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Hydrogeochemical groundwater monitoring

Results from water sampling in the Forsmark area 2021

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Abstract

The present report documents the hydrochemical monitoring of deep groundwaters in the Forsmark area including the Spent Nuclear Fuel Repository Project as well as the SFR Extension Project. The sampling during the 2021 campaign includes 44 borehole sections within the monitoring program.

Sampling was conducted in series of three samples collected on three different occasions during continuous pumping i.e. varying the purged volume prior to sampling. Most of the standpipes connected to the sections were cleaned before the sampling campaign, with some exceptions.

Many different parameters were analysed during the sampling in 2021. Measured values for a large group of major and minor constituents as well as trace elements and isotopes are presented in the appendices. The relative charge balance is within the acceptable limits for all samples except one. As observed in previous sampling campaigns, rather high pH values were also recorded in a couple of the monitored borehole sections in 2021. The agreement between pH and electrical conductivity (EC) values measured in the field and in the lab are in general good. According to the chloride concentrations, the groundwater composition in the sampled sections has generally been stable from year to year and no significant changes have been observed during latter years.

Sammanfattning

Denna rapport dokumenterar hydrokemisk övervakning av djupt grundvatten inom Forsmarksområdet där Projekt Kärnbränsleförvaret samt Projekt SFR-Utbyggnad ingår. Provtagningen som utförts under 2021 inkluderar 44 borrhålssektioner inom övervakningsprogrammet.

Provtagningen gjordes i serier med 3 prov, tagna vid tre olika tillfällen under tiden som kontinuerlig pumpning pågick, d.v.s. de omsatta volymerna innan provuttaget varierades. Med några undantag spolades de flesta vattenståndsrör som är kopplade till sektionerna innan provtagningskampanjen påbörjades.

Många olika parametrar analyserades under provtagningen 2021. Uppmätta värden för huvudkomponenter, mindre förekommande ämnen, spårämnen och isotoper presenteras i rapportens bilagor. Jonbalansen ligger inom acceptabla gränser för samtliga prov förutom ett. Som observerats under tidigare mätkampanjer förekommer relativt höga uppmätta pH-värden i ett par borrhålssektioner även under 2021. Överenstämmelsen mellan pH och elektrisk konduktivitet (EC) uppmätt i fält och på laboratorium är generellt bra. Med hänsyn till kloridkoncentrationerna har grundvatten-sammansättningarna i de provtagna sektionerna generellt varit stabila från år till år och inga signifikanta förändringar har observerats under senare år.

Content

1 Introduction

1.1 General

This report includes results from hydrochemical groundwater monitoring in boreholes included in the Spent Nuclear Fuel Repository Project as well as the SFR Extension Project in the Forsmark area during the year of 2021. The long-term hydrochemical monitoring programme for percussion-drilled and core-drilled boreholes aims at delivering long time series of data that will provide a baseline in order to facilitate evaluation of possible future impacts on the groundwater situation from the construction and the operation of the two facilities. The extent of natural variations is important information in order to identify possible future changes in water composition. Since the two study sites overlap, each project benefit from the increased amount of information about the hydrochemical conditions.

The controlling documents for the hydrochemical monitoring activities are listed in Table 1-1. Both activity plans and method descriptions are SKB:s internal controlling documents. Original data from the reported activities are stored in the primary database Sicada. Data are traceable in Sicada by the activity plan number (AP SFK-21-014). Only data in the database are accepted for further interpretation and modelling. The data presented in this report are regarded as copies of the original data. Data in the database may be revised, if needed. However, such revision of the database will not necessarily result in a revision of this report.

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

Activity plan	**Number**	**Version**
Hydrogeokemisk övervakning i hammar- och kärnborrhål 2021	AP SFK 21-014	1.0
Method descriptions	**Number**	**Version**
Metodbeskrivning för hydrogeokemisk provtagning i ytborrhål med fasta manschettinstallationer	SKB MD 425.001	2.0
Metodbeskrivning för hydrokemisk provtagning i tunnelborrhål med fasta manschettinstallationer	SKB MD 425.002	1.0
Mätsystembeskrivning (MSB) – Handhavandedel; System för hydrologisk och meteorologisk datainsamling.Vattenprovtagning och utspädningsmätning i observationshål.	SKB MD 368.010	2.0
Provtagning och provhantering	SKBdoc id 1063531	3.0, 12.0 and 13.0
Kvalitetsparametrar för kemianalyser – SKB:s kemiklasser, aktuella detektions-, rapporteringsgränser samt mätosäkerheter	SKBdoc id 1494275	1.0

The field work conducted during the 2021 campaign was entirely planned and performed by Geosigma while SKB determined which boreholes and sections were to be sampled. SKB also managed the laboratory analyses of the obtained samples, either by analysis or by distribution of samples to external laboratories. For more detailed information of the division of tasks, see Activity plan AP SFK 21-014.

1.2 Background

The monitoring program for groundwater has been on-going since 2005 (SKB 2005) and was initiated during the site investigations for a final repository of spent nuclear fuel (SKB 2001). The program was continued after the completion of the site investigation in 2007. The current monitoring program is developed from the program in R-07-34 (SKB 2007) and since 2012 boreholes drilled during the site investigations for the SFR extension project (SKB 2008) are incorporated in the monitoring program for the Forsmark area. During the years, the program has been modified concerning sampling techniques and analytical protocol. The monitoring history is presented in Appendix 1.

1.3 Boreholes and borehole sections

A total of 44 borehole sections, representing 20 core drilled boreholes and 11 percussion drilled boreholes, were included in 2021 in the hydrochemical monitoring program of groundwater in the bedrock, see Figure 1-1 and Table 1-2.

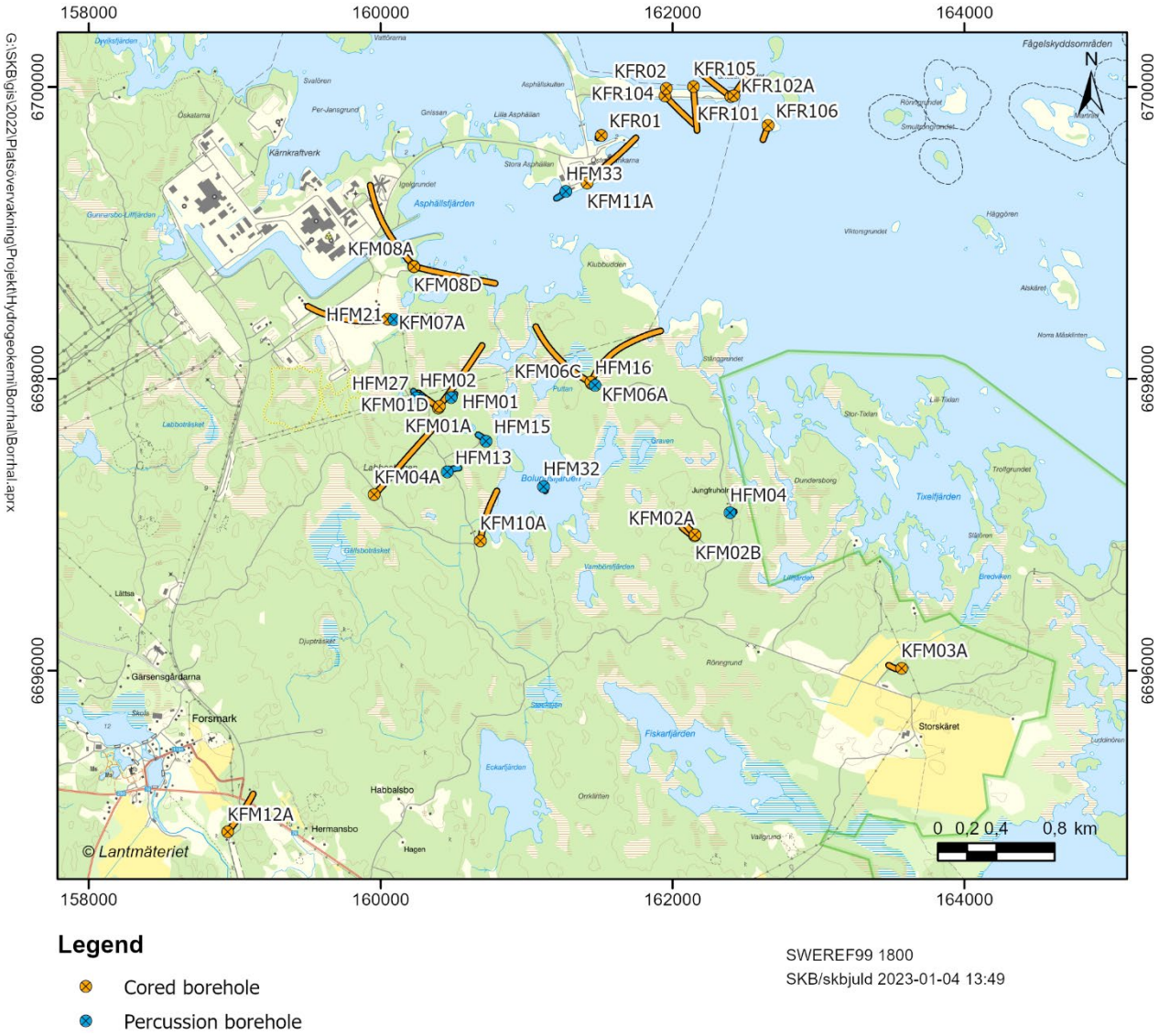

Figure 1-1. *General overview of the Forsmark area and the boreholes included in the hydrochemical monitoring program for deep groundwater. The cored boreholes and the percussion boreholes within the monitoring program are marked with orange and blue filled circles, respectively. Cored boreholes drilled from the SFR-tunnel are KFR01, KFR02 and KFR105.*

Table 1-2. Boreholes and borehole sections included in the monitoring programme for percussion- and core-drilled boreholes, corresponding transmissivity values and comments to sections and sampling.

Borehole [Idcode: section no.]	Section [mbl] [1]	Elevation secmid [m.b.s.l] [2]	Transmissivity [m^2/s]	Comments
KFM01A:5	109.0-130.0	115.6	1.0 E-7 [3]	
KFM01D:2	429.0-438.0	343.1	8.0 E-7 [3]	[7]
KFM01D:4	311.0-321.0	252.5	2.0 E-7 [3]	[7]
KFM02A:3	490.0-518.0	495.0	2.1 E-6 [3]	Section of interest for the Uranium project
KFM02A:5	411.0-442.0	417.8	2.5 E-6 [3]	
KFM02B:2	491.0-506.0	483.8	3.0 E-5 [4]	
KFM02B:4	410.0-431.0	407.1	2.0 E-5 [4]	
KFM03A:1	969.5-994.5	969.1	5.5 E-7 [3]	Suspected leakage to section KFM03A:2
KFM03A:4	633.5-650.0	631.1	2.4 E-6 [3]	Section of interest for the Uranium project
KFM04A:4	230.0-245.0	199.7	2.0 E-5 [3]	
KFM06A:3	738.0-748.0	622.8	1.2 E-7 [3]	Mixed water, marine/not-marine
KFM06A:5	341.0-362.0	298.5	3.5 E-6 [3]	
KFM06C:3	647.0-666.0	527.1	5.3 E-8 [3]	
KFM06C:5	531.0-540.0	434.9	1.1 E-6 [3]	
KFM07A:2	962.0-972.0	795.6	5.0 E-7 [3]	Not sampled 2017-2019 [6]
KFM08A:2	684.0-694.0	550.6	1.0 E-6 [3]	
KFM08A:6	265.0-280.0	127.8	1.0 E-6 [3]	
KFM08D:2	825.0-835.0	622.6	2.4 E-8 [3]	[8]
KFM08D:4	660.0-680.0	538.1	2.0 E-7 [3]	[8]
KFM10A:2	430.0-440.0	299.8	3.0 E-5 [3]	Zone A2
KFM11A:2	690.0-710.0	593.8	1.0 E-6 [3]	Section through Singö zone
KFM11A:4	446.0-456.0	389.6	6.0 E-7 [3]	Section through Singö zone
KFM12A:3	270.0-280.0	226.7	1.0 E-6 [3]	
HFM01:2	33.5-45.5	37.0	4.0 E-5 [5]	
HFM02:2	38.0-48.0	39.9	5.9 E-4 [5]	
HFM04:2	57.9-65.9	57.9	7.9 E-5 [5]	
HFM13:1	159.0-173.0	138.6	2.9 E-4 [5]	
HFM15:1	85.0-95.0	59.1	1.0 E-4 [5]	
HFM16:2	54.0-67.0	57.2	3.5 E-4 [5]	
HFM21:3	22.0-32.0	18.8	4.0 E-5 [5]	
HFM27:2	46.0-58.0	45.6	4.0 E-5 [5]	
HFM32:3	26.0-31.0	27.5	2.3 E-4 [5]	
HFM33:2	121.0-137.5	101.8	4.7 E-4	
KFR101:1	279.5-341.8	240.2	5.8 E-6 [3]	Section in bottom of borehole. Extremly low salinity. No dummy in section.
KFR102A:2	423.0-443.0	389.0	1.6 E-6 [3]	
KFR102A:5	214.0-219.0	194.6	3.6 E-7 [3]	
KFR104:1	333.0-454.6	306.5	6.5 E-8 [3]	Section in bottom of borehole. Extremly low salinity. No dummy in section.
KFR105:1	265.0-306.8	153.6	6.1 E-8 [3]	Tunnel borehole.
KFR106:1	260.0-300.1	261.0	1.0 E-5 [3]	Section of interest for the Uranium project. No dummy in section.
KFR106:2	143.0-259.0	187.2	3.3 E-5 [3]	Section of interest for the Uranium project. No dummy in section.
KFR01:1	44.65-62.3	94.3	-	Tunnel borehole
KFR02:2	119.24-136.24	213	-	Tunnel borehole
KFR02:3	81.24-118.24	185	-	Tunnel borehole
KFR02:4	43.24-80.24	147	-	Tunnel borehole

[1] mbl = metres borehole length
[2] m.b.s.l. = metres below sea level [RHB 70 = the national levelling system]
[3] From differential flow logging
[4] From injection tests
[5] From flow logging
[6] Due to CCC (Complete Chemical Characterization) measurements in 2017 and lifted borehole equipment in 2018-2019.
[7] Equipment lifted and reinstalled before the sampling in 2016. No changes in equipment.
[8] Equipment lifted and reinstalled in 2013-2014. PEEK (PolyEtherEtherKeton)-equipment was installed.

In order to evaluate the results of groundwater analyses and observed trends in the groundwater chemistry, it is important to have information about previous investigations in each borehole and to understand the implications of these activities on the groundwater chemistry. Investigations likely to affect subsequent water sampling include hydraulic pumping and injection tests, tracer tests, SWIW tests (*Single Well Injection and Withdrawal-tests*) and tracer dilution tests.

During the 2021 campaign, large remodelling and reconstruction works were ongoing in the area around *Barackbyn.* Drilling, excavation, rock blasting and other contract work might have affected the chemical composition and/or the hydrostatical pressure in some of the investigated borehole sections included in the campaign.

Other activities in the area during the year 2021 can be found in Sicada.

Early activities in the area for the Spent Nuclear Fuel Repository Project that may have affected, for example, the Uranine or trace metal concentrations are presented in Nilsson et al. (2010). After 2009 Amino-G was used as tracer instead of Uranine for dilution tests, except for in HFM15 and KFM05A where Uranine has been used as a tracer even later on, for example during the dilution tests performed in 2013 (Wass 2015).

2 Equipment

2.1 Installations in a borehole test section with connected standpipe

The monitored boreholes are divided into sections sealed off by inflated rubber packers. The ground-water pressure is measured on-line in standpipes, hydraulically connected to each section and transmitted to HMS (*Hydro Monitoring System*), i.e. SKB:s hard- and software system for processing and interim storage of hydrological, hydrogeological and meteorological data. Most of the sampled sections are so-called circulation sections and are also hydraulically connected to wider standpipes, in which the pump fits. The fixed equipment (packers, tubing, standpipes etc.) remains in the borehole from year to year. An overview of the installation equipment is seen in Figure 2-1.

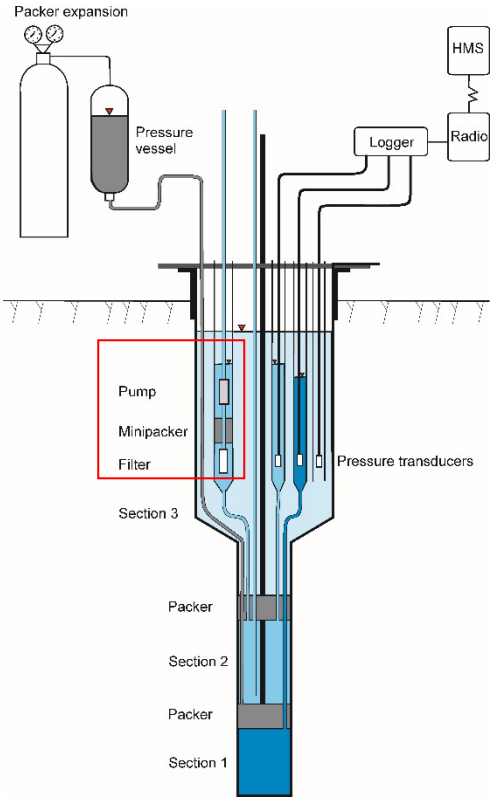

Figure 2-1. *Installations in a borehole test section with connected standpipes and monitoring equipment. The installation is permanent in the borehole, except for the pump and filter (marked with the red box), which are used in the standpipe at the pumping/sampling occasions.*

2.2 Cleaning equipment for standpipes

The cleaning is conducted using a specially designed nozzle combined with a pressure washer,
Figure 2-2. The nozzle is designed to direct the water jet in an upward direction in the standpipe in order to flush any flakes out of the standpipe. In order to lift the litter out of the standpipe more efficiently, a tube delivering nitrogen gas is mounted just above the nozzle to achieve a gas-lift pumping effect in the standpipe. A more detailed description of the cleaning equipment can be found in Lindquist et al. (2012).

Figure 2-2. *Cleaning equipment used to clean the standpipes prior to pumping and sampling.*

2.3 Sampling equipment

Several identical pumping equipment set-ups (GEOPUMP UV45) were used to retrieve the water samples from the sampled sections, Figure 2-3. The sampling equipment is identical to what was used in previous campaigns and is further described in Lindquist et al. (2012). When using this equipment, a mini-packer is expanded in the standpipe above the inlet to the filter and pump so that only water from the section and lowest part of the standpipe is pumped. In some sections, dissolved gas is released as pressure decreases. The gas accumulates under the mini-packer and causes pump stops. To avoid such problems, a special evacuation tube is used in some of the borehole sections, allowing the gas to evacuate. For more information about what pumping techniques were used in what sections, see Table 3-1.

Figure 2-3. *The pumping equipment (GEOPUMP UV-45) used for pumping in wide standpipes. The equipment consists of a filter and a pump connected to the mini-packer. The small diameter plastic hose is used for expanding the packer and the plastic hose connected to the pump is the pumping hose (enclosed picture right lower corner).*

There have been problems with corrosion of the installed equipment in borehole KFM08D during the past years. In 2013 the equipment (packers etc.) was lifted and then reinstalled in 2014. The upper part of the installation was replaced by equipment in the material PEEK. Because of this, no mini-packers are used in the standpipes, instead there are O-ring sealed plugs which were removed during the sampling. To allow pumping directly from the section (and avoid contaminating water from the standpipe) a special docking unit was used, see Figure 2-4, similar to the one used in a few sections in 2015 (Ragvald and Lindquist 2015). The unit is working together with the normal pump (GEOPUMP UV45) but instead of expanding the mini-packer in the standpipe, the docking unit docks on and tightens around the top of the tube leading directly to the section (located at the bottom of the standpipe).

Figure 2-4. *The docking unit, which is used together with the pump (GEOPUMP UV-45). Instead of using the mini-packer to isolate the lower part of the standpipe with the pump, the unit is tightly fitted to the tube in the bottom of the standpipe. The photo shows the docking unit used in normally equipped boreholes. The one used in KFM08D is modified to match with the special equipment in PEEK, but is very similar to the one in the photo.*

In the borehole sections lacking wide standpipes for sampling, sampling was performed in the standpipes for pressure measurements. Due to the smaller diameter of these standpipes, the sections were pumped using gas-lift pumping (with nitrogen). The function of this pump is briefly described in Lindquist and Nilsson (2013) and the sampling equipment is also further described by Sandström et al. (2011). Figure 2-5 shows a photo of the equipment. The sampling conditions caused by gas-lift pumping are different from the conventional pumping generally used in the hydrogeochemical monitoring programme. The more effective (intermittent) pump action might affect the borehole walls (microbe coating, mineral particles etc.), and thus might have an impact on the water composition. Especially, constituents such as hydrogen sulphide, TOC, DOC and trace metals may be affected.

