P-07-174

Oskarshamn site investigation

Summary of water pumping and release

Hydraulic disturbances from drilling and investigations during the site investigation in Oskarshamn, subareas Simpevarp and Laxemar, 2002–2009

Henrik Ask, H Ask Geokonsult AB

Liselotte Tiberg, Studsvik Nuclear AB

Mansueto Morosini, Svensk Kärnbränslehantering AB

October 2009

Svensk Kärnbränslehantering AB
Swedish Nuclear Fuel
and Waste Management Co

Box 250, SE-101 24 Stockholm
Phone +46 8 459 84 00

ISSN 1651-4416
SKB P-07-174

Oskarshamn site investigation

Summary of water pumping and release

Hydraulic disturbances from drilling and investigations during the site investigation in Oskarshamn, subareas Simpevarp and Laxemar, 2002–2009

Henrik Ask, H Ask Geokonsult AB

Liselotte Tiberg, Studsvik Nuclear AB

Mansueto Morosini, Svensk Kärnbränslehantering AB

October 2009

Keywords: water pumping, water release from drilling and pumping, core drilling, percussion drilling, pumping tests, nitrogen gas flushing, air-lift pumping, complete chemical characterization.

Abstract

This report is a compilation of the hydraulic disturbances that have been caused by activities within the site investigation in Oskarshamn. The site investigation started in 2002 and was formally concluded in 2007. Two long-term pumping tests were however made during 2008 and 2009.

The report summarizes the amounts of groundwater that has been extracted from boreholes by pumping, drilling or related activities and subsequently released to the ground or a surface water recipient. In this report the hydraulic disturbances are seen as human-induced activities (drilling or pumping) that causes or can cause a drawdown of the ground water table. The water chemistry, especially electrical conductivity, of the released water is also commented in the report.

The report should be seen as a reference for further analysis and as an aid in general understanding of the water handling during the site investigation.

Sammanfattning

Denna rapport är en sammanställning av de hydrauliska störningar som orsakats av aktiviteter inom platsundersökningen i Oskarshamn. Platsundersökningen startade 2002 och avslutades formellt under 2007. Två stycken långtidspumptester utfördes dock under 2008 och 2009.

Rapporten sammanfattar mängderna av grundvatten som tagits upp från borrhål via pumpning, borrning eller liknande aktiviteter och sedan släppts ut till marken eller någon ytvattenrecipient. I denna rapport utgörs hydrauliska störningar av mänskliga aktiviteter (borrning eller pumpning) som skapar eller kan skapa en avsänkning av grundvattenytan. Vattenkemin, speciellt elektrisk konduktivitet, i det utsläppta vattnet kommenteras även i rapporten.

Rapporten skall ses som en referens för fortsatt analys och som ett stöd för den generella förståelsen av vattenhanteringen under platsundersökningen.

Contents

1 Introduction

SKB, the Swedish Nuclear Fuel & Waste Management Company, performs site investigations in order to evaluate the feasibility of locating a deep repository for spent nuclear fuel /1/. The investigations are performed in two Swedish municipalities: Östhammar and Oskarshamn. The programme for the complete site investigation in Oskarshamn is described in /2/.

This activity has not generated any new raw data. However, compilations, estimations or calculations of water emissions have been made. This report consists of investigation data that is stored in the SKB site investigation database, SICADA, the GIS database, in temporary databases such as HMS (hydrological monitoring system) or DMS (drilling monitoring system) and data that has been or will be published elsewhere in other SKB reports.

The purpose of this report is therefore to facilitate a rapid overview of more significant hydraulic disturbances in the investigation area in Oskarshamn that could have been caused by site investigation activities.

The work was carried out in accordance with activity plan AP PS 400-07-050, see Table 1-1. The activity plan is an SKB internal controlling document. Water emissions from drilling or pumping that postdate the original activity plan has been incorporated in this report. The main events that were added on are activities in borehole KLX27A (drilling in late 2007) and the two tracer tests performed in 2008 and 2009. The reporting date, compared to the reporting date given in the activity plan was accordingly pushed forward in time by management decision.

Table 1-1. Controlling documents for the performance of the activity.

Activity plan	Number	Version
Uttag och utsläpp av grundvatten, spolvatten och pumptester- mängder och tider	AP PS 400-07-050	1.0

2 Objective and scope

This report summarizes the various activities that constitute significant hydraulic disturbances, quantifies the amount of water released and give the locations of the released water.

As most of the activities performed in a borehole will constitute a hydraulic disturbance, large or small, it was deemed necessary to do a selection of which potential hydraulic disturbances to include in order to provide a readable report and an overview for the hydrogeological modelling.

The basis for selection of which activities or tests to include is given in Table 2-1 together with a comment on why they are included. The exclusion of certain tests or activities from this report is based on expert judgement, for instance has the hydraulic injection tests. The water emissions from hydrogeological or hydrogeochemical wireline tests during core drilling is included in the water emissions from drilling and will not be further subdivided here. Minor hydraulic pressure disturbances from geophysical logging, water chemistry sampling, slug tests etc are not commented further in this report.

Table 2-1. Summary of activities included in this report together with a brief motivation.

Activity	Selection	Motive
Core drilling	All cored boreholes.	Flushing water is being pumped down the borehole. The deeper boreholes are normally constructed with a wider diameter upper part, a telescopic section. Retrieval of water and drill cuttings is done by air-lift pumping. The air-lift pumping in the telescopic section raises water from the borehole and creates a draw-down equivalent to any other pumping. In many cases the return water is infiltrated to the ground.
Nitrogen gas flushing	All cored boreholes.	The cored boreholes were rinsed from cuttings and water after drilling was completed to planned length by flushing (or “air-lifting”) with nitrogen gas. Flushing with nitrogen gas constitutes a short but very significant drawdown as it lifts more or less the entire water column in the borehole.
Pumping of water in the water supply wells for core drilling (flushing water wells)	All water supply wells	Pumping of water for supply of flushing water to core drilling. Most of the water is used for core drilling and subsequently released to the ground nearby the core drilling site. In some instances, however, water has also been released near the water source or at some other location between the pumped source and the core drilling site.
Percussion drilling	All percussion boreholes including the percussion drilled part of the deeper cored boreholes (telescopic section).	Lifting of water by compressed air which creates a drawdown of the water table during active drilling. The water thus removed from the borehole by air-lift pumping is released to the ground.
Pumping for complete chemical characterization	All tests i.e. results from boreholes KSH01A, KLX03, KLX08, KLX13A, KLX15A, KLX17A and KLX27A	Very variable flow and volumes pumped. Most of the water that is pumped for sampling purposes has been collected in containers and released to the Baltic Sea. However in some cases when larger amount of water has been pumped with the purpose of rinsing the borehole, the return water was allowed to infiltrate to the ground.
Hydraulic pumping test in boreholes	All single hole pumping tests and interference tests. All pumping tests with the Posiva Flow Log (PFL-tests). Long-term pumping with or without tracer addition	Pumping creates a hydraulic drawdown and the pumped-up water was allowed to infiltrate to the ground or to nearby watercourse. The tests included in this report are those considered most likely to constitute an appreciable hydraulic disturbance. Injection tests and pumping tests while drilling (i.e. wireline tests) are therefore **not** included in this report., see chapter 3.4 for further explanation. Furthermore, the water released from pumping tests while drilling are included in the core drilling, see 3.2.1.

Results from water chemistry measurements, especially electrical conductivity, of the released water are also commented in the report.

Further explanations of drilling related terminology and water consumption during percussion or core drilling can be seen in /3, 4 and 5/

A further account and description of a complete chemical characterization is given in /6/.

2.1 Comment on primary data

No primary data has been generated by this activity, however the coordinates for the emission point for return water from core drilling have not been reported in any database format previously. The water release point coordinates have been delivered to the GIS database as part of this activity. The data is traceable in the GIS-database by the Activity Plan number AP PS 400-07-050.

The original results, i.e. primary data that has been generated by drilling or previous investigation activities, are stored in the primary data bases (SICADA and/or GIS) or in temporary databases, HMS (hydro monitoring system) or DMS (drilling monitoring system). The data in the temporary databases are time series data where one channel corresponds to for instance pressure (i.e. water table) in a certain borehole. In HMS will any named channel contain data from the same borehole throughout the site investigation. In the DMS system, however, a channel name is reserved for a typical activity related to drilling.The coupling to one specific drill site in the DMS system is changed to the next as one borehole is finished and the next starts up. This means that a data series of, for instance, pressure data from the water supply well in one database channel (eg. DMSPO1) contains data from different boreholes at different time periods. During the drilling in Simpevarp there was only one drilling rig and hence only one DMS in operation. As investigations started in the Laxemar subarea, two drilling rigs and two monitoring systems, DMS1PO and DSM2PO, were used.

Data from HMS is quality assured and transferred to the Sicada database every four months. Routines for transferral of the DMS data to the Sicada database have been established but no data has been transferred at the time of writing.

Only the data in the Sicada and GIS databases should be used for further analysis and modelling.

References to Activity Plans and P-reports for specific testing or drilling activities are made wherever possible throughout this compilation report. The data is traceable in SICADA by the Activity Plan (AP) number that originally generated the data or the P-report number. No data is coupled to the AP-number of this compilation activity. Activity plans are SKB internal controlling document whereas P-reports are documents open to the public and can be downloaded from the SKB website (www.skb.se).

3 Results

3.1 Percussion drilling

A summary of the water emission from percussion drilled boreholes is given in Table 3-1. The calculation of the amount of released water is based on measured flows and estimates on the amount of time the emission lasted.

Table 3-1. Summary of water released from percussion drilling during the site investigation in Oskarshamn, subareas Simpevarp (HSH and HAV holes) and Laxemar (HLX holes).

Borehole	Drilling period		Borehole coordinates			Amount of water released (m^3)
	from	to	N	E	Z	
HSH01	2002-06-24	2002-07-02	6366217.770	1552545.717	2.864	1
HSH02	2002-06-27	2002-07-08	6365682.896	1551368.337	6.649	7*
HSH03	2002-07-02	2002-07-09	6366213.946	1552544.526	2.523	18
HAV09	2003-10-13	2003-10-16	6366653.14	1552411.36	2.172	3
HAV10	2003-10-20	2003-10-22	6366660.57	1552411.84	2.227	1
HLX13	2004-02-24	2004-02-26	6366953.00	1547690.42	17.391	3
HLX14	2004-03-08	2004-03-11	6366960.81	1547692.57	17.113	43
HSH04	2004-04-05	2004-04-13	6366237.275	1552223.476	2.858	10
HSH05	2004-04-14	2004-04-19	6365224.711	1551179.077	2.718	3
HSH06	2004-04-20	2004-04-22	6366214.627	1552534.621	2.346	2
HLX15	2004-04-27	2004-04-29	6365361.97	1548664.02	4.807	0
HAV12	2004-05-12	2004-05-19	6367765.872	1553194.416	9.404	23
HAV13	2004-05-24	2004-05-27	6367627.858	1552682.157	2.215	117
HAV14	2004-06-01	2004-06-04	6367227.977	1552350.548	7.761	70
HAV11	2004-06-07	2004-06-14	6366565.254	1553040.898	2.379	71
HLX20	2004-06-15	2004-06-21	6367996.26	1548446.08	11.179	17
HLX16	2004-06-22	2004-06-24	6366025.43	1549914.888	3.652	0
HLX17	2004-06-28	2004-07-01	6365951.51	1550040.75	3.350	1
HLX18	2004-07-01	2004-07-06	6365919.12	1550067.64	4.036	100
HLX19	2004-08-10	2004-08-12	6365757.88	1550090.87	5.951	3
HLX25	2004-08-17	2004-08-19	6366783.97	1547776.32	20.656	64
HLX22	2004-08-23	2004-08-26	6366487.83	1549661.52	10.057	78
HLX21	2004-08-30	2004-09-02	6366567.93	1549632.36	10.312	175
HLX24	2004-09-06	2004-09-09	6366503.72	1548865.89	12.769	115
HLX23	2004-09-13	2004-09-16	6366578.01	1548888.67	14.690	108
HLX27	2004-09-20	2004-09-22	6365605.07	1547882.68	4.248	52
HLX26	2004-09-23	2004-09-28	6365278.71	1548600.52	6.487	0
HLX28	2004-09-29	2004-10-02	6365861.70	1546834.47	13.424	135
HLX29	2004-10-02	2004-10-03	6365726.24	1546733.15	10.701	0
HLX30	2004-11-26	2004-11-30	6366730.73	1548026.73	12.184	132
HLX31	2004-12-01	2004-12-03	6366774.51	1548172.27	12.162	98
HLX33	2004-12-17	2004-12-20	6366471.74	1548562.71	12.201	28
HLX32	2005-01-04	2005-01-11	6365725.79	1546734.36	10.844	5
HLX35	2005-05-28	2005-06-02	6367194.788	1547437.792	14.444	76
HLX34	2005-06-09	2005-06-14	6367355.125	1547489.558	14.290	77
HLX36	2005-09-20	2005-09-22	6366172.94	1546558.45	15.558	0
HLX37	2005-09-26	2005-09-28	6366183.66	1546406.21	15.188	18
HLX38	2006-04-10	2006-04-24	6365868.86	1547146.08	11.53	58
HLX40	2006-05-02	2006-05-09	6366906.76	1546943.95	25.737	0
HLX41	2006-05-22	2006-06-01	6367013.20	1547017.61	21.797	0
HLX39	2006-06-07	2006-06-14	6366887.87	1546880.48	27.044	6
HLX43	2006-10-19	2006-10-26	6367517.45	1546626.60	24.20	156
HLX42	2006-11-13	2006-11-16	6364827.04	1547446.73	12.88	38

*Most of the water from HSH02 probably flowed to the storm drain system. The bulk of the released water should therefore be considered emitted at the same location as for the deep cored borehole KSH02.

A further account of water releases from percussion drilling is given in Appendix 1, together with comment on electrical conductivity of the return water and references to activity plans and reports.

The locations of the percussion drilled boreholes in the Simpevarp and Laxemar subareas are given in Figures 3-1 and 3-2 respectively. The emission of water was made within 30 metres of the borehole collar location. Most of the water from HSH02 however, probably flowed to the storm drain system. The bulk of the released water from HSH02 should therefore be considered emitted at the same location as for the deep cored borehole KSH02, see also section 3.2.1. A number of boreholes were dry and did not generate any water release.

A summary of the water emission in the percussion drilled part, i.e. the telescopic section, of deep cored boreholes is given in Table 3-2. A further account of water releases from percussion drilling of the telescopic sections is given in Appendix 2.

The location of the percussion drilled parts of the core drilled boreholes is given in Figure 3-3. The water from drilling of percussion boreholes was released within ca 30 m from the borehole collar position. A number of boreholes were dry and did not generate any water release.

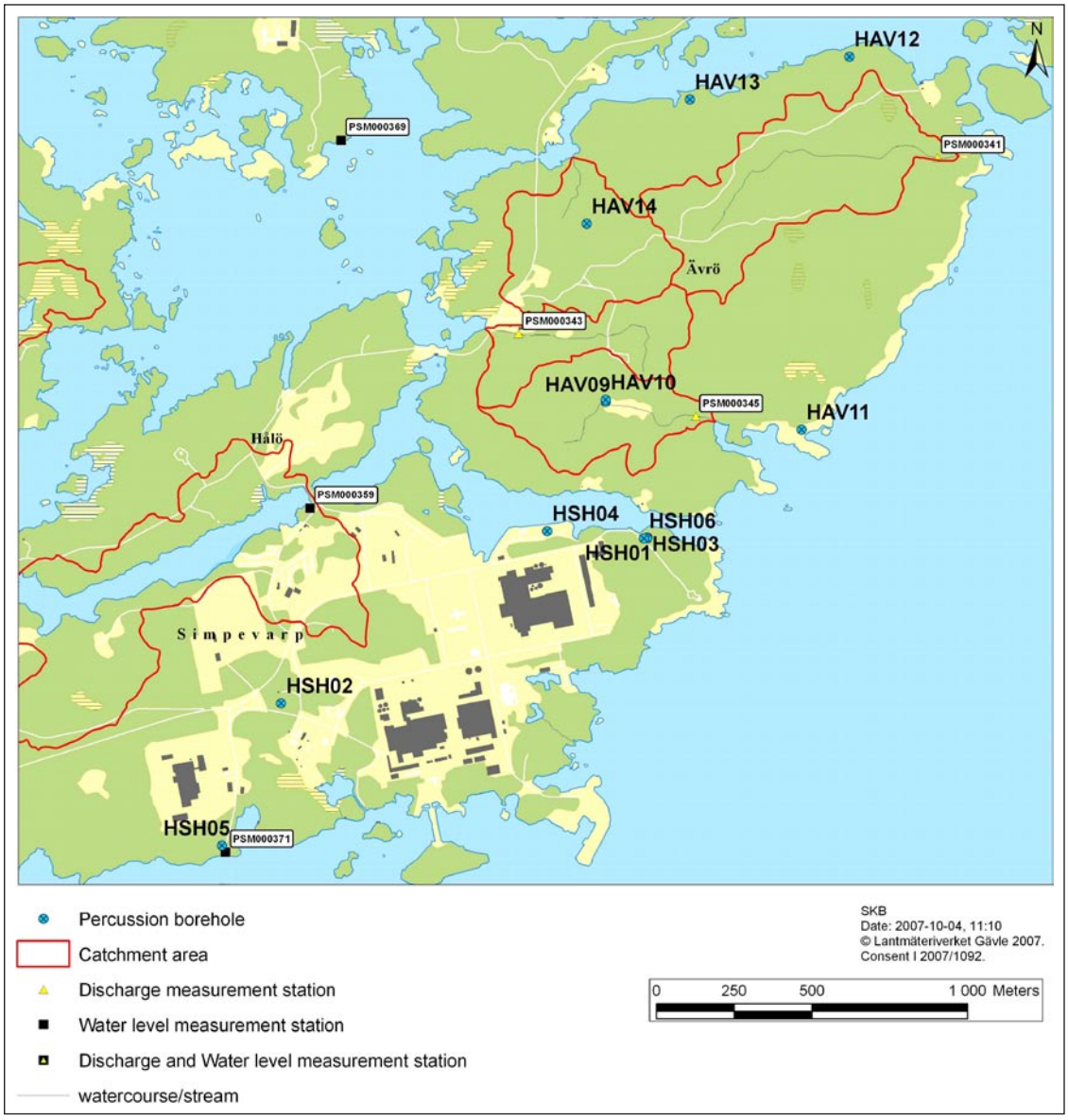


Figure 3-1. *Map with percussion boreholes in the Simpevarp subarea together with drainage areas and surface water discharge measurement stations.*

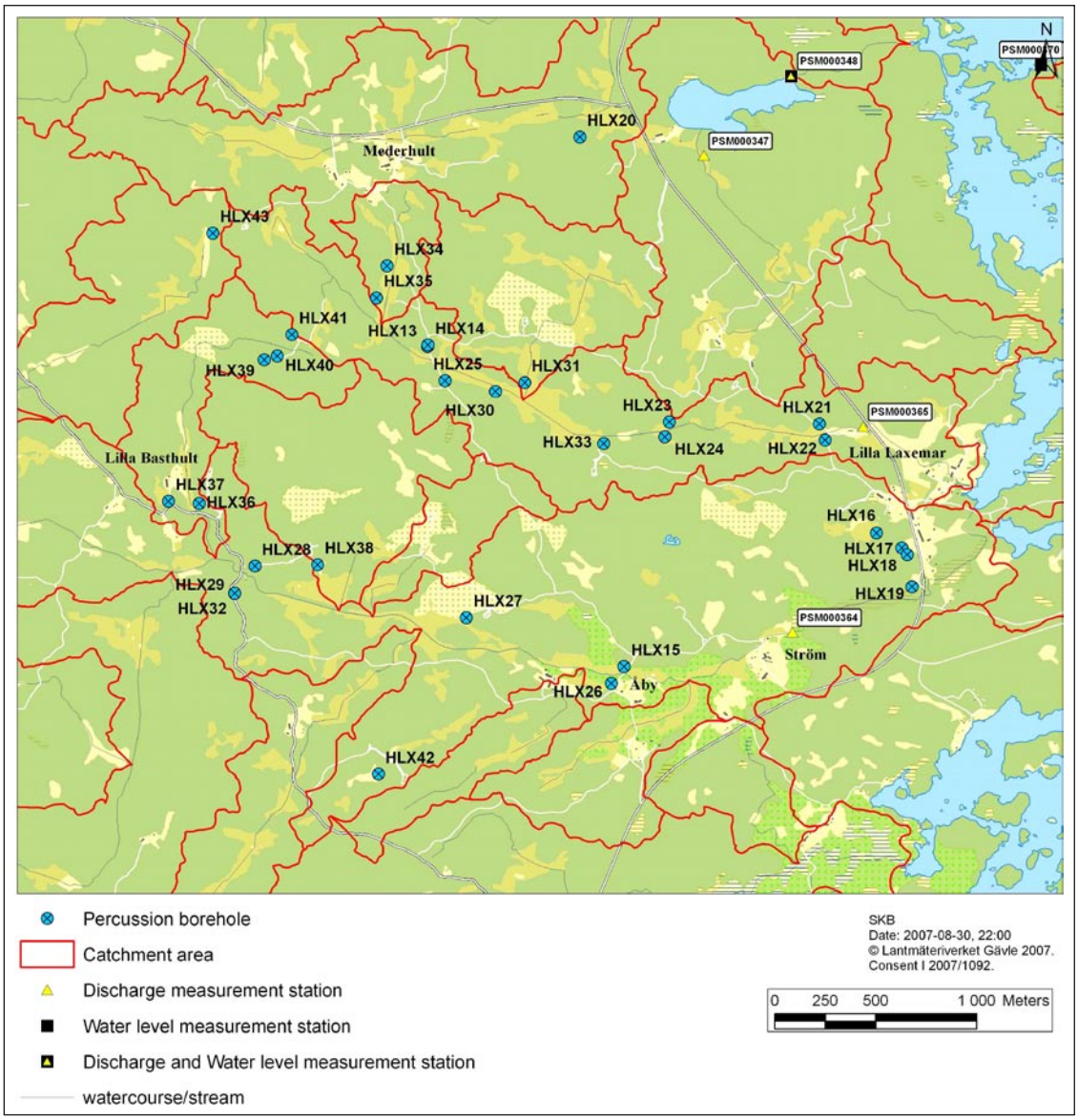


Figure 3-2. *Map with percussion boreholes in the Laxemar subarea together with drainage areas and surface water discharge measurement stations.*

Table 3-2. Summary of water emission in the percussion drilled part of the deep cored boreholes (ie the telescopic sections) during the site investigation in Oskarshamn, subareas Simpevarp (KSH, KAV and KBH holes) and Laxemar (KLX holes).

Borehole	Borehole coordinates			Period (percussion drilling)		Amount of water released (m^3)
	N	E	Z	from	to	
KSH01A	6366013.45	1552442.98	5.32	2002-08-22	2002-10-01	0
KSH02	6365658.33	1551528.93	5.48	2003-01-22	2003-03-03	0
KSH03A	6366018.66	1552711.17	4.15	2003-08-13	2003-09-02	0
KAV01	6367257.52	1553084.92	14.10	2003-08-20	2003-08-25	no data*
KAV04A	6366795.76	1552475.00	10.35	2003-10-06	2003-10-27	36
KBH03	6366486.08	1551047.39	7.82	2004-01-27	2004-02-13	0
KLX03	6366112.59	1547718.93	18.49	2004-03-03	2004-03-13	15
KLX04	6367077.19	1548171.94	24.09	2004-02-11	2004-02-18	1
KLX05	6365633.34	1548909.41	17.63	2004-08-11	2004-08-25	30
KLX06	6367806.64	1548566.88	17.68	2004-08-03	2004-08-10	3
KLX07A	6366752.09	1549206.86	18.47	2004-11-23	2004-12-03	5
KLX08	6367079.10	1548176.71	24.31	2005-01-12	2005-01-24	0
KLX09	6367323.45	1548863.18	23.45	2005-06-02	2005-06-13	0
KLX10	6366319.38	1548515.23	18.28	2005-05-24	2005-06-01	14
KLX11A	6366339.72	1546608.49	27.14	2005-11-01	2005-11-08	0
KLX12A	6365630.78	1548904.44	17.74	2005-10-19	2005-10-27	0
KLX13A	6367547.14	1546787.36	24.15	2006-03-23	2006-03-30	3
KLX15A	6365614.17	1547987.47	14.59	2006-12-21	2006-12-29	0
KLX17A	6366848.75	1546862.09	27.63	2006-08-07	2006-08-15	17
KLX18A	6366413.39	1547966.35	21.01	2006-02-15	2006-02-21	0
KLX19A	6365901.42	1547004.62	16.87	2006-05-10	2006-05-22	39
KLX20A	6366334.57	1546604.89	27.24	2006-02-22	2006-03-08	0
KLX21A	6366158.177	1549706.228	10.690	2006-08-21	2006-08-29	0
KLX21B	6366164.00	1549715.10	10.68	2006-09-20	2006-09-25	0
KLX27A	6365608.29	1546742.63	16.98	2007-08-15	2007-08-27	4

* Borehole KAV01 was core drilled prior to the site investigation. The upper part was, however, reamed during the site investigation to become a telescopic section. No records were taken on the amounts of water emitted from this activity.

Figure 3-3. *Map of the percussion drilled parts of the deep cored boreholes (ie the telescopic sections) during the site investigation in Oskarshamn, subareas Simpevarp (KSH, KAV and KBH holes) and Laxemar (KLX holes). Also shown on the map are drainage areas and surface water discharge stations.*

3.2 Core drilling

Core drilling can be divided into:

- the deep cored boreholes that typically include telescopic sections, large consumptions of flushing water and therefore large amounts of return water released and
- short cored boreholes without telescopic sections that typically only has a minor consumption and emission of water (DFN and MDZ boreholes).

3.2.1 Deep cored boreholes

A summary of the water emission from the core drilled part of the deep cored boreholes is given in Table 3-3. A further account of water releases from core drilling is given in Appendix 3.

Diagrams of the amounts of water released from each individual cored borehole are given in Appendix 4. The diagrams show the amount of water released over time as well as the electrical conductivity of the return water and the drill bit position i.e. drilling progress over time in each cored borehole.

Table 3-3. Summary of water release from deep cored boreholes.

Borehole	Borehole coordinates			Drilling period (core drilling)		Amount of water released (m^3)
	N	E	Z	from	to	
KSH01A	6366013.45	1552442.98	5.32	2002-10-07	2002-12-18	1,100
KSH01B	6366014.04	1552442.89	5.20	2003-01-17	2003-01-25	no data
KSH02	6365658.33	1551528.93	5.48	2003-01-28	2003-06-11	1,150
KAV01	6367257.52	1553084.92	14.10	2003-06-11	2004-01-10	no data
KSH03A	6366018.66	1552711.17	4.15	2003-09-11	2003-11-07	2,000
KSH03B	6366018.98	1552710.70	4.08	2003-11-21	2003-11-26	no data
KAV04A	6366795.76	1552475.00	10.35	2003-12-10	2004-05-03	1,800
KAV04B	6366795.64	1552474.47	10.35	2004-05-12	2004-05-18	no data
KLX04	6367077.19	1548171.94	24.09	2004-03-13	2004-06-28	4,000
KLX03	6366112.59	1547718.93	18.49	2004-05-28	2004-09-07	1,200
KLX06	6367806.64	1548566.88	17.68	2004-08-25	2004-11-25	3,100
KLX05	6365633.34	1548909.41	17.63	2004-10-01	2005-01-22	2,260
KLX07A	6366752.09	1549206.86	18.47	2005-01-06	2005-05-04	3,600
KLX08	6367079.10	1548176.71	24.31	2005-04-04	2005-06-13	2,600
KLX07B	6366753.14	1549206.76	18.38	2005-05-23	2005-06-03	no data
KLX10	6366319.38	1548515.23	18.28	2005-06-18	2005-10-15	3,300
KLX09	6367323.45	1548863.18	23.45	2005-08-26	2005-10-15	1,700
KLX12A	6365630.78	1548904.44	17.74	2005-11-10	2006-03-04	1,300
KLX11A	6366339.72	1546608.49	27.14	2005-11-24	2006-03-02	2,000
KLX20A	6366334.57	1546604.89	27.24	2006-03-25	2006-04-24	750
KLX18A	6366413.39	1547966.35	21.01	2006-03-29	2006-05-02	700
KLX13A	6367547.14	1546787.36	24.15	2006-05-19	2006-08-16	4,000
KLX19A	6365901.42	1547004.62	16.87	2006-06-03	2006-09-20	2,300
KLX14A	6365959.69	1547146.87	16.35	2006-08-19	2006-09-04	no data
KLX17A	6366848.75	1546862.09	27.63	2006-09-13	2006-10-23	1,100
KLX21B	6366164.00	1549715.10	10.68	2006-10-12	2006-11-29	2,900
KLX16A	6364797.69	1547584.06	18.85	2006-11-28	2007-01-09	200
KLX15A	6365614.17	1547987.47	14.59	2007-01-17	2007-02-25	1,800
KLX27A	6365608.29	1546742.63	16.98	2007-10-08	2007-11-21	1,900

The return water from core drilling in the Simpevarp subarea was released to the Baltic Sea. The locations of the water release point are given in Figure 3-4. The return water from KSH02 was led to the storm water drainage system at the nuclear power plant and thereby led to the discharge point in the sea some 700 metres to the north-east. In the other cored boreholes in the Simpevarp subarea, the return water was led in temporary pipes from the drill site to the Baltic Sea.

