

# Combining geological mapping, aerial photos and geophysical methods to enhance groundwater abstraction.

Sylvi Gaut & Amund Gaut – Sweco Norway AS

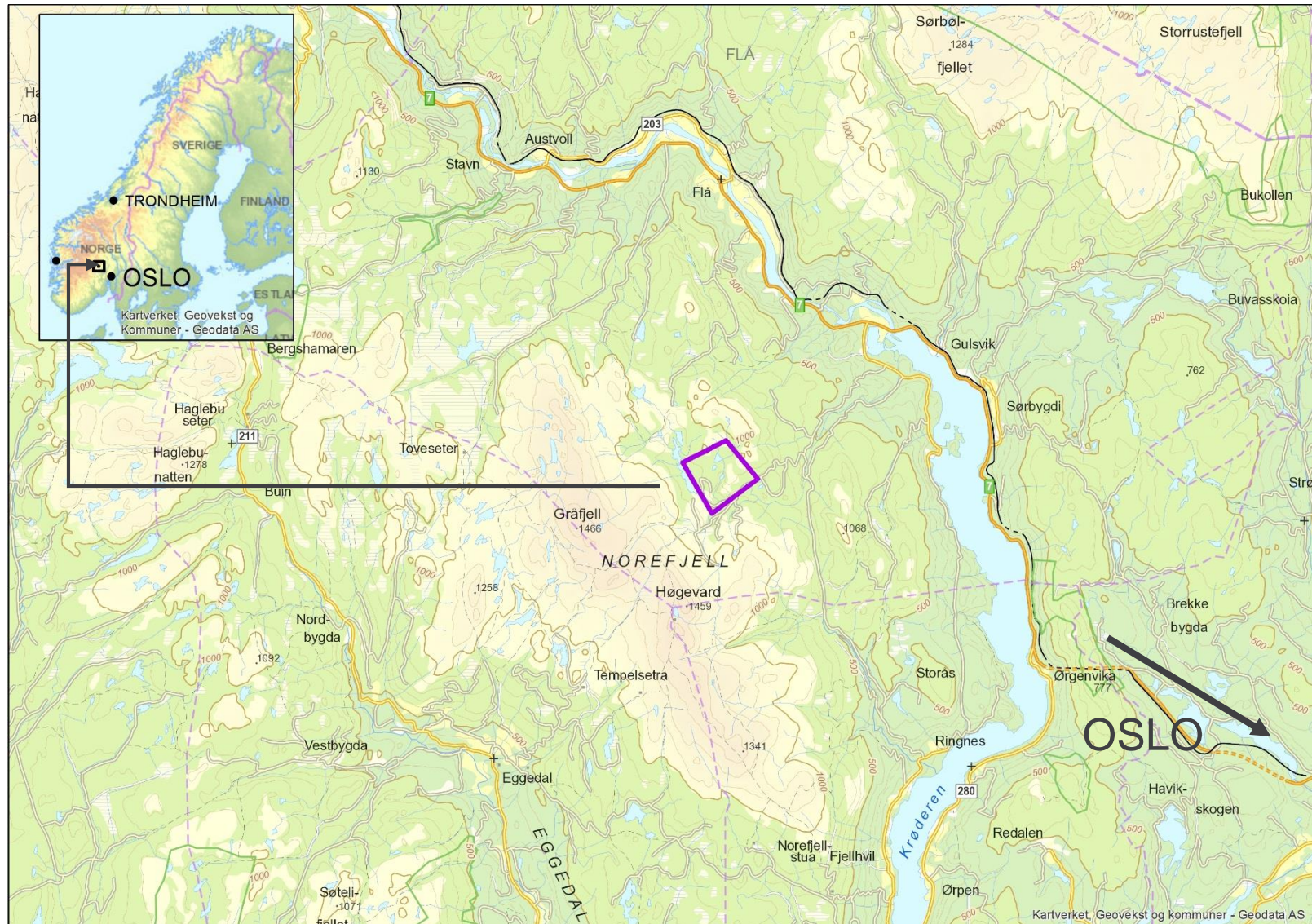
Alfredo Mendoza & Anders Blom – Sweco Environment AB

