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Oskarshamn site investigation

Slug tests in groundwater monitoring wells in soil in the Simpevarp area

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June 2004

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Keywords: Simpevarp, Ävrö, Soil, Quaternary deposits, Slug test, Hydraulic parameters, Soil tubes.

Abstract

The methodology, analysis and results of slug test performed in 13 groundwater-monitoring wells in the Simpevarp area during February 2004 are presented in this report. The specific objective of the performed slug tests is to obtain the hydro geological and hydro geochemical characteristics of the soils and describe and relate these to the corresponding characteristics of the bedrock and the groundwater. The data from the tests were evaluated using three similar methods: the Hvorslev method, the Bouwer & Rice method and the Cooper-Bredehoeft-Papadopulos method.

The principle of slug tests is to initiate an instantaneous displacement of the water level in a groundwater-monitoring well, and to observe the following recovery of the water level in the well as a function of time. A slug test can be performed by causing a sudden rise of the water level (referred to as a falling-head test), or a sudden fall of the water level (referred to as a rising-head test). In all the wells both falling-head tests and rising-head test were performed.

The Hvorslev method and the Bouwer & Rice method are both designed to estimate the hydraulic conductivity of an aquifer. The methods assume a fully or partially penetrating well in a confined or unconfined aquifer. In the computer program, a straight-line plot of the logarithm of the ratio h/h_0 versus time is automatically fitted to the measured data. If the semi-logarithmic plot of the measured data gives a concave-upward curve, automatic fitting is inappropriate, and manual curve fitting is preferred. The manual curve fitting method has been used for all analyses in this report.

Results of the hydraulic conductivity seem high for some of the groundwater-monitoring well (e.g. SSM000018). The most probable reason is that the actual sand pack diameter is greater than the 120 mm that were used in the analyses. This occurs when the wall of the well collapses during drilling and a hole arises. Later, when filter sand were filled outside the well the sand also filled up the hole and the diameter of the sand pack becomes greater than 120 mm.

Other sources to unreliable results are: the thickness of the aquifer is difficult to predict, determine if confined or unconfined conditions prevail, the homogeneity of the soil etc.

The values of the transmissivity obtained from the analysis from the Hvorslev, the Bouwer & Rice and the Cooper-Bredehoeft-Papadopulos method varied betwee·n $1{,}95 \cdot 10^{-6}$ m^2/s and $8{,}96 \cdot 10^{-4}$ m^2/s.

The values of the hydraulic conductivity obtained from the analysis from the Hvorslev, the Bouwer & Rice and the Cooper-Bredehoeft-Papadopulos method varied between $1{,}95 \cdot 10^{-6}$ m/s and $6{,}10 \cdot 10^{-4}$ m/s.

Sammanfattning

Metodik, analys och resultat från de slugtester som utfördes i 13 grundvattenrör i Simpevarpsområdet under februari 2004 redovisas i rapporten. Målet med slugtesterna är att erhålla jordens hydrogeologiska och hydrogeokemiska egenskaper och beskriva och relatera dessa till bergets och grundvattnets egenskaper. Data från testerna utvärderades med tre liknande metoder: Hvorslev, Bouwer & Rice och Cooper-Bredehoeft-Papadopulos.

Principen för slugtesterna är att starta en ögonblicklig förändring av vattenytan i grundvattenröret och samtidigt mäta trycket till dess att vattenytan har återställts till ursprunglig nivå. Slugtesterna kan utföras genom en snabb höjning av vattenytan (s.k. falling-head test) eller genom en snabb sänkning av vattenytan (s.k. rising-head test). I alla grundvattenrör utfördes båda dessa tester.

Både Hvorslev-metoden och Bouwer & Rice-metoden är avsedda att uppskatta den hydrauliska konduktiviteten hos en akvifer. Metoderna förutsätter ett fullständig eller delvis genomträngande rör i en öppen eller sluten akvifer. I dataprogrammet ritas automatiskt en rak linje upp mot de uppmätta värdena i diagrammet (logaritmen av h/h_0 – tidsdiagrammet). Om en konkav kurva erhålls vid uppritandet av de uppmätta värdena, är det olämpligt att använda sig av den automatiskt uppritade linjen, och istället använder man manuell passning av linjen. I den här rapporten användes manuell passning i alla analyser.

Resultaten av konduktiviteten verkade höga för en del grundvattenrör (t.ex. SSM000018). Den troligaste orsaken till detta är att diametern hos filtersanden är större än de 120 mm som användes vid analyserna. Detta inträffar då rörväggen kollapsar under borrningsskedet och ett hål uppkommer. När sedan filtersanden fylls utanför röret fyller den även ut hålet och diametern hos filtersanden blir större än 120 mm.

Andra orsaker till att resultaten är osäkra kan vara: akviferens mäktighet är svår att fastställa, om slutna eller öppna förhållanden råder, jordens homogenitet mm.

Värdena på transmissiviteten som erhölls från analyserna med Hvorslev-metoden, Bouwer & Rice-metoden och Cooper-Bredehoeft-Papadopulos-metoden varierade mellan $1{,}95 \cdot 10^{-6}$ m^2/s och $8{,}96 \cdot 10^{-4}$ m^2/s.

Värdena på den hydrauliska konduktiviteten som erhölls från analyserna med Hvorslev-metoden, Bouwer & Rice-metoden och Cooper-Bredehoeft-Papadopulos-metoden varierade mellan $1{,}95 \cdot 10^{-6}$ m/s och $6{,}10 \cdot 10^{-4}$ m/s.

Contents

1 Introduction

A general program for site investigations presenting survey methods has been prepared (SKB 2001a /1/), as well as a site-specific program for the investigations in the Simpevarp area (SKB 2001b /2/). The hydrogeological characterization of the Quaternary deposits by means of slug-tests form part of the site characterization program under item 1.1.8.1 soil drilling in the work breakdown structure of the execution programme, SKB 2002 /3/.

The hydraulic tests were carried out during February 2004 following the methodologies described in SKB MD 325.001,and in the activity plan AP PS 400-03-061 (SKB internal controlling documents). Data and results were delivered to the SKB site characterization database SICADA with field note number: Simpevarp 192, 199, 209, 210, 213, 214, 219, 224.

This report presents the methodology, analysis and result of slug tests performed in the Simpevarp sub-area at the Oskarshamn site. The tests have been performed according to the Activity Plan AP PS 400-03-061 and to SKB´s method description for slug tests in groundwater monitoring wells. A total of 13 observation wells were tested. The locations of the tested groundwater monitoring wells are shown in Figure 1-1.

Most tested wells are placed in till, in the contact zone between soil and bedrock. The composition of the till varies from sandy silty till to clayey till. At many locations the till is overlain by peat and/or clay which implies semi-confined to confined conditions. At a few locations the till extend to the ground surface or is overlain by sand deposits, which implies unconfined conditions. For information on soil profiles at the location of the groundwater monitoring wells, see /4/.

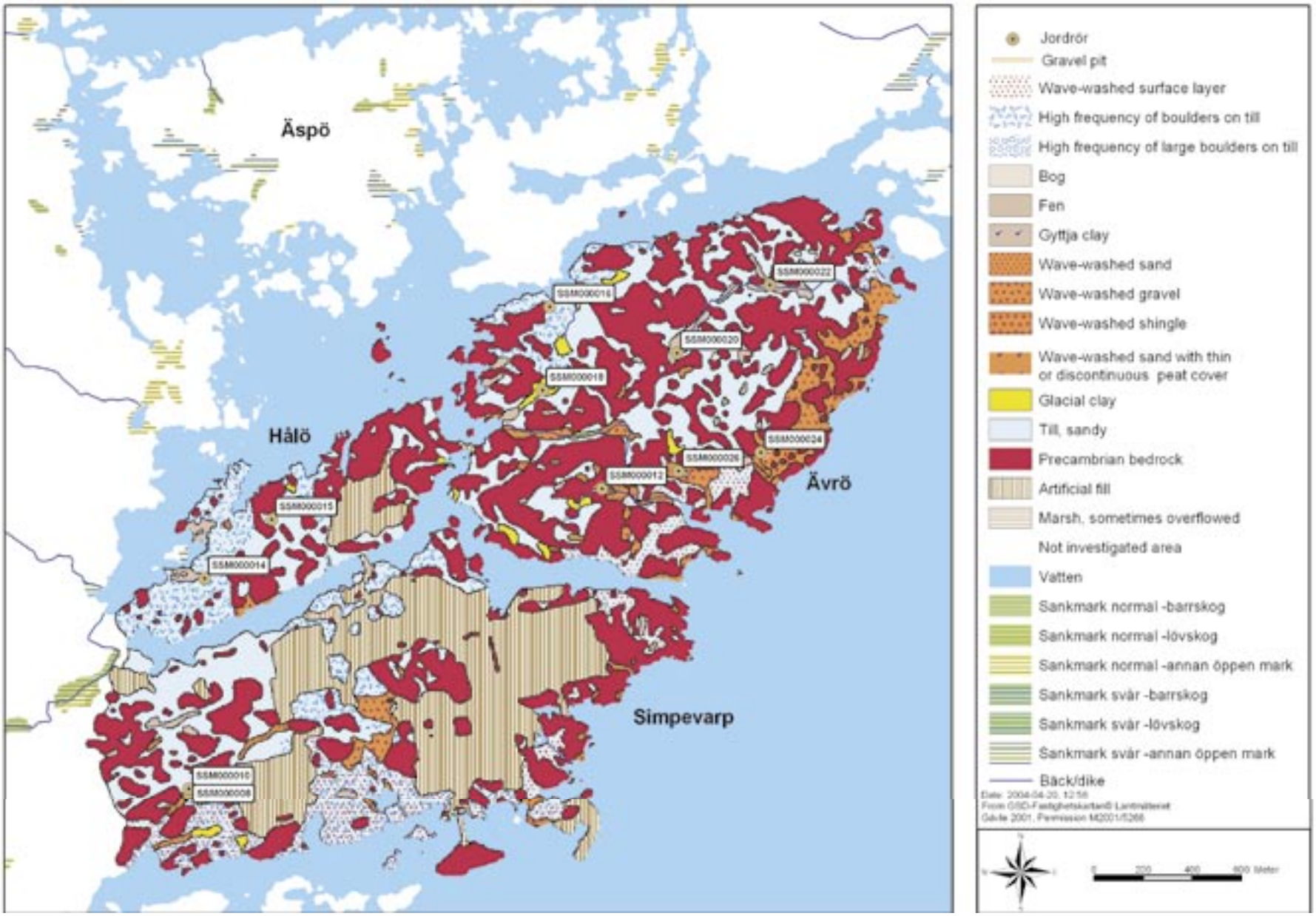

Figure 1-1. *Groundwater monitoring soil tubes in the Simpevarp area in which slug tests have been performed.*

2 Objective and scope

The specific objective of the performed slug tests is to obtain the hydro-geological and hydro geochemical characteristics of the soils and describe and relate these to the corresponding characteristics of the bedrock and the groundwater.

3 Scope

3.1 Borehole tested

Basic technical data of the groundwater monitoring wells in which the slug tests were performed are shown in table 3-1. The groundwater monitoring wells have a stand pipe and screen made of PEH.

Table 3-1. Technical data of the groundwater monitoring wells.

Groundwater monitoring wells		Stand pipe		Screen		
Borehole ID	**Borehole diameter (mm)**	**Inner diameter (mm)**	**Inclination from vertical plane (°)**	**Depth to upper screen level[1] (m)**	**Depth to lower screen level[1] (m)**	**Screen length (m)**
SSM000008	120	50	0	3,0	5,0	2,0
SSM000009	120	50	0	3,0	4,0	1,0
SSM000010	120	50	0	2,0	3,0	1,0
SSM000011	120	50	0	1,0	3,0	2,0
SSM000012	120	50	0	5,0	6,0	1,0
SSM000014	120	50	0	2,0	3,0	1,0
SSM000015	120	50	0	4,0	5,0	1,0
SSM000016	120	50	0	2,0	3,0	1,0
SSM000018	120	50	0	2,0	3,0	1,0
SSM000020	120	50	0	2,0	3,0	1,0
SSM000022	120	50	0	5,0	7,0	2,0
SSM000024	120	50	0	2,8	3,8	1,0
SSM000026	120	50	0	2,0	4,0	2,0

[1] Depth is measured from the top of the stand pipe.

3.2 Equipment check

Prior to each slug test, the equipment that was used for logging of water pressure head during the tests (Van Essen Instruments Divers®) was exposed against air pressure and undisturbed water pressure.

3.3 Tests

The performed slug tests are summarized in table 3-2.

Table 3-2. Slug test performed in the groundwater monitoring wells SSM000008 – SSM000026.

Groundwater monitoring well	Test start (YYYY-MM-DD hh:mm)	Time of falling-head test (s)	Depth to water level in well prior to slug test[1] (m)	Diver® depth during slug test[1] (m)	Slug length (m)
SSM000008	2004-02-18 12:39	74	0,61	2,8	1,0
SSM000009	2004-02-23 14:30	455	1,69	2,9	0,5
SSM000010	2004-02-18 10:35	173	0,51	2,8	1,0
SSM000011	2004-02-23 15:39	452	1,34	2,8	0,5
SSM000012	2004-02-20 10:59	2225	0,9	2,8	1,0
SSM000014	2004-02-23 10:51	73	1,43	2,8	0,5
SSM000015	2004-02-23 10:02	45	2,18	4,0	1,0
SSM000016	2004-02-20 13:17	20	1,56	2,8	0,5
SSM000018	2004-02-19 10:53	21	0,42	2,8	1,0
SSM000020	2004-02-18 14:37	68	1,02	2,8	1,0
SSM000022	2004-02-19 08:49	89	0,65	3,8	2,0
SSM000024	2004-02-19 13:18	852	0,65	2,8	1,0
SSM000026	2004-02-19 15:16	91	0,55	2,8	1,0

[1] The depth is measured from the top of the stand pipe.

4 Equipment

4.1 Description of equipment

For the slug test, the following equipment was used:

- Two different types of Van Essen Instruments Divers® with built-in pressure transducer and connecting cable.
- Portable PC.
- Slug and wire.
- Wire stopper.
- Light- and sound indicator.

4.2 Sensors and slug

General sensor data of the Divers® and data of the slug used for the test:

Diver® type 1:

- Material: stainless steel
- Material pressure sensor: ceramic
- Diameter: 22 mm
- Length: 230 mm
- Measurement range: 0-500 centimeters water column
- Resolution: 0,2 cm
- Accuracy: ±0,1 % of measurement range
- Wire ∅: 1 mm

Diver® type 2:

- Material: stainless steel
- Material pressure sensor: ceramic
- Diameter: 22 mm
- Length: 125 mm
- Measurement range: 0-3000 centimeters water column
- Resolution: 0,6 cm
- Accuracy: ±0,1 % of measurement range
- Wire ∅: 1 mm

Slug and wire:

- Slug ∅: 40 mm
- Slug length: 0,5 ; 1,0 or 2,0 m
- Slug wire ∅: 6 mm

Table 4-1. The position of the pressure transducer in the Diver®, the wire length[2] and the slug length for each test.

