10.6 Land Regulation

In principle, flood plain areas should not be developed for urban use. However, the zoning of flood plain areas has been adopted in many countries in order to control land development in flood plain areas.

A zoning of the flood plain is recommended by considering the flood flow characteristics.

Fig. 10.3 shows flood plain zoning based on the flood flow information, observation of satellite image, and hydraulic simulation results for the 1988 floods.

(1) Main Flood Flow Zone : The area is to be recognized as main flood flow zone.

Most of this zone shall be used as agricultural land. In this zone, land development for residential, commercial and industrial use should be prohibited.

(2) Sub Flood Flow Zone : The area is less affected by flood flow.

At present, the land use pattern is composed of rural settlement and rice fields. The land development for this area is to be controlled by the Government.

Table 10.1 Danger Water Levels

	Flood Plain & Water Level	Water Level Monitoring Station	Danger Water Level (m) (Flood Frequency)
1.	Buriganga/Dhaleswari Flood Plan		
	A. Lower Part (BD-1)	(Sta.No. 43) Abdullahpur (Proposed Sta.)	5.9 m (1/3)
	B. Middle Part (BD-2)		6.0 (1/3)
	C. Upper Part (BD-3)	Mirpur (Sta. No. 302) Kalatia (Sta. No. 70)	6.4 (1/3)
2.	Turag River Flood Plain		
	A. Lower Part (TL-1)	Mirpur (Sta. No. 302)	6.7 (1/3)
	B. Upper Part (TL-2)	Qasimpur (Proposed Sta.)	6.7 (1/3)
3.	Savar South Flood Plain	Savar (Sta. No. 69)	6.5 (1/3)
4.	Savar North Flood Plain	Nayarhat (Sta. No. 145)	7.4 (1/3)
5.	Buriganga Lower Flood Plain	Hariharpara (Sta. No. 43)	5.9 (1/3)

10.7 Zoning of Khal and Retarding Pond Areas in Urban Areas

Swampy areas in 19 locations, amounting to 4,529 ha, should be preserved for the retarding ponds. If the retarding pond areas are not kept properly, the required pump capacity and operation cost will increase.

Zoning and preservation of the retarding pond areas are very important.

Land development should allow for a retarding pond with a storage capacity of 1,200 m3/ha or a pond area corresponding 12% of the developed area.

Preservation of land for khals and trunk drains is very necessaty. Many khal or trunk drain sections in the urban areas are occupied and encroached upon illegally by settlements and sanction by roads and buildings. This is one of the major causes of internal floods in the urban area.

The proposed khal and trunk drain sections should be preserved to prevent any enchroachment.

Future urban areas in the low-lying areas protected from external floods by embankment will be developed by filling. However the design water levels of the proposed retarding ponds, khals and trunk drains should be considered.

The minimum ground elevations of the future low land area developments by drainage zone are proposed as follows :

- Greater Dhaka : 4.50 to 5.50 m PWD
- Tongi : 5.00 to 5.50 m PWD
- Savar : 6.00 m PWD
- Narayanganj : 4.50 to 5.00 m PWD
- Keraniganj : 4.50 to 5.00 m PWD

Details of the above are illustrated in Fig. 10.4.