# Content

- Geology
- Methods used
- Results



# Høgevarde "hyttefelt" – aggregation of cabins

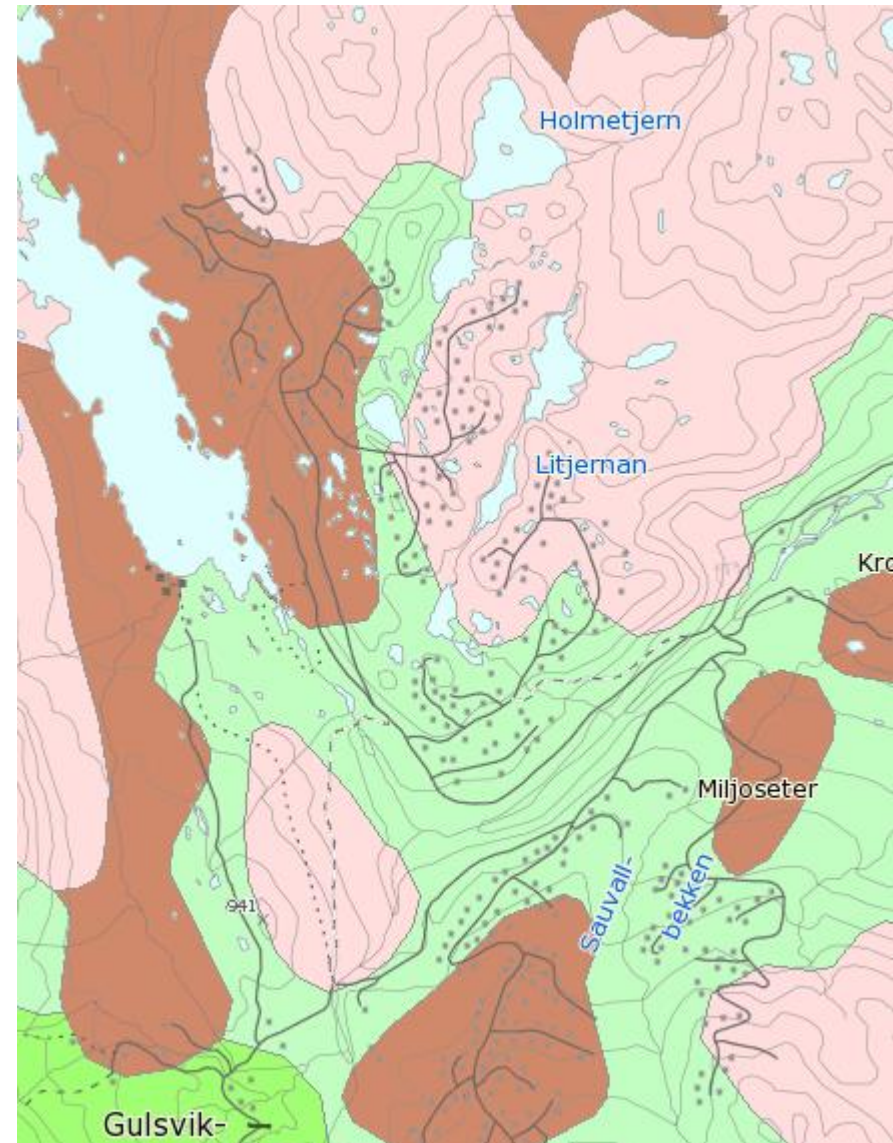


## Bedrock wells in Norway

- Groundwater is widely used in rural areas
- Wells normally 60-120 m deep
- Single households and holiday cottages
- Small and medium sized (< 1000 people) waterworks
  - private or municipal supplying households
  - aggregations of cottages such as Høgevarde

