No.

BASIC DESIGN STUDY REPORT

ON

THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (V)

IN

THE PEOPLE'S REPUBLIC OF BANGLADESH

AUGUST 2003

JAPAN INTERNATIONAL COOPERATION AGENCY

JAPAN ENGINEERING CONSULTANTS CO., LTD.

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PREFACE

In response to a request from the Government of the People's Republic of Bangladesh, the Government of Japan decided to conduct a basic design study on the Project for the Construction of Multipurpose Cyclone Shelters (V) in the People's Republic of Bangladesh and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Bangladesh a study team from March 8 to April 19, 2003.

The team held discussions with the officials concerned of the Government of Bangladesh, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Bangladesh in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the People's Republic of Bangladesh for their close cooperation extended to the teams.

August, 2003

Takao Kawakami
President
Japan International Cooperation Agency

August, 2003

LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for the Construction of Multipurpose Cyclone Shelters (V) in the People's Republic of Bangladesh.

This study was conducted by Japan Engineering Consultants Co., Ltd., under a contract to JICA, during the period from March, 2003 to August, 2003. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Bangladesh and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

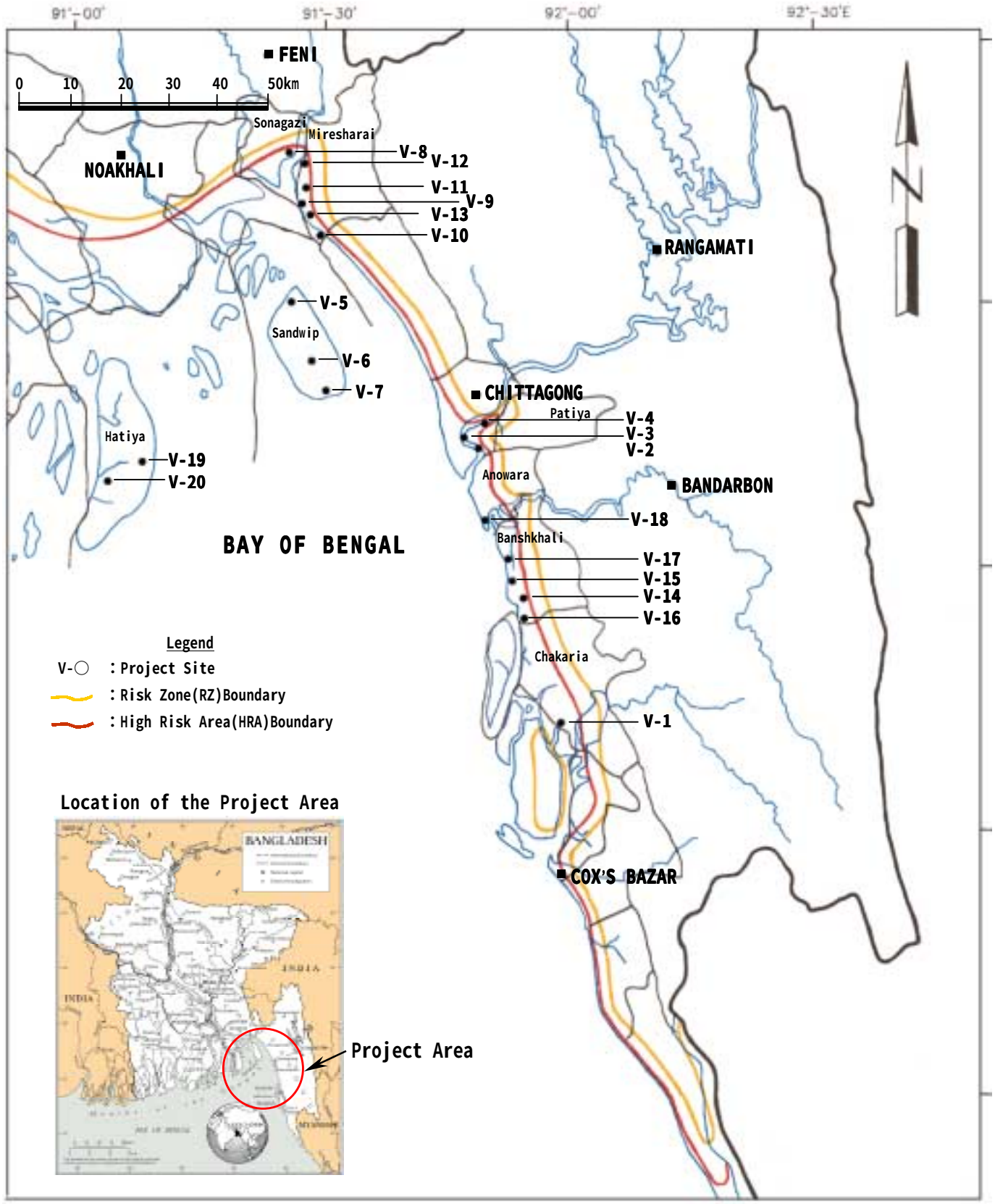
Very truly yours,

Sakae Nakamura
Project manager

Basic Design Study Team on the Project for the Construction of Multipurpose Cyclone Shelters (V)

Japan Engineering Consultants Co., Ltd.

LOCATION MAP



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ABBREVIATIONS

ADB	:	Asian Development Bank
ADP	:	Annual Development Programme
A/P	:	Authorisation to Pay
AUEO	:	Assistant Upazila Education Officer
B/A	:	Banking Arrangement
BAMWSP	:	Bangladesh Arsenic Mitigation Water Supply Project
BD	:	Basic Design
BDRCS	:	Bangladesh Red Crescent Society
BMD	:	Bangladesh Meteorological Department
BNBC	:	Bangladesh National Building Code
BUET	:	Bangladesh University of Engineering and Technology
BWDB	:	Bangladesh Water Development Board
COB	:	Concerned Bangladesh Organizations
CPP	:	Cyclone Preparedness Programme
C/S	:	Community School
DEO	:	District Education Officer
DFID	:	Department of International Development
DMB	:	Disaster Management Bureau
DMC	:	Disaster Management Committee
DPE	:	Directorate of Primary Education
DPHE	:	Department of Public Health Engineering
E/N	:	Exchange of Notes
ERD	:	Economic Relations Division
EU	:	European Union
GPS	:	Government Primary School
HRA	:	High Risk Area
JICA	:	Japan International Cooperation Agency
KfW	:	Kreditanstalt für Wiederaufbau
LGED	:	Local Government Engineering Department
MCSP	:	Multipurpose Cyclone Shelter Programme
MDMR	:	Ministry of Disaster Management and Relief
MLGRD&C	:	Ministry of Local Government, Rural Development and Cooperatives
MOPME	:	Ministry of Primary and Mass Education
NGO	:	Non-Governmental Organization
PEDP-I	:	Primary Education Development Programme
PEDP-II	:	Second Primary Education Development Programme

P/Q	:	Pre-Qualification
PTI	:	Primary Training Institute
PWD	:	Public Works Department
SDMC	:	Site-Level Disaster Management Committee
SMC	:	School Management Committee
UEO	:	Upazila Education Officer
UNDP	:	United Nations Development Programme
UNO	:	Upazila Nirbahi Officer
UNCEF	:	United Nations Children's Fund

SUMMARY

SUMMARY

Some 90% of the national land of the People's Republic of Bangladesh (hereinafter referred to as "Bangladesh") consists of the world's largest delta formed by such great rivers as the Ganges, the Bramaputra and Megna River and this gigantic delta is mostly lowland with an elevation of 10 m or less. Given this geographical condition, floods and cyclones are the two most damaging natural disasters in the country.

Many human lives, animals and property have been lost, particularly in the mainly coastal High Risk Area (HRA), due to storm surge caused by cyclones. For example, 300,000 and 140,000 people lost their lives in this way in 1970 and 1991 respectively.

The urgency felt by international aid organizations, donors and NGOs to construct cyclone shelters to minimise such disasters led to their aid efforts to construct shelters. However, as these shelters were constructed without coordinated ideas and methods among the aid organizations, many problems emerged including shelters being constructed at wrong sites, failing to properly function as disaster prevention facilities. In view of the need to coordinate disaster prevention efforts throughout the country in an integrated manner to avoid the recurrence of such problems and to ensure efficient as well as effective construction of cyclone shelters, the Multipurpose Cyclone Shelter Programme (hereinafter referred to as "the Master Plan") was formulated in July, 1993 with the cooperation of the World Bank and the UNDP as the master plan for the construction of the said shelters in Bangladesh.

According to the Master Plan, the HRA prone to cyclone damage extends to 45 Upazilas and its total area of 8,093 km^2 is equivalent to 5.6% of the national land area. The population of the HRA in 2002 was estimated to be approximately 6.4 million.

As the existing shelters and private, public as well as commercial buildings to which evacuation would be possible could only accommodate 2.15 million people, the Master Plan calls for the construction of some 2,500 cyclone shelters to provide evacuation facilities for the remaining 4.25 million people, assuming an accommodation capacity of a single shelter of some 1,750 persons.

On the basis of the required number of new cyclone shelters (approximately 2,500) as indicated by the Master Plan, the Government of Bangladesh began the construction of new shelters with the assistance by various donors and NGO's, etc. As part of this drive, the Government of Bangladesh requested the Japanese official assistance for the construction of cyclone shelters. In response, Japan provided grant aid in a series of four phases from 1993 to

1999 for the construction of cyclone shelters which can be used as primary education facilities at normal times. As a result, Japan constructed 61 shelters and these shelters are highly evaluated as they are said to have saved many lives at the time of the cyclone disaster in 1997 and they have been effectively used as shelters to escape from more ordinary flooding.

While some 1,300 shelters out of the necessary 2,500 shelters have been constructed up until 2003 with the assistance by Japan and other donors, it is still necessary to build further 1,200 shelters.

Against this background, the Government of Bangladesh planned a project to construct 39 cyclone shelter-cum-primary school buildings in the HRA in the Chittagong, Cox's Bazar, Noakhali and Feni Districts and requested the Government of Japan's provision of fresh grant aid to finance the project as the fifth phase of the Japanese assistance.

In response to this request, the Government of Japan decided to conduct a basic design study to verify the necessity and relevance of the construction of these shelters and the JICA dispatched the Basic Design Study Team to Bangladesh for the period from 8th March to 19th April, 2003.

Following consultations with officials of the Government of Bangladesh and a site survey, the Basic Design Study Team returned to Japan to further analyse the field survey results. The Draft Final Report was then compiled and a mission to explain the said Draft Final Report was sent to Bangladesh for the period from 5th to 12th July, 2003.

39 candidate sites were originally suggested by the Bangladesh side for Phase V, i.e. four in the Feni District (in Chhagolnaia and Songazi Upazilas), seven in the Cox's Bazar District (in Chakaria, Teknaf and Cox's Bazar Sadar Upazilas), 25 in the Chittagong District (in Patiya, Sandwip, Miresharai, Banshkhali and Anowara Upazilas) and three in the Noakhali District (Hatiya Upazila). Out of these, four sites were immediately rejected because of their location outside the HRA and other site was also rejected because of the ongoing construction of a cyclone shelter at the site, leaving 34 sites as the subject sites of the Study.

As part of the basic design study, an outline survey on the site conditions using the following site selection criteria previously agreed by the two sides and taking the background and experience of the Phase I through Phase IV projects into consideration was conducted. 20 sites were finally judged to be suitable sites based on the results of the final analysis in Japan.

Site Selection Criteria

1.	The subject site shall be the site of a government primary school which is managed by the central government.
2.	The subject site shall be located in the HRA*1 designated by the Master Plan for the Multipurpose Cyclone Shelter Programme.
3.	In principle, the subject site shall not have a solid building or hill of sufficient size and height to provide a reliable evacuation site vis-à-vis storm surge caused by a cyclone within a 1.5km radius of the site.
4.	The subject site shall have a sufficient land area for the construction of a multipurpose cyclone shelter and the central government shall have secured land ownership of the site. However, even if sufficient space for shelter construction is not available, this does not exclude cases where it is possible to secure the necessary space by removing facilities which are judged to be unusable or where it is possible to secure an additional area on adjacent land together with the assurance by the Bangladesh side that any removal work or expropriation of adjacent land will be conducted without fail.
5.	It is highly unlikely that the subject site will be eroded by a change of the river course.
6.	The subject site shall not be associated with a similar project or plan of the Government of Bangladesh or a foreign aid organization or a donor country for cyclone shelter construction.
7.	The subject site shall allow access by vehicle for the transportation of construction materials to the site.
8.	The subject site shall have an operating primary school with teachers, administrative staff and students and it is judged that the facilities to be newly constructed will be fully used as a primary school facilities during normal times.
9.	The subject site shall already have a school management committee (SMC) capable of maintaining the new facilities and equipment.
10.	The subject site shall have a killa*2 for the evacuation of livestock within a 0.3km radius of the site. Alternatively, there shall be a feasible site for the construction of a killa and such an assurance shall be obtained from the Bangladesh side.

*1 The HRA is an area where there is a strong likelihood that human lives will be lost due to major flooding as the water depth at the time of a storm surge caused by a cyclone can exceed 1 m.

*2 A killa is a banked site for the temporary evacuation of livestock, etc. at the time of a cyclone.

Locations of Project Sites

Old Site No.	New Site No.	District	Upazila	Union	Name of Primary School
6	V-1	Cox's Bazar	Chakaria	West Boro Veola	Ilishia GPS
13	V-2	Chittagong	Patiya	Charlaksma	West Charlaksma GPS
14	V-3	Chittagong	Patiya	Char Patharghata	Ichanagar GPS
15	V-4	Chittagong	Patiya	Char Patharghata	Char Patharghata GPS
16	V-5	Chittagong	Sandwip	Haramina	Kachhiapur GPS
18	V-6	Chittagong	Sandwip	Musapur	South East Musapur GPS
19	V-7	Chittagong	Sandwip	Bauria	Bauria G.K. GPS
21	V-8	Chittagong	Miresharai	Katachhora	Temuhani GPS
22	V-9	Chittagong	Miresharai	Mayani	Solaiman GPS
23	V-10	Chittagong	Miresharai	Wahedpur	Jafarabad GPS
24	V-11	Chittagong	Miresharai	Mayani	SM Hazipara GPS
25	V-12	Chittagong	Miresharai	Durgapur	Hazisorai GPS
27	V-13	Chittagong	Miresharai	Sahebkhali	East Sahebkhali GPS
28	V-14	Chittagong	Banshkhali	Shilkup	Munkirchar GPS
29	V-15	Chittagong	Banshkhali	Katharia	Modya Katharia GPS
31	V-16	Chittagong	Banshkhali	Puichari	Puichari Sultania GPS
32	V-17	Chittagong	Banshkhali	Shadhanpur	North Shadhanpur GPS
35	V-18	Chittagong	Anowara	Burumchhora	West Burumchhora GPS
37	V-19	Noakhali	Hatiya	Burirchar	Hornipalgram GPS
38	V-20	Noakhali	Hatiya	Sonadia	Purba Chanandi GPS

Note : GPS = government primary school
Union = local administrative unit below a Upazila

While the facilities to be constructed under the Project will be used as shelters at the time of a cyclone, it will be essential to adopt measures designed to keep them in good condition and to ensure their effective use at normal times. Because of these requirements, it has been decided that these facilities will also be planned to function as primary school facilities. It is also assumed that apart from primary school buildings, these facilities will be used as meeting places, simple health facilities and polling stations. However, functions other than primary schools are considered to be incidental functions and no special consideration is given in terms of the facility design to support such incidental functions. For the planning and design of the facilities, the functions, structure and construction cost are taken into full consideration based on the background and experience of the Phase I through Phase IV projects and the findings of post-project evaluation study and other reviews.

The outline of the Project is given below.

1) Number of Shelters to be Constructed : 20

2) Facility Layout

The new shelters will have two storeys and the ground floor will be an open space. The first floor will have classrooms, one teachers' room, one store room and toilets (separate areas for boys and girls). Depending on the site situation, one of three building types will be selected, i.e. three classroom type (at eight sites), four classroom type (at five sites) and five classroom type (at seven sites). The rooftop area will be used for evacuation purposes as in the case of the first floor.

3) Main Structure : Reinforced Concrete (brick masonry walls)

4) Floor Area

Floor Area Table (m^2)

Building Type	Ground Floor (Open Space)	First Floor	Roof	Total	No. of Buildings	Total Floor Area by Building Type
3 Classrooms	264.6	269.68	32.38	566.66	8	4,533.28
4 Classrooms	275.1	297.68	32.38	605.16	5	3,025.80
5 Classrooms	319.2	341.78	32.38	693.36	7	4,853.52
				Total	20	12,412.60

5) Height

The height of the first floor is 4.0 m, 5.0 m or 6.5 m from the ground (3 types) while the roof is 3.3 m above the floor height of the first floor.

6) Accommodation (Sheltering) Capacity at Time of Cyclone

Building Type	Indoor	Roof Top	Total
3 Classrooms	1,273	426	1,703
4 Classrooms	1,435	358	1,793
5 Classrooms	1,663	418	2,081

A killa, which is a necessary facility to accompany a cyclone shelter, will be constructed at all sites by the Bangladesh side. Its scale should be determined on the bases of the accommodation capacity of the shelter at each site and the expected tide level at the time of cyclone.

The scale of the shelters used as primary school buildings is given below. In order to determine the number of classrooms required at each site to accommodate the number of existing students, the total number of students per shift at each site is surveyed first in view of the fact that teaching is currently conducted in two shifts at all of the schools at the Project sites. Then, each site is classified into one of 3-classroomed, 4-classroomed or 5-classroomed site.

1) Building Type and Size of Teachers' Room

Site No.	No. of Classrooms	Size of Teachers' Room (No. of Teachers)
V-1	5	One room (6 teachers)
V-2	4	One room (5 teachers)
V-3	4	One room (5 teachers)
V-4	5	One room (6 teachers)
V-5	3	One room (4 teachers)
V-6	5	One room (6 teachers)
V-7	5	One room (6 teachers)
V-8	3	One room (4 teachers)
V-9	3	One room (4 teachers)
V-10	3	One room (4 teachers)
V-11	3	One room (4 teachers)
V-12	3	One room (4 teachers)
V-13	4	One room (5 teachers)
V-14	5	One room (6 teachers)
V-15	5	One room (6 teachers)
V-16	3	One room (4 teachers)
V-17	4	One room (5 teachers)
V-18	5	One room (6 teachers)
V-19	3	One room (4 teachers)
V-20	4	One room (5 teachers)

2) Furniture and Fixtures

Furniture and fixtures will be introduced to enable the new facilities to function as primary schools.

(per classroom and teachers' room)

Room	Furniture and Fixtures	Specifications	Quantity
Classroom	Students' desks and chairs	Steel, three students /set	17 sets
	Teacher's desk and chair	Steel; single use	1 set
	Blackboard (2,400 x 1,200 mm)	Wooden	1
Teachers' Room	Teachers' desks and chairs	Steel; single use	Number of classrooms + one extra pair
	Blackboard (1,200 x 900 mm)	Wooden	1

(3) Water Supply and Drainage Facilities

The water supply and drainage facilities to be provided at 20 sites are as follows.

(per 20 shelters)

	Specifications	Remarks
Well	Depth 300 m, Drilling Diameter 150mm, Gravel Packing & Sealing	20 wells
Lifting pump	Tara Pump II; head: 35 m	20 sets
Arsenic treatment device	Resin Adsorption; Treatment Capacity: 160 litres/hr	Only at sites where As is detected(Maximum 9 sets)
Septic tank	Brick Structure: 5,740 x 2,000 x 2,925mm	20
Soak well	Brick Structure; round D=1.5m	20

The project implementation period will consist of 7.5 months for the detailed design and 12 months for the construction work, totalling 19.5 months. The estimated total project cost is ¥858 million (¥700 million for the Japanese portion and ¥158 million for the Bangladesh portion).

The Ministry of Local Government, Rural Development and Cooperatives (MLGRD&C) will be the competent authority for the Project and the Local Government Engineering Department (LGED), a subordinate organization of the MLGRD&C, will be the actual implementation organization for the Project. The LGED is responsible for all kinds of government-led civil engineering and building work in local areas and also conducts the construction and repair of government primary schools, central government buildings and housing for central government officials. The LGED was the implementation agency for the previous cyclone shelter construction project (Phase I through Phase IV) under the grant aid scheme of the Government of Japan and completed 61 shelters under this project without delay. Given not only its excellent technical capability but also its experience of similar Japanese projects four times in the past, the LGED can be described as having sufficient capability to implement the Project.

For the operation and maintenance of the new facilities after their completion, the Ministry of Primary and Mass Education (MOPME) will act as the competent authority in view of their use as primary school during normal times. The actual operation will be conducted by the Directorate of Primary Education (DPE), a subordinate organization of the MOPME. At the time of a cyclone, not only the DPE but also the Disaster Management Committee members at the site level who are under the jurisdiction of the MDMR (Ministry of Disaster Management and Relief) will also play active roles in the guidance of local residents to the shelter and the safety management during evacuation. However, the post-project reviews for Phase I through Phase III and the latest site survey found that the maintenance of cyclone shelters (primary school buildings) constructed in the past was not sufficient. For this reason, new arrangements for maintenance will be introduced for the Phase V Project. To be more precise, while the DPE will be mainly responsible for maintenance, Upazila-level engineers of the LGED will regularly monitor the sites to play a part in maintenance at normal times.

Routine cleaning of the facilities and replacement of simple spare parts, etc. will be conducted by the School Management Committee (SMC) at each site and the Primary Education Committee at the Upazila level. Repair of walls, etc. will be done by the LGED upon entrustment by the DPE. Given the instability of funding sources, the LGED will provide an annual budget of TK30,000/school separately from the main budget for the education sector.

The implementation of the Project is expected to achieve the following effects.

- Increased number of people who can evacuate at the time of a cyclone

  With the construction of 20 new shelters under the Project, some 37,000 people living in the HRA will be able to evacuate at the time of an emergency involving a storm tide caused by a cyclone and will be able to have peace of mind as they will be freed from danger to their lives.

- Improvement of the classroom shortage and over-crowding

  As the 20 primary schools at the target sites of the Project do not have a sufficient number of classrooms, the average number of students per classroom is currently 58 in the Cox's Bazar District (one site), 57 in the Chittagong District (17 sites) and 77 in the Noakhali District (two sites), indicating a state of over-crowding. Use of the facilities built as cyclone shelters as primary school buildings at normal times will increase the number of usable classrooms at the target sites, reducing the number of students per classroom to 44 in the Cox's Bazar District, 36 in the Chittagong District and 44 in the Noakhali District.

- Improvement of the teaching environment

  Some of the primary schools at the target sites are characterised by an unsafe environment because of the peeling of the ceilings and pillars due to aging of the buildings. The construction of new cyclone shelter-cum-primary school buildings will provide a safe teaching environment for the students.

- Multipurpose use of the facilities

  While the cyclone shelters to be constructed under the Project will be used as primary school buildings, local residents have suggested their additional use as meeting places, simple health facilities and polling stations, etc. This use of the new shelters as public facilities at normal times will broaden the scope of contribution of the new facilities to the local community.

As the above effects are in line with disaster prevention and the promotion of education, both of which are priorities of the National Development Plan of Bangladesh, the implementation of the Project with grant aid of the Government of Japan is judged to be appropriate.

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CHAPTER 1 BACKGROUND OF THE PROJECT

CHAPTER 1 BACKGROUND OF THE PROJECT

(1) Background of the Project

In Bangladesh's High Risk Area (HRA) which is mainly located along the coast, major disasters involving the loss of many human lives, animals and property have occurred in the past due to violent storm surges caused by powerful cyclones. At present, some 6.4 million people live in the HRA and approximately one-third of these people are unprotected due to the absence of hills or buildings to which they can evacuate at the time of an emergency, making the overall situation a major disaster waiting to happen with the onslaught of another severe cyclone. There has been growing awareness that the construction of shelters is as important as the reinforcement of the monitoring and warning networks to prevent disasters. Accordingly, some 1,300 cyclone shelters have been constructed in the last 10 years with the assistance of the World Bank and other donors.

Japan has also constructed 61 cyclone shelters which can be used as school buildings during normal times in a series of four phases (1993 – 1999) together with the drilling of deep wells and the introduction of septic tanks.

Despite the construction of many shelters, in view of the required number of cyclone shelters identified by the Multipurpose Cyclone Shelter Programme (the Mater Plan) formulated in 1993 with the assistance of World Bank and the UNDP and the number of shelters constructed thereafter, it is calculated that some 1,200 new shelters are necessary and further aid is hoped for in this regard.

Against this background, the Government of Bangladesh has requested the Government of Japan's provision of fresh grant aid for the construction of 39 cyclone shelter-cum-primary school buildings together with the introduction of such auxiliary facilities as wells and septic tanks, etc. in the HRA in the Chittagong, Cox's Bazar, Noakhali and Feni Districts as the fifth phase of the aforegoing Japanese grant aid project. The overall framework of the latest project requested by Bangladesh is outlined below.

(2) Outline of the Request

1) Overall Goal

Improvement of the lives of local residents through a reduction of cyclone damage

2) Project Purpose

Reduction of cyclone damage through the construction of cyclone shelters in the HRA

3) Expected Output

Availability of facilities capable of sheltering some 65,000 people (1,650 persons x 39 shelters)[1] at the time of a cyclone

4) Action and Input Plans

① Contents of Request to Japan

Construction of 39 cyclone shelters which can be used as primary school buildings (3 – 5 classroom buildings with a total floor area of approximately 550-700m^2 per building; including such fixtures as desks, chairs and blackboards, etc.) and the introduction of such auxiliary facilities as wells (deep wells), hand pumps and septic tanks

② Input Plan of Bangladesh Side

- Preparatory work for the construction of shelters
- Securing of the necessary operation and maintenance budget and the construction of killas (shelter facilities for domestic animals, etc.)
- Budgetary arrangements for the work to be undertaken by the Bangladesh side

5) Counterpart Organizations on Bangladesh Side

- Construction
  - Ministry of Local Government, Rural Development and Cooperatives (MLGRD&C)
  - Local Government Engineering Department (LGED) of the MLGRD&C

[1] Although the minimum sheltering capacity (1,650 persons) adopted in Phase I-IV Projects is used here for convenience, the optimal capacity for each target site will be examined under the Study for finalisation.

- Operation and maintenance at normal times
  - Ministry of Primary and Mass Education (MOPME)
  - Directorate of Primary Education (DPE) of the MOPME)

- Operation and maintenance at the time of a cyclone
  - Disaster Management Committee and CPP of the Ministry of Disaster Management and Relief (MDMR)
  - DPE

6) Direct and Indirect Beneficiaries

- Direct beneficiaries (at the time of a cyclone) : some 65,000 people living near the project sites (1,650 x 39 shelters)
- Indirect beneficiaries (at normal times) : some 12,000 primary school students living near the project sites (300 x 39 sites)[2]

[2] Teaching will be conducted in two shifts, i.e. morning and afternoon. The number of pupils at each site is calculated to be 300 (50 pupils/classroom x 3 classrooms x 2 shifts = 300 students) using a three classroom school as the basis for calculation for convenience.

CHAPTER 2 SELECTION OF PROJECT SITES

CHAPTER 2 SELECTION OF PROJECT SITES

The Government of Bangladesh originally requested the construction of a cyclone shelter at 39 sites. For the forthcoming Project, selection criteria were introduced based on the following principles, taking the evaluation results of the performance of cyclone shelters constructed during the previous phases into consideration. The actual project sites were then selected in accordance with the processes described in 2-2-1 onwards.

① There is a high risk of storm surge in view of the natural conditions and past disaster records.

② Despite local residents being unprotected against possible disasters, there is no suitable place for evacuation (including such places at the planning stage).

③ The likely evacuation routes will allow the easy evacuation of local residents.

④ A shelter can be properly constructed and can be used for a long time without concern regarding damage to it.

⑤ A shelter can be effectively used as a public facility (school building) during normal times and will be continually maintained in the future (continual use of the facility).

2-1 Selection of Survey Sites

The 39 originally requested sites by the Government of Bangladesh are listed in Table 2-1-1. After examination of these requested sites by Japanese government offices, it was agreed by the Japanese and Bangladesh sides that four sites (Site Nos. 1, 7, 9 and 26) which are clearly situated outside the High Risk Area (HRA) for cyclone attack would be removed from the survey sites.

It was also agreed that Site No. 33 where a shelter is under construction by the KfW would be removed from the survey sites of the Project while three sites (Site Nos. 30, 37 and 38) where a shelter already exists on adjacent land would be included because of the need to check the state of deterioration and accommodation capacity of the existing shelters.

Accordingly, the total number of survey sites is 34 as listed in Table 2-1-1. At these 34 sites, an outline survey on the site conditions was conducted based on the “site selection criteria”, followed by a detailed survey on the site conditions (including a bank erosion survey), a social environment survey and a natural conditions survey at those sites selected by the outline survey to finalise the project sites.

Table 2-1-1 List of Requested Project Sites (39 Sites)

No.	District	Upazila	Union	Name of Primary School
~~1~~	~~Feni~~	~~Chhagolnaia~~	~~9 no. Shavopur~~	~~Darogar Hat GPS~~
2	Feni	Sonagazi	6 no.Char Chandia	Mohesh Char GPS
3	Feni	Sonagazi	6 no.Char Chandia	Moddhom Char GPS
4	Feni	Sonagazi	7 no. Sonagazi	Sonagazi GPS
5	Cox's Bazar	Chakaria	Boroi Tali	Pohorchanda GPS
6	Cox's Bazar	Chakaria	West Boro Veola	Ilishia GPS
~~7~~	~~Cox's Bazar~~	~~Teknaf~~	~~Hoaicong~~	~~Kharanglchali GPS~~
8	Cox's Bazar	Chakaria	Taitong	Sonaichhory GPS
~~9~~	~~Cox's Bazar~~	~~Chakaria~~	~~Kakara~~	~~South Kakara GPS~~
10	Cox's Bazar	Cox's Bazar Sadar	Islamabar	Gojalia GPS
11	Cox's Bazar	Cox'sBazar Sadar	Eidgah	Vaditala GPS
12	Chittagong	Patiya	Borouthan	Borouthan Hamid Ali Khan GPS
13	Chittagong	Patiya	Charlaksma	West Charlaksma GPS
14	Chittagong	Patiya	Char Patharghata	Ichanagar GPS
15	Chittagong	Patiya	Char Patharghata	Char Patharghata GPS
16	Chittagong	Sandwip	Haramina	Kachhiapur GPS
17	Chittagong	Sandwip	Gachhua	Gachhua A. K. GPS
18	Chittagong	Sandwip	Musapur	South East Musapur GPS
19	Chittagong	Sandwip	Bauria	Bauria G. K. GPS
20	Chittagong	Miresharai	Mithanala	Banatali
21	Chittagong	Miresharai	Katachhora	Temuhani GPS
22	Chittagong	Miresharai	Mayani	Solaiman GPS
23	Chittagong	Miresharai	Wahedpur	Jafarabad GPS
24	Chittagong	Miresharai	Mayani	SM Hazipara GPS
25	Chittagong	Miresharai	Durgapur	Hazisorai GPS
~~26~~	~~Chittagong~~	~~Miresharai~~	~~Hinguli~~	~~Madya Azamnagar GPS~~
27	Chittagong	Miresharai	Sahebkhali	East Sahebkhali GPS
28	Chittagong	Banshkhali	Shilkup	Munkirchar GPS
29	Chittagong	Banshkhali	Katharia	Modya Katharia GPS
30	Chittagong	Banshkhali	Pukuria	South Burumchara GPS
31	Chittagong	Banshkhali	Puichari	Puichari Sultania GPS
32	Chittagong	Banshkhali	Shadhanpur	North Shadhanpur GPS
33	Chittagong	Anowara	Haildhor	Prikhain GPS
34	Chittagong	Anowara	Bairag	Badalpur GPS
35	Chittagong	Anowara	Burumchhora	West Burumchhora GPS
36	Chittagong	Anowara	Chatori	Dumuria GPS
37	Noakhali	Hatiya	Burirchar	Hornipalgram GPS
38	Noakhali	Hatiya	Sonadia	Purba Chanandi GPS
39	Noakhali	Hatiya	Tamaruddi	Tamaruddi Koralia GPS

Note : GPS = government primary school

Legend

~~V-1~~ : Removed from the survey sites as the site was judged by the analysis in Japan to be located outside the HRA

: Removed from the survey sites as a shelter is under construction at the same site by another donor (KfW)

: A small shelter exists on adjacent land

2-2 Finalisation of Project Sites

2-2-1 Outline Survey on Site Conditions

For the remaining 34 sites following the initial analysis described in 2-1, an outline survey was conducted as a primary survey to conduct screening on the following important items so that the subsequent site selection work could be efficiently conducted.

(1) Whether the site is inside or outside the HRA (level of risk for cyclone damage in the "Multipurpose Cyclone Shelter Programme (the Master Plan)")
(2) Maximum storm surge height caused by cyclones in the past
(3) Existance of a cyclone shelter within a 1.5 km radius
(4) Population within a 1.5 km radius
(5) Existence of a hill(s) within a 1.5 km radius
(6) Existence of a two or higher story public building(s) within a 1.5 km radius
(7) Maximum number of casualties by cyclones in the past
(8) Existence of a killa
(9) Site access conditions
(10) Duplication with shelter construction projects of other donors, etc.
(11) Possibility of erosion due to a change of the river course
(12) Type of existing primary school
(13) Total number of students
(14) Area of school site
(15) Site owner
(16) Natural conditions of and around the site
(17) Land size (area) of the site

The survey results for the 34 sites are compiled in Table 2-2-1-1. Twenty-two sites were judged to be suitable for the detailed survey on the site conditions based on Criteria 1) through 7) of the site selection criteria described later in 2-2-3.

Table 2-2-1-1 Results of Outline Survey on Site Conditions

Item	Site. No.	2	3	4	5	6	8	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	27	28	29	30	31	32	34	35	36	37	38	39	Remarks
Shelter	In or Outside the HRA	KfW shelter is being constructed.	*1 ×	*1 ×	○	○	○	KfW shelter is being constructed.	○	×	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	×	○	○	○	○: Inside HRA ×: Outside HRA
	Max. Surge Height of Cyclone in the past (m)		0.7	0.3	1.5	2.0	2.5		*13 0	0	2.2	1.5	2.2	2.0	2.0	1.5	2.5	2.0	1.5	1.2	1.0	1.2	1.2	1.5	2.0	2.0	3.0	3.0	3.0	2.1	2.1	0.9	3.0	3.0	3.0	
	Cyclone Shelter within 1.5km Radius		○	×	*2 ×	○	○		○	○	○	○	○	○	○	○	*8 ○	○	○	○	○	○	○	*10 ○	○	○	*10 ○	○	○	○	○	○	*10 ○	*10 ○	○	○: No ×: Yes
	Population within a 1.5Km Radius		6,000	10,000	12,000	10,000	14,000		10,000	15,000	13,000	25,000	30,000	12,000	25,000	15,000	20,000	4,000	22,000	20,000	6,000	15,000	15,000	6,000	20,000	11,000	4,500	15,000	7,000	6,000	6,000	6,000	5,000	4,500	4,000	
	Hilly Area within a 1.5 Km Radius		○	○	○	○	*4 ×		×	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	×	○	○	○	○	○	○: No ×: Yes
	Public Building (not less than 2-story) within a 1.5Km radius		○	○	○	*3 ○			○	○	○	○	○	○	*7 ×	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: No ×: Yes
	Max. No. of Casualties by Cyclone in the Past		10	5	100	500	150		0	0	150	1,000	500	300	500	600	1,000	400	500	300	200	250	300	250	350	200	400	150	200	400	4,000	0	1,500	1,200	3,000	
	Existing Kila		×	×	×	×	×		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	○: Yes ×: No
	Access Conditions to the Site		○	○	○	○	○		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	×	○	○	○	○	○	○: Good (4WD) ×: Bad
	Other Shelter Construction Project		○	○	○	○	○		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: No ×: Yes
	Possibility of Erosion *12		○	○	○	○	○		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	△	○	○	○	○	○	○	△	○: Low △: Not clear ×: High
School	Type of School		○	○	○	○	○		○	○	○	○	○	○	○	○	○	×	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: GPS ×: NGPS
	Total No. of Students		335	240	440	700	450		430	320	360	312	757	131	612	510	915	106	190	210	217	84	173	272	505	673	339	213	344	259	446	312	266	346	263	
	School Site Area (m2)		1,620	2,660	900	2,833	1,230		920	1,120	1,012	1,048	1,539	1,807	7,270	1,968	4,161	880	1,903	889	727	858	962	698	1,250	1,270	1,100	799	1,684	1,100	1,416	1,810	1,250	1,400	2,200	
	Ownership of the Site		○	○	○	○	○		○	○	○	○	○	○	○	○	○	×	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: Owned by Government ×: Owned by Individual
	Natural Conditions of the Site and Its Surroundings		○	○	○	○	○		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: Good ×: Bad
	Size of the Site		○	*11 △	○	○	○		*5 ×	*6 △	*6 △	○	○	○	○	○	○	○	○	*9 △ (300)	*6 △	○	*6 △	*6 △ (210)	△	*6 △ (170)	*6 △ partially	○	○	*6 △	*9 △ (1000)	○	○	○	○	○: Appropriate △: Appropriate on condition ×: Not appropriate
Total Evaluation		×	×	×	×	○	×	×	×	×	○	○	○	○	×	○	○	×	○	○	○	○	○	○	○	○	○	○	○	×	○	×	○	○	○	

Note *1 : Coastal line has been expanded to the south approximately 15km away from the site due to sedimentation by the river course change.
*2 : New IDB Shelter-cum-Primary School exists in the site.
*3 : Deteriorated two-story school buildings in no use exists in the site.
*4 : Existing school stands on the hill area with the height of approximately 5-6m.
*5 : Additional land acquisition is impossible because large ponds, mosquepray space around the site in three directions.
*6 : Removal of old school building is necessary.
*7 : Two large 3-story school building exists in the site.
*8 : Deteriorated PWD Shelter which is not suitable as a shelter, exists in the site
*9 : Number in the brackets shows the rough necessary land acquisition area (sq.m). Detailed land acquisition area will be fixed on the results of detailed site survey and topographic survey.
*10 : A small Caritus shelter of which the evacuee capacity does not meet the number of surrounding population exists next to the site/near the site.
*11 : Filling-up of the pond is necessary.
*12 : Regarding this item, final decision shall be made through the hydrological survey on all the site.
*13 : The site is located on the hilly area with height of 3m.

2-2-2 Detailed Survey on Site Conditions

A detailed survey here means a broad range of surveys, including a detailed survey, i.e. site survey in a narrow sense, socio-environmental survey, water quality survey which is part of the natural conditions survey and a river course alteration survey which is part of the hydraulic and hydrological survey.

The detailed survey was conducted at the 22 sites selected by the outline survey described earlier. As this survey was designed to finalise the project sites, the findings of the outline survey on its survey items were re-checked, followed by a detailed check of the following items to obtain vital information and data for the final selection.

(1) Availability of suitable land for killa construction
(2) Possibility of erosion due to a change of the river course
(3) Suitability of the coverage area for CPP (Cyclone Preparedness Programme)
(4) Number of students of morning classes
(5) Number of students of afternoon classes
(6) Number of teachers
(7) Existance of SMC (school management committee)
(8) Availability of a body responsible for maintenance
(9) Current conditions of school facilities
(10) Minimum area of additional land acquisition for extension
(11) Need to remove existing facilities
(12) Water quality (regarding arsenic) on and around the site

The survey results for each site are compiled in Table 2-2-2-1 (refer to Appendix 6-1 for further details).

Among the items mentioned above, Items (2) and (12) are described in detail later in 2-2-4-(5) Possibility of Bank Erosion of Water Bodies Around Survey Sites and in 2-2-4-(4) Water Quality Test respectively.

Table 2-2-2-1 Results of Detailed Survey on Site Conditions

Item	Site No.	6	13	14	15	16	18	19	21	22	23	24	25	27	28	29	30	31	32	35	37	38	39	Remarks
As an Cyclone Shelter	In or Outside the HRA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: Within HRA ×: Outside HRA
	Maximum Surge Height of Cyclone in the past (m)	2.0 ○	2.2 ○	1.5 ○	2.2 ○	2.0 ○	1.5 ○	2.5 ○	1.5 ○	1.2 ○	1.0 ○	1.2 ○	1.2 ○	1.5 ○	2.0 ○	2.0 ○	3.0 ◎	3.0 ◎	3.0 ◎	2.1 ○	3.0 ◎	3.0 ◎	3.0 ◎	◎: 3m or more ○: 1m or more to less than 3m △: Less than 1m
	Cyclone Shelter within 1.5km Radius	○	○	○	○	○	○	※2○	○	○	○	○	○	※3○	○	○	※3○	○	○	○	※3○	※3○	○	○: Non-existing ×: Existing
	Population within a 1.5km Radius	10,000	13,000	25,000	30,000	12,000	15,000	20,000	22,000	20,000	6,000	15,000	15,000	6,000	20,000	11,000	4,000	15,000	7,000	6,000	5,000	4,000	4,000	
	Hilly Area within a 1.5km Radius	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: Non-existing ×: Existing
	Public Building (2-story) within a 1.5km Radius	※1○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: Non-existing ×: Existing
	Maximum No. of Casualties by Cyclone in the past	500	150	1,000	500	300	600	1,000	500	300	200	250	300	250	350	200	400	150	200	4,000	1,500	1,200	3,000	
	Existing Killa	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	○: Non-existing ×: Existing
	Land for Killa Construction	○	□	○	○	□	○	□	○	○	□	○	○	○	○	□	○	○	□	○	○	○	○	○ Existing × Non-existing
	Possibility of Erosion	○	□	○	○	○	○	□	○	○	□	○	○	○	○	□	×	○	□	○	○	○	×	○ Low × High(Relatively High)
	CPP Coverage Area	○	□	○	○	□	○	□	○	○	□	○	○	○	○	□	○	○	□	○	□	○	○	○ Yes △ No (Warning by rovers of radio and Youth Volantee Committee)
	Existance of Shelter Construction Project	○	□	○	○	□	○	□	○	○	□	○	○	○	○	□	○	○	□	○	○	○	○	○ No × Yes
As a School Building	Type of School	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: GPS △: Registered NGPS
	Total No. of Students (Classes 1~5)	300	380	317	157	131	510	915	190	318	317	85	173	737	905	673	339	313	344	668	388	340	262	
	No. of Students in Morning Class	300	157	117	308	59	192	380	77	91	80	40	68	169	390	376	157	138	141	310	138	164	145	
	No. of Students in Afternoon Class(Classes 3~5)	400	223	200	457	72	330	535	113	119	157	44	113	164	515	298	182	75	203	358	138	182	118	
	No. of Teachers	5	4	4	18	3	8	5	4	4	5	3	4	3	3	5	4	4	6	3	4	3	3	
	School Management Committee	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: Existing △: Non-existing
	Maintenance Organization in Charge	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○: SMO(School Management Committee) △: Others
	School Building Conditions	○	○	△	○	△	△	○	○	○	△	△	△	△	△	△	△	△	△	○	△	△	○	○: Good △: No so bad ×: Bad
Area Size of the Site (m2)		2,933	1,012	1,048	1,539	1,807	1,968	4,151	1,603	939	727	958	982	696	1,298	1,270	1,100	799	1,884	1,415	1,250	1,480	2,200	
Area Size of the School Building (m2)		160	330	296	499	123	302	171	200	121	221	467	190	755	133	650	269	193	93	187	144	272	160	
Means of Accessibility		○	□	○	○	□	○	□	○	○	□	○	○	○	○	□	○	○	□	○	○	○	○	○: 4WD ×: Pushcart, Foot
Ownership of the Site		○	□	○	○	□	○	□	○	○	□	○	○	○	○	□	○	○	□	○	□	○	○	○: Government-owned △: SMO-owned
Natural Conditions of the Site and Its Surroundin		○	□	○	○	□	○	□	○	○	□	○	○	○	○	□	○	○	□	○	□	□	○	○: Good ×: Bad
Additional Land Acquisition (m2)		△ (405)	△ (1,858)	△ (1890)	○ -	△ (784)	○ -	○ -	○ -	△ (175)	△ (586)	△ (890)	△ (708)	△ (216)	△ (866)	○ -	△ (940)	△ (175)	△ (240)	△ (875)	○ -	△ (465)	○	○: Not necessary △: Necessary
Demolition of Existing Facilities		○	○	○	△	○	○	○	○	○	○	○	○	△	○	○	○	○	△	○	○	△	○	○: Not necessary △: Necessary
Water Quality in/and around the Site (As)		○	○	○	○ (0.021ppm)	○	○	○	○	○ (0.023ppm)	△ (0.131ppm)	○	○	△ (0.052)	○	○	○	○	○	○	○	○	○	○ Drinkable ※As Banglades Standard:0.05ppm △ Non-Drinkable in Shallow Well
Total Evaluation		△ A	△ A	△ A	△ B	△ A	○	□	○	△ A	△ A,C	△ A	△ A	△ A, B, C	△ A	□	×	△ A	△ B	△ A	□ -	△ A, B	×	○: Qualified A: Additional Land Acquisition △: Qualified with conditions B: Demolition of Existing Facilities ×: Disqualified C: Arsenic Contamination

Note *1 : Deteriorated two-story school buildings in no use exists in the site.
*2 : Deteriorated PWD Shelter which is not suitable as a shelter, exists in the site
*3 : A small Caritus shelter of which the evacuee capacity does not meet the number of surrounding population exists next to the site/near the site.

2-2-3 Selection Criteria for Project Sites

The site selection criteria shown below were introduced with full consideration of the similar criteria for the Phase I through Phase IV Projects and the post-evaluation findings of the JICA for the Phase I through Phase III Projects. These criteria considered the requirements for new facilities which will be used as cyclone shelter-cum-primary school buildings. Especially in view of the fact that the cyclone shelter constructed in Ragmati Upazila in the Phase III Project was lost in 1999 due to a rapid change of the course of Megna River (1 – 1.5 km), criterion 5, i.e. the unlikelihood that the subject site will be eroded by a change of the river course, was added to the latest selection criteria so that any possibility of a change of the river course could be examined from various angles for the selection of the sites.

Table 2-2-3-1 Site Selection Criteria

1.	The subject site shall be the site of a government primary school which is managed by the central government.
2.	The subject site shall be located in the HRA*1 designated by the Master Plan for the Multipurpose Cyclone Shelter Programme.
3.	In principle, the subject site shall not have a solid building or hill of sufficient size and height to provide a reliable evacuation site vis-à-vis storm surge caused by a cyclone within a 1.5km*2 radius of the site.
4.	The subject site shall have a sufficient land area for the construction of a multipurpose cyclone shelter and the central government shall have secured land ownership of the site. However, even if sufficient space for shelter construction is not available, this does not exclude cases where it is possible to secure the necessary space by removing facilities which are judged to be unusable or where it is possible to secure an additional area on adjacent land together with the assurance by the Bangladesh side that any removal work or expropriation of adjacent land will be conducted without fail.
5.	It is highly unlikely that the subject site will be eroded by a change of the river course.
6.	The subject site shall not be associated with a similar project or plan of the Government of Bangladesh or a foreign aid organization or a donor country for cyclone shelter construction.
7.	The subject site shall allow access by vehicle for the transportation of construction materials to the site.
8.	The subject site shall have an operating primary school with teachers, administrative staff and students and it is judged that the facilities to be newly constructed will be fully used as a primary school facilities during normal times.
9.	The subject site shall already have a school management committee (SMC) capable of maintaining the new facilities and equipment.
10.	The subject site shall have a killa*4 for the evacuation of livestock within a 0.3km*3 radius of the site. Alternatively, there shall be a feasible site for the construction of a killa and such an assurance shall be obtained from the Bangladesh side.

*1 The HRA is an area where there is a strong likelihood that human lives will be lost due to major flooding as the water depth at the time of a storm surge caused by a cyclone can exceed 1 m.

*2 In consideration of the maximum evacuation distance (1.5 km) stipulated in the Master Plan and the evacuation distance at BDRCS and Caritas (1.5 km each), and based on review of the Phase I through Phase IV Projects and also the primary school catchment area (radius of 1 km to 1.5 km), the maximum evacuation distance in the Project was set at 1.5 km.

*3 It is best to construct the killa on land adjoining the shelter sites, however, since there may be cases where this is difficult due to the local terrain and conditions such as the need to acquire land and so on, this distance was set at 0.3 km to ensure that livestock in the killa are visible and make it possible to quickly round up livestock after cyclones pass by.

*4 A killa is a banked site for the temporary evacuation of livestock, etc. at the time of a cyclone.

2-2-4 Finalisation of Project Sites

Based on the results of the detailed survey on the site conditions at the 22 sites mentioned in 2-2-2, 20 sites were judged to be suitable project sites for the construction of a cyclone shelter as shown in Table 2-2-2-1. Site Nos. 30 and 39 were removed from the project sites due to a relatively high possibility of a change of the river course based on the examination of various factors as described later in 2-2-4 (5) Possibility of Bank Erosion of Water Bodies Around Survey Sites.

Five sites, i.e. Site Nos. 18, 19, 21, 29 and 37, were selected as project sites without any conditions while the other sites, i.e. Site Nos. 6, 13, 14, 15, 16, 22, 23, 24, 25, 27, 28, 31, 32, 35 and 38, were selected with conditions attached. Those sites with conditions attached were regarded as planned project sites on the grounds that the attached conditions would be met.

(1) Additional Land Acquisition

The additional land acquisition is a condition attached to the following 14 sites and the minimum requirement for additional land is listed below.

Site No.	Area of Existing Site (m^2)	Minimum Requirement for Additional Land (m^2)
6	2,833	405
13	1,012	1,050
14	1,048	890
16	1,807	784
22	889	125
23	727	560
24	858	630
25	982	700
27	696	216
28	1,290	880
31	800	175
32	1,600	240
35	1,420	975
38	1,400	415

The acquisition of the required land listed above should be completed by the Bangladesh side prior to the signing of the E/N.

(2) Removal of Deteriorated Existing Facilities

The removal of deteriorated existing facilities is a condition attached to the following four sites and the subject facilities for removal are listed below.

Site No.	Facility to be Removed
15	Two existing school buildings out of four (brick built with zinc roofing)
27	Existing school building (brick built with zinc roofing)
32	Existing school building (brick built with zinc roofing)
38	Existing school building (brick built with zinc roofing)

The work to remove these deteriorated existing facilities should be completed by the Bangladesh side prior to the commencement of work under the Project.

(3) Sites with Small Cyclone Shelter on Adjacent Land

While Site Nos. 27, 30, 37 and 38 have a small cyclone shelter on adjacent land, the capacity of these shelters of approximately 700 is small. Given the local population size of 6,000, 4,500, 5,000 and 4,500 respectively within a 1.5 km radius, the necessity for the construction of a new shelter at these sites is judged to be sufficiently high. Accordingly, these sites are included in the project sites.

(4) Water Quality Test (Particularly Arsenic)

In Bangladesh, more than 90% of the population rely on groundwater for the supply of drinking water. In the mid-1990's, the widespread arsenic contamination of groundwater was discovered. While this discovery was too late for the Phase I through Phase III Projects to adopt appropriate measures, the new principle of blocking and abandoning deep wells as water supply facilities was adopted for the Phase IV Project (BD in 1998 and construction work in 1999) if the groundwater was found to contain an arsenic level exceeding the Bangladesh standard for drinking water. This principle was opted for because of the lack of effective measures to deal with the problem of the arsenic contamination of water.

At present, research to solve this problem is in progress by research institutions in Japan and international organizations. It was, therefore, decided that water quality analysis (arsenic) with a higher accuracy than that conducted in the Phase IV Project would be conducted for the Phase V Project with a view to examining suitable measures for problematic sites.

Groundwater in the study area is mainly found in the sandy layer and there are generally four aquifers with clay and silt (cohesive soil) layers which can be continually traced, forming boundaries, as shown in Table 2-2-4-1.

Table 2-2-4-1 Aquifers in the Study Area

Aquifer	Characteristics	Coastal Area (Other than Sandwip and Hatiya)	Island Area (Sandwip and Hatiya)
Upper Layer	Presence of a 10 m – several tens of metres thick cohesive soil layer at the bottom	Depth of the boundary to the lower layer of approx. 80 m	Depth of the boundary to the lower layer of approx. 90 – 120 m
Upper Middle	Presence of a 10 – 20 m thick cohesive soil layer at the boundary with the lower layer	Depth of the boundary to the lower layer of approx. 190 – 200 m	Depth of the boundary to the lower layer of approx. 190 – 200 mm
Lower Middle	-	Depth of the boundary to the lower layer of approx. 260 m	Depth of the boundary to the lower layer of approx. 270 – 285 m
Lower	Presence of a 10 m to several tens of metres cohesive soil layer at the top	-	-

Local wells in and around the study area are generally classified as shallow wells and deep wells with a depth of 75 m acting as the demarcation depth. Wells targeting groundwater in the upper aquifer are mainly classified as shallow wells while others are classified as deep wells.

The water quality test results for sample water taken from various wells are shown in Table 2-2-4-2. Arsenic is found at Site No. 15 in Patiya Upazila, Chittagong District and at Site Nos. 22, 23 and 27 in the Miresharai Upazila in the same district. The level of arsenic exceeds the relevant Bangladesh standard of 0.05 ppm at Site Nos. 23 and 27. Both are shallow wells with a depth of some 10 – 18 m. The construction of a deep well with a depth of some 300 m is planned at these sites under the Project and arsenic removal devices will be installed if the arsenic value of water from these deep wells exceeds the said standard [a more detailed description is given in 3-2-2-(3)].

Although common germs and colon bacilli are detected at all of the survey sites, it is judged to be highly likely that those found in groundwater from deep wells and brought in by slurry used for deep hole drilling and drilling equipment rather than being contained in the original groundwater. As such, it is possible to solve this problem by sterilising the groundwater in these deep wells prior to their use as water supply facilities.

For the present study, the dissolved quantity of arsenic in groundwater is the major concern. Table 2-2-4-3 shows arsenic data by district obtained from the Public Health Engineering Department (DPHE).

Based on the results of the water quality analysis and information gathering survey, the characteristics of the groundwater quality by aquifer and by district are compiled in Table 2-2-4-4.

Table 2-2-4-2 List of Water Quality Test Results

Parameter	Site NO.	Wee Depth	Aquifer	Colour	Turbidity	Odour	Taste	Temperature	pH	Electric Conductivity	Fe	Cl	Total Hardness	Ammonium	Common Germs	Colon Bacilli	Arsenic
Ubit		m						℃	—	mS/m	mg/l	mg/l	mg/l	mg/l	MPN	MPN	mg/l
WHO Guideline Value						Not unpleasant	As left	—	6.5～8.5		0.3	250	500				0.01
Provisional Bangladesh Standard								30	6.5～9.2		1	250	500				0.05
Somagazi	3	Unknown	Unknown	Clear	None	None	None	25.0	6.97	28.7	0.2	75	100	0.5	—	—	No reaction
	4	Unknown	Unknown	Clear	None	None	None	24.9	6.94	30.6	0.1	50	115	0.2	—	—	No reaction
Chakaria	5	60	Upper	Pale brown	None	None	None	25.0	7.17	27.7	0.2	50	100	0.5	15	4	No reaction
	6	250	Lower middle	Clear	None	None	None	24.8	7.76	38.2	0.2	75	100	0.5	7	3	No reaction
	8	300	Lower	Pale brown	None	None	None	25.0	6.80	15.55	0.1	100	100	0.2	0	0	No reaction
Cox's Bazar	11	400	Lower	Clear	None	None	None	25.0	7.20	28.0	0.2	75	125	0.2	—	—	No reaction
Patiya	12	40～60	Upper	Pale brown	Yes	None	None	25.1	6.30	31.0	0,2	150	115	0.5	9	8	No reaction
	13	45	Upper	Pale brown	None	None	None	25.2	7.79	104.6	0.4	275	110	0.2	9	5	No reaction
	14	45	Upper	Pale brown	None	None	None	25	7.02	146.4	0.1	225	410	0.2	12	7	No reaction
	15	10	Upper	Pale brown	None	None	None	25	7.03	383	0.2	75	430	2	10	6	0.021
Sandwip	16	300	Lower	Clear	None	None	None	24.5	7.48	67	0.2	50	200	0.2	16	11	No reaction
	17	300	Lower	Clear	None	None	None	25.0	7.11	47.2	0.2	225	210	0.2	10	7	No reaction
	18	300	Lower	Clear	None	None	None	25.0	7.40	46.4	0.2	125	150	0.5	7	6	No reaction
	19	300	Lower	Clear	None	None	None	25.0	7.25	61.3	0.2	325	150	0.5	11	9	No reaction
Miresharai	20	15	Upper	Pale brown	None	None	None	25.0	7.16	309	0.3	50	500	0.2	7	5	No reaction
	21	18	Upper	Pale brown	None	None	None	25.1	7.26	165.2	0.2	150	150	0.5	9	12	No reaction
	22	12～18	Upper	Clear	None	None	None	25.0	7.25	214	0.1	50	255	0.5	6	3	0.023
	23	18	Upper	Clear	None	None	None	25.2	7.48	62.1	0.2	25	185	1.0	13	10	0.131
	24	230	Lower middle	Clear	None	None	None	25.0	7.51	66.2	0.2	250	150	0.2	9	9	No reaction
	25	150	Lower middle	Clear	None	None	None	25.6	7.19	44.2	0.1	225	120	0.2	7	10	No reaction
	27	15	Upper	Clear	None	None	None	25.0	7.66	81.8	0.2	250	100	0.3	13	5	0.052
Banshkhali	28	210	Lower middle	Clear	None	None	None	24.7	7.10	33.6	0.2	50	110	0.4	9	9	No reaction
	29	270	Lower middle	Pale brown	None	None	None	24.7	6.68	27.4	0.1	125	100	0.3	0	12	No reaction
	30	45	Upper	Pale brown	Yes	None	None	24.7	6.44	45.6	0.2	225	100	0.3	8	11	No reaction
	31	300	Lower	Pale brown	Yes	None	None	24.8	6.41	13.48	0.3	25	100	0.2	12	11	No reaction
	32	36	Lower	Pale brown	Yes	None	None	24.8	5.89	6.93	0.1	25	120	0.1	10	11	No reaction
Anowara	34	12	Upper	Clear	None	None	None	24.6	6.03	26.6	0.2	225	100	0.2	12	8	No reaction
	35	60	Upper	Pale brown	None	None	None	25.0	6.92	23.5	0.3	25	100	0.8	—	—	No reaction
	36	Unknown	Unknown	Clear	None	None	None	24.8	6.92	171.4	0.2	150	205	1.5	—	—	No reaction
Hatiya	37	270	Lower middle	Clear	None	None	None	24.5	7.12	44.8	0.2	125	100	0.3	23	30	No reaction
	38	240	Lower middle	Clear	None	None	None	25.0	7.39	51.4	0.1	25	150	0.4	11	8	No reaction
	39	260	Lower middle	Clear	None	None	None	25.0	7.31	105.5	0.1	125	300	0.5	5	9	No reaction

[Legend] : Sites selected by the Outlining Survey on Site Conditions

Table 2-2-4-3 Arsenic Analysis Results for Wells Located in and around the Study Area (DPHE - UNICEF 2002)

Upazila	No. of Wells Analysed and No. of Wells with As 5 ppm or Higher			DPHE Data (Location of Deep Well Not Indicated)	Remarks
	Total	Deep Well	Shallow Well		
Chakaria	0/1000	0/587	0/413	Dissolved As: 0.01 ppm or lower for all deep wells (156 m, 233 m and 250 m deep)	Not contaminated by As at all.
Patiya	45/991	3/743	42/248	Dissolved As: 0.060 ppm for a deep well (150 m); Dissolved As: 0.050 ppm for a deep well (240 m); Dissolved As: 0.045 ppm for a deep well (300 m)	Both shallow and deep wells located at the western edge of the district are in a contaminated area (also covered by the present study area). According to DPHE data, the level of dissolved As is lower than the provisional Bangladesh standard for a depth of around 300 m.
Sandwip	0/995	0/293	0/702	Dissolved As: 0.037 ppm for a deep well (165 m); Dissolved As: 0.010 ppm for a deep well (255 m); Dissolved As: 0.008 ppm for a deep well (315 m)	The entire area is supposedly not contaminated by As. However, the As value for the upper middle aquifer is near the provisional Bangladesh standard.
Miresharai	3,350/9,015	-	-	No As is detected in the deep well data (depth: 185 - 200 m) provided by the DPHE for five sites in Mayanie and Wahedpur.	The entire area, except for two unions in the north, is contaminated by As. The general situation of the contamination of shallow and deep wells is not yet known as the data is currently being compiled. Project Site Nos. 22, 23 and 24 are located in Mayanie and Wahedpur.
※1	※2 （3,338/7,296）	-	-		
Banshkhali	2/883	1/525	1/358	-	Although contamination by As is observed in very limited areas, this district is not contaminated by As in general.
Anowara	10/1004	0/366	10/638	-	The upper aquifer is contaminated by AS despite in a very limited manner. Neither the middle aquifer nor the lower aquifer are contaminated.
Hatiya	340/684	0/16	340/668	-	The upper aquifer throughout the district is contaminated by As but neither the middle aquifer nor the lower aquifer are contaminated.

Note: No. of wells with a As level of 5 ppm or higher/no. of wells analysed

*1 Interim data

*2 In the case where the northern area of the district is removed from the totalled data.

Table 2-2-4-4 Water Quality Survey Results

Location	Upazila	Chakaria		Pekua		Kutubdia		Moheshkhali		Banshkhali		Anowara		Patiya	
	Site No.	6		13,14,15		15, 9,16		21,22,23,24,27,37		28,29,30,31,32		36		37,38,39	
	Geographical Location	Coastal South		Coastal Middle		Island		Coastal North		Coastal South		Coastal Middle		Island	
Aquifer Category	Upper		(As) No sign of contamination	The electric conductivity of 1046 - 380 mS/m is generally high and there is an area with a chloride ion level of 225 ppm suggesting a shift	(As) Contamination was found in some places Western end of the district in the study area during the latest survey As is detected at one site out of three		(As) No contamination throughout the island	The electric conductivity at Site Nos 21 and 22 is 165 - 214 mS/m suggesting a shift towards brine	(As) Generally contaminated by As The latest survey detected 0.020 - 0.131 ppm at three sites	The salinity is observed in general but harmful ions are not dissolved.	(As) Generally contamination The latest survey did not detect As	Turbidity is observed but dissolved harmful ions have not been confirmed	(As) Generally contaminated although partial contamination is observed The latest survey did not detect As		(As) Entirely contaminated
	Upper Middle		As above DPHE data depth 156 m As 0.01 ppm or lower		As above DPHE data depth 168 m As 0.069 ppm		As above DPHE data depth 150 m As 0.007 ppm	The water quality test results are generally non problematic	As above The latest survey did not detect As		As above		Generally uncontaminated		Generally uncontaminated
	Lower Middle	The water quality test results are generally below the provisions Bangladesh standard	As above DPHE data depth 233 m - 260 m As = 0.01 ppm or lower The latest survey failed to detect As		DPHE data depth 240 m As = 0.053 ppm		As above DPHE data depth 243 m As = 0.010 ppm	As above	As above DPHE data As not detected in the district to which Site Nos. 22, 23 and 24 belong The latest survey did not detect As	Turbidity is observed with some samples but harmful ions are not dissolved	As above The latest survey did not detect As		As above		As above
	Lower				DPHE data depth 300 m As = 0.045 ppm	The test results present no problem but the chlorine ion concentration at 325 ppm is high at Site No. 18	As above DPHE data depth 330 m As 0.006 ppm The latest survey did not detect As			Although turbidity is observed, harmful ions are not dissolved	As above The latest survey did not detect As.			The test results generally pose no problems	As above The latest survey did not detect As.
General Conclusions		None of the aquifers have a problem of As contamination but the shift towards brine at the upper aquifer requires further clarification The quality of deep groundwater from the lower middle aquifer onwards is judged to have no problem		Area requiring caution for groundwater development The upper aquifer has become brine around the area posing a problem along with As contamination Groundwater in the upper middle aquifer is believed to have a problem of As contamination The dissolved volume of As tends to become lower with deeper aquifers.		The situation of a shift towards brine in the upper aquifer is unclear Although there is no problem of As contamination at present, the water of As contained in the groundwater of the upper middle aquifer is near the provisions Bangladesh standard The dissolved volume of As tends to become lower with deeper aquifers		Area requiring caution for groundwater development The upper aquifer has become brine around the area posing a problem along with As contamination The problem of As contamination is highly likely in the case of the upper middle aquifer or even below		The groundwater in every aquifer is judged not to have any water quality problem including As contamination		Although the upper aquifer is contaminated by As in some areas deeper aquifers are free from contamination The water quality other than As is judged to pose no problem		The entire upper aquifer is contaminated by As The shift towards brine is unclear The upper middle and deeper aquifers are judged to pose no water quality problem including As contamination
Assessment of Groundwater Development Potential of Lower Middle and Lower Aquifers		Suitable		Requires a detailed survey		Suitable		Requires a detailed survey		Suitable		Suitable		Suitable	

(5) Possibility of Bank Erosion of Water Bodies Around Survey Sites

The possibility of bank erosion due to a change of the river course was added as a site selection criterion to the Study in view of the fact that one of the 61 cyclone shelters constructed by Japan under the Phase I through Phase IV Projects (Site No. 9 in Ramgati Upazila in the Phase III Project) was lost due to this reason and that another shelter (Site No. 2 in Banshkhali Upazila in the Phase II Project) is facing a risk of being washed away during to scouring of its foundations.

At the 22 sites selected by the outline survey on the site conditions, the possible impacts of bank erosion at each site were inferred by analysing the following matters while taking the possibility of the bank erosion of a neighbouring water body at each site into consideration.

1) Relative locations of the candidate site and nearby water body
2) Changing situation of the coastline over the years and trends of bank erosion as well as sedimentation based on four LANDSAT images (1973/73, 1984, 1996 and 2001).
3) National Hazard Map indicating likely areas to be affected by bank erosion in Bangladesh
4) Field survey results, including information on ongoing bank erosion at the sites and records of shelters which have been washed away obtained by field reconnaissance and an interview survey

Based on analysis of the above four matters, Site No. 30 located near the left bank of the lower reach of Sangu River in Banshkhali Upazila and Site No. 39 located near the west bank of the mouth of Megna River on Hatiya Island are inferred to have a relatively high possibility of being affected by the future bank erosion compared to the other sites as described below (see Appendix 6-3 for further details).

[Site No. 30 Near Left Bank of Downstream of Sangu River at Banshkhali]

1) The candidate site is some 800 m away in a straight line from a bank which has no embankment. Flat farmland continues from the bank to the site. No measures are currently in place to prevent or control the erosion of the river bank.
2) Analysis of the changing situation of the coastline based on the LANDSAT images found that the course of Sangu River is meandering more than it did some 28 years ago, suggesting a shift of the river course.

3) As shown on the bank erosion hazard map, the field reconnaissance and interview survey confirmed the ongoing impacts of bank erosion at the left bank of Sangu River.

4) The survey on damage by bank erosion to existing shelters found that although no shelter has been washed away in Banshkhali Upazila, Phase II Site No. 2 located downstream of the candidate site is currently facing the crisis of being washed away due to scouring of its foundations. In addition, a shelter constructed by Saudi Arabia in the upstream of the nearest river bank of the candidate site is facing a risk of its foundations being scoured.

[Site No. 39 Located Near West Bank of Hatiya Island]

1) The candidate site is some 1.7 km away (as of 1973/74) from the bank in a straight line but the progressive bank erosion means that the minimum distance between the river bank and the embankment is as short as some 20 – 30 m, leaving the river bank area without any measure to protect against erosion.

2) Analysis of the changing situation of the coastline based on the LANDSAT images found that there has been a general progress of erosion along the entire west bank of the island by some 0.6 – 1.4 km over a period of some 28 years.

3) The bank erosion hazard map indicates that the east bank of Hatiya Island is vulnerable to erosion. However, the field reconnaissance investigating the state of bank erosion and the state of planted trees on both banks and the interview survey concluded that the west bank (coast) rather than the east bank has suffered much more from bank erosion.

4) According to the interview survey on damage by bank erosion to existing shelters, four BDRCS shelters and one Calitas shelter have been washed away on Hatiya Island.

CHAPTER 3 CONTENTS OF THE PROJECT

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3-1 Basic Concept of the Project

(1) Overall Goal and Project Purpose

Bangladesh continually faces a situation where many human lives, animals and assets are lost due to cyclones which almost constantly hit the country.

To alleviate this situation, the Multipurpose Cyclone Shelter Programme (the Master Plan) was formulated in 1993 with the assistance of the World Bank and the UNDP and the construction of cyclone shelters at 2,500 sites was declared.

While international aid organizations and donors have been constructing cyclone shelters in accordance with this plan, the number of shelters completed so far is only some 1,300 despite the fact that the target year of 2002 for the completion of 2,500 shelters has already been passed. Facing this shortage of cyclone shelters, the Government of Bangladesh aims to achieve the target as soon as possible. Under these circumstances, the declared goal of the Project is the construction of cyclone shelters at 20 sites in Chittagong, Cox's Bazar and Noakhali Districts to contribute to the alleviation of cyclone damage. The alleviation of cyclone damage will improve the lives of local residents.

(2) Outline of the Project

In order to achieve the above-mentioned purpose, the Project plans the construction of 20 cyclone shelters which can be used as primary school buildings during normal times in the Chittagong, Cox's Bazar and Noakhali Districts in the HRA where evacuation facilities for cyclones are non-existent. The construction of the new shelters will enable the evacuation of some 37,000 people while improving the educational environment for some 7,600 primary school pupils.

The locations and other attributes of the 20 project sites are outlined on the Location Map at the beginning of this report and in Table 3-1-1 below.

Table 3-1-1 Locations of Project Sites

Site No.	District	Upazila	Union	Name of Primary School
V-1	Cox's Bazar	Chakaria	West Boro Veola	Ilishia GPS
V-2	Chittagong	Patiya	Charlaksma	West Charlaksma GPS
V-3	Chittagong	Patiya	Char Patharghata	Ichanagar GPS
V-4	Chittagong	Patiya	Char Patharghata	Char Patharghata GPS
V-5	Chittagong	Sandwip	Haramina	Kachhiapur GPS
V-6	Chittagong	Sandwip	Musapur	South East Musapur GPS
V-7	Chittagong	Sandwip	Bauria	Bauria G. K. GPS
V-8	Chittagong	Miresharai	Katachhora	Temuhani GPS
V-9	Chittagong	Miresharai	Mayani	Solaiman GPS
V-10	Chittagong	Miresharai	Wahedpur	Jafarabad GPS
V-11	Chittagong	Miresharai	Mayani	SM Hazipara GPS
V-12	Chittagong	Miresharai	Durgapur	Hazisorai GPS
V-13	Chittagong	Miresharai	Sahebkhali	East Sahebkhali GPS
V-14	Chittagong	Banshkhali	Shilkup	Munkirchar GPS
V-15	Chittagong	Banshkhali	Katharia	Modya Katharia GPS
V-16	Chittagong	Banshkhali	Puichari	Puichari Sultania GPS
V-17	Chittagong	Banshkhali	Shadhanpur	North Shadhanpur GPS
V-18	Chittagong	Anowara	Burumchhora	West Burumchhora GPS
V-19	Noakhali	Hatiya	Burirchar	Hornipalgram GPS
V-20	Noakhali	Hatiya	Sonadia	Purba Chanandi GPS

Note: GPS = government primary school

3-2 Basic Design of the Requested Japanese Assistance

3-2-1 Design Policy

(1) Basic Concept

Upon examining and discussing the request by the Government of Bangladesh for construction of 39 cyclone shelters, both countries agreed to target 34 sites in the Study. This number was finally reduced to 20 construction sites following screening based on the separately agreed Site Selection Criteria as described in 2-2.

The Project facilities are intended for use as shelters in the event of cyclones. However, it is also planned to use them as primary school facilities at normal times in order to keep the facilities in good condition and ensure their effective utilization. Each facility shall be a two-story building consisting of classrooms, teachers' room, and toilets, etc., and shall be equipped with water supply facilities (deep-well and manual pump) and drainage facilities. Also, in cases where arsenic contamination has been confirmed in the Project sites, necessary countermeasures shall be taken.

It is assumed that the new facilities will serve multiple purposes, including as meeting places, simple health facilities (for polio vaccination) and polling stations in addition to primary schools.

Concerning the basic concept for design and structure of facilities, based on the past history and experience of the Phase I through Phase IV Projects and the review carried out in the post-project evaluation study, etc., the facilities shall be planned and designed with full consideration given to functions, structure and cost, etc.

(2) Concept with Respect to Natural Conditions

The design concept with respect to natural conditions in the Project will be as follows.

1) Wind Velocity

As a result of conducting analysis on past cyclone wind velocities and probable wind velocity, a 50-year probability wind velocity of 260 km/h (72.0 m/sec), which is within the Bangladesh National Building Code (BNBC) standard of 260 km/h (72.0 m/sec), will be adopted as the design wind velocity.

2) Seismic Load (horizontal force of inertia)

According to the BNBC, the country is divided into three seismic zones and the coefficient of the horizontal force of inertia is stipulated for each.

Zone 1 (north)	0.2
Zone 2 (center and east)	0.15
Zone 3 (south)	0.075

The Project area is located in Zone 2, where the coefficient is 0.15. However, this can be reduced to 0.12 by using various other coefficients (building height, soil quality, etc.) that are included in the BNBC guidelines.

3) Tide Level

Examination of the wave force is omitted here as such force has little effect on the designed shelters which are the stud-type, i.e. having a high floor. As such, the examination is limited to the tide level which significantly affects the decision on the floor height of the shelters.

With respect to storm surge analysis, by applying the method used in the Master Plan of the Multipurpose Cyclone Shelter Programme, the 50-year probability water level will be used.

The following two formulae are proposed for arriving at the storm surge height at cyclone shelter construction sites:

$H_1 = H_{50} - (X - 1)\,K + h_w$ ..... Formula ①

H_{50} Design surge height, 50-year return period (m)

X Distance of shelter from sea beach (km)

K Rate of decrease in surge height (m/km)

0.5 m/km at Chittagong coastal plain, 0.33 m/km elsewhere

h_w Amplitude of local wave in m from mean water level

$h_w = [(h_{50} - (x - 1)\,K)]\ 1/4 \quad h_w = 1$ if $h_w < 1$

H_1 indicates tide level at the site

$H_2 = Y_{50} - Y_g + h_f$ ..... Formula ②

Y_{50} 50-year extreme surface water level

Y_g Elevation of ground level at shelter

hf Allowance for local wave 1 m

H_2 Tide level from the site ground level

In view of the recorded tide levels affecting inland areas in the past, Formula ①, which takes the topographical features and the distance from the nearby coast into consideration, is adopted for the present purpose as the value calculated by this formula can reflect the actual tide level more accurately than that based on Formula ②.

