

What is a Hydrogeological Map?

International Approaches to Hydrogeological Mapping

by: David Banks
Hydrogeologist and
thermogeologist



Photo by D Banks

NORAD supported project in MRRD:
Capacity Building and Institutional Cooperation in the field of Hydrogeology for Faryab
Province , Afghanistan

What is a Hydrogeological Map?

ANSWER: A paper-based, digital or web-based map service, which aims to provide information on:

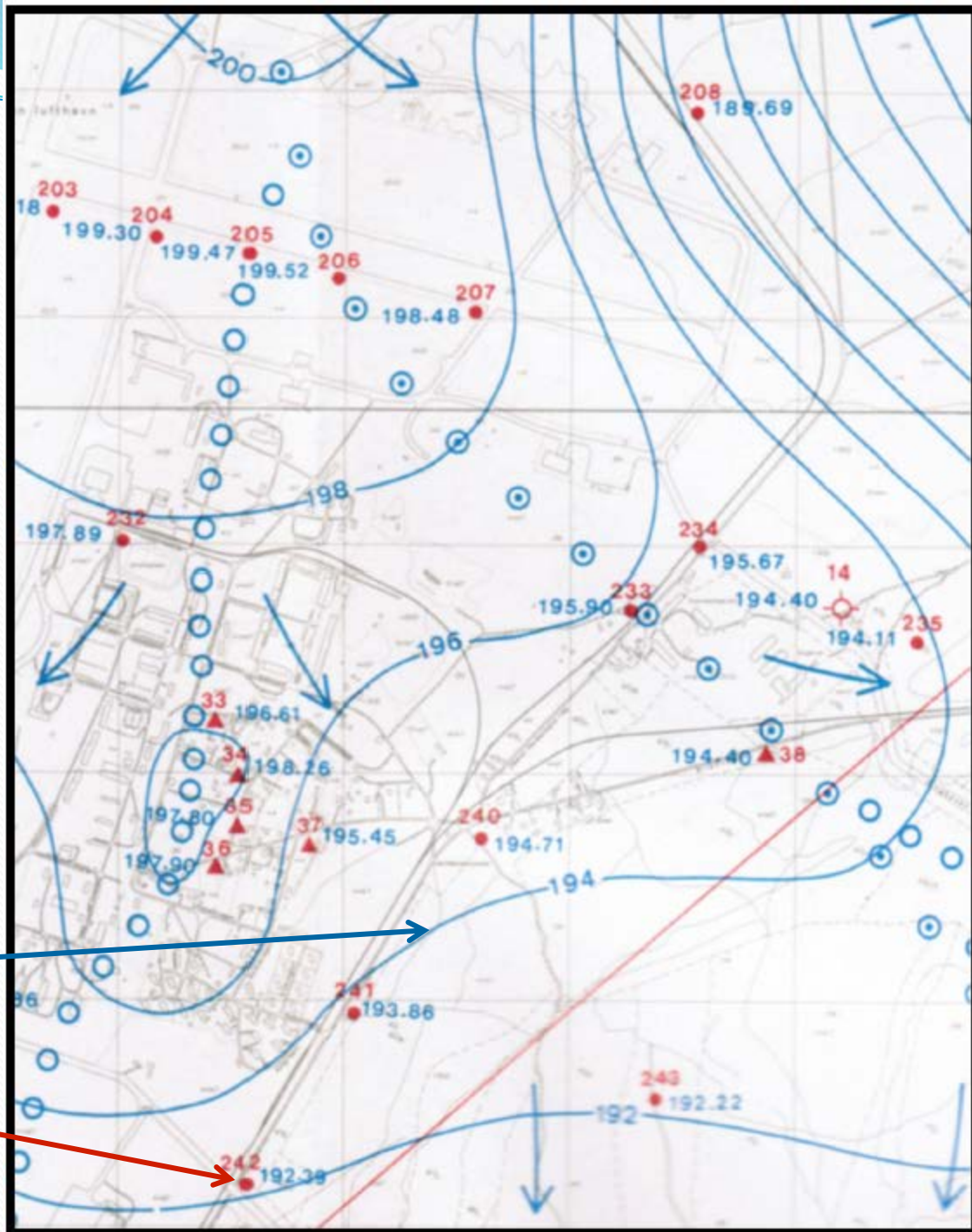
1. The occurrence of groundwater (aquifers)
2. The depth to groundwater (water table and aquifer horizons) and its direction of flow
3. The likely yield of wells (aquifer properties)
4. The quality of groundwater
5. ...and to provide some information about the third dimension (e.g. By cross-sections or structure contours)

Norway

Østmo, S.R. (1976). Øvre Romerike, groundwater in superficial deposits between Jessheim and Hurdalssjøen: hydrogeological map. Scale 1:20,000. Oslo Universitetsforlag / Norges geologiske undersøkelse.

Groundwater contours
in m above sea level

Wells and boreholes



United Kingdom

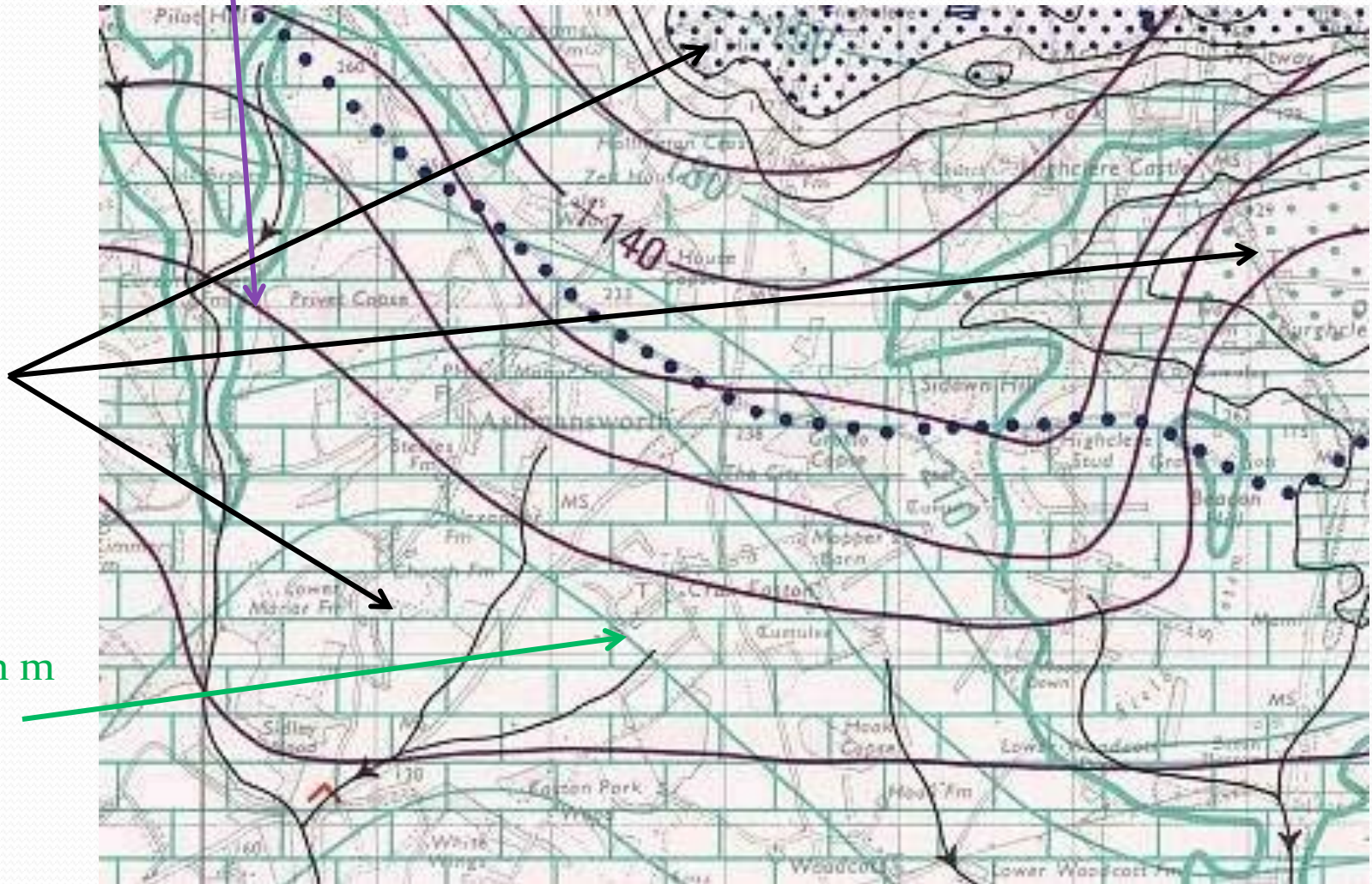
Groundwater contours in m above sea level

Different aquifers

Structure
contours in m
above sea level

IGS (1979). Hydrogeological Map of Hampshire and the Isle of Wight. Scale 1:100,000. Institute of Geological Sciences.

