 m³/day)

b) With Planned Sewerage (1990)

direct to drains/river/sea

3,500 to drain/river/sea via sewer/sewage treatment overflow

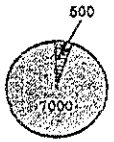


effective sewage treatment capacity (peak rate of flow 19,500 m³/day)

Total Sewage Generated 29,000 cu m/day (peak day)
Sewage treatment capacity 13,000 cu m/day average flow (19,500 m³/day peak flow rate)

JOMTIEN CATCHMENT 1989

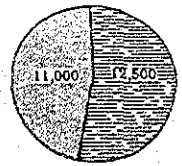
Total Sewage Generated
7,500 cu m/day (Peak day)



SEWAGE DISPOSAL TODAY

NA KLUA CATCHMENT 2006

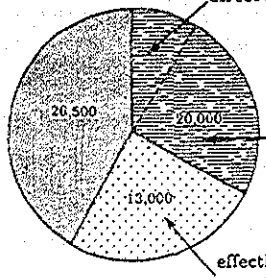
Total Sewage Generated
23,500 cu m/day
(peak day)



PHATTHAYA TOWN CATCHMENT 2006

Total Sewage Generated
59,500 cu m/day
(peak day)

direct to drains/river/sea

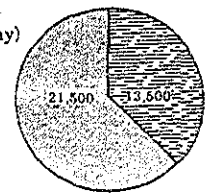


to drain/river/sea via sewage/sewage treatment overflow

effective sewage treatment capacity
(peak rate of flow 19,500 m³/day)

JOMTIEN CATCHMENT 2006

Total Sewage Generated
35,000 cu m/day (peak day)



Legend

- to soak away/ irrigation
- to drains/river sea
- to municipal sewage treatment

SEWAGE DISPOSAL WITH NO FURTHER SEWAGE DEVELOPMENT

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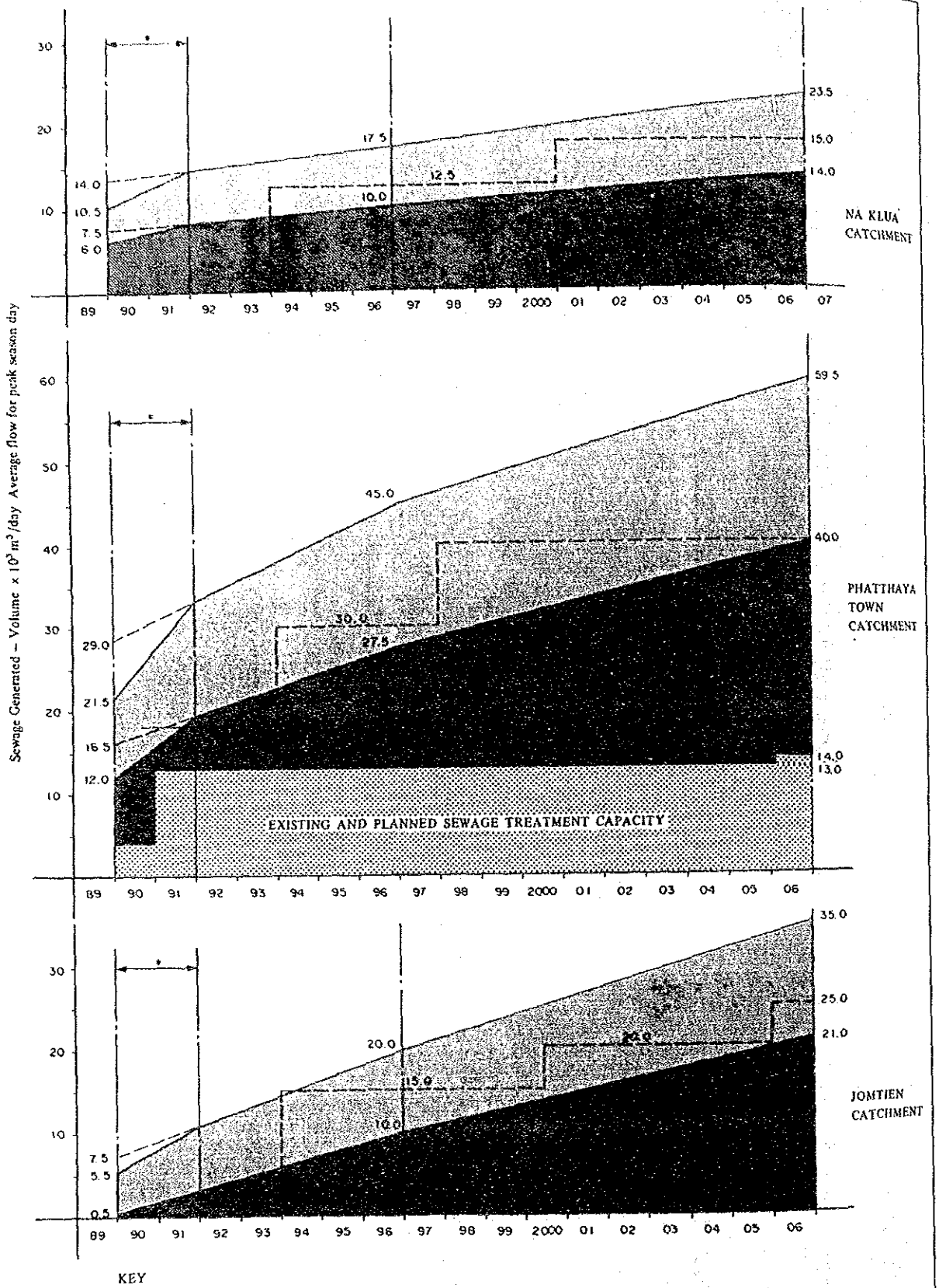
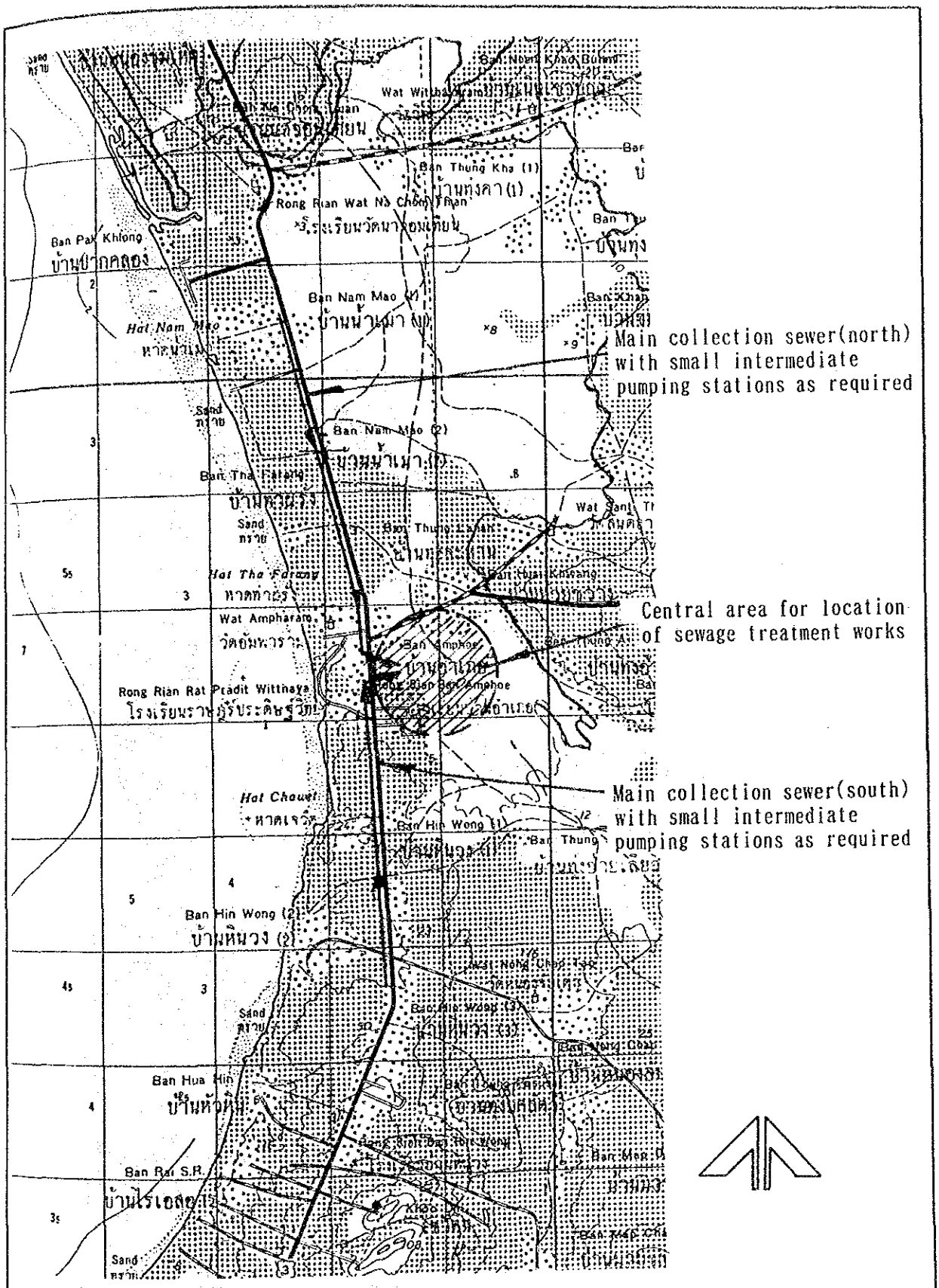
Fig. 4.2.13 Sewage Disposal with No Further Sewage Development