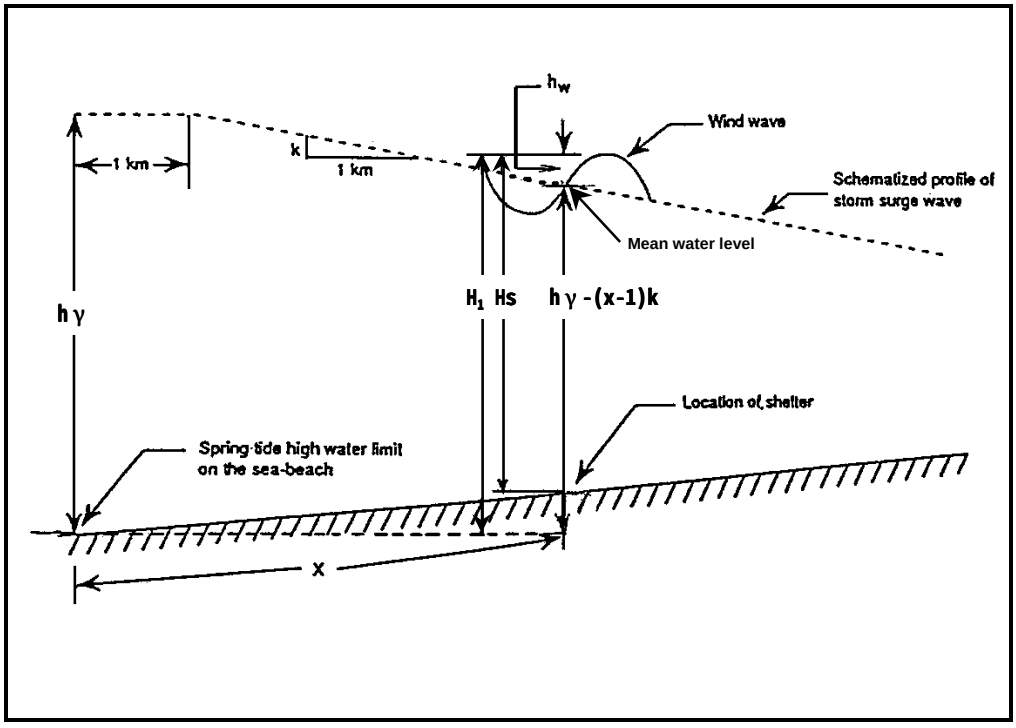


Fig. 3-2-1-1 Schematic of Calculation for Storm Surge Height

4) Geological Conditions (Determination of Foundation Type)

There can basically be two types of foundations for the planned shelters depending on the geological composition and bearing capacity of the ground, i.e. spread foundations or pile foundations. The actual type of foundations to be used will be determined based on the boring survey and indoor soil quality test results. As B NBC has only reference data on design standards for building foundations, Japanese standards will be used to determine the foundation construction method, i.e. type of foundations.

The load per unit area of the entire building which forms the basis for the selection of the desirable foundation construction method is approximately 7.5 tons/m^2. Accordingly, spread foundations will be opted for if (i) the allowable bearing capacity at the bottom of the foundations is 7.5 tons/m^2 or higher and (ii) the expected consolidation settlement is less than 15 cm. When these conditions are not met, pile foundations will be opted for.

In the case of pile foundations, the supporting ground must have a N value of at least 20 and a layer thickness of 5 m or thicker. The bearing capacity of the piles is calculated as the sum of the end bearing capacity and the frictional force. If there is no supporting ground, friction piles will be employed to utilise the friction force around the piles.

(3) Concept with Respect to Social Economy

The Project aims to construct cyclone shelters-cum-schools in the premises of the existing primary schools and thereby improve education facilities within the HRA, and at the same time to make use of these facilities as cyclone shelters.

To prevent damage caused by cyclones, Bangladesh began constructing cyclone shelters in the 1960's which would also function as coastal community centers. In more recent years, around 2,100 cyclone shelters, almost all of which serve as primary schools at normal times, have been constructed and these have become the standard design for cyclone shelters throughout the HRA.

Most of the residents in the target area are engaged in agriculture and live on or below the poverty line. In such areas, where population mobility is high due to large numbers of landless farmers, etc. who possess no economic base, cyclone shelters contribute to the settlement of residents. Because of the local religious background whereby more than 90% of the population are Muslims, there was initially some resistance to joint

evacuation by men and women. However, thanks to official disaster prevention activities placing priority on human life, there have been some changes in people's attitudes, and cyclone shelters have come to be accepted and used more widely.

Cyclone shelters in the Project will be planned to have a low maintenance cost, solid raised floor type RC structure, and will also function as primary school buildings.

(4) Concept with Respect to Construction Conditions

1) Building Construction Methods

Concerning building construction methods in Bangladesh, low buildings generally consist of the brick masonry structure, while larger buildings of four or more storeys combine the RC rigid frame structure and brick masonry walls. Such preference appears to reflect the local availability of certain construction equipment, materials and skills in Bangladesh.

It has been confirmed that the main structures of all cyclone shelters that have so far been constructed or are currently being constructed by other aid organizations or donors consist of reinforced concrete because of the need to construct solid and safe evacuation facilities. The main structure of the shelters constructed under Japan's Phase I through Phase IV Projects is a reinforced concrete structure which can be satisfactorily constructed using local construction materials and skills based on a comparative analysis of the various types of structures. Accordingly, reinforced concrete structures will also be adopted for the Project.

2) Permit System Pertaining to Project Implementation

Bangladesh does not have a detailed permit system that pertains to implementation of the Project. The only system of this sort is a notification system for construction that is established in urban areas in the following four Metropolitan Cities. This only requires that the submission of documents describing construction site and scale of construction.

Dhaka	RAJUK (Dhaka Metropolitan Development Authority)
Chittagong	DA (Chittagong Development Authority)
Khulna	DA (Khulna Development Authority)
Rajshahi	DA (Rajshahi Development Authority)

3) Related Legislation and Standards

Bangladesh does not have any legislation pertaining to building design or construction. As a kind of building design standards, however, the Bangladesh National Building Code (BNBC) was established in 1997. Even though this carries no legally binding power but only provides design guidelines, they are basically followed for the design of the Project.

4) Level of Local Construction Companies

The technical level of construction companies in Bangladesh has improved dramatically over the past few years. Local contractors have constructed a number of high-rise buildings of 20 or more stories in Dhaka. The impacts of Bangladeshi engineers learning technical knowledge and skills overseas and of receiving guidance from foreign engineers in Bangladesh have been truly substantial. Many construction companies in Bangladesh possess the sufficient technical capability and have experience of working for Japanese assistance projects. As such, no technical problem in using a local construction company for the Project is recognised.

5) Level and Quantity of Workforce

Technical levels of local workers have improved considerably as indicated above although their experience of work requiring special skills and tools, etc. is limited. Bangladesh has sufficient workforce in terms of technical capability and quantity to implement widely used construction methods, but skilled workers for jobs other than light work are concentrated in the cities. Therefore, construction workers other than ordinary labourers need to be recruited in Dhaka or Chittagong for the type of work envisaged by the Project, and this recruitment practice will be followed for the Project for which the actual construction work will be conducted in local areas.

6) Quality and Quantity of Local Equipment and Materials

The experience of Japan's Phase I through Phase IV Projects confirms that construction materials of a stable quality can be locally procured in bulk volume for common local construction methods (brick masonry and reinforced concrete). However, the direct purchase of reinforcing bars and cement, which are particularly important items, from manufacturing plants where strict quality control is enforced is essential.

In the case of reinforcing bars, price comparison between local procurement and import from a third country (for example, India) found that their import will be

cheaper. One drawback of the import option, however, is that some two months are required for delivery. In view of the planned construction schedule for the Project, reinforcing bars for the upper structure can be imported while those used for the foundation work will be locally procured because of the need for their immediate delivery to the sites after the commencement of the construction work. Other materials will be procured in Chittagong and its suburbs which are not far from the planned construction sites.

The local procurement of construction materials, except for some of the reinforcing bars, will not only be effective to reduce the overall construction cost but will also contribute to the local economy.

(5) Concept with Respect to Local Subcontractors

While the main contractor for the construction work under the Project will be a Japanese construction company, the use of local subcontractors is judged to be essential in view of the perceived difficulties for the Japanese contractor acting alone in Bangladesh where the construction conditions, social conditions and customs greatly differ from those in Japan. Moreover, Japan's Phase I through Phase IV Projects have been successfully completed with the use of local companies as subcontractors. Accordingly, it is assumed that local subcontractors will be used for the construction work under the Project.

(6) Concept with Respect to Operation and Maintenance Capacity of the Implementing Agencies

As the new cyclone shelters constructed with Japanese grant aid will be used as government primary school buildings during normal times, they will be placed under the control of the Directorate of Primary Education (DPE). In reality, daily operation and maintenance will be conducted by the School Management Committee (SMC) at each site. As the current budget of the DPE is mainly used for the payment of school staff salaries, it is believed that hardly any budget will be available to finance the daily operation and maintenance of these schools. It has been confirmed that the budget shortage of the DPE is the main cause of the insufficient maintenance of the shelters constructed in the Phase I through Phase IV Projects. This situation indicates the importance of making the financial burden on the DPE as low as possible in accordance with the principle adopted by the previous projects and also of creating maintenance-free facilities.

Based on the above, the following concept is adopted for the equipment plan.

(Ventilation)

The maximum mean monthly temperature at all of the sites is more than 30°C from March to November. As pleasant teaching conditions, i.e. the avoidance of abnormally high temperatures, can be secured by a ceiling height of at least 3 m (heat insulation by an air layer) and the introduction of an insulation layer above the roof slabs, windows and louvres, the natural ventilation method will be adopted without an air-conditioning system using electricity.

(Lighting)

Under the Phase I Project, a solar system to supply electricity was installed at one site for experimental purposes. The subsequent lack of sufficient maintenance has led to the abandonment of such a system from the Phase II Project onwards. In the case of the present Phase V Project, no lighting system will be installed to avoid the cost of electricity and as many windows as feasible will be introduced for the maximum use of natural light.

(7) Concept Regarding Design Grade of Facilities

The following design grades of the facilities are adopted for the planned shelters (primary school buildings) based on the results of the review of Japan's Phase I through Phase IV Projects and also of the survey on similar facilities constructed with the aid of other donors.

1) Contents of Facilities

① The shelter site will be set at the minimum accomodation capacity of some 1,700 people per shelter in line with the Master Plan and the Design Standards for Primary Schools.

② Size as Primary School

・ The number of classrooms required at each site is calculated based on the number of existing students. Even if the number of students is small, a minimum of three classrooms will be constructed to ensure a minimum evacuation capacity as a cyclone shelter.

・Even if the required number of classrooms exceeds five, five classrooms will be set as the upper limit.

・The number of classrooms at each site will be three, four or five.

③ The furniture and fixtures which are generally required by a primary school will be provided.

④ Such systems as an air-conditioning system and lighting system which require electricity for their operation will not be installed.

⑤ A deep well will be drilled at each site as a water supply source and a large head pump will be installed to supply water.

⑥ Sewage will be treated at a septic tank at each site.

2) Facilities Specification Level

In regard to the building and finishing work specifications, either a reinforced concrete or brick masonry structure with a trowelled mortar finish will be adopted as the past results have proved the ease of the local procurement of the necessary materials and of the implementation of this work. The specifications for finishing adopted for shelters constructed by Japan and other donors are shown in Table 3-2-1-1 for reference purposes.

Table 3-2-1-1 Finishing Specifications of Other Donors

	Floor	Wall	Ceiling	Roof Waterproofing
Japan	Trowelled mortar finish	Trowelled mortar and paint finish	Concrete and paint finish	Lime terracing
KfW	Same as above	Same as above	Same as above	Same as above
Saudi Arabia	Same as above	Same as above	Same as above	Pad roll waterproofing
EU	Same as above	Same as above	Same as above	Lime terracing
IFAD	Same as above	Same as above	Same as above	Same as above

(8) Concept with Respect to Construction Method, Procurement and Construction Schedule

The construction schedule must be set upon giving overall consideration to the aforementioned social situation, customs, religion, construction conditions, labor conditions, materials supply situation and meteorological conditions, etc. in Bangladesh. During the rainy season, roads turn into mud tracks and make it difficult to transport goods. Moreover, since generation of mud will also interfere with earth and foundation works, etc., these works must be implemented outside of the rainy season. Moreover, work efficiency plummets during the month of Ramadan (fasting). These factors will be taken into full consideration when setting the construction schedule.

1) The start of works will be planned at the beginning of the dry season, and foundation and earth works will be completed during this period.
2) The delivery of the structural materials to the sites will be completed before the rainy season.
3) As the structural work will be conducted even during the rainy season, the schedule for this work will be given some leeway in consideration of the poor working conditions.
4) Finishing works will be implemented during the dry season.
5) Construction materials will in principal be those which can be procured locally.

Based on the above conditions, the overall construction period for the 20 sites is set at 12 months.

3-2-2 Basic Plan

(1) Site and Layout Plan

Each construction site under the Project will be located on either the premises of an existing government primary school or land which has been additionally acquired. In either case, the necessary space for the construction work under the Project will be secured and access to each site from a nearby main road will be available. In regard to the layout of the new facilities, the following points will be considered to suit the characteristics of each site.

① The layout of the new facilities will take the shape of the site, the conditions of adjacent land and the existing facilities into consideration.

② The existing facilities will be kept where ever possible and only dilapidated facilities will be removed to minimise the scale of the removal work.

③ The layout plan will be formulated to minimise the size of the additional land to be acquired.

④ Toilet bowls and urinals will be installed along the north-south axis, i.e. to avoid the east-west axis as Mecca, a holy place in Islam, is situated to the west.

⑤ As much space as possible will be secured for sporting activities.

⑥ The existing trees will be kept where ever possible.

(2) Facilities Plan

1) Cyclone Shelter Capacity

The Project facilities will be used as cyclone shelters and also as education facilities (primary schools) at normal times. Therefore, both functions should be taken into account when setting the scale of the facilities. First, concerning the method for determining scale (accommodating capacity) as cyclone shelters, the World Bank/UNDP Master Plan (approximately 1,750 people per building) will be referred to; moreover, upon giving careful consideration to the standard design criteria of primary schools as stipulated by the MOPME and the review results of the Phase I through Phase IV Projects, a three-classroom building (1,700 people capacity at times of disaster) will be considered as the minimum shelter scale. Furthermore, depending on the number of students at existing schools, the number of classrooms will be increased to either four (approx. 1,800 evacuation capacity) or five (approx. 2,080 evacuation capacity).

2) Purpose of Use at Normal Times

Almost all of the existing shelters are effectively used as primary schools during normal times. In the case of the Phave V Project, the new shelters will mainly be used as primary schools where a maintenance system is in place by the SMC. Concerning utilization of facilities for purposes other than schools, 16, 12 and 3 sites have expressed the desire to use the school facility as a community center, health facility (for polio vaccinations, etc.) and polling station respectively, the use of the new facilities for these activities is assumed. However, as the assumed functions of the shelters apart from their function as primary schools are assumed to be incidental

functions, no special consideration is given to the facility design in regard to such facilities.

3) Necessary Number of Classrooms per Site

Currently almost 99% of government primary education in Bangladesh is conducted over two shifts (1st and 2nd grades in the mornings, 3rd to 5th grades in the afternoons). The government is planning to adopt a single shift system in the future. However, the Second Primary Education Development Plan (PEDP-II), which is to be implemented over five years starting in 2003, does not contain any specific measures for implementing the single shift system. This is because the Primary Training Institute (PTI), in charge of training teachers, and the LGED, in charge of building primary schools, are unable to secure the numbers of teachers and classrooms that the single shift system will require. Therefore, it is likely that dual shift primary education will still continue at many primary schools.

Considering that the number of students at the requested sites has been static or declining in recent years and that many of the schools do not require five classrooms, the basic facility size should be three classrooms with the number of classrooms being adjusted according to the number of students at each school (50 students per classroom according to the MOPME).

Therefore, the maximum number of classrooms and number of classrooms at each site are examined as below.

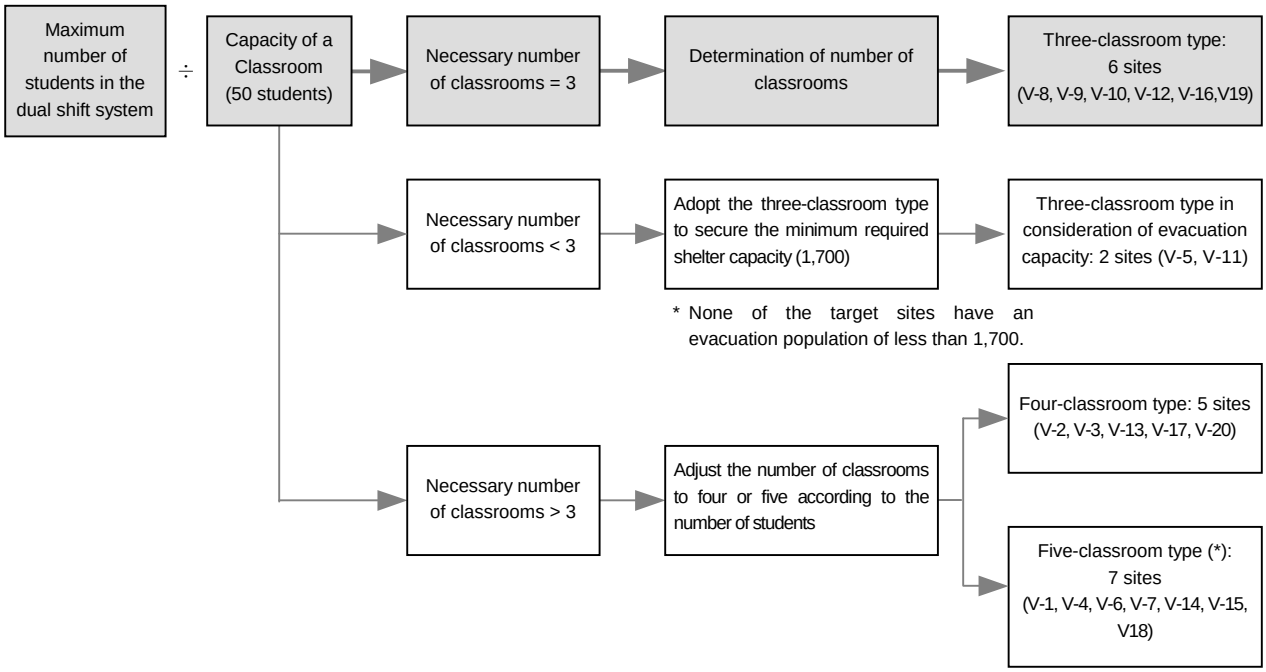
[Calculation of the Maximum Number of Classrooms per Shift]

The total number of students at each site (existing primary school) was obtained in the detailed site survey. Since lessons are carried out over two shifts at all the target schools, the number of students attending school in the first shift or the second shift which is busier, will be divided by the standard classroom capacity of 50 students to obtain the maximum number of classrooms per shift (see Table 3-2-2-1). Based on the calculation results as well as the standard number of classrooms (five) set forth by the PEDP-II, facilities can be divided into three types, i.e. the three-classroom type, the four-classroom type, and the five-classroom type. Fig. 3-2-2-1 shows the calculation flow used to obtain the above number of classrooms.

Concerning site Nos. V-1, V-4, V-6, V-7, V-14, and V-15, there will be a shortage of three, four, two, five, one and three classrooms respectively

compared to the above maximum facility size, but these shortages will be compensated by utilizing the existing classrooms.

The maximum number of classrooms at site Nos. V-5 and V-11 is two and one respectively. However, since the primary purpose of the facilities is to protect the lives of residents in the event of cyclones, each school will be constructed as the three-classroom type capable of holding at least 1,700 evacuees at times of disaster.



(*): Concerning the six sites (V-1, V-4, V-6, V-7, V-14, V-15) where the number of classrooms is still not enough, the existing classrooms will be utilized.
Incidentally, an area within a 1~1.5 km radius of the school is, in principle, prescribed as the school catchment area, but it varies according to the natural environment and whether or not the site already has an existing school.

Fig. 3-2-2-1 Flow for Determining the Number of Classrooms

- Lessons are conducted over two shifts at all 20 sites.
- The basic facility size will be the three-classroom type, which is equivalent to a minimum evacuation capacity of 1,700 during cyclones.
- The standard number of classrooms in PEDP-II is five.

  Therefore, facility size in the Project will range from the basic size of three classrooms to the maximum size of five classrooms.

Table 3-2-2-1 Classroom Type Calculation Sheet

Site No.	Total Number of Students	Number of Students Shift 1(Morning)	Number of Students Shift 2(Afternoon)	Maximum Number of Students in 2-Shift System	Number of Students per Classroom (Morning)	Number of Students per Classroom (Afternoon)	Number of Students per Classroom (Average)	Number of Existing Classrooms	Planned Number of Classrooms for Removal	Maximum Number of Classrooms per Shift	Number of Existing Teachers	Teacher Shotage vis-à-vis maximum Number of Classrooms	Planned Number of Classrooms under the Project	Number of Classrooms to Use Including Existing Ones	Classroom-Type Selected by the Project	Number of Students per Classroom after the Project (Morning)	Number of Students per Classroom after the Project (Afternoon)	Number of Students per Classroom after the Project (Average)
V-1	700	300	400	400	50.0	66.7	58.3	6	(0)	8	5	3	5	8	5	37.5	50.0	43.8
V-2	360	157	203	203	52.3	67.7	60.0	3	(0)	4	4	-	4	4	4	39.3	50.8	45.0
V-3	312	112	200	200	37.3	66.7	52.0	3	(0)	4	4	-	4	4	4	28.0	50.0	39.0
V-4	757	300	457	457	30.0	45.7	37.9	10	(5)	9	10	-	5	9	5	33.3	50.8	42.1
V-5	131	59	72	72	19.7	24.0	21.8	3	(0)	2	3	-	3 ※1	3	3	19.7	24.0	21.8
V-6	510	180	330	330	30.0	55.0	42.5	6	(0)	7	8	-	5	7	5	25.7	47.1	36.4
V-7	915	392	523	523	98.0	130.8	114.4	4	(0)	10	5	5	5	10	5	39.2	52.3	45.8
V-8	190	77	113	113	25.7	37.7	31.7	3	(0)	3	4	-	3	3	3	25.7	37.7	31.7
V-9	210	91	119	119	30.3	39.7	35.0	3	(0)	3	4	-	3	3	3	30.3	39.7	35.0
V-10	217	90	127	127	22.5	31.8	27.1	4	(0)	3	5	-	3	3	3	30.0	42.3	36.2
V-11	84	40	44	44	20.0	22.0	21.0	2	(0)	1	3	-	3 ※1	3	3	13.3	14.7	14.0
V-12	173	60	113	113	20.0	37.7	28.8	3	(0)	3	4	-	3	3	3	20.0	37.7	28.8
V-13	272	108	164	164	108.0	164.0	136.0	1	(1)	4	3	1	4	4	4	27.0	41.0	34.0
V-14	505	290	215	290	145.0	107.5	126.3	2	(0)	6	3	3	5	6	5	48.3	35.8	42.1
V-15	673	375	298	375	125.0	99.3	112.2	3	(0)	8	5	3	5	8	5	46.9	37.3	42.1
V-16	213	138	75	138	34.5	18.8	26.6	4	(0)	3	4	-	3	3	3	46.0	25.0	35.5
V-17	344	141	203	203	35.3	50.8	43.0	4	(4)	4	6	-	4	4	4	35.3	50.8	43.0
V-18	446	210	236	236	42.0	47.2	44.6	5	(0)	5	3	2	5	5	5	42.0	47.2	44.6
V-19	266	130	136	136	65.0	68.0	66.5	2	(0)	3	4	-	3	3	3	43.3	45.3	44.3
V-20	346	164	182	182	82.0	91.0	86.5	2	(2)	4	3	1	4	4	4	41.0	45.5	43.3

*1: Minimum Number of classrooms, taking the accommodation capacity as a shelter into consideration.

4) Composition of Facilities

The facilities will have dual functions, i.e. they will be used as primary schools during normal times and as shelters at the time of a cyclone. These facilities will be constructed for use as primary school buildings with suitable design features while a high floor to prevent damage by storm surge will be adopted in view of their use as cyclone shelters.

① The first floor will be open design.
② Classrooms : 3, 4 or 5 rooms
③ Teachers' room : 1 room
④ Toilets : installed separately for boys and girls.
⑤ Storeroom : 1 room
⑥ Others : deep well with a large head pump; septic tank; soak well

5) Determination of Scale

The scale of facilities will basically be determined according to the number of classrooms. However, the basis size required as a cyclone shelter (1,700 capacity per building) will be secured in all cases. The number of classrooms will be set at between three and five according to the number of students.

① School facilities

- Classrooms : Number of students per class : 50
  Occupied area per student : 0.665 m^2 (7 ft^2)
  Minimum area requirement per classroom
  : 50 students x 0.665 = 33.25 m^2
  Classroom size (based on the adopted spans)
  : 7 m x 4.8 m = 33.6 m^2

- Teachers' room : 1 room (the number of teachers is the number of classrooms plus one)
  Standard occupied area per teacher: 4.6 m^2 (50 ft^2)

- Toilets : The following number will be installed separately for boys and girls.
  According to the BNBC, two toilet outlets each are provided for boys and girls in a three-classroom school which is half the number set forth by Japanese standards.

For the Project, the number of toilet outlets will be the BNBC standards plus one.

Three classrooms : 3 outlets each for boys and girls
Four classrooms : 3 outlets each for boys and girls
Five classrooms : 4 outlets each for boys and girls

- Storeroom : As a rule, this will be used to store teaching materials at normal times.

② Cyclone shelter: unit floor area per person

Based on the relevant standard in the Master Plan and information on evacuation to the existing shelters constructed under the Phase I through Phase III Projects by JICA post-projects evaluation study, the unit floor area per person is determined in the following manner.

No major cyclones have struck since the one that occurred in 1991, but according to evacuation statistics at the time of the relatively large cyclones that occurred in 1997 and 1998, the design occupation area of shelters was filled to a maximum of 120% in the three-classroom types and a maximum of 135% in the five-classroom types.

According to the findings of the disaster prevention measures survey, detailed site surveys, and the reports of the first through the third projects, etc., the time spent at a shelter for evacuation has been shortened considerably (a few hours from evacuation) thanks to: 1) development of Cyclone Preparedness Programme (CPP) and extension of enlightenment activities, 2) improvement in the accuracy and reliability of warnings, 3) raising of social awareness, and 4) construction of access roads, etc.

In view of the above conditions, the occupied area per person was determined as follows based on the premise of achieving short-term evacuation and saving the lives of as many evacuees as possible.

Indoor: 2 ft^2 (0.185 m^2)
Rooftop: 8 ft^2 (0.743 m^2)

However, it is assumed that evacuees only carry a small amount of valuables and clothing, etc. when evacuating to the shelters. Therefore, it will be necessary to thoroughly instruct residents to store other belongings in 'killa' and so on.

6) Floor Plan

The number of classrooms has been fixed at three, four or five according to the existing number of students and minimum required scale of cyclone shelters.

So far, the area per classroom has been set at 37.8 m^2 based on the unit floor area per students of 8 ft^2 (÷ 0.74 m^2) arrived through reference to data collected by the Study for the Phase I Project and the same figure was inherited up to the fourth plan. For the Project, the floor plan will be 33.25 m^2 in line with the new MOPME design standards.

Moreover, when deciding the floor plan, consideration will be given to reducing structural stress and cutting costs by adopting a uniform span along the long side.

In order to effectively locate the building at each site, a compact central corridor type configuration will be adopted together with the locationing of the staircase at the halfway point of the building to ensure a smooth line of flow.

Verandas will be used as rest areas during lesson intervals and also as a space for the installation of the well pump.

Toilets and water supply facilities will be installed on the first floor in preparation for high waves at the time of a cyclone.

The ground floor will remain an open space so that it can be used for multiple purposes. The basic design drawings show the outline of the planned layout.

① Floor area

Tables 3-2-2-2 shows the floor area of each type of facility planned according to the above criteria.

Table 3-2-2-2 Floor Area (m^2)

Building Type	Ground Floor (open space)	First Floor	Roof	Total Floor Area	No. of Building	Building Type-Wise Total Floor Area
3-classroom type	264.6	269.68	32.38	556.66	8	4,533.28
4-classroom type	275.1	297.68	32.38	605.16	5	3,025.80
5-classroom type	319.2	341.78	32.38	693.36	7	4,853.52
Total					20	12,412.60

② Capacity at times of cyclone

Criteria for calculating the capacity of facilities during cyclones are as follows:

- Occupied area per person indoors: 0.185 m^2 (2 ft^2)
- Occupied area per person on roof: 0.743 m^2 (8 ft^2)
- Incorporate 50% for stair areas
- Exclude toilets
- Exclude 50 cm on corridors and in front of toilets as passage width

Table 3-2-2-3 shows the results of calculation according to the above:

Table 3-2-2-3 Capacity at Times of Cyclone

Building Type	Indoor	Roof	Total
3-classroom type	1,273	426	1,703
4-classroom type	1,435	358	1,793
5-classroom type	1,663	418	2,081

7) Section (Height) Plan

① Building height

Floor height on the first floor will be high enough to deal with storm surge during cyclones. Storm surge height is calculated by the formula indicated in section 3-2-1-(2)-3) (tide level) and the calculation results are shown in Table

3-2-2-4 which also shows the tide level and the finalised first floor height at each site. However, in cases where tide level is lower than the necessary height required by the building (around 3.3 m), it will be assumed to be 3.3 m to ensure easy use of facilities. The floor height of the first floor will be set around 0.7 m which is 10 cm higher than the maximum flood level of 0.6 m (clarified by the site survey).

Table 3-2-2-4 Tide Level and Building Height

Site No.	h_{50} (m)	X (km)	K (m/m)	h_{50}-1 (X-1) K(m)	h_w (m)	H_1 (m)	Ground Height (m)	Hs (m)	H (m)	h_1 (m)
V-1	5.8	3.5	0.5	4.55	1.14	5.69	1.15	4.54	5.0	4.3
V-2	6.5	1.2	0.5	6.40	1.60	8.00	5.14	2.86	4.0	3.3
V-3	6.5	0.5	0.5	6.50	1.63	8.13	5.13	3.00	4.0	3.3
V-4	6.5	0.7	0.5	6.50	1.63	8.13	5.82	2.31	4.0	3.3
V-5	6.5	4.0	0.33	5.51	1.38	6.89	3.71	3.18	4.0	3.3
V-6	6.5	4.7	0.33	5.28	1.32	6.60	2.76	3.84	4.0	3.3
V-7	6.5	3.8	0.33	5.28	1.39	6.97	3.73	3.24	4.0	3.3
V-8	6.5	2.5	0.5	5.75	1.44	7.19	4.07	3.12	4.0	3.3
V-9	6.5	4.4	0.5	4.80	1.20	6.00	3.55	2.45	4.0	3.3
V-10	6.5	4.7	0.5	4.65	1.16	5.81	4.19	1.62	4.0	3.3
V-11	6.5	4.4	0.5	4.80	1.20	6.00	3.62	2.38	4.0	3.3
V-12	6.5	5.0	0.5	4.50	1.13	5.63	4.25	1.38	4.0	3.3
V-13	6.5	2.8	0.5	5.60	1.40	7.00	3.85	3.15	4.0	3.3
V-14	5.8	5.5	0.5	3.55	0.89	4.44	2.37	2.07	4.0	3.3
V-15	5.8	2.1	0.5	5.25	1.31	6.56	2.05	4.51	5.0	4.3
V-16	5.8	4.5	0.5	4.05	1.01	5.06	1.77	3.29	4.0	3.3
V-17	5.8	2.9	0.5	4.85	1.21	6.06	4.31	1.75	4.0	3.3
V-18	5.8	1.1	0.5	5.75	1.44	7.19	2.91	4.28	5.0	4.3
V-19	6.5	2.7	0.33	5.94	1.48	7.42	1.66	5.75	6.5	5.8
V-20	6.5	1.1	0.33	6.47	1.62	8.09	1.95	6.14	6.5	5.8

Hs = Tide level height from the ground on site (m)
H = First floor height from the ground on site (m)
h1 = Height from ground floor to first floor (m)

② Larger steps on stairs

In the Phase I through Phase IV projects, the length of steps was set at 25 cm (as is also the case at shelters constructed by almost all other donors). For the Phase V Project, as staircases are considered to be spaces to accommodate evacuees at the time of a cyclone, the length will be lengthened to approximately 27 cm for extra safety and in response to the local request.

③ Removal of roof overhangs

In the first through fourth projects, roof overhangs also serving as window eaves were adopted for all classroom types. In the fourth project, since there was a gap between the roof overhang and top of the windows and rainwater was blowing into the building in some cases, eaves were directly attached above the windows. In the Project, however, since it is thought that window eaves can prevent incoming rainwater, roof overhangs can be removed. Moreover, upon giving due consideration to cost cutting, roof overhangs will not be included in the design of facilities.

As an exception, however, in order to secure sheltering capacity (minimum 1,700 people) as a cyclone shelter in the case of three-classroom type facilities, the conventional building design will be adopted.

8) Structural Design

① Structural Design Standards

Strength and durability are the most important features of the main structure of an evacuation facility. A reinforced concrete structure has been adopted as the main structure for the existing cyclone shelters constructed under Japan's Phase I through Phase IV Projects and by other donors.

Table 3-2-2-5 compares the structural design standards for the Project (Phase V Project) with those for the Phase IV Project. In the case of the latest project, the increased design strength of the concrete and reinforcing bars means an increased mixing ratio of the cement and a higher unit cost of the reinforcing bars. However, the resulting decline of the volume of the structure will enable an overall cost reduction.

Table 3-2-2-5 Structural Design Standards for the Phase V Project

Item	Phase V Project	Phase IV Project	Remarks
Floor Load	Long-term: 300 kgf/m^2 Short-term: 480 kgf/m^2	480 kgf/m^2	Efforts will be made to reduce the overall structural load by effectively employing the school operation load as the long-term load and the total weight of the design number of evacuees at the time of a cyclone as the short-term load.
Wind Load (Mean Wind Velocity)	72 m/sec	72 m/sec	No change
Seismic Coefficient	0.12	0.15	A lower coefficient authorised by the BNBC is adopted in reference to the mitigating conditions.
Compressive Strength of Concrete	24 N/mm^2	21 N/mm^2	The increased strength of the concrete will increase the strength of the joints and the shear strength of the members, in turn enabling a reduction of the number of shear reinforcing bars as well as the reinforcing strength on the compression sides.
Tensile Strength of Reinforcing Bars	Thin bars: 295 N/mm^2 Thick bars: 390 N/mm^2	Thin bars: 295 N/mm^2 Thick bars: 345 N/mm^2	The use of reinforcing bars with high tensile strength will enable a reduction of the number of bars used, reducing the total amount of bars and improving the workability.

② Foundation Plan

Examination of the suitable type of foundations at each site based on the principles described in 3-2-1-(2)-4) has produced the following results.

7 sites : spread foundations
11 sites : pile foundations (end-bearing piles)
2 sites : pile foundations (friction piles)

Spread foundations are further divided into two types, i.e. isolated foundations and floating foundations. In the case of isolated foundations, it is necessary to broaden the width of the embedded footings to resist uneven subsidence. In the case of floating foundations, the foundation width tends to be wide to obtain the necessary bearing capacity. Floating foundations will be employed for the Project in view of better economy.

In the case of pile foundations, the piles used in Bangladesh for this purpose are almost exclusively cast-in-place concrete piles of either 500 mm or 600 mm in diameter. 600 mm piles will be used for the Project to reduce the number of piles in view of a shorter construction period and cost reduction. Cast-in-place piling work can avoid adverse impacts on the surrounding area due to vibration and noise as it does not involve pile driving.

Table 3-2-2-6 Details of Foundation Work

Site No.	Type of Foundations	Supporting Ground		Estimated Subsidence for Spread Foundations (cm)	Shape of Piles	
		Soil	N Value		Pile Length (m)	Pile Diameter (mm)
V-1	Pile	Fine/medium sand	21	-	9	600
V-2	Pile	Fine/medium sand to silt	21	-	12	600
V-3	Pile	Fine/medium sand	22	-	11	600
V-4	Pile	Silt	20	-	11	600
V-5	Spread (Floating)	Silt	10	6.0	-	-
V-6	Spread (Floating)	Silt	8	6.1	-	-
V-7	Spread (Floating)	Silt	9	7.6	-	-
V-8	Pile	Fine/medium sand to silt	22	-	11	600
V-9	Spread (Floating)	Clay	6	5.7	-	-
V-10	Spread (Floating)	Clay	7	7.0	-	-
V11	Spread (Floating)	Silt	7	7.0	-	-
V-12	Spread (Floating)	Clay	6	7.3	-	-
V-13	Pile	Fine/medium sand to silt	24	-	16	600
V-14	Pile	Fine/medium sand	32	-	7	600
V-15	Pile	Silty fine/medium sand	25	-	11	600
V-16	Pile	Fine/medium sand	20	-	17	600
V-17	Pile	Fine/medium sand	30	-	5	600
V-18	Pile	Silty fine/medium sand	30	-	15	600
V-19	Pile (Friction)	None	-	-	29	600
V-20	Pile (Friction)	None	-	-	29	600

③ Bar Arrangement for Slabs

In the Phase I through Phase IV Projects, the reinforcing bars for the slabs were arranged in two layers, i.e. at the upper end and the lower end, because of the emphasis on work efficiency. For the Phase V Project, however, the standard bar arrangement in the structural plan will be adhered to and no bars will be arranged at the upper end of the central slab section.

④ Uniformatisation of Column Span

In the Phase I through Phase IV Projects, the column span (distance between the columns) was necessarily uniform. Compared to an uneven span, uniformatisation of the column span reduces the stress, making it more economical. For this reason, the floor plan for the Project adopts a uniform column span.

9) Building Materials Plan (finishing, furnishings)

With a view to realising cheap and easy maintenance of facilities in the future, priority will be given to finishing materials that can be easily procured locally. Also, general school specifications will be planned.

① Exterior

- Roof waterproofing

Lime terracing concrete is commonly used for roof waterproofing in Bangladesh. Combining waterproof performance with good heat insulation, this method was used in the first to fourth projects. However, since there are some sites where the lime terracing concrete is peeling off due to lack of precision in application and so on, brick chip concrete will be employed in the Project as a better alternative. It is judged that the selection of brick chip concrete is suitable because of its good performance in terms of (i) waterproofing and shortening of the water drainage time through the introduction of a sufficient gradient and (ii) the heat insulation effect of the brick chips used as aggregates. Table 3-2-2-7 shows a comparison of specifications between lime terracing concrete and brick chip concrete.

Table 3-2-2-7 Comparison of Waterproofing Materials

Method / Item	Lime Terracing Concrete	Brick Chip Concrete
Waterproof performance	A common method that provides waterproof performance	Adequate waterproofing can be secured by raising the finishing precision and imparting gradient.
Expansion joints	Unnecessary because expansion and contraction are minor	Expansion joints are necessary.
Heat insulation	Yes	Almost the same
Surface finishing	Cement paste is prone to cracking and peeling.	Surface finish is hard and not subject to peeling.
Workability	Specialists are needed.	Specialists are not needed.
Works preiod	The works period is long and dictated by the weather.	The works period is short.
Works cost	Expensive	Cheap

・ Exterior walls

Wall specifications are shown in Table 3-2-2-8.

Table 3-2-2-8 Exterior Finishing

Section	Finish
Exterior wall	Trowelled mortar and paint finish
Pillars, beams	Fair-faced concrete and paint finish
Window frames	Paint finish

② Interior

General school specifications will be adopted for interiors. Specifications are shown in Table 3-2-2-9.

Table 3-2-2-9 Interior Finishing

Section	Substrate	Finishing Material
Floors	Trowelled mortar finish	-
Walls	Trowelled mortar finish	Paint finish
Ceilings	Fair-faced concrete finish	Paint finish

10) Furniture and Fixtures

School furniture and fixtures will be provided. Table 3-2-2-10 gives a list of the selected furniture and fixtures.

Table 3-2-2-10 Furniture and Fixtures (per classroom/teachers' room)

Room	Furniture/Fixtures	Specifications	Quantity
Classroom	Student desk and chair	Steel, 3 students per set	17 sets
	Teacher's desk and chair	Steel, for one teacher	1 set
	Blackboard (2400mm x 1200mm)	Steel	1 board
Teachers' room	Teacher's desk and chair	Steel, for one teacher	1 set
	Blackboard (2400mm x 900mm)	Steel	1 board

(3) Equipment Plan

1) Water Supply Plan

As no public water supply facilities are available at any of the sites, local residents generally rely on groundwater from wells to meet their daily water needs. For the same reason, the existing shelters receive water from a shallow or deep well. According to the water supply facility installation standards of the DPHE for coastal areas, wells with a depth of 250 ft or more are classified as deep wells. As it is believed that water from shallow aquifers contains salt, most of the existing shelters use a deep well.

[Water Quality Survey]

As water supply facilities will be required to supply safe and clean water for preimary school teachers and students during normal times and for evacuees at the time of a cyclone, water quality analysis was conducted in the Study Area as described in 2-2-2-4 (4). The results indicate that there is a high likelihood of the arsenic contamination of groundwater in Miresharai Upazila and Patiya Upazila. These areas are also marked on the arsenic contamination map compiled by the DPHE/BGS/DFID (2000).

[Arsenic Countermeasures]

As indicated above, at sites located in areas where there is a strong possibility of arsenic contamination, it was decided to select the necessary water supply facilities upon investigating from the dual viewpoints of 1) alternative water sources and 2) arsenic removal equipment.

① Alternative water sources

- Water supply by pond sand filter

This method, which is adopted in inland areas around the border with India and so on, is advantageous in that it offers water cleansing capacity and can be built using local materials. However, since the Project sites are located in the HRA at high risk from high waves whipped up by cyclones (once pond water has been infiltrated by salt water, it can no longer be used by a pond sand filter), and maintenance is difficult, adoption of this approach is considered difficult in the Project.

A survey on the pond conditions at the project sites towards the end of the dry season found that most of the ponds are either depleted or dirty due to the scanty water volume as shown in Table 3-2-2-11, making the use of ponds as water supply sources for pond sand filtering inappropriate.

Table 3-2-2-11 Pond Conditions at the Project Sites (20 Sites)

Site No.	Pond Size (m)	State of Water		
		Hardly None	Drinking is possible if a filter is used	Undrinkable
V-1	24.0 × 16.0	√		
V-2	16.0 × 12.0	√		
V-3	24.68 × 22.55			√
V-4	43.8 × 21.5			√
V-5	31.0 × 25.0			√
V-6	110.0 × 80.0		√	
V-7	No pond at the site			
V-8	36.0 × 28.0			√
V-9	36.0 × 24.0			√
V-10	34.0 × 28.0			√
V-11	34.0 × 22.0			√
V-12	36.0 × 28.0			√
V-13	30.0 × 22.0			√
V-14	No pond at the site			
V-15	No pond at the site			
V-16	24.0×18.0			√
V-17	24.0 × 16.0 30.0 × 20.0			√
V-18	No pond at the site			
V-19	No pond at the site			
V-20	50.0-40.0 × 30.0			√

- Water supply from rainwater collection

  This approach relies on collected rainwater for use as drinking water. As the water supply source is rainwater in the rainy season (June to September), the stored rainwater only lasts for approximately three months after the rainy season, making water supply throughout the year practically impossible. From the Phase III Project onwards, a rainwater tank was installed above the staircase of the shelter to channel rainwater to the toilets on the first floor. It has been found that algae tends to appear inside the tank. For this reason, the use of this water for drinking purposes is judged to be inappropriate.

② Arsenic removal device

In addition to the survey on alternative water sources, a comparative survey on arsenic removal devices was conducted for comparison and the results are shown in Table 3-2-2-12.

There are four principal arsenic removal methods: ① simple filtration method (Sono 3-Ko), ② coagulation and filtration method (Stevens and Danida Bucket Unit), ③ oxidation, sedimentation and filtration method (Alcan Active Alumina and BUET Active Alumina) and ④ absorption method (Tetra Head, Pal Trock and Read-F). Based on the assessment of these devices in terms of their performance, treatment quantity and maintenance, Read-F is singled out as the most suitable device at present because of its highest removal performance, adequate treatment quantity and easy maintenance.

Table 3-2-2-12　Comparison of Arsenic Removal Devices

No.	Name	Outline of Technology	Performance	Treatment Quantity※1	Method of Use/Maintenance	Maintenance Level	Assessment
1	Sono 3-Ko	Adsorption and filtration by iron fillings + rough sand, charcoal + fine sand	○ (16)	× (domestic use) 5	Inject into the upper container; clean the upper sieve, cloth and nozzle every 5 days; replace sand at appropriate intervals	×	×
2	Stevens	Coagulation (add iron chloride), filtration	○ (19)	× (domestic use) 18	Chemical addition, stirring for 1 minute, filtration,/remove sand and wash with washing agent every 5 batches (100 liters); collect and remove sludge.	×	×
3	Alcan Active Alumina	Sedimentation, filtration, activated alumina adsorption	○ (10)	○ 300	Inject from above/backwash every 5 days	△	△
4	BUET Active Alumina	Oxidation (chemical), sedimentation, filtration, activated alumina adsorption	○ (8)	× (domestic use) 4	Add chemicals, filtration after leaving still for 1 hour, adsorption, daily washing of cloth and upper container	×	×
5	Danida Bucket Unit	Oxidation (aluminum sulfate + potassium permanganate), coagulation, filtration	× (136)	× (domestic use) 17	Add chemicals, 30 seconds stirring, leave for 2 hours, dispose of sludge in the upper container and wash it	×	×
6	Tetra Head	Ion exchange resin via chlorine	× (84)	○ 85	Pour water through the chemical table/backwash every day	×	×
7	Pal Trock	Adsorption by iron hydroxide	○ (12)	× (domestic use) 10~30	Inject from above/backwash every 5 days	△	△
8	Read-F	Filtration and adsorption by cerium hydroxide	○ (4)	○ 160	Inject from above/remove and wash sand at appropriate intervals, replace resin every 1 years	○	○

※1 The figures in brackets indicate the arsenic concentration (ppb) after treatment
Note: Arsenic standard in Bangladesh: 0.05 ppm = 50 ppb

Although the primary requirement for the planned water supply facilities under the Project is the simplest possible structure to ensure few breakdowns and easy maintenance, an arsenic removal device will be introduced for the reason explained above. While Read-F currently appears to be the best device, the final decision will be made at the time of the

detailed design by obtaining and anlysing the latest information and data at the time.

[Drinking Water]

In the absence of a public water supply system in the vicinity of each site, groundwater from a well will be used to meet the daily water need at all of the sites. Water for drinking will rely on groundwater at all of the project sites because of the absence of any suitable alternative source of water supply.

A Tara hand pump will be used at all of the sites in view of its popular use in Bangladesh and ease of parts replacement. As this pump will be located on the first floor to avoid damage due to a storm surge caused by a cyclone, a large pump head type Tara pump will be employed.

The contamination of shallow groundwater by salt water and arsenic is in progress in the HRA because of the excessive pumping of groundwater and other reasons. This situation makes it essential to rely on deep groundwater which offers a better chance of supplying clean and safe water with less contamination. The required well drilling depth is approximately 300 m.

At the time of the detailed design, however, test drilling will be conducted at nine sites (Site Nos. V2 – 4, V8 – 13) in Patiya Upazila and Miresharai Upazila where there is a high potential of arsenic contamination. At those sites for which the test drilling results suggest that the current arsenic level exceeds the relevant water quality standard for drinking water in Bangladesh or that there is a likelihood that the said standard will be exceeded in the future, an arsenic removal device will be installed.

If the water quality analysis results for any of the nine sites in question justify the non-use of an arsenic removal device, any surplus device will be installed at another site out of the remaining 11 sites where arsenic exceeding the relevant standard is detected. If the number of surplus arsenic removal devices is insufficient to cover all of the sites requiring such a device, additional devices will be procured and installed at the expense of the Bangladesh side.

[Toilet Flushing Water]

There is usually a sufficient volume of groundwater for the purpose of flushing toilets. At the time of a cyclone, however, some 1,700 – 2,000 evacuees cram

into a shelter, making it essential to secure more water from sources other than the deep well. It is fortunate that cyclones can be expected to bring much rain and, therefore, a rainwater tank will be installed on the rooftop and the stored water will be used for the flushing of toilets. Such a tank was first introduced under the Phase III Project and its effectiveness has been verified together with a positive assessment by evacuees. In the case of a water supply system equipped with an arsenic removal device, the water supply volume is limited. Moreover, the absence of water in the tank during the dry season may cause a water shortage for the toilet facilities. To compensate for this water shortage, the use of pond water for the toilets is also planned.

The planned water supply system to provide drinking water and flushing water at each site is shown in Table 3-2-2-13.

Table 3-2-2-13 Water Supply System at Each Site

Area	Site No.	Water Supply System				
		Drinking water		Toilet water, etc.		
		Deep-well	Well fitted with arsenic removal device	Deep-well	Rainwater tank	Pond
A	V-1	○	-	○	○	-
B	V-2	-	○	-	○	○
	V-3	-	○	-	○	○
	V-4	-	○	-	○	○
A	V-5	○	-	○	○	-
	V-6	○	-	○	○	-
	V-7	○	-	○	○	-
B	V-8	-	○	-	○	○
	V-9	-	○	-	○	○
	V-10	-	○	-	○	○
	V-11	-	○	-	○	○
	V-12	-	○	-	○	○
	V-13	-	○	-	○	○
A	V-14	○	-	○	○	-
	V-15	○	-	○	○	-
	V-16	○	-	○	○	-
	V-17	○	-	○	○	-
	V-18	○	-	○	○	-
	V-19	○	-	○	○	-
	V-20	○	-	○	○	-

[Legend] A : Areas with low arsenic contamination
B : Areas with high arsenic contamination

(4) Drainage Plan

1) Drainage Situation Around the Sites

There are no public water drainage facilities around the planned sites as in the case of a water supply system. Miscellaneous everyday waste water is either discharged to a nearby pond/ditch or treated through a soak well. Even though a septic tank is installed at public facilities, including schools, sewage from ordinary households is simply infiltrated into the ground without treatment.

2) Drainage Situation at Existing Shelters

A septic tank is installed at all of the shelters constructed with the assistance of Japan (Phase I through Phase IV Projects) or other donors to treat sewage and the treated water is infiltrated into the ground through a soak well.

3) Drainage Plan for the Project

① Sewage

As the infiltration of untreated sewage into the ground can contaminate groundwater and soil, a septic tank will be installed at all of the sites as in the case of the existing shelters to avoid any adverse impacts on the surrounding environment. The treated water will then be infiltrated into the ground through a soak well on the premises. The location of this soak well should be at a distance of at least 10 m from the well to avoid contamination of the well.

② Miscellaneous Waste Water

Given the absence of any public drainage facilities at present, miscellaneous waste water will also be infiltrated into the ground through a soak well as in the case of treated sewage.

Table 3-2-2-14 outlines the water supply and drainage plan for the Project.

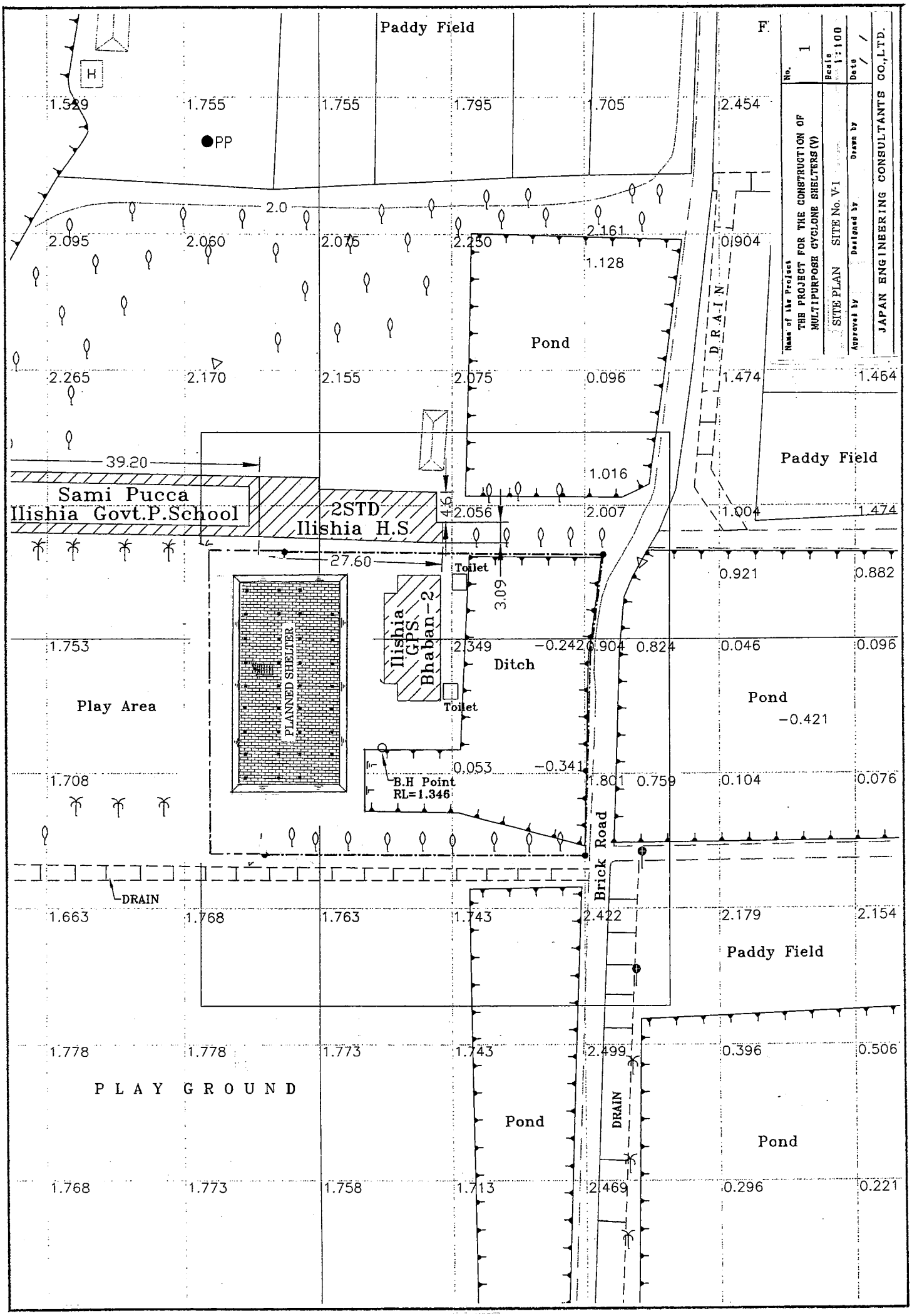
Table 3-2-2-14 Equipment Plan (per site)

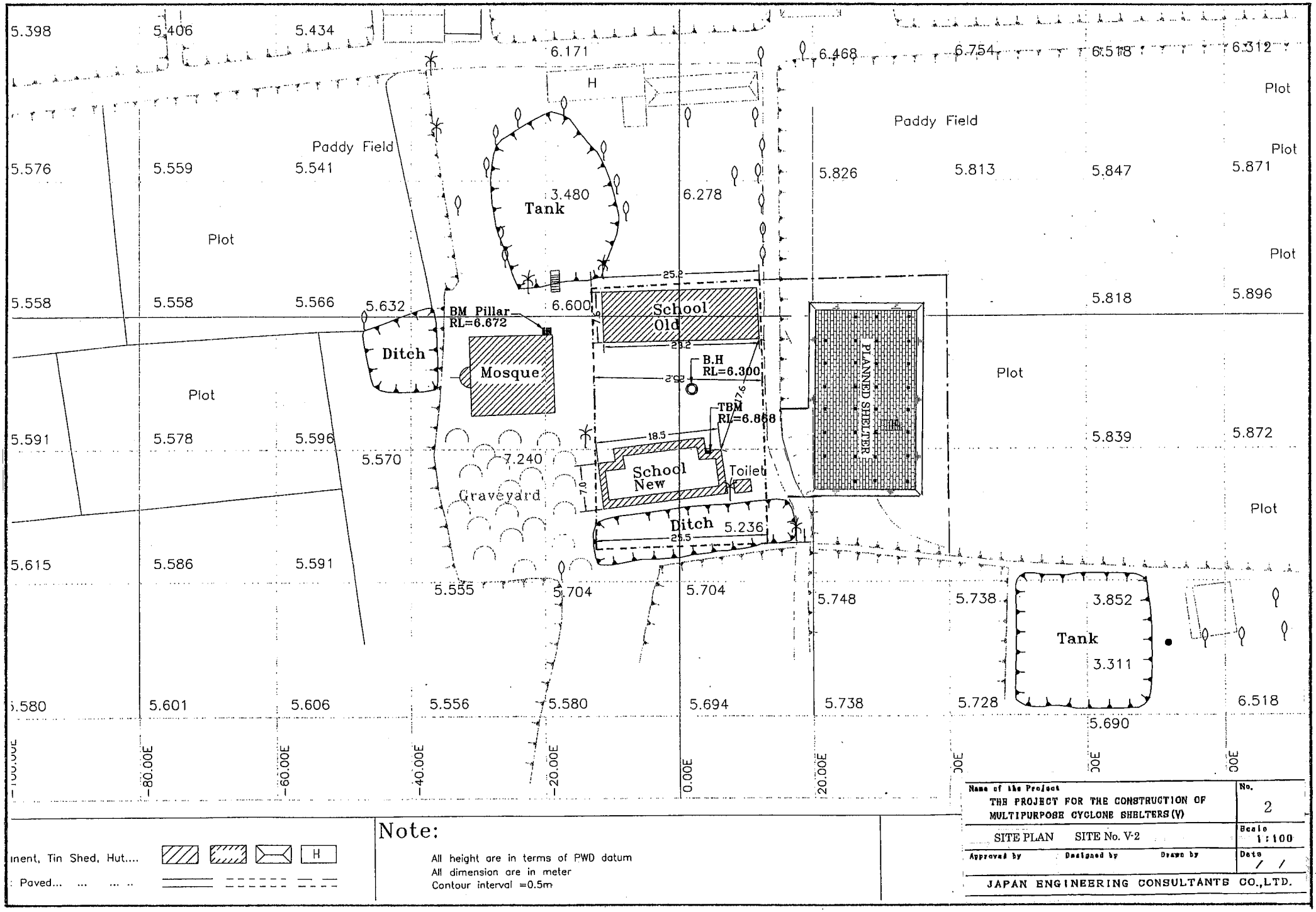
	Specifications	Remarks
Well	Depth 300 m, Drilling Diameter 150mm, Gravel Packing & Sealing	
Hand pump	Tara pump II, head 35 m	DPHE specifications
Arsenic removal device	Resin adsorption, treatment capacity 160 l/h	
Septic tank	Brick structure	5740mm×2000mm×2925mm
Soak well	Brick structure, round	D=1.5m

3-2-3 Basic Design Drawings

Basic design drawings in the Project consist of the following:

Drawings No.	Title
1	SITE PLAN (Site No. V-1)
2	SITE PLAN (Site No. V-2)
3	SITE PLAN (Site No. V-3)
4	SITE PLAN (Site No. V-4)
5	SITE PLAN (Site No. V-5)
6	SITE PLAN (Site No. V-6)
7	SITE PLAN (Site No. V-7)
8	SITE PLAN (Site No. V-8)
9	SITE PLAN (Site No. V-9)
10	SITE PLAN (Site No. V-10)
11	SITE PLAN (Site No. V-11)
12	SITE PLAN (Site No. V-12)
13	SITE PLAN (Site No. V-13)
14	SITE PLAN (Site No. V-14)
15	SITE PLAN (Site No. V-15)
16	SITE PLAN (Site No. V-16)
17	SITE PLAN (Site No. V-17)
18	SITE PLAN (Site No. V-18)
19	SITE PLAN (Site No. V-19)
20	SITE PLAN (Site No. V-20)
21	GROUND FLOOR PLAN-1 (3-CLASSROOM TYPE)
22	FIRST FLOOR PLAN-1 (3-CLASSROOM TYPE)
23	ROOF FLOOR PLAN-1 (3-CLASSROOM TYPE)
24	ELEVATION (3-CLASSROOM TYPE)
25	GROUND FLOOR PLAN-1 (4-CLASSROOM TYPE)
26	FIRST FLOOR PLAN-1 (4-CLASSROOM TYPE)
27	ROOF FLOOR PLAN-1 (4-CLASSROOM TYPE)
28	ELEVATION (4-CLASSROOM TYPE)
29	GROUND FLOOR PLAN-1 (5-CLASSROOM TYPE)
30	FIRST FLOOR PLAN-1 (5-CLASSROOM TYPE)
31	ROOF FLOOR PLAN-1 (5-CLASSROOM TYPE)
32	ELEVATION (5-CLASSROOM TYPE)
33	SECTION (COMMON TO EACH CLASSROOM TYPE)
34	SECTION OF HAND PUMP AND DEEP WELL

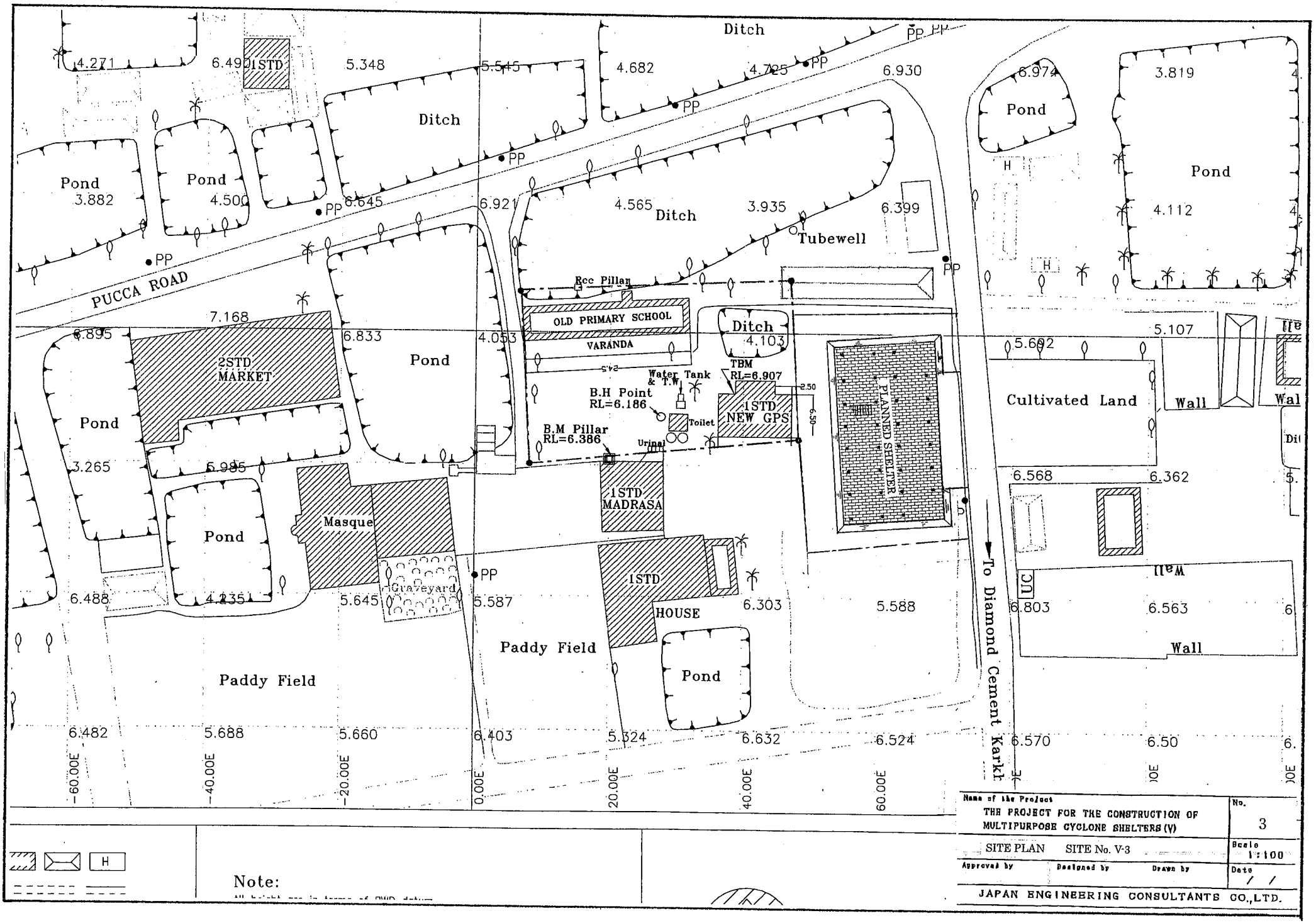

Paddy Field
H
PP
1.529
1.755
1.755
1.795
1.705
2.454
2.0
2.095
2.060
2.075
2.250
2.161
0.904
1.128
Pond
D R A I N
2.265
2.170
2.155
2.075
0.096
1.474
1.464
Paddy Field
39.20
1.016
Sami Pucca
Ilishia Govt.P.School
2STD
Ilishia H.S
4.6
2.056
2.007
1.004
1.474
27.60
Toilet
3.09
0.921
0.882
PLANNED SHELTER
Ilishia GPS Bhaban-2
1.753
2.349
-0.242
0.904
0.824
0.046
0.096
Ditch
Play Area
Pond
-0.421
Toilet
0.053
-0.341
1.708
B.H Point
RL=1.346
1.801
0.759
0.104
0.076
Brick Road
DRAIN
1.663
1.768
1.763
1.743
2.422
2.179
2.154
Paddy Field
1.778
1.778
1.773
1.743
2.499
0.396
0.506
P L A Y G R O U N D
Pond
DRAIN
Pond
1.768
1.773
1.758
1.713
2.469
0.296
0.221
No. 1
Scale 1:100
Date
Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (V)
SITE PLAN
SITE No. V-1
Approved by
Designed by
Drawn by
JAPAN ENGINEERING CONSULTANTS CO.,LTD.

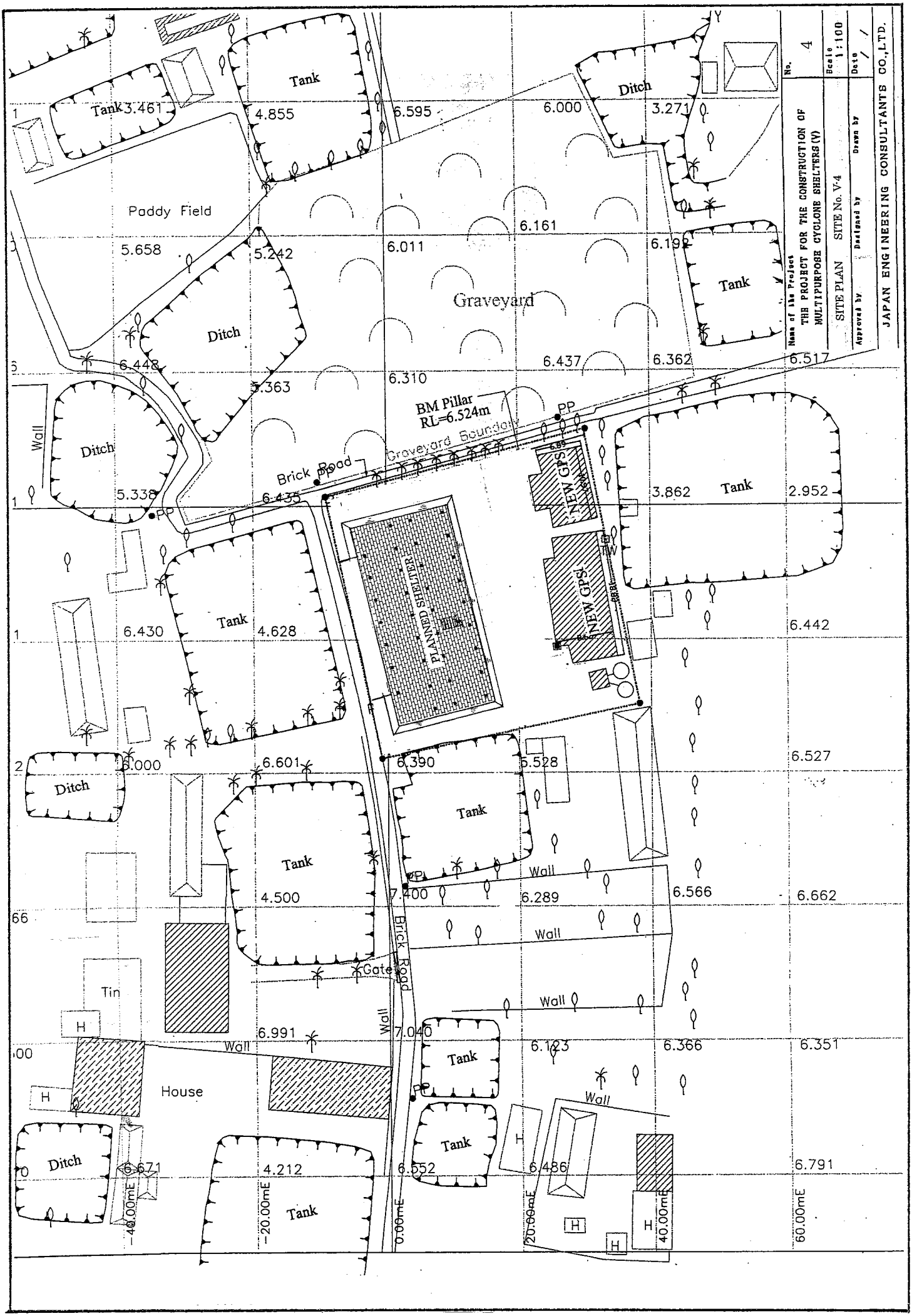


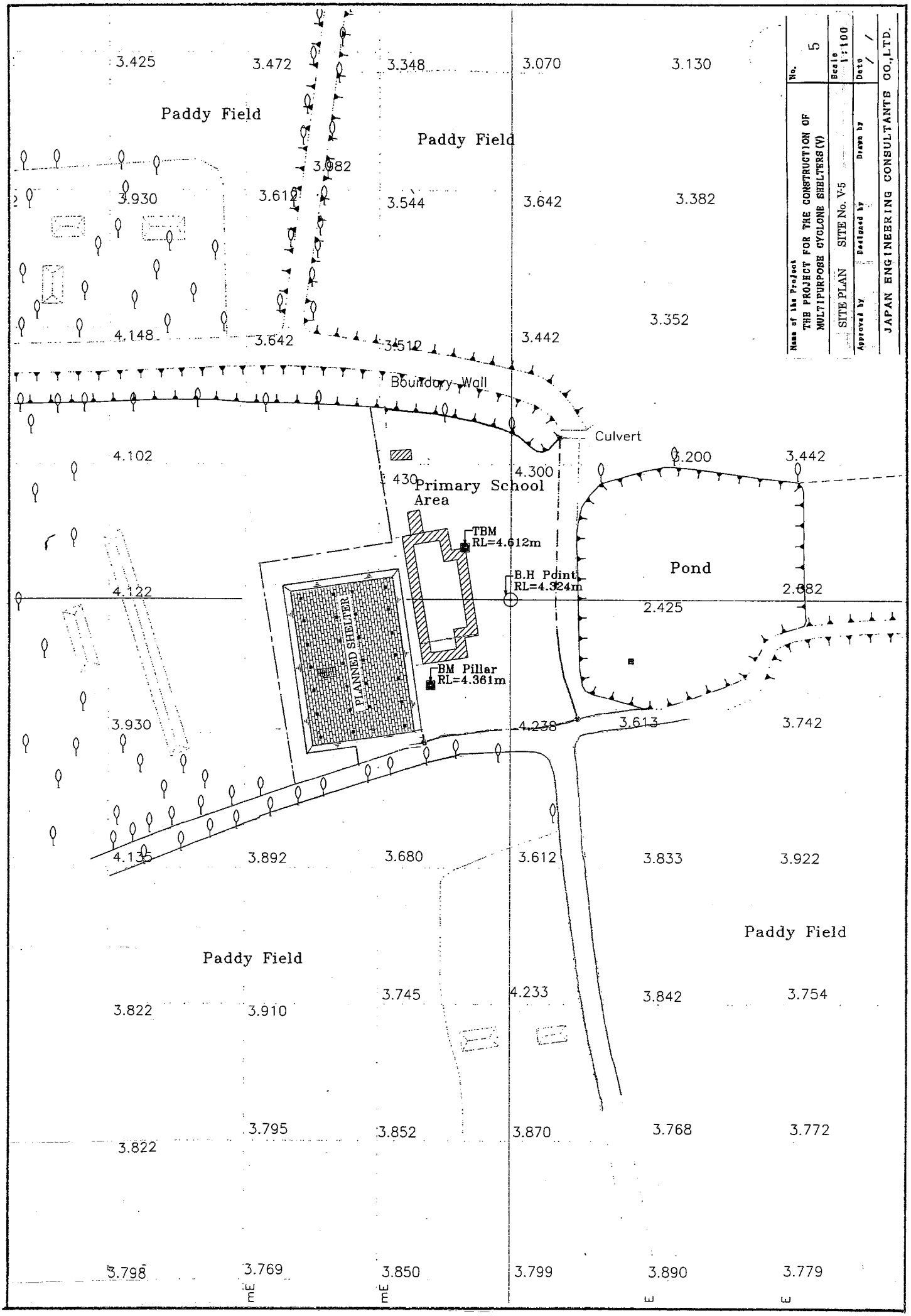
Note:

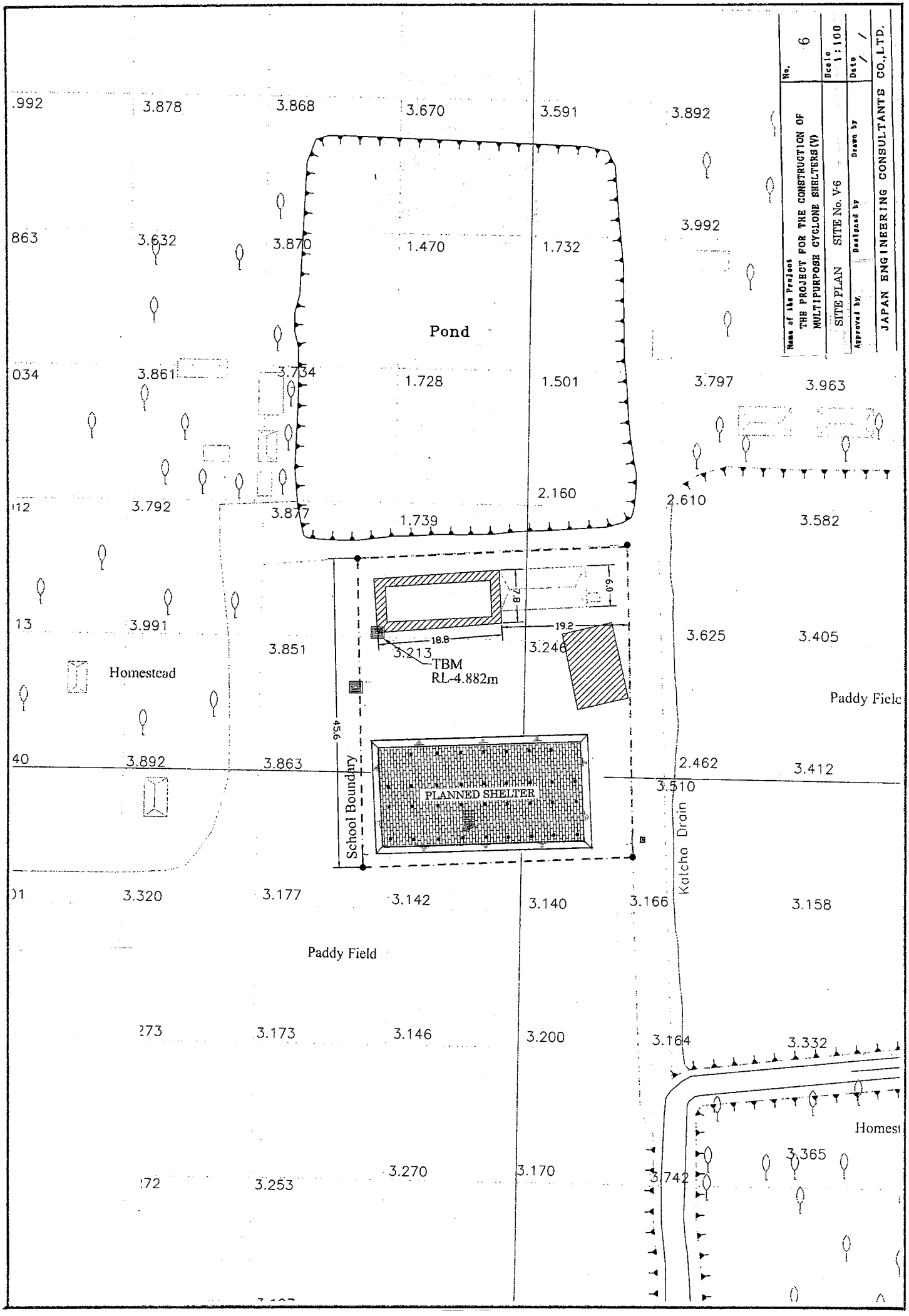
All height are in terms of PWD datum
All dimension are in meter
Contour interval =0.5m

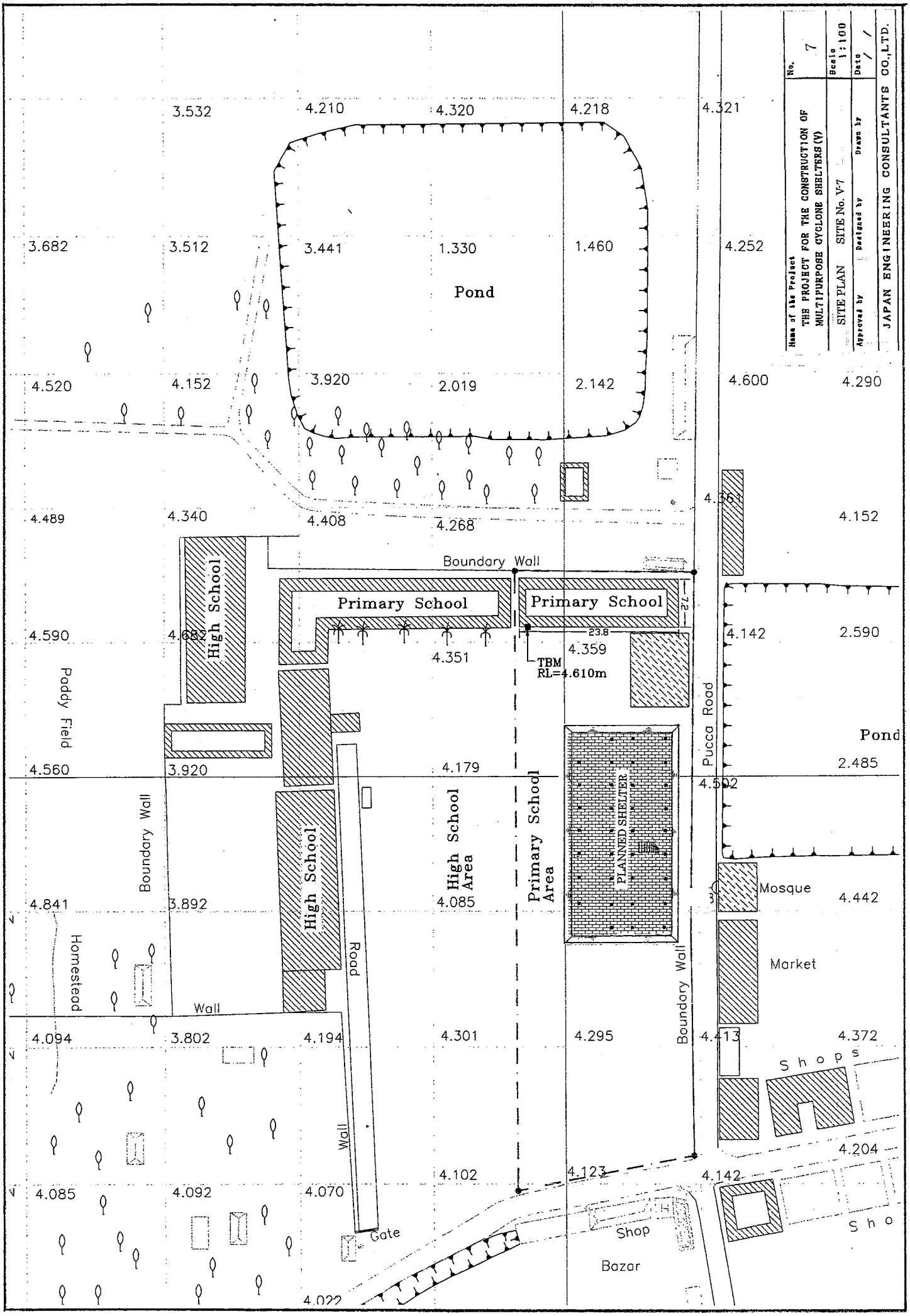
Name of the Project: THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (V)	No. 2
SITE PLAN SITE No. V-2	Scale 1:100
Approved by / Designed by / Drawn by	Date / /
JAPAN ENGINEERING CONSULTANTS CO.,LTD.	

