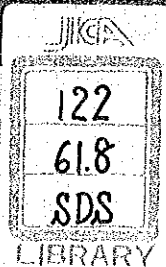


**THE KINGDOM OF THAILAND
BANGKOK METROPOLITAN ADMINISTRATION**

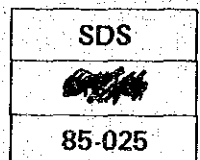
**MASTER PLAN
ON FLOOD PROTECTION/DRAINAGE PROJECT
IN EASTERN SUBURBAN-BANGKOK**

SUMMARY

MARCH, 1985



JAPAN INTERNATIONAL COOPERATION AGENCY



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SUMMARY

MARCH, 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

国際協力事業団	
受入 月日 '85. 6. 11	122
登録No. 11553	61.8
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PREFACE

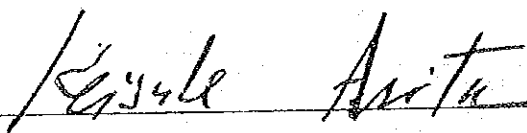
In response to the request of the Government of the Kingdom of Thailand, the Japanese Government decided to conduct a study on the Flood Protection/Drainage Project in Eastern Suburban-Bangkok, comprising two stages, Preliminary Study and Master Plan. The study was entrusted to the Japan International Cooperation Agency (JICA) who sent to Thailand a study team headed by Mr. Saburo Fukagawa.

Based on the Preliminary Study completed in early 1984, the preparation of the Master Plan was carried out between May 1984 and March 1985. The team exchanged views on the Project with the officials concerned of the Government of Thailand and conducted a field survey in the eastern suburbs of Bangkok. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve to assist the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Kingdom of Thailand for their close cooperation extended to the team.

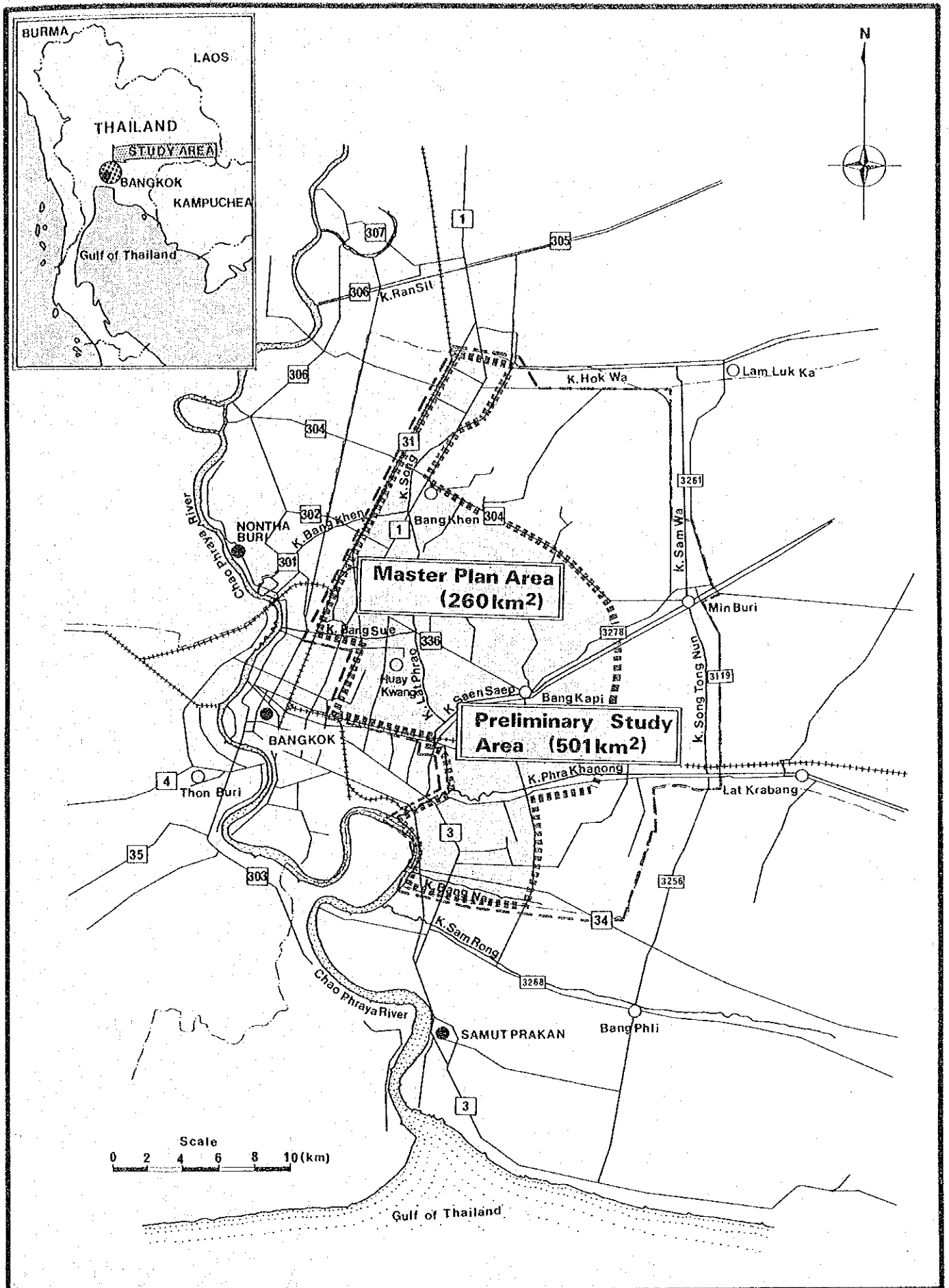
March, 1985

A handwritten signature in black ink, reading "Keisuke Arita", is written over a horizontal line.