Monitoring well	Diver® depth[1] (m)	Wire length[2] (m)	Slug length (m)
SSM000008	2,80	1,00	1,00
SSM000009	2,90	0,50	0,50
SSM000010	2,80	1,00	1,00
SSM000011	2,80	0,70	0,50
SSM000012	2,80	0,60	1,00
SSM000014	2,80	0,60	0,50
SSM000015	4,00	0,50	1,00
SSM000016	2,80	0,10	0,50
SSM000018	2,80	1,00	1,00
SSM000020	2,80	0,50	1,00
SSM000022	3,80	0,90	2,00
SSM000024	2,80	0,85	1,00
SSM000026	2,80	0,95	1,00

[1] The depth is measured from the top of the stand pipe.

[2] The length of the wire, which is in contact with the water.

5 Performance

5.1 Preparations

During another field test one week prior to the slug tests, the water level changes measured by the Divers® were compared to the water level changes measured by a handheld water level meter. The Divers® measurements were similar to those measured by the handheld water level meter.

Equipment checks were also performed in connection the each slug test (see chapter 3.2).

Prior to each slug test, the pipes were checked so that no sediment was present at the bottom of the pipe. If there was any sediment present, it was removed with a suction pipe.

5.2 Test principle

The principle of slug tests is to initiate an instantaneous displacement of the water level in a groundwater-monitoring well, and to observe the following recovery of the water level in the well as a function of time. A slug test can be performed by causing a sudden rise of the water level (referred to as a falling-head test), or a sudden fall of the water level (referred to as a rising-head test). In all the wells both falling-head tests and rising-head test were performed. The sampling interval of the pressure measurements during the tests was 1 second.

Falling-head test

The Diver® is lowered into the well. The Diver® cause a small displacement of the groundwater level but after recovery of the water level the test begin. The light- and sound indicator was used to control that the water level was fully recovered. The slug is rapidly lowered into the well causing a sudden rise of the water level. While the water level recovers, the Diver® measure the pressure every second. When the recovery of the water level is fully reached the rising-head test commence. For wells with a very quick recovery (less than 5 minutes), another two tests are performed.

Rising-head test

Same principle as falling-head test but this time the slug is rapidly withdrawn from the well causing a sudden drop of the water level. While the water level recovers, the Diver® measures the pressure every second until the recovery of the water level is fully reached. For wells with a very quick recovery (less than 5 minutes), another two tests are performed.

Results in table 6-1 are showing hydraulic conductivity and transmissivity from the falling-head tests. The data from the rising-head tests were also evaluated but since the results were similar to those from falling-head tests the results were excluded.

5.2.1 Test procedure

The test procedure is briefly described below:

1. Cleaning of equipment that is lowered into the well.
2. Measurement of the depth from the top of the standpipe to the bottom of the well.
3. Determination of the slug- and wire length. The objective is to cause a large initial displacement of the water level as possible. In the majority of the present tests, a shallow undisturbed water level implied that the slug length was restricted to 0.50 m, 1.00 m or 2.00 m, in order to prevent water from rising over the top of the rising pipe in the falling-head tests.
4. Logging of pressure in air, and thereafter to undisturbed water level in the well, with the Diver®.
5. Performance of falling-head test: Rapid lowering of slug into the well (fixed with a wire stop). Sampling frequency of the Diver®: 1 measurement per second. Measurement of the recovery of the water level in the well using a water-level meter.
6. Performance of rising-head test: Withdrawal of the slug from the well when the water level has recovered following the falling-head test. Sampling frequency of the Diver®: 1 measurement per second.
7. Termination of slug tests approximately 1 h after start of the rising-head test.

5.3 Data handling

Raw data from the Diver® (internal *.mon format) was saved on a portable PC, using the computer programme EnviroMon Ver. 1.45. After each test, the saved *.mon files were exported from EnviroMon to *.csv (comma-separated format).

Prior to the data evaluation for the generation of primary data files, all files in *.csv format were imported to MS Excel and saved in *.xls format. Data processing was performed in MS Excel, in order to produce data files for the estimation of transmissivity and hydraulic conductivity (see Sections 5.4 and 6). The data processing performed in MS Excel involved (1) correction of the pressure data for the barometric pressure (obtained by keeping the Diver® in the open air prior to each slug test), and (2) identification of the exact starting time of the test for the analysis (removal of intial oscillation effects, usually lasting on the order of 1–10 seconds after lowering the slug into the well).

A list of all generated raw and primary data files is given in Appendix 1. The raw data files (*.mon and *.csv) were delivered in digital form to the Activity Leader as well as the results of the evaluation (slugtester_Simpevarp_resultat_0402XX.xls) for quality control and storage in the SICADA database.

5.4 Analyses and interpretation

The following section gives an overview of the methods used for analysis and interpretation of the slug test data.

For all the slug test analysis, the computer program Aquifer Test Version 3.5 was used, see /5/. The programme allows for both automatic and manual fitting of a straight-line plot to the measured data. In the evaluation the aquifer thickness is the distance between groundwater level and bedrock in the unconfined case and the distance between bottom of the clay layer and bedrock in the confined case.

5.4.1 Hvorslev method and Bouwer & Rice method

The Hvorslev method and the Bouwer & Rice method are both designed to estimate the hydraulic conductivity of an aquifer. The methods assume a fully or partially penetrating well in a confined or unconfined aquifer. A straight-line plot of the logarithm of the ratio h/h_0 versus time is automatically fitted to the measured data. If the semi-logarithmic plot of the measured data gives a concave-upward curve, automatic fitting is inappropriate, and manual curve fitting is preferred. The manual curve fitting method has been used for all analyses in this report. The theory of the Hvorslev method and the Bouwer & Rice method and practical recommendations for their application are given in /6/.

The analyses in this report have been made with the Hvorslev method for confined conditions and with the Bouwer & Rice method for unconfined conditions.

5.4.2 Cooper-Bredehoeft-Papadopulos method

The Cooper-Bredehoeft-Papadopulos method is designed to estimate the hydraulic conductivity of an aquifer. The method is usually used for wells with great diameters and when confined conditions prevail /5/ and /6/. The method gives a semi- logarithmic plot of the measured data. The program automatically draws a number of curves with different α-values. The data is then manually fitted to the α-curve that best correspond with the measured data.

The Cooper-Bredehoeft-Papadopulos method have been used for estimating the hydraulic conductivity in four wells.

6 Results

6.1 Nomenclature and symbols

The nomenclature and symbols used for the results presented in the following sections are as follows:

h_0 (m): Water pressure head at measuring point prior to the slug test.

dh_0* (m): Expected initial displacement.

dh_0_p (m): Initial displacement for falling-head test.

dh_0*/dh_0_p: Proportion between expected and actual displacement.

hp (m): Water pressure head at the measuring point at end of falling-head test.

6.2 Results

The results of the performed slug tests are summarized in table 6-1. below.

Table 6-1. Summary of the results of the slug tests.

Well ID	h_0 (m)	dh_0* (m)	dh_0_p (m)	dh_0*/dh_0_p	hp (m)
SSM000008	2,19	0,65	0,67	0,97	2,18
SSM000009	1,21	0,33	0,44	0,75	1,19
SSM000010	2,29	0,65	0,78	0,83	2,28
SSM000011	1,46	0,33	0,39	0,85	1,45
SSM000012	1,90	0,65	0,88	0,74	1,89
SSM000014	1,37	0,33	0,65	0,51	1,35
SSM000015	1,82	0,65	0,77	0,84	1,82
SSM000016	1,24	0,33	0,33	1,00	1,22
SSM000018	2,38	0,65	0,43	1,51	2,38
SSM000020	1,78	0,65	0,63	1,03	1,76
SSM000022	3,15	1,30	0,58	2,24	3,14
SSM000024	3,15	0,65	1,09	0,60	3,13
SSM000026	2,25	0,65	0,47	1,38	2,23

For some wells the initial displacement is greater than the expected displacement. The reason for this is obscure, but the initial displacement is ignored in the analysis. The first seconds after the slug is lowered or withdrawn from the well the water level is fluctuating and these first seconds are left out from the analyses.

6.3 Results evaluated by the Hvorslev and Bouwer & Rice method

Table 6-2. below presents the results of the slug test analyses according to the Hvorslev, the Bouwer & Rice and the Cooper-Bredehoeft-Papadopulos methods. The results show the hydraulic conductivity (K), aquifer thickness (b^1) and transmissivity (T) for respectively monitoring well.

Table 6-2. Results evaluated by the Hvorslev, Bouwer & Rice and the Cooper-Bredehoeft-Papadopulos methods.

Groundwater monitoring well	Hydraulic conductivity K (m/s)	Aquifer thickness B[1] (m)	Transmissivity T (m^2/s)	Analysis method
SSM000008	4,03E-05	2	8,06E-05	Hvorslev
SSM000009	5,67E-06	1	5,67E-06	Bouwer & Rice
SSM000010	2,52E-05	1	2,52E-05	Hvorslev
SSM000011	3,32E-06	1,66	5,51E-06	Bouwer & Rice
SSM000012	2,16E-06	1	2,16E-06	Hvorslev
SSM000014	3,31E-05	1	3,31E-05	Bouwer & Rice
SSM000015	1,19E-04	1	1,19E-04	Hvorslev
SSM000016	1,48E-04	1	1,48E-04	Bouwer & Rice
SSM000018	1,83E-04	1	1,83E-04	Hvorslev
SSM000018	6,10E-04	1	6,10E-04	Cooper-Bredehoeft-Papadopulos
SSM000020	6,61E-05	0,4	2,64E-05	Hvorslev
SSM000020	2,76E-04	0,4	1,10E-04	Cooper-Bredehoeft-Papadopulos
SSM000022	1,85E-05	2	3,70E-05	Hvorslev
SSM000022	4,48E-04	2	8,96E-04	Cooper-Bredehoeft-Papadopulos
SSM000024	1,95E-06	1	1,95E-06	Bouwer & Rice
SSM000026	1,52E-05	2	3,04E-05	Hvorslev
SSM000026	1,86E-04	2	3,72E-04	Cooper-Bredehoeft-Papadopulos

[1]The B-value is the smaller of the two values: aquifer thickness and screen length.

7 Summary and discussions

The groundwater monitoring wells was evaluated according to Hvorslev, Bouwer & Rice and Cooper-Bredehoeft-Papadopulos methods. The computer program Aquifer Test Version 3.5 was used for the analyses.

Results of the hydraulic conductivity seem high for some of the groundwater-monitoring well (e.g. SSM000018). The most probable reason is that the actual sand pack diameter is greater than the 120 mm that were used in the analyses. This occurs when the wall of the well collapse during drilling and a hole is formed. Later, when filter sand were filled outside the well the sand also filled up the hole and the diameter of the sand pack becomes greater than 120 mm. Another explanation can be that there exist a thin layer of coarse material between the till and the rock surface and that the hydraulic property of this material governs the test result.

Other sources to unreliable results are: the thickness of the aquifer is difficult to predict, determine if confined or unconfined conditions prevailed, the homogeneity of the soil etc.

The values of the transmissivity obtained from the analysis from the Hvorslev, the Bouwer & Rice and the Cooper-Bredehoeft-Papadopulos method varied between $1{,}95 \cdot 10^{-6}$ m^2/s and $8{,}96 \cdot 10^{-4}$ m^2/s.

The values of the hydraulic conductivity obtained from the analysis from the Hvorslev, the Bouwer & Rice and the Cooper-Bredehoeft-Papadopulos method varied between $1{,}95 \cdot 10^{-6}$ m/s and $6{,}10 \cdot 10^{-4}$ m/s.

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Appendix 1

List of generated raw data files and primary data files

Table A1-1. *List of generated rawdata files and primary data files.*

Obs. well	Raw data files: *.mon	Data processing files: *.xls	Primary data files: *.mdb
SSM000008	SSM000008	Sammanställning_slugT_rev eng	Simpevarp_redovisning
SSM000009	SSM000009	Sammanställning_slugT_rev eng	Simpevarp_redovisning
SSM000010	SSM000010	Sammanställning_slugT_rev eng	Simpevarp_redovisning
SSM000011	SSM000011	Sammanställning_slugT_rev eng	Simpevarp_redovisning
SSM000012	SSM000012	Sammanställning_slugT_rev eng	Simpevarp_redovisning
SSM000014	SSM000014	Sammanställning_slugT_rev eng	Simpevarp_redovisning
SSM000015	SSM000015	Sammanställning_slugT_rev eng	Simpevarp_redovisning
SSM000016	SSM000016	Sammanställning_slugT_rev eng	Simpevarp_redovisning
SSM000018	SSM000018	Sammanställning_slugT_rev eng	Simpevarp_redovisning
SSM000020	SSM000020	Sammanställning_slugT_rev eng	Simpevarp_redovisning
SSM000022	SSM000022	Sammanställning_slugT_rev eng	Simpevarp_redovisning
SSM000024	SSM000024	Sammanställning_slugT_rev eng	Simpevarp_redovisning
SSM000026	SSM000026	Sammanställning_slugT_rev eng	Simpevarp_redovisning