The water release from boreholes in the Laxemar subarea was made at positions specified in Figure 3-5, water release points. The position of these can sometimes differ substantially from the borehole drilling location. The water release points were located in coarse soils deemed suitable for accommodating water without rapid or significant disturbance of the nearby ground or surface water recipient.

Borehole KLX14A was drilled to a length of only 176 meters. The borehole does not have a telescopic section, nor was the DMS system in use i.e. the amount of water released from the borehole was not logged during the core drilling. From an environmental point of view, borehole KLX14A was treated as the short cored boreholes drilled for investigation of minor zones or DFN, see section 3.2.3. This implies that water released from borehole KLX14A was released within 30 meters of the collar location and that monitoring of parameters such as electrical conductivity was not measured. The purpose of the borehole was to penetrate the deformation zone NS059 and borehole KLX14A is therefore presented together with the deeper boreholes.

Water from the core drilling in KLX27A was released at the same spot as for KLX19A.

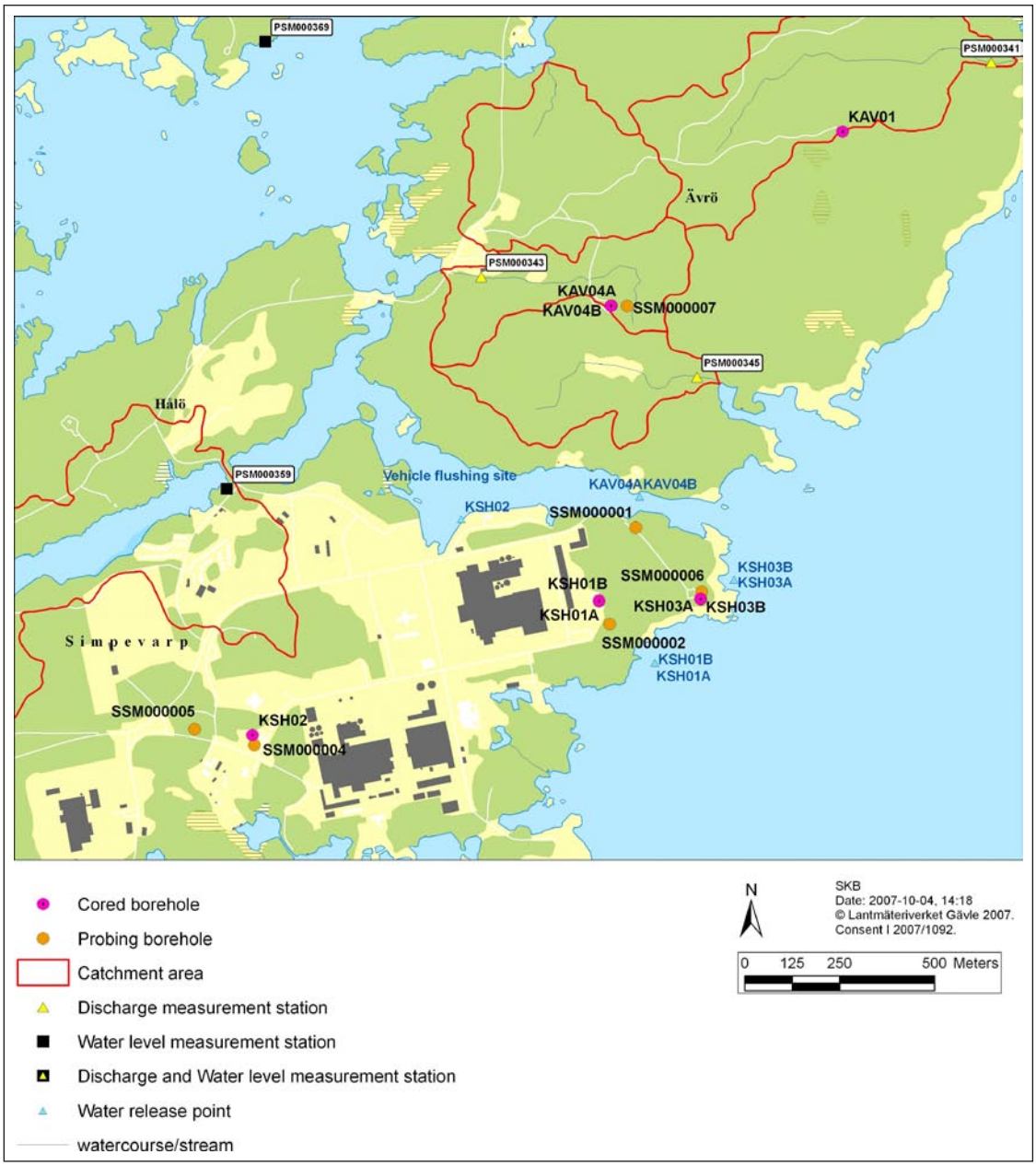


Figure 3-4. *Map of all deep cored boreholes and the environmental monitoring wells in the Simpevarp subarea within the site investigation area, Oskarshamn. The map also shows the catchment areas and measuring stations for surface water level and discharge rate. The release point for return drilling water is shown with blue triangles. The position of the environmental monitoring wells (probing borehole) is also shown. The return water from KSH02 was led to the storm water drainage system at the Nuclear Power plant and thereby led to the discharge point in the sea some 700 metres to the north-east.*

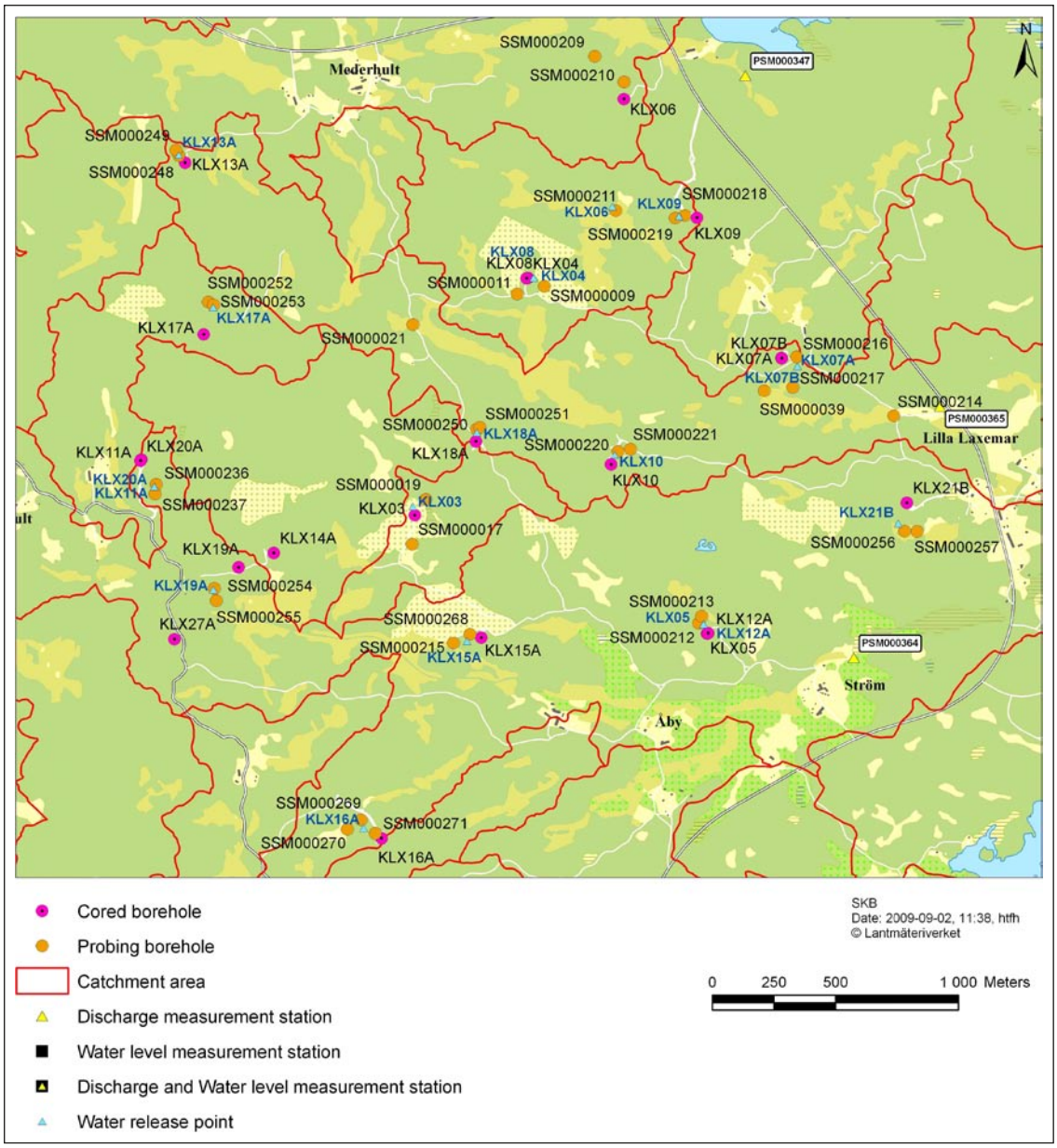


Figure 3-5. *Map of all deep cored boreholes and the environmental monitoring wells in the Laxemar subarea at the site investigation area in Oskarshamn. The map also shows the catchment areas and measuring stations for surface water level and discharge rate. The release point for return drilling water is shown with blue triangles. The water from KLX14A was released within 30 metres of the collar position. Return water from the core drilling in KLX27A was released at the same spot as for KLX19A. The position of the environmental monitoring wells (probing borehole) is also shown.*

3.2.2 Flushing water wells

The location of the percussion drilled boreholes used as flushing water wells, i.e. supply of water for core drilling, is shown in Figure 3-6.

Table 3-4 shows the flushing water wells and the corresponding deep cored boreholes in the Simpevarp subarea. During the core drilling in the Simpevarp subarea only one drilling rig was operating at any given time. All drilling data and the whole time span for pumped up volumes from the flushing water supply wells are therefore in the DMS unit DMSPO1.

An overview of the consumption of flushing water, expressed as flow, taken from each water supply well in the Laxemar subarea is shown in Table 3-5 together with information on which borehole the water has been pumped to and which, if any, DMS channel the water flows have been logged in. DMS, the site investigation drilling monitoring system, was used to measure the consumption and emission of flushing and return water during core drilling together with several other drilling related parameters. During core drilling in Laxemar two drill rigs were used simultaneously. As the DMS data is a time series, it is necessary to know which flushing water supply well that was in use. There are also periods when the flushing water wells have been in use without the amounts removed from the wells being logged by DMS.

Figure 3-6. *Map of flushing water wells in the Oskarshamn site investigation area together with catchment areas and surface water level and discharge measuring stations.*

Table 3-4. Flushing water wells for boreholes drilled in Simpevarp (unit DMSPO1).

Well	Date		Borehole drilled	Comment
HSH03	2002-10-07	2002-12-21	KSH01A	Total consumption 1,100 m^3.
HSH03	2003-01-17	2003-01-25	KSH01B	Water consumption not recorded in DMS
HLX10	2003-03-09	2003-05-28	KSH02	Total consumption 850 m^3
HSH03	2003-09-12	2003-11-09	KSH03A	Total consumption 900 m^3.
HSH03	2003-11-21	2003-11-26	KSH03B	Water consumption not recorded in DMS
HSH03	2003-12-09	2004-01-18	KAV04A	
HLX10	2004-01-28	2004-04-29	KAV04A	Total amount of consumed flushing water in KAV04A, i.e. both from flushing water wells HSH03 and HLX10 between 031209 and 040429 was 1,200 m^3.
HLX10	2004-05-12	2004-05-18	KAV04B	Water consumption not recorded in DMS

Table 3-5. Flushing water wells in Laxemar.

Periods with pumping from a supply well that was not registered in DMS

Well	Date		Flow L/min	Borehole drilled
HLX20	2005-10-28	2005-11-22	0–75	KLX09D
HLX20	2006-01-27	2006-05-03	0–75	KLX09G and others
HLX28	2006-03-17	2006-03-20	0–78	See Appendix 6
HLX28	2006-05-04	2006-05-23	0–78	KLX22A, B KLX23A, B
HLX27	2005-06-18	2005-06-27	0–60	KLX10
HLX14	2006-08-09	2006-08-13	55	KLX26A and KLX26B
HLX14	2006-09-11	2006-09-13	53–54	KLX28A and KLX29A
HLX14	2006-08-13	2006-09-11	55	See Appendix 6

Periods registered in DMS channel 1 (DMS1PO)

Well	Date		Flow L/min	Borehole drilled
HLX10	2004-10-03	2004-10-06	0–90	KLX05
HLX10	2004-10-06	2004-12-17	0–90	KLX05
HLX10	2005-06-14	2005-06-27	40	KLX07A and KLX08
HLX20	2005-08-25	2005-10-28	0–75	KLX09
HLX10	2005-11-11	2005-12-21	30	KLX12A and short holes
HLX10	2005-12-21	2006-01-03	0	
HLX10	2006-01-03	2006-03-28	45–90	KLX12A and short holes
HLX14	2006-03-30	2006-03-31	50	KLX18A
HLX14	2006-03-31	2006-05-18	52	KLX18A
HLX14	2006-05-18	2006-05-22	47	KLX18A and KLX13A
HLX28	2006-05-23	2006-06-02	0–78	KLX22A, B KLX23A, B
HLX28	2006-06-02	2006-06-26	50	KLX19A and short holes
HLX28	2006-06-26	2006-07-26	40	KLX19A and short holes
HLX28	2006-07-26	2006-08-01	0	
HLX28	2006-08-01	2006-08-28	38	KLX19A
HLX28	2006-08-28	2006-09-28	53	KLX19A and KLX14A
HLX28	2006-09-28	2006-10-09	0	
HLX10	2006-10-11	2007-01-17	0–50	KLX21B and KLX16A
HLX14	2007-01-17	2007-03-07	44	KLX15A

Periods registered in DMS channel 2 (DMS2PO)

Well	Date		Flow L/min	Borehole drilled
HLX10	2004-03-15	2004-03-18	25	KLX04
HLX10	2004-03-18	2004-08-26	0–70	KLX04
HLX10	2004-08-26	2004-10-06	0–45	KLX06
HLX20	2004-10-06	2004-12-15	0–95	KLX06
HLX10	2004-12-17	2004-12-22	40–45	KLX07A and KLX05
HLX10	2004-12-22	2004-12-29	0	
HLX10	2004-12-29	2005-02-10	90	KLX07A and KLX05
HLX10	2005-02-10	2005-06-14	40	KLX07A and KLX08
HLX10	2005-06-27	2005-07-09	40	KLX10
HLX10	2005-07-09	2005-08-09	4	KLX10
HLX10	2005-08-09	2005-09-01	30	KLX10

HLX10	2005-09-01	2005-11-11	30 (90)	KLX10
HLX28	2005-11-29	2005-12-21	0–78	KLX11A
HLX28	2005-12-21	2006-01-03	0	
HLX28	2006-01-03	2006-03-17	0–78	KLX11A and KLX11F
HLX28	2006-03-20	2006-05-04	0–78	KLX20A, KLX11C, D, E and B
HLX14	2006-05-22	2006-06-26	47	KLX13A
HLX14	2006-06-26	2006-08-03	55	KLX13A
HLX14	2006-08-03	2006-08-09	55	KLX13, KLX26A and KLX26B
HLX14	2006-09-13	2006-09-20	53–54	KLX17A, KLX28A and KLX29A
HLX14	2006-09-20	2006-10-27	53–54	KLX17A
HLX10	2007-10-03	2007-11-27	0–110	By truck to KLX27A

3.2.3 Short cored boreholes for for investigation of discrete fracture network (DFN) and minor deformation zones (MDZ).

A summary of the amounts of water consumed during drilling of the short cored boreholes for investigation of discrete fracture network and minor deformation zones is given in Table 3-6. The location of the short cored boreholes is given in Figure 3-7. The emission of water from the DFN holes was made as for the deep cored boreholes KLX09 and KLX11A respectively. The water release from drilling of the MDZ boreholes was made within 30 metres of the borehole collar location. Flushing water was taken between October 2005 and September 2006 from different wells as summarized below.

- HLX10 supplied KLX09B-G, KLX10B-C.
- HLX20 supplied some water to KLX09D and KLX09G.
- HLX14 supplied KLX26A-B, KLX28A, KLX29A.
- HLX28 supplied KLX11B-F, KLX23A-B, KLX24A, KLX25A.

A more detailed account of the amounts of water, together with dates and indicated flow rates is given in Appendix 6.

Table 3-6. Summary- core drilling of short boreholes (DFN and MDZ).

Borehole (type)	Borehole coordinates			Drilling period		Amount of water consumed* (m^3)
	N	E	Z	from	to	
KLX09D (DFN)	6367336.99	1548878.22	23.10	2005-11-05	2005-11-17	52.5
KLX09E (DFN)	6367304.45	1548880.37	22.16	2005-11-23	2005-12-05	73.5
KLX09F (DFN)	6367318.02	1548817.27	19.57	2005-12-06	2006-01-06	78.0
KLX09C (DFN)	6367353.43	1548838.82	23.75	2006-01-07	2006-01-15	52.5
KLX09B (DFN)	6367329.07	1548859.01	23.62	2006-01-16	2006-01-26	43.5
KLX09G (MDZ)	6367330.09	1548905.77	19.63	2006-01-27	2006-02-03	no data
KLX10B (MDZ)	6366316.49	1548525.15	18.15	2006-02-08	2006-02-14	no data
KLX10C (MDZ)	6366372.07	1548506.94	16.94	2006-02-15	2006-02-28	no data
KLX11F (DFN)	6366314.09	1546577.96	24.47	2006-03-14	2006-03-17	60.0
KLX11C (DFN)	6366350.26	1546586.89	27.19	2006-03-30	2006-04-05	39.0
KLX11D (DFN)	6366357.37	1546631.42	25.57	2006-04-06	2006-04-13	45.0
KLX11E (DFN)	6366300.39	1546627.23	22.65	2006-04-13	2006-04-21	35.0
KLX11B (DFN)	6366339.51	1546604.89	27.27	2006-04-22	2006-04-28	39.0
KLX22A (MDZ)	6366548.35	1546688.60	21.98	2006-05-05	2006-05-12	no data
KLX22B (MDZ)	6366553.13	1546685.40	21.58	2006-05-13	2006-05-18	no data
KLX23A (MDZ)	6366106.89	1546715.74	22.26	2006-05-21	2006-05-27	no data
KLX23B (MDZ)	6366101.90	1546717.33	22.32	2006-05-28	2006-05-31	no data
KLX24A (MDZ)	6366423.35	1546853.80	21.29	2006-06-14	2006-06-29	no data
KLX25A (MDZ)	6366274.74	1546769.66	22.84	2006-07-01	2006-07-04	no data
KLX26A (MDZ)	6365546.49	1549029.90	15.63	2006-08-03	2006-08-11	no data
KLX26B (MDZ)	6365550.66	1549025.61	15.82	2006-08-12	2006-08-17	no data
KLX29A (MDZ)	6366264.54	1549443.99	13.63	2006-09-09	2006-09-13	no data
KLX28A (MDZ)	6365682.22	1549333.71	15.82	2006-09-14	2006-09-20	no data

*The consumed amount of water is likely to be slightly higher than the released amount of water. This is because there is no air-lift pumping done in the short cored boreholes. Somewhat less water will therefore be recovered in the return water compared to the amounts of water introduced in the borehole as flushing water. The effect of the introduced flushing water creating a slight injection could be demonstrated during drilling of the DFN- boreholes /5/.

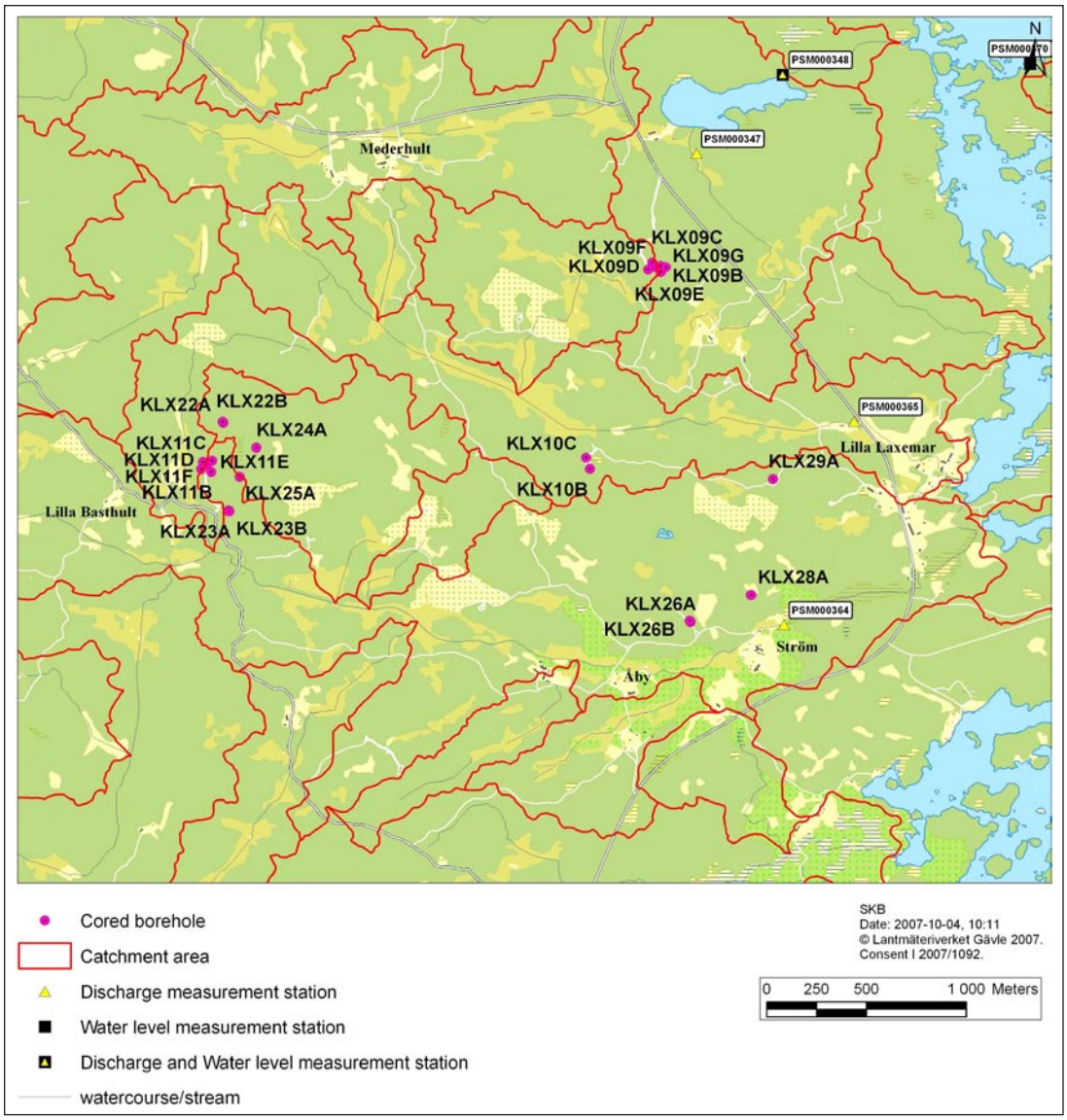


Figure 3-7. *Map of short cored boreholes, i.e. the boreholes drilled for investigation of discrete fracture network (DFN) and minor deformation zone (MDZ).*

3.2.4 Nitrogen flushing ("air"-lifting with nitrogen gas)

The cored boreholes were flushed with nitrogen gas in order to remove drill cuttings and drilling water spiked with uranine tracer from the borehole. The nitrogen gas flushing (or "air"-lifting with nitrogen gas) was done after drilling was completed and as a routine part of the borehole completion. The nitrogen gas flushing creates a very strong drawdown of the water table and significant amounts of water can be removed from the borehole even though the drawdown is momentary only.

A complete account of the nitrogen flushing made in core drilled boreholes for the purpose of rinsing the borehole after drilling has been completed is given in Appendix 7. It must be noted that nitrogen gas flushing is also made in a much smaller scale for rinsing of the borehole in conjunction with measurements of rock stress with the overcoring method. The latter type of nitrogen flushing is not further commented in this report.

3.2.5 Environmental monitoring wells

Construction of the environmental monitoring wells has been made by combined auger drilling for soil sampling and air-blast drilling methods (NO-X 90 or similar) for emplacement of the stand-pipe. Drilling with air-blast methods gives a drawdown of the water table. The amount of water removed by drilling has not been recorded.

Sampling of the wells has been done in conjunction with core drilling (ie in the relevant monitoring wells while core drilling was in progress) on a weekly or bi-weekly basis. The amounts of water thus removed has been very limited, typically three times the amount in the stand pipe (ca 10 litres or so).

Environmental monitoring wells were emplaced at two different types of site:

- Deep core drilling, typically one well at the drill site and one well at the place for water emission to the ground.
- Flushing water wells for use as water supply for deep core drilling.

A summary of the environmental monitoring wells is given for reference in Appendix 8. The summary includes information on which monitoring well that corresponds to which core drilled borehole or percussion drilled borehole used as a flushing water well.

3.2.6 Other soil drilling

Soil drilling for investigation of hydrogeological or regolith properties have been made during the site investigation. The main drilling methods have been air-blast drilling methods (NO-X 90 or similar) for emplacement or the stand-pipe combined with auger drilling for soil sampling. Drilling with air-blast methods gives a drawdown of the ground water table. The amount of water removed by drilling has not been recorded.

3.3 Hydrogeochemical investigations

Complete chemical characterization has been done in boreholes KSH01A, KLX03, KLX08, KLX13A, KLX17A, KLX15A and KLX27A, see Figure 3-8.

A summary of the water releases originated by the complete chemical characterization investigations up until July 2006 (KSH01A, KLX03 and KLX08) is given in Appendix 9. Water retrieved from pumping during the sampling was collected in containers, carried to the Vehicle flushing site and from there released to the Baltic Sea. Typical flows during the sampling phase were 0.5 L/minute which amounts to quite low volumes of water. The location of the Vehicle flushing site is shown in Figure 3-8.

The main water emissions related to the complete chemical characterization came from rinse pumping in between sampling events in KLX03 and KLX08. The latter emissions were done at the drill site, i.e. at the water release points for core drilling as specified in Appendix 3, and amounted to 200 m^3 and 2,300 m^3 respectively.

Figure 3-8. *Map of boreholes where complete chemical characterization has been done or is planned to be performed (KSH01A, KLX03, KLX08, KLX13A, KLX17A, KLX15A and KLX27A). The main water emissions have arisen not from the actual sampling but from rinse pumping in between sampling events in KLX03 and KLX08.*

3.4 Hydrogeological investigations

About two thousand hydraulic tests have been performed during the site investigations. These create hydraulic disturbances to various degrees. The tests are performed by either pumping water out or injecting water to the aquifer. The main test types that are considered likely to constitute an appreciable hydraulic disturbance are listed below.