Keisuke Arita

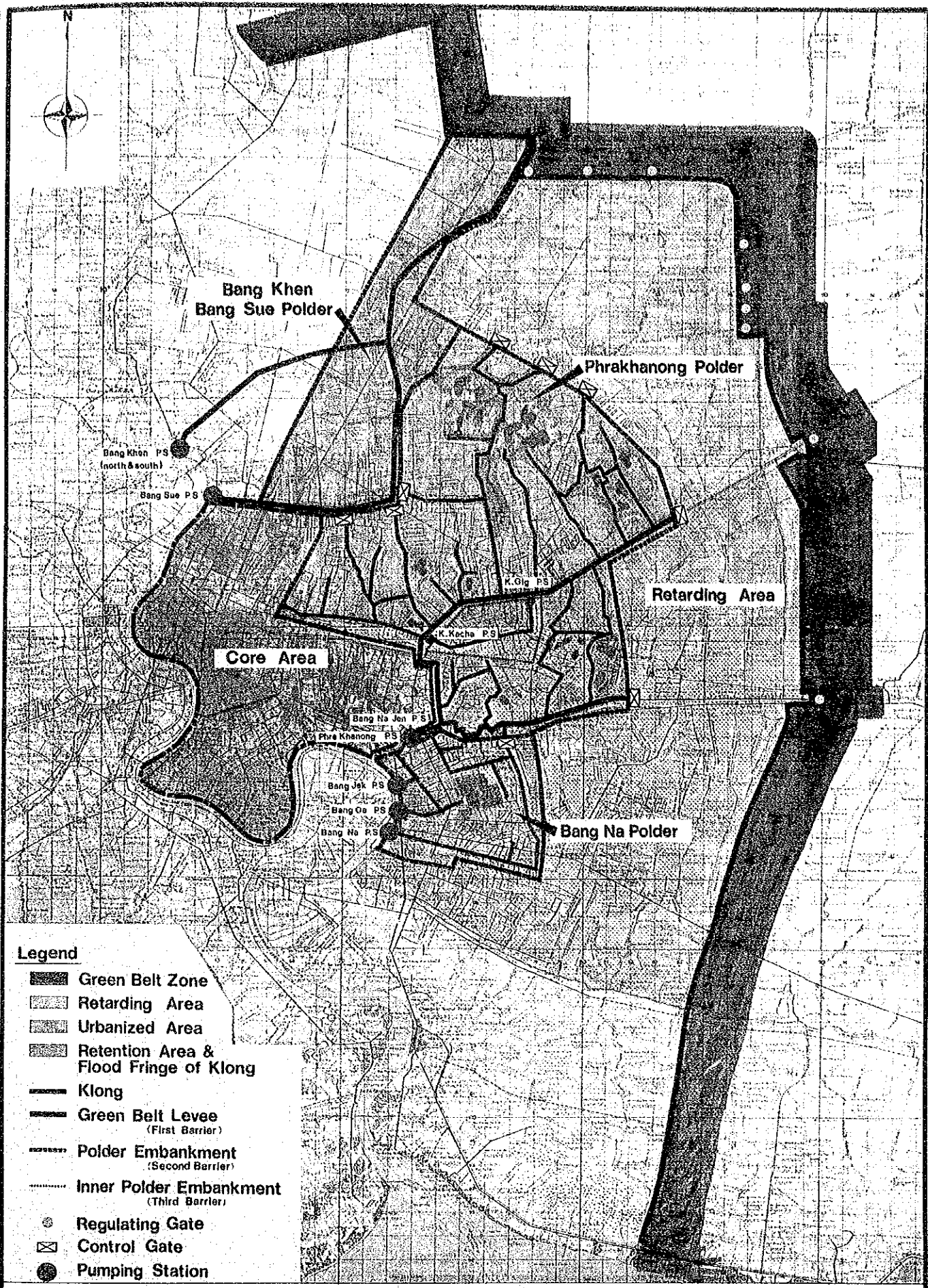
President

Japan International Cooperation Agency



MASTER PLAN AREA

MASTER PLAN ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK



- Legend**
- Green Belt Zone
 - Retarding Area
 - Urbanized Area
 - Retention Area & Flood Fringe of Klong
 - Klong
 - Green Belt Levee (First Barrier)
 - Polder Embankment (Second Barrier)
 - Inner Polder Embankment (Third Barrier)
 - Regulating Gate
 - Control Gate
 - Pumping Station

CONCEPT FOR FLOOD PROTECTION/DRAINAGE SYSTEM

MASTER PLAN ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

SUMMARY

SUMMARY

1. Introduction

Bangkok, the capital of Thailand, is located on the flat deltaic plain of the Chao Phraya River, and founded on low marshland where flooding has been a seasonal phenomenon. The floods used to bring no substantial damages for the residents living in stilt-elevated houses and relying on boat transportation. But modernization of life-style and rapid urbanization has changed the susceptibility to damage by seasonal floods as indicated by the rising cost of the severe floods which have hit Bangkok since the 1950s. The eastern part of Bangkok is particularly vulnerable to flood due to the continuing land subsidence and rapid urbanization.

