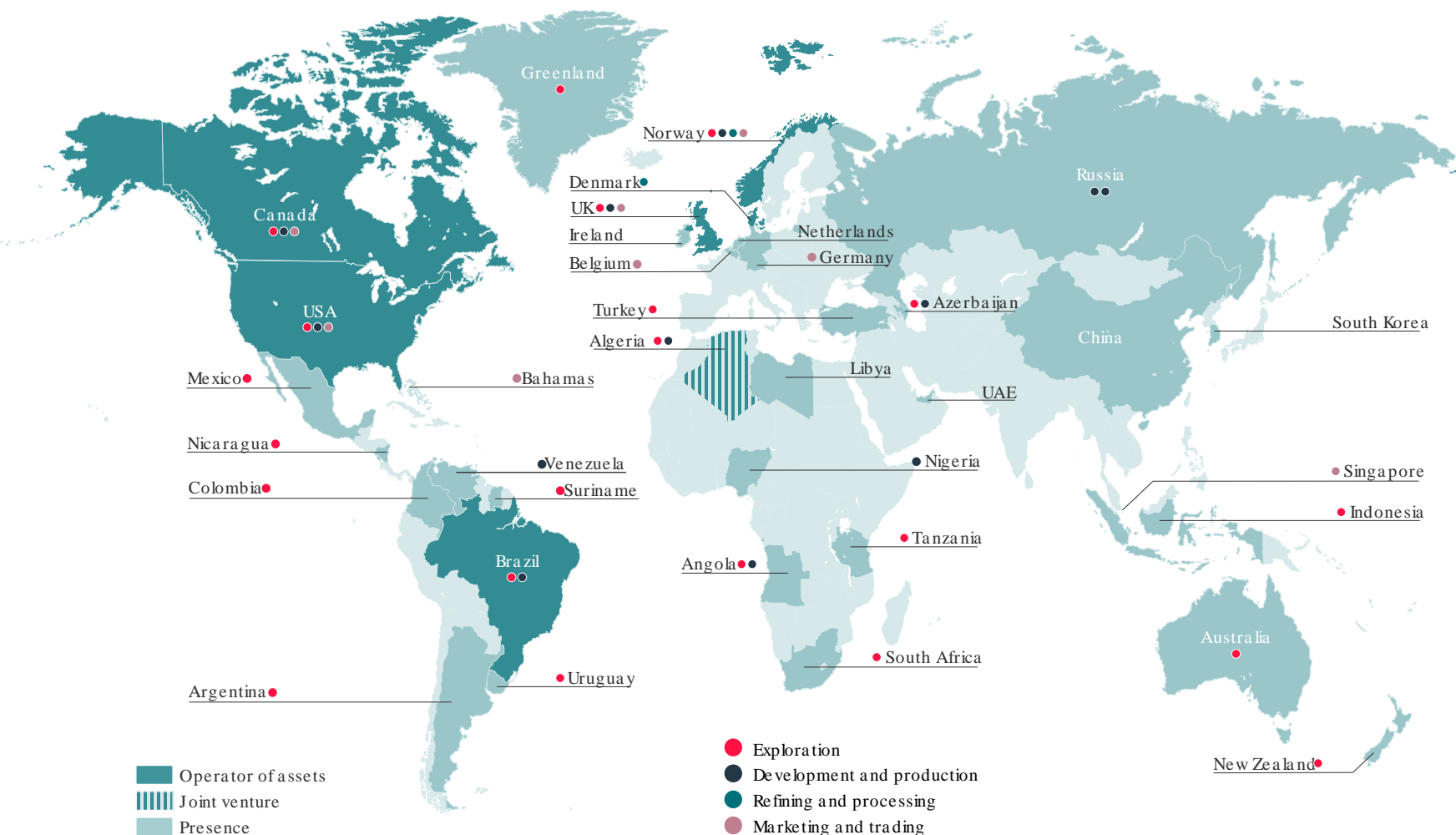




Geotechnical considerations throughout the entire project life cycle: from perception to execution

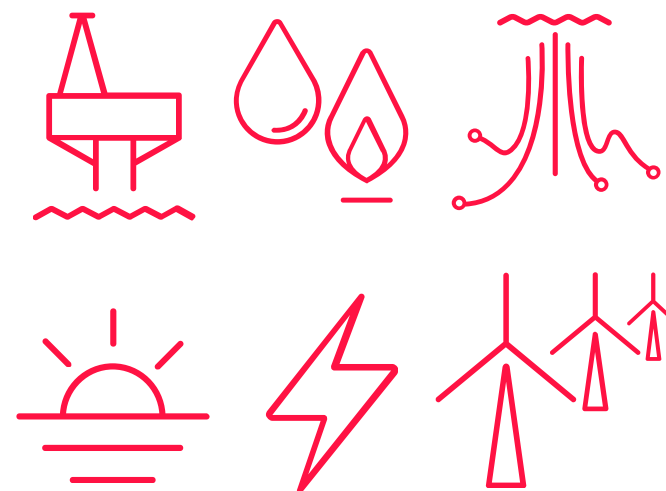
Gülin Yetginer, Equinor Leading Advisor Geotechnics

Equinor: shaping the future of energy



«We aim to be the world's most carbon-efficient oil and gas producer, and are investing actively in renewables.»

Turning natural resources into energy for people and progress for society



How can we ensure that considerations do not become challenges?