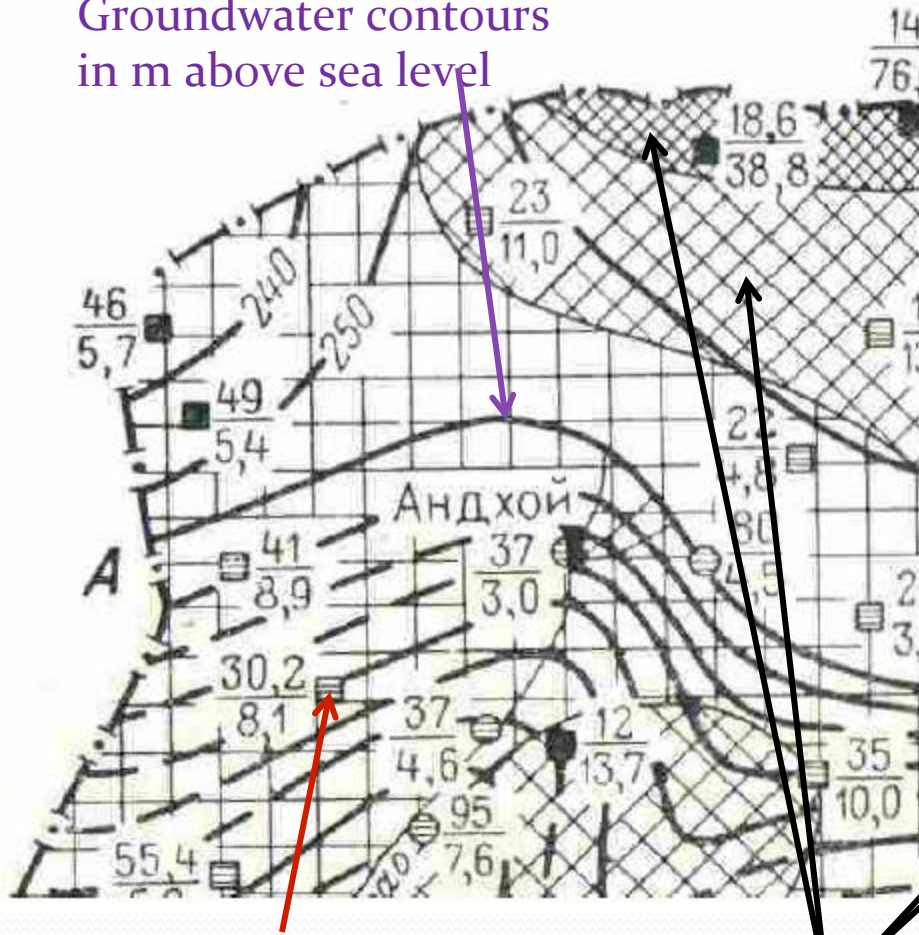
http://www.bgs.ac.uk/research/groundwater/datainfo/hydromaps/hydro_maps_scanviewer.html.



Afghanistan

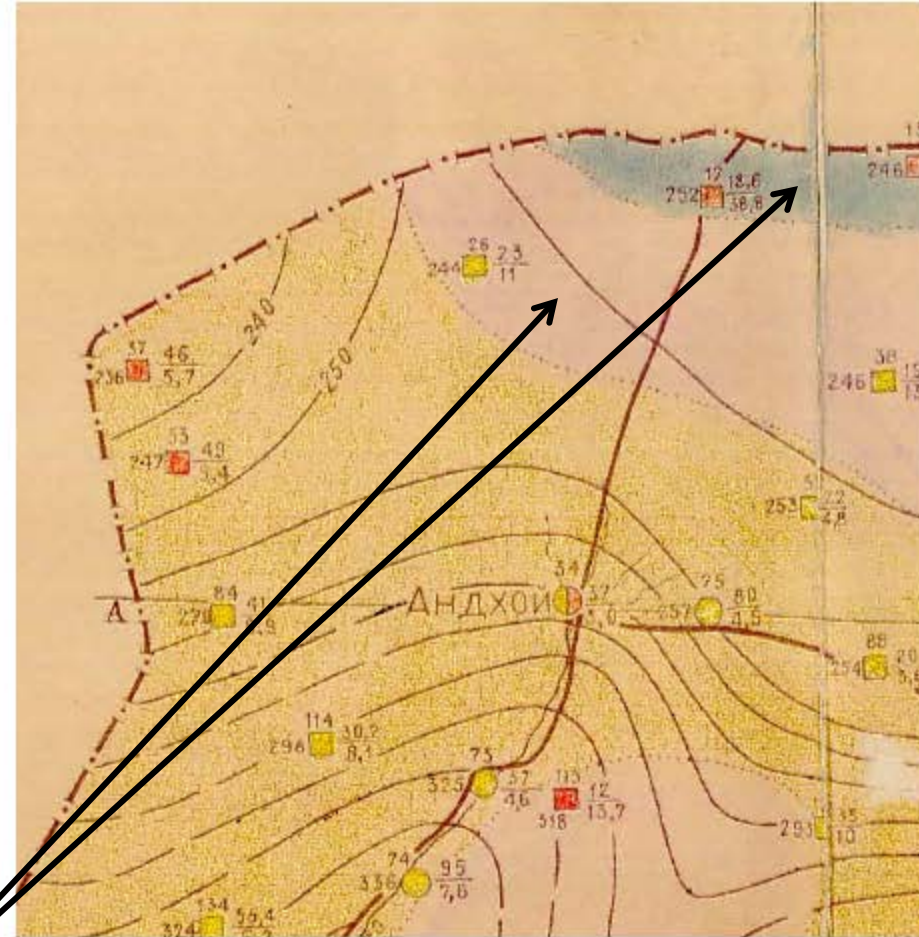
Мышкин Л.П. (1968). Схематическая карта гидроизогипсы минерализации подземных вод четвертичных отложений центральной части Северного Афганистана. Масштаб 1:500,000 (Schematic map of hydroisohypses of groundwater mineralization in the Quaternary deposits of the central part of northern Afghanistan. Scale 1:500,000).

Groundwater contours
in m above sea level



Wells and boreholes

Areas of different
salinity
(shaded)



International Association of Hydrogeologists / UNESCO

An extract of the IAH/UNESCO 1:500,000 sheet for Moscow.

