

Geotechnical Design of Highway 101 Exit 6 Embankment

1. PROJECT BACKGROUND

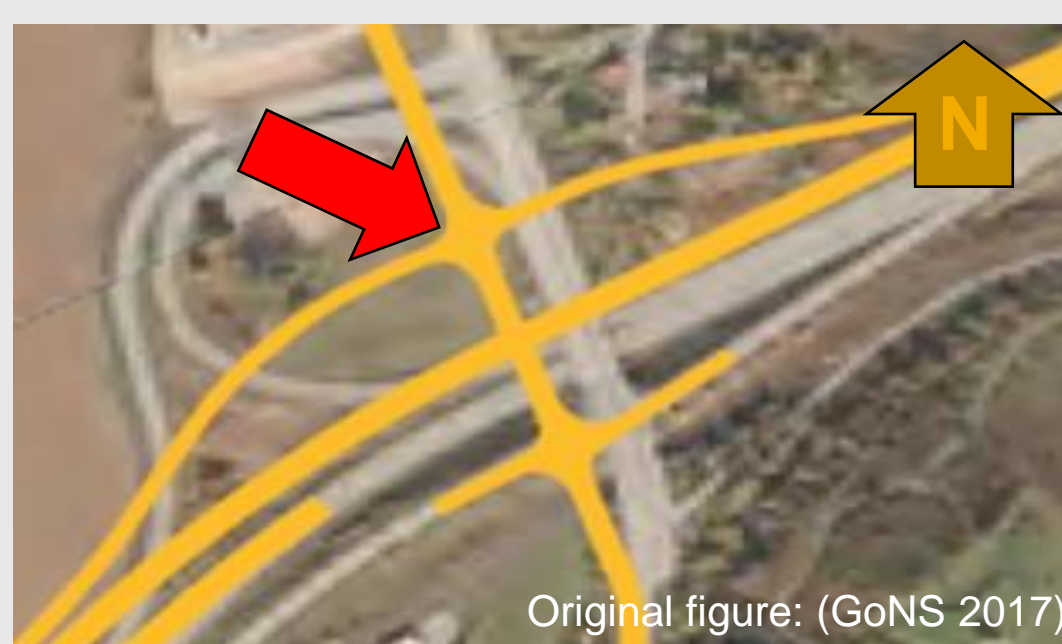
Scope of Work

As part of the Highway 101 Twinning Project, the new proposed Exit 6 interchange near Windsor, NS, requires the construction of two roundabouts and a new overpass. The embankment required to satisfy the vertical alignment poses substantial slope stability concerns due to the anticipated underlying strata.

Exit 6 rests in the low-lying areas of the Avon River, and pervasive deposits of fine-grained marine sediment was expected to undermine the interchange if left unaddressed. As well, the embankment construction must be completed within 2 years. EB Consultants was thus charged with the analysis of available geotechnical data and the production of a recommended embankment design to mitigate these concerns. The design should encompass cost efficiencies and sustainable components where practical.

Site Details

Site: Exit 6 Interchange
Location: North of Highway 101 in Windsor, Nova Scotia
Embankment: North side, ~10.3 meters in height
Soil: Finely grained marine sediment making thick clay layers