Table A1-2. *Evaluated parameters*

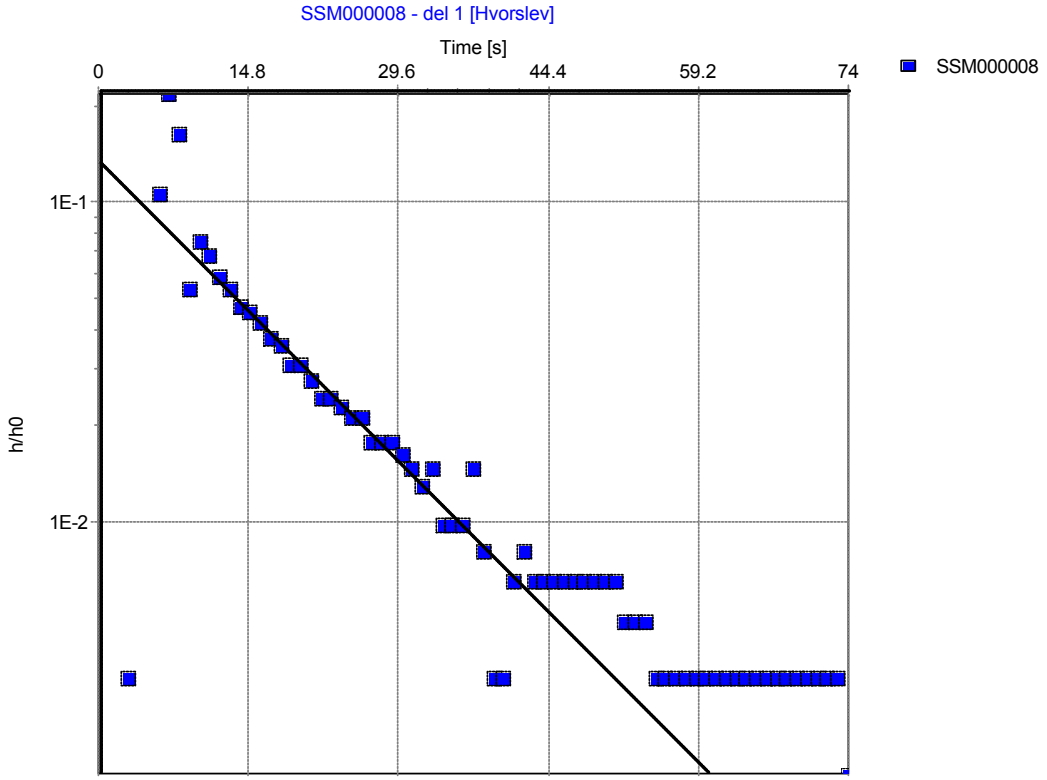
Borehole	Borehole secup[1] (m)	Borehole seclow[1] (m)	Test type (1-6)	Date for test, start YY-MM-DD	Start test hh:mm	tp (s)	h_0 (m)	dh_0 (m)	h_p (m)	b (m)	T_s (m^2/s)
SSM000008	3,0	5,0	4	2004-02-18	12:39	74	2,19	0,67	2,18	3,20	4,20E-04
SSM000009	3,0	4,0	4	2004-02-23	14:30	455	1,21	0,33	1,19	2,91	5,20E-05
SSM000010	2,0	3,0	4	2004-02-18	10:35	173	2,29	0,65	2,28	1,00	7,60E-05
SSM000011	1,0	3,0	4	2004-02-23	15:39	452	1,46	0,33	1,45	1,66	1,70E-05
SSM000012	5,0	6,0	4	2004-02-20	10:59	2225	1,90	0,64	1,89	3,60	2,30E-04
SSM000014	2,0	3,0	4	2004-02-23	10:51	73	1,37	0,32	1,35	1,40	1,40E-04
SSM000015	4,0	5,0	4	2004-02-23	10:02	45	1,82	0,65	1,82	2,82	1,00E-03
SSM000016	2,0	3,0	4	2004-02-20	13:17	21	1,24	0,33	1,22	1,54	6,90E-04
SSM000018	2,0	3,0	4	2004-02-19	10:53	30	2,38	0,43	2,38	1,40	7,70E-04
SSM000020	2,0	3,0	4	2004-02-18	14:37	68	1,78	0,65	1,76	0,40	8,00E-05
SSM000022	5,0	7,0	4	2004-02-19	08:49	91	3,15	0,58	3,14	4,00	2,40E-04
SSM000024	2,8	3,8	4	2004-02-19	13:18	852	3,15	0,78	3,13	4,10	2,60E-05
SSM000026	2,0	4,0	4	2004-02-19	15:16	90	2,25	0,65	2,23	2,50	1,20E-04

[1] The length is measured from the top of the standpipe.

Slug test analysis report

WSP Environmental
Slagthuset
211 20 Malmö
040 - 699 62 00

Slug Test Analysis Report	
Project:	Simpevarp Oskarshamn
Number:	10042320-11
Client:	SKB



Slug Test: **SSM000008**

Analysis Method: **Hvorslev**

Analysis Results:

Conductivity: 4.03E-5 [m/s]

Test parameters:

Test Well:	SSM000008	Aquifer Thickness:	3.2 [m]
Casing radius:	0.025 [m]		
Screen length:	2 [m]		
Boring radius:	0.06 [m]		

Comments: The analysis is performed with the Hvorslev method as the aquifer is considered to be confined. The aquifer thickness refers to the soil layers.

Evaluated by: AS

Evaluation Date: 2004-03-02

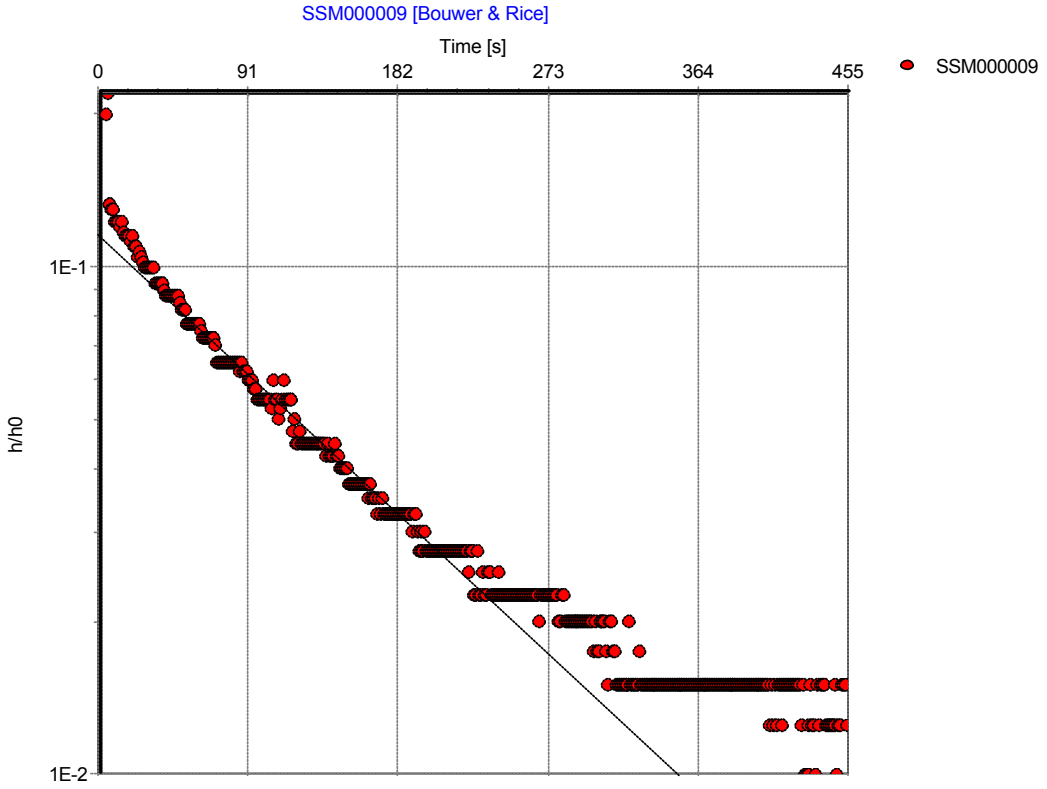
WSP Environmental
Slagthuset
211 20 Malmö
040 - 699 62 00

Slug Test Analysis Report

Project: Simpevarp Oskarshamn

Number: 10042320-11

Client: SKB



Slug Test: **SSM000009**

Analysis Method: **Bouwer & Rice**

Analysis Results:				
			Conductivity:	5.67E-6 [m/s]

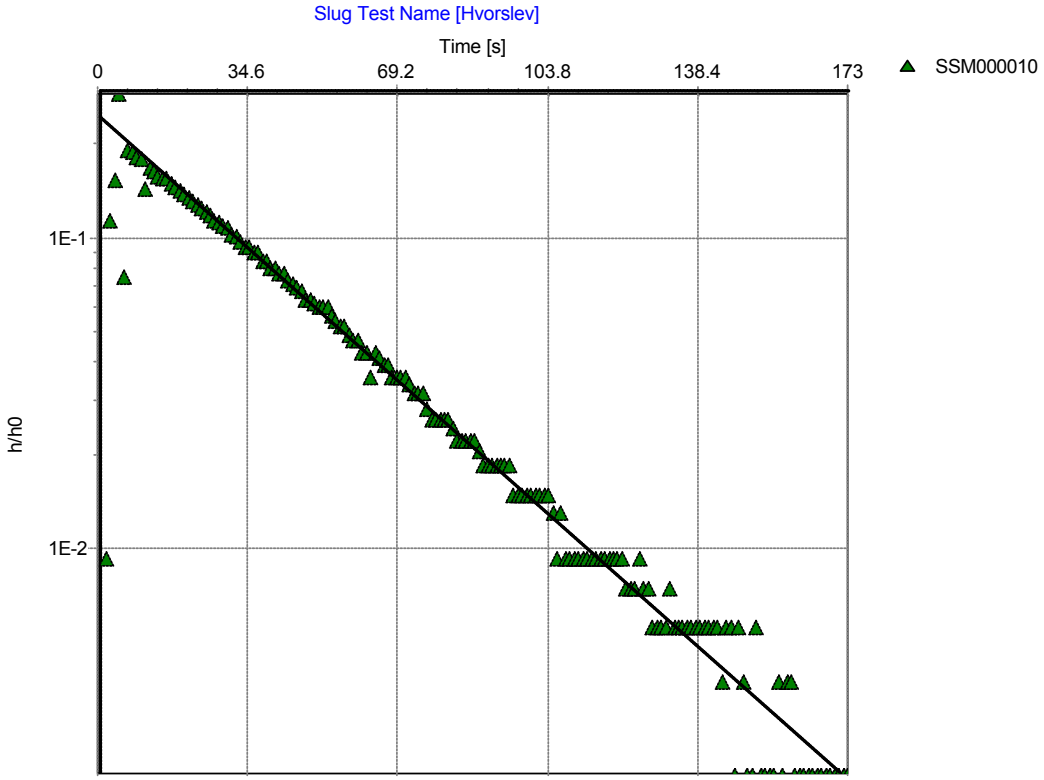
Test parameters:				
	Test Well:	SSM000009	Aquifer Thickness:	2.91 [m]
	Casing radius:	0.025 [m]	Gravel Pack Porosity (%)	25
	Screen length:	1 [m]		
	Boring radius:	0.06 [m]		
	r(eff):	0.037 [m]		

Comments: The analysis is performed with the Bouwer and Rice method as the aquifer is considered to be unconfined. The aquifer thickness refers to the soil layers.

Evaluated by: AS

Evaluation Date: 2004-03-02

WSP Environmental	Slug Test Analysis Report
Slagthuset	Project: Simpevarp Oskarshamn
211 20 Malmö	Number: 10042320-11
040 - 699 62 00	Client: SKB



Slug Test: **SSM000010**

Analysis Method: **Hvorslev**

Analysis Results:

Conductivity: 2.52E-5 [m/s]

Test parameters:

Test Well:	SSM000010	Aquifer Thickness:	1 [m]
Casing radius:	0.025 [m]		
Screen length:	1 [m]		
Boring radius:	0.06 [m]		

Comments: The analysis is performed with the Hvorslev method as the aquifer is considered to be confined. The aquifer thickness refers to the soil layers.

Evaluated by: AS

Evaluation Date: 2004-03-02

WSP Environmental
Slagthuset
211 20 Malmö
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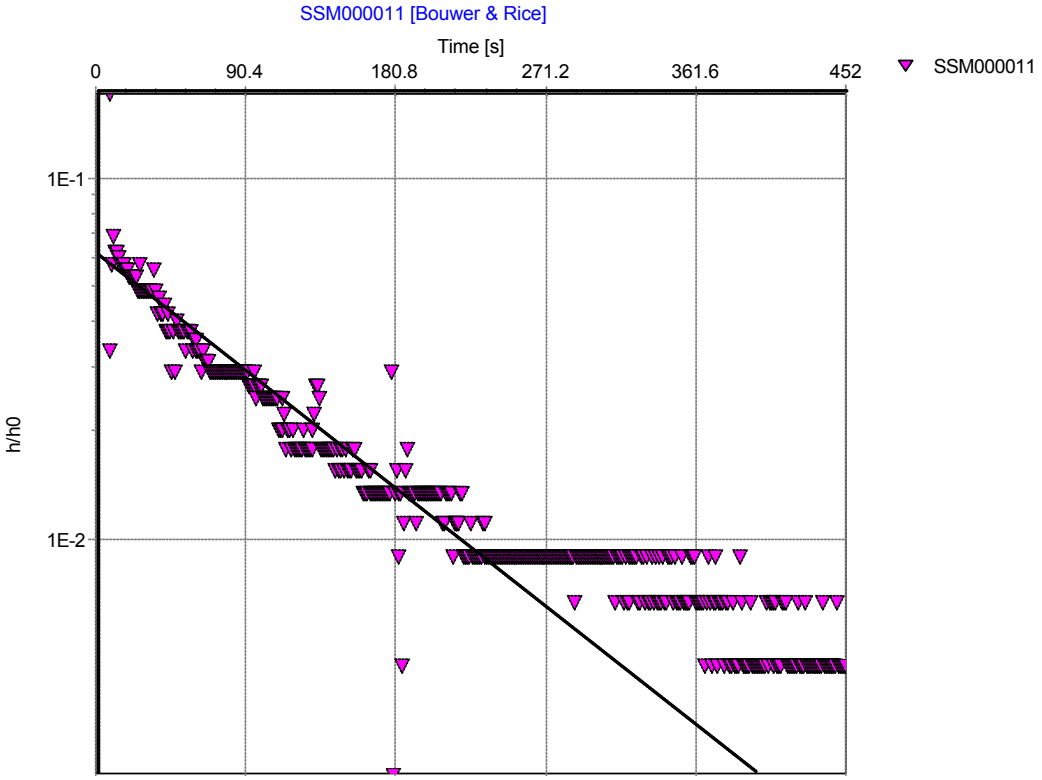
Slug Test Analysis Report

Project: Simpevarp Oskarshamn
Number: 10042320-11
Client: SKB



Slug Test: **SSM000011**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 3.32E-6 [m/s]

Test parameters:

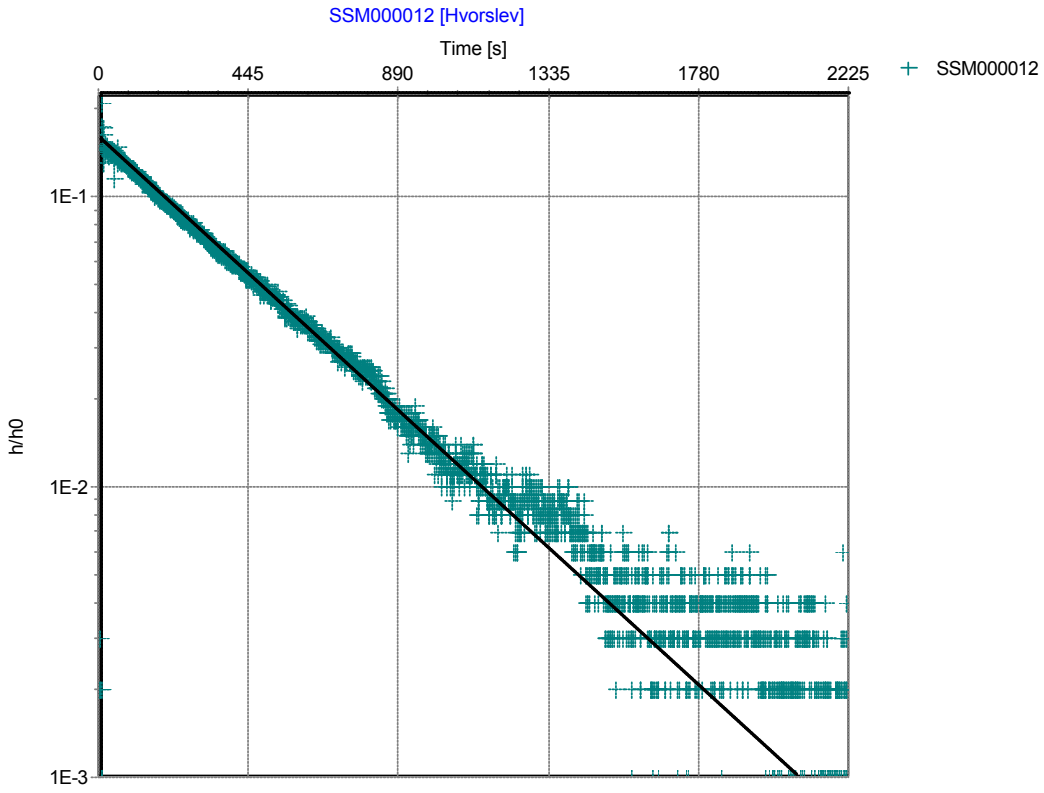
Test Well:	SSM000011	Aquifer Thickness:	1.66 [m]
Casing radius:	0.025 [m]	Gravel Pack Porosity (%)	25
Screen length:	2 [m]		
Boring radius:	0.06 [m]		
r(eff):	0.037 [m]		

Comments: The analysis is performed with the Bouwer and Rice method as the aquifer is considered to be unconfined. The aquifer thickness refers to the soil layers.

