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TECHNICAL NOTE MES-037

NIJHUM DWIP CROSS DAM TRIAL SECTION

June 2001

DHV CONSULTANTS BV

in association with

DEVCONSULTANTS LTD
SURFACE WATER MODELLING CENTRE

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1. SITE DESCRIPTION

1.1 Location, site selection and time schedule

Nijhum Dwip is located in the southern part of the Meghna Estuary in the mouth of the Meghna River. The cross dam trial was built in the channel between the islands Nijhum Dwip and Hatia in the Noakhali district. The coordinates of the location are 606275 m East and 443502 m North. The location is shown in Fig-1.

The reason for the choice of this location is that the Nijhum Dwip channel has been favorite location for acceleration of accretion for two decades (ref. 21)
A closed cross dam is a traditional earthen dam that completely closes of the channel. A pilot has been implemented from March 4 to 21 1997. This was just to try the technique and assess the soil properties in the area.

1.2 Soils

Nijhum Dwip and South Hatia are part of the young lower Meghna estuarine flood plain. The soils are seasonally flooded, poorly drained and have been developed from moderately fine textured silt loams (ref. 8).
The soils of Nijhum Dwip are mainly undeveloped and slightly developed Meghna alluvial deposits. The surface soil is mostly medium textured silt loam. However, detailed investigations of the characteristics of different groups of soils of Nijhum Dwip have not been carried out.
The average median grainsize diameter of the bedding material as defined by LRP is 0.023 mm.

The soils are olive-grey to olive, finely stratified, usually slightly calcareous, silt loam to silty clay loam affected by salt to varying degrees. They are flooded to less than 30 cm for 3 to 4 months in the monsoon season. The land outside the embankment on Hatia has generally poor fertility. South Hatia has somewhat older soils, finely stratified usually calcareous and slightly alkaline (pH 6.6 to 8.3) whereas Nijhum Dwip has younger, much more poorly developed soils that are more calcareous and alkaline. The pH of the surface soil is lower than of the subsurface soil. These soils are generally poor in organic matter and low in nitrogen. Crop yields are generally low.

1.3 History

Satellite imagery shows that Nijhum Dwip is a relatively young island, which started to emerge in the 1950s (ref. 8). During the 1970s and 1980s the higher parts of Nijhum Dwip, as well as south Hatia, silted up to about MHW line (+2.2 m PWD). The coastline development during the last decades shows a natural tendency to shift in an eastward direction, see figure A2.

Satellite imagery indicates that the total area of Nijhum Dwip has increased from 1,105 ha to 3,108 ha over the period 1973-1984. In 1996 the total area of Nijhum Dwip was 3,272 ha. This means that the natural gain of newly accreted land over the period 1973-1984 is about 182 ha per year. Over the period 1984-1996, the formation of new accreted land is circa 15 ha per year. A recent satellite image of 2000 indicates that the rate of formation of intertidal areas is high. The coastline of south Hatia shows a tendency to shift in a southeasterly direction.
Between 1997 and 2000 an island appeared in the channel, this island is now part of the proposed location of the cross dam.

1.4 Bathymetry

The bathymetry is presented in figure A3. This is the situation in 2000. The Nijhum Dwip channel is bordered on both sides by the shallow part of the main channels. In the west the depths of the channel is deepest on the west side, with a lowest bedlevel of -11 m PWD. The east side is less than -6 m PWD.

On the east side, the Nijhum Dwip channel is sheltered from the Bay of Bengal by Damar Char, which first appeared in 1990. This char deflects the current in a southern direction causing the deepest area around Damar Char to be in the South.
Comparison of depth contour lines of bathymetric maps of 1988, 1990, and 1993 distinctly show the dynamic behavior of the Hatia - Nijhum Dwip Channel and adjacent shallow areas. The width of the Hatia Nijhum Dwip Channel decreases in an easterly direction. The maximum depth of the channel shows a tendency to increase in an easterly direction. In the vicinity, the maximum depth of the channel is -6 m to -8 m PWD.

The development of the Hatia - Nijhum Dwip channel, is illustrated by changes in cross-sectional area over the period 1997-2000. It is clear from figure A4 that the average bottom has come up. The average bottom level is -3.3 m PWD in 1997 and -1.6 in 2000. In addition figure A5 shows that the whole channel has silted up in this period.

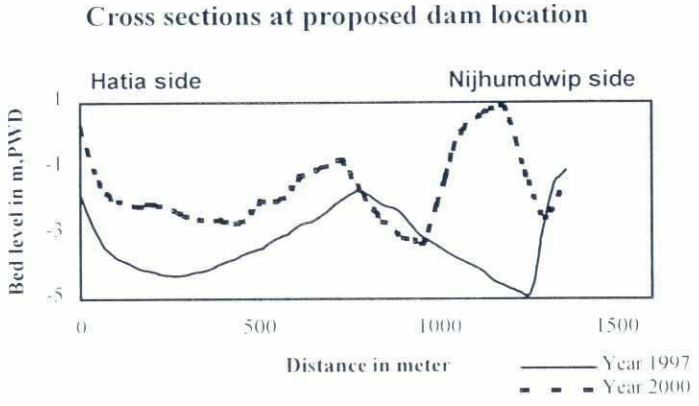

Figure A4. 1997 and 2000 cross sections at the proposed dam location in the Nijhum Dwip channel

1.5 Flow

Currents and discharges in the channels are tide dominated, even in the monsoon season when large quantities of fresh water from the Shahbazpur Channel pass through the Nijhum Dwip Channel. During spring tide in the pre- and post-monsoon periods, the tidal volume amounts to some 40 million m3 during flood and 60 million m3 during ebb. The tidal volume during flood and ebb counterbalance more or less during neap-tide conditions at circa 30 million m^3.

Generally, the channel is ebb dominated. Current measurements in the dry season (pre- and post-monsoon) indicate that the maximum ebb velocity in the deeper parts of the channel is about 1.1 to 2.2 m/s and maximum flood velocity 1.1 to 2.4 m/s, (ref.8).

Float tracking measurements were taken in November and December 2000. The minimum found maximum current speeds during a neap tidal cycle are 0.5 m/s in both directions. The maximum current velocities are 1.7 m/s in the west direction and 1.4 m/s in the east direction during spring tide

Waves often have an important influence on the erosion and deposition processes. For this location the wind is also regarded as important as the area is in a more exposed location. Waves generate an orbital velocity, which is superimposed on the normal velocities in an area, thus stimulating erosion from the bottom and preventing settling of suspended sediment. In shallow areas, the waves may break thus generating a lot of turbulence in the water, which is even more effective for generating erosion. Calculations of the significant wave height for the dry period indicate that the average significant wave height near Nijhum Dwip is 0.3 to 0.9 meters. The prevailing wave and wind direction is S-SE with average wind speed of 8 to 12 m/s. During monsoon wave attack can be more severe.

2. DESCRIPTION OF PILOT SCHEME

2.1 Objectives of the Pilot Scheme

Objective of the pilot scheme is to test the installation method of geotextile bed mattress in required position under tidal channel like Nijhum Dwip. Construction procedure of a section of core dam with earth-filled synthetic bags covered by a large bag of geotextile sheet also will be tested in the pilot scheme. The functionality of the core dam under morphological condition as at Nijhum Dwip will be checked here.

3. DESIGN

3.1 General cross dam design

In Bangladesh the main components of a cross dam generally are the following:

1. bed protection
2. core layers of gunny bags
3. outer layers of gunny bags
4. embankment protection

A cross dam will generally be oriented perpendicular to the dominant tidal currents. Construction of the cross dam will take place in two phases. The first phase is the closure of the channel. During this phase the bed protection and the core of the dam will be constructed. In Bangladesh this core is generally composed of gunny bags. Once the closure of the channel has been established the construction of the cross dam can be finalized by placing the outer layers and constructing the embankment protection.

3.2 Design of the pilot scheme

The design is based on the concept that initially through installation of a silt - catching geotextile curtain at river bed a naturally raised base will develop after some time / season and the dam core will be constructed over this raised bed. Thus the cost of the cross dam construction will be minimized.

As a pilot project the raised up base will be prepared artificially over which the core dam will be constructed. The components of the test section of the cross dam are:

1. A raised base of 1.5 meter height consisting of sand, covered by geotextile fabric.
2. A cross dam core consisting of a layer of gunny bag packages wrapped in geo-net. The geo-net will reduce the required slope of the section and thus the volume of gunny bags to be placed during closure will be minimum.

3.3 Design parameters used

1. The size of the geotextile to prepare the raised bed was selected as the maximum dimensional size possible to install with the help of the bamboo raft of size 25m x 20m.
2. The size of the core dam was selected arbitrarily. However, the height was fixed to enable labourers to fill the geo-net by gunny bags through head load.
3. Design of PVC float pipe was based on test result for static hydraulic pressure done at BUET (Appendix-6).

3.4 Design description of items

3.4.1 Geo-textile covered base

The base of the cross dam is built up of sand covered with a geo-textile sheet. The textile will function as a bed protection and will prevent tidal currents from washing away the sand. Three rows of sand filled ballast bags are fixed to the sides of the textile facing the tidal currents. In addition to the ballast bags, anchors are fixed to the side of the textile to prevent the tidal currents to move the textile. The space below the textile is filled with sand through pumping. Two rows of PVC floaters are attached to the center section of the textile to provide extra buoyancy to this section.

Materials	Specification
Geo-textile	Propex 6082 with interwoven loops
Ballast bags	Propex 6082 with non-woven innerbag
Anchors	Fishing boat type, 10 Kg
Sand	Borrow pit on South Hatia

3.4.2 Gunny bag packages

The gunny bag packages are used to quickly realize the initial closure of the cross dam. During closure time current velocities will increase. The gunny bags are wrapped in a geonet to increase the stability of the gunny bag layers and to prevent individual gunny bags to be washed away by the current. To facilitate the construction of the packages, a frame is positioned on top of the sand base.

Materials	Specification
Gunny bags	Jute, 50 Kg
Geonet	Tenax LBO 31 x 40 mm
Frame	Bamboo, 5 m x 3 m x 2 m
Sand	Borrow pit on South Hatia

4. EXPECTED IMPACT

Installation of a small section of core dam over a raised bed at Nijhum Dwip is expected to induce accretion in the area to a very limited extent under normal morphological condition. However, this accretion will not sustain for a longer period longer than one season.

5. COST ESTIMATE

The costs of implementing the pilot scheme can be divided in the following main items:

1. Person power
2. Materials
3. Equipment

1 NLG = 24 Taka

Item	Foreign [NLG]	Local [Tk]	Total [NLG]
Person power		181,900	7,570
Materials	7,000	671,000	34,960
Equipment (*)		515,500	21,480
Total	7,000	1,368,400	64,010

(*) The construction costs of the raft have been accounted for 30% of the material value as the raft will also be used for extensive embankment protection trials at Char Alexander.

6. IMPLEMENTATION

6.1 Implementation Period

4th March 1997 till 23rd March 1997

6.2 Preparation and installation activities

- Selecting installation site

  The installation site was selected at the south point of Hatia, just westward of the narrowest part of channel. The location of the site was about 50m off the embankment with a water depth at low tide of about 1.5 m.

- Selecting preparation site

  Inspection of "chars" in the vicinity showed that no sandy material could be found for filling the ballast bags and that the mud was so soft that preparing the geo-textile would be very difficult. The preparation site was selected at the low embankment at the installation location.

  The width of the low embankment during low tide was insufficient to spread out the whole textile and fix the textile under the raft in one phase. The methodology for fixing the textile under the raft was altered to fixing the textile under the raft in two stages, keeping the two raft sections unfixed.

- Preparing the geo-textile on the high embankment

  The following preparations were made on the high embankment near the installation site:

  1. PVC pipes were fitted into the prefabricated sleeves
  2. Short bamboo poles were attached at the edges of the textile at the location where the anchors are to be fixed.
  3. The geo-net (for holding the gunny bags) was fixed to the centre of the geo textile.

- Preparing the geotextile on the low embankment

  The geo-textile was folded and dragged to the low embankment during low tide. Before the textile could be placed, however the raft section had to be moved further off shore. Due to extra time required for executing this operation, the tide had started to rise. Therefore the textile had to be placed rather high on the embankment. Three rows of ballast bags were attached to the textile.

- Positioning the raft above the textile during rising tide.

  The raft was then moved above the textile, pulling and pushing the floating textile under the raft. Especially getting the PVC floaters under the raft proved time consuming. Once the edge of the raft was in position above the ballast bags, the tide was beginning to fall. The operation was abandoned, considering the danger of grounding the raft (with increased weight due to attached ballast bags) on the embankment.

  The installation methodology was changed once again. The edges of the textile were to be placed on top of the raft allowing easier handling of the ballast bags. The two raft sections were kept separate.

- Fixing the textile to the bottom of the raft

  As the textile was under one of the raft sections, the edge of the textile was placed on top of the raft's edge and one row of ballast bags was attached. Half of the textile was pulled from under the opposite edge of the raft section. This edge of the textile was now placed on the other raft section's edge (positioning the textile under this section would probably be impossible and would otherwise prove too time consuming) and two rows of ballast bags were fixed to the textile.

- Positioning the floating bridge

  The floating bridge was positioned perpendicular to the shore line.

- Transporting the raft to the installation site

  As the installation site was in front of the preparation site moving the raft was done by manpower

- Positioning the raft at the installation site

  The raft section with half of the textile underneath was placed and fixed at one corner at the end of the floating bridge. One corner was fixed to shore and the two outer corners were fixed by anchors. The other raft section was placed alongside with half of the textile floating in between.

- Placing the anchors of the textile

  The anchors could not yet be placed due to the position of the raft.

- Lowering the textile to the channel bed at low tide

  At low tide, the raft section with the textile alongside was moved away from the other half by pulling of the tender boat. Once the textile was pulled tight, the ballast bags were pushed off the edge of the raft and the edge of the textile sank to the bottom. While pulling the raft section away the anchors were lowered into the water. Checking the position of the textile proved the edge of the textile was not in a straight line. As it was becoming dark and assisting labour went home, it was decided to wait till next low tide next morning to straighten out the edge with the help of a diver and lower the other half.
  A midnight check proved that the raft was moved by the current and that the remaining half had slid from the raft. The position of textile could not be corrected and it was decided to cut the ballast bags by diver and retrieve the textile. Due to time constraints the installation methodology was changed again. During low tide, the geo-textile was placed on the lower embankment alongside the floating bridge by manpower and two rows of ballast bags were fixed to the textile.

- Fixing the anchors and checking vertical position of the textile

  The anchors were fixed to the textile by manpower during low water and placed several meters away from the edge.