In tunnel boreholes, no pumping equipment is needed due to the pressure gradient. When the valve is opened, water flows out from the section.

Figure 2-5. *The equipment used for gas-lift pumping. On the left, the tubing lowered down the standpipe (the narrower tube for sample water and the wider for gas) on a bobbin to simplify the lowering. To the upper right the control unit for the pumping/gas supply and lower right the end of the gas-lift pump.*

3 Performance

3.1 General

The sampling conducted in the 2021-campaign includes 44 borehole sections. Monitored boreholes, borehole sections and pumping technique at each sampling location are presented in Table 3-1.

Table 3-1. Boreholes, borehole sections and pumping technique within the monitoring program 2021.

Borehole [Idcode:section no.]	Section [mbl]	Comments	Used pumping technique[1)]
KFM01A:5	109.0-130.0		A
KFM01D:2	429.0-438.0		A
KFM01D:4	311.0-321.0		A
KFM02A:3	490.0-518.0		A
KFM02A:5	411.0-442.0		A
KFM02B:2	491.0-506.0		A
KFM02B:4	410.0-431.0		A
KFM03A:1	969.5-994.5	Gas evacuation	A
KFM03A:4	633.5-650.0		A
KFM04A:4	230.0-245.0		A
KFM06A:3	738.0-748.0	Gas evacuation	A
KFM06A:5	341.0-362.0	Gas evacuation	A
KFM06C:3	647.0-666.0	Gas evacuation	A
KFM06C:5	531.0-540.0	Gas evacuation	A
KFM07A:2	962.0-972.0	Gas evacuation	A
KFM08A:2	684.0-694.0		A
KFM08A:6	265.0-280.0		A
KFM08D:2	825.0-835.0	Gas evacuation	D
KFM08D:4	660.0-680.0	Gas evacuation	D
KFM10A:2	430.0-440.0		A
KFM11A:2	690.0-710.0	Gas evacuation	A
KFM11A:4	446.0-456.0	Gas evacuation	A
KFM12A:3	270.0-280.0	Gas evacuation	A
HFM01:2	33.5-45.5		A
HFM02:2	38.0-48.0		A
HFM04:2	57.9-65.9		A
HFM13:1	159.0-173.0		A
HFM15:1	85.0-95.0		A
HFM16:2	54.0-67.0		A
HFM21:3	22.0-32.0		A
HFM27:2	46.0-58.0		A
HFM32:3	26.0-31.0		A
HFM33:2	121-137.5		A
KFR101:1	279.5-341.8		B
KFR102A:2	423.0-443.0		A
KFR102A:5	214.0-219.0		A
KFR104:1	333.0-454.6		B
KFR105:1	265.0-306.8		C
KFR106:1	260.0-300.1		B
KFR106:2	143.0-259.0		B
KFR01:1	44.65-62.3		C
KFR02:2	119.24-136.24		C
KFR02:3	81.24-118.24		C
KFR02:4	43.24-80.24		C

[1)] A= UV45 pump, B= nitrogen lifting pump (in standpipe for pressure measurements), C= valve opening (no pump) and D= docking unit

3.2 Cleaning of standpipes

A special cleaning procedure was performed in most of the standpipes connected to the borehole sections prior to the sampling campaign in 2021. Some sections were not cleaned for different reasons:

- HFM32:3 because the locations of the borehole make it difficult to transport the cleaning equipment
- KFR106:1 and KFR106:2 because of the location
- KFM08D due to risk of damage on borehole equipment.
- KFR105:1, KFR01:1, KFR02:2, KFR02:3 and KFR02:4 (tunnel boreholes) are not connected to standpipes, so no cleaning is needed.

After cleaning, the water in the standpipes was evacuated with gas (mammoth pumping) so that the standpipe filled up from underneath with section water. This was done to remove cleaning water from the standpipe and avoid cleaning water in the samples. The mammoth pumping was done twice in each standpipe. The groundwater in the standpipes and the borehole sections was then allowed to settle for a period of at least 3 weeks before the pumping and sample collection started.

3.3 Water sample treatment and analyses

The constituents included in the different SKB chemistry classes are listed in Table 3-2. Sample treatment (filtration, conservation, storage etc.) of samples, for analyses performed by SKB as well as for analyses performed by external laboratories, generally follow standard procedures. An overview of sample treatment and analysis routines/methods for major and minor constituents, organic carbon, trace metals and isotopes are given in "*Kvalitetsparametrar för kemianalyser – SKB:s kemiklasser, aktuella detektions-, rapporteringsgränser samt mätosäkerheter"*, see Table 1-1. The routines are applicable independently of sampling method or sampling object. See Appendix 3 for the results of the water composition for all the sampled boreholes and sections.

Table 3-2. Constituents analysed within the sampling series in the monitoring programme of deep groundwater in Forsmark, 2021, required volumes, pre-treatment and storage prior to analysis.

Constituent	Bottle[1)]/Volume	Preparation	Comment
pH_F, EC_F, temperature	-	-	On-line measurement in the field.
pH_L, EC_L, alkalinity	500 mL	-	Analysis within 24h.
Cl^-, SO_4^{2-}, Br^-, F^-	250 mL	Filtered with 0.4 µm filter	-
Na, K, Ca, Mg, SO_4-S, Si, Fe, Mn, Li, Sr, Th and U	Acid washed, 60 mL	Filtered with 0.4 µm filter Conserved with 1 mL HNO_3.	Suprapure acid is used for conservation.
δ^2H, $\delta^{18}O$	100 mL	-	-
Uranine	60 mL, Dark bottle		-.
HS^-	2x120 mL glass Winkler bottles	Conserved with 0.5 mL 1 M ZnAc and 0.5 mL 1M NaOH in the field. Bottle volume exchanged 2 times	
TOC	100 mL		Stored in freezer
DOC	100 mL	Filtered with 0.4 µm filter.	Stored in freezer
Archive	2x250 mL	Filtered with 0,4µm filter	
Archive	3x60 mL	Filtered with 0.4 µm filter Conserved with 1 mL HNO_3.	Suprapure acid is used for conservation.
Archive	1000 mL	-	

Constituent	Bottle[1)]/Volume	Preparation	Comment
Density	100 mL		
^{3}H	500 mL	Bottle volume exchanged 3 times	
Br^{-} / I^{-}	100 mL	-	-
Fe (+II), Fe-tot	250 mL plastic Winkler bottles	Filtered with 0.4 µm filter. Conserved with 2.5 mL HCl	Analysis within 20 h. Suprapure acid is used for conservation.
NH_4-N, NO_2-N, NO_3-N, NO_2+NO_3 and PO_4-P	250 mL	Filtered with 0,4µm filter	Do not store sample together with bottles containing HNO_3
NH_4-N	100 mL		
Al, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, P, Pb, V, Zn, (U, Th)	60 mL	Filtered with 0,4µm filter	U and Th only included for samples in sections KFM02A:3, KFM03A:4, KFR106:1 and KFR106:2.
U/Th-isotopes	1000 mL	-	-
^{36}Cl	100-500 mL		Last sample in KFR02
pmC/^{13}C organic	2x500 mL dark glass bottle		Last sample in KFR02
pmC/^{13} inorganic	2x500 mL dark glass bottle		Last sample in KFR02
Fe isotopes	250 mL	Filtered with 0.4 µm filter. Conserved with 0,25 mL HCl	Suprapure acid is used for conservation. Stored in freezer

Constituents determined in the different SKB chemistry classes:
Class I: Constituents in brown cells are included in class I
Class II: Constituents in brown and green cells are included in class II
Class II+: Constituents in brown, green and grey cells are included in class II+
Class III: Constituents in brown, green, grey and purple cells are included in class III
Class III+: Constituents in brown, green, grey, purple and orange cells are included in class III+
Blue cells contain additional constituents as complement to class III in some selected sections (KFR02).
Yellow cells are included together with the other analyses and are applied according to Table 3-2.

[1)] Plastic bottles are used if nothing else is mentioned.

3.4 Water sampling in series and field measurements

3.4.1 General

Sampling in series was performed in all sampled borehole sections. During earlier sampling campaigns in 2011-2020, generally each series consisted of three samples distributed with respect to pumped "plug-flow volumes" (also including the volume of the tube connecting to the section). The term "plug-flow volume" refers to the theoretical volume that needs to be withdrawn in order to remove the exchangeable water present in the borehole section and achieve samples constituting close to 100 % formation water (water originating directly from water bearing fractures in the surrounding rock). As the theoretical plug-flow volume may be underestimated due to laminar flow effects, 100 % formation water is assumed at minimum 1.5 times the calculated plug-flow volume. The plug-flow volume varies from section to section, depending on the distribution of water-yielding fractures along the section and their hydraulic transmissivities. This concept is further described in Nilsson et al. (2010) and Lindquist et al. (2012). With some exceptions 1.5, 3 and 5 plug-flow volumes were removed before sampling in 2011-2021. Corresponding plug flow volumes for each borehole section are listed in Appendix 6.

In general, adequate water volumes according to the plug flow calculations were removed. However, in KFM06C:3, KFM08D:2 and KFM08D:4, the volumes pumped before sampling were less than 100 % of the plug flow volumes due to uneven flow rates. The volumes and percent formation water for each of these borehole sections are presented separately in Appendix 6.

The sample procedure for the campaign in 2021 is described in section 3.4.2.

In order to rule out factors in the sampling procedure that could affect for example the sulphide concentrations, the discharge flow rate from each borehole section was set to the same flow rate as used during previous years. In sections with low hydraulic transmissivity, where a low flow rate must be used, all three samples in the series could not be collected during the working hours of a day. The collected samples and the removed water volumes prior to each sample are presented in Appendix 2. The discrepancy between actually removed volumes and those prescribed is partly due to practical reasons (i.e., sampling could not be performed in the middle of the night). The total removed volumes were calculated from the readings in the field protocols, where date, time and flow rates for the discharge periods and sampling occasions were noted.

Sample portions intended for analysis of major constituents and trace metals (by ICP technique), DOC, anions, iron (by spectrometry) and nutrient salts were filtered on-line in the field. Disposable 0.4 µm filters were fitted directly to the 8/6 mm polyamide-tube leading the pumped water from the borehole section. During the entire sampling, laboratory gloves were used to minimize the risk of contaminating the samples.

In addition to sampling of groundwater, field measurements of temperature, electrical conductivity (EC) and pH were conducted. The water from the borehole was led through a measurement cell on the ground surface with probes and electrodes as well as a temperature sensor for measurements of field pH (pH_F), field electrical conductivity (EC_F) and groundwater temperature. The results are given in chapter 4 and in Appendix 3.

The pumped water was, where needed, collected in tanks to prevent saline water from affecting the surroundings of the boreholes. The water was then discharged to the Baltic Sea.

The pressure in the borehole sections is continuously monitored by HMS, also during sampling. Pressure diagrams for each borehole and sampling occasion are given in Appendix 4. Possible short-circuiting, indicated by pressure responses in one or more sections other than the sampled ones, can be observed in several boreholes, see Appendix 4. However, observation of pressure propagation does not necessarily mean that water is transported between the sections. Information on flow rates, removed volumes and pressure responses are reported in Appendix 2. In the boreholes sampled from the small diameter standpipes where gas-lift pumping was used, the pressure transducers had to be lifted and the pressure in the pumped section could not be monitored during pumping.

3.4.2 Sampling in 2021

In 2021, each series consisted of three samples. Sampling was conducted in 44 borehole sections included in the monitoring program. HFM19 was omitted due to deflated borehole packers.

During the 2021 campaign, mainly 1.5, 3 and 5 plug-flow volumes were planned to be removed before sampling. For boreholes and sections for which the removed volume differs from 1.5, 3 and 5 plug-flow volumes, see Table 3-3. Collected samples and chemistry classes are listed in Table 3-4.

Generally, sampling was carried out successfully with the exception of pump stops in KFM06A:3 (before the first sample), KFM06A:4 (between sample 2 and 3) and KFM01A:5 (after the first sample). In the sections where a pump stop occurred, the pumped volume prior to the next sample was measured from the new pump start, but the total pumped volume includes all pumping periods. For this and for more comments on nonconformities, see section 0.

Table 3-3. Sections where planned pumped volumes in sampling campaign in 2021 differ from normally used 1.5, 3 and 5 plug flow volumes.

Borehole [Idcode: section no.]	Sample 1	Sample 2	Sample 3
KFM06A:3	3 pf [1)]	+2 pf	+2 pf
KFM06C:3	115 L[2)]	+100 L	+100 L
KFM11A:2	300 L	+150 L	+150 L
KFM12A:3	3 sv [3)]	5 sv	7 sv
KFR01:1	3 sv	5 sv	7 sv
KFR02:2	3 sv	5 sv	7 sv
KFR02:3	3 sv	5 sv	7 sv
KFR02:4	3 sv	5 sv	7 sv

[1)] pf= plug flow volumes. Corresponding volume in litre for each section are found in Appendix 6.
[2)] L= Litre
[3)] sv= Section volumes including the volume of the plastic hoses. 1 sv is 23 L for KFM12A:3, 40 L for KFR01:1, 42 L for KFR02:2, 87 L for KFR02:3 and 86 L for KFR02:4

Table 3-4. Collected samples and analyses performed within the monitoring program 2021.

Borehole [Idcode: section no.]	Sample No in series	Chemistry class		
		Sample 1	Sample 2	Sample 3
KFM01A:5	89549-89551	II,b+	II,b+	III, a-d, h
KFM01D:2	89552-89554	II,b+	II,b+	III, a-d, h
KFM01D:4	89555-89557	II,b+	II,b+	III, a-d, h
KFM02A:3	89558-89560	II,b+	II,b+	IIIa-d, h, f [1)]
KFM02A:5	89561-89563	II,b+	II,b+	III, a-d, h
KFM02B:2	89564-89566	II,b+	II,b+	III, a-d, h
KFM02B:4	89567-89569	II,b+	II,b+	III, a-d, h
KFM03A:1	89570-89572	II,b+	II,b+	III, a-d, h
KFM03A:4	89573-89575	II,b+	II,b+	III, a-d, h, f [1)]
KFM04A:4	89576-89578	II,b+	II,b+	III, a-d, h
KFM06A:3	89579-89581	II,b+	II,b+	III, a-d, h
KFM06A:5	89582-89584	II,b+	II,b+	III, a-d, h
KFM06C:3	89585-89587	II,b+	II,b+	III, a-d, h
KFM06C:5	89588-89590	II,b+	II,b+	III, a-d, h
KFM07A:2	89591-89593	II,b+	II,b+	III, a-d, h
KFM08A:2	89594-89596	II,b+	II,b+	III, a-d, h
KFM08A:6	89597-89599	II,b+	II,b+	III, a-d, h
KFM08D:2	89600-89602	II,b+	II,b+	III, a-d, h
KFM08D:4	89603-89605	II,b+	II,b+	III, a-d, h
KFM10A:2	89606-89608	II,b+	II,b+	III, a-d, h
KFM11A:2	89609-89611	II,b+	II,b+	III, a-d, h
KFM11A:4	89612-89614	II,b+	II,b+	III, a-d, h
KFM12A:3	89615-89617	II,b+	II,b+	III, a-d, h
HFM01:2	89618-89620	II,b+	II,b+	III, a-d, h
HFM02:2	89621-89623	II,b+	II,b+	III, a-d, h
HFM04:2	89624-89626	II,b+	II,b+	III, a-d, h
HFM13:1	89627-89629	II,b+	II,b+	III, a-d, h
HFM15:1	89630-89632	II,b+	II,b+	III, a-d, h
HFM16:2	89633-89635	II,b+	II,b+	III, a-d, h
HFM21:3	89636-89638	II,b+	II,b+	III, a-d, h
HFM27:2	89639-89641	II,b+	II,b+	III, a-d, h
HFM32:3	89642-89644	II,b+	II,b+	III, a-d, h
HFM33:2	89645-89647	II,b+	II,b+	III, a-d, h
KFR101:1	89648-89650	II,b+	II,b+	III, a-d, h
KFR102A:2	89651-89653	II,b+	II,b+	III, a-d, h
KFR102A:5	89654-89656	II,b+	II,b+	III, a-d, h
KFR104:1	89657-89659	II,b+	II,b+	III, a-d, h [2)]
KFR106:1	89681-89683	II,b+	II,b+	III, a-d, h, f [1) 2)]
KFR106:2	89684-89686	II,b+	II,b+	III, a-d, h, f [1) 2)]
KFR01:1	89660-89662	II,b+	II,b+	III, a-d, h [2)]
KFR02:2	89666-89668	II,b+	II,b+	III, a-c, f, h [2)]
KFR02:3	89674	II,b+	II,b+	III, a-c, f, h [2)]
KFR02:4	89675-89677	II,b+	II,b+	III, a-c, f, h [2)]
KFR105:1	89678-89680	II,b+	II,b+	III, b-d, h [2)]

1) Only U/Th isotopes from option f
2) No HS^- or Fe^{2+} analyses due to pumping technique

3.5 Nonconformities

The hydrochemical monitoring of deep groundwater has been conducted according to the SKB internal controlling document AP SFK SFK-21-014 with the following nonconformities.

Pumping procedures:

- pump stops occurred in KFM06A:3 (before the first sample), KFM03A:4 (between sample 2 and sample 3) and KFM01A:5 (between sample 1 and sample 2).
- for some sections (KFM06C:3, KFM08D:2 and KFM08D:4) the pumped volume before the sampling were lower than planned (see Appendix 2) because of lower pump flows than planned.
- for some of the sections, the pumped volume before the first sample was larger than planned (see Appendix 2) because the pump started with a higher flow rate than planned.
- flow rates are difficult to adjust when gas-lift pumping is used. Therefore, pumped volumes are slightly higher or lower than planned for some of the sections (i.e. KFR106:1 and KFR106:2) pumped with this method.

Sampling:

- sampling was not performed in HFM19:1 during 2021 due to that the borehole packer pressure was released.
- in 2021 KFR02:1 was originally included in the campaign, but due to low to zero flow rates, the section was removed from the campaign.

Analyses

- in the second sample in KFM08D:2 and in the third sample in KFR106:1 the dissolved organic carbon was significantly higher than the total organic carbon in the sample.
- the second sample in HFM21 did not meet the relative charge balance criteria, see chapter 4.1 for more information concerning the criteria.
- the last sample in KFM08D:4 was unintentionally analysed for elemental U and Th.

4 Results

4.1 Water analysis and measurements

The results from analyses and field measurements are presented in Appendix 3. The first table for each year includes the major constituents Na, K, Ca, Mg, HCO_3^-, Cl^-, SO_4^{2-}, SO_4-S, Br^-, F^-, Si, Fe, Mn, Li and Sr as well as minor constituents like HS^-, NO_2^-, NO_3^-, NH_4^+, PO_4^{3-}, TOC and DOC from all sampled boreholes. Furthermore, this table contains laboratory data and field measurement data on pH, electrical conductivity (EC) and the water temperature recorded in the field.

The relative charge balance (RCB) provides an indication of the quality and uncertainty of the analyses of major constituents and, the charge balance errors were calculated for all samples. Relative errors within ± 5 % are considered acceptable.

$$rel.error(\%) = 100 \times \frac{\sum cation(equivalents) - \sum anion(equivalents)}{\sum cation(equivalents) + \sum anion(equivalents)}$$

The relative charge balances were for all samples, except for one sample in HFM21:3, within the acceptable limit of ± 5%.

Trace elements and the isotopes δ^2H, $\delta^{18}O$ and ^3H were determined in the last sample in each series (see Appendix 3). In 2019 (Föhlinger 2021) and 2020 (Olofsson 2022) analyses of Ag, As, B, Nb, Rb, Zr, Sb, Cs and Nd were added in some sections, and in 2021 these elements were included in all borehole sections.

Furthermore, the uranium and thorium element concentrations and isotopes (^{238}U, ^{235}U, ^{234}U, ^{232}Th and ^{230}Th) were determined in the last sample from sections KFM02A:3, KFM03A:4, KFR106:1 and KFR106:2 (see Appendix 3). (The last sample from section KFM08D:4 was unintentionally analysed for elemental uranium and thorium.)

The laboratory measurements and field measurements of pH and EC are compared in Figure 4-1 and Figure 4-2 respectively.