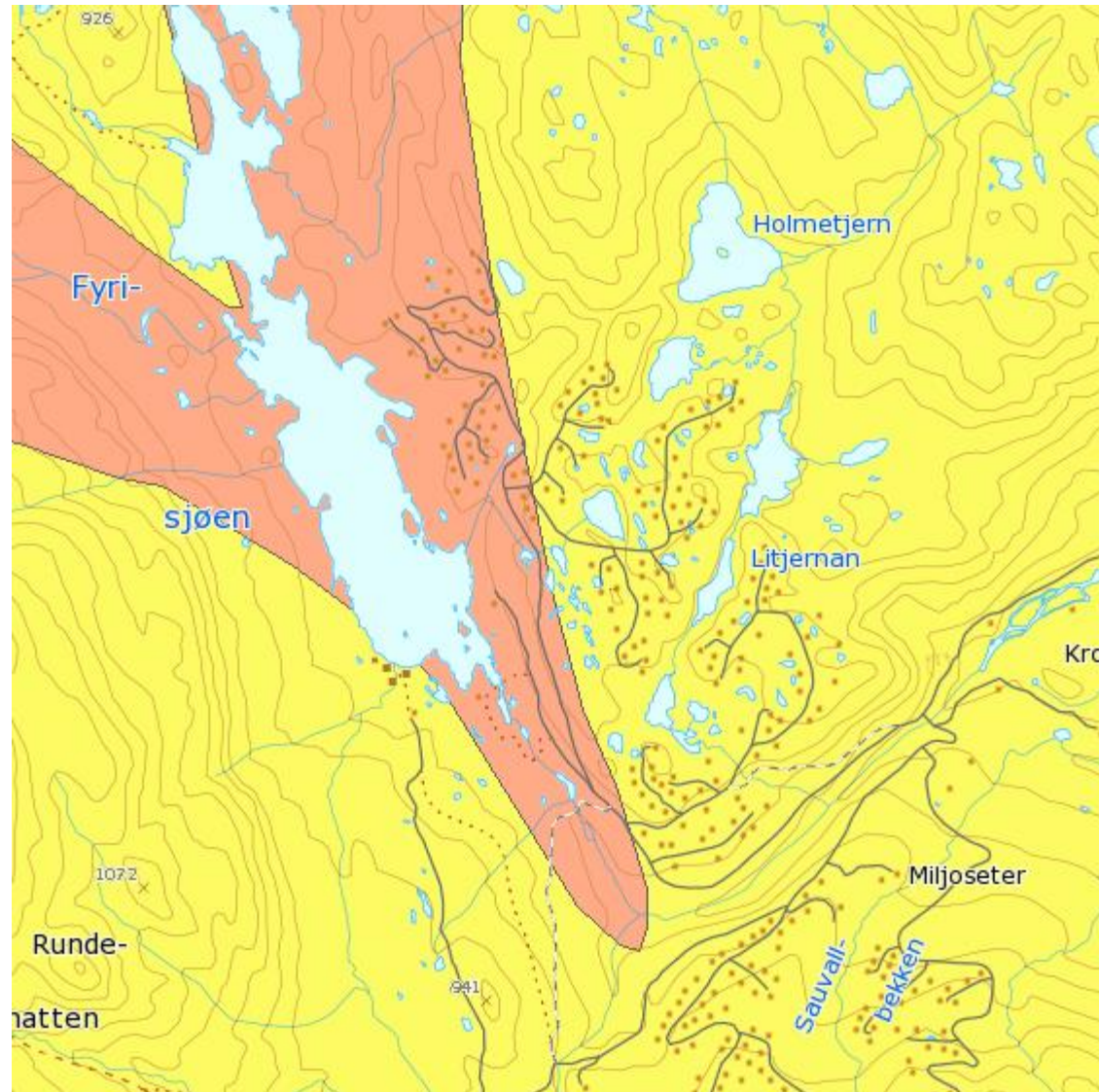
# Quaternary deposits

- Thin
  - moraine (green)
  - peat or bog (brown)
  - bedrock (pink)