Evaluated by: AS
Evaluation Date: 2004-03-02

WSP Environmental
Slagthuset
211 20 Malmö
040 - 699 62 00

Slug Test Analysis Report	
Project:	Simpevarp Oskarshamn
Number:	10042320-11
Client:	SKB



Slug Test: **SSM000012**

Analysis Method: **Hvorslev**

Analysis Results:

Conductivity: 2.16E-6 [m/s]

Test parameters:

Test Well:	SSM000012	Aquifer Thickness:	3.6 [m]
Casing radius:	0.025 [m]		
Screen length:	1 [m]		
Boring radius:	0.06 [m]		

Comments: The analysis is performed with the Hvorslev method as the aquifer is considered to be confined. The aquifer thickness refers to the soil layers.

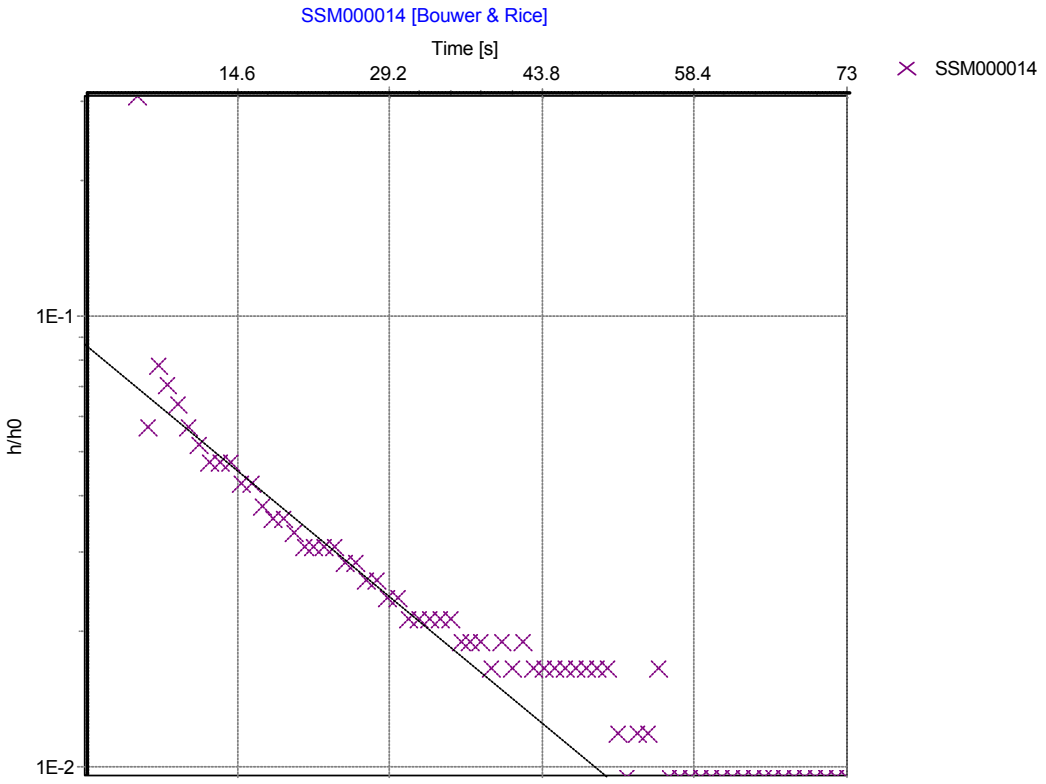
Evaluated by: AS

Evaluation Date: 2004-03-03

WSP Environmental
Slagthuset
211 20 Malmö
040 - 699 62 00

Slug Test Analysis Report

Project: Simpevarp Oskarshamn
Number: 10042320-11
Client: SKB



Slug Test: **SSM000014**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 3.31E-5 [m/s]

Test parameters:

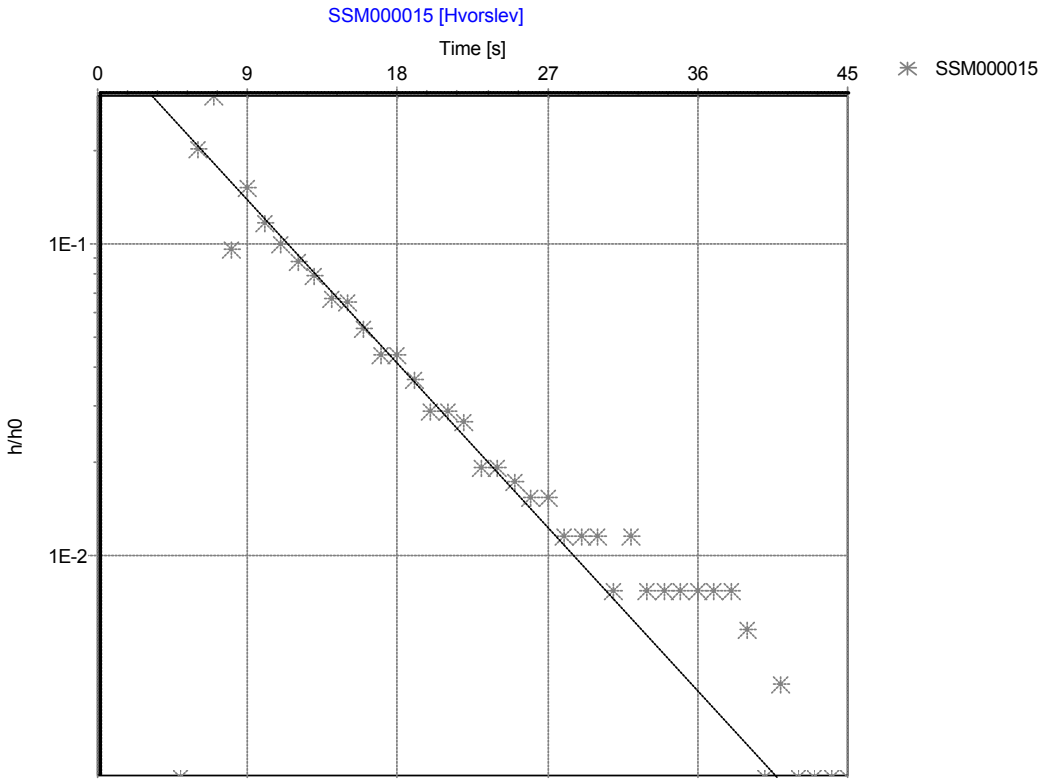
Test Well:	SSM000014	Aquifer Thickness:	1.4 [m]
Casing radius:	0.025 [m]	Gravel Pack Porosity (%)	25
Screen length:	1 [m]		
Boring radius:	0.06 [m]		
r(eff):	0.037 [m]		

Comments: The analysis is performed with the Bouwer and Rice method as the aquifer is considered to be unconfined. The aquifer thickness refers to the soil layers.

Evaluated by: AS
Evaluation Date: 2004-03-03

WSP Environmental
Slagthuset
211 20 Malmö
040 - 699 62 00

Slug Test Analysis Report	
Project:	Simpevarp Oskarshamn
Number:	10042320-11
Client:	SKB



Slug Test: **SSM000015**

Analysis Method: **Hvorslev**

Analysis Results:

Conductivity: 1.19E-4 [m/s]

Test parameters:

Test Well:	SSM000015	Aquifer Thickness:	2.82 [m]
Casing radius:	0.025 [m]		
Screen length:	1 [m]		
Boring radius:	0.06 [m]		

Comments: The analysis is performed with the Hvorslev method as the aquifer is considered to be confined. The aquifer thickness refers to the soil layers.

Evaluated by: AS

Evaluation Date: 2004-03-03

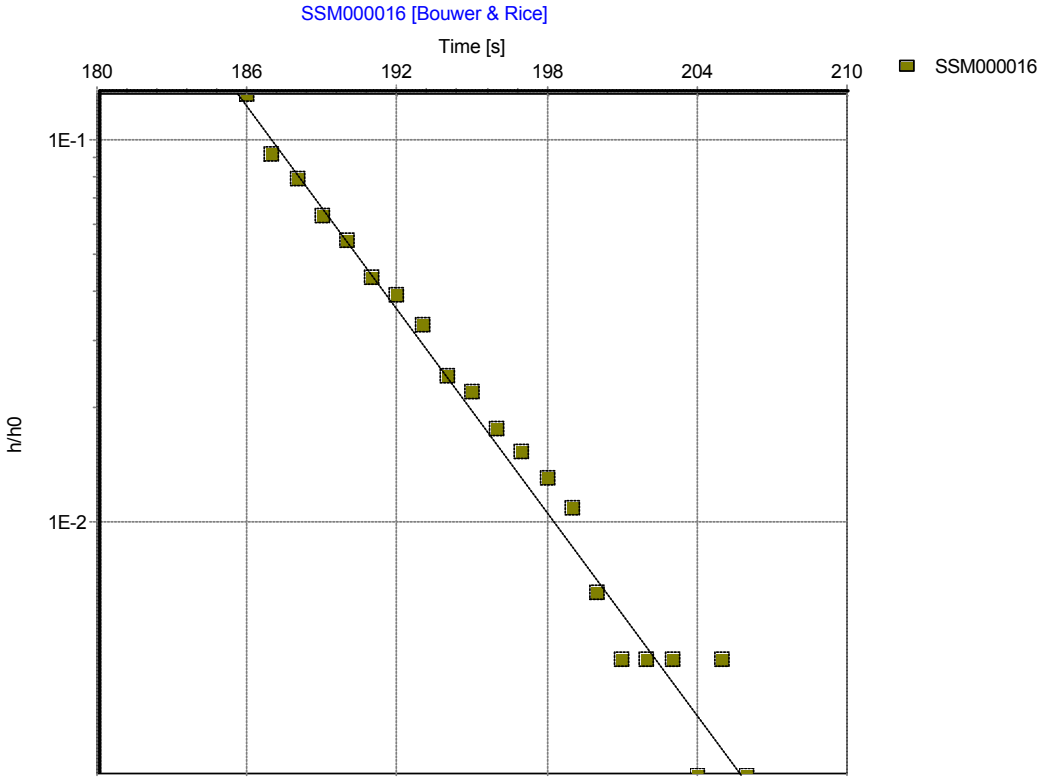
WSP Environmental
Slagthuset
211 20 Malmö
040 - 699 62 00

Slug Test Analysis Report

Project: Simpevarp Oskarshamn

Number: 10042320-11

Client: SKB



Slug Test: **SSM000016**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 1.48E-4 [m/s]

Test parameters:

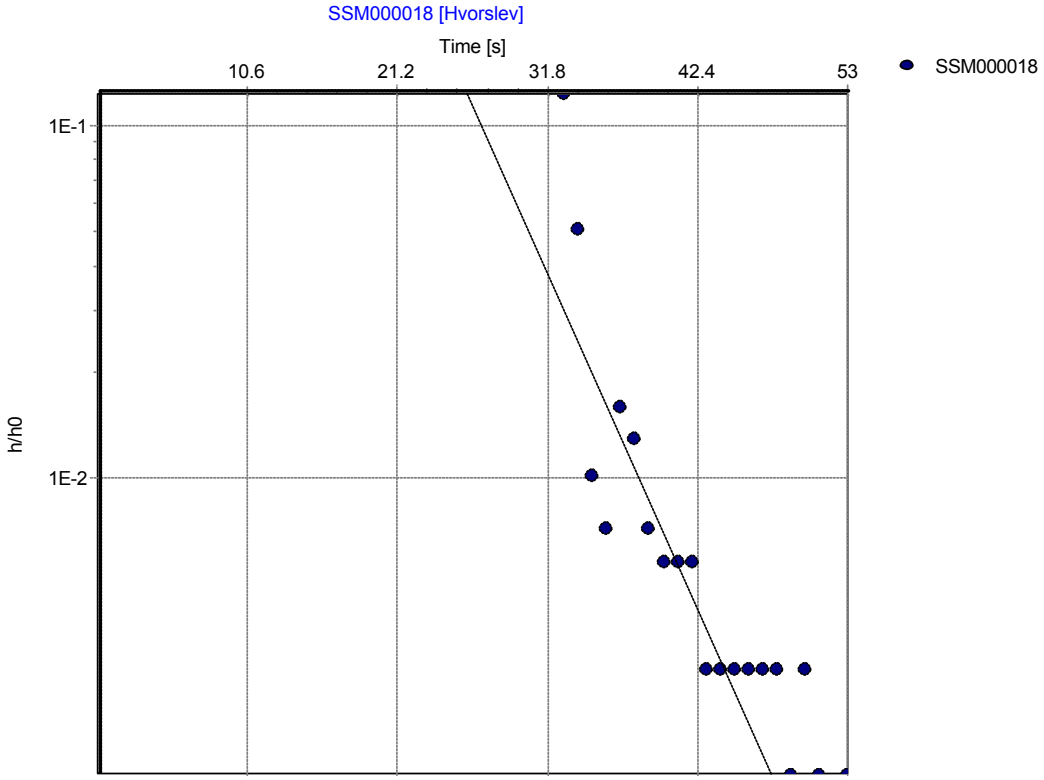
Test Well:	SSM000016	Aquifer Thickness:	1.54 [m]
Casing radius:	0.025 [m]	Gravel Pack Porosity (%)	25
Screen length:	1 [m]		
Boring radius:	0.06 [m]		
r(eff):	0.037 [m]		

Comments: The analysis is performed with the Bouwer and Rice method as the aquifer is considered to be unconfined. The aquifer thickness refers to the soil layers.

