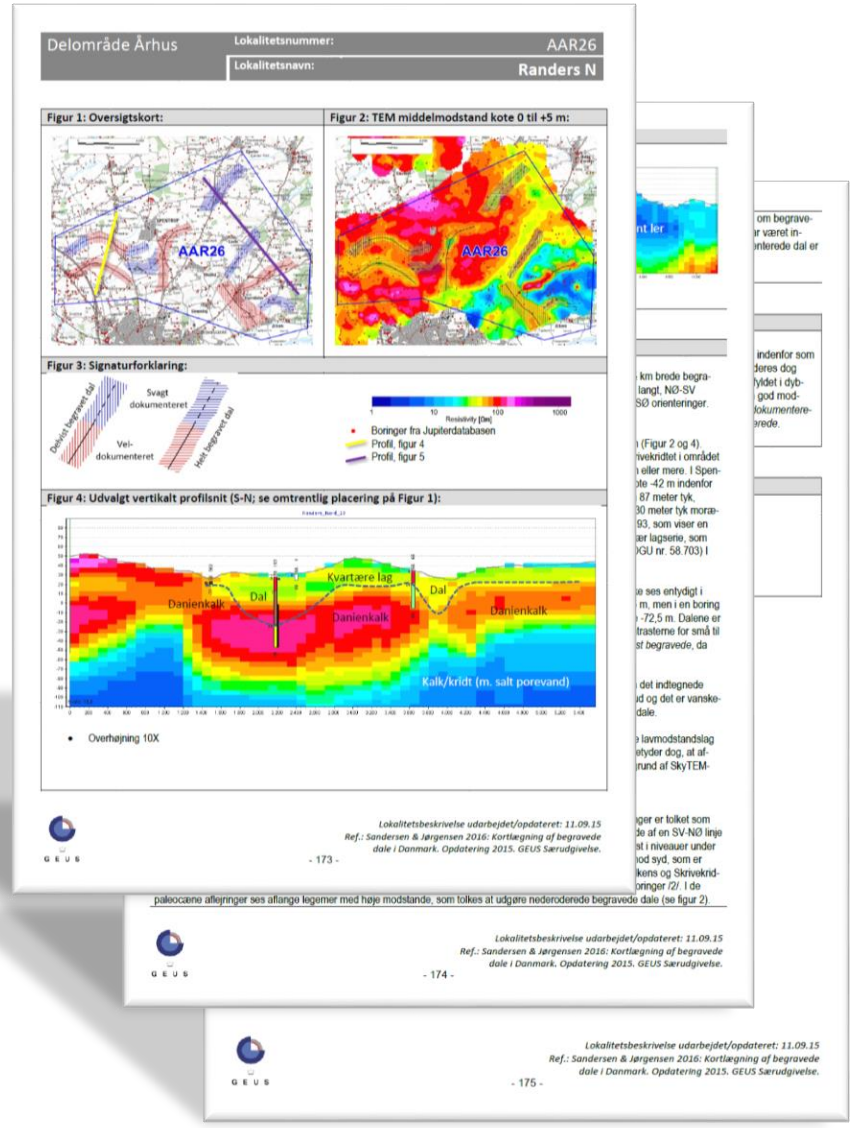
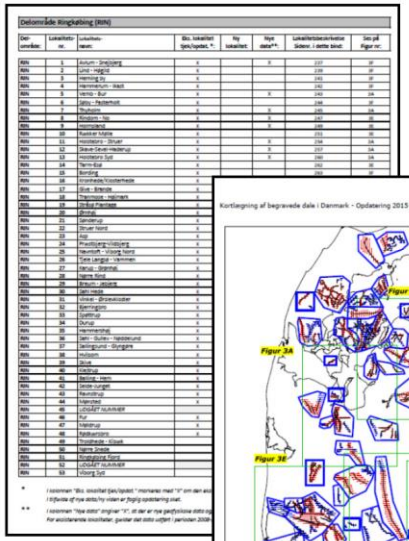
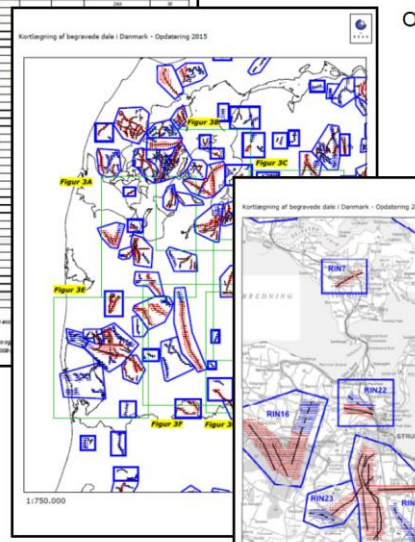
Eksempler på praktisk anvendelse af ny viden om begravede dale i forurenings- og grundvandssammenhænge

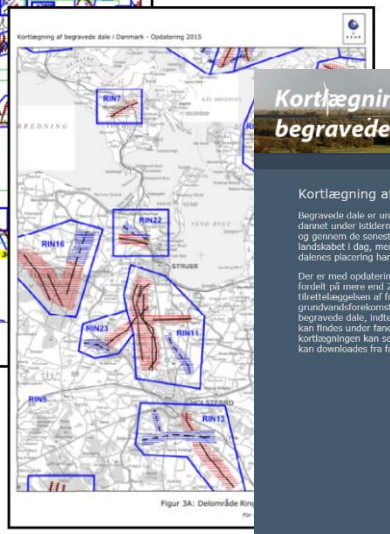
Flemming Jørgensen,
Region Midtjylland, fljoer@rm.dk

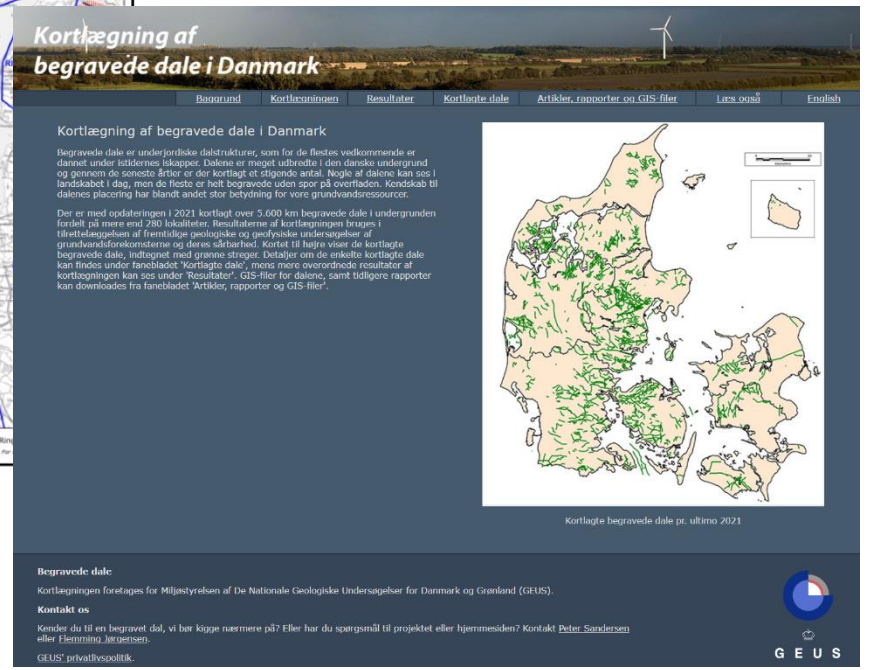
25 års kortlægning af begravede dale




Dal-liste


Oversigtskort


Dal-kort



www.begravededale.dk

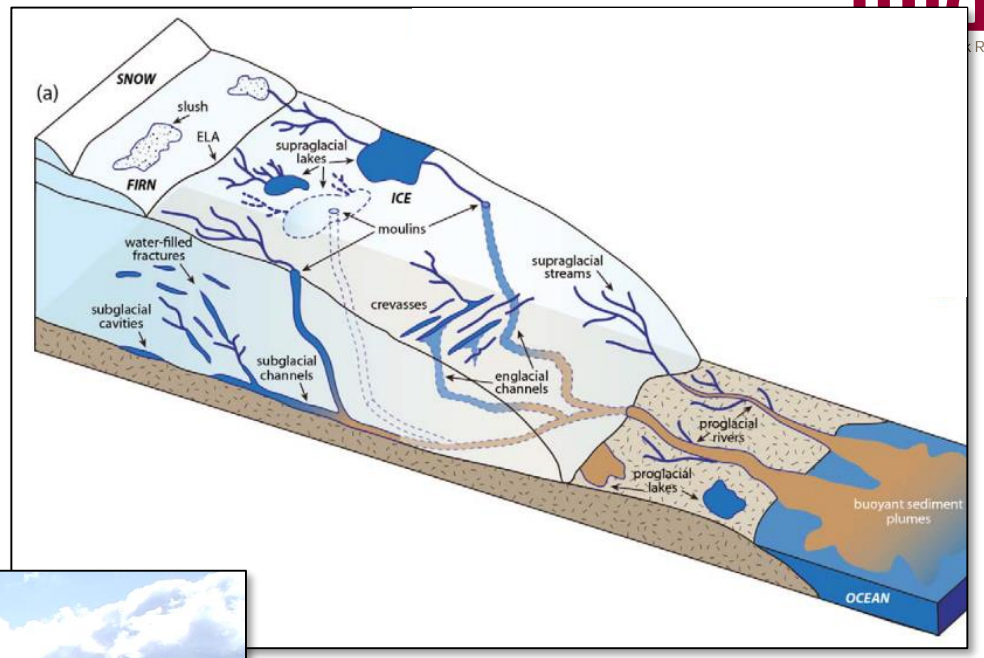

BOREAS

Rapid tunnel-valley formation beneath the receding Late Weichselian ice sheet in Vendsyssel, Denmark

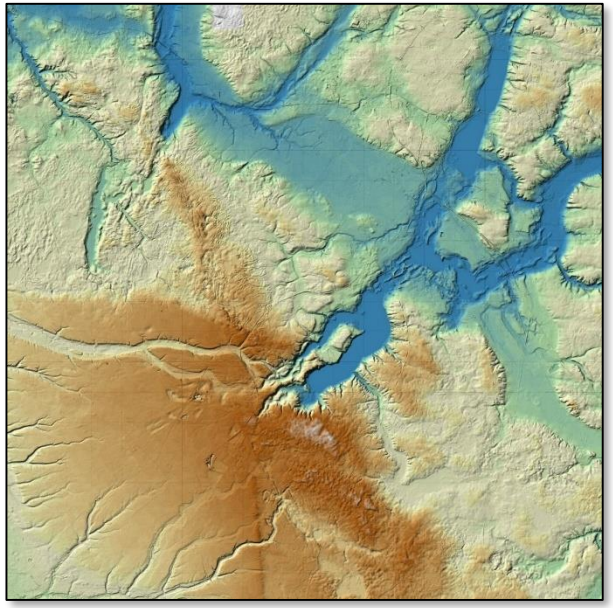
Peter Sandersen

Dalenes oprindelse

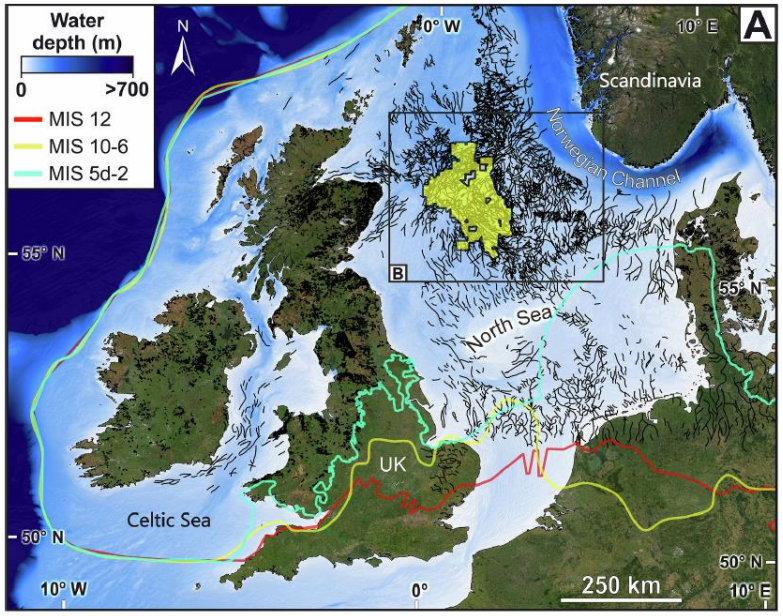
- De fleste begravede dale er gamle tunneldale
- Subglacial smeltevandserosion tæt ved isranden
- Smeltevand under højt hydrostatisk tryk
- Istidernes gletschere har skabt mange generationer af tunneldale