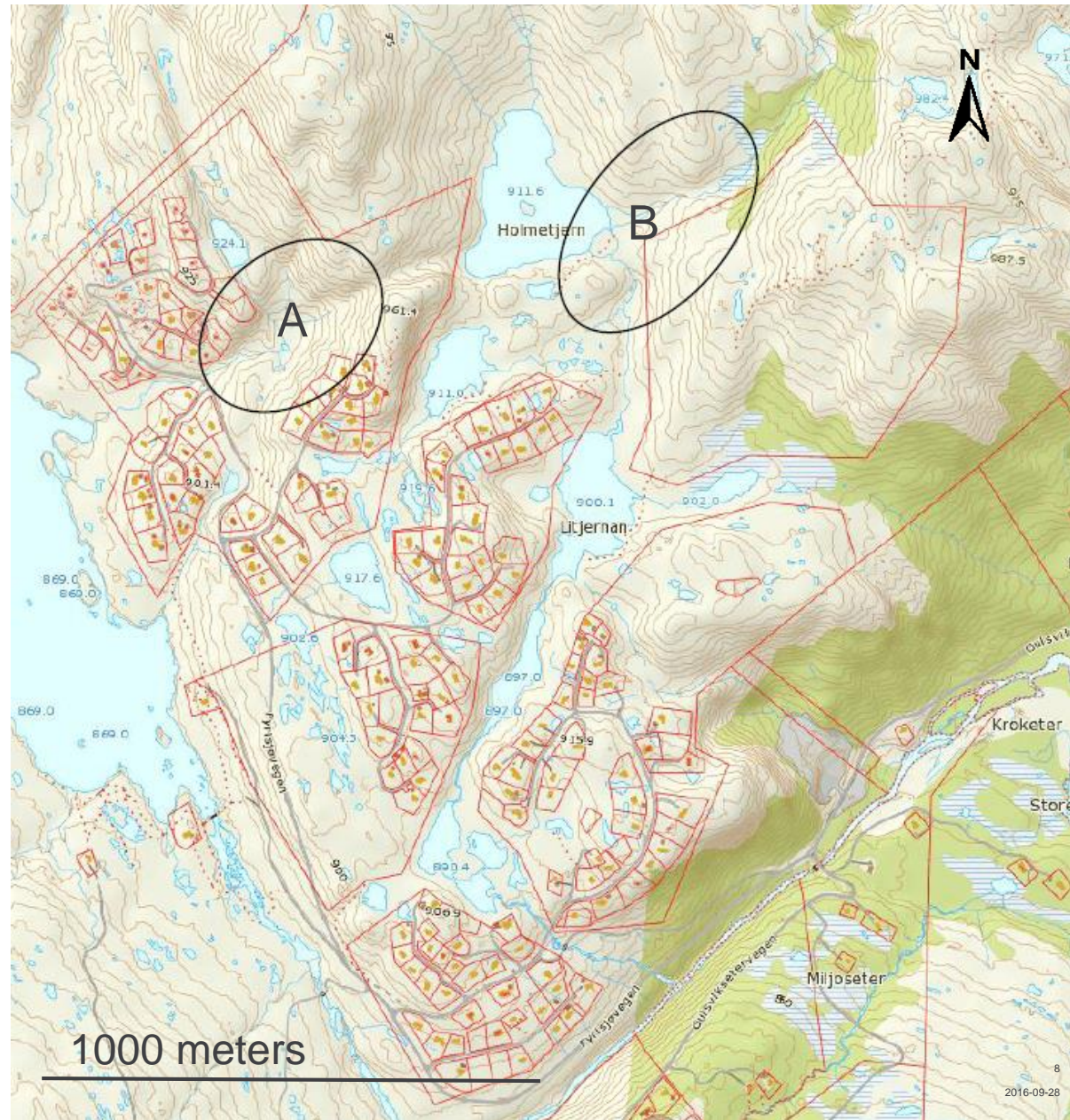
# Bedrock

- Quartzite or quartz schist - yellow
- Biotite gneiss – light brown/orange



# Høgevarde hyttefelt

- Plan to build 200-250 new cottages
- Investigate the possibility for new wells in the areas A and B.