THE MASTER PLAN STUDY FOR THE DEVELOPMENT OF PHATTHAYA AREA	JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. 4.2.14 Sewage Treatment Demand



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THE DEVELOPMENT OF PHATTHAYA AREA

Fig. 4.2.15 The Farang Beach Sewerage and Sewage Treatment Project Outline

LEGEND

- Potentially suitable area for sewage treatment works
- ◎ Suitable site for sewage treatment works
- ○ Sewage pumping station
- ▪▪▪▪▪▪▪▪ Sewage rising mains

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Fig. 4.2.16
Outline for Ban Sare Sewerage

4.2.6 Rainwater Drainage

1) Present Conditions and Necessity of Drainage Plan

Table 4.2.16 shows present conditions and necessity of drainage plan to be clarified through the study. Drainage conditions in each divided area is evaluated as follows:

① Krating Lai Sub-division

Krating Lai river is the main river in this area and has a large discharge capacity. From this reason drainage plan in the Krating Lai Sub-division does not become as an urgent matter.

② Na Klua Sub-division

Na Klua canal is the main river in this area and in the Study Area also. Its discharge capacity is enough to flow discharge to the sea sufficiently. Therefore, drainage plan in the Na Klua Sub-division does not become as an urgent matter.

③ South Na Klua Sub-division

Urgent drainage plan is required in the South Na Klua Sub-division to protect this area from flood damage. Discharge capacity of the Puk Plub canal which is the main channel in this area is very small and the area easily gets flood damage at present.

④ Phatthaya Town Sub-division and Phatthaya River Sub-division

Phatthaya Town Sub-division and Phatthaya River Sub-division in the Phatthaya Town Area also need urgent drainage plan. Development, land use conditions and accumulation of properties in this area indicates high damage potential and decrement of safety margin against flood.

⑤ Huay Yai Sub-division

Present land use in this sub-division is mainly grassed area except Jomtien beach area. Development, reclamation and construction of condominiums concentrate in Jomtien beach area. From the reason rainwater drainage facilities in this area are not sufficient, urgent drainage plan is required in Jomtien beach area and behind lower area.

⑥ Huay Yai Sub-division, Ban Amphoe Sub-division and Ban Sare Sub-division

Present land use in these areas is mainly grassed area. Residential area can be seen partially along main roads and along seashore. From the reason discharge capacity of the main river in each sub-division is large, drainage plan does not become as an urgent matter.

⑦ Ko Lan

Main part of Ko Lan island is mountain and hill slope area. Flat area is seen only along seashore. From the reason of its small catchment area, main channel does not form in this island. Taking into consideration geographical characteristics and no experience of flood damage in the past, drainage plan does not become an urgent matter in the Ko Lan area.

2) Requirements and constraints

Requirements and constraints concerning rainwater drainage plan are listed in the following table.

Rainwater drainage improvement plans should be worked out, taking into consideration these matters so that urgent and effective implementation can be made.

REQUIREMENTS AND CONSTRAINTS
TO RAINWATER DRAINAGE PLAN

Item	Content
Require-ment	① Future development plan in the area. ② Flood protection of existing high density developed area along Phatthaya beach. ③ Flood protection of the frequent damaged area. ④ Flood protection which will be caused by reclamation of ponding area. ⑤ Setting up safety degree standard of flood as a city and international resort area. ⑥ Coordination with regional development plan. ⑦ Aesthtic aspect of river as a precious open space in the city. ⑧ Plan which stands from long-term view point and have immediate effects also.
Difficulties and constraints	① Difficulty of land acquisition ② Consideration for the utilization of the coastal area. ③ Tidal condition ④ Limited budget ⑤ Control and maintenance matter.

3) Direction of Rainwater Drainage Plan

Rainwater drainage plan should be worked out on the basis of basic ideas concerning the following key issues.

[Key issues]

①	Return Period
②	Planning area
③	Other condition
④	Drainage system
⑤	Runoff calculation method
⑥	Adjustment to other development plans
⑦	Maintenance
⑧	Aesthetic aspect on river

Basic ideas for rainwater drainage planning based on present and future conditions in the Study Area are listed in Table 4.2.17.

An important matter to be considered in the items in this table are summarized as follows:

- Return period should be decided based on safety margin standard of flood as a city in Thailand and as an international resort.
- These areas which have an urgent drainage problem such as Phatthaya Town sub-division area. Phatthaya river sub-division area and South Na Klua sub-division area should be included in the planning area.
- Tidal level, Inflow area, land use, reclamation of ponding area are important items to make a drainage plan. Therefore, the way of thinking or determination method of these items should be clarified in the report.
- Drainage system should be decided based on present drainage system, geographical conditions, drainage effects, maintenance matter and cost matter.
- As a maintenance items, sedimentations in the river bed or channel bed can become a serious problem.
- From the viewpoint of aesthehics of river, utilization of the open space which is produced by the river is very important.

4) Long-List Projects

(1) Background and necessity

Phatthaya City area is the most developed area in the Study Area. At present, development and reclamation is remarkable especially in the lower area which used to function as retarding basin. This tendency of development and reclamation in the lower area were thought to continue in the future. Without construction of sufficient drainage facilities, serious flood damage would occur in this development area and existing town area.

In south Na Klua area, main land use pattern is medium density residential use at present and also high density residential area can be seen along Phatthaya-Na Klua road. Because of small discharge capacity of Puk Plub river, upstream area of the road was often damaged by flood. Solution to this flood problem is very important subject in this area.