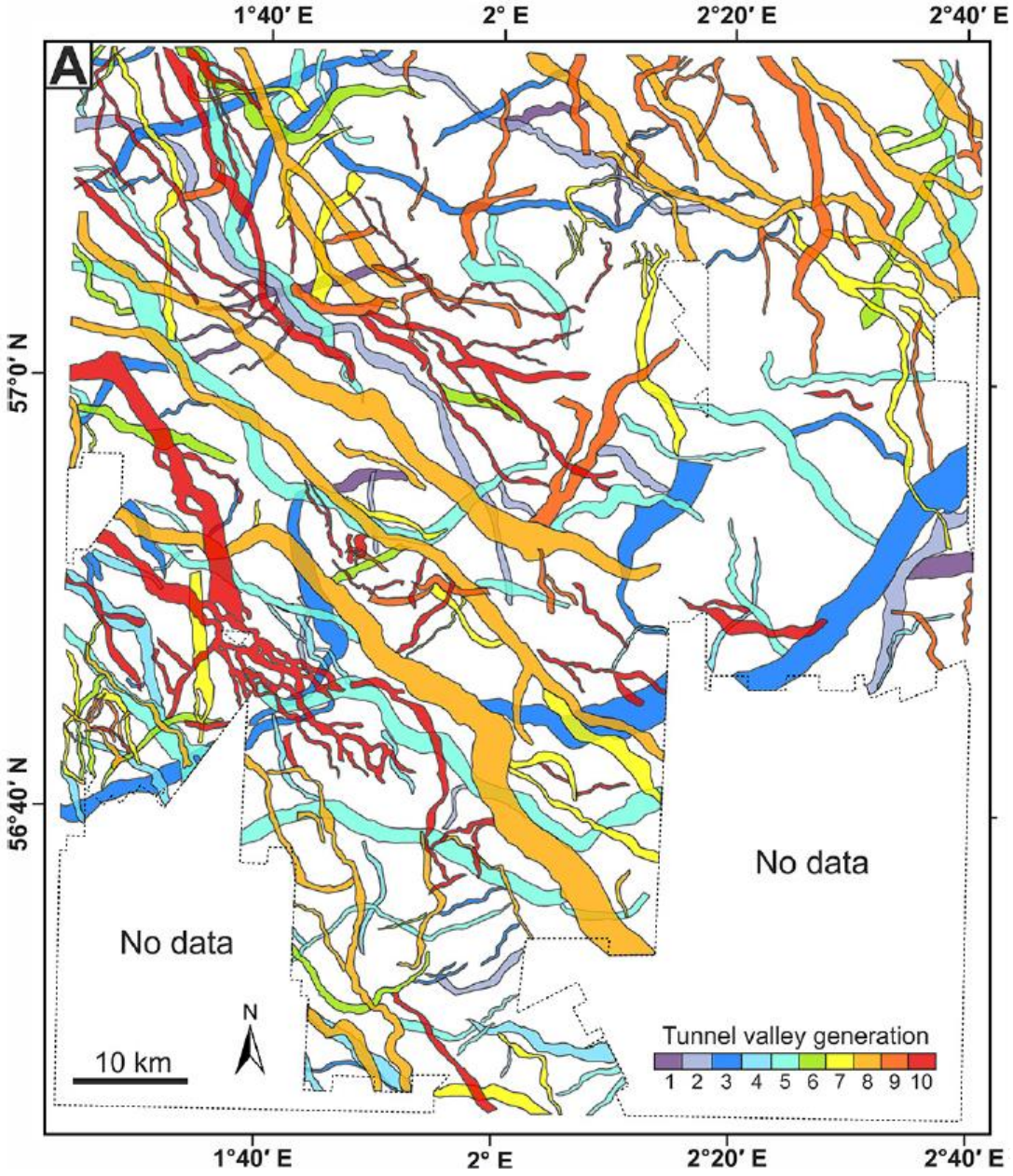


Chu 2014



Udblik til Nordsøen

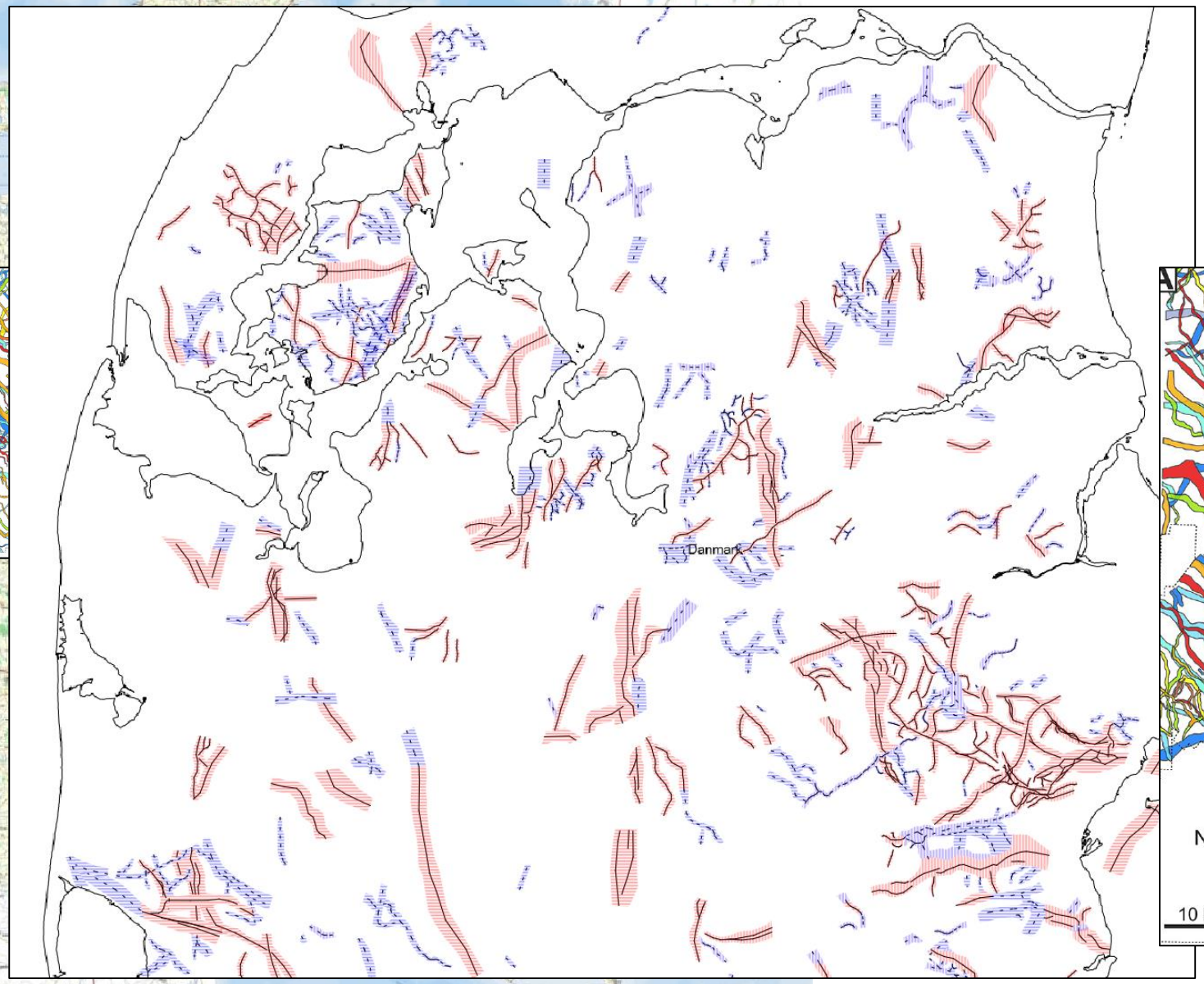


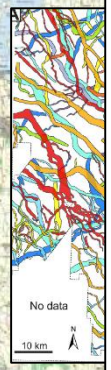


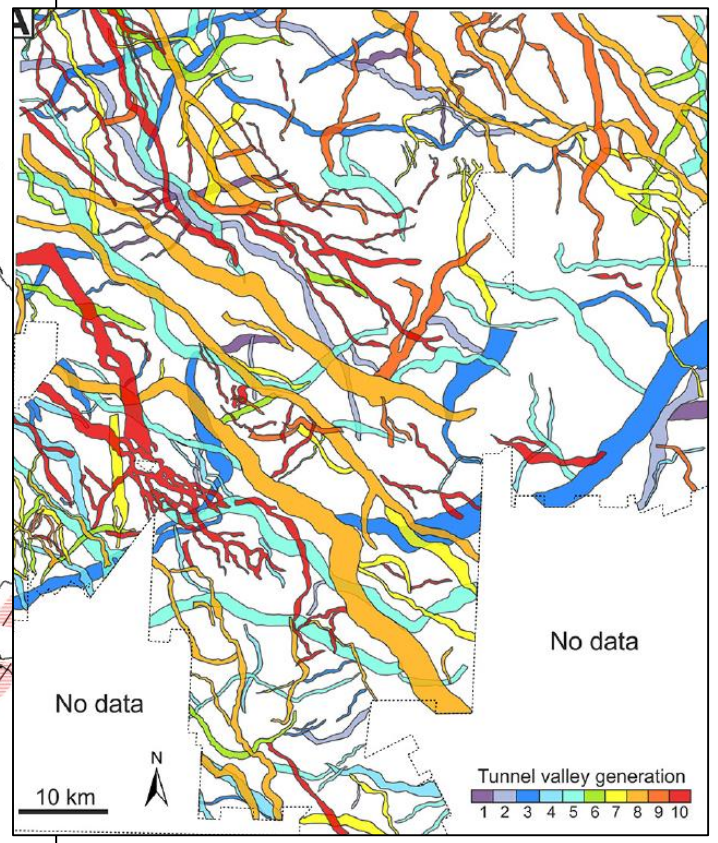
Kirkham et al. 2024

Hjem igen

- Dalene udgør en meget stor del af den terrænnære danske undergrund
- Mere end 50 % af det danske drikkevand vurderes at stamme fra begravede dale