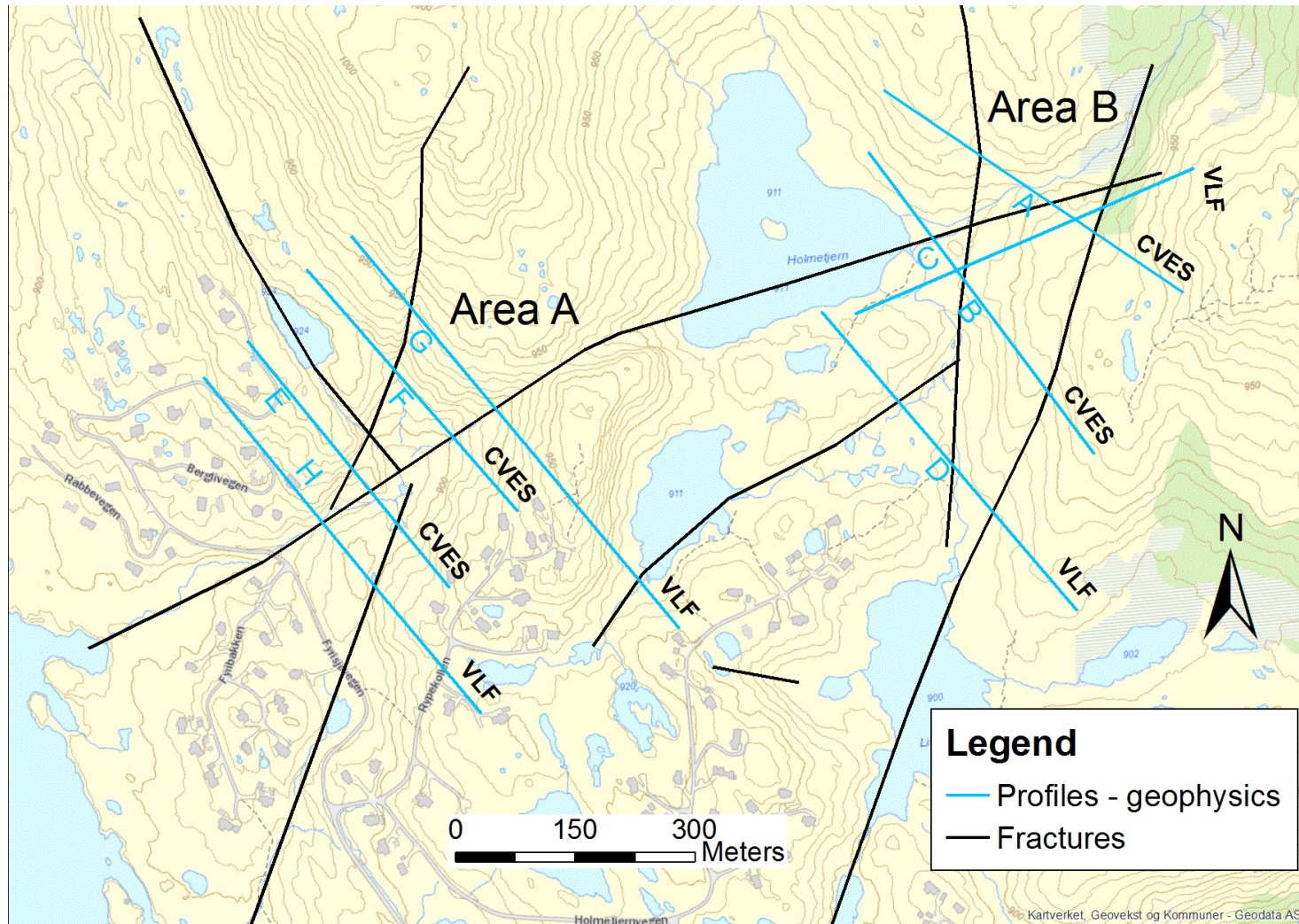


## Existing wells

- Drilled to 120 m
- Located close to assumed fracture zones
- The capacity varies
  - most have low yields (< 200 l/hour)
- Explosives used to increase the yield
  