- Filling the textile with sand

  Moving the raft along the textile following the rise and fall of tide the two "lowest" filling sleeves were used to pour sand under the textile using a crew of labourers carrying the sand from the shore via the floating bridge and raft. At the same time sand was shovelled under the "upper" part of the textile.

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- Removing the raft

  The raft was removed and anchored in deeper waters

- Installing support frame and geo-net

  A support frame was made of bamboo and placed on the geo-textile the geo-net was unfolded and temporarily fixed to the frame.

- Filling geo-net with gunny bags

  The geo-net was filled with gunny bags from the shore during low tide.

- Closing the geo-net

  The geo-net box was closed and fixed with steel wire

A list of equipment and materials used for the installation is presented in Appendix-4.

A day to day activity report recorded during installation is as follows:

A field trip was made at Char Alexander, Ramgati & Nijhum Dwip, Hatia for the Nijhum Dwip Pilot Scheme Project and the description of the entire works are stated below:

4th March 1997: Mr. Adriaan Ris (MES), Mr. Quamrul Hassan (MES), Mr. S.M Parvez (DETS), Site Engineer and Foreman (DETS) visited the site at Char Alexander, Ramgoti and selected the site at Bahaddar ghat for the construction of bamboo rafts and bridges.

7th March 1997: Site Engineer (DETS) and some other staff came to char Alexander from Dhaka and prepared a worker accommodation for their living nearest to the site.

8th March 1997: Two trucks with 800 (Eight hundred) bamboo's arrived at 11 o'clock but it could not go to our selected site as because the bamboo's were too long and the road from Char Alexander to Baddarghat was under construction. That's why we had decided to keep all the bamboo's at Banglabazar which was 5 km away from our selected site.

9th March 1997: All the bamboo's were carried to the nearest ghat by push car (locally arranged) and after that those were towed up to the selected site by some workers. The entire programme i.e. transporting, shifting and towing of bamboo's were carried out the whole day and night by push car and workers simultaneously.

10th March 1997: Jointly we finalized the lay-out for the bamboo raft at site and work programme and accordingly the work was going on by the joint supervision of Mr. Quarnrul Hassan, Construction Engr. (MES) and Mr. Nidhir, Team Manager (DETS), Site Engr. was involved to carry up the technical matters and foremen were involved directly in construction, some other workers from DETS had also come from Dhaka. They worked in construction of 1st layer of 1st raft.

11th March'1997: The work forces were more and local workers were engaged in cutting, shaping, carrying & *placing* the bamboo's at site. They finished the 2nd layer of 1st raft. On the same day, we gave the lay-out *of* the 2nd raft also. Tug boat from Dhaka came to our site at 3.00 pm.

12th March'1997: The 1st raft was almost finished and 1st layer of 2nd raft was going on. The remaining 800 (Eight hundred) bamboo's arrived at 3.00 pm at site by two trucks and it was carried to our sciected site in the same way as before.

13th March 1997: The 3rd layer of 2nd raft was almost finished. Also we gave the lay-out of the 1st pontoon bridge and it was done a little bit.

14th March 1997: The fixing of brackets and diagonals of the rafts was finished. Also the 1st bamboo bridge was finished. In the evening, all the workers pushed the rafts and launched to the water during the high tide.

15th March 1997: The construction of two bamboo bridges were almost finished. Again in the same way, bamboo bridges were launched to the water.

16th March 1997: We finished the final tying, fixing diagonal of the rafts and bamboo bridges. After that those were tied correctly with the tug boat and the tug boat started at 10.00 am towards Nijhum Dwip.

17th March 1997: Engine vessel and Tender-4 came from Dhaka at 6.00 pm. We hired one Engine trawler to carry the workers and some materials to Nijhum Dwip.

18th March 1997: In midnight i.e. 2.00 am geo- textile with necessary items came to Char Alexander from Dhaka and 3.00 am, we started from there towards Nijhum Dwip. Tender-4 and E. Vessel were tied with Engine trawler. On the way i.e. north part of 1-latia, we found tug boat with rafts and it was grounded at that time. We suggested them to start again when high tide starts from there. Again we started by E. vessel separately and 4.00 pm, we arrived at Nijhum Dwip. Together we selected the site for the Cross Dam Pilot Scheme.

19th March 1997: We did not find available worker as because locality was far away from our selected site. The workers started excavation and filled the ballast bags also . We checked in some where to find out sand. We found one place for sand but it was far away from our selected site. That's why we had decided to excavate the soil nearest to our site which was a sandy SILT type soil. Also the geo-textile was spreaded the flat area and found everything was o.k.

20th March 1997: The workers were more. Some of them excavated the soil and filled it in gunny bags. Some of them were involved for tying ballast bags with geo-textile, some of them were involved to fix the rafts with bridges and some of them were involved to spread the geo-textile in the deeper area which was 50 m away from the embankment. But due to the current, the spreaded geo-textile was interwined in the water at night.

21st March 1997: We tried to cover that failure by Diver. He cut the ballast bags which were tied with geo-textile and lastly at 3 o'clock, we towed the whole geo-textile by the help of worker and Tender-4. Lastly we had decided to spread the geo-textile nearest to the embankment and we did it. After that the ballast bags were tied all around with geotextile again. Also workers excavated soil and filled the gunny bags.

22nd March 1997: They fixed two funnels on the top of geo-textile and fixed with the hole to put the soil underneath of geotextile. Some workers were in carrying soil by head basket and some were in filling ballast underneath, some were with pump to put water so that soil can spread although the area. In the mid way of works, it was obstructed due to heavy rainfall also. We contracted the workers to work day & night but at night due to heavy rainfall and windy weather, they didn't work. That's why we could not fill the ballast underneath perfectly.

23rd March 1997: Early morning, the bamboo frame was prepared outside. After that we fixed it with the geo-net frame and some workers were engaged in filling gunny bags into the frame. At 2 o'clock we had finished filling and at 3.00 pm we started from Nijhum Dwip. Tender-4 went to Anwesha & E-vessel came with us. We suggested DETS there to watch the whole installation, DETS agreed with us and they provided 2 (two) workers to watch it upto our requirement.

Bamboo bridges and rafts were fixed with tug boat and it could not start due to low tide on that day. 24th March it will start and probably it will arrive at Char Alexander on 25th night or 26th morning. DETS have provided 4 personnels and site Engr. with tug boat to supervise the rafts and bridges on the way. DETS also agreed to provide two workers to watch the bamboo rafts and bridges at Bahaddar ghat.

At 10.00 pm we arrived at Bahaddar ghat and due to non-availability of accommodation in BWDB guest house, we started from Char Alexander at 11.00 pm and we arrived in Dhaka at 5.00 am early morning.

The daily working personal and equipment statement during the working period for the construction of Nijhum Dwip Cross Dam Pilot Scheme are attached herewith which were duly signed by the Contractor's and MES representatives jointly.

7. MONITORING AND EVALUATION

7.1 Monitoring

Monitoring of this first trial was limited because of lack of transport facilities and time constraints. However after one month from installation time it was observed that the float pipes came out of the geotextile sleeves damaging the geotextile through continuous friction with the PVC pipe edges. The earth filled bags that were used for the dam body were gradually emptied by the flowing water as well as suction by waves. A few months after installation the bags started to deteriorate and after the monsoon all the bags had been removed and the bed protection mattress had been covered by silt deposits.

7.2 Evaluation

The design and installation of the initial trial section at Nijhum Dwip has provided valuable information for further development of the innovative design concept as well as the implementation methodology. Earth filled bags should not be used if exposed to waves and/or currents. The installation of bed protection mattresses should not be allowed during periods that inclement weather is likely to occur. The installation of bed mattresses requires specialized equipment.

Evaluating the implementation of the Nijhum Dwip Cross dam pilot scheme, the following conclusions can be drawn:

7.2.1 Selection of sites

Selecting the installation and preparation site at the Hatia side of the channel provided good working conditions on a firm embankment and the possibility to establish a base camp near to the sites.

7.2.2 Maneuvering the raft

The raft could reasonably well be moved by manpower with assistance from the tender boat. Keeping the raft in position in an environment of changing water levels and currents proved very difficult and took more time than previously estimated. It must be noted that the installation operations were eventually carried out close to spring tide conditions. The towing line broke during transport from Char Alexander to Nijhum Dwip, probably caused by the use of just a single towing line. Transportation was finally successfully completed using a double line. A specialized equipment instead of bamboo raft should be used for installation of bed mattress.

7.2.3 Dimensions of the raft

The raft should not be made to the exact dimensions of the textile. Some contingency should be considered.

7.2.4 Fixing textile under the raft

Positioning the raft over the textile proved very troublesome. It took a lot of effort to push the floating geo-textile under the raft, especially the PVC floaters. The original plan to fix the ballast bags at the edges of the textile to the bottom of the raft was abandoned because positioning the raft above the textile took too much time and tide was beginning to fall when the attempt was made. Eventually the ballast bags fixed to the textile were placed on top of the raft, which made handling the textile much easier.

7.2.5 Fixing ballast bags to the textile

Once the three rows of ballast bags were fixed to the textile, it was impossible to handle the geo-textile by manpower. One row of sandbags proved sufficient to keep the geo-textile down at the bottom.

7.2.6 Positioning qeo-textile in required position

When the ballast bags are attached to the geo-textile, it is virtually impossible to place the geo-textile in the exact required position. A derivation of the horizontal position of the edges will result in a substantial derivation in vertical position. This can cause problems for the filling process during strong currents and may require extra filling material to fill the geo-textile. As the geo-textile floats by itself, it is much easier to handle un-attached to raft or ballast bags.

7.2.7 Filling of geo-textile

Filling the geo-textile using manpower carrying baskets filled with sand took more time than planned. It takes a lot of time to get the process of sand carrying started and working on a movable bamboo surface proved difficult. The sand had to flushed down to prevent the filling funnels to be blocked. The pump providing the flushing water had a lot of down time, hence interrupting the filling process.

7.2.8 Filling of geo-net with gunny bags

The filling of the geo-net with gunny bags was relatively easy, due to the larger volume of the gunny bags compared with the baskets and easier to handle. Filling production was therefore higher than filling the geo-textile with baskets.

7.2.9 Assisting vessels

The tender boat proved to be a very useful tool in handling the raft, transport people, checking depths. The e-vessel was useful for transporting people fast over longer distances. However, the e-vessel is relatively fragile for working in off-shore conditions. The tug boat successfully towed the raft to the installation site and additionally transported a lot of equipment. For assisting in the installation procedures the tug boat was to bulky and communication was difficult.

7.2.10 Weather conditions

During the trial period constant strong winds hampered positioning of the raft. At the end of the trial very bad weather was encountered, including hail storms and thunder storms. Work was delayed and operating small vessels became hazardous. It is recommended to perform offshore activities in the Nijhum Dwip area during the months November to March, as from the end of

March Nor'wester storms are common to occur. Installation of Bed Protection mattress should not be allowed during periods that inclement weather is likely to occur.

7.2.11 Accommodation and food

No proper accommodation is available at the Nijhum Dwip channel area. The nearest guest house is at the south of Nijhum Dwip island. Proper food is difficult to acquire. If long term construction activities are planned in this area, proper accommodation,food and drinking water supply should be arranged.

7.2.12 Float pipe

Installation of the pilot scheme was completed on 23rd March 1997. During end April 1997 it was observed that some of the PVC float pipes attached to the geotextile sheet came out of the sleeves. It happened due to failure of the geotextile material of the sleeve occurred from continuous friction with the float pipe edges at their ends.

7.2.13 Stability of Core Dam

The core of the cross dam made by geo-net bag filled with earth-filled gunny bags was also damaged apparently from high waves. During 3rd week of September 1997 a portion of the Geotextile covering the sand-fill at bottom of dam was found floating being torn off from its place. After checking through divers it was found that only a heap of sand was lying there without any cover. This is a part of the sand filled under the geotextile cover during construction.

8. OVERALL IMPACT AND LESSON LEARNED

8.1 Overall Impact

The small section of the cross dam did not have any overall impact on the area. However, at both sides of the trial section deposition of silt was observed even after damage of the core dam.

8.2 Lessons Learned

1. Placement of geotextile sheet of size 25m x 20m was possible under water through the use of bamboo raft.
2. Keeping the bamboo raft in position in an environment of changing water levels and currents proved very difficult. As such the installation process of geotextile sheet took more time than anticipated.

   The first attempt to install the geotextile sheet at riverbed beyond 50m from the shoreline was a failure as the bamboo raft went almost out of control due to high waves and current force. Eventually it had to be installed close to shoreline where the wave action and current force were limited. Thus the use of bamboo raft is not expected to be workable in places where current speed will be more than 0.50 meter per second and high waves will be encountered. Rather a steel pontoon will be the proper equipment for the purpose.
3. The edges of the 1.5m long PVC float pipes caused damage to the geotextile sheet due to continuous friction under water. This can be avoided through use of longer pipes to reduce number of edges and wrapping the edges with geotextile materials.
4. Earth-filled bags should not be used if exposed to waves and / or currents.