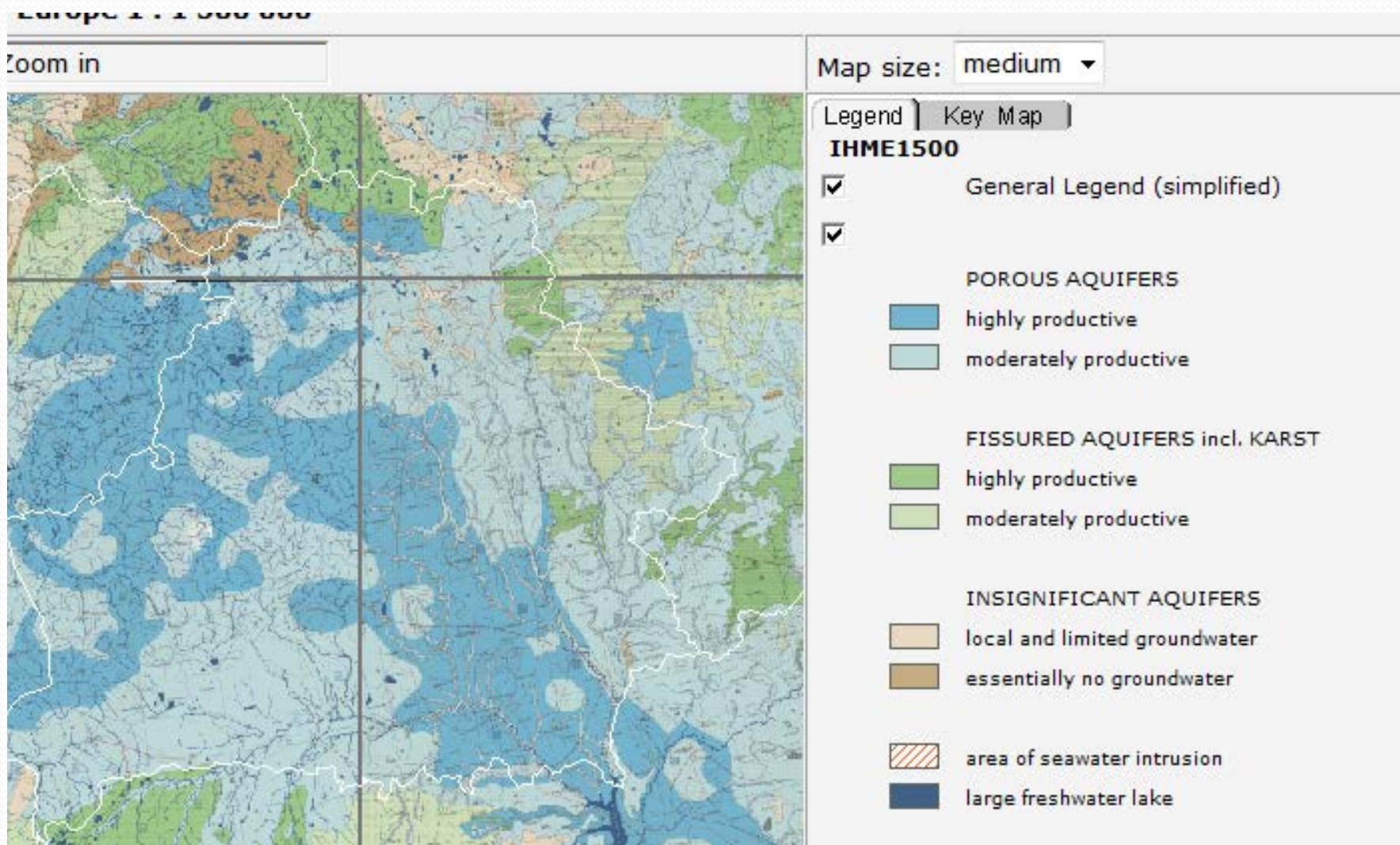
Green shows fractured / fissured aquifers

Blue shows granular aquifers

Brown shows aquitards (poor aquifers)



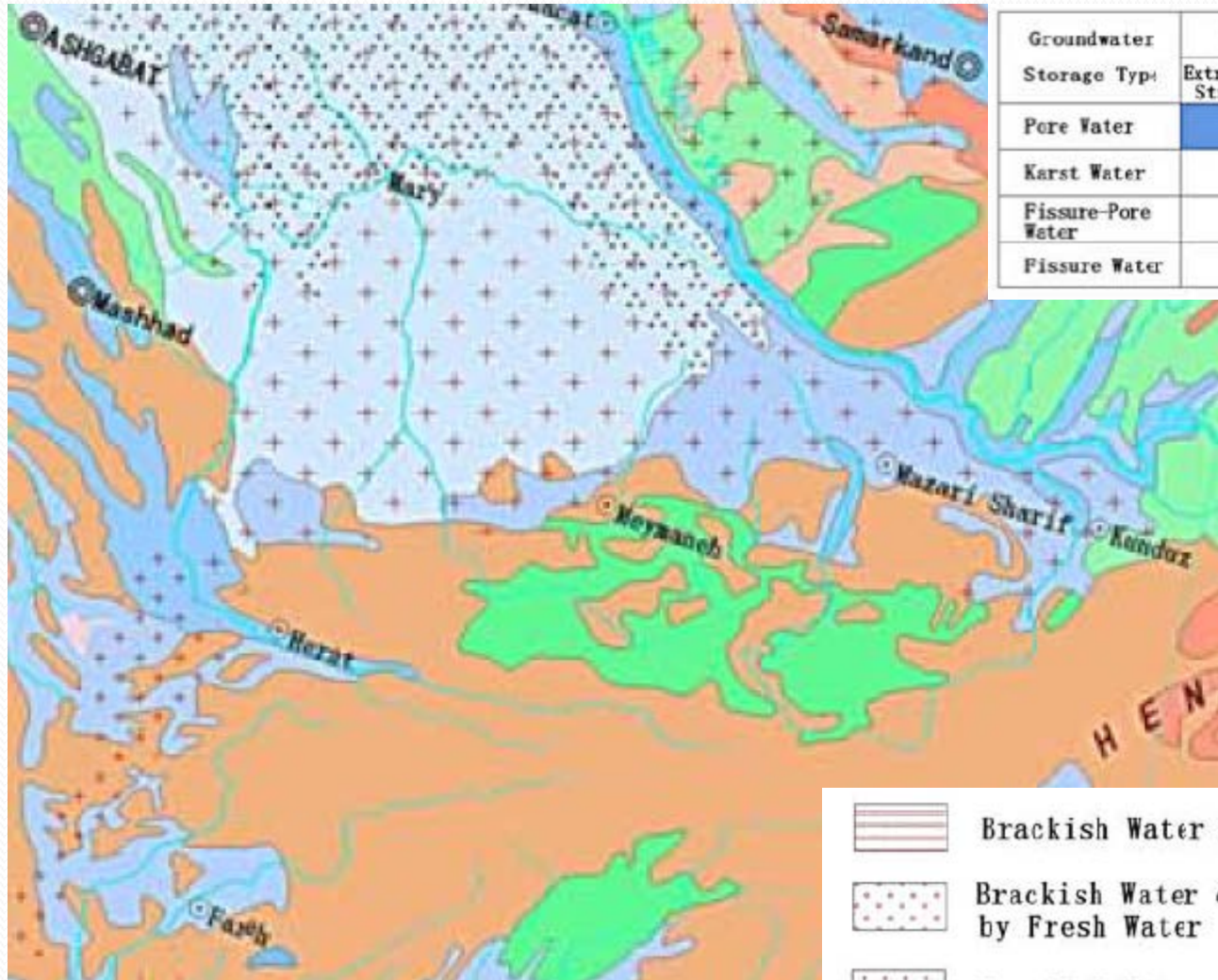
International Association of Hydrogeologists / UNESCO legend






IAH Hydrogeological Map of Asia

China Geological Survey (2012). *Groundwater Serial Maps of Asia: Hydrogeological Map, Groundwater Resources Map, Geothermal Map - Explanation*. Sinomaps Press, ISBN 978-7-5031-7398-1.

<http://unesdoc.unesco.org/images/0022/002207/220768EO.pdf>



Groundwater Storage Type	Productivity of Aquifer				
	Extremely Strong	Strong	Moderate	Weak	Extremely Weak
Pore Water					
Karst Water					
Fissure-Pore Water					
Fissure Water					

-  Brackish Water with Scattered Fresh Water
-  Brackish Water or Saline Water Underlain by Fresh Water
-  Brackish Water and Saline Water

IAH Hydrogeological Map of Asia



Groundwater Resources Zone	Natural Recharge (Runoff) Modulus ($10^4 \text{ m}^3 / \text{km}^2 \cdot \text{a}$)			
Continuous Aquifer in Plain and Intermontane Basin				
	10	20	30	50
Discontinuous Aquifer in Hilly Area				
	6	10	20	30
Scattered Aquifer				
	5	10	20	30