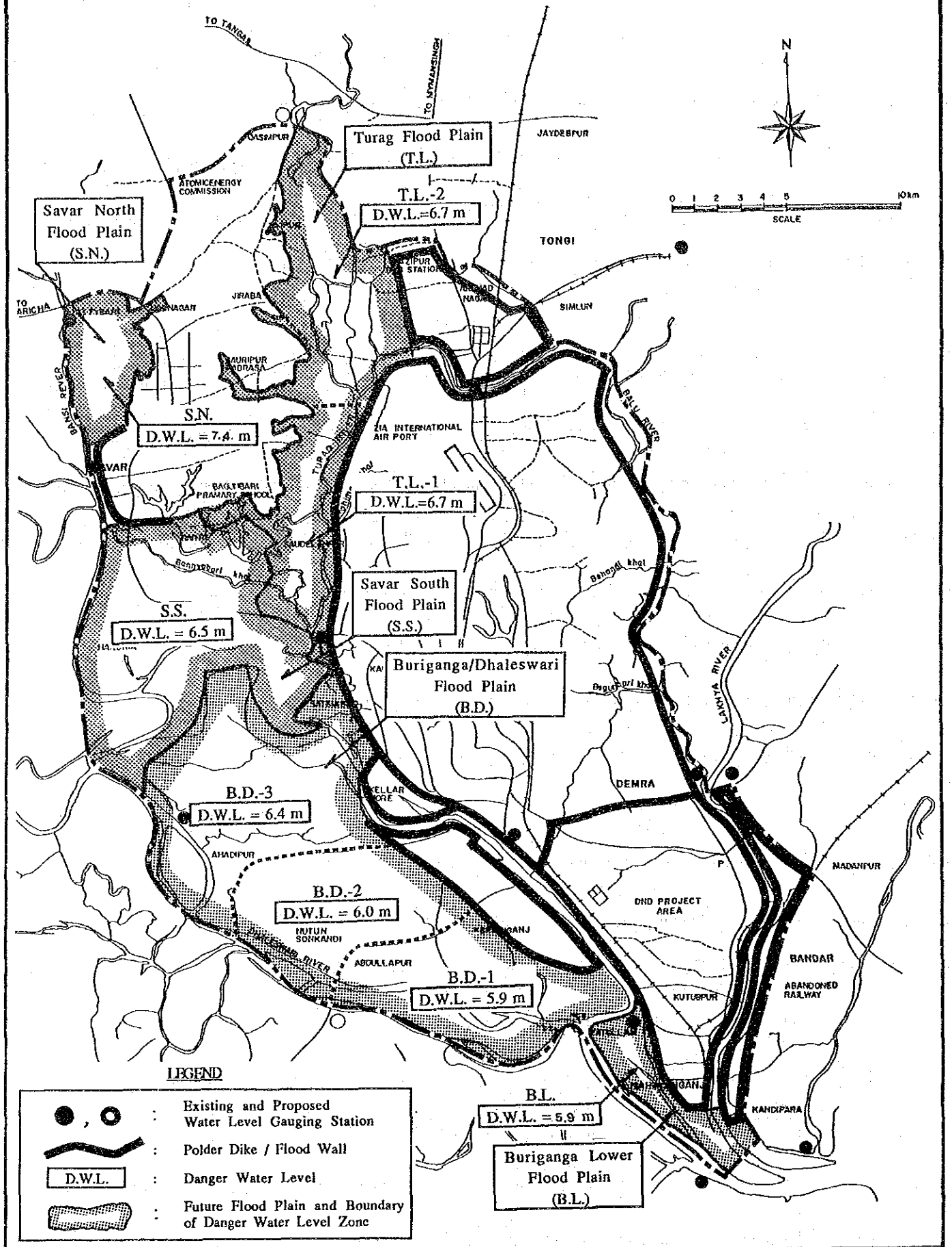

FIG. 10.1 FUTURE FLOOD PLAIN AND DANGER WATER LEVELS

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

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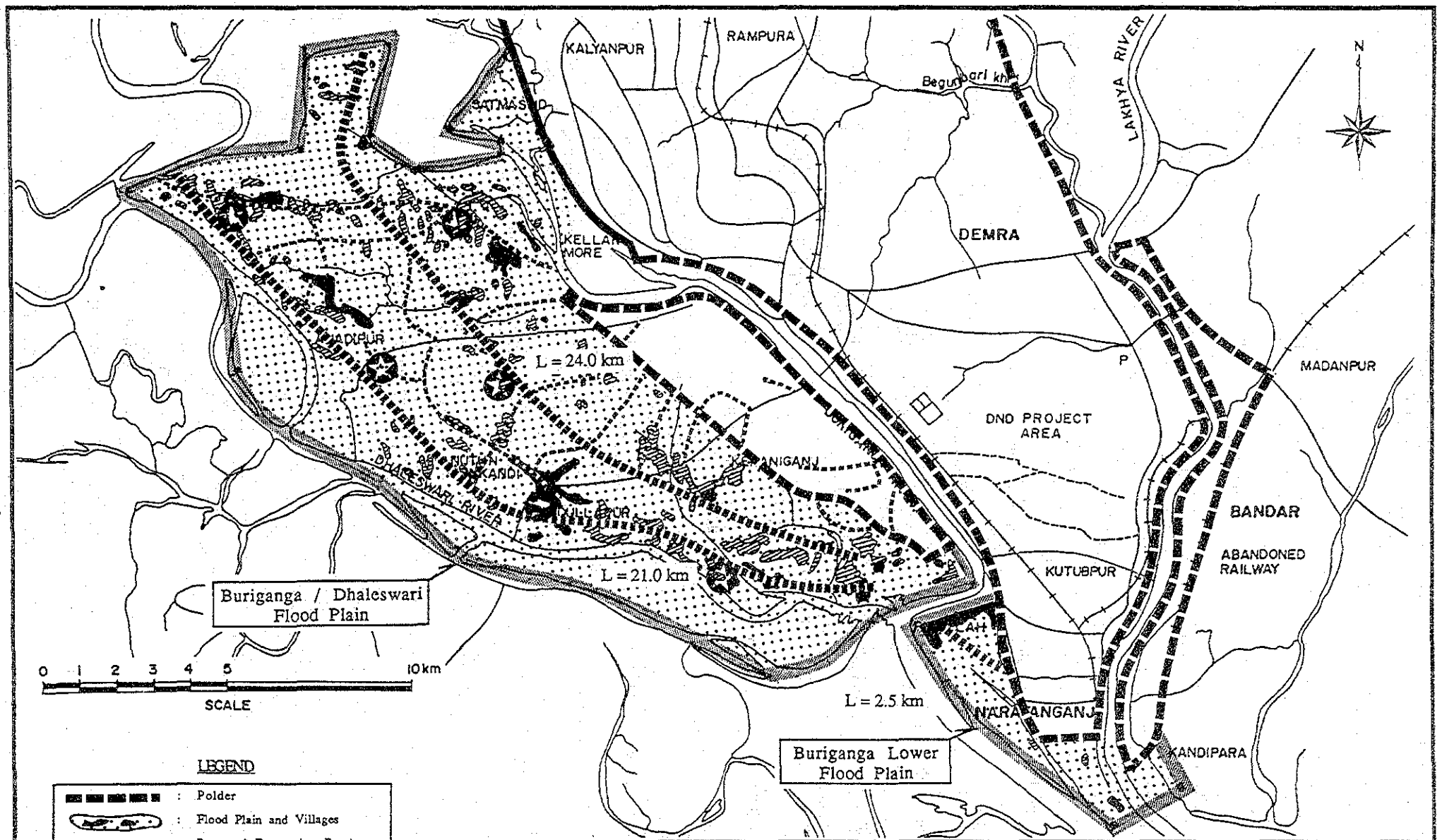


FIG. 10.2 (1) PROPOSED EVACUATION ROADS (IMPROVEMENT) AND EVACUATION CENTERS (1)