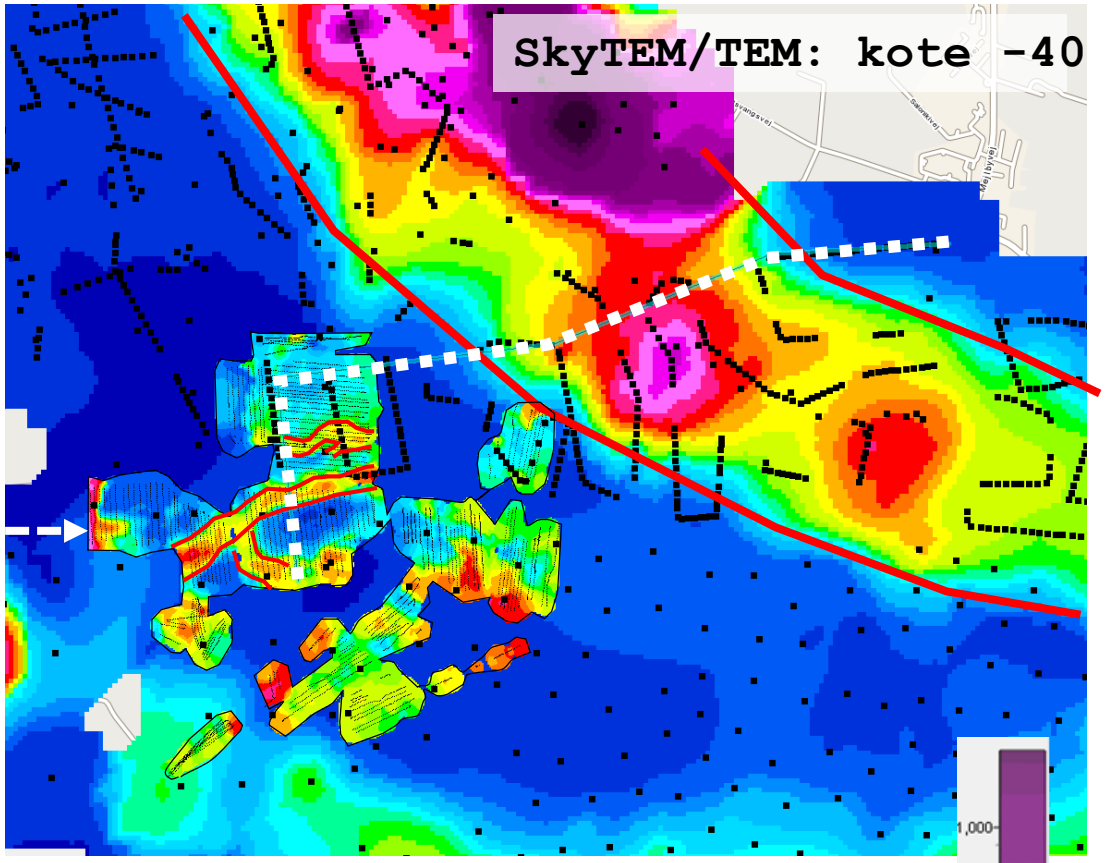


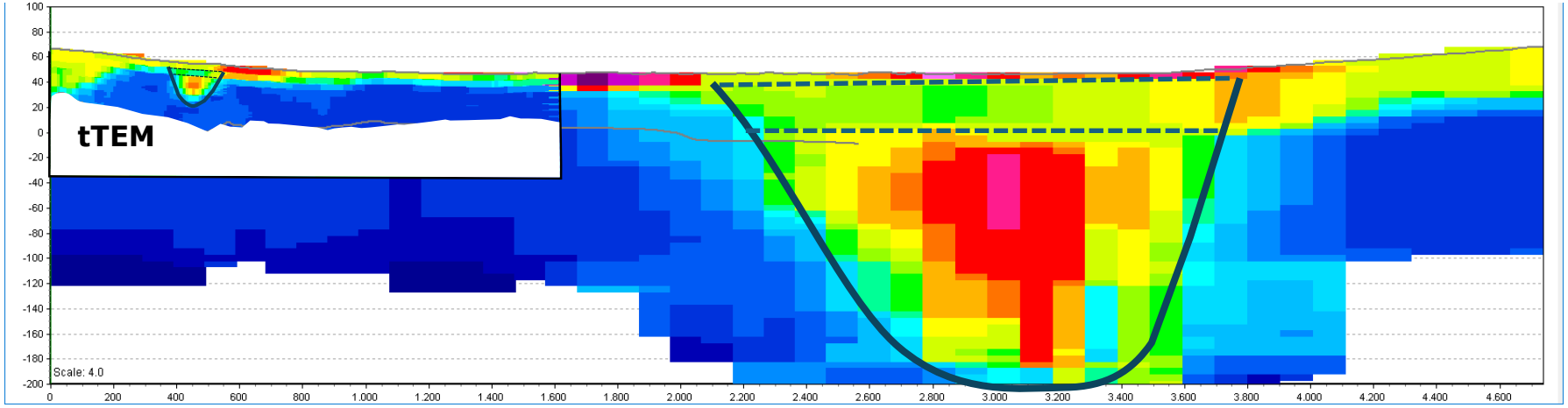


Kirkham et al. 2024

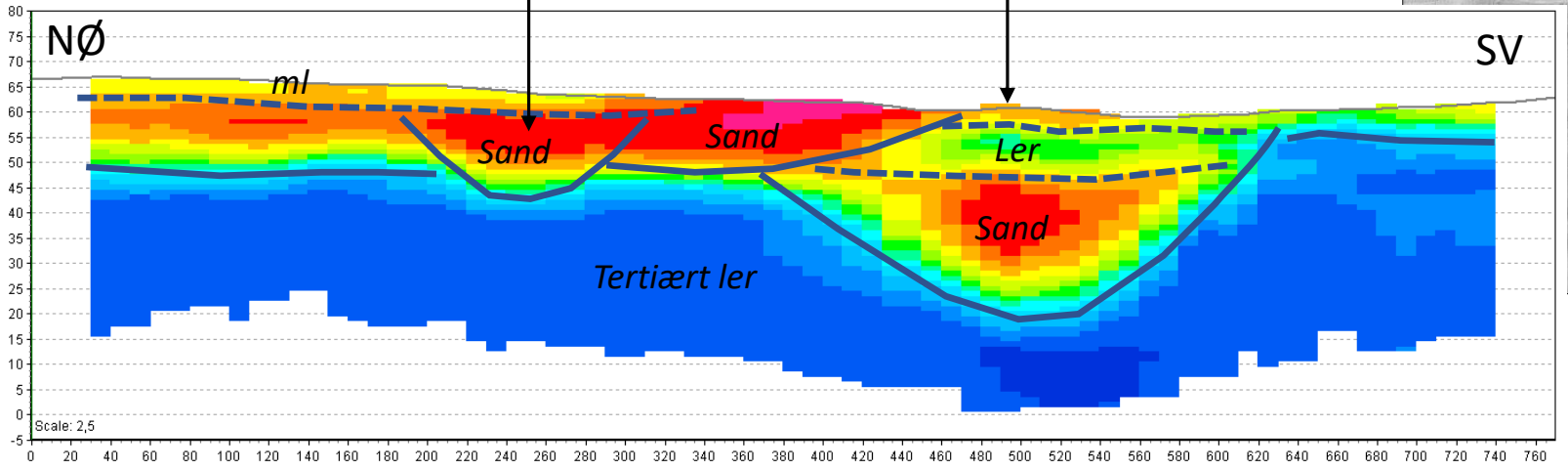
Begravede dale i alle størrelser

tTEM: kote +40 m



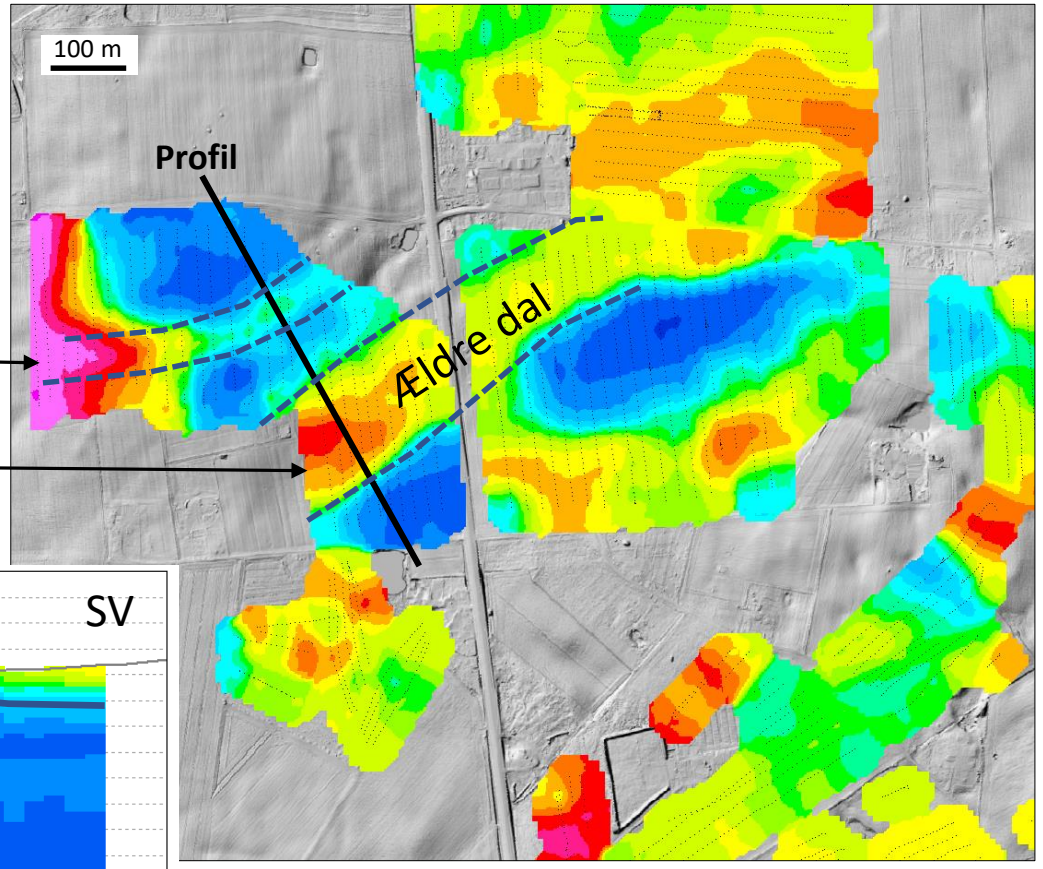


Begravede dale i alle størrelser



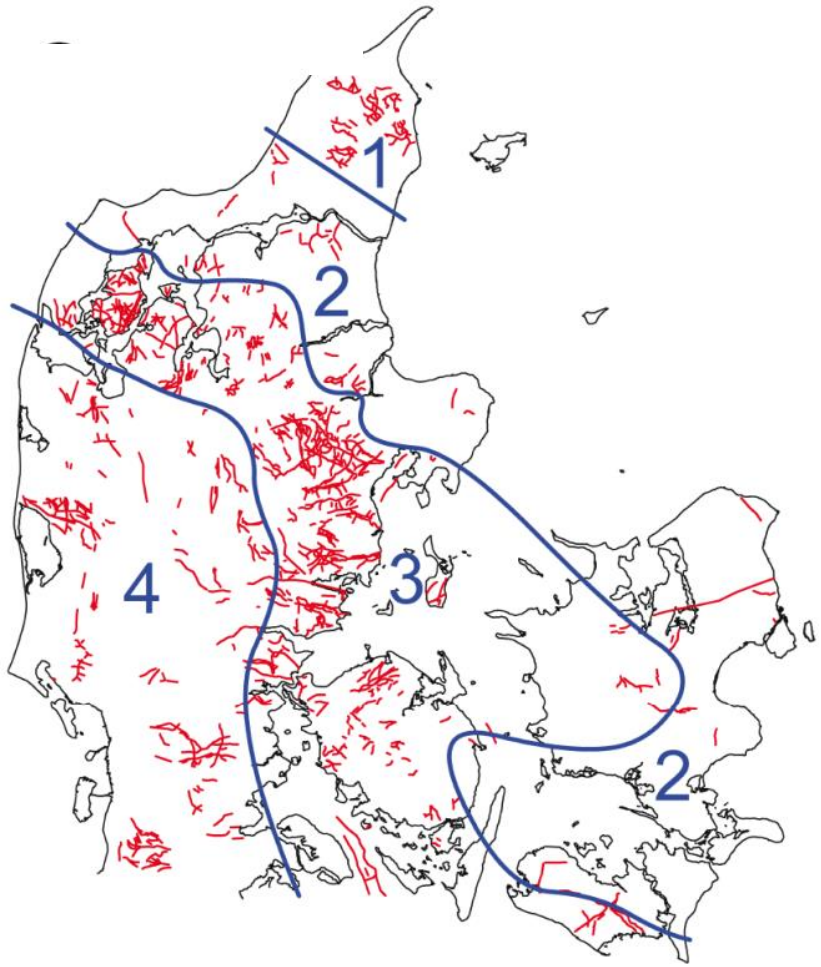
Yngre dal

Ældre dal



Kote +44 m

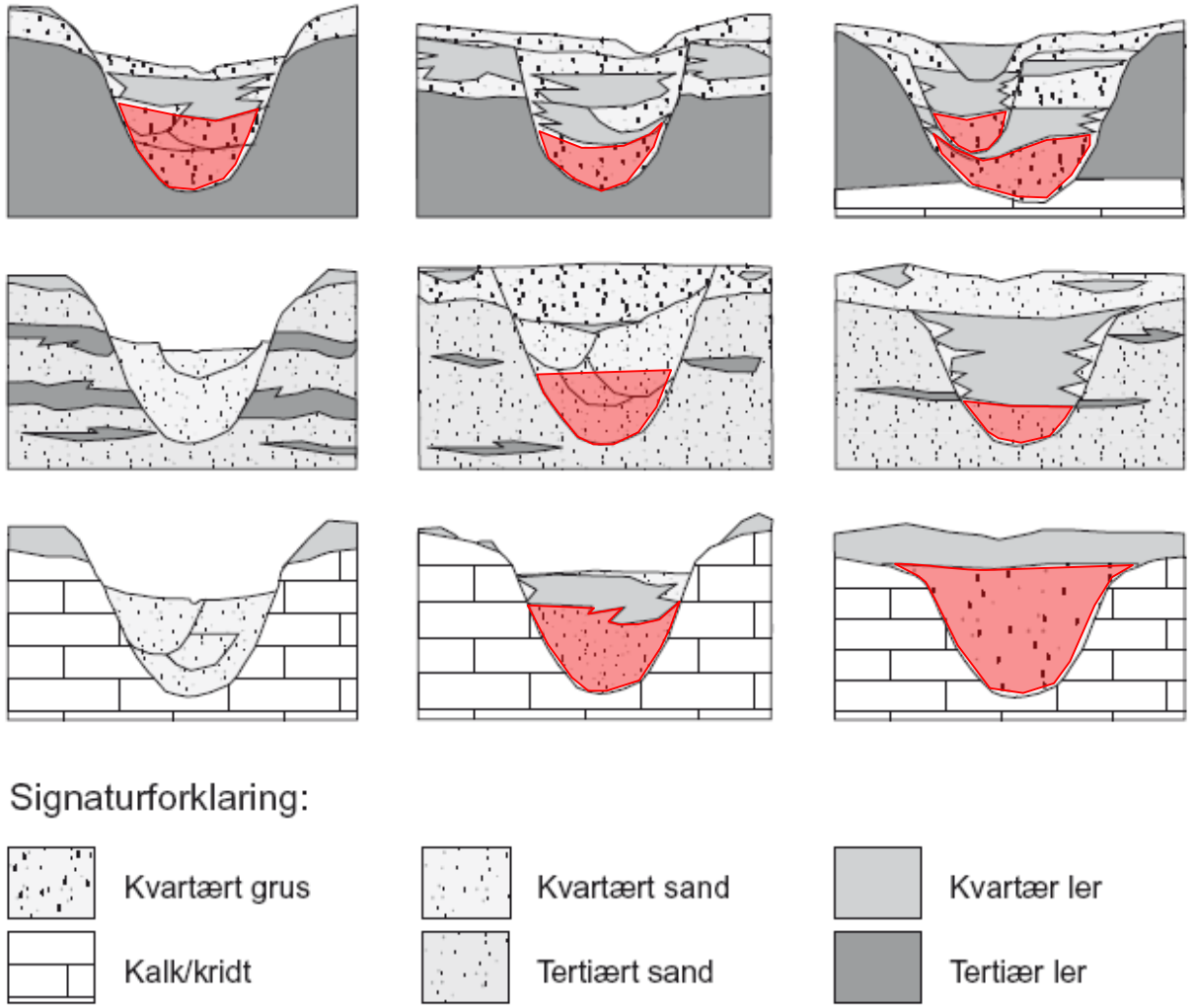
Begravede dale og grundvandsforhold



3: Begravede dale i ler

4: Begravede dale i sand

2: Begravede dale i kalk

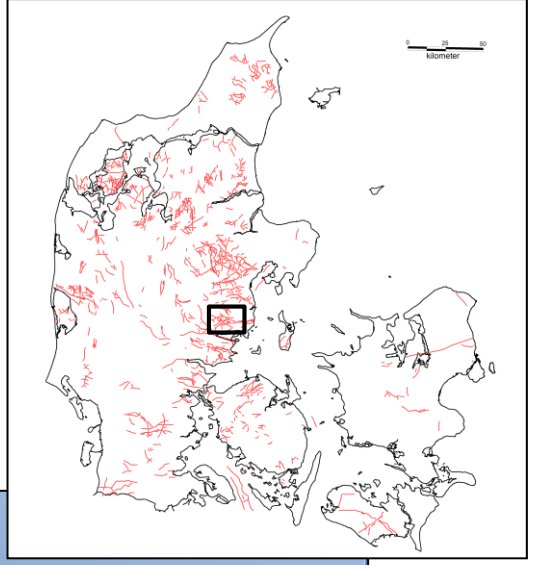


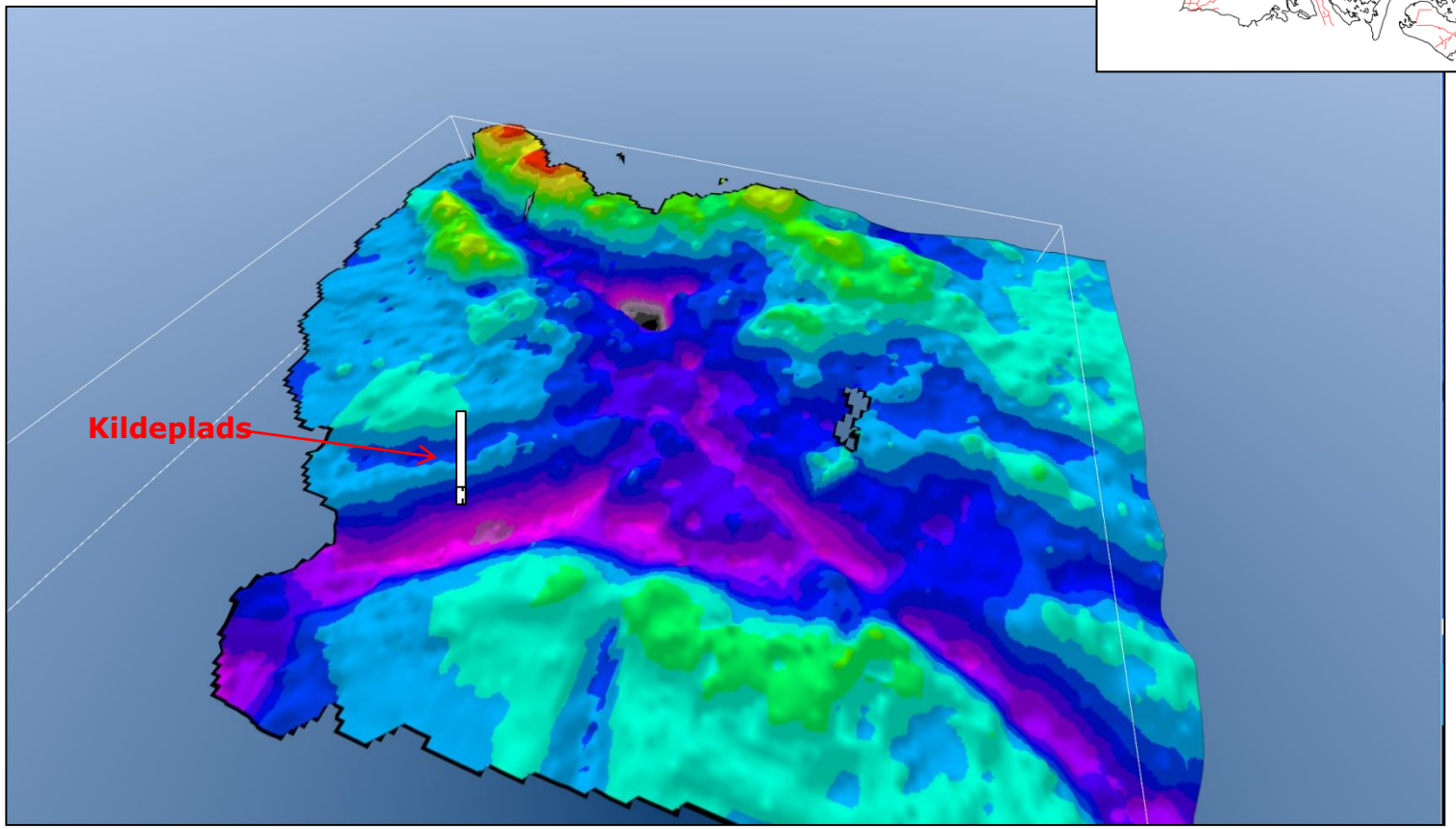
Sandersen & Jørgensen 2003

Strømning i begravede dale

Egebjerg nordøst for Horsens

- Begravede dale nederoderet i Palæogen ler

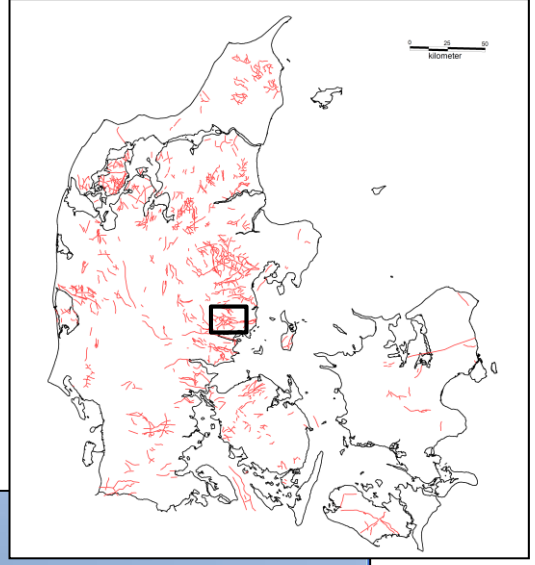


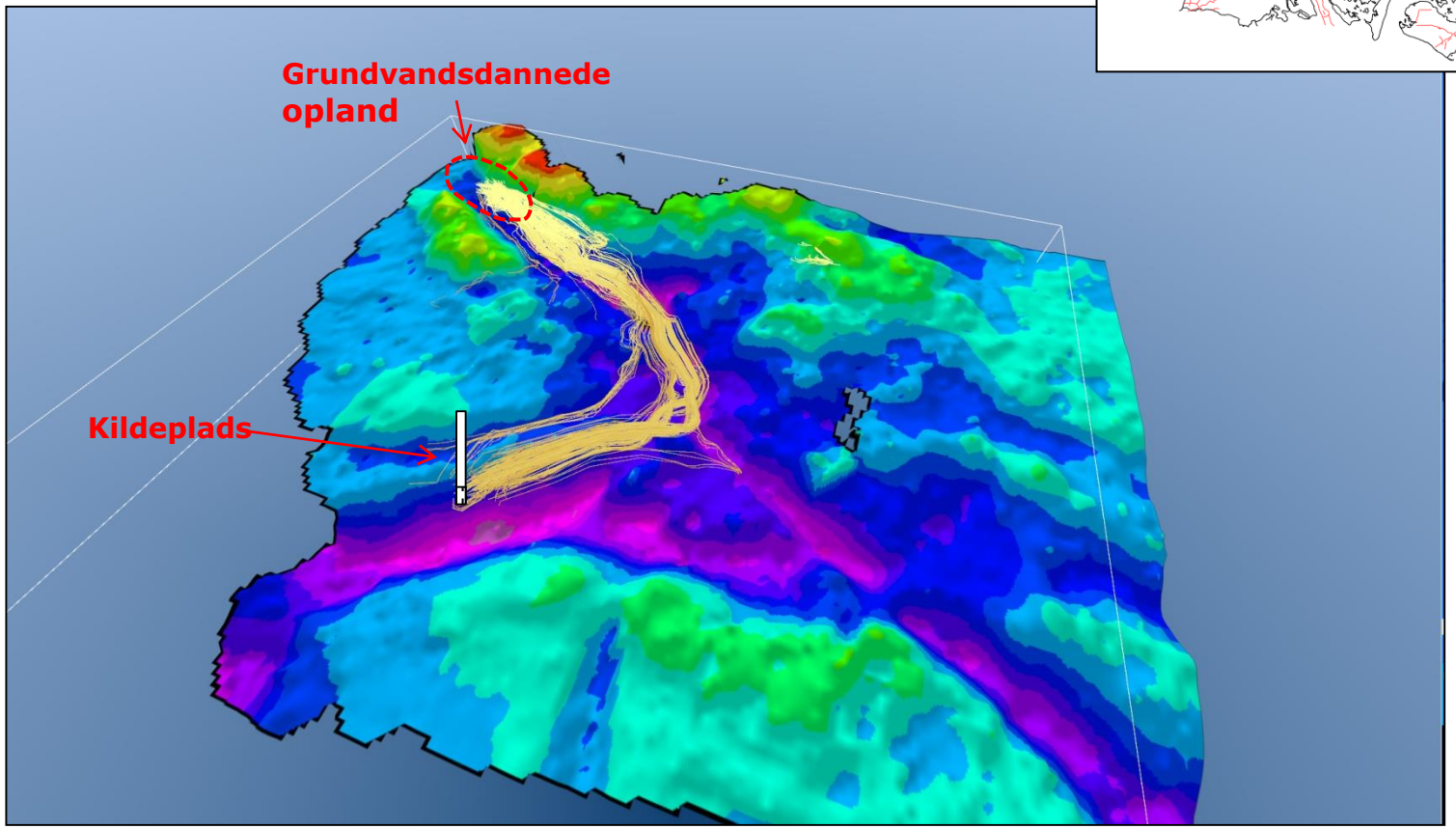


