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Memo

Til: CTS Nordics AS

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Opprettet av: Kjetil Sandsbråten
Prosjektnummer: 10228015
Prosjekt: WintherGreen
Kunde: CTS Nordics AS
[redacted]

Hydrological memo – WinterGreen Data centre, Enebakk

In conjunction with construction plans for the WinterGreen Data centre at property no. 91/908 in Enebakk county we have conducted a brief hydrological analysis for the property and the existing drainage solutions of the area today.

Today's map and terrain height data does not reflect the work done on the levelling of the area prior to construction as shown in Figure 1.

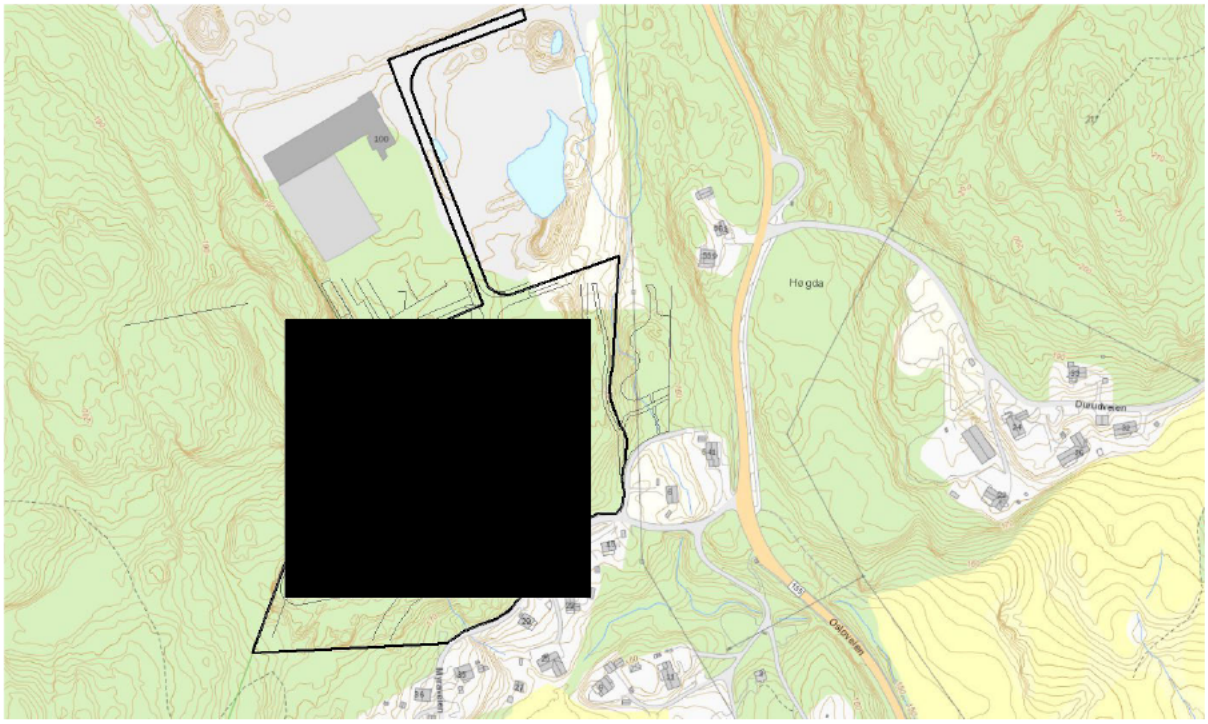

Figure 1 Area with planned data centre and property borders.

Based on other available information from CTS Nordics, a brief visit at the site and information from Mr.Pukk, the plot contractor, a functioning terrain model of the terrain has been developed as shown in Figure 2. Such information is necessary to model hydrological responses and drainage in and from the area.

From the western edge of the land plot, a small brook, enters the area as shown in Figure 3 and Figure 4. Here comes drainage and flood water from three watersheds, with a total area of 20,5 hectares. The different watersheds are marked 1 to 3 in Figure 3. The main brook is from watershed 1.

Sweco
Kjetil Sandsbråten
Fagsjef Hydrologi og vannressursforvaltning
kjetil.sandsbraten@sweco.no
Mobil +47 97129216

Drammensveien 260
NO 0212 Oslo
Norway
Telefon +47 67 12 80 00
www.sweco.no

Sweco Norge AS
Organisasjonsnr. 967032271
Hovedkontor: Oslo

[redacted]

Watershed 3 used to drain to the south and out of the area but is now draining into the plot because of the constructed embankment around the plot.

Today the drainage from watershed 1 goes into a 600 mm culvert placed under the landfill. The brook is shown in Figure 4 and the culvert intake in Figure 5. Halfway through the landfill this culvert increases in size to an 800 mm.