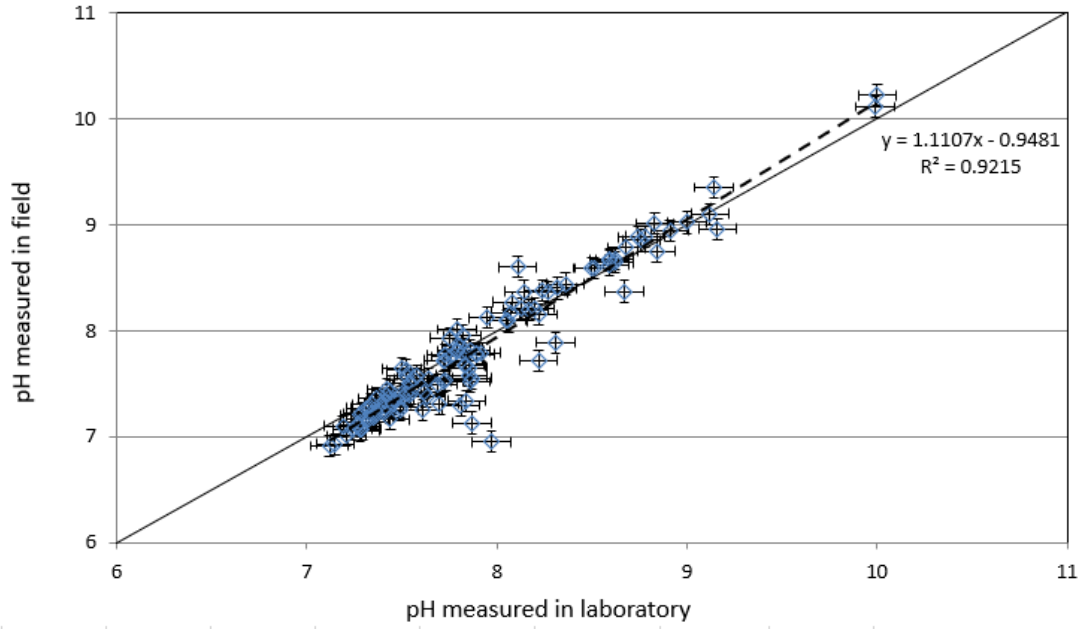

Figure 4-1. *Comparison between laboratory measurements and field measurements of pH. The laboratory measurements are performed at 25 °C and the field measurements are performed at the actual water temperature. The dashed line is the linear fit.*

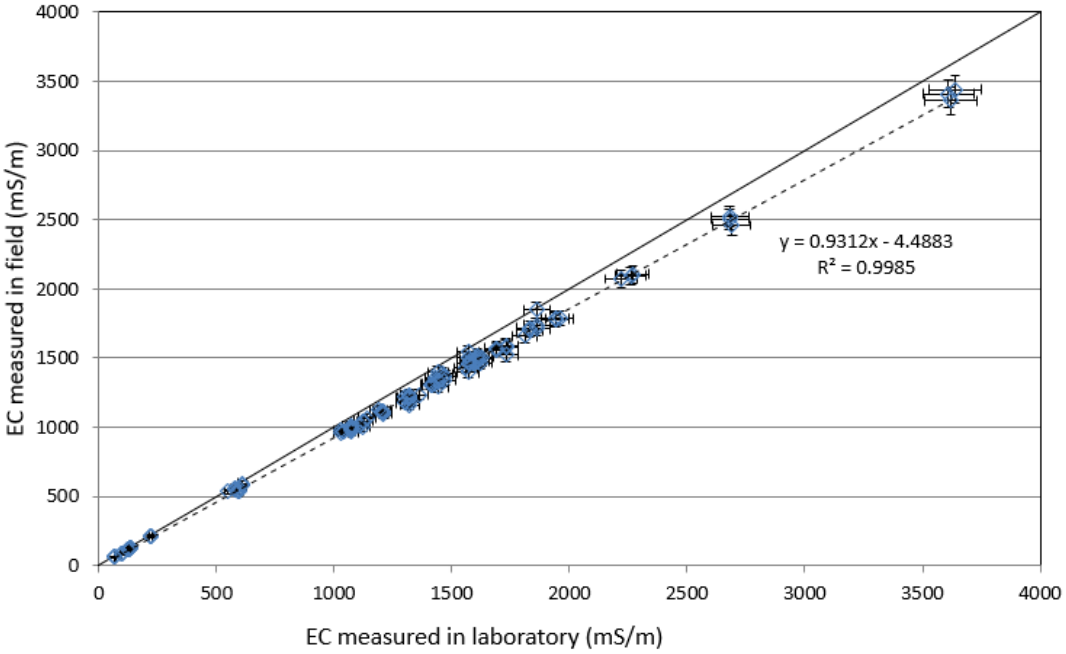

Figure 4-2. *Comparison between laboratory measurements and field measurements of EC. All values are corrected to the conductivity at 25 °C. The dashed line is the linear fit.*

The agreement between the different pH values is in general good but there are some samples where the compared pH values deviate more than others, which may be due to temperature and pressure differences and/or time delay. For some samples there are larger discrepancies between laboratory and field pH-measurements. For some of these, the field value differs compared to other pH-measurements in the same section and mistakes during field measurement is the most plausible reason. Another reason for the deviation between pH values measured in field and in the laboratory could be explained by exchange of CO_2 between the water sample and the surrounding air. If CO_2 exchange could be a reason, there should be an increase in pH for samples with lower pH and a decrease in pH for samples with higher pH. This could be the case for some samples with higher pH field values, seen in the slope of the trendline in Figure 4-1.

As previously observed in some of the monitored boreholes belonging to the Spent Nuclear Fuel Repository Project (see e.g. Ragvald 2016, 2018), some high pH values were also recorded in 2021, although no pH values above 10 have been measured in the laboratory. During earlier campaigns, especially in 2019, there were several samples with pH values above 10. Diagrams of pH values during the years in sections with elevated pH values are presented in Appendix 5. The issue with elevated pH values is discussed in Nilsson and Sandberg (2017). The earlier increase seems to have ceased or at least be less obvious and the measured pH values seem to have stabilized during the last years of sampling.

The agreement between the EC values from field and lab is very good, and the dispersion between different years is small.

In the comparison between the laboratory measurements and field measurements for both EC and pH, no outliers have been removed.

For the borehole sections for which no cleaning of the stand pipes was performed prior to the sampling campaigns (see Appendix 1), the water compositions generally seem to have been quite stable through the sampling series. An exception might be KFM08D:2, for which the bicarbonate, DOC, TOC and Uranine content, decreased, as well as pH.

4.2 Chloride

Figure 4-3 to Figure 4-10 present chloride concentrations in collected samples from hydrochemical monitoring 2021 together with data from hydrochemical monitoring earlier years. The analytical uncertainty (± 5%) is shown as error bars in the diagrams. For some of the core drilled boreholes, data from the initial complete chemical characterisation (CCC) in corresponding borehole sections (Lindquist et al. 2012; SKB Database Sicada) are also presented. The CCC data are shown as dots on the y-axes (not corresponding to date on the x-axis). In the cases of sample series (after October 2009 and onwards), the value from the last sample in the series is presented in the diagrams. For boreholes included in the SFR Extension Project, the hydrochemical monitoring program started in 2012, but the diagrams of chloride concentrations (Figure 4-8e), f) and Figure 4-9) also include data from earlier studies. Results from KFR02:2, KFR02:3 and KFR02:4, shown in Figures 4-9 and 4-10 do not include data from earlier studies. Results from HFM19:1, seen in Figure 4-7f), not sampled during the 2021 campaign, is included in the presentation.

Within each sample series (increasing plug flow volumes), the chloride concentrations were generally stable in 2021. The exceptions are HFM21 and KFR106:1 for which chloride concentrations increased with pumped volumes and KFM01D for which chloride concentrations decreased with pumped volumes. For KFR106:1, also sodium, calcium, magnesium and sulphate concentrations increased, which has also been the case during earlier campaigns.

In 2016, lower chloride concentrations were detected in KFR106:1. The lower chloride concentrations were thought to be due to smaller pumping volumes (Ragvald 2018). The values during last years in KFR106:1 vary from year to year. When comparing chloride concentrations and pumping volumes for 2014-2021, there is an indication that they might be correlated to each other.

In KFM08D:2 and KFM08D:4, higher chloride concentrations have been measured since the measurements continued in 2015, after reinstallation in 2014.

In KFM01D:2, KFM01D:4, KFM06C:3 and KFM11A:2 there appears to be an increasing trend in chloride concentrations, although within the analytical uncertainty for the results from last years.

In HFM01:2, HFM02:2, HFM15:1, KFM08A:6, KFR102A:5 and KFR104:1 there have been decreasing trends since the measurements started, which now seem to have levelled out during the latter years. In HFM27:2 there is an ongoing decreasing trend in chloride concentration.

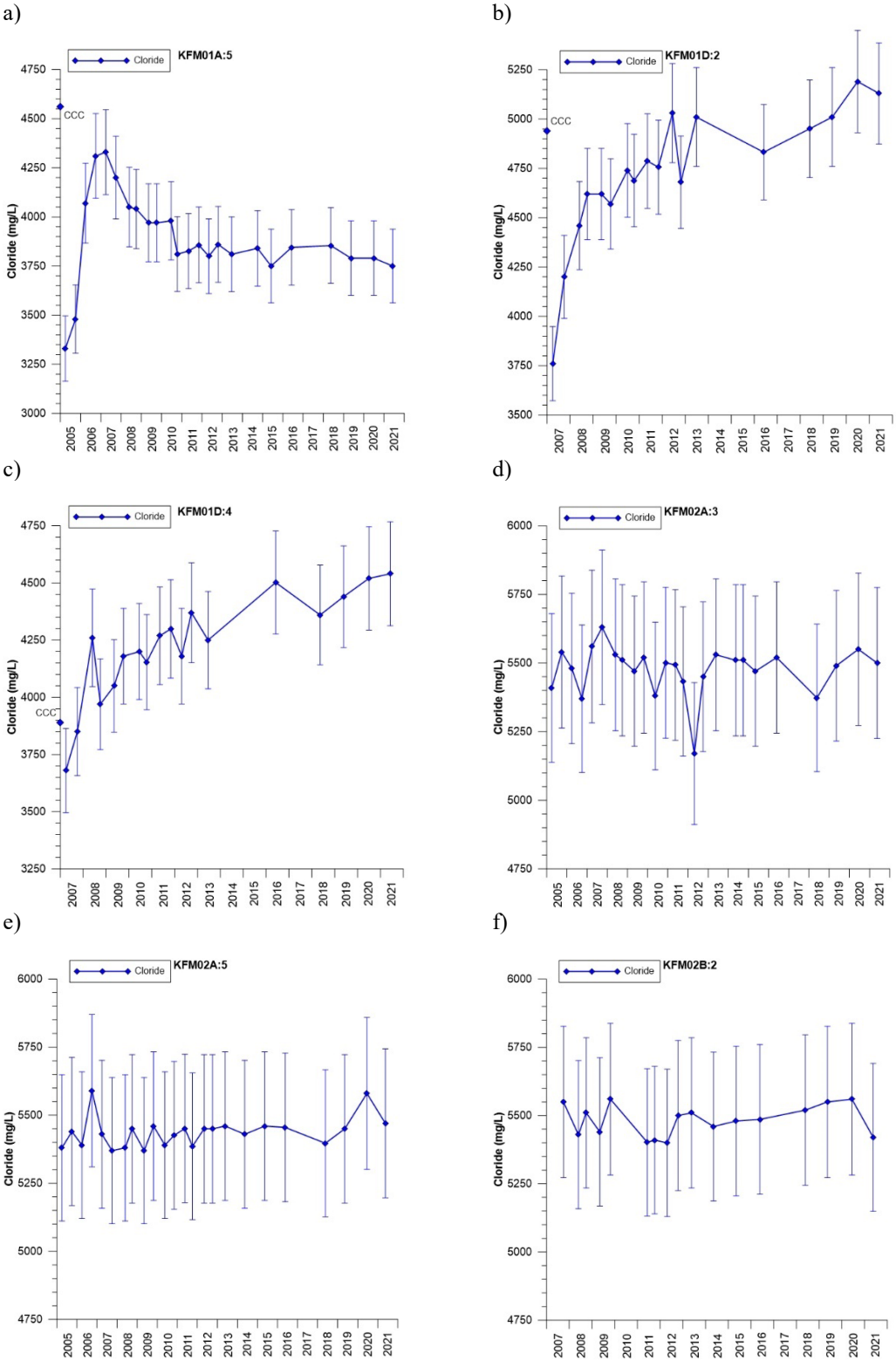

Figure 4-3. *Chloride concentrations in collected samples from hydrochemical monitoring 2005 to 2021 and from the initial complete chemical characterisation (CCC). The data points for CCC are placed on the y-axes with no correlation to date on x-axis.*

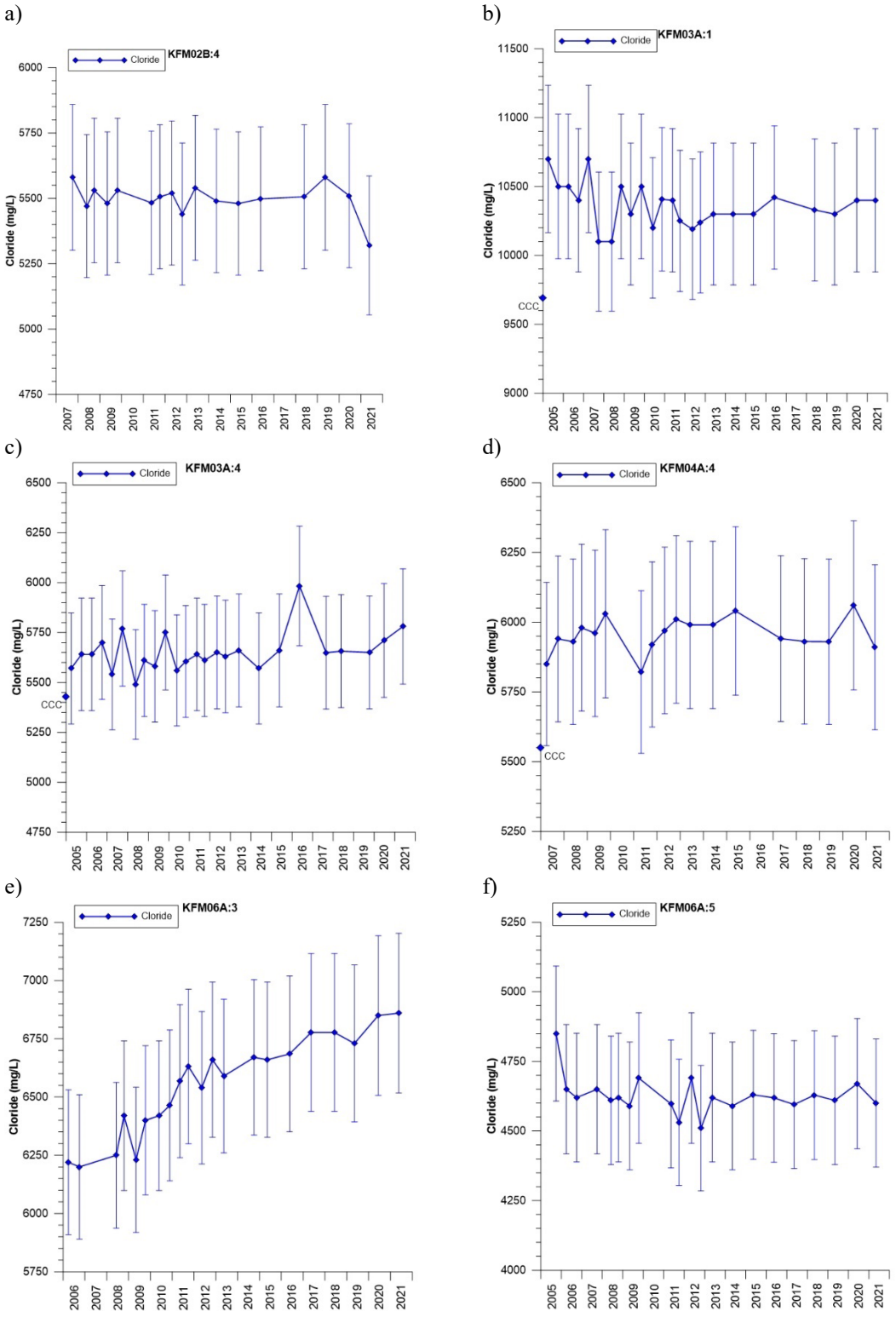

Figure 4-4. *Chloride concentrations in collected samples from hydrochemical monitoring 2005 to 2021 and from the initial complete chemical characterisation (CCC). The points for CCC are placed on the y-axes with no correlation to date on x-axis.*

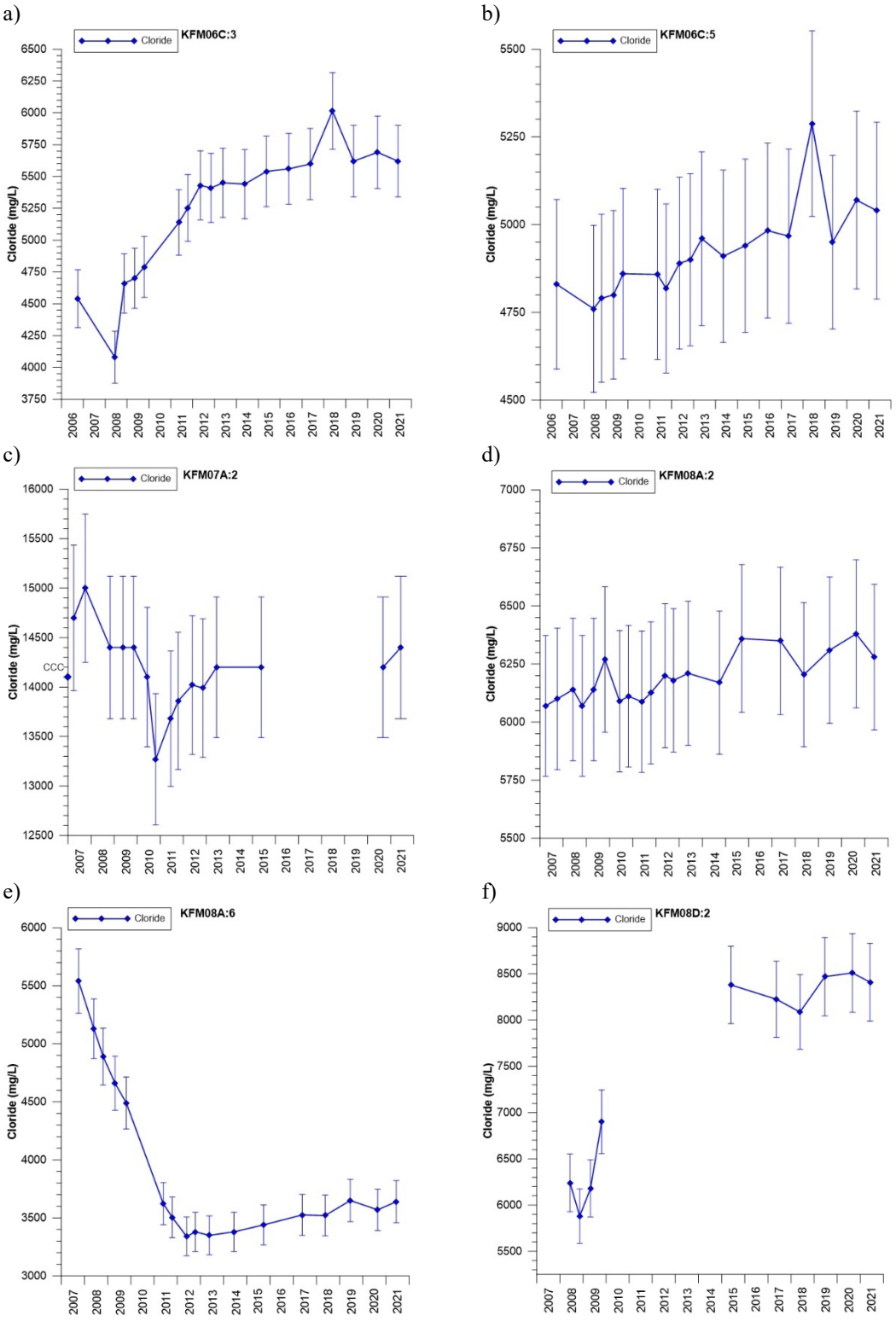

Figure 4-5. *Chloride concentrations in collected samples from hydrochemical monitoring 2006 to 2021 and from the initial complete chemical characterisation (CCC). The points for CCC are placed on the y-axes with no correlation to date on x-axis.*