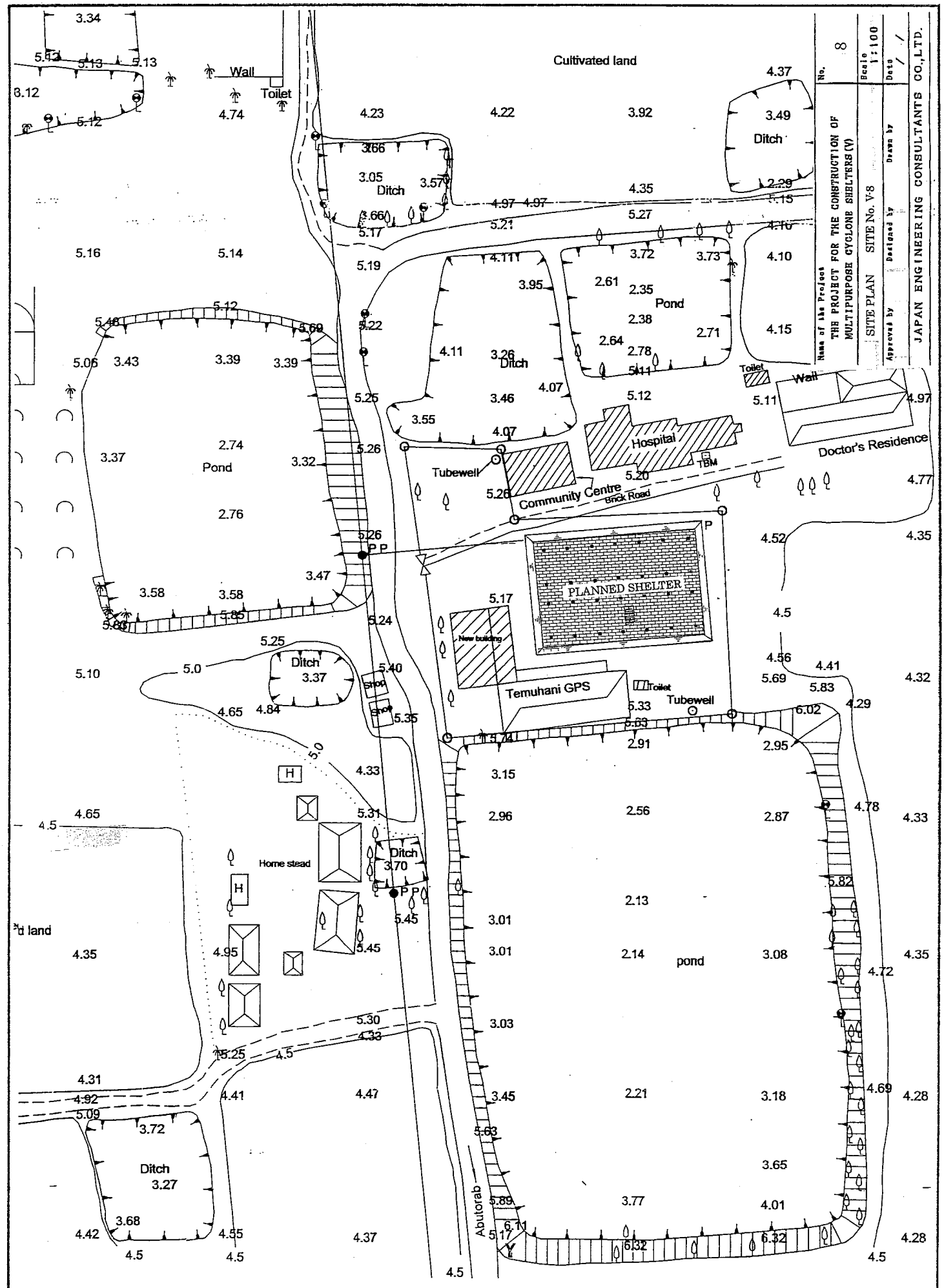

Ditch
4.271
6.490
1STD
5.348
5.545
4.682
4.725
6.930
6.974
3.819
Pond
Pond
3.882
Pond
4.500
6.645
6.921
4.565
Ditch
3.935
6.399
Tubewell
4.112
PUCCA ROAD
Rcc Pillar
OLD PRIMARY SCHOOL
VARANDA
7.168
6.895
6.833
4.053
Ditch
4.103
5.107
5.602
2STD
MARKET
Pond
Water Tank
& T.W
TBM
RL=6.907
B.H Point
RL=6.186
1STD
NEW GPS
PLANNED SHELTER
Cultivated Land
Wall
Pond
B.M Pillar
RL=6.386
Toilet
Urinal
3.265
5.985
6.568
6.362
1STD
MADRASA
Masque
Pond
Graveyard
1STD
HOUSE
6.303
5.588
6.488
4.235
5.645
5.587
6.803
6.563
Wall
Paddy Field
Paddy Field
Pond
6.482
5.688
5.660
6.403
5.324
6.632
6.524
6.570
6.50
To Diamond Cement Karki
-60.00E
-40.00E
-20.00E
0.00E
20.00E
40.00E
60.00E
Note:
Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (V)
No.
3
SITE PLAN SITE No. V-3
Scale
1:100
Approved by
Designed by
Drawn by
Date
JAPAN ENGINEERING CONSULTANTS CO.,LTD.

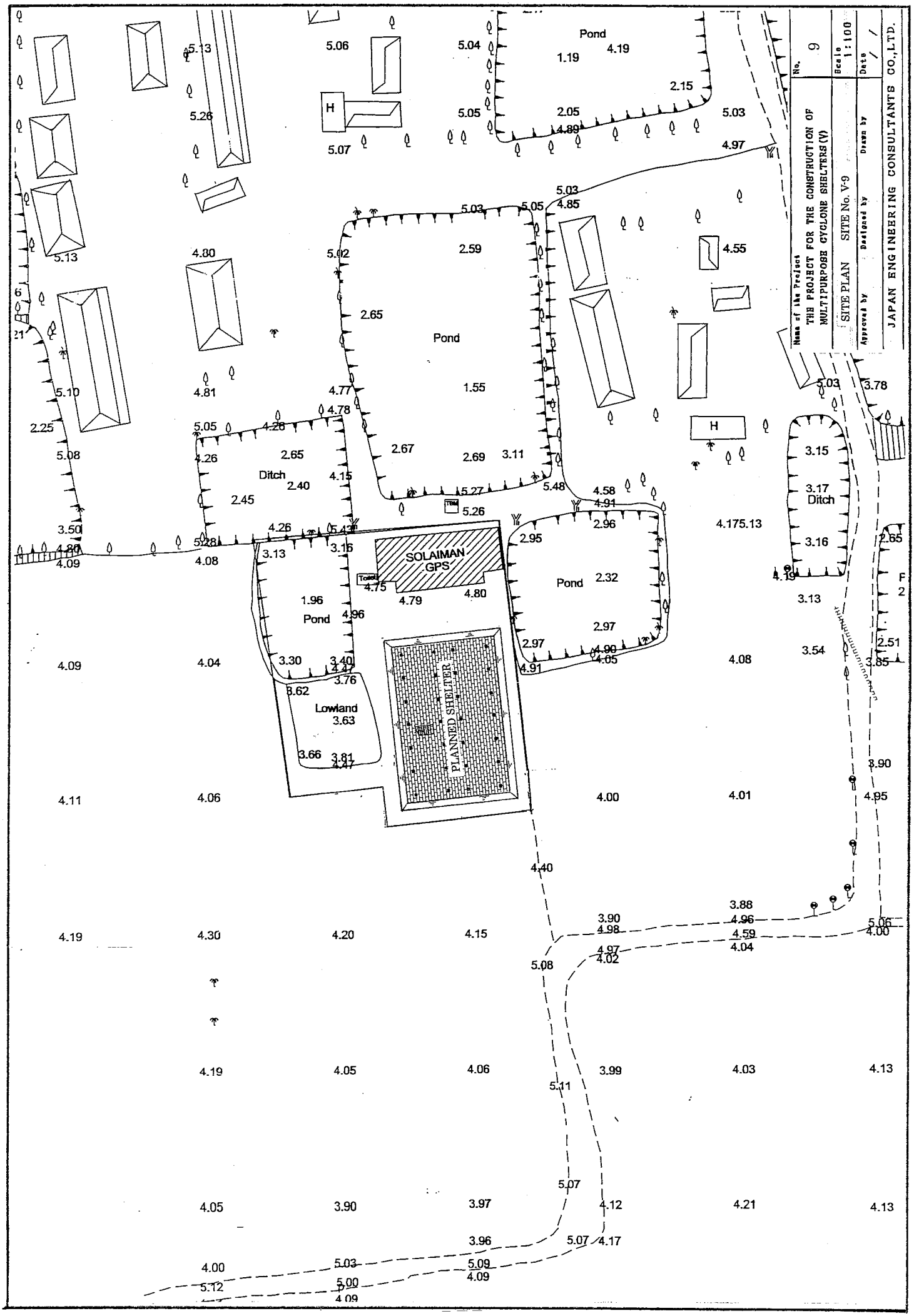

Tank
Tank 3.461
4.855
6.595
6.000
Ditch
3.271
Paddy Field
6.161
5.658
5.242
6.011
6.198
Tank
Graveyard
Ditch
6.448
6.437
6.362
6.517
5.363
6.310
BM Pillar
RL=6.524m
PP
Graveyard Boundary
Wall
Ditch
Brick Road
5.338
6.435
NEW GPS
3.862
Tank
2.952
PP
PLANNED SHELTER
NEW GPS
6.442
Tank
4.628
6.430
6.000
6.601
6.390
5.528
6.527
Ditch
Tank
Tank
4.500
7.400
6.289
6.566
6.662
Wall
Wall
Brick Road
Gate
Tin
Wall
H
6.991
7.040
6.123
6.366
6.351
Wall
House
H
Tank
Wall
Ditch
6.671
4.212
6.552
6.486
6.791
Tank
40.00mE
20.00mE
0.00mE
20.00mE
40.00mE
60.00mE
H
H
H
No. 4
Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (V)
SITE PLAN SITE No. V-4
Scale 1:100
Date / /
Drawn by
Designed by
Approved by
JAPAN ENGINEERING CONSULTANTS CO.,LTD.

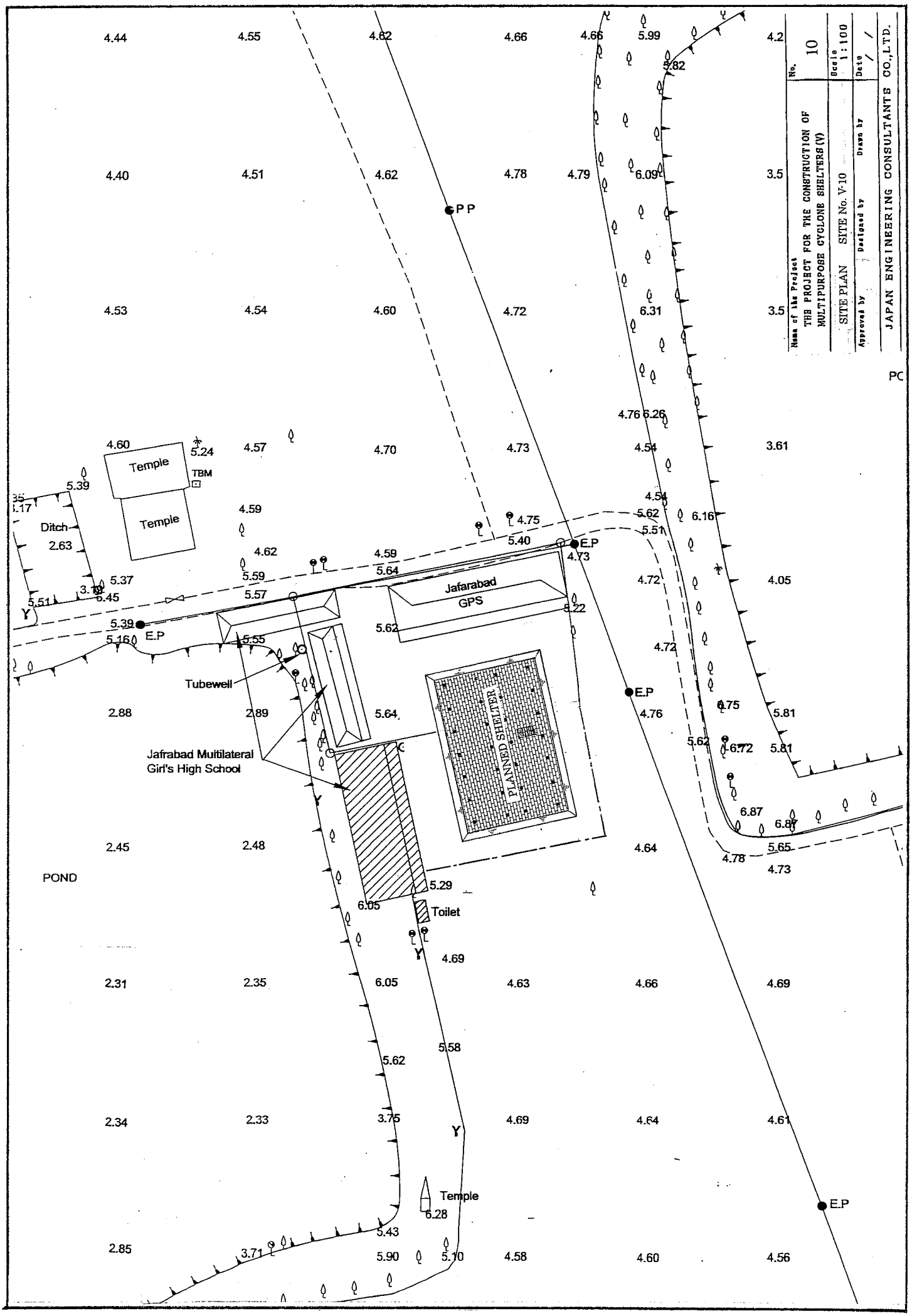

Paddy Field
Paddy Field
Boundary Wall
Culvert
Primary School Area
TBM
RL=4.612m
B.H Point
RL=4.324m
BM Piller
RL=4.361m
PLANNED SHELTER
Pond
Paddy Field
Paddy Field
Paddy Field
3.425
3.472
3.348
3.070
3.130
3.930
3.610
3.544
3.642
3.382
4.148
3.642
3.512
3.442
3.352
4.102
4.300
3.200
3.442
4.122
2.425
2.682
3.930
4.238
3.613
3.742
4.135
3.892
3.680
3.612
3.833
3.922
3.822
3.910
3.745
4.233
3.842
3.754
3.822
3.795
3.852
3.870
3.768
3.772
3.798
3.769
3.850
3.799
3.890
3.779
No. 5
Scale 1:100
Date /
Name of the Project THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS(V)
SITE PLAN SITE No. V-5
Designed by
Drawn by
Approved by
JAPAN ENGINEERING CONSULTANTS CO.,LTD.

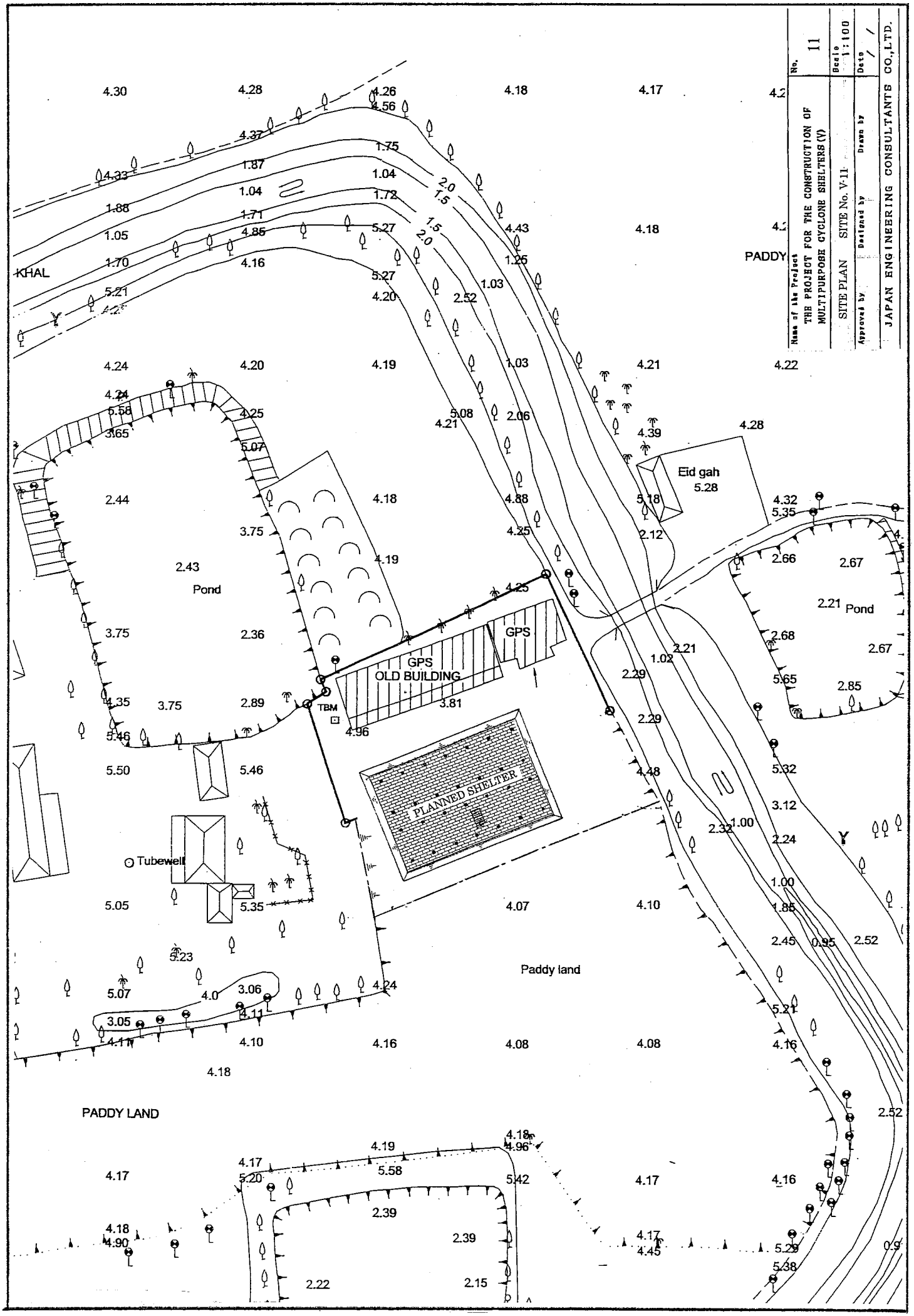

Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS(V)
SITE PLAN
SITE No. V-6
Approved by
Designed by
Drawn by
Date
Scale 1:100
No. 6
JAPAN ENGINEERING CONSULTANTS CO.,LTD.
Pond
Homestead
Paddy Field
PLANNED SHELTER
School Boundary
Katcha Drain
TBM
RL-4.882m
18.8
19.2
8.7
6.0
45.6
.992
3.878
3.868
3.670
3.591
3.892
863
3.632
3.870
1.470
1.732
3.992
034
3.861
3.734
1.728
1.501
3.797
3.963
12
3.792
3.877
1.739
2.160
2.610
3.582
13
3.991
3.851
3.213
3.246
3.625
3.405
40
3.892
3.863
2.462
3.412
3.510
01
3.320
3.177
3.142
3.140
3.166
3.158
273
3.173
3.146
3.200
3.164
3.332
72
3.253
3.270
3.170
3.742
3.365

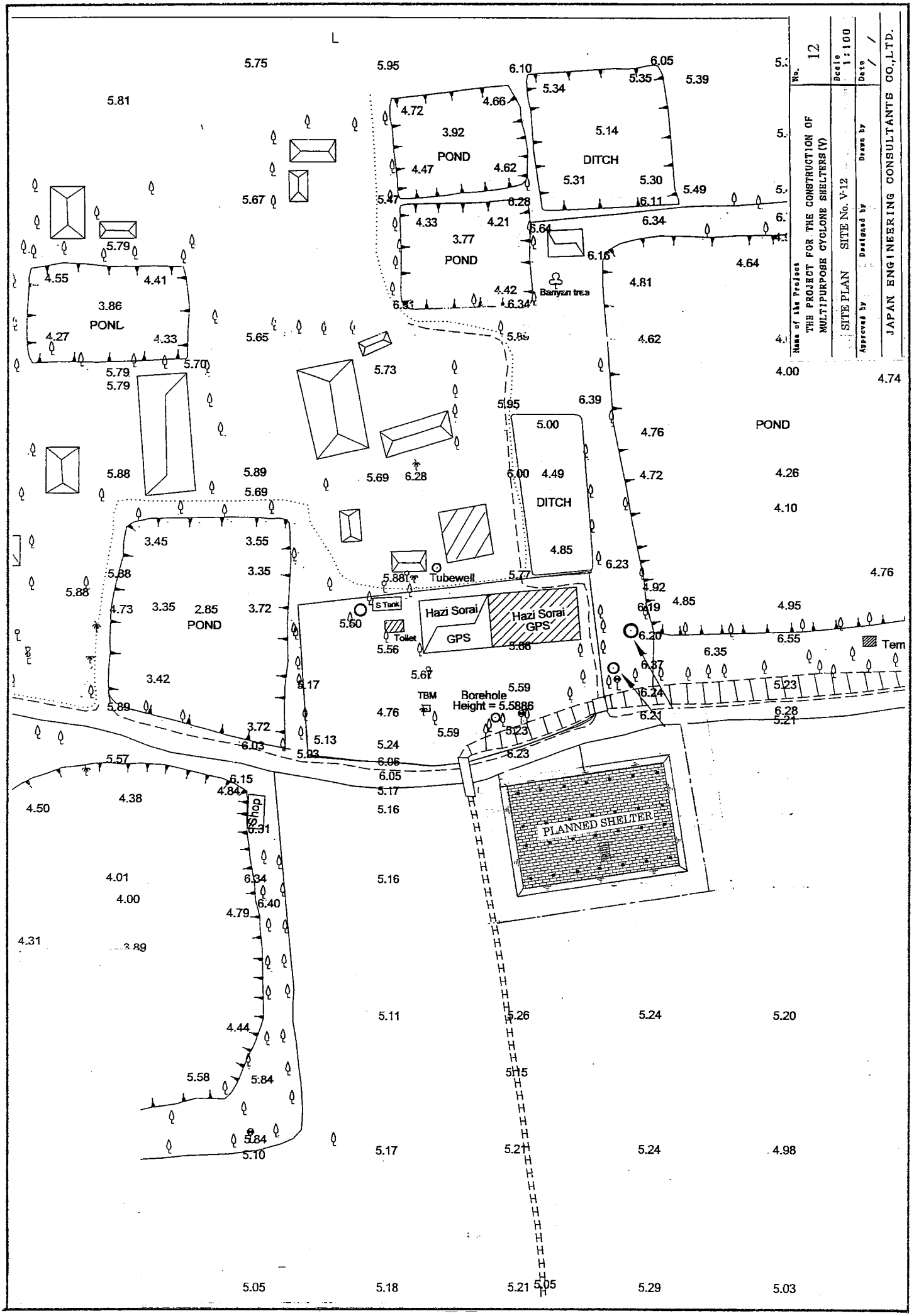

Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS(V)
No. 7
Scale 1:100
SITE PLAN SITE No. V-7
Approval by
Designed by
Drawn by
Date
JAPAN ENGINEERING CONSULTANTS CO.,LTD.
Pond
Primary School
Primary School
High School
Boundary Wall
TBM
RL=4.610m
Paddy Field
Pucca Road
Pond
Boundary Wall
High School
High School Area
Primary School Area
PLANNED SHELTER
Mosque
Market
Homestead
Wall
Road
Wall
Boundary Wall
Shops
Gate
Shop
Bazar

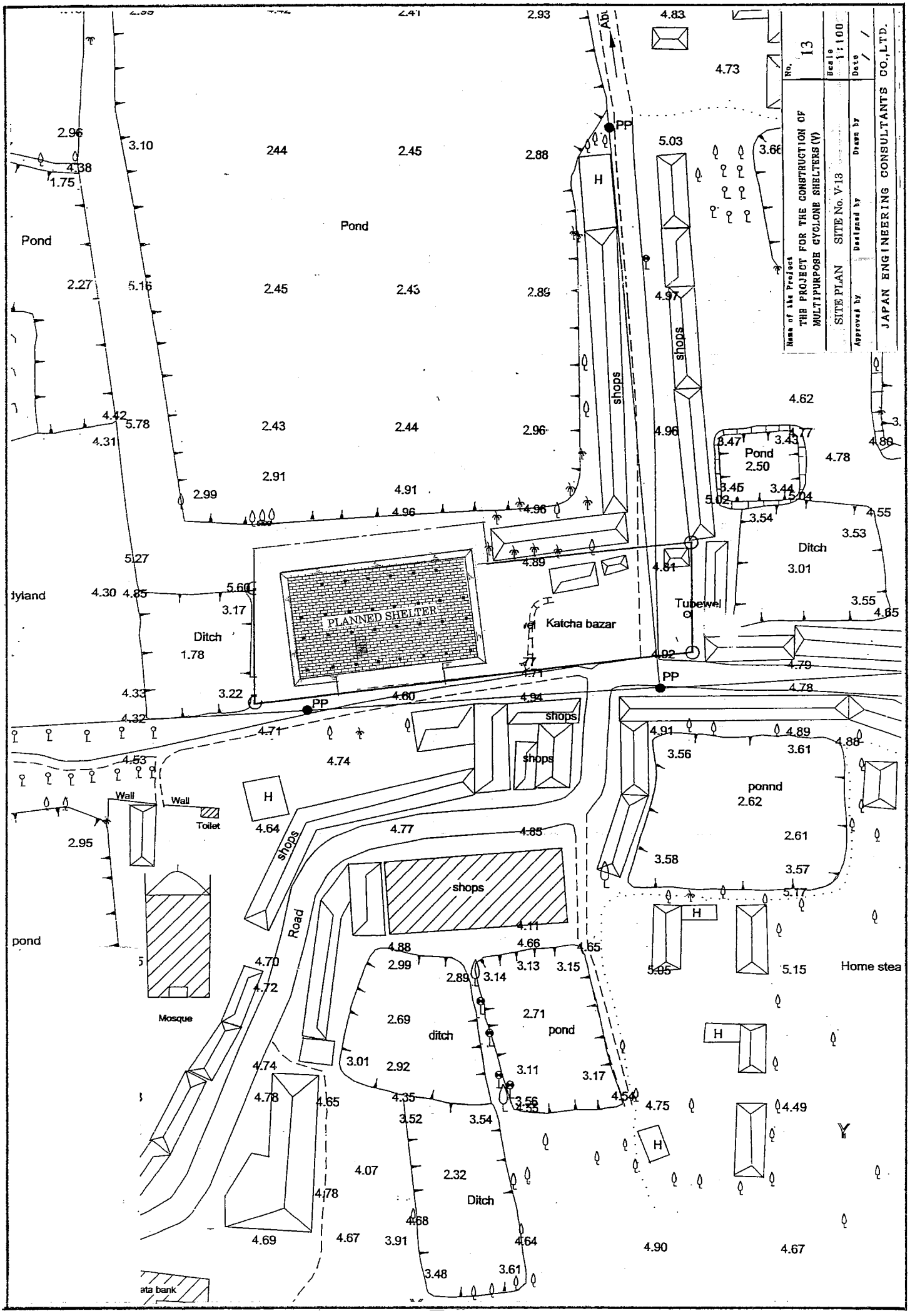

Cultivated land
Wall
Toilet
Ditch
Pond
Hospital
TBM
Doctor's Residence
Community Centre
Brick Road
Tubewell
PLANNED SHELTER
New building
Temuhani GPS
Toilet
Shop
Shop
Home stead
Abutorab
pond
Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (V)
SITE PLAN
SITE No. V-8
Scale 1:100
No. 8
Designed by
Drawn by
Approved by
Date
JAPAN ENGINEERING CONSULTANTS CO.,LTD.

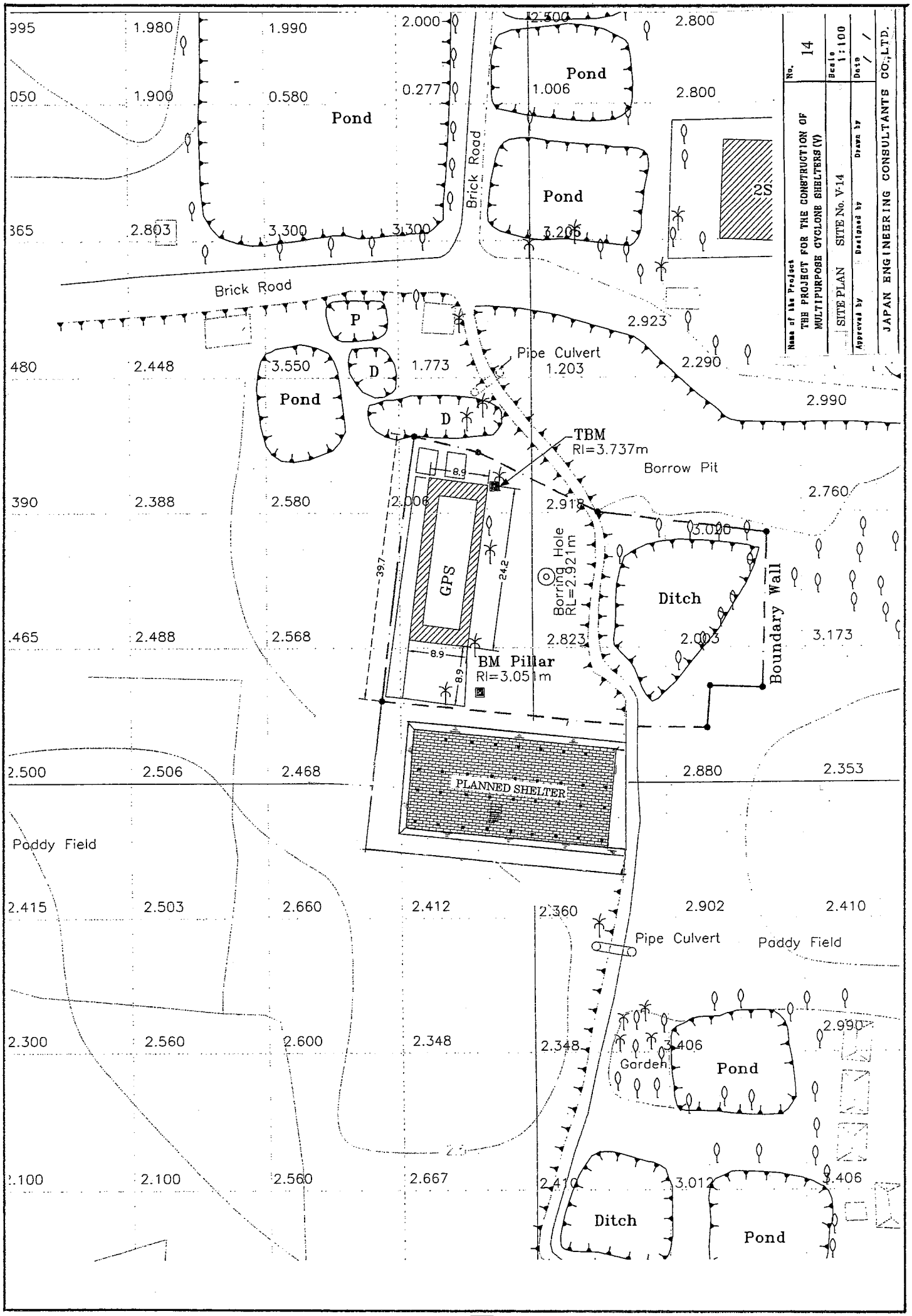

Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (V)
SITE PLAN SITE No. V-9
Scale 1:100
No. 9
Date
Designed by
Drawn by
Approved by
JAPAN ENGINEERING CONSULTANTS CO.,LTD.
Pond
Ditch
Lowland
SOLAIMAN GPS
PLANNED SHELTER
Toilet
TBM
H

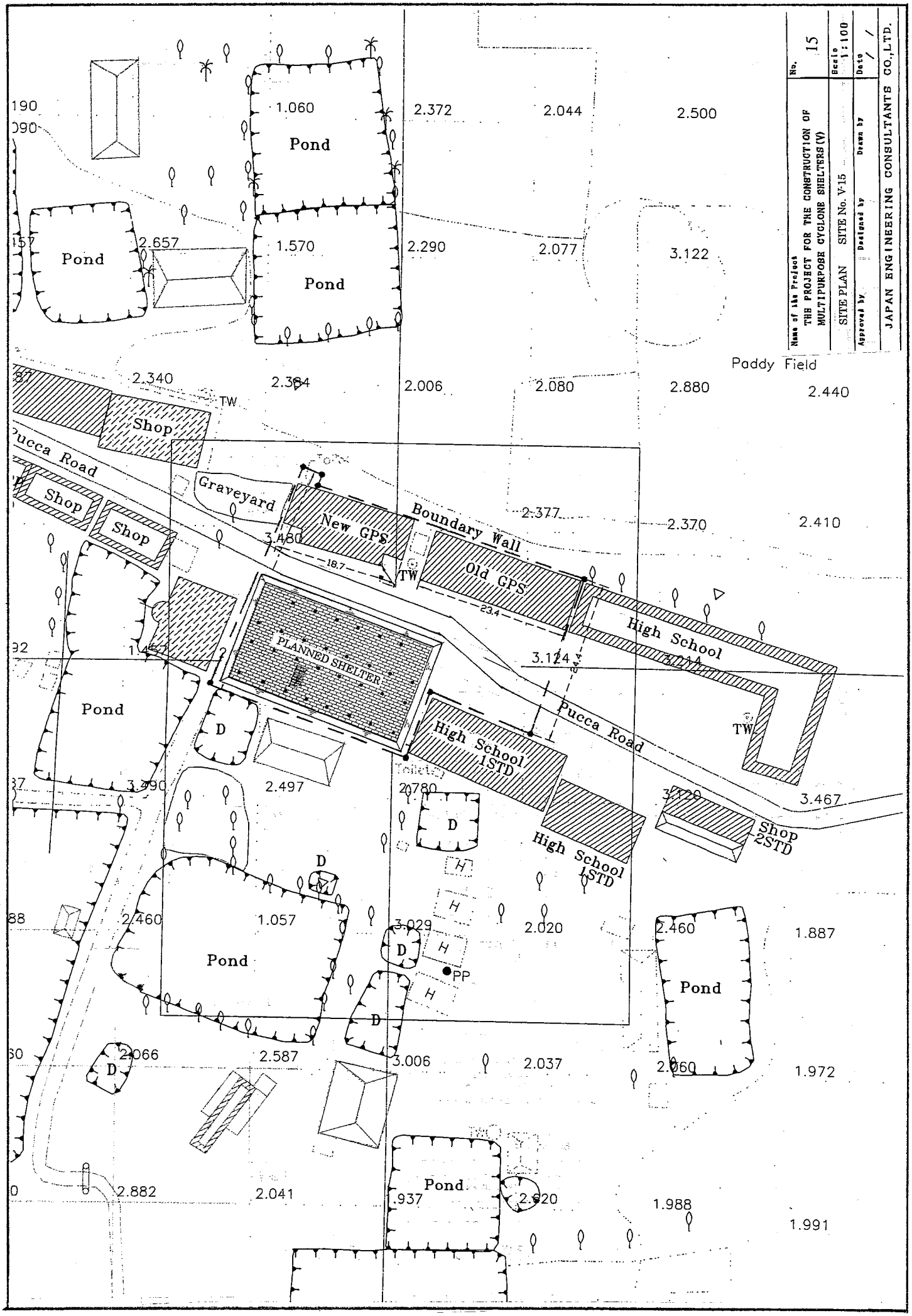

Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (V)
No. 10
SITE PLAN SITE No. V-10
Scale 1:100
Approved by
Designed by
Drawn by
Date
JAPAN ENGINEERING CONSULTANTS CO.,LTD.
Temple
TBM
Temple
Ditch
Jafarabad GPS
E.P
Tubewell
Jafrabad Multilateral Girl's High School
PLANNED SHELTER
Toilet
POND
Temple
PC

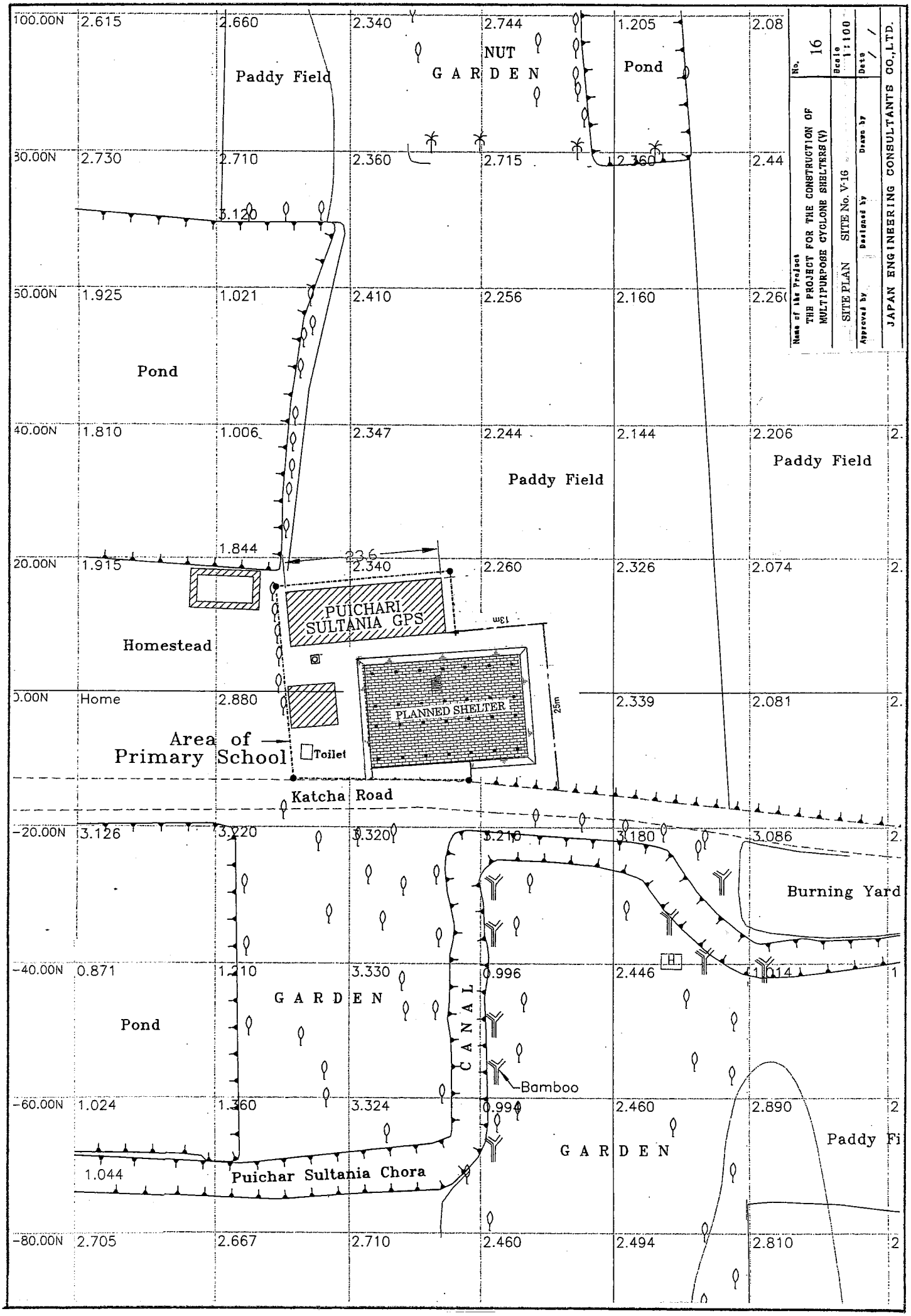

No. 11
Scale 1:100
Date /
Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (V)
SITE PLAN SITE No. V-11
Approved by
Designed by
Drawn by
JAPAN ENGINEERING CONSULTANTS CO.,LTD.
KHAL
PADDY
Eid gah
5.28
Pond
2.43
Pond
2.21
GPS
GPS
OLD BUILDING
TBM
4.96
PLANNED SHELTER
Tubewell
Paddy land
PADDY LAND
4.30
4.28
4.26
4.56
4.37
4.33
1.75
1.87
1.04
1.04
1.72
1.88
1.71
1.05
4.85
5.27
1.70
4.16
5.27
5.21
4.20
2.52
1.03
4.24
4.20
4.19
1.03
4.21
4.22
4.24
5.58
4.25
3.65
5.07
5.08
2.06
4.21
4.39
4.28
2.44
4.18
4.88
5.18
4.32
5.35
3.75
4.25
2.12
4.19
2.66
2.67
4.25
3.75
2.36
2.68
2.67
2.21
1.02
2.29
5.65
2.85
4.35
3.75
2.89
3.81
5.46
2.29
5.50
5.46
4.48
5.32
3.12
2.32
1.00
2.24
5.05
5.35
4.07
4.10
1.00
1.85
2.45
0.95
2.52
3.23
5.07
4.0
3.06
4.24
3.05
4.11
4.11
4.10
4.16
4.08
4.08
4.16
4.18
5.21
2.52
4.18
4.96
4.19
4.17
5.20
5.58
5.42
4.17
4.16
4.17
2.39
4.18
4.90
2.39
4.17
4.45
5.29
5.38
0.9
2.22
2.15

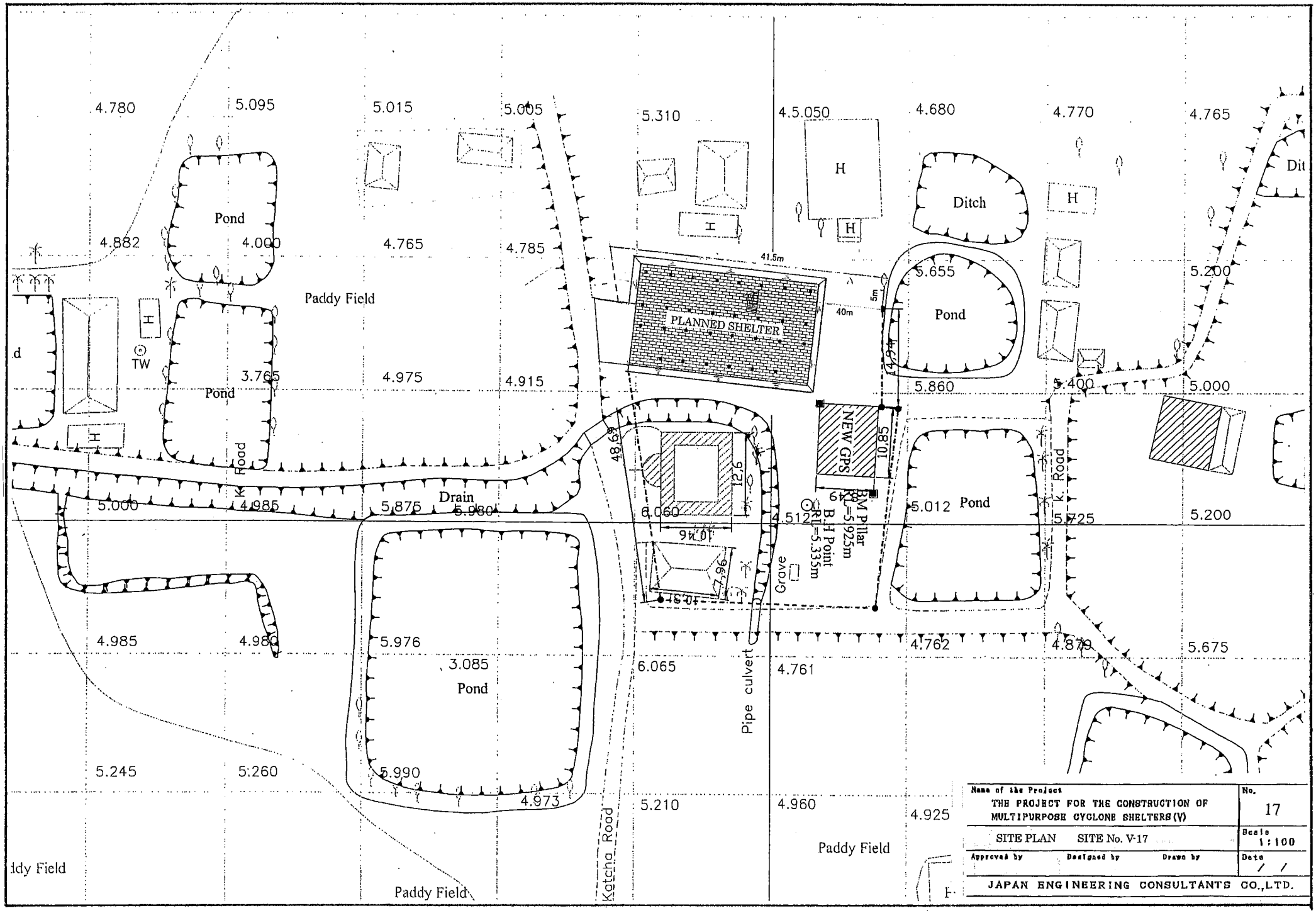

No. 12
Scale 1:100
Date / /
Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (V)
SITE PLAN SITE No. V-12
Approved by
Designed by
Drawn by
JAPAN ENGINEERING CONSULTANTS CO.,LTD.
POND
DITCH
Banyan tree
Tubewell
S.Tank
Toilet
Hazi Sorai GPS
TBM
Borehole Height = 5.5886
PLANNED SHELTER
Shop

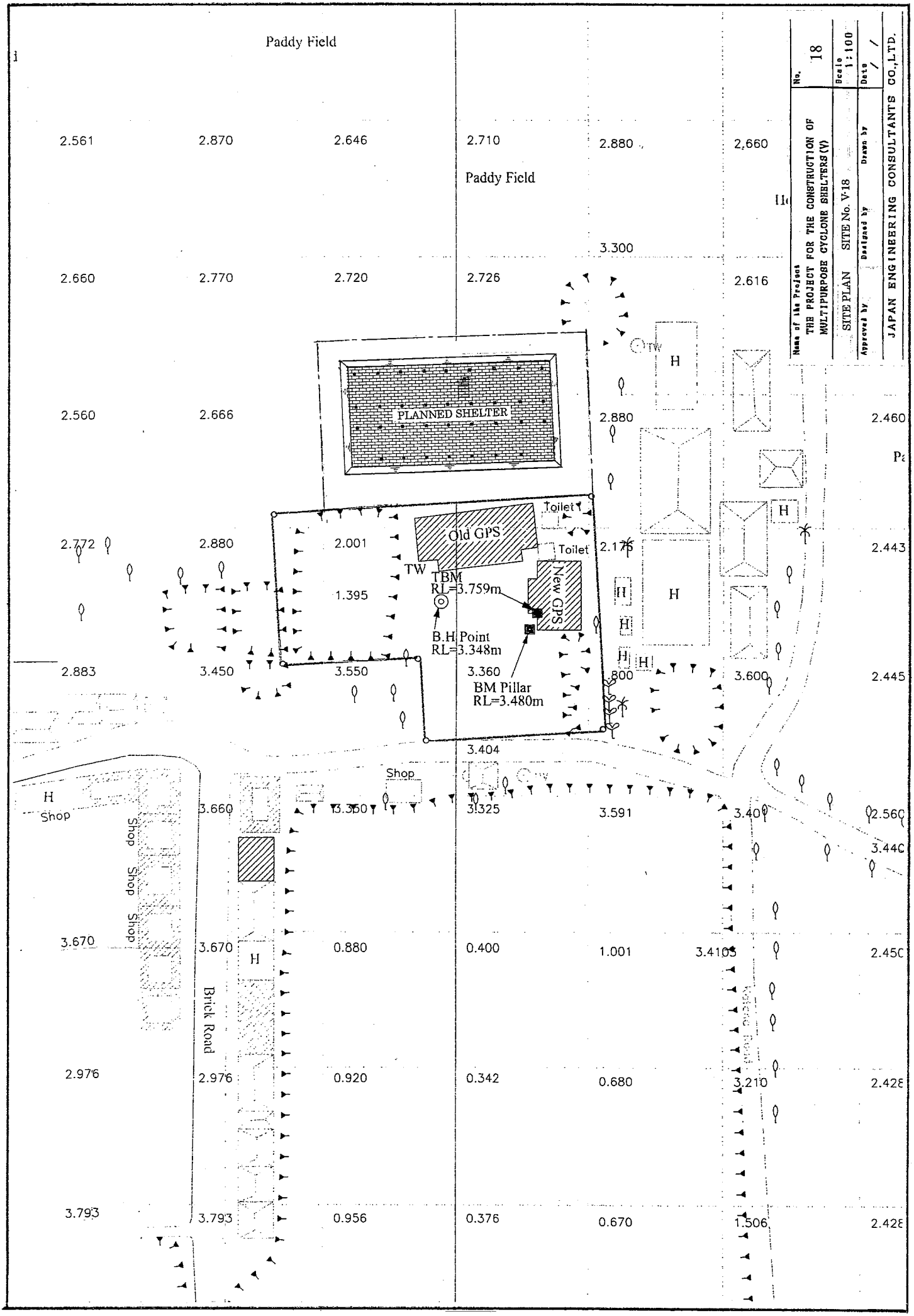

JAPAN ENGINEERING CONSULTANTS CO.,LTD.
No. 13
Scale 1:100
Date
Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS(V)
SITE PLAN
SITE No. V-13
Designed by
Drawn by
Approved by
PLANNED SHELTER
Katcha bazar
Tubewel
Pond
Ditch
shops
Road
Wall
Toilet
Mosque
ponnd
ditch
Home stea
ata bank
PP
H

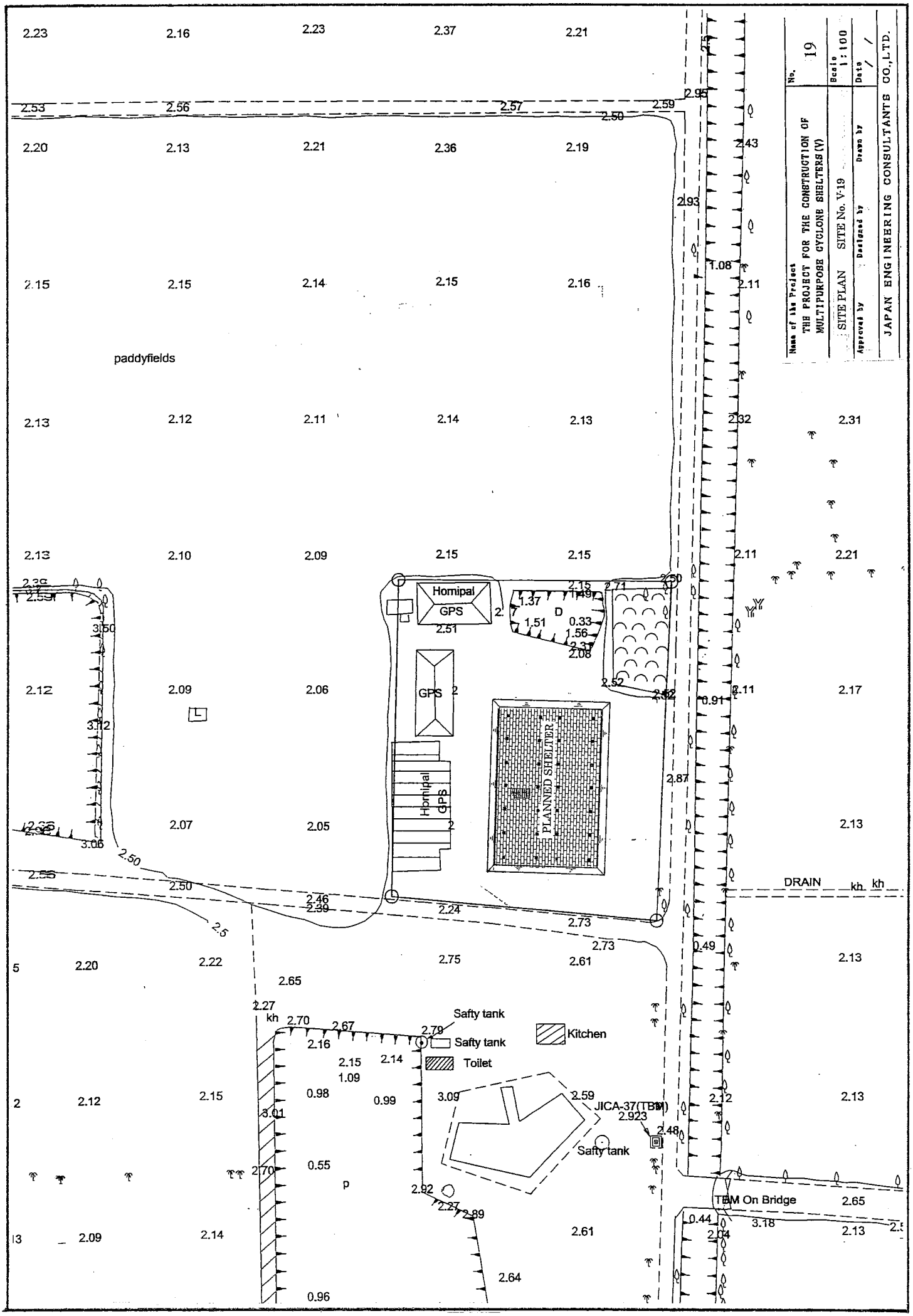

No. 14
Scale 1:100
Date / /
Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (V)
SITE PLAN SITE No. V-14
Designed by
Drawn by
Approved by
JAPAN ENGINEERING CONSULTANTS CO.,LTD.
Pond
Brick Road
Pipe Culvert
TBM
RI=3.737m
Borrow Pit
Boring Hole
RL=2.921m
GPS
Ditch
Boundary Wall
BM Pillar
RI=3.051m
PLANNED SHELTER
Paddy Field
Garden
Pond
Ditch
Pond

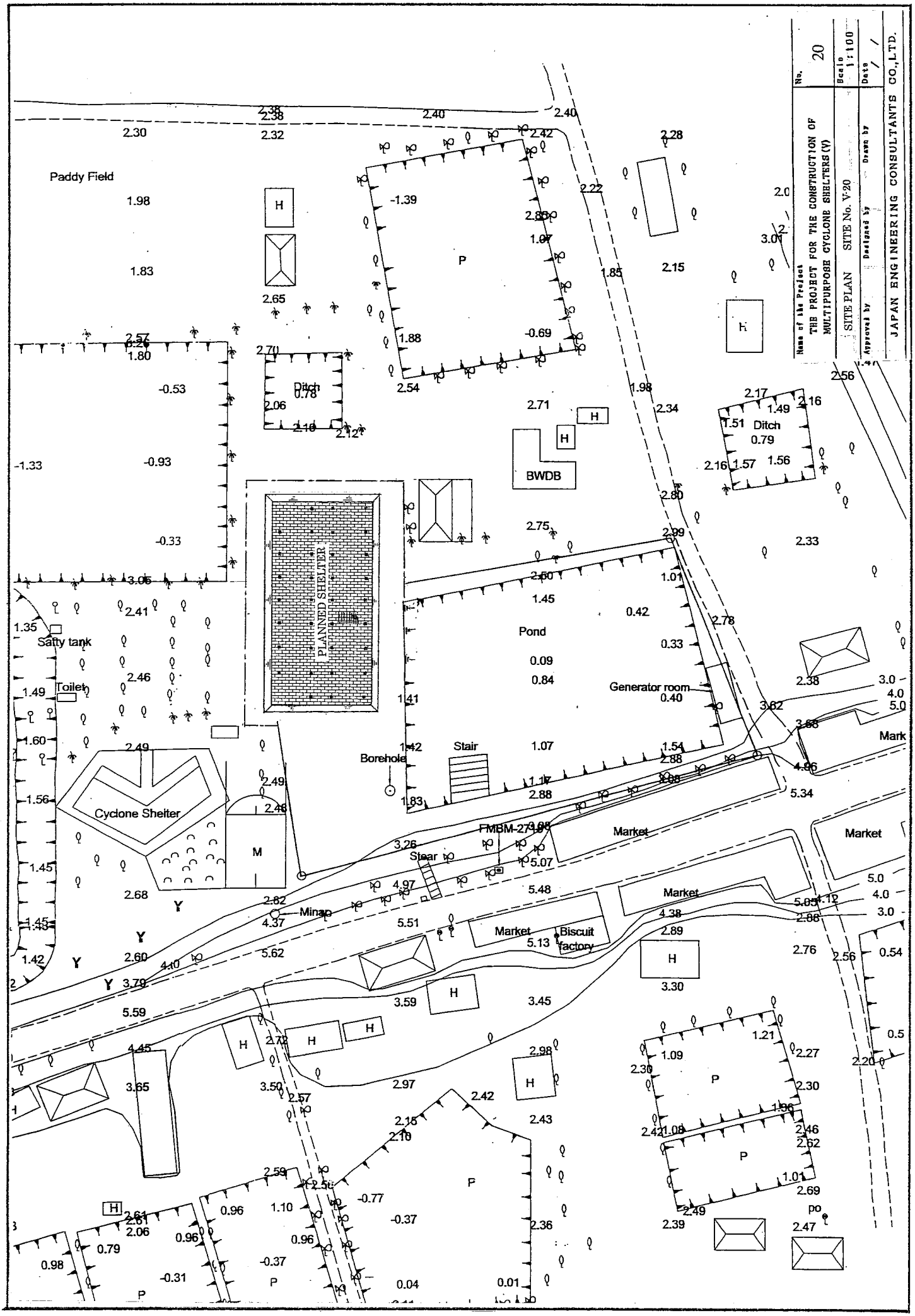

No. 15
Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (V)
SITE PLAN SITE No. V-15
Scale 1:100
Date
Approved by
Designed by
Drawn by
JAPAN ENGINEERING CONSULTANTS CO.,LTD.
Pond
Paddy Field
Shop
Pucca Road
Graveyard
New GPS
Boundary Wall
Old GPS
PLANNED SHELTER
High School
High School 1STD
Shop 2STD
TW
PP
D
H

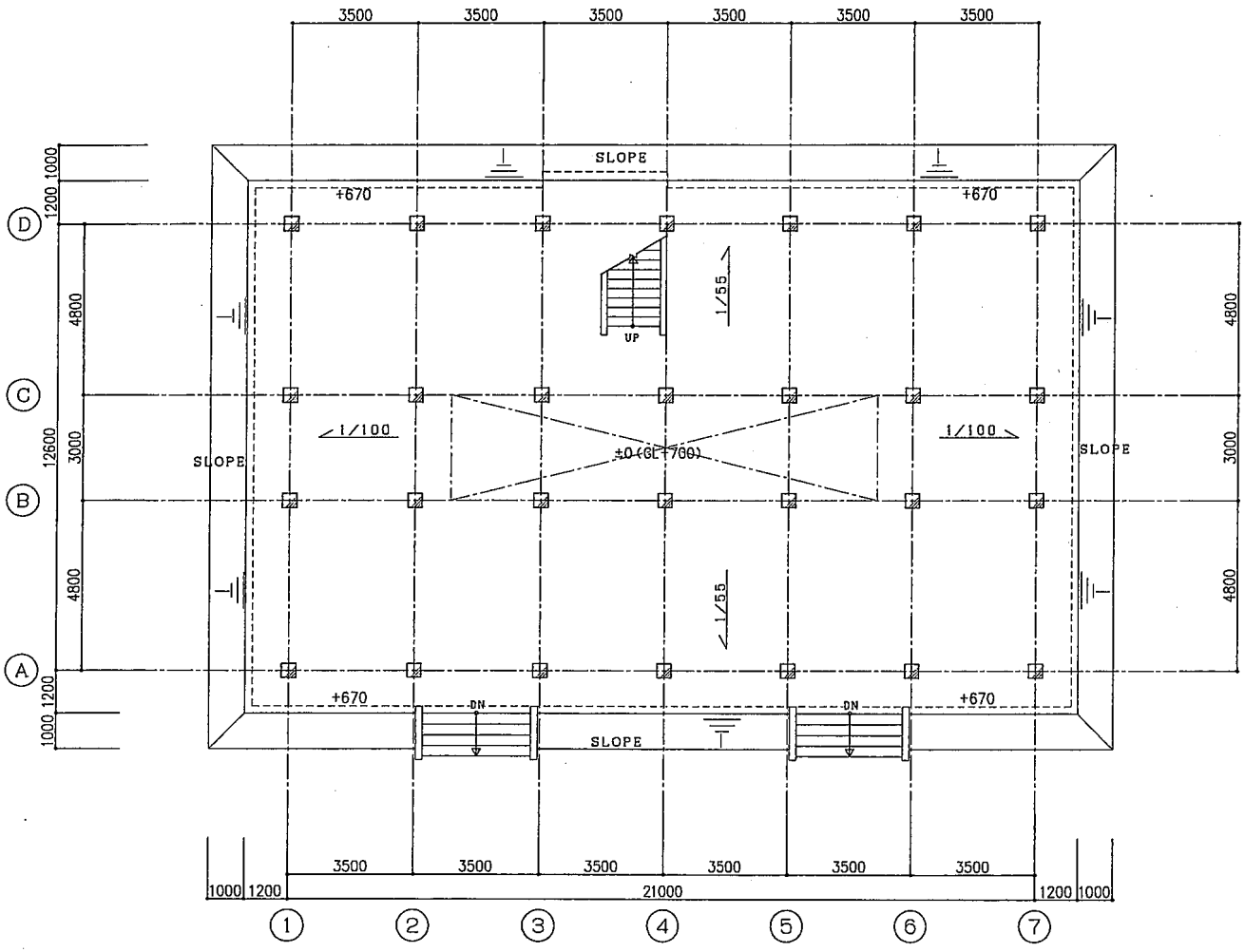

100.00N
2.615
2.660
2.340
2.744
1.205
2.08
Paddy Field
NUT
G A R D E N
Pond
30.00N
2.730
2.710
2.360
2.715
2.360
2.44
3.120
50.00N
1.925
1.021
2.410
2.256
2.160
2.26(
Pond
40.00N
1.810
1.006
2.347
2.244
2.144
2.206
2.
Paddy Field
Paddy Field
1.844
23.6
20.00N
1.915
2.340
2.260
2.326
2.074
2.
PUICHARI
SULTANIA GPS
13m
Homestead
25m
PLANNED SHELTER
0.00N
Home
2.880
2.339
2.081
2.
Area of
Primary School
Toilet
Katcha Road
-20.00N
3.126
3.220
3.320
3.210
3.180
3.086
2.
Burning Yard
-40.00N
0.871
1.210
3.330
0.996
2.446
1.014
1
G A R D E N
Pond
CANAL
Bamboo
-60.00N
1.024
1.360
3.324
0.994
2.460
2.890
2
G A R D E N
Paddy Fi
1.044
Puichar Sultania Chora
-80.00N
2.705
2.667
2.710
2.460
2.494
2.810
2
No. 16
Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS(V)
Scale 1:100
SITE PLAN SITE No. V-16
Approved by
Designed by
Drawn by
Date / /
JAPAN ENGINEERING CONSULTANTS CO.,LTD.


4.780
5.095
5.015
5.005
5.310
4.5.050
4.680
4.770
4.765
Pond
4.882
4.000
4.765
4.785
Paddy Field
H
TW
3.765
4.975
4.915
Pond
Road
5.000
4.985
5.875
5.980
Drain
PLANNED SHELTER
41.5m
40m
5m
Ditch
5.655
Pond
5.860
5.400
5.000
5.200
NEW GPS
58.0
48.6
12.6
12.1
6.060
10.46
7.96
10.39
4.512
BM Pillar
RL=5.925m
B.J Point
RL=5.335m
Grave
5.012
Pond
5.725
5.200
4.985
4.980
5.976
3.085
Pond
6.065
Pipe culvert
4.761
4.762
4.879
5.675
5.245
5.260
5.990
4.973
5.210
4.960
4.925
Katcha Road
Paddy Field
Paddy Field
Paddy Field
Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (V)
No.
17
SITE PLAN
SITE No. V-17
Scale
1:100
Approved by
Designed by
Drawn by
Date
/ /
JAPAN ENGINEERING CONSULTANTS CO.,LTD.


Paddy Field
Paddy Field
PLANNED SHELTER
Old GPS
New GPS
Toilet
Toilet
TW
TBM
RL=3.759m
B.H Point
RL=3.348m
BM Pillar
RL=3.480m
Shop
Shop
Shop
Shop
Shop
Brick Road
No. 18
Scale 1:100
Date / /
Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS(V)
SITE PLAN SITE No. V-18
Approved by
Designed by
Drawn by
JAPAN ENGINEERING CONSULTANTS CO.,LTD.

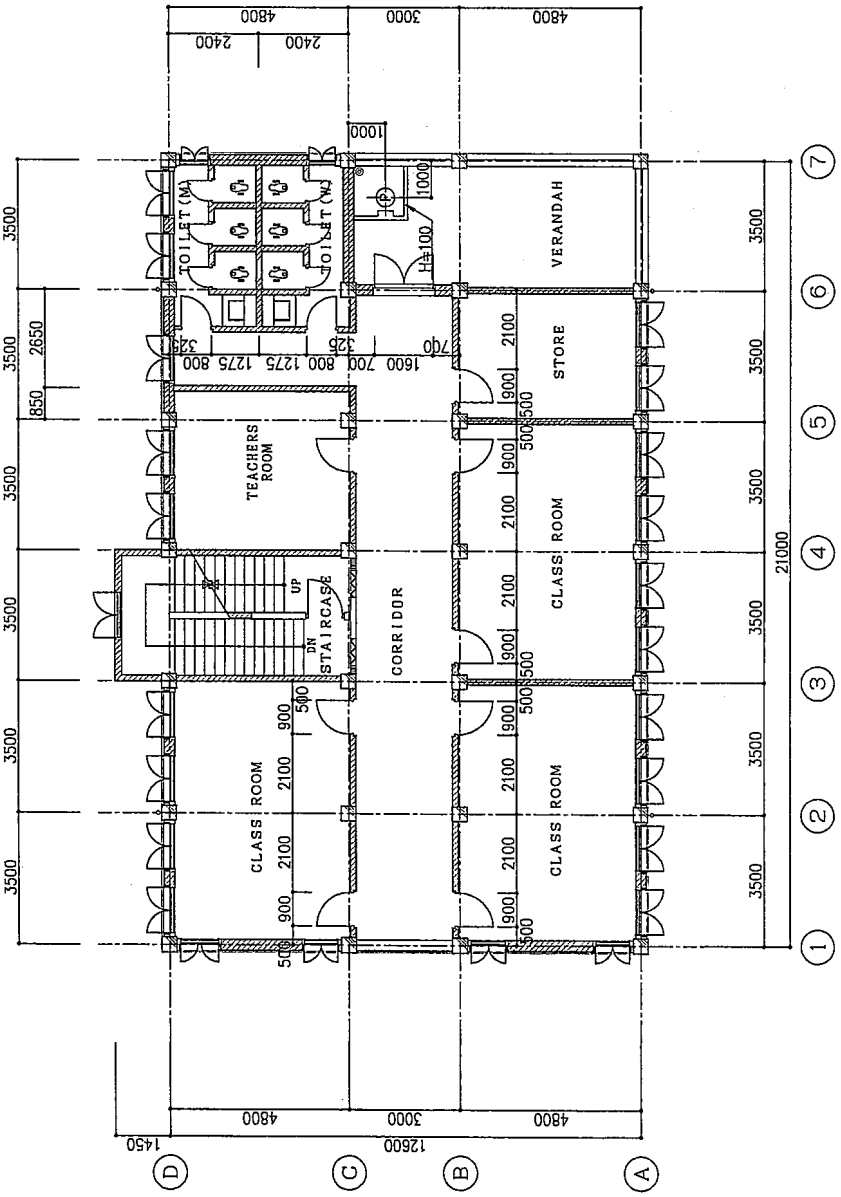

No. 19
Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (V)
SITE PLAN SITE No. V-19
Scale 1:100
Date
Drawn by
Designed by
Approved by
JAPAN ENGINEERING CONSULTANTS CO.,LTD.
paddyfields
Homipal GPS
GPS
Homipal GPS
PLANNED SHELTER
DRAIN
Safty tank
Safty tank
Kitchen
Toilet
JICA-37(TBM)
Safty tank
TBM On Bridge


No. 20
Scale 1:100
Date / /
Name of the Project
THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (V)
SITE PLAN
SITE No. V-20
Designed by
Drawn by
Approved by
JAPAN ENGINEERING CONSULTANTS CO.,LTD.
Paddy Field
PLANNED SHELTER
Ditch
Pond
BWDB
Generator room
Stair
Borehole
Cyclone Shelter
Toilet
Satty tank
Minap
Biscuit factory
Market
Mark
FMBM-2749
Stear
P
M
H



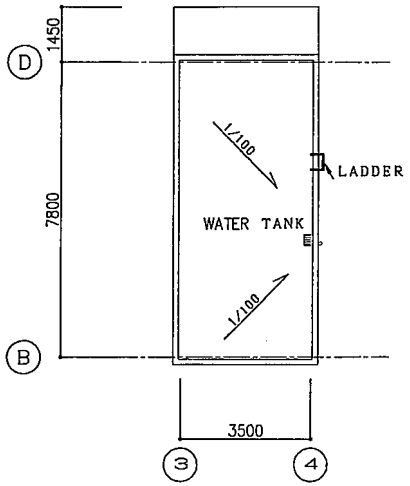
GROUND FLOOR PLAN S=1:100

Name of the Project: THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS(V)	No. 21
GROUND FLOOR PLAN-1 3-CLASS ROOM Type	Scale 1:100
Approved by / Designed by / Drawn by	Date / /'99
JAPAN ENGINEERING CONSULTANTS CO.,LTD.	