In the Jomtien area located north-western part of the Huay Yai sub-division, many condominiums are under construction along beach road. Although main development at present is concentrated along the beach, lower area behind Jomtien beach will be widely developed in the near future. From the reason that existing drainage facilities in Jomtien area is very poor, to make drainage plan and to construct drainage facilities will become an urgent subject.

(2) Project outline

Following three projects are selected for the long-list in the rainwater drainage sector (See Fig. 4.2.17).

Outlines of the projects are shown in the table below.

DESCRIPTION OF RAINWATER DRAINAGE
LONG-LIST PROJECTS

Project Name	Location	Purpose	Outline of the Project	Dimension
① South Phatthaya box culvert construction	Central-South Phatthaya area	• To protect Central and South Phatthaya area from flood damage • To create safety zone in the lower area behind existing town	To construct new box culverts along existing road. (South Phatthaya Rd.) (Phatthaya 3Rd.)	Length: 1 km (South Phatthaya Rd.) 2 km (Phatthaya 3 Rd.)
② Phatthaya canal improvement	South Phatthaya area	• To protect South Phatthaya town from flood damage. • To create safety zone in upstream of the Phatthaya river	To improve Phatthaya river taking into consideration of aesthetic aspect.	Length: 1 km (Open channel)
③ Puk Plub canal improvement	South Na Klua area	• To protect South Na Klua area from flood damage. • To create safety zone in upstream of Puk Plub river.	To improve Puk Plub river or construct a new box culvert.	Length: 0.5 km
④ Jomtien Drainage Channel Construction	Jomtien area	• To protect Jomtien Beach area from flood damage. • To create safety zone behind Jomtien beach.	To construct box culverts under the existing roads.	Length: 3 Km (Box culverts)

(3) Expected effects

Expected effects of long-list projects are thought as below.

① Flood protection of the flood-prone area.

② Flood protection of existing highly developed area along Phatthaya beach and Jomtien beach.

③ To create new safety zone in the lower area behind existing town.

④ To create open space in the town with aesthetic aspect of Phatthaya river.

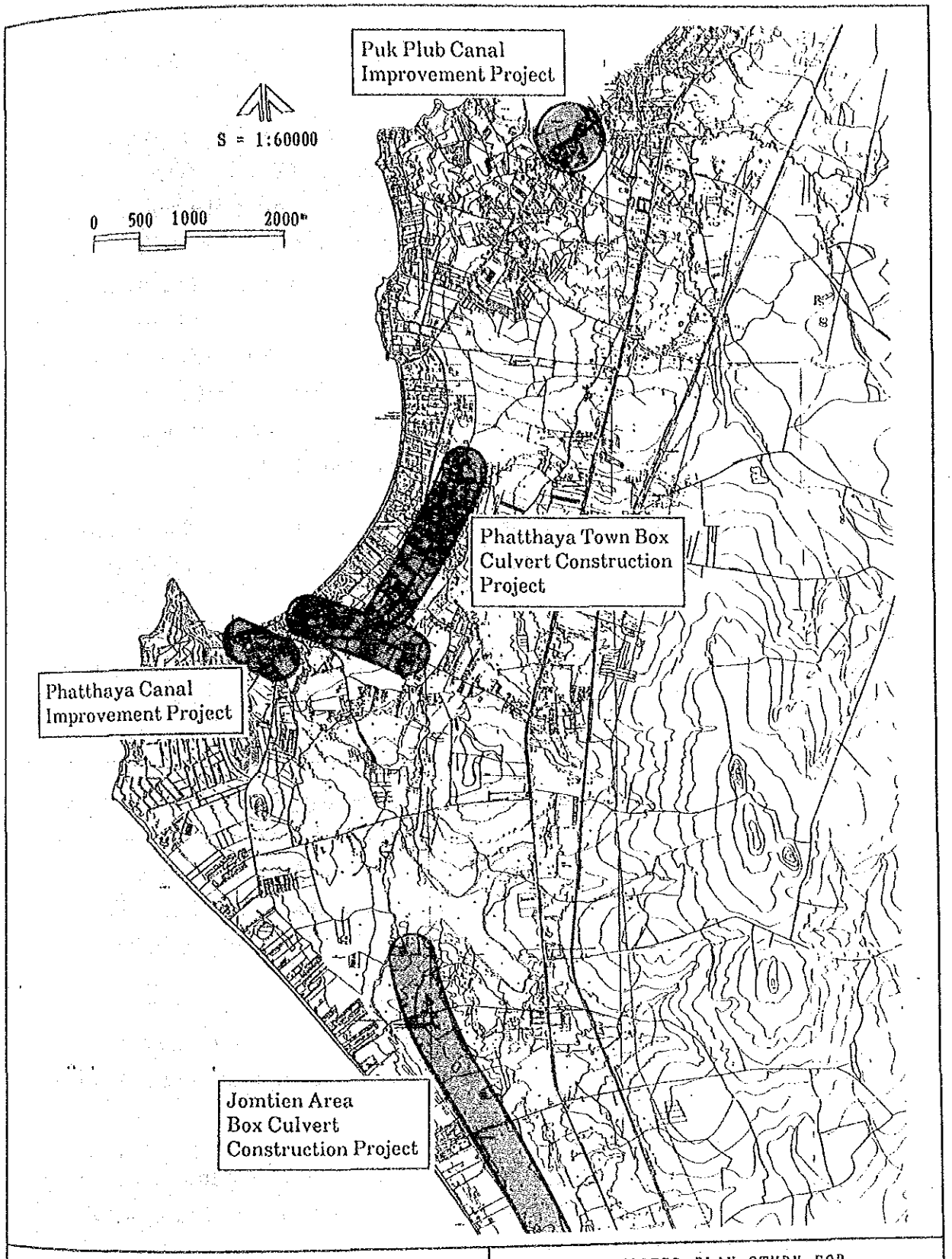
Table 4.2.16 NECESSITY OF THE DRAINAGE PLAN IN THE DIVIDED AREA

Division /1 (Basin area)	Sub-division /1	Present Condition					Future Land Use Plan	Necessity of Drainage Plan
		Land Use	Property	Flood Damage	Development Trend	Discharge Capacity		
(1) Northern Area (CA = 116.68 km²)	① Krating Lai (14.76 km²)	Grassed area. Low density residential area.	Small	Nothing	Small	Large	Low density residential	No need in the present. Partially construction will be needed
	② Na Klua (98.73 km²)	Medium density residential area. Grassed area	Small ~ Middle	Occurred once in small area	Middle	Large	Low density~high density residential	No need in the present. Partially construction will be needed
	③ South Na Klua (Puk Plub Canal) (2.60 km²)	Medium density residential area. Grassed area	Small ~ Middle	Exist (almost every year)	Middle	Small	Medium~high density residential	Urgent drainage plan will be required.
(2) Phatthaya Town Area (CA = 21.07 km²)	① Phatthaya Town (16.60 km²)	Commercial area High density residential area.	Middle ~ Large	Exist (almost every year)	Large	Small	High density residential	Urgent drainage plan will be required.
	② Phatthaya Canal (4.47 km²)	Commercial area. High density residential area.	Middle ~ Large	Exist (almost every year)	Large	Small	High density residential	Urgent drainage plan will be required.
(3) Southern Area (CA = 247.74 km²)	① Huay Yai (132.36 km²)	Grassed area. Residential area along Jomtien Beach	Small ~ Middle	Nothing	Small (Except Jomtien area)	Large	Low density~high density residential	Urgent drainage plan will be required in Jomtien area.
	② Ban Amphoe (70.09 km²)	Grass area. Partially low residential area	Small	Nothing (Except Sukhumvit Rd.)	Small	Large	Rural and agricultural area. Low density residential	No need in the present. Partially construction will be needed
	③ Bang Sare (34.20 km²)	Grassed area. Residential area along seashore.	Small	Nothing	Small	Large	Rural and agricultural area, Low density residential	No need in the present. Partially construction will be needed
(4) Ko Lan	(5.26 km²)	Partially low residential area along seashore	Small	Nothing	Small	–	Rural and agricultural	No need in the present. Partially construction will be needed

Remarks: /1: As shown on 2.5.2 3) Drainage.

