DESIGN CONSIDERATIONS OF CONSTRUCTION OF EMBANKMENTS/COMPARTMENTAL ROADS OF THE POLDERS

Presented by

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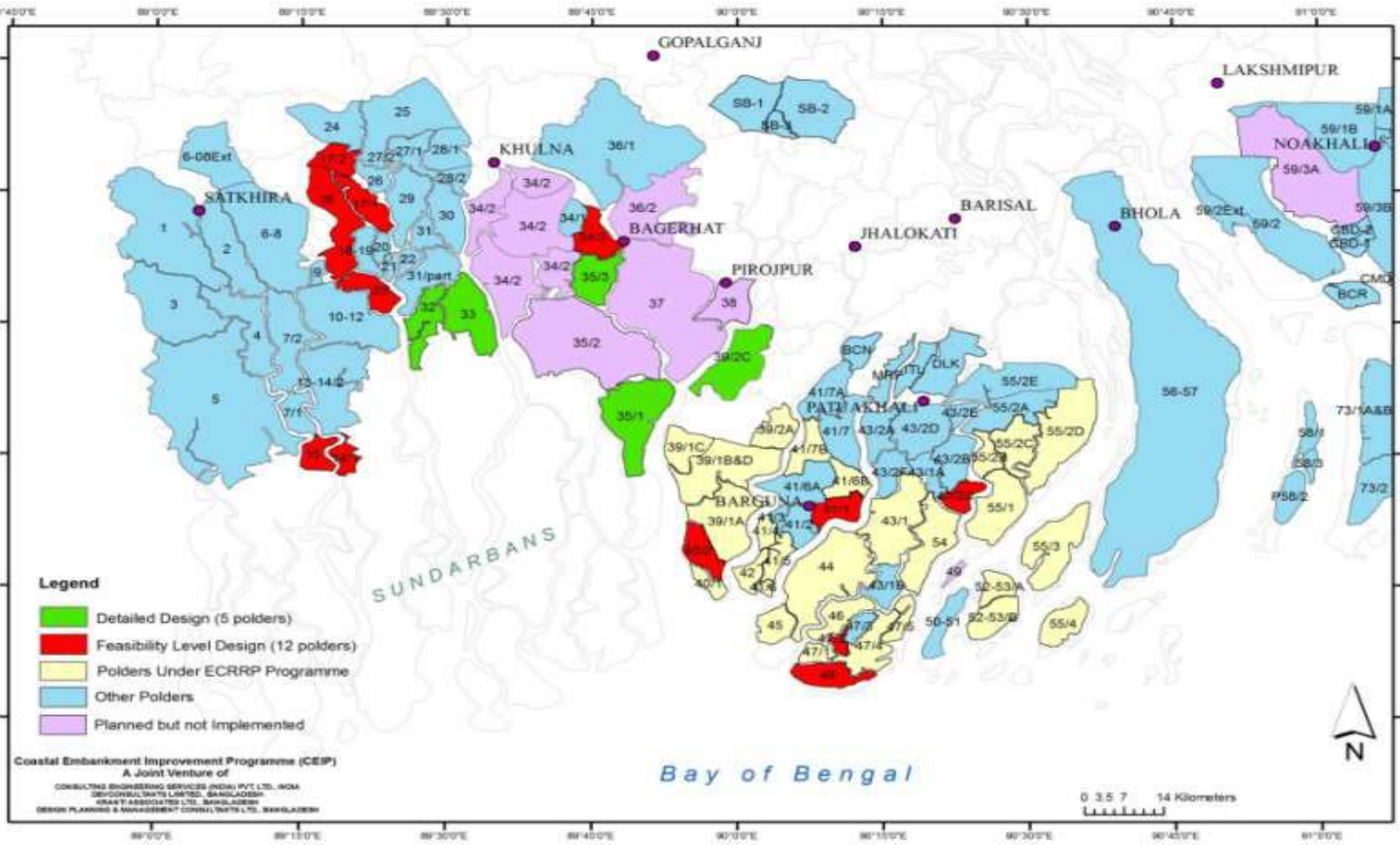
POLDERS