The Government of Thailand has been planning and implementing various flood control projects in the Bangkok area. The JICA Study Team initiated the Preliminary Study on Flood Protection/Drainage Project in Eastern Suburban-Bangkok in 1983, which studied an overall flood damage mitigation plan for 501 km² of the eastern part of Bangkok, and concluded that the selected 260 km² is to be covered with a flood protection/drainage facilities as the Master Plan Area targeted for the year 2000.

In the rainy season of 1983, a severe flood enveloped the Bangkok area. The estimated flood damage in the Master Plan Area was 3,500 million Baht, the highest in the whole Bangkok. For an immediate mitigation of the flood condition, the Government of Thailand executed urgent projects which are estimated to reduce future flood damage to one-third of the 1983 flood. However, it is anticipated that the flood damage potential of the area is increasing each year, because the population will increase by more than twice (Fig. 1) and the ground elevations will be further lowered to below mean sea level by the year 2000 (Fig. 2). As a result, if the same rainfall as 1983 occurs in the year 2000, the flood damage would be 7,000 million Baht at 1984 prices even with the existence of urgent facilities.

In order to bring a permanent solution which is effective for the expected topographical change and urbanization by 2000, this Master Plan incorporates comprehensive flood protection/drainage systems for the Eastern Suburban-Bangkok.

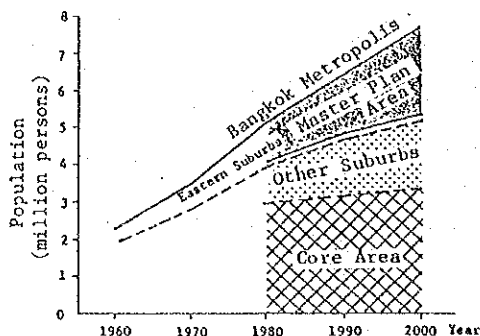


Fig. 1 Population Increase

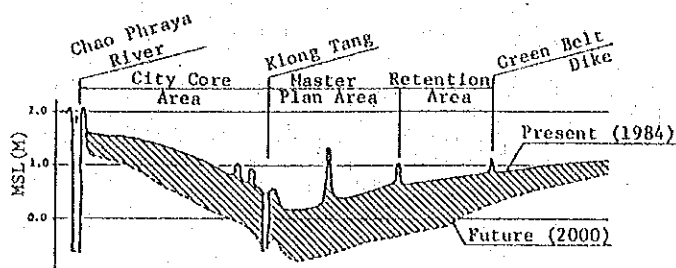


Fig. 2 Progression of Land Subsidence

2. Comprehensive Flood Damage Mitigation Plan

Numerous examples of floods, which have occurred in cities of other countries indicate that the drainage capacities of the conventional structural measures have not been able to catch up with rapid urbanization and sprawling of urbanization in flood-prone areas. It has become increasingly evident that in order to minimize losses to future development and reduce losses to existing development, a combination of structural and non-structural measures must be employed (Fig. 3). This combination is common for all neighboring areas such as the Core Area, Thonburi Area, Samut Prakan Province in the Lower Central Plain.

For the eastern suburbs of Bangkok, since the area is on the verge of urbanization, it is particularly effective to employ a comprehensive approach, consisting of both structural and non-structural measures, as shown in Fig. 4.

2.1 Proposed Structural Measures

The basic idea behind the structural measures is the establishment of a polder system. The inside of the polder is to be protected against inflow from outer areas and the Chao Phraya River by polder embankments and gates. Rainfall inside the polder is to be discharged by the drainage facilities installed inside the polder.