2. DESIGN STEPS

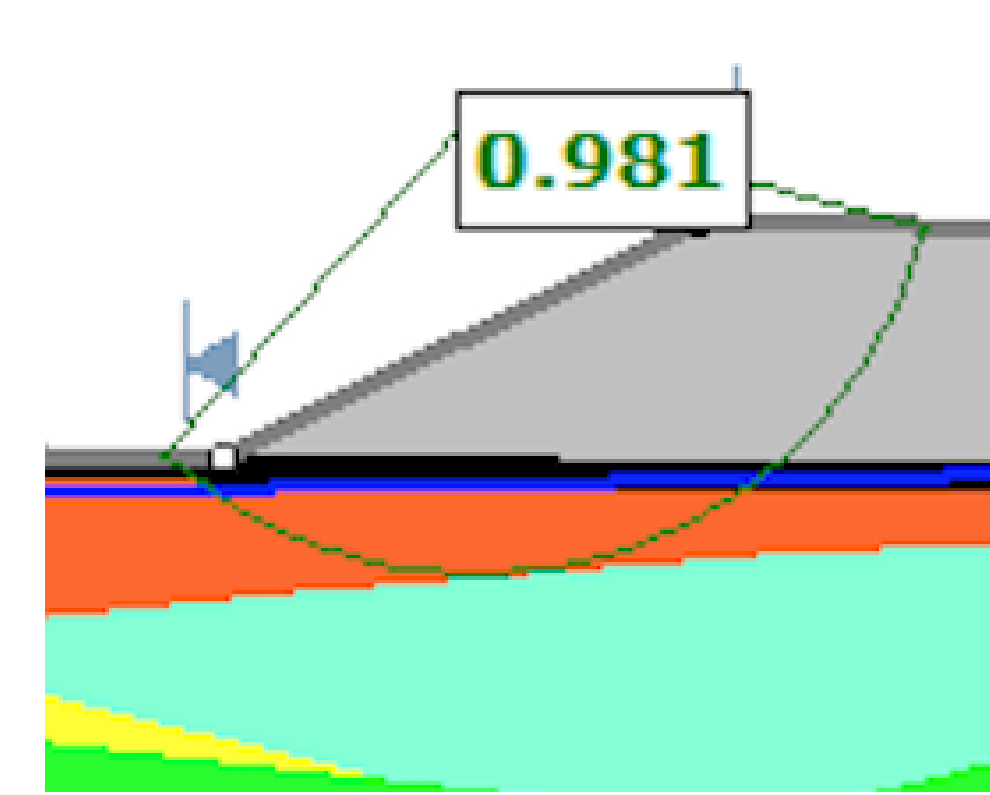
- Define the problem, visit the site
- Investigate soil conditions
- Identify stability concerns and soil properties
- Briefly identify and evaluate solutions
 - Single-staged construction
 - Rockfill material
 - Stabilizing berm
 - Light-weight fills
 - Staged construction
 - Without wick drains
 - With wick drains
- Evaluate preferred solution(s) for consolidation
- Produce final drawing(s) and recommendations

3. DESIGN OPTIONS

(a) to (c) Single-Stage Construction

(a) Tradition Fill Material

- ❑ Completion in single-phase
- ❑ Improved logistics
 - Homogenous construction
 - Single mobilization phase
 - Rapid construction