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

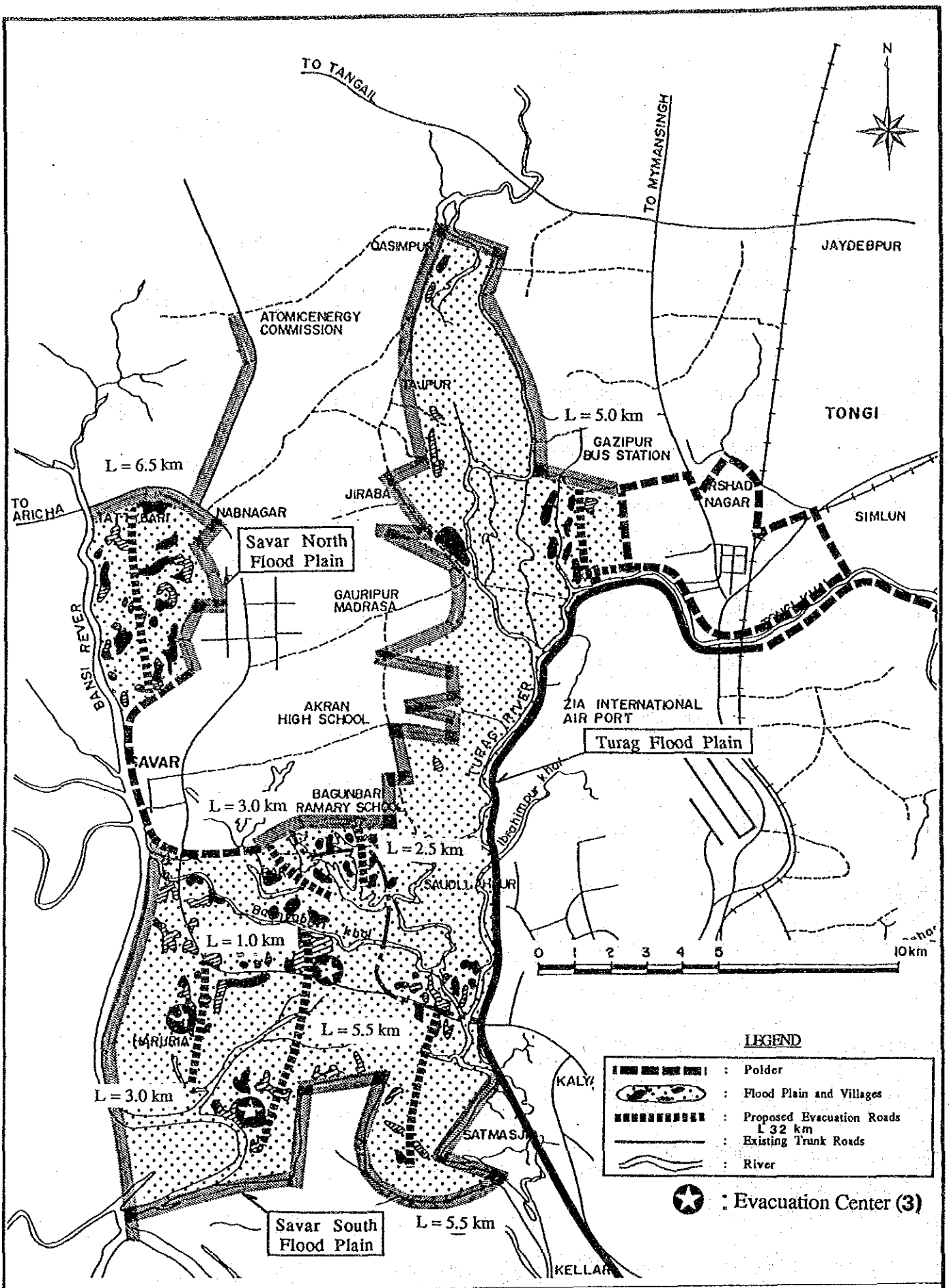


FIG. 10.2 (2) PROPOSED EVACUATION ROADS (IMPROVEMENT) AND EVACUATION CENTERS (2)