GOPALGANJ
LAKSHMIPUR
KHULNA
SATKHIRA
BAGERHAT
JHALOKATI
BARISAL
BHOLA
PIROJPUR
NOAKHALI
PATUAKHALI
BARGUNA
SUNDARBANS
Bay of Bengal
Legend
Detailed Design (5 polders)
Feasibility Level Design (12 polders)
Polders Under ECRRP Programme
Other Polders
Planned but not implemented
Coastal Embankment Improvement Programme (CEIP)
A Joint Venture of
0 3.5 7 14 Kilometers
N

DESIGN CRITERIA FOR EMBANKMENT

- For embankment design the major design parameter required is the selection of the magnitude of the flood flows, corresponding flood levels and their frequency of occurrence.
- To accomplish the design of embankment must fulfill the two major criteria:

  (a)The embankment must not be overtopped during the passage of the design flood i.e it should have sufficient freeboard.

  (b)The body of the embankment must remain stable against external forces and foundation failure during normal and critical conditions of loading.

TYPES OF EMBANKMENTS

Embankments may be classified under three major heads depending on the nature of protection they provide and their locations:

(a)Full flood protection embankments;

(b)Submersible embankments;

(c)Sea dykes.

ALIGNMENT OF EMBANKMENT

- The alignment of an embankment is governed mainly by technical, economical and morphological considerations. Economically the best alignment is that, which can be built as efficient and cheap as possible, requires least land acquisition, uses locally available suitable material and encloses as much land as possible.

SET BACK

- Set backs is the space between actual river bank and riverside toe of the embankment. Set back of an embankment is to be used on:
- Space for borrow pit
- Space for 10 years of erosion
- Enough floodway
- Minimum 6.0m
- For sea dyke, enough space for afforestation to reduce wave atuck.

