Hydrogeology: Intruding in the Wetland - Urban Development Relationship

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WaterTech 2014, Banff, Alberta

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Presentation Outline

1. Introduction
2. Planning during the Area Structure Plan (ASP) stage
3. Pre-construction detailed design stage
4. Construction stage
5. Conclusion

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1 Introduction

Urban (development) legend:

- Geotechnical studies will cover the ***required*** bases
- Hydrogeology is expensive, mysterious, and complicates ***standard*** development strategies in wetland areas.

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Introduction

Developments in wetland areas, Capital Region.

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Introduction

Urban development and wetland types

- Floodplain wetland areas supported by groundwater (Fig. 1 – A)
- Break in slope wetland areas (Fig. 1 – C)

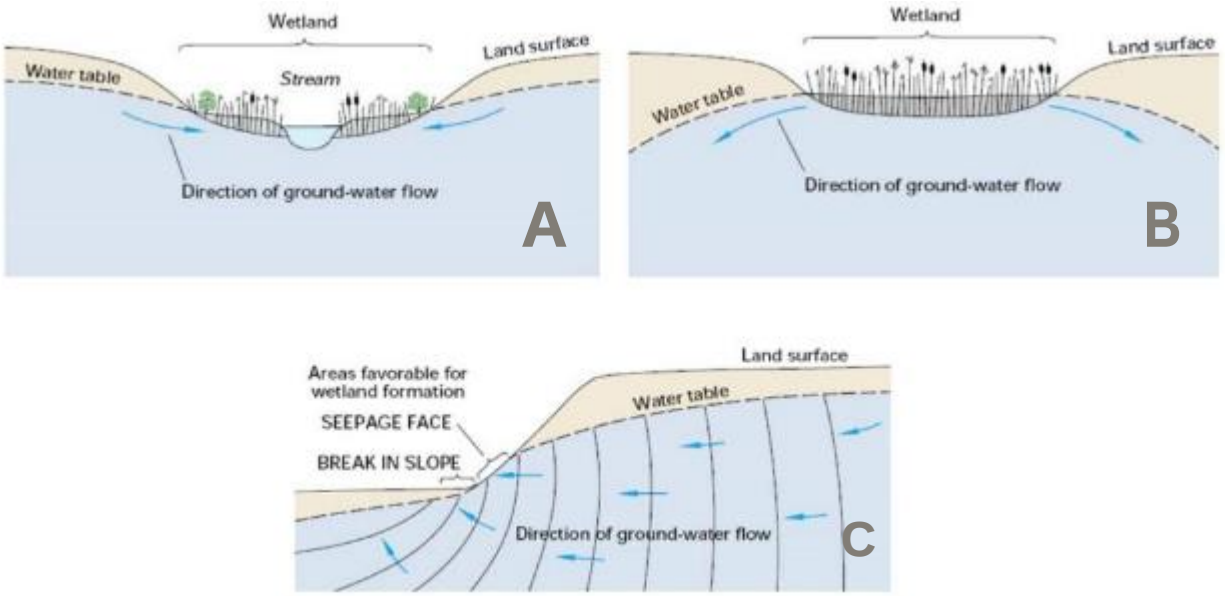

Figure 1 (adopted from USGS, 1998)

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Introduction

Symptoms and the spread of the problem

- Important to recognize wetland features in early stages of development to minimize effects on future structures, buildings and landscaping
- Frost heave on deck piles
- Saturated root zone depth affects plants and trees
- Sump pump work continuously
- In the Edmonton area alone, hundreds of buildings are affected by groundwater close to or above surface.

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Introduction

Overlooked environmental factors

- Transient nature of shallow water tables is affected by:
  - precipitation (rain and snow)
  - drought periods
- High groundwater levels may not present themselves at the time of construction: look for indicators
- Groundwater assessment in the vicinity of wetland areas should be part of a staged approach during the following development phases.

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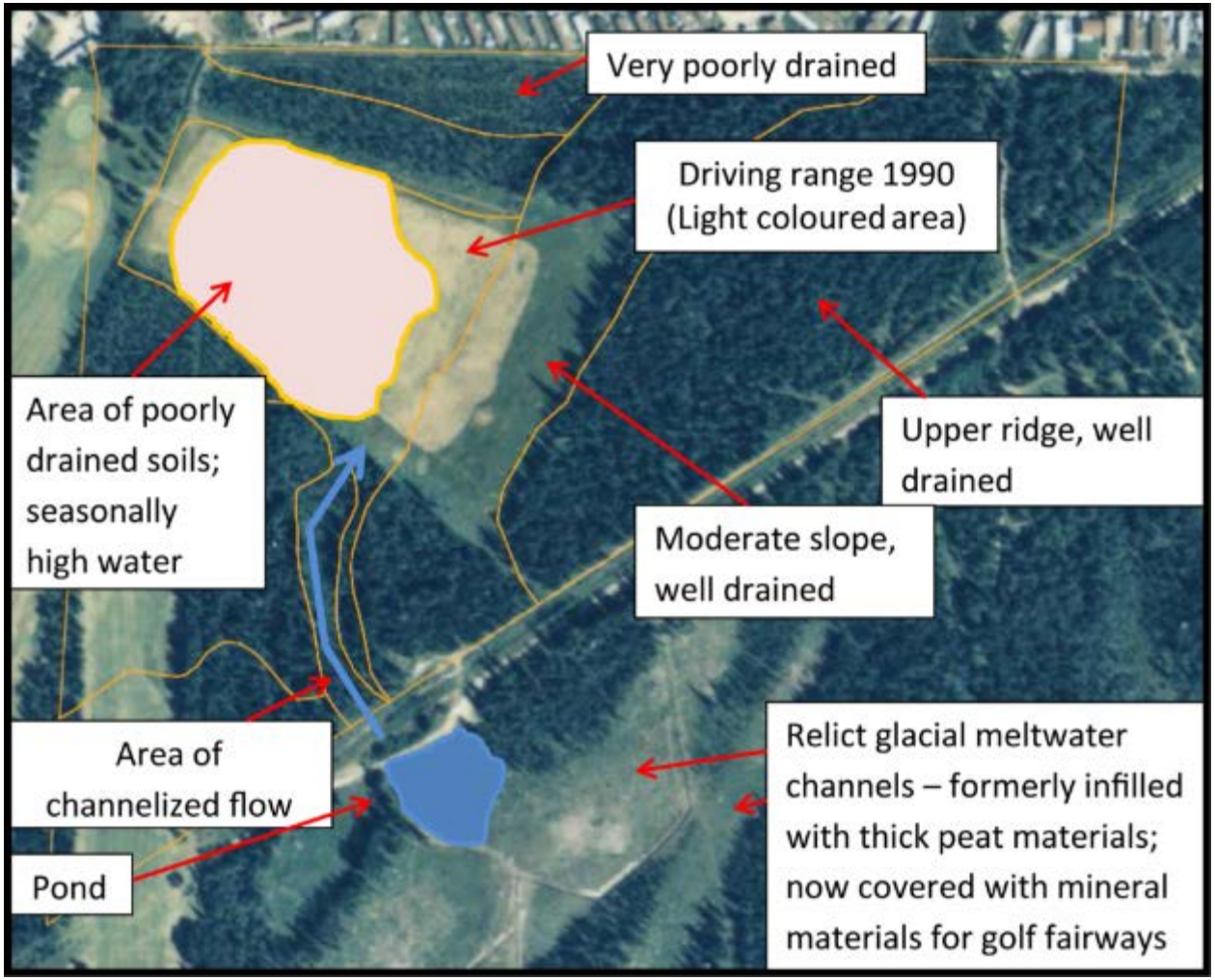
2 Planning during the ASP stage

Desktop-level assessment identifying potential current or historical groundwater supported wetland areas.

Planning during the ASP stage

Not so much planning…

Planning during the ASP stage



And guess what happened?

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Planning during the ASP stage

No previous hydrogeologic assessment.

3 Pre-construction detailed design stage

When hydrogeology intrudes in the wetland – urban development relationship (no room for drama).

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Pre-construction detailed design stage

If groundwater is a key player

- A field level hydrogeologic assessment may clarify local groundwater conditions and identify potential mitigation measures
- Development of Conceptual Site Models (CSMs) increases the hydrogeologic understanding of site conditions for all stakeholders involved in the decision process, regardless of their background knowledge of hydrogeology.

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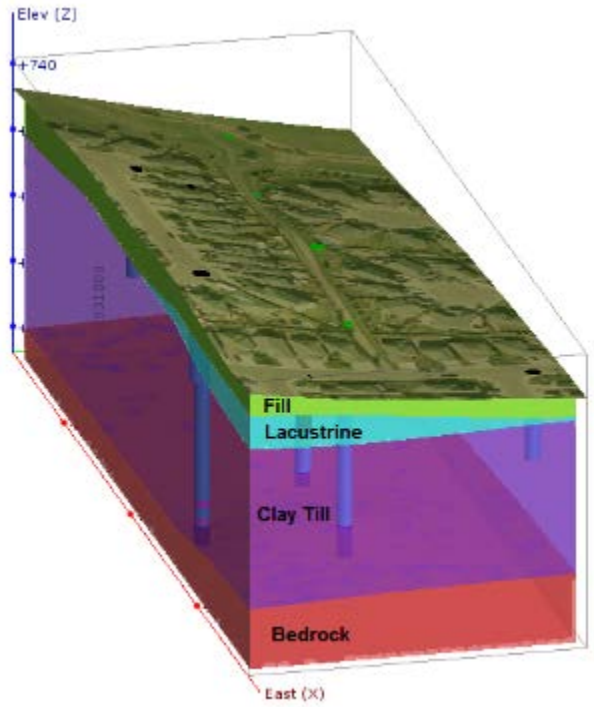
Pre-construction detailed design stage

Stratigraphic conceptual model

- Local soil stratigraphy consists of:
  - Topsoil or asphalt
  - Clay and/or sand and gravel fill (up to 3.7 m thick in places)
  - Lacustrine sand and clay
  - Clay till with thick, water saturated sand layer.



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Pre-construction detailed design stage

If groundwater brings “bad news”

- Where the construction of engineered features is not feasible, changes to the development design at this stage may be required to avoid or otherwise mitigate the effects due to groundwater interactions.

Pre-construction detailed design stage

Developments in wetland areas, Capital Region.

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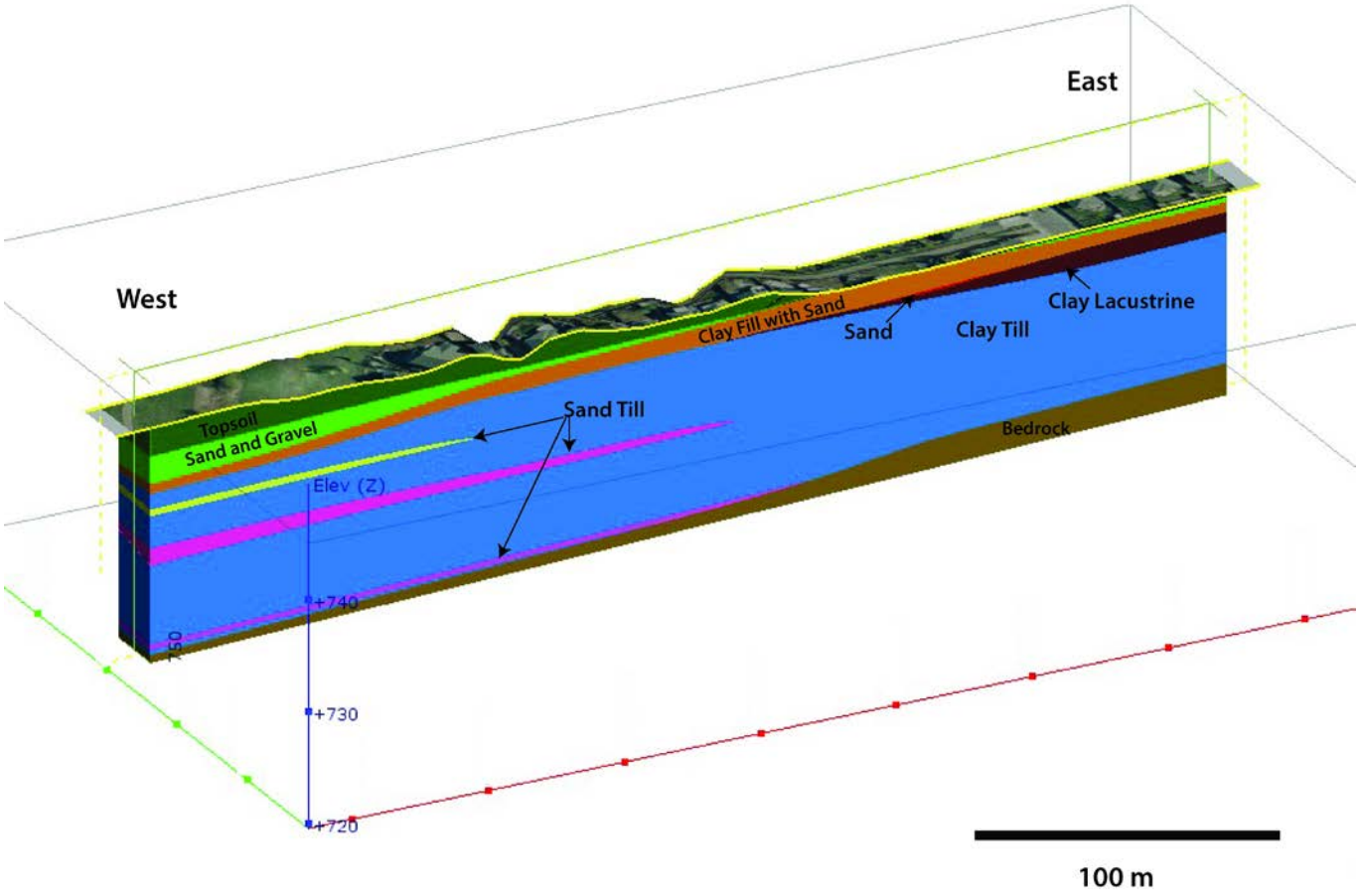
Pre-construction detailed design stage



Developments in wetland areas, Capital Region.

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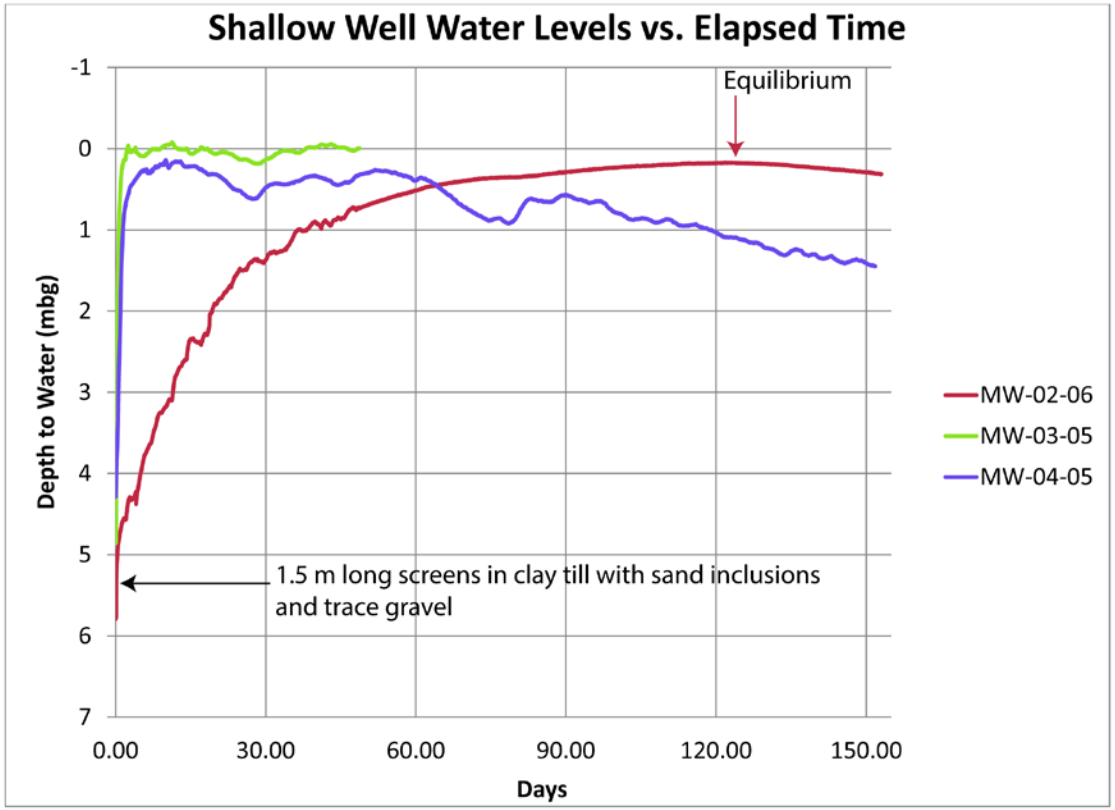
Pre-construction detailed design stage



Developments in wetland areas, Capital Region.

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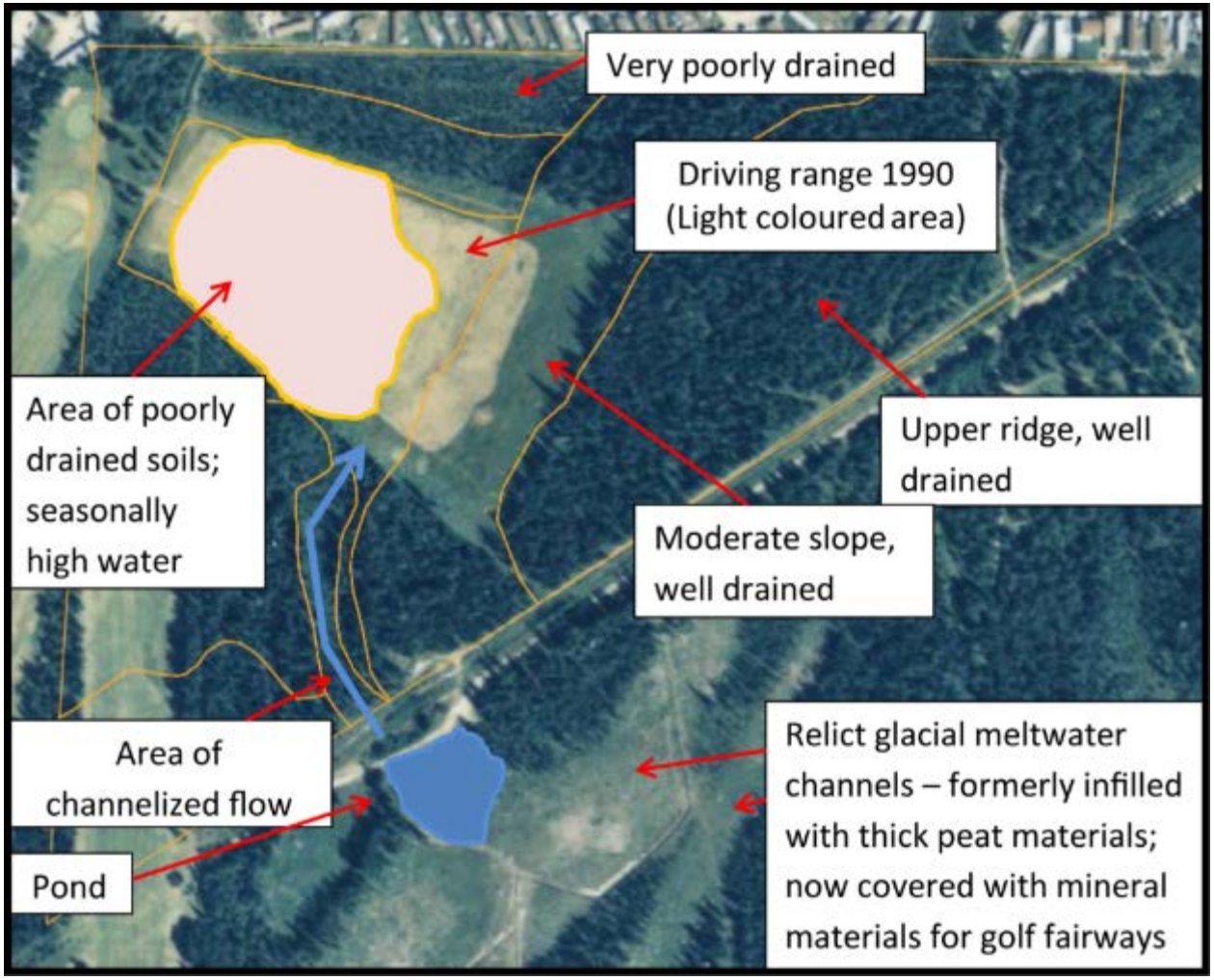
Pre-construction detailed design stage



Developments in wetland areas, Foothills.

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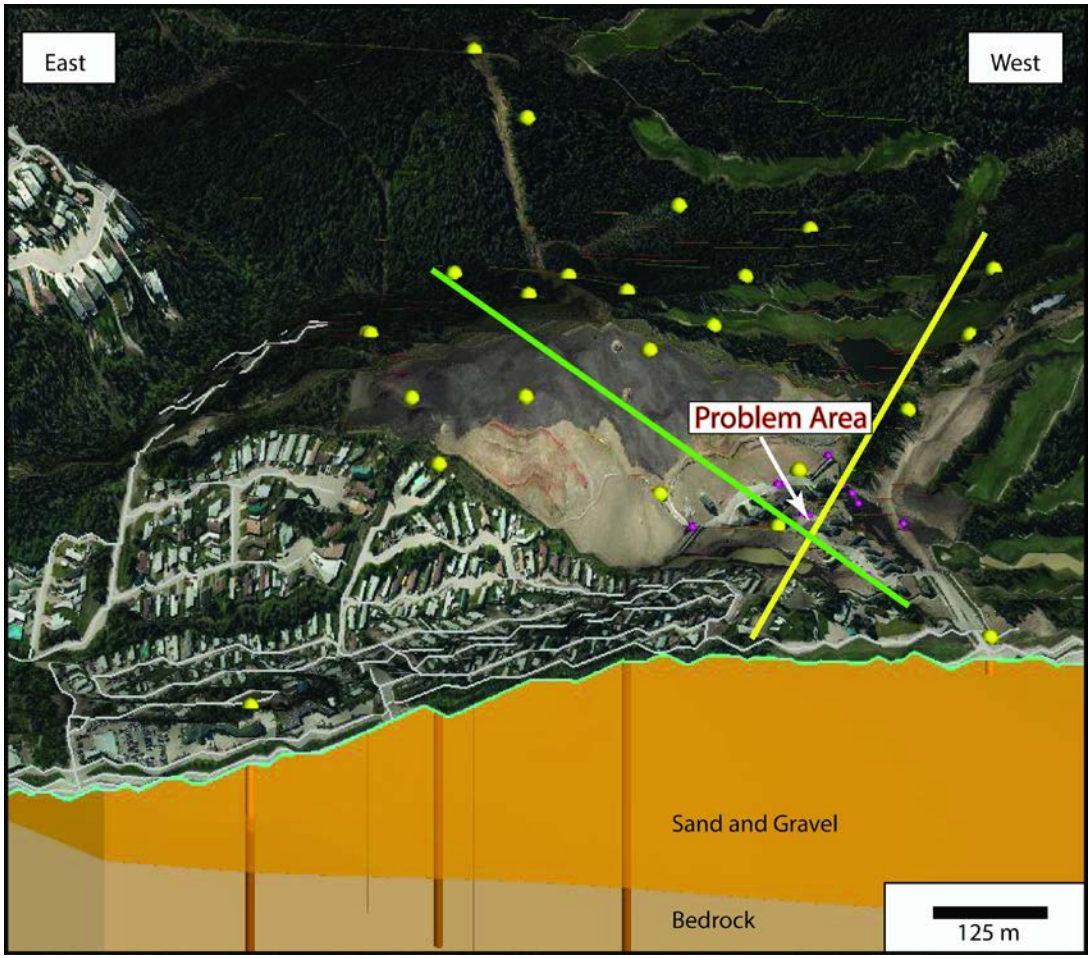
Pre-construction detailed design stage



Developments in wetland areas, Foothills.

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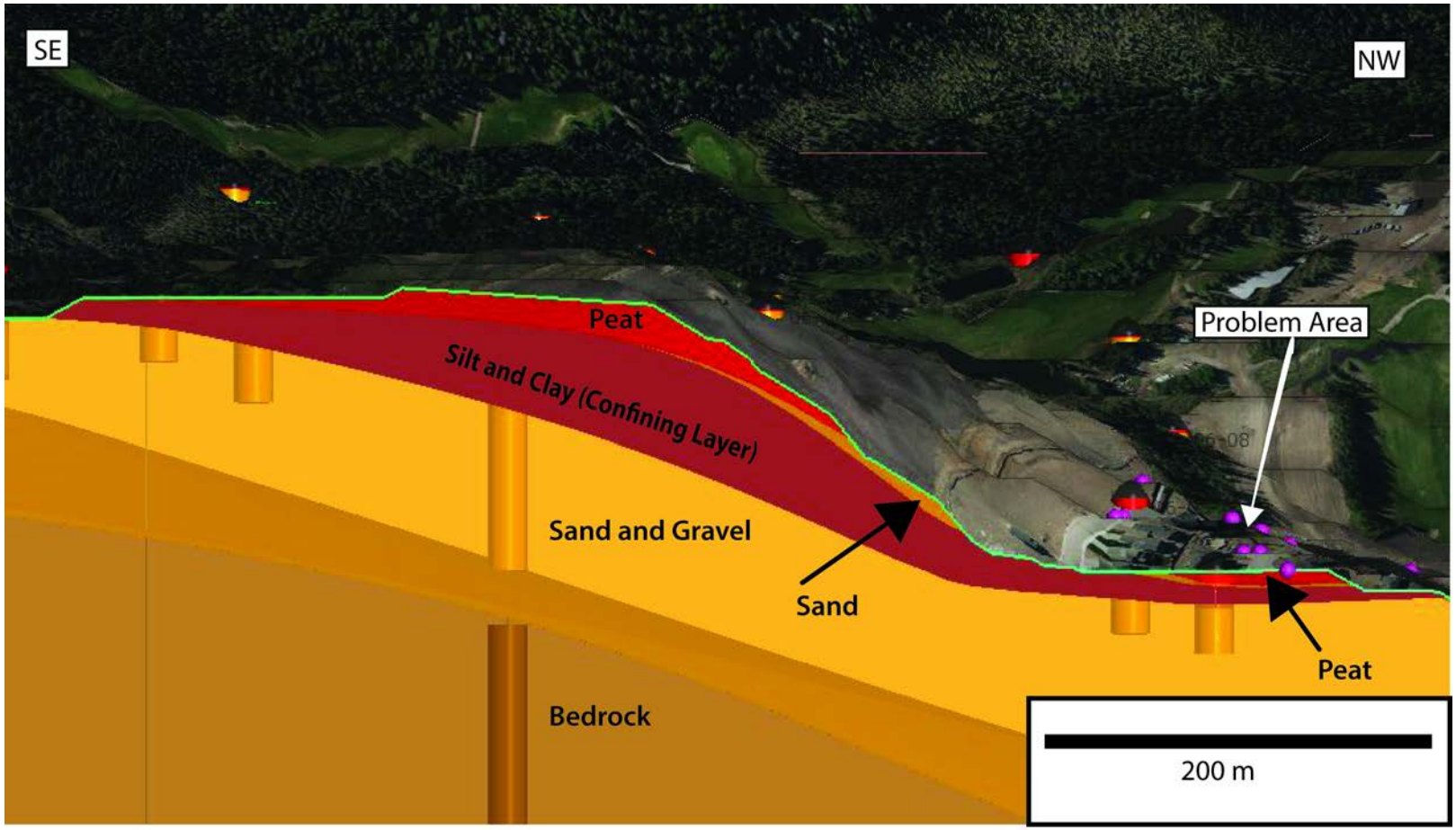
Pre-construction detailed design stage



Developments in wetland areas, Foothills.

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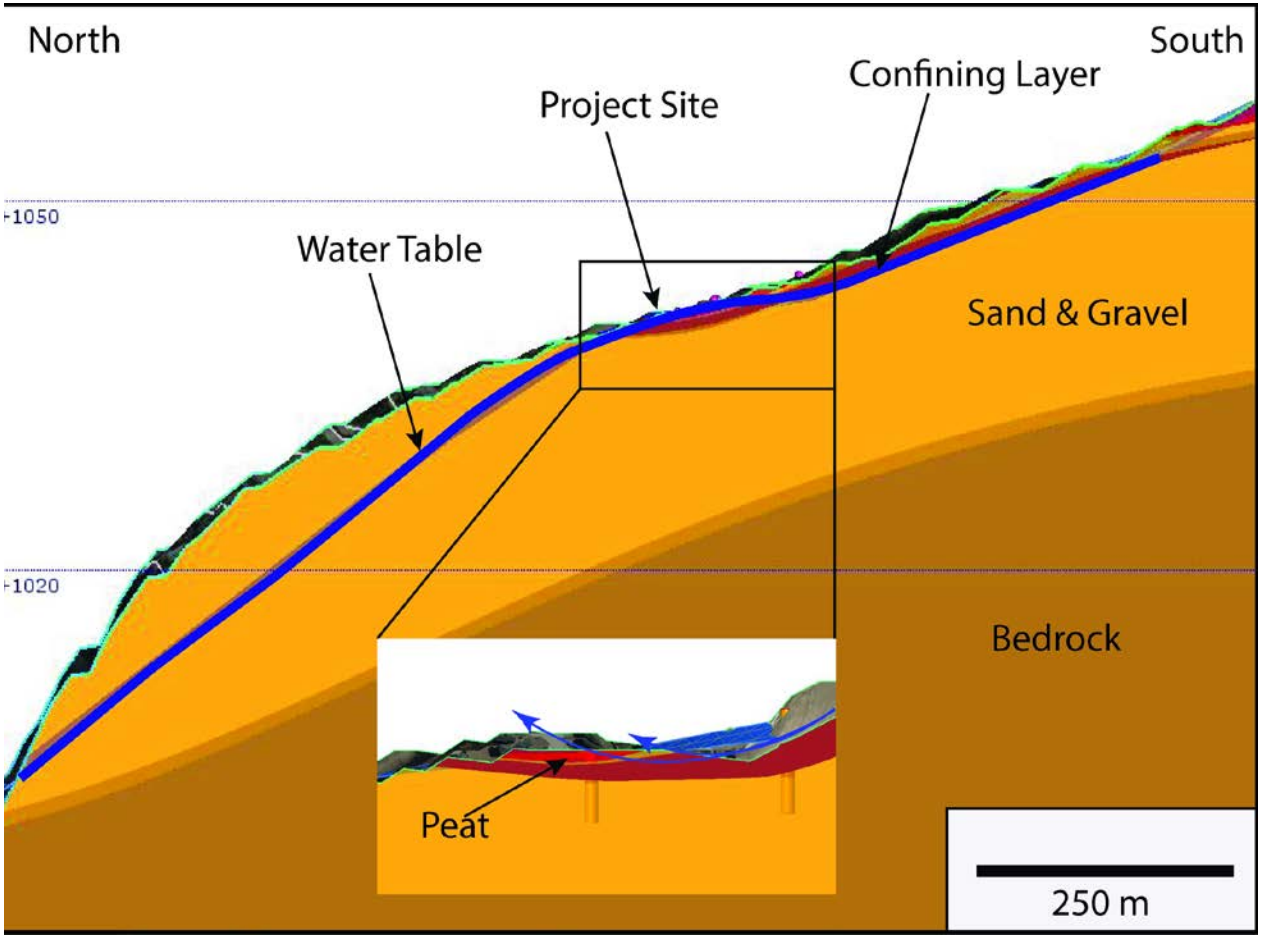
Pre-construction detailed design stage



Developments in wetland areas, Foothills.

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4 Construction stage

Follow classic mitigative measures and be creative, when necessary!

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Construction stage

Implementation of localized engineered groundwater mitigation features

- Alter design elevations to create a topography that promotes favourable shallow groundwater flow regimes
- Use appropriate fill materials to control drainage in the new development areas
- Install residential deck piles up to a depth of 20 feet to avoid frost heave induced movement
- Avoid walkout basement developments in areas, where the groundwater surface is close to design ground level elevations.

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Construction stage

Localized engineered groundwater mitigation features

- Increase thickness of soil/topsoil to allow enough unsaturated (water free) root zone depth for plants and trees.

Extended engineered groundwater mitigation measures

- French drains with secondary surface drainage into the stormwater system
- Active/passive pumping solutions to depress the groundwater level
- Broader plan for the entire development.

5 Conclusion

When developing on suspected wetland areas, think before acting!

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Conclusion

Hydrogeologic assessment in wetland areas

- Critical component to avoid development issues related to near surface groundwater
- Completed alongside geotechnical studies
- Early identification of shallow groundwater issues during urban development increases success of mitigative measures
- ➔ Happy home owners
- ➔ Positive Community environment.

Questions?

Thank you!

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