Strømning i begravede dale

Egebjerg nordøst for Horsens

- Partikelbaner følger de begravede dale

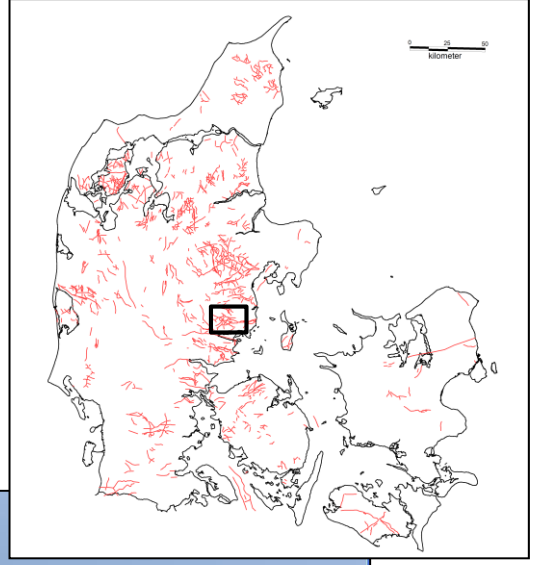


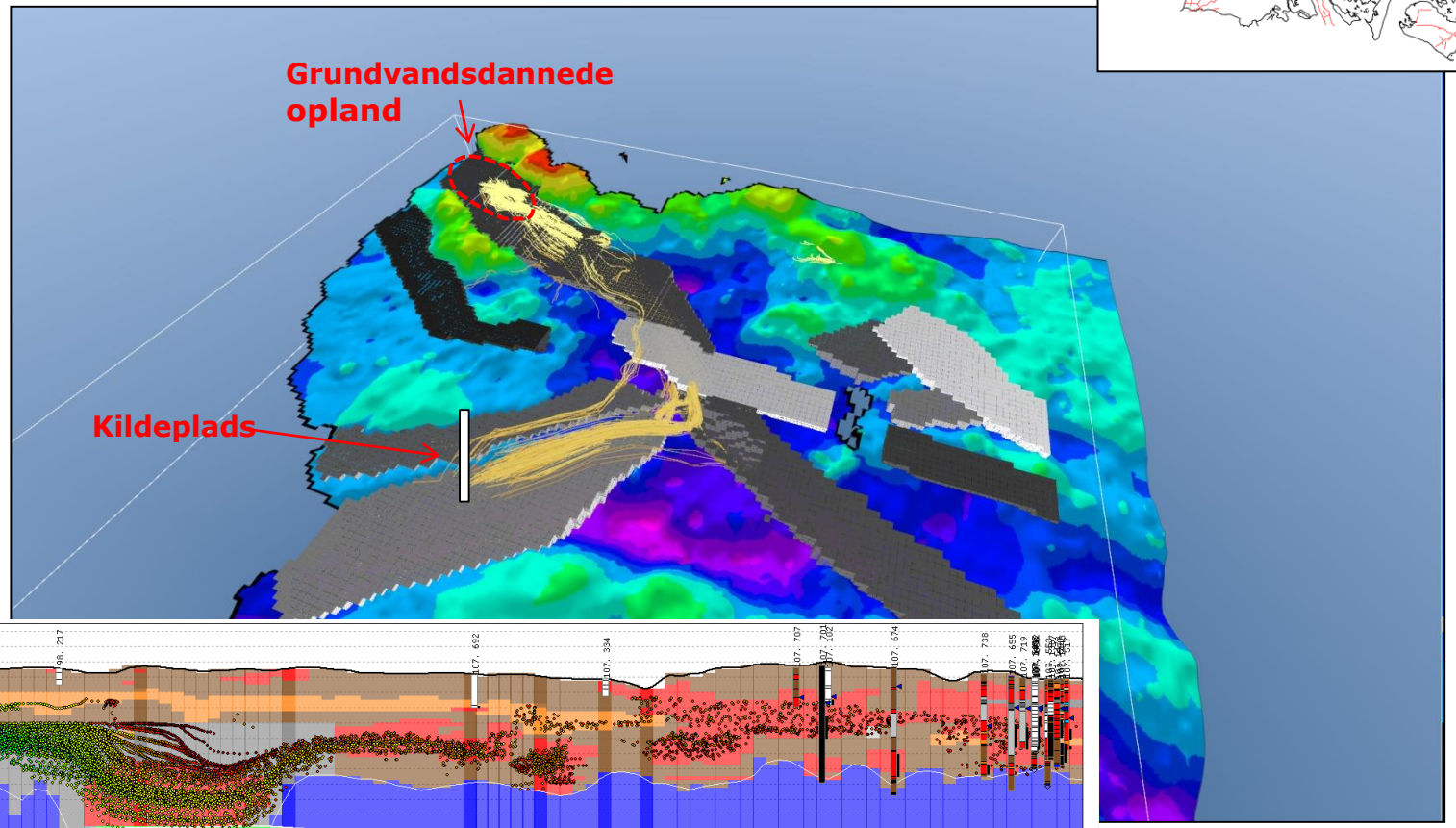


Strømning i begravede dale

Egebjerg nordøst for Horsens

- Partikelbaner følger de begravede dale

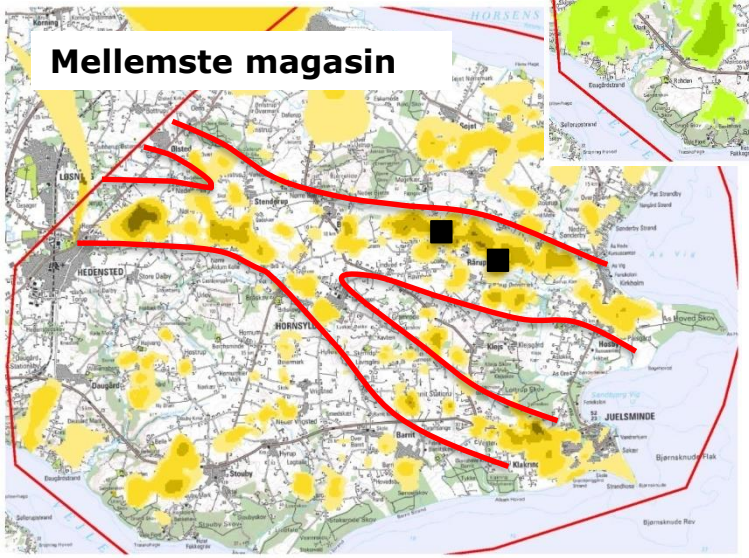


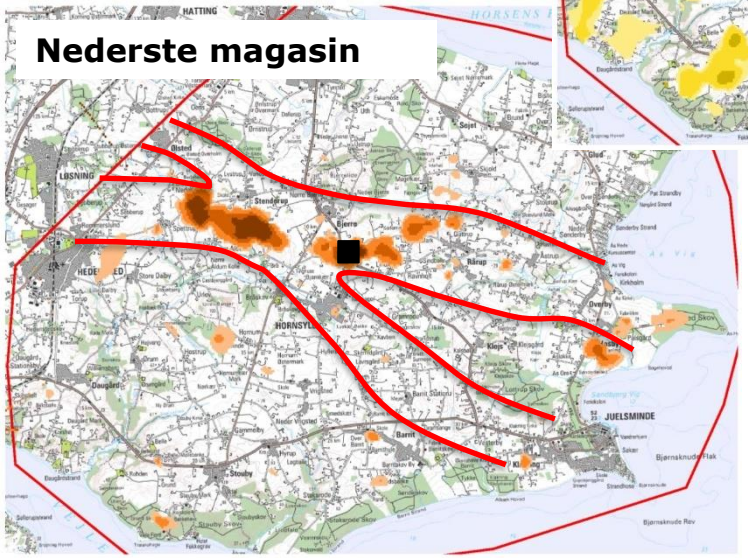


Strømning i begravede dale

Juelsminde

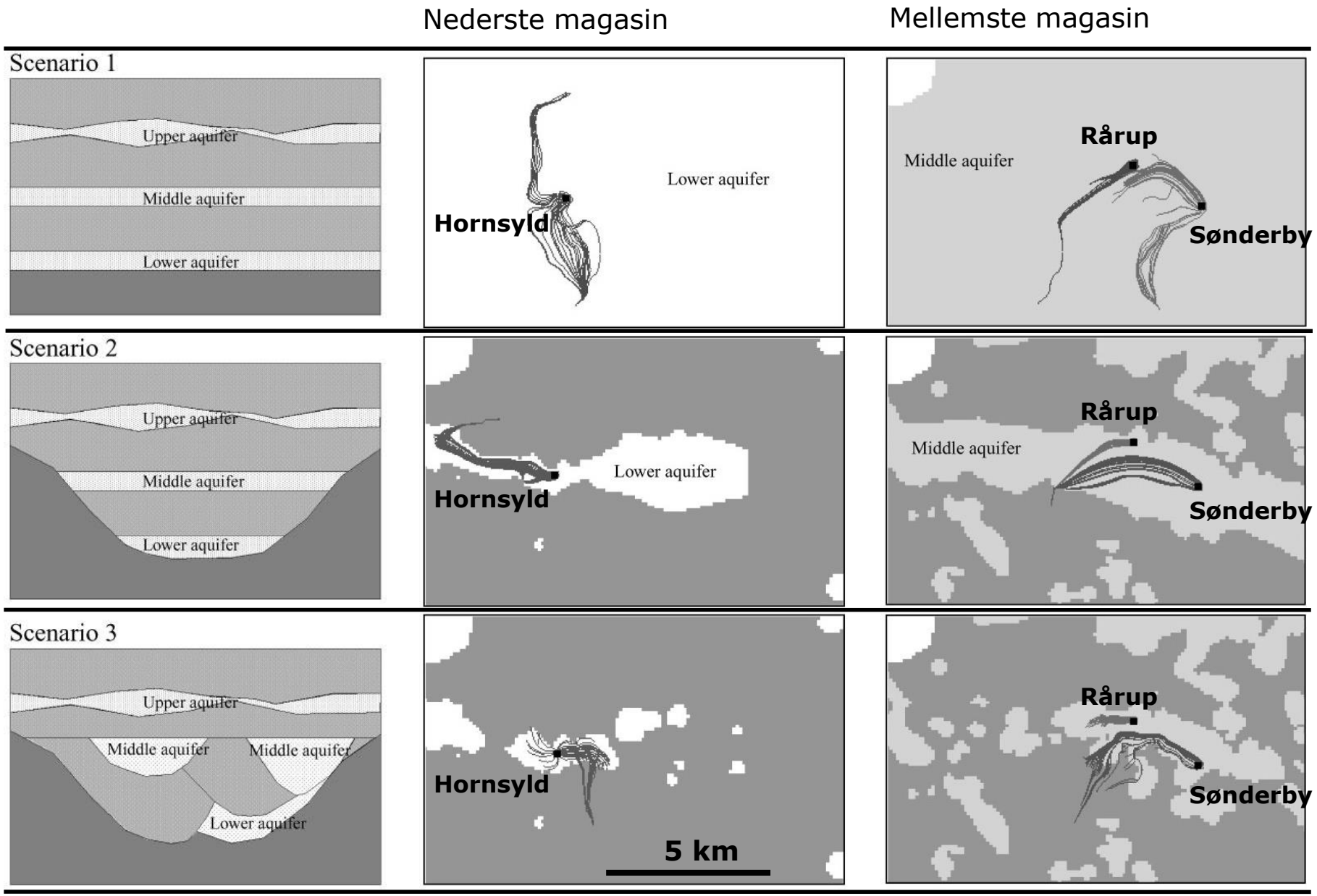
- Fordeling af grundvandsmagasiner





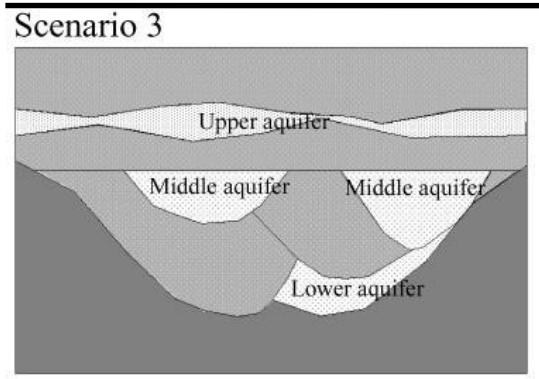
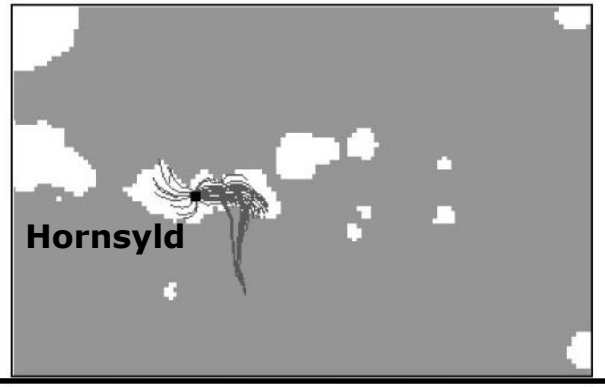
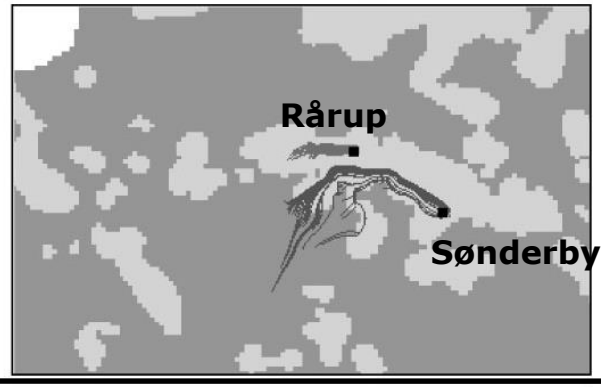
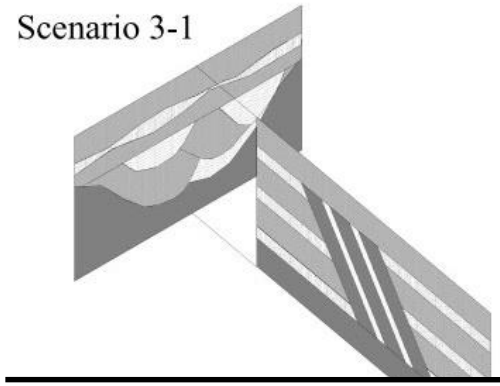
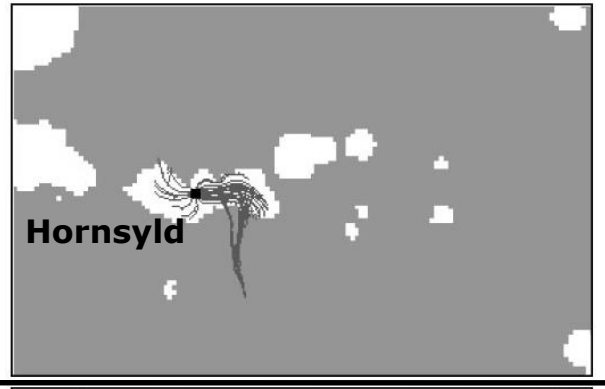
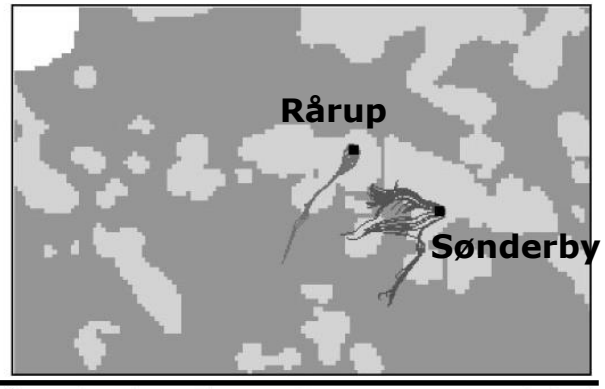
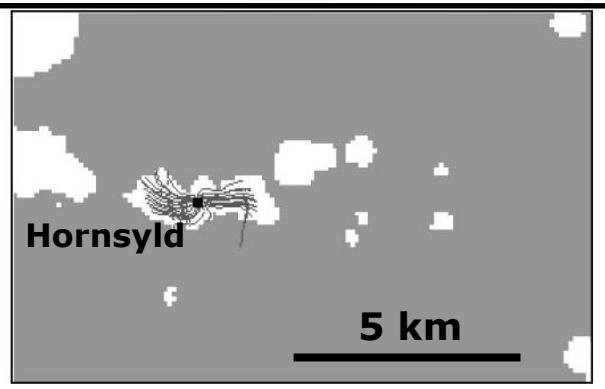
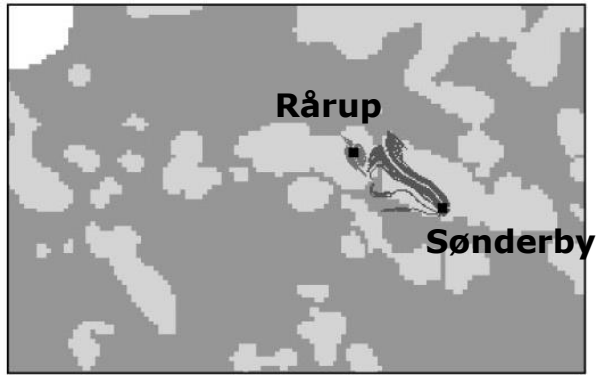
Jørgensen et al. 2007