- New methods to enhance the possibility to drill new wells with larger yields

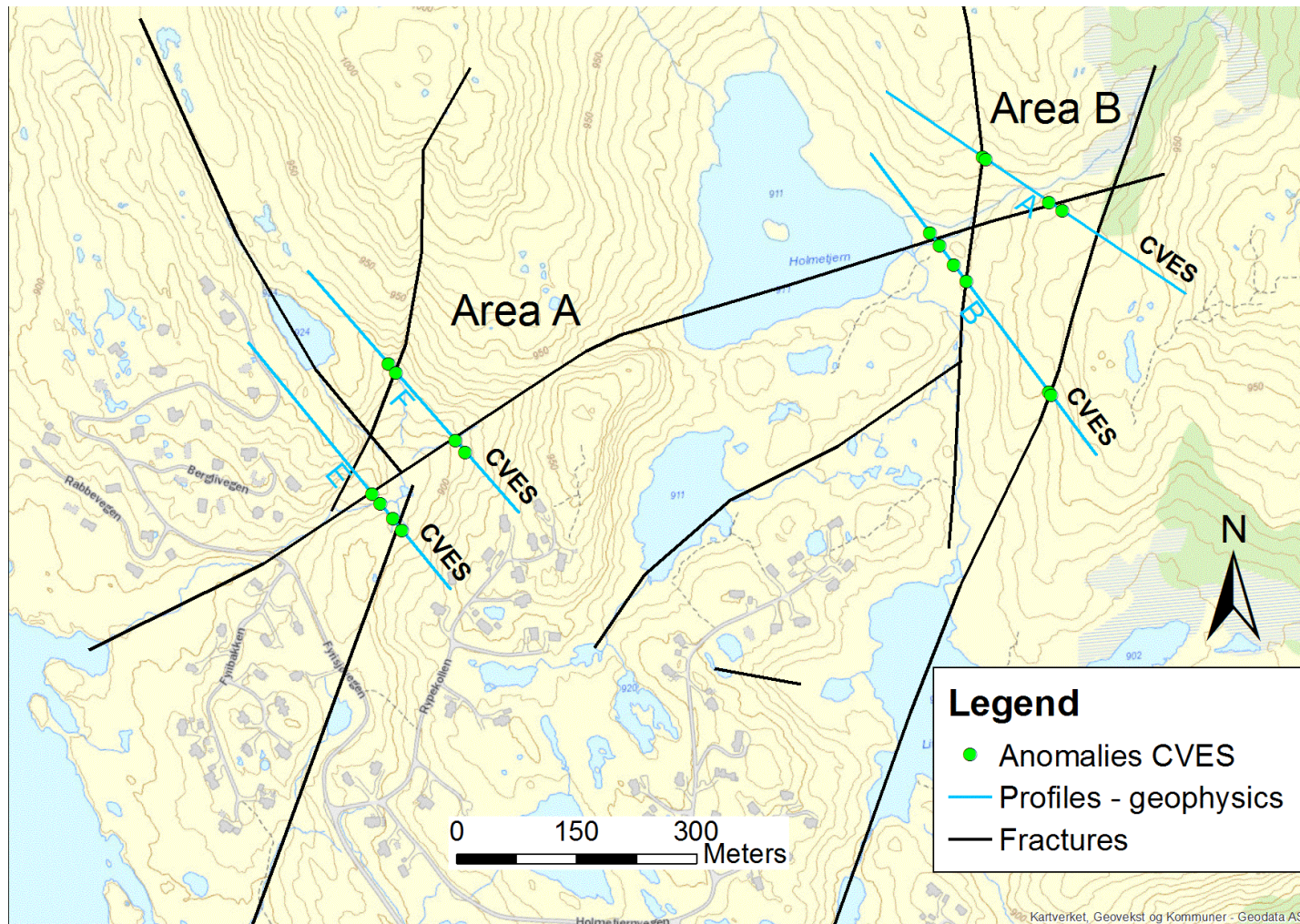


# Geophysical profiles locate based on fracture mapping

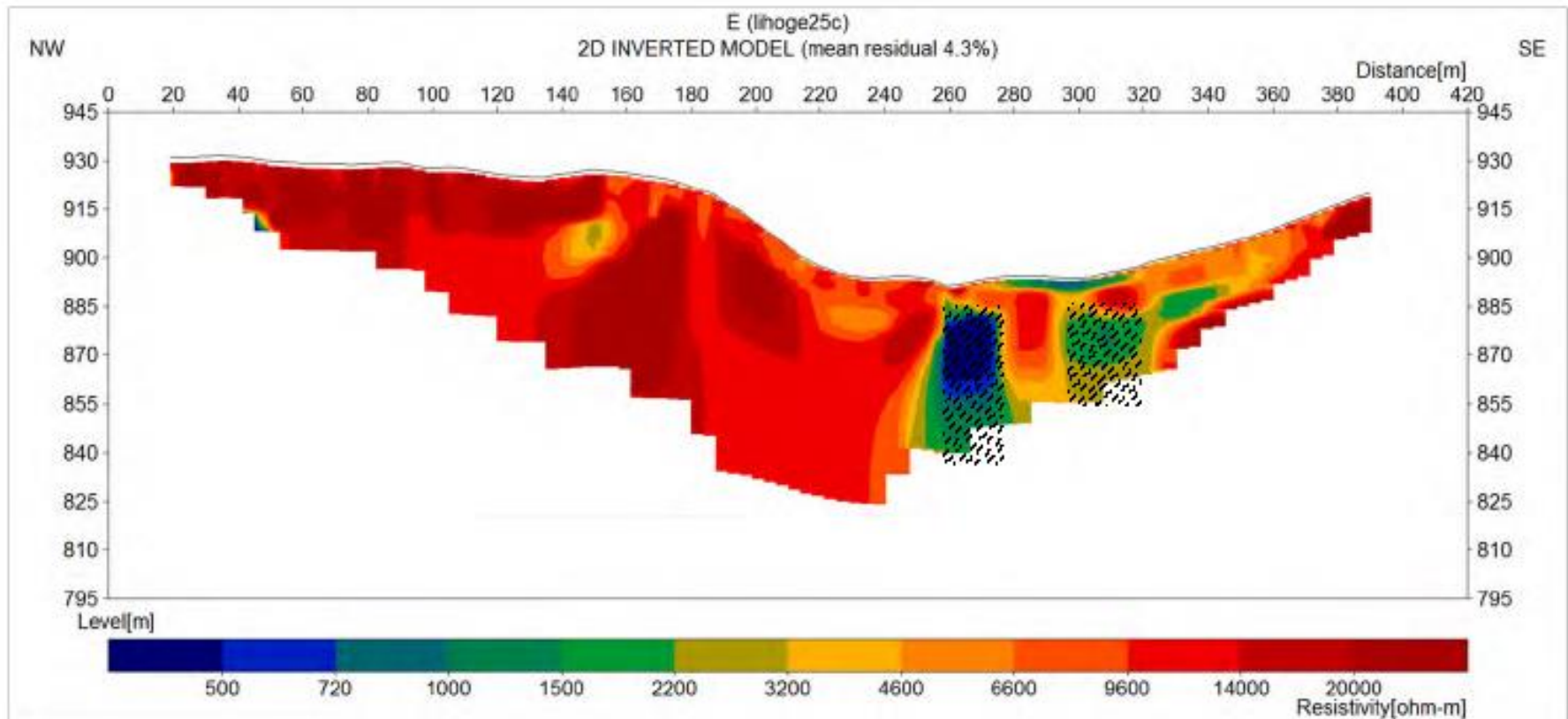


# Results

- VLF was not successful
- 2D-resistivity indicated fracture zones with high permeability