Web-based maps: GRANADA Norway

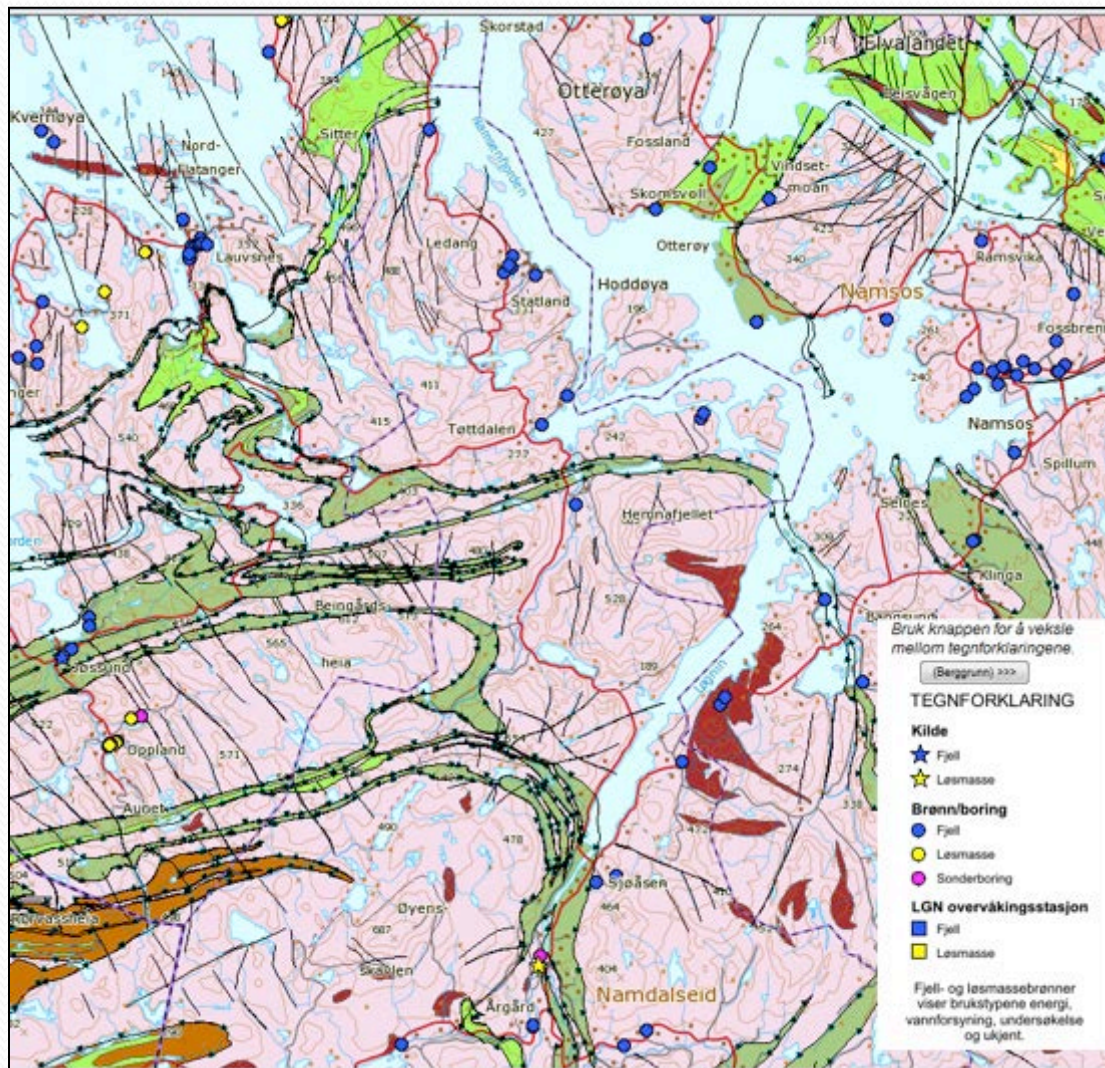
Geology (Flatanger)

The GRANADA database and WebGIS, hosted by the Geological Survey of Norway, shows

- geology
- groundwater potential
- information on individual boreholes and wells

The service is located at

<http://geo.ngu.no/kart/granada/>



Web-based maps: GRANADA Norway

Fjellbrønn nr. 40950

Lokalisering

Fylke: Nord-Trøndelag
Kommune: Flatanger (1749)
Gårdsmr.:
Bruksnummer:
UTM sone: 32 V
ØV-koordinater: 577417.00
NS-koordinater: 7147503.00
Kartblad (1:50 000): Osen (1623-4)
Stedfestningsmetode: Avlast fra 1:50000 kart
Stedfestningsnøyaktighet: 10000 cm

Totalt dyp av brønn: 45.00 meter
Dyp til fjell:
Vannføring: (for trykkløst sprøngning)
Stabil vannstand: (etter boring målt fra overflaten)
Boredato: 14.09.1992
Brønnens bruk: Undersøkelse / Sonderboring, Ukjent
Vannverk:
Borediameter: 140 mm
Forings/brønnrørmaterial: 1.50 m
Forings/brønnrørlengde: 1.50 m
Boring: Skrå
Hvis skråboring, avvik: (0°-90°)
Hvis skråboring, retning: 122°N
Borefirma: Norges geologiske undersøkelse
Borerens navn: Frank Svendsvik og Geir Lyngæær
Andre opplysninger: Informasjon om boreprofil finnes i rapporten.

Kontakt opplysninger:
Boresteds adresse: Hasvåg

Konsulent/Rapporter/referanser:

Konsulent	Rapportnr	Tittel	År
David Banks (Norges geologiske undersøkelse)	93.034	Grunnvannsundersøkelser i Flatanger kommune. Oppfølging av GIN-prosjektet i Nord-Trøndelag fylke	1993

© Norges geologiske undersøkelse

The map shows the Flatanger area in Nord-Trøndelag, Norway. It includes various islands and fjords, with the well location marked. The legend indicates different groundwater potential zones: 'Påvist betydelig grunnvannressurs' (dark blue), 'Antatt betydelig grunnvannspotensial' (medium blue), 'Begrenset grunnvannspotensial' (light blue), and 'Ikke grunnvannspotensial i løsmassene' (white). The well is located in a zone with 'Antatt betydelig grunnvannspotensial'.

Web-based maps: JUPITER Denmark

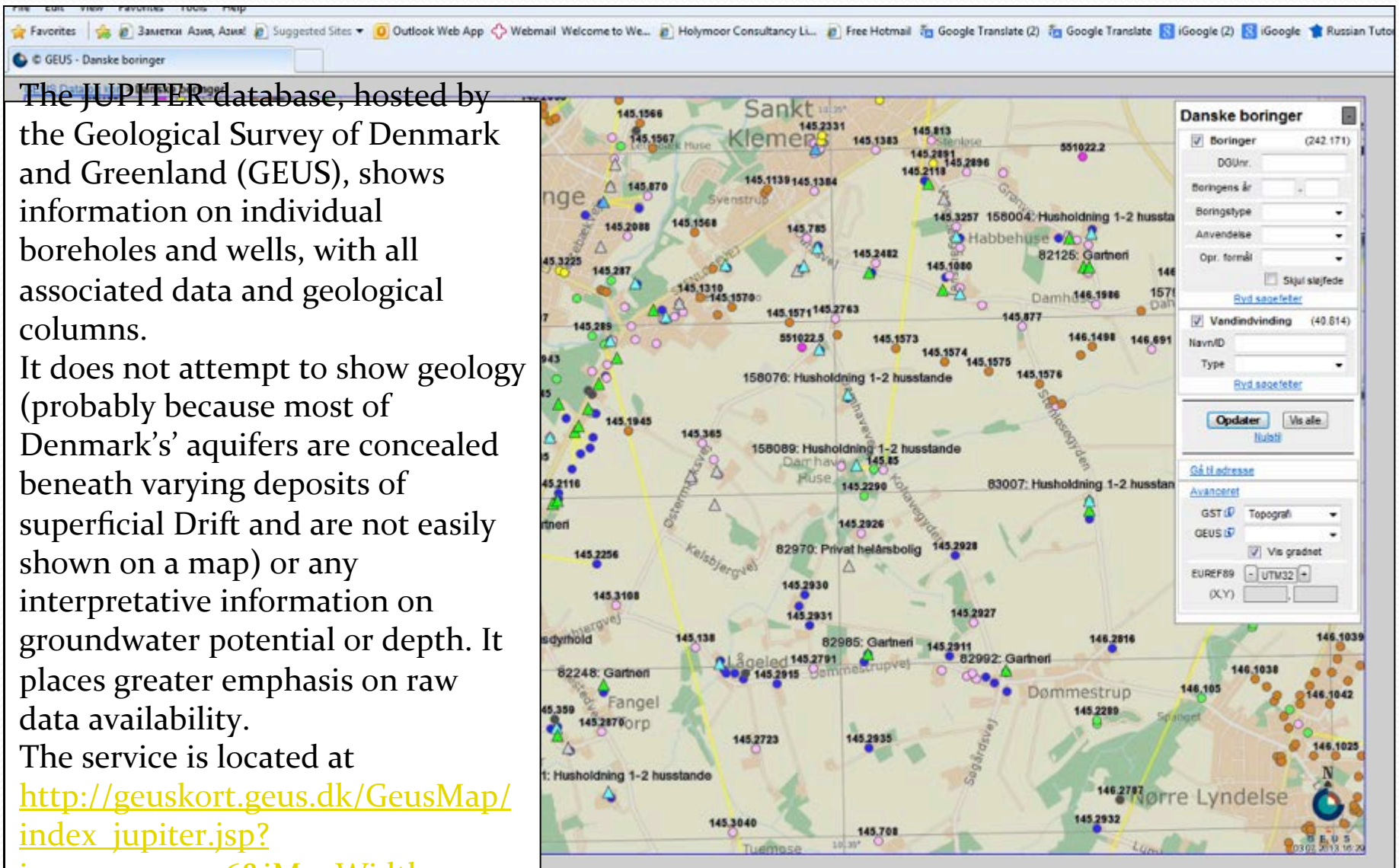
The JUPITER database, hosted by the Geological Survey of Denmark and Greenland (GEUS), shows information on individual boreholes and wells, with all associated data and geological columns.