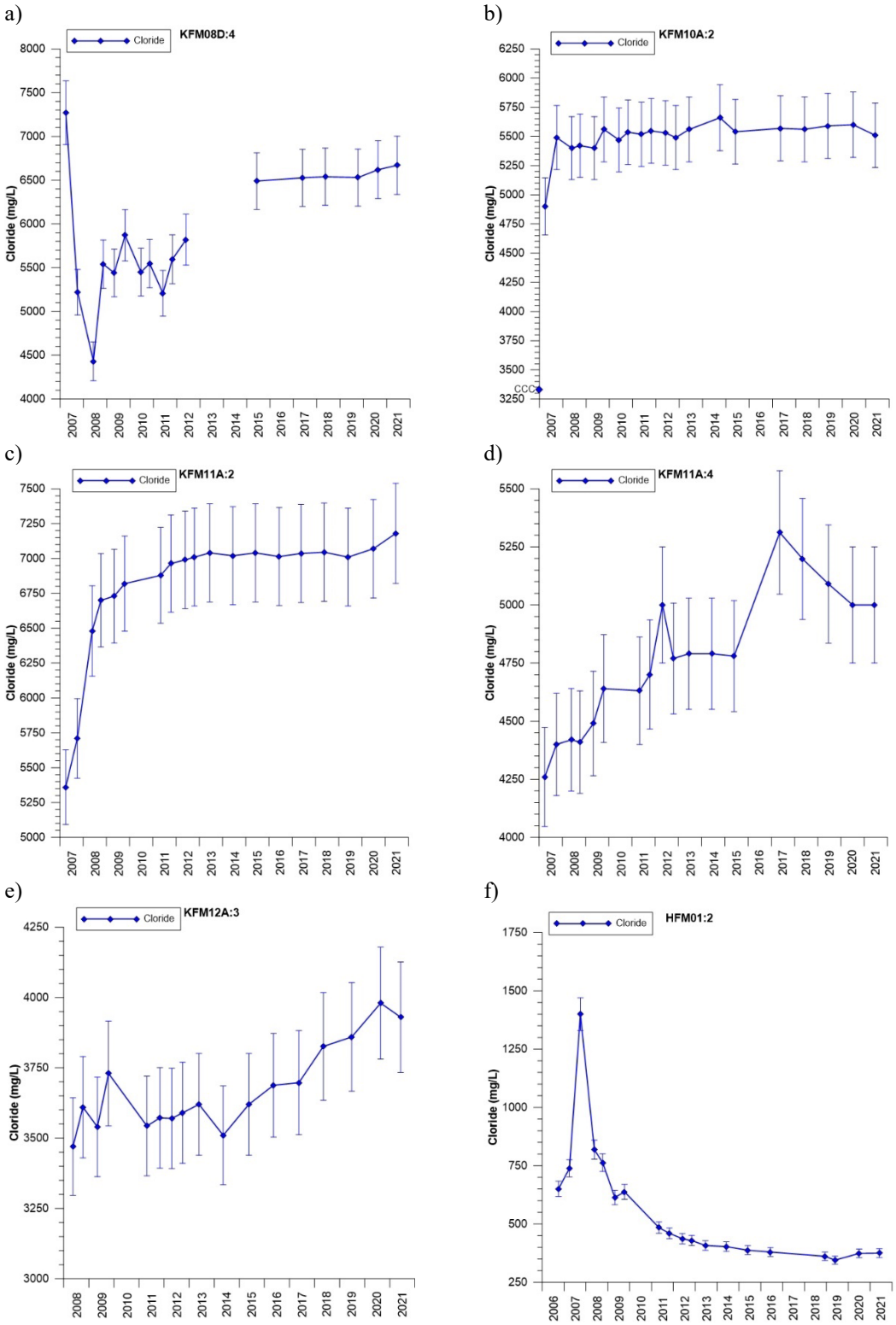

***Figure 4-6**. Chloride concentrations in collected samples from hydrochemical monitoring 2006 to 2021.*

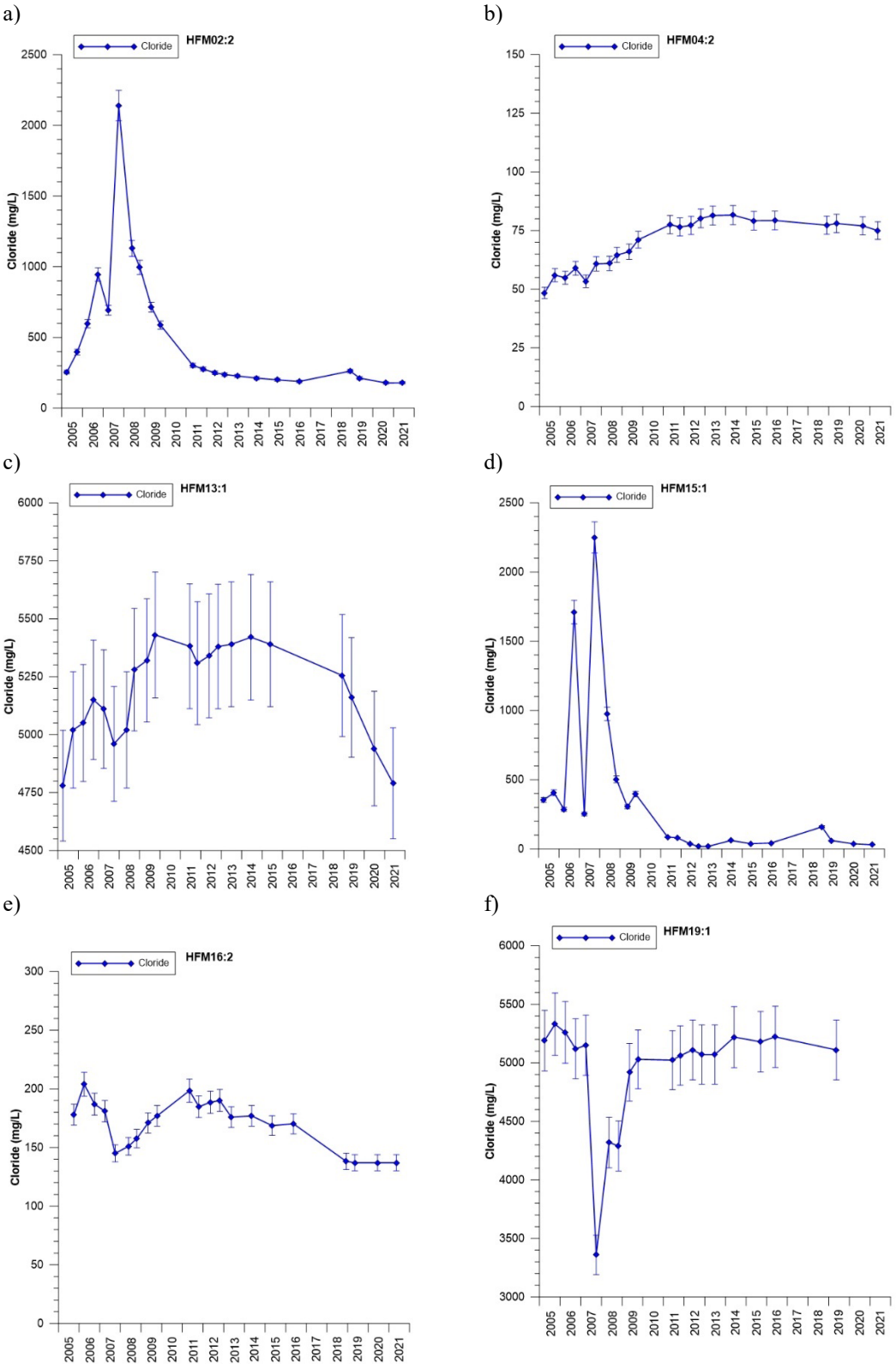

Figure 4-7. *Chloride concentrations in collected samples from hydrochemical monitoring 2005 to 2021.*

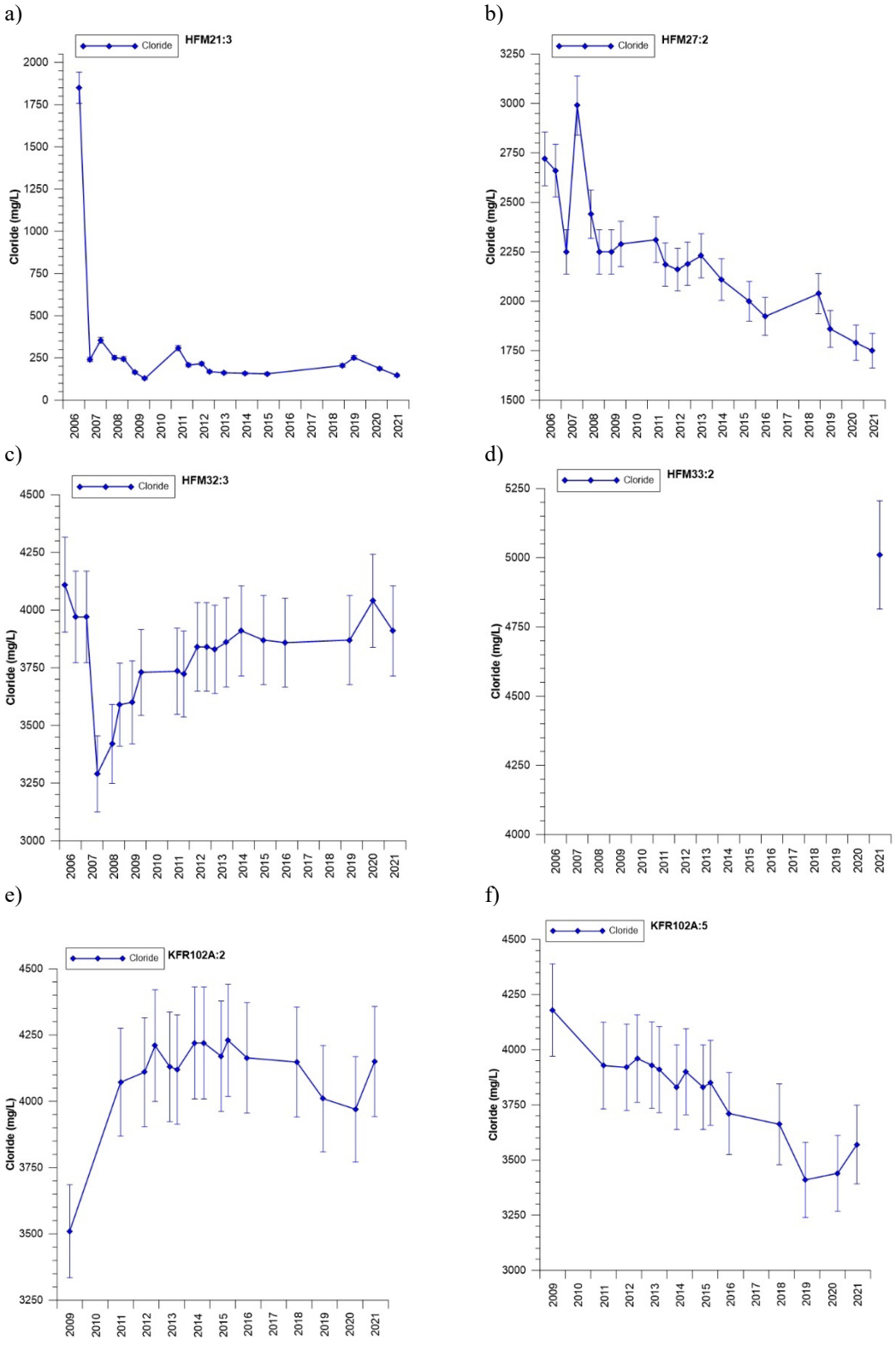

Figure 4-8. *Chloride concentrations in collected samples from hydrochemical monitoring 2005 to 2021.*

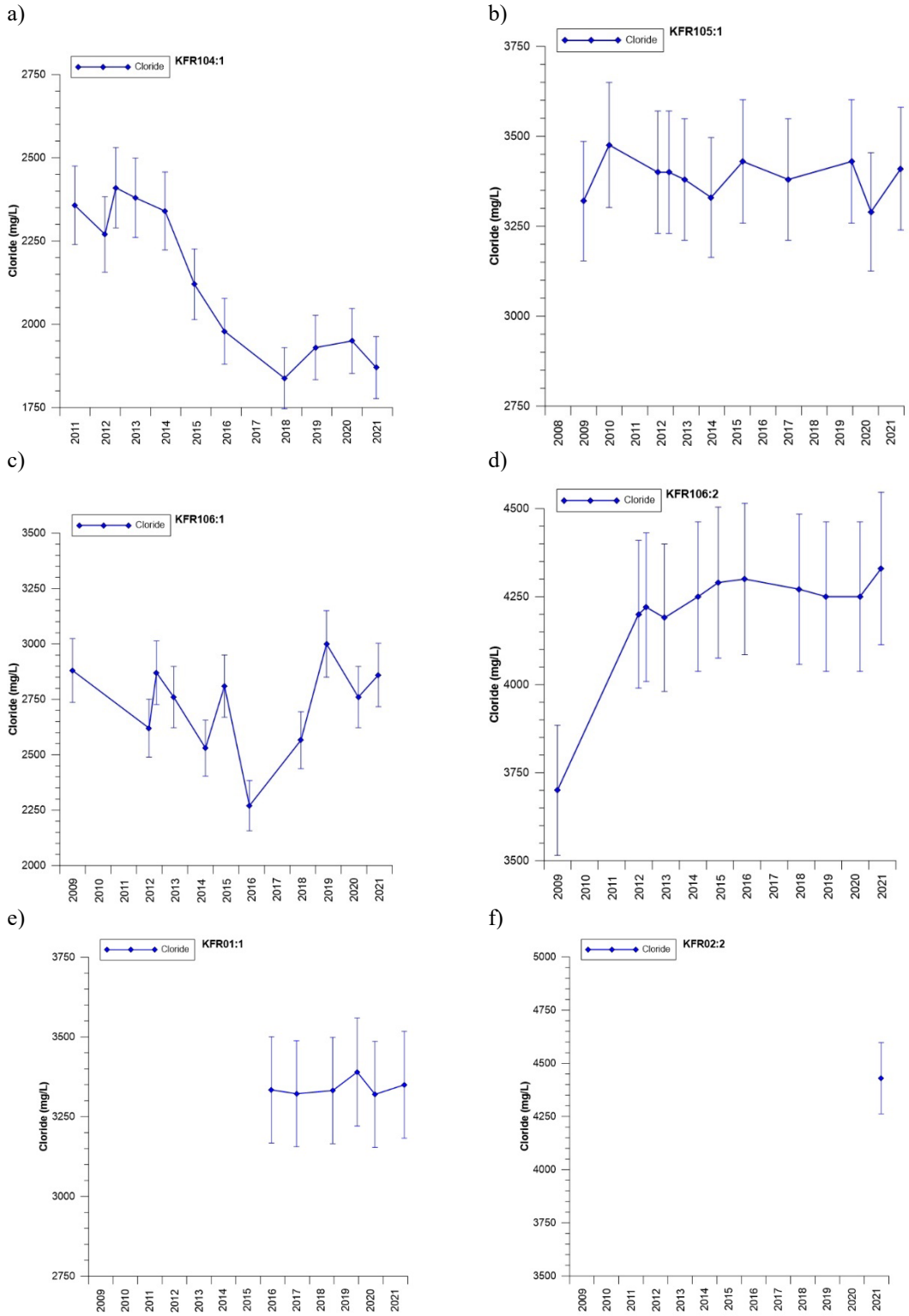

Figure 4-9. *Chloride concentrations in collected samples from hydrochemical monitoring 2009 to 2021.*

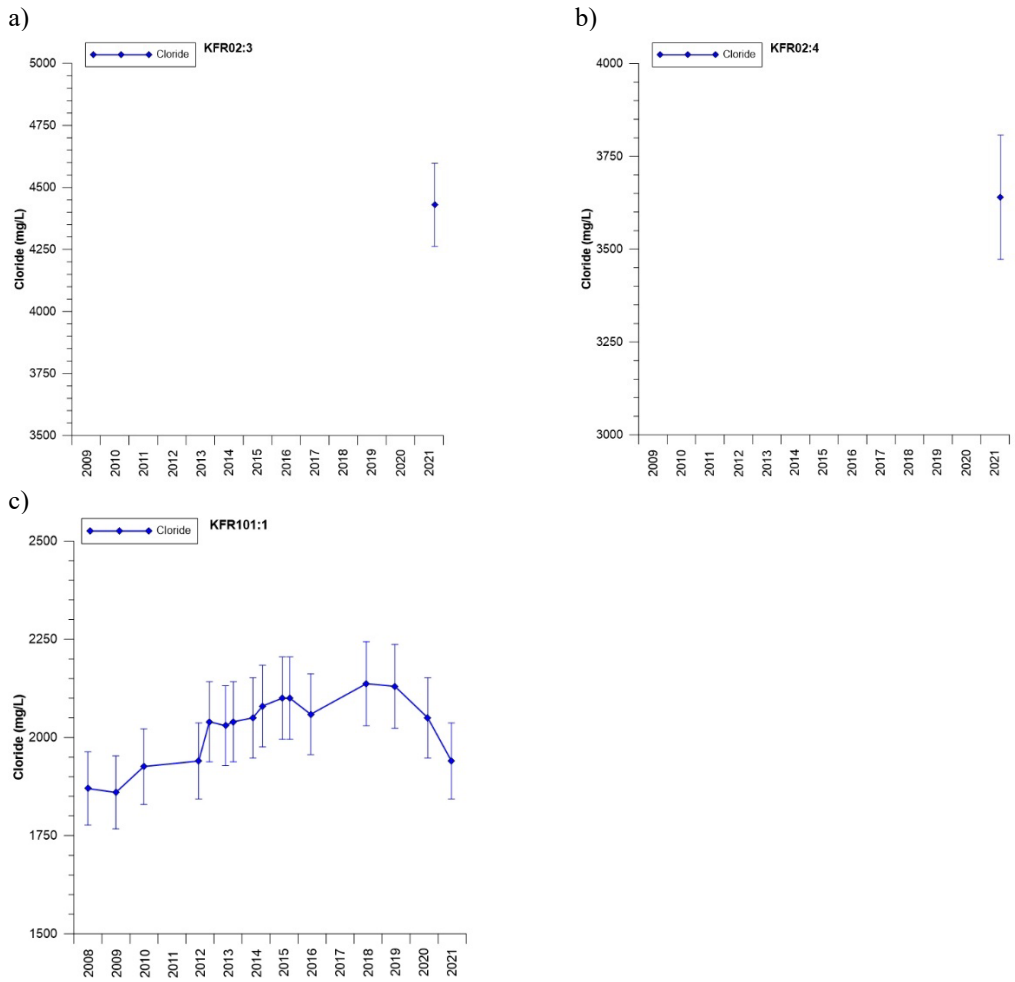

Figure 4-10. *Chloride concentrations in collected samples from hydrochemical monitoring 2008 to 2021.*

5 Summary and discussions

A total of 44 borehole sections included in the monitoring program were sampled during the 2021 campaign. Sampling was conducted in series of three samples collected on three different occasions during continuous pumping i.e. varying the purged volume prior to sampling. With large enough purging prior to sampling, the contribution from influenced section water present in the borehole section decreased with more representative groundwater samples as a result.

Many different parameters were analysed during the sampling in 2021 including measured values for a large group of major and minor constituents as well as trace elements and isotopes. The relative charge balance was within the acceptable limits for all analysed samples, except one. As observed in previous sampling campaigns for the Spent Nuclear Fuel Repository Project, high pH values were also recorded in some of the monitored borehole sections in 2021 although no pH values above 10 were measured in the laboratory. The agreement between the pH- and EC-values measured in the field and in the lab are in general good.

According to the analysed chloride concentrations, the groundwater compositions in the sampled sections are generally stable, although some increasing and decreasing trends (compared with 2009, when sampling series were introduced) can be discerned in some sections during the last years of sampling. Weak increasing trends within the analytical uncertainty are present in KFM01D:2, KFM01D:4, KFM06C:3, KFM11A:2 and KFM12A:3 and a decreasing trend are present for HFM27:2 with differences larger than the analytical error.

During the campaign a total of three pump stops occurred. A gas evacuation tube was used in the same sections as previous years, which probably helped to avoid additional pump stops.

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SKBdoc documents will be submitted upon request to document@skb.se.