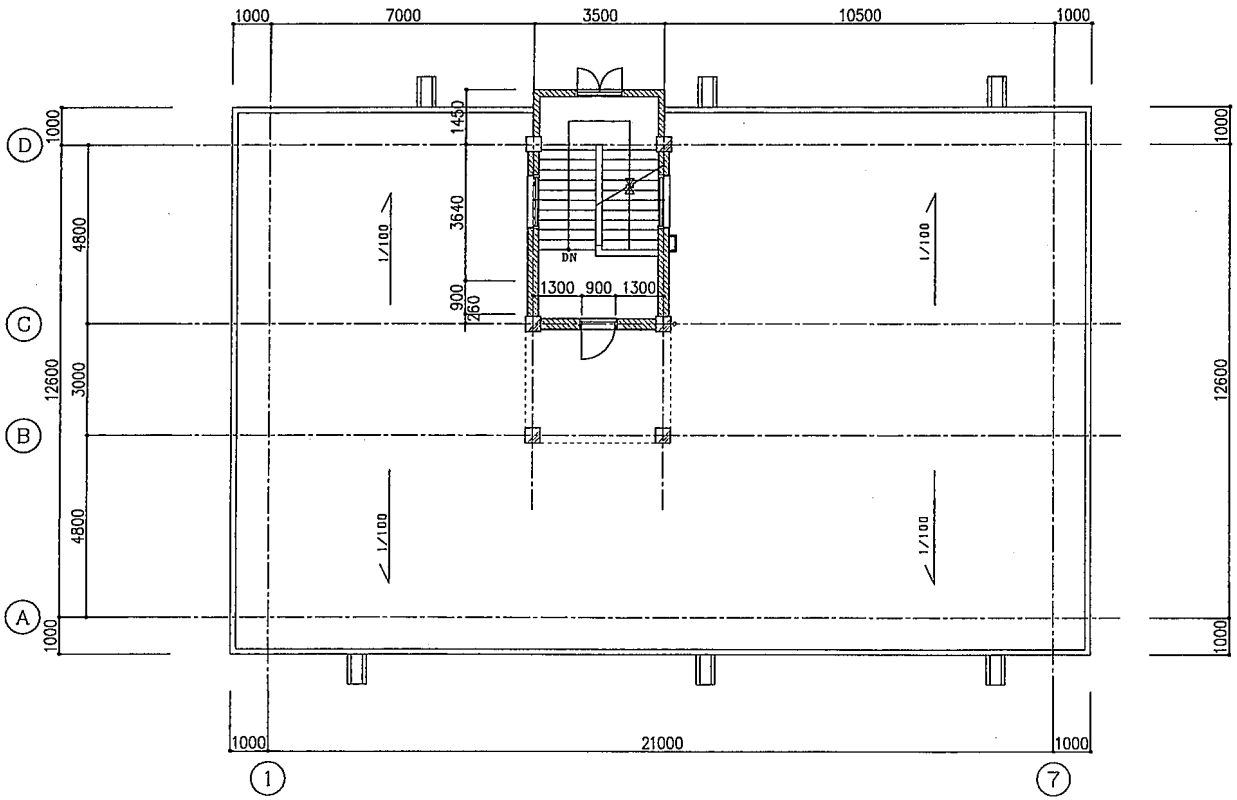


FIRST FLOOR PLAN S=1:100

Name of the Project: THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS(V)		No. 22
FIRST FLOOR PLAN-I 3-CLASS ROOM Type		Scale 1:100
Approved by	Designed by / Drawn by	Date / /'99
JAPAN ENGINEERING CONSULTANTS CO.,LTD.		

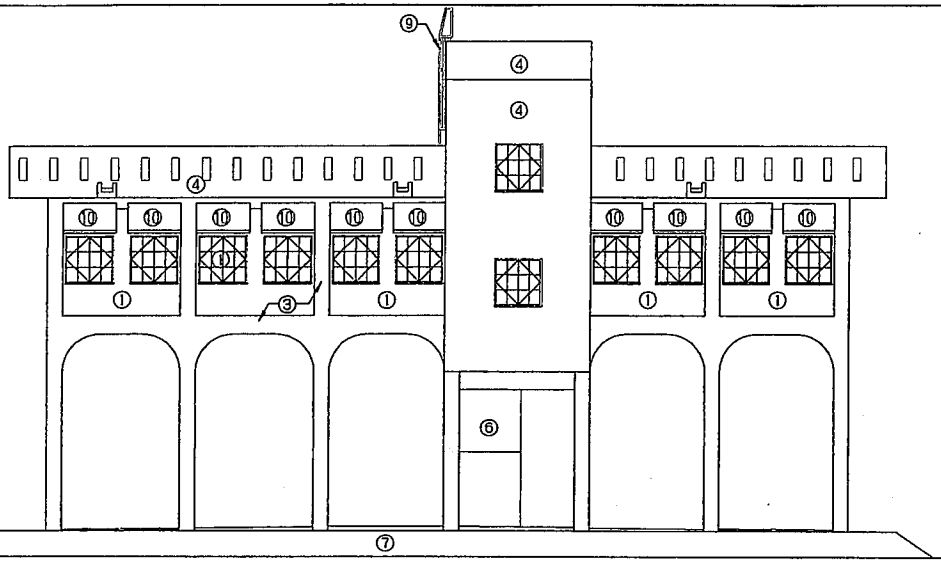


STAIRCASE ROOF PLAN S=1:100

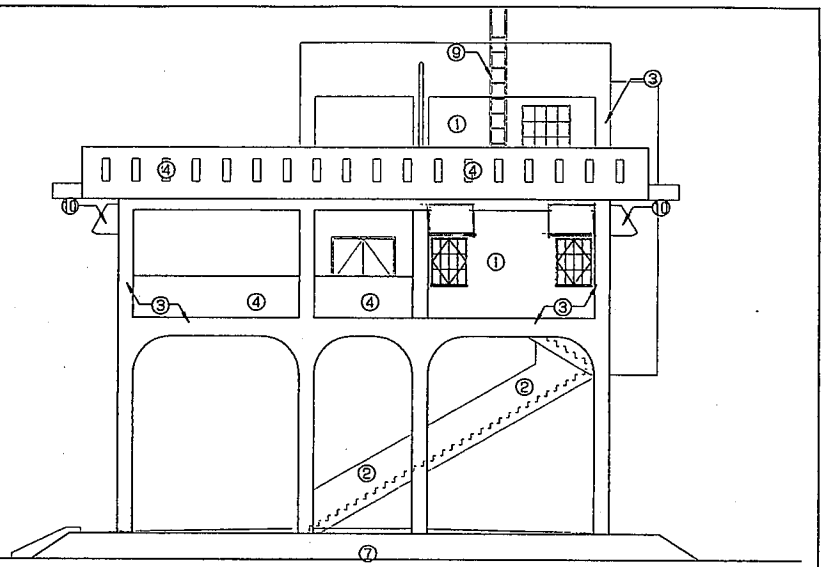


TYPE ROOF FLOOR PLAN S=1:100

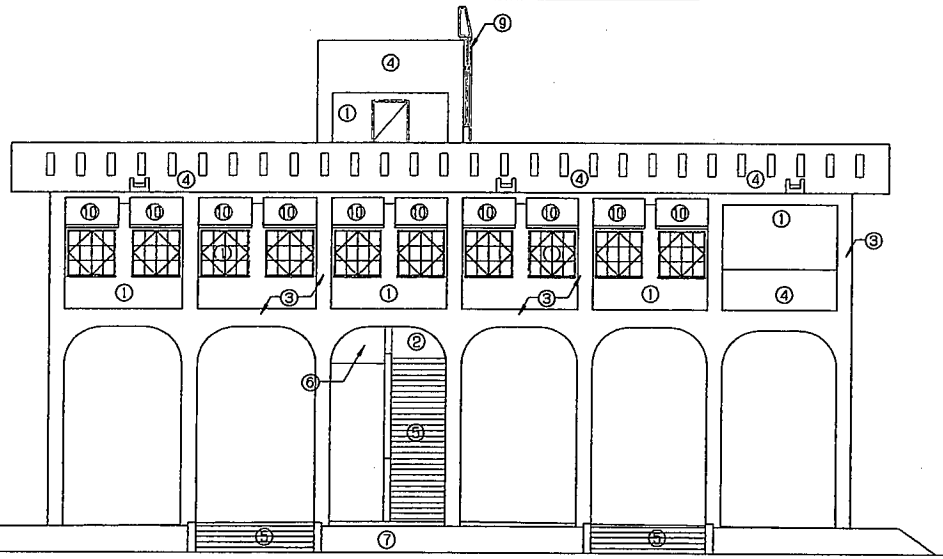
Name of the Project: THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS(V)	No. 23
ROOF FLOOR PLAN-1 3-CLASS ROOM Type	Scale 1:100
Approved by / Designed by / Drawn by	Date / /'99
JAPAN ENGINEERING CONSULTANTS CO.,LTD.	



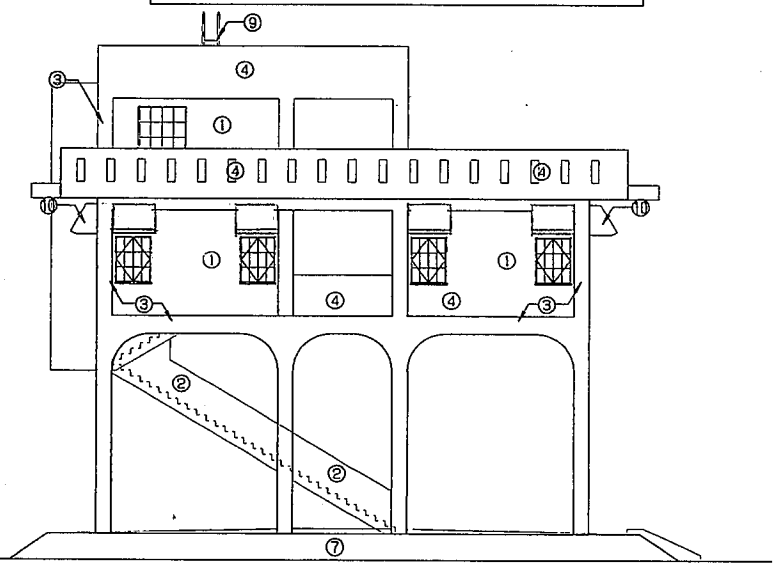
A ELEVATION S=1:100



B ELEVATION S=1:100



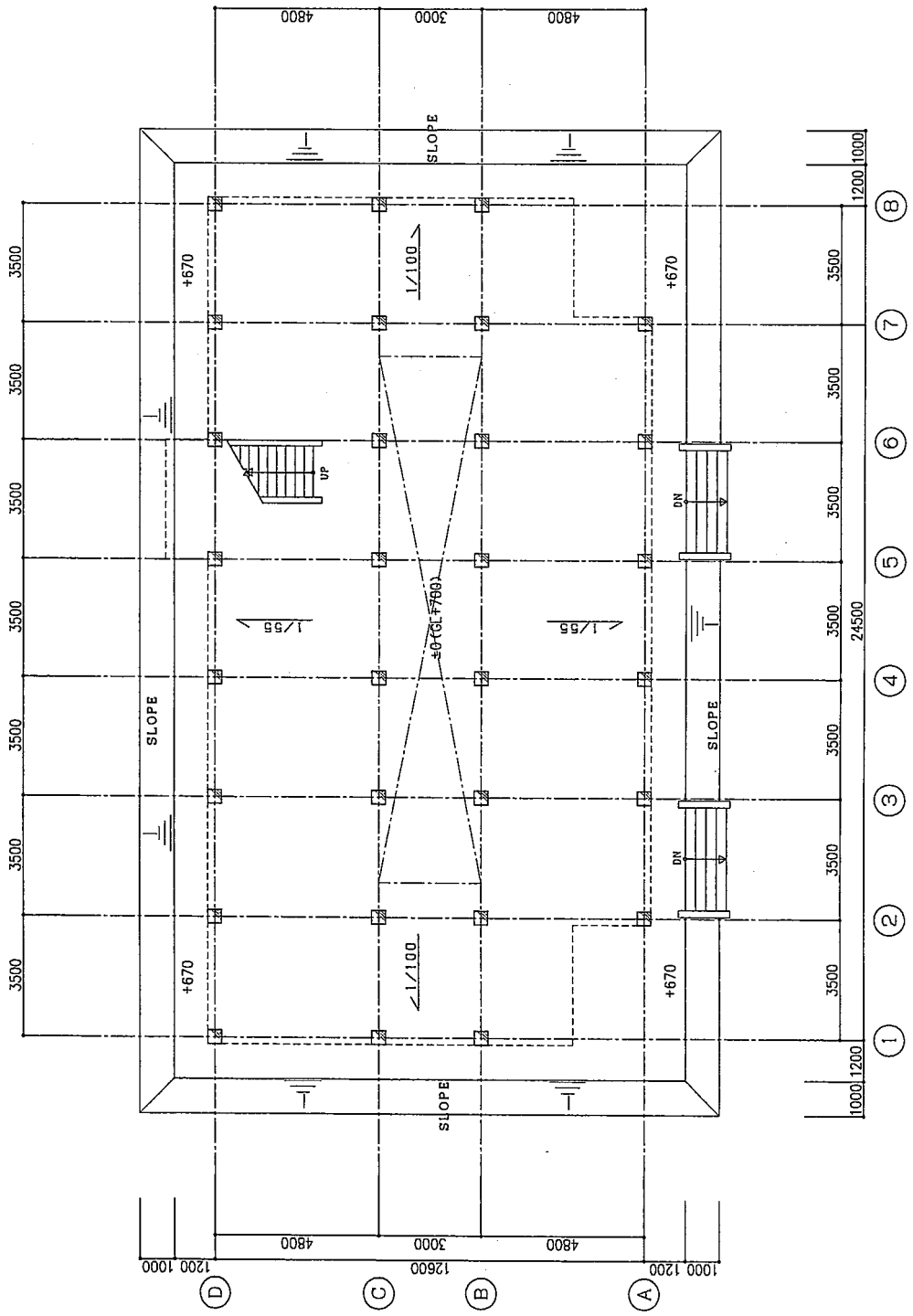
C ELEVATION S=1:100



D ELEVATION S=1:100

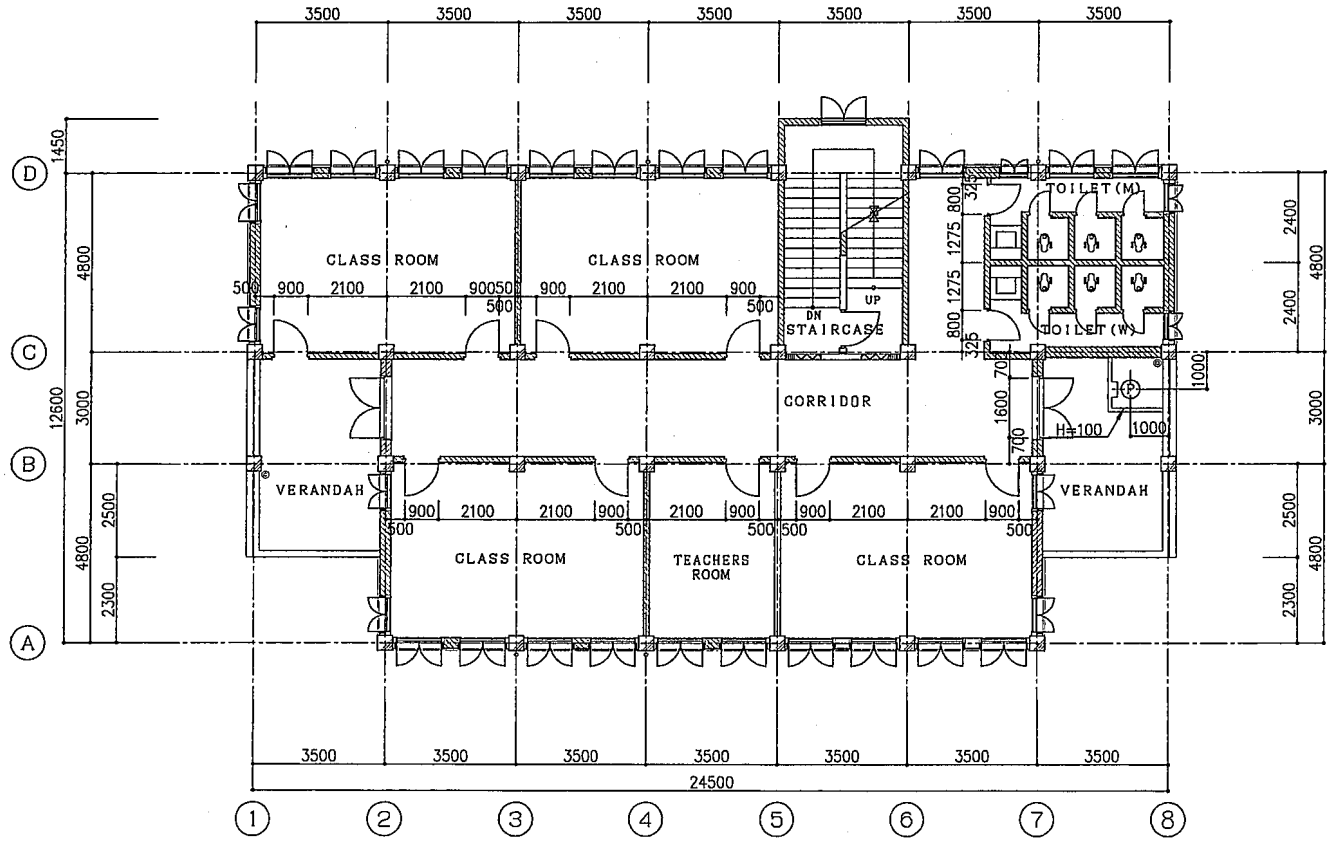
SIGN	FINISHES	SIGN	FINISHES
①	EXTERIOR WALL: V.P ON TROWELLED MORTAR T=25 MASONRY JOINT(15x15)	⑥	CEILING:V.P ON CONCRETE FAIR FACE
②	HANDRAIL:V.P ON TROWELLED MORTAR T=25	⑦	FACE OF SLOPE:CONCRETE, TROWELLED
③	COLUMU, GIRDER:V.P ON CONCRETE FAIR FACE	⑧	DOWN PIPE:STEEL PIPE O.P
④	PARAPET, HANDRAIL:V.P ON CONCRETE FAIR FACE	⑨	LADDER:STEEL PIPE O.P
⑤	STAIRS:TROWELLED MORTAR FINISH T=30	⑩	EAVES:VP ON CONCRETE FAIR FACE

Name of the Project: THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS(V)	No. 24
ELEVATION 3-CLASS ROOM Type	Scale 1:100
Approved by / Designed by / Drawn by	Date / /'99
JAPAN ENGINEERING CONSULTANTS CO.,LTD.	



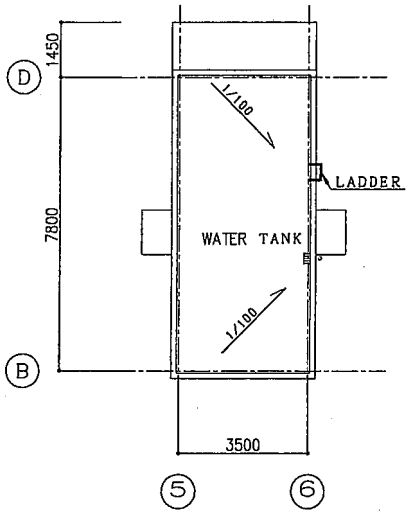
GROUND FLOOR PLAN S=1:100

Name of the Project: THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS(V)	No. 25
GROUND FLOOR PLAN-1 4-CLASS ROOM Type	Scale 1:100
Approved by / Designed by / Drawn by	Date / /'99
JAPAN ENGINEERING CONSULTANTS CO.,LTD.	

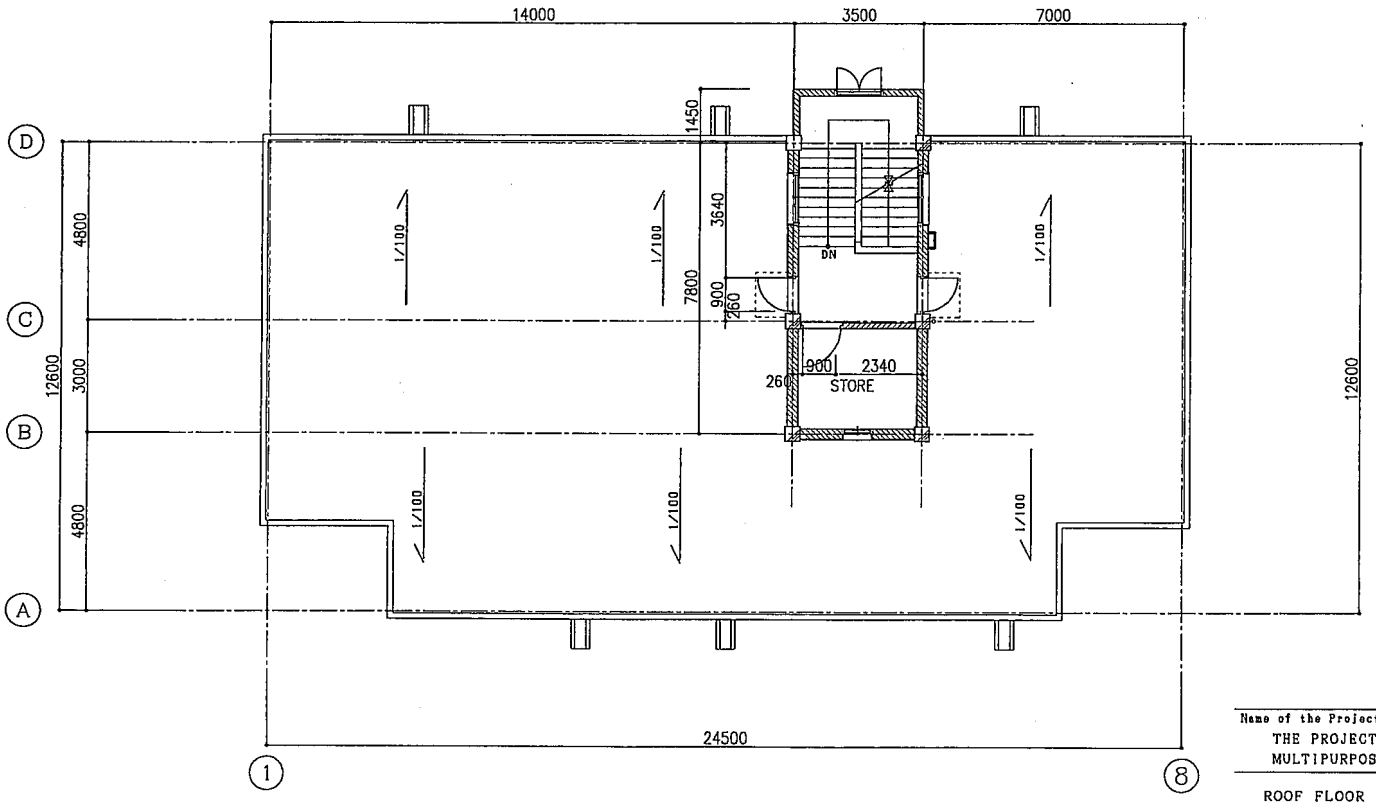


FIRST FLOOR PLAN S=1:100

Name of the Project: THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS(V)	No. 26
FIRST FLOOR PLAN-1 4-CLASS ROOM Type	Scale 1:100
Approved by / Designed by / Drawn by	Date / /'99
JAPAN ENGINEERING CONSULTANTS CO.,LTD.	

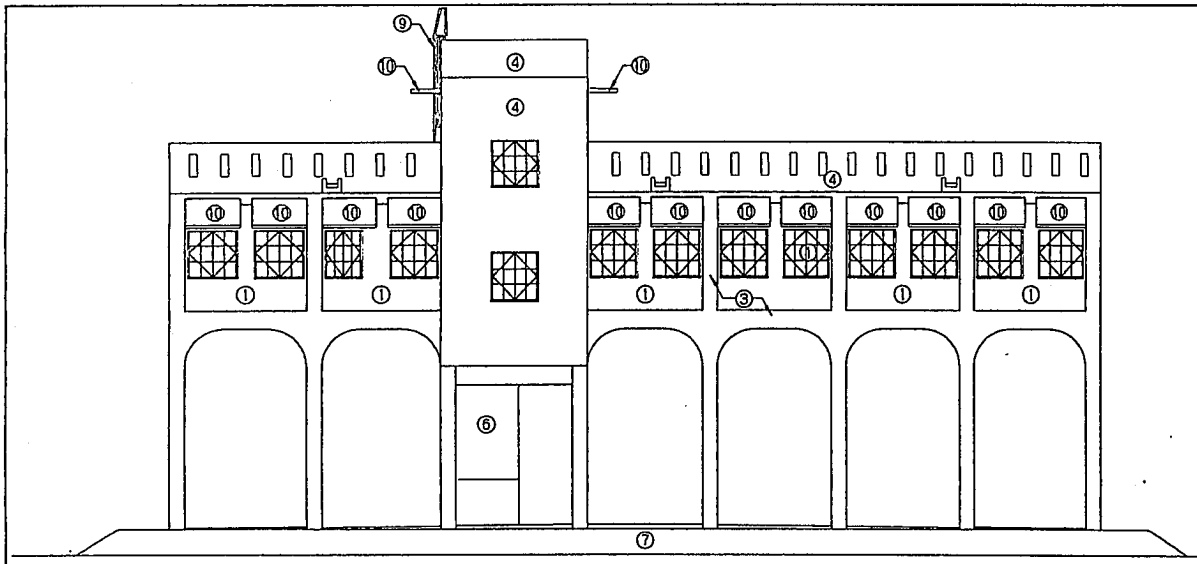


STAIRCASE ROOF PLAN S=1:100

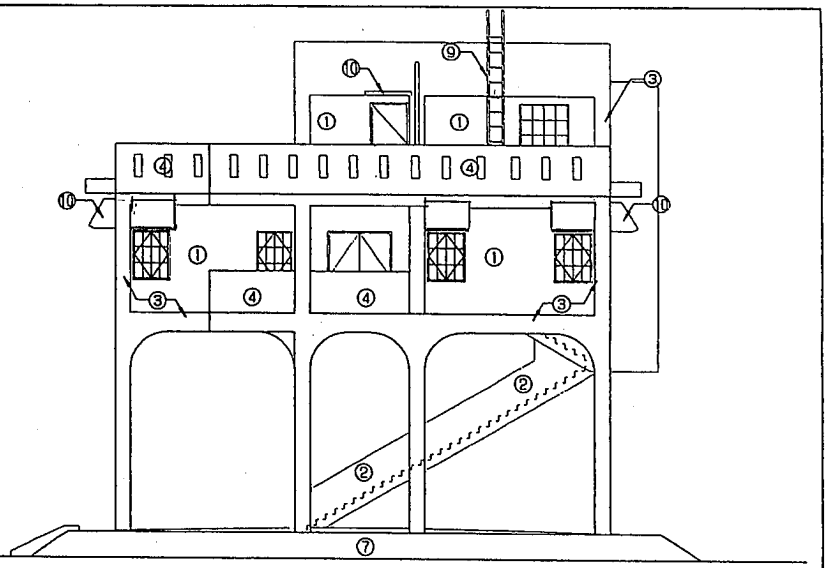


TYPE ROOF FLOOR PLAN S=1:100

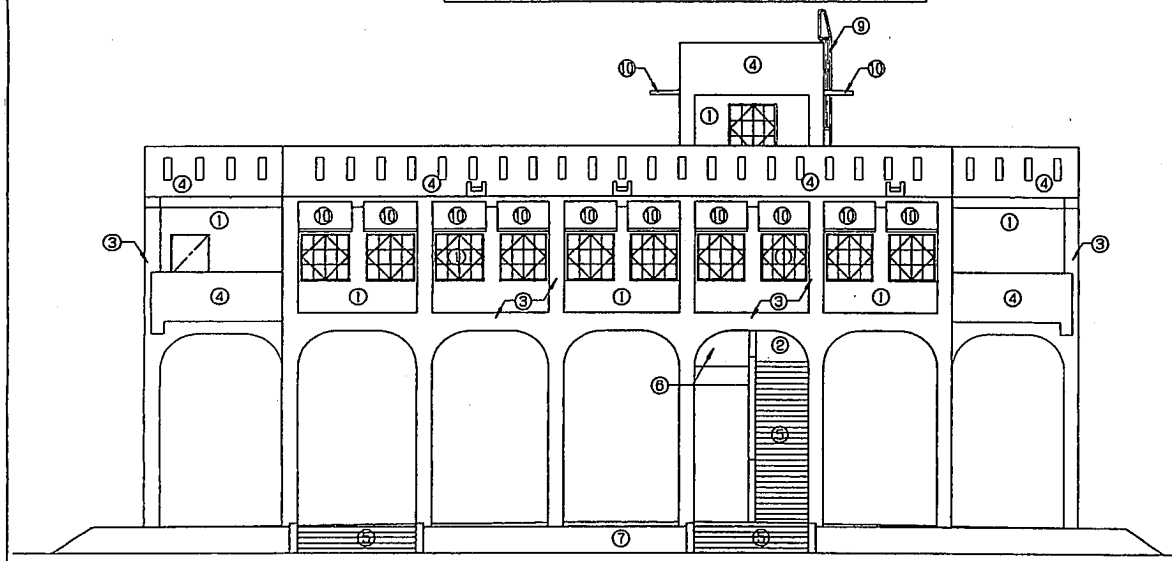
Name of the Project: THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS(V)	No. 27
ROOF FLOOR PLAN-1 4-CLASS ROOM Type	Scale 1:100
Approved by / Designed by / Drawn by	Date / /'99
JAPAN ENGINEERING CONSULTANTS CO.,LTD.	



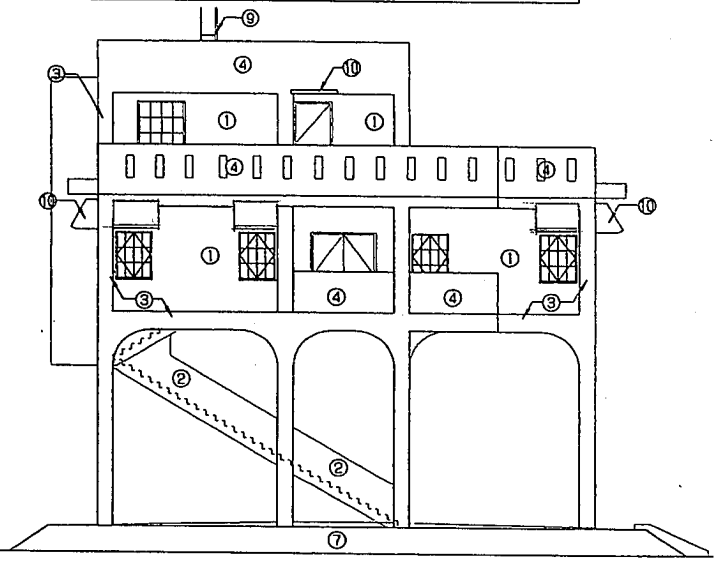
A ELEVATION S=1:100



B ELEVATION S=1:100



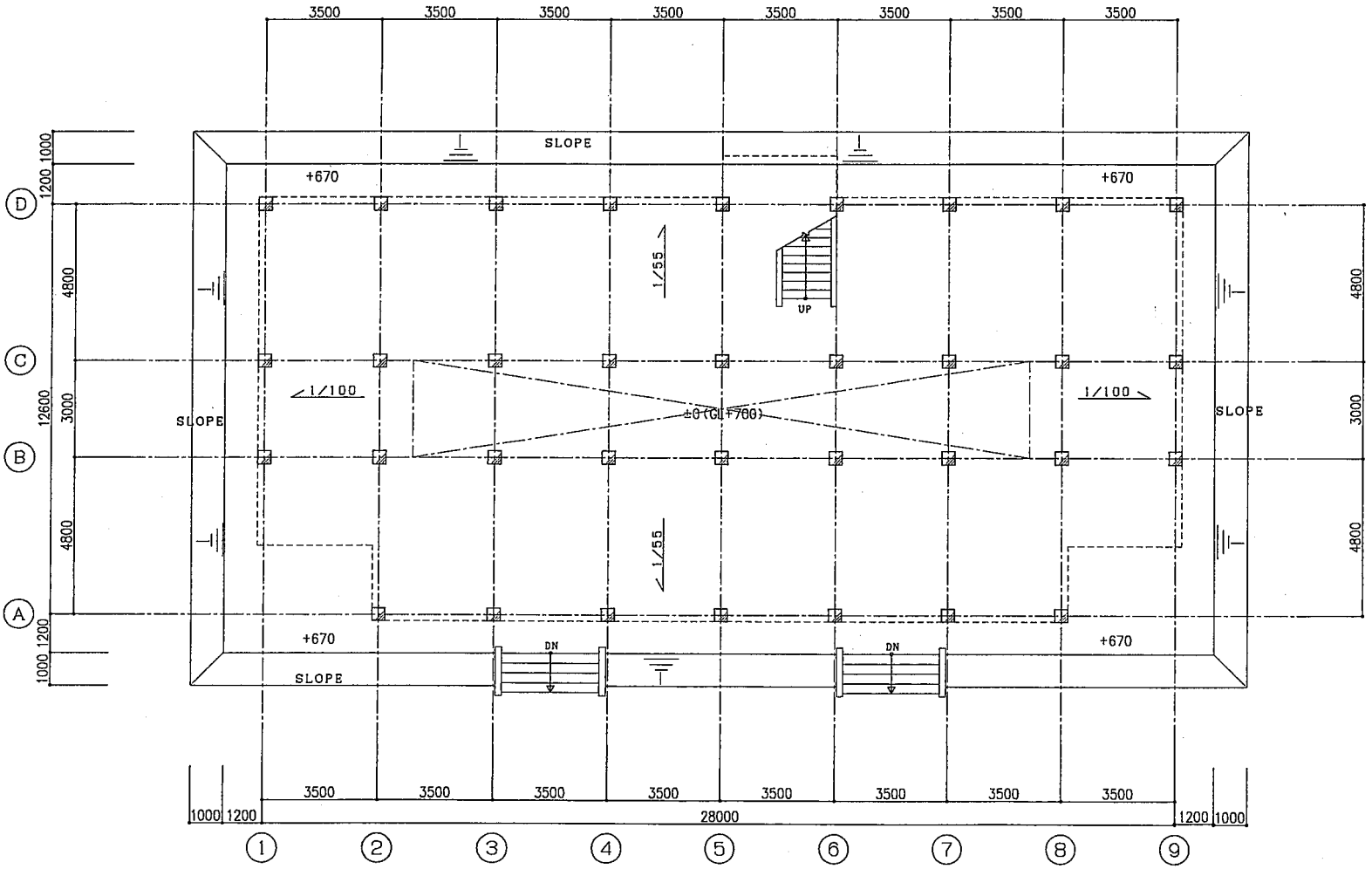
C ELEVATION S=1:100



D ELEVATION S=1:100

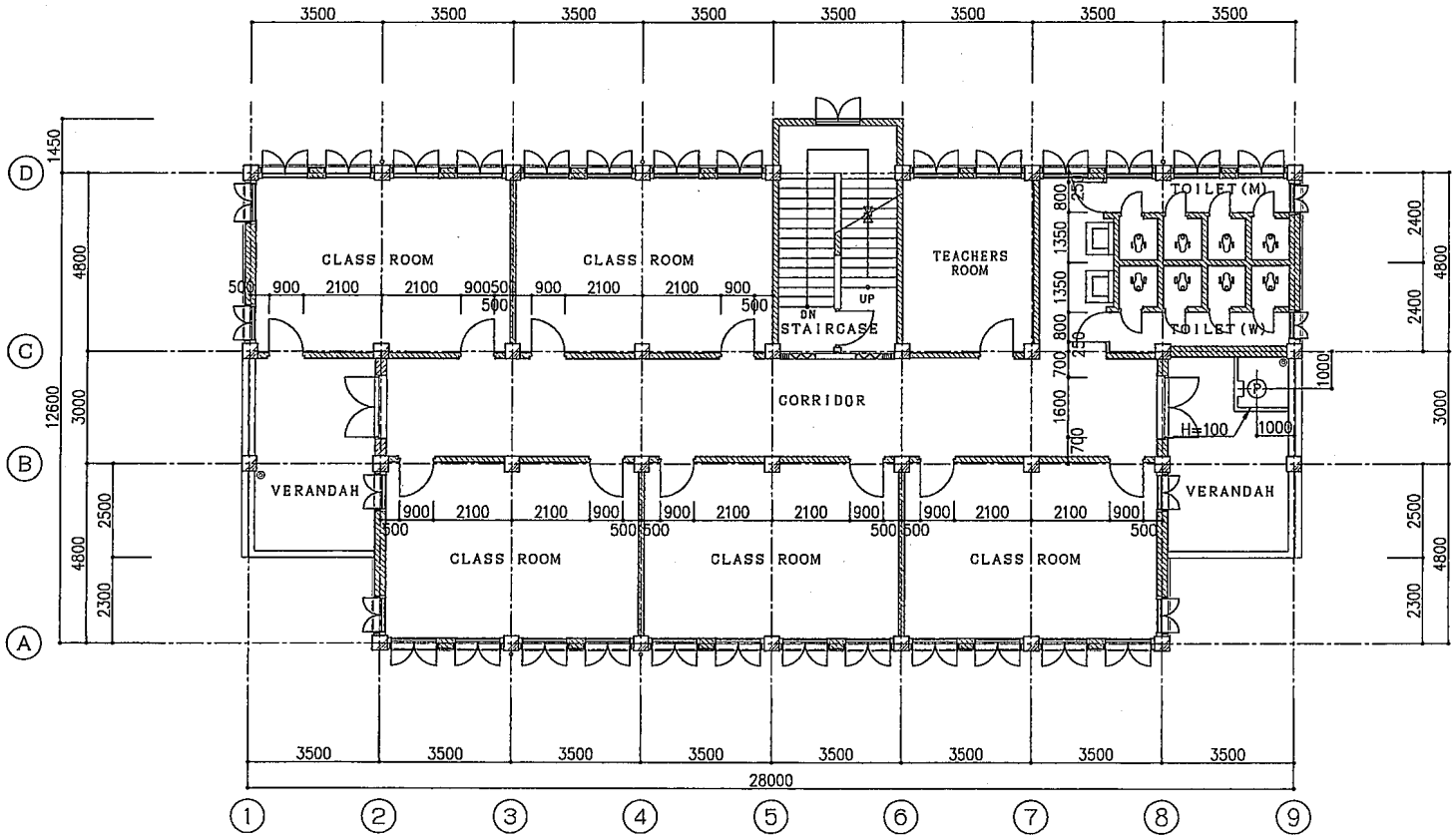
SIGN	FINISHES	SIGN	FINISHES
①	EXTERIOR WALL: V. P ON TROWELLED MORTAR T=25 MASONRY JOINT(15×15)	⑥	CEILING: V. P ON CONCRETE FAIR FACE
②	HANDRAIL: V. P ON TROWELLED MORTAR T=25	⑦	FACE OF SLOPE: CONCRETE, TROWELLED
③	COLUMU, GIRDER: V. P ON CONCRETE FAIR FACE	⑧	DOWN PIPE: STEEL PIPE O. P
④	PARAPET, HANDRAIL: V. P ON CONCRETE FAIR FACE	⑨	LADDER: STEEL PIPE O. P
⑤	STAIRS: TROWELLED MORTAR FINISH T=30	⑩	EAVES: VP ON CONCRETE FAIR FACE

Name of the Project: THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (V)	No. 28
ELEVATION 4-CLASS ROOM Type	Scale 1:100
Approved by / Designed by / Drawn by	Date / /'99
JAPAN ENGINEERING CONSULTANTS CO.,LTD.	



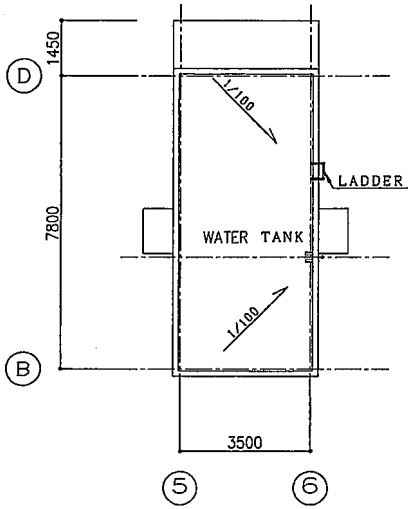
GROUND FLOOR PLAN S=1:100

Name of the Project: THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS (V)	No. 29
GROUND FLOOR PLAN-1 5-CLASS ROOM Type	Scale 1:100
Approved by / Designed by / Drawn by	Date / /'99
JAPAN ENGINEERING CONSULTANTS CO.,LTD.	

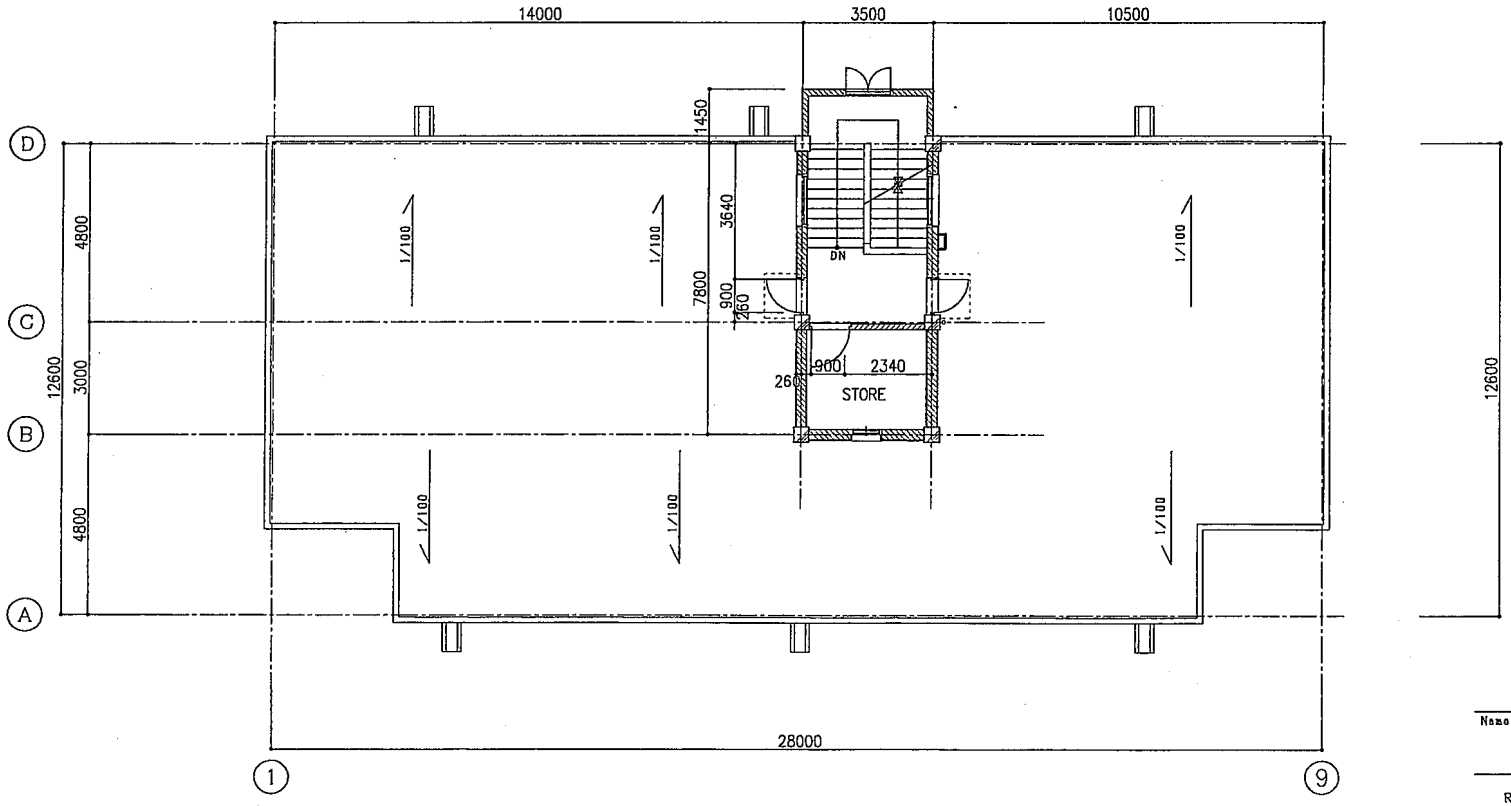


FIRST FLOOR PLAN S=1:100

Name of the Project: THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS(V)	No. 30
FIRST FLOOR PLAN-1 5-CLASS ROOM Type	Scale 1:100
Approved by / Designed by / Drawn by	Date / /'99
JAPAN ENGINEERING CONSULTANTS CO.,LTD.	

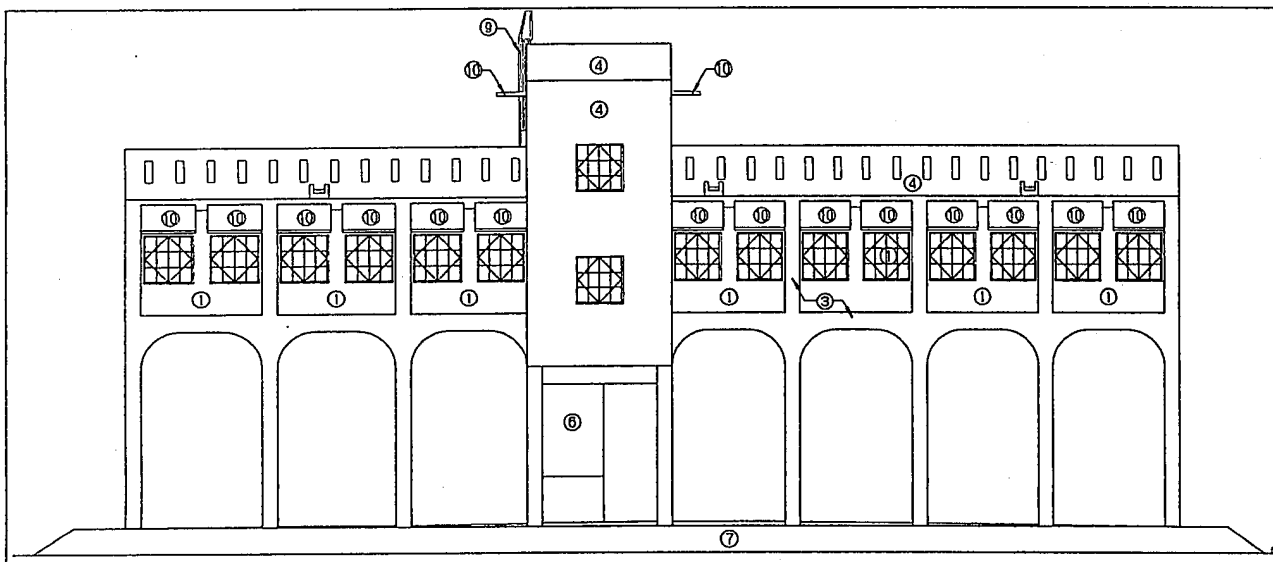


STAIRCASE ROOF PLAN S=1:100

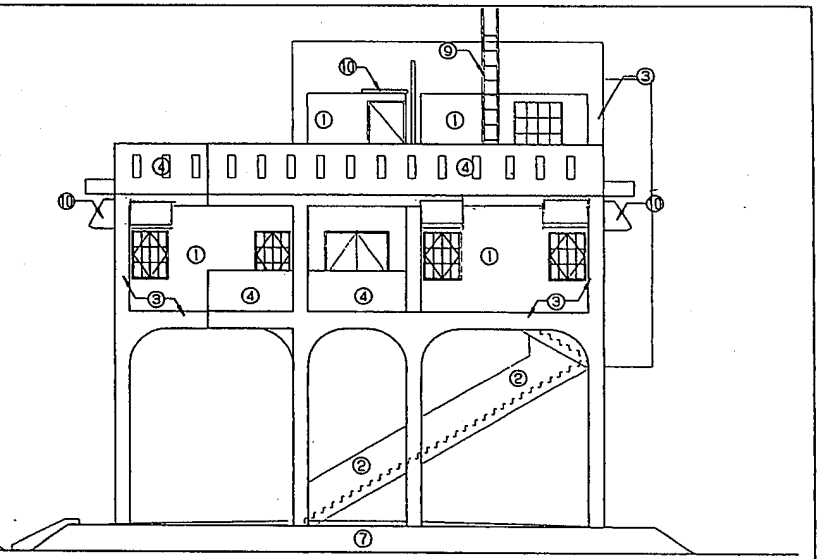


TYPE ROOF FLOOR PLAN S=1:100

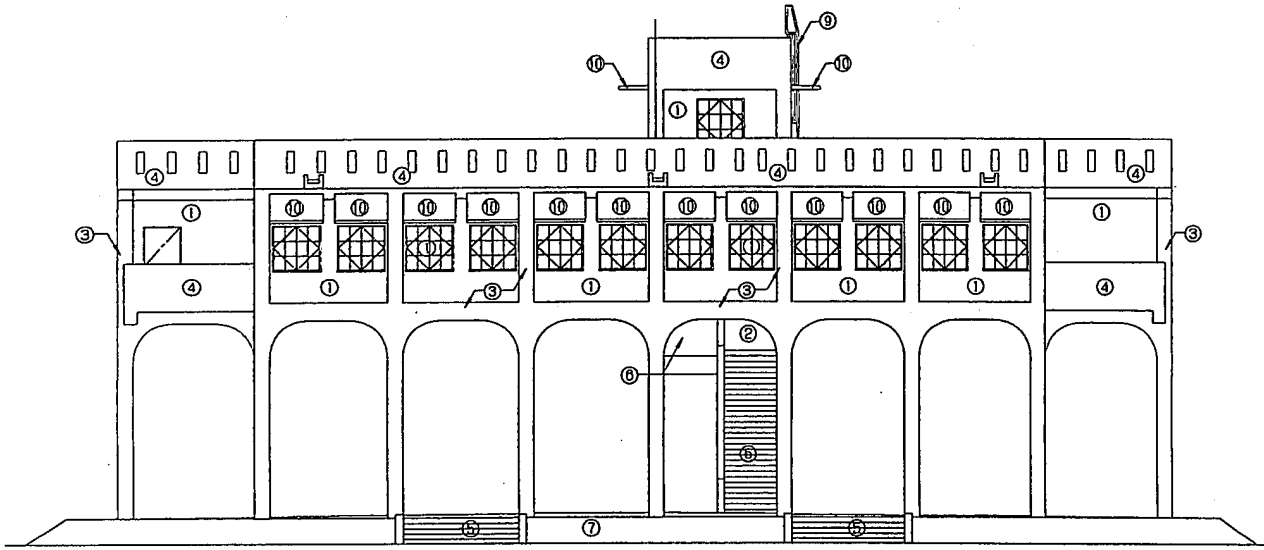
Name of the Project: THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS(V)	No. 31
ROOF FLOOR PLAN-1 5-CLASS ROOM Type	Scale 1:100
Approved by / Designed by / Drawn by	Date / /'99
JAPAN ENGINEERING CONSULTANTS CO.,LTD.	



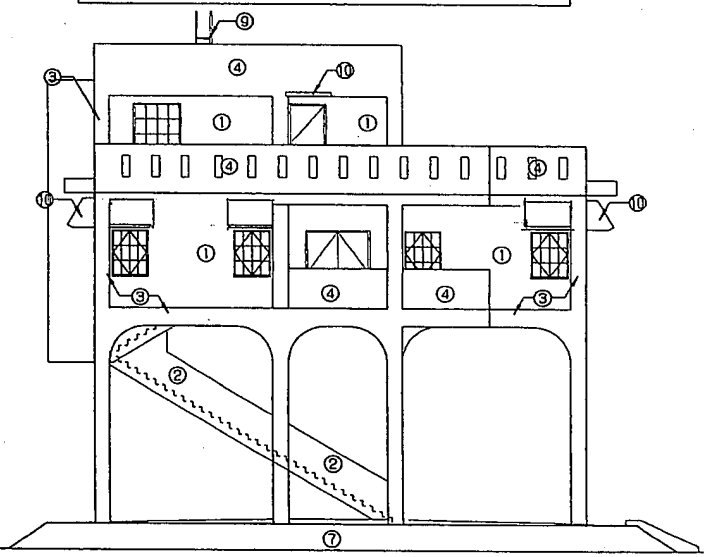
A ELEVATION S=1:100



B ELEVATION S=1:100



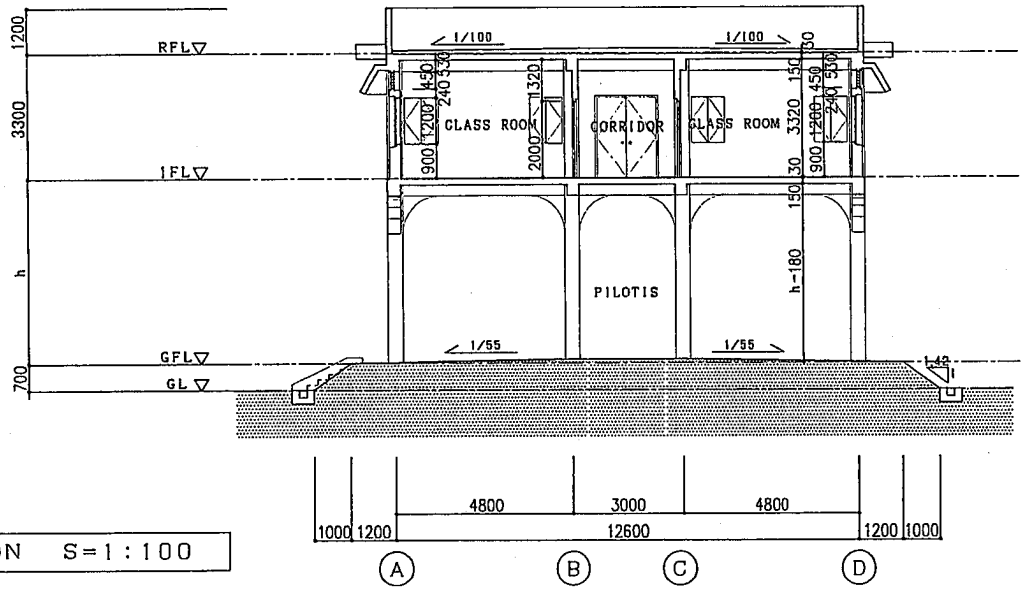
C ELEVATION S=1:100



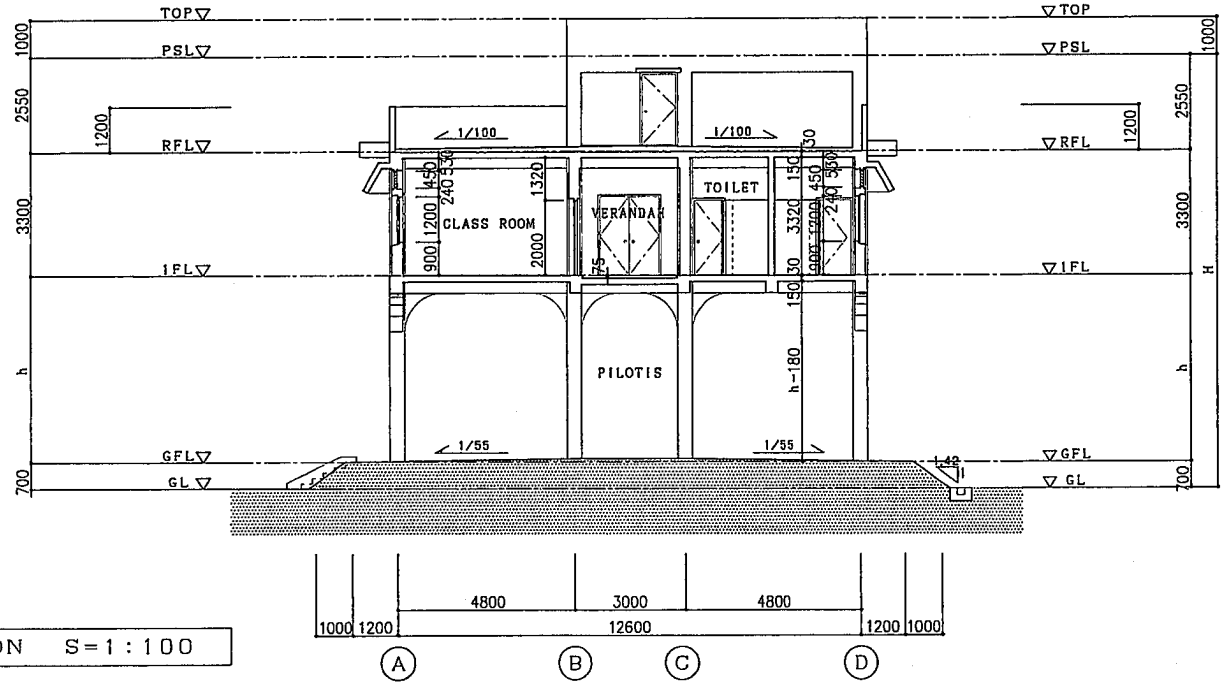
D ELEVATION S=1:100

SIGN	FINISHES	SIGN	FINISHES
①	EXTERIOR WALL: V.P ON TROWELLED MORTAR T=25 MASONRY JOINT(15X15)	⑥	CEILING:V.P ON CONCRETE FAIR FACE
②	HANDRAIL:V.P ON TROWELLED MORTAR T=25	⑦	FACE OF SLOPE:CONCRETE, TROWELLED
③	COLUMU, GIRDER:V.P ON CONCRETE FAIR FACE	⑧	DOWN PIPE:STEEL PIPE O.P
④	PARAPET, HANDRAIL:V.P ON CONCRETE FAIR FACE	⑨	LADDER:STEEL PIPE O.P
⑤	STAIRS:TROWELLED MORTAR FINISH T=30	⑩	EAVES:VP ON CONCRETE FAIR FACE

Name of the Project: THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS(V)	No. 32
ELEVATION 5-CLASS ROOM Type	Scale 1:100
Approved by / Designed by / Drawn by	Date / /'99
JAPAN ENGINEERING CONSULTANTS CO.,LTD.	



a-a SECTION S=1:100

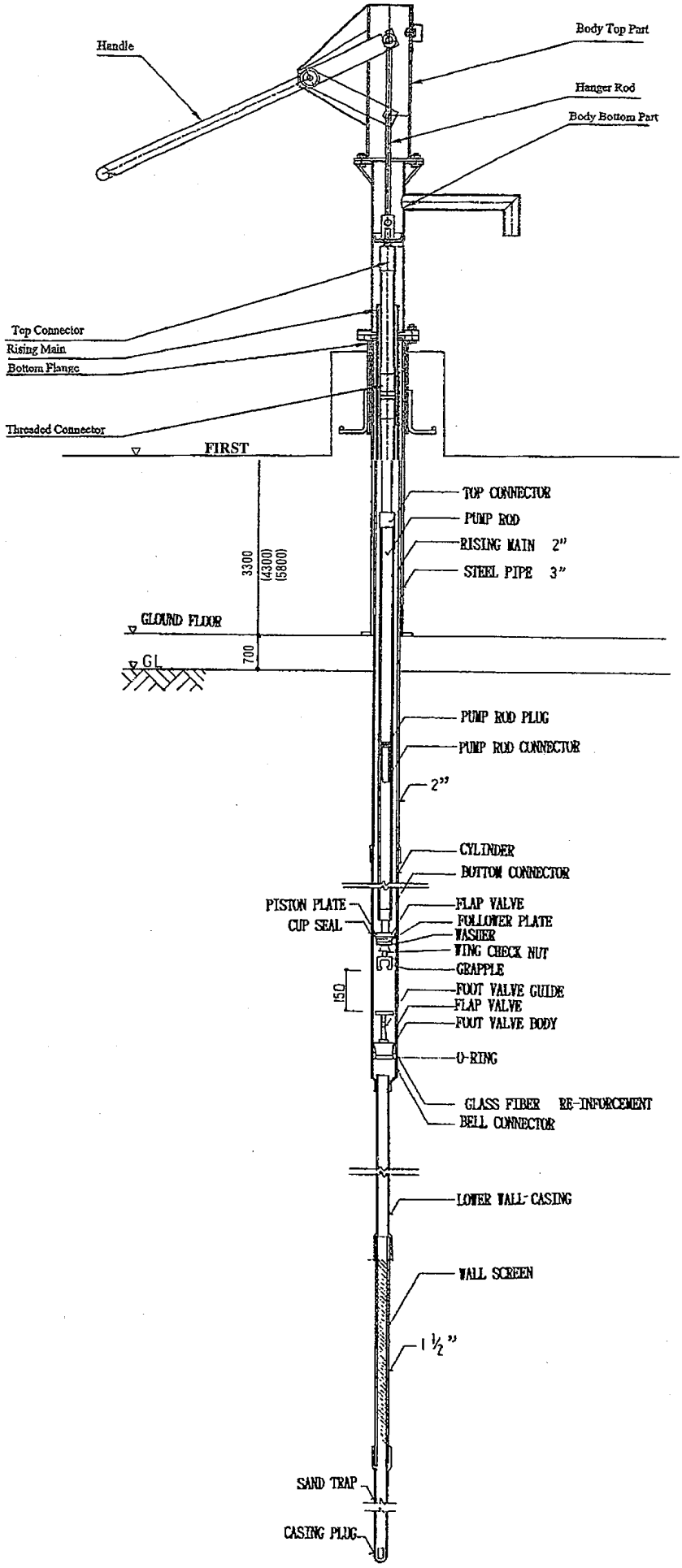


b-b SECTION S=1:100

SITE No.	H (m)	h (m)
V-1	10.85	4.3
V-2	9.85	3.3
V-3	9.85	3.3
V-4	9.85	3.3
V-5	9.85	3.3
V-6	9.85	3.3
V-7	9.85	3.3
V-8	9.85	3.3
V-9	9.85	3.3
V-10	9.85	3.3
V-11	9.85	3.3
V-12	9.85	3.3
V-13	9.85	3.3
V-14	9.85	3.3
V-15	10.85	4.3
V-16	9.85	3.3
V-17	9.85	3.3
V-18	10.85	4.3
V-19	12.35	5.8
V-20	12.35	5.8

Name of the Project: THE PROJECT FOR THE CONSTRUCTION OF MULTIPURPOSE CYCLONE SHELTERS(V)	No. 33
SECTION	Scale 1:100
Approved by / Designed by / Drawn by	Date / /'99
JAPAN ENGINEERING CONSULTANTS CO.,LTD.	

DRAWING NO. 34 SECTION OF HAND PUMP AND DEEP WELL



3-2-4 Implementation Plan

3-2-4-1 Implementation Policy

(1) Basic Issues Relating to Project Implementation

The implementation of the Project will require a cabinet decision by the Government of Japan after examination of the Project contents by various related organizations in Japan based on the Basic Design Study Report. The implementation stage of the planned Project as a grant aid project of the Government of Japan will commence following the signing of the Exchange of Notes (E/N) regarding project implementation between the Government of Bangladesh and the Government of Japan after the said cabinet decision.

The Project will be implemented based on an agreement / contract between the implementing organization in Bangladesh and a Japanese consultancy firm and a Japanese construction company in accordance with the grant aid scheme of the Government of Japan. These agreements must be verified by the Government of Japan.

(2) Implementation System

The MLGRD&C will be the implementing organization on the Bangladesh side and will be responsible for coordination of the signing of the E/N regarding the implementation of the Project between the two governments and also for project implementation. The actual front work will be conducted by the LGED.

The LGED will be party to a design/supervision agreement with a Japanese consultancy firm and the construction contract with a Japanese construction company. The LGED will also be responsible for coordination work with other departments, including general management of the work to be conducted by the Bangladesh side, Banking Arrangement (B/A), issue of the Authorisation to Pay (A/P) and supervision of the construction work.

(3) Consultant

Following the signing of the E/N by the two governments, the LGED will conclude the design/work supervision agreement for the Project with a Japanese consultancy firm (the consultant). The consultant will execute the following work in accordance with this agreement.

① Detailed design : detailed design, including the test drilling of a deep well at nine sites (preparation of the tender documents also included here)

② Tender : selection of the contractor through tender and assistance for the signing of the construction contract

③ Work supervision : supervisory work up to the completion of the construction work

(4) Contractor

The contractor will be selected through open competitive bidding preceded by the pre-qualification process. In this way, only those Japanese companies with suitable qualifications will be allowed to participate in the bidding process. In principle, the bidder with the lowest bid will be announced as the successful bidder and will conclude a construction contract with the LGED.

Following verification of the construction contract by the Government of Japan, the contractor will execute the work within the planned period set forth in the contract and will hand over the completed facilities to the LGED after successful completion inspection.

(5) Areas and Methods of Use of Local Consultant and Local Construction Companies (Subcontractors)

As already described in 3-2-1(5) explaining the concept of using local construction companies, it is judged to be essential to use such companies as subcontractors because of their detailed knowledge of the relevant local conditions for the Project, including the situation of the construction industry, social conditions and customs. There are 20 project sites and it is believed to be necessary to divide the sites (into four blocks or so) and to use a subcontractor for each block in view of the material procurement capacity, labour recruitment capacity, number of engineers and past performance, etc. of local construction companies. In regard to work supervision, while the dispatch of Japanese engineers is a precondition, the use of a local engineer who is familiar with the supervision of local workers as assistance supervisor is deemed to be necessary in view of the local work practices, social customs and other relevant conditions.

3-2-4-2 Implementation Conditions

Special attention will be paid to the following points in connection with the implementation of the Project in view of the work performance during the Phase I through Phase IV Projects, the

situation of the local construction industry and labour and the local meteorological conditions, etc.

(1) Procurement of Materials

The procurement of materials is a particularly important issue given the questions relating to schedule control and quality control described later.

As already described in 3-2-1(4)-3), the bulk procurement of reinforcing bars and cement from local manufacturers who can supply products of a stable quality within the specified delivery period (although some of the reinforcing bars will be procured in a third country) is necessary.

In the case of window frames, doors, fixtures, including student desks and chairs, and equipment, including water pumps, each item should be procured in bulk from a single manufacturer who enforces strict quality control as the quality of these items substantially varies from one manufacturer to another.

The supply source for aggregates differs for each block was described in 3-2-4-1 (5). As the strength of concrete is considerably affected by the quality of the aggregates used, the enforcement of strict quality checks will be essential to ensure uniform quality.

(2) Schedule Control

For the implementation of the various types of construction work, the critical path at not only each site but also in the overall work schedule must be clarified and strictly adhered to. For this reason, liaison meetings which are attended by all people involved in work supervision should be regularly held to strictly enforce the management criteria regarding the completed work amount and to raise their sense of participation in the Project. In particular, the pile work and foundation work which must be completed at an early stage of the construction work must be conducted under dry conditions because of their involvement of earth work. Once the rainy season commences, the ground stays muddy for a long period of time, making it impossible to proceed with these types of work. Accordingly, the work schedule must plan their completion prior to the commencement of the rainy season.

It has been substantiated by past performance records that the work efficiency of local workers declines by approximately 40% during Ramadan (the month of fasting). The rate of work progress should, therefore, be kept low and careful attention should be paid to schedule control during this period.

(3) Quality Control

While the facilities to be constructed are classified into three types (three, four and five classroom types), the building specifications are almost identical for all types. Following the practice introduced in the Phase IV Project to improve the work quality, the construction work will commence with a model building so that the design features, structural tidiness and details of the general finishing can be carefully examined to ensure the uniform work quality of all the buildings.

In regard to the quality control of concrete, special attention must be paid to the control and storage of such materials as aggregates, cement, forms and reinforcing bars, etc. as well as the casting method, etc. to prevent any decline of the quality as the concrete will be entirely mixed on site. All of the participants of the above-mentioned liaison committee will be made fully aware of the control criteria for the work quality to achieve a uniform work quality.

(4) Safety Control

As several subcontactors will conduct the construction work at designated sites, liaison meetings for safety control will also be held to foster safety control awareness to ensure work safety. Special attention should be paid to the following issues.

1) Communication links should be constantly maintained between each site and the Chittagong Office using mobile phones.

2) A morning meeting should be held every day at each site to strictly enforce safety control.

3) The transportation of materials during the rainy season always involves a risk of slippage or falling into a pond, etc. because of the poor road conditions, making it essential to maintain reasonable road conditions by means of constant repair. No transportation of materials to an island will be conducted during the rainy season because of the high risk posed by violent sea.

4) If a cyclone is anticipated, early evacuation should be ordered without exception. Construction materials, etc. should be stored in the warehouse and should be anchored to the ground to prevent them being scattered.

5) Close communication with the LGED and the local police should be maintained. If any risk to workers is perceived because of a general strike by transport workers,

demonstration, protest or election, etc., the safety of workers should be ensured by means of employing appropriate measures, including temporary suspension of the work.

3-2-4-3 Scope of Works

The scope of works for the Japanese and Bangladesh sides under the Project is shown in Table 3-2-4-1.

Table 3-2-4-1 Scope of Works

	Scope of Execution and Procurement
Japanese side	・ Construction of 20 shelters ・ Furnishing of said shelters ・ Water supply equipment (deep wells, pumps, rainwater tanks) (including 9sets of arsenic removal devices) ・ Drainage equipment (septic tanks, soak wells)
Bangladesh side	・ Preparation of construction sites (removal of existing facilities, acquisition of additional land) ・ Construction of access roads ・ Construction of killas

3-2-4-4 Consultant Supervision

Following signing of the Exchange of Notes and the consultancy agreement, the consultant will implement the detailed design, prepare the tender documents, act on behalf of the Government of Bangladesh in the tender, and carry out the supervision of the shelter construction work following signing of the construction contract.

(1) Preparation of Detailed Design and Tender Documents

Based on the survey drawings at the time of the basic design, the boring survey results, and the further detailed field survey at the time of the detailed design (including test drilling of deep wells at nine sites in the arsenic contaminated areas of Miresharai and Patiya Upazilas), the consultant will prepare the detailed design drawings and documents necessary for the tender, and then hold discussions with and obtain approval for those contents with the Government of Bangladesh.

(2) Agent of Tender Work

Acting on behalf of the Government of Bangladesh, the consultant will publicly notify the prequalification, accept and evaluate tender applications, distribute tender documents, and receive, analyze and assess written tenders. It will also offer advice in contract negotiations between the Government of Bangladesh and the successful bidder and assist in signing of the contract between the said parties.

(3) Supervision of Construction Work

In accordance with the standard practice under the grant aid scheme of the Government of Japan, the consultant will organize a consistent project execution team to ensure the smooth implementation of work supervision in line with the purport of the Basic Design. The following principles will be adopted for the work supervision for the Project.

1) Maintenance of close communication with those relating to the Project at various organizations in both countries with the aim of completing the construction of the facilities without delay.

2) Provision of fair guidance as well as advice for the contractor and other related parties in a swift and appropriate manner.

3) Witnessing of the handing over of the facilities after confirmation of the completion of the construction work and satisfactory execution of the contract conditions and completion of the work after obtaining the acceptance and approval of the Bangladesh side.

The important points for the supervision of the Project are listed below.

1) Maintenance of close communication with and regular reporting to the LGED which is the responsible organization for the implementation of the Project throughout the construction period for the purposes of (i) ensuring a full understanding of the purposes of the Project and the cooperation of the Bangladesh side and (ii) urging related bodies to implement tax exemption measures and budgetary measures

2) Preparation of a “work supervision plan”, examining particularly important items in regard to quality, completion amount, schedule, safety and hygiene, etc., and discussion of these items with those responsible of the LGED

3) Full examination of the work plan and working drawings submitted by the contractor prior to the commencement of the work with a view to assessing the appropriateness of the schedule plan, work execution system, work methods, temporary work plan, quality control plan, procurement plan and safety control plan.

4) Holding of regular meetings with the contractor throughout the work period to check, discuss and instruct on the situation of work progress, control of quality and completed amount and control of safety and hygiene while witnessing various work inspections. The minutes of these meetings will be distributed to related bodies as official records and any design alteration will be reported in advance to the Government of Japan via the JICA.

5) Inspection of the attendance of representatives of the LGED and the contractor to determine whether or not the facilities satisfy the functions and performance stipulated by the design documents prior to the handing over of the facilities on their completion and issue of appropriate instructions to the contractor if any modification is found to be necessary

6) Preservation of such materials as the specifications, work plans, work records, completion drawings, photographs and design changes, etc. for a period of 10 years.

(4) Staff Plan

The anticipated work volume of the consultant under the Project is huge, partly because of the fact that as many as 20 sites are scattered over a wide area and partly because of the fact that the consultant will be involved in (i) witnessing designed to maintain the quality and accuracy of the work (various tests and checking of the construction method and processes), (ii) guidance and adjustment regarding schedule and safety control, etc. and (iii) consultation with and reporting to related organizations. The following work supervision system will, therefore, be introduced to ensure the smooth implementation of the work.

1) Two full-time supervisors will be stationed in Bangladesh. While the chief supervisor will be a Japanese engineer, the appointment of a local engineer familiar with the required work supervision will be considered for the second post.

2) Spot supervisors (general supervisor and hydrological/geological engineer) will be dispatched at appropriate times in reflection of the importance of the work to be supervised.

The required staff and their work assignments to conduct the work supervision by the consultant under the system described above are listed below.

1) Overall Supervision (spot supervision)

- General administration of the commencement and final inspections on the shelter construction work.

2) Construction Supervision (resident supervision)

- Decision on immediate responses to any problems that may arise during execution
- Schedule control
- Inspection and approval of quality control and materials control carried out by the contractor
- Intermediate and final inspections of the shelter construction work

3) Construction Supervision (assistance for resident supervision)

- Assistance for schedule control
- Assistance for inspection of quality control and materials control carried out by the contractor
- Assistance for intermediate and final inspections of the shelter construction work

4) Hydrology (spot supervision)

- Test drilling of deep wells at nine sites located in arsenic contamination areas (Miresharai and Patiya Upazilas) at the time of the detailed design and water quality test and supervision of deep well construction at the construction stage.

The test deep wells drilled at the detailed design stage will be given a pump head at the construction stage and will then be used as part of the new facilities.