Strømning i begravede dale



Jørgensen et al. 2007

Strømning i begravede dale

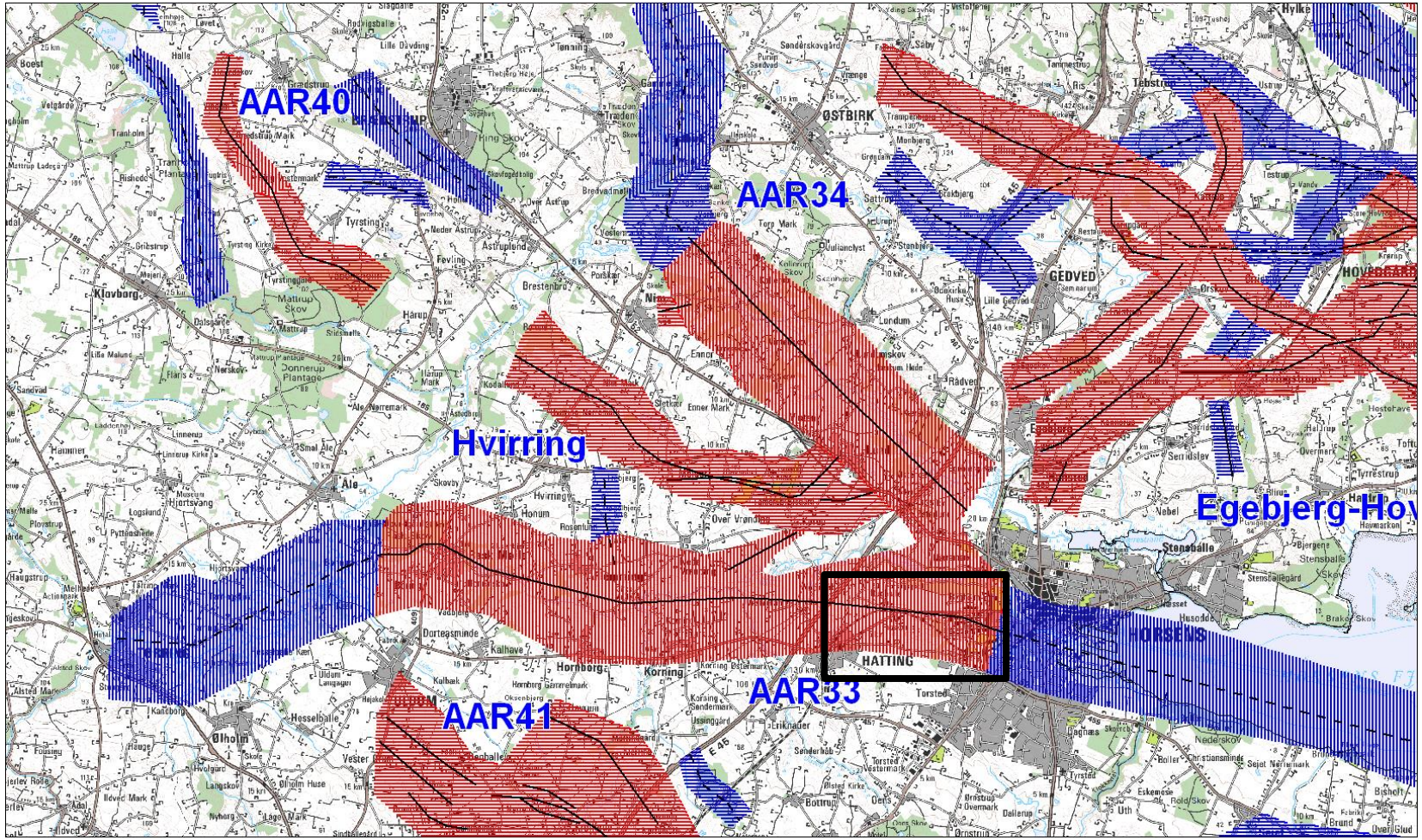
	Nederste magasin	Mellemste magasin
Avanceret geologisk model	 	
Introduktion af deformation	 	
Små justeringer i forbindelse mellem magasiner	Scenario 3-2 Joining and blinding of minor aquifers south of Sønderby 	