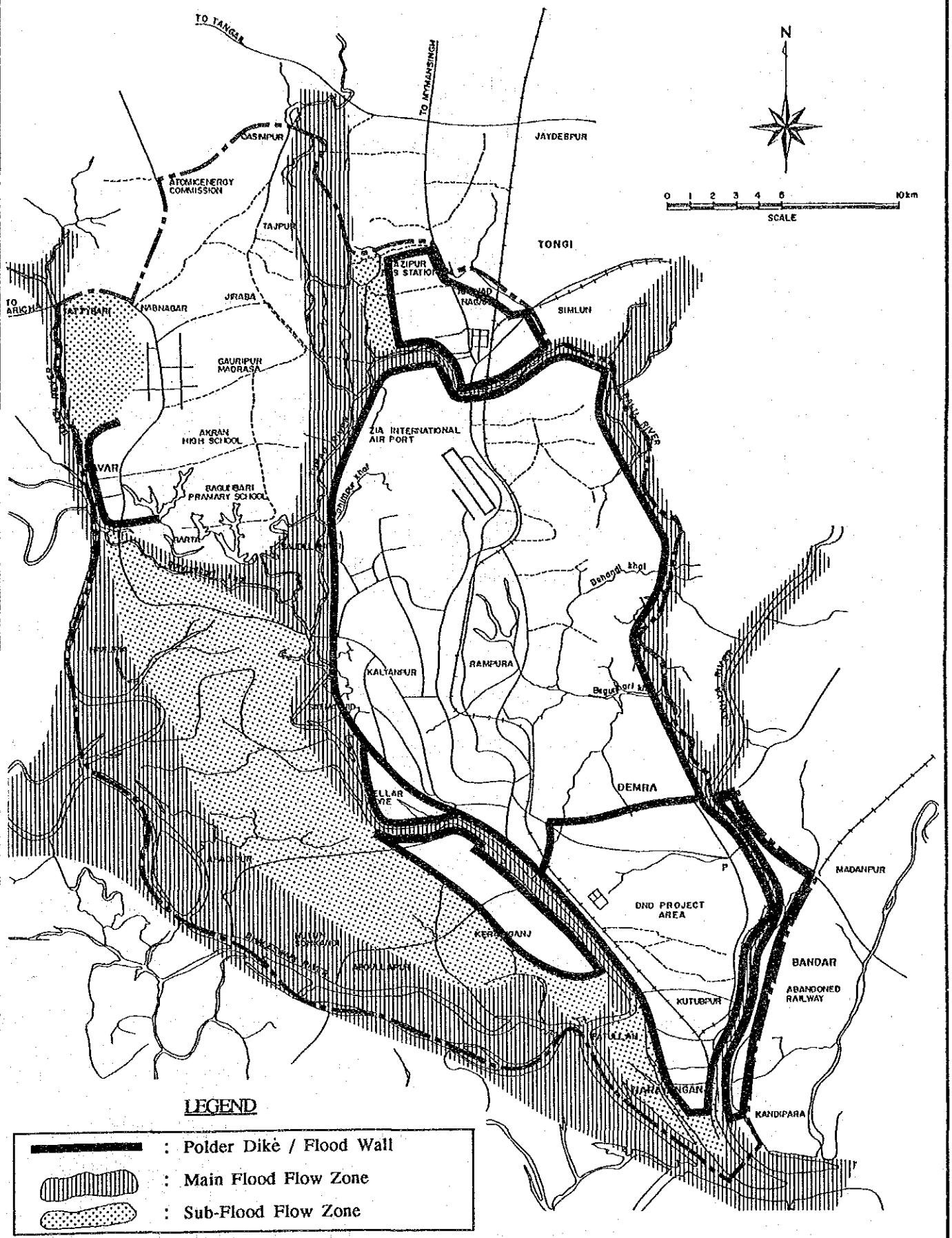
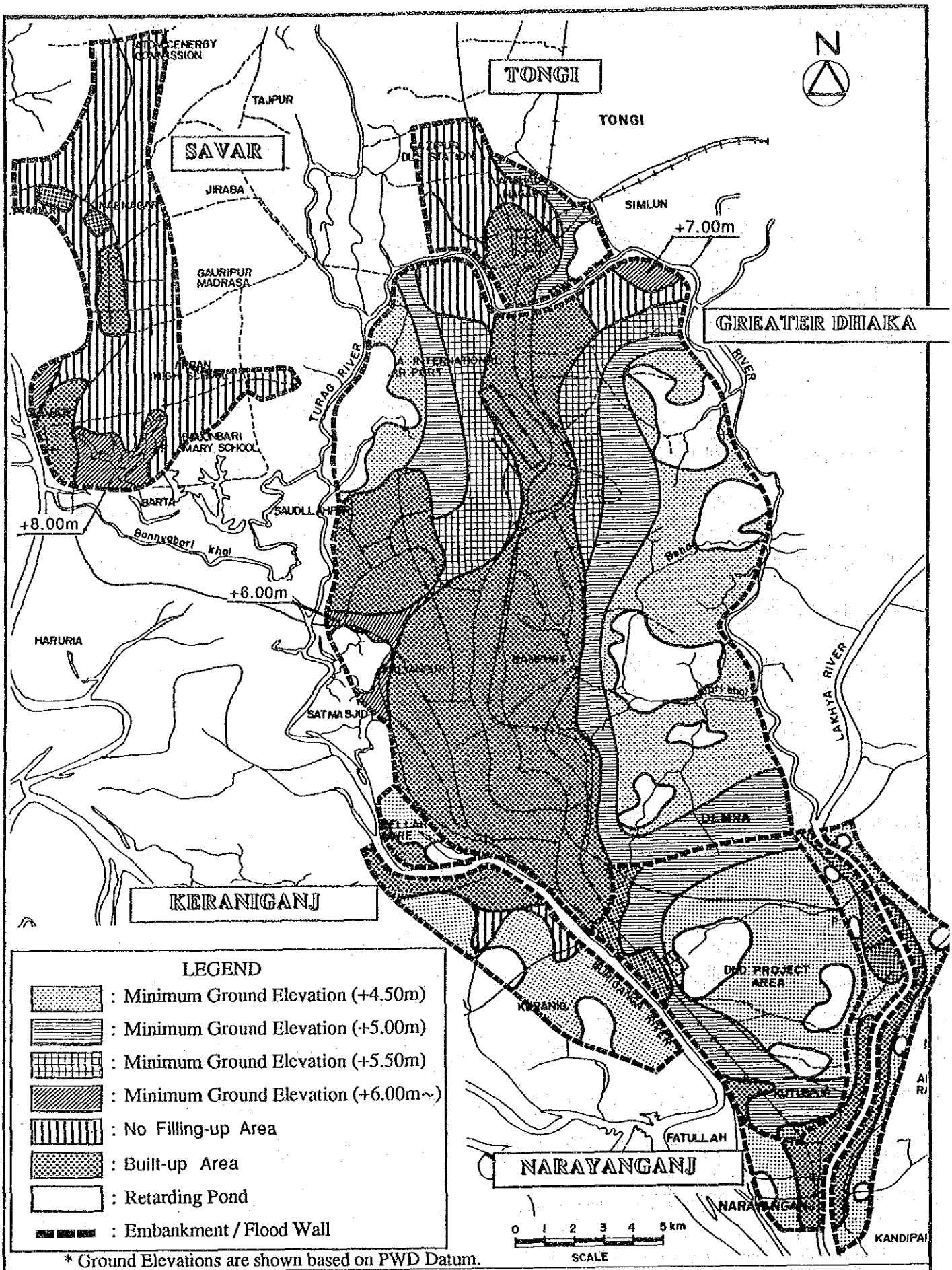