challenge = unidentified risk

The Compliance and Leadership model

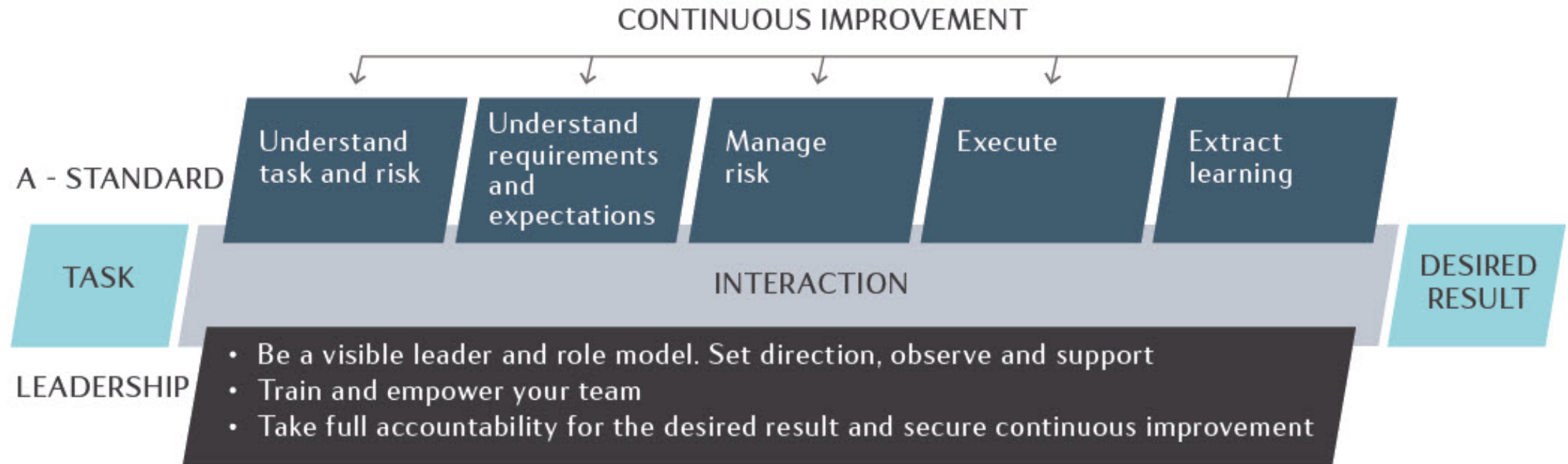
A - STANDARD



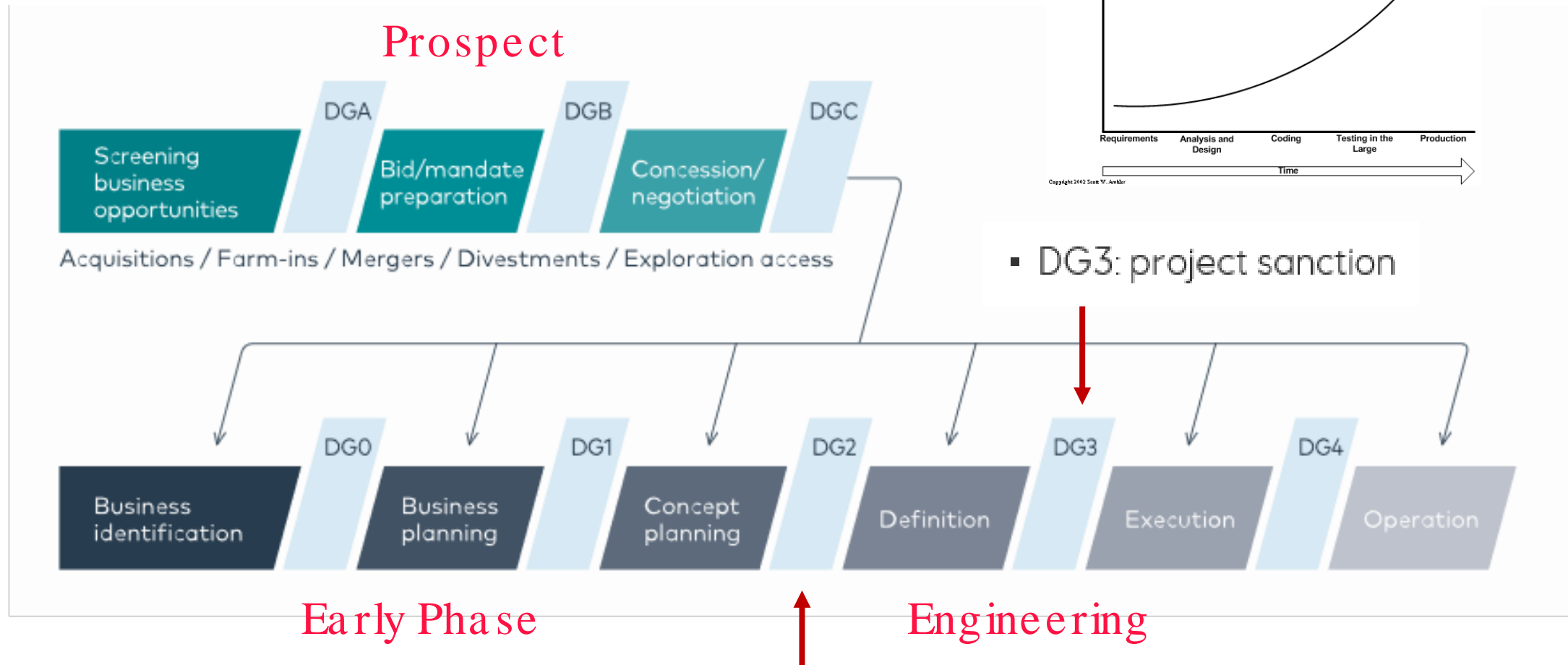
LEADERSHIP



The Compliance and Leadership model



Project Lifecycle: «The Capital Value Process»



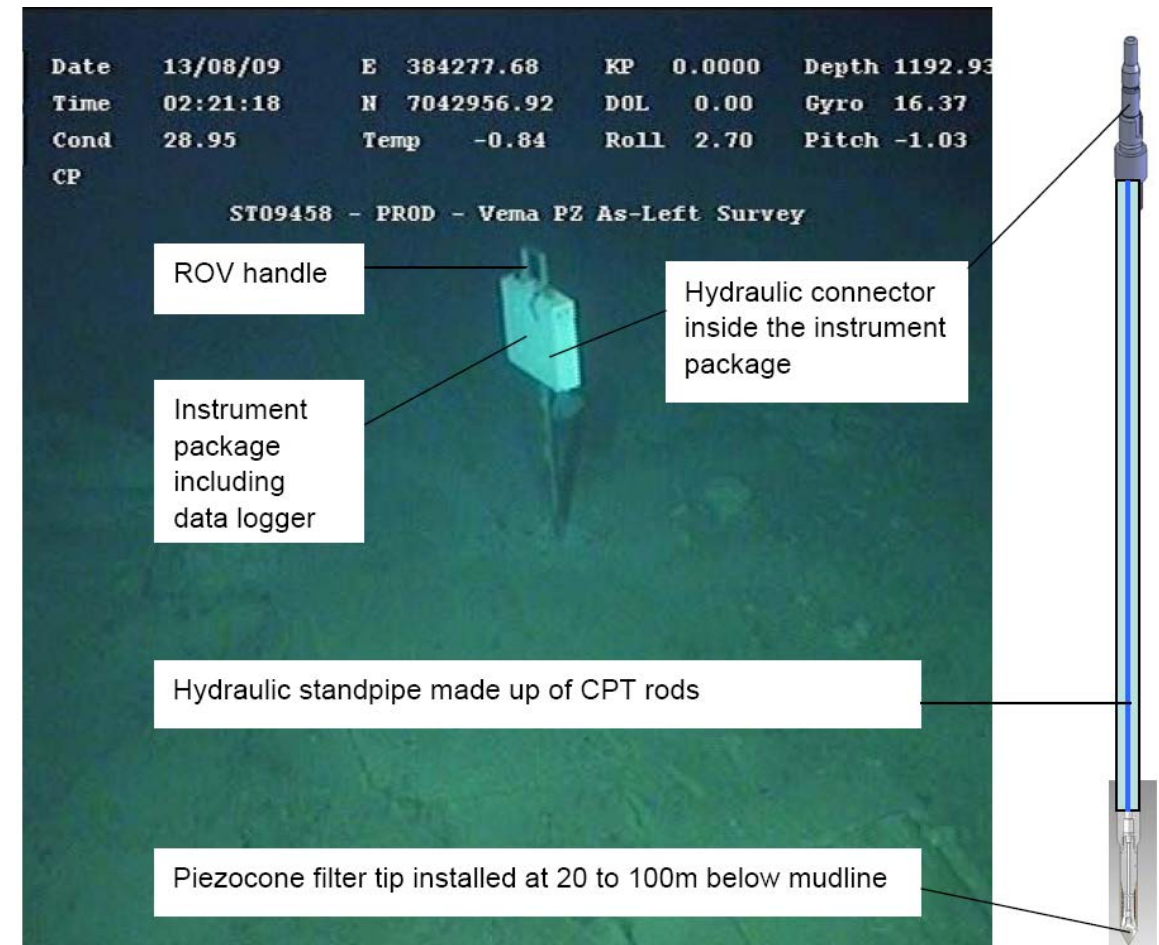
- DG2: approval to start Front-End Engineering and Design (FEED) based on selected concept