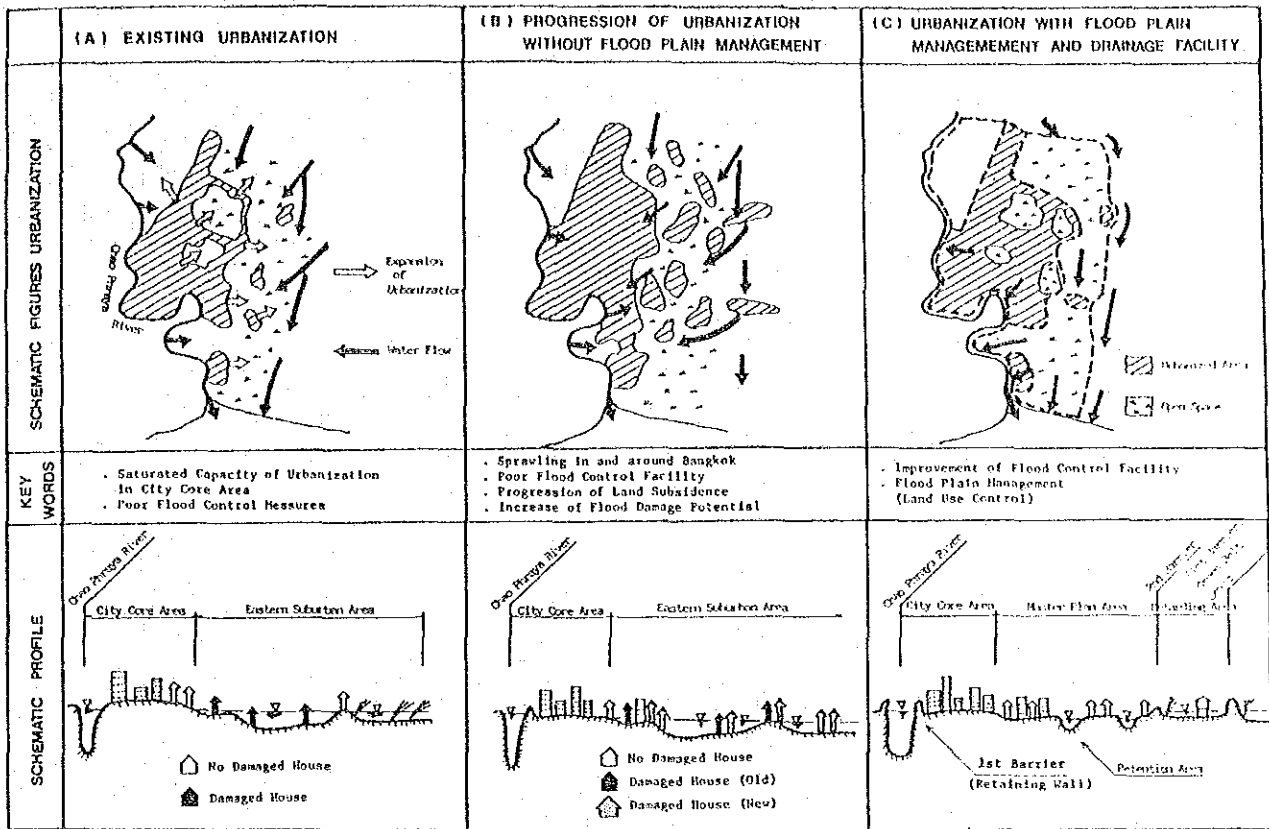


Fig. 3 Concept of Comprehensive Flood Damage Mitigation Plan

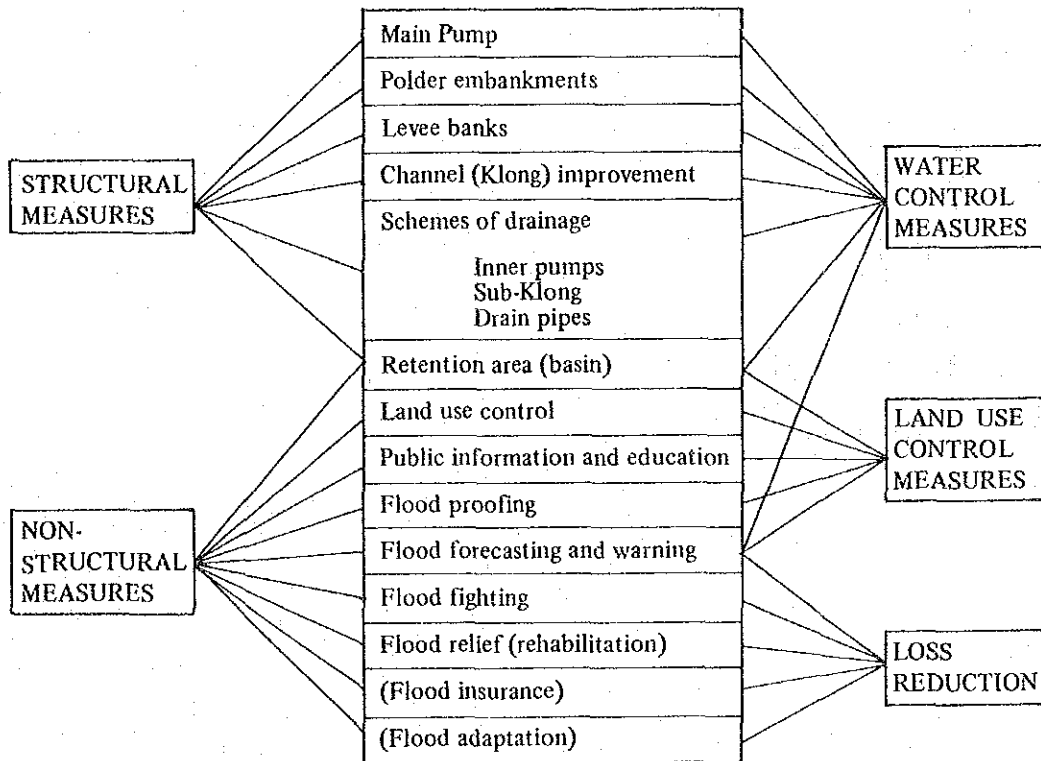


Fig. 4 Comprehensive Flood Damage Mitigation Measures

The Eastern Suburbs (501 km²) covered by the Preliminary Study has been protected already by the Green Belt embankment. Further, since about half (230 km²) of the Eastern Suburbs (501 km²) is estimated to be urbanized, the Master Plan Area (260 km²) is proposed for protection by the construction of polder embankments and gates surrounding the Master Plan Area.

The Master Plan Area should be subdivided into three polders i.e., Bang Khen – Bang Sue, Phra Khanong and Bang Na, using topography and the road network acting as natural boundaries and the klong network (Fig. 5).

Once the outer water is blocked off, the inner storm water will be discharged by drainage facilities. Installation of outlet pumping stations discharging storm water into the Chao Phraya River and improvement of main klongs leading to the pumping stations will alleviate overall flooding. On the other hand, heavy local flooding will be relieved by improvements to a large number of sub-klongs and main drain pipes, and the installation of inner pumps (Fig. 6).

The structural-measures proposed are shown in Table 1 and Fig. 5.