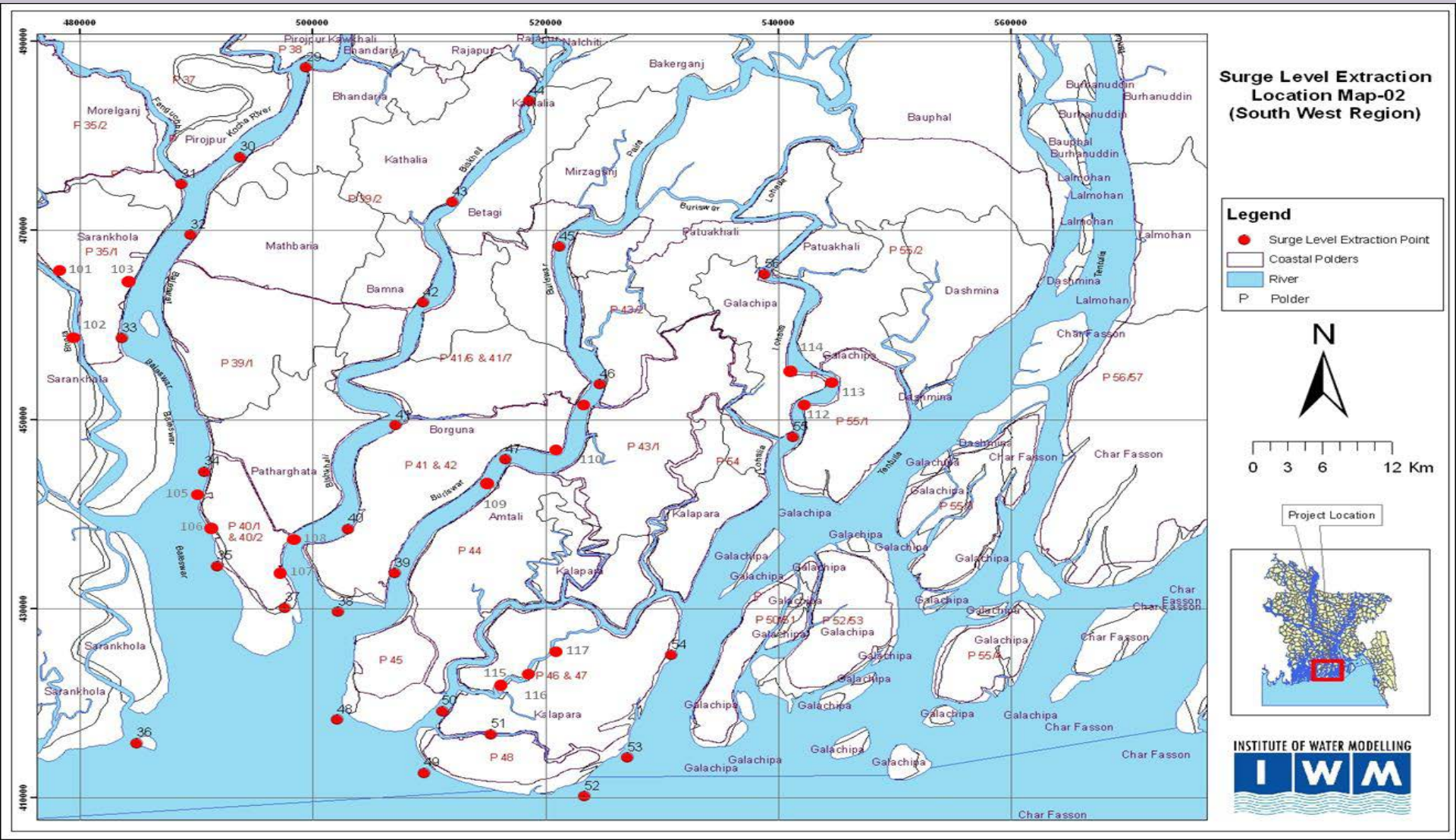
DESIGN FLOOD LEVELS

- Having selected the flood frequency the design flood levels need to be assessed .
- **Hydraulic Models is now been used for obtaining Design Parameters**
- The embankment crest levels is to be checked against the 25 years return period monsoon flood levels and the required free board.
- The 25 years return period Computed Maximum Surge levels With **Climate Change scenario**.