- Injection tests.
- Pumping tests with a submersible pump.
- Pumping test with wireline equipment.
- PFL pumping tests with a submersible pump.

The "pumping tests with a submersible pump" and the "PFL pumping tests with a submersible pump" constitute the potentially largest disturbances of the groundwater level. These are compiled in Table 3-7 with pumped flow and/or volume and recipient where the pumped water was released.

It is regarded here that a selection of tests and methods is critical to creating an overview of potential hydraulic disturbances as the amount of pumping tests made during the site investigation is substantial. It must therefore be emphasized that events other than the ones listed here can have hydraulic influence on a given issue at hand.

A brief description of the main test types is given below:

- Injection tests: Primarily done in the cored boreholes. The borehole is tested section-wise and sequentially with 100 metre, 20 metre and sometimes 5 metre section length. Water is injected with 200kPa overpressure for a duration of 15–30 minutes. The injected water is always groundwater. These tests have a rather limited radius of disturbance and are therefore not included in Table 3-7.
- Pumping tests with a submersible pump: When single well test is performed, a shorter duration pumping is done since the main purpose is to asses the nearfield transmissivity. When multiple well interference testing is performed the pumping duration is longer since the main purpose is to investigate hydraulic connectivity.
- Pumping test with wireline equipment: These pumping tests are performed through the drill stem with a submersible pump and the wireline probe. Normally of a few hours pumping duration but sometime the pumping is conducted overnight. The wireline tests are performed in conjunction with drilling and the hydraulic disturbance from these tests is therefore included in the compilation presented in section 3.2 concerning core drilling. The wireline tests are therefore not included in Table 3-7. Further information on how the wireline tests are made and the results obtained can be seen in the individual core drilling reports, see example in /4/.
- PFL pumping tests with a submersible pump: These are pumping tests with a submersible pump conducted when flow logging the core drilled borehole with the Posiva Flow Log. Pumping is done intermittently with durations of about 2 days to 2 weeks, depending on the length of the borehole and the adopted testing programme.

The water release point is located at a short distance from the borehole and may be the ground, a nearby stream, a ditch or the sea. Discharge to ground was made within 30 m radius from the borehole collar for the tested short cored boreholes KLX09G, KLX10A-B, KLX22A- KLX26B, KLX28A, KLX29A (MDZ-holes) and KLX14A.

For the longer core drilled boreholes the distance to the discharge point varies more and may be as much as 600m, as for KLX06. The location of the water release point is shown in Figures 3-4 and 3-5. Pumped water from the soil wells were normally released about 50m away from the well, except for SSM000228 which were approximately 100 m away.

A full account of all tests may be obtained from the site characterization database, SICADA.

The location of the pumping sites of percussion and core drilled boreholes mentioned in Table 3-8 are shown in Figures 3-1 through 3-8 while the location for the soil wells is shown in Figure 3-9.

Table 3-7. Selected hydraulic pumping tests.

Activity start	Activity stop	Id code	Secup [m]	Seclow [m]	Mean flow [L/min]	Pumped volume [m³]	Activity plan	Report number	Discharge basin
Pumpingtest submersible pump									
2004-07-11	2004-07-14	HAV11	6.03	220.50	71	45	AP PS 400-03-077	P-04-287	Sea
2004-07-02	2004-07-03	HAV12	11.34	157.80	64	37	AP PS 400-03-077	P-04-287	Sea
2004-07-04	2004-07-05	HAV12	11.34	157.80	64	38	AP PS 400-03-077	P-04-287	Sea
2004-07-20	2004-07-22	HAV13	9.04	142.20	70	42	AP PS 400-03-077	P-04-287	Sea
2004-07-07	2004-07-09	HAV14	6.03	182.40	64	42	AP PS 400-03-077	P-04-287	Sea
2006-04-25	2006-04-26	HLX04	1.20	125.00	Almost dry		AP PS 400-06-035	Ingen rapp. Akt avbruten	Ground
2004-07-06	2004-07-20	HLX10	3.00	85.00	70		AP PS 400-04-062	P-05-20	Ground
2004-12-29	2005-02-14	HLX10	3.00	85.00	93		AP PS 400-04-062	P-05-20	Ekerumsån
2006-11-04	2006-11-04	HLX14	11.90	115.90	39	11	AP PS 400-06-110	P-06-319	Ekerumsån
2004-07-07	2004-07-13	HLX18	15.12	181.20	60		AP PS 400-04-052	P-05-190	Ground
2004-06-23	2004-06-24	HLX20	9.12	202.20	60		AP PS 400-04-057	P-04-236	Ground
2006-11-10	2006-11-10	HLX20	9.03	202.20	19	7	AP PS 400-06-110	P-06-319	Ground
2005-08-15	2005-08-23	HLX21	9.00	151.80	106		AP PS 400-04-105	P-08-91	Ekerumsån
2006-05-18	2006-05-18	HLX21	9.10	150.30	65	35	AP PS 400-06-014	P-06-147	Ekerumsån
2004-09-16	2004-09-20	HLX22	9.10	163.20	105		AP PS 400-04-105	P-05-55	Ekerumsån
2004-09-16	2004-09-20	HLX22	9.10	163.20	105		AP PS 400-04-072	P-05-55	Ekerumsån
2005-06-28	2005-07-05	HLX23	6.00	160.20	102		AP PS 400-04-105	P-08-91	Ekerumsån
2004-09-09	2004-09-13	HLX24	9.10	175.20	112		AP PS 400-04-105	P-05-55	Ekerumsån
2004-09-09	2004-09-13	HLX24	9.10	175.20	112		AP PS 400-04-072	P-05-55	Ekerumsån
2004-09-02	2004-09-06	HLX25	6.12	202.50	91		AP PS 400-04-105	P-04-280 P-05-55	Ekerumsån
2004-11-17	2004-12-03	HLX27	6.00	164.70	88		AP PS 400-04-072	P-05-55	Laxemarån
2006-11-24	2006-11-24	HLX27	6.03	164.70	40	13	AP PS 400-06-110	P-06-319	Laxemarån
2007-05-30	2007-06-02	HLX27	6.00	164.70	91	397	AP PS 400-07-025	P-07-186	Laxemarån
2005-04-11	2005-04-14	HLX28	6.00	154.20	109		AP PS 400-04-072	P-05-55	
2006-11-08	2006-11-08	HLX28	6.03	154.20	64	20	AP PS 400-06-110	P-06-319	Laxemarån
2007-04-05	2007-04-10	HLX28	6.00	154.20	97	661	AP PS 400-07-025	P-07-186	Laxemarån
2005-09-02	2005-09-14	HLX30	9.03	163.40	106		AP PS 400-04-105 AP PS 400-05-034	P-07-185	Ekerumsån
2005-02-22	2005-02-25	HLX32	12.30	162.60	14		AP PS 400-04-072 AP PS 400-04-105	P-05-55	Laxemarån
2006-11-30	2006-11-30	HLX32	12.30	162.60	12	3	AP PS 400-06-110	P-06-319	Laxemarån
2005-03-31	2005-04-01	HLX33	9.00	202.10	380		AP PS 400-04-105		Ekerumsån
2006-06-28	2006-08-29	HLX33	9.00	202.10	98	5,631	AP PS 400-06-115	P-07-182	Ekerumsåm
2006-11-12	2006-11-12	HLX33	9.03	202.10	65	21	AP PS 400-06-110	P-06-319	Ekerumsån
2005-06-15	2005-09-23	HLX34	9.03	151.80	108		AP PS 400-04-105		Ekerumsån
2006-01-16	2006-02-15	HLX35	6.10	151.80	104		AP PS 400-05-108	P-06-151	Ekerumsån
2006-05-20	2006-05-20	HLX35	6.10	151.80	60	30	AP PS 400-06-014	P-06-147	Ekerumsån
2005-10-18	2005-11-03	HLX37	12.00	199.80	36	310	AP PS 400-06-115	P-07-182	Ground
2006-11-02	2006-11-02	HLX37	12.10	199.80	15	5	AP PS 400-06-110	P-06-319	Ground
2006-05-22	2006-05-23	HLX38	15.10	199.50	67	39	AP PS 400-06-014	P-06-147	Ground
2006-09-01	2006-09-04	HLX39	6.00	199.30	24	35	AP PS 400-06-115	P-07-182	Ground
2006-11-06	2006-11-06	HLX39	6.10	199.30	33	13	AP PS 400-06-110	P-06-319	Ground
2007-05-15	2007-05-18	HLX42	9.10	152.60	67	292	AP PS 400-07-025	P-07-186	Ground
2006-12-02	2006-12-03	HLX43	6.00	170.60	63	35	AP PS 400-06-110	P-06-319	Ground
2003-08-27	2003-08-28	HSH02	12.00	200.00	5	3	AP PS 400-03-046	P-04-212	Ground
2003-08-28	2003-08-29	HSH02	12.00	33.00	2	0	AP PS 400-03-046	P-04-212	Ground
2002-08-20	2002-08-22	HSH03	12.03	201.00	17	10	AP PS 400-02-008	P-03-56	Sea
2002-08-22	2002-08-23	HSH03	12.03	103.00	22	5	AP PS 400-02-008	P-03-56	Sea
2002-09-05	2002-09-06	HSH03	12.03	201.00	35	14	AP PS 400-02-008	P-03-56	Sea

Activity start	Activity stop	Id code	Secup [m]	Seclow [m]	Mean flow [L/min]	Pumped volume [m³]	Activity plan	Report number	Discharge basin
2004-07-15	2004-07-17	HSH04	9.00	236.20	35	21	AP PS 400-03-077	P-04-287	Sea
2004-07-15	2004-07-17	HSH04	9.00	236.20	35	21	AP PS 400-03-077	P-04-287	Sea
2004-07-17	2004-07-19	HSH05	6.20	200.20	4	3	AP PS 400-03-077	P-04-287	Sea
2004-09-29	2004-09-30	KLX04	104.00	109.00	4		AP PS 400-04-075	P-04-292 Pumping test	Ground
2004-08-20	2004-08-20	KLX04	510.66	515.66	4	32	AP PS 400-04-075	P-04-292 Pumping test	Ground
2004-08-21	2004-08-21	KLX04	971.21	976.21	0	1	AP PS 400-04-075	P-04-292	Ground
2005-03-07	2005-03-10	KLX06	260.00	265.00	8	0	AP PS 400-04-118	P-05-184	Ground
2005-03-10	2005-03-17	KLX06	558.20	563.20	4	30	AP PS 400-04-118	P-05-184	Ground
2005-03-17	2005-03-23	KLX06	776.20	781.20	1	10	AP PS 400-04-118	P-05-184	Ground
2005-10-28	2005-11-03	KLX07A	103.20	193.20	41	178	AP PS 400-05-045	P-05-273	Ekerumsån
2005-11-04	2005-11-12	KLX07A	335.00	455.00	18	87	AP PS 400-05-045	P-05-273	Ekerumsån
2005-11-12	2005-11-20	KLX07A	193.00	313.00	36	148	AP PS 400-05-045	P-05-273	Ekerumsån
2005-11-22	2005-11-29	KLX07A	747.00	792.00	21	80	AP PS 400-05-045	P-05-273	Ekerumsån
2005-11-30	2005-12-08	KLX07A	610.00	655.00	18	78	AP PS 400-05-045	P-05-273	Ekerumsån
2005-05-30	2005-05-31	KLX07B	9.50	108.41	30		AP PS 400-04-096	P-06-14	Ekerumsån
2005-02-07	2005-02-11	KLX08	12.12	100.30	2		AP PS 400-04-115		Ground
2006-08-30	2006-09-07	KLX08	241.00	341.00	5	22	AP PS 400-06-001	P-07-18	Ground
2006-09-11	2006-09-18	KLX08	357.00	497.00	31	134	AP PS 400-06-001	P-07-18	Ground
2006-09-21	2006-09-27	KLX08	102.00	242.00	41	178	AP PS 400-06-001	P-07-18	Ground
2005-08-24	2005-08-25	KLX09	11.95	100.60	16	4	AP PS 400-06-115	P-07-182	Ground
2005-06-02	2005-06-09	KLX10	12.10	100.60	37		AP PS 400-05-021	P-06-116	Ground
2005-11-26	2005-11-27	KLX11A	12.05	100.60	14	7	AP PS 400-06-115	P-07-182	Ground
2005-11-14	2005-11-15	KLX12A	102.50	200.20	4	3	AP PS 400-06-115	P-07-182	Ground
2005-11-15	2005-11-16	KLX12A	17.92	200.15	7	3	AP PS 400-06-115	P-07-182	Ground
2006-05-11	2006-05-13	KLX13A	11.75	99.86	20	29	AP PS 400-06-115	P-07-182	Ground
2007-01-13	2007-01-14	KLX15A	12.00	74.62	3		AP PS 400-06-101	P-08-58	Ground
2006-12-04	2006-12-05	KLX16A	11.25	109.20	14		AP PS 400-06-133	P-08-50	Ground
2006-10-28	2006-10-29	KLX17A	12.00	701.08	24	34	AP PS 400-06-073	P-06-309	Ground
2006-03-29	2006-03-31	KLX18A	11.80	99.90	2	2	AP PS 400-06-115	P-07-182	Ground
2006-05-12	2006-05-14	KLX19A	6.30	99.30	109	160	AP PS 400-06-115	P-07-182	Ground
2006-11-15	2006-11-20	KLX20A	250.20	306.20	3	8	AP PS 400-06-112	P-07-39	Ground
2006-11-21	2006-11-25	KLX20A	99.50	180.00	15	44	AP PS 400-06-112	P-07-39	Ground
2003-09-02	2003-09-02	KSH02	419.00	424.00	25	115	AP PS 400-03-043	P-04-281	Ground
2003-09-09	2003-09-09	KSH02	575.00	580.00	998	8,191	AP PS 400-03-043	P-04-281	Ground
2003-08-21	2003-08-22	KSH03A	11.80	100.60	8	5	AP PS 400-03-046	P-04-212	Sea
2003-08-25	2003-08-26	KSH03A	11.80	28.00	5	1	AP PS 400-03-046	P-04-212	Sea
2007-05-07	2007-05-10	SSM000220	2.00	3.00	14	42	AP PS 400-06-124	P-07-173	Ground: Nearby bog with visible watertable
2007-05-09	2007-05-11	SSM000223	6.00	8.00	124	81	AP PS 400-06-124	P-07-173	Ekerumsån.
2007-05-03	2007-05-04	SSM000224	16.00	17.00	139	83	AP PS 400-06-124	P-07-173	Mederhultsån
2007-05-09	2007-05-14	SSM000228	6.00	7.00	15	41	AP PS 400-06-124	P-07-173	Ekerumsån,
2007-05-10	2007-05-11	SSM000236	2.00	3.00	0	0	AP PS 400-06-124	P-07-173	Small stream in a bog area .
2007-05-02	2007-05-07	SSM000261	9.20	10.20	8	22	AP PS 400-06-124	P-07-173	Mederhultsån
2007-05-02	2007-05-07	SSM000263	6.30	8.30	67	86	AP PS 400-06-124	P-07-173	Laxemarån.
2007-05-07	2007-05-10	SSM000265	3.58	5.58	17	46	AP PS 400-06-124	P-07-173	Ground: Bog area with visible watertable.

Activity start	Activity stop	Id code	Secup [m]	Seclow [m]	Mean flow [L/min]	Pumped volume [m³]	Activity plan	Report number	Discharge basin
PFL pumping test submersible pump									
2003-02-22	2003-03-01	KSH01A	12.10	1,003.00	4		AP PS 400-02-30	P-03-70	Ground, see chapter 3.2
2003-07-11	2003-07-20	KSH02	80.00	1,001.11	4		AP PS 400-03-33	P-03-110	Ground, see chapter 3.3
2004-02-21	2004-02-25	KAV01	70.04	757.31	20		AP PS 400-03-85	P-04-213	Ground, see chapter 3.3
2004-06-10	2004-06-15	KAV04A	100.16	994.17	13		AP PS 400-04-35	P-04-216	Ground, see chapter 3.3
2004-06-16	2004-06-17	KAV04B	19.53	96.93	27		AP PS 400-04-35	P-04-216	Ground, see chapter 3.3
2000-06-01	2000-06-18	KLX02	202.95	1,700.50	25			IPR-01-06	Ground, see chapter 3.3
2004-11-08	2004-11-17	KLX03	100.05	1,000.42	11		AP PS 400-04-82	P-05-67	Ground, see chapter 3.3
2004-07-29	2004-08-06	KLX04	12.24	993.49	55		AP SP 400-04-66	P-05-68	Ground, see chapter 3.3
2005-04-17	2005-04-25	KLX05	15.00	1,000.16	9		AP PS 400-04-117	P-05-160	Ground, see chapter 3.3
2005-02-18	2005-02-28	KLX06	11.88	994.94	85		AP PS 400-04-116	P-05-74	Ground, see chapter 3.3
2005-06-17	2005-06-29	KLX07A	11.80	844.73	90		AP PS 400-05-42	P-05-225	Ground, see chapter 3.3
2005-06-29	2005-07-01	KLX07B	9.64	200.13	20		AP PS 400-05-42	P-05-225	Ground, see chapter 3.3
2005-10-10	2005-10-16	KLX08	12.20	1,000.41	80		AP PS 400-05-44	P-05-267	Ground, see chapter 3.3
2006-05-13	2006-05-23	KLX09	9.80	880.38	75		AP PS 400-05-107	P-06-164	Ground, see chapter 3.3
2006-02-22	2006-02-28	KLX09B	11.00	100.20	10		AP PS 400-05-106	P-06-199 P-06-146	Ground, see chapter 3.3
2006-03-03	2006-03-09	KLX09C	9.00	120.05	32		AP PS 400-05-106	P-06-199 P-06-146	Ground, see chapter 3.3
2006-03-22	2006-03-28	KLX09D	9.75	121.02	14		AP PS 400-05-106	P-06-199 P-06-146	Ground, see chapter 3.3
2006-03-13	2006-03-19	KLX09E	9.00	120.00	32		AP PS 400-05-106	P-06-199 P-06-146	Ground, see chapter 3.3
2006-03-31	2006-04-06	KLX09F	9.00	152.30	33		AP PS 400-05-106	P-06-199 P-06-146	Ground, see chapter 3.3
2006-07-13	2006-07-15	KLX09G	9.30	100.10	8		AP PS 400-06-84	P-06-229	Ground, see chapter 3.3
2005-12-13	2005-12-21	KLX10	12.10	1,001.20	90		AP PS 400-05-082	P-06-58	Ground, see chapter 3.3
2006-07-19	2006-07-23	KLX10B	9.00	50.25	26		AP PS 400-06-84	P-06-229	Ground, see chapter 3.3
2006-07-25	2006-07-27	KLX10C	9.00	146.25	6		AP PS 400-06-84	P-06-229	Ground, see chapter 3.3
2006-11-03	2006-11-10	KLX11A	12.05	992.29	40		AP PS 400-06-79	P-07-24	Ground, see chapter 3.3
2006-09-11	2006-10-22	KLX11B	2.44	100.20	17		AP PS 400-06-87	P-07-64 P-07-65	Ground, see chapter 3.3
2006-10-12	2006-10-20	KLX11C	2.00	120.15	2		AP PS 400-06-87	P-07-64 P-07-65	Ground, see chapter 3.3
2006-10-02	2006-10-21	KLX11D	2.00	120.35	23		AP PS 400-06-87	P-07-64 P-07-65	Ground, see chapter 3.3
2006-09-22	2006-10-19	KLX11E	2.00	121.30	2		AP PS 400-06-87	P-07-64 P-07-65	Ground, see chapter 3.3
2006-10-16	2006-10-21	KLX11F	2.00	120.05	25		AP PS 400-06-87	P-07-64 P-07-65	Ground, see chapter 3.3
2006-06-10	2006-06-15	KLX12A	17.92	602.29	6		AP PS 400-06-48	P-06-185	Ground, see chapter 3.3

Activity start	Activity stop	Id code	Secup [m]	Seclow [m]	Mean flow [L/min]	Pumped volume [m³]	Activity plan	Report number	Discharge basin
2006-09-25	2006-09-30	KLX13A	11.75	595.85	50		AP PS 400-06-80	P-06-245	Ground, see chapter 3.3
2006-11-16	2006-11-19	KLX14A	6.45	176.27	31	131	AP PS 400-06-085	P-06-318	Ground, see chapter 3.3
2007-05-08	2007-05-17	KLX15A	11.65	1,000.43	30	388	AP PS 400-06-151	P-07-176	Ground, see chapter 3.3
2007-02-24	2007-03-05	KLX16A	11.25	433.55	28	237	AP PS 400-06-150	P-07-87	Ground, see chapter 3.3
2006-12-13	2007-01-08	KLX17A	2.60	701.08	15		AP PS 400-06-119	P-07-34	Ground, see chapter 3.3
2006-07-08	2006-07-15	KLX18A	11.83	611.00	12		AP PS 400-06-70	P-06-184	Ground, see chapter 3.3
2006-11-12	2006-11-22	KLX19A	92.75	800.07	60		AP PS 400-06-086	P-07-20	Ground, see chapter 3.3
2006-06-27	2006-07-01	KLX20A	100.90	457.92	9		AP PS 400-06-71	P-06-183	Ground, see chapter 3.3
2007-03-11	2007-03-18	KLX21B	11.85	858.78	54	565	AP PS 400-06-120	P-07-116	Ground, see chapter 3.3
2006-07-18	2006-07-24	KLX22A	2.00	100.45	9	36	AP PS 400-06-092	P-06-246	Ground
2006-07-26	2006-07-30	KLX22B	2.00	100.25	4	15	AP PS 400-06-092	P-06-246	Ground
2006-08-03	2006-08-05	KLX23A	2.30	100.15	7	19	AP PS 400-06-092	P-06-246	Ground
2006-07-30	2006-08-01	KLX23B	2.30	50.27	1	3	AP PS 400-06-092	P-06-246	Ground
2006-08-24	2006-08-27	KLX24A	2.41	100.17	15		AP PS 400-06-92	P-06-246	Ground, see chapter 3.3
2006-08-17	2006-08-19	KLX25A	2.20	50.24	1		AP PS 400-06-92	P-06-246	Ground, see chapter 3.3
2007-02-16	2007-02-18	KLX26A	2.64	101.14	1	3	AP PS 400-06-105	P-07-72	Ground
2007-02-19	2007-02-20	KLX26B	2.31	50.37	1	2	AP PS 400-06-105	P-07-72	Ground
2006-11-24	2006-11-26	KLX28A	5.10	80.23	2		AP PS 400-06-106	P-07-17	Ground, see chapter 3.3
2006-11-27	2006-11-28	KLX29A	2.35	60.25	13		AP PS 400-06-106	P-07-17	Ground, see chapter 3.3

Table 3-8. Amounts and dates for water release from tracer tests.

Test	Date start	Date stop	Total amount of released water (m³)
Tracer test at HLX27	2008-03-26	2008-06-26	22,000*
Long-term pumping test	2009-01-20	2009-05-26	136,000**

*The amount is estimated from logged DMS data; 50 L/minute between 2008-03-26 an 2008-04-21 and 75 L/minute between 2008-04-22 and 2008-06-26.

** Amount estimated from logged DMS data; 300 L/minute between 2009-01-20 and 2009-05-26.

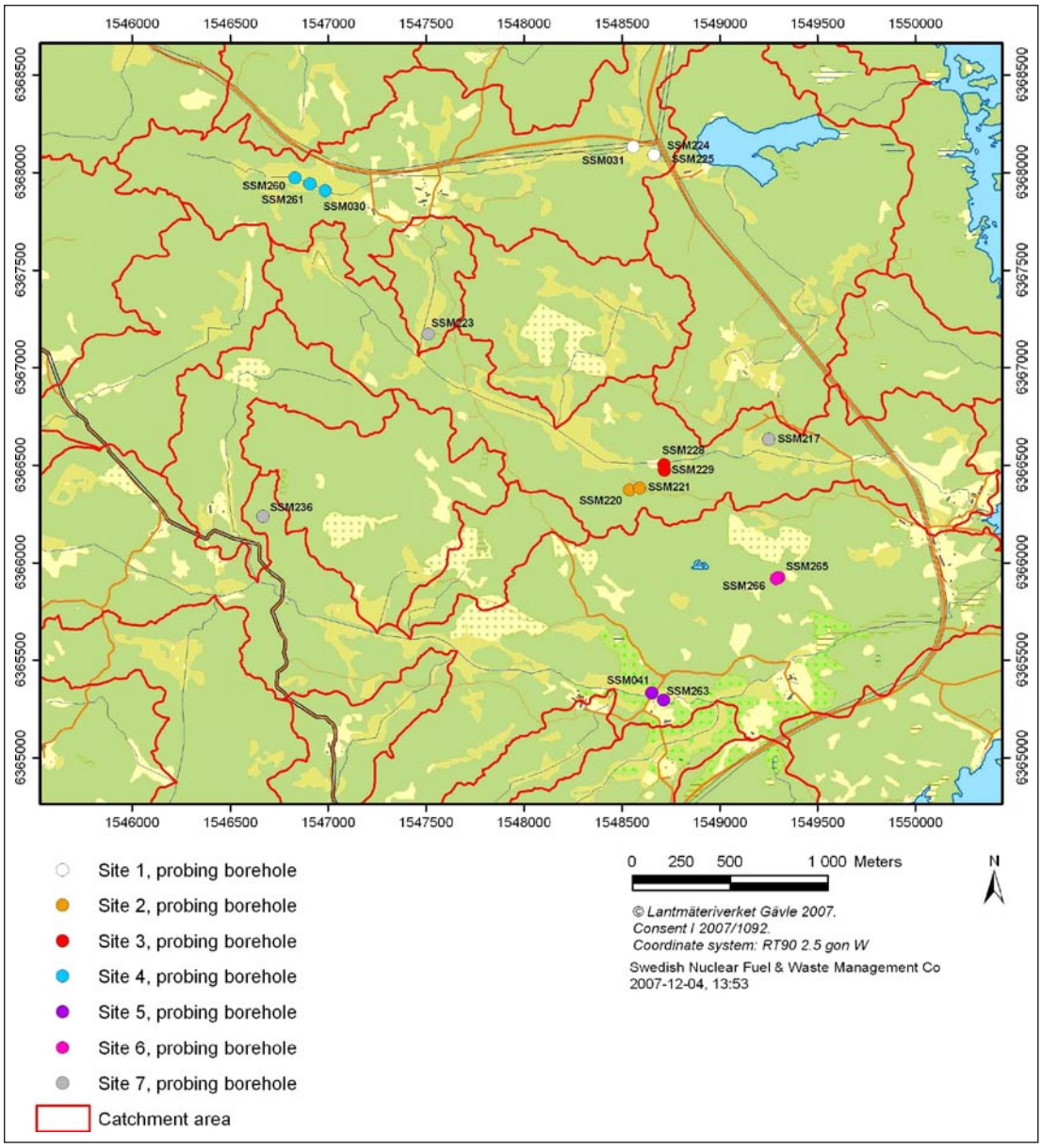


Figure 3-9. *Map showing the location of the soil wells mentioned in Table 3-8 that were pumped for interference test purposes. The pumping borehole and their associated observation wells are also shown.*

3.5 Tracer tests

Two tests with prolonged periods of pumping were made in 2008 and 2009.

- Tracer test in HLX27 /9/.
- Long-term pumping test in HLX28 /10/.

The amounts and dates for water release are given in Table 3-8. The location of the water release points is shown in Figures 3-10 and 3-11 respectively.

Figure 3-10. *Pumping during the tracer test in HLX27, AP PS 400-08-007, was made in HLX27. The water was released to the Laxemar river about 100 metres south of borehole HLX27. The location of the hydrological measurement station, PSM000364, along the Laxemar river is also shown.*

Figure 3-11. *Pumping during the long-term pumping test was made in HLX28. The water was released to the Laxemar river about 100 metres south of borehole HLX28. The location of the hydrological measurement station, PSM000364, along the Laxemar river is shown. The boreholes where tracer substances were introduced are also shown.*

3.6 Other sources of water pumping or release

It should be mentioned that a complete account of the use of water for private, or non-SKB, use in the Site Investigation area is outside the control of this study. An inventory of wells in the Site Investigation area was however made in 2003 /7/.