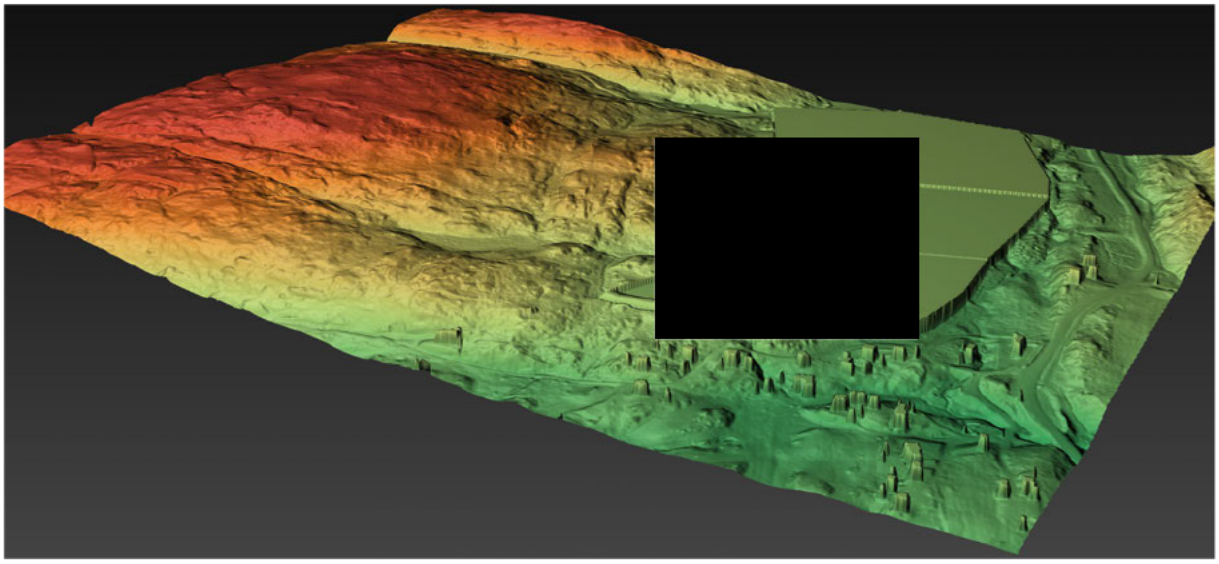

Figure 2 Terrain model

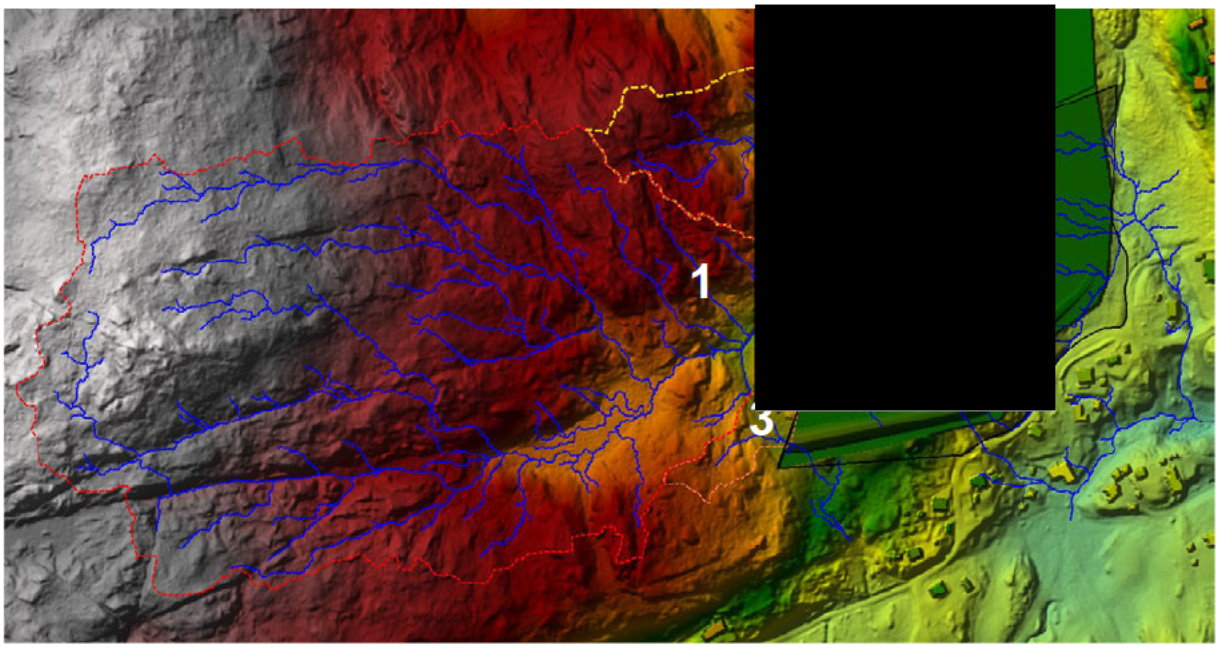

Figure 3 Terrain model, watersheds, and drainage lines. Watersheds marked 1-3.