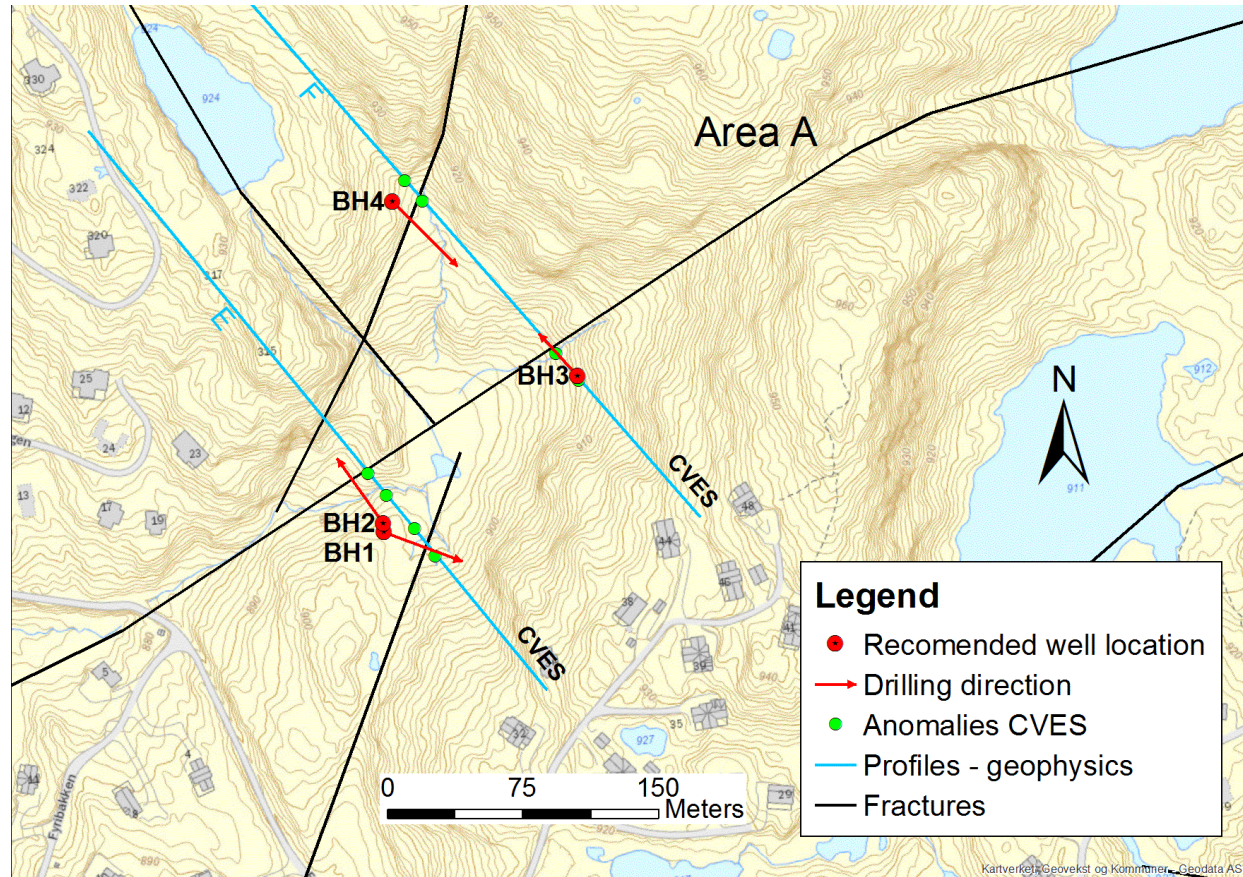


# Profile E



# Well locations

- Fieldwork with mapping of fractures and measurements of strike and dip
- Based on the geophysics and fieldwork four locations were picked as possible well sites in Area A
- Dip and drilling direction was recommended for each well