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Appendices

Appendix 1
Overview of the monitoring program 2005-2021

Appendix 2
Sampling information

Appendix 3
Water Composition

Appendix 4
Pressure registrations during pumping and sampling, HMS system

Appendix 5
pH trends in some of the core drilled boreholes

Appendix 6
Plug flow volumes

Appendix 1 Overview of the monitoring program 2005-2021

Table A1-1. Overview of the monitoring program in the Forsmark area 2005-2011

Year	Number of sections included		Sampling programme		Analyses of sulphide (HS^-)		Analyses of Uranium (U)		Cleaning	Exchange of water prior to sampling		Analytical protocol (general)
	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn		Ordinary	Series	
2005	8	10	One sample/section	One sample/section	no	yes	no	yes	no	At least 3 section volumes	-	**Spring:** Class 3 **Autumn:** Class 5
2006	15	17	One sample/section	One sample/section	no	yes	no	yes	no	At least 3 section volumes	-	**Spring:** Class 3 **Autumn**: Class 5
2007	21	28	One sample/section	Series of 3 samples in 2 sections. One sample/section in the others	no	yes	no	yes	no	At least 3 section volumes	1 tube vol., 1 section vol., 3 section vol.	**Spring:** Class 3, some class 5 **Autumn:** Mainly class 5, some class 4
2008	33	33	One sample/section	One sample/section	In class 5	yes	in class 5	in class 5	no	At least 3 section volumes	-	**Spring:** Class 5 (in 7 sections) and class 3. **Autumn:** Mainly class 5, some class 4
2009	33	33	One sample/section	Series of 5 samples in 13 sections. One sample/section in the others	In class 4	All samples in series. Not in single samples.	no	All samples in series. Not in single samples.	Rinse pumping in 13 selected sections. No measure in other sections.	At least 5 section volumes	1 tube vol., 1 section vol., 2, 3, 5 section vol.	**Spring:** Class 3 and 4 (in 7 sections) **Autumn:** Class 3 for single samples. For series 4, 4+ and 5+)
2010	12	12	Series of 5 samples in 12 sections.	Series of 3 samples in 12 sections.	In all samples	Last sample in each series	All samples.	In last sample in series in 4 sections.	Cleaning[1)] in all 12 sections both spring and autumn.	-	Plug flow vol. spring: (<1, 2, 3, 4, 5) autumn: (3, 4, 5-6)	**Spring:** Class 5 **Autumn:** Class 3 and 4
2011	32[2)]	32[2)]	Series of 3 samples from all sections	Series of 3 samples from all sections	In all samples	In all samples	Last sample in series in KFM02A:2 and KFM03A:4.	Last sample in series in KFM02A:2 and KFM03A:4.	Cleaning[1)] in all sections either in spring or in autumn.	-	Plug flow volumes (1.5, 3, 5)	**Spring:** Class 4 **Autumn:** Class 4

[1)] High pressure cleaning and rinse pumping
[2)] KFM08D:2 was omitted

Table A1-2. Overview of the monitoring program in the Forsmark area 2012-2016

Year	Number of sections included		Sampling programme		Analyses of sulphide (HS^-)		Analyses of Uranium (U)		Cleaning	Exchange of water prior to sampling series	Use of docking unit	Analytical protocol (general)
	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn				
2012	32[3]	31[4]	Series of 3 samples	Series of 3 samples	In all samples	no	Last sample in series in KFM02A:2 and KFM03A:4.	Last sample in series in KFM02A:2 and KFM03A:4.	Cleaning[1] in all sections in spring	Plug flow volumes (1.5, 3, 5)	-	**Spring:** Class 4 **Autumn:** Class 3
2013	31[4]	1	Series of 3 samples	Series of 3 samples	In all samples	In all samples	Last sample in series in KFM02A:2 and KFM03A:4.	no	Cleaning[1] in all sections in spring	Plug flow volumes (1.5, 3, 5)	-	**Spring:** Class 4 **Autumn:** Class 4
2014	24[5]	5	Series of 3 samples	Series of 3 samples	In all samples	In all samples	Last sample in series in KFM02A:2 and KFM03A:4.	no	Cleaning[1] in all sections except HFM32:3 either in spring or in autumn.	Plug flow volumes (1.5, 3, 5)	1 section in spring	**Spring:** Class 4 **Autumn:** Class 4
2015	27[6]	4	Series of 3 samples	Series of 3 samples	In all samples	In all samples	Last sample in series in KFM02A:2 and KFM03A:4.	no	Cleaning[1] or cleaning[2] in all sections except HFM32:3 and KFM08D:2 and 4 either in spring or in autumn.	Plug flow volumes (1.5, 3, 5)	KFM08D:2 and 4 (borehole equipment in PEEK)	**Spring:** Class 4 **Autumn:** Class 4
2016	23[7]	0	Series of 3 samples	No sampling performed during autumn	In all samples	-	Last sample in series in KFM02A:3	No	Cleaning[2] in most sections[9]	Plug flow volumes (1.5, 3, 5) in all sections except KFM06A:3, KFM06C:3 and KFM11A:2[10]	-	**Spring:** Class 4 **Autumn:** -

1) High pressure cleaning and rinse pumping
2) High pressure cleaning and gas lift pumping (2 gas blows).
3) KFM08D:2 was omitted
4) KFM08D:2 and KFM08D:4 were omitted
5) KFM01D:2, KFM01D:4, KFM07A:2, KFM08D:2 and KFM08D:4 were omitted this year.
6) KFM01D:2 and KFM01D:4 were omitted
7) KFM03A:4, KFM07A:2, KFM08A:6, KFM08A:2, KFM08D:4, KFM08D:2, KFM10A:2, KFM11A:4, HFM13:1 and HFM21:3 were omitted.
8) No cleaning in KFM03A:1, KFM11A:2, HFM01:2 and HFM32:3 due to various reasons.
9) Due to high pH values during earlier years, the plug flow volumes were increased during 2016.

Table A1-3. Overview of the monitoring program in the Forsmark area 2017-2021

Year	Number of sections included		Sampling programme		Analyses of sulphide (HS^-)		Analyses of Uranium (U)		Cleaning	Exchange of water prior to sampling series	Use of docking unit	Analytical protocol (general)
	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn				
2017	13[5)]	0	Series of 3 or 4 samples from all sampled sections[4)]	No sampling performed during autumn	In most samples, except 1st sample in series	-	No	-	Cleaning[2)] in most sections[3)]	Plug flow volumes (1.5, 3, 5) in all sections except a few.[7)]	KFM08D:2 and KFM08D:4 (borehole equipment in PEEK)	**Spring: C**lass II, b+ and III, d-h, h **Autumn: -**
2018	22[6)]	8	Series of 3 samples	Series of 3 samples	In all samples	in all samples	Last sample in series in KFM02A:3, KFM02A:5	-	Cleaning[2)] in most sections[9)]	Plug flow volumes (1.5, 3, 5) in all sections except a few. [8)]	KFM08D:2 and KFM08D:4 (borehole equipment in PEEK)	**Spring: C**lass II, b+ and III, d-h, h **Autumn: C**lass II, b+ and III, d-h, h
2019	30[8)]	2	Series of 3 samples	Series of 3 samples	In all samples	in all samples	Last sample in series in KFM02A:3, KFM02A:5	Last sample in series in KFM03A:4	Cleaning[2)] in most sections[9)]	Plug flow volumes (1.5, 3, 5) in all sections except KFM06A:3, KFM06C:3 and KFM11A:2[10)]	KFM08D:2 and KFM08D:4 (borehole equipment in PEEK)	**Spring: C**lass II, b+ and III, d-h, h **Autumn: C**lass II, b+ and III, d-h, h
2020	32	0	Series of 3 samples	No sampling performed during autumn	In all samples	-	Last sample in series in KFM02A:3 and KFM03A:4		Cleaning[2)] in most sections[10)]	Plug flow volumes (1.5, 3, 5) in all sections except KFM06A:3, KFM06C:3 and KFM11A:2[11)]	KFM08D:2 and KFM08D:4 (borehole equipment in PEEK)	**Spring: C**lass II, b+ and III, d-h, h **Autumn: -**
2021	33	0	Series of 3 samples	No sampling performed during autumn	In all samples	-	Last sample in series in KFM02A:3, KFM03A:4 and KFM08D:4		Cleaning[2)] in most sections[10)]	Plug flow volumes (1.5, 3, 5) in all sections except KFM06A:3, KFM06C:3, KFM11A:2 and KFM12A:3	KFM08D:2 and KFM08D:4 (borehole equipment in PEEK)	**Spring: C**lass II, b+ and III, a-d, h, f[12)] **Autumn: C**lass II, b+ and III, a-d, h, f

1) High pressure cleaning and gas lift pumping (2 gas blows).
2) No cleaning in HFM32, KFM08D due to various reasons.
3) 4 samples in: KFM06A:3 ,KFM06A:5 , KFM06C:3 , KFM06C:5 , KFM08A:2 , KFM08A:6 , KFM08D:2 , KFM08D:4 , KFM11A:2 , KFM11A:4 ,KFM12A:3. Second sample by stable pH-value.
4) KFM01A:5, KFM01D:2, KFM01D:4, KFM02A:3, KFM02A:5, KFM02B:2, KFM02B:4, KFM03A:1, KFM03A:4, HFM01:2, HFM02:2, HFM04:2, HFM13:1, HFM15:1, HFM16:2, HFM19:1, HFM21:3, HFM27:2, HFM32:3 were omitted
5) HFM32:3, HFM19:1, KFM07A:2 were omitted
6) Changed pump volume in KFM06A:5, KFM06A:3, KFM06C:5, KFM06C:3, KFM08A:6, KFM08A:2, KFM08D:4, KFM08D:2, KFM11A:4, KFM11A:2, KFM12A:3.
7) Changed pump volume in KFM06A:5, KFM06A:3, KFM06C:5, KFM06C:3, KFM08A:2, KFM08D:4, KFM08D:2, KFM11A:2
8) No cleaning in KFM08D.
9) No cleaning in HFM32:3, KFM08D, KFM02A, KFM02B, KFM04A, KFM07A
10) Changed pump volume in KFM06A:3,KFM06C:3, KFM11A:2
11) Third sample in section KFM02A:3 and KFM03A:4

Table A1-4. Overview of the monitoring program at the SFR-site 2012-2018

Year	Number of sections included		Sampling programme		Analyses of sulphide (HS^-)		Analyses of Uranium (U)		Cleaning	Exchange of water prior to sampling series	Analytical protocol (general)
	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn			
2012	7	7	Series of 3 samples	Series of 3 samples	In KFR102A (2 sect.)	no	Last sample in series in KFR106:1 and KFR106:2	Last sample in series in KFR106:1 and KFR106:2	Cleaning[1)] in all sections in spring.	Plug flow volumes (1.5, 3, 5)	**Spring:** Class 4 **Autumn**: Class 3
2013	7	3	Series of 3 samples f	Series of 3 samples	In KFR102A (2 sect.) and KFR105	no	Last sample in series in KFR106:1 and KFR106:2	no	Cleaning[1)] in all sections in spring.	Plug flow volumes (1.5, 3, 5)	**Spring:** Class 4 **Autumn:** Class 3
2014	5	5	Series of 3 samples	Series of 3 samples	In KFR102A (2 sect.) and KFR105	no	no	Last sample in series in KFR106:1 and KFR106:2	Cleaning[1)] in all sections in spring.	Plug flow volumes (1.5, 3, 5)	**Spring:** Class 4 **Autumn:** Class 3
2015	6	4	Series of 3 samples	Series of 3 samples	In KFR102A (2 sect.)	KFR105	Last sample in series in KFR106:1 and KFR106:2	no	Cleaning[2)] in all sections except KFR105 in spring.	Plug flow volumes (1.5, 3, 5)	**Spring:** Class 4 **Autumn:** Class 3
2016	7[3)]	0	Series of 3 samples	No sampling performed during autumn	In KFR102A (2 sect.) and KFR01	-	Last sample in series in KFR106:1 and KFR106:2	-	Cleaning[2)] in section KFR102A:5 and KFR102A:2	Plug flow volumes (1.5, 3, 5)	**Spring:** Class 4 **Autumn:** -
2017	2[4)]	0	Series of 3 samples	No sampling performed during autumn	In all samples	-	no	-	no	Plug flow volumes (1.5, 3, 5) except KFR01:1.	**Spring: C**lass II, b+ and III, d-h, h **Autumn: -**
2018	7[5)]	0	Series of 3 samples	No sampling performed during autumn	In all samples except in KFR01	-	Last sample in series in KFR106:1 and KFR106:2	-	Cleaning[2)] in all sections except KFR01 and KFR106.	Plug flow volumes (1.5, 3, 5) except KFR01:1.	**Spring: C**lass II, b+ and III, d-h, h **Autumn: -**

1) High pressure cleaning and rinse pumping
2) High pressure cleaning and gas lift pumping (2 gas blows)
3) KFR01:1 was added to the monitoring program. KRF105:1 was not available during the sampling period due to hydraulic injection test.
4) KFR101:1, KFR102A.2, KFR102A:5, KFR104:1, KFR106:1, KFR106:2 were omitted.
5) KFR105:1 was omitted

Table A1-5. Overview of the monitoring program at the SFR-site 2019-2021

Year	Number of sections included		Sampling programme		Analyses of sulphide (HS^-)		Analyses of Uranium (U)		Cleaning	Exchange of water prior to sampling series	Analytical protocol (general)
	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn			
2019	6	2	Series of 3 samples	Series of 3 samples	In all samples	In all samples	Last sample in series in KFR106:1 and KFR106:2	-	Cleaning[1)] in all sections except KFR01, KFR105 KFR106.	Plug flow volumes (1.5, 3, 5) except KFR01:1.	Spring: Class II, b+ and III, d-h, h Autumn: Class II, b+ and III, d-h, h
2020	8	0	Series of 3 samples	No sampling performed during autumn	In all samples	-	Last sample in series in KFR106:1 and KFR106:2	-	Cleaning[1)] in all sections except KFR01, KFR105 KFR106.	Plug flow volumes (1.5, 3, 5) except KFR01:1	Spring: Class II, b+ and III, d-h, h Autumn: -
2021	8	4	Series of 3 samples	Series of 3 samples	In all samples	In all samples	Last sample in series in KFR106:1 and KFR106:2	-	Cleaning[1)] in KFR101:1, KFR102A:5, KFR102A:2, KFR104:1	Plug flow volumes (1.5, 3, 5) except KFR01:1, KFR02:2, KFR02:3, KFR02:4	Spring: Class II, b+ and III, a-h, h Autumn: Class II, b+ and III, a-h, f, h

[1)] High pressure cleaning and gas lift pumping (2 gas blows)

Appendix 2 Sampling information

Table A2-1. Sampling information in 2021

Idcode: section	Tube volume [L]	Section volume [L]	Length of pumping period	Medium flow rate[1)] [mL/min]	Planned removed volume[2)] [L]	Pumped volume[3)] [L]	Sampling date	Sample no.	Responses observed in other sections in the borehole (if yes, se Appendix 4) /Comments
KFM01A:5	1.4	18	7 days 13 h 38 min	178		910	-	-	Yes
					139.5	135	2021-06-01	89549	
					279	241	2021-06-07	89550	
					465	459	2021-06-08	89551	
KFM01D:2	3.3	24.5	1 day 6 h 52 min	80		148	-	-	Yes
					24	24	2021-06-02	89552	
					48	48	2021-06-02	89553	
					80	139	2021-06-03	89554	
KFM01D:4	9	12.3	0 days 7 h 8 min	244		105	-	-	Yes
					27	26	2021-06-07	89555	
					54	60	2021-06-07	89556	
					90	93	2021-06-07	89557	
KFM02A:3	14.1	33.4	1 day 8 h 5 min	113		218	-	-	No
					63	60	2021-05-17	89558	
					126	183	2021-05-18	89559	
					210	207	2021-05-18	89560	
KFM02A:5	11.9	31.8	3 days 5 h 1 min	207		957	-	-	No
					273	305	2021-05-17	89561	
					546	586	2021-05-18	89562	
					910	946	2021-05-19	89563	
KFM02B:2	12.8	15	1 day 5 h 29 min	342		604	-	-	No
					90	101	2021-05-19	89564	
					180	187	2021-05-19	89565	
					300	591	2021-05-20	89566	
KFM02B:4	10.5	21	1 day 7 h 29 min	515		973	-	-	Yes
					286.5	286	2021-05-18	89567	
					573	858	2021-05-19	89568	

Idcode: section	Tube volume [L]	Section volume [L]	Length of pumping period	Medium flow rate[1] [mL/min]	Planned removed volume[2] [L]	Pumped volume[3] [L]	Sampling date	Sample no.	Responses observed in other sections in the borehole (if yes, se Appendix 4) /Comments
					955	955	2021-05-19	89569	
KFM03A:1	27.7	31.5	4 days 15 h 31 min	65		432	-	-	Yes
					118.5	138	2021-05-24	89570	
					237	314	2021-05-26	89571	
					395	426	2021-05-27	89572	
KFM03A:4	18.2	18.6	2 days 8 h 23 min	203		422	-	-	No
					43.5	47	2021-05-25	89573	
					87	90	2021-05-25	89574	
					145	151	2021-05-27	89575	
KFM04A:4	6.8	18.7	0 days 7 h 58 min	209		100	-	-	No
					24	27	2021-05-20	89576	
					48	55	2021-05-20	89577	
					80	87	2021-05-20	89578	
KFM06A:3	21.1	13.6	11 days 0 h 39 min	58		265	-	-	Yes
					84	88	2021-05-18	89579	
					140	153	2021-05-19	89580	
					196	235	2021-05-20	89581	
KFM06A:5	9.9	22.4	1 day 5 h 55 min	137		246	-	-	Yes
					39	41	2021-05-10	89582	
					78	76	2021-05-10	89583	
					130	236	2021-05-11	89584	
KFM06C:3	18.5	23.5	11 days 2 h 41 min	18		293	-	-	Yes
					115	109	2021-05-17	89585	
					215	202	2021-05-21	89586	
					315	288	2021-05-24	89587	
KFM06C:5	15.3	11.1	1 day 6 h 20 min	173		315	-	-	Yes
					42	54	2021-05-10	89588	
					84	102	2021-05-10	89589	

Idcode: section	Tube volume [L]	Section volume [L]	Length of pumping period	Medium flow rate[1] [mL/min]	Planned removed volume[2] [L]	Pumped volume[3] [L]	Sampling date	Sample no.	Responses observed in other sections in the borehole (if yes, se Appendix 4) /Comments
					140	301	2021-05-11	89590	
KFM07A:2	27.4	13.9	1 day 9 h 10 min	101		200	-	-	Yes
					57	58	2021-06-09	89591	
					114	156	2021-06-10	89592	
					190	192	2021-06-10	89593	
KFM08A:2	19.6	13.9	0 days 7 h 15 min	297		129	-	-	Yes
					33	26	2021-05-31	89594	
					66	65	2021-05-31	89595	
					110	108	2021-05-31	89596	
KFM08A:6	7.7	16.3	4 days 0 h 3 min	281		1575	-	-	Yes
					388.5	391	2021-06-08	89597	
					777	791	2021-06-09	89598	
					1295	1505	2021-06-11	89599	
KFM08D:2	0	0	4 days 8 h 57 min	25		157	-	-	Yes
					49.5	37	2021-05-31	89600	
					99	83	2021-06-01	89601	
					165	149	2021-06-03	89602	
KFM08D:4	18.9	22	7 days 1 h 38 min	105		1070	-	-	Yes
					352.5	352	2021-06-09	89603	
					705	712	2021-06-11	89604	
					1175	1064	2021-06-14	89605	
KFM10A:2	12.4	13.9	2 days 13 h 3 min	211		773	-	-	No
					187.5	211	2021-05-26	89606	
					375	448	2021-05-27	89607	
					625	762	2021-05-28	89608	
KFM11A:2	19.8	25.2	2 days 8 h 29 min	180		610	-	-	No
					300	284	2021-06-15	89609	
					450	543	2021-06-16	89610	

Idcode: section	Tube volume [L]	Section volume [L]	Length of pumping period	Medium flow rate[1] [mL/min]	Planned removed volume[2] [L]	Pumped volume[3] [L]	Sampling date	Sample no.	Responses observed in other sections in the borehole (if yes, se Appendix 4) /Comments
					600	600	2021-06-16	89611	
KFM11A:4	12.9	12.3	0 days 8 h 45 min	237		124	-	-	Yes
					31.5	30	2021-06-10	89612	
					63	61	2021-06-10	89613	
					105	114	2021-06-10	89614	
KFM12A:3	7.9	13.6	0 days 11 h 47 min	258		183	-	-	Yes
					34.5	67	2021-06-08	89615	
					69	117	2021-06-08	89616	
					115	170	2021-06-08	89617	
HFM01:2	1.5	36.5	4 days 2 h 55 min	289		1715	-	-	Yes
					459	466	2021-06-01	89618	
					918	920	2021-06-02	89619	
					1530	1705	2021-06-04	89620	
HFM02:2	1.6	31.3	2 days 23 h 54 min	297		1283	-	-	No
					357	382	2021-06-01	89621	
					714	738	2021-06-02	89622	
					1190	1269	2021-06-03	89623	
HFM04:2	2.2	26.1	1 day 12 h 0 min	300		648	-	-	No
					154.5	186	2021-05-17	89624	
					309	296	2021-05-17	89625	
					515	633	2021-05-18	89626	
HFM13:1	5	45.6	8 days 13 h 46 min	214		2637	-	-	No
					772.5	724	2021-05-25	89627	
					1545	1637	2021-05-28	89628	
					2575	2624	2021-05-31	89629	
HFM15:1	2.9	31.8	2 days 17 h 3 min	204		794	-	-	Yes. Strong and fast response to rain rall.
					174	183	2021-05-24	89630	
					348	445	2021-05-25	89631	
					580	783	2021-05-26	89632	