Evaluated by: AS

Evaluation Date: 2004-03-03

WSP Environmental	Slug Test Analysis Report
Slagthuset	Project: Simpevarp Oskarshamn
211 20 Malmö	Number: 10042320-11
040 - 699 62 00	Client: SKB



Slug Test: **SSM000018**

Analysis Method: **Hvorslev**

Analysis Results:

Conductivity: 1.83E-4 [m/s]

Test parameters:

Test Well:	SSM000018	Aquifer Thickness:	1.4 [m]
Casing radius:	0.025 [m]		
Screen length:	1 [m]		
Boring radius:	0.06 [m]		

Comments: The analysis is performed with the Hvorslev method as the aquifer is considered to be confined. The aquifer thickness refers to the soil layers.

Evaluated by: AS

Evaluation Date: 2004-03-03

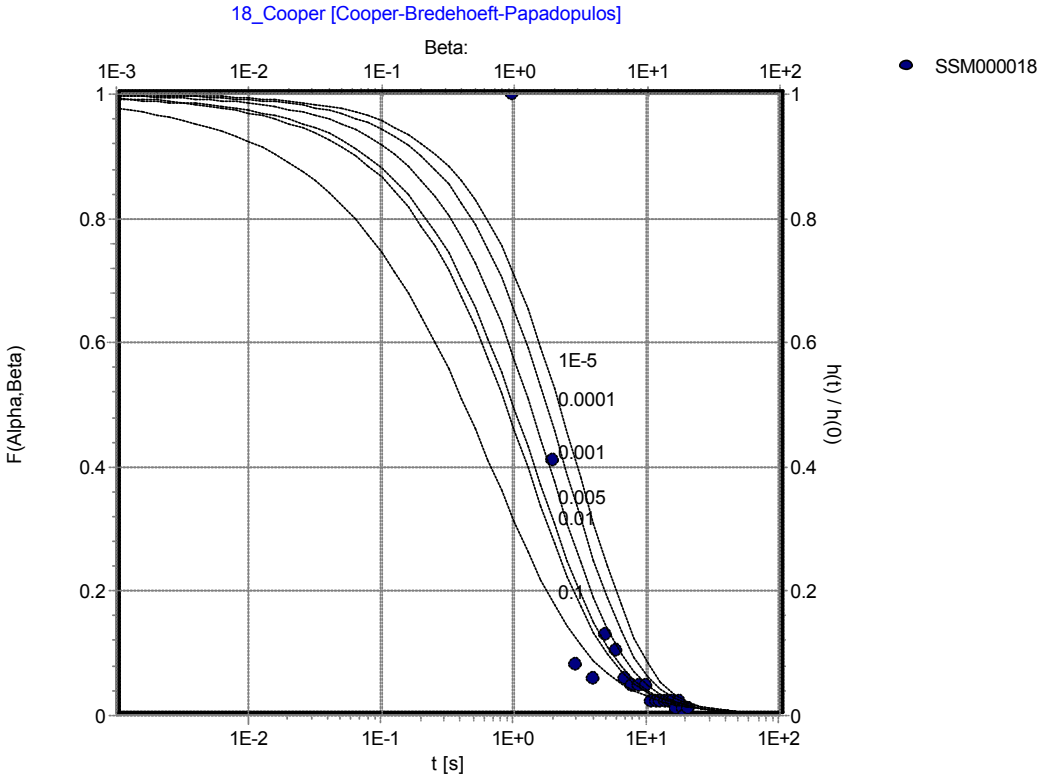
WSP Environmental
Slagthuset
211 20 Malmö
040 - 699 62 00

Slug Test Analysis Report

Project: Simpevarp Oskarshamn

Number: 10042320-11

Client: SKB



Slug Test: **SSM000018_Cooper et al.**

Analysis Method: **Cooper-Bredehoeft-Papadopulos**

Analysis Results:				
	Transmissivity:	6.10E-4 [m²/s]	Conductivity:	6.10E-4 [m/s]
	Storativity:	5.00E-7		

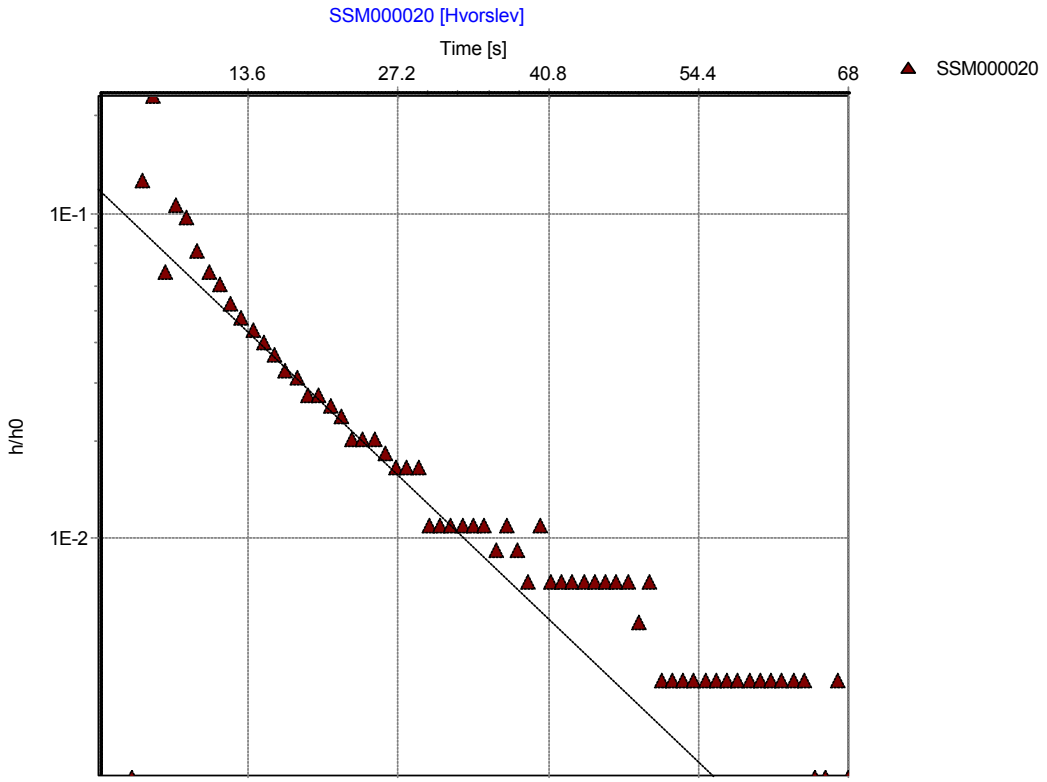
Test parameters:				
	Test Well:	SSM000018	Aquifer Thickness:	1 [m]
	Casing radius:	0.025 [m]	Alpha:	0.005
	Screen length:	1 [m]		
	Boring radius:	0.06 [m]		
	r(c):	2.5 [m]		

Comments:

Evaluated by:

Evaluation Date: 2004-04-22

WSP Environmental	Slug Test Analysis Report
Slagthuset	Project: Simpevarp Oskarshamn
211 20 Malmö	Number: 10042320-11
040 - 699 62 00	Client: SKB



Slug Test: **SSM000020**

Analysis Method: **Hvorslev**

Analysis Results:

Conductivity: 6.61E-5 [m/s]

Test parameters:

Test Well:	SSM000020	Aquifer Thickness:	0.4 [m]
Casing radius:	0.025 [m]		
Screen length:	1 [m]		
Boring radius:	0.06 [m]		

Comments: The analysis is performed with the Hvorslev method as the aquifer is considered to be confined. The aquifer thickness refers to the soil layers.

Evaluated by: AS

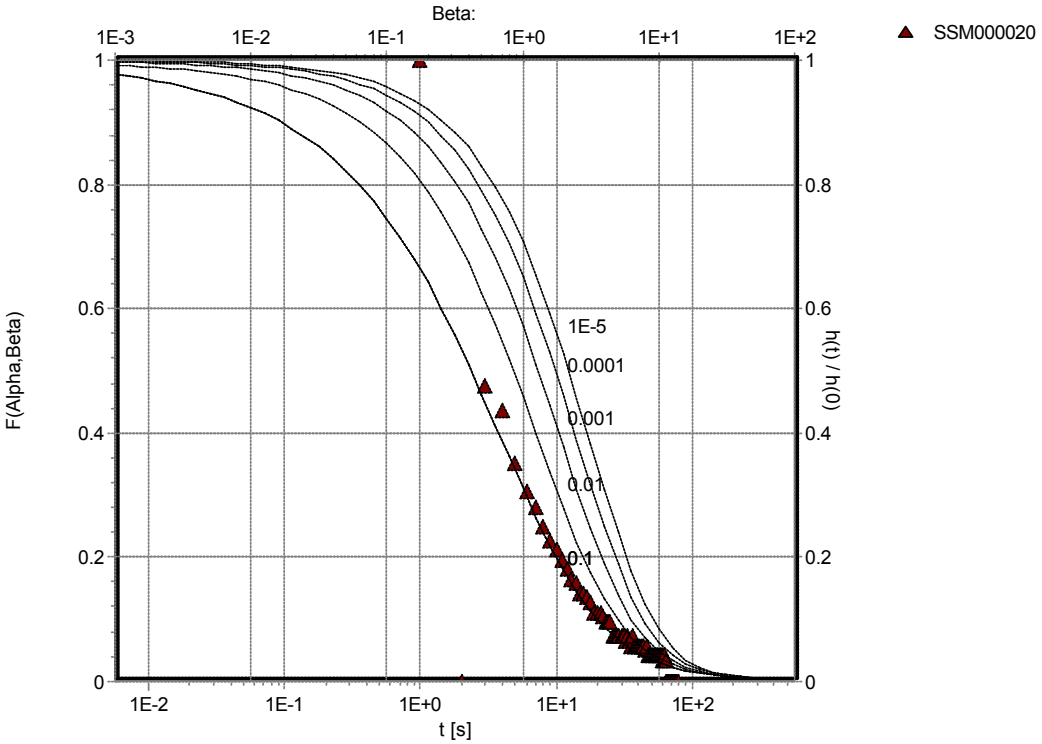
Evaluation Date: 2004-03-03

WSP Environmental
Slagthuset
211 20 Malmö
040 - 699 62 00

Slug Test Analysis Report

Project: Simpevarp Oskarshamn
Number: 10042320-11
Client: SKB

SSM000020_Cooper et al [Cooper-Bredehoeft-Papadopulos]



Slug Test: **SSM000020_Cooper et al**

Analysis Method: **Cooper-Bredehoeft-Papadopulos**

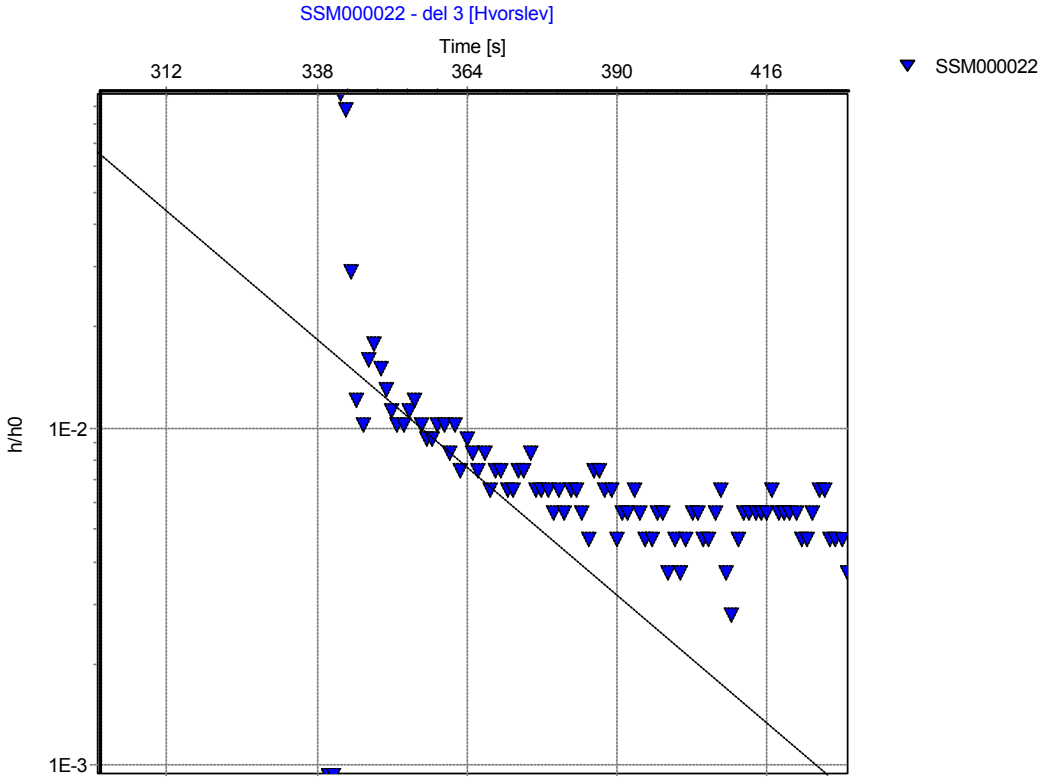
Analysis Results:	Transmissivity:	1.10E-4 [m²/s]	Conductivity:	2.76E-4 [m/s]
	Storativity:	1.00E-5		
Test parameters:	Test Well:	SSM000020	Aquifer Thickness:	0.4 [m]
	Casing radius:	0.025 [m]	Alpha:	0.1
	Screen length:	1 [m]		
	Boring radius:	0.06 [m]		
	r(c):	2.5 [m]		

Comments:

Evaluated by:

Evaluation Date: 2004-04-22

WSP Environmental	Slug Test Analysis Report
Slagthuset	Project: Simpevarp Oskarshamn
211 20 Malmö	Number: 10042320-11
040 - 699 62 00	Client: SKB



Slug Test: **SSM000022 - del 3**

Analysis Method: **Hvorslev**

Analysis Results:

Conductivity: 1.85E-5 [m/s]

Test parameters:

Test Well:	SSM000022	Aquifer Thickness:	4 [m]
Casing radius:	0.025 [m]		
Screen length:	2 [m]		
Boring radius:	0.06 [m]		

Comments: The analysis is performed with Hvorslev method as the aquifer is considered to be confined. The aquifer thickness refers to the soil layers.