Table 1 Proposed Structural Measures

Embankment	6.2 km
Gates	55 places
Pumping Station with Gate	
Outlet	7 stations (200 m ³ /sec)
Inner	3 stations (18 m ³ /sec)
Klong Improvement	
Main Klong (Phra Khanong, Tan and Saen Saep)	25.5 km
Sub-Klong	107.5 km
Main Drain Pipe	110 km (80 km ²)

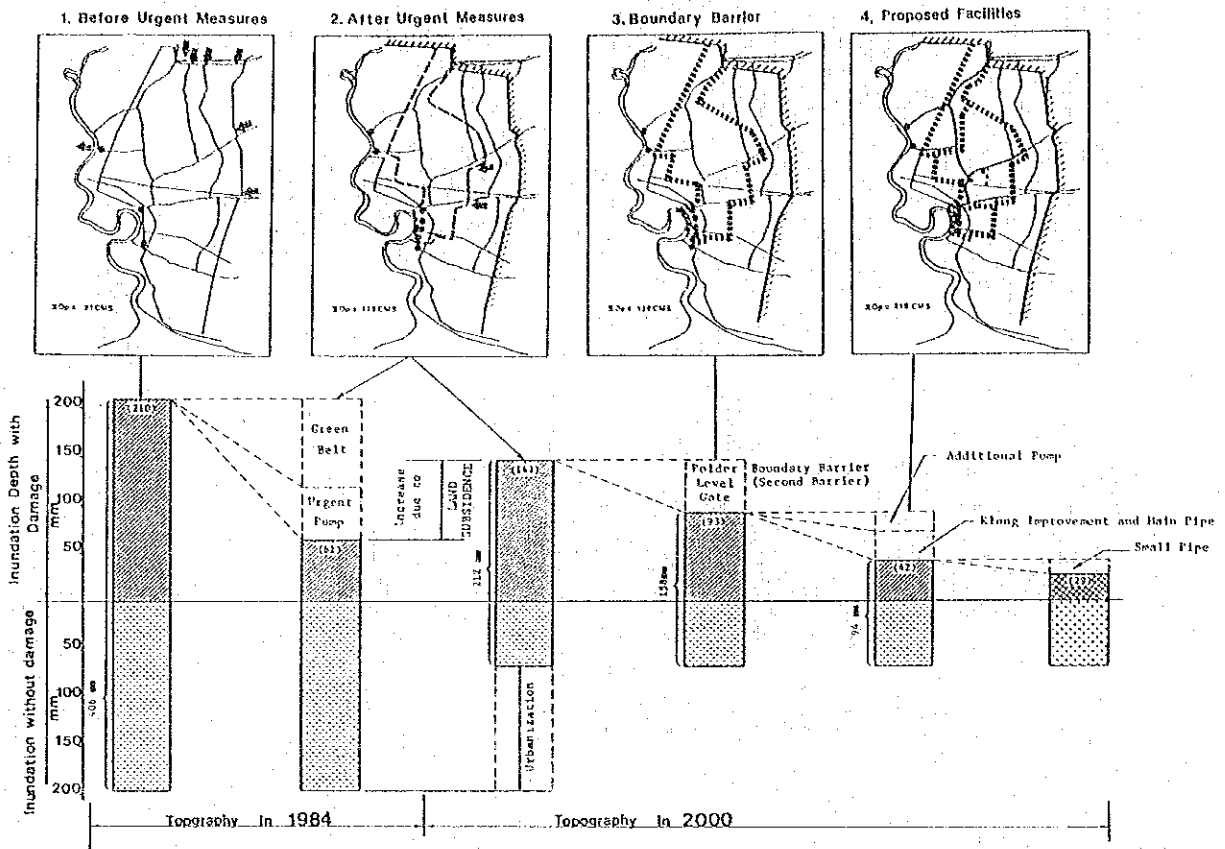


Fig. 6 Hydrological Effect of the Proposed Project

2.2 Proposed Non-Structural Measures

The basic idea for non-structural measures is to modify the susceptibility to damage from flooding of property and activities in the flood-prone areas.

The future urbanized area of 82 km², which will be required between 1980 and 2000, should be allocated to flood-free areas (Fig. 7). Publication of the observed extent and depth of the 1983 flooding should be first made for the education of residents. Then proper guidance of land use and application of building codes should be taken according to the flood risk.

The remaining non-urbanized area (44 km²) in the year 2000 will have the natural function of storm water retention (11 million m³). This will reduce the requirements placed on the klongs and capacities of the pumps and hence reduces the investment in structural facilities, and brings a higher efficiency in the invested funds.

Additionally individual self-help community programmes should be prepared, particularly for the existing urbanized, flood-prone areas.

These will be greatly assisted by the institution of a flood forecasting and warning system which should provide for the proper operation of the structural facilities and flood fighting control.