No pumping tests have been made by the Äspö HRL in the site investigation boreholes during the period 2002–2009. Pumping done in the Äspö HRL is described in annual monitoring reports, see example from 2005 /8/.

3.6.1 Water supply to Lilla Laxemar village

Water has been pumped from borehole HLX22, see Figure 3-2, to supply the local homes in Lilla Laxemar village with drinking water. The borehole HLX22 was thereby transformed to a plant for water supply and fitted with suitable pumps and measuring devices. The consumption of water from borehole HLX22 was 808 m^3 between 1 January 2007 and 30 August 2007, which is equivalent to a pumped out volume of 3.3 m^3/day. The actual start-up of the water supply plant was gradual from late December 2006 until early January 2007. For the purpose of this report the calculations are based on a start on January 1, 2007. A more detailed account of the momentary flow and drawdown in HLX22 is logged through the HMS, hydrological monitoring system. The data from HMS is delivered to the Sicada database.

References

/1/ **SKB, 2001.** Platsundersökningar. Undersökningsmetoder och generellt genomförandeprogram. SKB R-01-10, Svensk Kärnbränslehantering AB.

/2/ **SKB, 2005.** Platsundersökning Oskarshamn. Program för fortsatta undersökningar av berggrund, mark, vatten och miljö inom delområde Laxemar. SKB R-05-37, Svensk Kärnbränslehantering AB.

/3/ **Ask H, 2007.** Oskarshamn site investigation. Percussion drilling of HLX38, HLX39, HLX40, HLX41, HLX42 and HLX43. SKB P-06-291, Svensk Kärnbränslehantering AB.

/4/ **Ask H, Morosini M, Samuelsson L-E, Ekström L, Håkanson N, 2005.** Oskarshamn site investigation. Drilling of cored borehole KLX05. SKB P-05-233, Svensk Kärnbränslehantering AB.

/5/ **Ask H, 2006.** Oskarshamn site investigation. Core drilling of short boreholes KLX11B, KLX11C, KLX11D, KLX11E and KLX11F for discrete fracture network investigation (DFN). SKB P-06-283, Svensk Kärnbränslehantering AB.

/6/ **Bergelin A, Berg C, Wacker P, 2006.** Oskarshamn site investigation. Complete chemical characterisation in KLX03. Results from four investigated borehole sections. P-06-08, Svensk Kärnbränslehantering AB.

/7/ **Morosini M, Hultgren H, 2003.** Inventering av privata brunnar i Simpevarpsområdet, 2001– 2002. SKB P-03-05, Svensk Kärnbränslehantering AB.

/8/ **Nyberg G, Jönsson S, Wass, E, 2006.** Hydro Monitoring Program. Report for 2005. IPR-06-14, Svensk Kärnbränslehantering AB.

/9/ **Lindquist A, Hjerne C, Nordqvist R, Ludvigson J-E, Harrström J, Carlsten S, 2008.** Oskarshamn site investigation. Confirmatory hydraulic interference test and tracer test in Laxemar. SKB P-08-96, Svensk Kärnbränslehantering AB.

/10/ **Thur P, Hjerne C, Ludvigson J-E, Svensson T, Nordqvist R, 2009.** Oskarshamn site investigation. HLX28 large-scale confirmatory multiple-hole tracer test and hydraulic interference test. SKB P-09-62, Svensk Kärnbränslehantering AB.

Appendix 1

Summary of water release from percussion drilling

Borehole	Drilling period		Borehole coordinates			Amount of water released (m^3)	Comment Electrical conductivity	Estimation of released amount of water*	Drilling report	Activity plan
	from	to	N	E	Z					
HSH01	6/24/2002	7/2/2002	6366217.770	1552545.717	2.864	1		assumed 14 h at 1 L/min	P-03-114	AP PS-400-02-003
HSH02	6/27/2002	7/8/2002	6365682.896	1551368.337	6.649	7		assumed 14 h at 8 L/min	P-03-114	AP PS-400-02-003
HSH03	7/2/2002	7/9/2002	6366213.946	1552544.526	2.523	18		assumed 2 h at 0 L/min and 12 h at 25 L/min	P-03-114	AP PS-400-02-003
HSH04	4/5/2004	4/13/2004	6366237.275	1552223.476	2.858	10	Samples SKB 7554 and 7555	in drill report	P-05-194	AP PS-400-03-096
HSH05	4/14/2004	4/19/2004	6365224.711	1551179.077	2.718	3	Samples SKB 7550 and 7548	in drill report	P-05-194	AP PS-400-03-096
HSH06	4/20/2004	4/22/2004	6366214.627	1552534.621	2.346	2		in drill report	P-05-194	AP PS-400-03-096
HAV09	10/13/2003	10/16/2003	6366653.14	1552411.36	2.172	3	Sample SKB 5906 869 mS/m (130.9 m)	assumed 14 h at 3 L/min	P-04-150	AP PS-400-03-074
HAV10	10/20/2003	10/22/2003	6366660.57	1552411.84	2.227	1	Sample SKB 5910 64 mS/m (22.6 m) Sample SKB 5911 70 mS/m (100 m)	assumed 6 h at 2.5 L/min	P-04-150	AP PS-400-03-074
HAV11	6/7/2004	6/14/2004	6366565.254	1553040.898	2.379	71	Samples SKB 7552 and 7551	in drill report	P-05-194	AP PS-400-03-096
HAV12	5/12/2004	5/19/2004	6367765.872	1553194.416	9.404	23	Samples SKB 7558 and 7556	in drill report	P-05-194	AP PS-400-03-096
HAV13	5/24/2004	5/27/2004	6367627.858	1552682.157	2.215	117	Samples SKB 7549 and 7557	in drill report	P-05-194	AP PS-400-03-096
HAV14	6/1/2004	6/4/2004	6367227.977	1552350.548	7.761	70	Samples SKB 7553 and 7559	in drill report	P-05-194	AP PS-400-03-096
HLX13	2/24/2004	2/26/2004	6366953.00	1547690.42	17.391	3		assumed 14 h drill time at 3 L/min	P-04-234	AP PS-400-04-016
HLX14	3/8/2004	3/11/2004	6366960.81	1547692.57	17.113	43		assumed 12 h drill time at 60 L/min	P-04-234	AP PS-400-04-016
HLX15	4/27/2004	4/29/2004	6365361.97	1548664.02	4.807	0		in drill report	P-04-235	AP PS-400-04-039
HLX16	6/22/2004	6/24/2004	6366025.43	1549914.888	3.652	0		in drill report	P-05-190	AP PS-400-04-052
HLX17	6/28/2004	7/1/2004	6365951.51	1550040.75	3.350	1		in drill report	P-05-190	AP PS-400-04-052
HLX18	7/1/2004	7/6/2004	6365919.12	1550067.64	4.036	100	Sample SKB 7566 127 mS/m (66.9 m) Sample SKB 7567 821 mS/m (181.2 m)	in drill report	P-05-190	AP PS-400-04-052
HLX19	8/10/2004	8/12/2004	6365757.88	1550090.87	5.951	3		in drill report	P-05-190	AP PS-400-04-052
HLX20	6/15/2004	6/21/2004	6367996.26	1548446.08	11.179	17	Sample SKB 7560 54.4 mS/m (202 m)	assumed 2 h at 5.5 L/min, 4 h at 11.5 L/min and 8 h at 28 L/min.	P-04-236	AP PS-400-04-057
HLX21	8/30/2004	9/2/2004	6366567.93	1549632.36	10.312	175		in drill report	P-05-55	AP PS-400-04-072
HLX22	8/23/2004	8/26/2004	6366487.83	1549661.52	10.057	78	Sample SKB 7762 54.1 mS/m	in drill report	P-05-55	AP PS-400-04-072
HLX23	9/13/2004	9/16/2004	6366578.01	1548888.67	14.690	108		in drill report	P-05-55	AP PS-400-04-072
HLX24	9/6/2004	9/9/2004	6366503.72	1548865.89	12.769	115	Sample SKB 7758 54.1 mS/m	in drill report	P-05-55	AP PS-400-04-072
HLX25	8/17/2004	8/19/2004	6366783.97	1547776.32	20.656	64		in drill report	P-05-55	AP PS-400-04-072
HLX26	9/23/2004	9/28/2004	6365278.71	1548600.52	6.487	0		in drill report	P-04-235	AP PS-400-04-072
HLX27	9/20/2004	9/22/2004	6365605.07	1547882.68	4.248	52		in drill report	P-04-235	AP PS-400-04-072

Borehole	Drilling period		Borehole coordinates			Amount of water released (m^3)	Comment Electrical conductivity	Estimation of released amount of water*	Drilling report	Activity plan
	from	to	N	E	Z					
HLX28	9/29/2004	10/2/2004	6365861.70	1546834.47	13.424	135		in drill report	P-04-235	AP PS-400-04-072
HLX29	10/2/2004	10/3/2004	6365726.24	1546733.15	10.701	0		in drill report	P-04-235	AP PS-400-04-072
HLX30	11/26/2004	11/30/2004	6366730.73	1548026.73	12.184	132		in drill report	P-05-55	AP PS-400-04-112
HLX31	12/1/2004	12/3/2004	6366774.51	1548172.27	12.162	98		in drill report	P-05-55	AP PS-400-04-112
HLX32	1/4/2005	1/11/2005	6365725.79	1546734.36	10.844	5		in drill report	P-04-235	AP PS-400-04-072
HLX33	12/17/2004	12/20/2004	6366471.74	1548562.71	12.201	28		in drill report	P-05-55	AP PS-400-04-112
HLX34	6/9/2005	6/14/2005	6367355.125	1547489.558	14.290	77	40–70 mS/m	in drill report	P-05-237	AP PS-400-05-039
HLX35	5/28/2005	6/2/2005	6367194.788	1547437.792	14.444	76	80–120 mS/m	in drill report	P-05-237	AP PS-400-05-039
HLX36	9/20/2005	9/22/2005	6366172.94	1546558.45	15.558	0	30–70 mS/m	in drill report	P-05-275	AP PS-400-05-064
HLX37	9/26/2005	9/28/2005	6366183.66	1546406.21	15.188	18	30–80 mS/m	in drill report	P-05-275	AP PS-400-05-064
HLX38	4/10/2006	4/24/2006	6365868.86	1547146.08	11.53	58	ca 300–400 mS/m in return water below drilled length 100 m	in drill report	P-06-291	AP PS-400-06-037
HLX39	6/7/2006	6/14/2006	6366887.87	1546880.48	27.044	6	30–60 mS/m	in drill report	P-06-291	AP PS-400-06-037
HLX40	5/2/2006	5/9/2006	6366906.76	1546943.95	25.737	0	40–50 mS/m	in drill report	P-06-291	AP PS-400-06-037
HLX41	5/22/2006	6/1/2006	6367013.20	1547017.61	21.797	0	30–40 mS/m	in drill report	P-06-291	AP PS-400-06-037
HLX42	11/13/2006	11/16/2006	6364827.04	1547446.73	12.88	38	Sample SKB 11529 at 152.6 m held 36 mS/m	in drill report	P-06-291	AP PS-400-06-109
HLX43	10/19/2006	10/26/2006	6367517.45	1546626.60	24.20	156	Slightly elevated electrical conductivity (ca 100 mS/m) in return water while drilling through the dolerite	in drill report	P-06-291	AP PS-400-06-114

Appendix 2

Summary of water release from percussion drilling of telescopic section of deep cored boreholes

Borehole	Borehole coordinates			Drilling period (percussion drilling)		Amount of water released (m^3)	Comment on amount of water released	P-report	Activity plan
	N	E	Z	from	to				
KSH01A	6366013.45	1552442.98	5.32	2002/08/22	2002/10/01	0		P-03-113	AP PS 400-02-004
KSH02	6365658.33	1551528.93	5.48	2003/01/22	2003/03/03	0		P-04-151	AP PS 400-02-019
KSH03A	6366018.66	1552711.17	4.15	2003/08/13	2003/09/02	0		P-04-233	AP PS 400-03-021
KAV01	6367257.52	1553084.92	14.10	2003/08/20	2003/08/25	no data	No data on water flow during percussion drilling	P-09-01	AP PS 400-03-042
KAV04A	6366795.76	1552475.00	10.35	2003/10/06	2003/10/27	36	Assumed 5 hours release at 120 L/min	P-05-25	AP PS 400-03-050
KBH03	6366486.08	1551047.39	7.82	2004/01/27	2004/02/13	0	No core drilling – only percussion drilling of the telescopic section performed	P-09_01	AP PS 400-03-095
KLX03	6366112.59	1547718.93	18.49	2004/03/03	2004/03/13	15	Assumed 5 hours at 50 L/min	P-05-167	AP PS 400-04-008
KLX04	6367077.19	1548171.94	24.09	2004/02/11	2004/02/18	1	Assumed 5 hours at 3 L/min	P-05-111	AP PS 400-04-007
KLX05	6365633.34	1548909.41	17.63	2004/08/11	2004/08/25	30	Assumed 5 hours release at 100 L/min	P-05-233	AP PS 400-04-056
KLX06	6367806.64	1548566.88	17.68	2004/08/03	2004/08/10	3	Assumed 5 hours release at 10 L/min	P-05-234	AP PS 400-04-055
KLX07A	6366752.09	1549206.86	18.47	2004/11/23	2004/12/03	5	Assumed 5 hours release at 18 L/min	P-06-14	AP PS 400-04-096
KLX08	6367079.10	1548176.71	24.31	2005/01/12	2005/01/24	0		P-06-222	AP PS 400-04-115
KLX09	6367323.45	1548863.18	23.45	2005/06/02	2005/06/13	0		P-08-33	AP PS 400-05-020
KLX10	6366319.38	1548515.23	18.28	2005/05/24	2005/06/01	14	Assumed 5 hours at 45 L/min.	P-06-116	AP PS 400-05-021
KLX11A	6366339.72	1546608.49	27.14	2005/11/01	2005/11/08	0		P-06-306	AP PS 400-05-065
KLX12A	6365630.78	1548904.44	17.74	2005/10/19	2005/10/27	0		P-06-305	AP PS 400-05-070
KLX13A	6367547.14	1546787.36	24.15	2006/03/23	2006/03/30	3	Assumed 5 hours release at 11 L/min	P-07-195	AP PS 400-06-010
KLX15A	6365614.17	1547987.47	14.59	2006/12/21	2006/12/29	0		P-08-58	AP PS 400-06-101
KLX17A	6366848.75	1546862.09	27.63	2006/08/07	2006/08/15	17		P-07-221	AP PS 400-06-073
KLX18A	6366413.39	1547966.35	21.01	2006/02/15	2006/02/21	0		P-07-98	AP PS 400-06-011
KLX19A	6365901.42	1547004.62	16.87	2006/05/10	2006/05/22	39	Assumed 5 hours release at 130 L/min	P-07-202	AP PS 400-06-054
KLX20A	6366334.57	1546604.89	27.24	2006/02/22	2006/03/08	0		P-07-134	AP PS 400-06-026
KLX21A	6366158.177	1549706.228	10.690	2006/08/21	2006/08/29	0	No core drilling – only percussion drilling of the telescopic section performed	P-08-24	AP PS 400-06-095
KLX21B	6366164.00	1549715.10	10.68	2006/09/20	2006/09/25	0		P-08-24	AP PS 400-06-108
KLX27A	6365608.29	1546742.63	16.98	2007/08/15	2007/08/27	4	Assumed 5 hours at 14 L/min.	P-08-61	AP PS 400-07-058

Appendix 3

Summary of water release from deep core drilling

Borehole	Borehole coordinates			Drilling period (core drilling)		Amount of water released (m^3)	Comment	P-report	Activity plan	Water release point (+– 10 m)		comment
	N	E	Z	from	to					N	E	
KSH01A	6366013.45	1552442.98	5.32	2002/10/07	2002/12/18	1,100		P-03-113	AP PS 400-02-004	6365850	1552590	Baltic sea
KSH01B	6366014.04	1552442.89	5.20	2003/01/17	2003/01/27	no data	no DMS reading were made in KSH01B	P-03-113	AP PS 400-02-004	6365850	1552590	Baltic sea
KSH02	6365658.33	1551528.93	5.48	2003/01/28	2003/06/11	1,150		P-04-151	AP PS 400-02-019	6366230	1552080	Water led to the Baltic Sea through the local sewage system in Simpevarp
KSH03A	6366018.66	1552711.17	4.15	2003/09/11	2003/11/07	2,000		P-04-233	AP PS 400-03-021	6366070	1552800	Baltic sea
KSH03B	6366018.98	1552710.70	4.08	2003/11/21	2003/11/26	no data	no DMS reading were made in KSH03B	P-04-233	AP PS 400-03-021	6366070	1552800	Baltic sea
KAV01	6367257.52	1553084.92	14.10	2003/06/11	2004/01/10	no data	No data on water flow in or out. The drilling of KAV01 was done prior to the Site Investigation. DMS system not used during drilling. Drilling operations perfomed 030612-060703 (reaming, flushing); 030820-030821 (percussion drilling); 030917-030930 (reaming, flushing); 040108-040110 (flushing)	P-09-01	AP PS 400-03-042			Minor amounts of water released to the ground in the vicinity of the borehole
KAV04A	6366795.76	1552475.00	10.35	2003/12/10	2004/05/03	1,800		P-05-25	AP PS 400-03-050	6366290	1552550	Baltic sea
KAV04B	6366795.64	1552474.47	10.35	2004/05/12	2004/05/18	no data	no DMS reading were made in KAV04B	P-05-25	AP PS 400-03-050	6366290	1552550	Baltic sea
KLX03	6366112.59	1547718.93	18.49	2004/05/28	2004/09/07	1,200		P-05-167	AP PS 400-04-008	6366150	1547710	infiltration to the ground
KLX04	6367077.19	1548171.94	24.09	2004/03/13	2004/06/28	4,000		P-05-111	AP PS 400-04-007	6367080	1548200	infiltration to the ground
KLX05	6365633.34	1548909.41	17.63	2004/10/01	2005/01/22	2,260		P-05-233	AP PS 400-04-056	6365670	1548890	infiltration to the ground
KLX06	6367806.64	1548566.88	17.68	2004/08/25	2004/11/25	3,100		P-05-234	AP PS 400-04-055	6367370	1548520	infiltration to the ground
KLX07A	6366752.09	1549206.86	18.47	2005/01/06	2005/05/04	3,600		P-06-14	AP PS 400-04-096	6366720	1549270	infiltration to the ground
KLX07B	6366753.14	1549206.76	18.38	2005/05/23	2005/06/03	no data	no DMS reading were made in KAV04B	P-06-14	AP PS 400-04-096	6366720	1549270	infiltration to the ground
KLX08	6367079.10	1548176.71	24.31	2005/04/04	2005/06/13	2,600		P-06-222	AP PS 400-04-115	6367080	1548200	infiltration to the ground

Borehole	Borehole coordinates			Drilling period (core drilling)		Amount of water released (m^3)	Comment	P-report	Activity plan	Water release point (+– 10 m)		comment
	N	E	Z	from	to					N	E	
KLX09	6367323.45	1548863.18	23.45	2005/08/26	2005/10/15	1,700		P-08-33	AP PS 400-05-020	6367330	1548790	infiltration to the ground
KLX10	6366319.38	1548515.23	18.28	2005/06/18	2005/10/15	3,300		P-06-116	AP PS 400-05-021	6366360	1548530	infiltration to the ground
KLX11A	6366339.72	1546608.49	27.14	2005/11/24	2006/03/02	2,000		P-06-306	AP PS 400-05-065	6366230	1546660	infiltration to the ground
KLX12A	6365630.78	1548904.44	17.74	2005/11/10	2006/03/04	1,300		P-06-305	AP PS 400-05-070	6365670	1548890	infiltration to the ground
KLX13A	6367547.14	1546787.36	24.15	2006/05/19	2006/08/16	4,000		P-07-195	AP PS 400-06-010	6367580	1546760	infiltration to the ground
KLX14A	6365959.69	1547146.87	16.35	2006/08/19	2006/09/04	no data	no DMS reading were made in the short cored borehole KLX14A	P-08-21	AP PS 400-06-091			infiltration to the ground near the borehole
KLX15A	6365614.17	1547987.47	14.59	2007/01/17	2007/02/25	1,800		P-08-58	AP PS 400-06-101	6365600	1547930	infiltration to the ground
KLX16A	6364797.69	1547584.06	18.85	2006/11/28	2007/01/09	200	no telescopic section exists in KLX16A i.e. no air-lift pumping was done	P-08-50	AP PS 400-06-133	6364840	1547510	infiltration to the ground
KLX17A	6366848.75	1546862.09	27.63	2006/09/13	2006/10/23	1,100		P-07-221	AP PS 400-06-073	6366960	1546900	infiltration to the ground
KLX18A	6366413.39	1547966.35	21.01	2006/03/29	2006/05/02	700		P-07-98	AP PS 400-06-011	6366450	1547970	infiltration to the ground
KLX19A	6365901.42	1547004.62	16.87	2006/06/03	2006/09/20	2,300		P-07-202	AP PS 400-06-054	6365810	1546900	infiltration to the ground
KLX20A	6366334.57	1546604.89	27.24	2006/03/25	2006/04/24	750		P-07-134	AP PS 400-06-026	6366230	1546660	infiltration to the ground
KLX21B	6366164.00	1549715.10	10.68	2006/10/12	2006/11/29	2,900		P-08-24	AP PS 400-06-108	6366080	1549680	infiltration to the ground
KLX27A	6365608.29	1546742.63	16.98	2007/08/15	2007/08/27	1,900		P-08-61	AP PS 400-07-058	6365810	1546900	infiltration to the ground, same location as for KLX19A

Appendix 4

Diagrams of accumulated amounts of released water, electrical conductivity and drill bit position in deep cored boreholes

Description of the parameters in the enclosed plots.

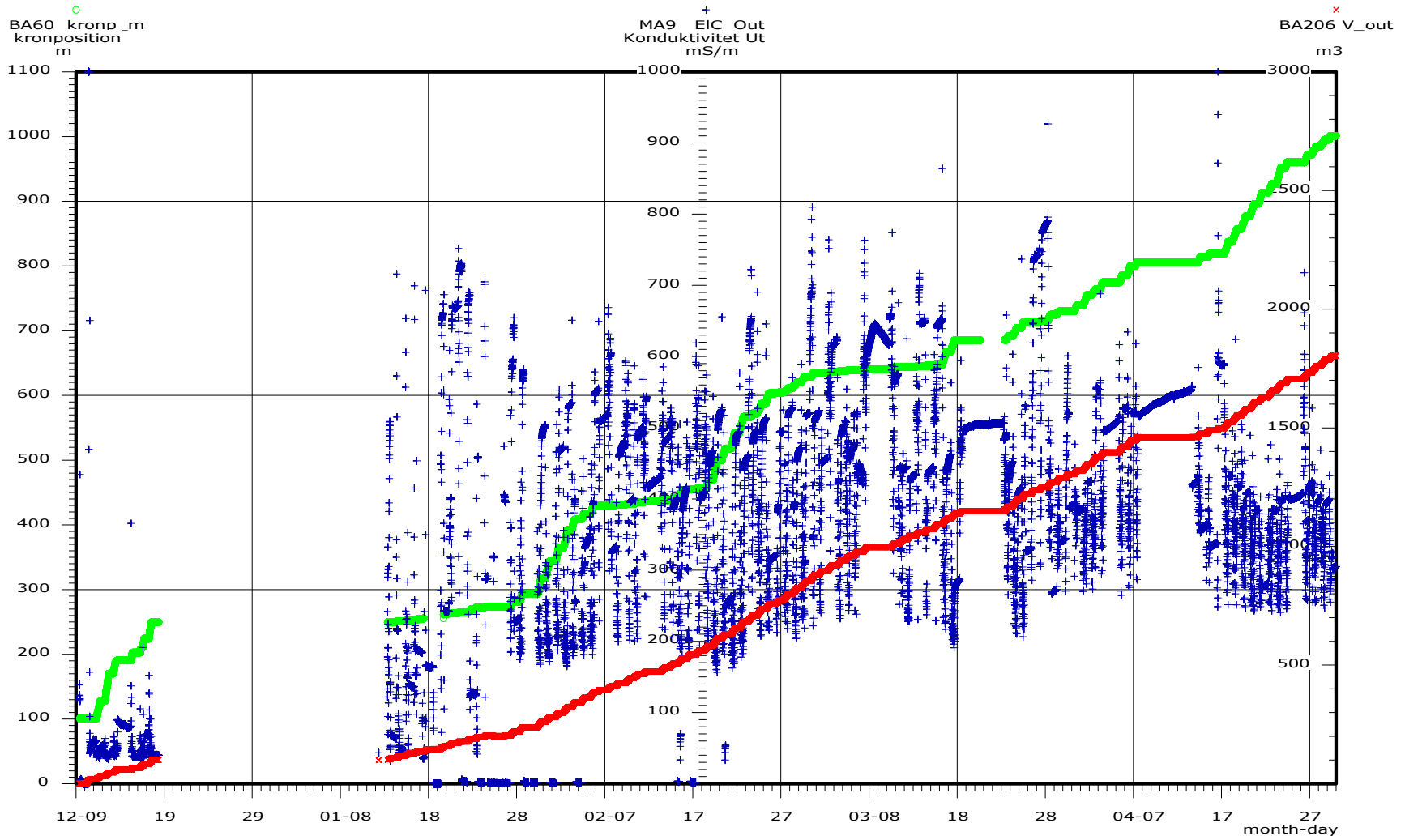
Channel	Parameter	Unit	Description	Symbol
BA60 or BB60 (MA51 in KSH01A)	Drill bit position	Metre (cm in KSH01A)	Position of drill bit below reference level (top of casing) given in metres drilled length (or cm in KSH01A)	Green ring
MA9 or MB9	Electrical conductivity out	mS/m	Electrical conductivity in the released water	Blue cross
BA206 or BB 206	Accumulated volume out	m^3	The amount of water released from the core drilling over time.	Red cross

* The coding “BA” or “BB” etc depends on which DMS system has been in use (BA for DMS1PO and BB for DMS2PO).