3-2-4-5 Quality Control Plan

The facilities to be constructed under the Project will be reinforced concrete cyclone shelters. Based on the work results in the Phase I through Phase IV Projects, the consultant will instruct the contractor to conduct the analysis/testing of the items listed in Table 3-2-4-2 with a view to fully reflecting the analysis/test results on the quality control.

Table 3-2-4-2 Inspection and Test Methods Relating to Quality Management

Type of Work	Management Item	Testing (Inspection) Method	Testing Frequency
Foundation work	Bearing strength	Plate bearing test	One place of each spread foundation
	Pile supporting layer	Comparison between excavated soil and boring test data; measuring	For each pile
Concrete work	Size of aggregates	Sieve-analysis test	Once
	Admixture; water-cement ratio	Test mixing test	Once
	Compressive strength	Compressive strength test	Once for each member
	Slump	Slump test	Once for each member
Reinforcing bars	Tensile strength	Tensile strength test	Once for each size
	General quality	Mill sheet inspection	Once for each size
	Bar arrangement	Bar arrangement test	Prior to concrete placing
Brick work	Brick quality	Factory inspection	Once
Doors and windows	Quality of doors and windows	Visual inspection; measuring	At the time of delivery
Furniture and fixtures	Quality of furniture and fixtures	Visual inspection; measuring	At the time of delivery

3-2-4-6 Procurement Plan

As a result of the market survey conducted in Bangladesh, it was found that all the equipment and materials needed to construct the Project facilities can be basically procured in Bangladesh. Table 3-2-4-3 shows the procurement sources and production/manufacturing areas of the major equipment and materials in the Project.

Table 3-2-4-3 Procurement Sources and Production/Manufacturing Sites of Equipment and Materials

Equipment/Materials	Procurement Source	Production or Manufacturing Area
Cement	Chittagong	Chittagong
Sand	Chittagong	Sylhet
Gravel	- do -	- do -
Rock for crushed stone	- do -	- do -
Reinforcing bars	Chittagong / third country	Chittagong / third country
Bricks	Around the sites	Around the sites
Paint	Chittagong	Chittagong
Furnishings	- do -	- do -
Sanitary ware	- do -	- do -
Deep-well pumps	- do -	Dhaka
Arsenic removal devices	Dhaka / Japan / third country	Dhaka / Japan / third country

In the case of reinforcing bars, their import will be more cost effective and the total construction cost will be chapter. However, the transportation of imported bars to the project sites will take some two months, making the completion of the Project in accordance with the schedule shown in Table 3-2-4-4 difficult to achieve. Accordingly, it will be necessary to procure reinforcing bars for foundations locally and to import reinforcing bars for the superstructure by import. On this basis, the ratio of imported reinforcing bars is estimated to be approximately 65% of the total.

In the case of arsenic removal devices, the most suitable devices will be selected based on the latest information available at the time of the detailed design and the supply source will be decided accordingly.

3-2-4-7 Implementation Schedule

(1) Implementation Schedule

The work under the Project can be divided into the detailed design work (including the tender) and the shelter construction work. In regard to the detailed design work, the Bangladesh side (LGED) will conclude a consultancy agreement regarding the detailed design for the Project with a Japanese consultant after the signing of the E/N. Following the signing of this agreement, the consultant will conduct a field survey, including the test drilling of deep wells at six sites in Miresharai Upazila and three sites in Potiya

Upazila where the level of arsenic concentration of the groundwater is inferred to be high. The consultant will report the findings of this field survey to the LGED and will also prepare the tender documents and specifications for their approval by both the Government of Japan and the Government of Bangladesh. It is expected that five months will be required from the signing of the E/N to the completion of the detailed design stage.

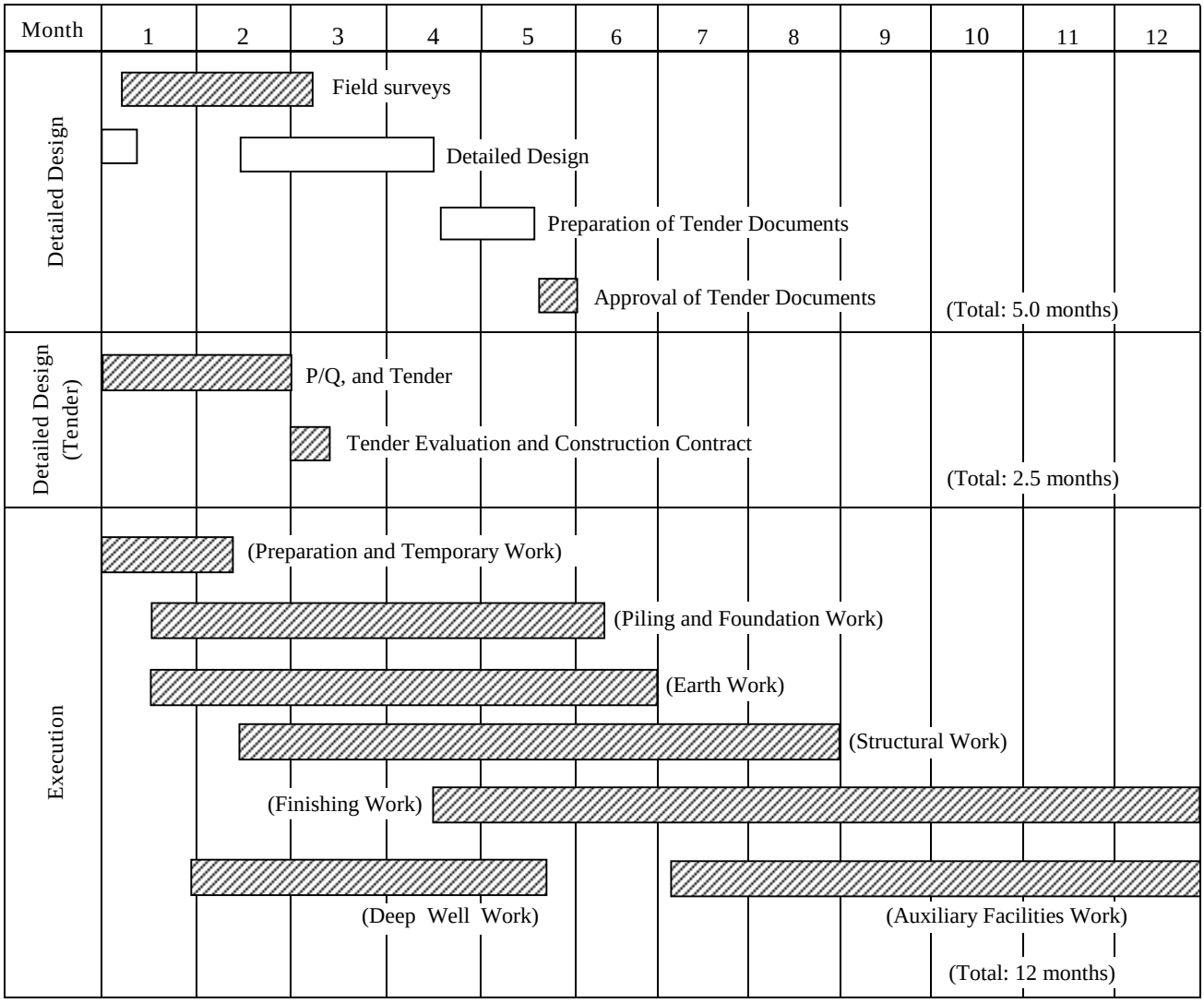
Following the signing of the consultancy agreement with a Japanese consultancy firm for the construction supervision, the tender for the construction work will then be held with prequalified Japanese construction companies. The successful bidder will conclude a construction contract with the LGED to commence the work. In consideration of the rainy season, it is expected that five months will be required from the signing of the consultancy contract to the signing of the construction contract.

The construction work of the 20 cyclone shelters is expected to take 12 months to complete after its commencement.

(2) Implementation Schedule Table

The implementation schedule for the Project, taking the conditions described above into consideration, is shown in Table 3-2-4-4.

Table 3-2-4-4 Implementation Schedule



3-3 Obligations of Recipient Country

For the implementation of the Project, it will be necessary for the Bangladesh side to undertake the wide range of work described below.

(1) Additional Land Acquisition at Some Project Sites

At the following 14 sites, the area of the existing site is not sufficient for the construction of the planned facilities, necessitating the additional land acquisition.

Site No.	Area of Existing Land (m^2)	Minimum Requirement for Additional Land (m^2)
V-1	2,833	405
V-2	1,012	1,050
V-3	1,048	890
V-5	1,807	784
V-9	889	125
V-10	727	560
V-11	858	630
V-12	982	700
V-13	696	216
V-14	1,290	880
V-16	799	175
V-17	1,684	240
V-18	1,416	975
V-20	1,400	415
	Total	8,045

(2) Removal of the existing facilities prior to the commencement of the construction work under the Project

At the following four sites, the existing school buildings have deteriorated, posing an obstacle to the construction of the planned facilities. The removal of such buildings, is, therefore, necessary.

Site No.	Facility to be Removed
V-4	Two existing school buildings out of four (brick built with zinc roofing)
V-13	Existing school building (brick built with zinc roofing)
V-17	Existing school building (brick built with zinc roofing)
V-20	Existing school building (brick built with zinc roofing

(3) Construction of a killa near the Project Site

The findings of the detailed site survey at the basic design study stage and the evaluation of post-projects for phase I through Phase III conducted by JICA confirmed that there is a lower tendency compared to the past for people to stay in their homes to protect domestic animals. The principal reasons for this are listed below. Items which are indicated as being taken at the time of evacuation are a small amount of food and clothing, etc., illustrating the fact that evacuation is rarely accompanied by domestic animals. This situation appears to suggest a lower need for a killa compared to the past.

1) In the past, there have been many cases where people have lost their lives trying to protect domestic animals, which are valuable assets, at the time of a cyclone. Educational activities over many years in regard to cyclones have, however, now reduced the tendency of local residents to remain in their homes to protect their animals.

2) The recent improvement of the forecasting and warning system has made it possible for local residents to obtain vital information and to move their animals to a safe place prior to the arrival of a cyclone.

3) The improvement of the road network has shortened the time required to move animals to a safe place nearby, including high banked sites.

Nevertheless, as the existence of a killa is still deemed to be necessary in view of the storm surge height with a return period of 50 years in the HRA and the number of animals around each site, a killa will be constructed near each shelter by the Bangladesh side.

In principle, this killa will be constructed next to the shelter and its site should be large enough to accommodate domestic animals and household goods.

The decision on the actual killa size at each site is made with reference to the number of domestic animals per person by Upazila given in the Master Plan, the accommodation capacity of each shelter and the specifications adopted by the Phase I through Phase IV Projects (see Appendix 6-6 for further details).

The size of the killa at each site is shown in Table 3-3-1.

Table 3-3-1 Required Killa Size

Site No.	Killa Size (m)
V-1	61 x 52 x 5.0
V-2	61 x 28 x 3.0
V-3	61 x 28 x 3.0
V-4	61 x 28 x 2.5
V-5	61 x 34 x 3.5
V-6	61 x 42 x 4.0
V-7	61 x 39 x 3.5
V-8	61 x 39 x 3.5
V-9	61 x 33 x 2.5
V-10	61 x 30 x 2.0
V-11	61 x 33 x 2.5
V-12	61 x 27 x 1.5
V-13	61 x 40 x 3.5
V-14	61 x 37 x 2.5
V-15	61 x 54 x 5.0
V-16	61 x 39 x 3.5
V-17	61 x 31 x 2.0
V-18	61 x 44 x 4.5
V-19	61 x 54 x 6.0
V-20	61 x 59 x 6.5

Notes Bottom length x bottom width x height

Slope gradient of 1:2

(4) Improvement (or construction) of an access road to each site

Local roads providing the final access to each target site are mostly unpaved, allowing passage by four-wheel drive cars or small trucks during the dry season. These roads become muddy during the rainy season and even four-wheel drive cars often find it difficult to use them. Given such conditions, improvement of these roads by means of laying bricks is necessary prior to the commencement of the construction work to prevent any disruption of the said work while maintaining the existing road width.

(5) Required number of teachers to run the primary school after the completion of the new building and the distribution of students

1) Judging from the existing number of teachers and the maximum number of classrooms per shift, it will be necessary to increase the number of teachers by one each at Site Nos. V-13 and V-20, by two at Site No. V-18, by three each at Site Nos. V-1, V-14 and V-15 and by five at Site No. V-7 (18 in total) to ensure the maximum use of the educational facilities.

2) Following the completion of the new building, there will be a classroom shortage of three at Site No. V-1, four at Site No. V-4, two at Site No. V-6, five at Site No. V-7, one at Site No. V-14 and three at Site No. V-15. At these schools, it will be necessary to distribute students on the grounds that the existing classrooms will also be used.

(6) Payment to the commissions to a Japanese bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commissions.

(7) Ensuring prompt unloading and customs clearance at ports of disembarkation in Bangladesh and internal transportation therein of the products purchased for the Project.

(8) Exempting Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Bangladesh with respect to the supply of the products and services under the verified contracts.

(9) According Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contracts such facilities as may be necessary for their entry into the Bangladesh and stay therein for the performance of their work.

(10) Maintenance and effective use of the facilities and equipment provided with Japanese grant aid.

(11) Payment of all expenses which are not covered by the Japanese grant aid.

In regard to Item (1) above, it is essential that the LGED be urged well in advance to complete this item prior to the signing of the E/N as the acquisition of additional land will require at least four months to complete.

Item (2) and Item (5) will require collaboration with the MOPME and should be conducted through consultations at the central, Upazila and site levels.

3-4 Project Operation Plan

(1) Operation and Maintenance System

The MOPME will be the competent authority for the operation and maintenance of the cyclone shelter-cum-primary school buildings after their completion and the DPE, a subordinate organization of the MOPME, will be in charge of the actual operation of these facilities. The arrangements for operation and maintenance are described below separately for normal times and at the time of a cyclone.

1) Operation and Maintenance at Normal Time

Government primary schools are run by education offices set up at the division, district and upazila levels. A divisional education officer, district primary education officer (DEO), upazila education officer (UEO) and assistant upazila education officer (AUEO) are assigned to the relevant education offices. Although the divisional education office is supposed to control the DEOs, DEOs are actually controlled directly by the Director of the DPE in Dhaka. The authority of the divisional education office is rather limited as illustrated by the fact, for example, that budget requests are directly made by each DEO to the Director of the DPE. While the district and upazila education offices are generally responsible for the operation of schools, enhancement of leadership ability of these others is desirable.

At the upazila level, an upazila primary education committee consisting of the members listed in Fig. 3-4-1 is organized. This committee plays the roles of channelling requests for the maintenance budget, assisting the operation and management of primary schools in the upazila and solving the financial, educational and management problems of each school in addition to having the power to decide the priority ranking of schools in the upazila for distribution of the maintenance budget. The AUEO is the main provider of information on primary schools in the upazila to the upazila primary education committee. Each AUEO supervises some 20 primary schools within its area of jurisdiction (Upazila) and visits approximately 10 primary schools every month for monitoring purposes. Based on the information obtained by monitoring, the AUEO prepares a priority list of primary schools in need of repair and submits this list to the upazila primary education committee.

- Main primary school monitoring items by AUEO

  ① Conditions of school building
  ② Enrolment situation of school-age children

③ Activities of the School Management Committee (SMC)
④ State of cleaning of classrooms and toilets, etc.
⑤ Teaching contents by teachers

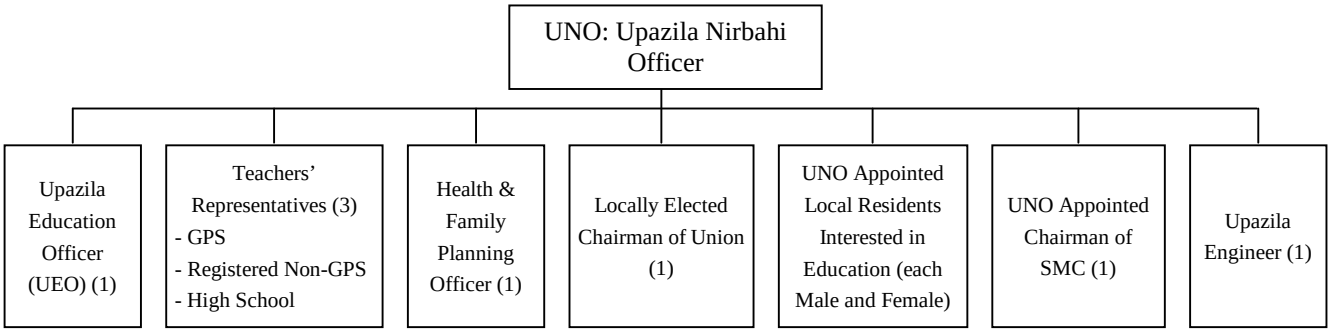


Fig. 3-4-1 Organization of Upazila Primary Education Committee

Each school has its own SMC which meets once a month. This SMC is responsible for the support and supervision of teachers and also for school maintenance. When a school is in need of repair, the SMC submits the relevant proposal to the upazila primary education committee.

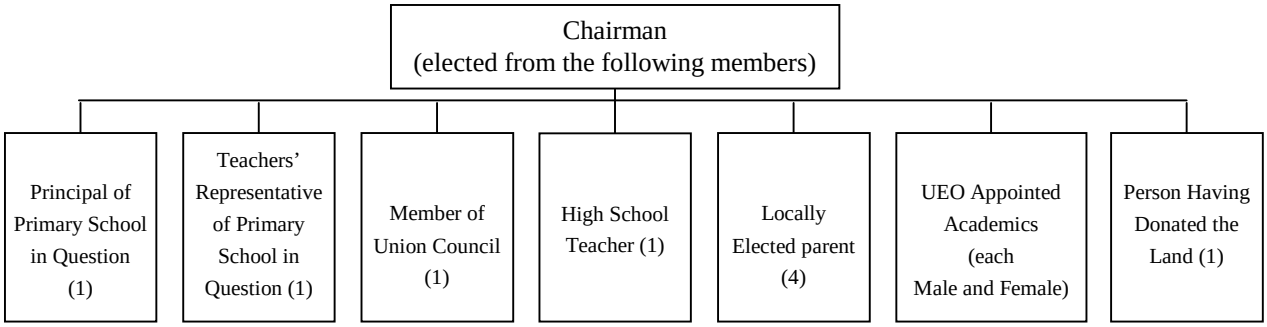


Fig. 3-4-2 Organization of SMC

Even though the roles of the SMC are set forth, its actual ability and willingness to be involved in school management vary from one school to another.

Table 3-4-1 shows the roles of the organizations involved in primary education and their degree of involvement in operation and maintenance. Both the divisional and district education offices are intermediaries between the central government and the upazila education offices and cannot be said to play an actual role in operation and maintenance. The authority of the divisional offices in particular is limited in this regard.

Table 3-4-1 Roles of Organizations Involved in Primary Education and Their Degree of Involvement in Maintenance

Organization	Roles	Degree of Involvement in Maintenance
MOPME	・Decisions on primary and adult education policies and implementation of development programmes	○
DPE	・Control of primary schools and teachers ・Provision of advice to the government on primary education ・Formulation and implementation of development schemes for primary education	◎
Divisional Education Office	・Control of related organizations in the division ・Monitoring of primary education activities in the division	×
District Education Office	・Monitoring of upazila education offices ・Inspection of upazila education offices and primary schools ・Selection and assignment of teachers in the district ・Evaluation of DEOs	△
Upazila Primary Education Office	・Implementation of issues decided by the upazila primary education committee ・Inspection of primary schools ・Monitoring of primary schools and teachers ・Provision of guidance for principals, teachers, SMCs and PTAs ・Assignment of teachers in the upazila ・Implementation of training	◎
Upazila Primary Education Committee	・Solving of the financial, educational and management problems of government primary schools	◎
School Management Committee (SMC)	・Provision of support for and monitoring of teachers ・Maintenance of school facilities	◎

Note: ◎; very high; ○; high; △; low; ×; not involved

The budget for the maintenance of government primary school facilities is secured at the central government level (ordinary and development budgets). Very limited budgetary funding for maintenance is available at the local level (upazila primary education offices and primary schools).

[Routine Maintenance]

Most of the ordinary budget is used to cover the salaries of teachers and administrative staff and the maintenance budget is only available for routine maintenance (such as the repair of furniture, windows and pump as well as the replacement of parts; see Tables 3-4-2 and 3-4-3). Up to TK 30,000 (up to TK 500,000 – 700,000 as the total amount for one Upazila) is distributed to each school in need of simple maintenance work.

Table 3-4-2 Breakdown of Current Budgetary Expenditure for Primary Education (1995)

Teacher/Staff Salaries	Teacher Training	Distribution of Textbooks	Repair and Management	Indirect Cost
95.7%	0.2%	0.1%	0.4%	3.6%

Source: Based on Jalaluddin (eds.), Getting Started, 1997, p. 151

Table 3-4-3 Historical Trend of Primary School Maintenance Budget (Unit: TK'000)

Year	2000 – 2001	2001 – 2002	2002 – 2003
Primary School Maintenance Budget	105,200	109,700	110,700

Source: MOPME

Depending on the scale of the perceived maintenance cost, the maintenance budget is requested to the upazila primary education office but such request is not necessarily approved because of the budgetary limit. There is no mechanism to save up the necessary funds at each school. The detailed site survey found that maintenance expenditure was recorded at six of the 22 sites surveyed. The actual amounts were TK 5,400, TK 12,000, TK 1,200, TK 3,000, TK 1,800 and TK 1,104, illustrating the very small scale of the repair work conducted at these sites with mostly contributions from parents and local donations.

Apart from the central government budget, there are local sources to fund the maintenance budget at the level of the upazila primary education office. One of these is the annual development programme (ADP) which gives funding priority mainly to the communication and agricultural sectors. Another is called the upazila polishad fund, the revenue of which comes from rents, bazaars and auctions. According to the upazila primary education committees, however, although these funds can be used to finance repair work at primary schools, there is no precedence of such use because of the low priority of school repair.

As part of the routine maintenance of primary school facilities, cleaning is conducted prior to lessons in the case of single shift schools and prior to and after lessons in the case of double shift schools.

[New Construction or Rebuilding of School]

The cost of the rehabilitation or rebuilding of primary schools or the construction of new primary schools is funded by the development budget (see

Tables 3-4-4 and 3-4-5). An upazila education office can apply for funding by the central government with an upper limit and lower limit of TK 250,000 and TK 100,000 respectively per school. When repair is essential despite the non-appropriation of the repair budget, a project fund is set up to finance the work.

Table 3-4-4 Breakdown of Expenditure under Development Budget for Primary Education (Average for 1990 – 1995)

School Construction or Repair	Teacher Training	Supply and Distribution of Textbooks	Indirect Cost
92.0%	1.2%	5.1%	2.2%

Source: Based on Jalaluddin (eds.), Getting Started, 1997, p. 152

Table 3-4-5 Historical Trend of Primary School Repair Budget under Development Budget

(Unit: TK '000)

Year	2000 – 2001	2001 – 2002	2002 – 2003
Repair Budget	188,550	168,350	185,400

Source: MOPME

2) Operation and Maintenance at Time of Cyclone

At the time of a cyclone, the operation and maintenance of school facilities, including guidance for local residents to the shelter and safety management at the time of evacuation, are conducted by the site-level disaster management committee consisting of the members listed below, with the cooperation of the DPE and CPP.

- Union members
- SMC members
- NGO representative(s)
- CPP members
- Village representative selected by local residents
- Village representative (Gram Shalker) selected by the government

Other related bodies include the disaster management committee (DMC) at the district, upazila and union levels. All DMCs determine the disaster prevention and control activities at four stages, i.e. normal times, at the time of the issue of a warning, at the time of a disaster and at the time of rehabilitation. The main

activities are the storage and distribution of relief goods, formulation of an action plan specifying the disaster prevention/control measures, disaster prevention exercises, coordination of various aid organization and the issue of warnings.

(2) Operation and Maintenance Plan

While the SMC is responsible for the routine maintenance of existing school facilities, the main maintenance work is essentially cleaning by teachers and students. As every school has its own SMC, the members of which include a community leader, teachers and local residents, it is appropriate to make the SMC the responsible body for school maintenance. The situation of the shelters completed under the Phase I through Phase IV Projects suggests that the will and ability of and influence on the local community vary from one SMC to another and that the prospect of adequate school maintenance by the SMC largely depends on personal factors. Needless to say, while the will and ability of the teachers affect the school maintenance regime, consolidation of the SMC, which plays a leadership role for school maintenance, appears to be essential by means of the following measures.

① Such government staff as the UNO, UEO and Upazila Engineer of the Upazila Primary Education Committee should play a central role in sorting the monthly monitoring data provided by the AUEO to assist school management and should try to solve problems by providing further guidance for those SMCs of which the school management performance is found to be inadequate.

② Strengthening of the SMC by the upazila primary education committee (improvement of the SMC's motivation for routine maintenance and the thorough implementation of cleaning with the guidance of the AUEO)

③ Securing of budget for routine maintenance

Funding for ③ above relies on donations by the local community (parents, etc.) and it cannot be said that the necessary budget is totally secured. The Project calls for the involvement of the LGED, which is responsible for the practical work of constructing school facilities, in maintenance with a view to securing budgetary appropriation. At present, the LGED has decided to disburse TK 30,000/school/year for the routine maintenance of schools/shelters constructed or to be constructed with Japan's grant aid and has now commenced the procedure to secure the necessary budget.

Up to the previous phase, the ownership of the newly constructed school facilities (shelters) was transferred from the LGED to the MOPME (formerly the PMED) together with the responsibility for facility maintenance. From this phase onwards, however, it is planned for the routine maintenance of the school facilities (shelters) to be monitored by the upazila engineer of the LGED and for the cost of maintenance work (TK 30,000/school/year) to be borne by the LGED.

3-5 Estimated Project Cost

3-5-1 Estimated Project Cost

The total cost required to implement the Project is estimated to be ¥858 million and each side is expected to bear their respective cost given below based on the estimation conditions described in (3) later. The above cost estimate is provisional and will be further examined by the Government of Japan for its approval of the grant aid.

(1) Cost to be Borne by Japanese Side

Estimated Total Cost: Approximately ¥ 700million)

・ Noakhali District: 2 buildings; 7 classrooms

(Total floor area: approximately 1,170m^2)

Cost Item		Estimated Cost (¥ million)	
Facilities	School Building	72	75
	Furniture and Fixtures	3	
Detailed Design; Work Supervision			8

Estimated Cost (Sub-Total): approximately ¥83 million

・ Chittagong District: 17 buildings; 67 classrooms

(Total floor area: approximately 10,550m^2)

Cost Item		Estimated Cost (¥ million)	
Facilities	School Building	482	512
	Furniture and Fixtures	30	
Detailed Design; Work Supervision			68

Estimated Cost (Sub-Total): approximately ¥ 580 million

・ Cox's Bazar District: 1 building; 5 classrooms

(Total floor area: approximately 690m^2)

Cost Item		Estimated Cost (¥ million)	
Facilities	School Building	31	33
	Furniture and Fixtures	2	
Detailed Design; Work Supervision			4

Estimated Cost (Sub-Total): approximately ¥37 million

(2) Cost to be Borne by Bangladesh Side

TK76,530,000 (approx. ¥158.41million)

①	Additional land acquisition cost	:	TK580,000	(approx.¥1.2million)
②	Killa construction cost	:	TK15,180,000	(approx.¥31.42million)
③	Old building removal cost	:	TK440,000	(approx.¥0.91million)
④	Access road construction cost	:	TK60,000,000	(approx.¥124.20millioin)
⑤	Others	:	TK330,000	(approx.¥0.68million)

(3) Estimation Conditions

①	Date of estimation	:	April, 2003
②	Foreign exchange rates	:	US$ 1 = ¥121.79 TK 1 = ¥2.07
③	Project implementation period	:	The detailed design and construction periods are those indicated on the Project Implementation Schedule.
④	Others	:	The Project will be implemented in accordance with the grant aid scheme of the Government of Japan

3-5-2 Operation and Maintenance Costs

(1) Facility Maintenance

The planned facilities under the Project should be able to function properly provided that repair work, including repainting of the internal and external walls every 10 years is conducted together with their appropriate use.

Item	Frequency	Cost per Year
Repainting of external walls	Every 10 years	TK 12,450 (¥25,800)
Repainting of internal walls	Every 10 years	TK 13,750 (¥28,400)
Repair of peeling columns, beams and walls	As required	TK 2,000 (¥4,100)
Repair of doors and window	As required	TK 4,100 (¥8,500)
Total		TK 32,300 (¥66,800)

(2) Maintenance of Water Supply Facilities (Wed-Related Facilities)

For the maintenance of the water supply facilities, TK 450 (¥900) per building will be required for the procurement of spare parts for the pump and others.

(3) Maintenance of Sanitary Facilities

Although the facilities to be constructed under the Project will be basically maintenance-free, cleaning of the following facilities will at least be required. As the work will be conducted by local residents organized by the SMC, no cost will be incurred by such cleaning.

① Cleaning and management of the septic tank: cleaning of the septic tank and urinals and the dipping up of night soil (approximately once a year)

② Cleaning and management of the soak well: regular checking and cleaning (removal of foreign matters and dirt from the strainer)

(4) Annual Maintenance Cost

The total maintenance cost of (1) through (3) above will be TK 32,750 (¥67,700) a year per school.

The LGED will secure TK 30,000/school for the maintenance of the school facilities constructed under the Project as a separate budget from that for the educational sector.

Moreover, upazila engineers will conduct the routine monitoring of each primary school to ensure the smooth maintenance of these facilities. However, the amount of money to be allocated by the LGED will be insufficient and it will be necessary to consider requesting local residents who will benefit from the Project to make a financial contribution towards facility maintenance.

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATIONS

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATIONS

4-1 Project Effect

The implementation of the Project is expected to achieve the various effects described in Table 4-1-1.

Table 4-1-1 Effects/Degree of Improvement by the Project

Current Situation and Problems	Remedial Measures under the Project	Effects/Degree of Improvement by the Project
1. Some 6.4 million people live in the HRA (2002 estimate). To minimise the damage caused by cyclones, the construction of 2,500 cyclone shelters was planned in 1993. However, only 1,300 shelters have so far been constructed, leaving one-third of the population in the HRA unprotected against natural disasters associated with cyclones.	・ Construction of 20 new shelters in the HRA ・ Introduction of deep wells with hand pumps, toilets and septic tanks, etc. as auxiliary facilities	・ The construction of new shelters will protect the lives of 37,000 people at the time of a cyclone and a stable life will facilitate the permanent residence of people and promote local development.
2. Although the Government of Bangladesh has formulated the 2nd Primary Education Development Plan (PEDP-II) (2003 – 2008) to achieve a qualitative improvement of education, the overcrowding of classrooms due to the shortage of classrooms and the deterioration of school buildings have led to a situation where a safe learning environment with peace of mind is disrupted.	・ The new shelters will also function as primary school buildings. Each school building will have 3 – 5 classrooms and one teachers' room. The total number is 79 classrooms and 20 teachers' rooms. ・ Desks, chairs and blackboards will be provided as school furniture.	・ The shortage and overcrowding of classrooms will be alleviated at the primary schools at the target sites. - Cox's Bazar District 44 students/classroom (before the Project: 58 students/classroom) - Chittagong District 36 students/classroom (before the Project: 57 students/classroom) - Noakhali District 44 students/classroom (before the Project: 77 students/classroom) ・ The construction of new primary school buildings equipped with furniture, fixtures and auxiliary facilities will provide a far better learning environment for pupils.

4-2 Recommendations

The Bangladesh side should address the following tasks in order to ensure the continual and effective use of the cyclone shelter-cum-primary school buildings to be constructed under the Project with proper maintenance.

(1) Further Promotion of Cyclone Shelter Construction Projects and International Cooperation

Many lives and properties are lost in Bangladesh every time a cyclone hits the country and the construction of cyclone shelters is considered to be the sole effective measure at present to minimise the damage caused by such a fierce natural phenomenon.

The construction of cyclone shelters has been in progress in line with the country's Master Plan with the cooperation of Japan and other donors as well as aid organizations. Even though the target year of the Master Plan was already reached in 2002, only approximately half of the shelters (some 1,300 out of 2,500) had been constructed, illustrating the massive shortage of shelters. At one time, 16 organizations/countries provided assistance for the implementation of the Master Plan but general interest in shelter construction has declined, partly because of the absence of a large-scale cyclone since the great disaster in 1991, leaving only three countries, including Japan, actually planning or constructing shelters today.

It is possible to point out the following problems with the above-mentioned Master Plan which has passed some 10 years since its original formulation.

① As there is no domestic organization in Bangladesh to centrally control the implementation of the Master Plan, there is no accurate information regarding the required number of cyclone shelters in each area of the country. As a result, the construction of cyclone shelters has so far taken place in a disorderly manner.

② While the HRA was determined based on topographical information available in 1991, a major shift of the coastline has taken place in some areas, changing the actual geographical areas prone to a high disaster risk.

③ The population of the HRA is not very reliable as it is an estimate based on 1991 data.

④ Because of the absence of concrete site selection criteria, some cyclone shelters have been constructed at sites where they cannot function as shelters.

In order to overcome the problem of a shelter shortage through the continual implementation of the Master Plan, it is important to re-establish the status of the Master Plan as the official disaster prevention and development plan together with the introduction of a new target year by reviewing its contents, including the implementation body to play a central role, the operation and maintenance system, the geographical area of the HRA, the site selection criteria and the number of shelters to be constructed, so that the urgency of the implementation of the Master Plan is re-recognised by aid organizations and donors alike. At the same time, it is essential to establish a cooperation system whereby each donor is assigned a specific role by clearly determining the selection criteria for candidate shelter construction sites and their priority ranking with the cooperation of international aid organizations based on the experience of cyclone shelter construction in the past.

(2) Strengthening and Improvement of Maintenance System

The prospect of permanent use as a place for evacuation for local residents at the time of a cyclone is an essential requirement for cyclone shelters. However, the problem of insufficient maintenance has occurred with those shelters constructed under the previous phases (Phase I through Phase IV), partly because of the limited budgetary appropriation by the DPE which is responsible for routine maintenance. To solve this problem, it has now been decided that the LGED will participate in routine maintenance from Phase V and will set aside TK 30,000/site for the cyclone shelters constructed by Japan as separate funding from that of the DPE.

Nevertheless, given the tight fiscal situation of the Government of Bangladesh, it is judged to be difficult to permanently secure the LEGD budget for the purpose of cyclone shelter (primary school building) maintenance. What is crucial for cyclone shelter maintenance is the awareness and willingness of local residents to operate and manage such shelters as facilities which protect their own lives.

Accordingly, it is deemed necessary to actively implement educational activities to make local residents aware of the importance of the participatory maintenance of facilities, i.e. local residents as the beneficiaries to pay for the cost of maintenance, along with disaster prevention activities in progress with the backing of the government in Bangladesh by the SMC which is responsible for facility maintenance at each site.

Possible concrete measures to achieve a responsible maintenance system at each site include those described below.

① The SMC should play a central role in the establishment of a shelter management union in which all local residents using the shelter participate.

② A maintenance fund of which the funding sources are a government subsidy and a reserve contributed by members of the above union should be established with a view to financing the purchase of spare parts for the building and equipment.

③ Poor people who cannot contribute to the said reserve should play a role as union members by contributing their labour for cleaning and other types of maintenance work.

(3) Consolidation of Cyclone Preparedness Programme and Spread of Disaster Prevention Knowledge

The keys for the effective use of cyclone shelters at the time of a cyclone are the proper functioning of the Cyclone Preparedness Programme (CPP) and the spread of disaster prevention knowledge among local residents.

In regard to the CPP, a nationwide cyclone monitoring network using radar is already in place and warnings can be swiftly sent to shelter sites facing danger. The Bangladesh Red Crescent (BDRCS) is responsible for the issue of warnings and relief efforts at individual sites. However, the shortage of site staff means that the prospect of guiding local residents to a shelter is not totally satisfactory. In addition, the relief equipment in possession only meets the minimum requirement and is insufficient to ensure more effective relief efforts. Accordingly, financial support is required for the recruitment of manpower and the procurement of equipment.

Meanwhile, PR activities and education at schools are conducted together with disaster prevention exercises to spread disaster prevention knowledge. However, the vital message does not appear to have reached all individuals. Further efforts are necessary in this aspect and disaster prevention exercises should be conducted as a regular event as part of the efforts to effectively use cyclone shelters.

(4) Bank Erosion Control Measures

One of the 61 shelters constructed by Japan under the Phase I through Phase IV Projects has already been lost due to bank erosion while another is currently facing a danger of being lost due to scouring of its foundations. In the light of such a situation, the LGED should urgently establish a bank erosion monitoring system with the assistance of the BWDB to monitor the situation of riverbanks near the existing as well as future shelters.

The establishment of this system led by the LGED will enable routine checking of the possible impacts of bank erosion on shelters and the implementation of concrete, effective countermeasures (urgent bank protection work and the issue of an evacuation order for local residents) should a direct impact of bank erosion on a shelter building be assumed to take place. For the implementation of monitoring with the BWDB, it will be necessary for the LGED to examine the following matters in advance.

① Selection of target shelters for monitoring

② Setting up of the monitoring level (period and frequency) for each target shelter

③ Establishment of communication links with the BWDB (at both the national and local levels) and the communication methods (at normal times and at the time of an emergency)

④ Determination of the respective roles of the LGED and the BWDB in the analysis of monitoring data and the implementation of countermeasures

APPENDICES

APPENDIX 1 MEMBER LIST OF THE STUDY TEAM

APPENDIX 1 MEMBER LIST OF THE STUDY TEAM

1. Member List of the Study Team

Basic Design Study

Name	Assignment	Organization
Masaaki MATSUSHIMA	Team Leader	Director, 1st Project Management Div., Grant Aid Management Dept., JICA
Masayuki WATANABE	Technical Advisor	Specialist in Water Resources Development and Disaster Prevention, JICA
Daiki KUNITAKE	Planning Coordination	1st Project Management Div., Grant Aid Management Dept., JICA
Hisashi NOGUCHI	Grant Aid Management	Deputy Director, Grant Aid Div., Economic Cooperation Bureau, Ministry of Foreign Affairs
Sakae NAKAMURA	Chief Consultant	Japan Engineering Consultants Co., Ltd.
Shina OKAICHI	Education Planner / Social Environment	Japan Engineering Consultants Co., Ltd.
Hiroshi YONEHARA	Disaster Prevention Planner	Japan Engineering Consultants Co., Ltd.
Nobuyuki OKABE	Hydrological Planner	Japan Engineering Consultants Co., Ltd.
Keiji KOBAYASHI	Architectural Design / Facility Planner	Japan Engineering Consultants Co., Ltd.
Hisashi TAKADA	Procurement Planner / Cost Estimator	Japan Engineering Consultants Co., Ltd.

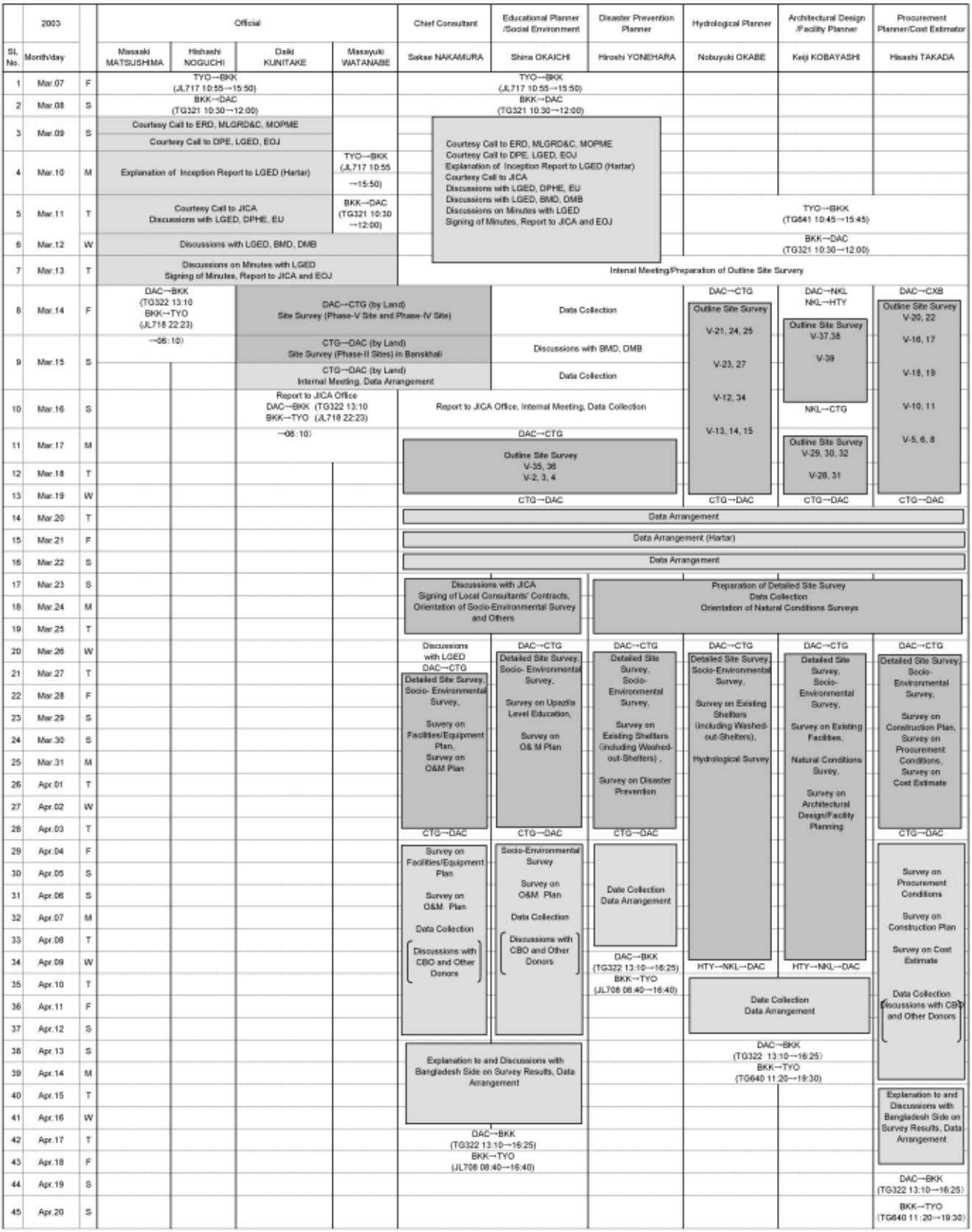
Draft Report Explanation

Name	Assignment	Organization
Takashi SAKAMOTO	Team Leader	Resident Representative, JICA Bangladesh Office
Sakae NAKAMURA	Chief Consultant	Japan Engineering Consultants Co., Ltd.
Hiroshi YONEHARA	Disaster Prevention Planner	Japan Engineering Consultants Co., Ltd.
Nobuyuki OKABE	Hydrological Planner	Japan Engineering Consultants Co., Ltd.
Hisashi TAKADA	Procurement Planner / Cost Estimator	Japan Engineering Consultants Co., Ltd.

APPENDIX 2 STUDY SCHEDULE

APPENDIX 2　STUDY SCHEDULE

Basic Design Study Schedule



(ABBREVIATIONS)
BMD : Bangladesh Meteorological Department, BWDB : Bangladesh Water Development Board, BKK : Bangkok, BKL : Banshkhali, BMD : Bangladesh Meteorological Department, COB : Concerned Bangladesh Organizations, CTG : Chittagong, CXB : Cox's Bazar, DAC : Dhaka, DPE : Directorate of Primary Education, DMB : Disaster Management Bureau, EOJ : Embassy of Japan, ERD : Economic Relations Division, EU : European Union, HTY : Hatiya, JICA : Japan International Cooperation Agency, LGED : Local Government Engineering Department, MLGRD&C : Ministry of Local Government, Rural Development and Cooperatives, MOPME : Ministry of Primary and Mass Education, NKL : Noakhali, TYO : Tokyo,

Draft Report Explanation Schedule

	2003		Official	Chief Consultant	Procurement Planner/ Cost Estimator	Disaster Prevention Planner	Hydrological Planner
SL No	Monthly/day		T.SAKAMOTO	S. NAKAMURA	H. TAKADA	H. YONEHARA	N. OKABE
1	July/ 04	Fri		NRT (10:55)→ →BKK (15:50)(JL 717)			
2	05	Sat		BKK (10:30) →DAC (12:00)(TG 321)			
3	06	Sun	(09:30) Discussions at JICA Office (10:30) Discussions at EOJ (14:00) Explanation and Discussions of D/R with ERD (15:00) Explanation and Discussions of D/R with MLGRD&C (16:30) Explanation and Discussions of D/R with LGED				
4	07	Mon		(09:00) Discussions with LGED (14:00) Explanation and Discussions of D/R with MOPME		(14:00) Discussions with MDMR	
5	08	Tue		(09:00) Discussions with LGED (14:00) Discussions with WB		(09:00) Discussions with BUET (14:00) Discussions with DMB (16:00) Discussions with BMD	
6	09	Wed	(09:00) Discussions of M/D draft with LGED Preparation of M/D		(09:00) Discussions with KfW (10:30) Discussions with Netherlands (14:00) Discussions with ADB		
7	10	Thu	(11:30) Signing of M/D (14:00) Report to EOJ		(09:00) Discussions with BAMWSP (10:00) Discussions with DPHE (12:00) Discussions with BWDB		
8	11	Fri		Additional Data Collection Team Meeting			
9	12	Sat		Additional Date Collection DAC (13:10)→BKK (16:25) (TG 322)			
10	13	Sun		BKK (08:40)→ →NRT (16:40)(JL 708)			

(ABBREVIATIONS)

ADB	:	Asian Development Bank
BAMWSP	:	Bangladesh Arsenic Mitigation Water Supply Project
BMD	:	Bangladesh Meteorological Department
BUET	:	Bangladesh University of Engineering and Technology
BWDB	:	Bangladesh Water Development Board
DMB	:	Disaster Management Bureau
DPHE	:	Department of Public Health Engineering
ERD	:	Economic Relations Division
KfW	:	Kreditanstalt für Wiederaufbau
LGED	:	Local Government Engineering Department
MDMR	:	Ministry of Disaster Management and Relief
MLGRD&C	:	Ministry of Local Government, Rural Development and Cooperatives
MOPME	:	Ministry of Primary & Mass Education

APPENDIX 3 LIST OF PARTIES CONCERNED IN THE RECIPIENT COUNTRY

APPENDIX 3 LIST OF PARTIES CONCERNED IN THE RECIPIENT COUNTRY

(1) Bangladesh Side

1) ERD

Mr. Iqbal Mahmood	Deputy Secretary
Mr. Eakul Ali	Deputy Chief
Mr. Md. Mafidul Islam	Assistant Chief

2) Ministry of Local Government, Rural Development & Cooperatives(MLGRD&C)

Mr. Md.Abdullah	Deputy Chief
Mr. Syed Mamunul Alam	Senior Assistant Chief

3) Local Government Engineering Department (LGED)

[Dhaka H.Q.]

Mr. Md. Shahidul Hassan	Chief Engineer
Mr. Md. Lokman Hakim	Superintending Engineer
Mr. Md. Zahangir Alam	Project Director (E.E)
Mr. Dhali Abdul Zalil	Project Director
Mr. A. B. M. Nazrul Islam	Senior Design Specialist

[Chittagong Xen Office]

Mr. Abdur Razzaque	Executive Engineer
Mr. A. N. M. Faizul Kabir	Upazila Engineer, Sandwip
Mr. Md. Adanan Akhtarul Azam	Upazila Engineer, Miresharai
Mr. N. Hassan Chowdhury	Upazila Engineer, Patiya
Mr. Md. Abu Taher Mollah	Upazila Engineer, Anowara
Mr. Md. Saniul Haque	Upazila Engineer, Banshkhali

[Cox’s Bazar Xen Office]

Mr. Abul Bashar	Executive Engineer
Mr. Syed Ahmed Based	Upazila Engineer, Chakoria

[Feni Xen Office]

Mr. Md. Abdul Kader	Executive Engineer
Mr. Abdur Razzaque	Upazila Engineer, Sonagazi

[Noakhali Xen Office]

Mr. Md. Abdul Quader	Executive Engineer

4) Ministry of Primary & Mass Education (MOPME)

Mr. Kazi Farid Ahammed	Joint Secretary
Mr. Md. Altaf Hossain	Deputy Chief
Mr. A. Q. M. Shafiul Azam	Assistant Chief of Planning
Mr. Jalal Ahamed	Assistant Chief of Planning

5) Directorate of Primary Education (DPE)

[Dhaka H.Q.]

Mr. A. M. Mosaddequl Islam	Director General
Mr. Mhammad Ibrahim	Deputy Director General
Mr. A.K.M. Abdul Moctadir	Director of Planning and Development

[Chittagong Office]

Mr. Md. Nurul Amin Chowdhury	District Primary Education Officer
Mr. Sharial Chowdhury	Upazila Education Officer, Mirsharai

[Baskhali Upazila Primary Education Committee]

Mr. Nur Mohammad Mazumder	Upazila Nirbahi Officer
Mr. Mo. Sniul Haque	Upazila Engineer
Mr. Tapan Kanti Chowdhury	Upazila Assistant Education Officer
Mr. Badal Krishna Drolta	Upazila Assistant Education Officer
Dr. Didaruw Alam	Upazila Health & Family Planning Officer
Mr. Muhammad Nowab Ali Chowdhury	Model High School Head Master
Mr. Mustafa Ali	Alaol Degree Collage Demonstrator
Mr. MD Abdul Awal	GPS Head Master
Mr. Farrok Ahmed	Non-governmental Primary School Head Master

[Miresharai Upazila Primary Education Committee]

Mr. MD. Abdul Hye	Upazila Nirbahi Officer
Mr. Jafar Uddin Ahmed Chowdury	UP Chairman
Mr. MD. Adnan Akhtarul Azam	Upazila Engineer
Mr. Syad Hasan	Upazila Education Officer
Mr. Fastuid Ahamad Chowdury	GPS Head Master
Mr. Mdrurul Slam	GPS Teacher
Mr. Md. Abul Farook Mia	Secondary School Head Master

6) Education Engineering Department (EED)

Mr. Md. Ahad Ali	Executive Engineer
Mr. Ali Asgar	Executive Engineer

7) Department of Public Health Engineering (DPHE)

[Dhaka H.Q.]

Mr. Amanullah Al Mahmood	Superintending Engineer, Ground Water Circle
Mr. S. M. Ihtishamul Huq	Executive Engneer, Programme & Coordination Division

[Chittagong]

Mr. Md. Abdul Wohab	Sub-Assistant Engineer, Miresharai
Mr. Mosharraf Hossain	Sub-Assistant Engineer, Patiya
Mr. Abdur Mannan Chowdhury	Sub-Assistant Engineer, Anowara
Mr. Md. Kamal Hossain	Sub-Assistant Engineer, Banshkhali

[Cox's Bazar]

Mr. Md. Moniruzzan Dewanzi	Sub-Assistant Engineer, Chakoria

8) Bangladesh Arsenic Mitigation Water Supply Project (BMWSP)

Mr. Kamal Uddin Ahmed	Project Director
Mr. Md. Akhtaruzzaman	Media/Communication Specialist

9) Ministry of Disaster Management and Relief (MDMR)

Mr. Morad Hossasin	Deputy Chief
Mr. Md. Manirul Haque	Assistant Chief

10) Disaster Management Bureau (DMB)

Mr. A. F. M. Salful Islam	Director General in Charge
Mr. Mohsena Fadausi	Deputy Director
Mr. Probir Kumar Das	Computer Programmer
Mr. M. H. Khan Chowdhury	Disaster Management Specialist
Mr. Syeda Humaira Quari	Research Officer
Mr. Metai Dey Sarker	Assistant Director (GIS)
Mr. MD. Mizanur Rahman	Deputy Director (Planning)
Mr. MD. Ashraf Ali Khan	Deputy Director (MITG)
Mr. MD. Shahjahan Ali Sarder	Deputy Director

11) Bangladesh Meteorological Department (BMD)

Mr. Samarendra Karmakar	Deputy Director (SWC)
Mr. Sujit Kumar Debsarma	Assistant Director & System Manager
Mr. Md. Enaifur Rahman Mian	Assistant Meteorologist

12) Bangladesh Water Development Board (BWDB)

Mr. Mukhles Uz Zaman	Director General
Mr. Md. Liaquat-Al-Jaruque	Director, Planning-I, Directorate of Planning-I
Mr. Md. Sarfaraz Wahed	Executive Engineer, Directorate of of Planning-I
Mr. Md. Aminul Hoque	Additional Chief Engineer, Hydrology
Mr. Md. Anwar Hossain	Superintending Engineer, Processing & Flood Forecasting Circle
Mr. A. Z. M. Naran Nabi Khan	Superintending Engineer, Design Circle-1

13) Institute of Water and Flood Management, BUET

Dr. Jahir Uddin Chowdhury	Professor
Dr. Rezaur Rahman	Assistant Professor

(2) International Organizations and Others

1) World Bank

Mr. S. A. M. Rafiquzzaman	Irrigation Engineer
Mr. Mohumd Alan	Assistant Education Advisor

2) Asian Development Bank

Mr. Jamal U. Mohmud	Head of Social Infrastructure

3) European Union

Mr. Hans Rhein	Second Secretary
Mr. Md. Arham Uddin Siddique	Senior Engineer

4) UNICEF

Mr. R. Davis	Chief of Water & Sanitation

5) KfW

Mr. Gerhard J. Rupprenht	Consulting Engineer
Mr. A. F. M. Ferdous	Consulting Engineer

6) DfID

Mr. Rodney Dyer	Manager (Water & Sanitation)

7) Royal Netherlands Embassy

Mr. Armand Evers	First Secretary, Water Sector

8) Bangladesh Red Crescent Society (BDRCS)

[Dhaka H.Q.]

Mr. A. S. M. Akram	Deputy Secretary General
Mr. Fazlul Wahab	Director (CPP)

[Chittagong Office]

Mr. A. J. M. Golam Rabbani	Zonal Officer
Mr. M. A. Mannan Majumder	Assistant Director
Mr. S. M. Abdur Hamid	Junior Assistant Director
Mr. H. M. Salauddin	Deputy Youth Chief (CPP)
Mr. M. A. Jabbar	Chief Volunteer(Red Crescent Youth)

[Noakhali Office]

Mr. Salahuddin Chowdhury	Deputy Director

9) Catritas Bangladesh

[Dhaka H.Q.]

Mr. Benedict Alo D'Rozario	Director, Disaster Management & Development

[Chittagong Office]

Mr. Akhila D'Rozario	Regional Director

10) BRAC

Mr. M. Rob Choudhury	Construction Section Programme Coordinator

11) Danida

Mr. Peter Herson	Chief Advisor

12) World Vision

Mr. Theophil Hajong	Operation Director

13) PROSHIKA

Mr. I. K. Baral	Director, Health, Water, Sanitation & Housing

14) Watsan Partners Project (WPP)

Mr. Shakil Ahmed Ferdousi	Deputy Director

15) Asian Arsenic Network (AAN)

Ms. Sachie Tsushima	Country Representative

(3) Japanese Side

1) Embassy of Japan in Bangladesh

Mr. Toru Maeda	Counselor
Mr. Takaharu Kakinuma	First Secretary
Mr. Yasukuni Kimura	Second Secretary

2) JICA Bangladesh Office

Mr. Takashi Sakamoto	Resident Representative
Mr. Mitsuyoshi Kawasaki	Additional Resident Representative

Mr. Takuya Otsuka	Deputy Resident Representative
Mr. Yoshitaka Kamigatakuchi	JICA Expert
Mr. Kazuyuki Kawahara	JICA Expert
Ms. Yuko Ogino	JICA Expert

APPENDIX 4 MINUTES OF DISCUSSIONS

APPENDIX 4 MINUTES OF DISCUSSIONS

Basic Design Study

Minutes of Discussions

on

the Basic Design Study on the Project for the Construction of

Multipurpose Cyclone Shelter (Phase Ⅴ)

in

the People's Republic of Bangladesh

In response to a request from the Government of the People's Republic of Bangladesh (hereinafter referred to as " GOB "), the Government of Japan has decided to conduct a Basic Design Study on the Project for the Basic Design Study on the Project for the Construction of Multipurpose Cyclone Shelter (Phase Ⅴ)(hereinafter referred to as "the Project"), and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to Bangladesh the Basic Design Study Team headed by Mr. Masaaki Matsushima, Director, 1st Project Management Division, Grant Aid Management Department, JICA, with a field survey period between the 7th of March and the 20th of April, 2003.

The Team held a series of discussions on the Project with the officials concerned with Local Government Engineering Department etc.. The discussions will be followed up with a field survey of the study area.

In the course of discussions and field survey, both parties confirmed the main items described on the attached sheets.

The Team will proceed to further work and prepare the Basic Design Study Report.

Dhaka, 13th March, 2003

Masaaki Matsushima
Leader,
Basic Design Study Team,
Japan International Cooperation Agency

Iqbal Mahmood
Deputy Secreary,
Economic Relation Division,
Ministry of Finance

Md. Abdullah
Deputy Chief,
Ministry of Local Government,
Rural Development & Cooperatives

Md. Zahangir Alam
Project Director,
Local Government
Engineering Department

ATTACHMENT

1. Objective of the Project

The objective of the Project is to construct cyclone shelters which contribute toward protecting human lives in case of natural calamities like cyclone and tidal surge as well as functioning as primary school in usual time in the Project area.

2. Responsible and Implementing Organization

2.1 The organization responsible for the Project is the Ministry of Local Government, Rural Development & Cooperatives (MLGRD&C).

2.2 The implementing organization of the Project is Local Government Engineering Department (LGED).

2.3 In terms of executing proper operation and maintenance of the facilities as well as enhancing the effectiveness of the Project, LGED is responsible for coordination with the relevant ministries and agencies such as Economic Relations Division (ERD) in Ministry of Finance, Ministry of Primary & Mass Education (MPME), Directorate of Primary Education (DPE), Ministry of Disaster Management and Relief (MDMR) and Bangladesh Water Development Board (BWDB).

As the shelters should be mainly used as primary school in usual time, LGED should cooperate especially with DPE which is responsible for the operation and maintenance of the facilities at ordinary time.

The organization chart of MLGRD&C and LGED is attached as Annex 1.

3. Project Areas

3.1 The project areas are located in the Feni, Chittagong, Noakhali, Cox's Bazar and the project sites are shown in Annex 2-1.

3.2 The requested number of the project sites is attached in Annex 2-2. The actual number of the sites will be determined base upon the result of further field survey.

3.3 Both sides agreed that the final sites covered by the Project will be decided upon the criteria shown in Annex-3 and minor modifications of this criteria should be made based on the result of further study.

4. Items Requested by GOB

After discussions with the Team, the Bangladesh side requested the following items. The details of the component will be decided based upon the result of further study.

4.1 Two-storied shelters which comprise classrooms, teacher's room and toilet room.

4.2 Water supply facilities (a tubewell and a manual pump) and drainage for each shelter in principle.

JICA will assess the appropriateness of the request and will recommend to the Government of Japan for approval.

5. Japan's Grant Aid Scheme

5-1. The Bangladesh side understood the Japan's Grant Aid Scheme explained by the Team, as described in Annex 4.

5-2. The Bangladesh side will take the necessary measures, described in Appendix-1 of Annex 4, for the smooth implementation of the Project on condition that the Japan's grant aid is extended to the Project.

6. Schedule of the Study

6-1. A consultant team will proceed to further studies in Bangladesh until the 20th of April 2003.

6-2. Based on the result of the field survey and analysis, JICA will prepare a Draft Report in English and dispatch a Team in order to explain the outline of the Basic Design approximately in and around July 2003.

6-3. In the event of the draft report being acceptable in principle by GOB, JICA will complete the final report and forward it to GOB approximately by the end of August 2003.

7.Other Relevant Issues

7-1. Cost Effectiveness

The Japanese side explained that under the severe financial situation in Japan, the necessary modification of the facilities should be considered in terms of cost effectiveness. Both sides agreed that every measures necessary for cost reduction should be taken by both sides through this survey.

7-2: Criteria for Site Selection

Both sides agreed that criteria for site selection shown in Annex 3, and through a series of discussions, the total number of proposed site was reduced from 39 to 34 based upon the criteria. Both sides confirmed that final number of sites would be determined on the occasion of Draft Final Report which was scheduled in July based on the field survey's analysis.

7-3. Consideration for Arsenic Contamination

To mitigate arsenic contamination as much as possible in the sites, both sides agreed that the necessary measures should be taken into consideration on condition that the necessity of water supply system would be confirmed in the sites.

7-4. Proper Operation and Maintenance

The Japanese side requested GOB to take proper measures to maintain the facilities including water supply system and toilet. GOB side agreed that necessary coordination among MLGRD&C, LGED, MPME, DPE, Department of Public Health Engineering(DPHE) and other related Ministries or Agencies, should be taken in proper manner.

7-5. Disaster Management

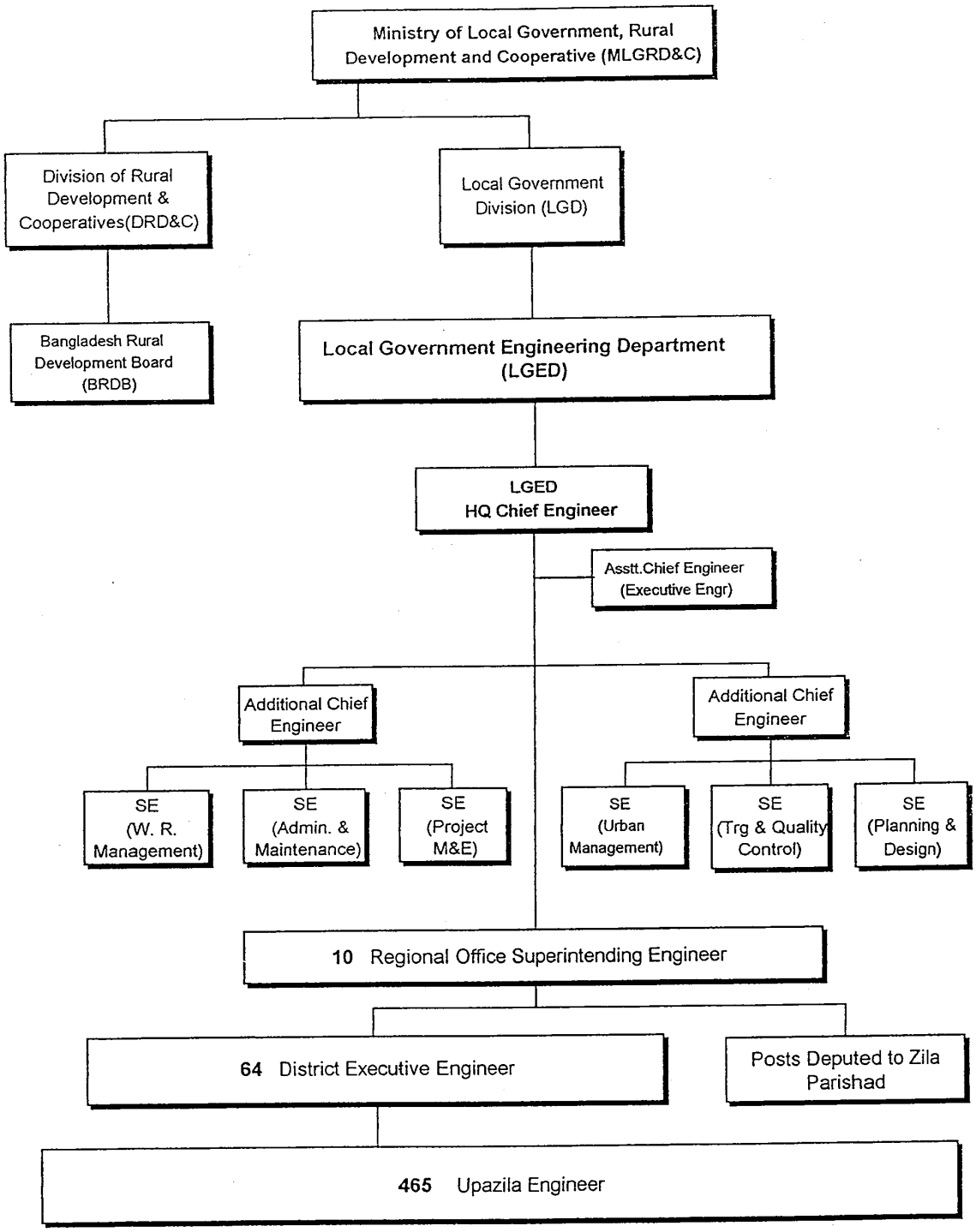
Both sides confirmed that disaster management system such as Cyclone Preparedness Programme (CPP) should be functioning properly in order to utilize the cyclone shelters effectively and efficiently.

7-6. Necessary measures to be taken by GOB

The Japanese side requested GOB side to take necessary measures for smooth implementation of the project including the construction of killas in necessary sites on condition that the project would be approved by the Japanese cabinet, and GOB side agreed to it.

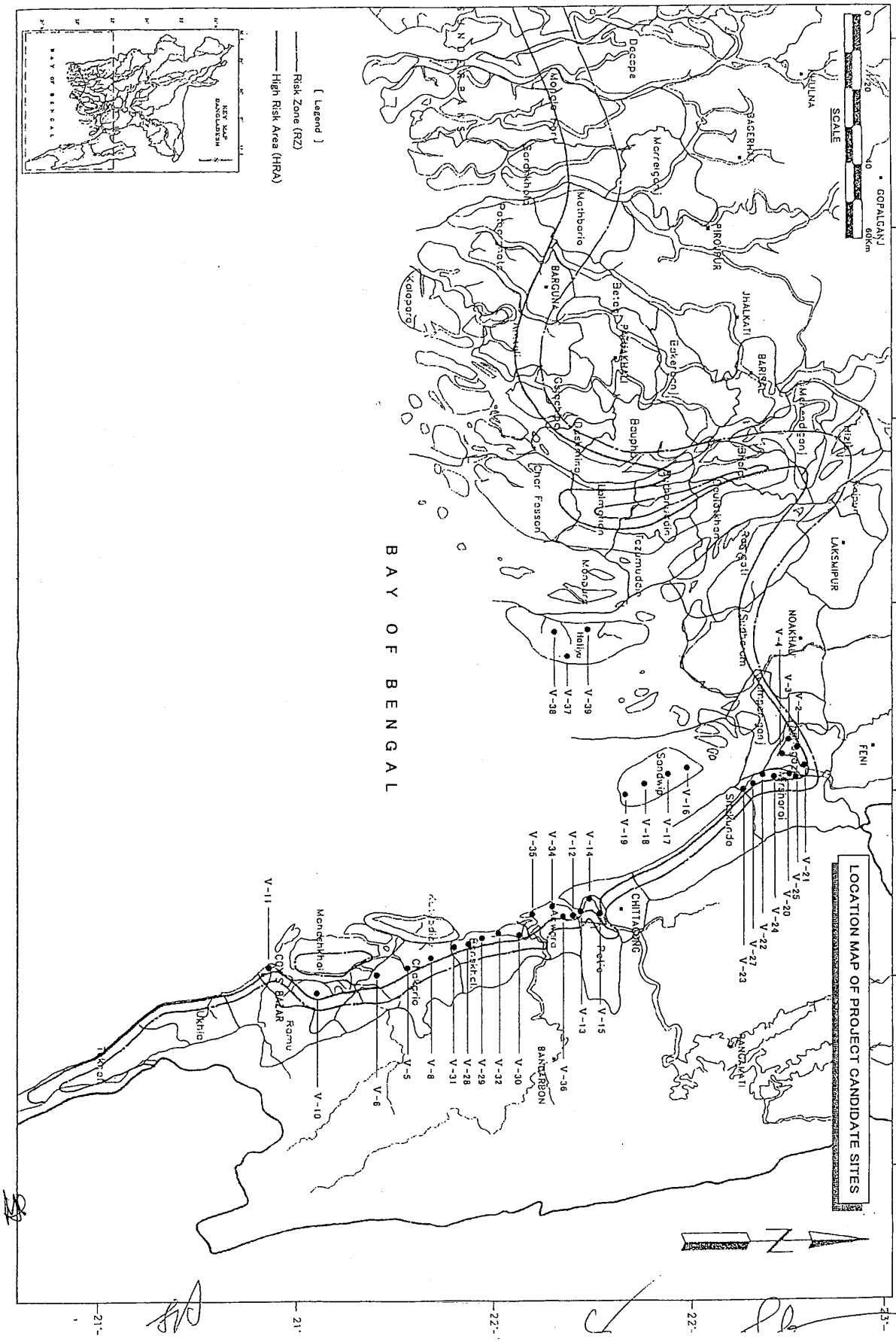
The Organization Chart of MLGRD&C and LGED

Annex- 1



HQ Level Posts	89
Circle Level Posts	70
District Level Posts including those deputed to Zila Parishad	723
Upazila Level Posts	8138
Total Post	**9628**

SE: Superintending Engineer


LOCATION MAP OF PROJECT CANDIDATE SITES
BAY OF BENGAL
[Legend]
Risk Zone (RZ)
High Risk Area (HRA)
SCALE
0 30 60Km
GOPALGANJ
KHULNA
BAGERHAT
PIROJPUR
BARGUNA
JHALKATI
BARISAL
PATUAKHALI
LAKSHMIPUR
NOAKHALI
FENI
CHITTAGONG
COX'S BAZAR
BANDARBON
RANGAMATI
Mongla Port
Mathbaria
Morrelganj
Dacope
Kalapara
Betagi
Barisal
Patuakhali
Bauphal
Dashmina
Lalmohan
Char Fasson
Monpura
Hatiya
Sandwip
Companiganj
Sonagazi
Feni
Sitakunda
Patiya
Anwara
Banshkali
Chakaria
Kutubdia
Maheshkhali
Ramu
Teknaf
Okhia
V-1
V-2
V-3
V-4
V-5
V-6
V-8
V-10
V-11
V-12
V-13
V-14
V-15
V-16
V-17
V-18
V-19
V-20
V-21
V-22
V-23
V-24
V-25
V-27
V-28
V-29
V-30
V-31
V-32
V-34
V-35
V-36
V-37
V-38
V-39
89°-30'
90°-00'
90°-30'
91°-00'
91°-30'
92°-00'
92°-30'E
21°
21°-30'
22°
22°-30'
N

List of Requested Sites

Annex 2-2

No.	District	Upazila	Union	Name of School
V-2	Feni	Sonagazi	6 no.Char Chandia	Mohesh Char GPS
V-3	Feni	Sonagazi	6 no.Char Chandia	Moddhom Char GPS
V-4	Feni	Sonagazi	7 no. Sonagazi	Sonagazi GPS
V-5	Cox's Bazar	Chakaria	Boroi Tali	Pohorchanda GPS
V-6	Cox's Bazar	Chakaria	West Boro Veola	Ilishia GPS
V-8	Cox's Bazar	Chakaria	Taitong	Sonaichhory GPS
V-10	Cox's Bazar	Cox's Bazar Sadar	Islamabar	Gojalia GPS
V-11	Cox's Bazar	Cox'sBazar Sadar	Eidgah	Vaditala GPS
V-12	Chittagong	Patiya	Borouthan	Borouthan Hamid Ali Khan GPS
V-13	Chittagong	Patiya	Charlaksma	West Charlaksma GPS
V-14	Chittagong	Patiya	Char Patharghata	Ichanagar GPS
V-15	Chittagong	Patiya	Char Patharghata	Char Patharghata GPS
V-16	Chittagong	Sandwip	Haramina	Kachhiapur GPS
V-17	Chittagong	Sandwip	Gachhua	Gachhua A. K. GPS
V-18	Chittagong	Sandwip	Musapur	South East Musapur GPS
V-19	Chittagong	Sandwip	Bauria	Bauria G. K. GPS
V-20	Chittagong	Miresharai	Mithanala	Banatali
V-21	Chittagong	Miresharai	Katachhora	Temuhani GPS
V-22	Chittagong	Miresharai	Mayani	Solaiman GPS
V-23	Chittagong	Miresharai	Wahedpur	Jafarabad GPS
V-24	Chittagong	Miresharai	Mayani	SM Hazipara GPS
V-25	Chittagong	Miresharai	Durgapur	Hazisorai GPS
V-27	Chittagong	Miresharai	Sahebkhali	East Sahebkhali GPS
V-28	Chittagong	Banshkhali	Shilkup	Munkirchar GPS
V-29	Chittagong	Banshkhali	Katharia	Modya Katharia GPS
V-30	Chittagong	Banshkhali	Pukuria	South Burumchara GPS
V-31	Chittagong	Banshkhali	Puichari	Puichari Sultania GPS
V-32	Chittagong	Banshkhali	Shadhanpur	Nouth Shadhanpur GPS
V-34	Chittagong	Anowara	Bairag	Badalpur GPS
V-35	Chittagong	Anowara	Burumchhora	West Burumchhora GPS
V-36	Chittagong	Anowara	Chatori	Dumuria GPS
V-37	Noakhali	Hatiya	Burirchar	Hornipalgram GPS
V-38	Noakhali	Hatiya	Sonsdia	Purba Chanandi GPS
V-39	Noakhali	Hatiya	Tamaruddi	Tamaruddi Koralia GPS

Abbr.:GPS; Government Primary School

The total number of the requested sites is 34.

Criteria for Site Selection

Annex 3

1)	The subject site shall be the site of a government primary school which is managed by the central government.
2)	The subject site shall be located in the HRA designated by the Master Plan for the Multi-Purpose Cyclone Shelter Programme.
3)	In principle, the subject site shall have a solid building or hill of sufficient size and height to provide a reliable evacuation site vis-à-vis storm surge caused by a cyclone within a 1.5 km radius of the site.
4)	The subject site shall have a sufficient land area for the construction of a multi-purpose cyclone shelter and the central government shall have secured land ownership of the site. However, even if sufficient space for shelter construction is not available, this does not exclude cases where it is possible to secure the necessary space by removing facilities which are judged to be unusable or where it is possible to secure an additional area on adjacent land together with the assurance by the Bangladesh side that any removal work or expropriation of adjacent land will be conducted without fail.
5)	It is highly unlikely that the subject site will be eroded by a change of the river course.
6)	The subject site shall not be associated with a similar project or plan of the Government of Bangladesh or a foreign aid organization or a donor country for cyclone shelter construction.
7)	The subject site shall allow access by vehicle for the transportation of construction materials to the site.
8)	The subject site shall have an operating primary school with teachers, administrative staff and pupils and it is judged that the facilities to be newly constructed will be fully used as a primary school facilities during normal times.
9)	The subject site shall already have a school management committee to be responsible for the maintenance of the newly constructed facilities and equipment and it is judged that this committee has a sustainable capacity to do the maintenance work in collaboration with LGED.
10)	The subject site shall have a killa for the evacuation of livestock within a 0.3 km radius of the site. Alternatively, there shall be a feasible site for the construction of a killa and such an assurance shall be obtained from the Bangladesh side.

1. Japan's Grant Aid System

(1) Grant Aid Procedure

1) Japan's Grant Aid Program is executed through the following procedures.