Evaluated by: AS

Evaluation Date: 2004-03-03

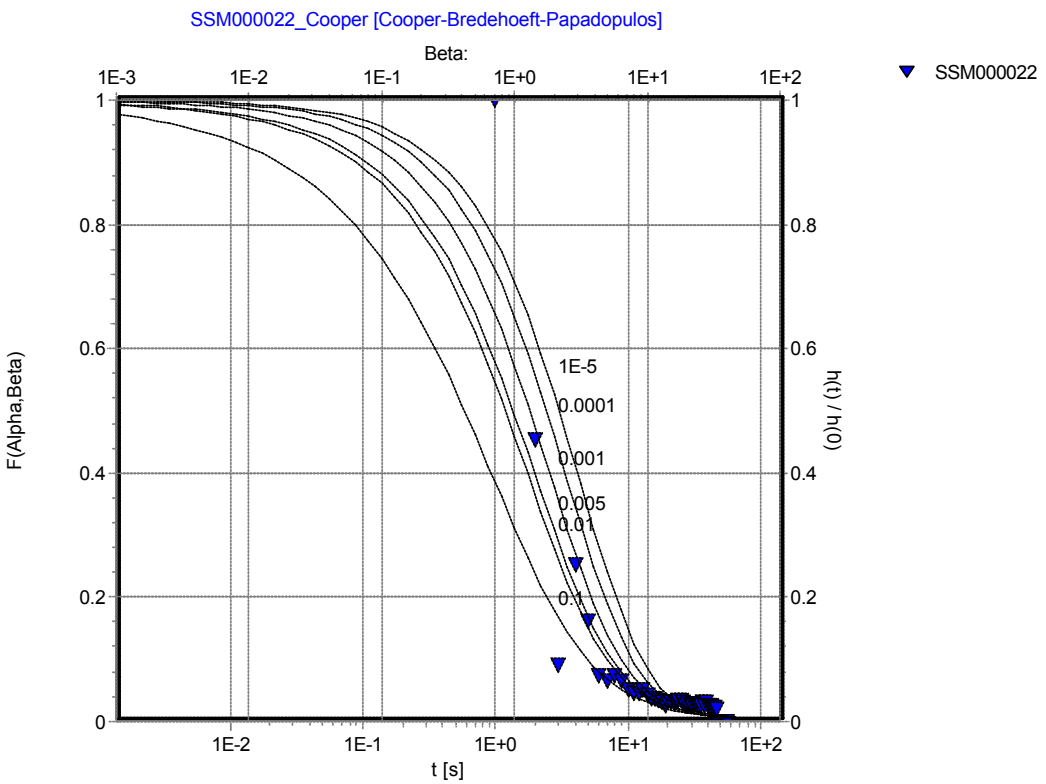
WSP Environmental
Slagthuset
211 20 Malmö
040 - 699 62 00

Slug Test Analysis Report

Project: Simpevarp Oskarshamn

Number: 10042320-11

Client: SKB



Slug Test: **SSM000022_Cooper**

Analysis Method: **Cooper-Bredehoeft-Papadopulos**

Analysis Results:	Transmissivity:	4.48E-4 [m²/s]	Conductivity:	4.48E-4 [m/s]
	Storativity:	5.00E-7		

Test parameters:	Test Well:	SSM000022	Aquifer Thickness:	1 [m]
	Casing radius:	0.025 [m]	Alpha:	0.005
	Screen length:	2 [m]		
	Boring radius:	0.06 [m]		
	r(c):	2.5 [m]		

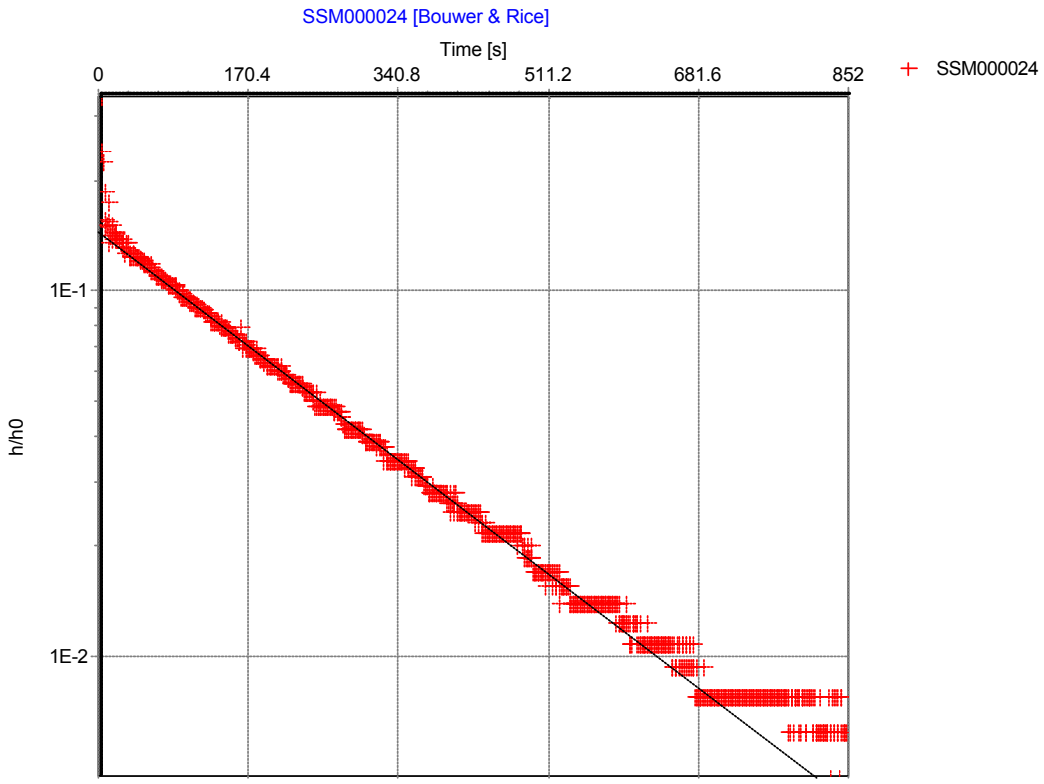
Comments:

Evaluated by:

Evaluation Date: 2004-04-22

WSP Environmental
Slagthuset
211 20 Malmö
040 - 699 62 00

Slug Test Analysis Report	
Project:	Simpevarp Oskarshamn
Number:	10042320-11
Client:	SKB



Slug Test: **SSM000024**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 1.95E-6 [m/s]

Test parameters:				
	Test Well:	SSM000024	Aquifer Thickness:	4.1 [m]
	Casing radius:	0.025 [m]	Gravel Pack Porosity (%)	25
	Screen length:	2 [m]		
	Boring radius:	0.06 [m]		
	r(eff):	0.037 [m]		

Comments: The analysis is performed with the Bouwer and Rice method as the aquifer is considered to be unconfined. The aquifer thickness refers to the soil layers.

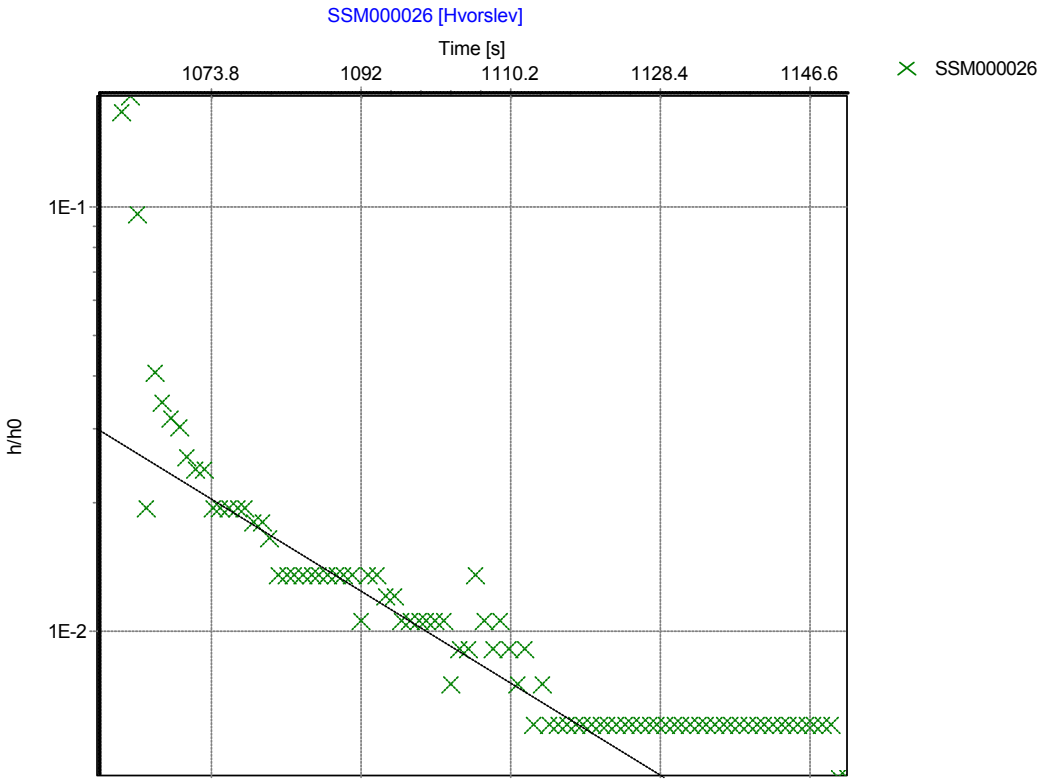
Evaluated by: AS

Evaluation Date: 2004-03-03

WSP Environmental
Slagthuset
211 20 Malmö
040 - 699 62 00

Slug Test Analysis Report

Project: Simpevarp Oskarshamn
Number: 10042320-11
Client: SKB



Slug Test: **SSM000026**

Analysis Method: **Hvorslev**

Analysis Results:

Conductivity: 1.52E-5 [m/s]

Test parameters:

Test Well:	SSM000026	Aquifer Thickness:	2.5 [m]
Casing radius:	0.025 [m]		
Screen length:	2 [m]		
Boring radius:	0.06 [m]		

Comments: The analysis is performed with the Hvorslev method as the aquifer is considered to be confined. The aquifer thickness refers to the soil layers.

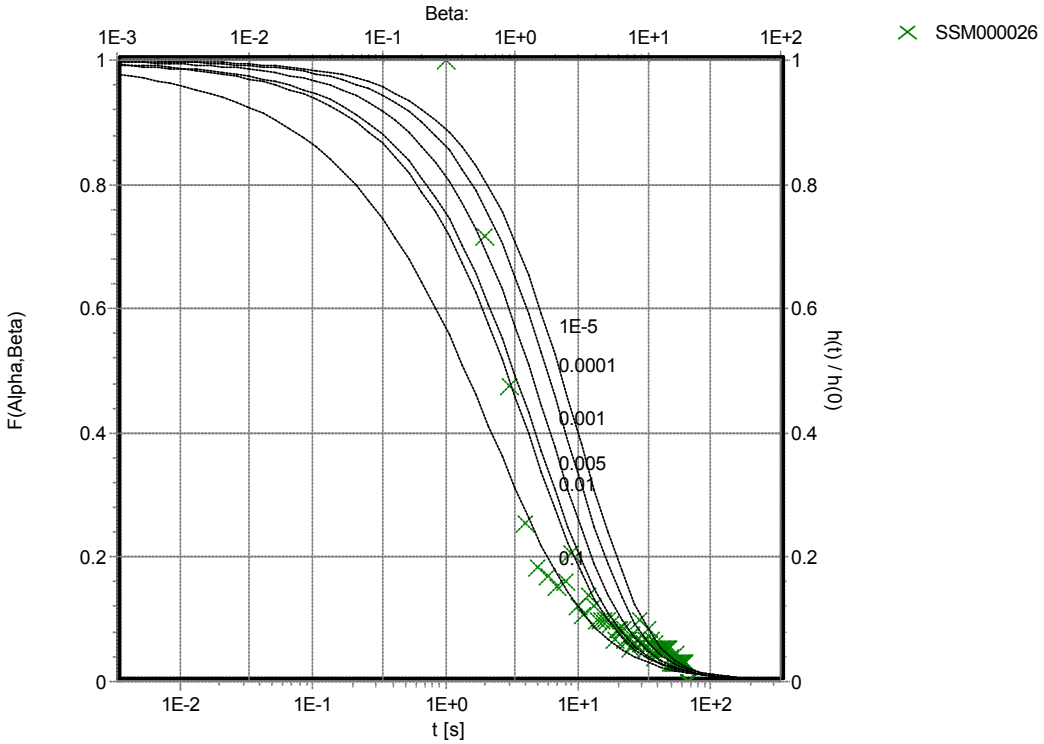
Evaluated by: AS

Evaluation Date: 2004-03-03

WSP Environmental
Slagthuset
211 20 Malmö
040 - 699 62 00

Slug Test Analysis Report	
Project:	Simpevarp Oskarshamn
Number:	10042320-11
Client:	SKB

SSM000026_Cooper [Cooper-Bredehoeft-Papadopulos]



Slug Test: **SSM000026_Cooper**

Analysis Method: **Cooper-Bredehoeft-Papadopulos**

Analysis Results:				
	Transmissivity:	1.86E-4 [m²/s]	Conductivity:	1.86E-4 [m/s]
	Storativity:	5.00E-7		

Test parameters:				
	Test Well:	SSM000026	Aquifer Thickness:	1 [m]
	Casing radius:	0.025 [m]	Alpha:	0.005
	Screen length:	2 [m]		
	Boring radius:	0.06 [m]		
	r(c):	2.5 [m]		

Comments:

Evaluated by:

Evaluation Date: 2004-04-22

Soil Tubes

WSP

SIMPEVARP BOREHOLE SSM000008

Company rep.
Lennart Adestam and Torbjörn Johansson

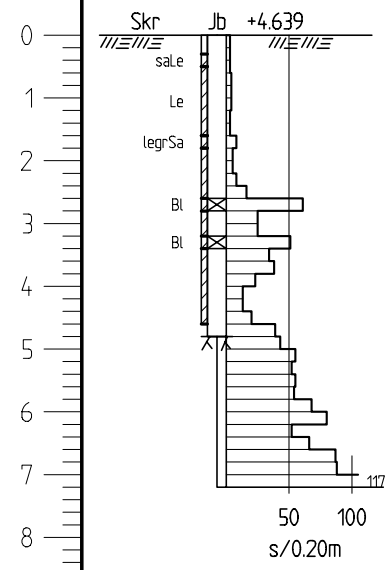
Client: Svensk Kärnbränslehantering AB

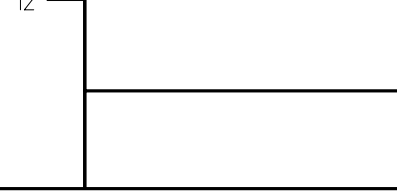
Northing :6365431.362
Easting :1550750.562

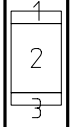
Coordinate system : RT90-RHB70

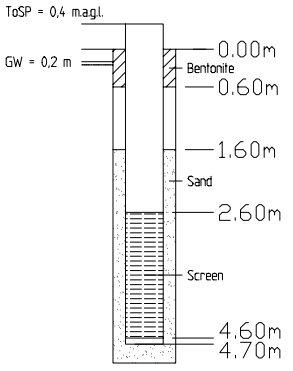
Top of stand pipe :0,4 m.a.g.l.
Total pipe length :5,10 m
Groundwater level :0,2 m.b.g.l.
Date of completion :2003-12-08