Idcode: section	Tube volume [L]	Section volume [L]	Length of pumping period	Medium flow rate[1)] [mL/min]	Planned removed volume[2)] [L]	Pumped volume[3)] [L]	Sampling date	Sample no.	Responses observed in other sections in the borehole (if yes, se Appendix 4) /Comments
HFM16:2	2	39	2 days 22 h 30 min	1005		4252	-	-	Yes
					1260	1270	2021-05-10	89633	
					2520	2664	2021-05-11	89634	
					4200	4222	2021-05-12	89635	
HFM21:3	1.5	30.8	2 days 9 h 42 min	207		716	-	-	Yes
					201	160	2021-06-07	89636	
					402	424	2021-06-08	89637	
					670	705	2021-06-09	89638	
HFM27:2	2	36.5	4 days 0 h 59 min	217		1262	-	-	No
					333	341	2021-05-25	89639	
					666	739	2021-05-26	89640	
					1110	1250	2021-05-28	89641	
HFM32:3	1.4	18	0 days 9 h 4 min	355		193	-	-	No
					43.5	49	2021-05-27	89642	
					87	94	2021-05-27	89643	
					145	182	2021-05-27	89644	
HFM33:2	0	0	1 day 8 h 45 min	305		600	-	-	No
					77.1	165	2021-06-21	89645	
					154.2	262	2021-06-21	89646	
					257	584	2021-06-22	89647	
KFR101:1	3.51	80.1	1 day 17 h 35 min	143		357	-	-	No
					109.5	106	2021-06-22	89648	
					219	300	2021-06-23	89649	
					365	349	2021-06-23	89650	
KFR102A:2	12	25.6	2 days 9 h 42 min	303		1048	-	-	Yes
					291	285	2021-06-16	89651	
					582	665	2021-06-17	89652	
					970	1036	2021-06-18	89653	

Idcode: section	Tube volume [L]	Section volume [L]	Length of pumping period	Medium flow rate[1] [mL/min]	Planned removed volume[2] [L]	Pumped volume[3] [L]	Sampling date	Sample no.	Responses observed in other sections in the borehole (if yes, se Appendix 4) /Comments
KFR102A:5	6.05	7.97	1 day 8 h 28 min	201		391	-	-	Yes
					78	80	2021-06-16	89654	
					156	157	2021-06-16	89655	
					260	380	2021-06-17	89656	
KFR104:1	9.42	199	4 days 4 h 20 min	53		318	-	-	
					90	92	2021-06-15	89657	Yes
					180	230	2021-06-17	89658	
					300	312	2021-06-18	89659	
KFR105:1		696							Yes
					2088	1888	2021-11-10	89678	
					3480	2553	2021-11-11	89679	
					4872	5180	2021-11-15	89680	
KFR106:1	7.35	174	0 days 9 h 55 min	140		83	-	-	No
					24	24	2021-06-14	89681	
					48	46	2021-06-14	89682	
					80	74	2021-06-14	89683	
KFR106:2	4.04	490	1 day 11 h 8 min	136		287	-	-	No
					82.5	81	2021-06-14	89684	
					165	222	2021-06-15	89685	
					275	278	2021-06-15	89686	
KFR01:1		40					-	-	No
					120	843	2021-11-09	89660	
					200	1392	2021-11-10	89661	
					280	1432	2021-11-10	89662	
KFR02:2		42					-	-	Possible
					126	169	2021-09-07	89666	
					210	274	2021-09-08	89667	
					294	459	2021-09-10	89668	

Idcode: section	Tube volume [L]	Section volume [L]	Length of pumping period	Medium flow rate[1] [mL/min]	Planned removed volume[2] [L]	Pumped volume[3] [L]	Sampling date	Sample no.	Responses observed in other sections in the borehole (if yes, se Appendix 4) /Comments
KFR02:3		87					-	-	Possible
					609	531	2021-09-13	89674	
KFR02:4		86					-	-	Possible
					258	184	2021-09-07	89675	
					430	407	2021-09-08	89676	
					602	801	2021-09-10	89677	

1) The pumping period may contain pump stops. Medium flow rate and pumped volume is calculated from periods of actual pumping.
2) The first sample is planned to be collected after 1,5 plug flow, the second after 3 and third and last sample in each series after 5 plug flow volumes.
3) Pump stops have occurred causing restart of pumping during the pumping period for some sections. Volume written by each sample number represent volume pumped since restart in those cases, but total pumped volume (first value) includes all pumping.

Appendix 3 Water Composition

Table A3-1. Water Composition – 2021

Id code	Secup	Seclow	Section	Sample	Sampling	RCB	Na	K	Ca	Mg	HCO_3^-	Cl^-	SO_4^{2-}	SO_4-S	Br^-	F^-	Si	Fe	Fe-tot	Fe(II)	Mn	Li
	m	m	no.	no.	date	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
HFM01	33.50	45.50	2	89618	2021-06-01	-1.48	413	13.1	46.4	13.4	487	373	172	59.7	1.2	2.5	5.79	0.322	-	-	0.0728	0.0125
HFM01	33.50	45.50	2	89619	2021-06-02	-1.05	414	13.1	46.3	13.4	486	369	171	59.3	1.2	2.5	5.76	0.321	-	-	0.0720	0.0124
HFM01	33.50	45.50	2	89620	2021-06-04	-1.94	408	13.2	46.7	13.4	486	375	172	59.3	1.2	2.4	5.75	0.310	0.32	0.27	0.0778	0.0125
HFM02	38.00	48.00	2	89621	2021-06-01	0.79	254	10.9	38.0	11.1	451	183	59.0	20.1	0.66	2.0	6.16	0.270	-	-	0.0689	0.0111
HFM02	38.00	48.00	2	89622	2021-06-02	1.06	254	11.1	38.5	11.1	453	180	58.0	20.2	0.64	2.0	6.28	0.267	-	-	0.0694	0.0110
HFM02	38.00	48.00	2	89623	2021-06-03	0.77	251	11.0	38.2	11.1	452	179	58.0	20.0	0.64	2.0	6.29	0.254	0.27	0.25	0.0719	0.0110
HFM04	58.00	66.00	2	89624	2021-05-17	1.62	180	7.16	33.6	8.14	424	75.0	41.0	14.0	0.29	1.8	6.72	0.398	-	-	0.0840	0.0106
HFM04	58.00	66.00	2	89625	2021-05-17	-0.09	173	6.81	31.5	7.58	423	73.0	41.0	13.3	0.29	1.8	6.37	0.372	-	-	0.0779	0.0100
HFM04	58.00	66.00	2	89626	2021-05-18	1.33	180	7.09	32.0	7.76	422	75.0	41.0	13.9	0.29	1.8	6.62	0.376	0.38	0.37	0.0825	0.0107
HFM13	159.00	173.00	1	89627	2021-05-25	1.59	1810	23.3	1180	191	124	4880	442	151	20	1.4	7.07	3.68	-	-	2.08	0.0524
HFM13	159.00	173.00	1	89628	2021-05-28	1.46	1780	22.9	1160	189	130	4810	436	149	20	1.3	6.95	3.62	-	-	2.05	0.0488
HFM13	159.00	173.00	1	89629	2021-05-31	1.58	1800	22.6	1140	185	130	4790	426	146	19.5	1.3	6.92	3.52	1.47	1.43	2.24	0.0498
HFM15	85.00	95.00	1	89630	2021-05-24	0.26	71.4	6.11	71.5	7.66	369	32.0	20.0	7.02	<0.2	0.84	6.99	1.06	-	-	0.178	0.0047
HFM15	85.00	95.00	1	89631	2021-05-25	0.45	68.7	6.07	72.8	7.64	368	30.0	19.9	6.88	<0.2	0.83	6.99	1.07	-	-	0.177	0.0047
HFM15	85.00	95.00	1	89632	2021-05-26	0.56	66.8	6.01	72.7	7.56	364	30.0	19.8	6.76	<0.2	0.81	6.94	1.03	1.03	1.03	0.184	0.0042
HFM16	54.00	67.00	2	89633	2021-05-10	1.54	267	6.63	31.2	6.98	467	137	86.0	29.5	0.54	2.5	6.03	0.398	-	-	0.0721	0.0115
HFM16	54.00	67.00	2	89634	2021-05-11	1.79	268	6.62	31.5	6.99	466	137	86.0	29.6	0.54	2.5	6.08	0.412	-	-	0.0731	0.0115
HFM16	54.00	67.00	2	89635	2021-05-12	2.13	269	6.56	30.8	6.89	462	137	86.0	29.4	0.54	2.5	6.02	0.406	0.41	0.40	0.0763	0.0113
HFM21	22.00	32.00	3	89636	2021-06-07	0.09	202	12.2	52.4	13.6	483	102	92.0	31.2	0.37	1.4	7.48	0.686	-	-	0.140	0.0139
HFM21	22.00	32.00	3	89637	2021-06-08	6.73	253	14.9	63.3	16.6	483	126	95.0	37.9	0.44	1.4	8.66	0.815	-	-	0.165	0.0180
HFM21	22.00	32.00	3	89638	2021-06-09	1.34	236	13.2	55.9	14.7	483	146	98.0	34.2	0.52	1.4	7.42	0.684	0.71	0.70	0.146	0.0148
HFM27	46.00	58.00	2	89639	2021-05-25	0.33	920	28.3	287.0	74.6	310	1780	258	86.4	6.0	1.7	5.81	1.81	-	-	0.486	<0.04
HFM27	46.00	58.00	2	89640	2021-05-26	0.00	897	28.0	282.0	73.0	311	1750	249	84.	6.0	1.6	5.89	1.79	-	-	0.477	<0.04
HFM27	46.00	58.00	2	89641	2021-05-28	-0.32	898	27.8	274.0	72.1	314	1750	243	83.4	5.9	1.6	5.88	1.62	1.7	1.60	0.489	<0.04

RCB % = Rel. charge balance error % - = Not analysed < "value" = value below reporting limit

Id code	Secup	Seclow	Section	Sample	Sampling	RCB	Na	K	Ca	Mg	HCO_3^-	Cl^-	SO_4^{2-}	SO_4-S	Br^-	F^-	Si	Fe	Fe-tot	Fe(II)	Mn	Li
	m	m	no.	no.	date	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
HFM32	26.00	31.00	3	89642	2021-05-27	0.03	1940	62.0	464	157	199	3920	371	128	13.6	1.4	5.26	4.85	-	-	0.776	0.0565
HFM32	26.00	31.00	3	89643	2021-05-27	-0.16	1930	62.2	463	157	198	3920	372	128	13.7	1.4	5.31	4.84	-	-	0.782	0.0566
HFM32	26.00	31.00	3	89644	2021-05-27	0.40	1950	62.0	464	156	196	3910	370	127	13.7	1.4	5.26	4.66	4.70	4.60	0.820	0.0570
HFM33	121.00	137.50	2	89645	2021-06-21	-0.41	2160	36.2	798	200	133	5000	434	146	16.6	1.4	6.52	3.29	-	-	1.60	0.0548
HFM33	121.00	137.50	2	89646	2021-06-21	-0.66	2130	35.7	809	199	131	5000	436	145	16.9	1.4	6.56	3.13	-	-	1.58	0.0508
HFM33	121.00	137.50	2	89647	2021-06-22	-0.47	2140	36.1	814	200	131	5010	431	146	16.6	1.3	6.58	3.26	3.20	3.20	1.71	0.0532
KFM01A	109.00	130.00	5	89549	2021-06-01	0.57	1650	18.8	717	100	64.6	3860	224	77.8	15.8	1.6	8.17	0.228	-	-	0.508	<0.04
KFM01A	109.00	130.00	5	89550	2021-06-07	-2.02	1540	18.2	666	93.1	66.5	3790	218	75.0	15.3	1.6	8.07	0.319	-	-	0.480	0.0368
KFM01A	109.00	130.00	5	89551	2021-06-08	-2.86	1490	17.6	654	90.4	66.7	3750	208	73.2	14.7	1.5	8.02	0.361	0.37	0.36	0.514	0.0350
KFM01D	429.00	438.00	2	89552	2021-06-02	0.55	1700	9.45	1430	22.8	16.1	5100	72.0	25.4	31	1.4	10.3	<0.2	-	-	0.0688	<0.04
KFM01D	429.00	438.00	2	89553	2021-06-02	0.22	1690	9.37	1420	22.8	15.5	5100	82.0	26.3	31	1.4	10.4	<0.2	-	-	0.0771	<0.04
KFM01D	429.00	438.00	2	89554	2021-06-03	0.49	1710	9.18	1440	22.4	14.3	5130	84.0	29.3	32	1.3	10.2	0.0137	<0.02	<0.02	0.0859	<0.04
KFM01D	311.00	321.00	4	89555	2021-06-07	-4.70	1520	9.11	1140	29.0	12.0	4810	95.0	32.2	29	1.7	8.92	0.193	-	-	0.166	0.0260
KFM01D	311.00	321.00	4	89556	2021-06-07	-2.62	1550	11.2	1120	43.0	15.2	4630	142	48.6	25	1.6	10.5	0.337	-	-	0.219	0.0313
KFM01D	311.00	321.00	4	89557	2021-06-07	-2.60	1550	11.8	1070	46.0	16.7	4540	150	50.6	24	1.5	10.5	0.413	0.45	0.44	0.242	0.0296
KFM02A	490.00	518.00	3	89558	2021-05-17	0.90	2360	39.0	962	221	128	5470	493	166	19.3	1.5	6.88	0.803	-	-	1.70	0.0519
KFM02A	490.00	518.00	3	89559	2021-05-18	0.41	2350	37.4	964	220	127	5510	496	167	19.2	1.5	6.58	1.51	-	-	1.88	0.0567
KFM02A	490.00	518.00	3	89560	2021-05-18	0.25	2330	37.1	963	220	126	5500	497	167	19.2	1.5	6.54	1.52	1.57	1.53	2.00	0.0577
KFM02A	411.00	442.00	5	89561	2021-05-17	0.60	2060	21.7	1200	188	93.1	5430	424	143	21	1.4	6.87	0.652	-	-	1.62	0.585
KFM02A	411.00	442.00	5	89562	2021-05-18	0.81	2070	21.6	1190	188	94.1	5400	423	144	20	1.4	7.02	0.673	-	-	1.65	0.548
KFM02A	411.00	442.00	5	89563	2021-05-19	0.30	2090	21.6	1180	187	94.7	5470	433	144	21	1.4	6.99	0.713	0.71	0.71	1.81	0.492
KFM02B	491.00	506.00	2	89564	2021-05-19	1.61	2380	38.8	924	225	126	5350	501	172	18.6	1.5	8.12	3.45	-	-	1.87	0.0633
KFM02B	491.00	506.00	2	89565	2021-05-19	2.62	2380	38.0	932	226	124	5250	502	172	18.7	1.6	8.03	3.80	-	-	1.90	0.0614
KFM02B	491.00	506.00	2	89566	2021-05-20	1.07	2370	37.9	932	226	124	5420	500	171	18.6	1.6	7.74	4.26	1.66	1.68	2.10	0.0646
KFM02B	410.00	431.00	4	89567	2021-05-18	1.14	2150	24.1	1100	199	102	5340	447	150	19.8	1.5	8.11	1.85	-	-	1.84	0.0903
KFM02B	410.00	431.00	4	89568	2021-05-19	1.40	2160	24.2	1110	200	105	5340	440	152	19.5	1.4	8.02	1.96	-	-	1.8	0.0931
KFM02B	410.00	431.00	4	89569	2021-05-19	1.48	2150	24.2	1110	200	105	5320	440	151	19.5	1.6	8.00	2.02	2.01	1.99	2.07	0.0910

RCB % = Rel. charge balance error % - = Not analysed < "value" = value below reporting limit

Id code	Secup	Seclow	Section	Sample	Sampling	RCB	Na	K	Ca	Mg	HCO_3^-	Cl^-	SO_4^{2-}	SO_4-S	Br^-	F^-	Si	Fe	Fe-tot	Fe(II)	Mn	Li
	m	m	no.	no.	date	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KFM03A	969.50	994.50	1	89570	2021-05-24	0.92	2330	8.24	3910	7.16	6.8	10300	51.0	15.0	95	1.5	5.07	<0.2	-	-	<0.03	<0.04
KFM03A	969.50	994.50	1	89571	2021-05-26	0.47	2310	8.27	3930	7.19	6.0	10400	50.0	15.1	94	1.5	4.68	<0.2	-	-	<0.03	<0.04
KFM03A	969.50	994.50	1	89572	2021-05-27	0.44	2330	8.21	3910	7.24	6.0	10400	49.0	15.5	94	1.5	4.64	0.181	0.049	0.047	0.0285	<0.04
KFM03A	633.50	650.00	4	89573	2021-05-25	0.59	1920	15.7	1580	52.2	18.4	5700	190	62.9	33	1.6	6.55	0.418	-	-	0.305	<0.04
KFM03A	633.50	650.00	4	89574	2021-05-25	0.77	1950	14.7	1580	51.1	16.9	5720	191	63.4	33	1.6	6.30	0.417	-	-	0.294	<0.04
KFM03A	633.50	650.00	4	89575	2021-05-27	0.51	1960	13.9	1590	50.2	15.6	5780	196	64.5	33	1.6	6.01	0.379	0.40	0.40	0.294	<0.04
KFM04A	230.00	245.00	4	89576	2021-05-20	0.33	2050	25.1	1430	219	101	5890	473	165	25	1.1	6.14	1.66	-	-	2.60	0.0658
KFM04A	230.00	245.00	4	89577	2021-05-20	0.80	2090	25.4	1430	219	102	5890	475	165	26	1.1	6.25	1.76	-	-	2.59	0.0653
KFM04A	230.00	245.00	4	89578	2021-05-20	0.08	2040	25.1	1430	219	101	5910	474	164	26	1.2	6.23	1.79	1.73	1.74	2.88	0.0632
KFM06A	738.00	748.00	3	89579	2021-05-18	0.98	1950	8.52	2220	15.1	10.4	6770	99.0	32.3	48	1.4	6.48	<0.2	-	-	0.182	0.0474
KFM06A	738.00	748.00	3	89580	2021-05-19	0.60	1930	8.15	2220	14.1	9.1	6790	97.0	32.0	48	1.4	6.24	<0.2	-	-	0.166	0.0503
KFM06A	738.00	748.00	3	89581	2021-05-20	0.34	1930	7.91	2240	13.3	8.6	6860	97.0	31.8	48	1.5	6.12	0.119	0.12	0.11	0.177	0.0490
KFM06A	341.00	362.00	5	89582	2021-05-10	1.12	1550	13.9	1270	39.3	26.0	4560	113	36.6	29	1.2	5.12	0.258	-	-	0.212	0.0605
KFM06A	341.00	362.00	5	89583	2021-05-10	-0.25	1560	11.5	1270	36.6	27.1	4700	105	34.4	29	1.3	5.43	0.362	-	-	0.234	0.0614
KFM06A	341.00	362.00	5	89584	2021-05-11	0.83	1540	9.37	1290	35.9	27.8	4600	103	33.5	29	1.2	5.19	0.462	0.45	0.45	0.260	0.0605
KFM06C	647.00	666.00	3	89585	2021-05-17	1.23	1580	5.47	1850	15.6	18.8	5560	64.0	20.7	42	1.3	3.32	<0.2	-	-	<0.03	0.0426
KFM06C	647.00	666.00	3	89586	2021-05-21	0.83	1590	5.10	1850	15.1	15.4	5620	63.0	21.0	42	1.4	3.81	<0.2	-	-	0.0392	0.0401
KFM06C	647.00	666.00	3	89587	2021-05-24	1.48	1570	5.31	1910	15.0	14.1	5620	66.0	20.4	43	1.3	3.99	0.094	<0.02	<0.02	0.0581	<0.04
KFM06C	531.00	540.00	5	89588	2021-05-10	0.70	1790	14.4	1280	76.2	38.3	4980	242	82.9	25	0.99	4.73	0.222	-	-	0.513	0.0520
KFM06C	531.00	540.00	5	89589	2021-05-10	0.33	1790	13.8	1300	76.5	41.3	5050	244	84.4	25	1.0	4.88	0.249	-	-	0.552	0.0525
KFM06C	531.00	540.00	5	89590	2021-05-11	0.06	1790	12.7	1280	77.9	47.2	5040	263	85.5	25	1.1	4.75	0.294	0.30	0.29	0.678	0.0541
KFM07A	962.00	972.00	2	89591	2021-06-09	-1.82	2980	11.2	5320	16.0	13.9	14500	100	31.6	130	1.6	3.51	<0.4	-	-	<0.06	<0.08
KFM07A	962.00	972.00	2	89592	2021-06-10	-1.47	2980	11.2	5320	16.0	10.6	14400	102	31.6	128	1.5	3.51	<0.4	-	-	<0.06	<0.0
KFM07A	962.00	972.00	2	89593	2021-06-10	-0.17	3060	11.4	5460	16.4	10.2	14400	101	32.4	128	1.5	3.54	0.148	0.033	0.031	0.0467	<0.08
KFM08A	684.00	694.00	2	89594	2021-05-31	-0.69	1750	10.0	2070	9.20	14.8	6420	72.0	23.8	48	1.4	4.39	<0.2	-	-	0.0384	<0.04
KFM08A	684.00	694.00	2	89595	2021-05-31	0.34	1760	10.3	2080	8.90	12.5	6320	72.0	24.1	48	1.4	5.33	<0.2	-	-	0.0675	<0.04
KFM08A	684.00	694.00	2	89596	2021-05-31	1.03	1790	10.3	2080	8.96	11.1	6280	73.0	23.6	48	1.4	5.66	0.0558	0.060	0.060	0.0879	<0.04