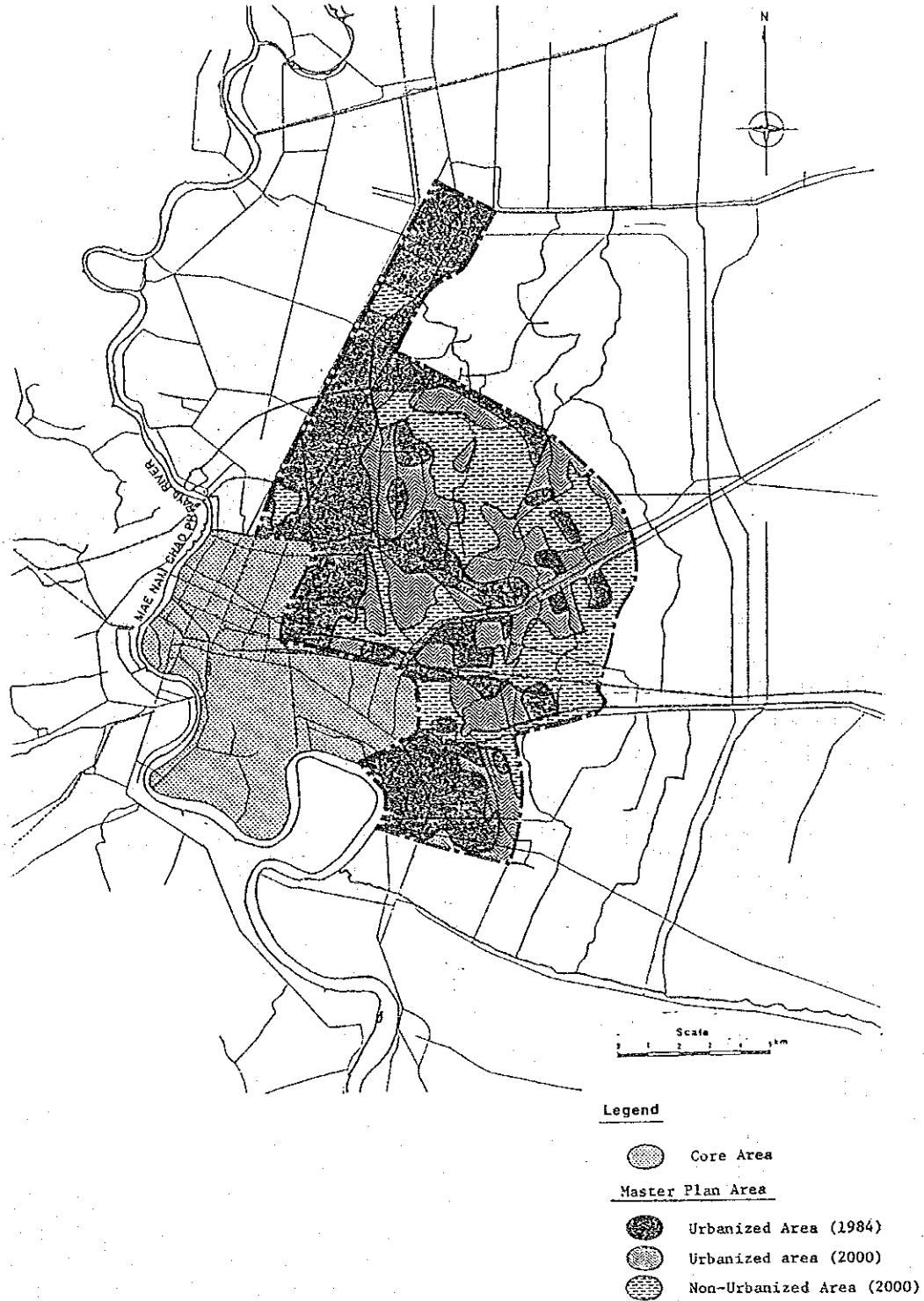


Fig. 7 Urbanized Area and Retention Area According to Flood Risk

3. Cost and Benefit of Project

6,280 million Baht is to be invested by the target year of 2000. When not only the proposed structural-measures but also non-structural measures are concurrently executed, the annual average flood damage will decrease from 2,716 million Baht to 147 million Baht in 2000. This indicates a high economic viability for the project. Other economic evaluation is shown below.

Benefit/Cost	1.5
Internal Rate of Return	26.5%

4. Implementation Schedule

Staged construction will enable capital expenditure to be distributed over a period of years and will facilitate implementation. After two-years of preparatory work for feasibility study, detailed design and financial procurement, construction can start in 1987 when the Sixth National Economic and Social Development Plan (Oct. 1986 to Sept. 1991) starts. Each stage is planned to correspond to the 5-year Development Plan.

Since the overall facilities such as polder embankment, gates, pumping stations and main klongs are effective in reducing overall flooding (Fig. 6), these facilities should be constructed at any early stage. On the other hand, facilities such as sub-klongs and main drain pipes which contribute to the alleviation of local flooding are proposed for implementation according to the area priority. As a result, the implementation schedules proposed are shown in Fig. 8, and the works included in the first stage (2,560 million Baht) are shown in Fig. 9.




Item	Total	First (1987 – 1991)	Second (1992 – 1996)	Third (1997 – 2000)
Cost (million Baht)	6,280	2,560 	1,830 	1,890 
Facilities				
Embankment	6.2 km	6.2 km	—	—
Pumping Station with Gate	10 stations (218 m ³ /sec)	Kacha (6 m ³ /sec) Gig (3 m ³ /sec) Bang Na Chine (9 m ³ /sec) Bang Sue (14 m ³ /sec) Bang Na (6 m ³ /sec)	Phra Khanong (90 m ³ /sec)	Replacement of Urgent Pumps Bang Khen North & Sourh (15 m ³ /sec) Bang Sue (36 m ³ /sec) Jek (6 m ³ /sec) Bang Oa (18 m ³ /sec) Bang Na (15 m ³ /sec)
Gate	55 places	4	26	25
Main Klong	25.5 km	(Phra Khanong, Tan & Saen Saep)		
		16.5 km	9.0 km	
Sub Klong	107.5 km	52.3 km	26.9 km	28.3 km
Main Pipe	351 km	30 km	40 km	40 km
Flood Forecasting and Warning System		1 set	—	—