FIG. 10.3 ZONING IN FLOOD PLAIN AREA

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

JICA

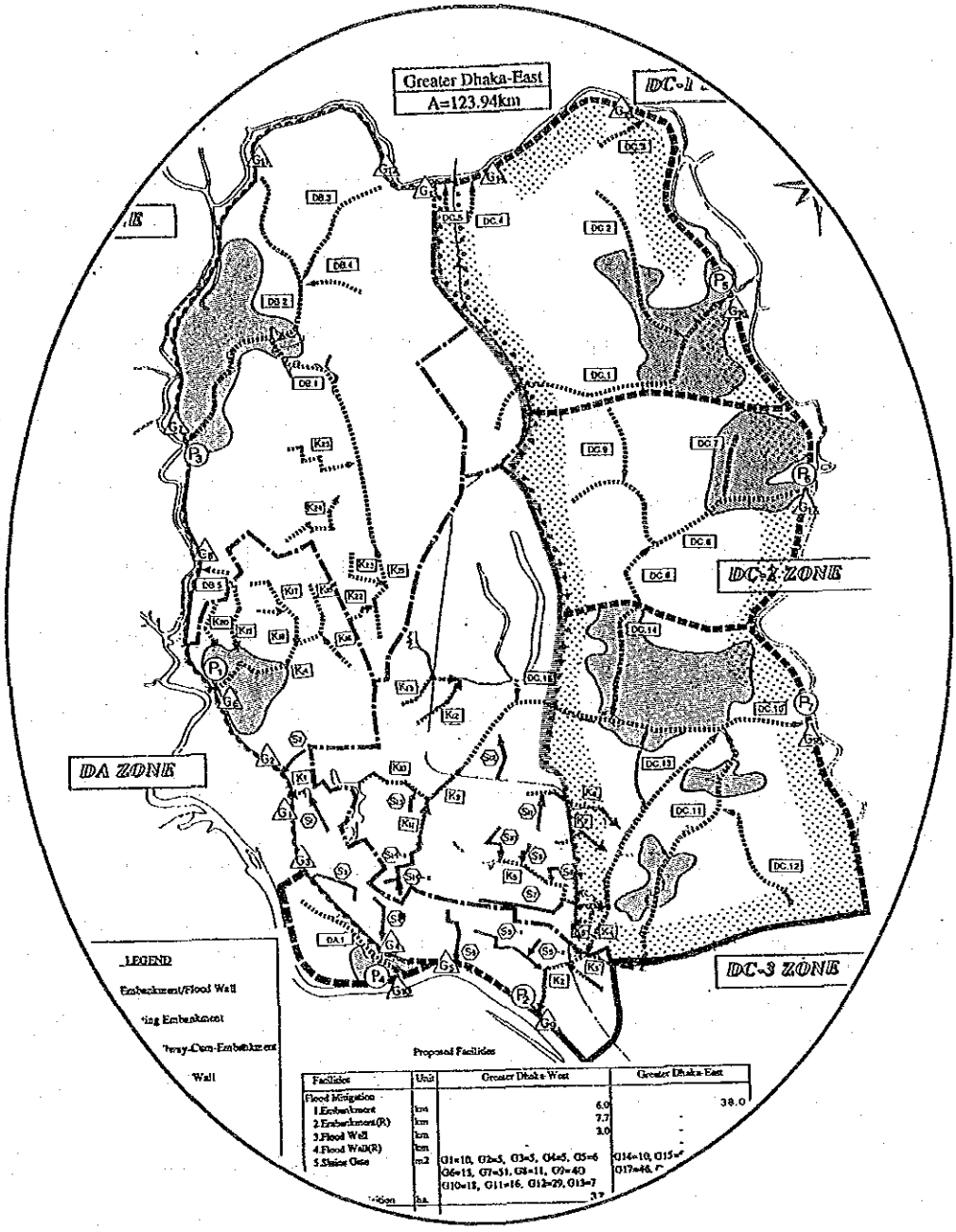


* Ground Elevations are shown based on PWD Datum.

FIG. 10.4 GUIDELINE OF FUTURE LOWLAND DEVELOPMENT

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

JICA



Proposed Facilities in Greater Dhaka Area

CHAPTER 11
CONCLUSION AND RECOMMENDATION

CHAPTER 11 CONCLUSIONS AND RECOMMENDATIONS

11.1 Priority Project F/S

(1) The proposed flood mitigation and drainage improvement facility plan is technically feasible and will be effective in economical, social and environmental terms, though Tongi and Keraniganj seem marginal, and Narayanganj East and Savar may not be feasible in economic terms. All the study area needs immediate action for implementation of structural and non-structural measures, because the area is extremely vulnerable both to external floods and to internal floods due to its low and flat topography and difficult meteo-hydrological conditions.

According to the project evaluation on measures required in each urban area and at each sub project area, Greater Dhaka and Narayanganj DND / West are the highest priority areas.

(2) According to the report (July 1991) by the Fact Finding Mission of ADB, many parts of proposed structural measures for the western part of Greater Dhaka (DA /DB) have already been selected by ADB as a part of the immediate investment program for the first stage.

Accordingly the F/S on Greater Dhaka West (GDW) will be carried out by ADB (FAP 8B).

Among the remaining 1st priority areas, Greater Dhaka East, DND and Narayanganj West must be the areas needing the most urgent implementation. They need more detailed assessments for early implementation.

Greater Dhaka East, DND and Narayanganj West are identified for the phase III study (F/S). Each proposed area for the F/S is explained as follows :

(Greater Dhaka East)

- The flood mitigation and storm water drainage improvement plans for Greater Dhaka East were approved as phase II of the Greater Dhaka Flood Control Committee's proposal by the GOB.