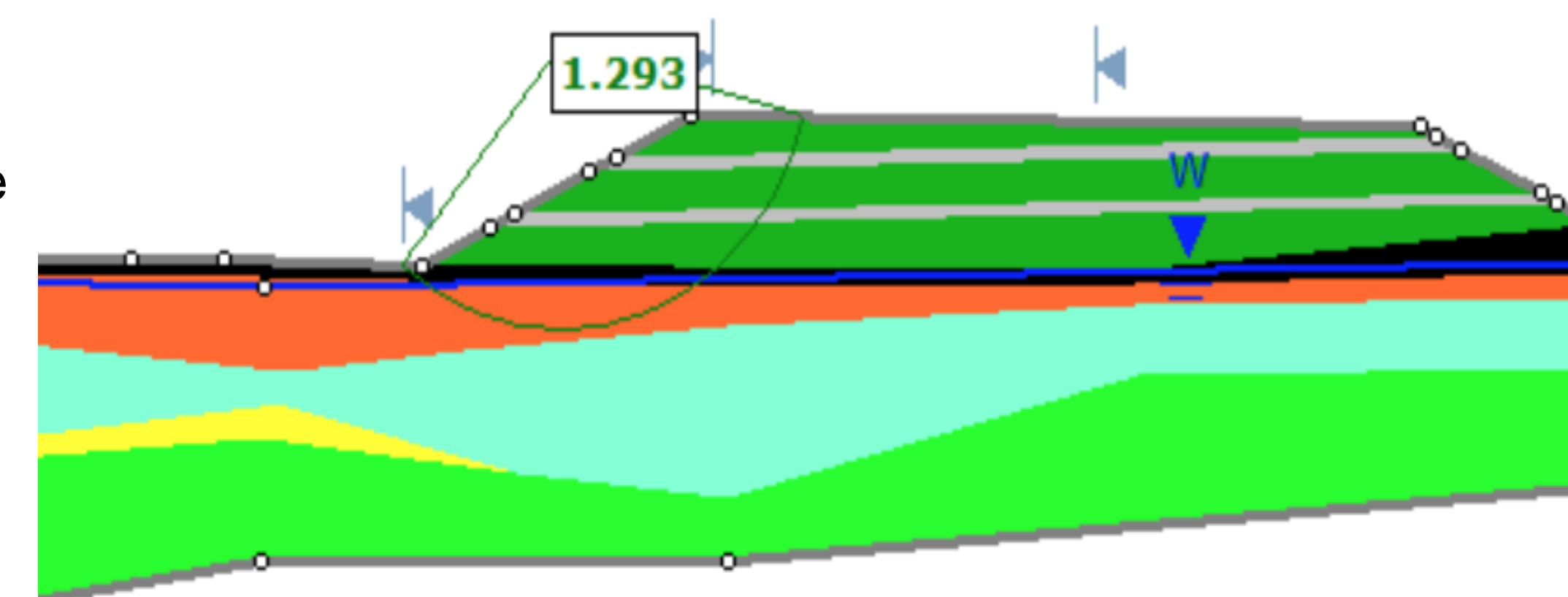


(b) Tradition Fill Material with Berm

- ❑ Completion in single-phase
 - Counter force increases FOS
- ❑ Improved logistics
 - Single mobilization phase
 - Rapid construction

(c) Light-Weight Materials: Tire-Derived Aggregate and Coal Combustion Residue

- ❑ Completion in single-phase
 - Light-weight material reduces surcharge
- ❑ Environmentally Considerate
 - Removes waste materials from landfills and processing facilities



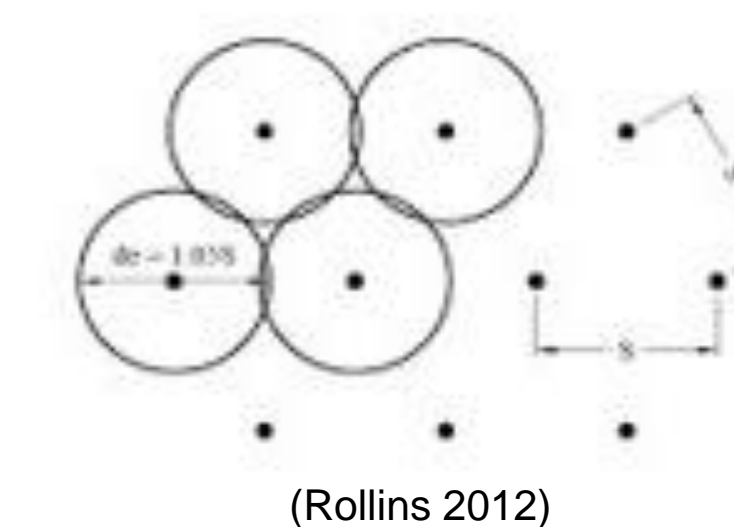
(d) and (e) Staged Construction

(d) Without Wick Drains

- ❑ Controlled Factor of Safety On-Site
 - Lift thickness and rate of consolidation control the FOS
- ❑ Rate of consolidation of clay layer is slow
 - Dependent on geologic properties
 - Estimate 90% consolidation in +6 years

(e) With Wick Drains

- ❑ Improves rate of consolidation of clay layer
 - Drainage path is reduced
 - Estimate 90% consolidation in 105 days
- ❑ Controlled Factor of Safety
 - Lift thickness and rate of consolidation control the FOS