RCB % = Rel. charge balance error % - = Not analysed < "value" = value below reporting limit

Id code	Secup	Seclow	Section	Sample	Sampling	RCB	Na	K	Ca	Mg	HCO_3^-	Cl^-	SO_4^{2-}	SO_4-S	Br^-	F^-	Si	Fe	Fe-tot	Fe(II)	Mn	Li
	m	m	no.	no.	date	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KFM08A	265.00	280.00	6	89597	2021-06-08	-0.67	1330	13.6	861	54.9	57.1	3610	200	69.2	15.9	1.5	6.88	1.03	-	-	0.553	0.0333
KFM08A	265.00	280.00	6	89598	2021-06-09	-0.36	1330	13.5	873	55.9	56.8	3610	202	69.8	16.3	1.3	6.73	1.08	-	-	0.565	0.0331
KFM08A	265.00	280.00	6	89599	2021-06-11	-0.64	1340	13.2	867	56.8	56.9	3640	203	69.6	16.2	1.3	6.50	1.16	1.16	1.15	0.624	0.0330
KFM08D	825.00	835.00	2	89600	2021-05-31	1.06	2150	5.91	2940	1.58	32.2	8240	112	37.1	64	1.5	3.60	<0.2	-	-	<0.03	<0.04
KFM08D	825.00	835.00	2	89601	2021-06-01	1.10	2220	5.08	3000	<0.9	35.1	8420	132	44.0	66	1.4	3.60	<0.2	-	-	<0.03	<0.04
KFM08D	825.00	835.00	2	89602	2021-06-03	1.00	2190	4.89	3000	2.18	13.7	8410	134	44.3	67	1.4	3.87	<0.004	<0.02	<0.02	0.00395	<0.04
KFM08D	660.00	680.00	4	89603	2021-06-09	-1.64	1750	6.87	2130	7.08	7.7	6650	76.0	22.8	52	1.5	5.51	<0.1	-	-	0.0729	0.0203
KFM08D	660.00	680.00	4	89604	2021-06-11	-1.66	1760	6.48	2130	6.69	7.0	6670	69.0	22.6	49	1.5	5.00	<0.1	-	-	0.0722	0.0215
KFM08D	660.00	680.00	4	89605	2021-06-14	-1.28	1760	6.22	2160	6.31	8.7	6670	66.0	22.5	50	1.5	4.78	0.0576	0.060	0.060	0.0762	0.0225
KFM10A	430.00	440.00	2	89606	2021-05-26	1.28	2210	29.1	1150	205	95.5	5430	569	193	19.2	1.3	7.15	2.89	-	-	1.30	0.0558
KFM10A	430.00	440.00	2	89607	2021-05-27	0.39	2210	28.9	1140	204	101	5510	572	194	19.4	1.4	7.02	3.00	-	-	1.36	0.0553
KFM10A	430.00	440.00	2	89608	2021-05-28	1.13	2240	29.2	1160	206	101	5510	567	195	19.2	1.5	6.95	2.99	2.98	2.94	1.49	0.0565
KFM11A	690.00	710.00	2	89609	2021-06-15	-2.13	1940	7.48	2210	13.8	10.9	7170	101	33.8	51	1.5	4.46	<0.1	-	-	0.0430	0.0494
KFM11A	690.00	710.00	2	89610	2021-06-16	-2.09	1950	7.37	2210	14.0	9.3	7180	106	33.7	54	1.4	4.49	<0.1	-	-	0.0487	0.0489
KFM11A	690.00	710.00	2	89611	2021-06-16	-2.68	1920	7.17	2190	13.7	9.1	7180	100	33.7	51	1.5	4.40	0.0686	0.080	0.070	0.0499	0.0490
KFM11A	446.00	456.00	4	89612	2021-06-10	-1.46	1460	5.18	1540	18.6	10.7	5000	251	82.4	24	1.4	3.20	<0.1	-	-	0.0446	0.0466
KFM11A	446.00	456.00	4	89613	2021-06-10	0.21	1500	5.24	1590	19.3	8.1	4980	236	83.5	23	1.5	3.64	<0.1	-	-	0.0572	0.0477
KFM11A	446.00	456.00	4	89614	2021-06-10	0.36	1490	5.17	1620	19.7	7.3	5000	236	85.2	23	1.5	3.72	0.0517	0.046	0.042	0.0673	0.0489
KFM12A	270.00	280.00	3	89615	2021-06-08	-0.07	1040	6.40	1290	31.9	30.4	3930	58.0	20.2	26	1.0	3.65	<0.1	-	-	0.341	0.0442
KFM12A	270.00	280.00	3	89616	2021-06-08	-0.49	1040	6.22	1270	32.8	30.7	3930	60.0	20.2	27	0.99	3.57	0.103	-	-	0.382	0.0434
KFM12A	270.00	280.00	3	89617	2021-06-08	-0.49	1050	6.09	1260	33.6	32.4	3930	59.0	20.0	26	1.0	3.65	0.110	0.110	0.110	0.456	0.0445
KFR01	44.65	62.30	1	89660	2021-11-09	2.69	1570	9.93	626	120	105	3330	342	132	12.2	1.4	4.78	0.475	-	-	0.695	0.0540
KFR01	44.65	62.30	1	89661	2021-11-10	0.96	1510	8.52	627	118	103	3370	343	130	12.4	1.3	4.59	0.468	-	-	0.661	0.0625
KFR01	44.65	62.30	1	89662	2021-11-10	0.58	1480	8.35	626	118	104	3350	340	130	12.3	1.4	4.50	0.44	0.460	0.460	0.682	0.0616
KFR02	119.24	136.24	2	89666	2021-09-07	0.39	1530	8.80	1220	135	74.5	4580	325	119	16.6	1.3	5.35	1.57	-	-	1.10	0.0705
KFR02	119.24	136.24	2	89667	2021-09-08	0.42	1500	7.09	1250	138	76.0	4590	319	119	16.4	1.2	5.36	1.58	-	-	1.11	0.0673
KFR02	119.24	136.24	2	89668	2021-09-10	1.67	1530	6.76	1200	135	72.8	4430	315	116	16.5	1.3	5.29	1.40	1.48	1.45	1.04	0.0645

RCB % = Rel. charge balance error % - = Not analysed < "value" = value below reporting limit

Id code	Secup m	Seclow m	Section no.	Sample no.	Sampling date	RCB %	Na mg/L	K mg/L	Ca mg/L	Mg mg/L	HCO_3^- mg/L	Cl^- mg/L	SO_4^{2-} mg/L	SO_4-S mg/L	Br^- mg/L	F^- mg/L	Si mg/L	Fe mg/L	Fe-tot mg/L	Fe(II) mg/L	Mn mg/L	Li mg/L
KFR02	81.24	118.24	3	89674	2021-09-13	1.27	1480	6.22	1220	128.	70.0	4430	281	106	16.0	1.2	5.48	0.912	0.910	0.910	0.823	0.0616
KFR02	43.24	80.24	4	89675	2021-09-07	0.87	1220	6.87	982	82.8	52.9	3650	158	55.6	14.7	1.2	5.18	0.370	-	-	0.440	0.0574
KFR02	43.24	80.24	4	89676	2021-09-08	0.82	1210	4.64	977	83.8	54.2	3630	154	55.3	14.6	1.2	5.25	0.400	-	-	0.439	0.0528
KFR02	43.24	80.24	4	89677	2021-09-10	0.60	1210	4.64	973	84.2	55.2	3640	154	55.8	14.4	1.2	5.26	0.385	0.390	0.390	0.432	0.0532
KFR101	279.50	341.76	1	89648	2021-06-22	-2.03	762	4.05	374	26.9	60.3	1930	42.0	14.4	10.0	1.5	4.71	0.256	-	-	0.428	0.0278
KFR101	279.50	341.76	1	89649	2021-06-23	-0.19	796	4.04	386	27.5	61.8	1930	44.0	15.5	10.0	1.6	4.82	0.335	-	-	0.449	0.0278
KFR101	279.50	341.76	1	89650	2021-06-23	-0.56	790	4.14	388	27.7	61.5	1940	45.0	15.6	10.0	1.6	4.83	0.320	0.330	0.330	0.511	0.0274
KFR102A	423.00	443.00	2	89651	2021-06-16	-0.33	1460	7.62	1050	73.0	31.1	4160	234	81.8	18.5	1.5	4.92	0.630	-	-	0.4280	0.0484
KFR102A	423.00	443.00	2	89652	2021-06-17	-0.32	1480	7.50	1050	73.6	32.6	4190	236	82.4	18.4	1.4	4.99	0.711	-	-	0.446	0.0507
KFR102A	423.00	443.00	2	89653	2021-06-18	-0.23	1460	7.55	1050	73.3	33.6	4150	236	82.7	18.3	1.5	5.03	0.777	0.780	0.770	0.494	0.0497
KFR102A	214.00	219.00	5	89654	2021-06-16	-1.67	1500	8.35	630	94.4	87.30	3560	300	102	12.9	1.4	4.85	0.355	-	-	0.410	0.0476
KFR102A	214.00	219.00	5	89655	2021-06-16	3.66	1680	9.36	700	105	88.8	3550	296	113	12.9	1.4	5.46	0.444	-	-	0.478	0.0571
KFR102A	214.00	219.00	5	89656	2021-06-17	-3.32	1460	7.94	604	89.4	90.3	3570	293	96.0	12.8	1.4	4.62	0.432	0.460	0.450	0.469	0.0452
KFR104	333.00	454.57	1	89657	2021-06-15	-0.46	712	3.66	401	5.35	19.2	1800	39.0	13.5	9.9	1.7	4.09	<0.02	-	-	0.00550	0.0195
KFR104	333.00	454.57	1	89658	2021-06-17	-0.49	736	3.80	420	7.12	20.3	1870	49.0	16.	9.9	1.8	4.19	<0.02	-	-	0.00902	0.0210
KFR104	333.00	454.57	1	89659	2021-06-18	-0.11	736	3.77	428	7.33	19.7	1870	51.0	17.1	10.0	1.6	4.28	0.0128	<0.02	<0.02	0.0135	0.0211
KFR105	265.00	306.80	1	89678	2021-11-10	1.49	1340	6.14	808	104	84.8	3430	260	97.6	13.1	1.4	4.96	0.776	-	-	1.56	0.0660
KFR105	265.00	306.80	1	89679	2021-11-11	1.48	1340	6.12	802	104	84.6	3420	253	98.2	12.9	1.3	4.94	0.777	-	-	1.57	0.0681
KFR105	265.00	306.80	1	89680	2021-11-15	1.29	1340	6.01	788	103	84.8	3410	238	97.2	12.4	1.3	5.04	0.727	0.730	0.720	1.59	0.0669
KFR106	260.00	300.13	1	89681	2021-06-14	0.85	1010	11.1	512	60.4	97.8	2460	101	39.1	10.9	1.7	4.95	0.0793	-	-	0.254	0.0431
KFR106	260.00	300.13	1	89682	2021-06-14	-1.35	1070	11.3	573	68.0	87.8	2790	135	49.3	11.6	1.6	5.02	0.217	-	-	0.330	0.0448
KFR106	260.00	300.13	1	89683	2021-06-14	0.82	1160	10.6	610	70.3	89.5	2860	144	54.2	11.9	1.7	5.19	0.512	0.400	0.390	0.418	0.0470
KFR106	143.00	259.00	2	89684	2021-06-14	-2.07	1670	14.4	760	161	110	4270	324	115	14.1	1.5	5.35	1.090	-	-	1.07	0.0551
KFR106	143.00	259.00	2	89685	2021-06-15	-3.48	1640	13.8	748	158	107	4330	327	111	14.4	1.5	5.09	1.100	-	-	1.04	0.0547
KFR106	143.00	259.00	2	89686	2021-06-15	-2.44	1670	14.4	769	162	107	4330	330	114	14.5	1.4	5.23	1.230	1.17	1.16	1.24	0.0557

RCB % = Rel. charge balance error % - = Not analysed < "value" = value below reporting limit

Id code	Secup	Seclow	Sec	Sample	Sampling	Sr	I^-	pH_L	pH_F	TOC	DOC	HS^-	Uranine	EC_L	EC_F	NO_2-N	NO_3-N	NH_4-N	NO_2-N+ NO_3-N
	m	m	no.	no.	Date	mg/L	mg/L			mg/L	mg/L	mg/L	µg/L	mS/m	mS/m	mg/L	mg/L	mg/L	mg/L
HFM01	33.50	45.50	2	89618	2021-06-01	0.285	-	7.92	7.79	10.3	10.5*	0.052	1.9	221	212	-	-	-	-
HFM01	33.50	45.50	2	89619	2021-06-02	0.284	-	7.89	7.77	10.5	10.5	0.051	1.8	222	213	-	-	-	-
HFM01	33.50	45.50	2	89620	2021-06-04	0.286	-	7.89	7.78	10.1	10.3*	0.048	1.8	222	214	<0.0002	0.0006	0.737	0.0006
HFM02	38.00	48.00	2	89621	2021-06-01	0.258	-	7.83	7.68	11.5	11.6*	0.033	1.7	136	127	-	-	-	-
HFM02	38.00	48.00	2	89622	2021-06-02	0.264	-	7.84	7.67	10.6	10.5	0.030	1.7	134	125	-	-	-	-
HFM02	38.00	48.00	2	89623	2021-06-03	0.259	-	7.85	7.65	11.3	11.4*	0.036	1.7	136	126	<0.0002	0.0004	0.458	0.0004
HFM04	58.00	66.00	2	89624	2021-05-17	0.264	-	7.69	7.49	10.5	10.3	0.047	1.4	97.0	89.5	-	-	-	-
HFM04	58.00	66.00	2	89625	2021-05-17	0.250	-	7.72	7.52	10.7	10.6	0.044	1.4	95.0	88.7	-	-	-	-
HFM04	58.00	66.00	2	89626	2021-05-18	0.254	-	7.73	7.53	10.3	10.5*	0.041	1.4	95.0	90.1	<0.0002	<0.0003	0.534	<0.0003
HFM13	159.00	173.00	1	89627	2021-05-25	11.9	-	7.28	7.21	1.9	1.9	0.032	0.6	1470	1340	-	-	-	-
HFM13	159.00	173.00	1	89628	2021-05-28	11.8	-	7.36	7.20	2.0	2.0	0.030	0.6	1440	1340	-	-	-	-
HFM13	159.00	173.00	1	89629	2021-05-31	11.6	-	7.29	7.22	1.9	1.9	0.033	0.6	1430	1340	<0.0002	<0.0003	1.480	<0.0003
HFM15	85.00	95.00	1	89630	2021-05-24	0.289	-	7.21	7.01	9.1	9.0	0.095	1.1	69.0	66.7	-	-	-	-
HFM15	85.00	95.00	1	89631	2021-05-25	0.289	-	7.15	6.93	9.1	8.9	0.098	1.0	68.0	63.3	-	-	-	-
HFM15	85.00	95.00	1	89632	2021-05-26	0.287	-	7.12	6.91	8.9	8.4	0.100	1.0	68.0	62.4	<0.0002	<0.0003	0.299	<0.0003
HFM16	54.00	67.00	2	89633	2021-05-10	0.273	-	7.87	7.55	13.8	13.6	0.100	2.1	131	121	-	-	-	-
HFM16	54.00	67.00	2	89634	2021-05-11	0.273	-	7.85	7.57	13.8	14.1*	0.072	2.2	131	121	-	-	-	-
HFM16	54.00	67.00	2	89635	2021-05-12	0.266	-	7.86	7.52	13.7	13.8*	0.066	2.2	131	119	<0.0002	<0.0003	0.687	<0.0003
HFM21	22.00	32.00	3	89636	2021-06-07	0.274	-	7.51	7.38	6.7	6.6	0.045	1.5	121	116	-	-	-	-
HFM21	22.00	32.00	3	89637	2021-06-08	0.334	-	7.55	7.41	7.0	6.8	0.035	1.5	128	124	-	-	-	-
HFM21	22.00	32.00	3	89638	2021-06-09	0.296	-	7.54	7.39	7.1	7.1	0.036	1.5	136	126	<0.0002	0.0004	0.425	0.0004
HFM27	46.00	58.00	2	89639	2021-05-25	1.93	-	7.50	7.40	6.4	6.5*	0.027	1.3	612	594	-	-	-	-
HFM27	46.00	58.00	2	89640	2021-05-26	1.89	-	7.49	7.28	6.5	6.6*	0.028	1.3	608	578	-	-	-	-
HFM27	46.00	58.00	2	89641	2021-05-28	1.86	-	7.52	7.41	5.7	5.7	0.027	1.4	595	561	<0.0002	<0.0003	1.350	<0.0003

pH_L; EC_L = Laboratory measurements of pH and EC - = Not analysed
pH_F; EC_F = Field measurements of pH and EC
*DOC > TOC, within measurement uncertainty < "value" = value below reporting limit

Id code	Secup	Seclow	Section	Sample	Sampling	Sr	I^-	pH_L	pH_F	TOC	DOC	HS^-	Uranine	EC_L	EC_F	NO_2-N	NO_3-N	NH_4-N	NO_2-N+ NO_3-N
	m	m	no.	no.	Date	mg/L	mg/L			mg/L	mg/L	mg/L	µg/L	mS/m	mS/m	mg/L	mg/L	mg/L	mg/L
HFM32	26.00	31.00	3	89642	2021-05-27	3.17	-	7.29	7.07	3.6	3.8*	0.10	0.6	1200	1120	-	-	-	-
HFM32	26.00	31.00	3	89643	2021-05-27	3.18	-	7.28	7.06	3.2	3.2	0.053	0.7	1200	1120	-	-	-	-
HFM32	26.00	31.00	3	89644	2021-05-27	3.18	-	7.24	7.07	3.3	3.1	0.040	0.5	1190	1120	<0.0002	<0.0003	2.14	<0.0003
HFM33	121.00	137.50	2	89645	2021-06-21	7.13	-	7.33	7.27	1.6	1.7*	0.060	<0.5	1470	1370	-	-	-	-
HFM33	121.00	137.50	2	89646	2021-06-21	7.39	-	7.34	7.30	1.6	1.7*	0.058	<0.5	1470	1370	-	-	-	-
HFM33	121.00	137.50	2	89647	2021-06-22	7.36	-	7.40	7.32	1.7	1.8*	0.042	<0.5	1460	1390	<0.0002	<0.0003	2.27	<0.0003
KFM01A	109.00	130.00	5	89549	2021-06-01	6.12	-	7.82	7.78	1.6	1.7*	0.29	28	1140	1070	-	-	-	-
KFM01A	109.00	130.00	5	89550	2021-06-07	5.60	-	7.76	7.76	1.7	1.7	0.16	31	1110	1020	-	-	-	-
KFM01A	109.00	130.00	5	89551	2021-06-08	5.52	-	7.79	7.81	1.7	1.6	0.14	33	1110	1020	<0.0002	<0.0003	0.778	<0.0003
KFM01D	429.00	438.00	2	89552	2021-06-02	16.3	-	8.24	8.38	2.0	1.8	2.7	12.4	1430	1350	-	-	-	-
KFM01D	429.00	438.00	2	89553	2021-06-02	16.2	-	8.08	8.27	1.7	1.8*	3.0	12.8	1440	1340	-	-	-	-
KFM01D	429.00	438.00	2	89554	2021-06-03	16.5	-	7.95	8.12	1.9	2.0*	3.3	12.5	1440	1400	<0.0002	<0.0003	0.0414	<0.0003
KFM01D	311.00	321.00	4	89555	2021-06-07	12.7	-	8.05	8.10	1.4	1.5*	0.29	4.8	1360	1230	-	-	-	-
KFM01D	311.00	321.00	4	89556	2021-06-07	12.1	-	7.79	8.01	1.6	1.6	0.19	10.5	1320	1210	-	-	-	-
KFM01D	311.00	321.00	4	89557	2021-06-07	11.5	-	7.75	7.93	1.7	1.7	0.16	13.0	1300	1180	<0.0002	0.0005	0.387	0.0006
KFM02A	490.00	518.00	3	89558	2021-05-17	8.95	-	7.45	7.31	2.2	2.4*	0.42	7.2	1600	1470	-	-	-	-
KFM02A	490.00	518.00	3	89559	2021-05-18	8.94	-	7.28	7.09	1.7	1.6	0.130	6.6	1610	1510	-	-	-	-
KFM02A	490.00	518.00	3	89560	2021-05-18	8.91	-	7.19	7.10	1.8	1.8	0.12	6.7	1600	1470	<0.0002	<0.0003	2.57	<0.0003
KFM02A	411.00	442.00	5	89561	2021-05-17	12.7	-	7.36	7.22	1.4	1.4	0.2	39	1570	1500	-	-	-	-
KFM02A	411.00	442.00	5	89562	2021-05-18	12.6	-	7.41	7.24	1.3	1.4*	0.16	35	1570	1540	-	-	-	-
KFM02A	411.00	442.00	5	89563	2021-05-19	12.5	-	7.34	7.22	1.4	1.4	0.140	31	1580	1490	<0.0002	<0.0003	1.61	<0.0003
KFM02B	491.00	506.00	2	89564	2021-05-19	8.44	-	7.41	7.33	1.8	1.7	0.093	0.8	1620	1490	-	-	-	-
KFM02B	491.00	506.00	2	89565	2021-05-19	8.44	-	7.31	7.27	1.6	1.6	0.082	<0.5	1610	1490	-	-	-	-
KFM02B	491.00	506.00	2	89566	2021-05-20	8.42	-	7.35	7.18	1.6	1.6	0.066	0.7	1610	1480	<0.0002	<0.0003	2.67	<0.0003
KFM02B	410.00	431.00	4	89567	2021-05-18	11.3	-	7.43	7.36	1.3	1.5*	0.065	3.7	1580	1480	-	-	-	-
KFM02B	410.00	431.00	4	89568	2021-05-19	11.4	-	7.44	7.16	1.4	1.4	0.057	3.8	1580	1460	-	-	-	-
KFM02B	410.00	431.00	4	89569	2021-05-19	11.4	-	7.46	7.35	1.4	1.3	0.057	3.9	1590	1460	<0.0002	<0.0003	1.95	<0.0003

pH_L; EC_L = Laboratory measurements of pH and EC
pH_F; EC_F = Field measurements of pH and EC
*DOC > TOC, within measurement uncertainty