Fig. 8 Implementation Schedule

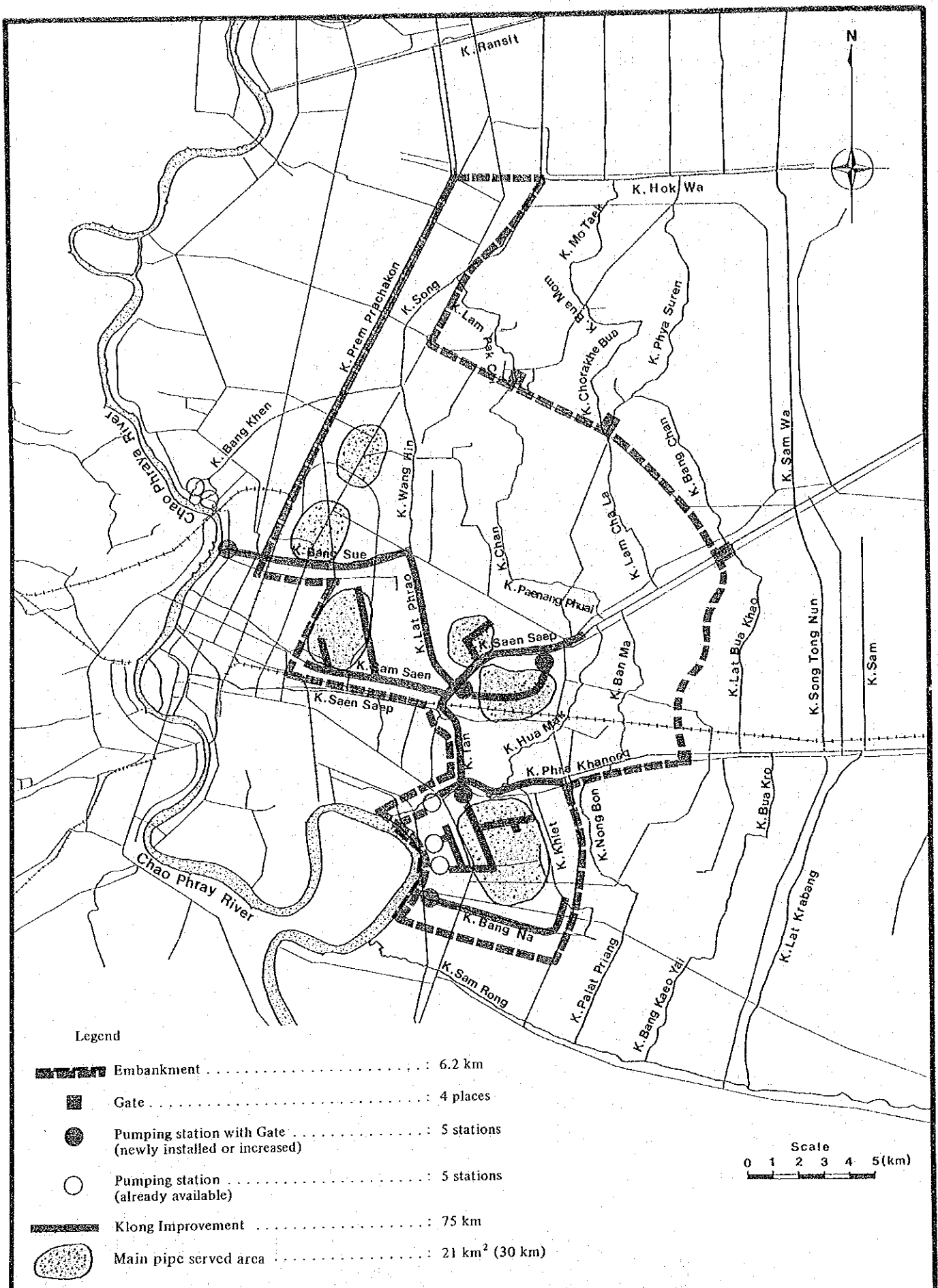


Fig. 9 .

PROPOSED FACILITIES AT FIRST STAGE

MASTER PLAN ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

5. Financial Plan

The construction cost of 6,280 million Baht by the year 2000 is to be financed by foreign loans (40%), government subsidy (30%) and the Bangkok Metropolitan Administration (30%), while the debt service of the loan and the operation and maintenance cost is covered by the BMA. In order to finance the BMA's financial requirement, three kinds of financial resources are recommended for each implementation stage (Fig. 10).

- (a) Increasing local taxes (stage I)
- (b) Collecting surcharge from developers (stage II)
- (c) Imposing "Urban Development Tax" (stage III)

6. Organization

In order to realize a comprehensive flood protection and drainage system, it is recommended that a permanent flood protection organization at national-level is established incorporating similar functions at the current Urgent Committee.

It is recommended that the current Urgent Sub-Committee, mainly in charge of structural measures, be made permanent, and an equivalent organization for flood plain management established.

7. Recommendation for Feasibility Study

A feasibility study for the implementation of stage I should be conducted. The works to be included in the first stage are flood protection barriers and main drainage facilities to prevent overall flooding, and drainage facilities for high priority areas within the polders. Thus, it is expected that the first stage package will yield a highly efficient return on investment. It should be emphasized that the realization of the planned functions are contingent upon the administrators' efforts in controlling land-use, and in strengthening financial resources and other administrative measures taken by the Government and BMA.