Jørgensen et al. 2007

Eksempel: Torsted-Rugballegaard

Begravede dale

- Røde: Veldokumenterede
- Blå: Svagt dokumenterede



Sandersen, P. & Jørgensen, F. www.begravededale.dk

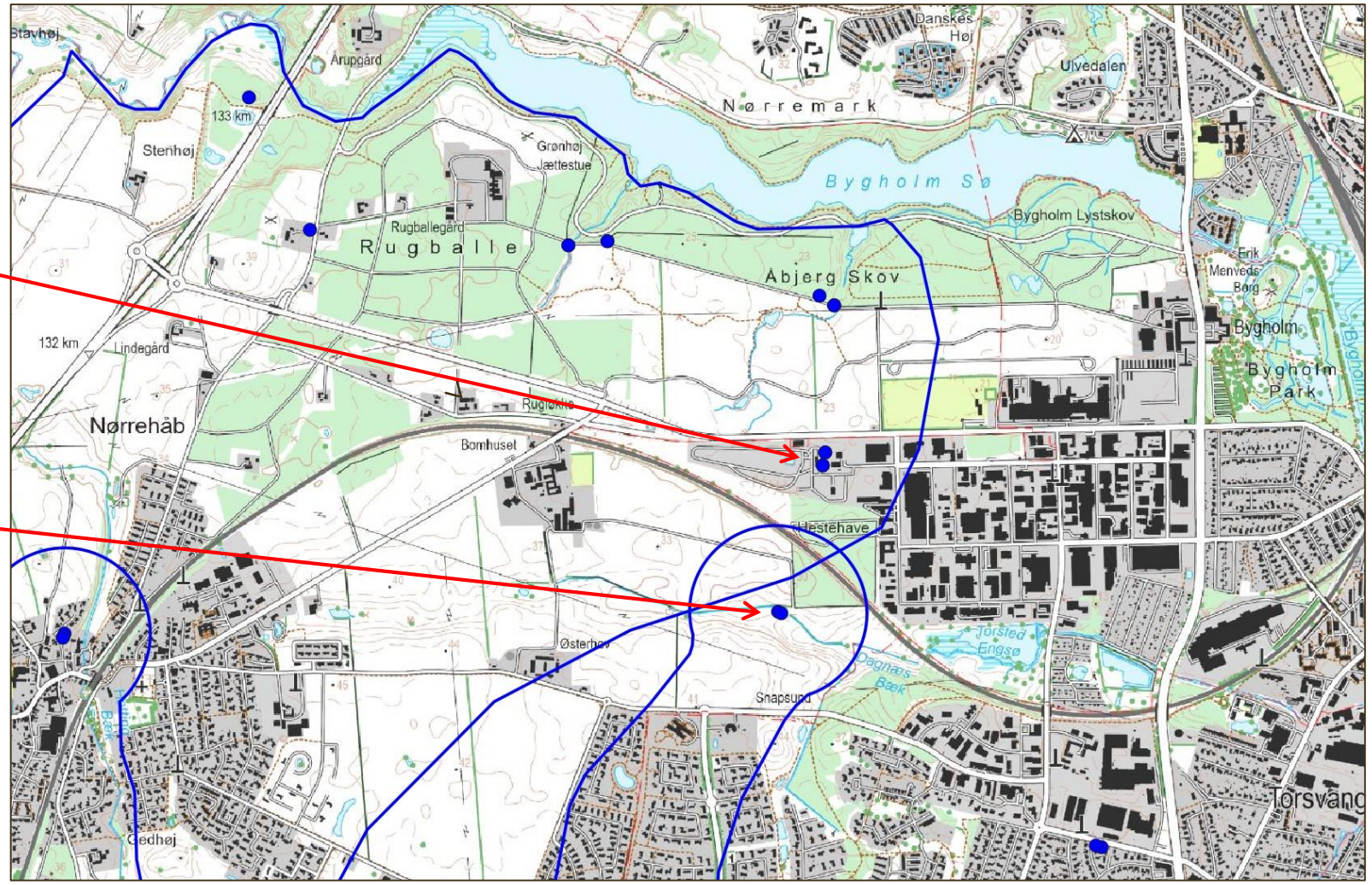
Problemstilling

Rugballegård Vandværk

- Desphenyl-chloridazon (DPC)
- Bentazon

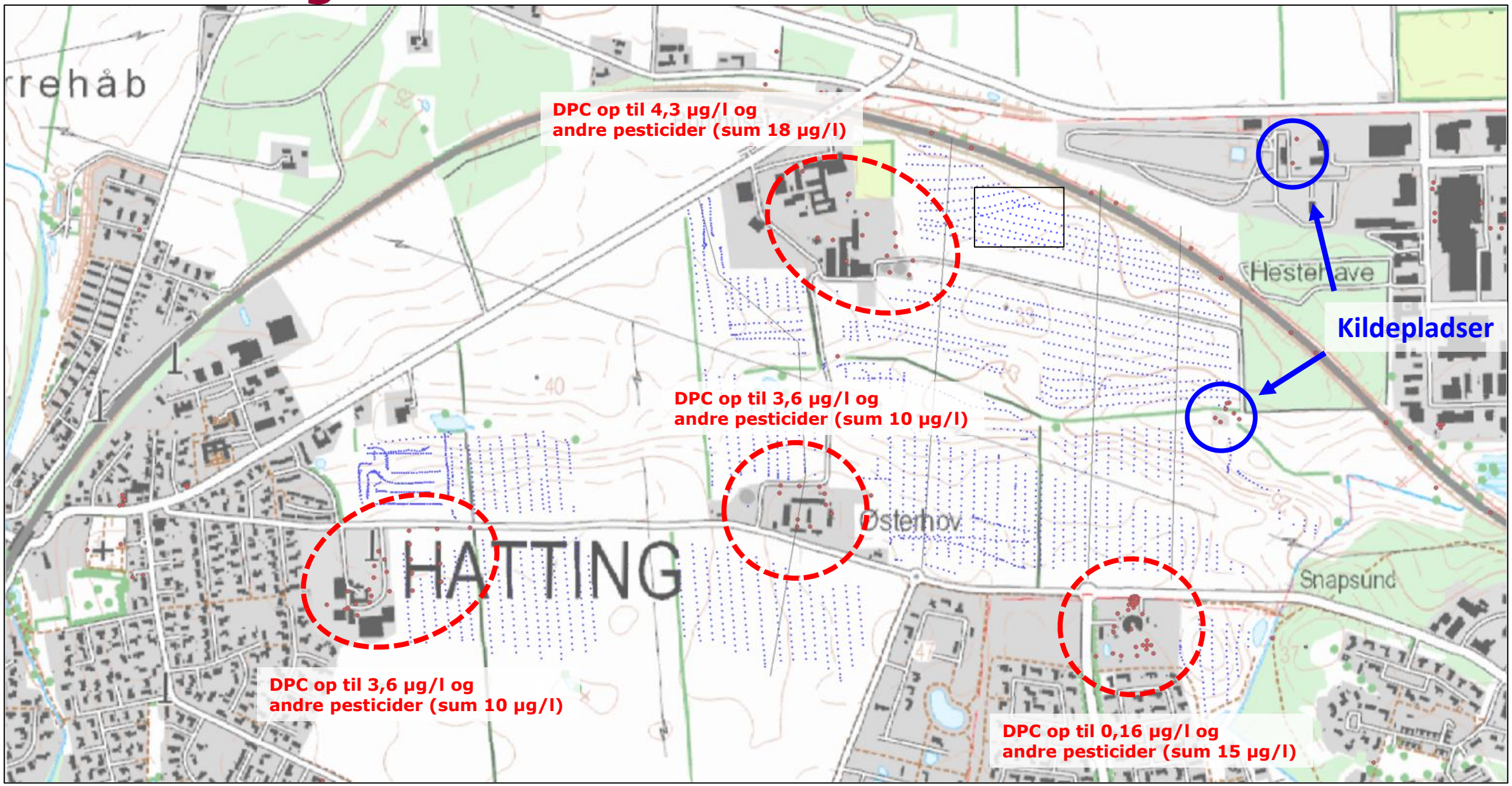
Torsted Vandværk

- Desphenyl-chloridazon (DPC)
- Methyl-desphenyl-chloridazon

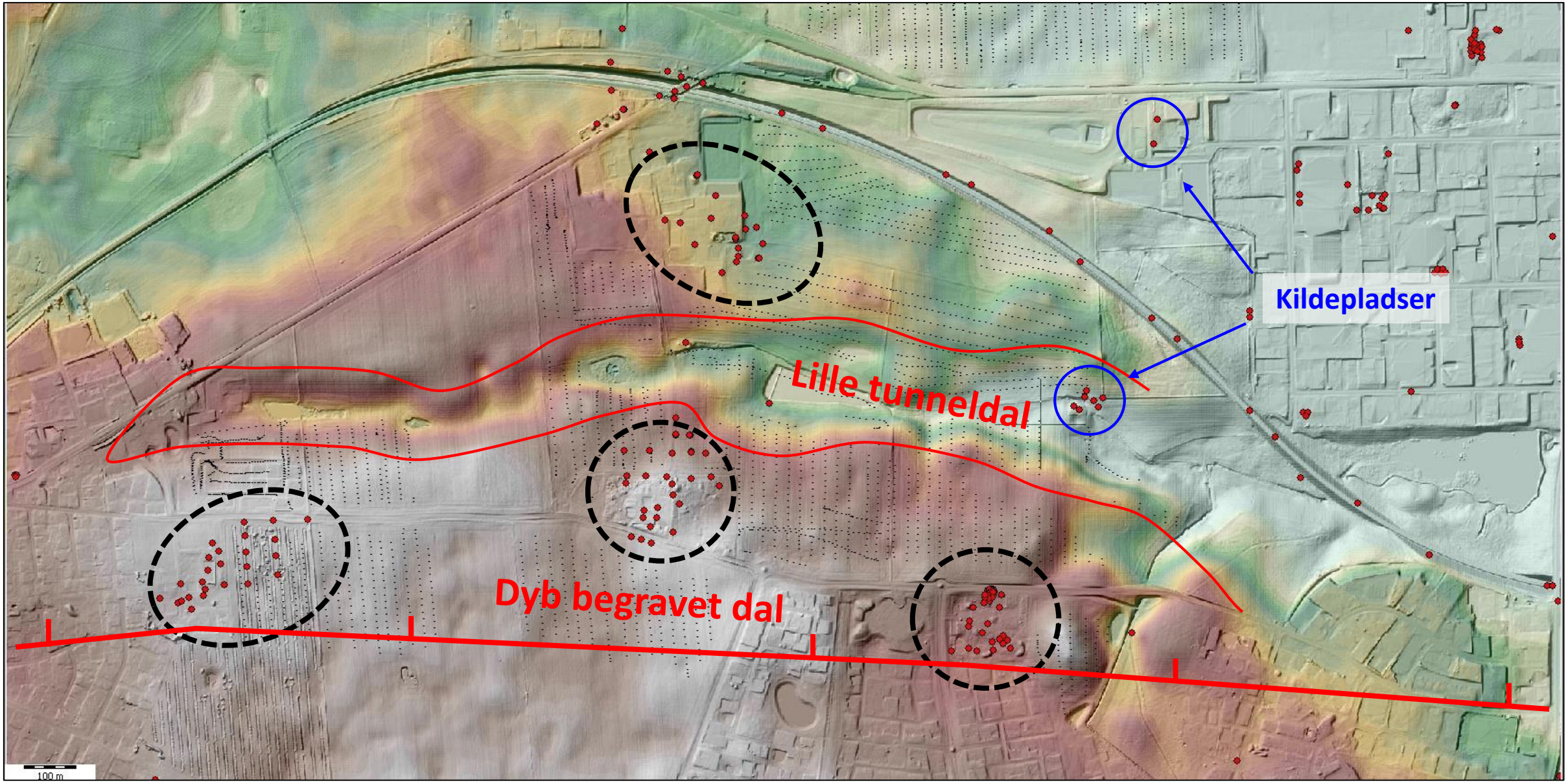


Forureningslokaliteter

tTEM



Terræn og forekomst af tunneldal + dyb begravet dal



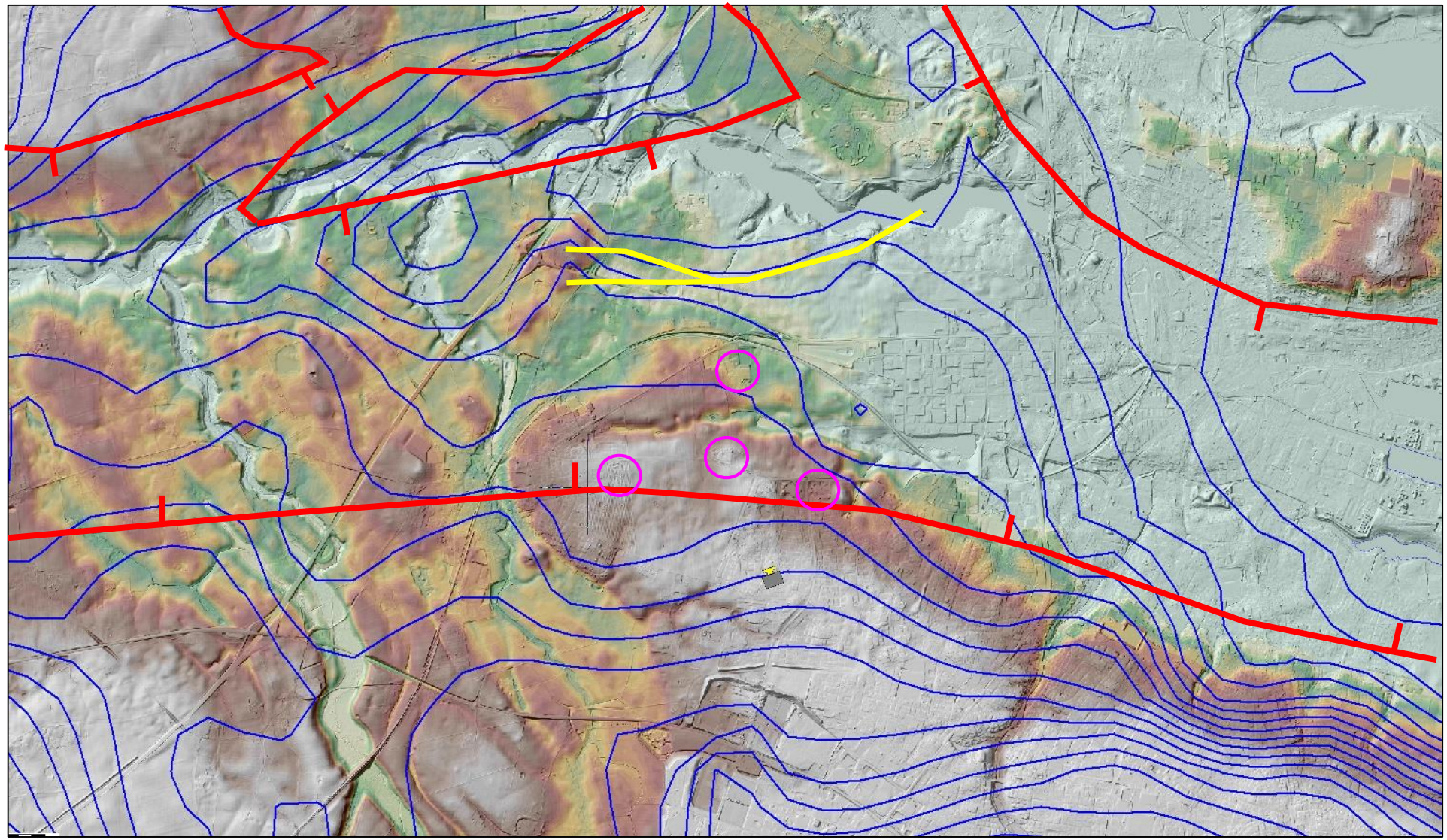
Potentialekort for primære magasiner

Hydraulisk barriere – kortlagt i 2003

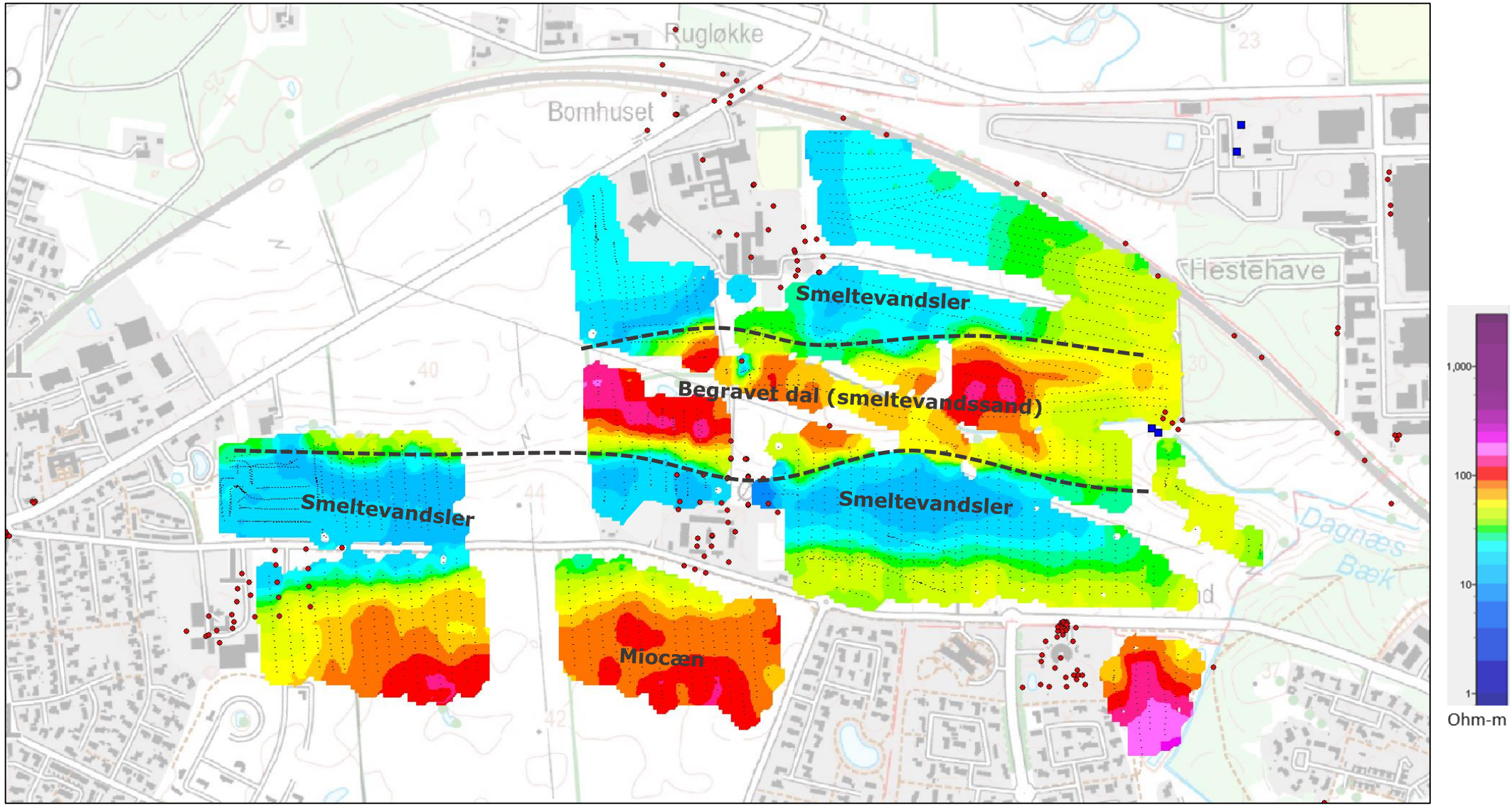
Afgrænsning af dybe begravede dale

Lokaliteter

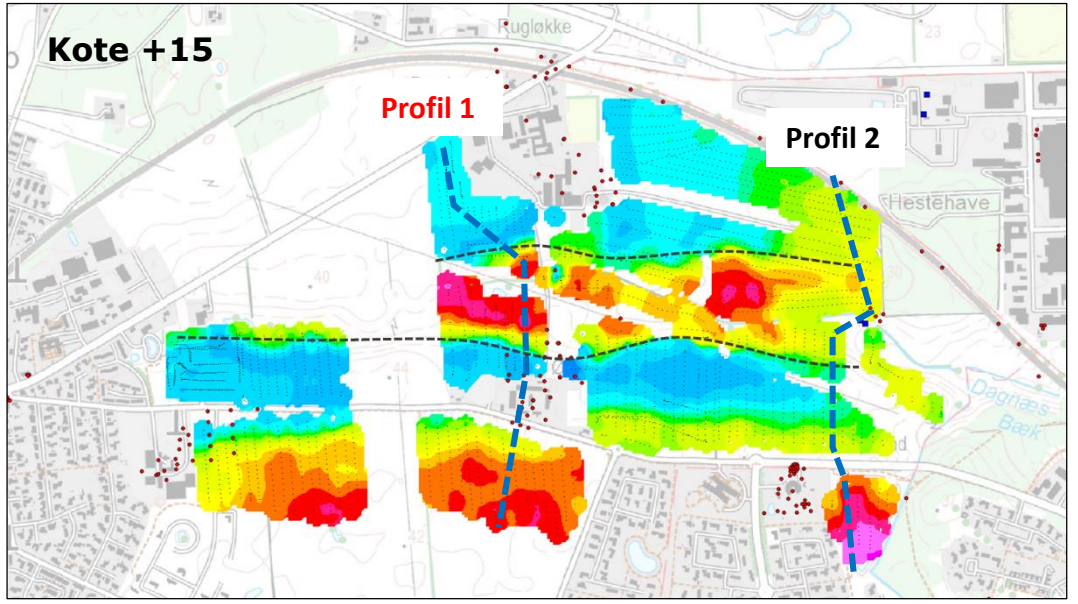
Potentialelinjer

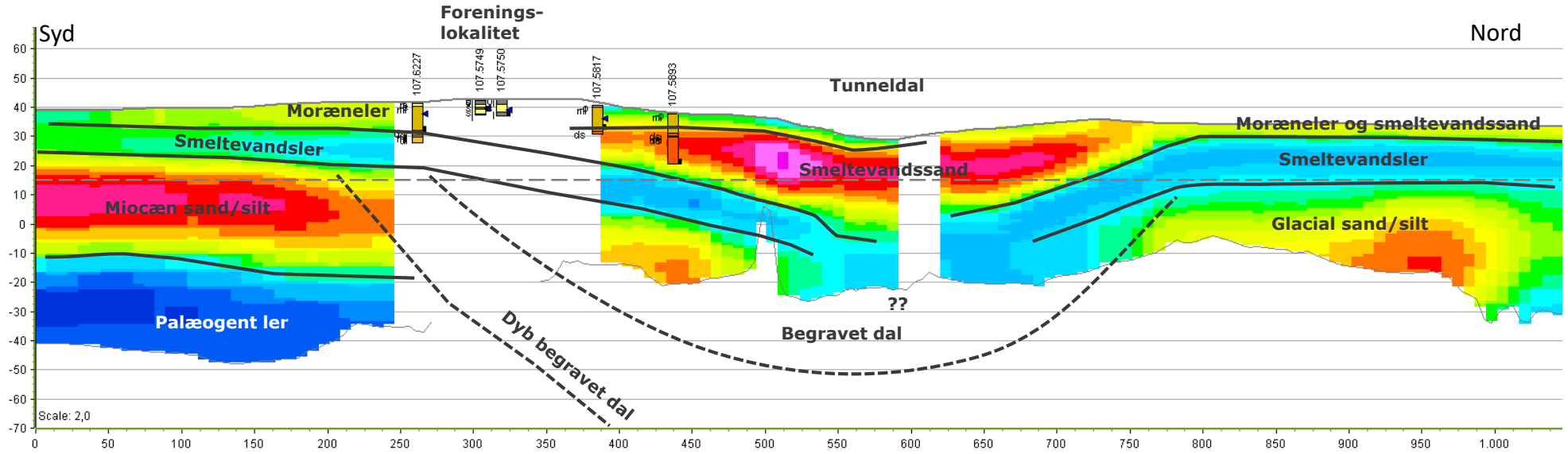


Horisontalt snit gennem tTEM data i kote +15 m



Profil 1


Kote +15
Profil 1
Profil 2
Hestehave
Dagnæs Bæk


Syd
Forenings-
lokalitet
Nord
Tunneldal
Moræneler
Smeltevandsler
Miocæn sand/silt
Palæogent ler
Smeltevandssand
Moræneler og smeltevandssand
Smeltevandsler
Glacial sand/silt
??
Begravet dal
Dyb begravet dal
Scale: 2,0
107.6227
107.5749
107.5750
107.5817
107.5893
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
0
50
100
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700
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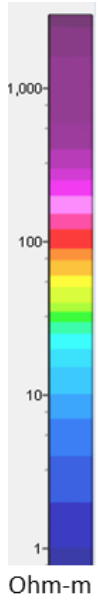
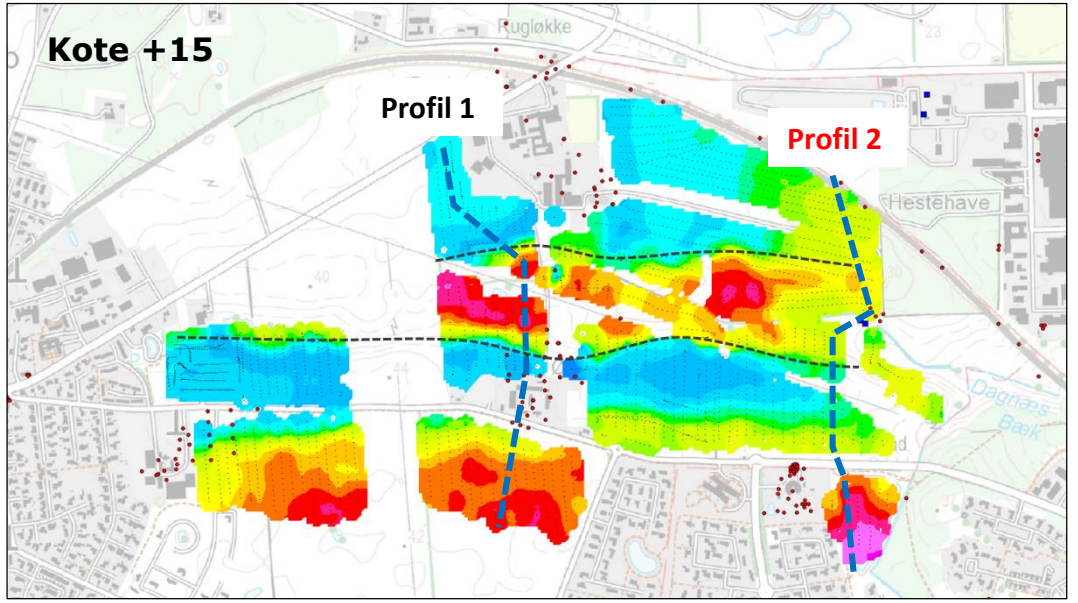
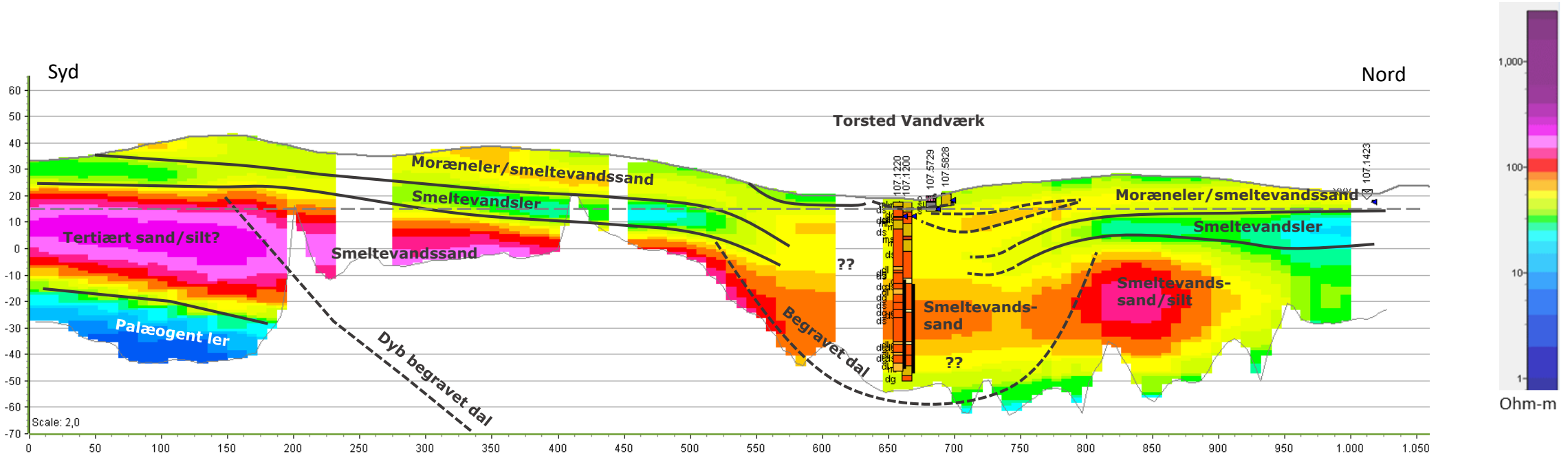
900
950
1.000