Depth (m)	Description	Samples	Groundwater monitoring well description	Borehole Construction Information









Drilling method : NOEK
Borehole diameter : 120 mm
sampling method : Auger

CASING
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 3,00 m

SCREEN
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 2,00 m
Slot : 0,3 mm

ANNULUS SEAL
Material : Bentonite clay
Total length : 0,60 m

SAND PACK
Grain size : 0,4-0,8 mm
Total length : 3,30 m

DRILLING EQUIPMENT
Drilling rig : Geotech 604
Drill hammer : Furukawa HB2G
Drill rod : Geostång Φ44
Drill bit : Stift Φ54

GEOLOGICAL LOG

0-0,3m	Top soil
0,3-0,5m	sandy clay
0,5-1,6m	clay
1,6-1,8m	clayey gravelly sand
2,6m	boulders
3,2m	boulders
4,6m	rock surface

ToSP : Top of Stand Pipe
m.a.g.l. : meters above ground level
m.b.g.l. : meters below ground level

SIMPEVARP BOREHOLE SSM000009

Company rep.
Lennart Adestam and Torbjörn Johansson

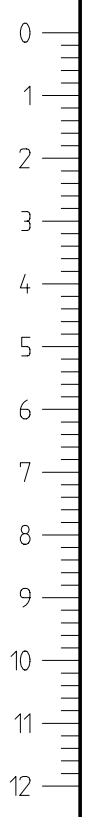
Client: Svensk Kärnbränslehantering AB

Northing :6367044.367
Easting :1548244.188

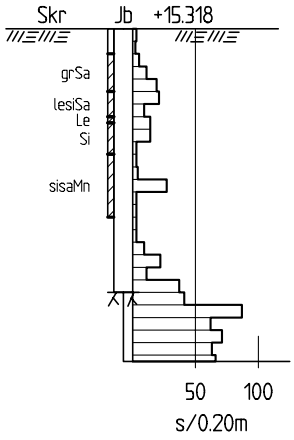
Coordinate system : RT90-RHB70

Top of stand pipe :0,4 m.a.g.l.
Total pipe length :4,10 m
Groundwater level :1,3 m.b.g.l.
Date of completion :2004-01-29

Depth (m)



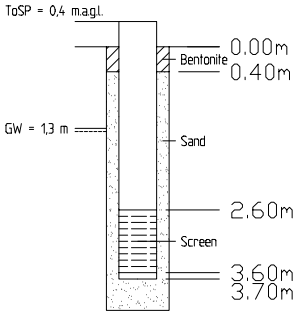
Description



Samples

1M
2M
3M
4M
5M
6M

Groundwater monitoring well description



Borehole Construction Information

Drilling method : NQEK
Borehole diameter : 120 mm
sampling method : Auger

CASING
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 3,00 m

SCREEN
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 1,00 m
Slot : 0,3 mm

ANNULUS SEAL
Material : Bentonite clay
Total length : 0,40 m

SAND PACK
Grain size : 0,4-0,8 mm
Total length : 3,50 m

DRILLING EQUIPMENT
Drilling rig : Geotech 604
Drill hammer : Furukawa HB2G
Drill rod : Geostång Φ44
Drill bit : Stift Φ54

GEOLOGICAL LOG
0-0,4m Top soil
0,4-1,0m gravelly sand
1,0-1,4m clayey silty sand
1,4-1,5m clay
1,5-2,0m silt
2,0-3,0m silty sandy till
3,0m boulders
4,2m rock surface

ToSP : Top of Stand Pipe
m.a.g.l. : meters above ground level
m.b.g.l. : meters below ground level

SIMPEVARP BOREHOLE SSM000010

Company rep.
Lennart Adestam and Torbjörn Johansson

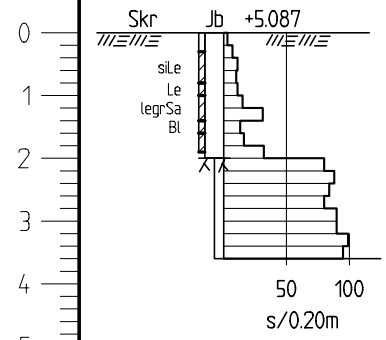
Client: Svensk Kärnbränslehantering AB

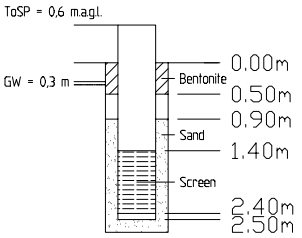
Northing :6365447.166
Easting :1550747.936

Coordinate system : RT90-RHB70

Top of stand pipe : 0,6 m.a.g.l.
Total pipe length : 3.10 m
Groundwater level : 0,3 m.b.g.l.
Date of completion : 2003-12-05

Depth (m)	Description	Samples	Groundwater monitoring well description	Borehole Construction Information





Drilling method : NOEK
Borehole diameter : 120 mm
sampling method : Auger

CASING
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 2,00 m

SCREEN
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 1,00 m
Slot : 0,3 mm

ANNULUS SEAL
Material : Bentonite clay
Total length : 0,50 m

SAND PACK
Grain size : 0,4-0,8 mm
Total length : 1,80 m

DRILLING EQUIPMENT
Drilling rig : Geotech 604
Drill hammer : Furukawa HB2G
Drill rod : Geostång Φ44
Drill bit : Stift Φ54

GEOLOGICAL LOG
0-0,3m Top soil
0,3-0,8m silty clay
0,8-1,0m clay
1,0-1,4m clayey gravelly sand
1,4m boulders
2,0m rock surface

ToSP : Top of Stand Pipe
m.a.g.l. : meters above ground level
m.b.g.l. : meters below ground level

SIMPEVARP BOREHOLE SSM000011

Company rep.
Lennart Adestam and Torbjörn Johansson

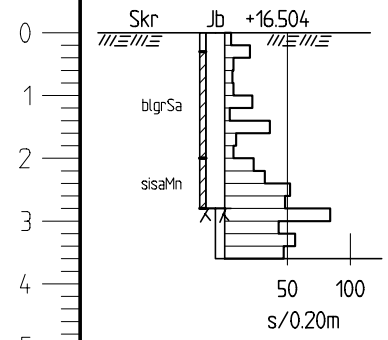
Client: Svensk Kärnbränslehantering AB

Northing : 6367013.025
Easting : 1548132.649

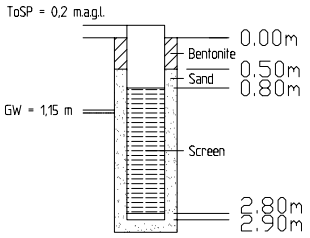
Coordinate system : RT90-RHB70

Top of stand pipe : 0,2 m.a.g.l.
Total pipe length : 3,10 m
Groundwater level : 1,15 m.b.g.l.
Date of completion : 2004-01-29

Depth (m)	Description	Samples	Groundwater monitoring well description	Borehole Construction Information



1M
2M
3M
4M
5M
6M



Drilling method : NQEK
Borehole diameter : 120 mm
sampling method : Auger

CASING
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 1,00 m

SCREEN
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 2,00 m
Slot : 0,3 mm

ANNULUS SEAL
Material : Bentonite clay
Total length : 0,50 m

SAND PACK
Grain size : 0,4-0,8 mm
Total length : 2,60 m

DRILLING EQUIPMENT
Drilling rig : Geotech 604
Drill hammer : Furukawa HB2G
Drill rod : Geostång Φ44
Drill bit : Stift Φ54

GEOLOGICAL LOG
0-0,3m Top soil
0,3-2,0m boulder-bearing gravelly sand
2,0-2,8m silty sandy till
2,8m rock surface

ToSP : Top of Stand Pipe
m.a.g.l. : meters above ground level
m.b.g.l. : meters below ground level

SIMPEVARP BOREHOLE SSM000012

Company rep.
Lennart Adestam and Torbjörn Johansson

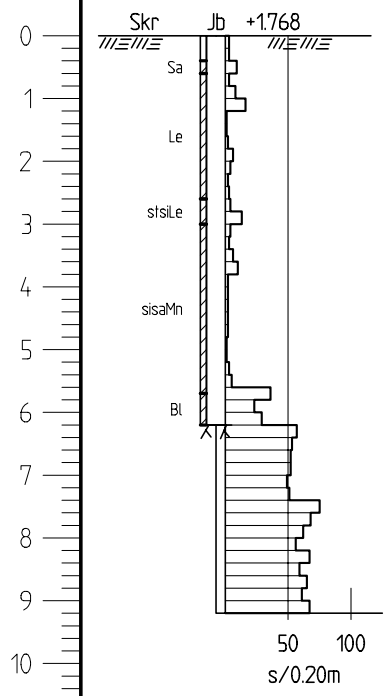
Client: Svensk Kärnbränslehantering AB

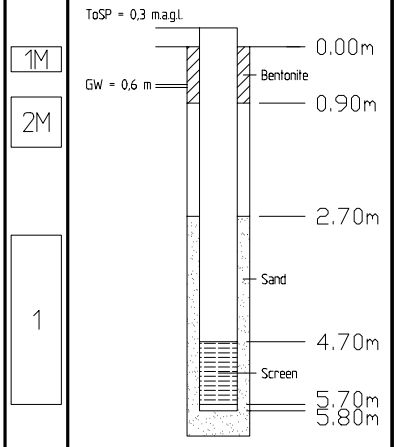
Northing :6366645.034
Easting :1552435.049

Coordinate system : RT90-RHB70

Top of stand pipe :0,3 m.a.g.l.
Total pipe length :6,10 m
Groundwater level :0,6 m.b.g.l.
Date of completion :2004-01-22

Depth (m)	Description	Samples	Groundwater monitoring well description	Borehole Construction Information





Drilling method : NOEK
Borehole diameter : 120 mm
sampling method : Auger

CASING
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 5,00 m

SCREEN
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 1,00 m
Slot : 0,3 mm

ANNULUS SEAL
Material : Bentonite clay
Total length : 0,90 m

SAND PACK
Grain size : 0,4-0,8 mm
Total length : 3,30 m

DRILLING EQUIPMENT
Drilling rig : Geotech 604
Drill hammer : Furukawa HB2G
Drill rod : Geostång Φ44
Drill bit : Stift Φ54

GEOLOGICAL LOG
0-0,4m Top soil
0,4-0,6m sand
0,6-2,6m clay
2,6-3,0m cobble-bearing silty clay
3,0-5,7m silty sandy till
5,7m boulders
6,1m rock surface

ToSP : Top of Stand Pipe
m.a.g.l. : meters above ground level
m.b.g.l. : meters below ground level

SIMPEVARP BOREHOLE SSM000014

Company rep.
Lennart Adestam and Torbjörn Johansson

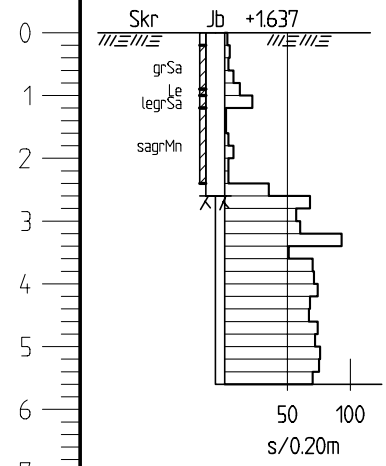
Client: Svensk Kärnbränslehantering AB

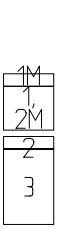
Northing : 6366286.479
Easting : 1550812.794

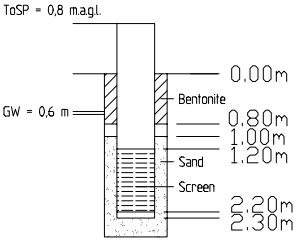
Coordinate system : RT90-RHB70

Top of stand pipe : 0,8 m.a.g.l.
Total pipe length : 3,10 m
Groundwater level : 0,6 m.b.g.l.
Date of completion : 2003-12-09

Depth (m)	Description	Samples	Groundwater monitoring well description	Borehole Construction Information







Drilling method : NOEK
Borehole diameter : 120 mm
sampling method : Auger

CASING
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 2,00 m

SCREEN
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 1,00 m
Slot : 0,3 mm

ANNULUS SEAL
Material : Bentonite clay
Total length : 0,80 m

SAND PACK
Grain size : 0,4-0,8 mm
Total length : 1,50 m

DRILLING EQUIPMENT
Drilling rig : Geotech 604
Drill hammer : Furukawa HB2G
Drill rod : Geostång Φ44
Drill bit : Stift Φ54

GEOLOGICAL LOG
0-0,2m Top soil
0,2-0,9m garvelly sand
0,9-1,0m clay
1,0-1,2m clayey gravelly sand
1,2-2,4m sandy gravelly till
2,4m rock surface

ToSP : Top of Stand Pipe
m.a.g.l. : meters above ground level
m.b.g.l. : meters below ground level

SIMPEVARP BOREHOLE SSM000015

Company rep.
Lennart Adestam and Torbjörn Johansson

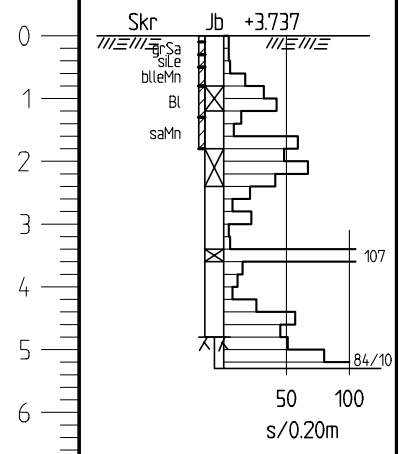
Client: Svensk Kärnbränslehantering AB

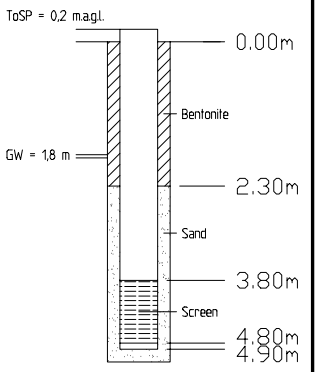
Northing :6366521.840
Easting :1551087.228

Coordinate system : RT90-RHB70

Top of stand pipe : 0,2 m.a.g.l.
Total pipe length : 5,10 m
Groundwater level : 1,8 m.b.g.l.
Date of completion : 2004-01-28

Depth (m)	Description	Samples	Groundwater monitoring well description	Borehole Construction Information





Drilling method : NOEK
Borehole diameter : 120 mm
sampling method : Auger

CASING
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 4,00 m

SCREEN
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 1,00 m
Slot : 0,3 mm

ANNULUS SEAL
Material : Bentonite clay
Total length : 2,30 m

SAND PACK
Grain size : 0,4-0,8 mm
Total length : 2,80 m

DRILLING EQUIPMENT
Drilling rig : Geotech 604
Drill hammer : Furukawa HB2G
Drill rod : Geostång Φ44
Drill bit : Stift Φ54