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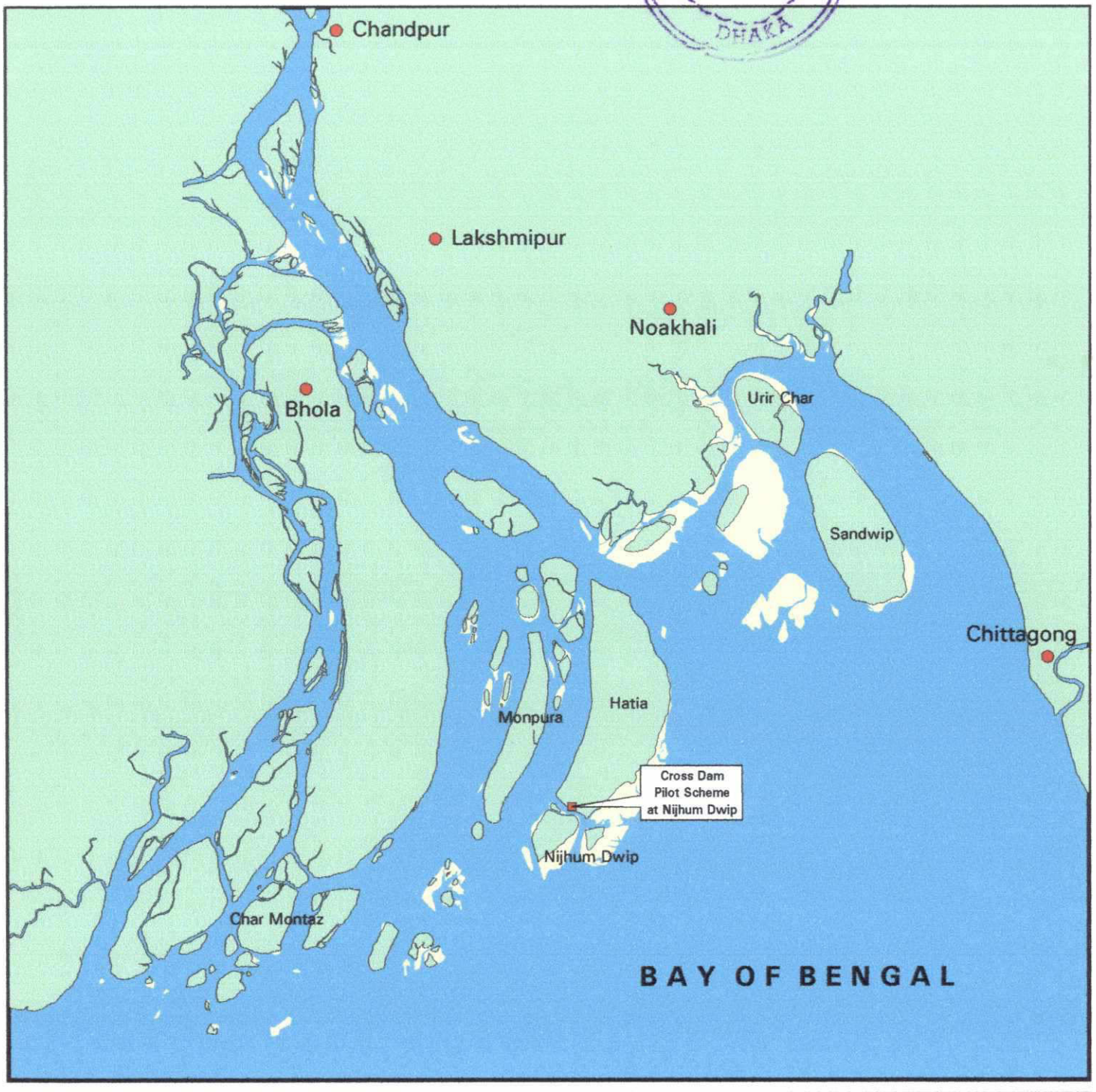
Figure - 1

Location map of pilot scheme at Nijhum Dwip



Legend:

- Land of 2000
- Mudflat
- Water body
- Location of Pilot Scheme(s)
- District HQ

MES II **Meghna Estuary Study - II**

10 0 40km

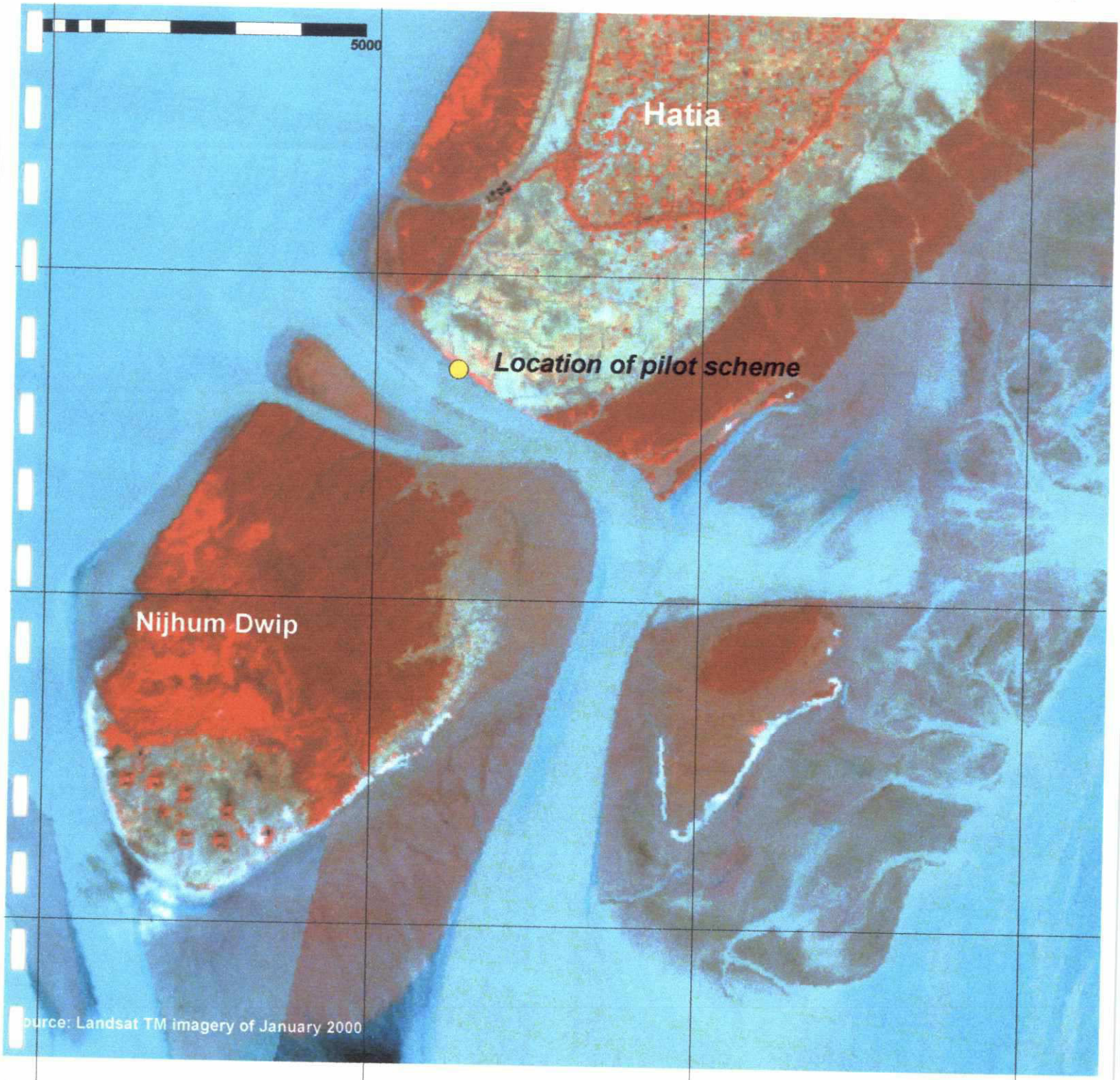
SCALE

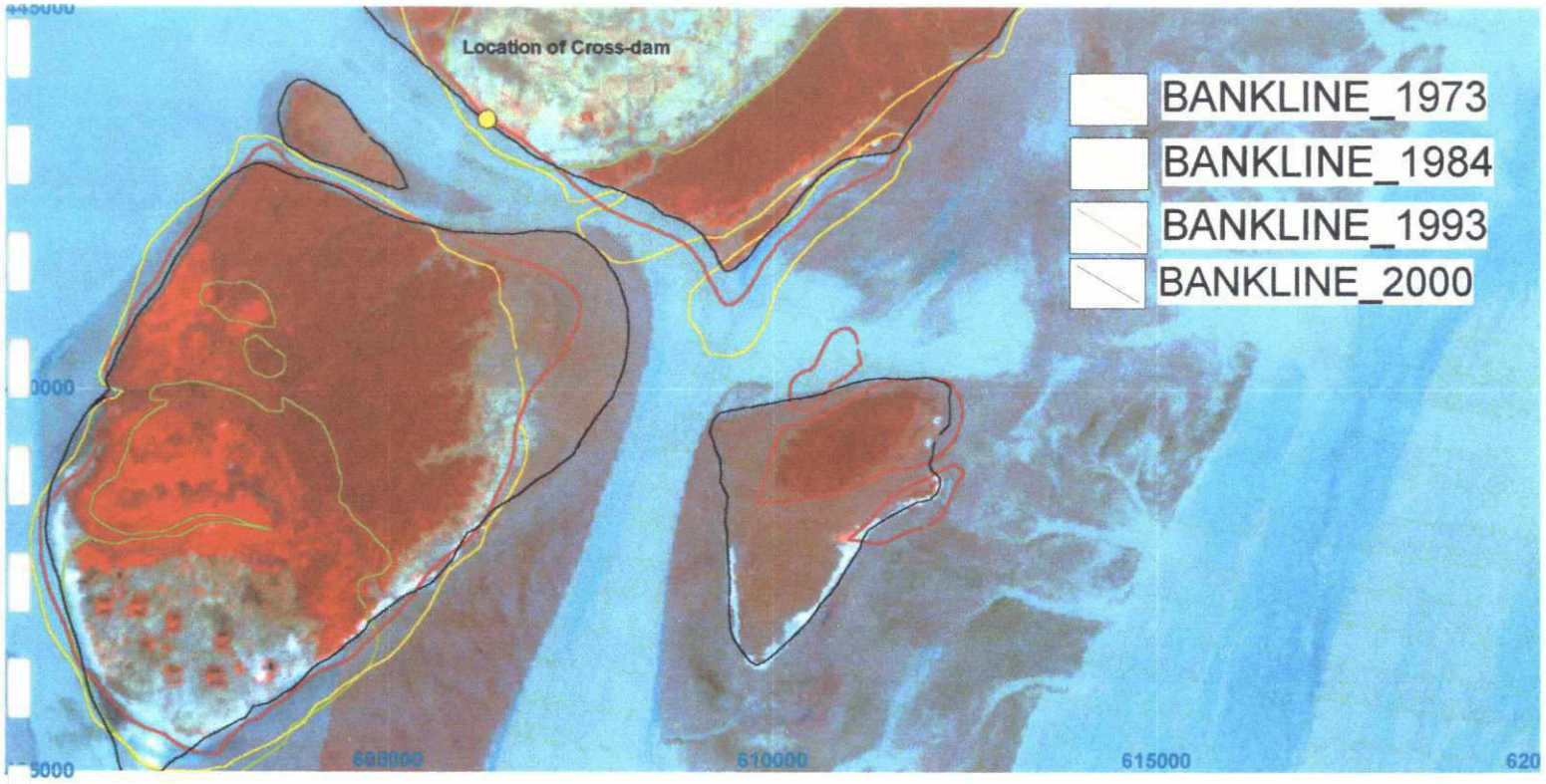
Prepared by: GIS/RS/CAD Section of Meghna Estuary Study II

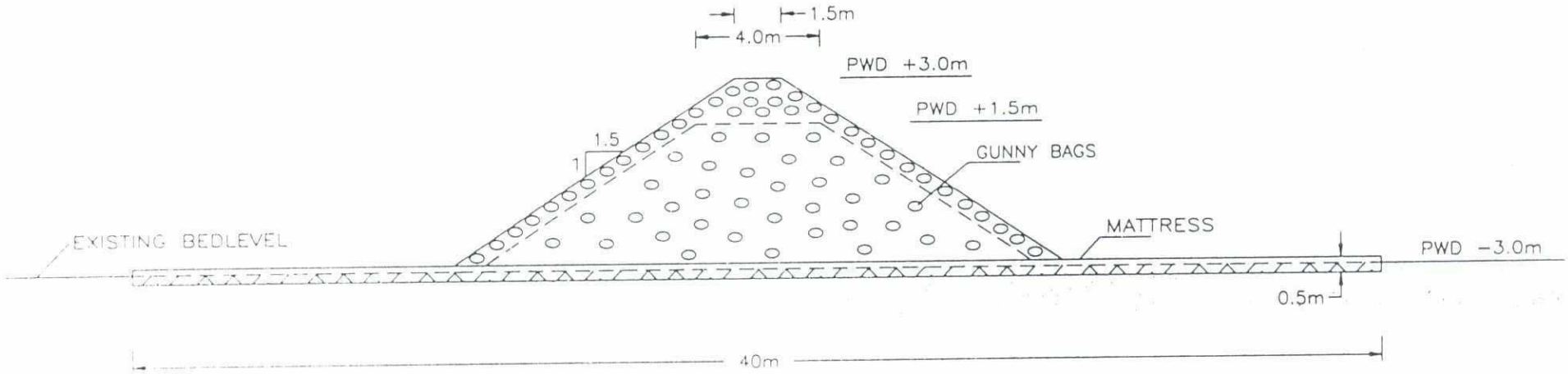
Note: Bankline were digitized from the Landsat TM imagery of January 2000

File- E:\MES-II\Civil\Emdad\Nijhm-loc.cdr

Figure - 1.1


5000
Hatia
Location of pilot scheme
Nijhum Dwip
ource: Landsat TM imagery of January 2000


Location of Cross-dam
BANKLINE_1973
BANKLINE_1984
BANKLINE_1993
BANKLINE_2000
610000
615000