A flood analysis based on extreme precipitation constructed as a 200-year event (IVF-curves from the meteorological station at Ås-Rudskogen), has been performed with NVEs hydrological model, PQRUT, with results as shown in Figure 6. Peak discharge will be 0,74 m^3/s. Calculations with the rational formula gives similar results.

A 40 % climate change increase in flood values are required in calculation of flood values in this area. That gives a peak discharge of 1.04 m^3/s. A 600 mm culvert is not sufficient for handling such flood volumes.

Figure 4 The main brook, watershed 2.

Figure 5 The existing 600 mm smooth HDPE culvert under the landfill.

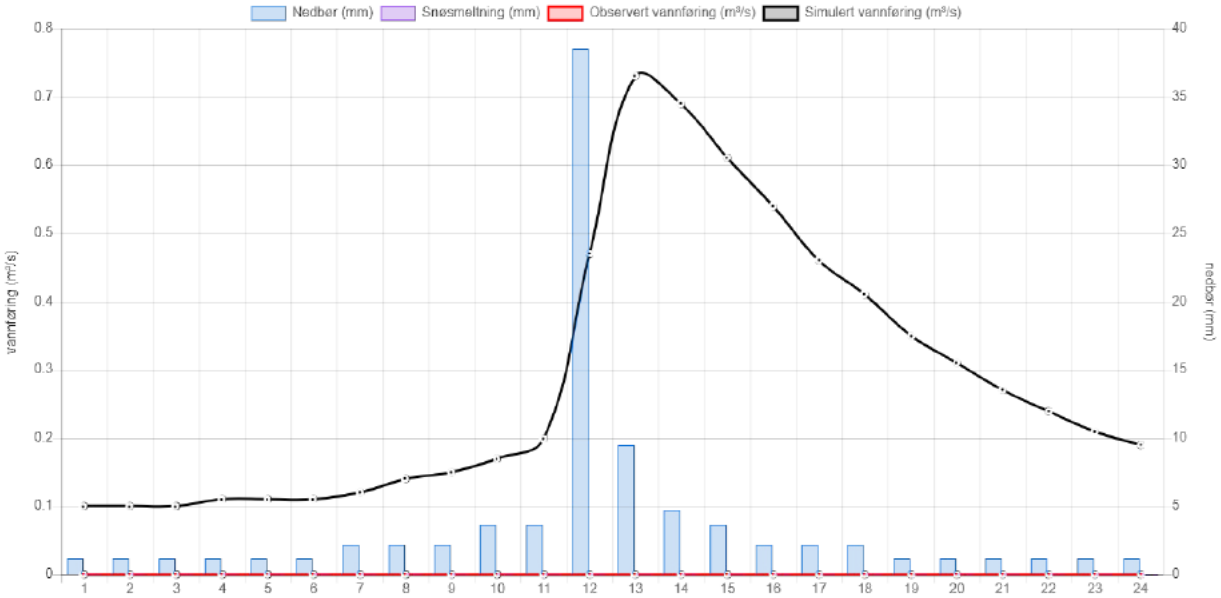

Figure 6 Flood analysis PQRUT, based on total drainage from watersheds 1-3.

Figure 7 Example of V-shaped culvert intake.

Even an 800 mm intake is not in itself sufficient if it is just a culvert projecting from the landfill as shown in Figure 5. To get sufficient capacity, the intake has to be V-shaped, with the possibility to have water depth upstream of the intake up to at least 1.2 of the height of the culvert. Similar to the example in Figure 7.

Calculations done with HY-8, a hydraulic modelling tool from the Federal Highway Administration (US) gives a capacity of 1,09 m^3/s with such an intake solution and with a smooth HDPE culvert.

To reduce the risk of floodwater above the current height of the landfill the existing 600 mm culvert must be replaced with an 800 mm culvert and a proper V-shaped intake has to be constructed. The bottom of the 800 mm culvert must not be higher than elevation 173,50 (NN2000).

At the base of the cliff, along the western side of the land plot, there must be constructed a drainage ditch to lead the flood water from watershed 2 and 3 to this new proposed intake.

In general, on the flat area where the data centre buildings are to be built, the buildings have to have a ground floor at least 20 centimeters above the surrounding terrain at elevation 174,60. Elevation of the terrain today is according to measurements approx.174,50. From the buildings the terrain must slope downward.

The detailed drainage solutions of the area surrounding the buildings, must be discussed and planned with a VA Engineer and Landscape Architect. An open drainage with ditches, rain beds or other green solutions are preferred so as to be robust against flood situations. Permeable solutions for roads/ parking areas are also preferable.