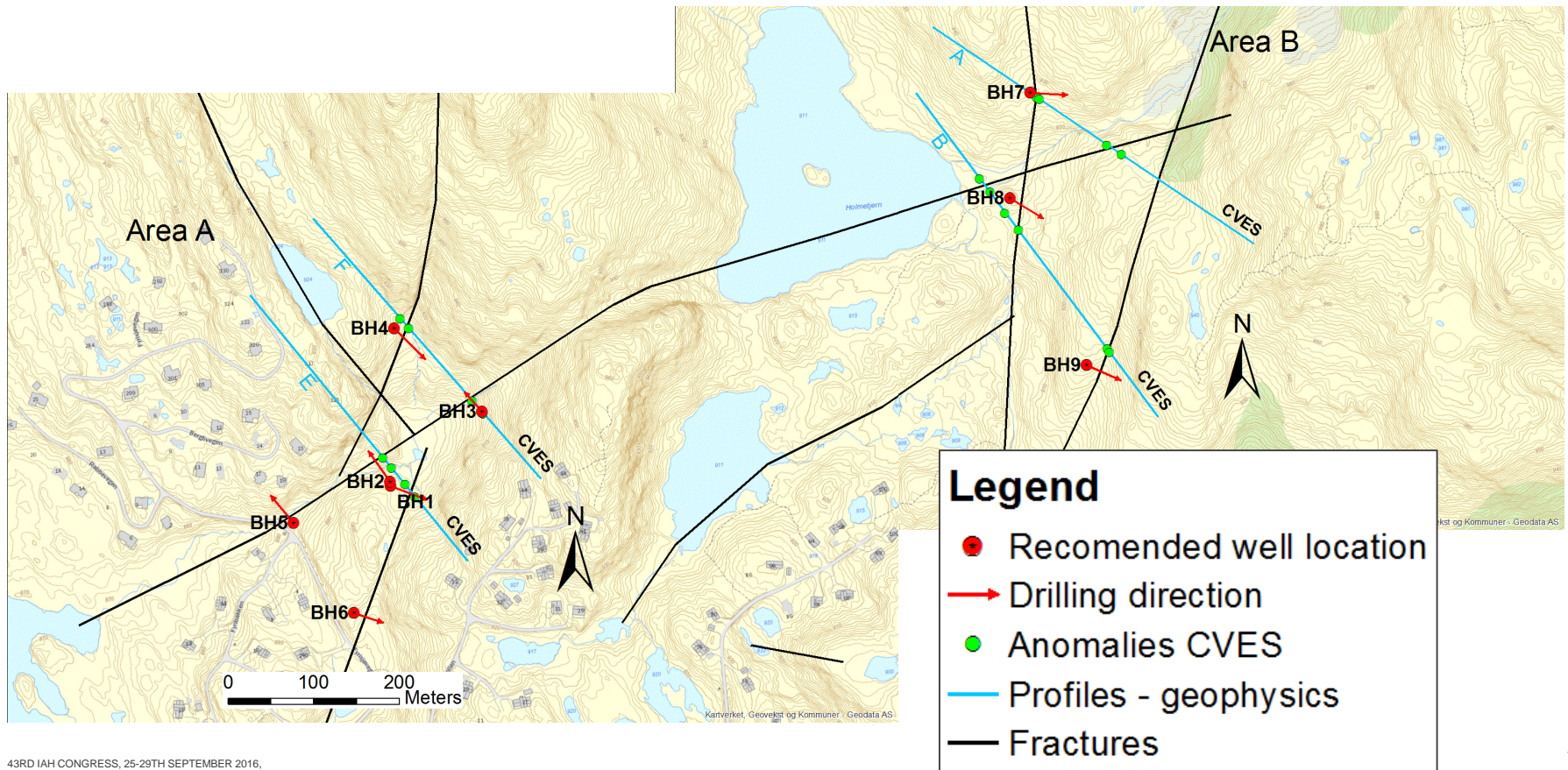
## Capacity of new wells

- Boreholes 1 and 2 was drilled in 2015
- 120 m depth

<b>Well number</b>	<b>Capacity after drilling</b>	<b>Capacity after two days pumping</b>
BH1	1300 l/hour	About 4000 l/hour
BH2	Nearly dry*	About 500 l/hour
* Hydraulic fracturing used		

# Conclusions

- Compared to earlier drillings, the use of 2D resistivity seems to have been successful to enhance the well yield.
- Based on the results five more wells sites are recommended



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