- According to the projection of the future population and land use at the target year of 2010, population of Greater Dhaka will increase from 4.4 million in 1990 to 8.6 million in 2010. Flood mitigation and drainage improvements of Greater Dhaka will be one of the most urgent measures needed to cater for this increase.

- The evaluation in the master plan shows that the project is not only technically feasible, but will likely be effective in economical, social and environmental terms as well.

- The central part of Dhaka city (drainage area 44 km^2 of PD - 7) drains east to the Balu River. The protection of this eastern area is also needed if flood protection of the western part is to be safeguarded.

(DND Area)

- The DND irrigation project area is changing to urban. RAJUK is preparing a detailed development plan.

- This area has a high potential as a future urban area, according to the preliminary projection of future population and land use, and it is estimated that population of DND will increase from 0.45 million in 1990 to 1.3 million in 2010.

- The project is technically feasible and will be effective in economical, social and environmental terms.

- The area is expected to develop intensively. Accordingly it will be essential that flood mitigation and drainage improvement be provided as a basic needs for enhancement of the area.

(Narayanganj West)

- The area has numbers of business / industries located along the Lakhya River and also a high population density. It is estimated that population of the area will increase from 0.47 million (359 people/ha) in 1990 to 0.93 million (539 people/ha) in 2010, according to the preliminary projection of future population and land use.

- The project is technically feasible and will be effective in economical, social and environmental terms.

A detailed study plan for F /S is attached in Appendix II

11.2 Others

(1) Immediate completion of all the remedial works and rehabilitation works for the existing flood mitigation facilities at the western part of Greater Dhaka is the most urgent measure.

(2) Proper operation and maintenance of flood mitigation and drainage facilities are essential. After completion, security of the schemes will be very important. An O&M plan should be developed, and properly trained personnel will be needed to assume the required duties of inspection, etc.

(3) It is recommended that a project implementation organization be established for smooth execution of the master plan, in order to carry out structural and non-structural measures smoothly, and also to control land use effectively. A strong implementation /coordination organization at ministerial level, with considerable control and management abilities will be necessary.

(4) It is recommended an environmental monitoring system for surface water, ground water and ambient air quality for environmental management be established. Without proper monitoring systems, the environmental laws, regulation standards would remain useless.

(5) It is recommended that the following priority actions be carried out for enhancement of basic public health, related to living environmental conditions of the urban areas.

- Preparation of improvement plan of service level of on-site sanitation aspects.
- Preparation of solid waste management plan for sanitary land reclamation.
- Preparation of improvement plan for living environmental conditions and improvement and relocation of slums.
- Creation of a master plan and execution of expansion of water supply, sewerage, sanitation and solid waste management, to cope with increasing urbanization as the provision of basic public health services.

APPENDIX

APPENDIX I	:	List of Participant
APPENDIX II	:	Detail Study Plan for Feasibility Study (Phase III)

APPENDIX I : List of Participant

1. JICA Advisory Committee

Dr. Hiroyoshi Shigai	Chairman Professor, University of Tsukuba
Mr. Tadahiko Nakao	Ministry of Construction
Mr. Hidetoni OI	Development Specialist, JICA
Mr. Motoharu Sekizawa	Ministry of Construction
Mr. Atsushi Suzuki	Ministry of Construction

2. JICA Study Team

Mr. Hajime Tanaka	Team Leader
Mr. Toshiaki Tokumasu	Deputy Team Leader Drainage Planning Engineer
Mr. Isao Misono	Flood Prevention Planning Engr.
Mr. J.R. Jones	Urban Planner
Mr. Hiroshi Matsuo	Land Use Analyst
Mr. Takashi Furukawa	Hydrologist/hydraulic Engineer
Mr. Kunihiko Okada	Drainage Facility Engineer
Mr. Kimio Takeya	River Structure Engineer
Mr. Tokihiko Ina	Construction Planner/Cost Estimator
Mr. Dr. S. Jayamohan	Environmental Engineer
Mr. Yuichi Hashimoto	Flood Damage Survey Expert
Mr. Naomichi Ishibashi	Socio-economist
Mr. Yoshiaki Ohtoku	Mapping Specialist
Mr. Etsuro Warashina	Topo. Survey Expert

3. GOB Study Team

Mr. M.N. Huda	FPCO	Chairman, Local Panel of Experts
Mr. A.M.M. Nurul Huq	FPCO	Chief Engineer
Prof. Ainun Nishat	FPCO	Member POE
Mr. K.B.M. Shafiuddin	FPCO	SE
Mr. A.K.M. Halimur Rahman	FPCO	SE
Mr. Md. Masud Ahmed	FPCO	SE

Mr. Emaduddin Ahmed	EPCO	SE
Mr. Md. Abdur Rahman	BWDB	SE
Mr. Yusuf Harun	BWDB	SE
Mr. A. Quader Choudhury	DWASA	SE
Mr. Md. Mehedi Ali Khan	DCC (DMC)	SE
Mr. Emdadul Islam	RAJUK	EE
Mr. Md. Moksed Alam	LGEB	EE
Mr. Md. Farhad Hossain	RHD	EE
Mr. Abu Taleb Khandaker	DOE	DD
Mr. M. Anwarul Islam	DOE	DD
Mr. Joynul Abedin Khan	HSD	FE
Mr. Abullah	HSD	SDE

4. Panel of Experts

Mr. W. Van Allen	Panel of Expert
Mr. Hidetoni OI	Panel of Expert
Mr. Tadahiko Nakao	Panel of Expert

5. World bank

Mr. Ross Wallace	Co-ordinator

6. Surface Water Modelling Center

Alasdair Macdonald, PHD	Team Leader
Muzharul Islam	SE
Ranjit Galappatti, PHD	Computational Hydraulic Engr.