PLOT TIME :07/06/14 12:54:54
PLOT FILE :Water release
No DST Adjustment

DMS1 PO

KAV04



START :03/12/09 00:00:00

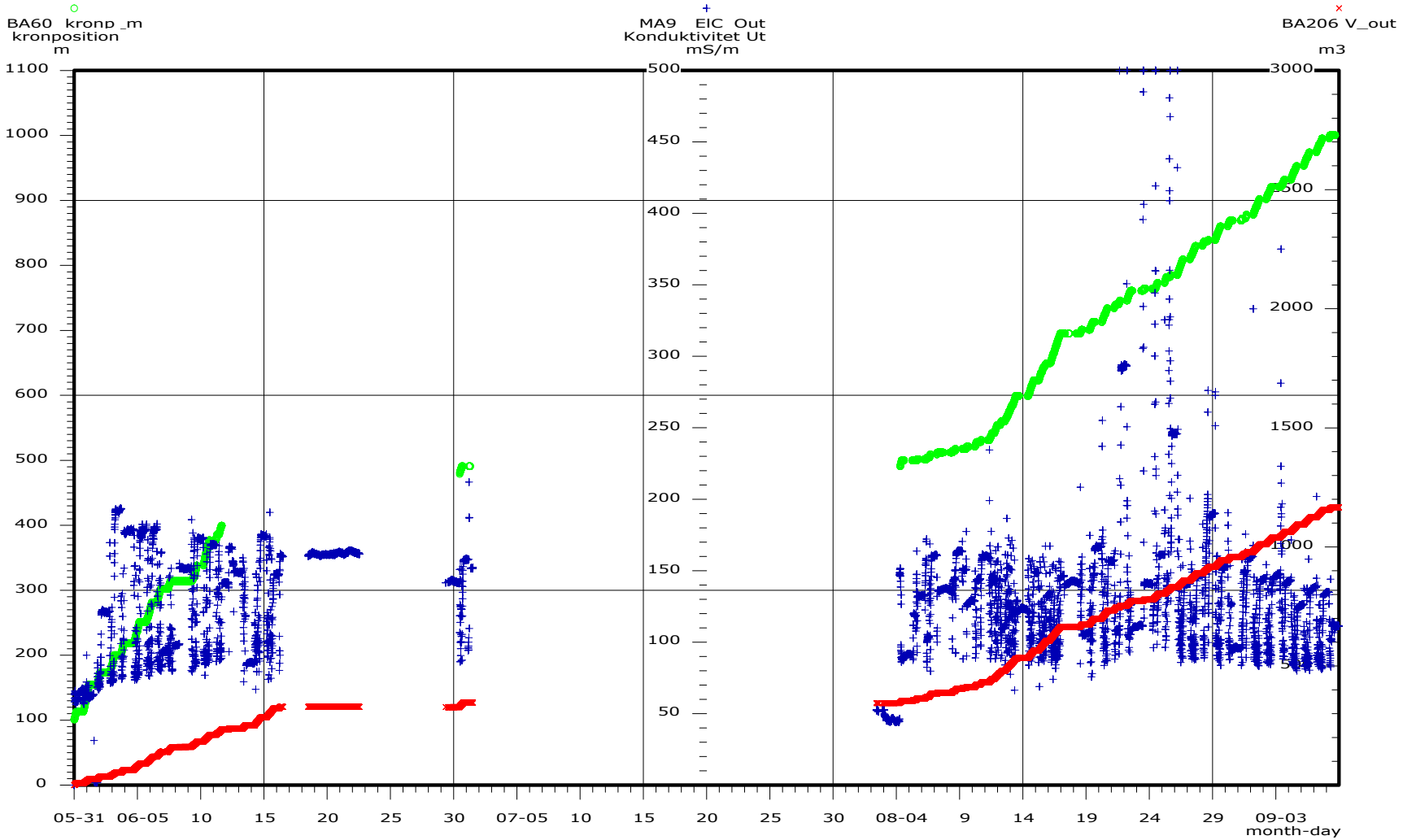
INTERVAL: >= 10 Minutes

STOP :04/04/29 23:59:59

PLOT TIME :07/06/14 12:48:15
PLOT FILE :Water release
No DST Adjustment

DMS1 PO

KLX03



START :04/05/31 00:00:00

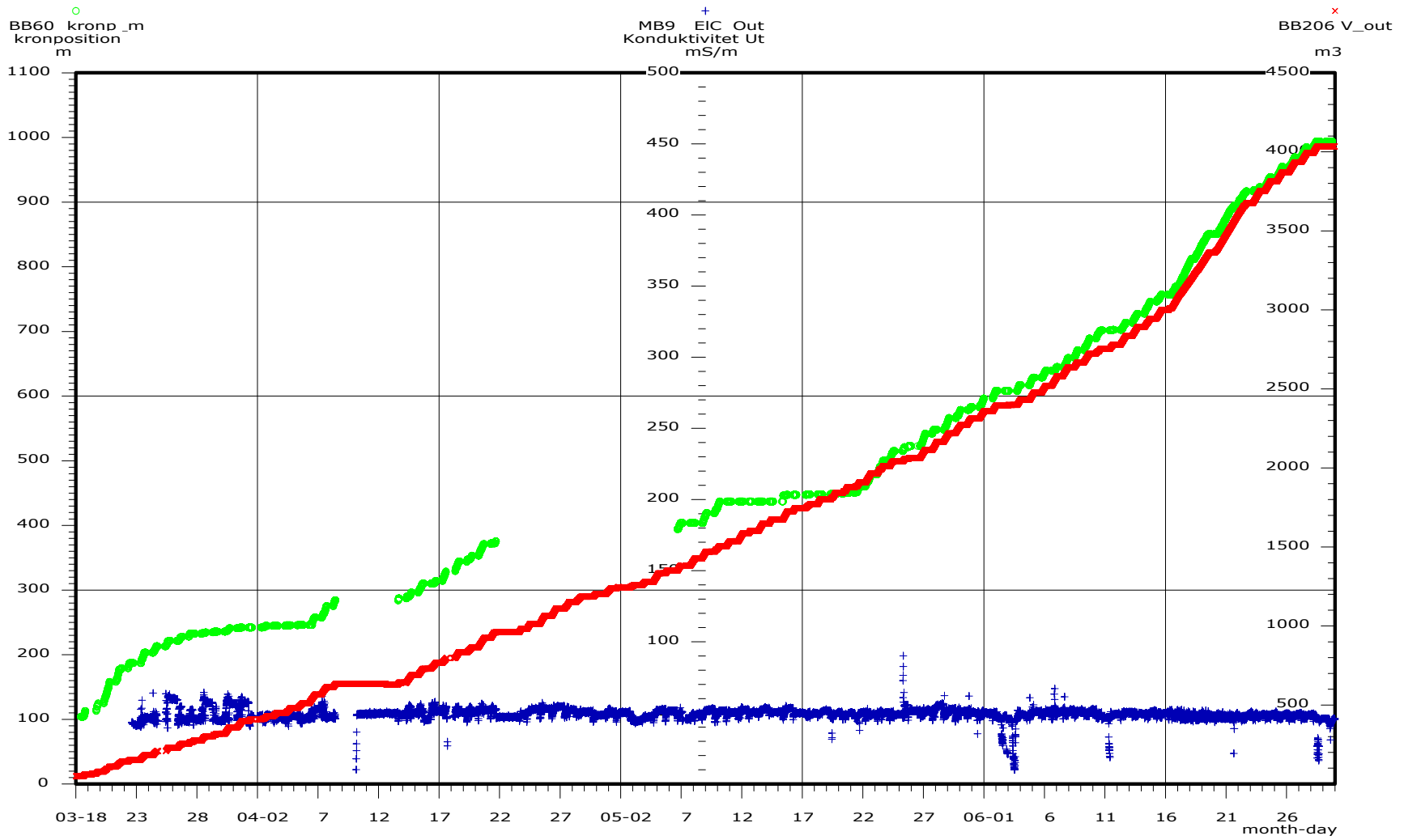
INTERVAL: >= 10 Minutes

STOP :04/09/07 23:59:59

PLOT TIME :07/06/14 12:43:04
PLOT FILE :Water release
No DST Adjustment

DMS2 PO

KLX04



START :04/03/18 00:00:00

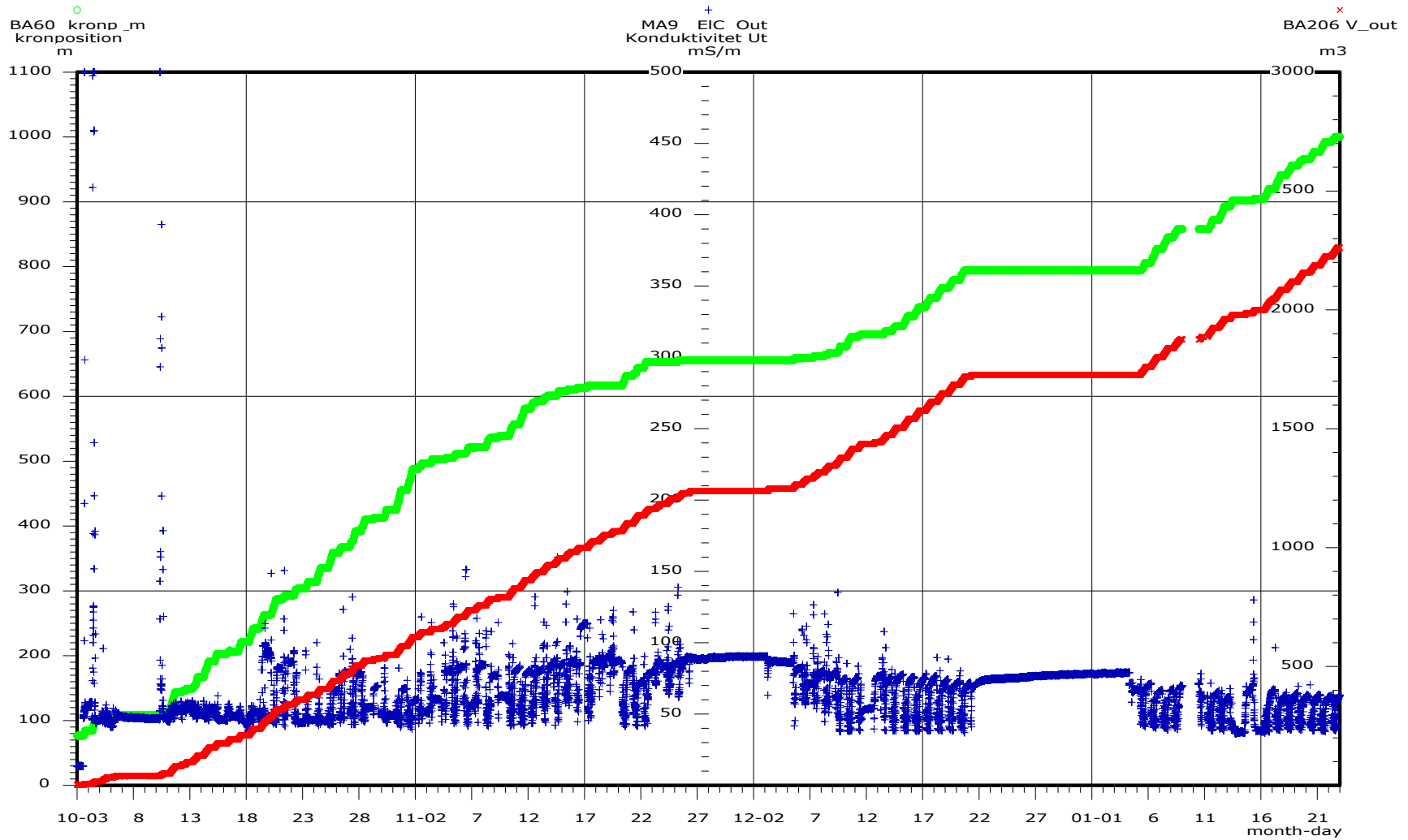
INTERVAL: >= 10 Minutes

STOP :04/06/29 23:59:59

PLOT TIME :07/06/14 12:35:57
PLOT FILE :Water release
No DST Adjustment

DMS1 PO

KLX05



START :04/10/03 00:00:00

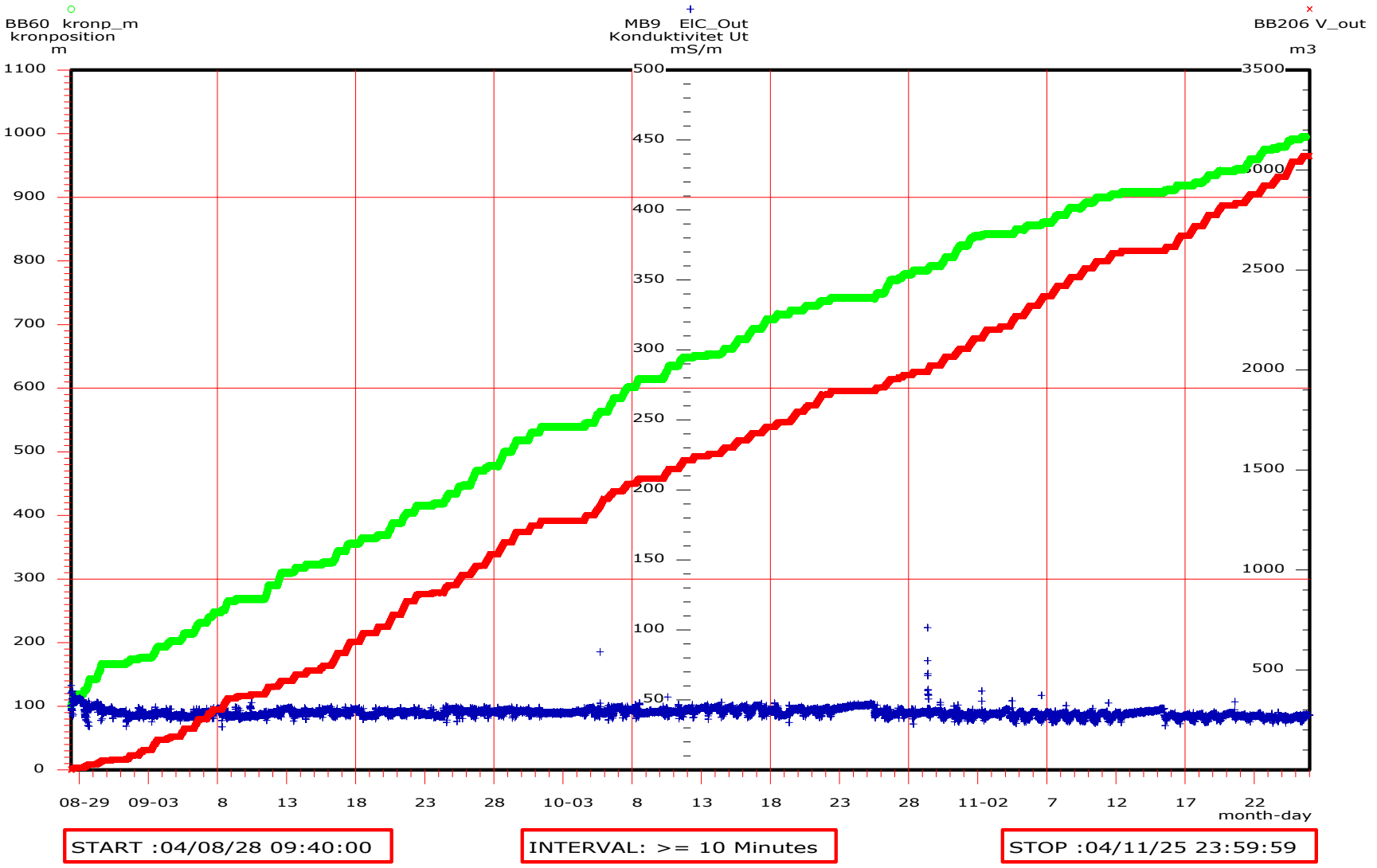
INTERVAL: >= 10 Minutes

STOP :05/01/22 23:59:59

PLOT TIME :07/06/14 12:30:33
PLOT FILE :Water release
No DST Adjustment

DMS2 PO

KLX06



START :04/08/28 09:40:00

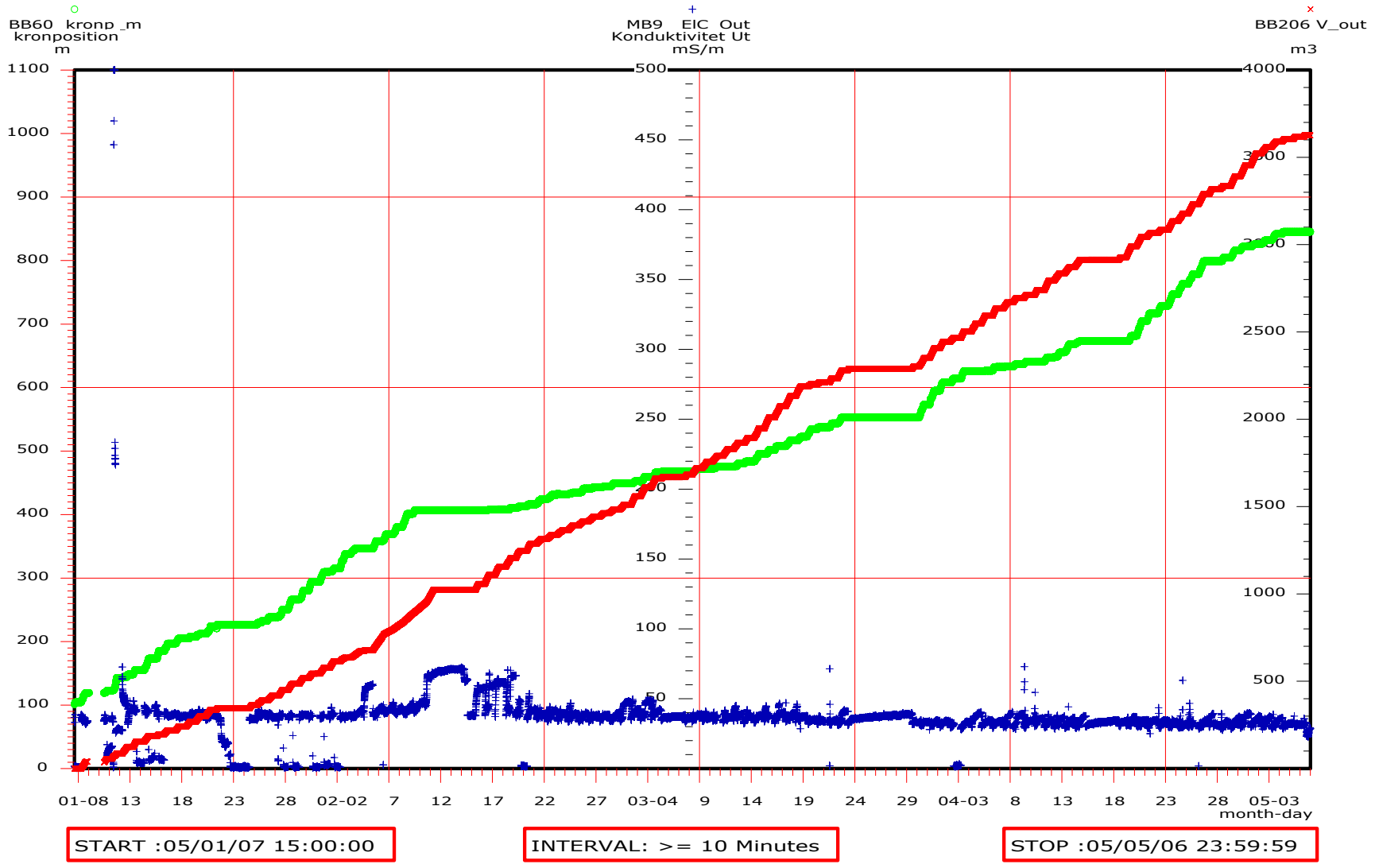
INTERVAL: >= 10 Minutes

STOP :04/11/25 23:59:59

PLOT TIME :07/06/14 09:42:56
PLOT FILE :Water release
No DST Adjustment

DMS2 PO

KLX07



START :05/01/07 15:00:00

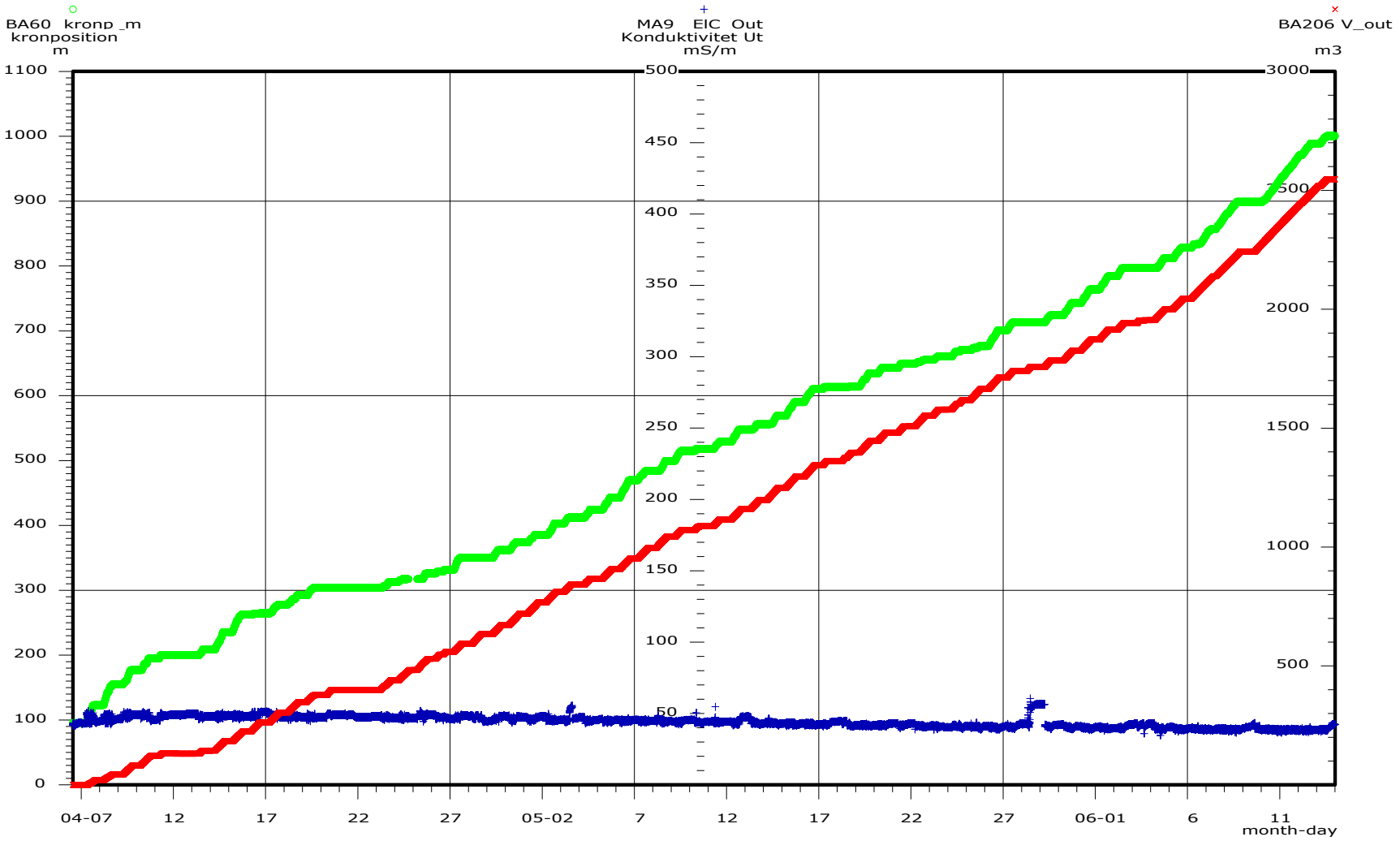
INTERVAL: >= 10 Minutes

STOP :05/05/06 23:59:59

PLOT TIME :07/06/14 09:28:21
PLOT FILE :Water release
No DST Adjustment

DMS1 PO

KLX08



START :05/04/06 13:10:00

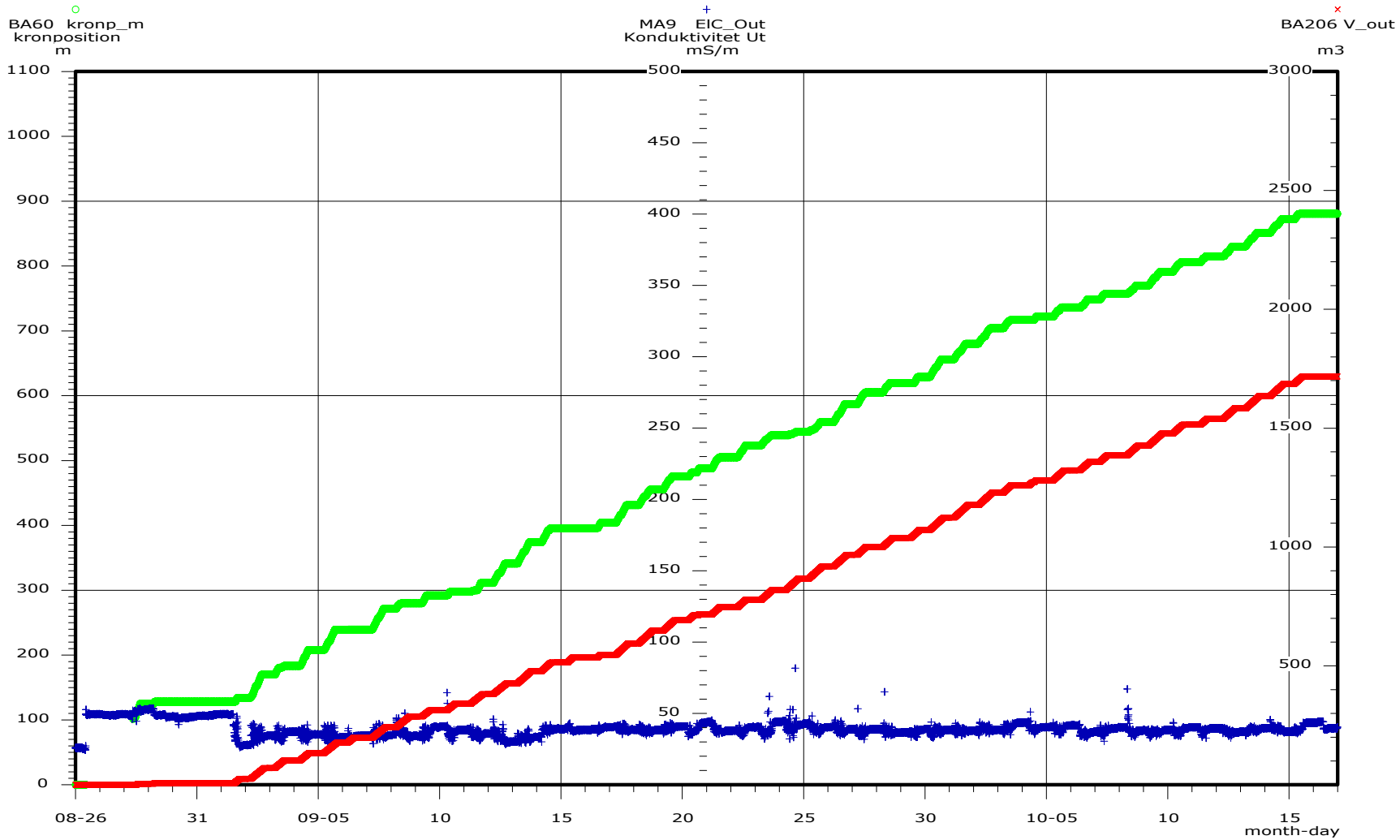
INTERVAL: >= 10 Minutes

STOP :05/06/13 23:59:59

PLOT TIME :07/06/14 09:23:37
PLOT FILE :Water release
No DST Adjustment

DMS1 PO

KLX09



START :05/08/26 00:00:00

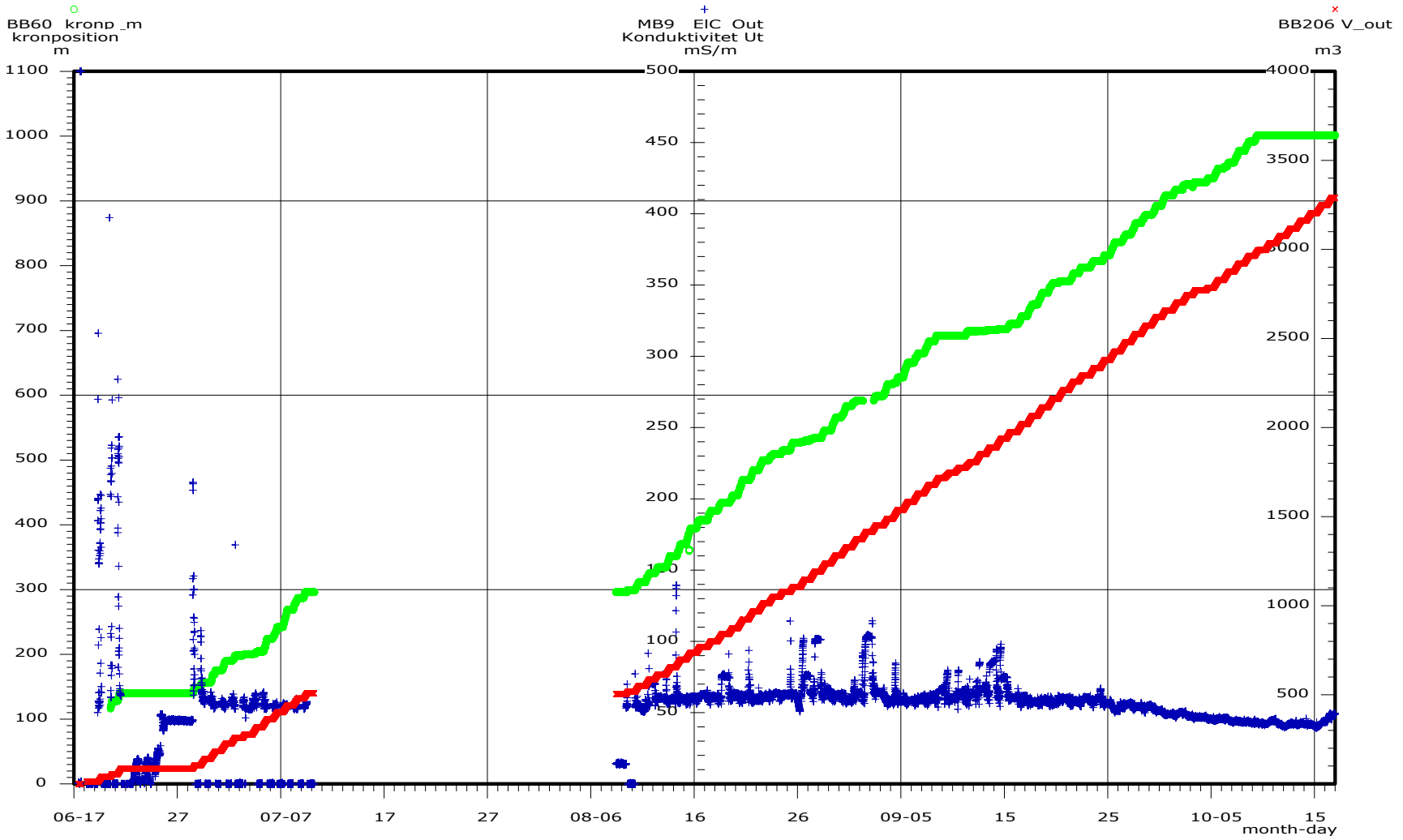
INTERVAL: >= 10 Minutes

STOP :05/10/16 23:59:59

PLOT TIME :07/06/14 09:19:06
PLOT FILE :Water release
No DST Adjustment

DMS2 PO

KLX10



START :05/06/17 00:00:00

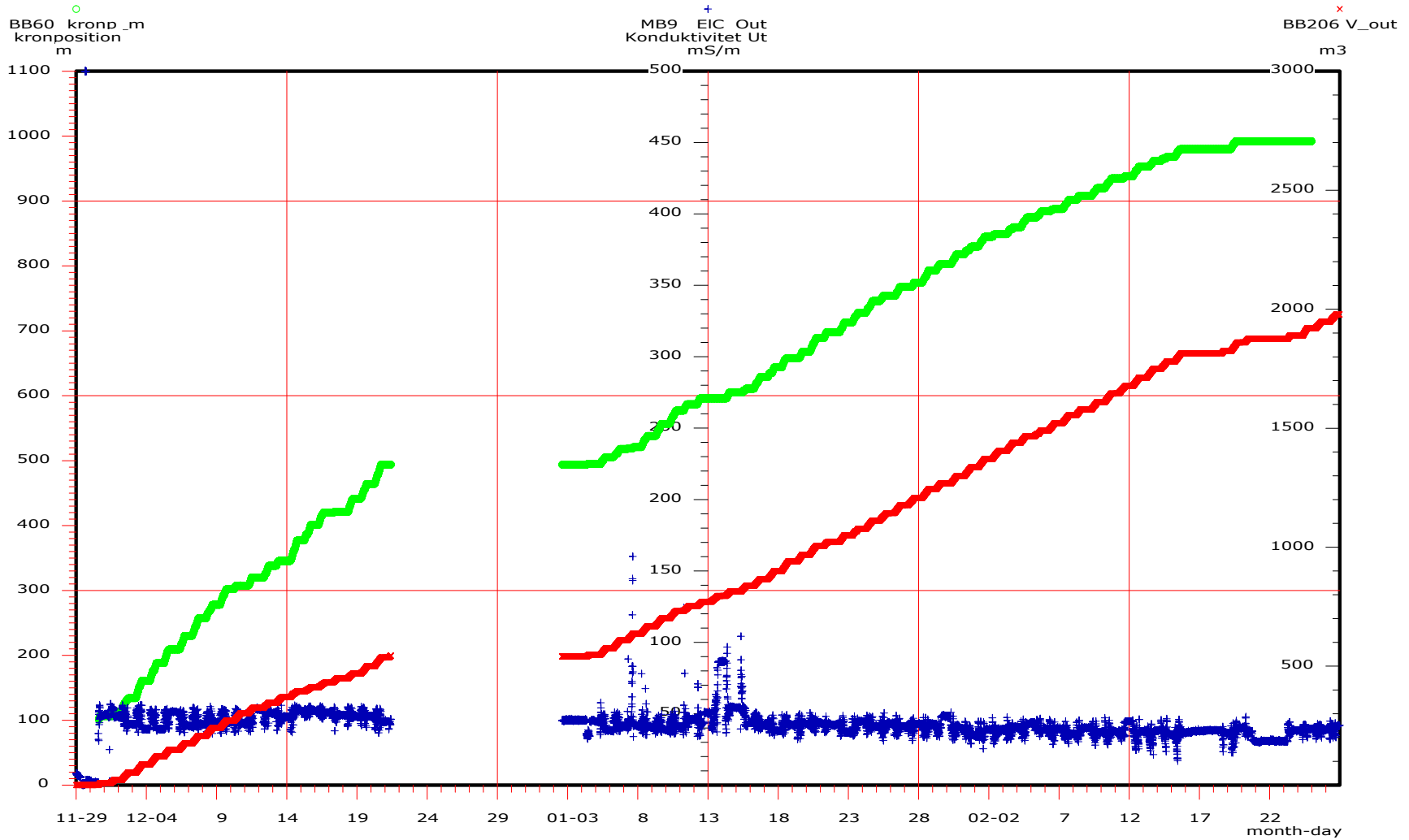
INTERVAL: >= 10 Minutes

STOP :05/10/16 23:59:59

PLOT TIME :07/06/14 08:43:11
PLOT FILE :Water release
No DST Adjustment

DMS2 PO

KLX11A



START :05/11/29 00:00:00

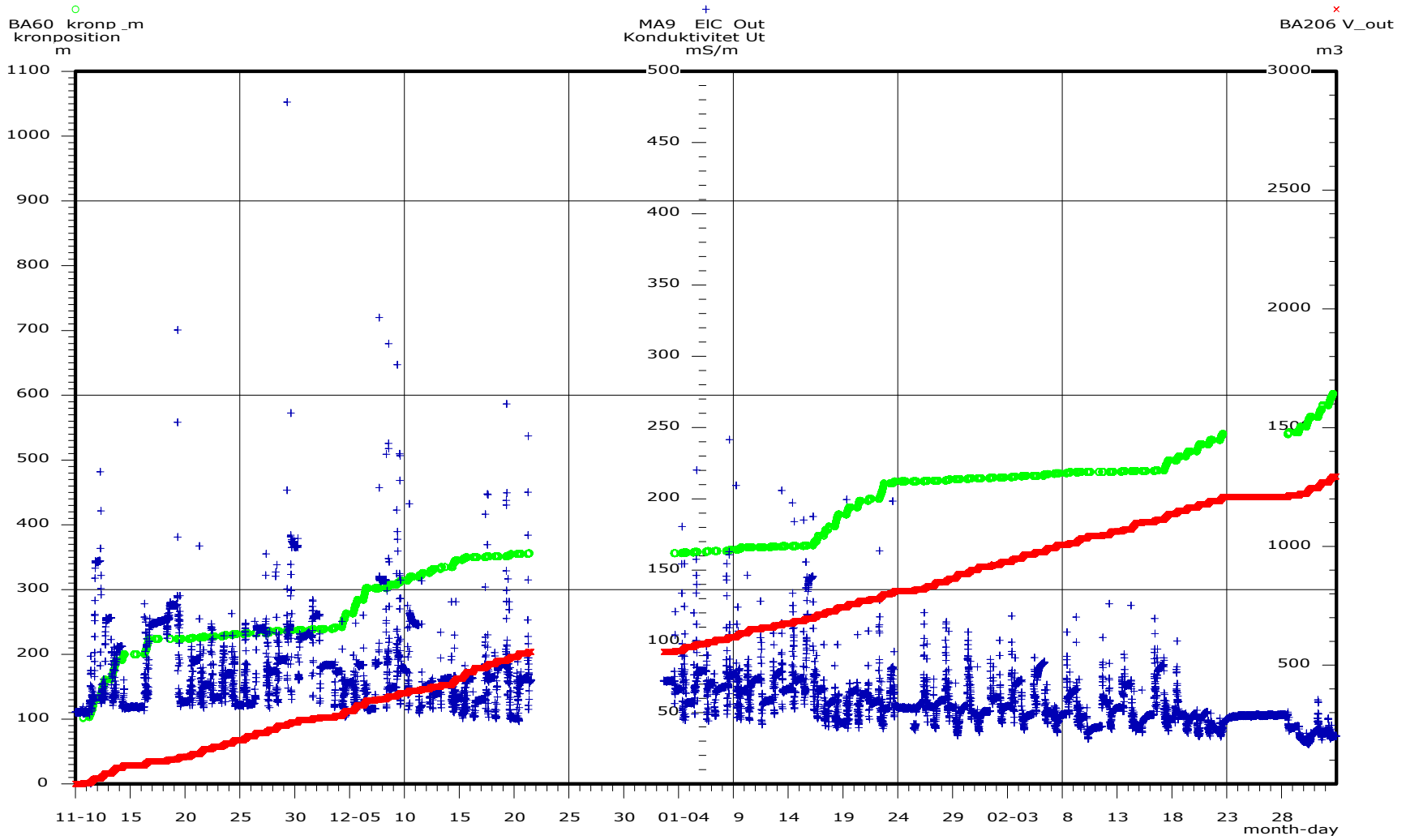
INTERVAL: >= 10 Minutes

STOP :06/02/26 23:59:59

PLOT TIME :07/06/14 08:39:24
PLOT FILE :Water release
No DST Adjustment

DMS1 PO

KLX12A



START :05/11/10 00:00:00

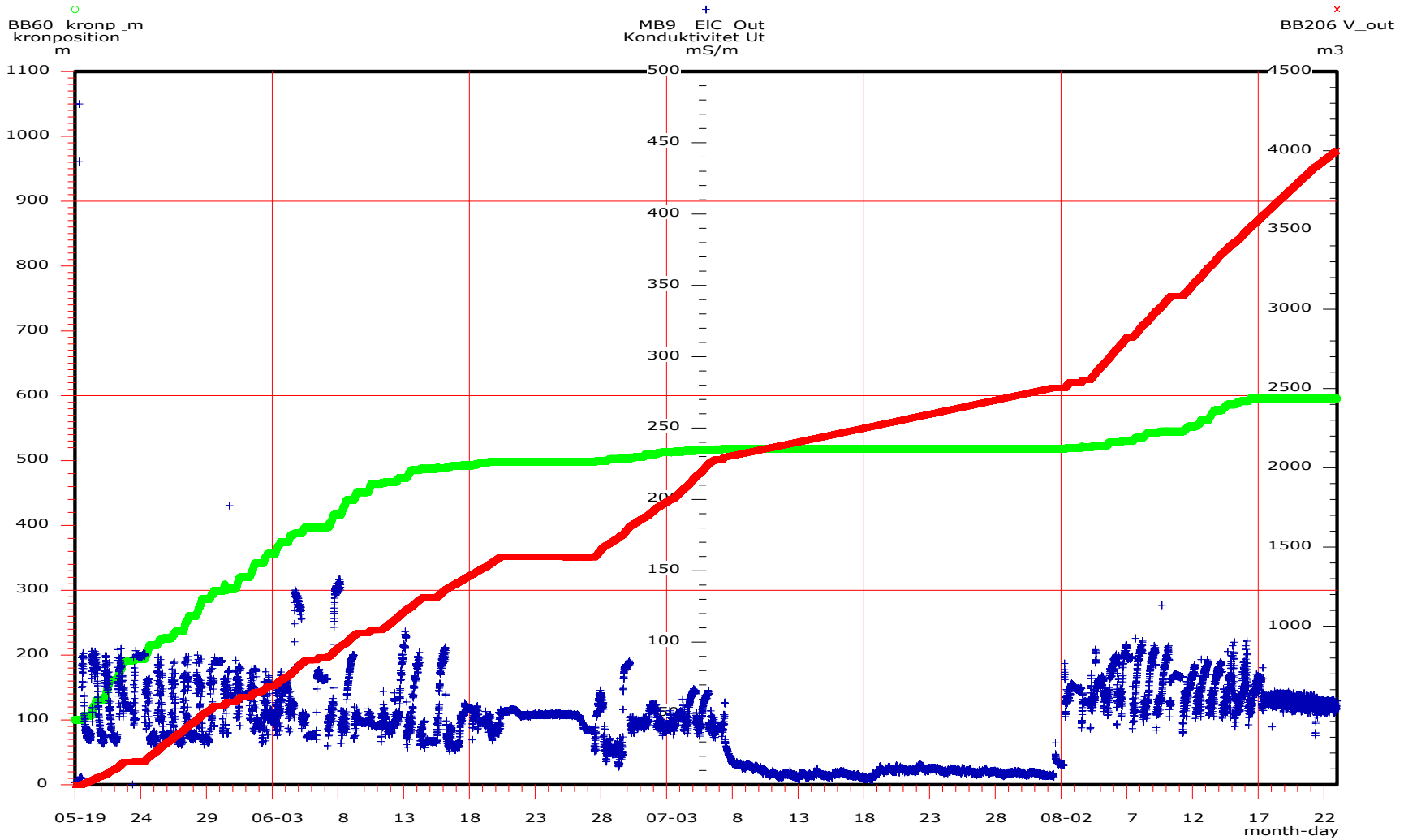
INTERVAL: >= 10 Minutes

STOP :06/03/04 23:59:59

PLOT TIME :07/06/14 08:31:10
PLOT FILE :Water release
No DST Adjustment

DMS2 PO

KLX13A



START :06/05/19 00:00:00

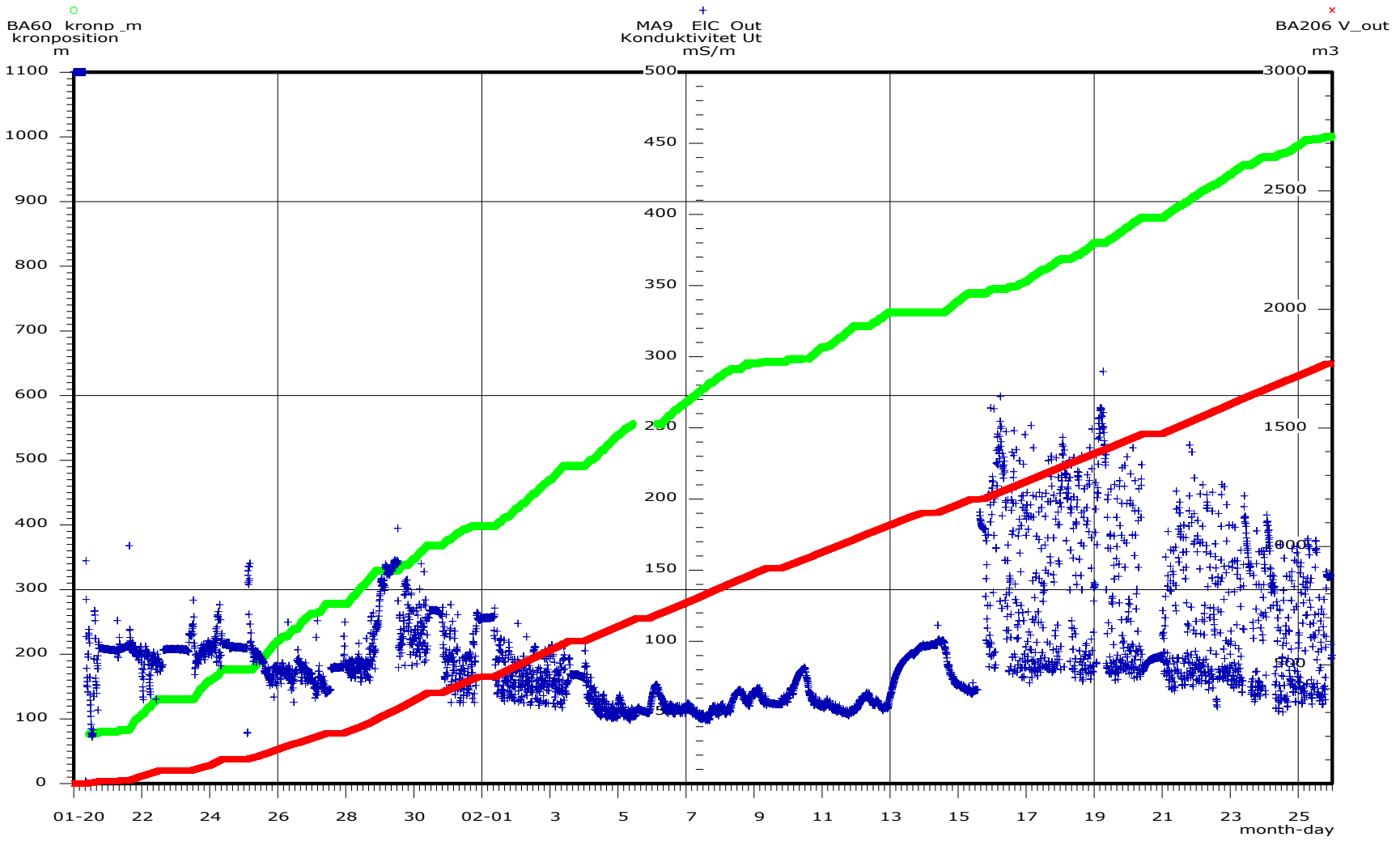
INTERVAL: >= 10 Minutes

STOP :06/08/22 23:59:59

PLOT TIME :07/06/14 08:11:34
PLOT FILE :Water release
No DST Adjustment

DMS1 PO

KLX15A



START :07/01/20 00:00:00

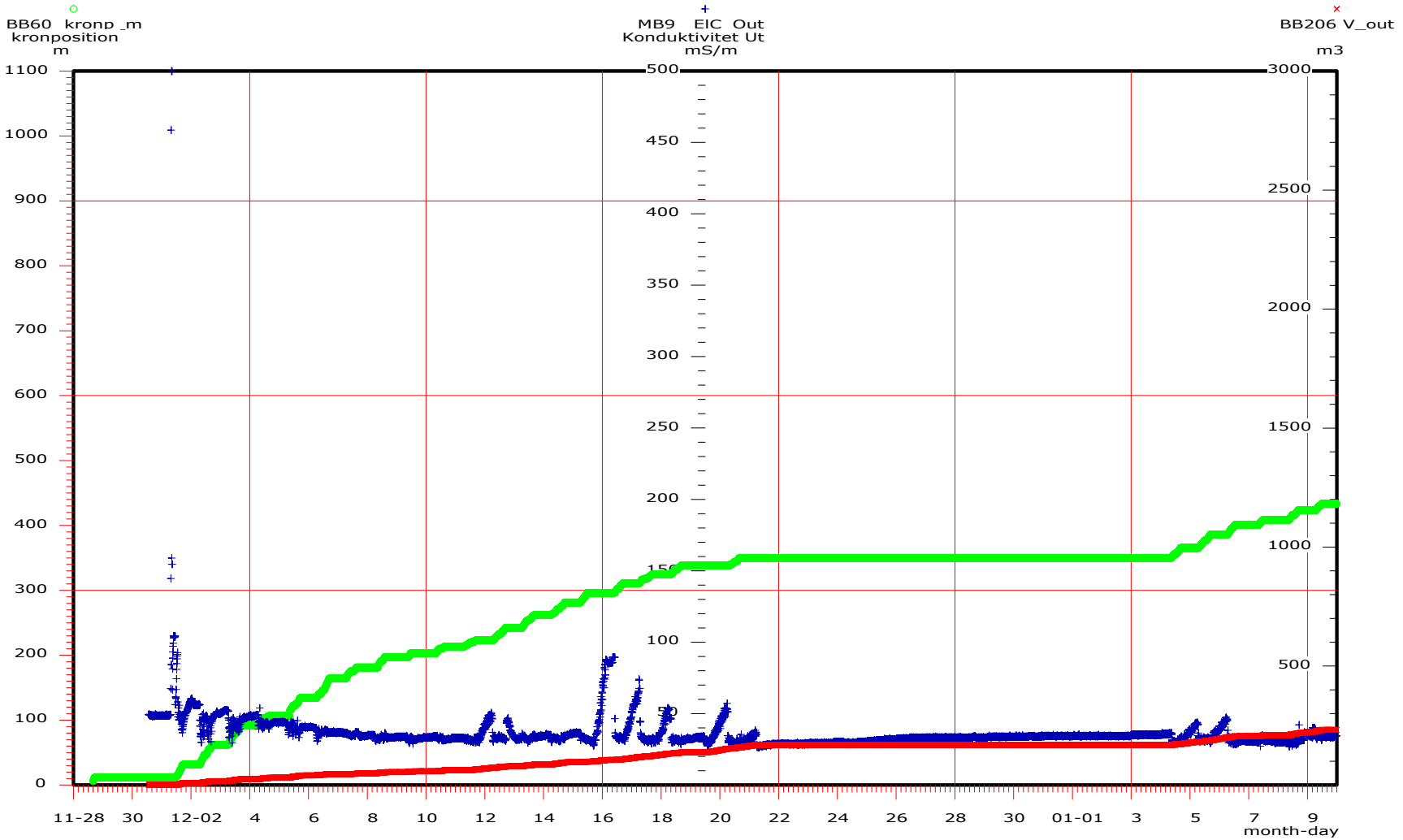
INTERVAL: >= 10 Minutes

STOP :07/02/25 23:59:59

PLOT TIME :07/06/14 08:06:25
PLOT FILE :Water release
No DST Adjustment

DMS2 PO

KLX16A



START :06/11/28 00:00:00

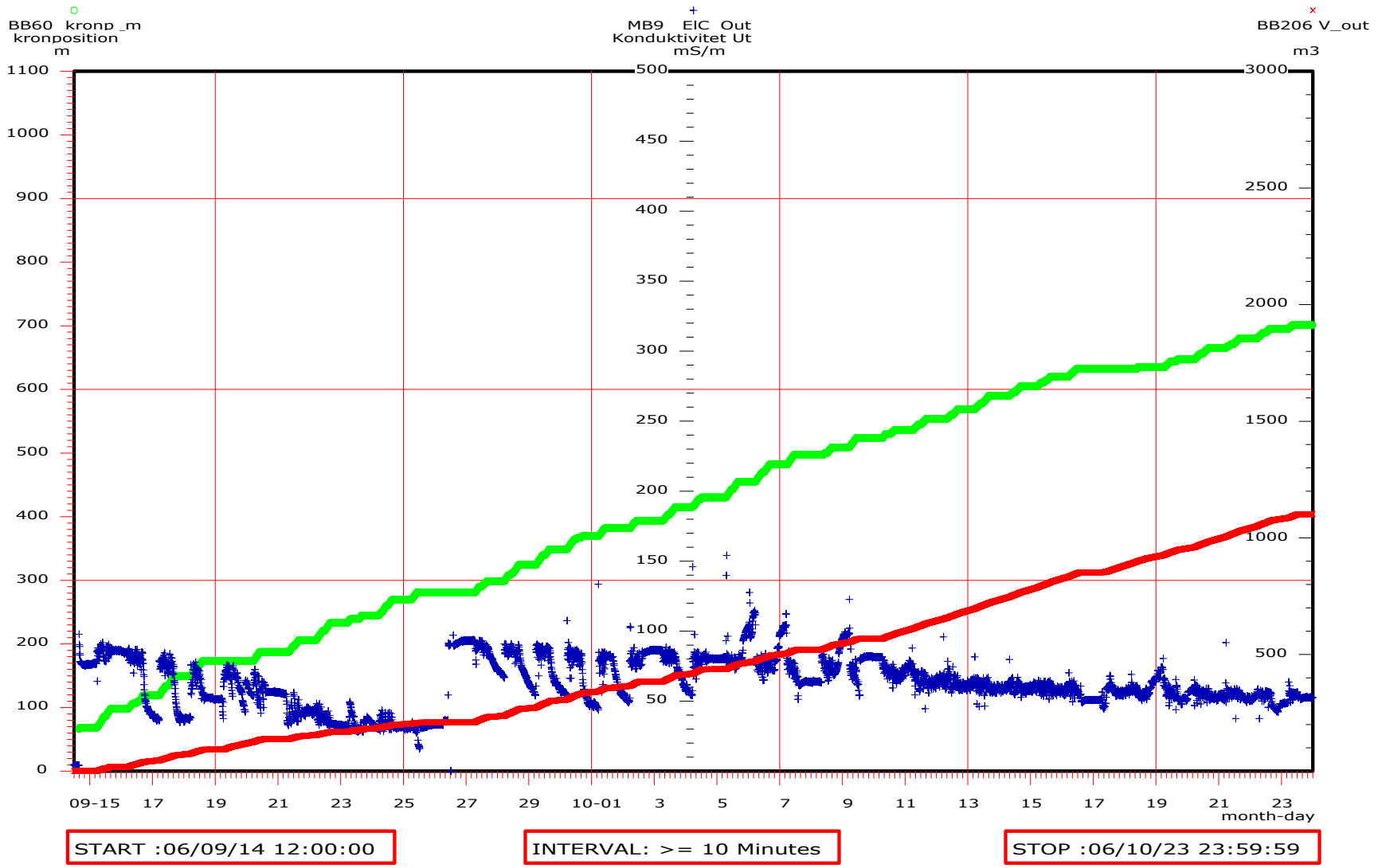
INTERVAL: >= 10 Minutes

STOP :07/01/09 23:59:59

PLOT TIME :07/06/14 07:58:54
PLOT FILE :Water release
No DST Adjustment

DMS2 PO

KLX17A



START :06/09/14 12:00:00

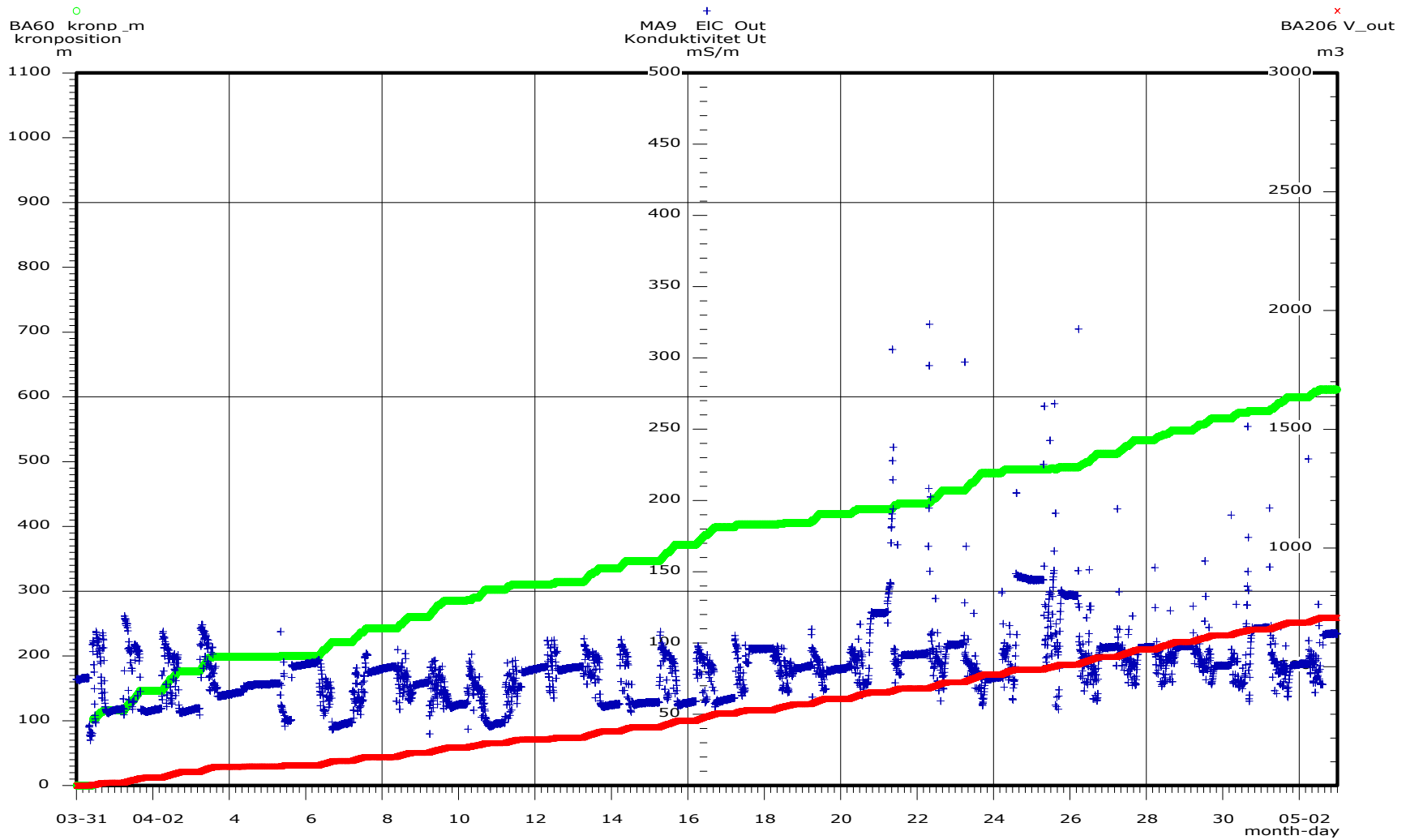
INTERVAL: >= 10 Minutes

STOP :06/10/23 23:59:59

PLOT TIME :07/06/13 14:17:10
PLOT FILE :Water release
No DST Adjustment

DMS1 PO

KLX18A



START :06/03/31 00:00:00

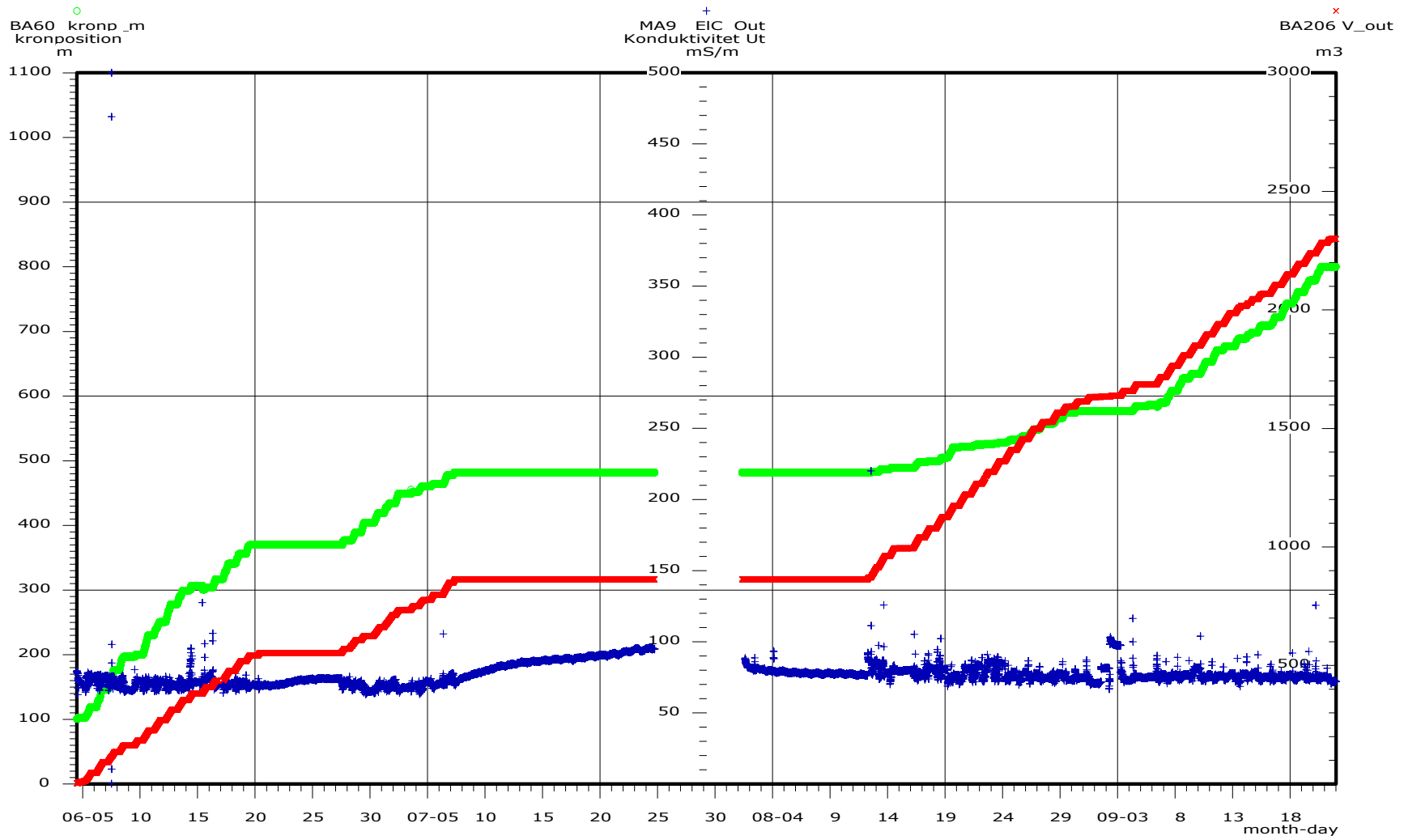
INTERVAL: >= 10 Minutes

STOP :06/05/02 23:59:59

PLOT TIME :07/06/13 13:49:22
PLOT FILE :Water release
No DST Adjustment

DMS1 PO

KLX19A



START :06/06/04 12:00:00

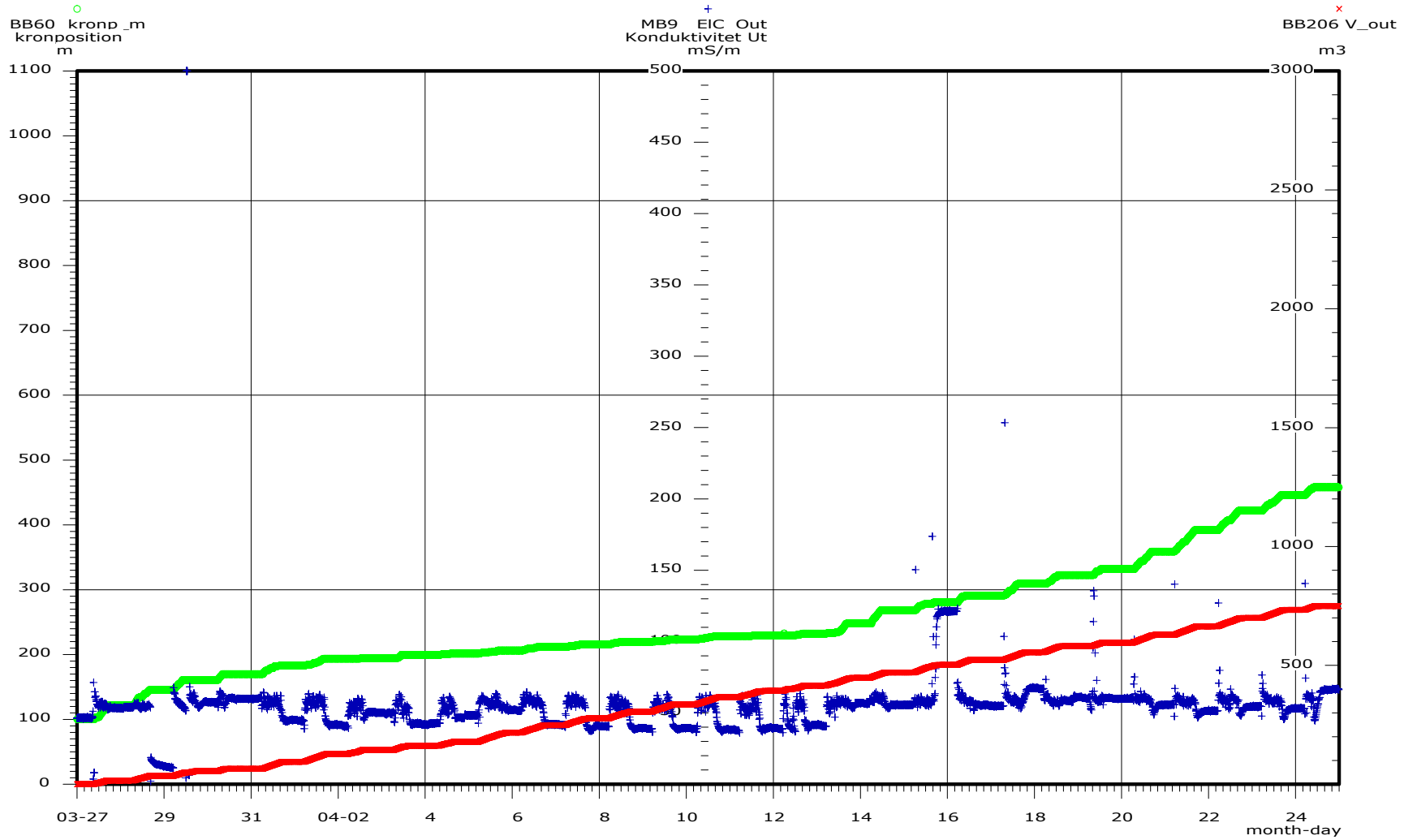
INTERVAL: >= 10 Minutes

STOP :06/09/21 23:59:59

PLOT TIME :07/06/13 13:45:46
PLOT FILE :Water release
No DST Adjustment

DMS2 PO

KLX20A



START :06/03/27 00:00:00

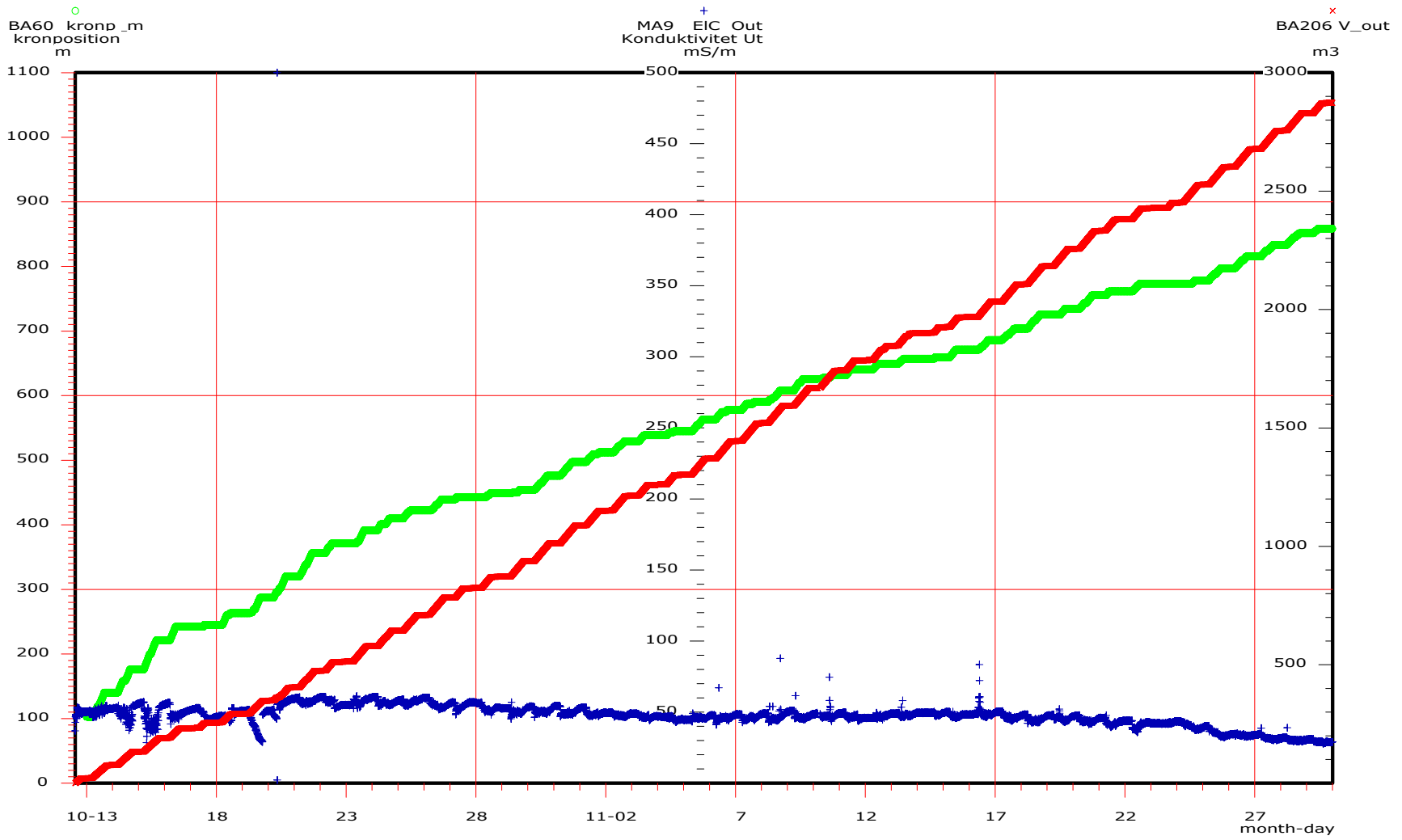
INTERVAL: >= 10 Minutes

STOP :06/04/24 23:59:59

PLOT TIME :07/06/13 12:21:39
PLOT FILE :Water release
No DST Adjustment

DMS1 PO

KLX21B



START :06/10/12 13:30:00

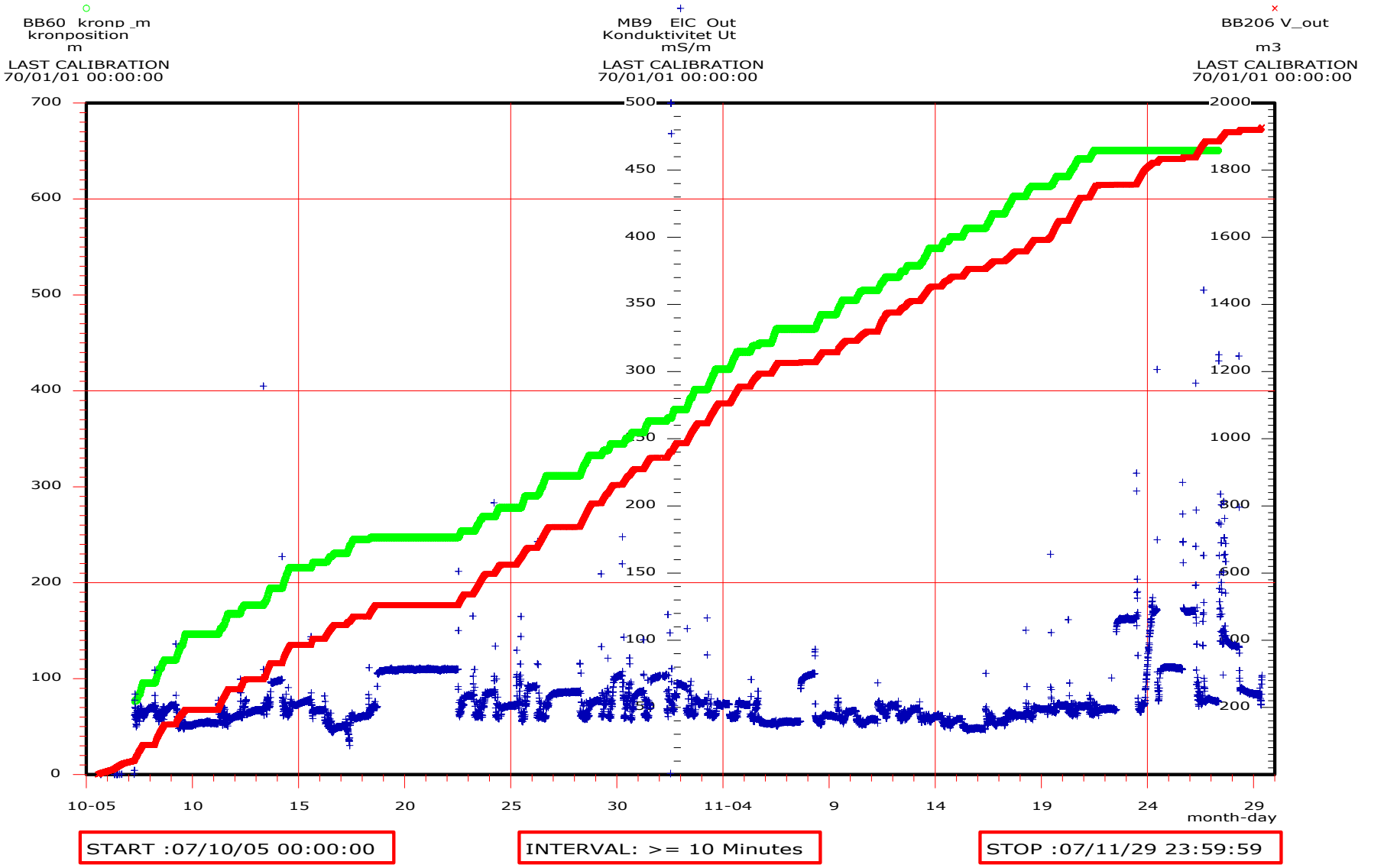
INTERVAL: >= 10 Minutes

STOP :06/11/29 23:59:59

PLOT TIME :08/02/28 16:54:38
PLOT FILE :Water release
No DST Adjustment

DMS2 PO

KLX27A



START :07/10/05 00:00:00

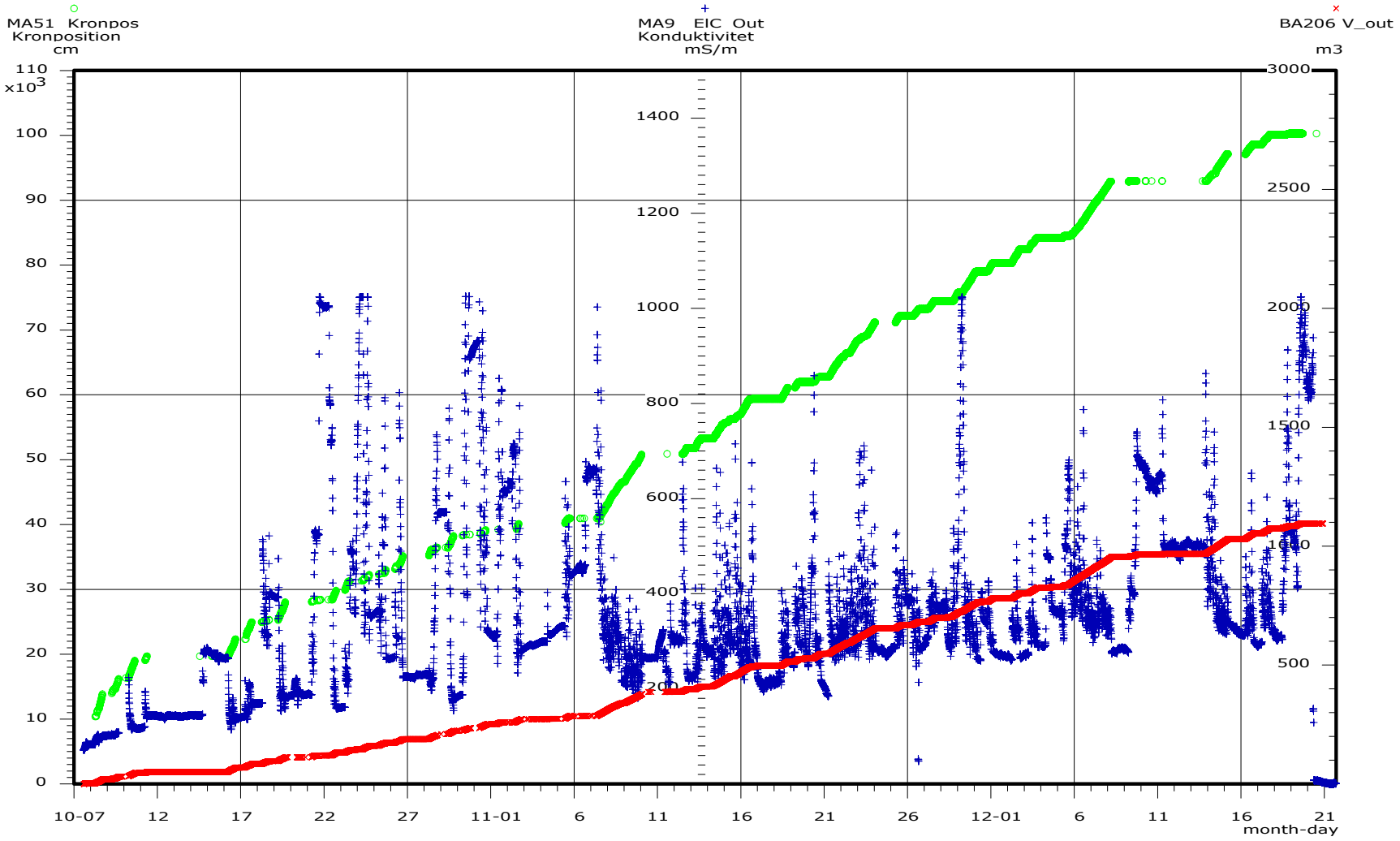
INTERVAL: >= 10 Minutes

STOP :07/11/29 23:59:59

PLOT TIME :07/06/14 13:33:01
PLOT FILE :Water release
No DST Adjustment

DMS1 PO

KSH01



START :02/10/07 00:00:00

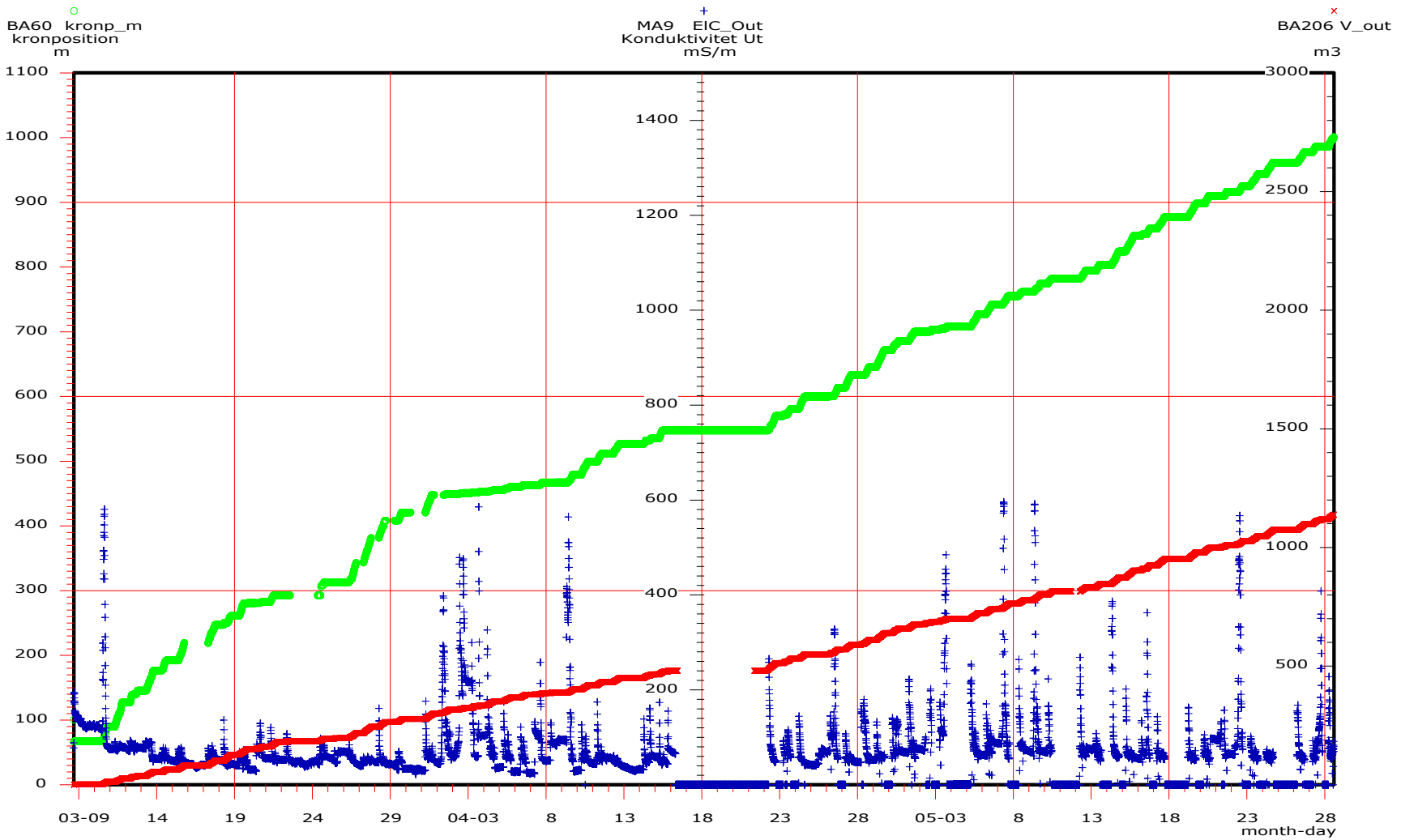
INTERVAL: >= 10 Minutes

STOP :02/12/21 16:59:59

PLOT TIME :07/06/13 13:35:16
PLOT FILE :Water release
No DST Adjustment

DMS1 PO

KSH02



START :03/03/08 16:15:00

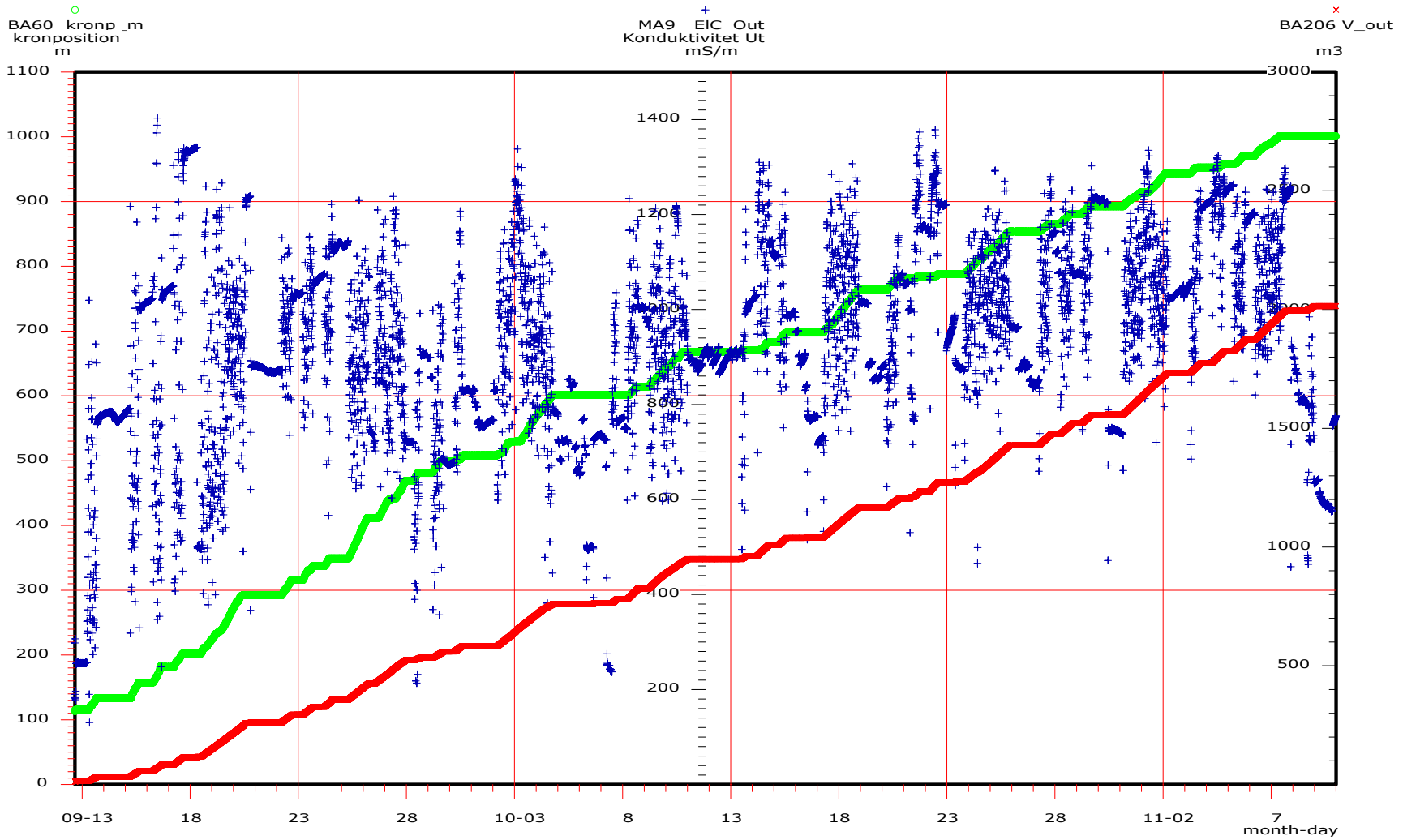
INTERVAL: >= 10 Minutes

STOP :03/05/28 13:59:59

PLOT TIME :07/06/13 12:56:02
PLOT FILE :Water release
No DST Adjustment

DMS1 PO

KSH03



START :03/09/12 16:00:00

INTERVAL: >= 10 Minutes

STOP :03/11/09 23:59:59

Appendix 5

Summary of water release from drilling of short cored boreholes for DFN and MDZ

Borehole	Drilling period		Borehole coordinates			Amount of water consumed* (m^3)	Comment	release point	report	Activity plan
	from	to	N	E	Z					
KLX09B	1/16/2006	1/26/2006	6367329.07	1548859.01	23.62	43.5		KLX09	P-06-265	AP PS 400-05-075
KLX09C	1/7/2006	1/15/2006	6367353.43	1548838.82	23.75	52.5		KLX09	P-06-265	AP PS 400-05-075
KLX09D	11/5/2005	11/17/2005	6367336.99	1548878.22	23.10	52.5		KLX09	P-06-265	AP PS 400-05-075
KLX09E	11/23/2005	12/5/2005	6367304.45	1548880.37	22.16	73.5		KLX09	P-06-265	AP PS 400-05-075
KLX09F	12/6/2005	1/6/2006	6367318.02	1548817.27	19.57	78.0		KLX09	P-06-265	AP PS 400-05-075
KLX11B	4/22/2006	4/28/2006	6366339.51	1546604.89	27.27	39.0		KLX11A	P-06-283	AP PS 400-06-020
KLX11C	3/30/2006	4/5/2006	6366350.26	1546586.89	27.19	39.0		KLX11A	P-06-283	AP PS 400-06-020
KLX11D	4/6/2006	4/13/2006	6366357.37	1546631.42	25.57	45.0		KLX11A	P-06-283	AP PS 400-06-020
KLX11E	4/13/2006	4/21/2006	6366300.39	1546627.23	22.65	35.0		KLX11A	P-06-283	AP PS 400-06-020
KLX11F	3/14/2006	3/17/2006	6366314.09	1546577.96	24.47	60.0		KLX11A	P-06-283	AP PS 400-06-020
KLX09G	1/27/2006	2/3/2006	6367330.09	1548905.77	19.63	no data		KLX09	P-06-297	AP PS 400-05-100
KLX10B	2/8/2006	2/14/2006	6366316.49	1548525.15	18.15	no data		KLX10	P-06-297	AP PS 400-05-102
KLX10C	2/15/2006	2/28/2006	6366372.07	1548506.94	16.94	no data		KLX10	P-06-297	AP PS 400-05-102
KLX22A	5/5/2006	5/12/2006	6366548.35	1546688.60	21.98	no data	hydraulic injection test made June 7	within 30 m from collar location	P-06-297	AP PS 400-06-055
KLX22B	5/13/2006	5/18/2006	6366553.13	1546685.40	21.58	no data	hydraulic injection test made June 7	within 30 m from collar location	P-06-297	AP PS 400-06-055