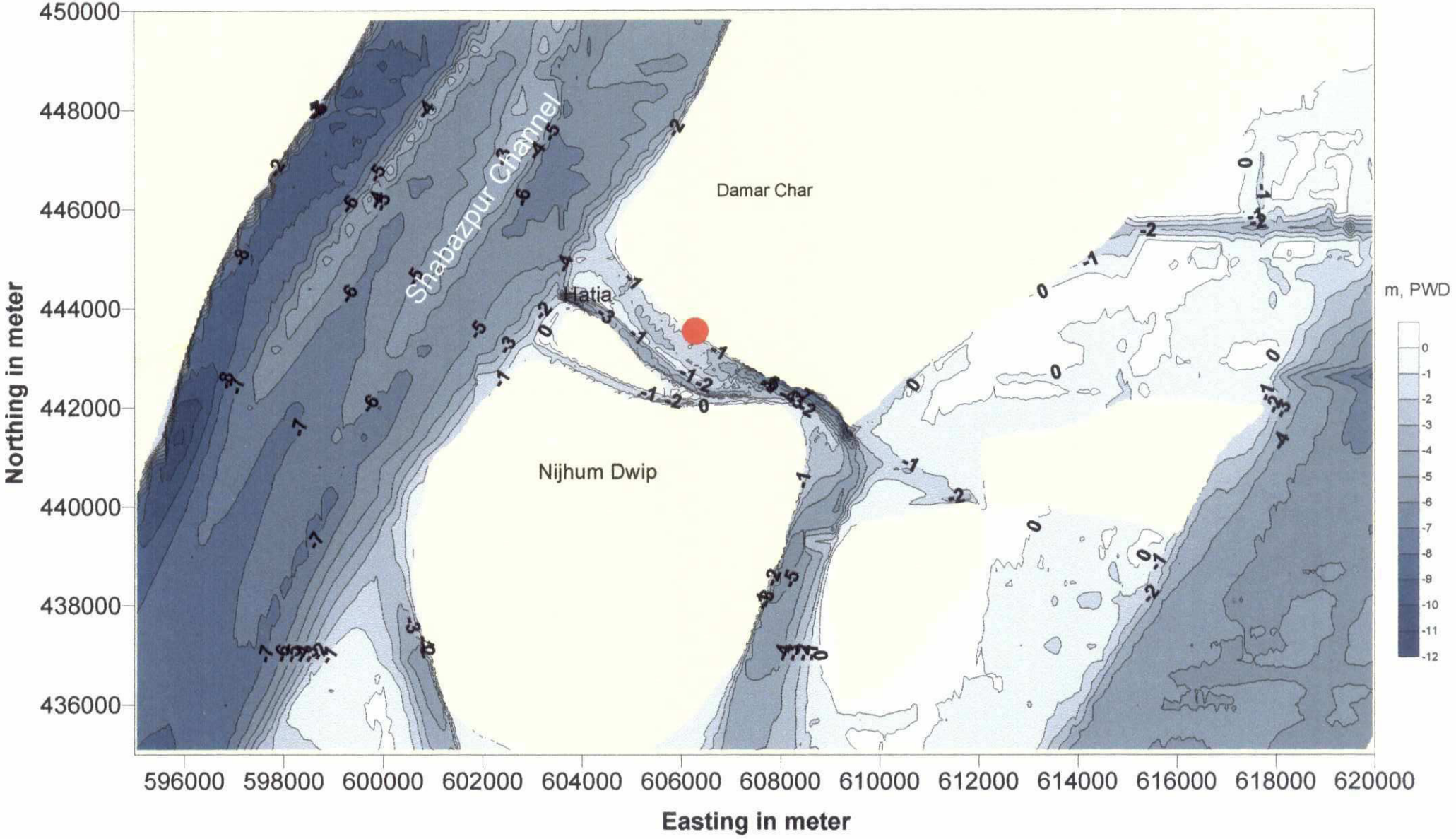


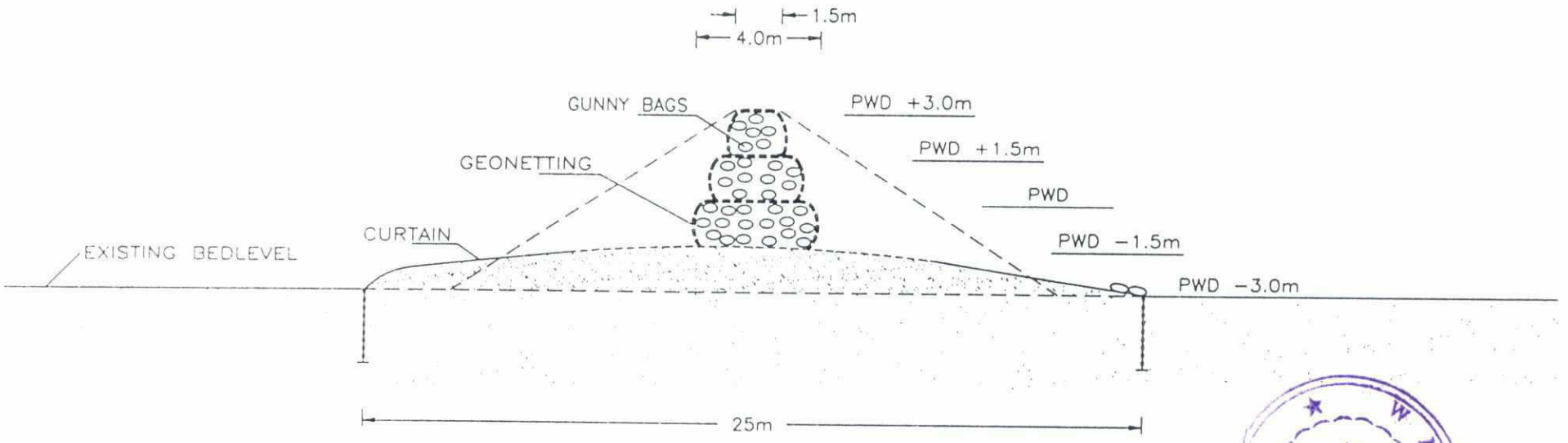
SECTION OF CROSS DAM
(PREVIOUS DESIGN)

Figure - 2

SCALE 1:200

Figure A 3 Bathymetry at Nijhum Dwip in 2000





SECTION OF CROSS DAM
(ADVANCED DESIGN)

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Figure - 3

SCALE 1:200

Figure - 4

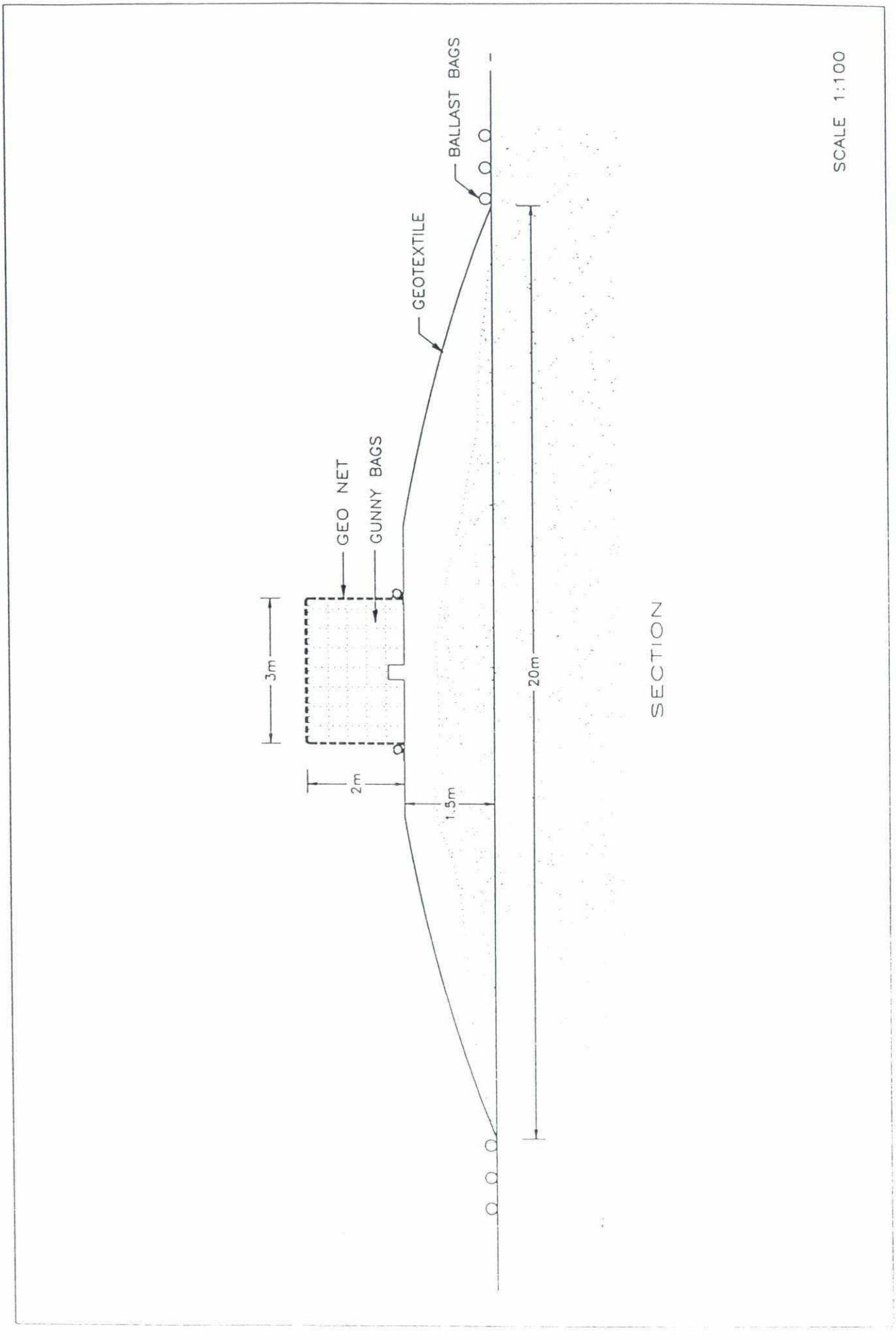

SCALE 1:100
BALLAST BAGS
GEOTEXTILE
GEO NET
GUNNY BAGS
3m
2m
1.5m
20m
SECTION

Figure A5 : Contour map of bathymetric change (2000 from 1997)