Early Phase: Understanding the Soil

- “Memory”: the soil response depends on the geological and man-made past (has it been loaded before? decreased porosity and water content)
- “Mood”: the soil response depends on how we treat it and load it (how much drainage is expected)
- “Temper”: it is possible to trigger an unexpected failure if the bigger picture is not well understood (regional geology)
- Important to perform a good quality soil investigation to assess the above and construct a ground model that presents the complete picture

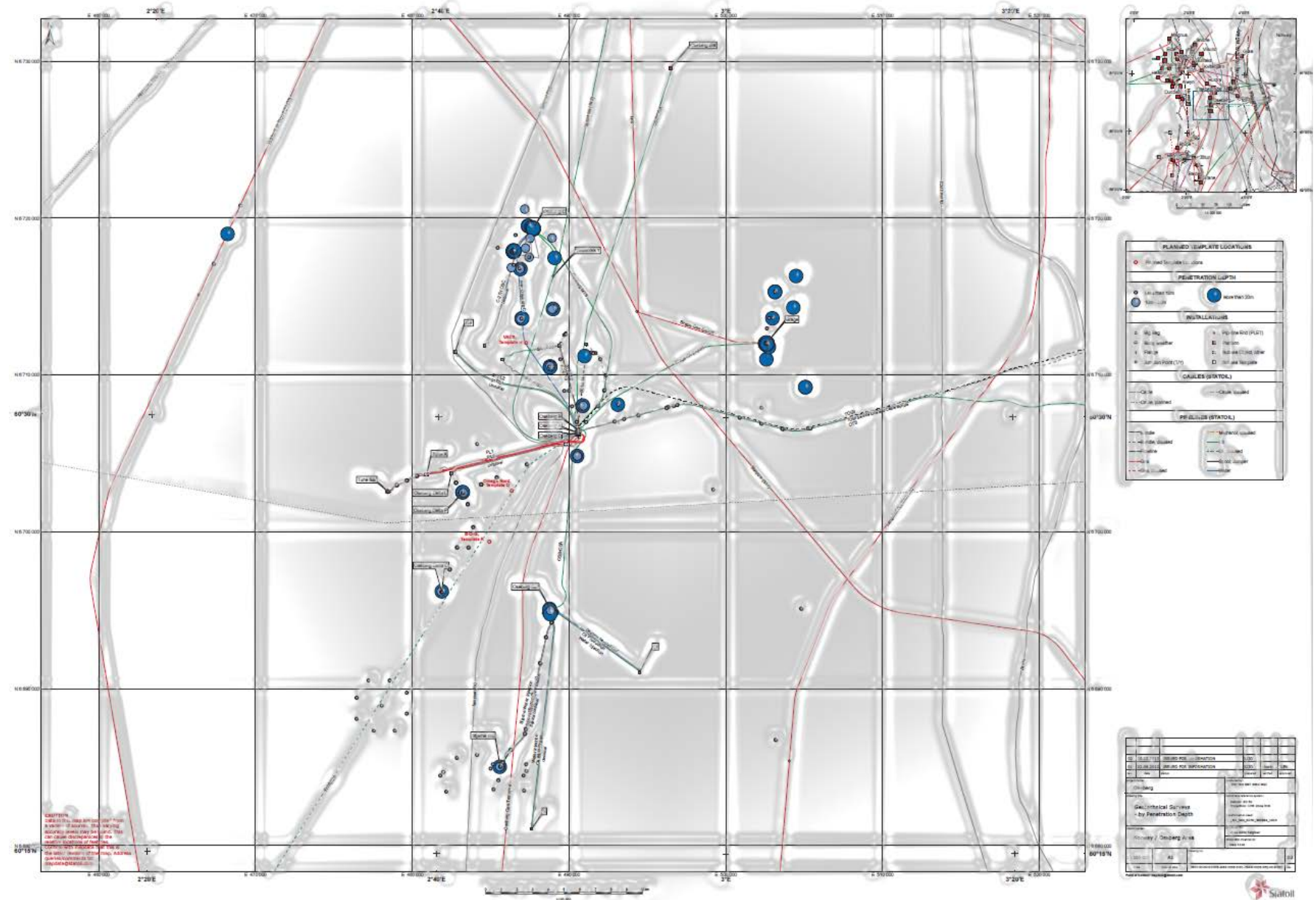
Early Phase: Geohazards

- Pore pressure modelling
- Slope stability
- Shallow gas and other drilling hazards
- Earthquakes



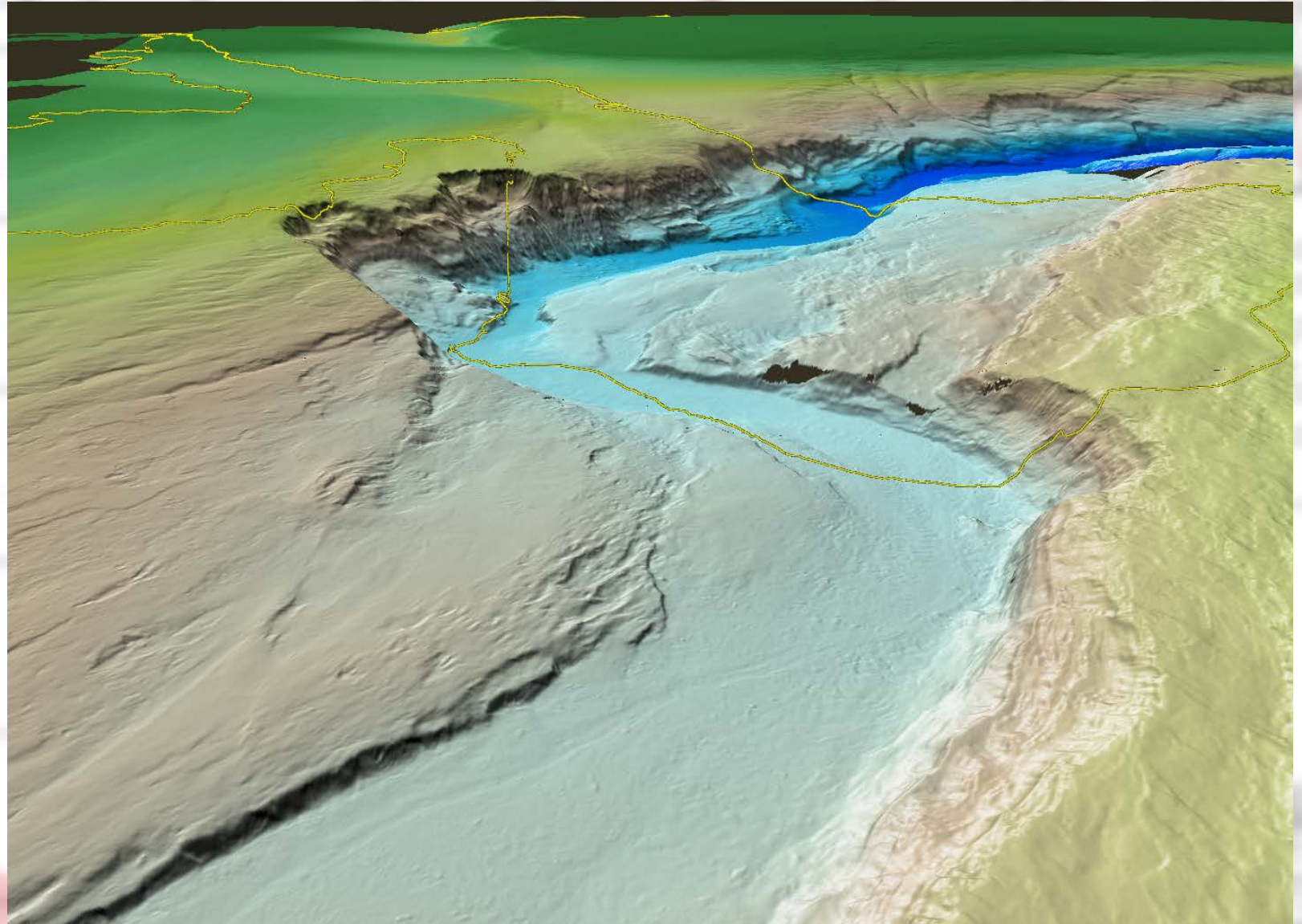
Desktop Study

- Information sources typically available during the desktop study phase for a new project development in a mature area (e.g. North Sea):
 - Geological setting
 - Preliminary geophysical information
 - Geotechnical information from the larger development area
 - Installation experience