Application (Request made by a recipient country)
Study (Basic Design Study conducted by JICA)
Appraisal & Approval
(Appraisal by the Government of Japan and Approval by Cabinet)
Determination of Implementation
(The Notes exchanged between the Governments of Japan and the recipient country)

2) Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA to conduct a study on the request. If necessary, JICA send a Preliminary Study Mission to the recipient country to confirm the contents of the request.

Secondly, JICA conducts the study (Basic Design Study), using Japanese consulting firms.

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Programme, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes signed by the Governments of Japan and the recipient country.

Finally, for the implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

(2) Basic Design Study

1) Contents of the Study

The aim of the Basic Design Study (hereinafter referred to as "the Study"), conducted by JICA on a requested project (hereinafter referred to as "the Project"), is to provide a basic document necessary for the appraisal of the Project by the Government of Japan. The contents of the Study are as follows:

a) confirmation of the background, objectives and benefits of the Project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation;
b) evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from the technical, social and economic points of view;
c) confirmation of items agreed on by both parties concerning the basic concept of the Project;
d) preparation of a basic design of the Project; and
e) estimation of costs of the Project.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even through they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

2) Selection of Consultants

For the smooth implementation of the Study, JICA uses a consulting firm selected through its own procedure (competitive proposal). The selected firm participates in the Study and prepares for a report based upon the terms of reference set by JICA.

At the beginning of implementation after the Exchange of Notes, for the services of the Detailed Design and Construction Supervision of the Project, JICA recommends the same consulting firm which participated in the Study to the recipient country in order to maintain the technical consistency between the Basic Design and Detailed Design.

(3) Japan's Grant Aid Scheme

1) What is Grant Aid?

The Grant Aid Program provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. Grant Aid is not supplied through the donation of materials as such.

2) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

3) "The period of the Grant" means the one fiscal year which the Cabinet approves the project for. Within the fiscal year, all procedure such as exchanging of the Notes, concluding contracts with consulting firms and contractors and final payment to them must be completed.

However, in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.

4) Under the Grant, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However, the prime contractors, namely consulting, contracting and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

5) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This "Verification" is deemed necessary to secure accountability of Japanese taxpayers.

6) Undertakings required to the Government of the recipient country

a) to secure a lot of land necessary for the construction of the Project and to clear the site;

b) to provide facilities for distribution of electricity, water supply and drainage and other incidental facilities outside the site;

c) to ensure prompt unloading and customs clearance at ports of disembarkation in the recipient country and internal transportation therein of the products purchased under the Grant Aid;

d) to exempt Japanese nationals from customs duties, internal taxes and fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contracts;

e) to accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contracts such as facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work;

f) to ensure that the facilities constructed and products purchased under the Grant Aid be maintained and used properly and effectively for the Project; and

g) to bear all the expenses, other than those covered by the Grant Aid, necessary for the Project.

7) "Proper Use"

The recipient country is required to maintain and use the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign the necessary staff for operation and maintenance of them as well as to bear all the expenses other than those covered by the Grant Aid.

8) "Re-export"

The products purchased under the Grant Aid shall not be re-exported from the recipient country.

9) Banking Arrangement (B/A)

a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the verified contracts.

b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an Authorization to Pay (A/P) issued by the Government of recipient country or its designated authority.

c) Commission of payment will be arranged and covered by the Government of the recipient country.

2. Necessary measures undertakings by each government

Major undertakings to be taken by each government is shown in the Appendix-1

Appendix-1 Necessary measures undertakings by each government

No	Items	To be covered by Grant Aid	To be covered by Recipient side
1	To secure land		㉕
2	To clear, level and reclaim the site when needed		㉖
3	To construct gates and fences in and around the site		㉗
4	To construct the parking lot	㉘	
5	To construct roads		
	1) Within the site	㉙	
	2) Outside the site		㉚
6	To construct the building	㉛	
7	To provide facilities for the distribution of electricity, water supply, drainage and other incidental facilities		
	1) Electricity		
	a. The distributing line to the site		㉜
	b. The drop wiring and internal wiring within the site	㉝	
	c. The main circuit breaker and transformer	㉞	
	2) Water Supply		
	a. The city water distribution main to the site		㉟
	b. The supply system within the site (receiving and/or elevated tanks)	㊱	
	3) Drainage		
	a. The city drainage main (for storm, sewer and others) to the site		㊲
	b. The drainage system (for toilet sewer, ordinary waste, storm drainage and others) within the site	㊳	
	4) Gas Supply		
	a. The city gas main to the site		㊴
	b. The gas supply system within the site	㊵	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame / panel (MDF) of the building		㊶
	b. The MDF and the extension after the frame / panel	㊷	
	6) Furniture and Equipment		
	a. General furniture		㊸
	b. Project equipment	㊹	
8	To bear the following commissions to a bank of Japan for the banking services based upon the B/A		
	1) Advising commission of A/P		㊺
	2) Payment commission		㊻
9	To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country		
	1) Marine(Air) transportation of the products from Japan to the recipient country	㊼	
	2) Tax exemption and customs clearance of the products at the port of disembarkation		㊽
	3) Internal transportation from the port of disembarkation to the project site	㊾	
10	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contact such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		㊿
11	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contracts		(51)
12	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant		(52)
13	To bear all the expenses, other than those to be borne by the Grant, necessary for construction of the facilities as well as for transportation and installation of the equipment		(53)

Draft Report Explanation

Minutes of Discussions

on

the Basic Design Study on the Project for the Construction of Multipurpose Cyclone Shelters (Phase V)

in

the People's Republic of Bangladesh

(Explanation on Draft Report)

In March 2003, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Basic Design Study Team on Project for the Construction of Multipurpose Cyclone Shelters (Phase V)(hereinafter referred to as "the Project") to the People's Republic of Bangladesh, and through a series of discussion, field surveys and technical examination of the result in Japan, JICA prepared the draft report of the study.

In order to explain and to consult the Bangladeshi side on the contents of the draft report, JICA sent to Bangladesh the Draft Report Explanation Team (hereinafter referred to as "the Team"), which is headed by Mr. TAKASHI SAKAMOTO, Resident Representative of JICA Bangladesh Office, with a survey period from July 5 to 12, 2003.

As a result of discussions, both parties confirmed the main items described on the attached sheets.

Dhaka, 10th July, 2003

Takashi SAKAMOTO
Leader,
Basic Design Study Team,
JICA

Iqbal Mahmood
Deputy Secretary
Economic Relation Division,
Ministry of Finance

10.07.2003

Syed Mamunul Alam
Senior Assistant Chief,
Local Government Division,
Ministry of Local Government,
Rural Development & Cooperatives

10.7.03

Md. Wahidur Rahman
Superintending Engineer,
Local Government
Engineering Department

ATTACHMENT

1. Contents of the Draft Report

The government of the People's Republic of Bangladesh (hereinafter referred to as "GOB") agreed and accepted in principle the contents of the draft report proposed by the Team.

GOB understood that the cost estimate in the draft report is provisional and would be further examined by the Japanese side.

2. Japan's Grant Aid Scheme

GOB understood the Japan's Grant Aid Scheme and the necessary measures to be taken by GOB as described in Annex-4 and Appendix-1 of the Minutes of Discussions signed by both parties on 13th March 2003.

3. Final Report

JICA will complete the final report in accordance with the result of discussions and forward it to GOB around September 2003.

4. Necessary Measures to be Taken by Bangladesh Side

4-1. GOB agreed to secure additional land for the construction of the shelters in the sites as shown in ANNEX-1 before the conclusion of the E/N.

GOB also agreed to obtain the agreement for the land acquisition from each land owner and to secure the necessary budget in advance.

4-2. GOB agreed to remove the existing primary school buildings in the sites as shown in ANNEX-1 before the conclusion of the E/N and also agreed to build temporary facilities for classes during the construction by securing the necessary budget in advance.

4-3. GOB agreed to construct the KILLAS in all the sites before the completion of the construction work.

4-4. GOB agreed to improve access roads to each Project site before the commencement of the Project for the smooth implementation of the construction work.

4-5. GOB agreed to take necessary measures for transferring the teachers of the existing schools in the sites to the facilities to be constructed under the Project. GOB

also agreed to take necessary measures for securing 18 additional teachers to the 7 sites by the time of completion of the Project.

5. Other Relevant Issues

5-1. Project Sites

Both sides confirmed that the Project Sites are selected shown as in ANNEX-2

5-2. Improvement of Disaster Management System

GOB agreed to take necessary measures for further improvement of disaster management system in order that the facilities covered by the Project will give a full performance as cyclone shelter.

5-3. Measures to be Taken for Arsenic Contamination

As a result of the Basic Design Study, nine sites were found to be suspicious of arsenic contamination (six sites in Mirasharai Upazila and three sites in Patiya Upazila). Therefore, both sides confirmed that water quality tests will be conducted at trial boreholes at these nine sites by the Japanese side at the time of the Detailed Design. If the level of arsenic contamination is beyond the provisional Bangladesh standard (0.05ppm), a removal device will be installed to the contaminated sites by the Japanese side.

5-4. Proper Use and Maintenance

LGED agreed to strengthen and improve the maintenance system of not only the facilities covered by the Project but also the existing facilities constructed under the Japanese Grant Aid in collaboration with MOPME .

GOB agreed to take necessary measures for allocating at least one eligible staff with technical capability for maintenance and inspection for the planned facilities to the relevant Upazila Office by the time the construction work is completed.

5-5. Allocation of Necessary Budget

GOB agreed to secure the necessary budget for the work to be done by the Bangladesh side in the Project from Bangladesh Fiscal Year 2003-2004 to 2005-2006. GOB also agreed to secure the necessary budget for the recurrent cost after the completion of the Project.

5-6. Extension of the Time for Project Concept Paper (PCP)

GOB agreed to extend the time for PCP for the Project which will expire in June, 2004 upto Bangladesh Fiscal Year 2005-2006.

5-7. Exemption of Tax

Both sides confirmed that any and all import tax that may be levied on the products covered by the Project shall be paid by LGED and the products covered by the Project are exempted from surtax and other fiscal levies. Both sides agreed that the Japanese side should follow the necessary procedures for tax exemption before the procurement of the products under the Project.

Both sides confirmed that most of the construction materials will be procured in Bangladesh except that when both sides deem it necessary, the products like high tensile reinforcing bars will be procured from a third country.

ANNEX-1

LIST OF THE PROJECT SITES TO BE ARRANGED FOR THE SHELTER CONSTRUCTION

Site No.	Name of School	Additional Land Acquisition	Removal of Existing School
V-1	Ilishia GPS	Necessary	—
V-2	West Charlaksma GPS	Necessary	—
V-3	Ichanagar GPS	Necessary	—
V-4	Char Patharghata GPS	—	Necessary
V-5	Kachhiapur GPS	Necessary	—
V-9	Solaiman GPS	Necessary	—
V-10	Jafarabad GPS	Necessary	—
V-11	SM Hazipara GPS	Necessary	—
V-12	Hazisorai GPS	Necessary	—
V-13	East Sahebkhali GPS	Necessary	Necessary
V-14	Munkirchar GPS	Necessary	—
V-16	Puichari Sultania GPS	Necessary	—
V-17	Nouth Shadhanpur GPS	Necessary	Necessary
V-18	West Burumchhora GPS	Necessary	—
V-20	Purba Chanandi GPS	Necessary	Necessary

Note: GP= government primary school

ANNEX-2

SELECTED PROJECT SITES

Site No.	District	Upazila	Union	School
V-1	Cox's Bazar	Chakaria	West Boro Veola	Ilishia GPS
V-2	Chittagong	Patiya	Charlaksma	West Charlaksma GPS
V-3	Chittagong	Patiya	Char Patharghata	Ichanagar GPS
V-4	Chittagong	Patiya	Char Patharghata	Char Patharghata GPS
V-5	Chittagong	Sandwip	Haramina	Kachhiapur GPS
V-6	Chittagong	Sandwip	Musapur	South East Musapur GPS
V-7	Chittagong	Sandwip	Bauria	Bauria G. K. GPS
V-8	Chittagong	Miresharai	Katachhora	Temuhani GPS
V-9	Chittagong	Miresharai	Mayani	Solaiman GPS
V-10	Chittagong	Miresharai	Wahedpur	Jafarabad GPS
V-11	Chittagong	Miresharai	Mayani	SM Hazipara GPS
V-12	Chittagong	Miresharai	Durgapur	Hazisorai GPS
V-13	Chittagong	Miresharai	Sahebkhali	East Sahebkhali GPS
V-14	Chittagong	Banshkhali	Shilkup	Munkirchar GPS
V-15	Chittagong	Banshkhali	Katharia	Modya Katharia GPS
V-16	Chittagong	Banshkhali	Puichari	Puichari Sultania GPS
V-17	Chittagong	Banshkhali	Shadhanpur	Nouth Shadhanpur GPS
V-18	Chittagong	Anowara	Burumchhora	West Burumchhora GPS
V-19	Noakhali	Hatiya	Burirchar	Hornipalgram GPS
V-20	Noakhali	Hatiya	Sonadia	Purba Chanandi GPS

Note: GPS= government primary school

APPENDIX 5 ESTIMATED COST TO BE BORNE BY THE RECIPIENT COUNTRY

APPENDIX 5 ESTIMATED COST TO BE BORNE BY THE RECIPIENT COUNTRY

1. Additional Land Acquisition Cost

Refer to Chapter 3, 3-3-(1) for the Additional Land Acquisition at Some Project Sites

Site No.	Location Upazila)	Area (m^2)	Unit Cost (TK/m^2)	Amount (TK)
V-1	Chakaria	405	25.00	10,125
V-2,3	Patiya	1,050+890=1,940	142.04	275,558
V-5	Sandwip	784	44.35	34,770
V-9,10,11,12,13	Miresharai	125+560+630+700+216 =2,231	51.78	115,521
V-14,16,17	Banshkhali	880+175+240=1,295	47.00	60,865
V-18	Anowara	975	68.62	66,905
V-20	Hatiya	415	40.00	16,600
Total				580,344
				580,000 TK

2. Killa Construction Cost

Refer to Appendix 6-6 Calculation of Required Killa Size – Table A6-6-1.

① Land Acquisition Cost

Site No.	Location (Upazila)	Area (m^2)	Unit Cost (TK/m^2)	Amount (TK)
V-1	Chakaria	3,170	25.00	79,250
V-2～4	Patiya	5,060	142.04	718,722
V-5～7	Sandwip	6,930	44.35	307,346
V-8～13	Miresharai	12,070	51.78	624,985
V-14～17	Banshkhali	9,770	47.00	459,190
V-18	Anowara	2,690	68.62	184,588
V-19～20	Hatiya	6,890	40.00	275,600
Total				2,649,681

② Construction Cost

Total Banking Volume : 128,040m^3

Unit Cost : 97.9TK/m^3

Construction Cost : 12,535,116TK

Total ①+②＝15,184,797TK

15,180,000TK

3. Building Removal Cost

Site No.				
V-4	2 Buildings			
	23.6×7.76＝183.1m^2 26.3×4.7 ＝123.6m^2	} 307m^2	TK500/m^2 (Semi-Pacca)	153,500TK
V-13	2 Buildings			
	22.5×7.6＝171.0m^2		TK500/ m^2 (Semi-Pacca)	85,500TK
	11.2×8.7＝97.4 97 m^2		TK800/ m^2 (Pacca)	77,600TK
V-17	1 Building		TK500/ m^2 (Semi-Pacca)	
	21.01×8.02＝168.5 169m^2			84,500TK
V-20	2 Buildings			
	14.7×5.0＝73.5m^2 3.8×1.8＝ 6.8m^2	} 80m^2	TK500/ m^2 (Semi-Pacca)	40,000TK
	Total			441,100TK
				440,000TK

4. Access Road

1 Sit Average of 2 km Unit Cost per 1 km TK15Lhak

20 Sites in Total ×2km＝40km 40km×15 Lhak＝600 Lhak

60,000,000 TK

APPENDIX 6 OTHER RELEVANT DATA

6-1 FINDINGS OF DETAILED SITE SURVEY

6-2 FINDINGS OF SOCIO-ENVIRONMENTAL SURVEY

6-3 RESULTS OF HYDRAULIC AND HYDROLOGICAL SURVEYS

6-4 RESULTS OF GEOTECHNICAL SITE SURVEY

6-5 FINDINGS OF EXISTING SHELTER SURVEY

6-6 CALCULATION OF KILLA SIZE

6-1 FINDINGS OF DETAILED SITE SURVEY

6-1 FINDINGS OF DETAILED SITE SURVEY

[Objectives]

The purpose of this survey was to gather information to establish (i) the natural conditions around the target shelter sites and (ii) the social conditions required to determine the appropriate size of the facilities, etc. in order to properly judge the suitability of each target shelter site.

[Survey Method]

Work was consigned to the local consultant, which conducted investigation at the 22 sites selected in the outline site surveys from March 26 to April 4. Interviews based on question forms were carried out with officials having general know-how of site conditions (local government personnel, union assembly members, community representatives, etc.), and principals, head teachers and SMC members who have a good grasp of primary education-related information.

[Survey Items and Findings]

The survey items and findings are indicated below. See Tables A6-1-1~A6-1-4 for conditions at each of the sites.

1. Conditions Surrounding Sites

Population

Population in a radius of 1.5 km around the sites ranges from around 20,000 in sites situated in urban areas to between 2,000-5,000 in rural sites.

Infrastructure

Many roads around the sites are dirt roads accessible only to jeeps and rickshaws. None of the sites have public water supply or sewerage systems. Drinking water is mainly obtained from wells, and wastewater is simply discharged. Electricity supply is provided at 13 of the 22 sites.

Existing or Planned Shelters by Other Donors

Caritas shelters exist close to site Nos. 27, 30, 37 and 38, but these can only accommodate very small numbers. It can basically be understood that no existing or planned shelters by other donors are situated around the Project sites.

2. Relevant Information at Times of Disaster

Warnings

Warnings are classified into levels 1-10. The contents of these warnings are transmitted by microphone via organizations such as the Bangladesh Red Crescent Society (BDRCS) and Cyclone Preparedness Programme (CPP).

Past Cyclone Damage Conditions

The greatest damage in the past was caused by the cyclone that struck in 1991, when many lives (150~4,000) were lost as a result of drowning caused by storm surge, etc.

Killa

No killa exist around the sites. Judging from the appearance of all 22 sites, there are possible places to construct killas. Having said that, local residents replied that land for killa construction could be secured at only 15 of the sites. Residents at the remaining seven sites responded that no land was available for killa construction, or that there was no need for killa. Reasons given for these responses included the following: 1) the areas in question are too poor to spare land for killa; moreover, livestock are evacuated in hills located 7 km away, and 2) a banked road has been constructed nearby, and livestock can be evacuated on this. According to the result of the socio-environmental survey, concerning belongings carried by people when evacuating, most residents replied that they took food, clothing and bedding, whereas livestock was only mentioned at two of the sites. Concerning this point, awareness activities by the CPP stress that human lives take precedence over all other matters.

Therefore, thanks to the more rapid and accurate transmission of information by the warning system following the last major cyclone disaster in 1991, awareness has been changed so that residents no longer refuse to evacuate to shelters that do not possess killa, but rather evacuate upon making the necessary preparations in response to warnings. Therefore, it can be said that there is not so strong pressing need to provide shelters with killa as there once was.

3. State of Existing Primary School Facilities

The Government of Bangladesh owns all the primary schools at the target sites. Many of the school buildings are made of concrete or brick. They suffer from deterioration and are not in very good condition.

Auxiliary Facilities

The sites have no telephone or electricity supply lines, however, all the sites apart from one are equipped with wells for water supply. Having said that, wells at nine of 21 sites are broken down. Also, toilets are installed at all but one of the sites.

Multipurpose Use

According to the responses, multipurpose uses of existing primary schools include election polling booths (11 sites), assembly halls (11 sites), health spots (9 sites) and so forth.

4. Current Conditions of Primary Education

School Attendance

The numbers of children attending school (374 on average), dropping out (37 on average) and repeating (25 on average) vary according to each site. The average school attendance rate is 84%. The number of students on the whole is in slight decline.

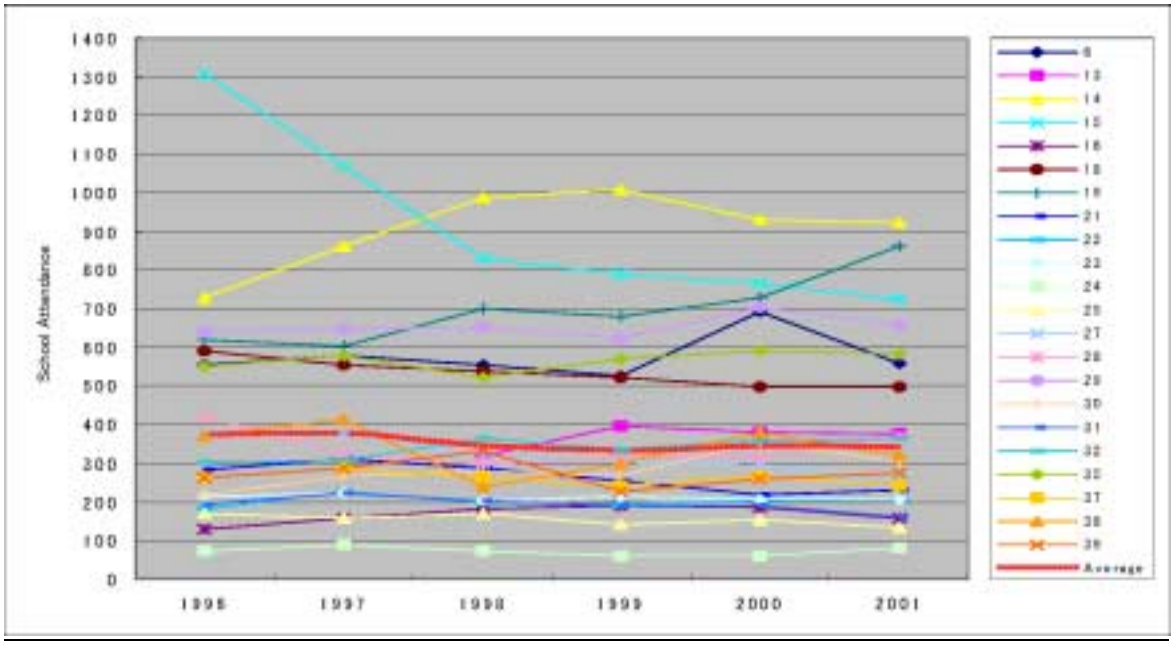


Fig. A6-1-1 Transitions of School Attendance at the Target Schools (1996-2001)

Assignment of Teachers

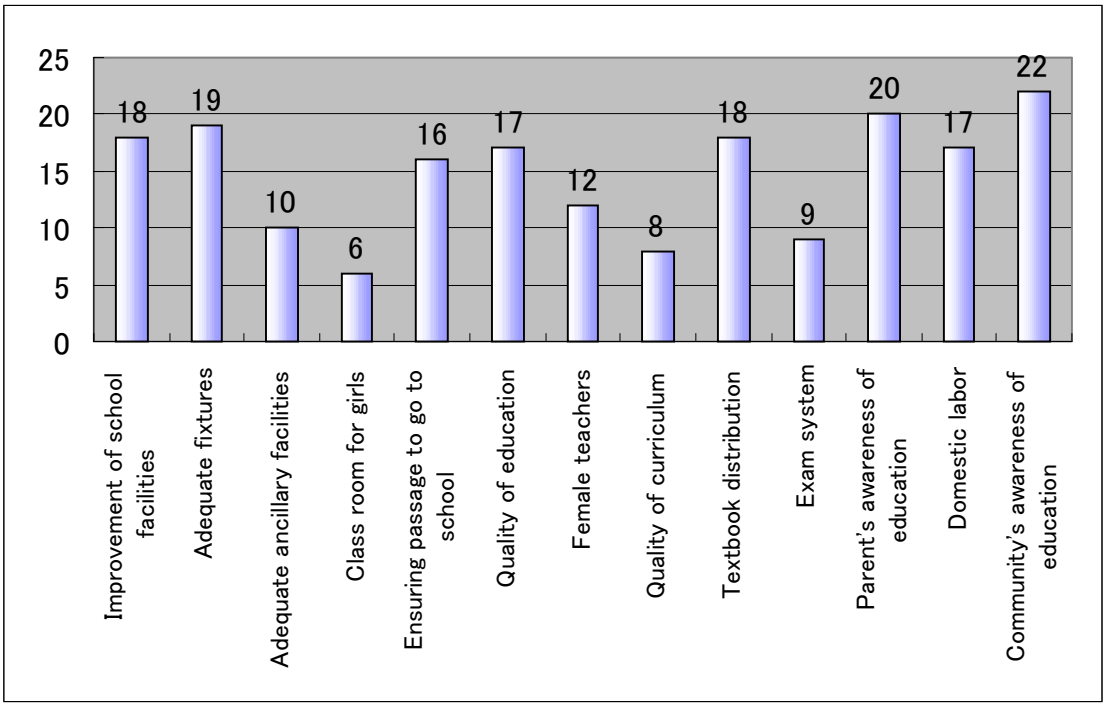
At least three teachers are assigned to a school, however, the ratio of female teachers is low at 35% and some schools have no female teachers at all. In many cases, both female teachers and male teachers have qualifications.

Shift System

Primary schools at all the 22 sites operate on the dual shift system with classes one and two being taught in the morning and classes 3-5 in the afternoon.

Important Issues for Improving School Attendance and Reducing School Dropout Rates

Among the ideas suggested were improvement of education awareness in the community and among parents, reduction of child domestic labor, improvement of school facilities, and improvement of the quality of education (see Fig. A6-1-2).



Note: multiple answers

Fig. A6-1-2 Important Issues for Increase of Enrolment Ratio and Decrease of Drop-outs (Teachers' Opinions)

5. Actual State of Utilization and Maintenance of Schools

Income and Expenditure Balance at Existing Primary Schools

The average budget of government-owned primary schools at the target sites is 370,000 Tk with funds derived from the government, contributions, examination fees and other miscellaneous income. Most government funding, which is the prime source of funds, is allocated for teachers' salaries and scholarships. Other fund sources are small and irregular.

Accordingly, the size of budgets that can actually be used by government-owned primary schools is very limited. This is demonstrated by the fact that 14 of the 22 sites pointed to the lack of funds as a problem confronting maintenance.

Furthermore, since half of all residents are engaged in agriculture and do not have large incomes, it is difficult to raise contributions. The primary schools at six of the 22 sites spent funds for maintenance (mainor repairs, etc.). The amount provided is 5,400 Tk, 12,000 Tk, 1,200 Tk, 3,000 Tk, 1,800 Tk and 1,104 Tk respectively. Almost all these finances are raised from funds and contributions from parents, however, they are very small amounts used only for minor repairs.

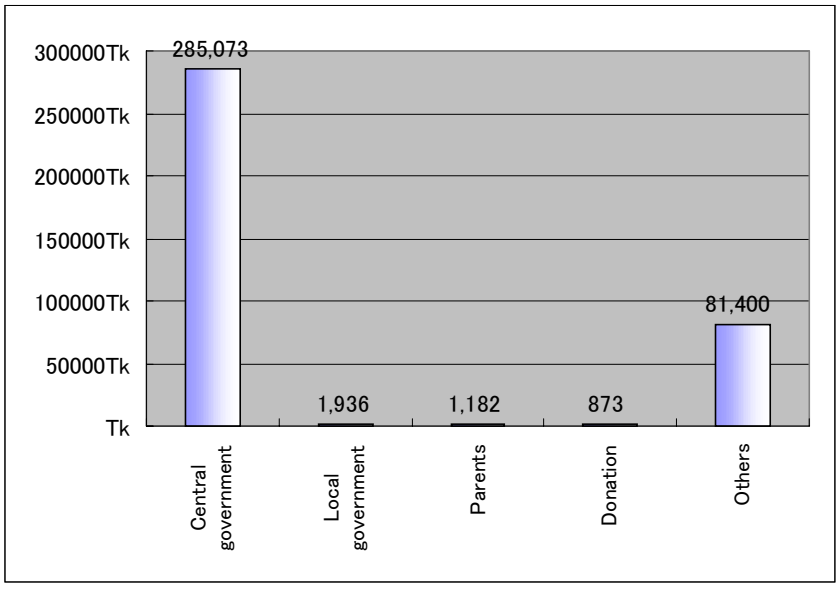


Fig. A6-1-3 Breakdown of Average Revenue of the Target Schools (Average of All Sites)

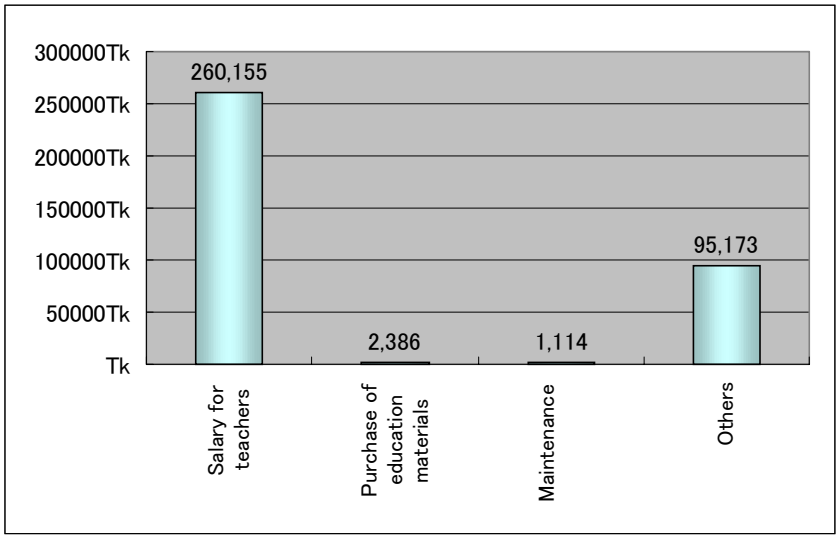


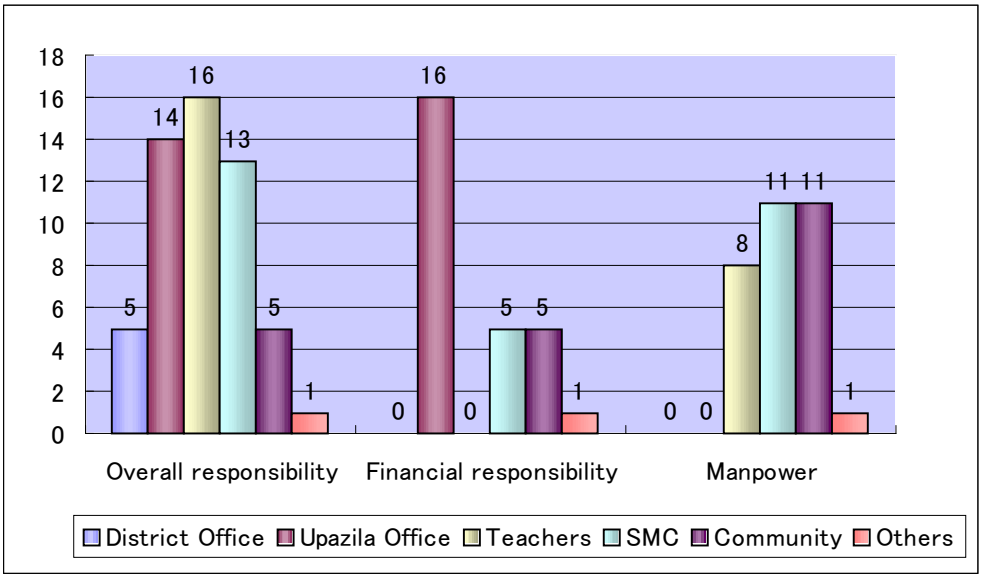
Fig. A6-1-4 Breakdown of Average Expenditure of the Target Schools (Average of All Sites)

School Management Responsibility

Overall responsibility for schools is borne by district offices, teachers and SMC (see Fig. A6-1-5). Since district offices are responsible for all primary schools in their district areas, actual management within the schools themselves is carried out by the SMC including teachers. When conducting the survey and collecting responses, it was found that, since principals and teachers often commute from other areas, the SMC members had a better understanding of school and community conditions. SMC members possess management capacity because of their extensive grasp of information, although disparities do exist between areas.

Since it is difficult for the communities to make much of a contribution as was described above, the Upazila offices assume the main financial responsibility in many cases (16 sites). In the survey responses, it was stated that communities could make a contribution by providing labor for maintenance activities.

SMC gatherings are held every month, while PTA meetings are often held every three months. Management problems confronted by the schools are a lack of human resources (teachers) (17 sites) and shortage of funds (17 sites).



Note: multiple answers

Fig. A6-1-5 Different Responsibilities of School Management in the Target Areas

Table A6-1-1 Surrounding Condition of the Sites

Site No.	Inside High Risk Area	Population within 1.5km radius	Public Water Supply	Well	Public Drainage	Depth of Well	Power Line	Distance to Main Road	Road Type: Earth	Brick	Asphalt	Concrete
6	○	10,000	×	○	×	250m	○	0.1 km	V	V		
13	○	13,000	×	○	×	45m	○	0.7 km	V			
14	○	25,000	×	○	×	45m	○	3.1 km	V	V	V	
15	○	30,000	×	○	×	15m	○	1.4 km	V	V		
16	○	12,000	×	○	×	300m	×	0.5 km	V			
18	○	15,000	×	○	×	300m	×	0.2 km	V			V
19	○	20,000	×	○	×	300m	×	0.3 km	V			
21	○	22,000	×	○	×	18m	○	3.5 km	V		V	
22	○	20,000	×	○	×	18m	×	3.3 km	V		V	V
23	○	6,000	×	○	×	18m	○	0.25 km	V	V		
24	○	15,000	×	○	×	230m	×	4.7 km	V	V	V	
25	○	15,000	×	○	×	150m	○	0.5 km	V	V		
27	○	6,000	×	○	×	15m	○	4.8 km	V	V		
28	○	20,000	×	○	×	200m	×	2 km	V			
29	○	11,000	×	○	×	300m	○	3 km	V	V		
30	○	4,500	×	○	×	50m	○	2.5 km	V	V		
31	○	15,000	×	○	×	300m	○	1 km	V			
32	○	7,000	×	○	×	36m	○	2 km	V	V		
35	○	6,000	×	○	×	60m	○	10 km	V	V		
37	○	5,000	×	○	×	450m	×	7 km	V			
38	○	4,500	×	○	×	450m	×	5 km	V			
39	○	4,000	×	○	×	450m	×	10 km	V			

Table A6-1-2 Information on Disaster Management

Site No.	Warning Organization	Types of Warning	Means of Warning	Organization for Management and Maintenance during Cyclone	Worst Hit Year	Death Toll	Highest Wave	Distance to Shelter	Existing Killa	Possible lands for Killa	Need of Killa (local people's opinion)	Hill/public building within 1.5km radius	Personal items taking to shelters: Food	Cooking equipment	Bedding & Cloths	Valuable Goods	Livestock
6	BDRCS	1-10	Mike	DMC/BDRCS/UP	1991	500	2m	2km	×	○	○	×	∨	∨	∨	∨	
13	BDRCS	1-10	Mike	DMC/BDRCS	1991	150	2.2m	2.5km	×	○	○	×	∨	∨	∨		
14	BDRCS	1-10	Mike	DMC/BDRCS/UP	1991	1,000	1.5m	5km	×	○	○	×	∨		∨	∨	
15	BDRCS	1-10	TV/Radio	World Vision/CPP	1991	500	2.2m	5km	×	○	○	×			∨	∨	
16	BDRCS	1-10	Mike	N.A.	1991	300	2m	2km	×	○	×	×	∨	∨	∨		poultry, duck
18	BDRCS	1-10	Mike	N.A.	1991	600	1.5m	7km	×	○	○	×					
19	BDRCS	1-10	Mike	N.A.	1991	1,000	2.5m	N.A.*1	×	○	○	×	∨	∨	∨		goat, cow
21	BDRCS/UNO	1-10	Mike	SMC/PMED/LGED	1991	500	1.5m	3km	×	○	○	×	∨	∨	∨		
22	CPP/BDRCS	1-10	Mike	DMC/UP	1991	300	1.2m	4km	×	○	○	×	∨		∨		
23	BDRCS	1-10	Mike	BDRCS/local people	1991	200	1m	3km	×	○	○	×	∨		∨		
24	BDRCS	1-10	Mike	DMC/UP	1991	250	1.2m	2km	×	○	○	×	∨		∨		
25	CPP/BDRCS	1-10	Mike	DMC/SMC	1991	300	1.2m	7km	×	○	○	×	∨		∨		
27	BDRCS	1-10	Mike	DMC/BDRC S	1991	250	1.5m	2km.*2	×	○	×	×	∨		∨		
28	BDRCS	1-10	Mike	DMC/BDRCS	1991	350	2m	3.5km	×	○	×	×					
29	BDRCS	1-10	Mike	DMC/BDRCS/UP	1991	200	2m	2km	×	○	×	×	∨	∨	∨	∨	
30	BDRCS	1-10	Mike	DMC/BDRCS/UP	1991	400	3m	2km.*2	×	○	○	×	∨		∨	∨	
31	BDRCS	1-10	Mike	DMC/Local Club	1991	150	3m	2km	×	○	○	×	∨		∨		
32	BDRCS	1-10	Mike	DMC/BDRCS	1991	200	3m	2km	×	○	×	×	∨		∨		
35	CPP	1-10	Mike	DMC/CPP/UP	1991	4,000	2.1m	2.5km	×	○	×	×	∨		∨	∨	
37	BDRCS	1-10	Mike	DMC/BDRCS	1991	1,500	3m	3.5km.*2	×	○	○	×	∨				
38	BDRCS	1-10	Mike	DMC/BDRCS	1991	1200	3m	3.5km.*2	×	○	×	×	∨	∨			
39	BDRCS/ASPUK	1-10	Mike	BDRCS/ASPUK	1991	3000	3m	3km	×	○	○	×	∨	∨			

*1: Deteriorated PWD shelter which is not suitable as a shelter exists in the site.
*2: A small Caritas Shelter of which evacuation capacity does not meet the number of surrounding population exists next to the site/near the site.
*3: BDRCS means CPP in this column

Table A6-1-3 Facility Condition in the Target Schools

Site No.	Land Owner	Building Condition △: not so good	Actual Age of Building (year)	Necessity for Building Demolition	Power Line	Telephone line	Means of Water Supply	Condition of Well ×: out of order	Depth of Well	Existing Toilet	Management Organization; upazila office:U, teacher:T, SMC:S, community:C	Repair Procedure; filing application :F, patrol by engineer :P	Size of Pond (m)	Water not much left	Drinkable by using filter	Not drinkable
6	GoB	○	2	No	×	×	Well	○	250m	○	T	F	24.0 × 16.0	V		
13	GoB	○	12	No	×	×	Well	○	45m	○	U,T,S,C	F	16.0 × 12.0	V		
14	GoB	△	30	No	×	×	Well	×	45m	○	U,T	F	24.68 × 22.55			V
15	GoB	○	N.A.	Yes	×	×	Well	○	10m	○	U,T,S	F	43.8 × 21.5			V
16	GoB	△	25	No	×	×	Well	○	300m	○	N.A.	F	31.0 × 25.0			V
18	GoB	△	38	No	×	×	Well	×	300m	○	N.A.	F	110.0 × 80.0		V	
19	GoB	△	25	No	×	×	Well	○	300m	○	N.A.	F	No pond			
21	GoB	○	14	No	×	×	Well	×	25m	○	U,T,S	F/P	36.0 × 28.0			V
22	GoB	○	0.08	No	×	×	None	-	-	○	U,T,S	N.A.	36.0 × 24.0			V
23	GoB	△	20	No	×	×	Well	○	18m	○	U,T,S	N.A.	34.0 × 28.0			V
24	GoB	△	7	No	×	×	Well	○	240m	×	U,T	F	34.0 × 22.0			V
25	GoB	△	30	No	×	×	Well	×	10m	○	U,T	F/P	36.0 × 28.0			V
27	GoB	△	36	Yes	×	×	Well	×	15m	○	U,T,S	F	30.0 × 22.0			V
28	GoB	△	38	No	×	×	Well	×	200m	○	U,T,S,C	F	No pond			
29	GoB	△	9	No	×	×	Well	○	300m	○	U,T,S,C	F	No pond			
30	GoB	△	35	No	×	×	Well	×	50m	○	U,T,S,C	F	No pond			
31	GoB	△	39	No	×	×	Well	×	300m	○	U,T,S	F	24.0×18.0			V
32	GoB	△	18	Yes	×	×	Well	×	36m	○	U,T,S,C	F	(i) 24×16 (ii) 30×20			V
35	GoB	○/	N.A.	No	×	×	Well	○	60m	○	T,S	F	No pond			
37	GoB	△	11	No	×	×	Well	○	450m	○	N.A.	F	No pond			
38	GoB	△	16	Yes	×	×	Well	○	450m	○	N.A.	F	50.0-40.0×30.0			V
39	GoB	○	36	No	×	×	Well	○	450m	○	N.A.	F	No pond			

Table A6-1-4　Information on Primary Education

Site No.	Total Number of Students (2002)	Number of Students (AM)	Number of Students (PM)	Number of Repeaters (2001)	Number of Drop-out (2001)	Attendance Rate（%）	Total Number of Classes	Male Teacher (trained)	Female Teacher (trained)	Male Teacher (untrained)	Female Teacher (untrained)	Male Teacher (total)	Female Teacher (total)	Total Number of Teachers
6	700	300	400	41	7	90	10	5	0	0	0	5	0	5
13	360	157	203	86	0	80	9	4	0	0	0	4	0	4
14	312	112	200	17	20	80	5	1	3	0	0	1	3	4
15	757	300	457	19	108	70	10	3	7	0	0	3	7	10
16	131	59	72	3	12	95	5	0	2	0	1	0	3	3
18	510	180	330	0	23	90	10	8	0	0	0	8	0	8
19	915	392	523	0	98	90	15	1	0	2	2	3	2	5
21	190	77	113	11	230	80	6	2	2	0	0	2	2	4
22	210	91	119	14	0	80	5	4	0	0	0	4	0	4
23	217	90	127	9	0	80	5	1	4	0	0	1	4	5
24	84	40	44	3	0	75	5	2	1	0	0	2	1	3
25	173	60	113	6	0	90	5	1	3	0	0	1	3	4
27	272	108	164	8	10	85	5	3	0	0	0	3	0	3
28	505	290	215	16	15	86	9	3	0	0	0	3	0	3
29	673	375	298	39	34	82	5	3	2	0	0	3	2	5
30	339	152	187	66	0	83	5	2	2	0	0	2	2	4
31	213	138	75	36	17	84	5	3	0	1	0	4	0	4
32	344	141	203	38	28	85	9	2	3	0	0	3	0	3
35	446	210	236	48	7	85	7	3	0	0	0	3	0	3
37	266	130	136	35	71	90	5	2	1	0	1	2	2	4
38	346	164	182	43	109	89	7	1	0	2	1	3	1	4
39	263	145	118	5	33	87	5	1	0	1	1	2	1	3
Average	**374**	**169**	**205**	**24.7**	**37.4**	**84.4**	**6.9**	**2.5**	**1.4**	**0.3**	**0.3**	**2.8**	**1.5**	**4.3**

6-2 FINDINGS OF SOCIO- ENVIRONMENTAL SURVEY

6-2 FINDINGS OF SOCIO-ENVIRONMENTAL SURVEY

[Objective]

The purpose of this survey was to widely gather information on the socio-economic conditions, state of shelter usage and enrolment situation at primary schools, etc. in the Project Area.

[Survey Method]

Workshops were staged based on question forms. The workshops were attended by 10~15 people consisting of officials with general knowledge of site conditions (local government personnel, union assembly members, community representatives, etc.), primary school personnel (principals, head teachers and SMC members), and ordinary citizens including women. Detailed site investigations were consigned to the same local consultants.

[Survey Items and Findings]

1. Economic Conditions

The profession and income of the workshop participants are shown in Table A6-2-1.

47% of the participants are engaged in agriculture and the average monthly income of agricultural labourers accounting for 37.7% of the participants is TK 813. Given the poverty line in rural areas of the Chittagong District of TK 623.9 (1999), it can be inferred that many local residents are forced to live below the poverty line.

Based on their own perception of economic status by local residents, the rich account for 3.8%, the middle class for 18.6%, the poor for 31.1% and the very poor for 45.3%, indicating that more than 75% of local residents consider themselves to be either poor or very poor (see Table A6-2-2).

Table A6-2-1 Questionnaire Survey Results for Workshop Participants

	Average annual income (Tk)	Average monthly income (Tk)
Agricultural labourer	9,752	813
Agriculture (landowner etc.)	11,573	964
Boat operator	19,567	1,631
Fisherman	27,473	2,289
Service provider	76,981	6,415
Small trader	30,732	2,561
Transport worker	25,254	2,105
Mason	41,055	3,421
Carpenter	136,108	11,342
Business owner	895,942	74,662

2. Social Conditions

The most popular religion in the Project Area is Islam and Muslims account for 90% or more of the local population at 14 sites. The second largest religion is Hinduism. At five sites (Site Nos. 21, 23, 25, 27 and 32), Hindus account for 20 – 50% of the local population. Also present are Christians (Site No. 32) and Buddhists (Site Nos. 24 and 28) although their number is very small.

Many NGOs are active in the HRA to improve the lives of local residents and have established community-based organizations providing vocational training, agricultural guidance, loans of money and equipment to assist production activities and participatory activities. Proshika has the largest number of local operating sites (11 sites), followed by Grameen Bank (9 sites), BRAC (4 sites), Caritas (4 sites), BDRCS (4 sites), ASPUK (2 sites and CARE (1 site) (see Table A6-2-3).

3. Situation of Shelter Usage

Various means are used to issue a warning as shown in Fig. A6-2-1. Residents at many sites evacuate to neighbors' or relatives' houses (16 sites), education facilities (14 sites), public shelters [1)] (9 sites) and high land (8 sites). The principal reasons given for choosing such places as evacuation sites are safety (17 sites) and convenience (11 sites). Meanwhile, the lack of water supply and drainage facilities is pointed out as a problem regarding the use of shelters.

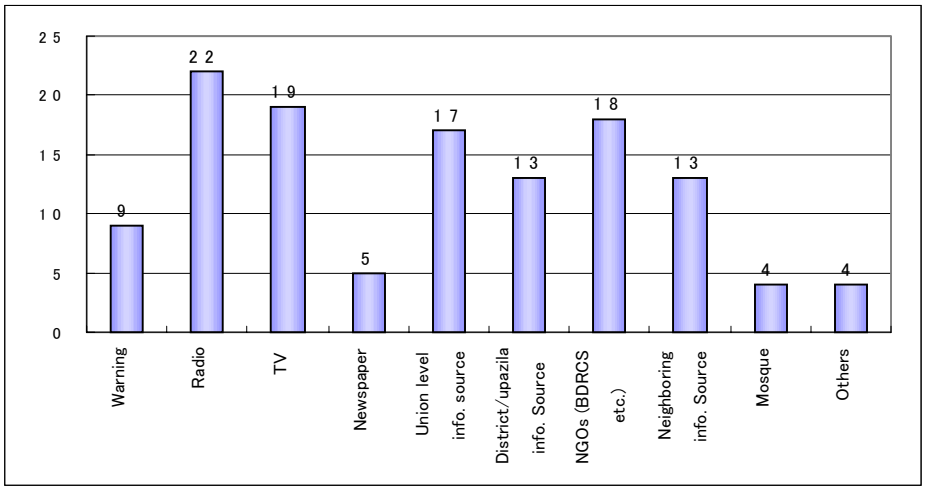
1) However, the public shelters in these cases are more than 1.5 km away.

Walking is the common means of evacuation (22 sites). The average traveling time to a shelter is around 30 minutes longer than at normal times due to the poor quality of access roads. The last time residents evacuated was 1991 (10 sites), 1997 (5 sites) and 1998 (3 sites) (18 valid responses given in total). It is now clear that the main roles of a community organization are support for the evacuation of women, children and the elderly and the conveyance of the warning level.

Concerning belongings that people take to evacuation sites, major responses are small amount of food (19 sites), bedding and clothing (17 sites), cooking utensils (9 sites), valuables (6 sites) and livestock (2 sites).

The means suggested to maintain shelters include regular cleaning, voluntary service by the community, establishment of a management committee and mobilization of SMC members and union assembly members.

The desirable usage of shelters includes primary school (16 sites), meeting place (16 sites), simple health facilities (12 sites), polling station (3 sites) and market (3 sites).



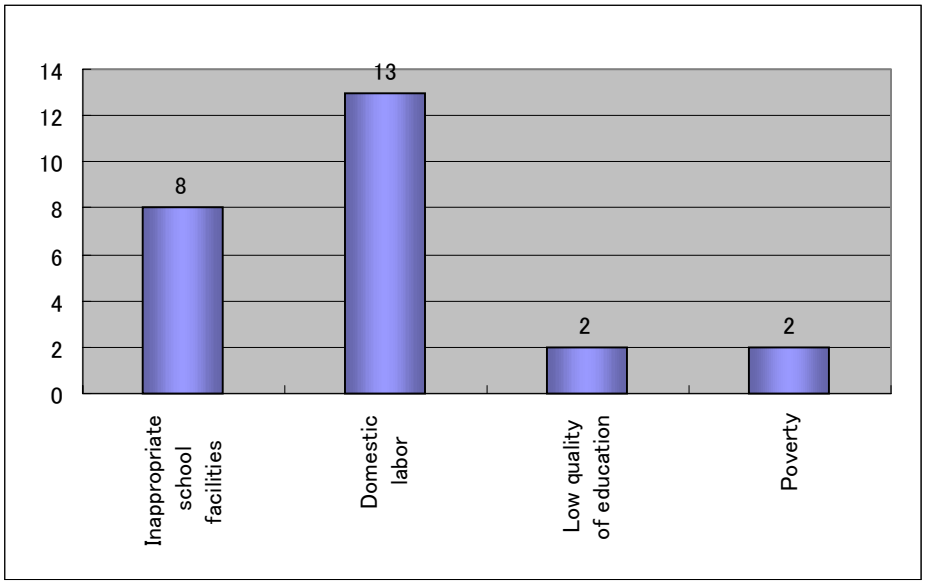
Note: multiple answers

Fig. A6-2-1 Means of Access to Warnings

4. Situation of Primary Education

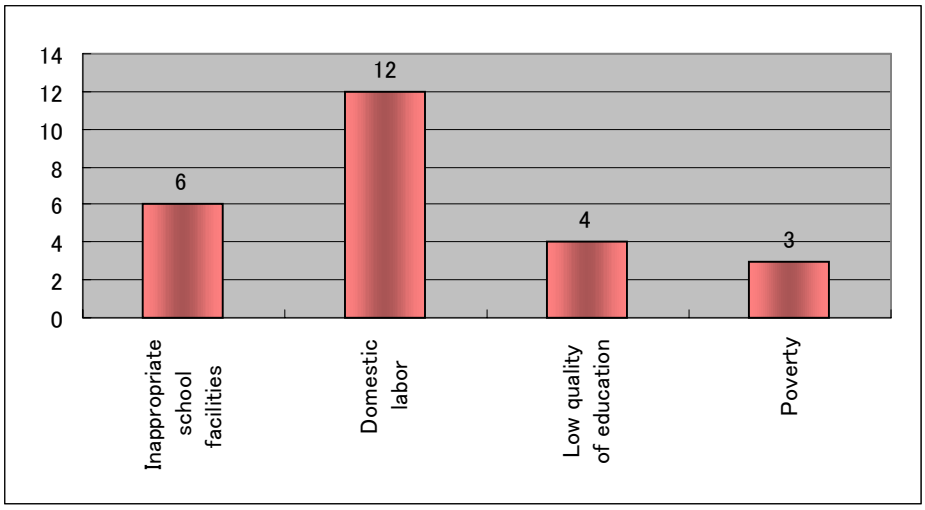
Factors pointed out as impediments to enrolment and causes of dropout are the involvement of children in domestic chores, insufficient school facilities, low quality of education and lack of money for education due to poverty (see Fig. A6-2-2 and A6-2-3). A lack of funds is

pointed out as a problem for school maintenance at many sites (13 sites). The above situation indicates the necessity to increase the reliable income to improve the lives of local residents who send their children to school and to invest more public funds in the improvement of educational facilities (and their maintenance) by the administration along with efforts to improve the quality of education.



Note: multiple answers

Fig. A6-2-2 Factors Preventing Enrolment



Note: multiple answers

Fig. A6-2-3 Factors for Drop-out

Table A6-2-2 Socioeconomic Conditions by Site

Site No.	Main Economic Activities of Local Residents (Unit : persons)										People's Perception of Economic Status (Unit：%)				Religion (Unit：%)				
	Agriculture (landowner ,etc)	Agricultural Laborer)	Transport	Boat Operator	Fisherman	Mason	Carpenter	Business Owner	Service	Small Trader	Rich	Middle Class	Poor	Very Poor	Muslim	Hindu	Christian	Buddhist	Others
6	250	1,200	150	50	550	20	50	70	300	150	3	22	25	50	90	10	0	0	0
13	700	1,400	140	140	350	350	140	14	70	350	5	10	70	15	95	5	0	0	0
14	360	7,200	120	2,400	120	120	120	30	30	360	2	18	30	50	98	0	0	0	2
15	400	4,000	200	4,000	200	200	200	200	5,000	600	3	27	50	20	98	0	0	0	2
16	125	570	80	15	20	10	5	3	30	75	5	60	5	30	90	10	0	0	0
18	200	3,000	170	12	**113**	200	250	3	1,100	60	1	10	20	69	95	5	0	0	0
19	50	2,000	30	30	300	7	30	3	125	300	2	8	20	70	97	3	0	0	0
21	100	100	60	-	-	5	5	5	100	15	30	25	15	30	65	35	0	0	0
22	800	500	100	-	150	30	20	1	100	50	1	15	34	50	0	0	0	0	0
23	150	50	20	-		20	20	10	40	40	10	50	15	25	60	40	0	0	0
24	800	450	100	-	150	50	10	-	200	100	1	25	30	44	65	20	0	15	0
25	250	250	50	-	10	7	5	5	60	100	1	34	25	40	50	50	0	0	0
27	1,700	600	700	-	400	100	50	-	200	100	5	15	25	55	60	40	0	0	0
28	150	350	35	15	40	20	15	25	140	30	5	20	50	25	95	2	0	3	0
29	40	4,000	120	80	50	20	15	-	300	40	2	10	20	68	95	5	0	0	0
30	100	500	50	20	20	25	20	30	200	35	2	20	50	28	90	10	0	0	0
31	125	350	20	22	25	8	15	10	40	20	-	2	18	80	95	5	0	0	0
32	30	1,500	150	10	15	10	30	12	150	20	-	2	90	8	75	23	2	0	0
35	1,050	1,725	100	75	1,200	45	10	25	225	50	1	3	20	49	99	1	0	0	0
37	480	1,000	200	300	500	50	50	15	100	500	1	2	17	80	100	0	0	0	0
38	150	1,300	60	80	150	15	20	8	60	85	1	14	25	60	90	10	0	0	0
39	220	870	40	70	130	45	15	2	100	50	2	18	30	50	80	20	0	0	0

Table A6-2-3　Locally Active NGO and CSO（by Site）

Site No.	Organization（1）	Number of Members	Organization（2）	Number of Members	Organization（3）	Number of Members	Organizatin（4）	Number of Members	Organization（5）	Number of Members
6	Grameen Bank	900	Caritas	240	Fisherman Samiti	120	Proshika	30	HEED Bangladesh	20
13	Momota Organization	400	Nowhojan Organization	200	BDRCS	33				
14	Shampari Organization	150	Ansar /VDP Club	64	Isana gar Youth Club	40	Protiva Organization	30	CPP (BDRCS)	24
15	Social Welfare Organization	214	Shampan Driver Welfare Organization	250	North East Youth Club Organization	130	Shah Somiya Fish Organization	110	Mukto Bihongo Organization	71
16										
18	Fight for Hunger	95	Nari Samiti	20	Caritas	11				
19	Caritas	90	ASPUK	21						
21	Grameen Bank	50	Temuhini Juba Sanga	24	ASA	22	Proshika	22		
22	Grameen Bank	200	CAP Bangladesh	160	Mishok　Sanga	160	Youth Development Organization	150	Proshika	100
23	Rangdhanu Social Club	25	Ralatan Club	25	Grameen Bank	48	ASA	22	Proshika	23
24	BRAC	30	Riksha Malik Samiti	30	Rabariful Babsayi Samiti	20				
25	Proshika	210	Hazisorai Youth Snaga	75	Grameen Bank	30				
27	SEBA	500	Shaheed Zia Sritti　Sanga	200	Saherkhali Souhanna Sanga	200	Grameen Bank	120	Proshika	100
28	BRAC	90	BRDB	45	Proshika	40	Grameen Bank	16	CARE	N.A.
29	Grameen Bank	100	BRAC	90						
30	UDDIPAN	300								
31	Proshika	120								
32	BRAC	90	UDDIPON	90	Proshika	90	Grameen Bank	90	HEED BANGLADESH	60
35	Nojoyan Somiti	67	Krishi Somohaya Samiti	42	Caritas	30	Shahti Para Somiti	25		
37	Proshika	10	ASPUK	9						
38	BDRCS	9								
39	Proshika	120	ASPUK	50						

6-3 RESULTS OF HYDRAULIC AND HYDROLOGICAL SURVEYS

6-3 RESULTS OF HYDRAULIC AND HYDROLOGICAL SURVEYS

Out of the 61 cyclone shelters constructed by Japan under the Phase I through Phase IV Projects, one shelter on the left bank in the lower reach of Meghna River (Phase III Project Site No. 9 at Ramgati) has already been lost due to a change of the river course while another on the left bank in the lower reach of Sangu River (Phase II Project Site No. 2 at Banshkhali) is facing a risk of being washed away due to scouring of the foundations.

In view of this situation, a new site selection criterion of "it is highly unlikely that the subject site will be eroded due to a change of the river course" was added for the Phase V Study and a hydraulic and hydrological survey on the possibility of bank erosion due to a change of the river course in the Project Area was conducted for the purpose of obtaining basic data for the assessment/judgement of the said possibility with the analysis of satellite images and other information.

1. Situation of Damage (Loss) to Existing Shelters by Bank Erosion

Table A6-3-1 lists the shelters likely to be lost and the shelters constructed with Japanese assistance which have already been lost or which are facing imminent loss due to bank erosion which were discovered through an interview survey conducted as part of the field survey among existing shelters in the study area.

The loss of the following 10 shelters was confirmed by the field survey.

- Calitas (2) : Sandwip and Hatiya
- BDRCS (5) : Hatiya (4) and Ramgati (1)
- Japan (1) : Ramgati (Phase III Project Site No.9)
- EU (1) : Ramgati
- Others (1) : Ramgati

By location, one shelter has been lost at Sandwip, five at Hatiya and four at Ramgati.

In addition, judging from the natural conditions at the shelter sites, there is a strong likelihood that the following six shelters will be lost due to bank erosion in the near future.

- Japan (1) : Banshkhali (Phase II Project Site No.2)
- Saudi Arabia (1) : Banshkhali (along the left bank of the lower reaches of Sangu River; upstream of Phase II Project Site No.2)

- Bangladesh (1) : Sandwip (on the college campus along the west bank of the island)
- Calitas (1) : Hatiya (along the embankment of the west bank of the island)
- EU (2) : Ramgati (the Ministry of Water Resources has commenced bank protection work at one site)

(1) Situation of Shelter Constructed with Japanese Assistance
(Phase II-2: Rata Khordo GPS)

According a JICA expert (assigned to the LGED), the situation of the shelter (Phase II Project Site No.2: Rata Khordo GPS) constructed with Japanese assistance at Banshkhali in mid-March, 2003 little differed from that in November, 2002 although it was facing imminent loss.

The current shore line on the left bank around this site shows that the shelter site is slightly protruding towards the centre of the river, greatly exposing the site to water flow at the time of flooding. This situation appears to encourage erosion, posing a danger to the shelter. While work has been conducted in the past to avoid the loss of this shelter, no such work is currently taking place. There are signs of the implementation of reinforcement work to resist bank erosion in both the upstream and downstream but the current shape of the embankment immediately upstream of the shelter is like a razor, i.e. an extremely narrow crown width of the embankment, suggesting that it is highly vulnerable to erosion. Depending on the scale of flooding this year, the bank erosion will further progress, possibly causing the circle of river water around the embankment to invade the embankment, leaving the shelter in the river. The shelter is currently being used as a school building with little protection.

View of the upstream from the rooftop

View of the shelter from the downstream

View of the downstream from the rooftop

Situation of Shelter Constructed with Japanese Assistance along the Left Bank of the Lower Reach of Sangu River (Phase II-2: Rata Khordo GPS)

(2) Situation of Shelter on Left Bank of Lower Reach of Sangu River Likely to be Affected by Bank Erosion

There is another shelter constructed with Saudi Arabian assistance on the left bank of the upper reach of Sangu River some 5.7 km north of the shelter referred to in (1) above. This shelter is situated some 15 m of the river bank of Sangu River at a section which is currently suffering from ongoing erosion. According to the interview survey results, a mosque located some 100 m upstream of this shelter was washed away last year. Because of the absence of a new embankment, etc. to prevent further bank erosion, there appears to be a strong likelihood of the erosion or even loss of the shelter's foundations depending on the scale of flooding this year and thereafter.

View of the left bank upstream seen from the shelter

View of the shelter seen from the upstream

View of Site No. 30 to the south seen from the river bank

Shelter on Left Bank in Lower Reach of Sangu River likely to be Affected by Bank Erosion in the Future

(3) Situation of Shelter on West Bank of Sandwip Island

The west bank of Sandwip Island has been eroded by some 2.2 km in the last some 30 years and the shoreline is now approaching the back of the college campus. As shown on the photographs, the bank is being reinforced but there is concern in regard to the further progress of erosion in the coming years.

View of the college building seen from the west bank side

State of slope protection at the west bank

Shelter on the college campus

College Campus along West Bank of Sandwip Island

(4) Situation of West Bank on Hatiya Island

The west bank of Hatiya Island has been eroded by approximately 1.5 km over a period of some 30 years and bank erosion is still in progress. According to the interview survey results, the last 12 months have seen the receding of the bank by some 600 m due to erosion. Along the bank near Site No. 39, the embankment is situated some 200 m inland from the bank and a shelter constructed by Caritas is located inside this embankment. Although this embankment extends along the bank, it ends some 300 m to the south where its distance from the bank is approximately 20 m.

View of the west bank seen from the south to the north

View of the west bank seen from the north to the south

View of Site No. 39 seen from the top of the embankment

Situation of West Bank on Hatiya Island

(5) Situation of Bank Erosion Prevention Work at Left Bank in Lower Reach of Meghna River (Ramgati)

One shelter constructed with Japanese assistance (Phase III-9: Char Gazi GPS) has already been lost along the left bank in the lower reach of Meghna River at Ramgati. At another shelter located upstream of this lost shelter along the trunk road, there is a shelter constructed by the EU. According to the interview survey results, a request was made two years ago for the implementation of bank erosion control work and work to protect the bank commenced by the Ministry of Water Resources in February this year. The current situation of the work is shown on the photographs below.

The implementation policy for bank protection facilities from next year onwards is believed to have been prepared based on the effects of erosion control work as bank protection work during this year's flooding season.

Bank protection work

View of the left bank
in the upstream of Meghna River

View of the left bank
in the downstream of Meghna River

Situation of Bank Erosion Control Work Being Implemented by the Ministry of Water Sources

Table A6-3-1 Situation of Damage by Bank Erosion to Existing Shelters in the Study Area

District	Upazila	Donor	Loss of Existing Shelter (Interview Survey)	Existing Shelter Liable to Loss (Field Reconnaissance, etc.)	Situation of Measures Implemented by Government of Bangladesh to Control Bank Erosion
Cox's Bazar	Chakaria	Japan	None	None	
		Others	None	None	
Chittagong	Patiya	Japan	None	None	
		Others	None	None	
	Sandwip	Japan	None	None	
		Others	Caritas : 1	Bangladesh : 1 at college	No bank protection (west bank)
	Miresharai	Japan	None	None	
		Others	None	None	
	Banshkhali	Japan	None	1 (Phase II-2)	No further work after the completion of slope protection work (left bank of Sangu River)
		Others	None	Saudi Arabia: 1	No bank protection (left bank of Sangu River)
	Anowara	Japan	None	None	
		Others	None	None	
Noakhali	Hatiya	Japan	None	None	
		Others	BDRCS : 4 Caritas : 1	Caritas : 1	No bank protection (west bank)
	Noakhali	Japan	None	None	
		Others	None	None	
Laksmipur	Ramgati	Japan	1 (Phase III-9)	None	(Bank erosion has completely changed the local topography and it was impossible to check the former site of the shelter.)
		Others	BDRCS : 1 EU : 1 Others : 1	EU : 2	Bank protection work to be completed in five years commenced in February this year by the Ministry of Water Resources; no protection for another site (left bank of Meghna River)

2. Establishment of Changes of River Banks over Time Using Satellite Images

To establish the changes of river banks over time due to erosion and sedimentation in the study area, the LANDSAT images (scale: 1: 150,000) listed in Table A6-3-2 were obtained to produce overlay images of two different dates (Fig. A6-3-1 through Fig. A6-3-6). Meanwhile, Table A6-3-3 shows the scale of erosion (distance), which took place in a period between the years of satellite image being taken, and the average annual change (distance) for the west bank of Sandwip Island, the west bank of Hatiya Island and at Ramgati on the left bank in the lower reach of Meghna River, all of which experienced considerable bank erosion in the study area.

Table A6-3-2 List of Satellite Images Covering the Study Area

Part of Study Area	LANDSAT Path/Row	1973/74	1984	1996	2001
North East	146/44	27-Jan-1973	25-Feb-1984	18-Feb-1996	14-Jan-2001
South East	146/45	9-Jan-1974	25-Feb-1984	18-Feb-1996	14-Jan-2001
North West	147/44	2-Feb-1973	19-Mar-1984	9-Feb-1996	29-Jan-2001
South West	147/45	2-Feb-1973	19-Mar-1984	9-Feb-1996	29-Jan-2001

Table A6-3-3 Amount of Bank Erosion (Distance) and Annual Amount of Erosion (Distance) at Places of Conspicuous Bank Erosion

	1973/74 – 1984 (Average of 11 Years)	1984 – 1996 (Average of 12 Years)	1996 - 2001 (Average of 5 Years)	1973/74 – 2001 (Average of 28 Years)
West Bank of Sandwip Island	0.9km (80m/year)	0.9km (80m/year)	0.3km (60m/year)	2.1km (80m/year)
West Bank of Hatiya Island	0.7km (60m/year)	0.3km (30m/year)	0.4km (80m/year)	1.4km (50m/year)
Ramgati on Left Bank of Lower Reach of Meghna River	1.0km (90m/year)	1.2km (100m/year)	0.9km (160m/year)	3.0km (110m/year)

(1) Chakaria Upazila, Cox's Bazar District (Site No. 6): See Fig. A6-3-1

Old Matamuhari River located at the back of Site No. 6 is currently used as a canal for shipping. Changes of the river bank observed with satellite image data of some 30 years apart indicate that no substantial bank erosion has taken place to change the river course.

In contrast, the course of the present Matamuhari River frequently changes at its mouth, the location of which has shifted some 20 km southward during this time.

In terms of land use, half of green plantation areas in the lower reach of Matamuhari River on the 1973/74 image changed to ponds (for shrimp culture and salt production) on the 1984 image. The 1996 image showed that all the areas practically changed to such ponds as in the case of the 2001 image, illustrating the substantial changes in these years.

(2) Chittagong District

1) Patiya Upazila (Site Nos. 13, 14 and 15): See Fig. A6-3-2

The satellite images over a period of some 30 years indicate no significant erosion causing a change of the river course at the banks of Karnaphuli River where these three sites are located nearby. The planned sites are near the left bank in the lower reach of Karnaphuli River and the presence of factory buildings and docks along this bank implies that local interest in river bank maintenance should be fairly high. No significant change of the river course due to the absence of large-scale erosion during these years can be presumably attributed to the facts that the urbanized area of Chittagong spreads along the opposite bank and the banks are protected because of the existence of Karnaphuli Bridge in the upstream and also because of the dam for hydropower generation further upstream at Rangmati.

2) Sandwip Upazila (Site Nos. 16, 18 and 19): See Fig. A6-3-3

The satellite images over the period in question indicate progressive erosion of the banks to the west and south of the island. As shown in Table A6-3-3, the average amount of erosion for the recent five years (60m/year) indicates the tendency of slightly easing bank erosion as compared to the average amount of erosion over 28 years (80m/year). In contrast, the banks to the north and east show that sedimentation rather than erosion has taken place. An increased area of greenery is recognisable on the east bank as planting has been conducted in this area with the eastward advancement of the bank.

As the planned sites are located in the central area of the island, it is believed that there is little likelihood that the new facilities will be affected by major bank erosion.

3) Miresharai Upazila (Site Nos. 21, 22, 23, 24, 25 and 27): See Fig. A6-3-4

The satellite images suggest a tendency towards sedimentation at Site Nos. 21, 22, 24, 25 and 27, all of which are located in the lower reach or near the mouth of Feni River. Site No. 23 is also less likely to be affected by major bank erosion as it is near a trunk road which is far from the bank.

An increase of a green tract of land due to planting over some 30 years is recognised along the banks in Upazila Miresharai.

4) Banshkhali Upazila (Site Nos. 28, 29, 30, 31 and 32): See Fig. A6-3-2

The satellite images of the shoreline of the Bay of Bengal where Site Nos. 28, 29 and 32 are located nearby indicate a tendency towards sedimentation and partial planting on the newly emerged land. A tendency towards sedimentation is similarly observed along the left bank of Kutubdia Channel where Site No. 31 is located nearby.

A significant change of the river banks over some 30 years in the lower reach of Sangu River where Site No. 30 is located on the left bank is confirmed by the satellite images. The fact that the left bank in particular has been affected by erosion is verified by other existing material (see Fig.A6-3-8). The bank to the north of Site No. 30 has not changed significantly over the 30 year period in question despite a change of the river course in both the upstream and downstream. As a bridge is currently being conducted at a ferry crossing point in the upstream, it is anticipated that work to stabilise the banks in the upstream and downstream of this bridge will be conducted in due course.

5) Anowara Upazila (Site No. 35): See Fig. A6-3-2

Site No. 35 is located on the right bank in the lower reach of Sangu River, a change of the course of which over the years is already described above. According to existing material (see Fig.A6-3-8), the effect of bank erosion on the right bank is evaluated as being relatively small. There are several water intakes along the river bank near Site No. 35 and the presence of a continuous embankment to protect these intakes means that it is unlikely that a large-scale change of the river course affecting Site No. 35 will take place in the foreseeable future.

(3) Hatiya Upazila, Noakhali District (Site Nos. 37, 38 and 39): See Fig. A6-3-5

While the north and west banks of the island are liable to erosion, illustrated by the fact that the average amount of erosion in the recent five years (80m/year) was greater than that for 28 years (50m/year) as shown in Fig.A6-3-5 and Table A6-3-3, a tendency towards sedimentation is observed at the east and south banks. The progress of planting over some 30 years can be observed at sedimentation areas along the east and south banks.

Site Nos. 37 and 38 are located in the east central and southeastern parts of the island respectively. Because of bank conservation measures, including plan, it appears less likely that these areas will suffer from large-scale erosion. In contrast, Site No. 39 is near the west bank where no erosion control measures are being implemented despite the progress of bank erosion. If the bank erosion progresses any further, this site is likely to be affected.

(4) Lower Reach of Meghna River: See Fig. A6-3-6

The satellite images over a period of 30 years confirm that bank erosion along Meghna River at Ramgati has inwardly taken place to a maximum distance of 3 km and a minimum distance of 1.5 km. According to Table A6-3-3, the average amount of erosion for the recent five years (160m/year) exceeded that for 28 years (110m/year), indicating the progressive nature of bank erosion at Ramgati for the period from 1996 to 2001. Along with this bank erosion, southward sedimentation has taken place at the left bank of Meghna River, creating new land.