REFERENCES

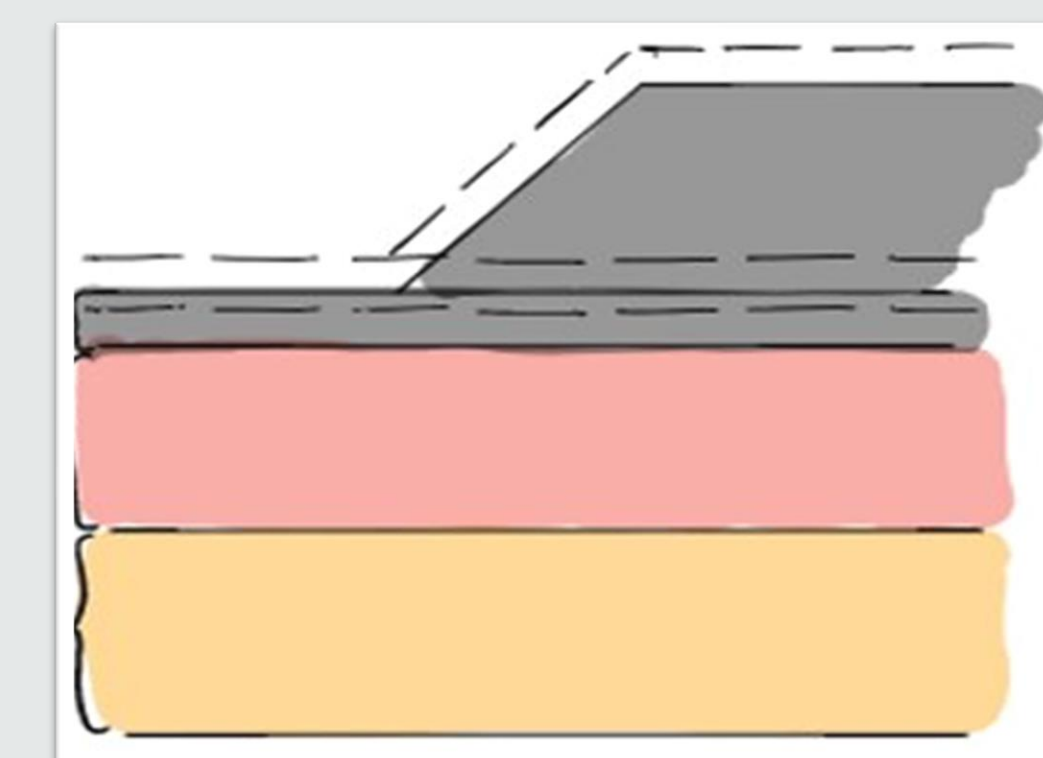
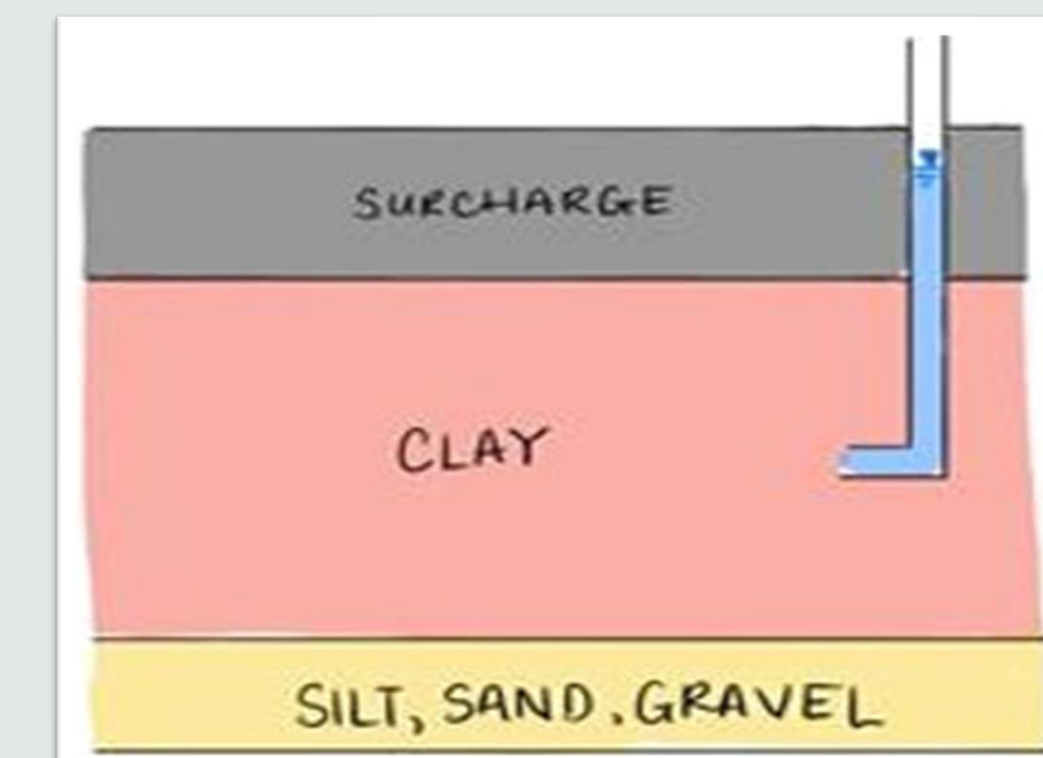
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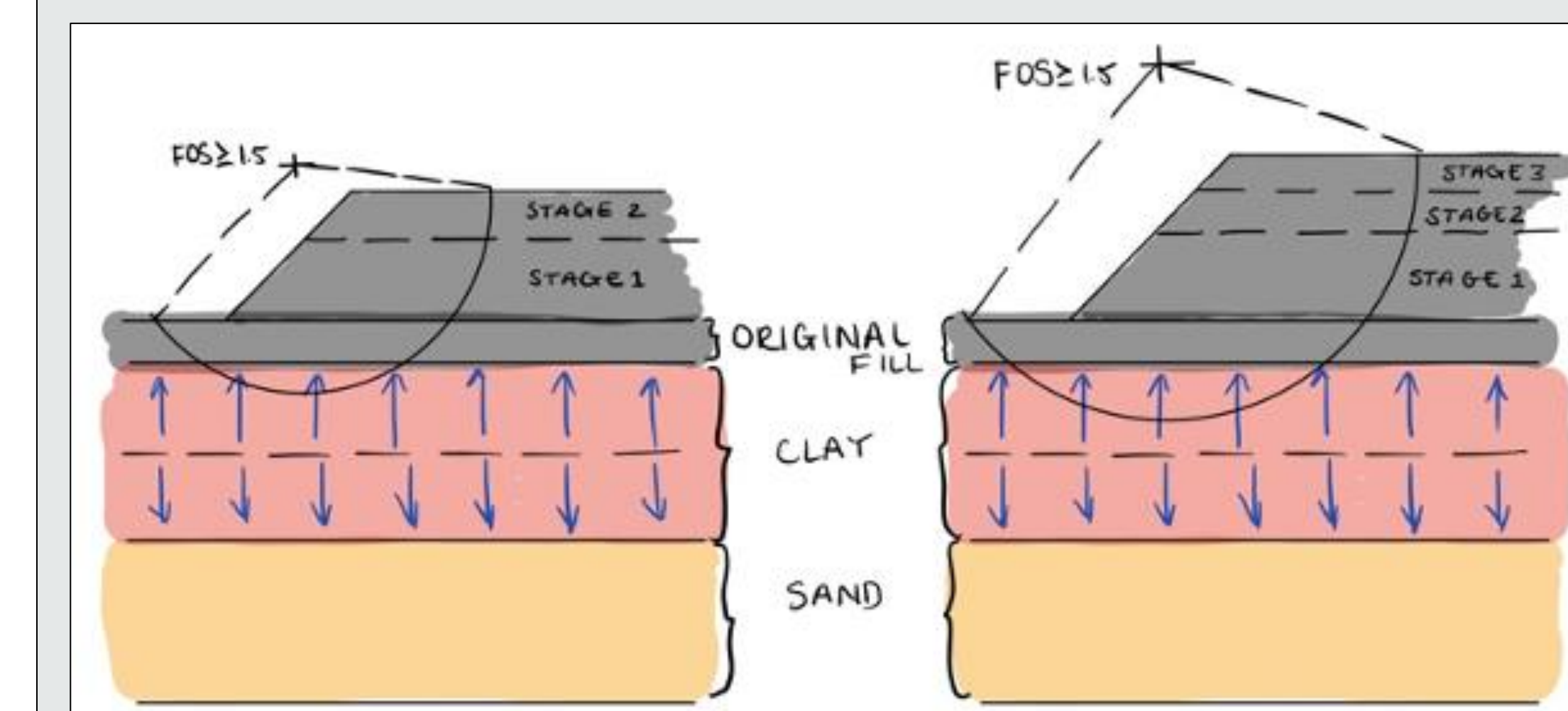
4. FINAL RECOMMENDATION(S)

- ❑ Monitoring Programme
 - Piezometers to measure porewater pressure
 - Settlement observation
- ❑ Settlement
 - Estimated 0.7 to 1.0 m
 - Add additional fill equal to settlement amount to achieve final grade



Staged - Without Wick Drains

- ❑ Initial stage of 6.25 m followed by 4 x 1 m stages
 - Estimated time to construct full embankment: 430 days
 - Estimated time to 90% consolidation of clay layer: +6 years



Staged - With Wick Drains

- ❑ Wick drains placed at 1.5 or 1.75 triangular spacing
- ❑ Initial stage of 6.25 m followed by 4 x 1 m stages
 - Estimated time to complete construction of full embankment: 24 to 39 days
 - Estimated time to 90% consolidation: 105 days
 - Additional cost of \$90,000 to \$125,000, depending on spacing