Desktop Study

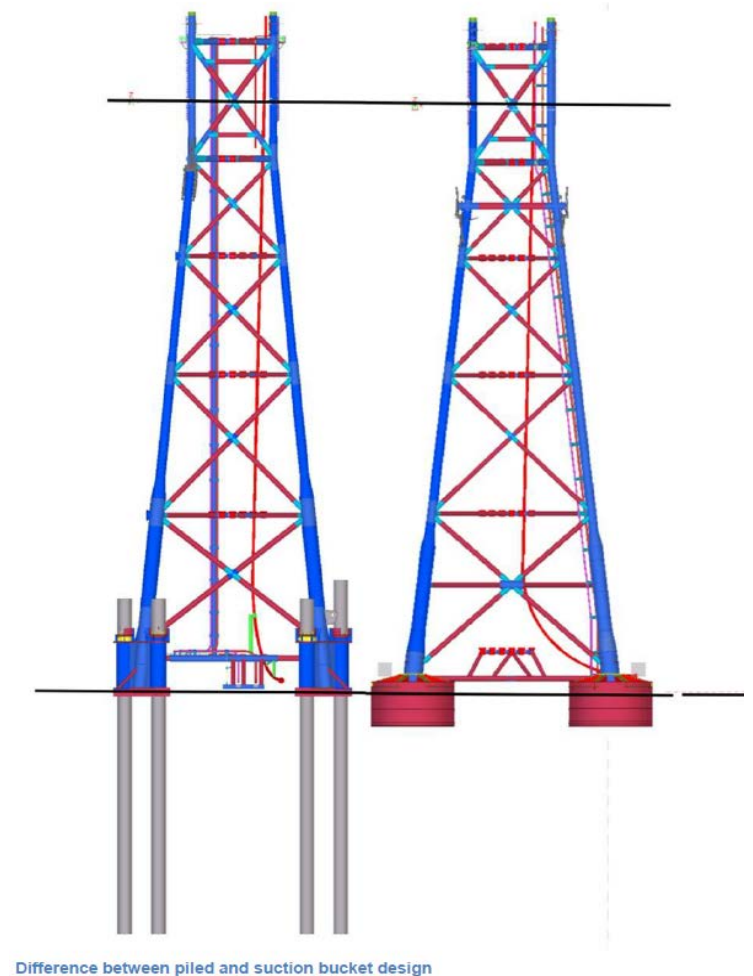
- Information sources typically available during the desktop study phase for a new project development in a new area (e.g. Tanzania):
 - Geological setting
 - Preliminary geophysical information



Early Phase: Soil Investigation Scope of Work Definition

“The scope of work for the ABC Development Area soil investigation consists of:

- A detailed soil investigation at TEMPLATE X where geotechnical information is required for foundation design purposes*
- Optional soil investigation at an additional template location*
- Optional soil investigation for an UnManned Wellhead Platform*
- Pipeline routes between the new template locations and existing infrastructure to determine pipe soil interaction properties and to assess trenchability”*