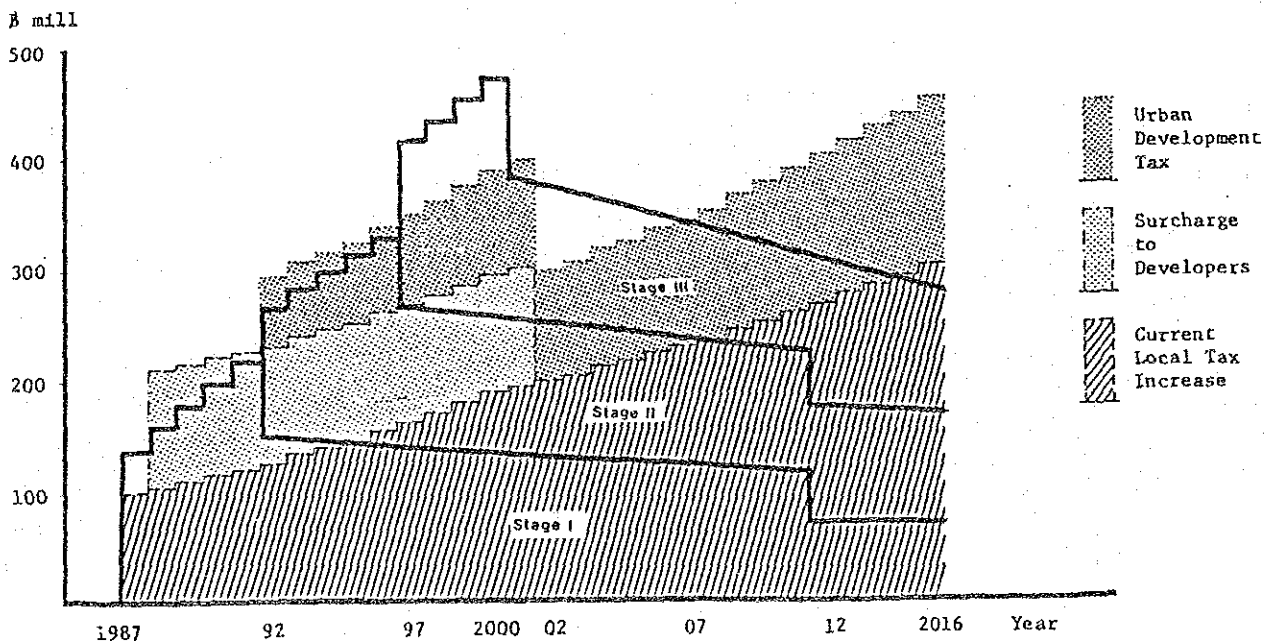
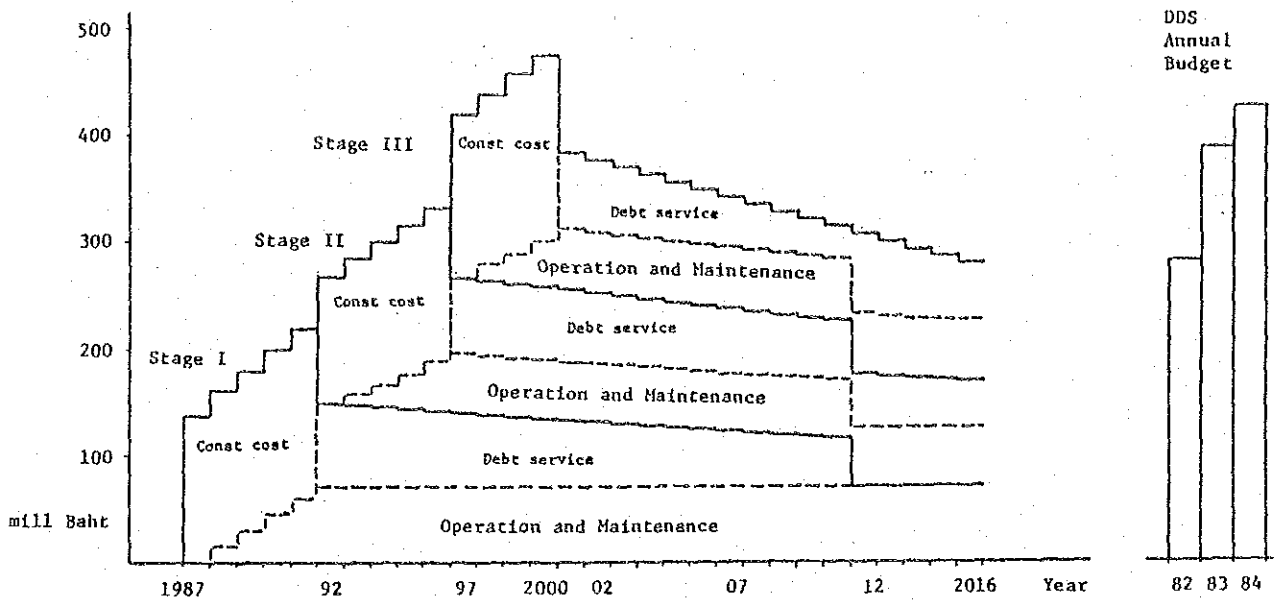


Fig. 10 Cash Flow Schedule of BMA for Stage I, II & III



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