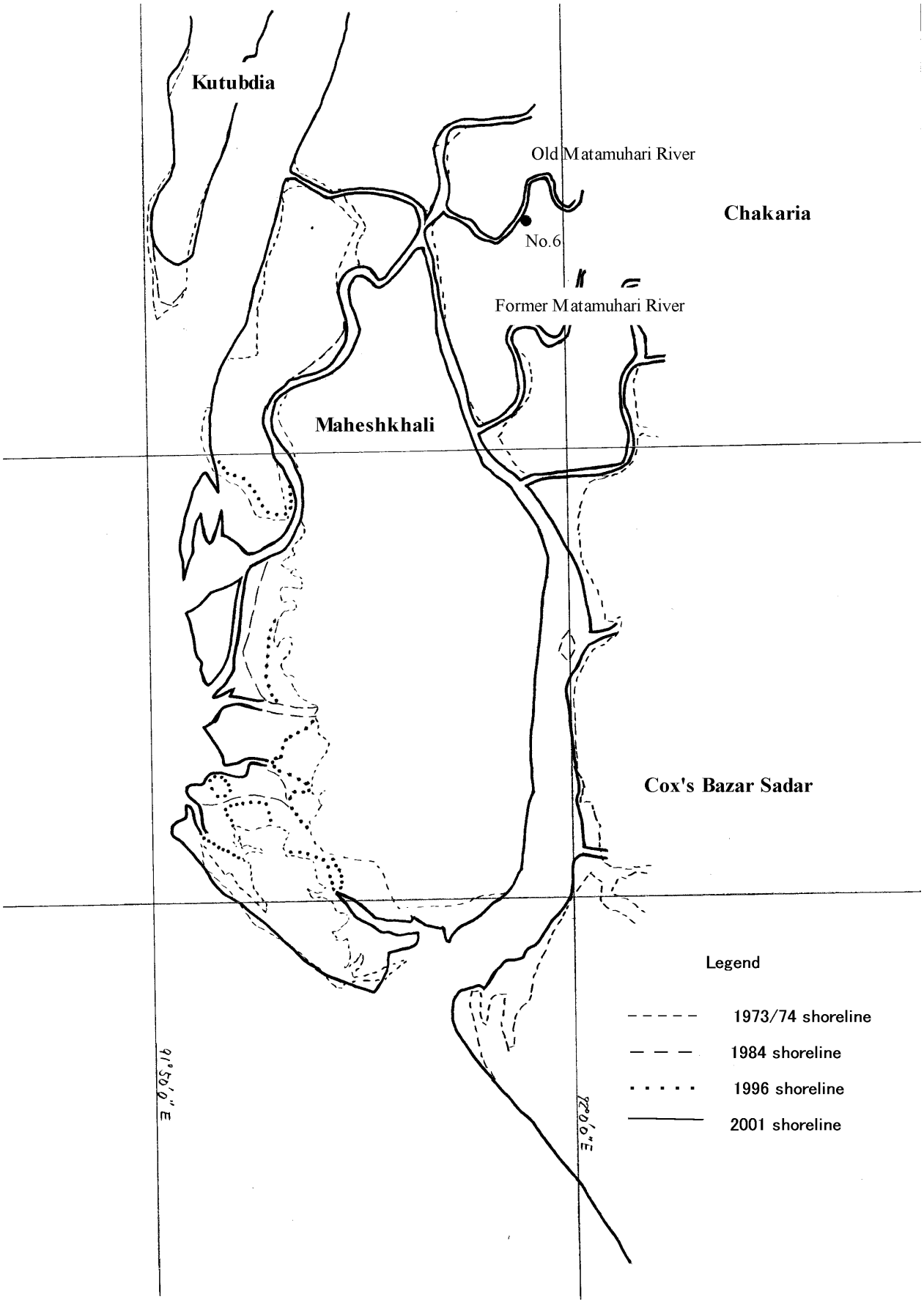


Fig. A6-3-1 Change of Shoreline Over Time Shown by Satellite Images (Chakaria)

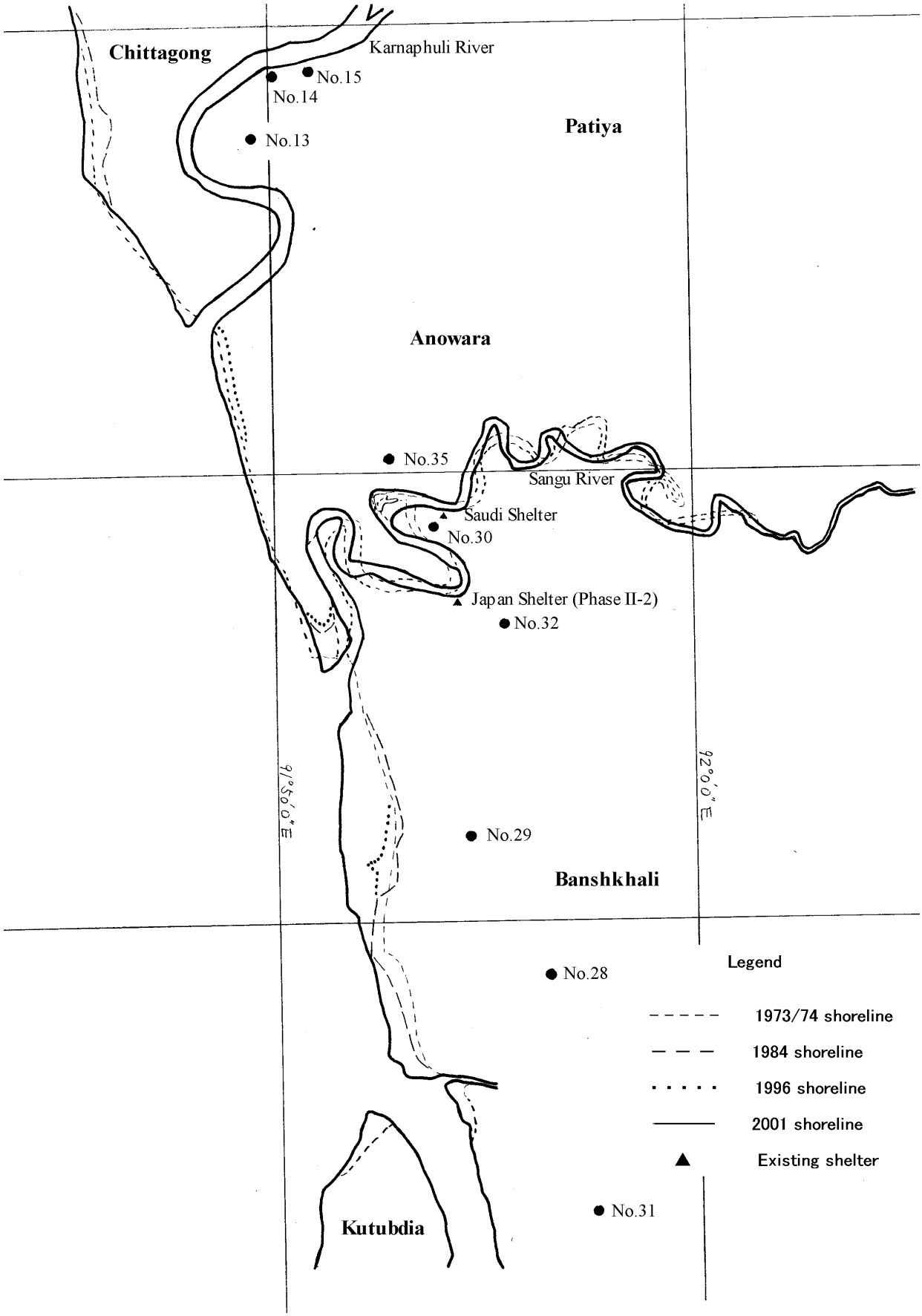


Fig. A6-3-2 Change of Shoreline Over Time Shown by Satellite Images
(Patiya, Anowara and Banshkhali)

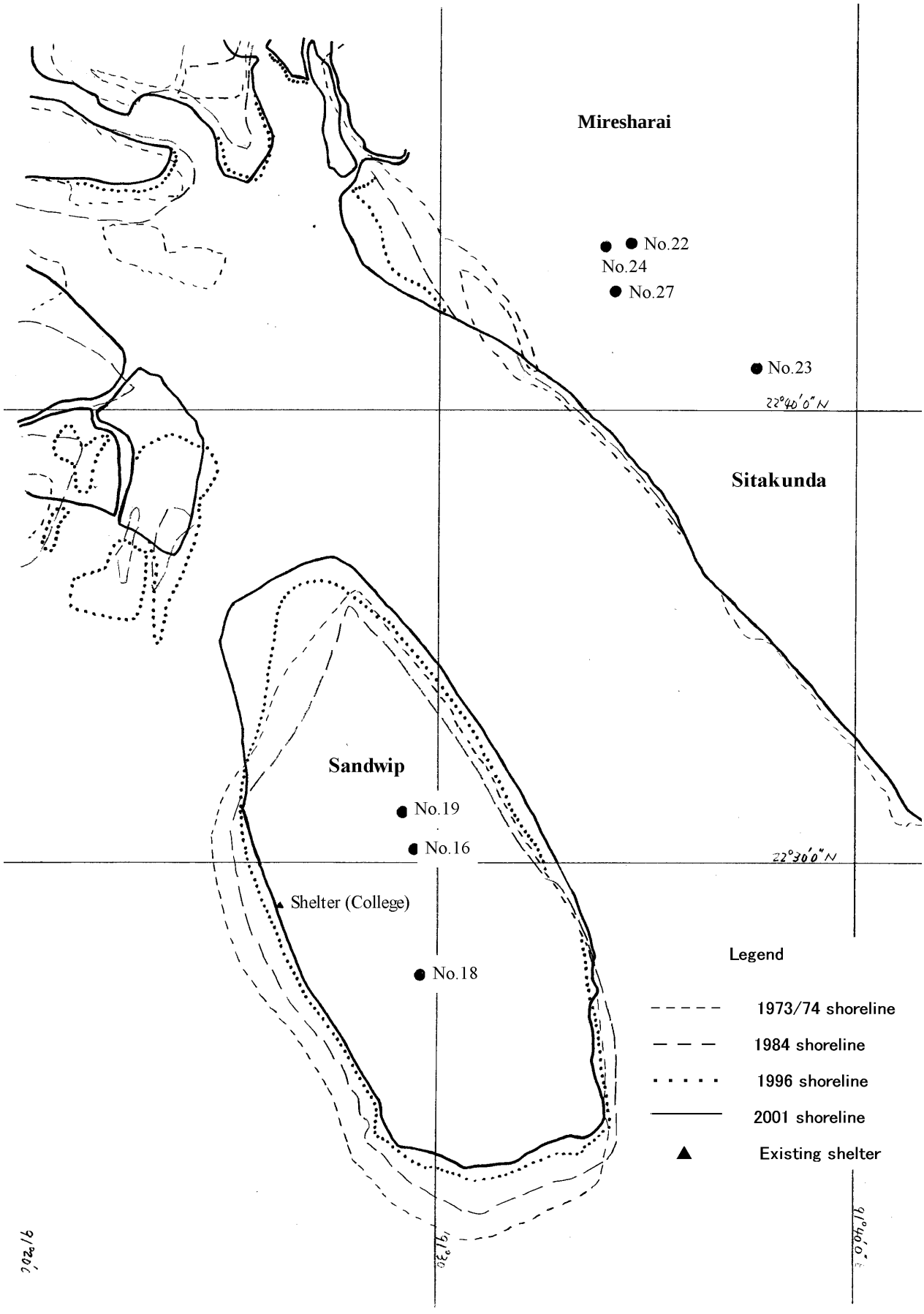


Fig. A6-3-3 Change of Shoreline Over Time Shown by Satellite Images (Sandwip)

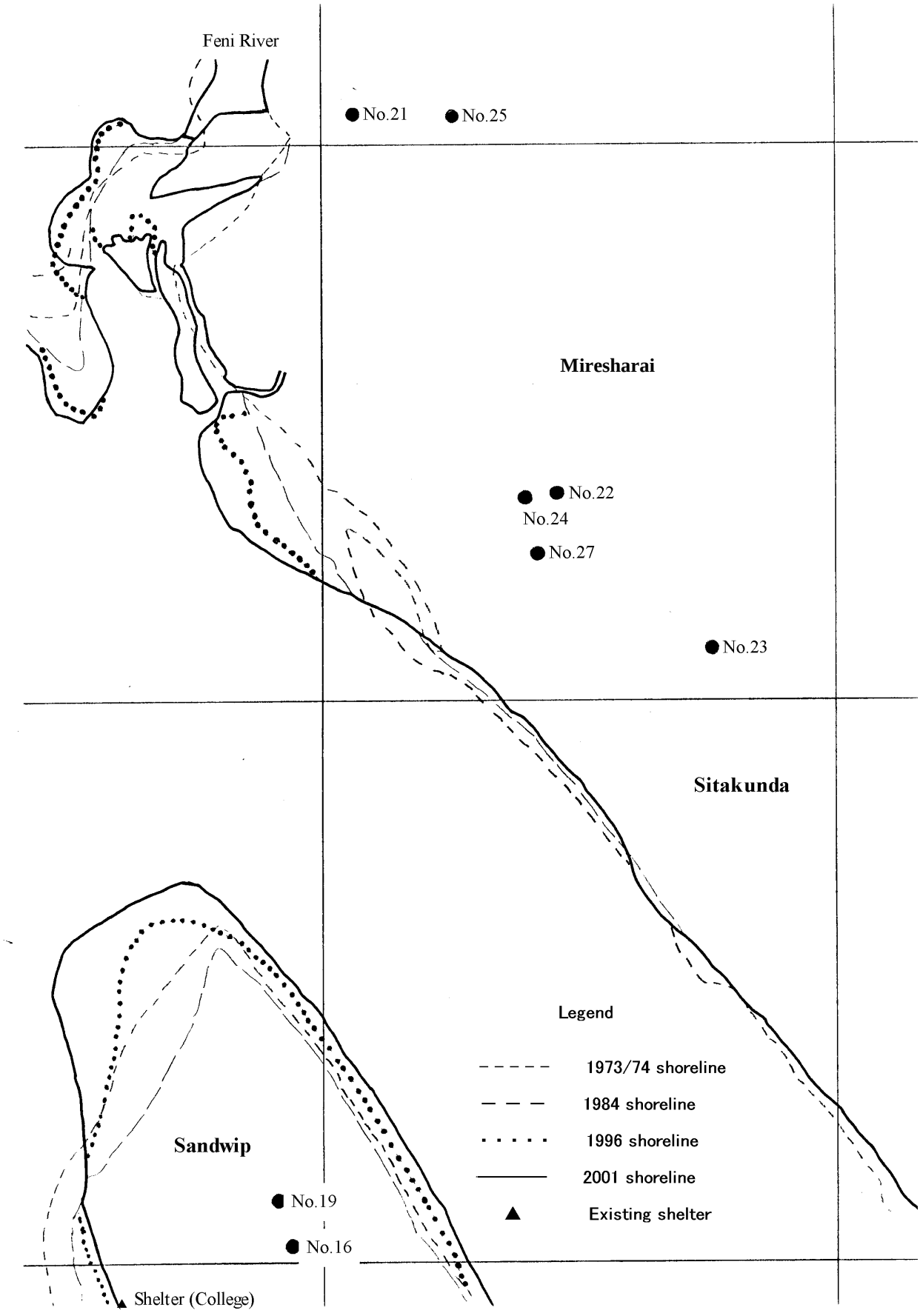


Fig. A6-3-4 Change of Shoreline Over Time Shown by Satellite Images (Miresharai)

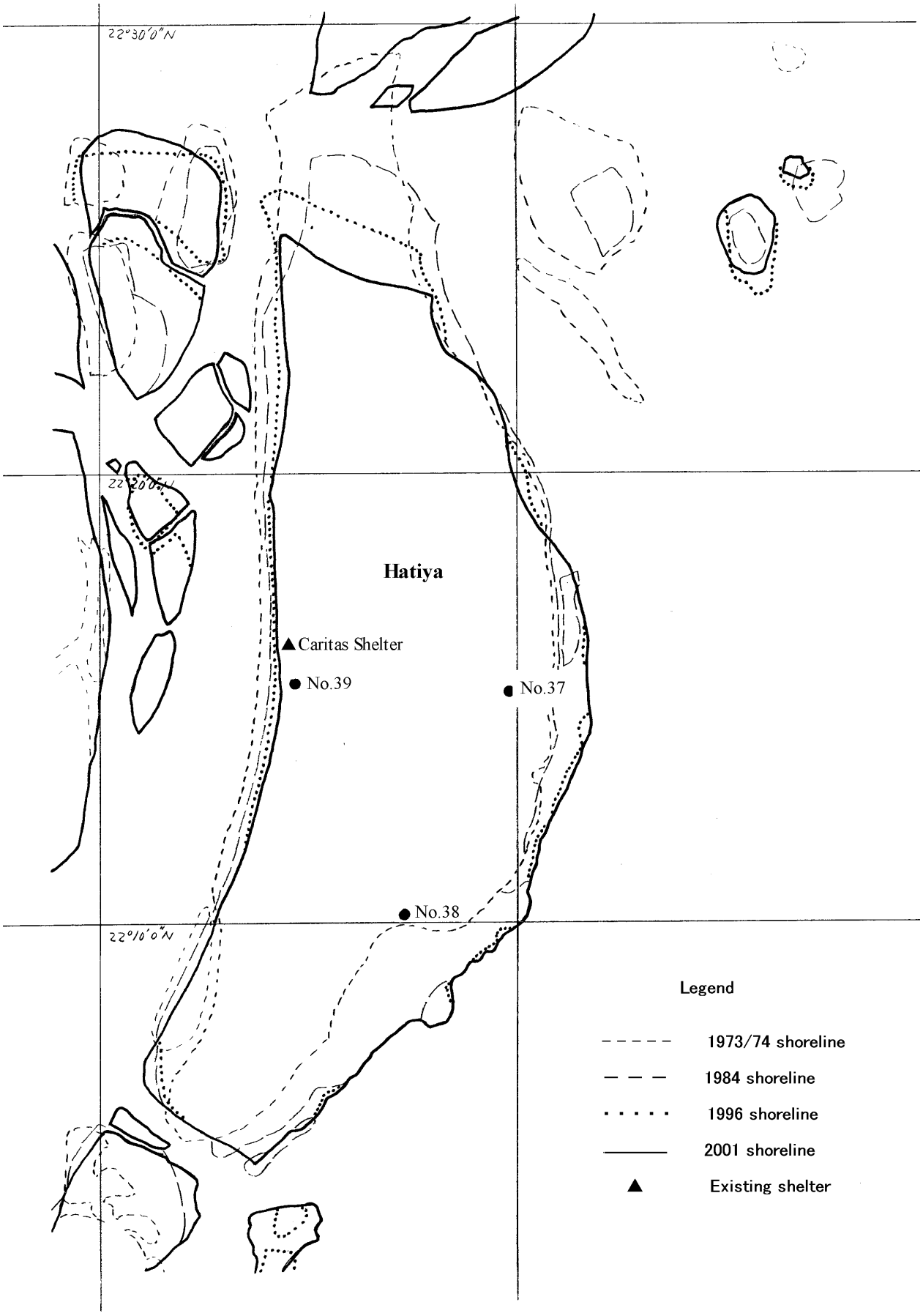


Fig. A6-3-5 Change of Shoreline Over Time Shown by Satellite Images (Hatiya)

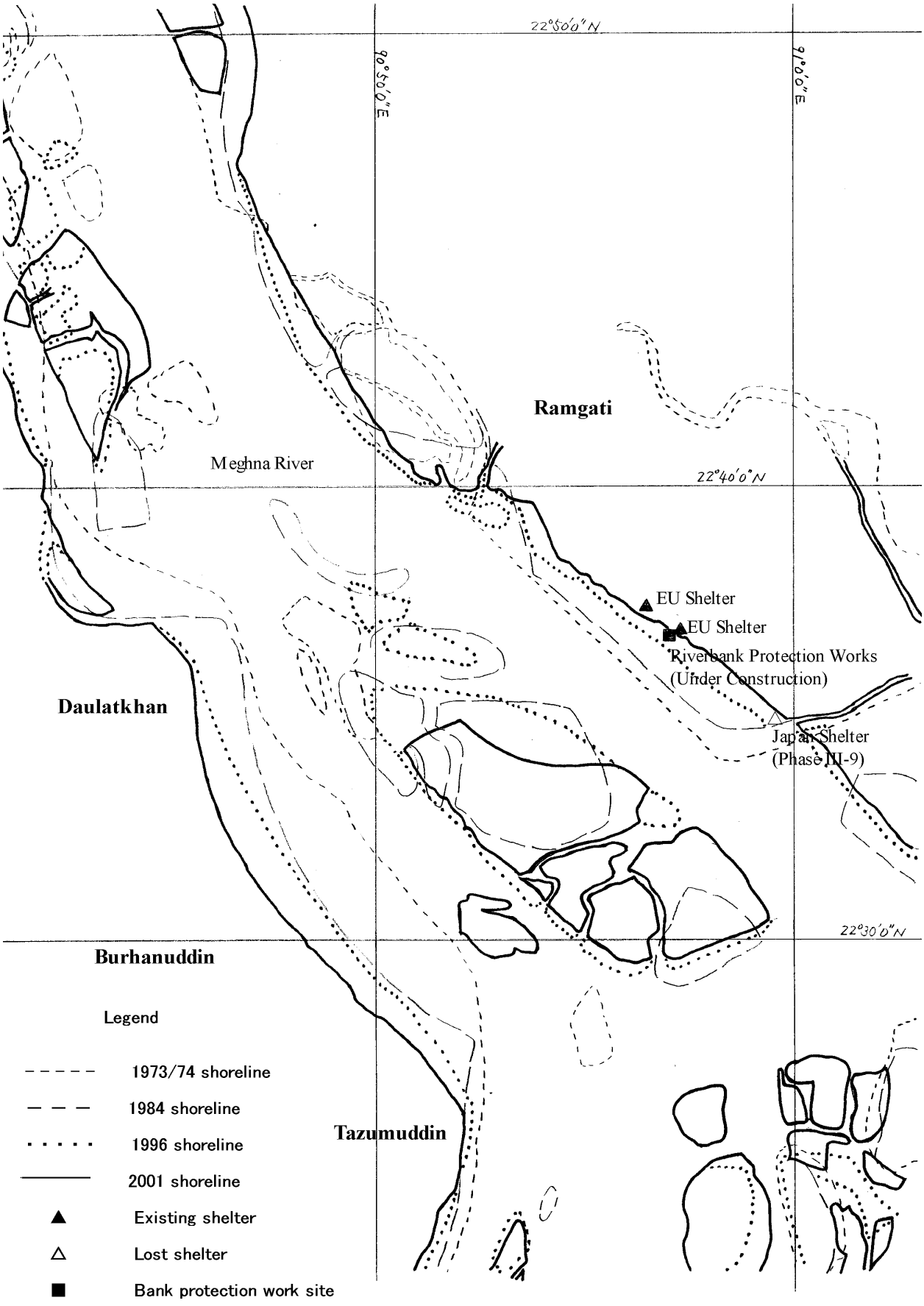


Fig. A6-3-6 Change of Shoreline Over Time Shown by Satellite Images (Ramgati: Meghna River)

3. Possibility of Bank Erosion at Water Bodies Around Planned Cyclone Shelter Construction Sites

(1) Course of the Study

It is believed to be difficult to accurately infer (estimate) the medium to long-term changes of river banks because of the fact that the degree of impact, i.e. degree of hazard, on individual facilities changes based on combinations of two or three of the factors listed below.

① Primary cause (scale and frequency of natural force)

② Land factors (topography, geology and change of the river course)

③ Factors relating to disaster prevention/control facilities
(embankment, shore protection and mangrove forests)

④ Human and social factors (land use)

For this reason, such phenomena as a change of the river course and the sedimentation or erosion of a river bank which are caused by the scale and frequency of a natural force, i.e. primary cause, are considered to be the result of changes over many years. At the same time, evaluation items are established to identify the situation of the study area and the situation at each candidate cyclone shelter site as comprehensively as possible, followed by the gathering of site information (topography, geology, disaster prevention/control facilities and land use, etc.) by means of a document survey, field reconnaissance and interview survey, etc. to compile a site evaluation table. Finally, the possibility (high or low) of the loss of a cyclone shelter at a planned site due to bank erosion is evaluated in an integral and qualitative manner, taking the available river engineering knowledge into consideration. The evaluation items for each site are listed below.

① Topographical Factors

- Type of topography
  (back swamp delta, tidal delta, tidal plane and dry beach, etc.)
- Type of geology (clay and silt, etc.)
- Situation of change of the bank (erosion or sedimentation)
- Area likely to be affected by bank erosion according to existing data (materials)

② Factors Relating to Disaster Prevention/Control Facilities

- Relative location to the bank
- Relative location to an embankment, etc.
- Current situation of forests, including mangrove forests
- Planned planting of mangrove, etc.
- Situation of bank erosion at nearby existing facilities

③ Human and Social Factors

- Current situation of land use in river bank areas
- Monitoring activities in river bank areas

(2) Patterns of Riverbed (Sand Waves) at Relevant River Sections

The riverbed pattern is an indicator of the movement of gravel forming the riverbed. Based on established knowledge, riverbed patterns are largely classified into two groups, reflecting the specific movement of gravel.

Scale of Riverbed		Pattern
Sand Waves	Small-Scale Riverbed	Rippes; dunes
	Medium-Scale Riverbed	Bars; alternating bars; linguoid bars

The current riverbed situation based on on-site observation during the field reconnaissance and the satellite image analysis results is outlined below for water bodies near the planned project sites. This description mainly features medium-scale riverbeds in connection with bars, bank erosion and meandering.

1) Chakaria Upazila (Site No. 6)

Old Matamuhari River at the back of Site No. 6 is currently used as a shipping canal. As it is an inland river with no flow, it is inferred that the riverbed has not changed.

2) Patiya Upazila (Site Nos. 13, 14 and 15)

The riverbed of Karnaphui River along which three candidate sites are located is inferred to have a pattern of alternating bars in terms of the riverbed classification. The deepest part of the riverbed near these sites appears to be near the left bank rather than at the centre of the river course based on visual observation and minor erosion of the left bank is observed.

3) Sandwip Upazila (Site Nos. 16, 18 and 19) and Miresharai Upazila (Site Nos. 21, 22, 23, 24, 25 and 27)

The riverbed between Sandwip Island and Miresharai is inferred to constitute the state of large-scale linguoid bars. Given the tendency towards sedimentation in the direction of Noakhali to the north and the east bank of Sandwip Island and the ongoing bank erosion at Miresharai, it is inferred that the deepest part of the riverbed is nearer Miresharai. At the time of low tide, the area near the bank on the Miresharai side shows the state of a shallow bed compared to the east bank of the island.

4) Banshkhali Upazila (Site Nos. 28, 29, 30, 31 and 32) and Anowara Upazila (Site No. 35)

The riverbed of Sangu River is inferred to show the state of alternating bars and the deepest part is located near the left bank, i.e. the side where Site No. 30 is located. This bank shows signs of ongoing erosion and this observation is supported by the fact that the small boat hired to observe the river banks from water navigated near the left bank in this particular section in both directions.

5) Hatiya Upazila, Noakhali District (Site Nos. 37, 38 and 39) and Lower Reach of Meghna River

The riverbed to the west of Hatiya Island and of the water body near Ramgati on the left bank in the lower reach of Meghna River are inferred to show the state of large-scale linguoid bars. The satellite images, etc. confirm a situation where the deepest points of the riverbed have emerged near both banks due to the development of a sand bar at the centre of the river which has become an island, forcing the river to erode the banks to secure its channel width.

(3) Examination of Disaster Hazard Associated With Bank Erosion

1) Rough Examination of Possibility of Shelter Loss Due to Bank Erosion

At the 22 sites which were short-listed after the outline survey, the situation of bank erosion or sedimentation, the situation of change of the river course and the situation of regreening due to the planting of mangrove were analysed by means of visual interpretation of overlaid LANDSAT satellite images of adjacent years which were taken at an interval of 27 – 28 years (1973/74, 1984, 1996 and 2001). In addition, a document survey (see Fig. A6-3-7), field reconnaissance and an interview survey were conducted to evaluate the factors/items which were not clarified by the satellite

images. The findings of the above analysis for each site were then compiled in Table A6-3-5.

In regard to ① topographical factors, “classification into sedimentation or scouring site”, “situation of change of the river course (channel)” and “water hammering site (section)”, all of which relate to “situation of change of the river bank (erosion or sedimentation)” to establish the vertical and lateral movement of the river bed in the river channel, were omitted from the evaluation items because of the unavailability of river survey drawings (vertical and lateral cross-sections), etc. which were essential for analysis purposes.

As the results of the rough evaluation (Table A6-3-5) show, the possibility of loss at Site No. 39 on Hatiya Island and at Site No. 30 at Banshkhali is estimated as “high” and “slightly high” respectively.

2) Analysis of Possibility of Loss Due to Bank Erosion

Based on the rough evaluation results, further analysis of the following matters was conducted to estimate the possibility of the impact of bank erosion at each site by means of qualitative evaluation, taking the possibility of the bank erosion of a nearby water body at each site into consideration.

- Relative location of the candidate site to nearby water body
- Tendency towards either erosion or sedimentation at the shoreline based on the changing situation of the shoreline through overlay analysis of four LANDSAT images (1973/74, 1984, 1996 and 2001)
- Natural Hazards Mapping showing areas affected by bank erosion in Bangladesh (see Fig. A6-3-8)
- Field survey results, including information on bank erosion at the planned sites and their surrounding areas, obtained by field reconnaissance and an interview survey and records of the actual loss of existing shelters, etc.

Among the 22 subject sites of the detailed survey, two sites, i.e. Site No. 30 located near the left bank in the lower reach of Sangu River in Upazila Banshkhali and Site No. 39 located near the west bank of Hatiya Island, are inferred to have a relatively high possibility of being affected by bank erosion in the future because of the reasons given below and because of the site evaluation results of the above four items (see Table A6-3-4).

[Site No. 30 Located near the Left Bank in Lower Reach of Sangu River in Upazila Banshkhali]

① The candidate site is some 800 m away from the nearest bank in a straight line. There is no embankment along the bank. Flat farmland spreads from the bank to the site and areas along the bank currently have no erosion prevention or control measure.

② Analysis of the changing situation of the shoreline over the years using the LANDSAT images revealed that the course of Sangu River meandered more in 2001 compared to some 28 years ago, indicating a shift of the river course.

③ The bank erosion hazard map indicates that the left bank of Sangu River is liable to bank erosion. The field reconnaissance and interview survey confirmed the ongoing erosion of the left bank.

④ According to the survey on damage by bank erosion to existing shelters, even though no shelter has been lost in Banshkhali Upazila, one shelter (Phase II-2) in the downstream of the candidate site is facing imminent loss due to the scouring of its foundations. In addition, a shelter constructed by Saudi Arabia is facing a risk of its foundations being scoured in the upstream of the nearest bank to the candidate site.

[Site No. 39 Located near the West Bank of Hatiya Island]

① While the distance between the candidate site and the bank is approximately 1.7 km in a straight line, the shortest distance between the bank and the embankment is some 20 – 30 m. The bank currently has no erosion prevention or control measure.

② Analysis of the changing situation of the shoreline over the years using the LANDSAT images revealed that the west bank of Hatiya Island has suffered from general erosion of some 0.6 – 1.4 km along its entire length from the north to the south over the period of 28 years.

③ The bank erosion hazard map indicates that the east bank of Hatiya Island is liable to erosion. The field reconnaissance and interview survey on the state of erosion and planted areas in both the east and west bank areas found that

the progress of bank erosion is more prominent in the case of the west bank than the east bank.

④ The interview survey on damage by bank erosion to existing shelters discovered that four BDRSC shelters and one Calitas shelter have been lost on Hatiya Island.

Table A6-3-4 Possibility of Bank Erosion by Site (1/2)

District	Upazila	Site No.	Relationship Between Site Location and Nearby Water Body	Satellite Image Analysis Results (Comparison Between Images Taken in 1973/74 and 2001) *1	Area Liable to Impact by Bank Erosion According to Natural Hazards Mapping *2	Field Reconnaissance and Interview Survey Results	Evaluated Possibility of Bank Erosion
Cox's Bazar	Chakaria	6	Along the left bank of former Matamuhari River	The river course has been stable without any changes over 30 years.	Irrelevant	Former Matumuhari River at the back of the site currently has no water flow and is used as a shipping canal. As Matamuhari River has experienced repeated changes of its river course, the current river mouth is some 20 km south of its position.	Low
Chittagong	Patiya	13 14 15	Along the left bank of Karnaphuli River	The river course has been stable without any changes over 30 years.	Irrelevant	Located on the opposite bank of the urbanized area of Chittagong, this site has Karnaphuli Bridge in its upstream. The left bank is lined by factory buildings and docks, etc. It is inferred that a stable flow regime due to the flood control effect of Lake Kaptai which is created by a dam for hydropower generation in the upper reach at Ramgmati has contributed to the stabilization of the river course.	Low
	Sandwip	16 18 19	Centre of the island	While erosion is taking place at the west bank, sedimentation is taking place at the east bank.	Only the north side of the island is classified as a hazard area.	The field survey has confirmed such satellite image analysis results as (i) the west bank and the east bank show a tendency towards erosion and sedimentation respectively and (ii) greening of the east bank by means of planting is taking place.	Low
	Miresharai	21	Near the left bank in the downstream of a dam at the mouth of Feni River	Sedimentation is taking place along the bank and planting is in progress.	Irrelevant	No record of loss of nearby existing shelters due to bank erosion in the past.	Low
		22 24 25	Near Chittagong Road	-do-	-do-	-do-	Low
		23	Along Chittagong Road	-do-	-do-	-do-	Low
		27	Away from the bank towards the inland	-do-	-do-	-do-	Low

Table A6-3-4 Possibility of Bank Erosion by Site (2/2)

District	Upazila	Site No.	Relationship Between Site Location and Nearby Water Body	Satellite Image Analysis Results (Comparison Between Images Taken in 1973/74 and 2001) *1	Area Liable to Impact by Bank Erosion According to Natural Hazards Mapping *2	Field Reconnaissance and Interview Survey Results	Evaluated Possibility of Bank Erosion
Chittagong	Banshkhali	28 29	Mountain side of a plain on the east shoreline of the Bay of Bengal	The area shows a tendency towards sedimentation.	-do-	-do-	Low
		30	At the end of a right bend on the left bank of Sangu River and near the former river course	No change of the river bank area over 30 years	Left bank from the mouth to the middle reach of Sangu River	Bank erosion is in progress at the bank near this site which is located near one end of a right bend along the bank in a straight section between a right bend and left bend. Bank erosion is taking place from this right bend to the straight section.	High
		31	Mountain side of a plain on the left bank of the Kutubdia Channel	A tendency towards sedimentation is observed along the bank.	Irrelevant	No record of loss of nearby existing shelters due to bank erosion in the past.	Low
		32	East shore of the Bay of Bengal	-do-	-do-	-do-	Low
	Anowara	35	Near the right bank of Sangu River	No change of the river bank area over 30 years	-do-	-do-	Low
Noakhali	Hatiya	37 38	Bay of Bengal side on the east side of the island Bay of Bengal side on the south side of the island	The east and south banks show a tendency towards sedimentation while the north and west banks show a tendency towards erosion.	North, east and south sides of the island	The field survey has confirmed such satellite image analysis results as (i) the west bank and the east bank show a tendency towards erosion and sedimentation respectively and (ii) greening of the east bank by means of planting is taking place. Planting has been taking place at a river bank area outside the embankment since the onslaught of a cyclone in 1991.	Low
		39	Near the left bank of Shahabazpur River on the west side of the island	-do-	Irrelevant	Bank erosion is taking place at parts of the west side of the island. The current situation will be confirmed by the satellite images. The bank is said to have been eroded by 600 m in the last 12 months.	High

*1 Increase (sedimentation) or decrease (erosion) based on comparison of the shorelines on the satellite images

*2 Natural Hazards Mapping, Ministry of Relief, Disaster Management Bureau

Table A6-3-5 Rough Evaluation of Disaster Hazard, Including Bank Erosion (1/4)

Upazila		Chakaria	Patiya		
Evaluation Item	Site No.	6	13	14	15
Topographical Factor	Type of topography	Δ Tidal delta	O Back swamp/delta	O Back swamp/delta	O Back swamp/delta
	Geology (soil type)	Δ/piedmont clay	Δ/piedmont clay	Δ/piedmont clay	Δ/piedmont clay
	Situation of river bank change (erosion/sedimentation)	O/no change	O/no change	O/no change	O/no change
	Area of impact by bank erosion in existing data	O/irrelevant	O/irrelevant	O/irrelevant	O/irrelevant
Factors Relating to Disaster Control/Prevention Facilities	Relative location of the bank	× Canal bank at the back	× 1.4 km	× 0.3 km	× 0.3 km
	Relative location to the embankment, etc.	-do-	O Land side (1.4 km)	O Land side (0.3 km)	O Land side (0.3 km)
	Current situation of mangrove forests, etc.	O/present	O/present	O/present	O/present
	Planned planting of mangrove, etc.	O In progress by a NGO	- (Unknown)	- (Unknown)	- (Unknown)
	Situation of scouring of nearby existing facilities	O/none	O/none	O/none	O/none
Human and Social Factors	Current land use of river bank area	O Housing and culture ponds, etc.	O Housing and farmland, etc.	O Housing and factories, etc.	O Housing and factories, etc.
	Monitoring activities at river bank area	O Can be conducted using a boat	O Can be conducted in housing area	O Can be conducted in housing and industrial areas	O Can be conducted in housing and industrial areas
Rough Evaluation	Possibility of adverse impacts by bank erosion	Small	Small	Small	Small

Table A6-3-5 Rough Evaluation of Disaster Hazard, Including Bank Erosion (2/4)

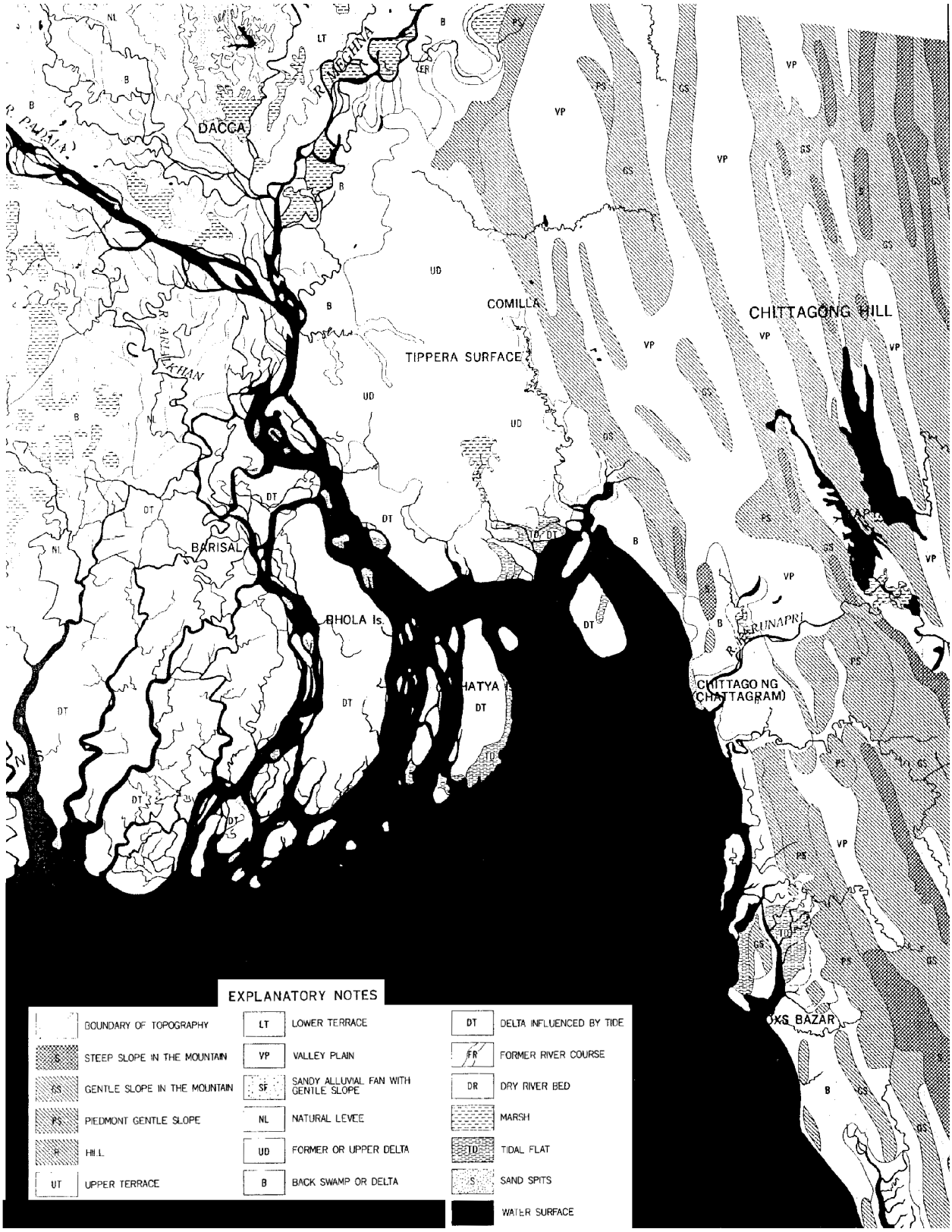
Upazila		Sandwip			Hatiya		
Evaluation Item	Site No.	16	18	19	37	38	39
Topographical Factor	Type of topography	Δ Tidal delta	Δ Tidal delta	Δ Tidal delta	Δ Tidal delta	Δ Tidal delta	Δ Tidal delta
	Geology (soil type)	× Silt at alluvial delta	× Silt at alluvial delta	× Silt at alluvial delta	× Silt at alluvial delta	× Silt at alluvial delta	× Silt at alluvial delta
	Situation of river bank change (erosion/sedimentation)	- Located at centre of island	- Located at centre of island	- Located at centre of island	O Sedimentation tendency	O Sedimentation tendency	O Sedimentation tendency
	Area of impact by bank erosion in existing data	O/irrelevant	O/irrelevant	O/irrelevant	X/relevant	X/relevant	O/irrelevant
Factors Relating to Disaster Control/Prevention Facilities	Relative location of the bank	O/5.0 km	O/4.0 km	O/4.5 km	O/3.3 km	O/3.3 km	Δ/1.7 km
	Relative location to the embankment, etc.	O Land side (2.5 km)	O Land side (4.7 km)	O Land side (3.3 km)	O Land side (1.3 km)	O Land side (0.3 km)	O Land side (1.6 km)
	Current situation of mangrove forests, etc.	O/present	O/present	O/present	O/present	O/present	O/present
	Planned planting of mangrove, etc.	O Yes (location undecided)	O Yes (location undecided)	O Yes (location undecided)	O Yes (location undecided)	O Yes (location undecided)	O Yes (location undecided)
	Situation of scouring of nearby existing facilities	O/none	O/none	O/none	O/none	O/none	X/anticipated
Human and Social Factors	Current land use of river bank area	O Farmland, etc.	O Farmland, etc.	O Farmland, etc.	O Farmland, etc.	O Farmland, etc.	O Farmland, etc.
	Monitoring activities at river bank area	O Special attention to planting, etc.	O Special attention to planting, etc.	O Special attention to planting, etc.	O Special attention to planting, etc.	O Special attention to planting, etc.	O Special attention to planting, etc.
Rough Evaluation	Possibility of adverse impacts by bank erosion	Low	Low	Low	Low	Low	High

Table A6-3-5 Rough Evaluation of Disaster Hazard, Including Bank Erosion (3/4)

Upazila		Miresharai					
Evaluation Item	Site No.	21	22	23	24	25	27
Topographical Factor	Type of topography	O Back swamp/delta	O Back swamp/delta	O Back swamp/delta	O Back swamp/delta	O Back swamp/delta	O Back swamp/delta
	Geology (soil type)	Δ Piedmont clay	Δ Piedmont clay	Δ Piedmont clay	Δ Piedmont clay	Δ Piedmont clay	Δ Piedmont clay
	Situation of river bank change (erosion/sedimentation)	O Sedimentation tendency	O Sedimentation tendency	O Sedimentation tendency	O Sedimentation tendency	O Sedimentation tendency	X Erosion tendency
	Area of impact by bank erosion in existing data	O/irrelevant	O/irrelevant	O/irrelevant	O/irrelevant	O/irrelevant	O/irrelevant
Factors Relating to Disaster Control/Prevention Facilities	Relative location of the bank	O/3.0 km	O/6.5 km	O/6.3 km	O/5.7 km	O/6.3 km	O/4.5 km
	Relative location to the embankment, etc.	O Land side (2.5 km)	O Land side (5.7 km)	O Land side (4.4 km)	O Land side (4.1 km)	O Land side (5.0 km)	O Land side (2.5 km)
	Current situation of mangrove forests, etc.	O/present	O/present	O/present	O/present	O/present	O/present
	Planned planting of mangrove, etc.	O Yes (location undecided)	O Yes (location undecided)	O Yes (location undecided)	O Yes (location undecided)	O Yes (location undecided)	O Yes (location undecided)
	Situation of scouring of nearby existing facilities	O/none	O/none	O/none	O/none	O/none	O/none
Human and Social Factors	Current land use of river bank area	O Farmland, etc.	O Farmland, etc.	O Farmland, etc.	O Farmland, etc.	O Farmland, etc.	O Farmland, etc.
	Monitoring activities at river bank area	O Special attention to planting, etc.	O Special attention to planting, etc.	O Special attention to planting, etc.	O Special attention to planting, etc.	O Special attention to planting, etc.	O Special attention to planting, etc.
Rough Evaluation	Possibility of adverse impacts by bank erosion	Low	Low	Low	Low	Low	Low

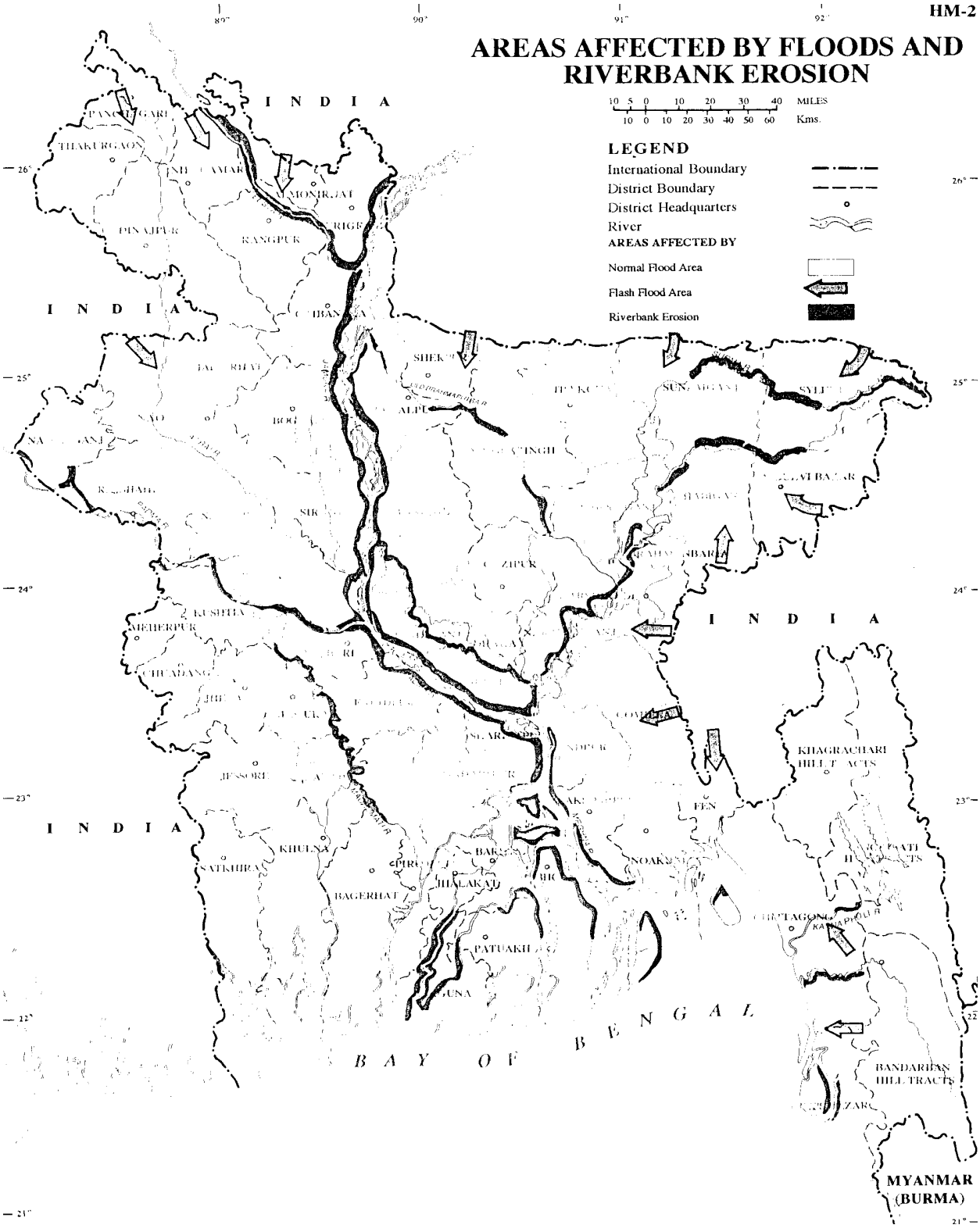
Table A6-3-5 Rough Evaluation of Disaster Hazard, Including Bank Erosion (4/4)

Upazila		Banshkhali					Anowara
Evaluation Item	Site No.	28	29	30	31	32	35
Topographical Factor	Type of topography	Δ Tidal delta	Δ Tidal delta	Δ Tidal delta	Δ Tidal delta	Δ Tidal delta	Δ Tidal delta
	Geology (soil type)	Δ Piedmont clay	Δ Piedmont clay	Δ Piedmont clay	Δ Piedmont clay	Δ Piedmont clay	Δ Piedmont clay
	Situation of river bank change (erosion/sedimentation)	O Sedimentation tendency	O Sedimentation tendency	O/no change	O Sedimentation tendency	O Sedimentation tendency	O/no change
	Area of impact by bank erosion in existing data	O/irrelevant	O/irrelevant	×/relevant	O/irrelevant	O/irrelevant	O/irrelevant
Factors Relating to Disaster Control/Prevention Facilities	Relative location of the bank	O/7.3 km	O/5.4 km	×/0.8 km	O/4.5 km	O/2.3 km	X/1.3 km
	Relative location to the embankment, etc.	O Land side (5.7 km)	O Land side (2/1 km)	× No embankment (0.8 km)	O Land side (4.8 km)	O Land side (2.3 km)	O Land side (1.3 km)
	Current situation of mangrove forests, etc.	O/present	O/present	O/present	O/present	O/present	O/present
	Planned planting of mangrove, etc.	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
	Situation of scouring of nearby existing facilities	O/none	O/none	O/none	O/none	O/none	O/none
Human and Social Factors	Current land use of river bank area	O Farmland, etc.	O Farmland, etc.	O Farmland, etc.	O Farmland, etc.	O Farmland, etc.	O Farmland, etc.
	Monitoring activities at river bank area	O Some special attention to planting, etc.	O Some special attention to planting, etc.	O Some special attention to planting, etc.	O Some special attention to planting, etc.	O Some special attention to planting, etc.	O Some special attention to planting, etc.
Rough Evaluation	Possibility of adverse impacts by bank erosion	Low	Low	Slightly high	Low	Low	Low



Source: Masahiko Ohya, River Geography

Fig. A6-3-7 Topographical Classification Map of Brahmaputra, Jamura and Ganges Plain



Source: Natural Hazards Mapping, Ministry of Relief, Disaster Management Bureau

Fig. A6-3-8 Areas Likely to be Affected by Flooding and Bank Erosion

6-4 RESULTS OF GEOTECHNICAL SITE SURVEY

Soiltech
INTERNATIONAL LIMITED

Client : J E C C L
Site : ILISHIA GPS, UC. WEST BOROVEOLA, PS. Chakaria, Chittagong.
Bore Chart of Boring No. 6

DATE	DEPTH in m	THICKNESS in m	STRATA ENCOUNTERED	LOG	DIA OF BORING	STANDARD PENETRATION TEST BLOWS/30cm or ft.	REMARKS U.W.T. SOIL SAMPLES VANE SHEAR TEST (P.S.L)
7-4-03	1.50	1.50	Brown very soft SILT with clay trace fine sand.		15 cm DIA PERCUSSION METHOD	0 0 1 1	
						0 0 1 1	
						0 0 1 1	
						0 0 1 1	
	8.50	7.00	Grey very soft SILT with clay trace fine sand & organic.			0 1 1 2	
						0 1 1 2	
						0 1 1 2	
						0 1 1 2	
	12.25	3.75	Grey med. dense med. to fine SAND trace silt.			6 9 13 22	
						6 9 14 23	
						5 10 16 26	
	13.50	1.25	Grey stiff SILT trace clay & fine sand.			5 8 13 21	
						4 7 7 14	
						6 8 12 20	
						8 17 21 38	
		5.50	Grey med. dense fine to med. SAND with silt.			8 14 17 31	
						7 13 17 30	
	19.00					8 14 16 30	
						7 14 16 30	
	20.00	1.00	Grey med. dense fine to med. Sandy SILT trace clay.			4 6 9 15	

REDUCED ELEV. 1.346m PWD
0.70 M

DISTURBED SAMPLE ▨ UNDISTURBED SAMPLE ■

Soiltech International limited: Drawn by : Samad Date 12-4-03 Scale 1 : 150 Plan No.

Soiltech
INTERNATIONAL LIMITED

Client : J E C C L
Site : WEST CHARLAKSMA GPS, U C, CHARLAKSMA P S. PATIYA. CHITTAGONG.
Bore Chart of Boring No. 13

DATE	DEPTH in m	THICKNESS in m	STRATA ENCOUNTERED	LOG	DIA OF BORING	STANDARD PENETRATION TEST BLOWS/30cm or ft.	REMARKS U.W.T. SOIL SAMPLES VANE SHEAR TEST (P.S.L)
30-3-03	2.00	2.00	Brown very soft Clayey SILT		15 cm DIA PERCUSSION METHOD	1 1 1 2	
						1 1 1 2	
						1 1 2 3	
	8.50	6.50	Grey soft SILT with clay trace fine sand.			0 1 1 2	
						1 1 2 3	
						1 1 1 2	
						1 1 2 3	
						1 1 1 2	
	10.50	2.00	Grey loose Silty fine to med. SAND.			1 2 2 4	
						1 2 2 4	
						3 6 7 13	
						6 9 12 21	
		10.65	Grey med. dense fine to med SAND & SILT.			5 10 12 22	
						5 10 14 24	
						7 12 15 27	
						7 12 13 25	
						4 7 8 15	
						6 6 9 15	
						6 6 10 16	
	21.15					4 8 12 20	
						4 6 8 14	
31-3-03		4.10	Brown med. dense fine Sandy SILT trace clay.			5 7 10 17	
						5 7 9 16	
	25.25					6 8 9 17	
						5 5 8 13	
		4.75	Grey med. dense fine to med SAND & SILT			6 8 10 18	
						7 9 12 21	
						7 8 12 20	
	30.00					8 10 13 23	
						10 12 15 27	

REDUCED ELEV. 6.300m pwd.
2.00 M

DISTURBED SAMPLE ▨ UNDISTURBED SAMPLE ■

Soiltech International limited: Drawn by : Samad Date 9-4-03 Scale . Plan No.

Soiltech
INTERNATIONAL LIMITED

Client : J E C C L
Site : ICHANGAR GPS, U C. CHAR PATHARGHATA
P S. PATIYA, CHITTAGONG.
Bore Chart of Boring No. 14

DATE	DEPTH in m	THICKNESS in m	STRATA ENCOUNTERED	LOG	DIA OF BORING	STANDARD PENETRATION TEST BLOWS/30cm or ft.	REMARKS S.W.T. SOIL SAMPLES VANE SHEAR TEST (P.S.I.)
							REDUCED ELEV. 6.186m PWD
29-3-03	2.50	2.50	Broud & Grey med. stiff Clayey SILT trace fine sand		15 cm DIA PERCUSSION METHOD	1 2 3 5	1.00
						1 1 2 3	2.00
	4.50	2.00	Grey soft Clayey SILT trace fine sand.			0 1 1 2	3.00
						0 1 1 2	4.00 4.20 M
	9.00	4.50	Grey loose to med. dense fine to med. SAND & SILT.			2 1 3 4	5.00
						4 5 7 12	6.00
						6 9 10 19	7.00
						5 7 7 14	8.00
						5 8 8 16	9.00
						5 7 10 17	10.00
						5 10 12 22	11.00
						7 12 16 28	12.00
						6 12 18 30	13.00
	16.50	7.50	Grey med. dense to dense med. to fine SAND. trace silt.			8 14 18 32	14.00
						8 13 19 32	15.00
						6 12 20 32	16.00
						4 5 6 11	17.00
	20.00	3.50	Grey stiff to med. stiff Clayey SILT trace fine sand.			2 3 4 7	18.00
						2 3 4 7	19.00
						2 3 3 6	20.00

DISTURBED SAMPLE ▨ UNDISTURBED SAMPLE ■

Soiltech International limited. Drawn by : Samad Date 9-4-03 Scale Plan No.

Soiltech
INTERNATIONAL LIMITED

Client : JECCL
Site : CHAR PATHARGHATA GPS, UC. CHAR PATHRGHATA
P S. PATIYA, CHITTAGONG.
Bore Chart of Boring No. 15

DATE	DEPTH in m	THICKNESS in m	STRATA ENCOUNTERED	LOG	DIA OF BORING	STANDARD PENETRATION TEST BLOWS/30cm or ft.	REMARKS S.W.T. SOIL SAMPLES VANE SHEAR TEST (P.S.I.)
							REDUCED ELEV. 6.271m PWD
28-3-02	2.00	2.00	Brown & Grey med. stiff Clayey SILT trace fine sand.		15 cm DIA PERCUSSION METHOD	2 3 4 7	1.00
						1 3 4 7	2.00
	5.00	3.00	Grey very soft Clayey SILT trace fine sand.			1 1 1 2	3.00 3.00 M
						1 1 1 2	4.00
	8.50	3.50	Grey loose Silty fine to med. SAND trace mica.			0 0 1 1	5.00
						1 3 4 7	6.00
						2 2 4 6	7.00
						2 3 4 7	8.00
	11.00	2.50	Grey med. dense med. to fine SAND trace silt.			9 14 16 30	9.00
						7 7 7 14	10.00
						5 6 8 14	11.00
						4 6 14 20	12.00
						8 18 20 38	13.00
						9 16 19 35	14.00
						10 18 22 40	15.00
						7 17 23 40	16.00
						9 18 23 41	17.00
	20.00	9.00	Grey Hard SILT with clay trace fine sand. (SHALE)			10 20 25 45	18.00
						10 18 27 45	19.00
						12 12 28 49	20.00

DISTURBED SAMPLE ▨ UNDISTURBED SAMPLE ■

Soiltech International limited. Drawn by : Samad Date 9-4-03 Scale 1 : 150 Plan No.

Soiltech
INTERNATIONAL LIMITED

Client : J E C C L
Site : KACHIAPUR GPS. UC. HARAMINA, PS. SANDWIP Chittagong.
Bore Chart of Boring No. 16

DATE	DEPTH in m	THICKNESS in m.	STRATA ENCOUNTERED	LOG	DIA OF BORING	STANDARD PENETRATION TEST BLOWS/30cm or ft.	REMARKS D.W.T. SOIL SAMPLES VANE SHEAR TEST (P.S.L)
1-4-03	4·50	4·50	Brown stiff to very stiff SILT with clay trace fine sand.		15 cm DIA PERCUSSION METHOD	2 4 6 10 / 6 11 14 25 / 2 6 8 14 / 2 3 3 6 / 6 7 8 15	
	7·25	2·75	Grey stiff SILT with clay trace fine sand.			1 2 2 4 / 1 2 3 5	
	13·00	5·75	Grey very stiff SILT with clay trace fine sand.			7 12 18 30 / 6 11 17 28 / 5 8 13 21 / 6 10 14 24 / 5 9 13 22 / 6 9 14 23	
	23·00	10·00	Grey loose fine to med. Sandy SILT .			1 2 4 6 / 1 3 3 6 / 1 3 3 6 / 3 3 4 7 / 3 3 4 7 / 3 4 5 9 / 3 4 4 8 / 3 5 5 10 / 3 5 4 9 / 3 4 5 9	
	30·00	7·00	Grey med. dense fine to med. SAND & SILT.			3 5 5 10 / 2 4 6 10 / 4 4 6 10 / 5 5 6 11 / 5 6 6 12 / 6 6 7 13 / 6 6 8 14	

REDUCED ELEV. 4.324m PWD
5·10 M
1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 24:00 25:00 26:00 27:00 28:00 29:00 30:00

DISTURBED SAMPLE ▨ UNDISTURBED SAMPLE ■

Soiltech International limited: Drawn by : Samad Date 11-4-03 Scale 1 : 150 Plan No.

Soiltech
INTERNATIONAL LIMITED

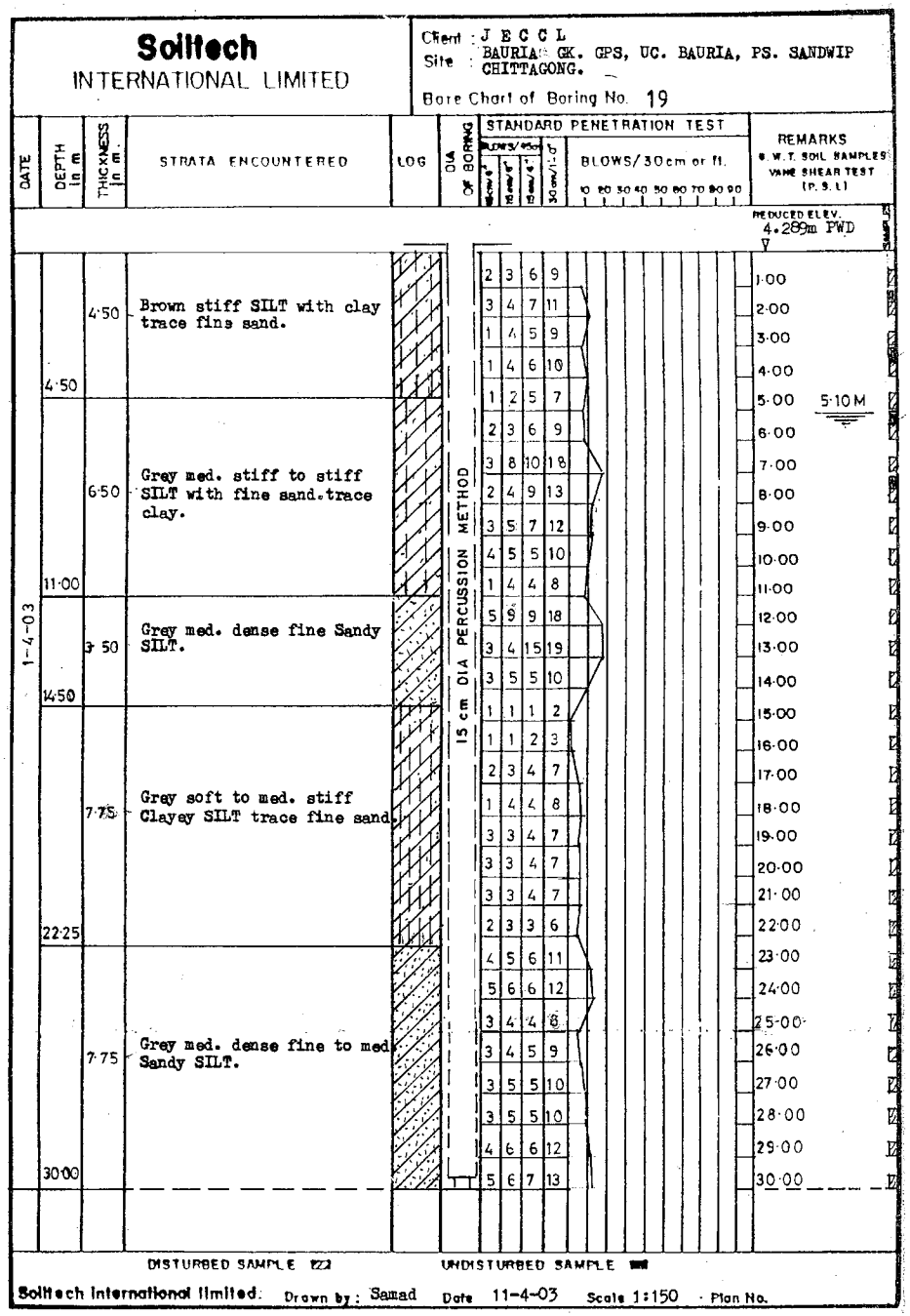
Client : J E C C L
Site : SOUTH EAST MUSAPUR GPS. UC. MUSAPUR, PS. SANDWIP. CHITTAGONG.
Bore Chart of Boring No. 18

DATE	DEPTH in m	THICKNESS in m	STRATA ENCOUNTERED	LOG	DIA OF BORING	STANDARD PENETRATION TEST BLOWS/30cm or ft.	REMARKS D.W.T. SOIL SAMPLES VANE SHEAR TEST (P.S.L)
30-3-03	4·25	4·25	Brown stiff SILT with clay trace fine sand.		15 cm DIA PERCUSSION METHOD	2 3 5 8 / 3 5 8 13 / 3 5 7 12 / 3 4 6 10 / 3 4 7 11	
	7·00	2·75	Grey stiff SILT with clay trace fine sand.			3 5 9 14 / 7 6 8 12	
	12·50	5·50	Grey med. dense to dense fine to med. Sandy SILT.			7 12 16 28 / 10 22 24 46 / 7 6 6 12 / 5 6 15 21 / 5 10 12 22	
	18·25	5·75	Grey very stiff to stiff SILT with fine sand trace clay.			2 5 9 14 / 13 13 14 27 / 2 3 4 7 / 1 2 2 4 / 2 3 3 6 / 1 2 10 12	
	24·00	5·75	Grey med. stiff to stiff SILT with clay trace fine sand.			1 2 2 4 / 4 4 6 10 / 3 4 5 9 / 3 5 5 10 / 3 6 6 12	
	30·00	6·00	Grey med. dense fine to med. SAND & SILT.			4 5 6 11 / 4 6 7 13 / 4 5 6 11 / 5 6 6 12 / 5 6 7 13 / 5 6 7 13 / 6 7 8 15	

REDUCED ELEV. 3.850m PWD
4·00 M
1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 24:00 25:00 26:00 27:00 28:00 29:00 30:00

DISTURBED SAMPLE ▨ UNDISTURBED SAMPLE ■

Soiltech International limited: Drawn by : Samad Date 11-4-03 Scale 1 : 150 Plan No.



A-6-50

b

GEOPHYSICAL RECORD OF BORING

SITE NO. 21

CLIENT: **J E C**		LOCATION:	**:TEMUHANI GPS, MIRSHARAI, :CHITTAGONG.**
GROUND ELEVATION:	DEPTH OF HOLE: **20m**		
DIAMETER OF HOLE: **100mm**	MACHINE PERCUSSION:	DATE OF DRILLING: **02-04-2003**	
CORE RECOVERY:	DEPTH OF GROUND WATER LEVEL IN HOLE: **3.5m**		
ANGLE FROM VERTICAL:	DRILLED BY: **A. M.**	LOGGED BY: **R. R.**	

ELEVATION (+) 5.08m	DEPTH -M	THICK-NESS -M	FIELD OBSERVATION AND LITHOLOGY	LOG	STANDARD PENETRATION TEST - BLOWS/SPT (10 20 30 40 50 60)	SOIL SAMPLE
	2.2	2.2	Light brown & grey high plastic CLAY (soft)		2	D- 1
					3	D- 2, U- 1
	4.4	2.2	Grey medium plastic CLAY (soft)		2	D- 3
					2	D- 4
	6.1	1.7	Grey medium plastic CLAY (medium stiff)		4	D- 5
					5	D- 6
	10.2	4.1	Deep grey sandy SILT (loose to medium dense)		13	D- 7, U- 2
					7	D- 8
					4	D- 9
					5	D- 10
	13.3	3.1	Blueish grey fine SAND & SILT (medium dense)		19	D- 11
					22	D- 12
					27	D- 13, U- 3
	17.5	4.2	Light grey fine SAND, some silt (medium dense to dense)		31	D- 14
					33	D- 15
					32	D- 16
					26	D- 17, U- 4
	20	2.5	Grey fine SAND, some silt (dense)		33	D- 18
					35	D- 19
					41	D- 20

Disturbed Sample..... ☐ Undisturbed Sample..... ▦

GEOPHYSICAL RECORD OF BORING

SITE NO. 22

CLIENT: **J E C**		LOCATION:	**:MAYANI SOLAIMAN GPS, MIRSHARAI, :CHITTAGONG.**
GROUND ELEVATION:	DEPTH OF HOLE: **20m**		
DIAMETER OF HOLE: **100mm**	MACHINE PERCUSSION:	DATE OF DRILLING: **23-03-2003**	
CORE RECOVERY:	DEPTH OF GROUND WATER LEVEL IN HOLE: **2m**		
ANGLE FROM VERTICAL:	DRILLED BY: **S. R.**	LOGGED BY: **R. R.**	

ELEVATION (+) 4.20m	DEPTH -M	THICK-NESS -M	FIELD OBSERVATION AND LITHOLOGY	LOG	STANDARD PENETRATION TEST - BLOWS/SPT (10 20 30 40 50 60)	SOIL SAMPLE
	3.5	3.5	Light brown & grey medium plastic CLAY (soft to medium stiff)		6, 4, 3	D- 1, D- 2, U- 1, D- 3
	6.8	3.3	Grey sandy SILT (loose)		6, 5, 5	D- 4, D- 5, D- 6
	9.3	2.5	Grey fine SAND & SILT (medium dense)		13, 16, 22	D- 7, U- 2, D- 8, D- 9
	11.5	2.2	Blueish grey fine sandy SILT (medium dense)		13, 14	D- 10, D- 11
	13.2	1.7	Grey fine SAND, some silt (medium dense to dense)		24, 34	D- 12, D- 13
	15.5	2.3	Grey sandy CLAY, medium plastic (stiff)		13, 14	D- 14, U- 3, D- 15
	18.2	2.7	Light grey fine SAND, some silt (medium dense to dense)		27, 31, 26	D- 16, D- 17, U- 4, D- 18
	21	2.8	Light grey fine SAND, little silt (dense)		33, 37, 40	D- 19, D- 20, D- 21

Disturbed Sample..... ☐ Undisturbed Sample..... ▦

GEOPHYSICAL RECORD OF BORING

SITE NO. 23

CLIENT: **J E C**		LOCATION:	**: JAFRABAD GPS, MIRSHARAI, :CHITTAGONG.**
GROUND ELEVATION:	DEPTH OF HOLE: **18m**		
DIAMETER OF HOLE: **100mm**	MACHINE PERCUSSION:	DATE OF DRILLING: **31-3-2003**	
CORE RECOVERY:	DEPTH OF GROUND WATER LEVEL IN HOLE: **3m**		
ANGLE FROM VERTICAL:	DRILLED BY: **A. M.**	LOGGED BY: **R. R.**	

ELEVATION	DEPTH -M	THICK-NESS -M	FIELD OBSERVATION AND LITHOLOGY	LOG	STANDARD PENETRATION TEST - BLOWS/SPT (10 20 30 40 50 60)	SOIL SAMPLE
	3.5	3.5	Light brown & grey medium plastic CLAY (medium stiff to stiff)		7, 8, 9, 10	D- 1, D- 2, U- 1, D- 3, D- 4
	5.3	1.8	Grey non-plastic sandy SILT (medium dense)		17, 19	D- 5, U- 2, D- 6
	7.2	1.9	Blueish grey sandy SILT (medium dense)		17, 19	D- 7, D- 8
	9.1	1.9	Light grey fine SAND & SILT (medium dense to dense)		30, 33	D- 9, U- 3, D- 10
	12.5	3.4	Brownish grey fine SAND, some silt (medium dense to dense)		34, 28	D- 11, D- 12
	15.4	2.9	Light brown & grey fine SAND & SILT (dense)		30, 32, 35	D- 13, D- 14, D- 15, U- 4
	18	2.6	Light grey fine SAND, some silt (dense)		38, 42, 45	D- 16, D- 17, D- 18

Disturbed Sample..... ☐ Undisturbed Sample..... ▦

GEOPHYSICAL RECORD OF BORING

SITE NO. 24

CLIENT: **J E C**		LOCATION:	**: S. M. HAJIPARA GPS, MIRSHARAI, :CHITTAGONG.**
GROUND ELEVATION:	DEPTH OF HOLE: **20m**		
DIAMETER OF HOLE: **100mm**	MACHINE PERCUSSION:	DATE OF DRILLING: **27-03-2003**	
CORE RECOVERY:	DEPTH OF GROUND WATER LEVEL IN HOLE: **1.5m**		
ANGLE FROM VERTICAL:	DRILLED BY: **A. M.**	LOGGED BY: **R. R.**	

ELEVATION (+) 4.98m	DEPTH -M	THICK-NESS -M	FIELD OBSERVATION AND LITHOLOGY	LOG	STANDARD PENETRATION TEST - BLOWS/SPT (10 20 30 40 50 60)	SOIL SAMPLE
	4.1	4.1	Light brown & grey liminated medium compressible SILT, trace sand (medium stiff)		7, 7, 6, 7	D- 1, D- 2, U- 1, D- 3, D- 4
	6.2	2.1	Grey medium plastic CLAY (soft)		3, 4	D- 5, D- 6, U- 2
	8.5	2.3	Blueish grey medium compressible SILT, trace sand (medium stiff to stiff)		7, 11, 21	D- 7, D- 8, D- 9
	13.2	4.7	Grey fine SAND & SILT (medium dense to dense)		35, 38, 40, 38	D- 10, D- 11, D- 12, U- 3, D- 13
	15.2	2	Blueish grey fine SAND & SILT (medium dense)		21, 25	D- 14, D- 15
	17.5	2.3	Grey fine SAND, some silt (dense)		30, 36	D- 16, D- 17
	20	2.5	Light grey fine SAND, some silt (dense)		39, 40, 45	D- 18, U- 4, D- 19, D- 20

Disturbed Sample..... ☐ Undisturbed Sample..... ▦

GEOPHYSICAL RECORD OF BORING

SITE NO. 25

CLIENT: **J E C**		LOCATION:	**: HAJI SORAI GPS, MIRSHARAI, :CHITTAGONG.**
GROUND ELEVATION:	DEPTH OF HOLE: **19m**		
DIAMETER OF HOLE: **100mm**	MACHINE PERCUSSION:	DATE OF DRILLING: **01-04-2003**	
CORE RECOVERY:	DEPTH OF GROUND WATER LEVEL IN HOLE: **3.1m**		
ANGLE FROM VERTICAL:	DRILLED BY: **S. R.**	LOGGED BY: **R. R.**	

ELEVATION (+) 5.59m	DEPTH -M	THICK-NESS -M	FIELD OBSERVATION AND LITHOLOGY	LOG	STANDARD PENETRATION TEST - BLOWS/SPT (10 20 30 40 50 60)	SOIL SAMPLE
	2.3	2.3	Light brown & grey high plastic CLAY (medium stiff)		6, 8	D- 1, D- 2, U- 1, D- 3
	4.5	2.2	Light brown & grey medium compressible SILT, trace sand (stiff)		12, 14	D- 4, D- 5
	6.3	1.8	Grey medium compressible SILT, trace sand (medium stiff to stiff)		17, 9	D- 6, U- 2, D- 7
	8.4	2.1	Brown & grey high plastic CLAY (very stiff)		16, 18	D- 8, D- 9
	10.1	1.7	Yellowish brown & grey high plastic CLAY (very stiff)		17, 19	D- 10, D- 11
	12	1.9	Yellowish brown & grey fine SAND, some silt (dense)		35, 37	D- 12, U- 3, D- 13
	15.5	3.5	Light brown & grey high plastic CLAY (very stiff)		16, 17, 20	D- 14, D- 15
	19	3.5	Brown & grey fine SAND, little silt (dense)		28, 36, 38, 41	D- 16, D- 17, U- 4, D- 18, D- 19

Disturbed Sample..... ☐ Undisturbed Sample..... ▦

GEOPHYSICAL RECORD OF BORING

SITE NO. 27

CLIENT: J E C		LOCATION:	: EAST SAHEB KHALI GPS, MIRSHARAI, :CHITTAGONG.
GROUND ELEVATION:	DEPTH OF HOLE: 22m		
DIAMETER OF HOLE: 100mm	MACHINE PERCUSSION:	DATE OF DRILLING: 29-03-2003	
CORE RECOVERY:	DEPTH OF GROUND WATER LEVEL IN HOLE: 2.5m		
ANGLE FROM VERTICAL:	DRILLED BY: A. M.	LOGGED BY: R. R.	

ELEVATION (+) 4.64m	DEPTH -M	THICK-NESS -M	FIELD OBSERVATION AND LITHOLOGY	LOG	STANDARD PENETRATION TEST - BLOWS/SPT (10 20 30 40 50 60)	SOIL SAMPLE
	2.5	2.5	Light brown & grey medium compressible SILT, trace sand (medium stiff)		7, 7	D- 1, D- 2, U- 1
	5.5	3	Light brown medium plastic CLAY (soft to medium stiff)		3, 6, 8	D- 3, D- 4, D- 5
	10.1	4.6	Grey sandy CLAY, medium plastic (soft)		4, 2, 2, 2, 3	D- 6, D- 7, D- 8, U- 2, D- 9, D- 10
	15.5	5.4	Grey laminated compressible SILT, trace sand (medium stiff)		4, 6, 5, 6, 7	D- 11, D- 12, D- 13, D- 14, D- 15, U- 3
	18.5	3	Blueish grey fine SAND & SILT (medium dense)		26, 24, 28	D- 16, D- 17, D- 18
	20.2	1.7	Grey fine SAND, some silt (dense)		38, 43	D- 19, D- 20, U- 4
	22	1.8	Light grey fine SAND, little silt (dense)		47, 41	D- 21, D- 22

Disturbed Sample..... ☐ Undisturbed Sample..... ▦

A-6-53

Soiltech INTERNATIONAL LIMITED

Client : J.E.C.C.L
Site : MUNKIRCHAR GPS. UC. SHILKUP, PS. BANSHKHALI CHITTAGONG.