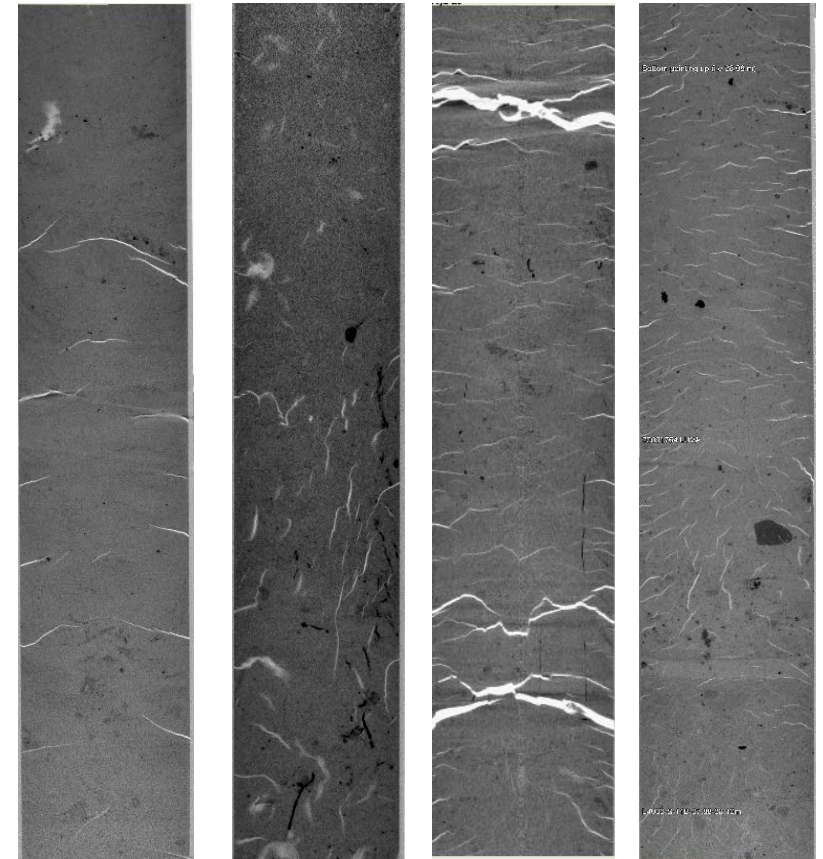


Early Phase (and beyond): Operations

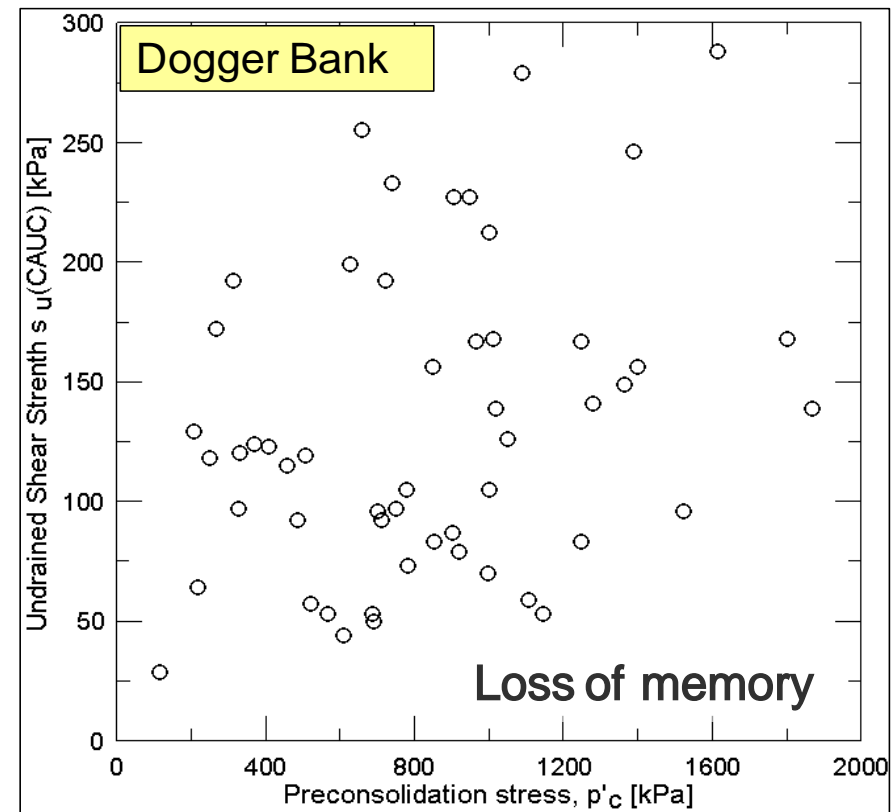
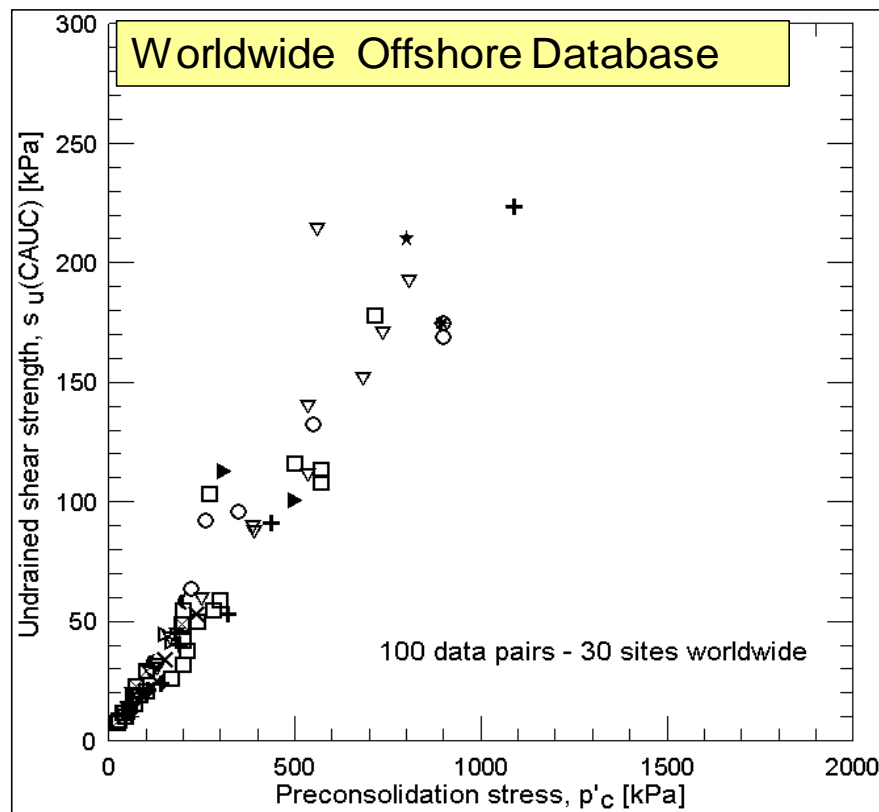
- Selection of geotechnical drilling equipment:
 - Remoteness
 - Water depth
 - Expected soil conditions