It does not attempt to show geology (probably because most of Denmark's aquifers are concealed beneath varying deposits of superficial Drift and are not easily shown on a map) or any interpretative information on groundwater potential or depth. It places greater emphasis on raw data availability.

The service is located at

[http://geuskort.geus.dk/GeusMap/index_jupiter.jsp?](http://geuskort.geus.dk/GeusMap/index_jupiter.jsp?imgxy=700+396&iMapWidth=1400&iMapHeight=791)

[imgxy=700+396&iMapWidth=1400&iMapHeight=791](http://geuskort.geus.dk/GeusMap/index_jupiter.jsp?imgxy=700+396&iMapWidth=1400&iMapHeight=791)



Web-based maps: JUPITER Denmark

The screenshot displays the JUPITER web application interface, which is a web-based map and data management system for boreholes in Denmark. The interface is divided into several sections:

- Top Section:** A header bar with the title "JUPITER - borerapport" and a search bar.
- Left Panel:** A sidebar containing navigation links and a list of boreholes.
- Main Content Area:** The central part of the page, divided into three main sections:
 - M. u. terræn:** A table showing borehole data for a specific location. The table has columns: Top, Bund, DGU-symbol, and Beskrivelse. The data is as follows:

Top	Bund	DGU-symbol	Beskrivelse
0	0,3	muld - m	MULD, (muld).
0,3	0,6	ukendt lag, oplysninger mangler - x	INGEN PRØVE, bbb opblanding af muld. (ukendt lag)
0,6	3,2	ler - l	LER, (ler).
3,2	9,8	ler - l	LER, (ler).
9,8	21	ler - l	LER, bbb opblanding af sand. (ler).
 - Boringsopbygning:** A section showing the borehole structure. It includes a table for the borehole structure and a filter section.

Stamme	Top*	Bund*	Materiale	Diameter
1	17,5	-	mm	

* Meter under terræn

Filtre

Stamme	Indtagsnr	Top*	Bund*	Materiale	Diameter	Slidsbredde	Periode
1	1	17,5	20,5	-			-

* Meter under terræn
 - Grundvand:** A section showing groundwater data. It includes a table for the latest measurement and a link to the measurement series.

Indtagsnr	Vandstand*	Vandstandskote	Dato
1	3,77	16,58m/DVR90	13. juli 2001

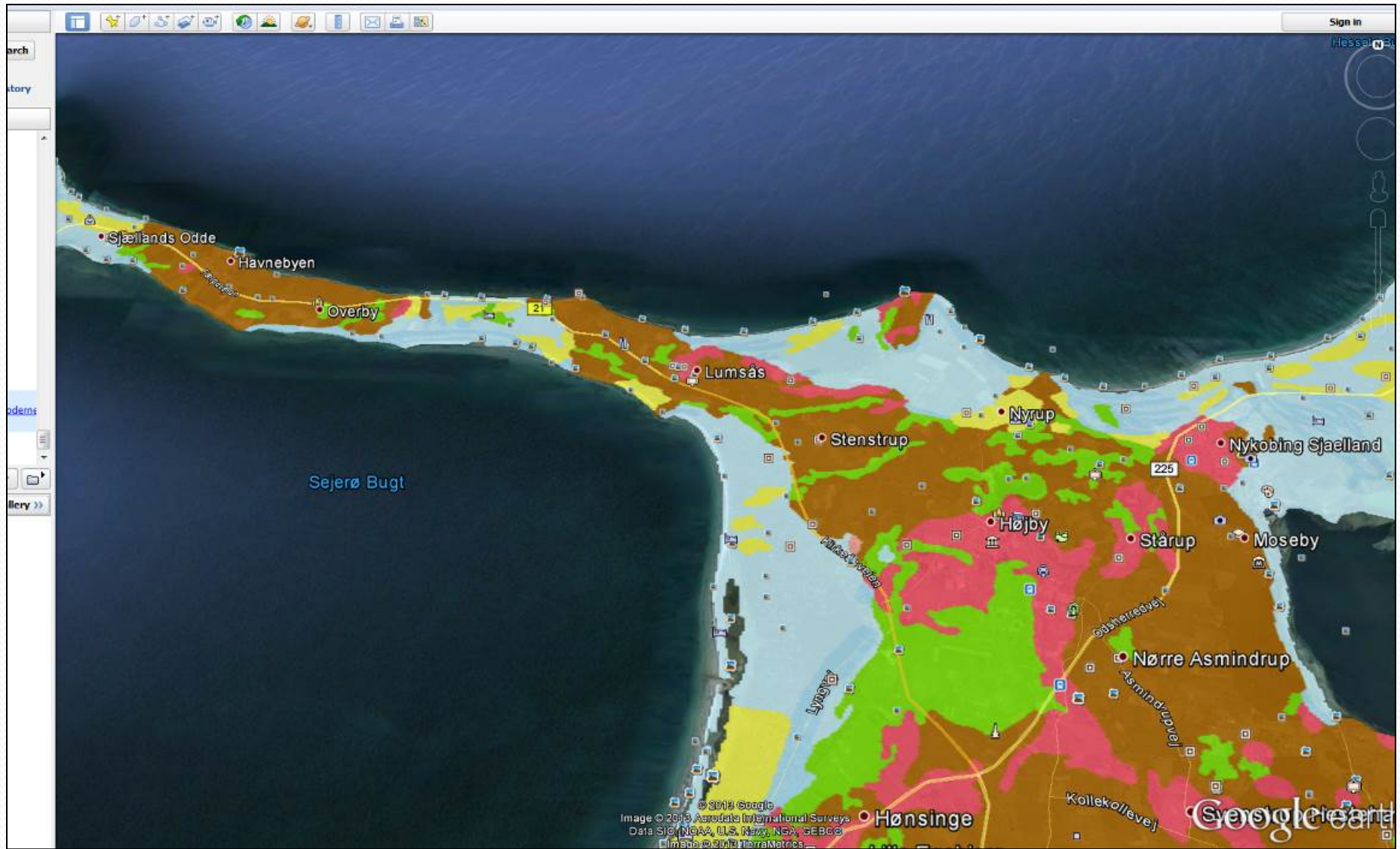
* Meter under terræn

[Pejleserie](#)
- Right Panel:** A sidebar containing a map and a search form.
 - Danske boringer:** A search form with fields for DGUnr., Boringens år, Boringstype, Anvendelse, and Opr. formål. It also includes a checkbox for "Skjul sløjfede" and a button for "Opdater".
 - Map:** A map showing the location of the boreholes. The map is labeled with coordinates and includes a scale bar.

The bottom of the screenshot shows the Windows taskbar with the Start button and several open applications, including "JUPITER - adgang t...", "GEUS - Danske b...", "JUPITER - borerapp...", "Corel PHOTO-PAIN...", and "NORPLAN new". The system clock shows the date and time as 05:44.

Web-based maps: Google Earth

Geological Maps of Denmark



We have also overlain Afghan geological maps in Google Earth

(see file Geological Maps 200000 external.kmz)



Web-based maps: GEOINDEX, UK

<http://mapapps2.bgs.ac.uk/geoindex/home.html>.