Determining Design Crest Levels for Embankments

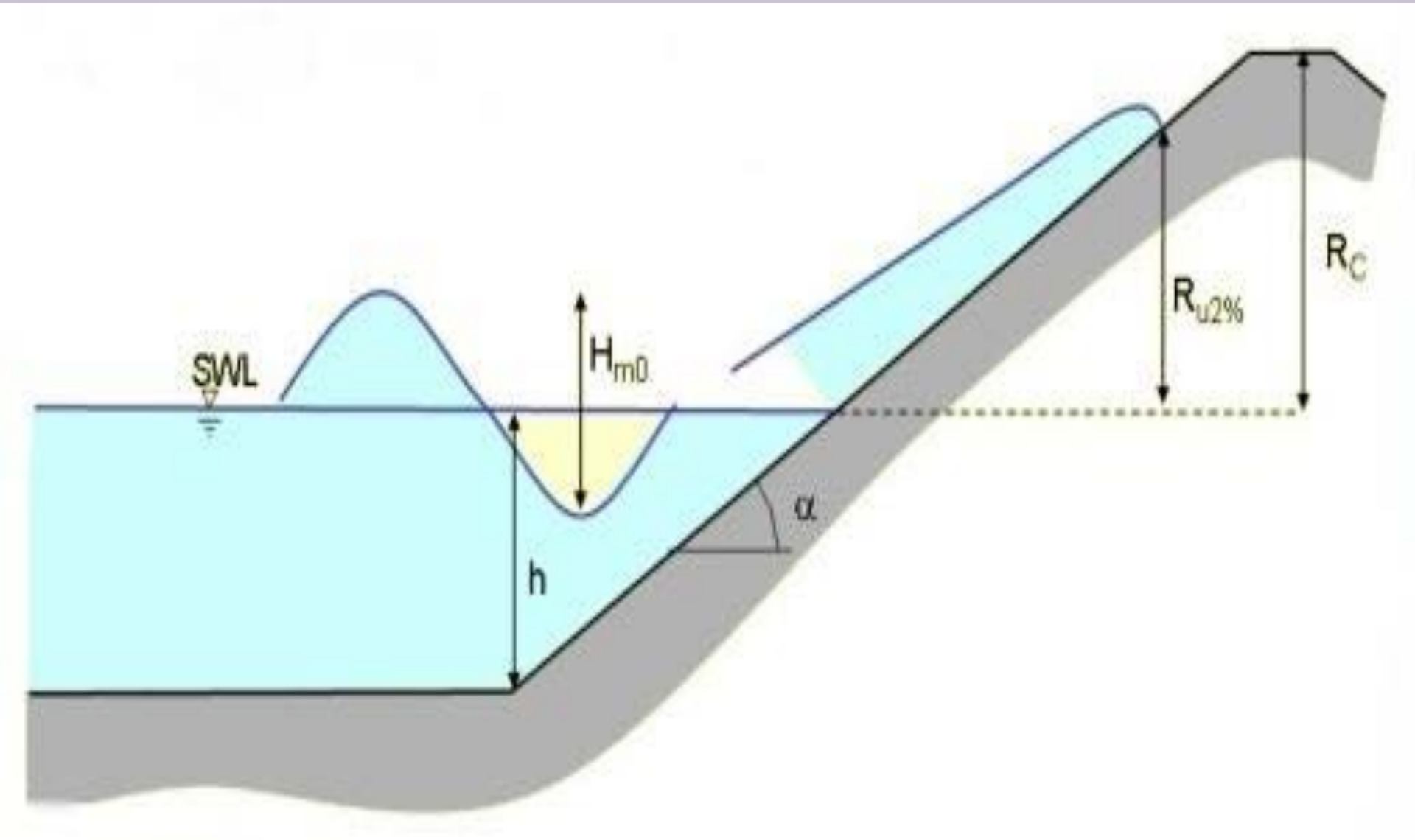
- f) The 25 years return period storm surge level
- g) Alternatives for freeboard depending on overtopping limit for several possible embankment slopes and roughness.
- h) 25 year return period monsoon level
- i) 25 year return period monsoon freeboard
- j) Allowance for subsidence