KLX23A	5/21/2006	5/27/2006	6366106.89	1546715.74	22.26	no data	hydraulic injection test made June 5, 6 and 7	within 30 m from collar location	P-06-297	AP PS 400-06-055
KLX23B	5/28/2006	5/31/2006	6366101.90	1546717.33	22.32	no data	hydraulic injection test made June 4	within 30 m from collar location	P-06-297	AP PS 400-06-055
KLX24A	6/14/2006	6/29/2006	6366423.35	1546853.80	21.29	no data	hydraulic injection test made June 29	within 30 m from collar location	P-06-297	AP PS 400-06-055
KLX25A	7/1/2006	7/4/2006	6366274.74	1546769.66	22.84	no data	hydraulic injection test made July 5	within 30 m from collar location	P-06-297	AP PS 400-06-055
KLX26A	8/3/2006	8/11/2006	6365546.49	1549029.90	15.63	no data	hydraulic injection test made August 7 and 17	within 30 m from collar location	P-06-297	AP PS 400-06-055
KLX26B	8/12/2006	8/17/2006	6365550.66	1549025.61	15.82	no data	hydraulic injection test made August 17	within 30 m from collar location	P-06-297	AP PS 400-06-055
KLX28A	9/14/2006	9/20/2006	6365682.22	1549333.71	15.82	no data	hydraulic injection test made September 20	within 30 m from collar location	P-06-297	AP PS 400-06-055
KLX29A	9/9/2006	9/13/2006	6366264.54	1549443.99	13.63	no data	hydraulic injection test made September 11	within 30 m from collar location	P-06-297	AP PS 400-06-055

* the consumed amount of water during drilling should be slightly higher than the released amount of water

Appendix 6

Overview of water consumption from supply wells

HLX10 Date		Flow L/min	Borehole	Comment	DMS1	DMS2
3/15/2004	3/18/2004	25	KLX04	Constant flow. Overflow released at KLX04		x
3/18/2004	8/26/2004	0–70	KLX04	Tracer test in KLX02-HLX10 between 040707-040713 and 040720-040728.		x
8/26/2004	10/6/2004	0–45	KLX06			x
10/3/2004	10/6/2004	0–90	KLX05	Water was carried from HLX10 to KLX05 in tanks	x	
10/6/2004	12/17/2004	0–90	KLX05		x	
12/17/2004	12/22/2004	40–45	KLX07A and KLX05	Constant flow in HLX10. Overflow released to Ekerumsbäcken close to KLX07A.		x
12/22/2004	12/29/2004	0		Recovery in well HLX10 before pumping test		x
12/29/2004	2/10/2005	90	KLX07A and KLX05	Constant flow in HLX10. Overflow released to Ekerumsbäcken close to KLX07A.		x
2/10/2005	6/14/2005	40	KLX07A and KLX08	Constant flow in HLX10. Overflow released to Ekerumsbäcken close to KLX07A.		x
6/14/2005	6/27/2005	40	KLX07A and KLX08	Constant flow in HLX10. Overflow released to Ekerumsbäcken close to KLX07A.	x	
6/27/2005	7/9/2005	40	KLX10	Constant flow 40 L/min pumped for supply of core drilling. Overflow released to the ground at KLX10.		x
7/9/2005	8/9/2005	40	KLX10	Constant flow 40 L/min pumped for supply of core drilling. Overflow released to the ground at KLX10. A second pump in HLX10 with unknown flow has been in use for water supply to Laxemar village.		x
8/9/2005	9/1/2005	30	KLX10	Constant flow. Overflow released to the ground at KLX10.		x
9/1/2005	11/11/2005	30	KLX10	Constant flow in HLX10. Overflow released to Ekerumsbäcken close to HLX10. The flow was temporarily increased to 90 L/min during two hours 2005-11-08 (ca 15–17)		x
11/11/2005	12/21/2005	30	KLX12A and short holes	Constant flow to water tank near HLX10. The overflow released to Ekerumsbäcken near HLX10. Water has been taken from the tank to the core drilling of the DFN boreholes KLX09D, E and F.	x	
2005/12/21	2006/01/03	0		No pumping	x	
2006/01/03	2006/03/28	45–90	KLX12A and short holes	Constant flow of 45 L/min to KLX12A and intermittent flow 80–90 l/min while filling tanks for short holes KLX09C, B, G and F; KLX10B and C. Overflow released to Ekerumsbäcken close to HLX10.	x	
2006/10/11	2007/01/17	0–50	KLX21B and KLX16A	Flushing water was transported from KLX21B to KLX16A. Pumping for water supply to drilling stopped 2007-01-17	x	
2007/10/03	2007/11/17	0–110	KLX27A	Water is pumped intermittently from HLX10 and trasnsported by truck to KLX27A		x
2007/11/17	2007/12/17	0		No pumping in HLX10. Registration as flushing water well is stopped on December 17, 2007		x

HLX20						
Date		**Flow L/min**	**Borehole**	**Comment**	**DMS1**	**DMS2**
10/6/2004	12/15/2004	0–95	KLX06			x
12/15/2004	8/25/2005	0		No pumping. No registration in DMS.		
8/25/2005	10/28/2005	0–75	KLX09		x	
10/28/2005	11/22/2005	0–75	KLX09D	Minor amount of water taken to KLX09D. Not logged in DMS.		
11/22/2005	1/27/2006	0		No pumping		
1/27/2006	5/3/2006	0–75	KLX09G and others	Water transported to short cored boreholes KLX09G and others 188 m^3. Not logged in DMS		

HLX14						
Date		**Flow L/min**	**Borehole**	**Comment**	**DMS1**	**DMS2**
3/30/2006	3/31/2006	50	KLX18A	Constant flow. Overflow released at HLX14 and led to Ekerumsbäcken.	x	
3/31/2006	5/18/2006	52	KLX18A	Constant flow. Overflow released at HLX14 and led to Ekerumsbäcken.	x	
5/18/2006	5/22/2006	47	KLX18A and KLX13A	Constant flow. Overflow released at HLX14 and led to Ekerumsbäcken.	x	
5/22/2006	6/26/2006	47	KLX13A	Constant flow. Overflow released at HLX14 and led to Ekerumsbäcken.		x
6/26/2006	8/3/2006	55	KLX13A	Constant flow. Overflow released at HLX14 and led to Ekerumsbäcken.		x
8/3/2006	8/9/2006	55	KLX13, KLX26A och KLX26B	Constant flow. Overflow released at HLX14 and led to Ekerumsbäcken. DMS2 is closed		x
8/9/2006	2006-08-13	55	KLX26A and KLX26B	Constant flow. Overflow released at HLX14 and led to Ekerumsbäcken. Water transported from buffer tank at HLX14 to KLX26A and KLX26B. No logging in DMS		
2006-08-13	9/11/2006	55		Constant flow. Overflow released at HLX14 and led to Ekerumsbäcken. No logging in DMS		
9/11/2006	9/13/2006	53–54	KLX28A and KLX29A	Constant flow. Overflow released at HLX14 and led to Ekerumsbäcken. Water transported from buffer tank at HLX14 to KLX28A and KLX29A. No logging in DMS.		
9/13/2006	9/20/2006	53–54	KLX17A, KLX28A and KLX29A	Constant flow. Overflow released at HLX14 and led to Ekerumsbäcken. Water transported from buffer tank at HLX14 to KLX28A and KLX29A. DMS2 is started for KLX17A.		x
9/20/2006	10/27/2006	53–54	KLX17A	Constant flow. Overflow released at HLX14 and led to Ekerumsbäcken.		x
10/27/2006	1/17/2007	0		No pumping. No registration in DMS.		
2007/01/17	2007/03/07	44	KLX15A	Constant flow. Water is pumped from HLX14 to KLX03. Overflow is allowed to infiltrate to the ground at KLX03. Flushing water for KLX15A pumped to the core drill site. Pumping stopped 2007-03-07	x	

HLX27						
Date		**Flow L/min**	**Borehole**	**Comment**	**DMS1**	**DMS2**