Table 4.2.17 BASIC IDEAS FOR RAINWATER DRAINAGE PLANNING

Item	Considerations	Ideas
① Return Period	Safety margin of flood as a city and international resort. Return period generally adopted in Thailand.	Five years
② Planning area		ⓐPhatthaya Town Sub-division Area ⓑPhatthaya River Sub-division Area ⓒSouth Na Klua Area
③ Other condition	Tidal level as a boundary conditions for calculation.	Mean high water spring (+0.84 m)
• Tidal Level • Inflow Area	Upstream area of Sukhumvit Rd. where a ponding area will be excepted.	Downstream area of Sukhumvit Rd.
	Future land use condition in the project area.	Land use plan in 2006.
• Land Use • Reclamation of ponding area	Ponding area expands in the downstream of Sukhumvit Rd.	Ponding area will be reclamated.
④ Drainage System	• Present drainage system • Concentrate drainage system of divisional drainage system • Natural drainage/pumping drainage • Drainage system with ponding function or without ponding function	Present drainage system should be kept. Partially concentrate drainage system. Natural drainage. Drainage system without ponding area.
⑤ Runoff calculation method	• Runoff calculation method which is convenient and generally used in Thailand and as a drainage plan.	Rational method will be adopted.
⑥ Adjustment to another plan • PWD plan • Phatthaya City Hall plan • Regional Development plan • Sewerage plan • Port and coastal plan • General plan (land use)	Adjustment between development and preservation of ponding area.	Preservation of natural ponding area
⑦ Maintenance	Solid waste in the river bed or Channel bed.	Maintenance matter such as a cleaning of the channel bed will be considered.
⑧ Aesthetic aspect of river	Open space as a city and internation resort area.	Taking into consideration landscape factor in the open channel planning.



LEGEND

THE MASTER PLAN STUDY FOR
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JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 4.2.17 Long List Projects for Drainage Improvement

4.2.7 Water Supply

1) Background

The waterworks of Phatthaya area are managed by Phatthaya Na Klua waterworks office under the jurisdiction of Regional Office of PWA. Its service covers the majority of highly populated area and of the center of economic activity in the city. Remaining rural parts in the study area, except the belt zone along major road, are outside the area of its service. The waterworks supply the water to the domestic population of about 27,000 and tourist of about 1,400,000 annually at present. The yearly average water supply in Phatthaya is grown from 20,700 cu m/d in 1985 to 33,000 cu m/d in 1989, reflecting the increase numbers of tourist and rising of life standard. Water supply was further increased to monthly peak of 37,000 cu m/d in August 1989.

According to present condition described in the subsection before, the development of the waterworks of Phatthaya area is to be based on the major factors that;

- The water consumption of the area currently is characterized by tourism and its related commercial activities.

- The recent growth of tourism in the study area with a good accessibility and high tourism potential has led to sharp water demand increase. Though some utmost measures were taken, they could not cope enough with the situation and since the end of 1986, the water supply has been conducted under overload condition of the treatment plant. The water production of more than 30,000 cu m/d (official capacity is 24,000 cu m/d) has been recorded extending recent 15 months.

- Map Prachan reservoir is a sole water source for Phatthaya area since 1987, the water demand has reached to the limit of supply capability of the reservoir.

- The Study Area is expected to have a roles of commerce, business, residence and so on in ESB area. Both tourism and these factors will require more water in future.

- The area to the south of Jomtien down to Bang Sare, inland of Phatthaya, and Ko Lan have no public water supply system and are still left at poor supply level.

In the end of 1989, Phatthaya has faced serious raw water shortage as only 5.6 MCM (34% of the capacity) of the water is left in the reservoir, a lower level than the previous year by 50% and water supply is reduced to 27,000 cu m/d.

The government is initiating several development programs, that is:

- RID has started a project for constructing four new reservoir in the vicinity of Phatthaya.

- The development based on the recommendation in previous JICA study is directed to following urgent development plan to remedy confronting problems, which are shown below;

DEVELOPMENT PLAN RECOMMENDED IN PREVIOUS JICA STUDY

Phase	1	2-1	2-2	3
- Water source	Nong Kho-Laem Chabang pipeline	Nong Klong Dong res.	Huay Chuk Nok res.	Huay Sapan & Huay Khun Jit res.
- Treatment plant (cu m/h)	700	1000	1000	1000
- Pipeline	600 × 7 km	600 × 21 km	600 × 3 km	600 × 17 km
- Complete	Apr./1990	Oct./1990	Apr./1991	End/1992
- Budget (mil. Baht)	148.4	225.3	108.4	159.4

The water supply which depends on the planning reservoirs is estimated to be from 9.61 MCM/y at present to 25.5 MCM/y when these projects are completed.

It shall be, however, noted that water demand is forecasted to grow more than two times larger than present level to 30.2 MCM/y in 1996 and further 46.2 MCM/y in 2006.

The water supply will not be able to catch up with the demand in later half of 1990's. Immediate improvement and expansion programs are urgently needed to exclude an obstruction against approaching development goal of ESB project.

2) Development Directions

The development area can be classified into the following 4 groups according to present service conditions.

- Highly urbanized Phatthaya town and Na Klua area.

  There are existing distribution network and facilities generating high water demand concentrated in this area. The development direction should be the upgrading and expansion of the existing distribution network.

- The hinter land behind the beach area in Phatthaya City.

  No system are provided in these areas except in the zones adjacent to the major roads.

  The area has low population density and is lightly developed. The new provision of distribution facilities should be carried out.

- The coastal belt developed area in Jomtien extending southwards including Tha Farang beach area and the fishing village of Bang Sare.

  The water supply systems are provided only in small part of Jomtien area and there are small scale waterworks in fishing village of Bang Sare. Major portion of these area has no water supply system. Existing tourism and residential facilities in these areas need the stable supply of water. The new provision of distribution facilities should be carried out.

- Inland area and Ko Lan.

  As there is no stable water supply system by public sector in these area, the new distribution facilities shall be provided for the place where tourism and public developments are proposed.

  For Ko Lan the clear water is planned to be transported from the mainland by water barges.

3) Population and tourism framework

In 1989, Phatthaya has the registered population of 53454, keeping the annual increase of around 4.8%.

Due to the characteristics of the area, the population to be cared in the plan is estimated to set at 100,000, at present, including non-registered population. The

tourist numbers 1,417,000 in 1987 with sharp growth in recent and with average stay length of four days.

The future population and tourist to be cared are estimated for two key years as follows, including the population of Ban Rong Po and Nong Preo in which existing PWA's system caters for.

ESTIMATION OF POPULATION BY PWA

	1989	1996	2006
- Population			
Phatthaya	100,000	141,000	200,000
Tha Farang, Nang Sare	19,100	19,500	20,000
* Ban Rong Po	9,000	10,000	11,300
* Nong Preo	5,700	5,900	6,000
- Tourist (1,000/y)	1,609	2,281	3,241

* Source : PWA's preliminary estimation

4) Water demand

Future water demand is projected for the Study Area which includes Phatthaya city and neighboring southern area. Following areas in which existing PWA's system covers are also included in the Study Area.