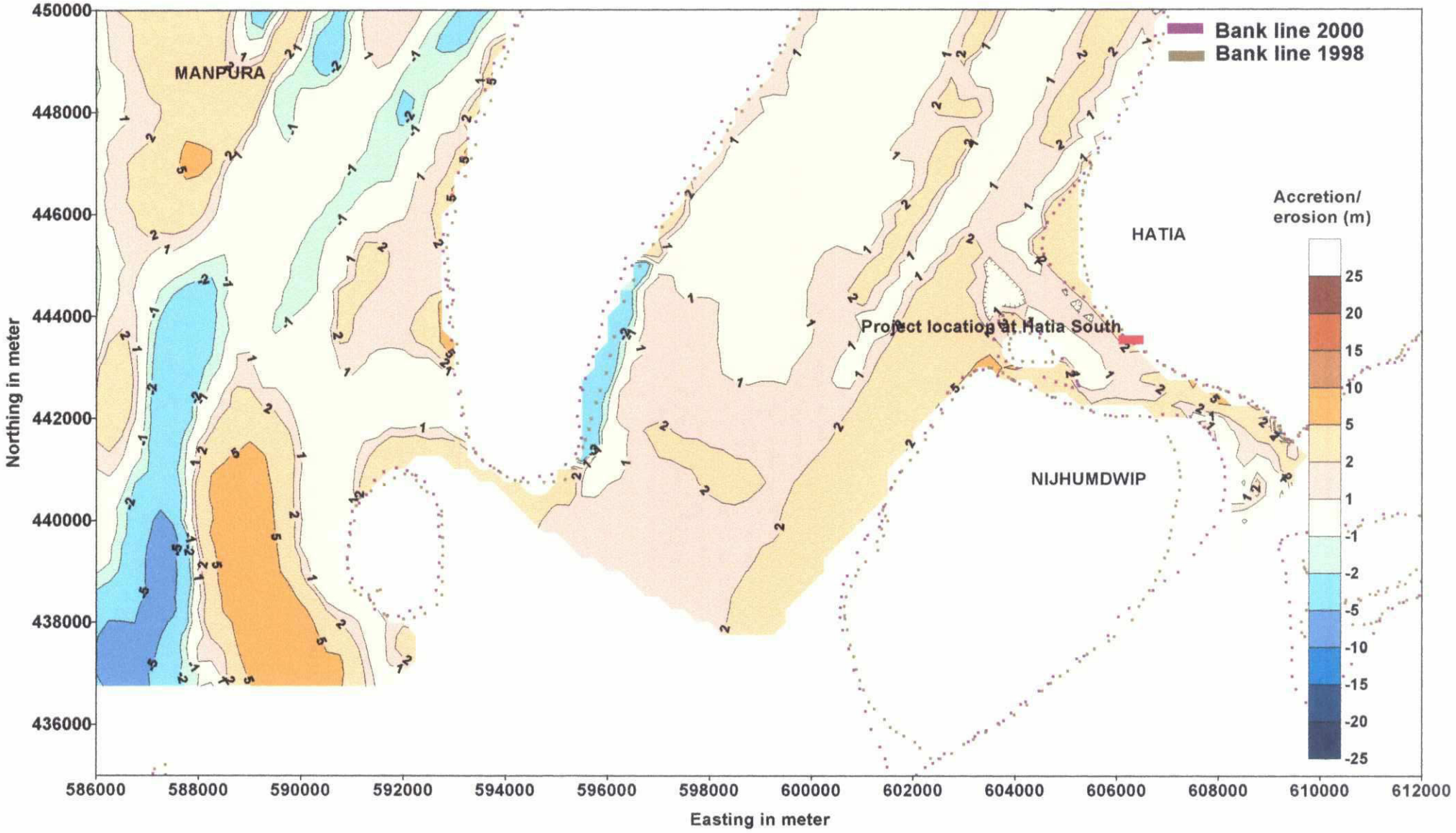


Figure - 5

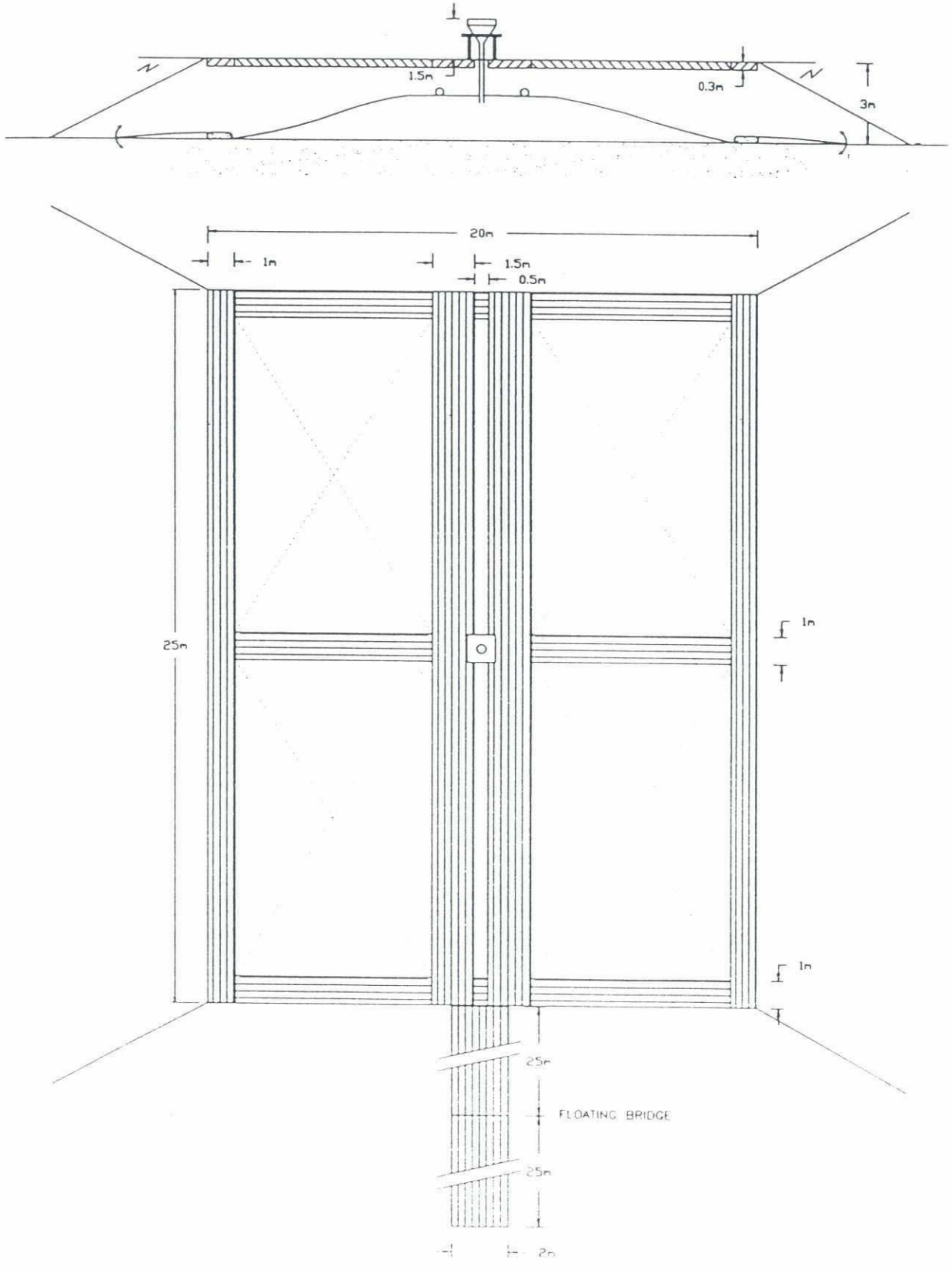
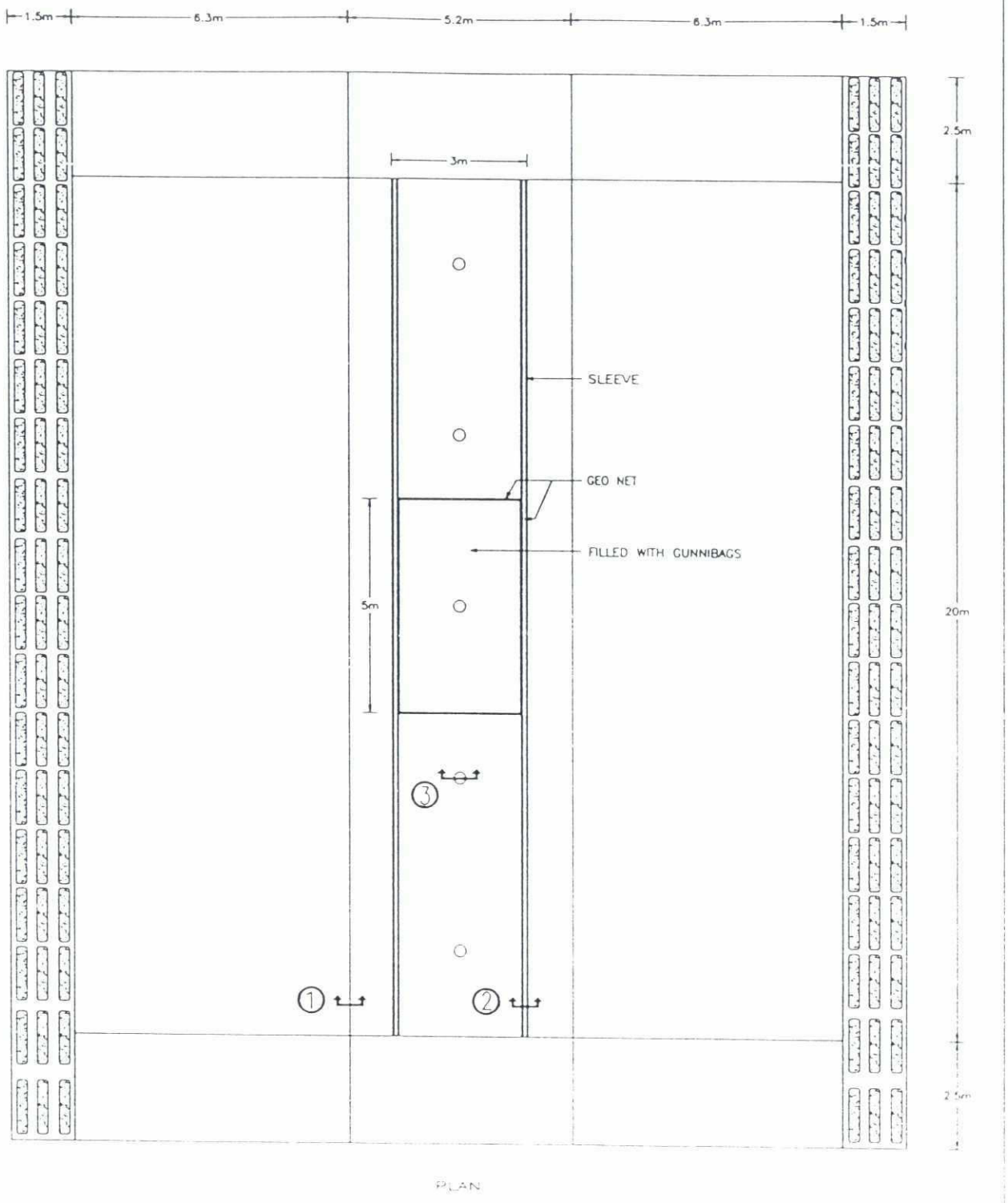


Figure 5



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APPENDICES

Appendix-1

Specification of Geo-textile and Geo-net

Technical Data Amoco ProPex® Geotextiles

Amoco ProPex® Styles – Typical Values

Test Method	Standard	Unit	6042		6049	
			Warp	Weft	Warp	Weft
Mass per Unit Area	DIN-EN-965	g/m²	90		115	
Thickness (2 kN/m²)	DIN-EN-964-1	mm	0.5		0.6	
Tensile Strength	DIN-EN-ISO 10 319	kN/m	18	15	20	20
Tensile Force at 5% Strain		kN/m	5.6	5.6	6.5	6.5
Strain at max. Load		%	20	20	21	22
Static Puncture Test (CBR)	DIN-EN-ISO 12 236					
Push-Trough Force (T-s)		kN	1.9		2.4	
Push-Trough Displacement		mm	30		32	
Dynamic Puncture Test	DIN-EN-918					
Hole Diameter		mm	17		17	
Water Permeability Normal to the Plane	NEN 5167					
Water Flow Head Δh = 100 mm (10° C)		l/m² · s	18		18	
Standardized Water Head Δhs (10° C)		mm	40		40	
Standard Permittivity ψs (10° C)		s⁻¹	0.25		0.25	
k_n-Value (10° C)		cm/s	1.0 x 10⁻²		1.1 x 10⁻²	
Characteristic Opening Size						
O_{90} (dry sieving)	NEN 5168	micron	380		200	
O_{90} (wet sieving)	E DIN 60 500	mm	0.46		0.37	
UV-Resistance	DIN-V-EN-12 224 Xenon Arc Lamp (ISO 4892-2)	50 MJ/m² tensile strength retained	≥ 80 %			

Packing	unit	6042	6049
Fabric width	cm	530	525
Roll length	m	200	200
Roll diameter	cm	30	35
Roll weight	kg	110	135
Area	m²	1050	1050

Amoco ProPex Styles® – Typical Values

6060		6082		6083		6084		6085		6086		6088	
Warp	Weft	Warp	Weft	Warp	Weft	Warp	Weft	Warp	Weft	Warp	Weft	Warp	Weft
130		210		260		330		300		400		500	
0.6		0.7		1.3		1.1		1.1		1.4		1.7	
30	28	40	40	54	54	65	65	65	55	80	80	100	100
9.0	9.0	9.0	19.0	13.0	27.8	30.0	30.0	30.0	30.0	36.0	36.0	40.0	50.0
20	18	22	14	22	14	12	12	12	12	13	13	13	13
3.3		5.0		5.4		8.0		7.2		10.0		12.0	
30		30		26		30		28		30		30	
13		12		13		14		16		13		9	
18		12		50		14		14		25		18	
40		90		10		75		75		24		45	
0.26		0.12		1.10		0.14		0.14		0.40		0.24	
1.2 x 10⁻²		0.9 x 10⁻²		6.0 x 10⁻²		1.5 x 10⁻²		1.5 x 10⁻²		3.5 x 10⁻²		3.0 x 10⁻²	
200		170		300		210		260		290		200	
0.30		0.13		0.44		0.30		0.27		0.50		0.15	
≥ 80 %		≥ 90 %											

6060		6082	6083	6084	6085		6086	6088
350	525	525	525	520	400	520	520	520
200	150	150	100	100	100	100	100	100
36	32	42	37	35	35	35	45	48
103	120	180	150	185	135	170	220	270
700	785	785	525	520	400	520	520	520

1) The values presented in this table are averages from standard tests and are, while not guaranteed, to the best of our knowledge true and accurate.
2) Specific weight of Polypropylene: 0.90 g/cm³, Melting Point: approx. 165° C
3) All ProPex® geotextiles are subjected to external product control (Fremdüberwachung)
4) Testing Institute: Institut für textile Bau- und Umwelttechnik GmbH (ITBU) D-48268 Greven (Germany)
5) Approved Fabrics Division

Appendix-2

Tide Tables for West Hatia

SHAHBAZPUR RIVER - CHARCHANGA (West Hatia)

MARCH

Time	Ht (m)	Time	Ht (m)	Time	Ht (m)
1 0006	.59	11 0308	3.27	21 0043	2.43
SA 0548	2.43	TU 0955	-.24	FR 0716	.48
1217	.42	1536	3.22	1314	2.38
1828	2.58	2217	-.06	1930	.63
2 0054	.75	12 0354	3.12	22 0116	2.60
SU 0638	2.21	WE 1034	-.08	SA 0746	.34
1307	.63	1624	3.13	1341	2.59
1945	2.44	2258	.12	2000	.47
3 0159	.95	13 0443	2.89	23 0144	2.75
MO 0813	1.99	TH 1113	.15	SU 0815	.25
1421	.86	1714	2.97	1405	2.77
2121	2.41	2341	.36	2028	.37
4 0340	1.02	14 0535	2.60	24 0206	2.86
TU 1004	1.98	FR 1152	.42	MO 0841	.19
1554	.94	1809	2.75	1426	2.92
2237	2.49			2056	.30
5 0518	.86	15 0028	.64	25 0227	2.96
WE 1129	2.13	SA 0632	2.28	TU 0908	.16
1717	.86	1234	.73	1450	3.03
2338	2.65	1909	2.50	2125	.28
6 0624	.59	16 0129	.91	26 0255	2.99
TH 1219	2.37	SU 0734	1.96	WE 0935	.16
1836	.64	1329	1.02	1520	3.08
		2015	2.25	2155	.31
7 0022	2.85	17 0305	1.05	27 0328	2.96
FR 0712	.27	MO 0947	1.75	TH 1004	.19
1254	2.63	1457	1.19	1555	3.08
1928	.34	2210	2.12	2227	.37
8 0101	3.06	18 0510	1.00	28 0404	2.87
SA 0755	-.01	TU 1114	1.78	FR 1035	.24
1329	2.90	1729	1.21	1633	3.03
2013	.07	2316	2.15	2302	.44
9 0140	3.23	19 0605	.84	29 0443	2.76
SU 0836	-.22	WE 1216	1.94	SA 1109	.31
1408	3.11	1920	1.64	1715	2.96
2055	-.10			2342	.54
10 0223	3.31	20 0004	2.29	30 0527	2.60
MO 0916	-.30	TH 0644	.66	SU 1150	.45
1451	3.22	1236	2.15	1805	2.83
2136	-.14	1857	.83		
				31 0041	.73
				MO 0620	2.39
				1213	.67
				1911	2.67

APRIL

Time	Ht (m)	Time	Ht (m)	Time	Ht (m)
1 0136	.89	11 0416	2.93	21 0107	2.81
TU 0736	2.19	FR 1041	.32	MO 0737	.43
1357	.92	1647	3.16	1331	3.05
2048	2.58	2313	.44	1958	.52
2 0310	.97	12 0505	2.70	22 0124	2.97
WE 0942	2.18	SA 1116	.54	TU 0805	.34
1527	1.01	1737	2.95	1348	3.24
2208	2.61	2355	.66	2027	.42
3 0445	.84	13 0555	2.45	23 0148	3.11
TH 1107	2.36	SU 1153	.79	WE 0833	.28
1653	.94	1828	2.72	1415	3.38
2311	2.73			2057	.36
4 0557	.60	14 0043	.88	24 0221	3.19
FR 1157	2.62	MO 0648	2.20	TH 0903	.25
1819	.71	1238	1.04	1449	3.45
2357	2.89	1921	2.48	2130	.36
5 0648	.32	15 0156	1.06	25 0259	3.19
SA 1234	2.88	TU 0744	1.99	FR 0935	.28
1910	.41	1344	1.25	1527	3.44
		2016	2.29	2205	.42
6 0037	3.08	16 0319	1.10	26 0339	3.11
SU 0732	.07	WE 1026	1.95	SA 1010	.36
1309	3.15	1518	1.32	1608	3.38
1954	.15	2218	2.21	2243	.50
7 0116	3.24	17 0438	1.05	27 0423	3.00
MO 0813	-.10	TH 1123	2.14	SU 1048	.47
1347	3.36	1636	1.27	1654	3.28
2035	-.01	2321	2.31	2326	.61
8 0159	3.31	18 0555	.88	28 0510	2.85
TU 0851	-.14	FR 1206	2.39	MO 1134	.63
1429	3.46	1820	1.05	1746	3.13
2115	-.03				
9 0244	3.27	19 0006	2.48	29 0618	.75
WE 0929	-.06	SA 0634	.69	TU 0606	2.69
1513	3.43	1241	2.64	1232	.83
2154	.07	1856	.83	1859	2.87
10 0330	3.13	20 0042	2.66	30 0123	.90
TH 1005	.11	SU 0708	.54	WE 0718	2.54
1559	3.32	1310	2.86	1311	1.03
2233	.23	1928	.65	2018	2.65

IMPORTANT NOTES INFORMATIONS

1) Heights are expressed in metres unless otherwise stated and are referenced to Chart Datum, a plane below which tide seldom falls.

2) Time refers to Bangladesh Standard Time (BST) which is [minus] six hours Universal Time (UT).

3) The total depth in the channel is the sum of the charted depth and the predicted height of tide.

4) The predictions in this booklet do not include changes due to meteorologic disturbances.

5) Predictions for stations shown in Index map can be supplied at additional cost on request in advance.

6) Copyright is reserved and permission should be obtained before any part is reproduced.