6/18/2005	6/28/2005	0–60	KLX10	Well HLX27 was discontinued due to high electrical conductivity in the water (ca 400 mS/m). A water consumption varying between 0 and 60 L7Min was regostered by the DMS2 system at drill site KLX10. No registration of the pumped up amounts of water was however taken at HLX27. The water was carried in tanks from HLX27 to the KLX10 drill site.		

HLX28						
Date		**Flow L/min**	**Borehole**	**Comment**	**DMS1**	**DMS2**
11/29/2005	12/21/2005	0–78	KLX11A			x
12/21/2005	1/3/2006	0		No pumping		x
1/3/2006	3/17/2006	0–78	KLX11A and KLX11F			x
3/17/2006	3/20/2006	0–78		Not logged in DMS. Limited amount of pumping done.		
3/20/2006	5/4/2006	0–78	KLX20A, KLX11C, D, E and B	Water supplied for drilling of KLX20A and short DFN holes		x
5/4/2006	5/23/2006	0–78	KLX22A, B KLX23A, B	Water transported for short boreholes KLX22A, B and KLX23A, B. Not logged in DMS. Total pumped volume from HLX28 was 409 m^3 20060504-20060602 (manual readings)		
5/23/2006	6/2/2006	0–78	KLX22A, B KLX23A, B	Water transported for short boreholes KLX22A, B and KLX23A, B. Logged in DMS1PO. Total pumped volume from HLX28 was 409 m^3 20060504-20060602 (manual readings)	x	
6/2/2006	6/26/2006	50	KLX19A and short holes (KLX24A, KLX25A)	Constant flow. Overflow released at HLX28 and led to Laxemarån.	x	
6/26/2006	7/26/2006	40	KLX19A and short holes (KLX24A, KLX25A)	Constant flow. Overflow released at HLX28 and led to Laxemarån.	x	
7/26/2006	8/1/2006	0		Pumping temporarily stopped due to thunderstorm	x	
8/1/2006	8/28/2006	38	KLX19A	Constant flow. Overflow released at HLX28 and led to Laxemarån.	x	
8/28/2006	9/28/2006	53	KLX19A and KLX14A	Constant flow. Overflow released at HLX28 and led to Laxemarån. Pumping stopped on 2006-10-06.	x	
9/28/2006	10/9/2006	0		No pumping – the water level in HLX28 is registered in DMS1PO	x	

Appendix 7

Dates and times for nitrogen gas flushing in cored boreholes

borehole	date	time from	to	comment
KSH01A	N/A	N/A		Not done
KSH01B	N/A	N/A		Not done
KSH02:	2003-06-10	14.02	14.16	
	2003-06-10	17.12	17.45	
KSH03A:	2003-11-19	14.00	17.35	
	2003-11-20	06.00	13.02	
KSH03B	N/A	N/A		Not done
KAV04A:	2004-05-09	12.30	18.00	
	2004-05-10	06.00	10.00	
KLX03:	2004-09-20	14.35	15.13	
	2004-09-20	17.04	17.25	
	2004-09-20	21.45	22.15	
KLX04:	2004-07-06	13.00	19.00	
	2004-07-07	06.00	14.00	
KLX05:	2005-03-22	10.35	11.15	
	2005-03-22	13.00	13.00	
	2005-03-22	13.10	13.40	
KLX06:	2004-12-18	07.00	19.00	
	2004-12-19	07.00	19.00	
KLX07A:	2005-06-06	09.00	18.00	
KLX07B:	2005-06-07	09.00	14.00	
KLX08:	2005-06-16	10.00	10.40	
	2005-06-17	15.30	18.00	
	2005-06-18	06.00	9.00	
	2005-07-04	13.00	18.00	
	2005-07-05	06.00	16.00	
	2005-09-23	13.00	18.00	
	2005-09-24	08.00	12.00	
KLX09:	2005-11-02	18.05		no data on stop time
	2005-11-03	06.00		no data on stop time
	2005-11-03	09.00		no data on stop time
KLX10:	2005-11-13	07.00		no data on stop time
	2005-11-13	12.00		no data on stop time
KLX11A:	2006-03-21	15.51		no data on stop time
	2006-03 22	07.07		no data on stop time
	2006-03 22	08.47		no data on stop time
	2006-03 22	14.10		no data on stop time
	2006-03 22	15.34		no data on stop time
	2006-03 22	16.31		no data on stop time
KLX12A:	2006-03-21	06.00	11.00	4 times
KLX13A:	2006-09-06	15.34	15.48	
	2006-09-06	16.33	16.50	
	2006-09-07	06.20	06.37	
	2006-09-07	07.13	07.33	
	2006-09-07	08.10	08.32	
KLX14A:	2006-09-08	12.30	17.00	
	2006-09-09	07.00	12.00	
	2006-09-22	16.07	16.13	
	2006-09-23	10.23	10.33	

borehole	date	time from	to	comment
	2006-09-23	10.37	10.43	
KLX15A:	2007-03-12	09.09	9.55	
	2007-03-12	10.47	11.26	
	2007-03-12	12.30	12.56	
	2007-03-12	14.18	14.51	
	2007-03-13	06.31	6.58	
	2007-03-13	08.14	8.42	
KLX16A	2007-01-20	11.27	11.38	
	2007-01-20	13.04	13.16	
	2007-01-20	13.39	13.49	
	2007-01-20	14.07	14.19	
	2007-01-20	14.38	14.51	
	2007-01-20	15.08	15.22	
	2007-01-20	15.41	15.58	
	2007-01-22	12.10	12.25	
	2007-01-23	10.15	10.30	
	2007-01-23	10.42	10.52	
KLX17A	2006-11-05	08.06	8.24	
	2006-11-05	08.33	8.50	
	2006-11-05	09.09	9.29	
	2006-11-05	10.01	10.18	
	2006-11-05	10.45	11.03	
	2007-01-25	09.00	11.30	2 times
KLX18A:	2006-05-14	08.12	08.35	
	2006-05-14	09.05	09.31	
	2006-05-14	09.57	10.16	
	2006-05-14	11.09	11.35	
	2006-05-18	08.00	10.00	2 times
	2006-05-24	13.07	13.29	
KLX19A:	2006-09-04	17.00		no data on stop time
	2006-09-04	17.30		no data on stop time
	2006-09-05	06.22		no data on stop time
	2006-10-06	13.55	14.10	
	2006-10-06	14.20	14.35	
	2006-10-06	14.50	15.20	
KLX20A:	2006-05-01	06.00		no data on stop time
	2006-05-08	10.53		no data on stop time
	2006-05-08	12.37		no data on stop time
	2006-05-08	13.25		no data on stop time
KLX21B:	2006-12-13	14.00	14.35	
	2006-12-13	15.35	16.08	
	2006-12-14	07.15	8.01	
	2006-12-14	09.05	9.38	
	2006-12-14	10.20	11.00	
KLX27A:	2007-12-01	16.22	16.39	
	2007-12-02	06.28	06.47	
	2007-12-02	07.18	07.43	
	2007-12-02	08.18	08.39	
	2007-12-02	09.14	09.31	
	2007-12-02	10.13	10.31	
	2007-12-02	12.40	13.01	
	2007-12-02	13.14	13.32	
	2007-12-02	13.58	14.27	
MDZ				
KLX22A:	2006-07-02	08.50	10.20	

borehole	date	time		comment
		from	to	
KLX22B:	2006-07-02	08.50	10.20	
KLX23A:	2006-07-01	10.00	17.00	
KLX23B:	2006-07-01	10.00	17.00	
KLX24A:	2006-07-01	10.00	17.00	
KLX25A:	2006-07-06	14.23	14.59	
KLX26A:	2006-08-20	11.11	11.39	
KLX26B:	2006-08-20	11.59	12.39	
KLX28A:	2006-09-21	10.30	11.30	
KLX29A:	2006-09-20	12.30	14.00	
	2006-09-20	18.30	19.15	
DFN				
KLX09B:	2006-01-28	10.30	11.50	
KLX09C:	2006-01-16	13.30	15.10	
KLX09D:	2005-11-18			no times are recorded
	2006-02-08	13.00	15.30	
KLX09E:	2005-12-06	08.15	08.45	
KLX09F:	2006-01-09	09.30	13.30	
KLX09G:	2006-02-08	13.00	15.30	
KLX10B:	2006-03-01	08.30	11.30	
KLX10C:	2006-03-01	08.30	11.30	
KLX11B:	2006-05-09	15.53	16.34	
KLX11C:	2006-05-08	15.37	17.38	
KLX11D:	2006-05-09	11.15	14.05	
KLX11E:	2006-05-09	10.20	11.00	
KLX11F:	2006-05-09	08.22	09.32	

Appendix 8

Overview of environmental monitoring wells

Subarea Simpevarp Borehole	no of wells /comment	enviromental well		Activity plan	P-report
KSH01A to B	1	SSM000002		AP PS 400-02-016	P-03-80
KSH02	1	SSM000004		AP PS 400-02-029	P-03-80
KSH03A to B	1	SSM000006		AP PS 400-03-047	P-04-46
KAV04A to B	1	SSM000007		AP PS 400-03-047	P-04-46
HSH01	1	SSM000001		AP PS 400-02-016	P-03-80
HSH02	1	SSM000005		AP PS 400-02-029	P-03-80
HSH03	see HSH01				
Subarea Laxemar **Borehole**	**no of wells /comment**	**enviromental well**		**Activity plan**	**P-report**
KLX01	none				
KLX02	same as KLX07A				
KLX03	2	SSM000017	SSM000019	AP PS 400-04-008	P-05-167
KLX04	2	SSM000009	SSM000011	AP PS 400-03-061	P-04-121
KLX05	2	SSM000212	SSM000213	AP PS 400-04-019	P-04-317