- Apart of Nong Preo Sanitary District along Khoa Mai Kaeo road
- The area along Sukhumvit round until Ban Rong Po

Population and number of tourist were set for the key years (1996 and 2006) as a planning framework for the study after due consideration of desirable development level and projected employment.

The water demand in future is preliminary estimated applying the basic figures in the preliminary demand estimation derived from PWA. It is summarized below.

(1) The rate of consumption for domestic and tourism is foreseen to grow steadily with expansion of economic development activities, upgrading of living standard and presumptive highly equipped tourism accommodations.

(2) Public and commercial water consumption are based on the water consumption by type of consumers in May, 1987, which is reported by PWA. These are assumed by proportion of domestic and tourism consumption respectively.

(3) Industrial water consumption is stay at present level as no long term industrial development plan is projected in the area.

(4) Unaccounted for water ratio of 9.4 - 12.7% are obtained from the production and sales record in 1982 - 1989. It is very low level in Phatthaya - Na Klua waterworks comparing countrywide figure of 28.1 - 31.5 in 1980 - 1987. At this stage of study, however, constant 15% will be applied for the projection. The waterworks have to pay consistent attention to leakage control in order to maintain good condition.

(5) The population in the service area of existing PWA's system for Nong Preo and Ban Kong Po was obtained from PWA's preliminary estimation.

(6) The water demand is estimated based on the forecast of unit consumption, population and tourist number and is presented in Table 4.2.18.

(7) Water demand of Ko Lan is estimated applying same assumption as for Tha Farang and Bang Sare.

		Unit	1996	2006
A.	Domestic			
	Population		1,765	2,000
	Service factor	%	42	62
	Unit consumption	lcd	184	206
	Consumption	cu m/d	136	255
B.	Public (15% of domestic)	cu m/d	20	38
C.	Tourism			
	No. of tourist (day tripper)	No./d	4,500	7,500
	Unit consumption	lcd	50	50
	Consumption	cu m/d	225	375
D.	Commercial (52% of tourism)	cu m/d	117	195
E.	Total consumption (A + B + C + D)	cu m/d	498	863
F.	Total demand (loss of 15%) (Average day damand)	cu m/d	586	1,015

Clear water is planned to be transported from the main land by water barges. Water barges will receive the water through the pier at the marine facilities of main land and unload at the piers on the island. Three 100 ton water barges will make 4 - 5 trips a day for the peak demand.

5) Water source

As described in previous subsections, present development plans of Phatthaya area are in progress with the construction of four new reservoirs. Secured water source for Phatthaya area is estimated as follows at present.

WATER SOURCES

Existing		New reservoirs								
Map Prachan		Huay Sapan		Nong Klong Dong		Huay Khun Jit		Huay Chuk Nok		Total
9.61	/1	3.49	/2	4.79	/2	2.97	/2	4.65	/2	25.48

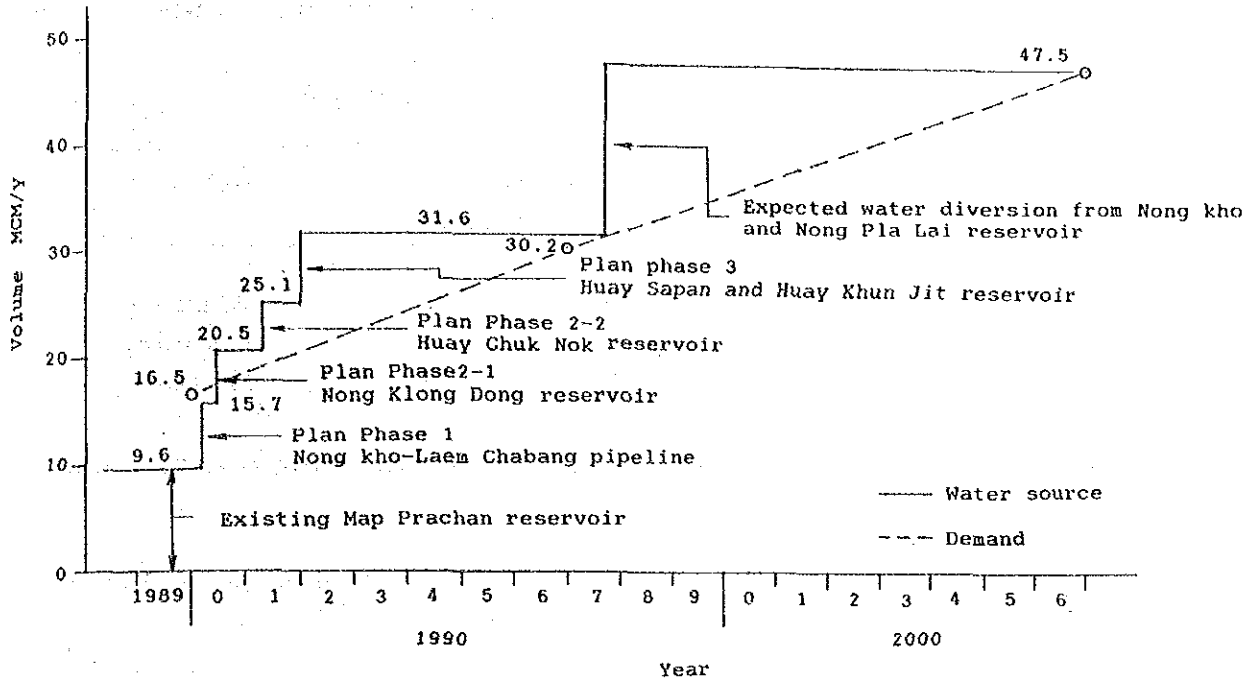
Unit: MCM/y

/1 Source : Previous JICA study

/2 Estimated by the Study Team by means of:

* Proportion of catchment area and run-off data of Bang Phra reservoir in 1968 - 1984
* Mass-curve analysis based on the drought period of 1976 - 1983.

The water supply capability of the study area is estimated to be 31.6 MCM/y, of which 9.6 MCM/y by existing Map Prachan reservoir, 6.1 MCM/y by Nong Kho-Laem Chabang pipeline and remaining 15.9 MCM/y by planned four new reservoirs scheduled to be completed by the end of 1992. As shown in the water supply and demand balance illustrated below, water supply capability will be able to catch up with the demand by present development plans until 1996. However, after that time, additional water should be conveyed from the other river basin.



Forecast of Water Demand and Supply Capacity

When current development program will progress on schedule, water supply seems to be able to cater for most of demand until the medium target year 1996. According to the previous JICA study, the ground water's share was 34% of the total water supply in 1996.* However, because of its small productivity in the aquifers* and degrated quality for drinking purpose,** groundwater is not recommendable for long term stable water source. The utilization of ground water must be limited for the emergency and supplemental use. The water sources of potable water especially should depend on surface water.

* Development Plan and feasibility Study on Provincial Water Supply Projects for Pattaya, March 1987, JICA.

** The same as the above and analysis results of shallow well's water in the environment section of this study.

Following three reservoirs are conceived to be additional water sources:

ADDITIONAL WATER SOURCES

Name	Estimated supply capacity (MCM/y)		Remarks
Nong Kho	13.9	/1	Existing
Nong Pla Lai	102.5	/2	Planning
Dok Krai	56.8	/2	Existing

/1 Feasibility Study on The Nong Kho - Laem Chabang Water Pipeline Project
Mar. 1984, JICA

/2 The East Cost Water Resources Development Project (Phase 2), Study Report
Jan. 1983, JICA

The water of Nong Kho reservoir is utilized for both Laem Chabang and Phatthaya in medium term. In the long-run, the supply of Nong Kho reservoir is conceptually planned by the water diversion from Nong Pla Lai reservoir.