Locations of storm surge level for different return periods

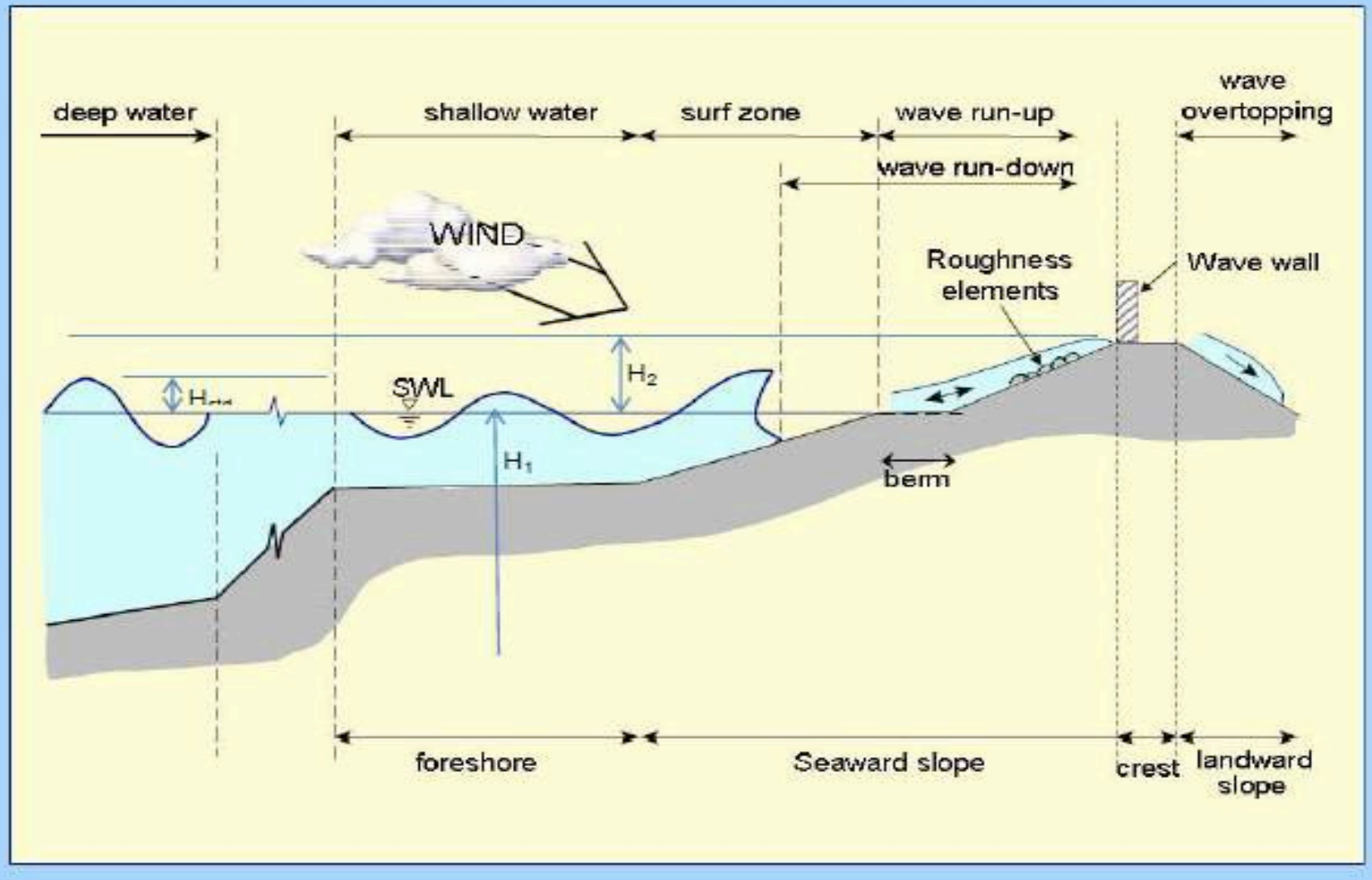


Tracks of Major Cyclones (1960-2009)

Definition of the wave run-up height on a smooth impermeable Slope



Layout for Wave Overtopping Calculation



Smooth slopes where surface roughness factor used as 1.0 (a) and roughness element where surface roughness factor used as 0.80 (b) (source: Eurotop Manual, 2007)

CREST WIDTH

The crest width of the embankment should be selected on the basis of the following criteria:

- Crest width should not be less than 2.50m.
- If the embankment is used as inspection road minimum crest width should be 4.30m.
- If the embankment is used as road, width shall be selected based on the type of road structure + 1.00m shoulder on both sides.

SIDE SLOPE

The criteria for selection for side slopes shall be based on:

- Embankment slopes should be stable against adverse seepage flow.
- Embankment should be stable against shear failure through its base.

For sea facing embankment:

- side slope of 1:7 on sea side and 1:3 on C/S are generally adopted , where the embankment Has no protective works.
- For protected embankment side slope of 1:5 on sea side and 1:3 on C/S are generally adopted .
- For interior embankment with less vulnerable to surge and wave side slope of 1:3 on both sides are generally adopted

DESIGN FOR SECTION

The embankment section must be selected so that:

- Countryside slopes remains steady during steady seepage at design high flood level.
- Riverside slope must be stable during rapid drawdown conditions where these prevail.
- Phreatic line should be well within the downstream face so that no sloughing of the slopes takes place and the factor of safety against boiling is not less than 1.5.
- Foundation base is flat enough to ensure a suitable factor of safety with respect to induced shear stress and shear strength of the embankment fill.
- River side slope must be protected against erosion by wave action, and the crest and countryside slope must be protected against erosion by wind and rain.

PHREATIC LINE OR LINE OF SEEPAGE

It is essential to determine the position of phreatic line, as its position will enable the designer to determine the following things:

- It gives a divide line between the dry and submerged soil for computations of shear strength of soil.
- It represents the top streamline and hence helps in drawing the flow net.