The screenshot displays the 'GeoIndex Onshore' web application within a Windows Internet Explorer browser window. The browser's address bar shows the URL <http://mapapps2.bgs.ac.uk/geoindex/home.html>. The application header includes the British Geological Survey logo and the text 'GeoIndex Onshore'. Below the header, a navigation bar contains buttons for 'Key', 'Map layers', 'Go to location', 'Search', 'Print/Export', and 'Measure'. A map of a region in the UK is displayed, showing various geographical features and data points. A scale bar indicates a scale of 1:100,000 and a location of 338597, 256082. A legend box on the left side of the map provides instructions on how to change the map theme and lists various data layers. The legend includes a section for 'Red layers cannot be viewed at this scale' and a list of layers with checkboxes. The bottom of the browser window shows the Windows taskbar with the 'start' button and several open applications.

GeoIndex | British Geological Survey (BGS) - Windows Internet Explorer

<http://mapapps2.bgs.ac.uk/geoindex/home.html>

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

GeoIndex Onshore

Key Map layers Go to location Search Print/Export Measure

To change the Map Theme, click on the button below.
Map Theme: Boreholes

Red layers cannot be viewed at this scale
Click on a layer name for layer details

- ☒ Borehole records
- ☐ Opencast coal prospecting sites
- ☒ Water wells
- ☐ Site investigation reports
- ☐ Drillcore
- ☐ Samples
- ☐ Onshore hydrocarbon wells
- ☐ Geophysical logs
- ☐ Well water levels
- ☐ Aquifer properties
- ☐ Geochemistry
- ☐ 1:50,000 Faults and other linear features
- ☐ 1:50,000 Mass movement deposits
- ☐ 1:50,000 Artificial ground
- ☐ 1:50,000 Superficial deposits
- ☒ 1:50,000 Bedrock geology
- ☐ 1:625,000 Faults
- ☐ 1:625,000 Dykes
- ☐ 1:625,000 Superficial deposits
- ☒ 1:625,000 Bedrock geology

Scale: 1: 100000 Location: 338597, 256082
Full Transparency None

Contains Ordnance Survey data © Crown copyright and database right 2013

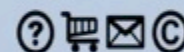
start GeoIndex | map inde... GeoIndex | British Ge... Search Desktop EN 22:46



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GeoIndex Onshore



Key Map layers Go to location Search Print/Export Measure

Scale: 1: 100000 Location: 325712, 249891

Full Transparency None

Record 1 of 2

REFERENCE: SO24/15
REGNO: SO24NE6BJ
LOCATION: THE CEFN, BRILLEY
DEPTH: 51.799999
YEAR: 1987
EASTING: 325140
NORTHING: 249710
DATUM:
AQUIFER: OLD RED SANDSTONE SUPERGROUP
GEOLOGICAL: Yes
CONSTRUCT: Yes
HYDROGEOL: Yes
CHEMICAL: No

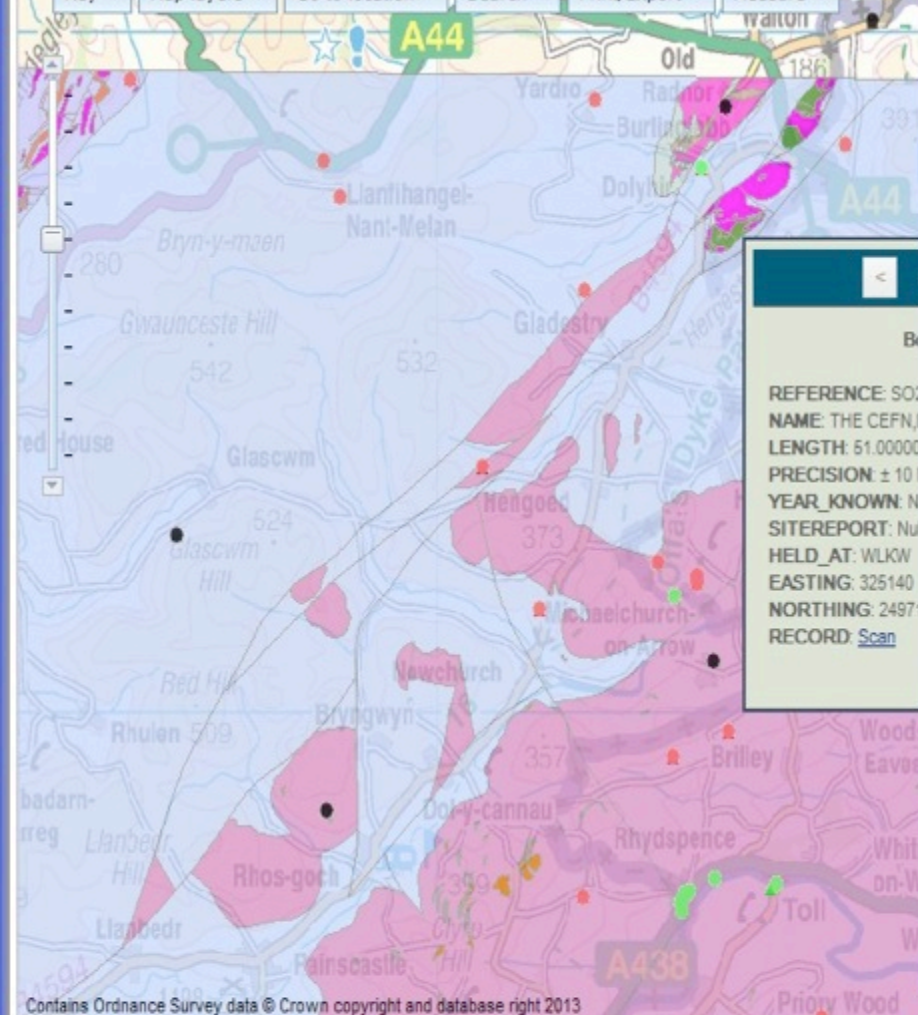


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GeolIndex Ons

Key ▾ Map layers ▾ Go to location ▾ Search ▾ Print/Export ▾ Measure ▾



REFERENCE: SO:
NAME: THE CEFN,
LENGTH: 51.00000
PRECISION: ± 10
YEAR_KNOWN: N
SITEREPORT: Nu
HELD_AT: WLKW
EASTING: 325140
NORTHING: 2497
RECORD: Scan

Contains Ordnance Survey data © Crown copyright and database right 2013

File Edit View Favorites Tools Help

★ Favorites ★ Webmail Welcome to Webmail Belkin Wireless DSL Router

Page 1 | Borehole SO24NE...

[illegible]