 - Potential geohazards
- Design and selection of foundation concept
 - All of the above
 - Installation / penetration



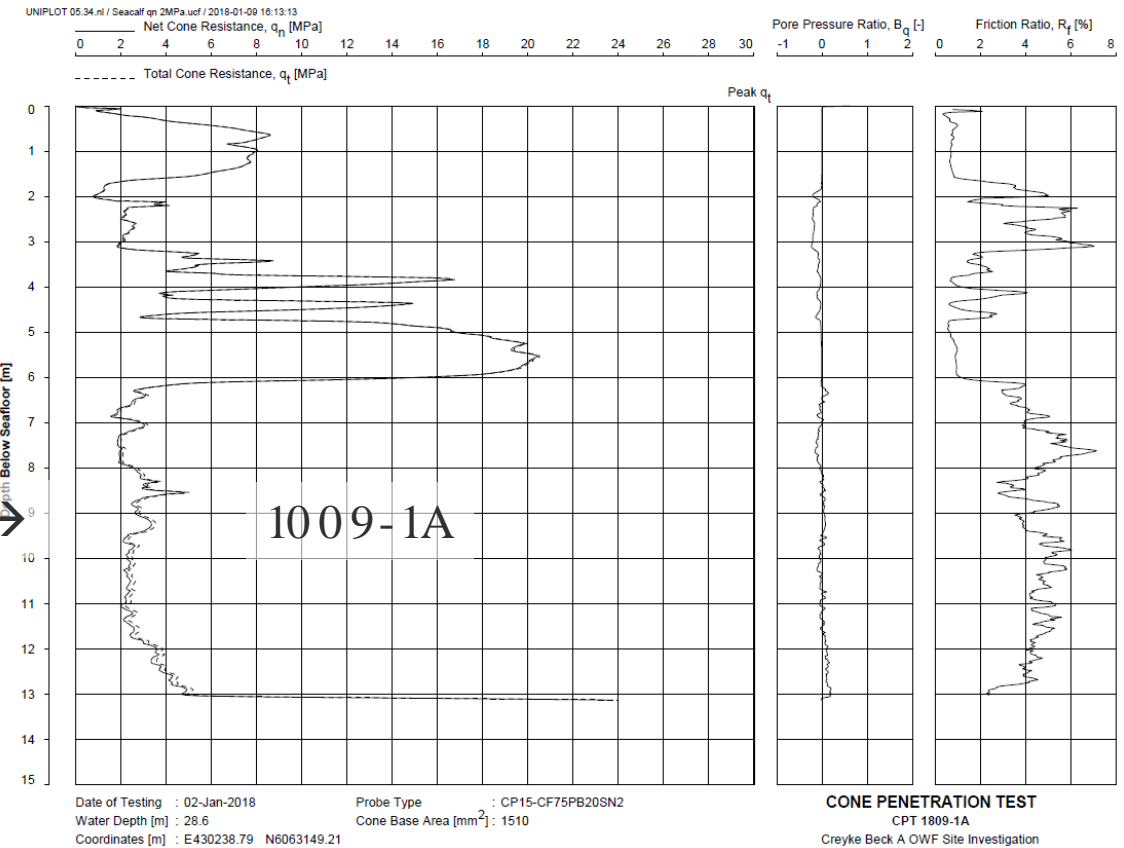
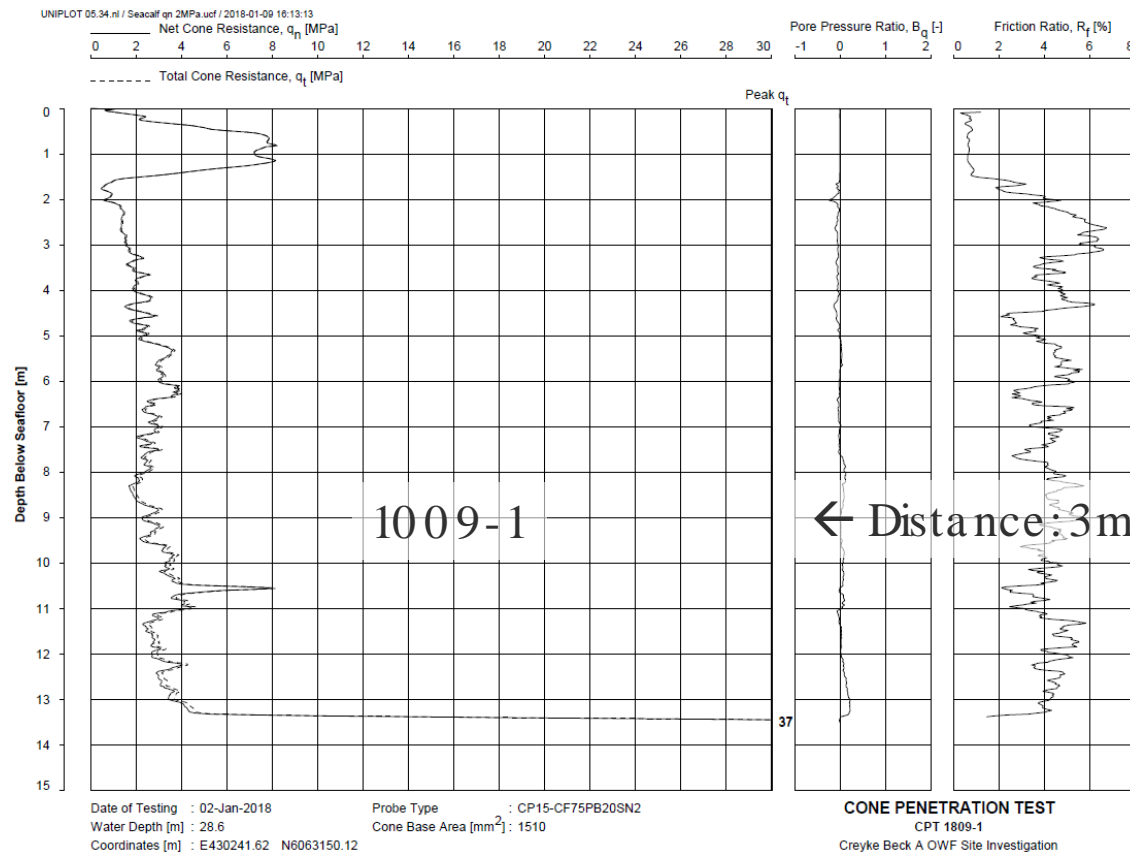
Early Phase: Soil Investigation Challenges / Lab Testing Considerations