7. Local Consultants

Development Design Consultants Ltd.
Engineering and Planning Consultants Ltd.
AQUA Consultant & Associates Ltd.

Greater Dhaka Protection Project
(Study in Dhaka Metropolitan Area)
Of
Bangladesh Flood Action Plan No. 8A

Detail study Plan for Feasibility Study (Phase -III)

Introduction

This is a draft of detail study plan for the phase III which aims to carry out a F/S for the priority projects identified in the Master Plan (Phase II) from January 1991 to July 1991.

The basic concept and the major study items were explained Report FAP 8A (October 1991) which was prepared based on the scope of work agreed upon between GOB and JICA on June 21, 1990.

The proposed study plan is based on the concept of the report above, however minor modification on the schedule and additional explanation are given according to the new findings up to date.

The proposed study master plan is feasible in economical, social and environmental terms.

According to the economic evaluation. All the projects except Narayanganj East project and Savar project, will be feasible from flood mitigation and drainage improvement aspects, though Tongi project and Keraniganj project seem marginal due to the high discount rate of 12%.

Based on the economic efficency and the likely social impacts in 1990 and in 2010, the priority of each project will be as follows :

(1) 1st Priority Area :
- Greater Dhaka West,
- Greater Dhaka East,
- DND,
- Narayanganj West.

(1) 2nd Priority Area :

- Tongi,
- Keraniganj.

(1) 3rd Priority Area :

- Narayanganj East,
- Savar.

Greater Dhaka East, DND and Narayanganj West are recommended for the Phase III study F/S.

The Western part of Greater Dhaka was committed as an urgent investment program by ADB in July 1991. Also F/S for the area will be carried out by ADB financed team.

STUDY PLAN FOR F/S

1. Objective of the Study

The objectives of the study are :

To conduct of Feasibility study on flood mitigation and storm water drainage improvement plans for Greater Dhaka East, DND and Narayanganj West which are identified in the Master Plan.

2. Study Area

The study area covers Greater Dhaka East, DND and Narayanganj West. The location is shown on Fig. 1.

3. Study Item

3.1 Supplementary Data Collection, Field Surveys and Investigation

3.1.1 Supplementary Topographic Survey

Most of the necessary field data have already been collected for the study, however some supplementary topographic surveys will be carried out.

They are :

(1) Longitudinal and cross-sectional surveys for for rivers and drainage channels which need improvement.

(2) Longitudinal and cross-section survey for proposed dikes.

(3) Topographic and cross-section surveys for proposed major storm water drainage facilities such as drainage pump station, sluice, and bridge etc.

3.1.2 Supplementary Geological and Soil Surveys

Supplementary geological and soil mechanic surveys will be carried out to provide data require for the preliminary design of dikes, pumping stations and other facilities.

3.1.3 Supplementary Data Collection and Site Investigations for the F/S areas.

Supplementary field investigation and necessary data cllection will be carried out on the followings:

- Major facilities
- Flood Damage
- Land use and urban planning
- Living environment
- Environmental impacts

3.2 Installation of Ganging Station and Observation of water levels

Two automatic water gauges will be installed, the sites for these stations will be determind after site investigations and discussions with BWDB, the observation will be carried out by the BWDB staff in cooperation with the JICA Team. The measuring sites for current meaters will be determind after discussions with BWDB.

3.3 Detailed Study for Flood Control and Storm water Drainage Plans

Based on the studies in Phase I and Phase II, supplementary data and information, detailed studies of proposed flood mitigation and storm water drainage improvement plan will be carried out, with due attention to appropriate technology and prevailing conditions in Bangladesh. The study includes the followings :

(1) Review and division of drainage basins,
(2) Setting up a hydraulic simulation model for the drainage system,
(3) Computation of hydraulic simulation,
(4) Establishment of the flood mitigation and storm water drainage plans.

3.4 Preliminary Design of Proposed Major Facilities

Preliminary design works for the proposed major facilities and related structures will be carried out, the works include the followings :

- structure design standards/criteria
- design calculation,
- standard drawings
- B/Q.

3.5 Study on Construction Plan

The construction plan will be prepared for the major facilities. The plan will includes the followings :

- construction methods
- construction schedule
- construction equipment etc.

3.6 Study on Operation and Maintenance (O&M)

O&M activities for the existing similar facilities will be investigated. Referring to the investigation, optimum operation and maintenance plans will be prepared. This plan will include the followings :

- required works
- facilities
- organization
- personnel
- expenses etc.

3.7 Cost Estimate

Total project cost will be estimated based on current construction works and related data. The total cost will be comprised of the following :

- construction cost,

- operation and maintenance costs,
- land acquisition and compensation costs,
- administration cost,
- engineering cost,
- other costs.

3.8 Project Evaluation

The proposed project will be evaluated and justified from the view points of economic, social and environmental aspects.

The study team will also consider the Guidelines for Project Assessment (GPA) for Flood Action Plan.

3.8.1 Economic Evaluation

This evaluation will be made in terms of benefit-cost ratio (B/C), economic internal rate of return (EIRR), net present value (NPV) and other indicators, including financial and sensitive analysis.

3.8.2 Social Impact Assessment

The following aspects will be evaluated :

- Flood free area and protected number of population,
- Increment of employment opportunity and annual income,
- Increment of development potential,
- level up of engineering development.

3.8.3 Environmental Impact Assessment

The following aspects will be evaluated :

- Water quality
- Changes in living conditions
- Ecological changes in urbanized areas.

3.9 Preparation of Implementation Program

Implementation program of the priority projects identified will be prepared for smooth execution of subsequent works by the Government of Bangladesh.