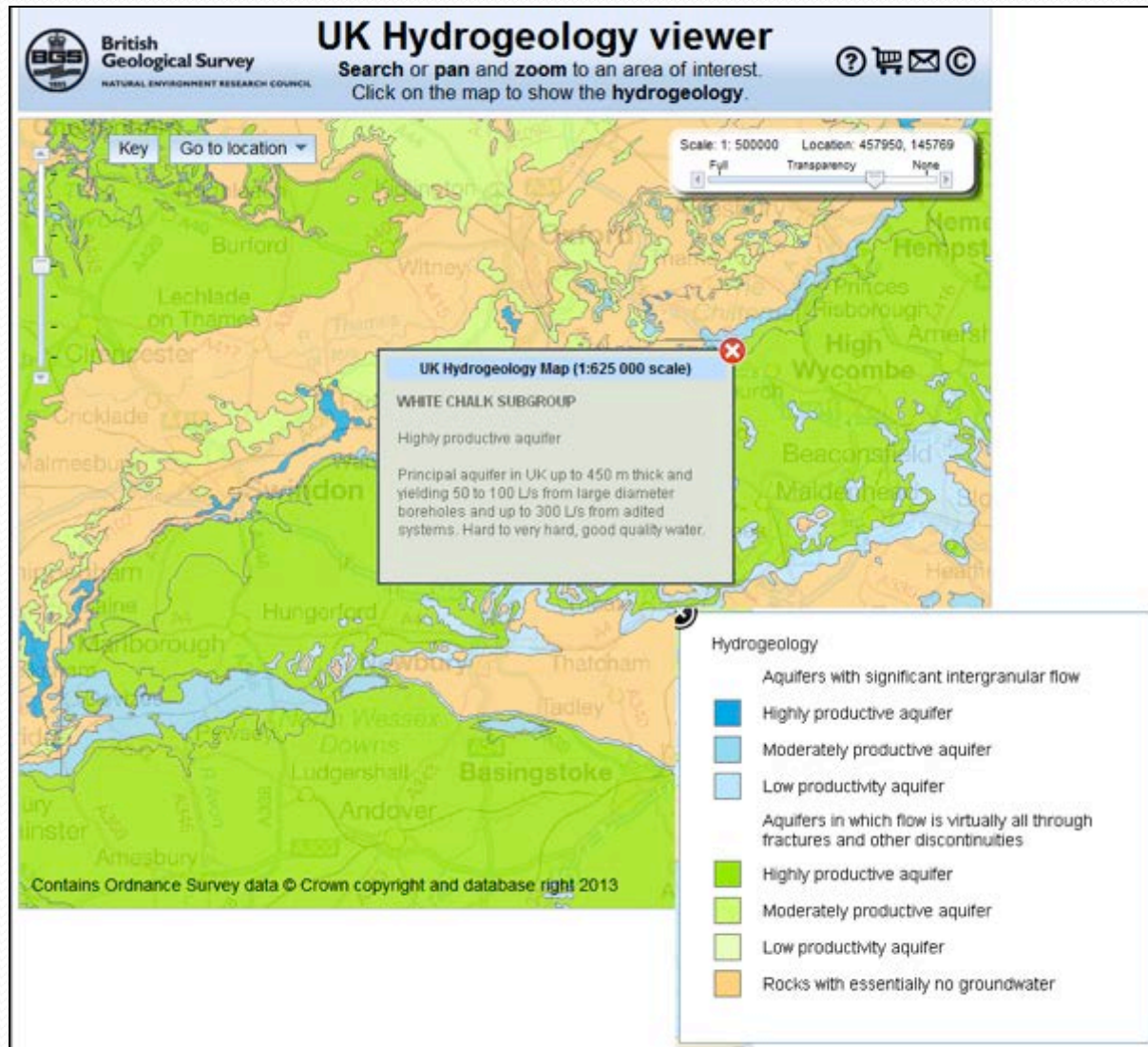
Done

 Internet

100%

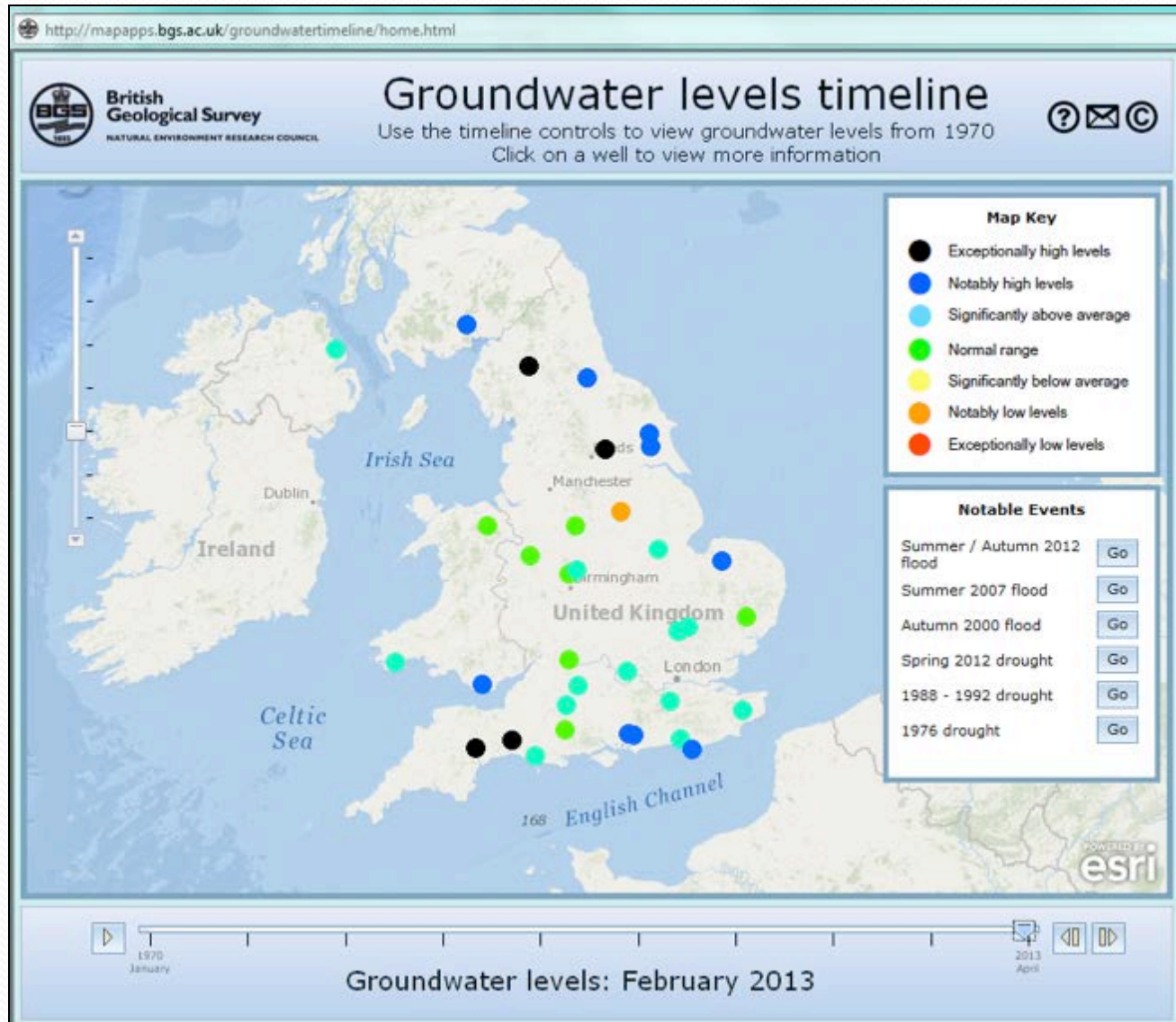
Web-based maps: Hydrogeology viewer

<http://mapapps.bgs.ac.uk/hydrogeologymap/hydromap.html>



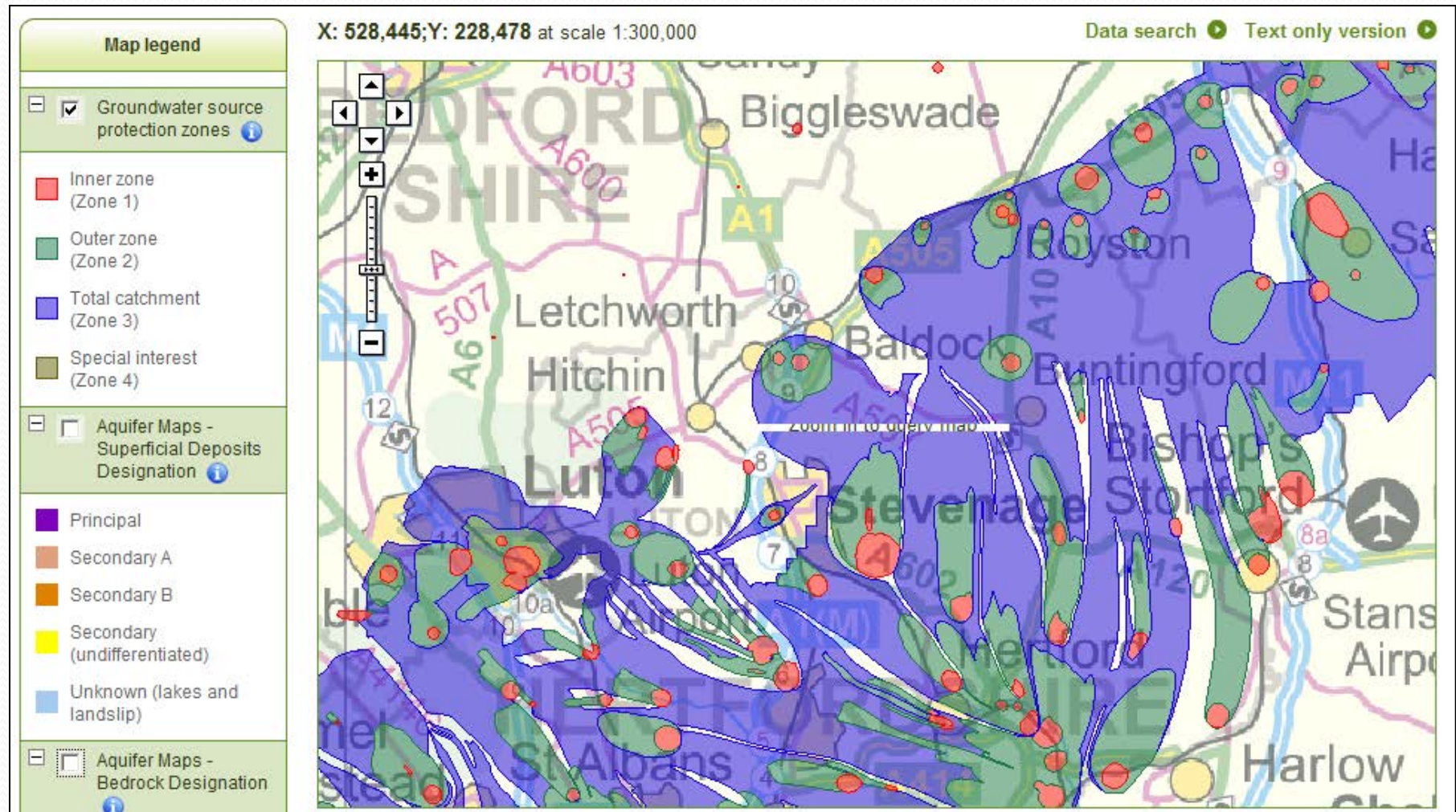
Web-based maps: Groundwater levels

<http://mapapps.bgs.ac.uk/groundwatertimeline/home.html>



Web-based maps: Groundwater protection zones

[http://maps.environment-agency.gov.uk/wiyby/wiybyController?
x=357683.0&y=355134.0&scale=1&layerGroups=default&ep=map&textonly=off&lang=
e&topic=groundwater.](http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683.0&y=355134.0&scale=1&layerGroups=default&ep=map&textonly=off&lang=e&topic=groundwater)



A Plea for Open Data

Information = power

If a private authority has as its ambition to maintain power and earnings for itself, it should restrict access to the data it holds and charge for access to that data.

If a public authority has as its ambition to spread power, encourage a freely competing and collaborating private / NGO sector and to facilitate the greatest possible use of data that, ultimately, has often been paid for by domestic public taxes or foreign public donors, then it should aim to make its data as freely available as possible, via the internet.

This applies not just to interpretations of data (because state experts can also be wrong!), but to the raw data itself.

We are working towards an open, web-based map tool and information system

▼ Search

Gurziwan, Afghanistan

Search

ex: pizza near NYC

[Get Directions](#) [History](#) Gurziwan, Afghanistan

▼ Places

- [-] Russian maps
- [+] [-] DACAAR Hydrogeog...
- [+] [-] Qaysar
- [+] [-] Pashkun Kot
- [+] [-] Khwaja Sabz Posh