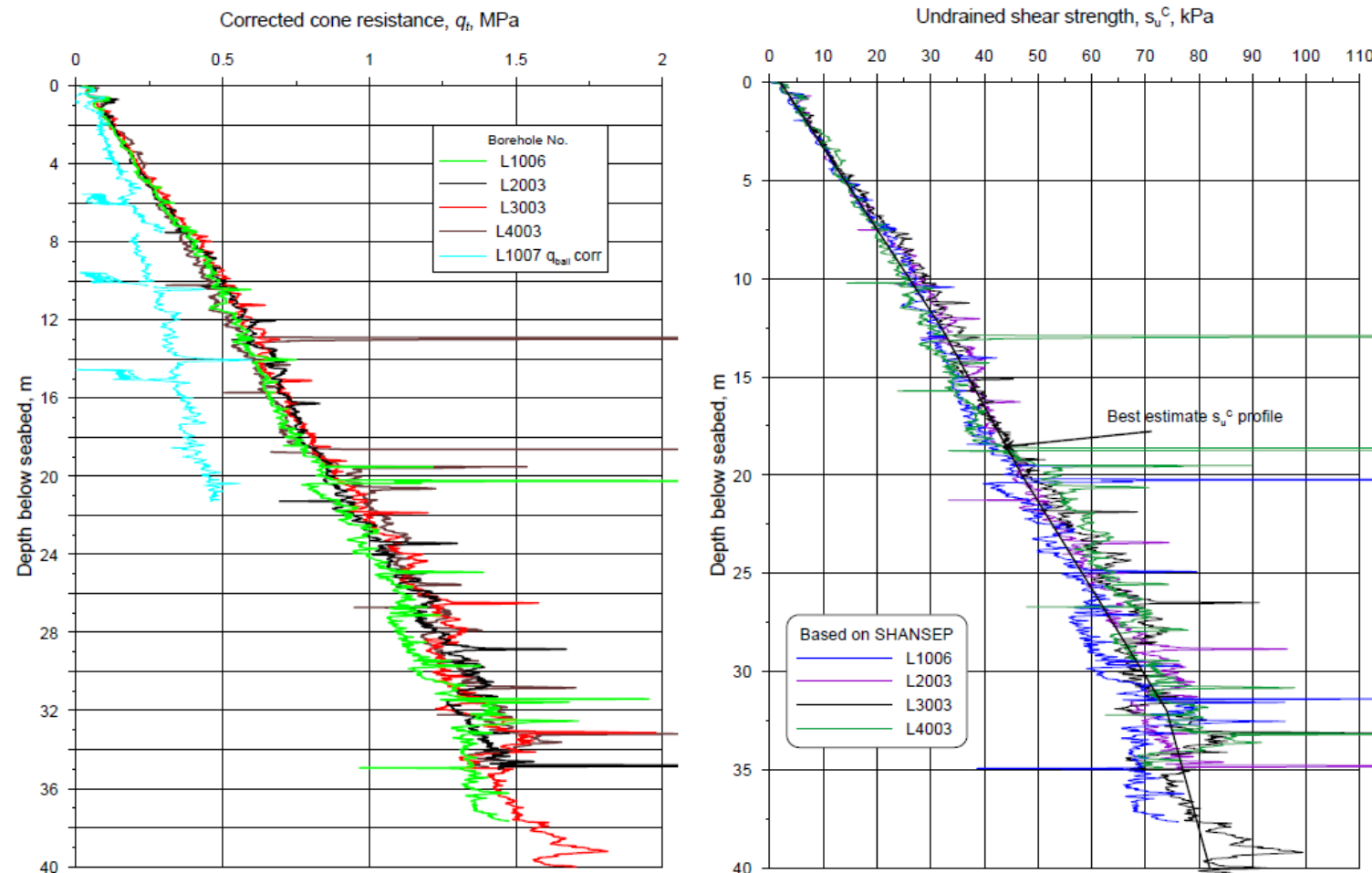
Early Phase: Lab Testing



Engineering: Natural Variability

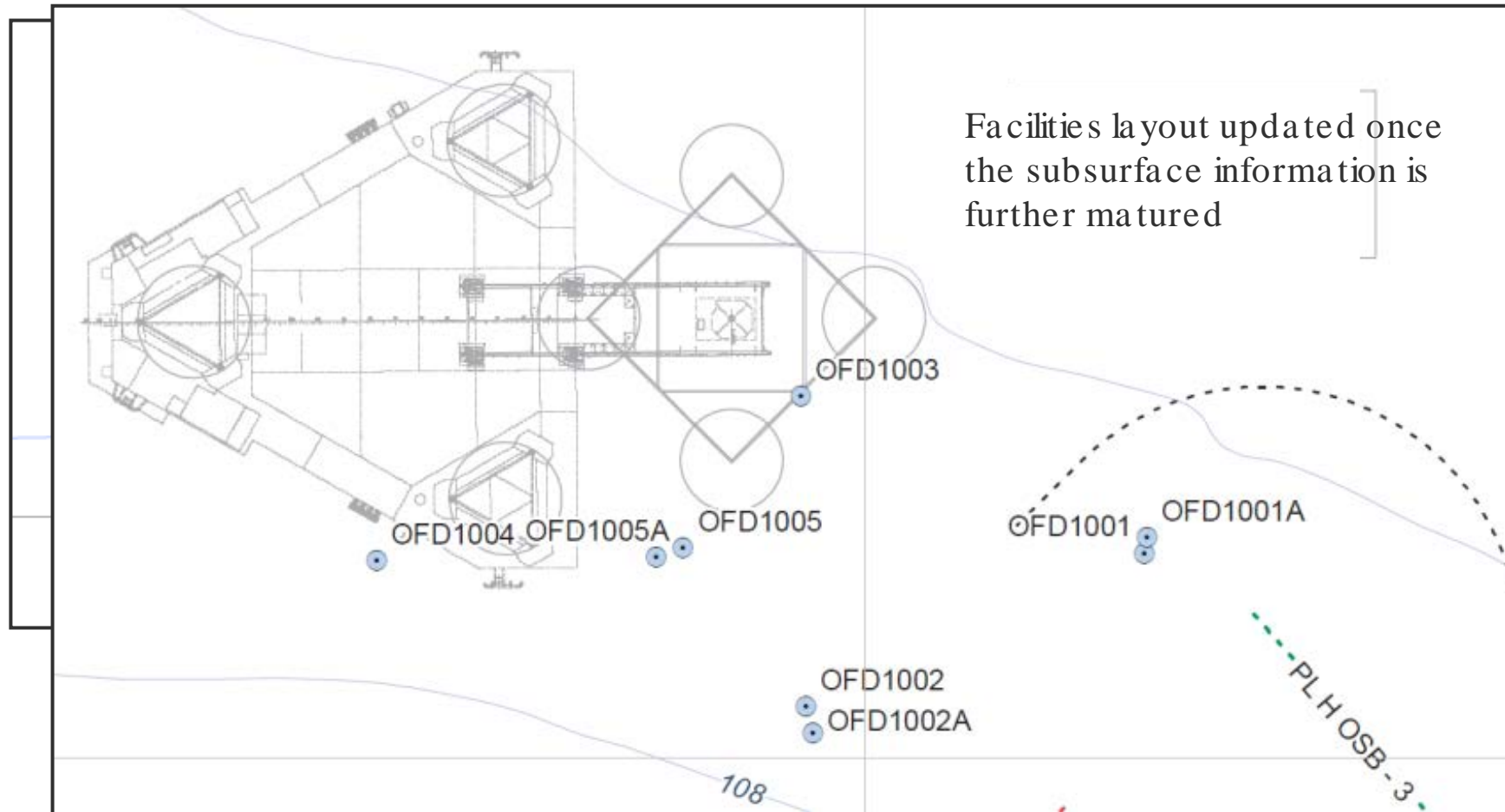


Engineering: Natural Variability



- Data from boreholes kilometers apart in a completely different geological setting

A Moving Target?



Execution: What you see is not what you get!