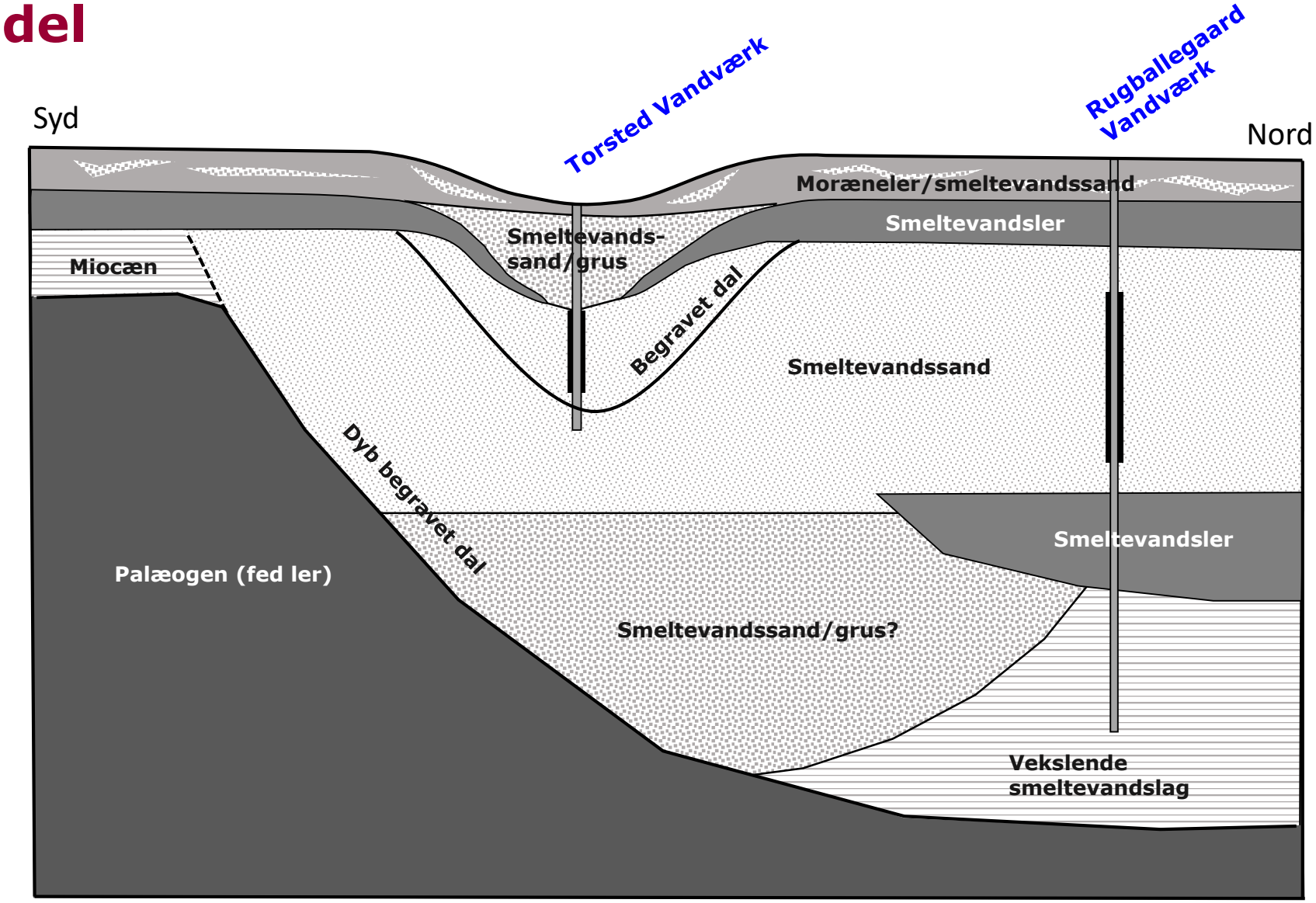

1,000
100
10
1
Ohm-m

Profil 2

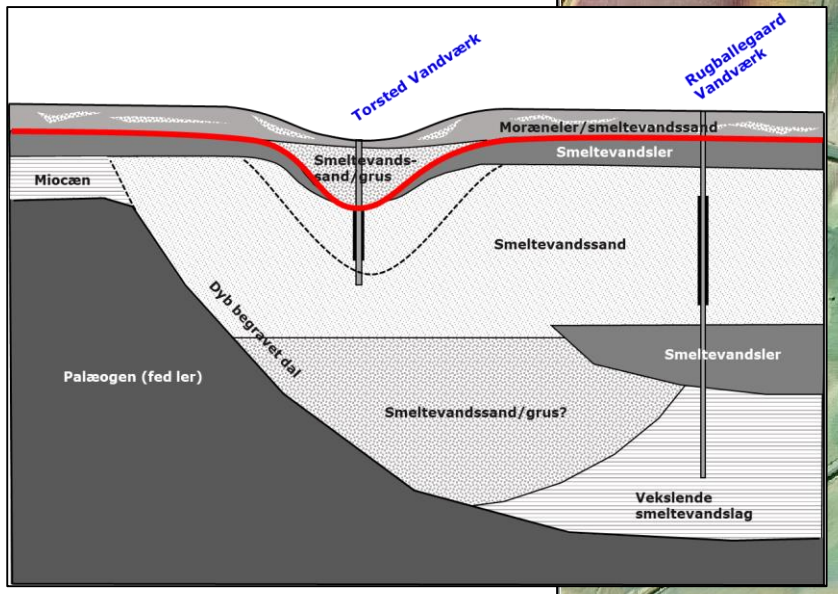

Kote +15
Profil 1
Profil 2
Hestehave
Dagnæs Bæk

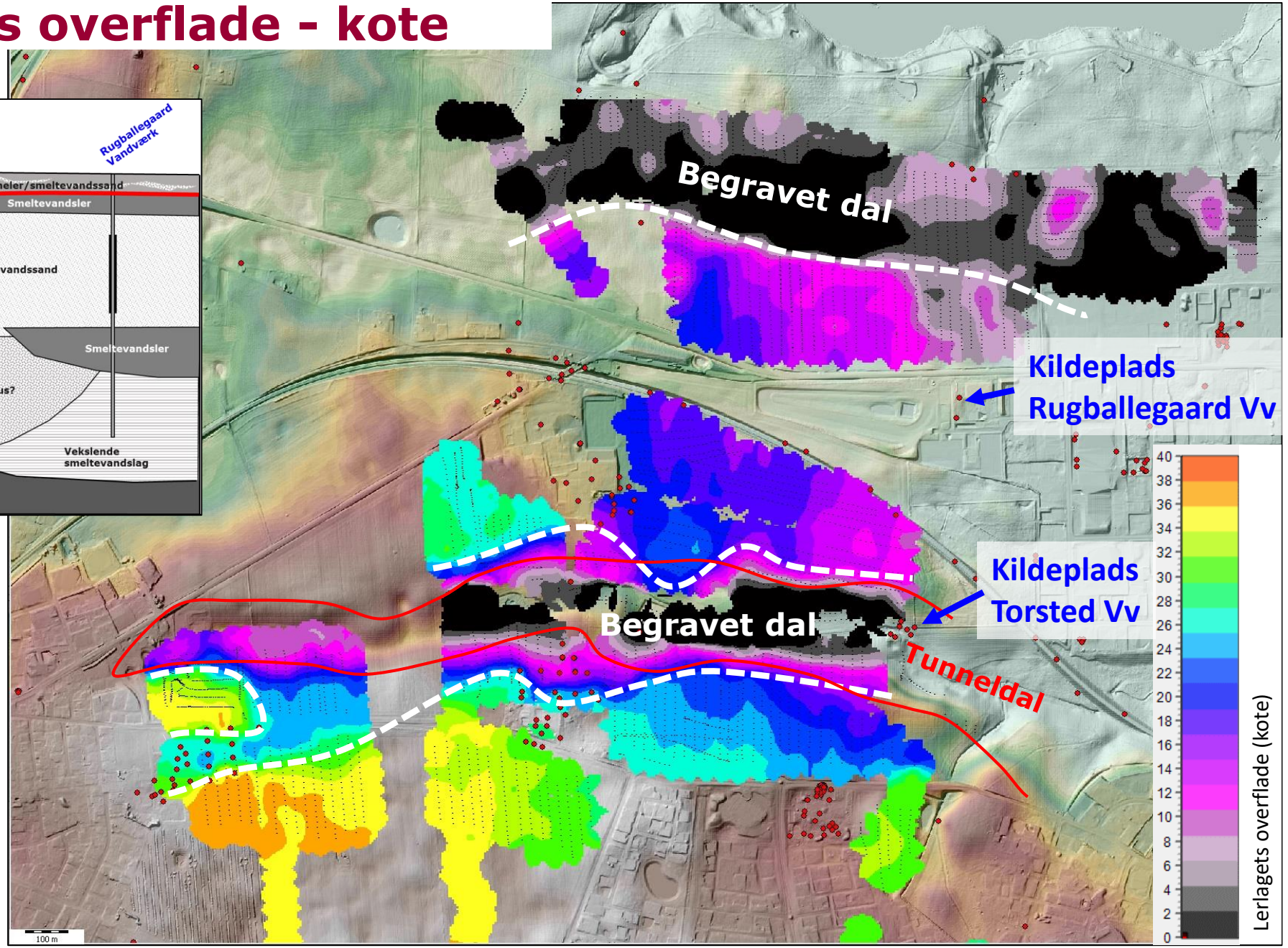

Syd
Nord
Torsted Vandværk
Moræneler/smeltevandssand
Smeltevandsler
Smeltevandssand
Tertiært sand/silt?
Palæogent ler
Dyb begravet dal
Begravet dal
??
Smeltevands-sand
Smeltevands-sand/silt
Scale: 2,0
1,000
100
10
1
Ohm-m