Additional water required after 1996 should be drawn from Nong Pla Lai reservoir through Nong Kho reservoir because of the following reasons.

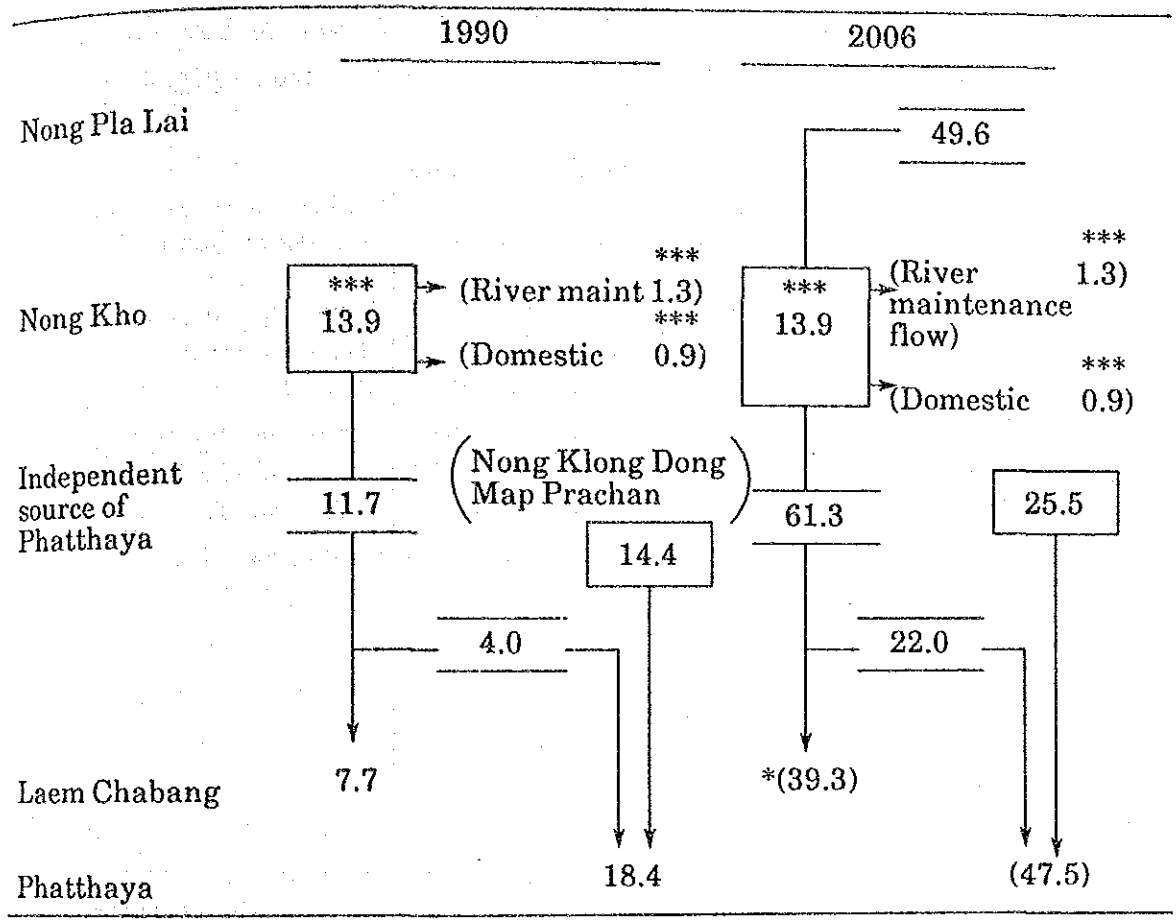
- The pipeline from Dok Krai to Map Ta Phut is completed and the construction of remaining part (up to Sattahip) will start soon. This pipe line has a limited capacity and no allocation will be allowed for Phatthaya area. Further, Dok Krai reservoir is located too far to convey raw water to Phatthaya by additional pipeline.

- Nong Pla Lai - Nong Kho pipeline project is scheduled to be completed by 1994 and is able to review the scale in accordance with additional water demand.

- The pipeline from Nong Kho will be easily layed parallel to existing one.

Judging from the above, water demand of Phatthaya can be met by the existing and the current development program up to 1996. In long term, Nong Pla Lai reservoir would be assigned the role of an additional source for Phatthaya with the pipeline to Nong Kho reservoir.

Proposed long term raw water distribution plan including Laem Chabang is shown below.



Unit: MCM/y

* : Laem Chabang 37.3**
Ao Udom 2.0

** : The study on The Development Project of Laem Chabang Coastal Area, Draft Final Report, Oct. 1984, JICA

***: Feasibility study on the Nong Kho-Laem Chabang Water Pipeline Project Main Report, Mar. 1984, JICA

□ : Supply

——— : Convey

( ) : Demand

Proposed Long-term Raw Water Distribution Plan

6) Water supply plan

The water supply system is planned basically as shown in the following table. The whole projects are conceived to be divided into two phases considering present development program. Proposed service area is shown in Fig. 4.2.18.

WATER SUPPLY PLAN

		First phase (1996)	Second phase (2006)
Stage		To implement current development programs	To meet long term water demand increase
Objective areas	• Phatthaya Na Klua town area • Jomtien area	• Improvement & extension of existing distribution facilities	• Raw and clear water transmission facilities • Treatment plant • Extension of distribution facilities
	• Tha Farang beach • Bang Sare • Inland	• New provision of distribution facilities	
	• Ko Lan		New provision of distribution facilities
Water Suorce		Five reservoirs around Phatthaya area and Nong Kho reservoir	Additional diversion from Nong Pla Lai (Boat transport to Ko Lan from main land)

Considering easiness of land acquisition, it is suggested that the proposed treatment plant in the second phase be sited in the existing treatment plant station after considering the following two alternatives.

Alternative 1. In a location of existing treatment plant at the shore of Map Prachan reservoir.

Raw water pipeline will be laid beside the planned highway and a pump station is necessary on the route to pass the highland. The treatment plant facilities are able to be placed in the open area of existing plant site.

The land of pump station may be easily acquired because of its small area and being located rural area.

Alternative 2. In the proper place along Sukhumvit road.

Raw and clear water will be sent to the network by means of the pipeline laid beside Sukhumvit road. Large area of the land shall be acquired for the treatment plant. A pump station will also be needed. But the necessary head may be lower than that of alternative 1.

Total length of the pipeline from the water source to the service area is nearly same in both cases.

The raw water transmission pipeline of the second phase is planned to originate at Nong Kho reservoir, parallel to existing pipeline and about 6.9 km long, running southward along the projected Chonburi - Phatthaya highway which is scheduled to start construction in 1989 - 1990. The pipeline ends at the existing treatment plant, at the shore of Map Prachan reservoir. A pump station is placed on the pipeline route to pass the high lands (Approx. elevation of 80 m and 70 m).

As no water source exist in the Ko Lan island except for direct storage of rain water, it is obvious that the water must be transported from main land. Regarding the transportation of water to Ko Lan, two alternatives can be conceived. One is to convey water from mainland by barge and the other is by pipeline. Cost comparison is made in the following table. Initial cost of the barge alternative includes the construction cost of three service reservoirs of 6,700 m^3 of total capacity with 13 million bahts. As seen in the table, barge alternative is preferable both in terms of initial cost and annual equivalent cost. Considering the more stable supply by pipeline and the accuracy of cost estimate at this master plan stage, it recommendable that in-depth study and comparison should be carried out between the two alternatives.