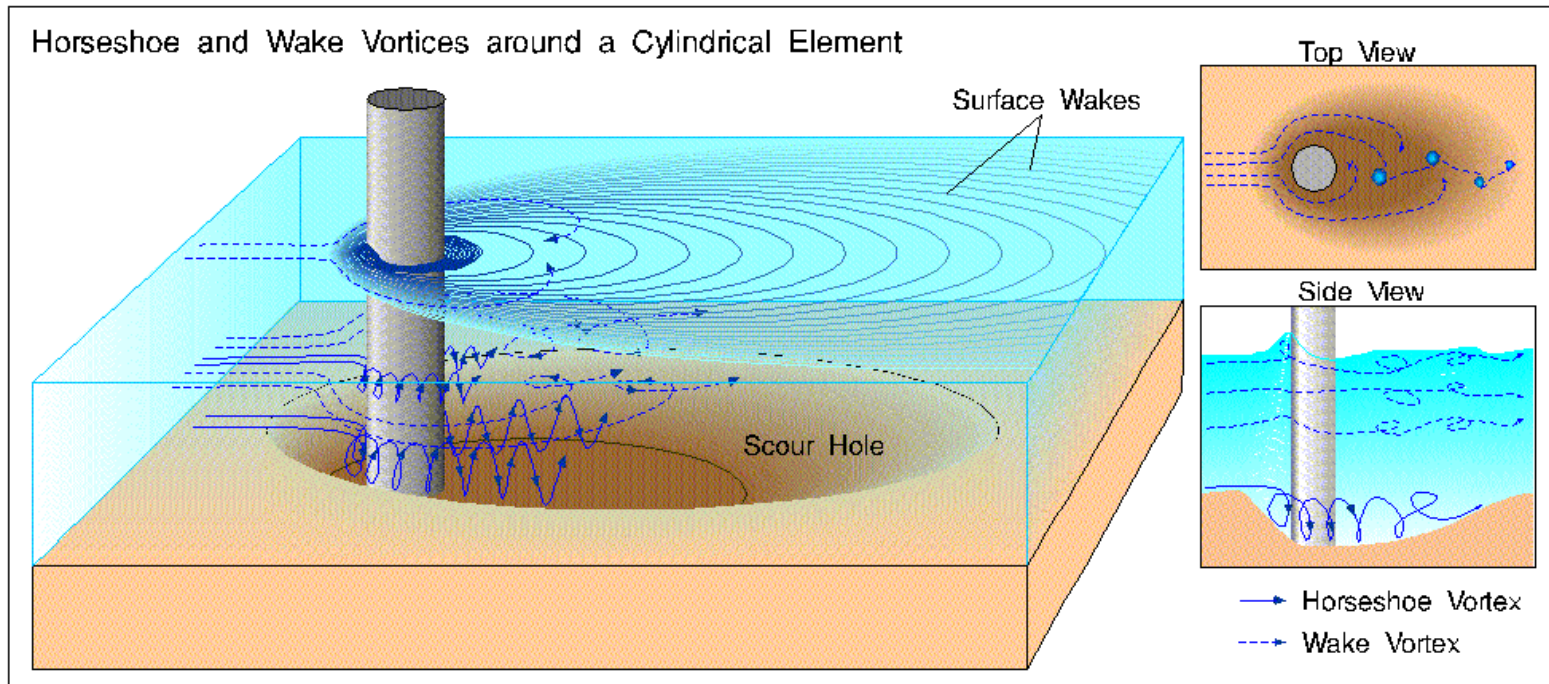


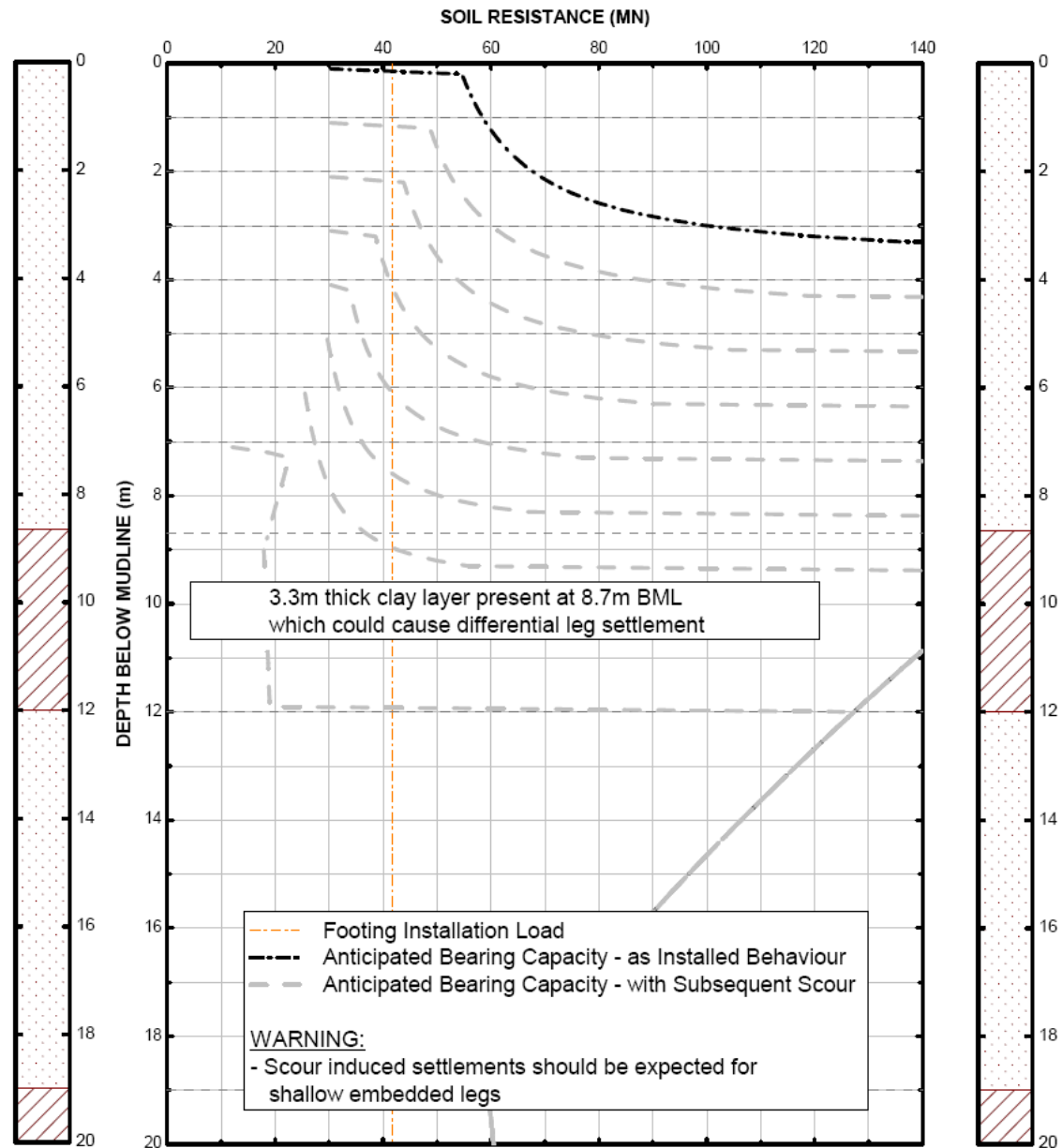
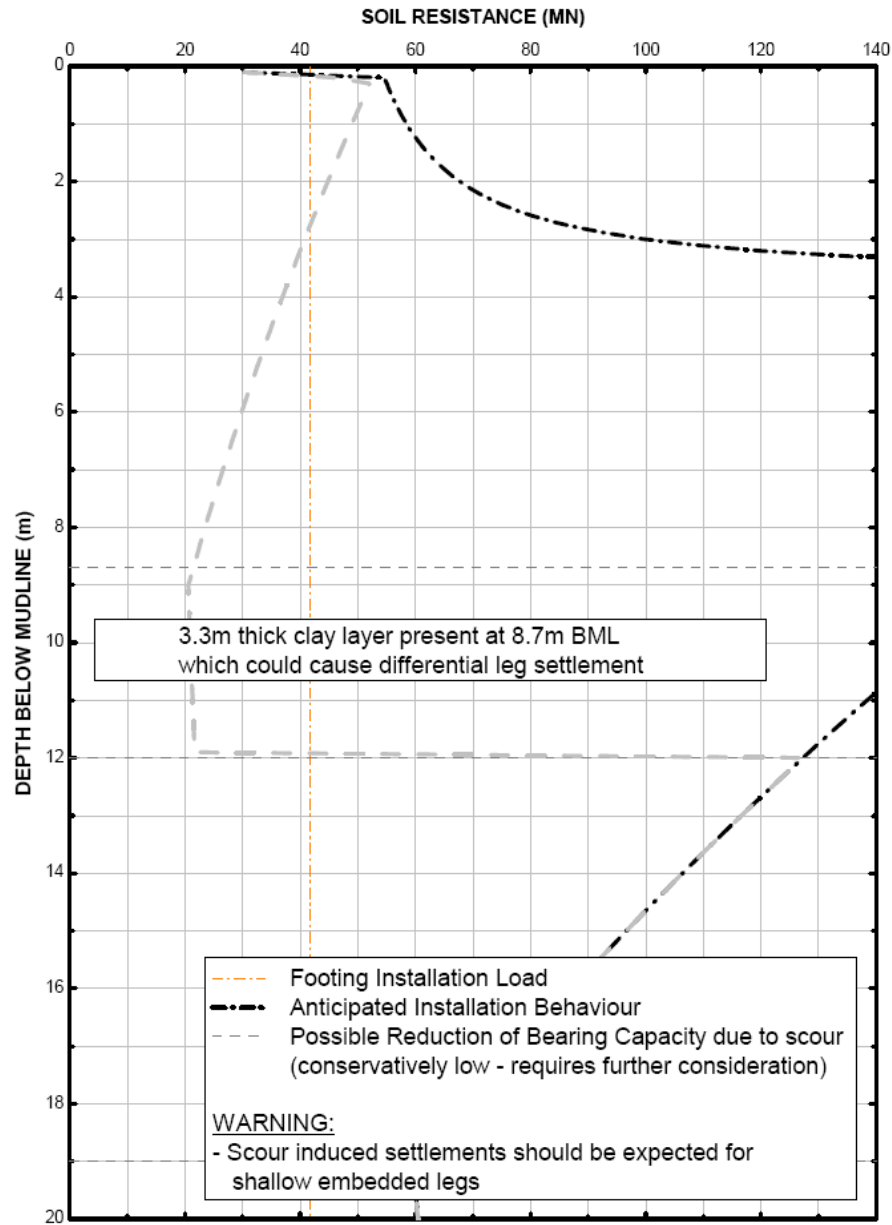
Ton up: the farm's 100 turbines were erected in just 200 days

Photo: Vattenfall

What you see is not what you get!

- Natural erosion of the seabed due to scour





What you see is not what you get!

- Manmade erosion of the seabed due to drilling



What you see is not what you get!

- Manmade erosion of the seabed due to drilling



ISO 13628-15:2011 Subsea Structures and Manifolds

5.5.2 Requirements

5.5.2.1 General

The foundation design should be able to withstand loads from tie-in of flowlines, spool-pieces, pipelines, umbilicals and other flowlines. For templates, all such loads should be accommodated prior to drilling and completion.

A system for measuring well growth and settlement should be considered based on project requirements.

Erosion/washout due to drilling should be accounted for in the design. If the distance between foundation and the well is short and soil conditions are sensitive to erosion/washout, 25 % of the circumference of one foundation should be considered eroded when drilling through the same conductor (i.e. 25 % of outer skirt area).



Geotechnical considerations throughout the entire project lifecycle: from perception to execution

Gülin Yetginer, Equinor Leading Advisor Geotechnics

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