Konceptuel model

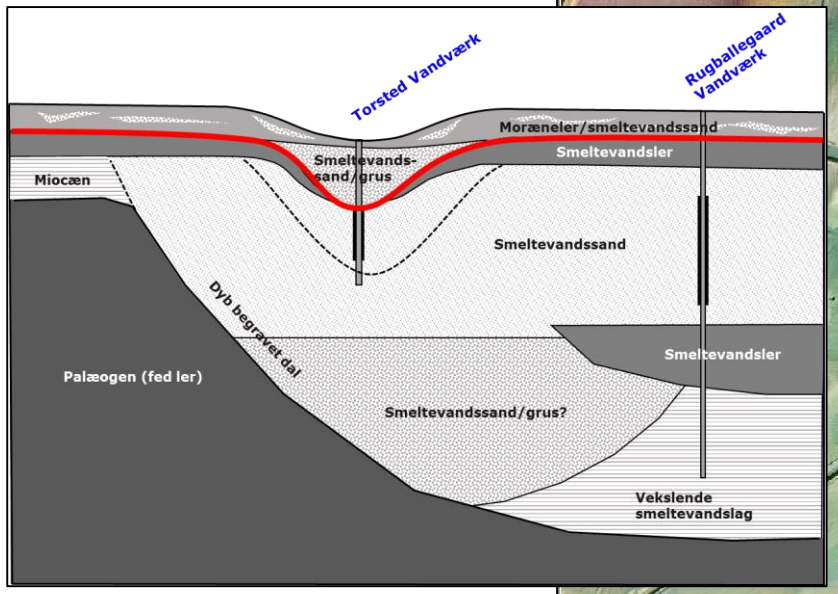


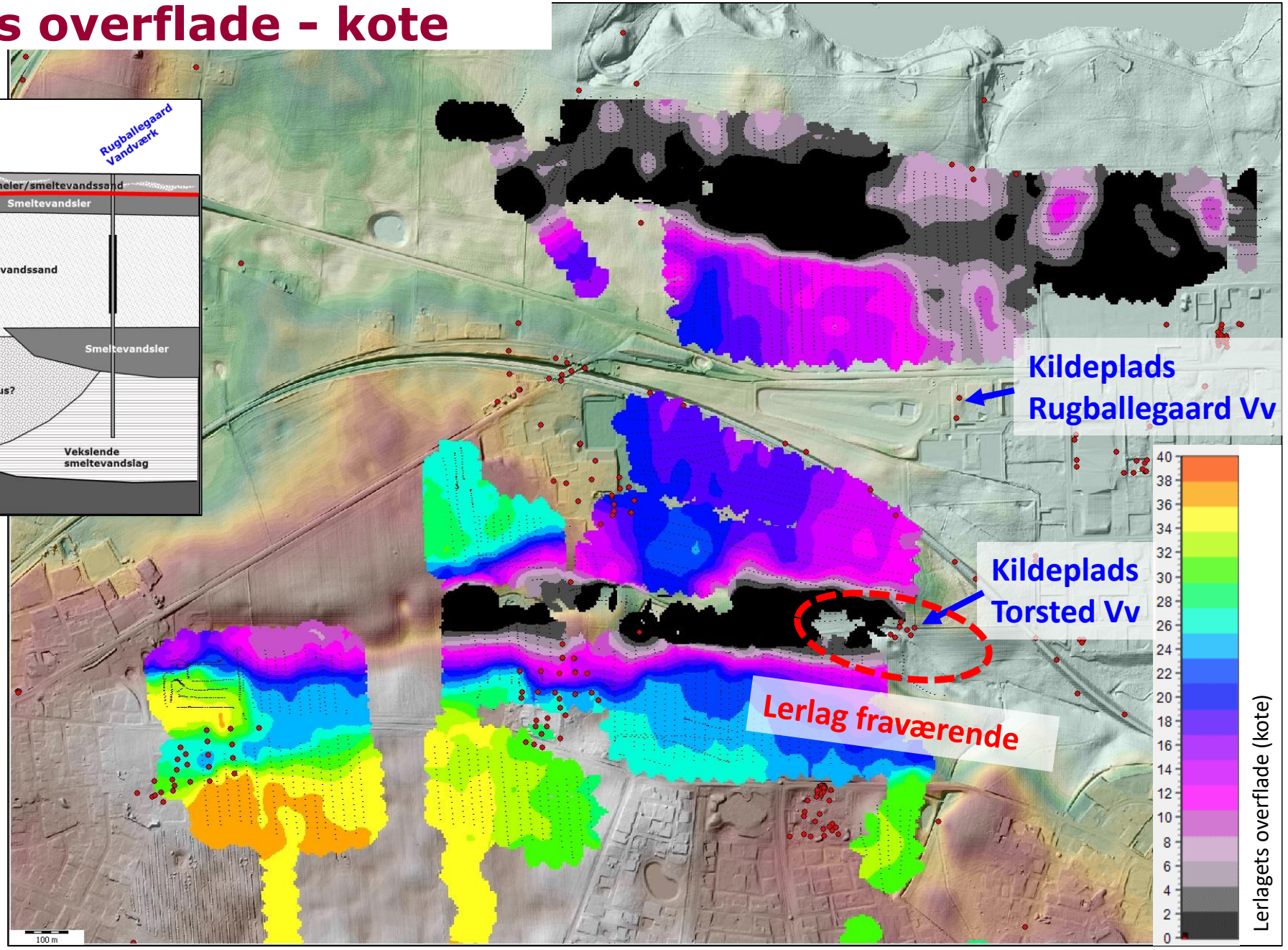
Model af lerlagets overflade - kote



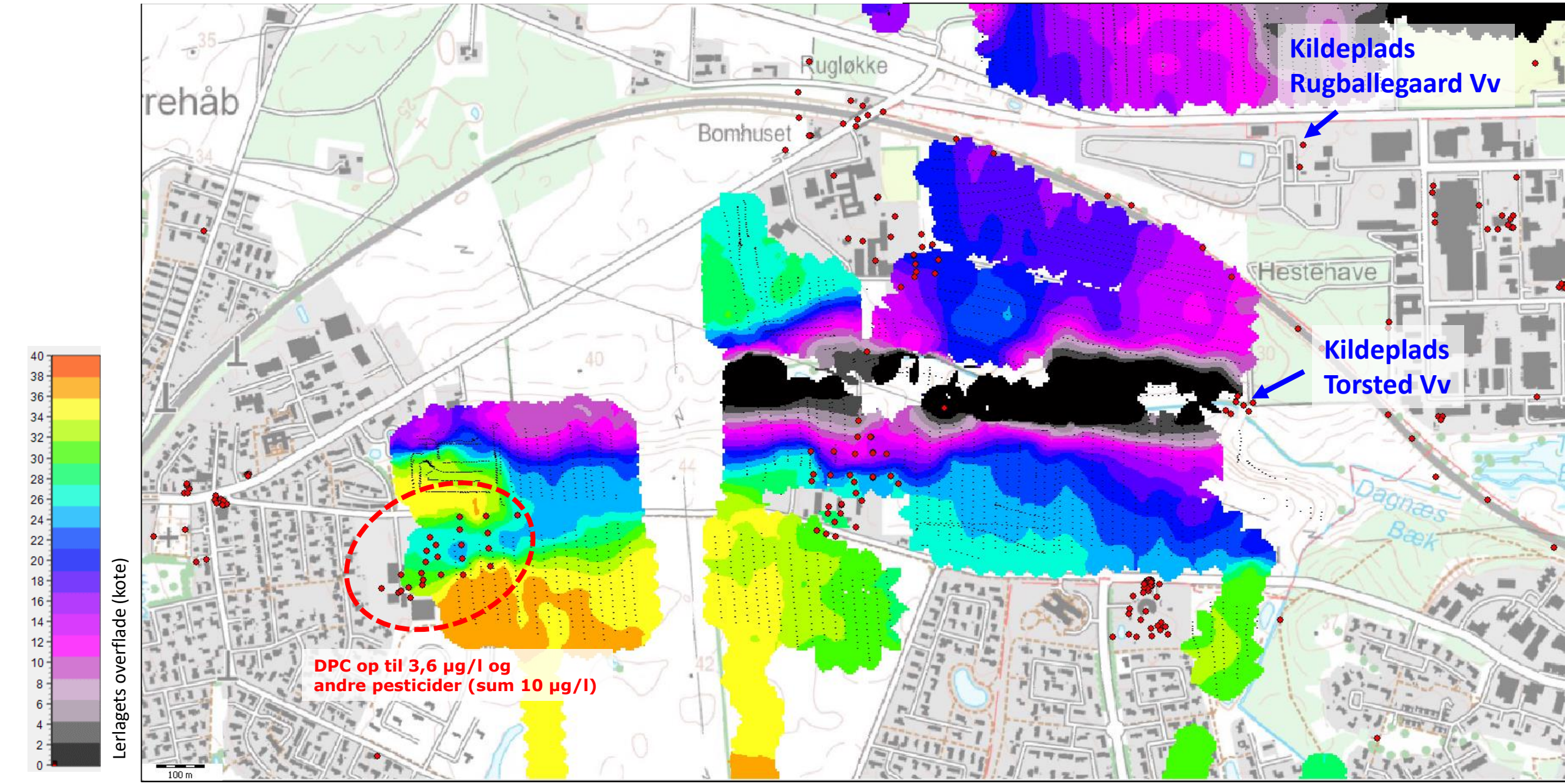


Model af lerlagets overflade - kote



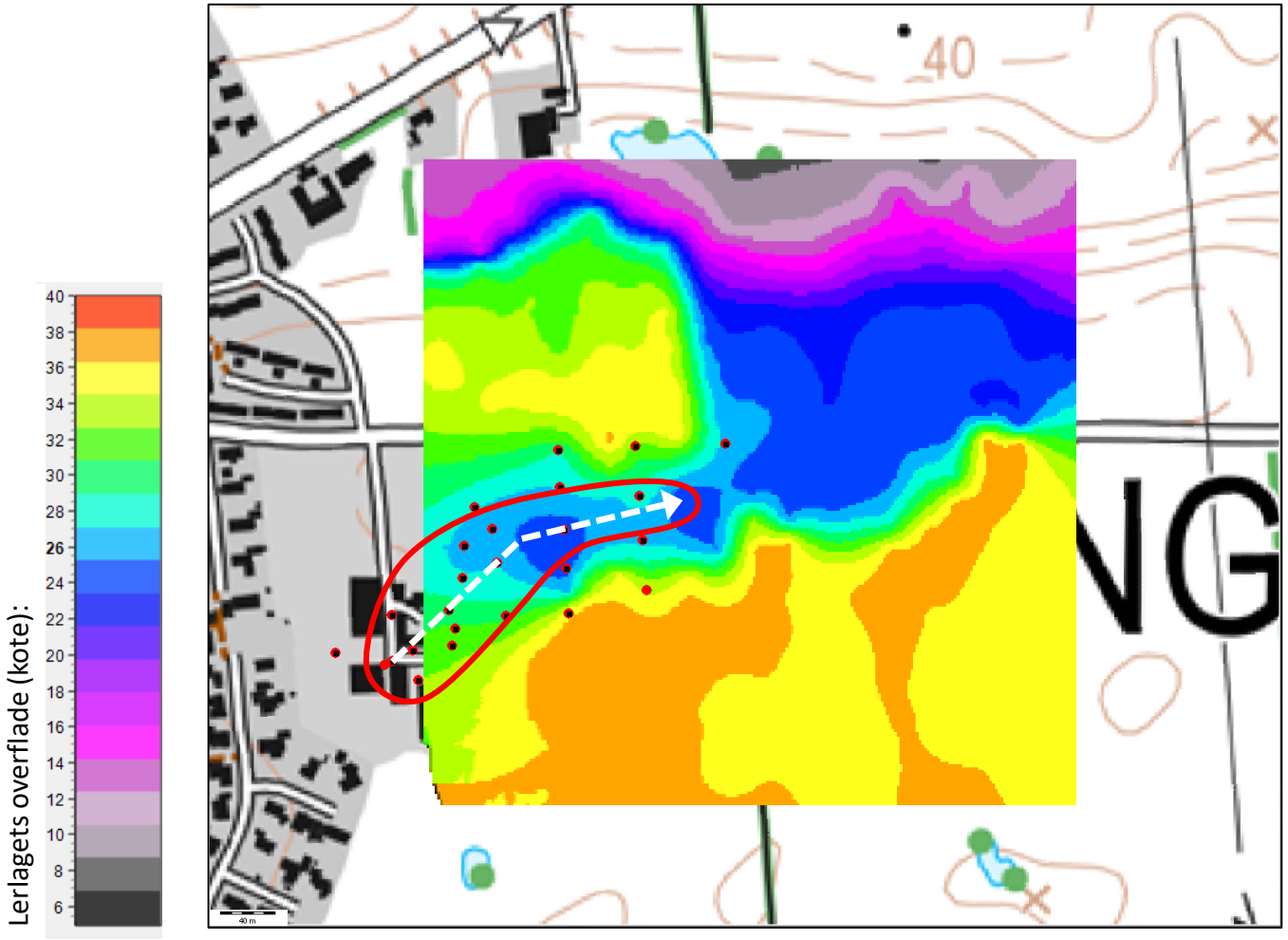


Maskinstationen



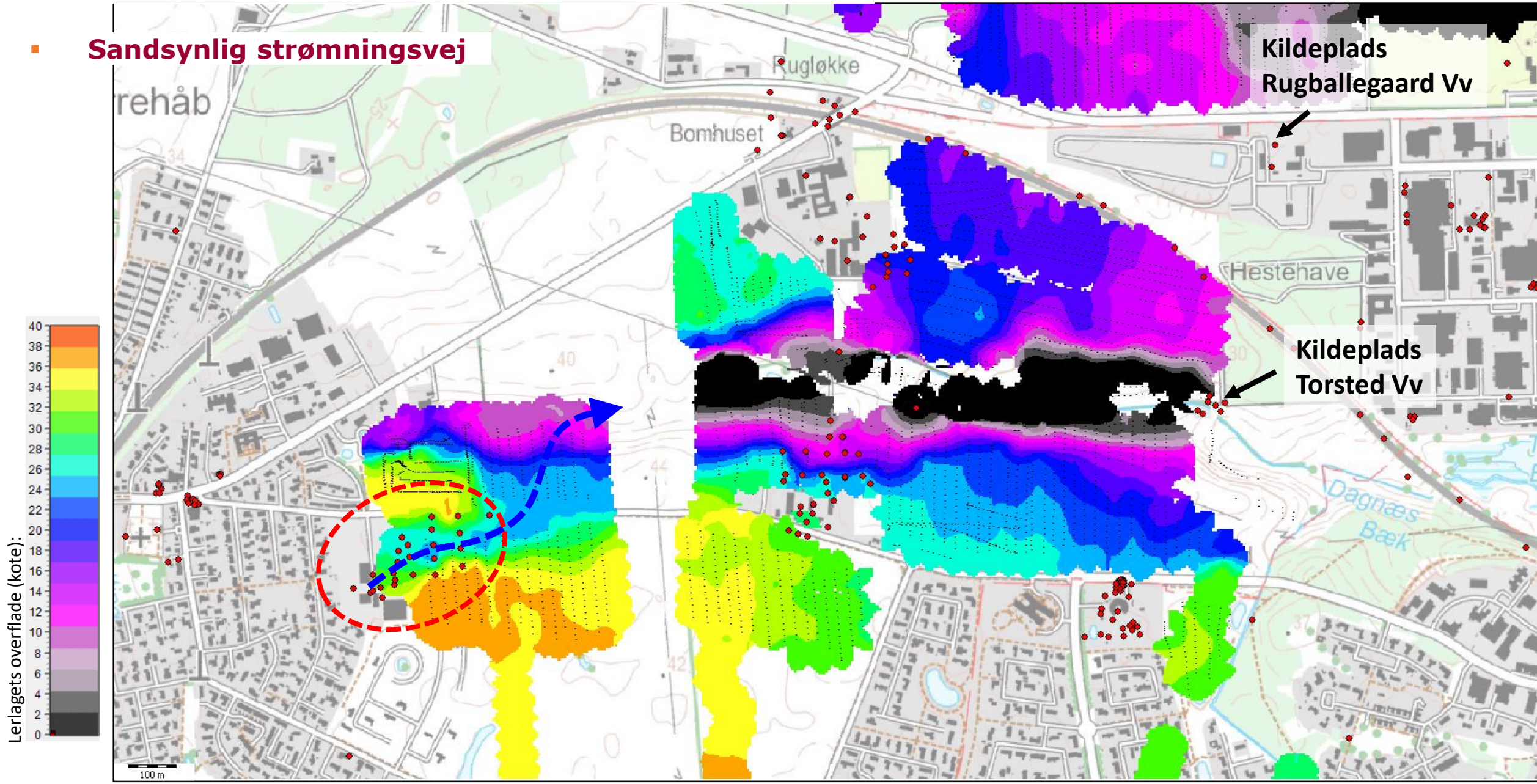
Maskinstationen

- Kortlagt forureningsfane (sum pesticider)
- Spredningsvej følger dalen



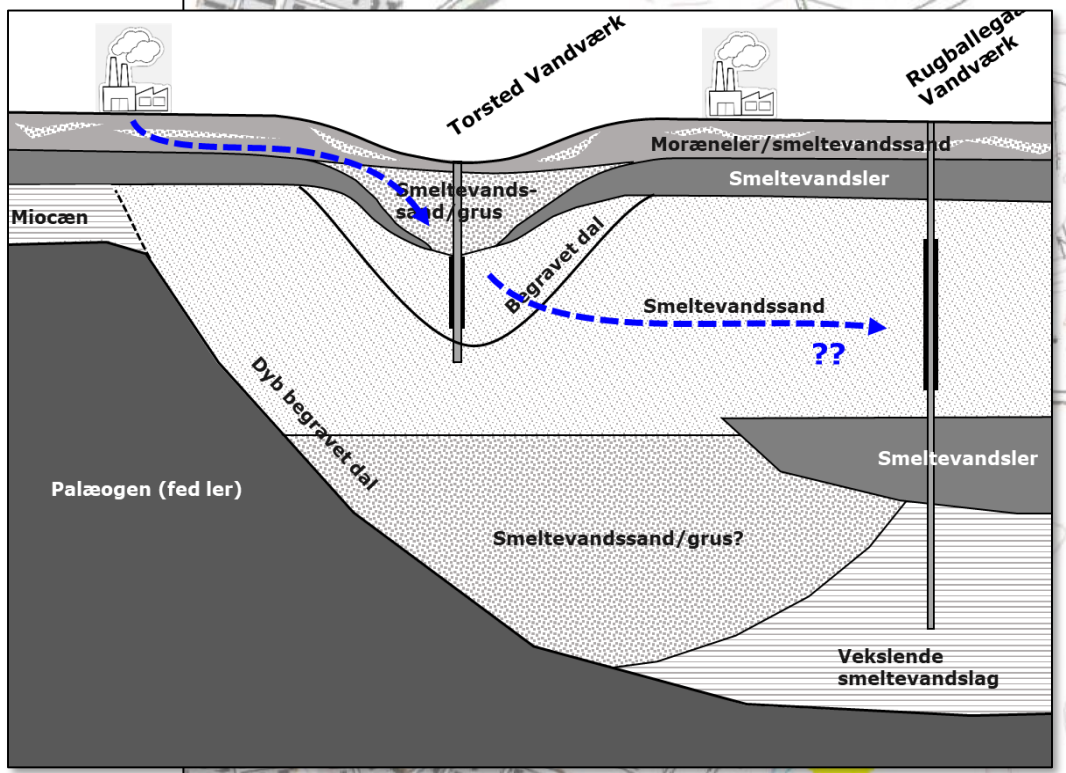
Maskinstation

- **Sandsynlig strømningsvej**



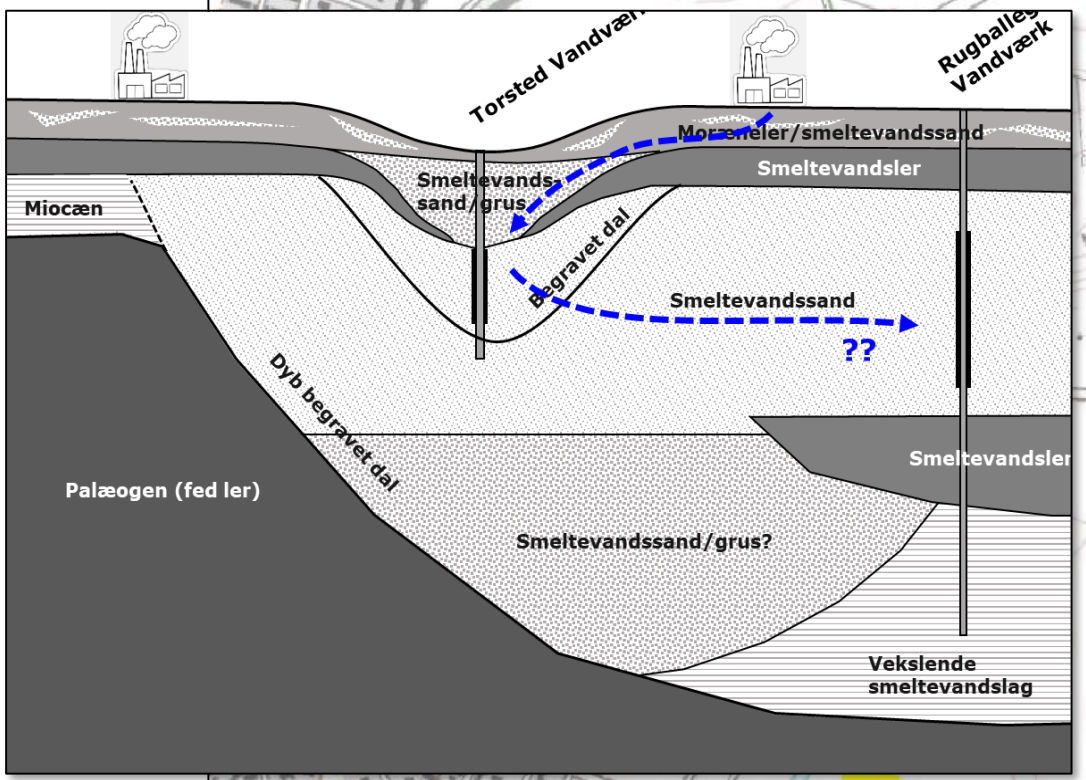
Landbruget

- **Sandsynlige strømningsveje**



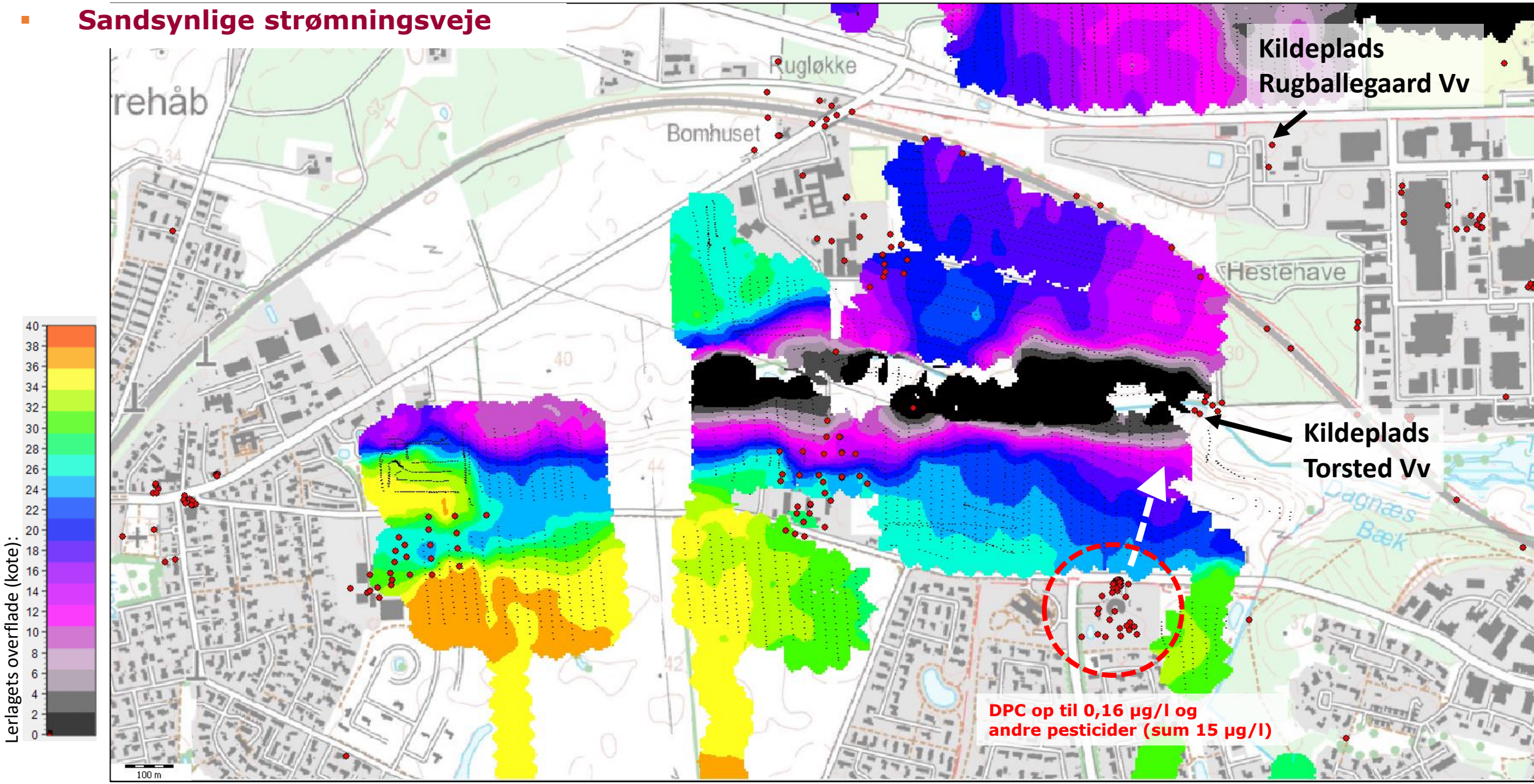
Landbrugsskolen

- **Sandsynlige strømningsveje**



Den tidligere tyrestation

- **Sandsynlige strømningsveje**



Hvad lærte vi?

- tTEM afslørede små begravede dale i området
- De begravede dale i området styrer grundvandet og forureningsspredningen
- Former i terrænet kunne vise forekomsten af den begravet dal
- Dødis i den begravede dal har haft betydning for dalens dannelse og dens geologiske opbygning
- Kendskabet til de begravede dale har været styrende for vores undersøgelser (især ift. placering af boringer)

Og helt generelt:

- Begravede dale spiller en rolle i en meget stor del af vores grundvandssager – ikke mindst de nyopdagede små dale, som vi nu kan kortlægge med tTEM.

Tak for opmærksomheden

Og tak til:

- Christine Bach Nielsen, RM
- Frede Busk Sørensen, (RM)
- Henrik Olesen, WSP
- Anders Edsen, WSP
- Peter Sandersen, GEUS

Spørgsmål?

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