7) All communications relating to this publication should be made to the

Department of Hydrography
Bangladesh Inland Water Transport Authority
BIWTA Bhaban (Tenth floor)
141 - 143, Motijheel Commercial Area
Dhaka-1000
Phone:9553742, 9556151-55 & 9555042/Ext-2107,2119

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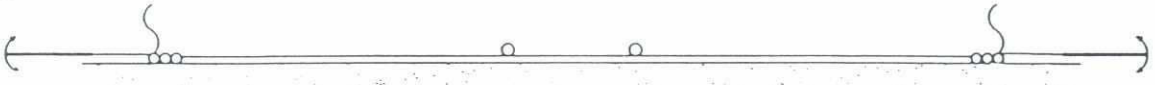
Appendix-3

Installation Methodology as planned

1



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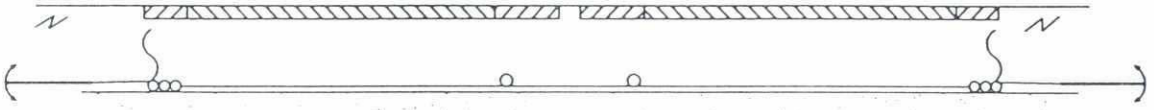

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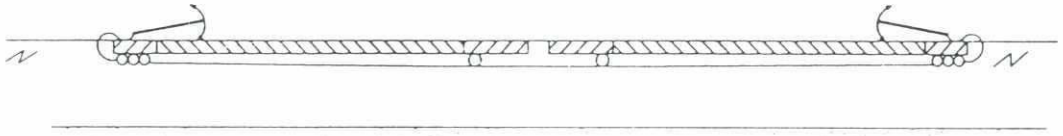

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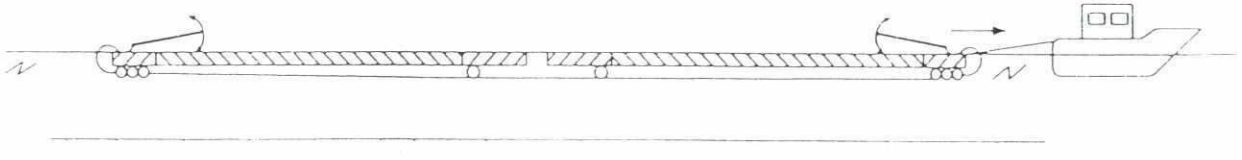

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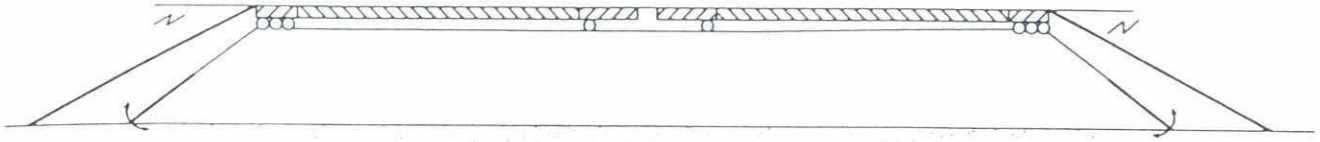

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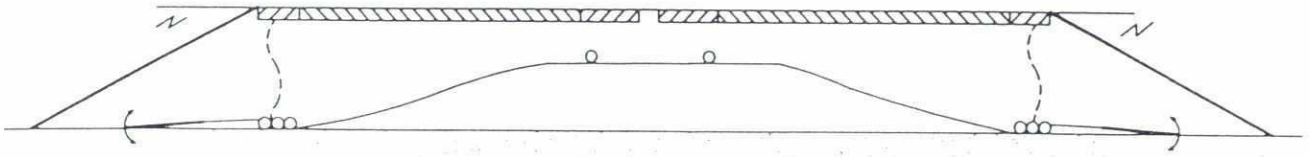

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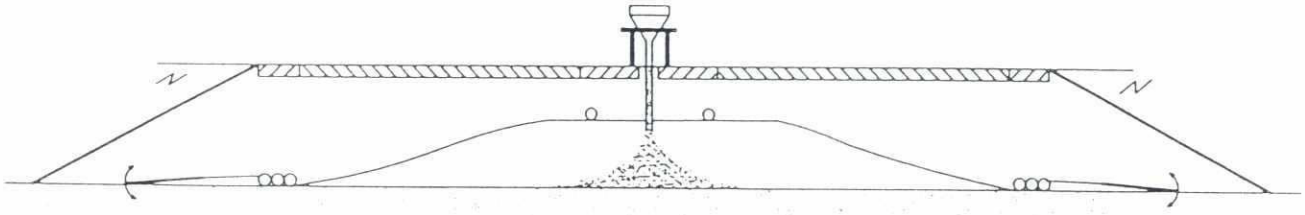

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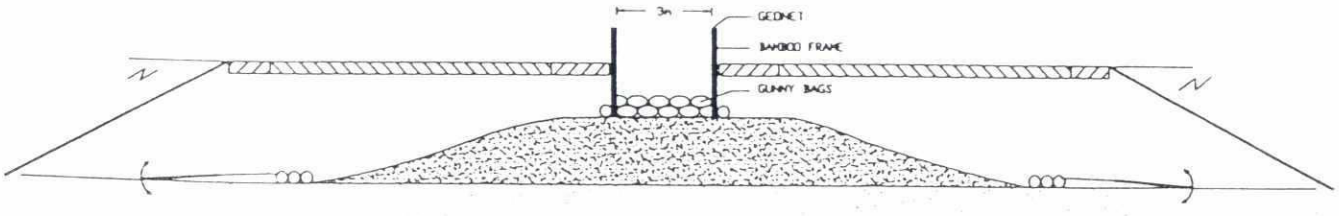


Appendix-4

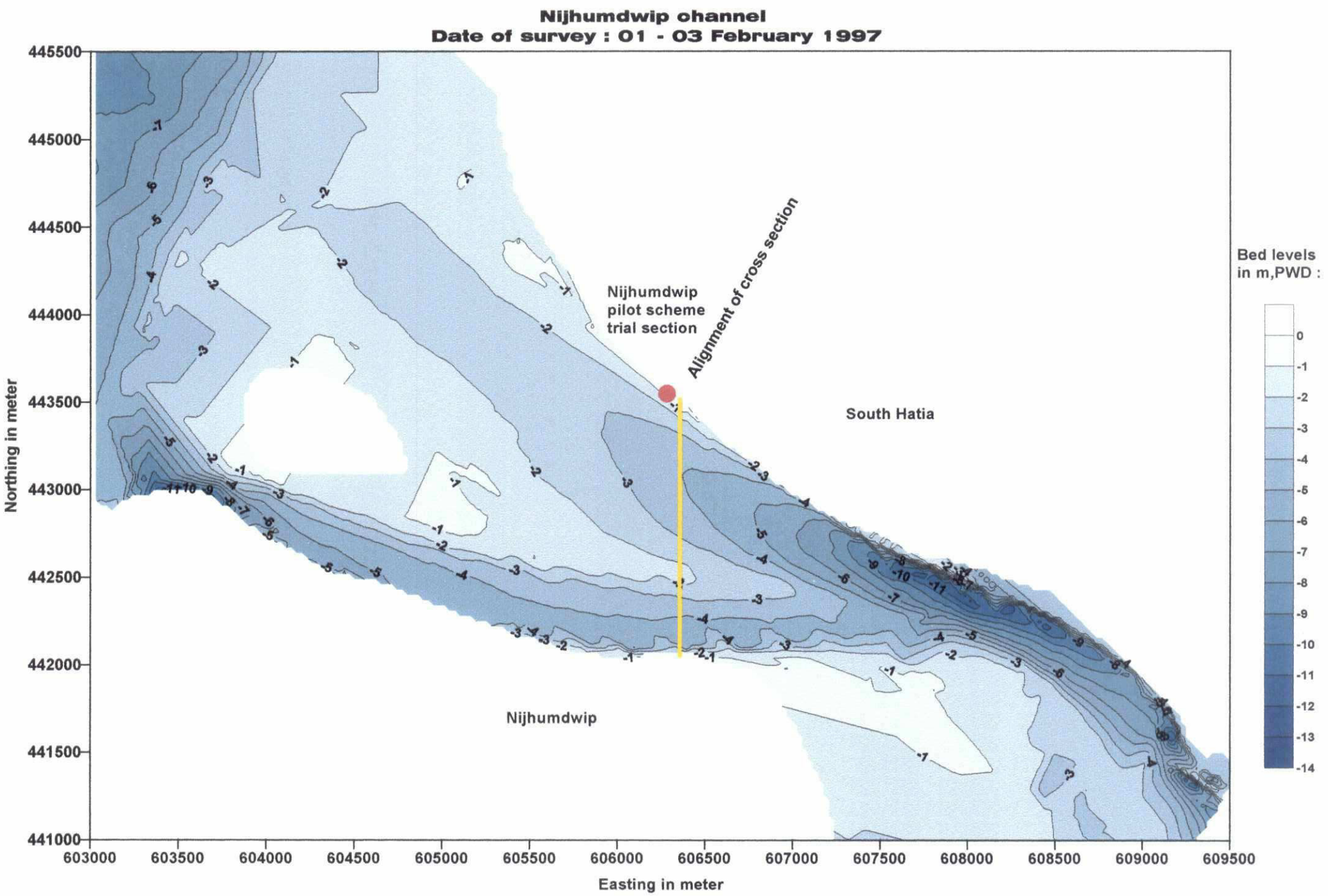
Equipment and Material List

Equipment and materials list

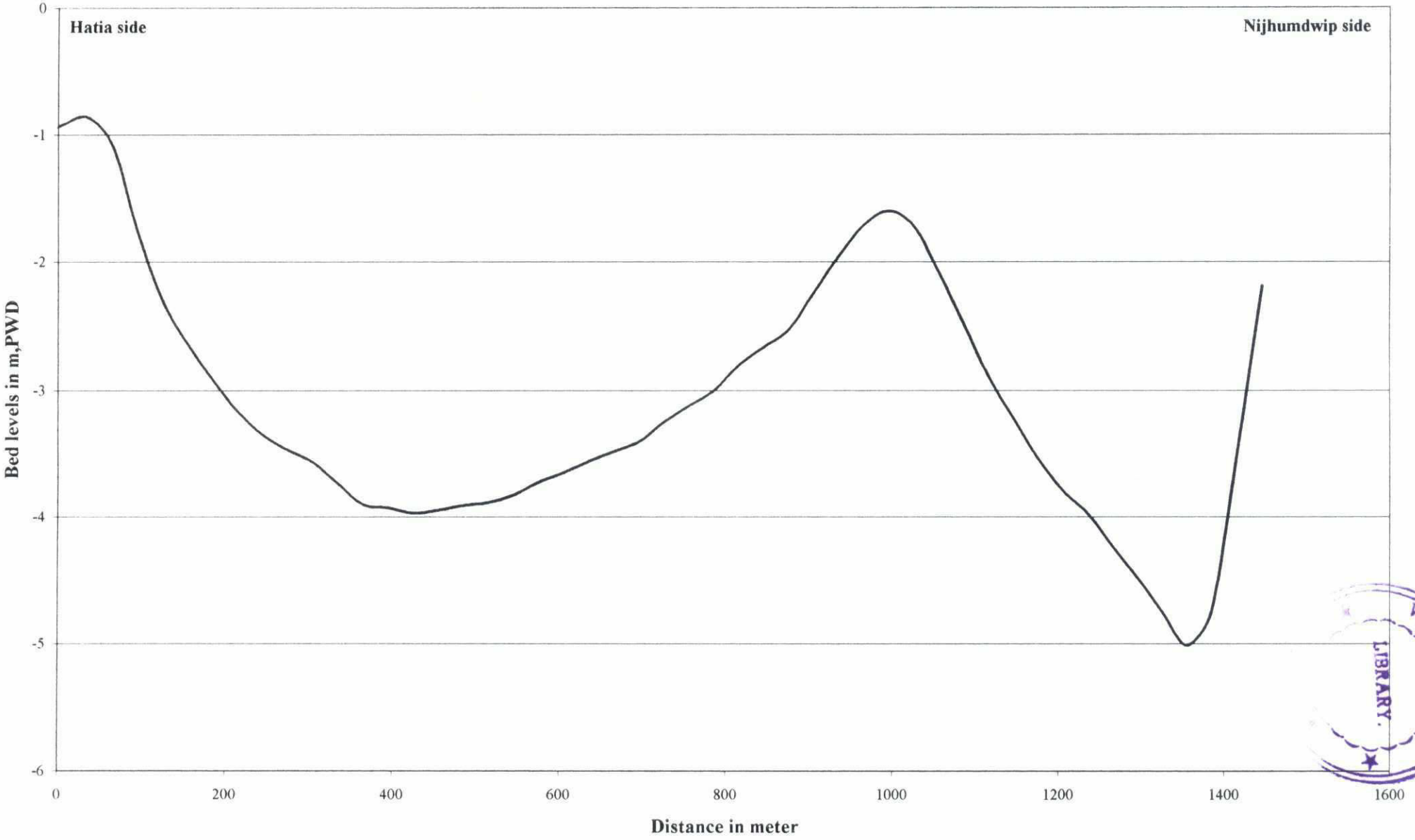
Items	Specifications	Units	Required	Spare	Total
Assistance					
Tugboat	550 HP for towing raft	-	1		1
Trawler	For transporting geotextile and crew				
Tenderboat	For handling raft	-	1		1
E vessel	For fast transport	-	1		1
Raft and floating bridge					
Bamboo poles	8-10 m long; diam. 7,5 cm	-	1600		1600
Fixing wire	GI wire	kg	600		600
Jute	for covering bottom of raft	m2	325	50	375
Anchor	30 kg	-	4	1	5
Anchor line	Manilla rope	50 m	4	2	6
Filling of geotextile					
Funnel	1m x 1m	-	1	1	2
Pipe	PVC 2 m; 20 cm dia.	-	1	1	2
Pump	10 m3/hr Irrigation pump	-	1	0	1
Hose		10 m	1	1	2
Gunny bag package					
Gunny bags	50 kg filled with local material	-	950	50	1000
Geonet	3 m x 3 m & 5 m x 4 m	-	1		1
Bamboo frame	3 m x 5 m x 2 m	-	1		1
		-			
Diving support					
Diving gear		-	1		1
Diving tanks	10 liters	-	1	1	2
Compressor	100 ltrs/min	-	1		1
Geo textile add-ons					
Anchor	Fisherboat type	-	20	0	20
Rope	Strength 250 kg	10 m	22	3	25
Ballast bags	Propex 6082; 1,25	m	75	10	85
Floaters	PVC pipe 15"	2 m	20		20
Communication & navigation					
VHF Radio	Hand held, 5 km radius	-	3		3
VHF Radio	On tender boat, 50 km radius	-	1		1
Safe com	For contact with MES office	-	1		1
GPS	On tender boat	-	1		1
Depth recorder	On tender boat	-	1		1
Tools					
Yarn		m	25	75	100
Needles		-	1	3	4
Ropes	(various for pratical needs)	750 kg	0	100	100
Adhesive tape		-	1	1	2
D-shakles	Strength 1000 kg	-	8	2	10
Marker buoys		-	20		20
Generator	220 V	-	1		1
Lanterns		-	10	2	12
Spades		-	2	2	4
Baskets		-	50	10	60