The program includes the following :

- Outline of the project,
- Time schedules for detailed design, tendering and construction works,
- disbursement schedule etc.

4. Study Schedule

4.1 Study Duration

The duration of the F/S will be nine (9) months from September 1991 through May 1992.

4.2 Reporting Schedule

In the course of the Feasibility Study, the following reports will be submitted to the Government of Bangladesh.

(1) Interim Report (II)

Fifty (50) copies of the report will be submitted within four (4) months after the commencement of the F/S.

(2) Draft Final Report

Fifty (50) copies of the report will be submitted six (6) months after the comment of the Feasibility Study.

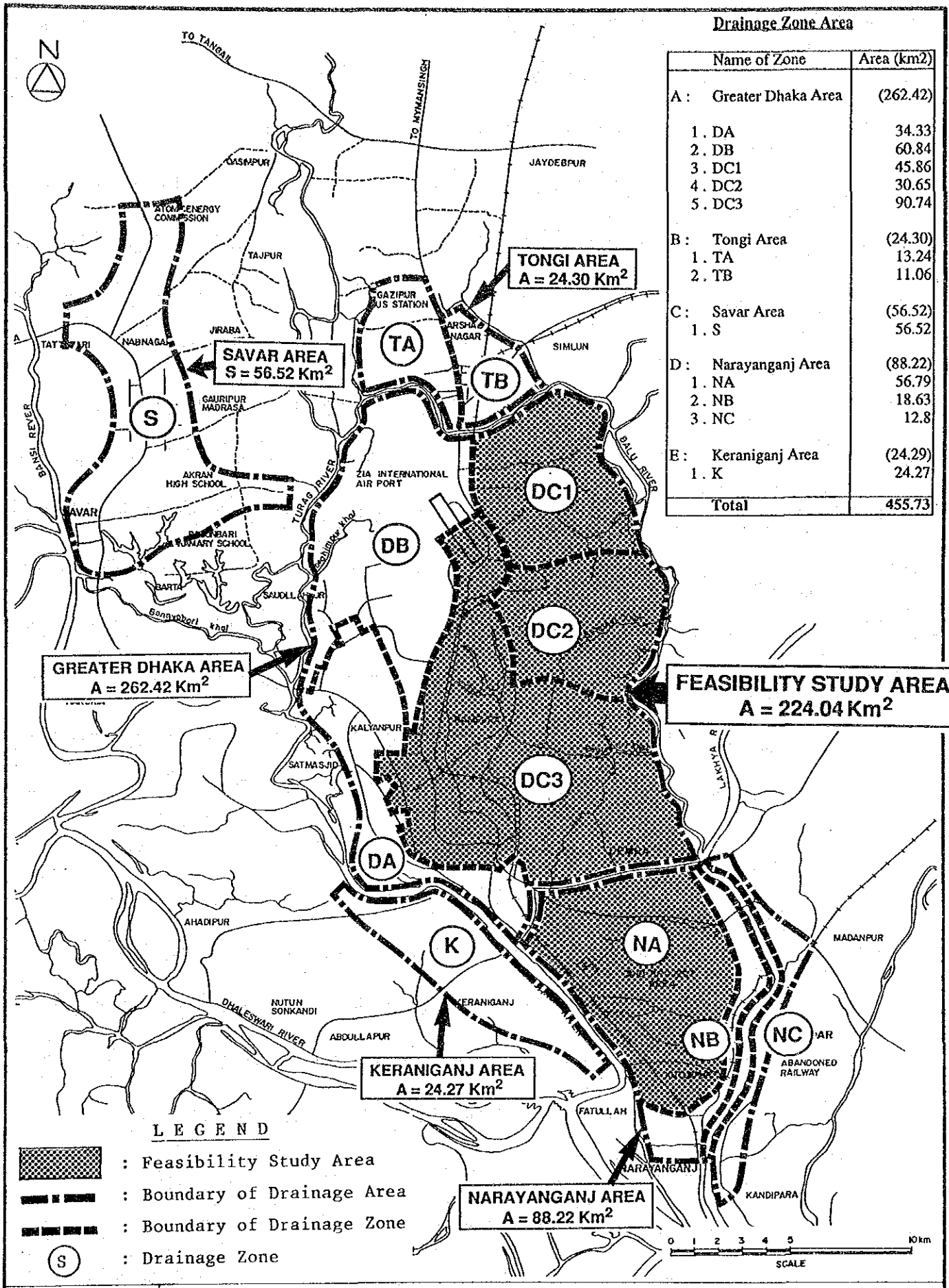
In order to confirm viability of the priority projects, the report will contain all engineering aspects, preliminary cost estimates, economic/financial evaluation, social/environmental assessment of the project.
GOB shall provide JICA with its comments within one (1) month after receipt of the Draft Final Report.

(3) Final Report

One hundred (100) copies will be submitted one (1) month after receipt of comments from GOB on the Draft Final Report.

(4) progress Report

Ten (10) copies will be prepared and submitted quarterly, in order to inform GOB of the activities of the JICA study team and the progress of the study.



Drainage Zone Area

Name of Zone	Area (km2)
A : Greater Dhaka Area	(262.42)
1 . DA	34.33
2 . DB	60.84
3 . DC1	45.86
4 . DC2	30.65
5 . DC3	90.74
B : Tongi Area	(24.30)
1 . TA	13.24
2 . TB	11.06
C : Savar Area	(56.52)
1 . S	56.52
D : Narayanganj Area	(88.22)
1 . NA	56.79
2 . NB	18.63
3 . NC	12.8
E : Keraniganj Area	(24.29)
1 . K	24.27
Total	455.73

FIG. 1 STUDY AREA FOR F/S

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH