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Geological and hydrogeological characterization of the subsurface to support climate adaptation in urban development

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- Background -

The world population in the year 2050 is approximately 10 billion people of which 75% reside in cities. The continuous growth of the cities combined with the future climate changes will present authorities with great challenges. One of the most significant challenges is to ensure a stable disposal of wastewater and surface water. In Denmark, the municipalities are implementing climate change adaptation (CCA) plans for existing urban areas. However, lack of geological and hydrological information about the subsurface introduce significant uncertainties in the CCA implementation. In Denmark some CCA plans have been impossible to implement due to insufficient characterization of geological and hydrological conditions.

Based on examples from a C2C-CC research project we demonstrate how detailed geological and hydrological information supports sustainable and more efficient implementation of the CCA plans in areas scheduled for urban development.

- Study area -

The study area is located at the eastern part of Denmark, near the town of Horsens (Figure 1) and covers 35Ha. The geological setting around Horsens is complex with alternating sand- and clay dominating sediments varying within few meters.

- Data -

In the research project the site has been mapped with high-precision geophysics supplemented with drillings and infiltration tests. A total of 30 km of profiling DualEM-421 data with a line spacing of 7.5m were collected in spring 2017. The DualEM-421 data provides the overall spatial distribution of the resistivity within the upper app. 8 m. To support the DualEM-421 data 19 boreholes and infiltration test were conducted (figure 2 to 4).

- Results -

All available data e.g. geophysical data, hydrological data, infiltrations tests and borehole information are combined into the construction of a series of planning maps e.g. maps of the infiltration potential for the development areas. Areas suitable for infiltration are clearly delineated in the DualEM-421 data by the presence of high resistivity sequences (>80 Ohmm) compared to the surroundings (figure 5 to 9 and table 1).

- Conclusions -

As shown in the project we have outline the benefits of geophysical mapping for improved fidelity of the geological and hydrogeological characterization at all depths of interest. The project shows a good correlation between electrical conductivity obtained from the DualEM-421 and the geological conditions of the soil and thus hydraulic conductivity. The results indicate a local site specific infiltration capacity which can change within few meters. With a dense geophysical survey in combination with boreholes and infiltration tests the site can be subdivided into areas most suitable for specific SuDS and aquifer recharge solutions.

The outcomes of the project will be implemented directly in the CCA plans for Horsens municipality over the next 2-6 years as SuDS solutions for handling rainwater are often a necessity and an integrated part in the development of urban and suburban development areas.

- Acknowledgments -

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