GEOLOGICAL LOG
0-0,1m Top soil
0,1-0,3m gravelly sand
0,3-0,5m silty clay
0,5-0,8m boulder-bearing clayey till
0,8-1,3m boulders
1,3-1,8m sandy till
1,8m boulders
3,4m boulders
4,8m rock surface

ToSP : Top of Stand Pipe
m.a.g.l. : meters above ground level
m.b.g.l. : meters below ground level

SIMPEVARP BOREHOLE SSM000016

Company rep.
Lennart Adestam and Torbjörn Johansson

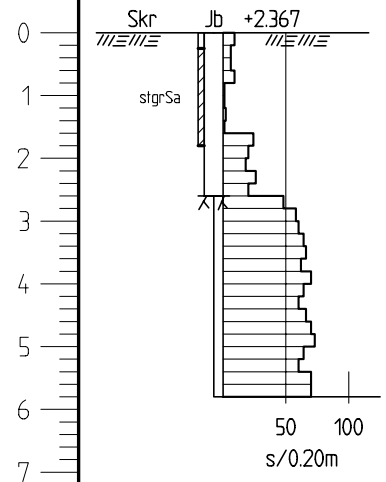
Client: Svensk Kärnbränslehantering AB

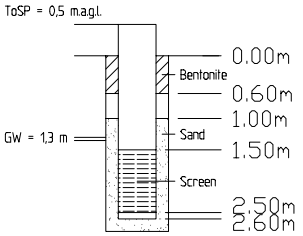
Northing : 6367371.552
Easting : 1552221.702

Coordinate system : RT90-RHB70

Top of stand pipe : 0,5 m.a.g.l.
Total pipe length : 3,10 m
Groundwater level : 1,3 m.b.g.l.
Date of completion : 2003-12-12

Depth (m)	Description	Samples	Groundwater monitoring well description	Borehole Construction Information





1

Drilling method : NOEK
Borehole diameter : 120 mm
sampling method : Auger

CASING
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 2,00 m

SCREEN
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 1,00 m
Slot : 0,3 mm

ANNULUS SEAL
Material : Bentonite clay
Total length : 0,60 m

SAND PACK
Grain size : 0,4-0,8 mm
Total length : 1,80 m

DRILLING EQUIPMENT
Drilling rig : Geotech 604
Drill hammer : Furukawa HB2G
Drill rod : Geostång Φ44
Drill bit : Stift Φ54

GEOLOGICAL LOG
0-0,25m Top soil
0,25-1,8m cobble-bearing gravelly sand
1,8m boulders
2,6m rock surface

ToSP : Top of Stand Pipe
m.a.g.l. : meters above ground level
m.b.g.l. : meters below ground level

SIMPEVARP BOREHOLE SSM000018

Company rep.
Lennart Adestam and Torbjörn Johansson

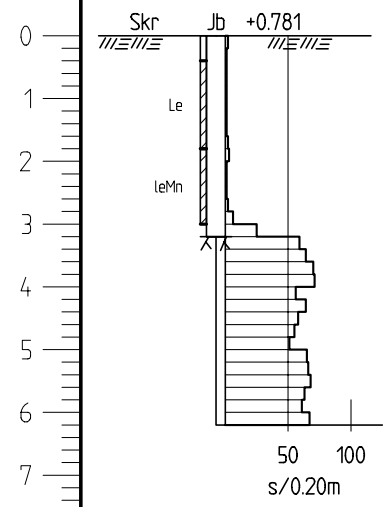
Client: Svensk Kärnbränslehantering AB

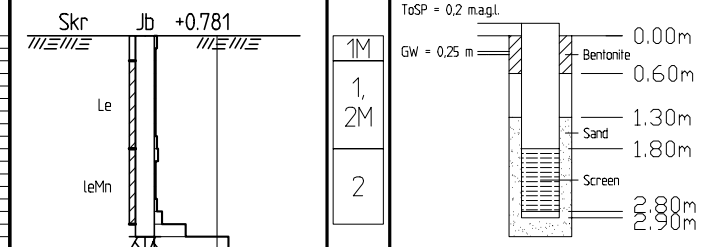
Northing :6367037.707
Easting :1552191.891

Coordinate system : RT90-RHB70

Top of stand pipe :0,2 m.a.g.l.
Total pipe length :3,10 m
Groundwater level :0,25 m.b.g.l.
Date of completion :2003-12-11

Depth (m)	Description	Samples	Groundwater monitoring well description	Borehole Construction Information





Drilling method : NOEK
Borehole diameter : 120 mm
sampling method : Auger

CASING
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 2,00 m

SCREEN
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 1,00 m
Slot : 0,3 mm

ANNULUS SEAL
Material : Bentonite clay
Total length : 0,60 m

SAND PACK
Grain size : 0,4-0,8 mm
Total length : 1,80 m

DRILLING EQUIPMENT
Drilling rig : Geotech 604
Drill hammer : Furukawa HB2G
Drill rod : Geostång Φ44
Drill bit : Stift Φ54

GEOLOGICAL LOG
0-0,4m clayey top soil
0,4-1,8m clay
1,8-3,0m clayey till
3,2m rock surface

ToSP : Top of Stand Pipe
m.a.g.l. : meters above ground level
m.b.g.l. : meters below ground level

SIMPEVARP BOREHOLE SSM000020

Company rep.
Lennart Adestam and Torbjörn Johansson

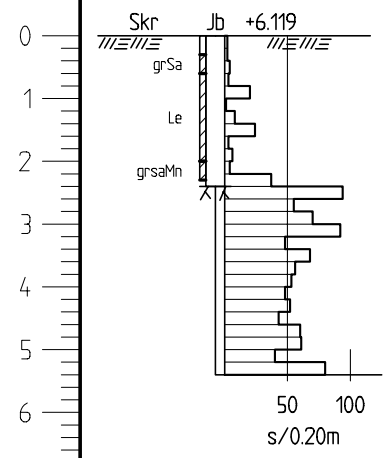
Client: Svensk Kärnbränslehantering AB

Northing :6367186.437
Easting :1552742.231

Coordinate system : RT90-RHB70

Top of stand pipe : 0,5 m.a.g.l.
Total pipe length : 3,10 m
Groundwater level : 0,4 m.b.g.l.
Date of completion : 2004-01-20

Depth (m)

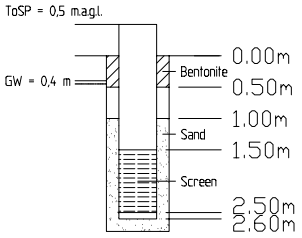


Description

Samples

1M
2M
1

Groundwater monitoring well description



Borehole Construction Information

Drilling method : NQEK
Borehole diameter : 120 mm
sampling method : Auger

CASING
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 2,00 m

SCREEN
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 1,00 m
Slot : 0,3 mm

ANNULUS SEAL
Material : Bentonite clay
Total length : 0,50 m

SAND PACK
Grain size : 0,4-0,8 mm
Total length : 1,80 m

DRILLING EQUIPMENT
Drilling rig : Geotech 604
Drill hammer : Furukawa HB2G
Drill rod : Geostång Φ44
Drill bit : Stift Φ54

GEOLOGICAL LOG
0-0,3m Top soil, peat
0,3-0,6m gravelly sand
0,6-2,0m clay
2,0-2,3m gravelly sandy till
2,4m rock surface

ToSP : Top of Stand Pipe
m.a.g.l. : meters above ground level
m.b.g.l. : meters below ground level

SIMPEVARP BOREHOLE SSM000022

Company rep.
Lennart Adestam and Torbjörn Johansson

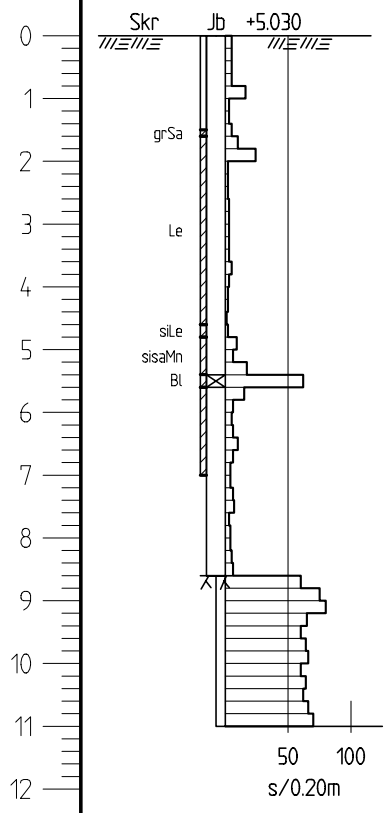
Client: Svensk Kärnbränslehantering AB

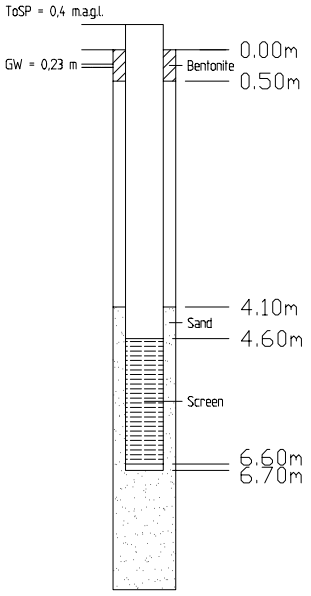
Northing :6367457.660
Easting :1553120.333

Coordinate system : RT90-RHB70

Top of stand pipe :0,4 m.a.g.l.
Total pipe length :7,10 m
Groundwater level :0,23 m.b.g.l.
Date of completion :2004-01-13

Depth (m)	Description	Samples	Groundwater monitoring well description	Borehole Construction Information





1

2

Drilling method : NOEK
Borehole diameter : 120 mm
sampling method : Auger

CASING
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 5,00 m

SCREEN
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 2,00 m
Slot : 0,3 mm

ANNULUS SEAL
Material : Bentonite clay
Total length : 0,50 m

SAND PACK
Grain size : 0,4-0,8 mm
Total length : 2,80 m

DRILLING EQUIPMENT
Drilling rig : Geotech 604
Drill hammer : Furukawa HB2G
Drill rod : Geostång Φ44
Drill bit : Stift Φ54

GEOLOGICAL LOG

0-1,5m	Peat
1,5-1,6m	gravelly sand
1,6-4,6m	clay
4,6-4,8m	silty clay
4,8-5,4m	silty sandy till
5,4m	boulders
8,6m	rock surface

ToSP : Top of Stand Pipe
m.a.g.l. : meters above ground level
m.b.g.l. : meters below ground level

SIMPEVARP BOREHOLE SSM000024

Company rep.
Lennart Adestam and Torbjörn Johansson

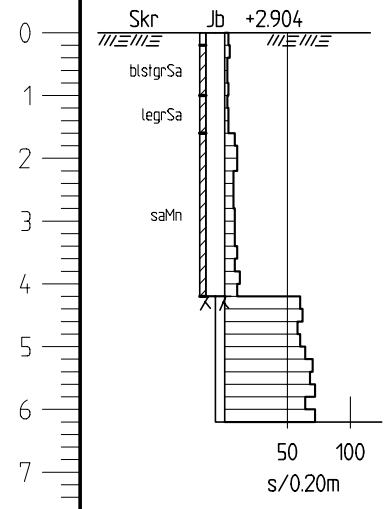
Client: Svensk Kärnbränslehantering AB

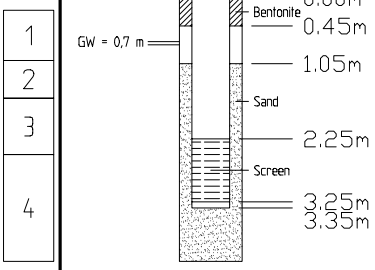
Northing :6366789.757
Easting :1553083.487

Coordinate system : RT90-RHB70

Top of stand pipe : 0,55 m.a.g.l.
Total pipe length : 3,90 m
Groundwater level : 0,7 m.b.g.l.
Date of completion : 2003-12-16

Depth (m)	Description	Samples	Groundwater monitoring well description	Borehole Construction Information





Drilling method : NOEK
Borehole diameter : 120 mm
sampling method : Auger

CASING
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 2,80 m

SCREEN
Material : PEH
Outer diameter : 63 mm
Inner diameter : 50 mm
Total length : 1,00 m
Slot : 0,3 mm

ANNULUS SEAL
Material : Bentonite clay
Total length : 0,45 m

SAND PACK
Grain size : 0,4-0,8 mm
Total length : 2,50 m

DRILLING EQUIPMENT
Drilling rig : Geotech 604
Drill hammer : Furukawa HB2G
Drill rod : Geostång Φ44
Drill bit : Stift Φ54

GEOLOGICAL LOG
0-0,2m Top soil
0,2-1,0m boulder and cobble-bearing gravelly sand
1,0-1,6m clayey gravelly sand
1,6-4,2m sandy till
4,2m rock surface

ToSP : Top of Stand Pipe
m.a.g.l. : meters above ground level
m.b.g.l. : meters below ground level

SIMPEVARP BOREHOLE SSM000026

Company rep.
Lennart Adestam and Torbjörn Johansson

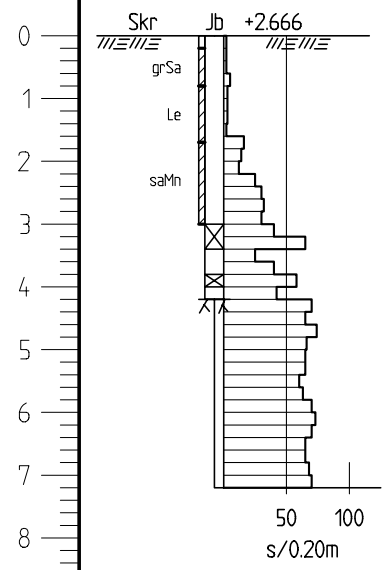
Client: Svensk Kärnbränslehantering AB

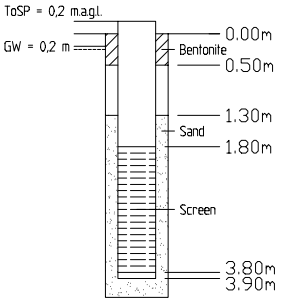
Northing :6366714.805
Easting :1552748.547

Coordinate system : RT90-RHB70

Top of stand pipe : 0,2 m.a.g.l.
Total pipe length : 4,10 m
Groundwater level : 0,2 m.b.g.l.
Date of completion : 2003-12-17

Depth (m)	Description	Samples	Groundwater monitoring well description	Borehole Construction Information





1
2
3
4

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GEOLOGICAL LOG
0-0,2m Top soil
0,2-0,8m gravelly sand
0,8-1,7m clay
1,7-4,0m sandy till
4,2m rock surface

ToSP : Top of Stand Pipe
m.a.g.l. : meters above ground level
m.b.g.l. : meters below ground level