Water supply plan for Ko Lan

	Unit	Pipeline	Barge
1. Supply	cu m/d	1015	1015
2. Facilities		∅ 200 x 8 km	100 cu m x 3 barges x 4 trips/d
3. Economic life	year	40	14
4. Cost			
a. Initial	M. Baht	193	55
b. Capital recovery factor		0.0839 (8%, 40 years)	0.121 (8%, 14 years)
c. Capital recovery cost (a x b)	M. Baht/y	16.2	6.7
d. Operation & maintenance cost	M. Baht/y	0.5	5.7
e. Annual equivalent cost (c + d)	M. Baht/y	16.7	12.4

Water barges will receive the water through the pier at the marine facilities of main land and unload at the piers on the island. Three 100 ton water barges will make 4 - 5 trips a day for the peak demand.

Proposed water supply system for each phase are schematically presented in Fig. 4.2.19 and shown generally in Fig. 4.2.20.

7) Project outline

Proposed projects are summarized as follows;

PROJECT OUTLINE

	Project Name	Location	Purpose	Outline of the Project	Dimension
Phase I	Improvement & extension of existing service network	Phatthaya, Na Klua town and Jomtien area	To meet the water demand in medium term (1996)	Upgrading & additional pipelines for existing distribution facilities	Total length of distribution main: 56 km
	Establish-ment of water supply system	Tha Farang beach, Bang Sare, Inland area		To construct new distribution facilities	Total length of distribution main: 36 km
Phase II	Water transmission facilities	Ban Huay Fao - Site of existing treatment plant	To meet the water demand in long term (2006)	To construct pipeline & related facilities form Nong Kho to treatment plant	Total length: 27.9 km
	Water treatment plant	Site of existing treatment plant		Construction of new treatment plan	Capacity: 66700 cu m/d
	Improvement & extension work of service network	Phatthaya, Na Klua town and Jomtien area		Upgrading & additional pipelines for distribution facilities	Total length of distribution main: 73 km
	Improvement & extension work of service network	Tha Farang beach, Bang Sare, Inland area		Upgrading & additional pipelines for distribution facilities	Total length of distribution main: 33 km
	Establishment of water suppluy system	Ko Lan		To construct new distribution facilities	Total length of distribution main: 7.6 km
	Pump station	Ban Nong Kwat		Construction of pump station	46.3 cu m/min x 62 m H

Table 4.2.18 WATER DAMAND FORECAST

	Unit	Year 1989	1996	2006
A. Domestic				
Population				
Phatthaya		100,000	142,000	200,000
Tha Farang, Bang Sare		19,100	19,500	20,000
Ban Rong Po		9,000	10,000	11,300
Nong Preo		5,700	5,900	6,000
Service factor*	%	49/-	64/42	77/62
Unit consumption*	lcd	230/-	289/184	303/206
Consumption	MCM/y	4.40	11.21	19.44
B. Public (15% of domestic)	MCM/y	0.71	1.68	2.92
C. Tourism				
No. of guest arrivals	1000/y	1,609	2,281	3,241
Unit consumption	lcd	850	900	900
Consumption	MCM/y	5.47	8.21	11.67
D. Commercial (52% of tourism)	MCM/y	2.84	4.27	6.07
E. Industrial	MCM/y	0.28	0.28	0.28
F. Total consumption (A+B+C+D+E)	MCM/y	14.00	25.65	40.38
G. Total demand (loss of 15%)	MCM/y	16.47	30.18	47.51
	cu m/d	45,100	82,700	130,200