KLX06	2	SSM000210	SSM000211	AP PS 400-04-019	P-04-317
KLX07A to B	2	SSM000216	SSM000217	AP PS 400-04-096	P-04-16
KLX08	same as KLX04				
KLX09	2	SSM000218	SSM000219	AP PS 400-05-020	
KLX10	2	SSM000220	SSM000221	AP PS 400-05-021	P-06-116
KLX11A	2	SSM000236	SSM000237	AP PS 400-05-065	P-06-306
KLX12A	same as KLX05				
KLX13A	2	SSM000248	SSM000249	AP PS 400-06-010	P-07-195
KLX14A	none				
KLX15A	1	SSM000268		AP PS 400-06-101	
KLX16A	2	SSM000269	SSM000271	AP PS 400-06-133	
KLX17A	2	SSM000252	SSM000253	AP PS 400-06-073	
KLX18A	2	SSM000250	SSM000251	AP PS 400-06-011	P-07-98
KLX19A	2	SSM000254	SSM000255	AP PS 400-06-054	
KLX20A	same as KLX11A				
KLX21B	2	SSM000256	SSM000257	AP PS 400-06-108	
KLX27A	and same as KLX19A	SSM000277		AP PS 400-07-058	
KLX09G	none				
KLX10B to C	none				
KLX22A to B	none				
KLX23A to B	none				
KLX24A	none				
KLX25A	none				
KLX26A to B	none				
KLX28A	none				
KLX29A	none				
KLX09B to F	none				
KLX11B to F	none				
HLX10	1	SSM000039		AP PS 400-04-019	P-04-317
HLX14	1	SSM000021		AP PS 400-04-008	P-05-167
HLX20	1	SSM000209		AP PS 400-04-019	P-04-317
HLX22	1	SSM000214		AP PS 400-04-096	
HLX27	1	SSM000215		AP PS 400-04-096	
HLX28	same as KLX19A				
HLX42	1	SSM000270		AP PS 400-06-109	P-06-291
Total	41				

Appendix 9

Summary of pumping in conjunction with complete chemical characterization

Borehole	Section (m)	Pumping start	Pumping stop	Estimated flow mL/min	Estimated amount of pumped up water m^3	Point of release	Activity plan	P-report	Comment
KSH01A	156.50–167.00	2003-03-27*	2003-04-23*	400	16	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-02-033	P-04-12	The flow was highest in the start. Later on stable at 350–400 mL/min.
KSH01A	245.00–261.58	2003-04-24*	2003-05-20*	680	26	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-02-033	P-04-12	The logged flow was 580–680 mL/min. However the manual readings indicate 200 mL/min.
KSH01A	586.00–595.69	2003-05-21*	2003-06-17*	400	16	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-02-033	P-04-12	Chemmac measurements were not done in this section. The flow was probably the same as the other sections. Assumed 400 mL/min
KSH01A	548.00–565.35	2003-06-23*	2003-09-17*	600	90	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-02-033	P-04-12	Most of the time 500–600 mL/min. However the manual readings indicate 200 mL/min.
KLX03	193.50–198.37	2004-11-25*	2004-12-16*	230	7	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-04-042	P-06-08	
KLX03	open hole	12/21/2004	1/17/2005	5,000	200	The water was released at the KLX03 drillsite (water release point as given in Appendix 3)	AP PS 400-04-042	P-06-08	Pumping of open hole to reduce uranine tracer content. Not constant flow. The pump would stop and start but average flow is estimated at 5 L/min.
KLX03	660.00–670.65	2005-01-18*	2005-01-21*	260	1	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-04-042	P-06-08	Interrupted investigation.
KLX03	964.50–975.15	2005-01-21*	2005-02-15*	280	8	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-04-042	P-06-08	
KLX03	408.00–415.30	2005-02-17*	2005-03-22*	240	7	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-04-042	P-06-08	
KLX03	735.50–748.04	2005-03-22*	2005-04-26*	260	8	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-04-042	P-06-08	

Borehole	Section (m)	Pumping start	Pumping stop	Estimated flow mL/min	Estimated amount of pumped up water m³	Point of release	Activity plan	P-report	Comment
KLX08	197.00–206.65	2005-11-22*	2005-12-20*	180	6	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-05-047	P-06-308	
KLX08	476.00–485.65	2006-01-03*	2006-01-17*	200	4	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-05-047	P-06-308	
KLX08	610.00–619.65	2006-01-17*	2006-02-01*	200	4	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-05-047	P-06-308	
KLX08	396.00–400.87	2006-02-02*	2006-03-07*	190	6	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-05-047	P-06-308	
KLX08	Open hole	3/8/2006	3/28/2006	84,000	2,070	The water was released at the KLX08 drillsite (water release point as given in Appendix 3)	AP PS 400-05-047	P-06-308	Pumping of open hole to reduce uranine tracer content. The value of electrical conductivity was 50–70 mS/m and is taken from analysis done at the Äspö laboratory
KLX08	610.00–619.62	3/30/2006	4/3/2006	600	4	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-05-047	P-06-308	Interrupted investigation. No flow data avalable from the section. It is assumed that the flow is 75–600 mL/min.
KLX08	476.00–485.62	2006-04-03*	2006-04-25*	250	6	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-05-047	P-06-308	
KLX08	599.27–1,000.41	5/3/2006	5/8/2006	15,000	100	The water was released at the KLX08 drillsite (water release point as given in Appendix 3).	AP PS 400-05-047	P-06-308	Rinse pumping to reduce uranine tracer content. The value of electrical conductivity was 230–260 mS/m and is taken from analysis done at the Äspö laboratory
KLX08	473.37–1,000.41	5/9/2006	5/17/2006	23,000	256	The water was released at the KLX08 drillsite (water release point as given in Appendix 3).	AP PS 400-05-047	P-06-308	Rinse pumping to reduce uranine tracer content. The value of electrical conductivity was 180–210 mS/m and is taken from analysis done at the Äspö laboratory
KLX08	476.00–485.62	2006-05-29*	2006-06-27*	200	10	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-05-047	P-06-308	

Borehole	Section (m)	Pumping start	Pumping stop	Estimated flow mL/min	Estimated amount of pumped up water m^3	Point of release	Activity plan	P-report	Comment
KLX08	609.00–618.51	2006-06-27*	2006-07-27*	150	5	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-05-047	P-06-308	
KLX13A	499.50–506.66	2006-11-20*	2006-12-12*	200	7	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-06-075	P-07-149	Interrupted investigation
KLX13A	432.00–439.16	2006-12-13*	2007-01-22*	125	8	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-06-075	P-07-149	
KLX15A	623.00–634.51	6/14/2007	8/7/2007	210	15	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-07-053	P-08-69	
KLX17A	642.00–701.08	1/29/2007	2/27/2007	270	11	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-06-138	P-07-164	
KLX17A	416.00–437.51	3/2/2007	4/24/2007	230	15	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-06-138	P-07-164	
KLX27A	641.50–650.56	2008-03-12*	2008-06-06*	220	25	Pumped to container . Water transported and released to the Baltic Sea at an approved site (Vehicle washing site)	AP PS 400-08-008	P-08-77	

*= date from SICADA (WC040).