Bore Chart of Boring No. 28

DATE	DEPTH in m	THICKNESS in m	STRATA ENCOUNTERED	LOG	DIA OF BORING	STANDARD PENETRATION TEST BLOWS/6" (15cm)	BLOWS/6" (15cm)	BLOWS/1ft (30cm)	BLOWS/30cm or ft. (10 20 30 40 50 60 70 80 90)	REMARKS U.W.T. SOIL SAMPLES VANE SHEAR TEST (P. S. L)
3-4-03	2.50	2.50	Brown med. stiff Clayey SILT trace fine sand.		15 cm DIA PERCUSSION METHOD	2	3	3	6	
	6.00	3.50	Grey soft Clayey SILT trace fine sand & organic.			2	3	3	6	
	13.50	7.50	Grey dense to very dense med. to fine SAND trace silt			0	1	1	2	
	18.00	4.50	Grey med. stiff to stiff SILT with clay trace fine sand.			1	1	1	2	
	20.00	2.00	Grey med. dense fine to med. Sandy SILT.			1	1	2	3	
						1	1	2	4	
						8	14	18	32	
						12	16	18	44	
						12	16	30	46	
						15	30	46	76	
						17	30	47	77	
						19	31	47	78	
						15	27	41	68	
						2	3	4	7	
						3	4	5	9	
						3	4	5	9	
						3	5	5	10	
						3	5	5	10	
						3	5	6	11	
						5	8	12	20	

REDUCED ELEV. 2.921m PWD

0.80 M

1.00, 2.00, 3.00, 4.00, 5.00, 6.00, 7.00, 8.00, 9.00, 10.00, 11.00, 12.00, 13.00, 14.00, 15.00, 16.00, 17.00, 18.00, 19.00, 20.00

DISTURBED SAMPLE ▨ UNDISTURBED SAMPLE ■

Soiltech International limited: Drawn by: Samad Date 11-4-03 Scale 1 : 150 Plan No.

Soiltech
INTERNATIONAL LIMITED

Client : J E C C L
Site : MODYAKATHARIA GPS. UC. KATHARIA, PS. BANSHKHALI CHITTAGONG.
Bore Chart of Boring No. 29

DATE	DEPTH in m	THICKNESS in m	STRATA ENCOUNTERED	LOG	DIA OF BORING	STANDARD PENETRATION TEST BLOWS/30cm or ft.	REMARKS U.W.T. SOIL SAMPLES VANE SHEAR TEST (P.S.L)
2-4-03	3.50	3.50	Brown & Grey med. stiff Clayey SILT trace fine sand.		15 cm DIA PERCUSSION METHOD	1 2 2 4 / 1 2 3 5 / 1 2 2 4	
	9.00	5.50	Grey med. stiff Clayey SILT trace fine sand.			0 0 1 1 / 1 1 1 2 / 1 1 2 3 / 2 3 3 6 / 2 3 4 7 / 2 3 3 6	
	11.50	2.50	Grey med. dense fine Sandy SILT trace clay.			2 4 5 9 / 8 10 10 20	
	16.25		Grey dense Silty fine to med. SAND .			10 14 16 30 / 10 13 17 30 / 11 13 17 30 / 10 15 15 30 / 10 15 18 33	
	20.00	3.75	Grey very stiff SILT with clay trace fine sand.			2 8 8 16 / 5 5 5 10 / 6 8 10 18 / 6 9 11 20	

REDUCED ELEV. 2.887m PWD
1.40 M
1.00 2.00 3.00 4.00 5.00 6.00 7.00 8.00 9.00 10.00 11.00 12.00 13.00 14.00 15.00 16.00 17.00 18.00 19.00 20.00

DISTURBED SAMPLE ▨ UNDISTURBED SAMPLE ■

Soiltech International limited: Drawn by : Samad Date 11-4-03 Scale 1 : 150 Plan No.

Soiltech
INTERNATIONAL LIMITED

Client : J E C C L
Site : SOUTH BURUMCHARA GPS. U C. PUKURIA P S. BANSHKHALI, CHITTAGONG.
Bore Chart of Boring No. BH-30

DATE	DEPTH in m	THICKNESS in m	STRATA ENCOUNTERED	LOG	DIA OF BORING	STANDARD PENETRATION TEST BLOWS/30cm or ft.	REMARKS U.W.T. SOIL SAMPLES VANE SHEAR TEST (P.S.L)
31-3-03	2.50	2.50	Brown & Grey med. stiff Clayey SILT trace fine sand.		15 cm DIA PERCUSSION METHOD	2 2 3 5 / 2 2 3 5	
	7.00	4.50	Grey very soft Clayey SILT trace fine sand.			1 1 1 2 / 0 0 ? 1 / 0 0 1 1 / 1 1 1 2 / 1 1 1 2	
	12.50	5.50	Grey loose to med. dense Silty fine to med. SAND trace mica.			1 2 3 5 / 5 6 7 13 / 4 6 9 15 / 5 10 14 24 / 6 10 15 25	
	20.00	7.50	Grey Hard SILT with clay trace fine sand.			12 14 18 32 / 10 14 19 33 / 10 13 18 31 / 9 13 17 30 / 10 13 18 31 / 10 13 19 32 / 10 12 20 32 / 11 13 20 33	

REDUCED ELEV. 3.582m PWD
1.10 M
1.00 2.00 3.00 4.00 5.00 6.00 7.00 8.00 9.00 10.00 11.00 12.00 13.00 14.00 15.00 16.00 17.00 18.00 19.00 20.00

DISTURBED SAMPLE ▨ UNDISTURBED SAMPLE ■

Soiltech International limited: Drawn by : Samad Date 9-4-03 Scale 1 : 150 Plan No.

Soiltech
INTERNATIONAL LIMITED

Client : J.E.C.C.L.
Site : PUICHARI SULTANIA GPS, UC. PUICHARI, PS. BANSHKHALI, CHITTAGONG.

Bore Chart of Boring No. 31

DATE	DEPTH in m	THICKNESS in m	STRATA ENCOUNTERED	LOG	DIA OF BORING	STANDARD PENETRATION TEST BLOWS/30cm or ft.	REMARKS U.W.T. SOIL SAMPLES VANE SHEAR TEST (P.S.L.)
5-4-03	2·10	2·10	Grey very soft Clayey SILT trace fine sand.		15 cm DIA PERCUSSION METHOD	1 1 1 2	
						1 1 1 2	
	8·25	6·25	Brown very soft to med. stiff Clayey SILT trace fine sand. & organic.			0 1 1 2	
						0 1 1 2	
						0 1 1 2	
						1 1 1 2	
						1 1 2 3	
						2 3 5 8	
	11·50	3·25	Grey dense med. to fine SAND trace silt.			8 12 19 31	
						5 11 27 38	
						3 5 5 10	
	15·25	3·75	Grey med. stiff to stiff Clayey SILT.			3 3 3 6	
						3 4 4 8	
						3 4 5 9	
						2 3 6 9	
	17·50	2·25	Brown very dense to med. dense fine to med. Sandy SILT. with clay.			20 32 47 79	
						5 5 5 10	
						13 14 16 30	
						15 28 40 68	
		4·50	Brown dense to very dense med. to fine SAND with silt.			30 37 51 82	
						32 52 for 15 cm	
	22·00					35 55 for 15 cm	

REDUCED ELEV. 2.366m PWD

0·93 M

DISTURBED SAMPLE ▭ UNDISTURBED SAMPLE ▬

Soiltech International limited: Drawn by : Samad Date 12-4-03 Scale 1 : 150 Plan No.

Soiltech
INTERNATIONAL LIMITED

Client : J E C C L
Site : NORTH SHADHANPUR GPS, U C, SHADHANPUR P S. BANSHKHALI, DIST. CHITTAGONG.

Bore Chart of Boring No. BH-32

DATE	DEPTH in m	THICKNESS in m	STRATA ENCOUNTERED	LOG	DIA OF BORING	STANDARD PENETRATION TEST BLOWS/30cm or ft.	REMARKS U.W.T. SOIL SAMPLES VANE SHEAR TEST (P.S.L.)
30-3-03	3·00	3·00	Brown loose fine to med. SAND with silt.		15 cm DIA PERCUSSION METHOD	2 2 3 5	
						2 2 2 4	
						2 3 3 6	
	9·00	6·00	Grey med. dense to dense med to fine SAND with silt.			4 6 7 13	
						12 17 19 36	
						12 16 20 36	
						11 15 18 33	
						10 15 17 32	
	10·50	1·50	Redish Brown stiff SILT with clay trace fine sand.			18 12 17 29	
						4 5 6 11	
						6 14 22 36	
						7 13 17 30	
						10 14 18 32	
						12 17 20 37	
		7·50	Brown very dense med. to fine & coarse SAND trace silt.			14 18 22 40	
						20 31 22 66	
						22 32 37 69	
						22 33 37 70	
						23 34 38 72	
	20·00					23 35 38 73	

REDUCED ELEV. 5.335m PWD

1·10 M.

DISTURBED SAMPLE ▭ UNDISTURBED SAMPLE ▬

Soiltech International limited: Drawn by : Samad Date 9-4-03 Scale 1 : 150 Plan No.

Soiltech
INTERNATIONAL LIMITED

Client : J E C C L.
Site : WEST BURUMCHARA, GPS: UC.BURUMCHARA
P S. ANOWARA, CHITTAGONG.
Bore Chart of Boring No. 35

DATE	DEPTH in m	THICKNESS in m	STRATA ENCOUNTERED	LOG	DIA OF BORING	STANDARD PENETRATION TEST BLOWS/45cm (15cm+15cm+15cm)	BLOWS/30cm or ft.	REMARKS
1-4-03	2.10	2.10	Brown & Grey med. stiff Clayey SILT trace fine sand.		15 cm DIA PERCUSSION METHOD	1 2 3	5	G.W.T. SOIL SAMPLES VANE SHEAR TEST (P.S.I.)
	7.20	5.10	Grey soft SILT with fine sand & clay.			1 2 2	4	
	11.00	3.80	Grey loose to med. dense Silty fine to med. SAND. trace mica.			0 1 1	2	
	12.50	1.50	Grey dense fine to med. SAND & SILT.			0 1 1	2	
	20.00	7.50	Grey dense Silty fine to med. SAND.			0 0 1	1	
						0 1 1	2	
						2 2 2	4	
						1 2 4	6	
						4 5 9	14	
						4 5 7	12	
						2 3 7	10	
						8 15 17	32	
						7 9 12	21	
						7 9 9	18	
						6 12 16	28	
						6 13 22	35	
						8 14 18	32	
						9 13 17	30	
						9 13 19	32	
						11 15 18	23	

REDUCED ELEV. 3.348m PWD
2.00M
1.00 2.00 3.00 4.00 5.00 6.00 7.00 8.00 9.00 10.00 11.00 12.00 13.00 14.00 15.00 16.00 17.00 18.00 19.00 20.00

DISTURBED SAMPLE ▨ UNDISTURBED SAMPLE ■

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GEOPHYSICAL RECORD OF BORING — SITE NO. 37

CLIENT: J E C		LOCATION:	:HORNI PALGRAM GPS, BURIRCHAR, :HATIYA, NOAKHALI
GROUND ELEVATION:	DEPTH OF HOLE: 30m		
DIAMETER OF HOLE: 4"	MACHINE PERCUSSION:	DATE OF DRILLING: 31-03-2003	
CORE RECOVERY:	DEPTH OF GROUND WATER LEVEL IN HOLE: 2.6m		
ANGLE FROM VERTICAL:	DRILLED BY: S. R.	LOGGED BY: R. R.	

ELEVATION (+) 2.14m	DEPTH -M	THICK-NESS -M	FIELD OBSERVATION AND LITHOLOGY	LOG	STANDARD PENETRATION TEST - BLOWS/SPT (10 20 30 40 50 60)	SOIL SAMPLE
	1.5	1.5	Light brown & grey medium compressible SILT, trace sand (medium stiff)		7	D- 1
	3.5	2	Brownish grey medium plastic CLAY (soft)		2 2	D- 2 D- 3
	5.2	1.7	Blueish grey medium compressible SILT, trace sand (soft)		2 3	D- 4 U- 1 D- 5
	7.5	2.3	Grey laminated medium compressible SILT, trace sand (medium stiff)		5 7	D- 6 D- 7
	9.5	2	Light grey non-plastic fine sandy SILT (medium dense)		12 12	D- 8 D- 9
	14.5	5	Grey laminated medium compressible SILT, trace sand (medium stiff to stiff)		6 5 11 8 5	D- 10 U- 2 D- 11 D- 12 D- 13 D- 14
	17.5	3	Blueish grey fine sandy SILT (medium dense)		15 14 5	D- 15 U- 3 D- 16 D- 17
	25	7.5	Grey laminated medium compressible SILT, trace sand (medium stiff)		4 6 6 5 5 6 7 9	D- 18 D- 19 D- 20 D- 21 U- 4 D- 22 D- 23 D- 24 D- 25
	27	2	Light grey medium compressible SILT, trace sand (stiff)		12 10	D- 26 D- 27
	30	3	Deepr grey medium plastic CLAY, trace sand (stiff)		11 11 12	D- 28 D- 29 D- 30

Disturbed Sample..... □ Undisturbed Sample..... ▦

GEOPHYSICAL RECORD OF BORING

SITE NO. 38

CLIENT: **J E C**

LOCATION: **:EAST CHANANDI GPS, SONADIA, :HATIYA, NOAKHALI**

GROUND ELEVATION:

DEPTH OF HOLE: **30m**

DIAMETER OF HOLE: **100mm**

MACHINE PERCUSSION:

DATE OF DRILLING: 30-03-2003

CORE RECOVERY:

DEPTH OF GROUND WATER LEVEL IN HOLE: **3m**

ANGLE FROM VERTICAL:

DRILLED BY: **S. R.**

LOGGED BY: **R. R.**

ELEVATION (+) 2.48m	DEPTH -M	THICK-NESS -M	FIELD OBSERVATION AND LITHOLOGY	LOG	STANDARD PENETRATION TEST - BLOWS/SPT (10 20 30 40 50 60)	SOIL SAMPLE
	2.5	2.5	Brownish grey medium compressible SILT, trace sand (medium stiff to stiff)		6, 10	D- 1, D- 2
	5.5	3	Grey medium plastic CLAY (soft)		2, 3, 2	D- 3, D- 4, D- 5
	6.4	0.9	Grey fine SAND & SILT (loose)		10	U- 1, D- 6
	8.5	2.1	Deep grey medium plastic CLAY (soft)		4, 3	D- 7, D- 8
	11.5	3	Grey medium laminated compressible SILT, trace sand (stiff)		8, 9, 7	D- 9, D- 10, U- 2, D- 11
	13.5	2	Light grey fine sandy SILT (medium dense)		15, 16	D- 12, D- 13
	16.5	3	Grey laminated medium compressible SILT, trace sand (stiff)		9, 10, 9	D- 14, D- 15, U- 3, D- 16
	20.5	4	Blueish grey medium plastic CLAY, trace sand (soft)		5, 4, 4, 3	D- 17, D- 18, D- 19, U- 4, D- 20
	24.5	4	Brownish grey medium plastic CLAY (medium stiff)		6, 7, 6, 6	D- 21, D- 22, D- 23, D- 24
	28.5	4	Deep grey laminated sandy SILT, trace sand (medium dense)		13, 14, 13, 12	D- 25, D- 26, D- 27, D- 28
	30	1.5	Grey medium compressible SILT, trace sand (stiff)		15, 15	D- 29, D- 30

Disturbed Sample..... ☐ Undisturbed Sample..... ▦

GEOPHYSICAL RECORD OF BORING

SITE NO. 39

CLIENT: **J E C**

LOCATION: **TAMARUDDI GPS, HATIYA, NOAKHALI**

GROUND ELEVATION:

DEPTH OF HOLE: **30m**

DIAMETER OF HOLE: **100mm**

MACHINE PERCUSSION:

DATE OF DRILLING: 28-03-2003

CORE RECOVERY:

DEPTH OF GROUND WATER LEVEL IN HOLE: **3m**

ANGLE FROM VERTICAL:

DRILLED BY: **S. R.**

LOGGED BY: **R. R.**

ELEVATION (+) 1.77m	DEPTH -M	THICK-NESS -M	FIELD OBSERVATION AND LITHOLOGY	LOG	STANDARD PENETRATION TEST - BLOWS/SPT (10 20 30 40 50 60)	SOIL SAMPLE
	2.5	2.5	Light brown medium compressible SILT, trace sand (soft to medium stiff)		7, 3	D- 1, D- 2
	5.25	2.75	Light grey fine SAND & SILT (loose)		8, 6, 5	D- 3, D- 4, U- 1, D- 5
	6.5	1.25	Grey medium plastic CLAY (soft)		4	D- 6
	10.5	4	Light grey laminated medium compressible SILT, trace sand (Stiff)		9, 8, 7, 8	D- 7, D- 8, D- 9, U- 2, D- 10
	14.5	4	Light grey laminated sandy SILT, trace sand (loose)		10, 10, 9, 10	D- 11, D- 12, D- 13, U- 3, D- 14
	16.4	1.9	Grey fine SAND & SILT (medium dense)		17, 20	D- 15, D- 16
	20.5	4.1	Light grey laminated medium compressible SILT, trace sand (medium stiff)		7, 6, 7, 8	D- 17, D- 18, D- 19, U- 4, D- 20
	25.2	4.7	Grey laminated medium plastic CLAY, trace sand (stiff)		16, 12, 13, 9, 9	D- 21, D- 22, D- 23, D- 24, D- 25
	27.5	2.3	Brownish grey fine SAND & SILT (dense)		35, 40	D- 26, D- 27
	30	2.5	Light brown fine SAND, some silt (dense)		36, 37, 42	D- 28, D- 29, D- 30

Disturbed Sample..... ☐ Undisturbed Sample..... ▦

Soiltech
SOIL MECHANIC & MATERIAL TESTING LABORATORY
D H A K A

SUMMARY OF LABORATORY TEST RESULTS

CLIENT : J E C C L.
SITE ILISHIA GPS. UC. WEST BORO VOOLA PS. C HAKARIA, COX'S BAZAR.

Borehole No.		6							
Sample No.		U-1	U-2	D-3	U-3	U-4	D-11	D-15	D-2
Depth in [illegible]		1.10to1.55	2.10to2.55	2.55to3.00	4.10to4.55	6.10to6.55	10.55to11.00	14.55to15.00	19.55to20.00
Moisture content (Natural)		48.82	100.19	77.30	45.19	46.44	25.26	25.21	26.10
Specifice gravity			2.561	2.567	2.567	2.572	2.70	2.71	2.577
Atterberg Limits	Liquid Limit, Lw		155.00	47.50	55.23	53.80			
	Plastic Limit, Pw		81.25	26.40	27.50	27.20			
Density	Wet (lbs/cft)	111.82	92.37		113.59	110.94			
	Dry (lbs/cft)	75.14	46.14		78.23	75.75			
Grain size Analysis	Gravel (%)								
	Sand (%)			2			91	81	34
	Silt (%)			78			9	19	58
	Clay (%)			20			-	-	8
Consolidation tests	Natural void ratio, eo					1.118			
	Compression index, Cc					0.541			
Unconfined Compression tests	Strain at failure (%)	10.71	10.71		8.92	8.92			
	Stress undist.(lbs/sq.inch)	4.30	2.99		3.45	7.28			
	Stress remould.(lbs/sq.inch)	2.68	2.10		2.30	4.21			
	Sensitivity	1.604	1.423		1.50	1.729			
Triaxial Compression Qc tests	C (p.s.i)								
	∅ (degree)								

Soiltech international limited Drawn by : Samad Date : 15-4-03 Plan #

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SOIL MECHANIC & MATERIAL TESTING LABORATORY
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SUMMARY OF LABORATORY TEST RESULTS

CLIENT : J E C C L.
SITE WEST CHARLAHSMA GPS. UC. CHAR LAKSMA, PS. PATIYA, CTG.

Borehole No.		13								
Sample No.		U-1	D-3	U-2	U-3	U-4	D-9	D-16	D-23	D-27
Depth in meter		2.05to2.50	2.55to3.00	3.10to3.55	5.05to5.50	6.10to6.55	8.55to9.00	15.55to16.00	22.55to23.0	26.55to26.0
Moisture content (Natural)		31.10	37.86	38.17	45.40	34.53	26.88	35.11	35.02	23.88
Specifice gravity		2.567	2.580		2.572		2.643	2.634	2.577	2.671
Atterberg Limits	Liquid Limit, Lw	56.81	50.00		51.35				37.82	
	Plastic Limit, Pw	29.16	28.33		25.60				22.22	
Density	Wet (lbs/cft)	121.10		113.59	111.82	115.36				
	Dry (lbs/cft)	92.37		82.21	76.90	85.74				
Grain size Analysis	Gravel (%)									
	Sand (%)		2				68	44	34	70
	Silt (%)		74				32	56	59	30
	Clay (%)		24				-	-	-	7
Consolidation tests	Natural void ratio, eo				1.087					
	Compression index, Cc				0.282					
Unconfined Compression tests	Strain at failure (%)	10.71		10.71	8.92	8.92				
	Stress undist.(lbs/sq.inch)	8.80		6.15	3.64	5.94				
	Stress remould.(lbs/sq.inch)	5.17		3.45	2.49	3.25				
	Sensitivity	1.702		1.782	1.461	1.827				
Triaxial Compression Qc tests	C (p.s.i)									
	∅ (degree)									

Soiltech international limited Drawn by : Samad Date : 15-4-03 Plan #

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SOIL MECHANIC & MATERIAL TESTING LABORATORY
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SUMMARY OF LABORATORY TEST RESULTS

CLIENT : J E C C L.
SITE ICHANAGAR GPS. UC. CHAR PATHARGHATA PS. PATIYA, CHITTAGONG.

Borehole No.		14							
Sample No.		U-1	D-2	U-2	U-3	U-4	D-5	D-11	D-17
Depth in feet		1.10to1.55	1.55to2.00	2.05to2.50	3.10to3.55	4.10to4.55	4.55to5.00	10.55to11.00	16.55to17.00
Moisture content (Natural)		39.44	41.80	35.82	37.77	33.67	28.11	23.70	38.64
Specifice gravity			2.561	2.567			2.640	2.70	2.577
Atterberg Limits	Liquid Limit, Lw		55.55	46.97			N. P.		48.33
	Plastic Limit, Pw		29.16	26.40					26.66
Density	Wet (lbs/cft)	110.94		112.26	113.15	115.80			
	Dry (lbs/cft)	79.56		82.65	83.09	86.63			
Grain size Analysis	Gravel (%)								
	Sand (%)		1				53	92	2
	Silt (%)		69				47	8	73
	Clay (%)		30				-	-	25
Consolidation tests	Natural void ratio, eo			0.937					
	Compression index, Cc			0.159					
Unconfined Compression tests	Strain at failure (%)	8.92		10.71	10.71	8.92			
	Stress undist.(lbs/sq.inch)	5.36		6.74	5.61	7.47			
	Stress remould.(lbs/sq.inch)	3.25		4.40	3.45	4.48			
	Sensitivity	1.649		1.531	1.626	1.662			
Triaxial Compression Qc tests	C (p.s.i)								
	∅ (degree)								

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SOIL MECHANIC & MATERIAL TESTING LABORATORY
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SUMMARY OF LABORATORY TEST RESULTS

CLIENT : J E C C L.
SITE CHAR PATHARGHATA GPS. UC. CHAR PATHARGHATA, PS. PATIYA, CTG.

Borehole No.		15							
Sample No.		U-1	U-2	D-3	U-3	U-4	D-6	D-10	D-18
Depth in : meter		1.10to1.55	2.05to2.50	5.55to3.00	3.10to3.55	5.05to5.55	5.55to6.00	9.55to10.00	17.55018.00
Moisture content (Natural)		30.66	29.95	42.34	38.33	40.31	23.41	18.51	27.92
Specifice gravity			2.561	2.572		2.572	2.615	2.706	2.580
Atterberg Limits	Liquid Limit, Lw		56.09	52.50		51.21			47.69
	Plastic Limit, Pw		29.16	27.50		27.50			26.15
Density	Wet (lbs/cft)	122.43	124.64		110.05	109.17			
	Dry (lbs/cft)	93.70	95.91		79.56	77.79			
Grain size Analysis	Gravel (%)								
	Sand (%)			2			74	96	4
	Silt (%)			72			26	4	76
	Clay (%)			26			-	-	20
Consolidation tests	Natural void ratio, eo		0.666						
	Compression index, Cc		0.182						
Unconfined Compression tests	Strain at failure (%)	10.71	8.92		10.71	8.92			
	Stress undist.(lbs/sq.inch)	14.04	16.29		5.05	4.02			
	Stress remould.(lbs/sq.inch)	9.39	10.92		3.25	2.68			
	Sensitivity	1.495	1.491		1.553	1.50			
Triaxial Compression Qc tests	C (p.s.i)								
	∅ (degree)								

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SOIL MECHANIC & MATERIAL TESTING LABORATORY
D H A K A

SUMMARY OF LABORATORY TEST RESULTS

CLIENT : J E C C L.
SITE : KACHIAPUR GPS. UC. HARAMINA. PS. SANDWIP, CHITTAGONG.

Borehole No.		16								
Sample No.		U-1	D-3	U-2	U-3	D-6	U-4	D-10	D-17	D-27
Depth in meter		1.10to1.55	2.55to3.00	3.10to3.55	5.10to5.55	5.55to6.00	7.10to7.55	9.55to10.00	16.55to17.0	26.55to27.00
Moisture content (Natural)		27.98	32.08	28.50	33.50	34.53	29.62	30.15	36.37	34.93
Specifice gravity		2.580	2.572			2.588	2.593	2.585	2.621	2.632
Atterberg Limits	Liquid Limit, Lw	42.50	44.00				43.80	37.77		
	Plastic Limit, Pw	25.38	24.61				24.61	23.07		
Density	Wet (lbs/cft)	123.31		121.55	118.01		123.76			
	Dry (lbs/cft)	96.35		94.58	88.40		95.47			
Grain size Analysis	Gravel (%)									
	Sand (%)		2			5		8	38	53
	Silt (%)		78			81		82	62	37
	Clay (%)		20			14		10	-	-
Consolidation tests	Naturcl void ratio, e0						0.694			
	Compression index, Cc						0.096			
Unconfined Compression tests	Strain at failure (%)	8.02		10.71	10.71		7.14			
	Stress undist.(lbs/sq.inch)	18.59		15.54	9.17		15.02			
	Stress remould.(lbs/sq.inch)	10.54		10.16	6.13		8.58			
	Sensitivity	1.763		1.529	1.495					
Triaxial Compression Qc tests	C (p.s.i)									
	∅ (degree)									

Soiltech international limited Drawn by : Samad Date : 15-4-04 Plan #

Soiltech
SOIL MECHANIC & MATERIAL TESTING LABORATORY
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SUMMARY OF LABORATORY TEST RESULTS

CLIENT : J E C C L.
SITE : SOUTH EAST MUSPUR, GPS. UC. MUSAPUR, PS. SANDWIP, CTG.

Borehole No.		18								
Sample No.		U-1	D-2	U-2	U-3	U-4	D-8	D-13	D-19	D-25
Depth in meter		1.10to1.55	1.55to2.00	2.10to2.55	4.10to4.55	7.10to7.55	7.55to8.00	12.55to13.0	18.55to19.0	24.55to25.0
Moisture content (Natural)		30.55	33.00	29.54	28.57	26.85	24.73	32.55	43.26	27.64
Specifice gravity		2.580	2.574			2.607	2.643	2.634	2.580	2.660
Atterberg Limits	Liquid Limit, Lw	46.15	47.69			34.78			48.50	
	Plastic Limit, Pw	24.61	25.18			19.35			26.26	
Density	Wet (lbs/cft)	124.64		125.97	127.29	128.62				
	Dry (lbs/cft)	95.47		97.24	99.00	101.39				
Grain size Analysis	Gravel (%)									
	Sand (%)		2				31	22	2	50
	Silt (%)		76				69	73	73	50
	Clay (%)		22				-	5	25	-
Consolidation tests	Natural void ratio, e0	0.686								
	Compression index, Cc	0.159								
Unconfined Compression tests	Strain at failure (%)	8.92		8.92	10.71	7.14				
	Stress undist.(lbs/sq.inch)	22.49		24.34	23.03	25.76				
	Stress remould.(lbs/sq.inch)	14.76		16.48	13.99	16.48				
	Sensitivity	1.519		1.476	1.646	1.563				
Triaxial Compression Qc tests	C (p.s.i)									
	∅ (degree)									

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SOIL MECHANIC & MATERIAL TESTING LABORATORY
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SUMMARY OF LABORATORY TEST RESULTS

CLIENT : J E C C L.
SITE BAURIA G.K. GPS. UC. BAURIA. PS. SANDWIP, CHITTAGONG.

Borehole No.		19							
Sample No.		U-1	D-3	U-2	U-3	D-7	U-4	D-18	D-24
Depth in meter		1.10to1.55	2.55to3.00	3.10to3.55	5.10to5.55	6.55to7.00	10.10to10.55	17.55to18.00	23.55to24.00
Moisture content (Natural)		30.80	33.25	32.52	32.84	30.99	29.35	46.26	21.34
Specifice gravity		2.580	2.588			2.593	2.607	2.559	2.622
Atterberg Limits	Liquid Limit, Lw	43.50	47.50				34.58	55.81	
	Plastic Limit, Pw	24.61	26.66				19.28	29.18	
Density	Wet (lbs/cft)	121.99		120.66	119.78		124.64		
	Dry (lbs/cft)	93.26		91.05	90.16		96.35		
Grain size Analysis	Gravel (%)								
	Sand (%)		4			12		2	25
	Silt (%)		76			79		66	75
	Clay (%)		20			9		32	-
Consolidation tests	Natural void ratio, eo						0.689		
	Compression index, Cc						0.116		
Unconfined Compression tests	Strain at failure (%)	8.92		10.71	10.71		7.14		
	Stress undist.(lbs/sq.inch)	15.91		13.10	14.23		18.15		
	Stress remould.(lbs/sq.inch)	9.39		8.43	9.20		10.73		
	Sensitivity	1.694		1.553	1.546		1.691		
Triaxial Compression Qc tests	C (p.s.i)								
	ø (degree)								

Soiltech international limited Drawn by : Samad Date : 15-4-03 Plan #

SOILTEST INTERNATIONAL
DHAKA

SUMMARY OF LABORATORY TEST RESULTS

Site no. 21, Temuhani GPS, Mirsharai, Chittagong.

Bore hole No.										
Sample No.		D-2	U-1	D-4	D-6	U-2	D-11	U-3	U-4	
Depth - m	From	1.5	2.0	3.5	5.5	7.0	10.5	13.0	17.0	
	To	2.0	2.5	4.0	6.0	7.5	11.0	13.5	17.5	
Natural Moisture content (%)			32.2			25.2		23.3	23.0	
Specific gravity			2.66			2.622		2.604	2.61	
Atterberg Limits	Liquid Limit, W_l (%)	52	46	47	48					
	Plastic Limits, Ip (%)	26	20	19	23					
Density	Wet (gm/cc)									
	Dry (gm/cc)		1.217			1.559		1.706	1.708	
Grain size analysis	Gravel (%)									
	Sand (%)									
	Silt or % (fines) Clay					84	46	34	26	
Consolidation tests	Natural Void ration, eo		0.959							
	Compression index, Cc		0.224							
Unconfined Compression tests	Strain at failure (%)		15							
	Stress undist. (kg/cm^2)		0.327							
	Stress remould ( )									
	Sensitivity									
Direct shear Test	ϕ (degree)					18		30	31	
	C (kg/cm^2)					0.115		0.050	0.035	

SOILTEST INTERNATIONAL
DHAKA

SUMMARY OF
LABORATORY TEST RESULTS

Site no. 22, Mayani Solaiman GPS, Mirsharai, Chittagong.

Bore hole No.									
Sample No.		D-1	U-1	D-5	U-2	D-12	D-14	U-3	U-4
Depth - m	From	0.5	2.0	4.5	7.0	11.5	13.5	14.0	17.0
	To	1.0	2.5	5.0	7.5	12.0	14.0	14.5	17.5
Natural Moisture content (%)			31.3		22.5		25.6		21.2
Specific gravity			2.655		2.624			2.646	2.61
Atterberg Limits	Liquid Limit, W_l (%)	45	47				46	48	
	Plastic Limits, Ip (%)	19	22				21	24	
Density	Wet (gm/cc)								
	Dry (gm/cc)		1.346		1.602		1.634		1.690
Grain size analysis	Gravel (%)								
	Sand (%)			9	51	66			72
	Silt or % (fines) Clay			91	49	34			28
Consolidation tests	Natural Void ration, eo							0.6770	
	Compression index, Cc							0.1520	
Unconfined Compression tests	Strain at failure (%)		14				11		
	Stress undist. (kg/cm^2)		0.455				1.758		
	Stress remould ( )								
	Sensitivity								
Direct shear Test	ϕ (degree)				21				28
	C (kg/cm^2)				0.120				0.070

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SUMMARY OF
LABORATORY TEST RESULTS

Site no. 23, Jafrabad GPS, Mirsharai, Chittagong.

Bore hole No.									
Sample No.		D-1	D-2	U-1	D-3	U-2	U-3	D-12	U-4
Depth - m	From	0.5	1.5	2.0	2.5	5.0	9.0	11.5	15.0
	To	1.0	2.0	2.5	3.0	5.5	9.5	12.0	15.5
Natural Moisture content (%)				26.5		22.7	21.1		19.8
Specific gravity				2.652		2.630	2.620		2.605
Atterberg Limits	Liquid Limit, W_l (%)	48	49	47	48				
	Plastic Limits, Ip (%)	26	27	28	24				
Density	Wet (gm/cc)								
	Dry (gm/cc)			1.541		1.670	1.712		1.719
Grain size analysis	Gravel (%)								
	Sand (%)					19	59	74	26
	Silt or % (fines) Clay					81	41	36	24
Consolidation tests	Natural Void ration, eo			0.7870					
	Compression index, Cc			0.1760					
Unconfined Compression tests	Strain at failure (%)			12					
	Stress undist. (kg/cm^2)			1.089					
	Stress remould ( )								
	Sensitivity								
Direct shear Test	ϕ (degree)					23	31		33
	C (kg/cm^2)					0.125	0.065		0.060

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SUMMARY OF
LABORATORY TEST RESULTS

Site no. 24, S.M. Hajipara GPS, Mirsharai, Chittagong.

Bore hole No.										
Sample No.		D-2	U-1	D-5	U-2	D-9	U-3	D-16	U-4	
Depth - m	From	1.5	2.0	4.5	6.0	8.5	12.0	15.5	18.0	
	To	2.0	2.5	5.0	6.5	9.0	12.5	16.0	18.5	
Natural Moisture content (%)			27.3		27.6		20.1		19.5	
Specific gravity			2.640		2.647		2.612		2.600	
Atterberg Limits	Liquid Limit, W_l (%)	37	39	46	43					
	Plastic Limits, Ip (%)	9	10	20	12					
Density	Wet (gm/cc)									
	Dry (gm/cc)		1.482		1.458		1.720		1.730	
Grain size analysis	Gravel (%)									
	Sand (%)					67	58	72	79	
	Silt or % (fines) Clay					33	42	28	21	
Consolidation tests	Natural Void ration, eo				0.8120					
	Compression index, Cc				0.1650					
Unconfined Compression tests	Strain at failure (%)		12		13					
	Stress undist. (kg/cm^2)		0.846		0.716					
	Stress remould ( )									
	Sensitivity									
Direct shear Test	ϕ (degree)						33		34	
	C (kg/cm^2)						0.060		0.050	

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SUMMARY OF
LABORATORY TEST RESULTS

Site no. 25,Hajisorai GPS, Mirsharai, Chittagong.

Bore hole No.										
Sample No.		U-1	U-2	D-9	D-11	D-12	U-3	D-16	D-17	U-4
Depth - m	From	2.0	6.0	8.5	10.5	11.5	12.0	15.5	16.5	17.0
	To	2.5	6.5	9.0	11.0	12.0	12.5	16.0	17.0	17.5
Natural Moisture content (%)		24.8	24.5				22.9			19.8
Specific gravity		2.650	2.658				2.640			2.620
Atterberg Limits	Liquid Limit, W_l (%)	38	51	55		52				
	Plastic Limits, Ip (%)	11	25	31		29				
Density	Wet (gm/cc)									
	Dry (gm/cc)	1.575	1.610							1.723
Grain size analysis	Gravel (%)						1.690			
	Sand (%)				70			81	84	89
	Silt or % (fines) Clay				30			19	16	11
Consolidation tests	Natural Void ration, eo		0.7380							
	Compression index, Cc		0.1640							
Unconfined Compression tests	Strain at failure (%)	12	11				10			
	Stress undist. (kg/cm^2)	1.288	1.409				2.154			
	Stress remould ( )									
	Sensitivity									
Direct shear Test	ϕ (degree)									33
	C (kg/cm^2)									0.065

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SUMMARY OF LABORATORY TEST RESULTS

Site no.27, East Sahebkhali GPS, Mirsharai, Chittagong.

Bore hole No.										
Sample No.		U-1	D-4	U-2	U-3	D-16	D-18	D-20	U-4	
Depth - m	From	2.0	3.5	8.0	14.5	15.5	17.5	19.5	20.0	
	To	2.5	4.0	8.5	15.0	16.0	18.0	20.0	20.5	
Natural Moisture content (%)		27.6		32.3	25.3				18.2	
Specific gravity		2.652		2.640	2.628				2.604	
Atterberg Limits	Liquid Limit, W_l (%)	39	47	43	40					
	Plastic Limits, Ip (%)	11	22	19	12					
Density	Wet (gm/cc)									
	Dry (gm/cc)	1.418	1.185	(1.85	1.511				1.732	
Grain size analysis	Gravel (%)									
	Sand (%)					59	52	67	84	
	Silt or % (fines) Clay					41	48	33	16	
Consolidation tests	Natural Void ration, eo			0.9680						
	Compression index, Cc			0.2180						
Unconfined Compression tests	Strain at failure (%)	13	16		12					
	Stress undist. (kg/cm^2)	0.651	0.267		1.042					
	Stress remould ( )									
	Sensitivity									
Direct shear Test	ϕ (degree)								35	
	C (kg/cm^2)								0.0	

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SUMMARY OF LABORATORY TEST RESULTS

CLIENT : J E C C L.
SITE MUNKIRCHAR GPS. UC. SHILKUP
PS. BANSHKHALI. CHITTAGONG.

Borehole No.		28							
Sample No.		U-1	D-2	U-2	U-3	U-4	D-7	D-14	D-19
Depth in meter		1.10to1.55	1.55to2.00	2.10to2.55	4.10to4.55	5.10to5.55	6.55to7.00	13.55to14.00	18.55to19.00
Moisture content (Natural)		58.00	31.25	64.08	46.36	48.29	20.13	37.80	23.31
Specifice gravity			2.567	2.552	2.567		2.70	2.593	2.463
Atterberg Limits	Liquid Limit, Lw		49.74	112.50	58.50			48.57	
	Plastic Limit, Pw		26.92	67.50	28.57			26.40	
Density	Wet (lbs/cft)	104.75		102.98	115.80	115.36			
	Dry (lbs/cft)	66.30		62.76	79.11	77.79			
Grain size Analysis	Gravel (%)								
	Sand (%)		2				93	4	36
	Silt (%)		73				7	75	64
	Clay (%)		25				-	-	-
Consolidation tests	Natural void ratio, eo			1.551					
	Compression index, Cc			0.641					
Unconfined Compression tests	Strain at failure (%)	8.92		8.92	8.92	10.71			
	Stress undist.(lbs/sq.inch)	10.92		8,24	7.09	5.99			
	Stress remould.(lbs/sq.inch)	6.32		4.98	4.80	3.45			
	Sensitivity	1.727		1.654	1.611	1.736			
Triaxial Compression Qc tests	C (p.s.i)								
	ϕ (degree)								

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SUMMARY OF LABORATORY TEST RESULTS

CLIENT : J E C C L.
SITE MODAYA KATHARIA GPS. UC. KATHARIA
PS. BANSHKHALI, CHITTAGONG.

Borehole No.		29							
Sample No.		U-1	D-3	U-2	U-3	U-4	D-10	D-13	D-17
Depth in meter		2.10to2.55	2.55to3.00	4.10to4.55	6.10to6.55	8.10to8.55	9.55to10.00	12.55to13.00	16.55to17.00
Moisture content (Natural)		31.42	33.93	38.88	32.03	32.36	33.62	27.17	41.85
Specifice gravity		2.567	2.561	2.572		2.663	2.643	2.660	2.588
Atterberg Limits	Liquid Limit, Lw	56.74	59.52	59.03		35.21			
	Plastic Limit, Pw	28.46	30.83	27.27		18.62			
Density	Wet (lbs/cft)	121.99		110.50	120.22	121.10			
	Dry (lbs/cft)	92.82		79.56	91.00	91.49			
Grain size Analysis	Gravel (%)								
	Sand (%)		2				32	74	4
	Silt (%)		68				62	26	77
	Clay (%)		30				6	-	19
Consolidation tests	Natural void ratio, eo			1.020					
	Compression index, Cc			0.336					
Unconfined Compression tests	Strain at failure (%)	10.71		10.71	10.71	8.92			
	Stress undist.(lbs/sq.inch)	12.36		6.36	10.67	13.80			
	Stress remould.(lbs/sq.inch)	8.05		3.51	5.36	7.66			
	Sensitivity	1.525		1.811	1.990	1.801			
Triaxial Compression Qc tests	C (p.s.i)								
	∅ (degree)								

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SUMMARY OF LABORATORY TEST RESULTS

CLIENT : J E C C L.
SITE SOUTH BURUMCHARA GPS. UC. PUKURIA
PS. BANSHKHALI, CHITTAGONG.

Borehole No.		30						
Sample No.		U-1	D-3	U-2	U-3	U-4	D-8	D-17
Depth in meter		1.10to1.55	2.55to3.00	3.10to3.55	5.10to5.55	6.10to6.55	7.55to8.00	16.55to17.00
Moisture content (Natural)		25.66	34.60	47.33	43.27	44.57	39.26	30.34
Specifice gravity		2.567	2.572	2.553	2.571		2.648	2.577
Atterberg Limits	Liquid Limit, Lw	51.21	48.88	53.50	47.02			
	Plastic Limit, Pw	27.27	26.15	27.55	24.54			
Density	Wet (lbs/cft)	125.52		110.05	108.29	111.82		
	Dry (lbs/cft)	99.89		74.69	75.58	77.35		
Grain size Analysis	Gravel (%)							
	Sand (%)	2	8				62	4
	Silt (%)	63	66				38	78
	Clay (%)	35	26				-	18
Consolidation tests	Natural void ratio, eo				1.123			
	Compression index, Cc				0.269			
Unconfined Compression tests	Strain at failure (%)	8.92		8.92	10.71	10.71		
	Stress undist.(lbs/sq.inch)	26.26		4.21	3.74	5.05		
	Stress remould.(lbs/sq.inch)	15.91		2.68	2.49	3.06		
	Sensitivity	1.650		1.570	1.502	1.650		
Triaxial Compression Qc tests	C (p.s.i)							
	∅ (degree)							

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SOIL MECHANIC & MATERIAL TESTING LABORATORY
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SUMMARY OF LABORATORY TEST RESULTS

CLIENT : J E C C L.
SITE : PUICHARI SULTANIA GPS. UC.
PUICHARI, PS. BANSHKHALI, CTG.

Borehole No.		31							
Sample No.		D-2	U-1	U-2	U-3	U-4	D-9	D-17	D-21
Depth in meter		1.55to2.00	2.10to2.55	4.10to4.55	6.10to6.55	7.10to7.55	8.55to9.00	16.55to17.00	20.55to21.00
Moisture content (Natural)		36.66	121.17	51.86	25.43	24.56	20.46	21.57	16.31
Specifice gravity		2.561	2.554	2.561	2.593		2.697	2.588	2.571
Atterberg Limits	Liquid Limit, Lw	54.76	157.14	73.52				46.15	
	Plastic Limit, Pw	29.16	87.50	38.26				24.00	
Density	Wet (lbs/cft)		83.09	111.82	126.41	127.73			
	Dry (lbs/cft)		37.47	73.63	100.77	102.54			
Grain size Analysis	Gravel (%)								
	Sand (%)	1					90	34	82
	Silt (%)	70					10	51	18
	Clay (%)	29					-	15	-
Consolidation tests	Natural void ratio, eo			1.173					
	Compression index, Cc			0.657					
Unconfined Compression tests	Strain at failure (%)		8.92	8.92	7.14	8.92			
	Stress undist.(lbs/sq.inch)		8.05	7.47	7,80	9.20			
	Stress remould.(lbs/sq.inch)		4.98	4.60	5.17	5.17			
	Sensitivity		1.616	1.623	1.598	1.779			
Triaxial Compression Qc tests	C (p.s.i)								
	∅ (degree)								

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SUMMARY OF LABORATORY TEST RESULTS

CLIENT : J E C C L.
SITE : NORTH SHADHANPUR GPS. UC. SHADHANPU
PS. BANSHKHALI, CHITTAGONG.

Borehole No.		32							
Sample No.		U-1	D-2	U-2	U-3	D-10	U-4	D-13	D-19
Depth in meter		1.10to1.55	1.55to2.00	2.10to2.55	3.10to3.55	9.55to10.00	10.10to10.55	12.55to13.00	18.55to19.00
Moisture content (Natural)		21.63	20.88	21.70	22.84	20.21	52.63	26.20	16.87
Specifice gravity		2.610	2.688			2.588	2.572	2.593	2.697
Atterberg Limits	Liquid Limit, Lw	52.10				45.26	55.26	37.20	
	Plastic Limit, Pw	27.50				24.80	29.16	22.85	
Density	Wet (lbs/cft)	125.26		126.41	125.97		102.54		
	Dry (lbs/cft)	102.98		103.87	102.54		67.18		
Grain size Analysis	Gravel (%)								
	Sand (%)		82			15		5	92
	Silt (%)		18			69		83	8
	Clay (%)		-			16		12	-
Consolidation tests	Natural void ratio, eo	0.582							
	Compression index, Cc	0.149							
Unconfined Compression tests	Strain at failure (%)	7.14		8.92	8.92		10.71		
	Stress undist.(lbs/sq.inch)	6.83		8.43	7.28		5.24		
	Stress remould.(lbs/sq.inch)	3.70		4.98	4.40		3.25		
	Sensitivity	1.845		1.692	1.654		1.612		
Triaxial Compression Qc tests	C (p.s.i)								
	∅ (degree)								

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SUMMARY OF LABORATORY TEST RESULTS

CLIENT : J E C C L.
SITE : WEST BURUMCHARA GPS. UC. BURUMCHARA PS. ANOWARA. CHITTAGONG.

Borehole No.		35							
Sample No.		U-1	D-2	U-2	U-3	D-5	U-4	D-9	D-16
Depth in meter		1.10to1.55	1.55to2.00	2.05to2.50	4.10to4.55	4.55to5.00	5.05to5.50	8.55to9.00	16.55to17.00
Moisture content (Natural)		29.52	29.54	28.97	34.00	35.53	34.16	23.35	22.87
Specifice gravity			2.561	2.567		2.593	2.572	2.663	2.677
Atterberg Limits	Liquid Limit, Lw		58.50	47.39		39.06	45.26		
	Plastic Limit, Pw		30.83	25.00		24.00	23.07		
Density	Wet (lbs/cft)	120.22		121.99	118.45		119.78		
	Dry (lbs/cft)	92.82		94.58	88.40		89.28		
Grain size Analysis	Gravel (%)								
	Sand (%)		1			20		74	70
	Silt (%)		68			68		26	30
	Clay (%)		31			12		-	-
Consolidation tests	Natural void ratio, eo						0.795		
	Compression index, Cc						0.122		
Unconfined Compression tests	Strain at failure (%)	10.71		8.92	10.71		8.92		
	Stress undist.(lbs/sq.inch)	12.36		14.37	6.18		5.17		
	Stress remould.(lbs/sq.inch)	7.66		9.20	3.45		2.87		
	Sensitivity	1.613		1.561	1.791		1.801		
Triaxial Compression Qc tests	C (p.s.i)								
	ϕ (degree)								

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SUMMARY OF LABORATORY TEST RESULTS

Site no. 37, Horni Palgram GPS, Hatiya, Noakhali.

Bore hole No.										
Sample No.		U-1	D-8	D-9	U-2	D-15	U-3	U-4	D-29	
Depth - m	From	4.0	7.5	8.5	10.0	14.5	15.0	21.0	28.5	
	To	4.5	8.0	9.0	10.5	15.0	15.5	21.5	29.0	
Natural Moisture content (%)		29.65			26.55		25.22	27.68		
Specific gravity		2.670			2.672		2.673	2.675		
Atterberg Limits	Liquid Limit, W_l (%)	35			36			37	48	
	Plastic Limits, Ip (%)	6			7			9	22	
Density	Wet (gm/cc)									
	Dry (gm/cc)	1.3181			1.4847		1.4110	1.4687		
Grain size analysis	Gravel (%)									
	Sand (%)		9	15		20	23			
	Silt or % (fines) Clay		91	85		80	77			
Consolidation tests	Natural Void ration, eo							0.8394		
	Compression index, Cc							0.2350		
Unconfined Compression tests	Strain at failure (%)	12	12					12		
	Stress undist. (kg/cm^2)	0.3160	0.6567					0.6223		
	Stress remould ( )									
	Sensitivity									
Direct shear Test	ϕ (degree)						19			
	C (kg/cm^2)						0.10			

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SUMMARY OF
LABORATORY TEST RESULTS

Site no.38, East Chanandi GPS, Hatiya, Noakhali.

Bore hole No.										
Sample No.		U-1	D-6	U-2	D-13	U-3	U-4	D-25	D-28	
Depth - m	From	5.0	5.5	10.0	12.5	15.0	19.0	24.5	27.5	
	To	5.5	6.0	10.5	13.0	15.5	19.5	25.0	28.0	
Natural Moisture content (%)		30.11		26.04		25.98	28.18			
Specific gravity		2.680		2.672		2.673	2.681			
Atterberg Limits	Liquid Limit, W_l (%)	46		36		38	47			
	Plastic Limits, Ip (%)	19		9		10	20			
Density	Wet (gm/cc)									
	Dry (gm/cc)	1.2977		1.5367		1.5516	1.4206			
Grain size analysis	Gravel (%)									
	Sand (%)		51		29			14	25	
	Silt or % (fines) Clay		49		71			86	75	
Consolidation tests	Natural Void ration, eo						0.9142			
	Compression index, Cc						0.2550			
Unconfined Compression tests	Strain at failure (%)	11		11		12	13			
	Stress undist. (kg/cm^2)	0.2967		1.003		1.1552	0.460			
	Stress remould ( )									
	Sensitivity									
Direct shear Test	ϕ (degree)									
	C (kg/cm^2)									

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SUMMARY OF
LABORATORY TEST RESULTS

Site no.39, Tamaruddi Koralia GPS, Hatiya, Noakhali.

Bore hole No.										
Sample No.		U-1	U-2	U-3	D-15	U-4	D-23	D-26	D-29	
Depth - m	From	4.0	9.0	13.0	14.5	19.0	22.5	25.5	28.5	
	To	4.5	9.5	13.5	15.0	19.5	23.0	26.0	29.0	
Natural Moisture content (%)		25.64	26.25	25.35		25.88				
Specific gravity		2.668	2.676	2.668		2.681				
Atterberg Limits	Liquid Limit, W_l (%)		38	39		37	38			
	Plastic Limits, Ip (%)		10	11		9	23			
Density	Wet (gm/cc)									
	Dry (gm/cc)	1.5566	1.446	1.499		1.5472				
Grain size analysis	Gravel (%)									
	Sand (%)	54			61			64	73	
	Silt or % (fines) Clay	46			39			36	27	
Consolidation tests	Natural Void ration, eo		0.7512							
	Compression index, Cc		0.2050							
Unconfined Compression tests	Strain at failure (%)	11				13				
	Stress undist. (kg/cm^2)	1.002				0.9596				
	Stress remould ( )									
	Sensitivity									
Direct shear Test	ϕ (degree)		24	20						
	C (kg/cm^2)		0.070	0.110						

6-5 FINDINGS OF EXISTING SHELTER SURVEY

6-5 FINDINGS OF EXISTING SHELTER SURVEY

[Survey Outline]

Interviews were conducted at the 12 sites listed in the table below with community leaders, school staff and parents of students for the purpose of clarifying the situation of use of the existing shelters and the maintenance conditions of the facilities and equipment to make the basic design study reflect the findings of these interviews.

No.	Name of Primary School	Donor	Year of Completion
1	East Tetoiya GPS	Japan	1997
2	West Monkirchar GPS	Saudi Arabia	1994
3	South East Chareota GPS	Japan	1997
4	Char Laxmi GPS	Japan	1997
5	Char Boisraki Thorar GPS	Netherlands	1997
6	Munshir Hot GPS	EU	1995
7	East Alexarder GPS	EU	1995
8	Moddya Alexarder (1) GPS	EU	1995
9	South East Char Alexarder GPS	EU	1995
10	Moddya Char Doctor GPS	Pakistan	1971
11	Maijchara GPS	Japan	1997
12	Charfakira C/S	BDRCS	1987

Note : GPS : Government Primary School
C/S : Community School

The survey items at each site are listed below.

① Structure, size (floor area; accommodation capacity) and workmanship of the shelter
② Conditions of the facilities
③ Situation of shelter use at the time of a cyclone
④ Availability of a body responsible for maintenance
⑤ Conditions of maintenance
⑥ Preparedness for a cyclone (situation of preparation)
⑦ Use of the facilities for other purposes

The survey results are compiled in Table A6-5-1.

[Survey Results]

① Structure, size and workmanship of the shelter

- All of the shelters surveyed are two storey buildings supported by pilotis and have a RC structure. The year of completion was 1971 for one shelter and 1987

onwards for the other shelters. In the case of the shelter constructed in 1971, cracks in the beams and slabs can be found as more than 30 years have now passed since the original completion of the shelter.

- While the total floor area of the shelter varies from one donor to another, the relationship between the floor area and the accommodation capacity can be classified into the following four categories.

Floor Area (m^2)	Accommodation Capacity (persons)
545	1,650
469	1,700
384	1,200 – 1,500
244	1,200

② Condition of the facilities

Only one shelter has indoor electrical wiring but this has deteriorated without any past use due to the lack of a transmission line to the area.

Nine shelters have a pumped well while three shelters completed prior to early 1995 have no water supply facilities. The pump is installed on the first floor at four shelters constructed by Japan, indicating careful consideration of its continual operation at the time of a cyclone. A rainwater tank is installed to provided water for hand washing and the flushing of toilets during the rainy season at the four shelters constructed by Japan in addition to one other shelter.

A septic tank to treat sewage is used at 10 out of the 12 shelters. In general, the standard building service systems are a water supply system relying on a well and a sewage treatment system using a septic tank and exclude electrical installation.

③ Situation of shelter use at the time of a cyclone

Two of the surveyed shelters were constructed before April, 1991 when a huge cyclone (storm surge height of 3.6 – 6.7 m, killing 138,882 people) hit Bangladesh, prompting the formulation of the Master Plan. The actual performance vis-à-vis the design accommodation capacity of these shelters was 75% and 129%, clearly indicating that one of these shelters was not fully utilised. The other 10 shelters were constructed in 1994 or later and the cyclone in September, 1997 (storm surge height of 3.0 – 4.5 m, killing 300 people) was a comparatively large cyclone following the construction of these shelters. At the time of this cyclone, six out of the 10 shelters

received evacuees, the number of which almost reached the capacity. The other four shelters were only 42 – 88% full, presumably because of the following reasons.

a) The warning system and evacuation system for local residents did not fully function.

b) The area was off the path of the cyclone and avoided a direct hit.

c) The shelter locations were inappropriate.

④ Availability of a body responsible for maintenance

A body responsible for maintenance has been organized at every visited shelter site. During normal times, 11 shelters are managed by the local SMC and one shelter by the BDRCS. At the time of a cyclone, eight sites are managed by the site level disaster management committee jointly established by the SMC and the BDRCS, three sites are managed by a similar committee jointly established by the CPP and the BDRCS and one site is managed by the BDRCS alone.

⑤ Conditions of maintenance

Following their completion, the shelter facilities require regular maintenance efforts, including the replacement of parts and repair. The conditions of maintenance at each shelter are summarised below.

	Number of Sites Surveyed	Sites Without Problems	Sites With Problems
(1) Roof conditions	12	12	0
(2) Colum conditions	12	6	6 (exfoliation)
(3) Painted surface of walls	12	6	6 (peeling)
(4) State of windows and exterior doors	12	2	10 (damaged)
(5) Water pump	9	5	4 (in need of new parts)
(6) Septic tank	10	0	10 (washing is not conducted)
(7) Repairs conducted	12	3	9

As above items (1) through (5) are problems relating to maintenance funds, they can be solved with the financial assistance of the government or by the saving of a repair fund by the SMC members and others. At all of the sites, the septic tank has not been washed. This problem must be solved by the voluntary labour of local residents

who are the beneficiaries of these facilities, suggesting the need to educate local residents, particularly members of the SMC.

⑥ Preparedness for a cyclone

For the effective use of a cyclone shelter, evacuation exercises for local residents during normal times are important. Out of the 12 sites, such exercises are not conducted at three of the sites. At those sites where exercises are organized, the frequency is once a year at five sites, twice a year at two sites, four times a year at one site and six times a year at one site, indicating a wide variety of the level of preparedness for a cyclone.

⑦ Use of the facilities for other purposes

While all of the shelters are used as primary school buildings during normal times, they are also used for other purposes as listed below.

1. Meeting place : 7 sites (3 – 12 times/year)
2. Health facilities : 2 sites (monthly at one site and weekly at the other)
3. Wedding hall : 1 site (10 times/year)
4. Agricultural training centre : 1 site (5 times/year)
5. Venue for local festivals : 1 site (twice/year)
6. Not used : 5 sites

Note : At some sites, the shelter is used for more than one additional purpose.

Survey Sheet on Existing Cyclone Shelters (1/3)

NO,	School/Facility	Exact Location	1. Administrative Area				2. Information Provider	
			District	Upazila	Union	Village	Name	Title,etc.
1	East Tetoiya GPS	N-22°50.040 E-91°31.286	Chittagong	Miresharai	Katachara	East Tetoiya	Smrite Kana Debi	Asst.Head Master
2	West Monkirchar GPS	N-21°59.014 E-91°55.222	Chittagong	Banshkhali	Shilkup	West Monkirchar	Md,Faroue Azan	Asst. Head Master
3	Southeast Chareota GPS (Southeast Char Bata GPS)	N-22°36.225 E-91°09.775	Noakhali	Sadar	Char Bata	East Chareota	Md.Mostafa	Asst. Teacher
4	Char Laxmi GPS	N-22°39.176 E-91°13.521	Noakhali	Sadar	Char Clark	Char Tard Ari	Md,Belol uddir	Asst. Teacher
5	Char Boisraki Thorar Hat GPS	N-22°42.122 E-91°10.445	Noakhali	Sadar	Charwapda	Char Baisraki	Md.Saidw Hoque	Asst.Head Master
6	Munshir Hat GPS	N-22°40.133 E-91°12.852	Noakhali	Sadar	Char Clark	Char Tarar Ari	Md.Siddique Ulloh	Head Master
7	East Alexander GPS	N-22°38.745 E-90°55.854	Laxmipur	Ramgati	Char Alexander	Est Alexander	Aparna Rani Doe	European Union
8	Moddya Alexander (1)GPS	N-22°37.361 E-90°56.136	Laxmipur	Ramgati	Char Alexander	Selagzam	Nirmarendu Mazumder	Head Teacher
9	South East Char Alexander GPS	N-22°36.826 E-91°56.910	Laxmipur	Ramgati	Char Alexander	Selagram	Mrs.Zakia Suedora	Head Mistress
10	Moddya Char Doctor GPS	N-22°15.175 E-91°09.691	Laxmipur	Ramgati	Char Alexander	Char Doctor	Md.Mostofa	Head Master
11	Maijchara GPS	N-22°10.281 E-91°07.942	Noakhali	Hatiya	Burirchar	Karirchar	Lipar Chardne Das	Teacher
12	Charfakira C/S	N-22°10.166 E-91°07.015	Noakhali	Hatiya	Sonadia	Sonadia	Md.Humayur Kabir	Head Teacher

Notes) GPS : Government Primary School
BDRCS : Bangladesh Red Crescent

Survey Sheet on Existing Cyclone Shelters (2/3)

NO.	① Year of Completion	② Donor,etc.	③ Planned Accommodation Capacity (Persons)	④ Actual Performance(Persons)	⑤ No.of Building/Floor Area（㎡）	⑥ Building Structure	⑦ Auxuliary Facilities		
							Electricity Supply	Water Supply （Well）	Sceptic Tank
1	1997	Japan	1,650	1,700	One 545 ㎡	RC	No	Yes・ good	yes・ not so good
2	1994	Saudi Arabia	1,700	1,500	One 469 ㎡	RC	Equipment in place but no supply	No	No
3	1997	Japan	1,650	800	One 545 ㎡	RC	No	Yes・ out of order	yes・ not so good
4	1997	Japan	1,650	1,500	One 545 ㎡	RC	No	Yes・ out of order	yes・ not so good
5	1997	CDSP & Netherlands	1,650	1,500	One 545 ㎡	RC	No	Yes・ good	yes・ not so good
6	1995	European Union	1,500	2,000	One 384 ㎡	RC	No	No	yes・ not so good
7	1995	European Union	1,500	1,000	One 384 ㎡	RC	No	Yes・ good	No
8	1995	European Union	1,200	1,200	One 384 ㎡	RC	Yes	Yes・ out of order	yes・ not so good
9	1995	European Union	1,500	1,400	One 384 ㎡	RC	No	Yes・ good	yes・ not so good
10	1971	Govt of Pakistan	1,400	1,800	One	RC	No	Yes・ good	yes・ not so good
11	1997	Japan	1,650	700	One 545 ㎡	RC	No	Yes・ out of order	yes・ not so good
12	1987	Japanese BDRCS	1,200	900	One 244 ㎡	RC	No	No	yes・ not so good

Survey Sheet on Existing Cyclone Shelters (3/3)

NO.	4. Maintenance Conditions of Shelter (Organization)				5. Maintenance Conditions of Shelter (Organization)		6.Activities of CPP Unit & CPP Volunteers	7. Actual Use of Shelter	
	①Roof / Pillars ・ Rainwater leakage ・ Peeling-off of surface	②Walls Painting	③Management Body	④Past Repair Repairing Method	①Normal time O&M Body	②Time of a Cyclone O&M Body	Type of Training Given	Use of Facilities Other than Shelter/ Primary School a. Purpose of Use	 b. Frequency of Use (Times/Year)
1	No・ good	Some stain・ good	SMC	No	YES (SMC)	Yes, SDMC (SMC & BDRCS)	Evacuation exercise:once a year	Helath clinic/ meeting place	Health clinic(12)/ Meeting Place(6)
2	No・ good	Some stain・ good	SMC	No (applied but not carried out)	YES（SMC）	Yes, SDMC（CPP & BDRCS）	None	—	—
3	No・ good	Some stain・ good	SMC	No	YES（SMC）	Yes, SDMC（CPP & BDRCS）	Evacuation exercise:twice a year	Meeting place	Wedding in dry season/10
4	No・ good	Some stain・ good	SMC	No	YES（SMC）	Yes, SDMC (SMC & BDRCS）	Evacuation exercise:once a year	Meeting place	Local ceremony (2) BDRCS (3)
5	No・ good	Some stain・ good	CDSP & Netherlands	Yes Repair by travelling engineer	YES（SMC）	Yes, SDMC (SMC & BDRCS）	Evacuation exercise:six times a year	Helath clinic/ meeting place	Meeting place(12)/ health care volunteer(weekly)
6	No・ good	Some stain・ good	SMC	No	YES（SMC）	Yes, SDMC (SMC & BDRCS）	Evacuation exercise:once a year	Meeting place	Meetingplace (6)
7	No・ not so good	Some stain・ not so good	SMC	No	YES（SMC）	Yes, SDMC (SMC & BDRCS）	None	None	None
8	No・ not so good	Some stain・ not so good	SMC	No	YES（SMC）	Yes, SDMC SMC & BDRCS）	Evacuation exercise:twice a year	None	None
9	No・ not so good	Some stain・ not so good	SMC	No	YES（SMC）	Yes, SDMC (SMC & BDRCS）	Evacuation exercise:four times a year	None	None
10	No・ not so good	Some stain・ not so good	SMC	NO	YES（SMC）	Yes, SDMC (SMC & BDRCS）	None	None	None
11	No・ not so good	Some stain・ not so good	SMC	Yes（SMC）	YES（SMC）	Yes, SDMC（CPP & BDRCS）	Evacuation exercise:once a year	Meeting place	Meeting place(SMC:12)/ agricultural training (5)
12	No・ not so good	Some stain・ not so good	BDRCS	Yes	YES (BDRCS)	BDRCS	Evacuation exercise:once a year	Meeting place	Meeting place (6)

Notes) SDMC : Site-Level Disaster Management Committee
SMC : School Management Committee

6-6 CALCULATION OF KILLA SIZE

6-6 CALCULATION OF KILLA SIZE

The size of each killa should be large enough to accommodate domestic animals and households goods possessed by the people evacuated to the shelter and is calculated based on (i) the estimated number of domestic animals (cattle, goats and sheep) per person by upazila for 2002 as shown in the Master Plan and the accommodation capacity of each shelter. For this calculation, the Phase I through Phase IV Projects are referred to.

The method to calculate the required killa size is shown below using Site No. V-1 as an example. Change of the parameters will allow determination of the killa size for other sites.

The calculation results are shown in Table A6-6-1.

1) Number of evacuating livestock

Since site No. V-1 is a five-classroom type shelter, building capacity is 2,080 people (see Table 3-2-2-3). Accordingly, in the event where these people bring their cattle, goats and sheep when evacuating, the number of head of livestock that will require sheltering in the killa can be calculated as follows:

Cattle : 0.214 (* Note) x 2,080 = 445.12 = 446 head
Goats/sheep : 0.180 (* Note) x 2,080 = 374.40 = 375 head

* Note: Number of livestock owned per person in Upazila Chakaria where Site No. V-1 is located (estimates for 2002 in the Master Plan)

2) Area occupied by livestock

The area occupied by livestock is as follows:

Cattle : 1.5 m x 0.7 m = 1.05 m^2
Goats/sheep : 0.8 m x 0.4 m = 0.32 m^2

Therefore, the area needed in order to hold the required number of livestock will be as follows:

Cattle	:	446 head x 1.05 m^2 = 468.3	469 m^2
Goats/sheep	:	375 head x 0.32 m^2 = 120.0 = 120.0 m^2	
		589	590 m^2

Assuming an additional 20% or so as allowance for corridors, etc., the area occupied by livestock will be approximately 710 m^2 (590 x 1.2).

3) Area occupied by belongings

Assuming that evacuating residents will have belongings, space shall be secured to hold them. The area occupied by belongings per person shall be 0.2 m^2.

$$0.2\ m^2 \times 2{,}080 = 416 \qquad 420\ m^2$$

4) Necessary area

Summing up, the area required in order to accommodate livestock (710 m^2) and belongings (420 m^2) works out as 1,130 m^2.

5) Killa area

It is not possible to utilize the entire top area of a killa as areas near the side slopes should be excluded from use for safety reasons. The required top area is calculated by added 10% to the area (1,130 m^2) calculated above. The resulting top area is 1,250 m^2.

Assuming the top part of the killa measures 46 m (150 ft) across, top dimensions will be 46 m x 28 m.

If the LGED's design slope gradient for killa (1:2.0) is adopted and the design tide level for site No. V-1 (Hs 5.0 m) is assumed to be the killa height (see Table 3-2-2-4), the killa base dimensions will be as follows:

$$(46 + 5.0 \times 2 \times 2)\ m \times (28 + 5.0 \times 2 \times 2)\ m$$

$$66\ m \times 48\ m\ (\text{area} \quad 3{,}170\ m^2)$$

If the breadth is adjusted to the LGED design value for killa crossway dimensions, (61 m), the following base size is obtained:

Breadth Base

61 m x 52 m (area 3,172 m^2)

(200 ft) x (170 ft)

Table A6-6-1 Killa Area and Banking Volume Calculation Sheet

No.	District	Upazila	Livestock owned per person		Shelter capacity per building	Occupied area (m^2)	Killa height (m)	Required killa area (m×m×m)	Acquired land area (m^2)	Banking volume (m^3)
			Cattle (head)	Goats/sheep (head)						
V-1	Cox's Bazar	Chakaria	0.214	0.180	2,080	1,250	5.00	(41×31) 61×52×5.0	3,170	11,140
V-2	Chittagong	Patiya	0.126	0.076	1,800	770	3.00	(49×16) 61×28×3.0	1,690	3,700
V-3	Chittagong	Patiya	0.126	0.076	1,800	770	3.00	(49×16) 61×28×3.0	1,690	3,700
V-4	Chittagong	Patiya	0.126	0.076	2,080	900	2.50	(51×18) 61×28×2.5	1,680	3,250
V-5	Chittagong	Sandwip	0.172	0.171	1,700	910	3.50	(47×20) 61×34×3.5	2,040	5,180
V-6	Chittagong	Sandwip	0.172	0.171	2,080	1,110	4.00	(45×25) 61×42×4.0	2,550	7,390
V-7	Chittagong	Sandwip	0.172	0.171	2,080	1,110	3.50	(47×24) 61×39×3.5	2,340	6,110
V-8	Chittagong	Miresharai	0.257	0.176	1,700	1,110	3.50	(47×24) 61×39×3.5	2,340	6,110
V-9	Chittagong	Miresharai	0.257	0.176	1,700	1,110	2.50	(51×22) 61×33×2.5	1,960	3,890
V-10	Chittagong	Miresharai	0.257	0.176	1,700	1,110	2.00	(53×21) 61×30×2.0	1,790	2,940
V-11	Chittagong	Miresharai	0.257	0.176	1,700	1,110	2.50	(51×22) 61×33×2.5	1,960	3,890
V-12	Chittagong	Miresharai	0.257	0.176	1,700	1,110	1.50	(55×21) 61×27×1.5	1,620	2,080
V-13	Chittagong	Miresharai	0.257	0.176	1,800	1,180	3.50	(47×26) 61×40×3.5	2,400	6,300
V-14	Chittagong	Banshkhali	0.256	0.203	2,080	1,380	2.50	(51×27) 61×37×2.5	2,240	4,530
V-15	Chittagong	Banshkhali	0.256	0.203	2,080	1,380	5.00	(41×34) 61×54×5.0	3,300	11,700
V-16	Chittagong	Banshkhali	0.256	0.203	1,700	1,130	3.50	(47×24) 61×39×3.5	2,340	6,110
V-17	Chittagong	Banshkhali	0.256	0.203	1,800	1,200	2.00	(53×23) 61×31×2.0	1,890	3,140
V-18	Chittagong	Anowara	0.180	0.094	2,080	1,070	4.50	(43×25) 61×44×4.5	2,690	8,540
V-19	Noakhali	Hatiya	0.216	0.174	1,700	1,020	6.00	(37×28) 61×54×6.0	3,290	13,050
V-20	Noakhali	Hatiya	0.216	0.174	1,800	1,070	6.50	(35×31) 61×59×6.5	3,600	15,290
								Total	46,580	128,040

* Upper parentheses indicate top dimensions
The lower line indicates base dimensions]

APPENDIX 7 REFERENCES

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№	Name of Data	Type	Collected Data	Data Prepared by Specialist	Data Prepared by JICA	Publishing Organization	Remarks
1	Standing Order on Disaster August 1999	Copied	○			MDM&R. DMB	
2	National Indicative Programme / Order for Services 2003-2005	Copied	○			Bangladesh	
3	Country Strategy Paper Bangladesh 2002-2006	Copied	○			European Commission	
4	Preparation of Primary Education Development Program II (PEDPII) Final Plan October 2002	Copied	○			DPE, PMED&ADB	
5	Second Primary Ecucation Development Program (PEDPII) Summary, January 2003	Copied	○			DPE, PMED&ADB	
6	Primary Education Statistics in Bangladesh 2001, May 2002	Copied	○			DPE	
7	Bangladesh Education Sector Overview March 2002	Copied	○			Japan Bank for International Cooperation	
8	Bangladesh Education Sector Review I-III 2000	Copied	○			World Bank	
9	An Introduction to Disaster Management Bangladesh	Copied	○			MDMR, DMB	
10	Meteorological Data 1990-2000	Copied	○			BMD	
11	CPP at a Glance February 2002	Book	○			CPP&BDRCS	
12	Cyclone Shelter and School Building of Caritas June 1995	Copied	○			Caritas Development Institute(CDI)	
13	Primary School-cum-Cyclone Shelters October 1996	Copied	○			PMED(by CEU)	
14	Comprehensive Disaster Management Programme (CDMP)	Copied	○			UNDP	
15	Coastal Embankment Rehabilitation Project 1995-2003	Book	○			BWDB	
16	Arsenic Contamination of Groundwater in Bangladesh	Copied	○			MLGRD&C	
17	Analysis of Rates (10^{th} Edition) October 2002	Copied	○			Public Works Department	
18	Analysis of Rates (9^{th} Edition) July, 1997	Copied	○			Barisal PWD Circle	
19	A National Strategy for Economic Growth, Poverty Reduction and Social Development	Copied	○			Ministry of Finance Economic Relations Division	
20	Cyclone Shelter Preparatory Study March 1998	Copied	○			Eeropean Commission	
21	Disasters and Public Finance August 2001	Copied	○			Overseas Development Institute, UK	

№	Name of Data	Type	Collected Data	Data Prepared by Specialist	Data Prepared by JICA	Publishing Organization	Remarks
22	Natural Disaster Risk Management (1980-1999) August 2000	Copied	○			Disaster Management Facility, The World Bank	
23	Annual Report 2001 January 2002	Copied	○			DPHE	
24	National Policy for Safe Water Supply & Sanitation 1998	Copied	○			MLGRD&C	
25	Deep Well Specifications January 1981	Copied	○			DPHE	
26	Shallow Well Specifications September 1976	Copied	○			DPHE	
27	Primary School Rehabilitation Project (2nd Phase)	Copied	○			ADB	
28	Estimate for Construction of Multipurpose Cyclone Shelter	Copied	○			CDSP-II, LGED, Noakhali	
29	Japan Bangladesh Joint Study Project on Floods, Final Report Sep 1997	Copied	○			BUET, JICA