UPLIFT AND SEEPAGE QUANTITY

- The method involves drawing a flow net for the embankment under the design flood condition and taking values of nf and nd. The number of flow channels and number of potential drops respectively, from the flow net.
- Uplift: Factor of safety, F.S≥1.5
- Seepage Quantity: Limiting value of q should not exceed 1.0 m^3/day/m of embankment. Filter should be provided in discharge face if limiting value of q exceeds in any reach.

SLOPE STABILITY ANALYSIS

Generally the embankment slope stability is determined by the following methods:

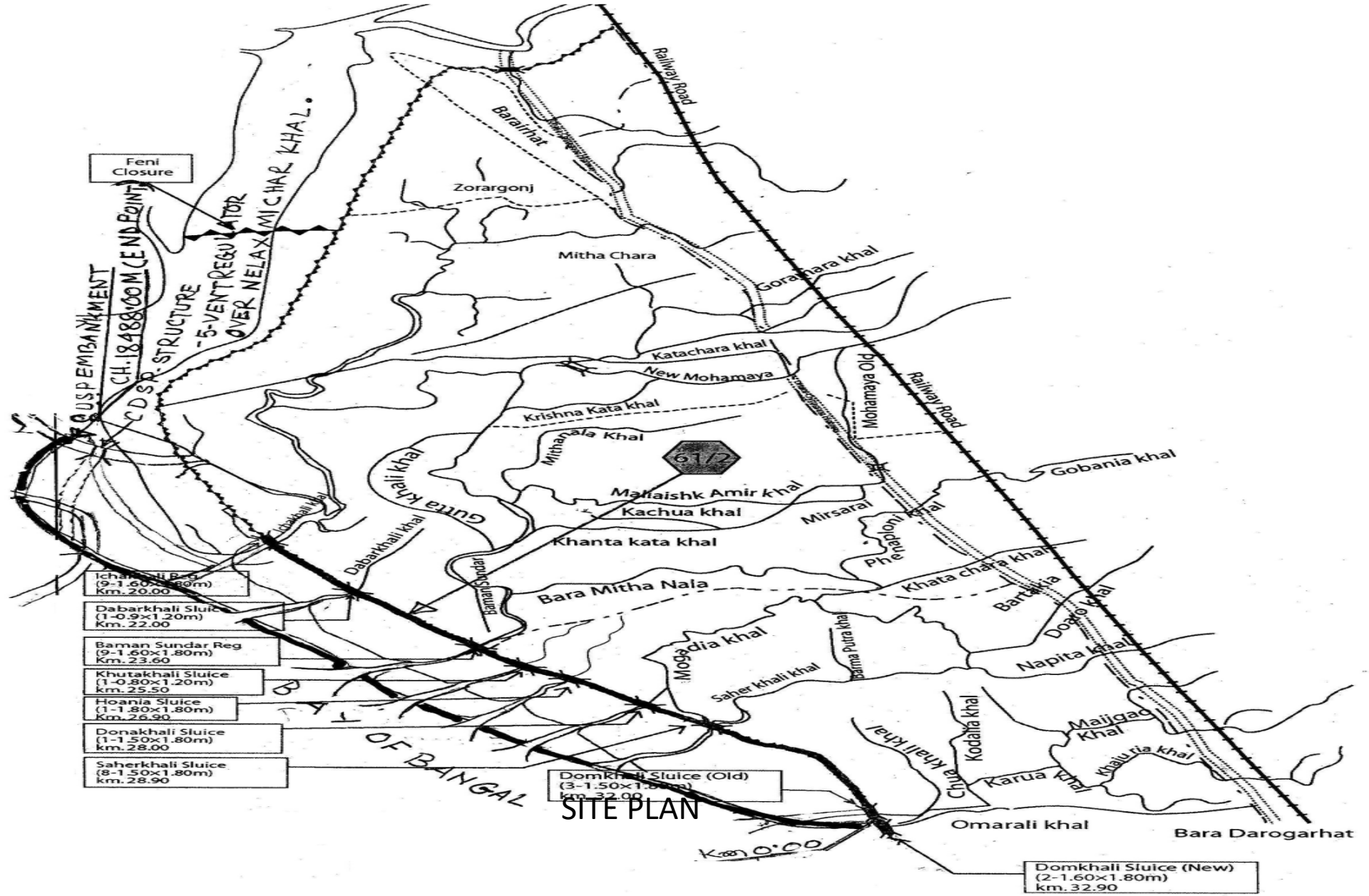
- Swedish Slip Circle Method
- Bishop’s Method

