Introduction

Problem Statements

Solutions for Application

Summary & Conclusions
Characteristics of Peat Soils

• **Lighter than water**
  – Always on top of formation & within depressions
  – High mobility with flow

• **Compressible & creeping**
  – High volumetric changes

• **Weak strength**
  – Low resistance against destabilising actions

• **High void ratio & permeable**
  – Good water storage & high seepage flow rate

• **Decomposable**
  – Low pH (acidic)
  – Fire hazard & combustible gases
Characteristics of Peats
Characteristics of Peats
Case Study 1

- Open pit coal mine operation
- Problems: High groundwater, excavation induced seepage flow, weak strength, high mobility flow failure
- Solutions: Dewatering & recharging
Ground Conditions

- Original GWT
- Drawdown GWT
- Peaty Soils
- Mudstone
- Coal Seam
Failure Mechanism
Option A – Dewatering Scheme

Diagram showing a dewatering scheme with components such as bund, recharge pond, peaty soils, steady state drawdown profile, mudstone, extraction well, coal seam.
Option B – Gravity Mass with Groundwater Barrier

- Original GWT
- Bund
- Earth Core
- Peaty Soils
- Mudstone
- Coal Seam
Option C – Structural Groundwater Cut-Off Wall
Option D – Ground Improvement

Jet Grouting/Stone Columns/Soil Mixing Piles

Mudstone

Peaty Soils

Original GWT

Coal Seam

Bund
## Technical Comparison & Cost

<table>
<thead>
<tr>
<th>Description</th>
<th>Pros</th>
<th>Cons</th>
<th>Cost</th>
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<tbody>
<tr>
<td><strong>A. Dewatering Scheme</strong></td>
<td>- Economical</td>
<td>- Uninterrupted SCADA Monitoring System</td>
<td>1.0X</td>
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<tr>
<td></td>
<td>- Simple &amp; Easy for Implementation</td>
<td>- Design Redundancy &amp; Contigency Plan</td>
<td>(Lowest)</td>
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<td></td>
<td>- Reusable of Equipment at other areas</td>
<td>- Large Setback Area</td>
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<td></td>
<td>- Environmental Friendly</td>
<td>- Backup Supply is also needed.</td>
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<td><strong>B. Gravity Mass with Groundwater Barrier</strong></td>
<td>- More Robust Design</td>
<td>- Costly and Time Consuming</td>
<td>3.9X</td>
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<td></td>
<td>- One Off Treatment</td>
<td>- Required Longer Haulage</td>
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<td></td>
<td>- Consume part of the Mining Waste.</td>
<td>- High Risk of Trench Excavation</td>
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<td>- Requiring Access of Heavy Machineries</td>
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<td><strong>C. Structural Groundwater Cut-Off (Wall Diaphragm Wall)</strong></td>
<td>- More Robust Design</td>
<td>- Costly &amp; Difficulty in Tremie Concrete Supply</td>
<td>5.6X</td>
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<td></td>
<td>- One Off Treatment</td>
<td>- Risk of Unstable Wall Trenching</td>
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<td>- Simple &amp; Easy for Implementation</td>
<td>- Acidic Condition</td>
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<td>- Requiring Access of Heavy Machineries</td>
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<td></td>
<td></td>
<td>- Less Environmental Friendly</td>
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<tr>
<td>Structural Groundwater Cut-Off Wall (Sheet Piled Wall)</td>
<td>- More Robust Design</td>
<td>- Costly Installation of Sheet Pile Walling Works</td>
<td>3.1X</td>
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<tr>
<td></td>
<td>- No Serious Maintenance is needed</td>
<td>- Requiring Access of Heavy Machineries</td>
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<td>- Sheet Piles are Recycleable</td>
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<td>- Simple &amp; Easy for Implementation</td>
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<tr>
<td><strong>D. Ground Improvement</strong></td>
<td>- More Robust Design</td>
<td>- Costly Installation</td>
<td>13.4X</td>
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<td>- One Off Treatment</td>
<td>- Less Environmental Friendly</td>
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<td>- Simple &amp; Easy for Implementation</td>
<td>- Requiring Access of Heavy Machineries</td>
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Case Study 2

- Palm oil mill project
- Problems: Weak soil strength to support structural loading, excavation instability, consolidation & creep settlement, high permeability
- Solutions: Pile foundation, structural retaining system, piled raft system, ground reinforcing system, pond lining system
Site Location

MALAYSIA

SINGAPORE

SITE

SUMATRA
Project Requirements

- Reduce Platform Thickness
- Reduce Construction Time & Cost
- Use Local Materials & Reduce Transported Construction Materials from Outside
- Innovative Geotechnical Design for Very Difficult Ground Conditions
Option 2

- **Crusher run**
- **OGL**
- **Heavy Machinery**
- **Steel Column**
- **Column 1.1m Sand Fill**
- **Light Machinery**
- **Steel Column**
- **Pile cap**
- **36m Prestressed Concrete Circular Spun Piles**
- **46m Very Soft to Medium Stiff Compressible Marine Clay**
- **9m Hardwood Blanket Piles**
- **9m Hardwood Piles**
- **Non Suspended Slab**
- **Dense Sand**
Hardwood Blanket Piling
Reinforced Soil Platform

Lean Concrete over Hardwood Piles

Column Stump

Crusher Run to be filled to 1.1m high

Woven Geotextile
Frictional Pile Foundation for Structure
Temporary Pilecap Excavation
Tipping Pit Excavation
Tank Foundation

2500-Ton Oil Storage Steel Tank

R. C. Tank Raft

1.1m Sand Fill

Prestressed Concrete Circular Spun Piles With Varying Lengths (24m, 30m and 36m)

46m Very Soft to Medium Stiff Compressible Marine Clay

Dense Sand
Tank Foundation
Completed Tank Foundation
Retaining System for Crane Bay (Gravity Containment System)
Perspective View FFB Crane Bay

- 3.6m Canal Water
- 46m Very Soft to Medium Stiff Compressible Marine Clay
- 12m Long FSP III Steel Sheet Piles
- Dense Sand
- Reinforced Concrete Wharf Deck
FFB Crane Bay

Canal to be excavated

FSPIIIA Sheet Pile Wall
FFB Crane Bay
Completed FFB Crane Bay & Canal
Effluent Pond
Completed Palm Oil Mill
Summary & Conclusions

Understand the behaviours of ground materials
Identify problem statements
Devise options for solution