Appendix-5

Cross Section of the Channel


Nijhumdwip channel
Date of survey : 01 - 03 February 1997
Nijhumdwip pilot scheme trial section
Alignment of cross section
South Hatia
Nijhumdwip
Bed levels in m,PWD :
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
Northing in meter
445500
445000
444500
444000
443500
443000
442500
442000
441500
441000
Easting in meter
603000
603500
604000
604500
605000
605500
606000
606500
607000
607500
608000
608500
609000
609500

Cross section along the pilot scheme trial section at Nijhumdwip channel (01-03 February 1997)



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Nijhumdwip pilot scheme trial section

Easting in meter	Northing in meter	Distance in meter	Bed levels in m,PWD
606355.00	443515.67	0.00	-0.94
606355.00	443510.00	5.67	-0.92
606355.00	443480.00	35.67	-0.86
606355.00	443450.00	65.67	-1.10
606355.00	443420.00	95.67	-1.77
606355.00	443390.00	125.67	-2.32
606355.00	443360.00	155.67	-2.64
606355.00	443330.00	185.67	-2.92
606355.00	443300.00	215.67	-3.17
606355.00	443270.00	245.67	-3.35
606355.00	443240.00	275.67	-3.47
606355.00	443210.00	305.67	-3.57
606355.00	443180.00	335.67	-3.74
606355.00	443150.00	365.67	-3.90
606355.00	443120.00	395.67	-3.93
606355.00	443090.00	425.67	-3.97
606355.00	443060.00	455.67	-3.95
606355.00	443030.00	485.67	-3.91
606355.00	443000.00	515.67	-3.88
606355.00	442970.00	545.67	-3.82
606355.00	442940.00	575.67	-3.73
606355.00	442910.00	605.67	-3.65
606355.00	442880.00	635.67	-3.56
606355.00	442850.00	665.67	-3.48
606355.00	442820.00	695.67	-3.40
606355.00	442790.00	725.67	-3.25
606355.00	442760.00	755.67	-3.12
606355.00	442730.00	785.67	-3.00
606355.00	442700.00	815.67	-2.80
606355.00	442670.00	845.67	-2.66
606355.00	442640.00	875.67	-2.53
606355.00	442610.00	905.67	-2.24
606355.00	442580.00	935.67	-1.96
606355.00	442550.00	965.67	-1.71
606355.00	442520.00	995.67	-1.60
606355.00	442490.00	1025.67	-1.72
606355.00	442460.00	1055.67	-2.08
606355.00	442430.00	1085.67	-2.48
606355.00	442400.00	1115.67	-2.89
606355.00	442370.00	1145.67	-3.22
606355.00	442340.00	1175.67	-3.54
606355.00	442310.00	1205.67	-3.79
606355.00	442280.00	1235.67	-3.97
606355.00	442250.00	1265.67	-4.23
606355.00	442220.00	1295.67	-4.48
606355.00	442190.00	1325.67	-4.75
606355.00	442160.00	1355.67	-5.01
606355.00	442130.00	1385.67	-4.73
606355.00	442100.00	1415.67	-3.50
606355.00	442070.00	1445.67	-2.19

PVC PIPE

PIPE DIMENSIONS

Dimensions and Maximum Working Pressures of PVC Pipe

British Standard 3505 : 1968
Unplasticized PVC Pipe
for Cold Water Services

Nominal Size	Outside diameter		Wall thickness							
			Class B 6.0 bar (60m head of water)		Class C 9.0 bar (90m head of water)		Class D 12.0 bar (120m head of water)		Class E 15.0 bar (150m head of water)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
in	mm (in)	mm (in)	mm (in)	mm (in)	mm (in)	mm (in)	mm (in)	mm (in)	mm (in)	mm (in)
$\frac{3}{8}$	17.0(0.669)	17.3(0.681)	—	—	—	—	—	—	1.5(0.059)	1.9(0.075)
$\frac{1}{2}$	21.2(0.835)	21.5(0.847)	—	—	—	—	—	—	1.7(0.067)	2.1(0.083)
$\frac{3}{4}$	26.6(1.047)	26.9(1.059)	—	—	—	—	—	—	1.9(0.075)	2.5(0.098)
1	33.4(1.315)	33.7(1.327)	—	—	—	—	—	—	2.2(0.087)	2.7(0.106)
$1\frac{1}{4}$	42.1(1.657)	42.4(1.669)	—	—	—	—	2.2(0.087)	2.7(0.106)	2.7(0.106)	3.2(0.126)
$1\frac{1}{2}$	48.1(1.894)	48.4(1.906)	—	—	—	—	2.5(0.098)	3.0(0.118)	3.1(0.122)	3.7(0.146)
2	60.2(2.370)	60.5(2.382)	—	—	2.5(0.098)	3.0(0.118)	3.1(0.122)	3.7(0.146)	3.9(0.154)	4.5(0.177)
$2\frac{1}{2}$	75.0(2.962)	75.3(2.964)	—	—	3.0(0.118)	3.5(0.138)	3.9(0.154)	4.5(0.177)	4.8(0.189)	5.5(0.217)
3	88.7(3.492)	89.1(3.508)	2.9(0.114)	3.4(0.134)	3.5(0.138)	4.1(0.161)	4.6(0.181)	5.3(0.209)	5.7(0.224)	6.6(0.260)
4	114.1(4.492)	114.5(4.508)	3.4(0.134)	4.0(0.157)	4.5(0.177)	5.2(0.205)	6.0(0.236)	6.9(0.272)	7.3(0.287)	8.4(0.331)
5	140.0(5.512)	140.4(5.528)	3.8(0.150)	4.4(0.173)	5.5(0.217)	6.4(0.252)	7.3(0.287)	8.4(0.331)	9.0(0.354)	10.4(0.409)
6	168.0(6.614)	168.5(6.634)	4.5(0.177)	5.2(0.205)	6.6(0.260)	7.6(0.299)	8.8(0.347)	10.2(0.402)	10.8(0.425)	12.5(0.492)
7	193.5(7.618)	194.0(7.638)	5.2(0.205)	6.0(0.236)	7.7(0.303)	8.9(0.350)	10.1(0.398)	11.7(0.461)	12.4(0.488)	13.9(0.547)
8	218.8(8.614)	219.4(8.638)	5.3(0.209)	6.1(0.240)	7.8(0.307)	9.0(0.354)	10.3(0.406)	11.9(0.469)	12.6(0.496)	14.5(0.571)
9	244.1(9.610)	244.8(9.638)	5.9(0.232)	6.8(0.268)	8.7(0.342)	10.0(0.394)	11.5(0.453)	13.3(0.524)	14.1(0.555)	15.8(0.622)
10	272.6(10.732)	273.4(10.764)	6.6(2.260)	7.6(0.299)	9.7(0.382)	11.2(0.441)	12.8(0.504)	14.8(0.583)	15.7(0.618)	18.1(0.713)
12	323.4(12.732)	324.3(12.768)	7.8(0.307)	9.0(0.354)	11.5(0.453)	13.3(0.524)	15.2(0.598)	17.5(0.689)	18.7(0.736)	21.6(0.850)
14	355.0(13.976)	356.0(14.015)	8.5(0.335)	9.8(0.386)	12.6(0.496)	14.5(0.571)	16.7(0.657)	19.2(0.756)	20.5(0.807)	23.6(0.929)
16	405.9(15.980)	406.9(16.019)	9.7(0.382)	11.2(0.441)	14.5(0.571)	16.7(0.657)	19.0(0.748)	21.9(0.862)	23.4(0.921)	27.0(1.063)
18	456.7(17.980)	457.7(18.019)	11.0(0.433)	12.7(0.500)	16.3(0.642)	18.8(0.740)	21.4(0.843)	24.6(0.969)	—	—
20	507.5(19.980)	508.5(20.019)	12.2(0.480)	14.1(0.555)	18.1(0.713)	20.9(0.823)	—	—	—	—
22	558.3(21.980)	559.3(22.019)	13.4(0.528)	15.5(0.610)	19.9(0.783)	22.9(0.902)	—	—	—	—
24	609.1(23.980)	610.1(24.019)	14.6(0.575)	16.8(0.661)	21.7(0.854)	25.0(0.984)	—	—	—	—

Note Fittings to BS are available.

যন্ত্রকৌশল বিভাগ
বাংলাদেশ প্রকৌশল বিশ্ববিদ্যালয়
ঢাকা-১০০০
ফোনঃ ৫০১২৫০, ৫০৫১৭১-৭, ৮৬৪৬৪০-৪/ ২৮২, ২৮৪
ফ্যাক্সঃ ৮৮০-২-৮৬৩০৪৬, ৮৬৩০২৬

DEPARTMENT OF MECHANICAL ENGINEERING
BANGLADESH UNIVERSITY OF ENGINEERING & TECHNOLOGY,
DHAKA-1000, BANGLADESH.
Phone : 501250, 505171-7, 864640-4/ 282, 284
Fax : 880-2-863046, 863026

TEST REPORT OF PVC PIPE

April 09, 1997.

SUPPLIER : DR. ATAUR RAHMAN
CO-TEAM LEADER
MEGHNA ESTUARY STUDY (MES-FAP 5B)
ROAD 25, HOUSE 34
GULSHAN, DHAKA.

W.A.R.P.O. LIBRARY.

SUPPLIER'S REFERENCE : Memo No. BUET-9703-241; Dated: 24/3/97.

UNIVERSITY REFERENCE : BRTC No. 3519/96-97/ME, Dated: 24/3/97.

SAMPLES SUPPLIED : Two types of 150 mm dia. PVC Pipe.

TEST CONDUCTED BY : DEPARTMENT OF MECHANICAL ENGINEERING
BUET, DHAKA-1000.

যন্ত্রকৌশল বিভাগ
বাংলাদেশ প্রকৌশল বিশ্ববিদ্যালয়
ঢাকা-১০০০
ফোন: ৫০১২৫০, ৫০৫১৭১-৭, ৮৬৪৬৪০-৪/ ২৮২, ২৮৪
ফ্যাক্স: ৮৮০-২-৮৬৩০৪৬, ৮৬৩০২৬

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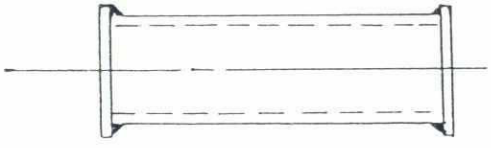
SUPPLIER'S REFERENCE: *Memo No. BUET-9703-241; Dated: 24/3/97.*

TEST RESULTS

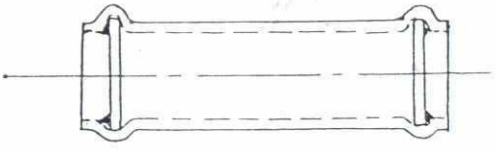
1. *EXTERNAL HYDROSTATIC PRESSURE*

Standard used: As per Client's Requirement.

Sample Identification	Observation
Type-A	Failure occured at the pressure of 60 psi. Cracking occured at the glue joint.
Type-B	Failure occured at the pressure of 75 psi. Cracking occured at the glue joint.