Land Subsidence

The lower deltaic area of Bangladesh is located on two active troughs, Faridpur Trough and Hatiya Trough. In this area, three types of subsidence are recognized (Hoque and Alam 1997):

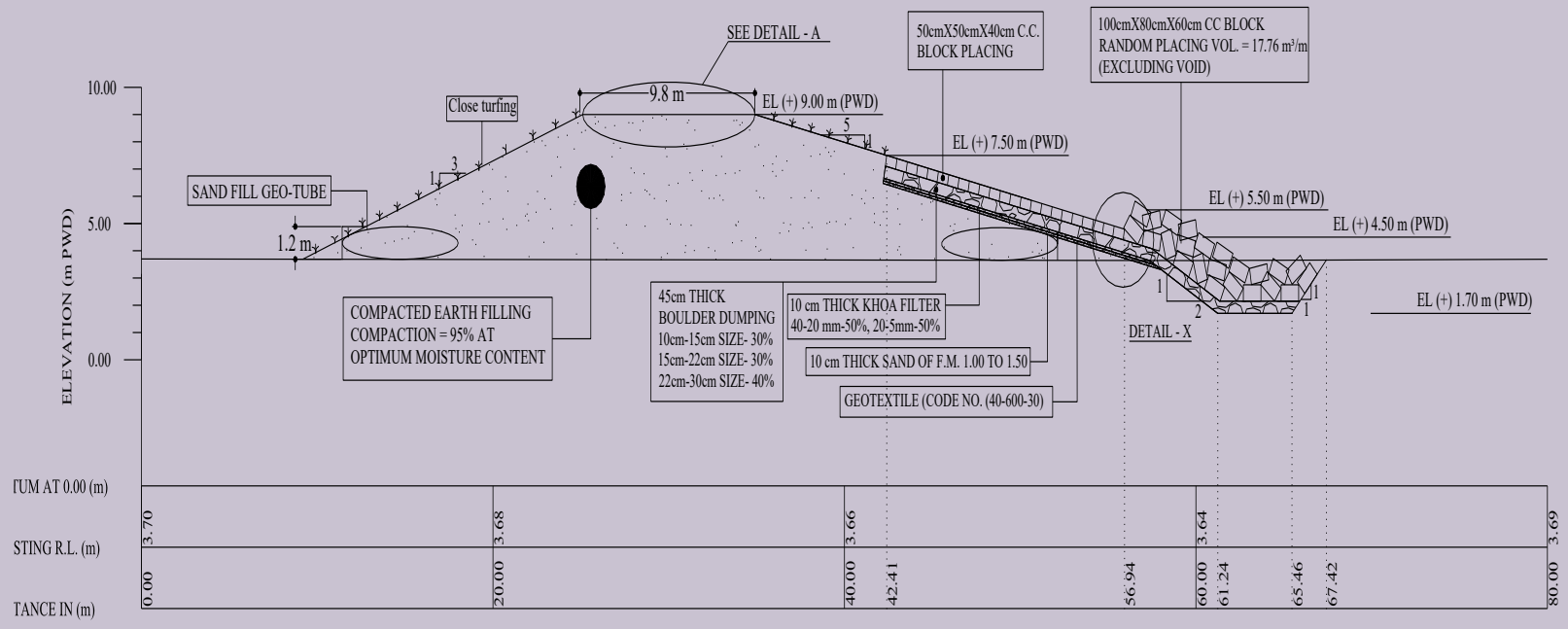
- Tectonic subsidence
- Compaction of peat layers; and
- Human induced subsidence

Typical Design Drawing of Coastal Embankment



SITE PLAN

Typical Design Drawing of Coastal Embankment



X - SECTION AT Km 9.050

(APPLICABLE FROM Km 0.000 TO Km 18.488)

Thank you