- [+] [-] Shirin Tagab
- [+] [-] Maimana
- [+] [-] Gurziwan
- [+] [-] Bilchiragh

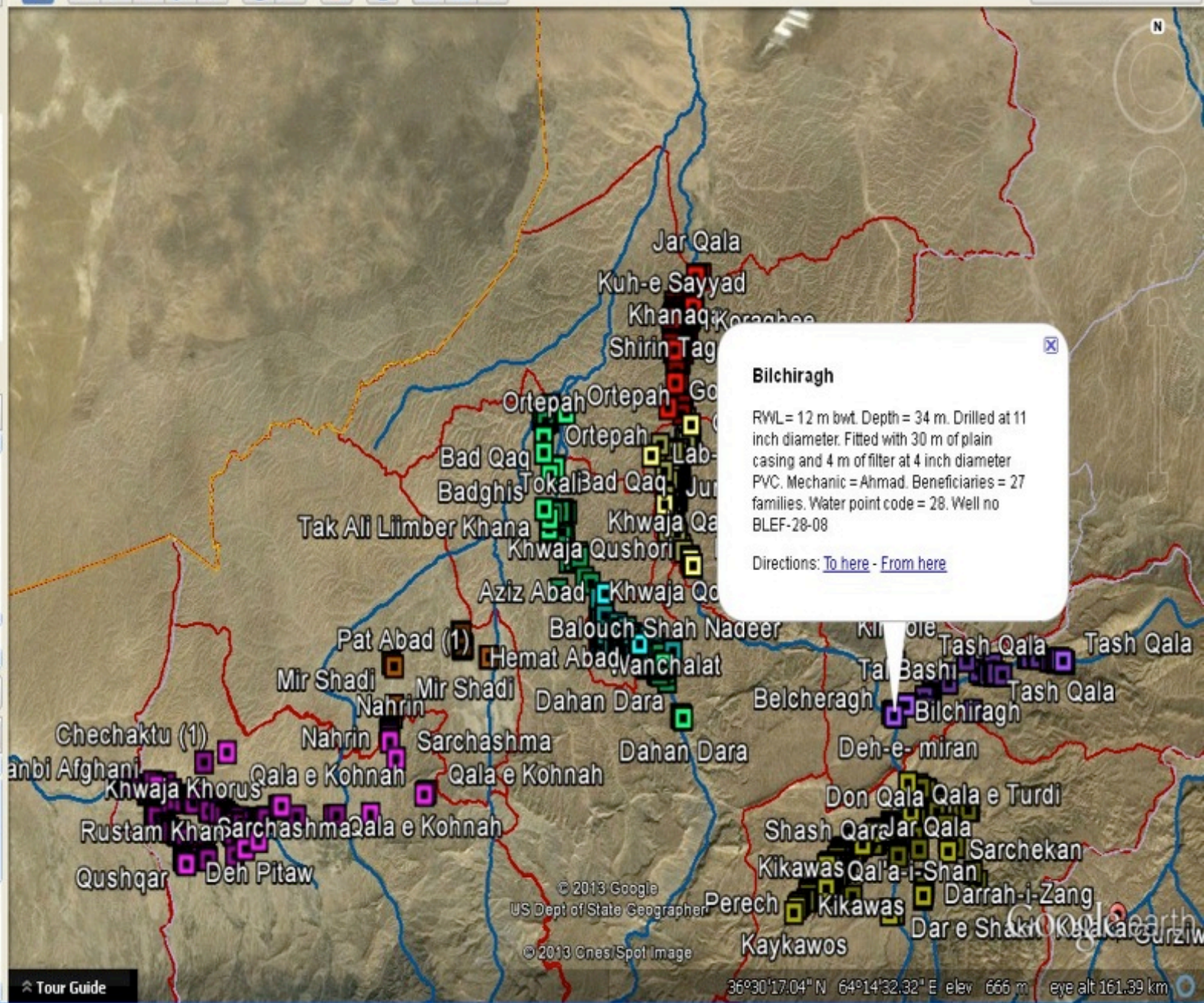
▼ Layers

Earth Gallery >>

- [+] [-] Primary Database
- [+] [-] Borders and Labels
- [+] [-] Borders
- [+] [-] Labels
- [+] [-] Populated Places
- [+] [-] Islands
- [+] [-] Geographic Features
- [+] [-] Water Bodies
- [+] [-] Places
- [+] [-] Photos



Sign in



Tour Guide

© 2013 Google
US Dept of State Geographer

© 2013 Cnes/Spot Image

36°30'17.04" N 64°14'32.32" E elev 666 m eye alt 161.39 km

Google Earth

BLEF-28-08.pdf - Adobe Reader

File Edit View Document Tools Window Help

1 / 1 54.8%

Find

Borehole Log Report

DACAAR Water Supply Program

Borehole S/NO 795

Dist, Prov, WP Code, Year Imp BLEF-28-08

Depth (m)	Lithology	Well Completion details	Drilling protocol
0	Clay		
5	Gravel		
10	Clay		
15			
20			
25	Clay		
30	Gravel		

Percussion

Sign in

Bilchiragh

RWL= 12 m bwt. Depth = 34 m. Drilled at 11 inch diameter. Fitted with 30 m of plain casing and 4 m of filter at 4 inch diameter PVC. Mechanic = Ahmad. Beneficiaries = 27 families. Water point code = 28. Well no BLEF-28-08

Directions: [To here](#) - [From here](#)

Bilchiragh, Belcheragh, Shiram Qashlaq, Belch

Google earth

© 2013 Cnes/Spot Image

35°50'18.03" N 65°13'42.86" E elev 1161 m eye alt 1.87 km

Hydrogeological Survey

OBJECTIVE: To improve possibilities of successful and sustainable groundwater resources development:

1. A good functional database / GIS
- 2. Collation of all existing data**
3. Collection of additional hydrogeological data in the field
- 4. A web-based interactive hydrogeological atlas of Faryab**
5. A “paper format” Atlas

Thanks for your attention