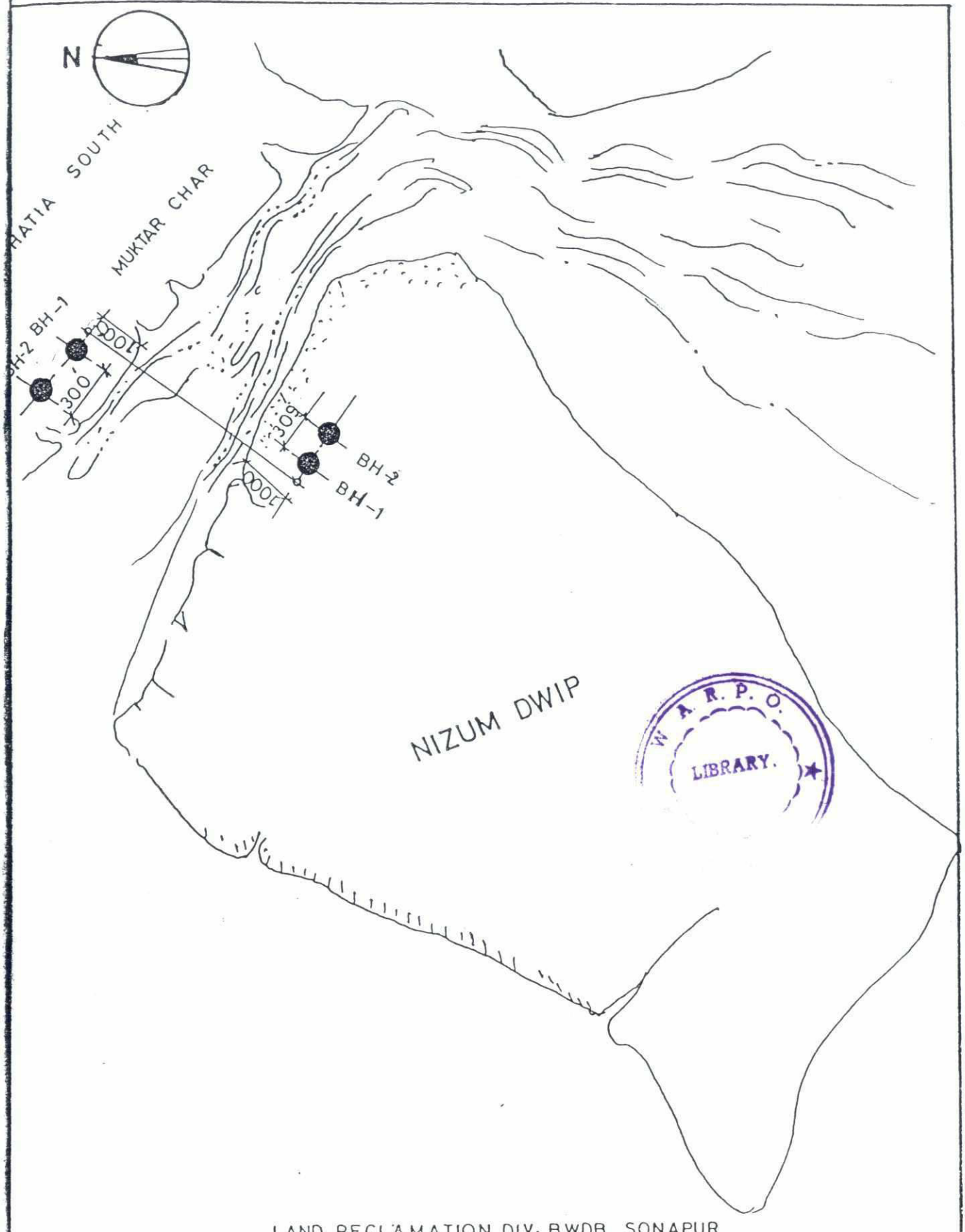
Type-A



Type-B

Dr. Amalesh Chandra Mandal
Professor

Dr. Md. Maksud Helali
Associate Professor



LAND RECLAMATION DIV. BWDB SONAPUR

LAYOUT OF BORING POINTS FOR

HATIA-NIZUM DWIP CROSS DAM

NOAKHALI

SOILTECH INTERNATIONAL LTD. DRN. DATE:-5-8-89 PLAN No. ST-4524

87

SOILTECH
INTERNATIONAL LIMITED
DHAKA

Client:- LAND RECLAMATION DIV. BWDB SONAPUR

Site:- HATIA — NIZUM DWIP CROSS DAM
SOUTH HATIA, NOAKHALI

Bore chart of Boring No :- 1

DATE	REDUCED ELEVATION	DEPTH (m)	THICKNESS (m)	STRATA ENCOUNTERED	LOG	DIA. OF BORING	STANDARD PENETRATION TESTS blows/0.30 m (10 20 30 40 50 60 70 80 90)	REMARKS (G.W.T, SOIL SAMPLES) VANE SHEAR TESTS Lbs./sq in.
13-6-89	REDUCED ELEV. 7.58 ft	2.35	2.35	Pale brown & grey stiff SILT & fine SAND		9.55 m 100 mm ø Percussion method	10	0.85
		3.10	0.75	Grey loose micacious fine SAND with silt			10	1.85
		5.00	1.90	Grey med. stiff to stiff SILT trace fine sand & clay			9	2.85
		8.50	3.50	Grey med. stiff to stiff SILT with fine sand			7	3.85
							10	4.85
							5	5.85
							12	6.85
							15	7.85
		10.00	1.50	Grey med., dense fine SAND laminated with thin layers of silt			17	8.85
							20	9.85

Water level 7.83 ft (Av.)

DISTURBED SAMPLE ☒ UNDISTURBED SAMPLE ☒ ○

DRN:- DATE:- 5-8-89 SCALE:- 1:100 PLAN NO. ST-4525

SOILTECH
INTERNATIONAL LIMITED
DHAKA

Client:- LAND RECLOMATION DIV. BWDB, SONAPUR

Site:- HATIA—NIZUM DWIP CROSS DAM
SOUTH HATIA, NOAKHALI

Bore chart of Boring No. 2

DATE	REDUCED ELEVATION	DEPTH (m)	THICKNESS (m)	STRATA ENCOUNTERED	LOG	DIA. OF BORING	STANDARD PENETRATION TESTS blows/0.30m (10 20 30 40 50 60 70 80 90)	REMARKS (G.W.T, SOIL SAMPLES) VANE SHEAR TESTS Lbs./sq in.

REDUCED ELEV. 7.75 ft.

Water level 8'00 (Over)

14-6-89

DEPTH (m)	THICKNESS (m)	STRATA ENCOUNTERED
1.00	1.00	Pale brown med. stiff SILT with clay & fine sa
2.00	1.00	Grey med. dense fine SAND laminated with thin layers of silt tr. clay
9.55	7.55	Grey med. stiff to very stiff SILT finely laminated with thin layers of sand
10.00	0.45	Grey med. dense fine SAND with silt

9.55 m ø 100 mm Percussion method

7	0.85
29	1.85
7	2.85
9	3.85
13	4.85
10	5.85
12	6.85
20	7.85
21	8.85
27	9.85

DISTURBED SAMPLE ☒ UNDISTURBED SAMPLE ☒

DRN. DATE - 5 - 8 - 89 SCALE - 1 : 100 PLAN No. ST-4526

SOILTECH
SOIL MECHANICS & MATERIAL TESTING LABORATORY
D H A K A

SUMMARY OF LABORATORY TEST RESULTS

L. R. DIV. BWDB SONAPUR
HATIA–NIZUM DWIP CROSS DAM
SOUTH HATIA. NOAKHALI

Borehole No.		1				2				
Sample No.		U–1	U–2	D–6	D–9	U–1	D–3	U–2	D–10	
Depth in meter		1·10 to 1·55	3·10 to 3·55	5·55 to 6·00	8'55 to 9·00	0.10 to 0.55	2.55 to 3.00	6.10 to 6·55	9·55 to 10.00	
Moisture content (Natural)		31.18	28·90	25.11	26.40	26·50	24·30	33.50	21·94	
Specific gravity		2·662	2·659	2. 662		2·660		2·659	2·664	
Atterberg limits	Liquid limit, Lw	N.P.	37·40	N.P.	N.P.	36·00	N.P	N.P		
	Plastic limit, Pw		21.73			20. 80				
Density	Wet (lbs/cft)	117. 26	120.40			119.20		118·20		
	Dry (lbs/cft)	89.40	93.40			94.25		88·50		
Grain size analysis	Gravel (%)									
	Sand (%)	43	6	20	63	6	9	26	82	
	Silt (%)	57	88	80	37	88	91	74	18	
	Clay (%)	—	6	—	—	6	—	—	—	
Consolidation tests	Natural void ratio, e_o		0·776			0·761				
	Compression index, Cc		0·144			0·101				
Unconfined compression tests	Strain at failure (%)	5·35	8·92			7·14		7.14		
	Stress undist. (lbs/sq.inch)	10·33	15·91			13·30		8·98		
	Stress remould (lbs/sq.inch)	6·63	10·16			7·66		5.66		
	Sensitivity	1·558	1·569			1·732		1.586		
Direct shear tests	ϕ (degree)	0·60	0·80			1·95		1·80		
	C (p.s.f)	11·00	9·00			13·50		7·00		

SOILTECH INTERNATIONAL LTD. DRN DATE - '6–8–89 PLAN NO. SL-21000

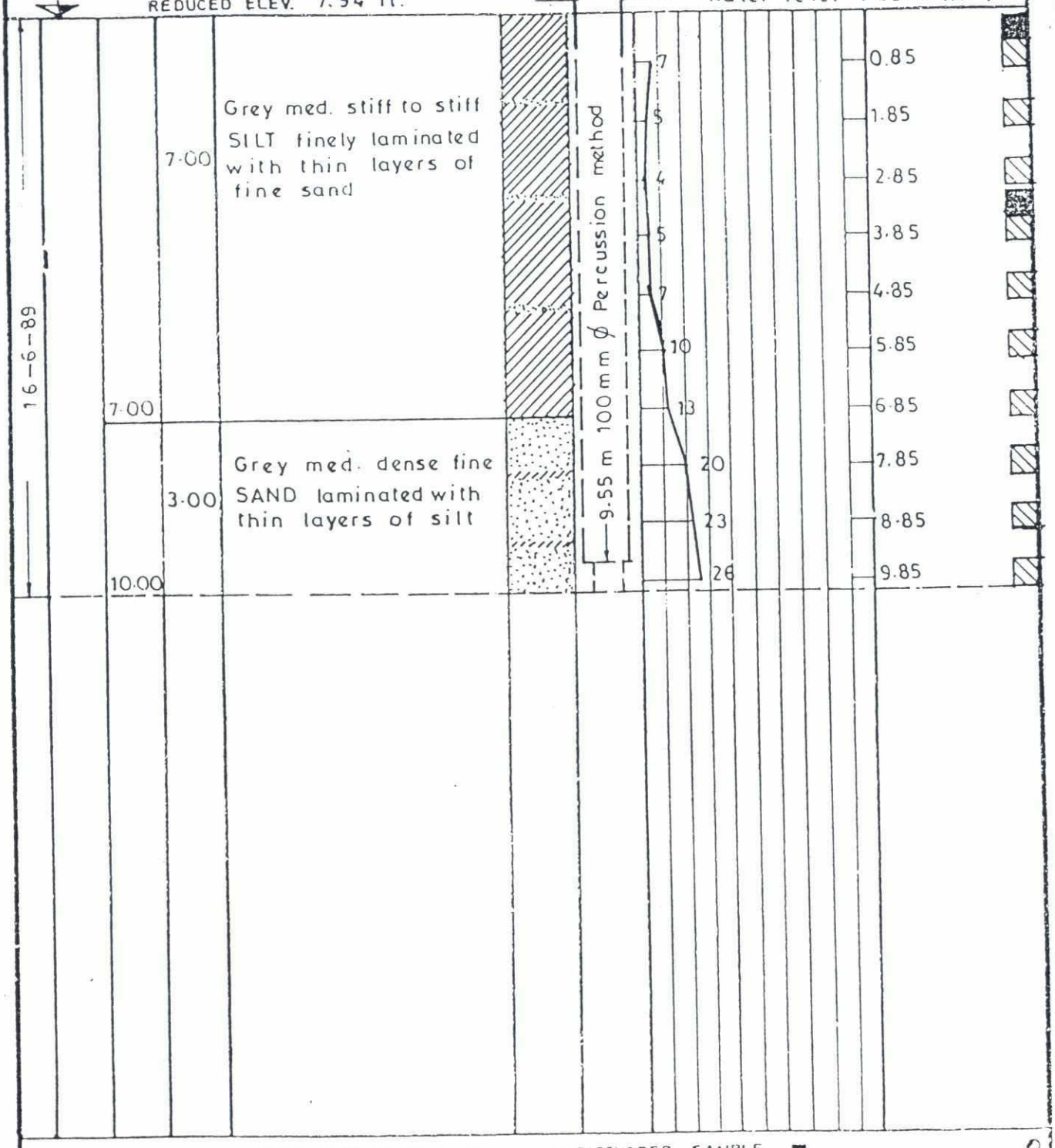
SOILTECH
INTERNATIONAL LIMITED
DHAKA

Client:- LAND RECLAMATION DIV. BWDB SONAPUR

Site:- HATIA-NIZUM DWIP CROSS DAM
NIZUM DWIP, NOAKHALIA

Bore chart of Boring No. 1

DATE	REDUCED ELEVATION	DEPTH (m)	THICKNESS (m)	STRATA ENCOUNTERED	LOG	DIA. OF BORING	STANDARD PENETRATION TESTS blows/ 0.30 m (10 20 30 40 50 60 70 80 90)	REMARKS (G.W.T, SOIL SAMPLES) VANE SHEAR TESTS Lbs./sq in.



DISTURBED SAMPLE..... ☒ UNDISTURBED SAMPLE..... ☐

DRN. Khair DATE - 6 - 8 - 89 SCALE:- 1 : 100 PLAN NO. ST-452A

SOILTECH
INTERNATIONAL LIMITED
DHAKA

Client:- LAND RECLOMATION DIV. BWDB SONAPUR

Site:- HATIA-NIZUM DWIP CROSS DAM
NIZUM DWIP, NOAKHALI

Bore chart of Boring No. 2

DATE	REDUCED ELEVATION	DEPTH (m)	THICKNESS (m)	STRATA ENCOUNTERED	LOG	DIA. OF BORING	STANDARD PENETRATION TESTS blows/ 0.30 m (10 20 30 40 50 60 70 80 90)	REMARKS (G.W.T, SOIL SAMPLES) VANE SHEAR TESTS Lbs./sq in.
17-6-89	REDUCED ELEV. 7.99 ft	2.00	2.00	Grey med. stiff SILT laminated with thin layers of fine sand		9.55 m 100 mm ϕ Percussion method	8, 7, 18, 15, 25, 23, 27, 29, 29, 27	Water level 7.5 ft (Aver)
		10.00	8.00	Grey med. dense fine SAND finely laminated with thin layers of silt				0.85, 1.85, 2.85, 3.85, 4.85, 5.85, 6.85, 7.85, 8.85, 9.85

DISTURBED SAMPLE ☒ UNDISTURBED SAMPLE ☒

DRN- Khair DATE - 6-8-89 SCALE - 1 : 100 PLAN NO. ST-4528

SOILTECH

SOIL MECHANICS & MATERIAL TESTING LABORATORY
D H A K A

SUMMARY OF LABORATORY TEST RESULTS

L. R. DIV. BWDB SONAPUR
HATIA–NIZUM DWIP CROSS DAM
NIZUM DWIP NOAKHALI

Borehole No.		1				2			
Sample No.		U— 1	U — 2	D — 6	D — 9	U —1	D — 2	U— 2	D —8
Depth in meter		0·10 to 0·55	3·10 to 3·55	5·55 to 6·00	8·55 to 9·00	0·10 to 0·55	1·55 to 2·00	3·10 to 3·55	7·55 to 8·00
Moisture content (Natural)		28·42	46·11	24·43	24·60	33·97	28·03	26·40	23·40
Specific gravity		2·659	2·660		2·664	2·656		2·659	2·663
Atterberg limits	Liquid limit, Lw	34·20	NP	NP		40·90	NP	NP	
	Plastic limit, Pw	20·80				25·10			
Density	Wet (lbs/cft)	118·80	116·40			116·20		120·80	
	Dry (lbs/cft)	92·50	79·65			86·70		95·60	
Grain size analysis	Gravel (%)								
	Sand (%)		15	46	75		14	30	58
	Silt (%)		85	54	25		86	70	42
	Clay (%)								
Consolidation tests	Natural void ratio, e_o		0·773					0·736	
	Compression index, Cc		0·120					0·120	
Unconfined compression tests	Strain at failure (%)	5·35	5·35			7·14		5·35	
	Stress undist. (lbs/sq inch)	13·37	7·97			8·78		13·11	
	Stress remould (lbs/sq inch)	8·39	5·26			5·58		7·61	
	Sensitivity	1·593	1·511			1·510		1·722	
Direct shear tests	ϕ (degree)	10·00	9·00			13·00		15·00	
	C (p.s.i)	0·90	0·75			1·60		1·30	

SOILTECH INTERNATIONAL LTD. DRN DATE: 5-8-89 PLAN No SL-2015