* Phatthaya, Rong Po, Nong Preo / Tha Farang, Bang Sare

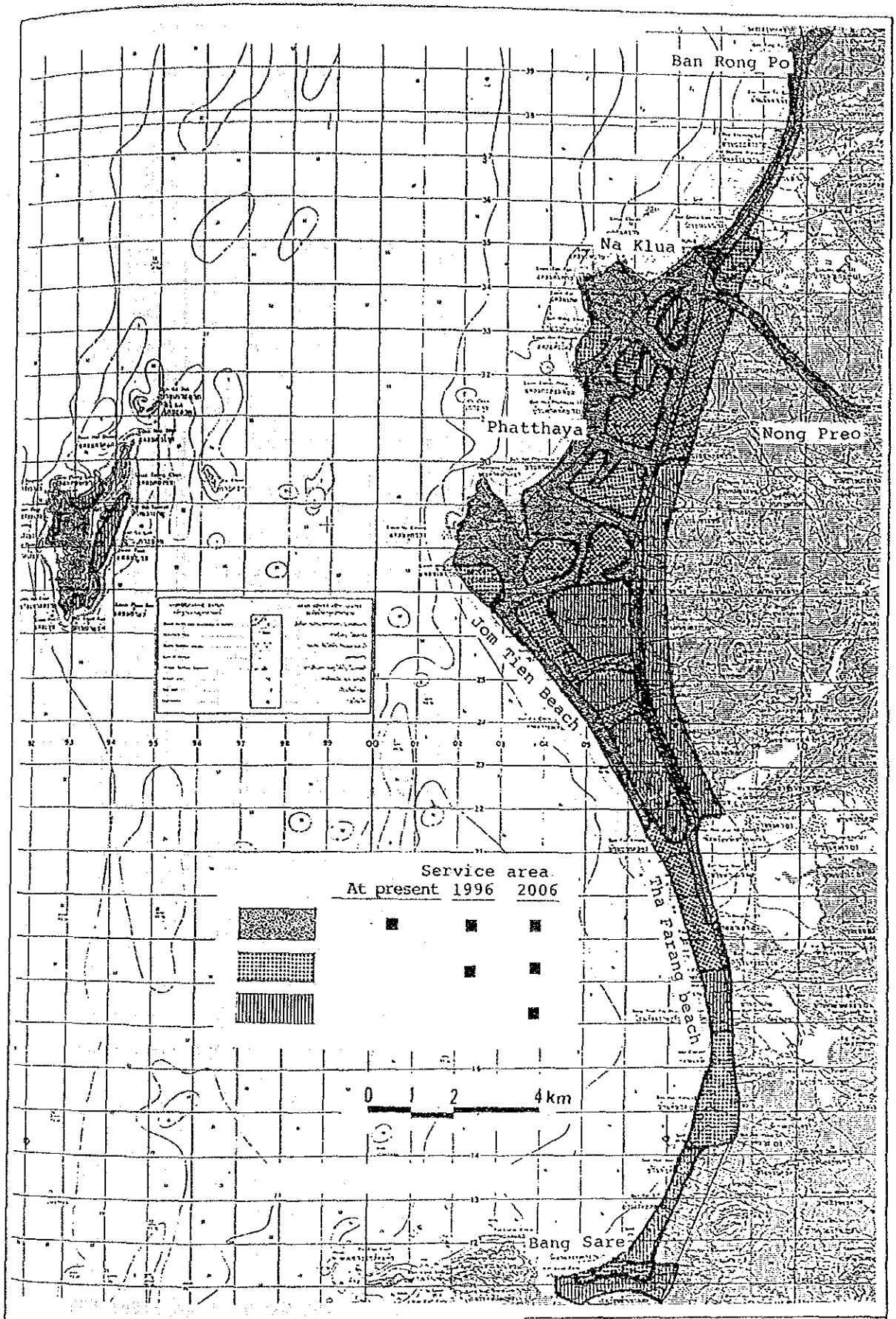


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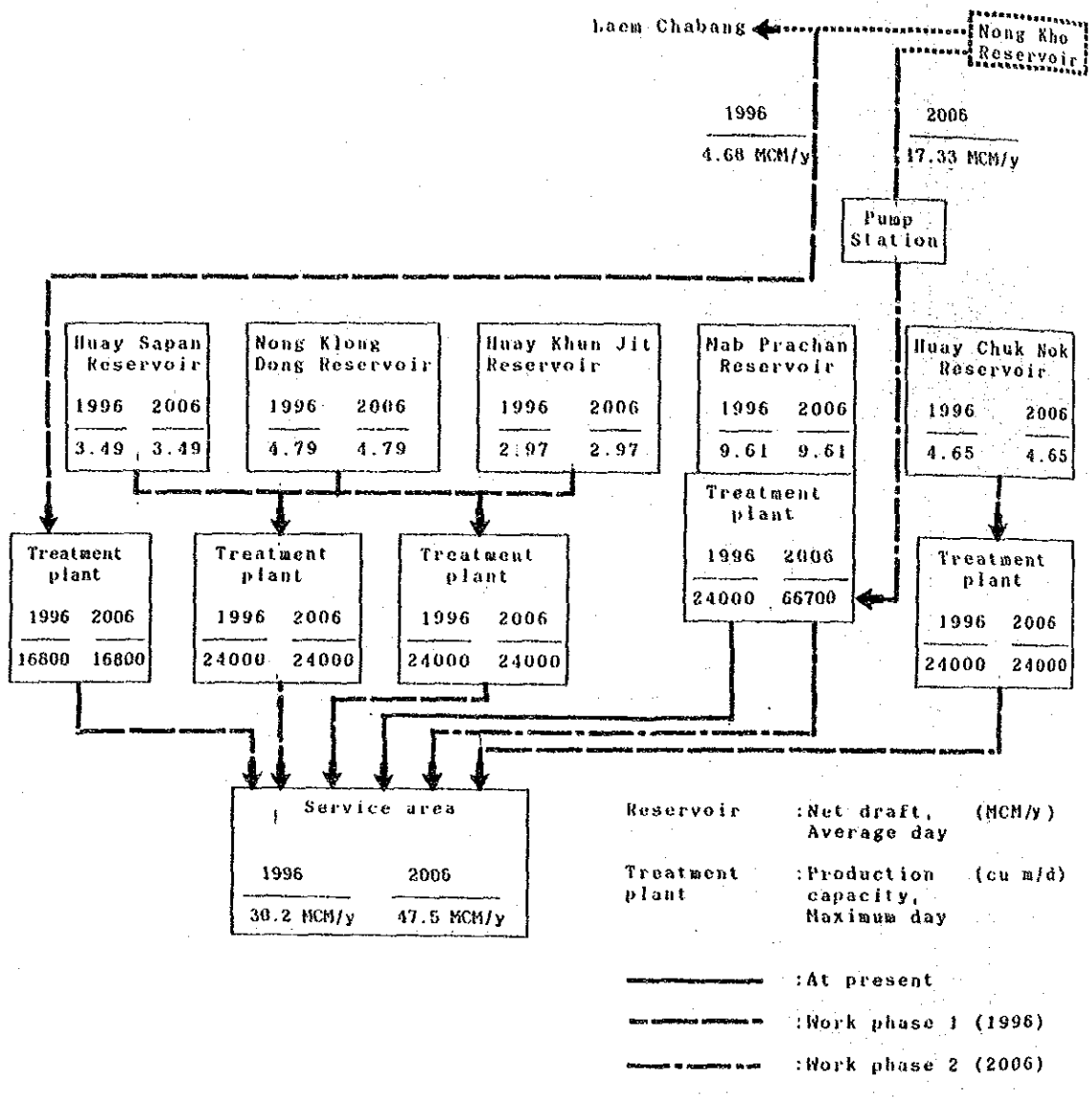
Fig. 4.2.18 Service Area Projection



LEGEND

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Fig. 1.2.19 Schematic Diagram of Water Supply System

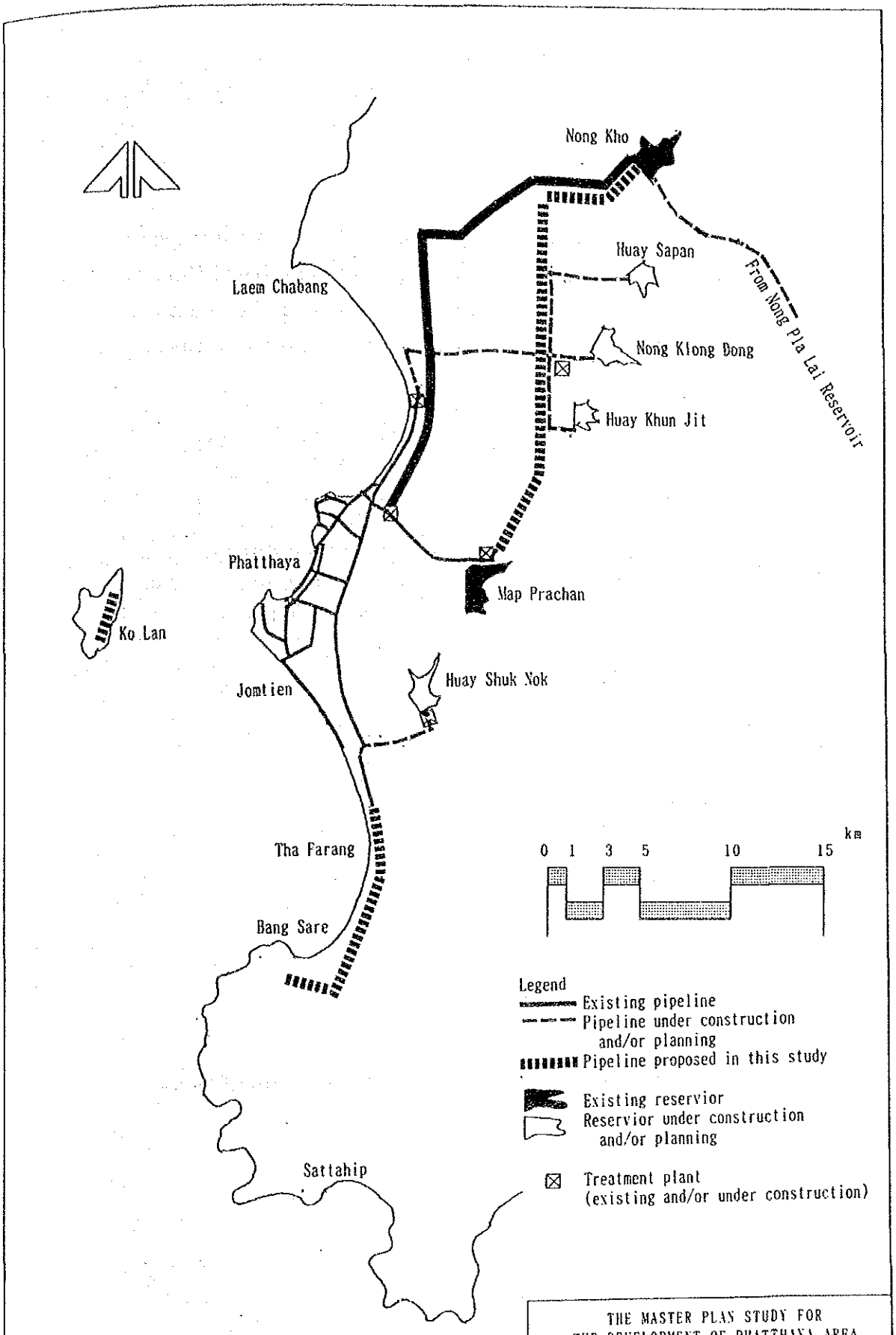

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Fig. 4.2.20 Water Supply System