- = Not analysed
< "value" = value below reporting limit

Id code	Secup	Seclow	Section	Sample	Sampling	Sr	I^-	pH_L	pH_F	TOC	DOC	HS^-	Uranine	EC_L	EC_F	NO_2-N	NO_3-N	NH_4-N	NO_2-N+ NO_3-N
	m	m	no.	no.	Date	mg/L	mg/L			mg/L	mg/L	mg/L	µg/L	mS/m	mS/m	mg/L	mg/L	mg/L	mg/L
KFM03A	969.50	994.50	1	89570	2021-05-24	45.30	-	8.06	8.09	0.7	0.7	0.15	<0.5	2680	2500	-	-	-	-
KFM03A	969.50	994.50	1	89571	2021-05-26	45.60	-	8.22	7.72	0.3	0.4*	0.097	<0.5	2690	2460	-	-	-	-
KFM03A	969.50	994.50	1	89572	2021-05-27	45.40	-	8.22	8.15	0.3	0.4*	0.077	<0.5	2680	2520	<0.0002	<0.0003	0.0133	<0.0003
KFM03A	633.50	650.00	4	89573	2021-05-25	18.80	-	7.55	7.50	1.1	0.9	0.24	2.6	1600	1470	-	-	-	-
KFM03A	633.50	650.00	4	89574	2021-05-25	18.80	-	7.52	7.57	0.8	0.9*	0.13	2.5	1600	1480	-	-	-	-
KFM03A	633.50	650.00	4	89575	2021-05-27	18.90	-	7.64	7.55	0.7	0.8*	0.12	2.2	1600	1490	<0.0002	0.0008	0.149	0.0008
KFM04A	230.00	245.00	4	89576	2021-05-20	16.00	-	7.31	7.17	1.5	1.5	0.25	2.5	1690	1570	-	-	-	-
KFM04A	230.00	245.00	4	89577	2021-05-20	16.10	-	7.28	7.14	1.4	1.6*	0.12	2.1	1690	1560	-	-	-	-
KFM04A	230.00	245.00	4	89578	2021-05-20	16.00	-	7.27	7.11	1.3	1.3	0.11	2.0	1690	1560	<0.0002	<0.0003	1.51	<0.0003
KFM06A	738.00	748.00	3	89579	2021-05-18	26.70	-	8.20	8.21	1.1	1.3*	0.12	24	1860	1850	-	-	-	-
KFM06A	738.00	748.00	3	89580	2021-05-19	26.90	-	8.17	8.20	0.9	1.1*	0.12	23	1860	1740	-	-	-	-
KFM06A	738.00	748.00	3	89581	2021-05-20	26.90	-	8.07	8.17	0.9	0.9	0.12	22	1860	1710	<0.0002	<0.0003	0.130	<0.0003
KFM06A	341.00	362.00	5	89582	2021-05-10	15.60	-	8.31	7.89	1.6	1.6	0.16	17	1320	1160	-	-	-	-
KFM06A	341.00	362.00	5	89583	2021-05-10	16.00	-	7.97	6.95	1.5	1.5	0.10	15	1320	1180	-	-	-	-
KFM06A	341.00	362.00	5	89584	2021-05-11	16.10	-	7.87	7.13	1.1	1.1	0.063	14.3	1320	1220	<0.0002	<0.0003	0.168	<0.0003
KFM06C	647.00	666.00	3	89585	2021-05-17	22.80	-	9.00	9.02	0.9	1.1*	0.35	10.2	1570	1470	-	-	-	-
KFM06C	647.00	666.00	3	89586	2021-05-21	22.80	-	8.84	8.75	1.0	1.0	0.24	9.8	1570	1400	-	-	-	-
KFM06C	647.00	666.00	3	89587	2021-05-24	22.60	-	8.67	8.37	0.7	0.8*	0.24	9.6	1560	1430	<0.0002	<0.0003	0.0921	<0.0003
KFM06C	531.00	540.00	5	89588	2021-05-10	14.60	-	7.84	7.34	1.6	1.6	0.14	44	1440	1290	-	-	-	-
KFM06C	531.00	540.00	5	89589	2021-05-10	14.70	-	7.81	7.29	1.6	1.4	0.12	43	1440	1330	-	-	-	-
KFM06C	531.00	540.00	5	89590	2021-05-11	14.50	-	7.70	7.31	1.3	1.4*	0.087	43	1440	1320	<0.0002	0.0005	0.425	0.0006
KFM07A	962.00	972.00	2	89591	2021-06-09	65.40	-	9.14	9.35	1.4	1.4	0.39	1.1	3640	3440	-	-	-	-
KFM07A	962.00	972.00	2	89592	2021-06-10	65.40	-	8.83	9.01	1.3	0.8	0.37	0.9	3620	3360	-	-	-	-
KFM07A	962.00	972.00	2	89593	2021-06-10	66.80	-	8.78	8.89	0.9	1.0*	0.40	0.9	3610	3410	<0.0002	<0.0003	0.0058	<0.0003
KFM08A	684.00	694.00	2	89594	2021-05-31	24.60	-	9.12	9.10	0.9	0.7	0.20	9.5	1730	1520	-	-	-	-
KFM08A	684.00	694.00	2	89595	2021-05-31	24.30	-	8.68	8.78	0.6	0.7*	0.074	9.9	1730	1590	-	-	-	-
KFM08A	684.00	694.00	2	89596	2021-05-31	24.40	-	8.51	8.59	0.6	0.6	0.050	10.1	1730	1580	<0.0002	<0.0003	0.0695	<0.0003

pH_L; EC_L = Laboratory measurements of pH and EC
pH_F; EC_F = Field measurements of pH and EC
*DOC > TOC, within measurement uncertainty

- = Not analysed
< "value" = value below reporting limit

Id code	Secup	Seclow	Section	Sample	Sampling	Sr	I^-	pH_L	pH_F	TOC	DOC	HS^-	Uranine	EC_L	EC_F	NO_2-N	NO_3-N	NH_4-N	NO_2-N+ NO_3-N
	m	m	no.	no.	Date	mg/L	mg/L			mg/L	mg/L	mg/L	µg/L	mS/m	mS/m	mg/L	mg/L	mg/L	mg/L
KFM08A	265.00	280.00	6	89597	2021-06-08	10.20	-	7.52	7.63	1.2	1.3*	0.084	3.8	1070	988	-	-	-	-
KFM08A	265.00	280.00	6	89598	2021-06-09	10.20	-	7.50	7.64	1.3	1.1	0.073	5.2	1070	975	-	-	-	-
KFM08A	265.00	280.00	6	89599	2021-06-11	10.20	-	7.58	7.58	1.2	1.0	0.069	5.3	1070	1000	<0.0002	0.0003	0.321	0.0003
KFM08D	825.00	835.00	2	89600	2021-05-31	31.80	-	9.99	10.11	7.3	7.2	2.1	2.8	2220	2070	-	-	-	-
KFM08D	825.00	835.00	2	89601	2021-06-01	32.60	-	10.00	10.22	1.6	3.9**	0.020	0.9	2270	2110	-	-	-	-
KFM08D	825.00	835.00	2	89602	2021-06-03	32.40	-	9.16	8.96	0.5	0.7*	0.032	0.6	2260	2010	<0.0002	0.0015	0.0129	0.0015***
KFM08D	660.00	680.00	4	89603	2021-06-09	25.00	-	8.36	8.44	0.5	0.5	0.028	22	1810	1660	-	-	-	-
KFM08D	660.00	680.00	4	89604	2021-06-11	25.10	-	8.32	8.40	0.5	0.5	<0.019	21	1830	1720	-	-	-	-
KFM08D	660.00	680.00	4	89605	2021-06-14	25.40	-	8.14	8.37	0.7	0.5	0.045	20	1830	1700	<0.0002	<0.0003	0.0650	<0.0003
KFM10A	430.00	440.00	2	89606	2021-05-26	11.60	-	7.42	7.45	1.8	1.8	0.11	1.0	1620	1470	-	-	-	-
KFM10A	430.00	440.00	2	89607	2021-05-27	11.50	-	7.56	7.54	1.4	1.6*	0.11	1.0	1630	1500	-	-	-	-
KFM10A	430.00	440.00	2	89608	2021-05-28	11.60	-	7.54	7.51	1.5	1.4	0.11	1.0	1610	1520	<0.0002	0.0088	1.30	0.0088
KFM11A	690.00	710.00	2	89609	2021-06-15	30.00	-	8.74	8.88	0.4	0.4	0.23	<0.5	1940	1790	-	-	-	-
KFM11A	690.00	710.00	2	89610	2021-06-16	30.10	-	8.62	8.64	<0.3	<0.3	0.19	<0.5	1960	1780	-	-	-	-
KFM11A	690.00	710.00	2	89611	2021-06-16	29.80	-	8.59	8.67	<0.3	<0.3	0.21	<0.5	1940	1780	<0.0002	0.0041	0.0588	0.0041***
KFM11A	446.00	456.00	4	89612	2021-06-10	21.20	-	8.91	8.94	0.9	0.9	0.33	1.6	1420	1310	-	-	-	-
KFM11A	446.00	456.00	4	89613	2021-06-10	21.90	-	8.59	8.66	0.8	0.7	0.18	1.7	1410	1310	-	-	-	-
KFM11A	446.00	456.00	4	89614	2021-06-10	22.20	-	8.11	8.60	0.7	0.8*	0.13	1.7	1420	1320	<0.0002	0.0017	0.0274	0.0017
KFM12A	270.00	280.00	3	89615	2021-06-08	19.10	-	8.50	8.59	0.7	0.8*	0.28	1.2	1120	1000	-	-	-	-
KFM12A	270.00	280.00	3	89616	2021-06-08	18.90	-	8.27	8.36	0.7	0.7	0.18	1.3	1130	1040	-	-	-	-
KFM12A	270.00	280.00	3	89617	2021-06-08	19.00	-	8.13	8.21	0.8	0.7	0.13	1.4	1120	1050	<0.0002	0.0016	0.206	0.0016
KFR01	44.65	62.30	1	89660	2021-11-09	8.65	-	7.42	7.39	1.1	1.2*	<0.019	<0.5	1030	963	-	-	-	-
KFR01	44.65	62.30	1	89661	2021-11-10	8.62	-	7.49	7.25	1.1	1.1	<0.019	<0.5	1040	973	-	-	-	-
KFR01	44.65	62.30	1	89662	2021-11-10	8.55	0.0309	7.52	7.40	1.2	1.1	<0.019	<0.5	1030	978	<0.0002	<0.0003	0.207	<0.0003
KFR02	119.24	136.24	2	89666	2021-09-07	17.40	-	7.33	7.16	0.9	0.9	<0.019	<0.5	1320	1220	-	-	-	-
KFR02	119.24	136.24	2	89667	2021-09-08	17.50	-	7.41	7.28	0.9	0.8	<0.019	<0.5	1320	1240	-	-	-	-
KFR02	119.24	136.24	2	89668	2021-09-10	17.40	0.0603	7.37	7.36	0.8	0.9*	<0.019	<0.5	1310	1210	<0.0002	0.0003	0.0182	0.0003

pH_L; EC_L = Laboratory measurements of pH and EC
pH_F; EC_F = Field measurements of pH and EC
*DOC > TOC, within measurement uncertainty
**possibly affected sample (DOC > TOC)
- = Not analysed
***calculated NO_2-N is negative, adjusted to 0 mg/L in calculation of NO_2-N + NO_3-N
< "value" = value below reporting limit

Id code	Secup	Seclow	Section	Sample	Sampling	Sr	I^-	pH_L	pH_F	TOC	DOC	HS^-	Uranine	EC_L	EC_F	NO_2-N	NO_3-N	NH_4-N	NO_2-N+ NO_3-N
	m	m	no.	no.	Date	mg/L	mg/L			mg/L	mg/L	mg/L	µg/L	mS/m	mS/m	mg/L	mg/L	mg/L	mg/L
KFR02	81.24	118.24	3	89674	2021-09-13	17.80	0.0638	7.44	7.43	0.8	0.8	<0.019	<0.5	1300	1220	<0.0002	0.0022	0.0121	0.0022
KFR02	43.24	80.24	4	89675	2021-09-07	15.20	-	7.61	7.25	0.6	0.6	<0.019	<0.5	1080	995	-	-	-	-
KFR02	43.24	80.24	4	89676	2021-09-08	14.90	-	7.62	7.42	0.6	0.6	<0.019	<0.5	1070	1010	-	-	-	-
KFR02	43.24	80.24	4	89677	2021-09-10	14.80	0.0584	7.63	7.38	0.5	0.6	<0.019	<0.5	1070	1000	<0.0002	0.0060	0.0088	0.0060
KFR101	279.50	341.76	1	89648	2021-06-22	6.07	-	7.86	7.81	1.0	0.9	0.47	<0.5	593	550	-	-	-	-
KFR101	279.50	341.76	1	89649	2021-06-23	6.22	-	7.72	7.72	0.7	0.7	0.44	<0.5	594	536	-	-	-	-
KFR101	279.50	341.76	1	89650	2021-06-23	6.33	-	7.79	7.80	0.9	0.9	0.52	<0.5	595	538	<0.0002	0.0004	0.0577	0.0004
KFR102A	423.00	443.00	2	89651	2021-06-16	15.20	-	7.82	7.95	0.6	0.5	0.33	<0.5	1210	1110	-	-	-	-
KFR102A	423.00	443.00	2	89652	2021-06-17	15.30	-	7.81	7.85	0.7	0.7	0.23	<0.5	1210	1110	-	-	-	-
KFR102A	423.00	443.00	2	89653	2021-06-18	15.20	-	7.73	7.77	0.6	0.6	0.22	<0.5	1210	1100	<0.0002	0.0287	0.0373	0.0287
KFR102A	214.00	219.00	5	89654	2021-06-16	9.76	-	7.83	7.81	1.1	1.1	0.28	0.9	1070	977	-	-	-	-
KFR102A	214.00	219.00	5	89655	2021-06-16	10.80	-	7.73	7.77	1.0	1.0	0.23	0.9	1070	980	-	-	-	-
KFR102A	214.00	219.00	5	89656	2021-06-17	9.30	-	7.73	7.72	1.1	1.1	0.18	0.9	1070	966	<0.0002	0.0025	0.0858	0.0025
KFR104	333.00	454.57	1	89657	2021-06-15	6.50	-	8.76	8.85	1.0	0.9	1.20	0.9	550	537	-	-	-	-
KFR104	333.00	454.57	1	89658	2021-06-17	6.73	-	8.62	8.67	0.9	1.0*	0.68	1.2	578	557	-	-	-	-
KFR104	333.00	454.57	1	89659	2021-06-18	6.81	-	8.59	8.62	0.8	0.9*	0.58	1.2	580	544	<0.0002	0.0025	0.0138	0.0025
KFR105	265.00	306.80	1	89678	2021-11-10	11.50	-	7.58	7.39	0.6	0.6	<0.019	<0.5	1040	962	-	-	-	-
KFR105	265.00	306.80	1	89679	2021-11-11	11.40	-	7.56	7.38	0.6	0.6	<0.019	<0.5	1050	954	-	-	-	-
KFR105	265.00	306.80	1	89680	2021-11-15	11.30	0.0437	7.53	7.54	0.7	0.6	<0.019	<0.5	1040	903	<0.0002	<0.0003	0.0116	<0.0003
KFR106	260.00	300.13	1	89681	2021-06-14	7.51	-	7.78	7.72	4.1	3.8	0.70	0.7	748	680	-	-	-	-
KFR106	260.00	300.13	1	89682	2021-06-14	8.29	-	7.77	7.76	4.0	4.2*	1.20	1.0	842	785	-	-	-	-
KFR106	260.00	300.13	1	89683	2021-06-14	8.84	-	7.72	7.71	2.8	5.9**	1.70	1.2	860	790	0.0011	0.0006	0.100	0.0017
KFR106	143.00	259.00	2	89684	2021-06-14	9.39	-	7.43	7.45	2.0	2.2*	0.51	0.6	1260	1160	-	-	-	-
KFR106	143.00	259.00	2	89685	2021-06-15	9.26	-	7.44	7.40	1.4	1.3	0.44	0.6	1270	1180	-	-	-	-
KFR106	143.00	259.00	2	89686	2021-06-15	9.52	-	7.43	7.41	1.3	1.1	0.34	0.6	1270	1170	<0.0002	0.0007	0.203	0.0007

pH_L; EC_L = Laboratory measurements of pH and EC
pH_F; EC_F = Field measurements of pH and EC
*DOC > TOC, within measurement uncertainty
**possibly affected sample (DOC > TOC)

- = Not analysed

< "value" = value below reporting limit

Id code	Secup	Seclow	Section	Sample	Sampling	PO_4-P	PO_4-P*	Density	Temp_F
	m	m	no.	no.	Date	mg/L	mg/L	g/mL	°C
HFM01	33.50	45.50	2	89618	2021-06-01	-	-		9.0
HFM01	33.50	45.50	2	89619	2021-06-02	-	-		10.2
HFM01	33.50	45.50	2	89620	2021-06-04	0.0648	0.0801	0.9980	9.7
HFM02	38.00	48.00	2	89621	2021-06-01	-	-		11.9
HFM02	38.00	48.00	2	89622	2021-06-02	-	-		12.9
HFM02	38.00	48.00	2	89623	2021-06-03	0.0301	0.0387	0.9976	12.1
HFM04	58.00	66.00	2	89624	2021-05-17	-	-		7.5
HFM04	58.00	66.00	2	89625	2021-05-17	-	-		10.7
HFM04	58.00	66.00	2	89626	2021-05-18	0.0130	0.0193	0.9974	9.2
HFM13	159.00	173.00	1	89627	2021-05-25	-	-		9.6
HFM13	159.00	173.00	1	89628	2021-05-28	-	-		8.5
HFM13	159.00	173.00	1	89629	2021-05-31	<0.0005	0.0007	1.0034	8.6
HFM15	85.00	95.00	1	89630	2021-05-24	-	-		7.7
HFM15	85.00	95.00	1	89631	2021-05-25	-	-		8.6
HFM15	85.00	95.00	1	89632	2021-05-26	0.0011	0.0069	0.9972	8.6
HFM16	54.00	67.00	2	89633	2021-05-10	-	-		8.8
HFM16	54.00	67.00	2	89634	2021-05-11	-	-		9.0
HFM16	54.00	67.00	2	89635	2021-05-12	0.0596	0.0731	0.9975	10.8
HFM21	22.00	32.00	3	89636	2021-06-07	-	-		18.6
HFM21	22.00	32.00	3	89637	2021-06-08	-	-		14.9
HFM21	22.00	32.00	3	89638	2021-06-09	0.0058	0.0115	0.9976	18.2
HFM27	46.00	58.00	2	89639	2021-05-25	-	-		12.5
HFM27	46.00	58.00	2	89640	2021-05-26	-	-		9.1
HFM27	46.00	58.00	2	89641	2021-05-28	0.0007	0.0152	0.9995	13.1

PO_4-P* = P after hydrolysis

- = Not analysed

< "value" = value below reporting limit

Id code	Secup	Seclow	Section	Sample	Sampling	PO_4-P	PO_4-P^2	Density	Temp_F
	m	m	no.	no.	Date	mg/L	mg/L	g/mL	°C
HFM32	26.00	31.00	3	89642	2021-05-27	-	-		7.9
HFM32	26.00	31.00	3	89643	2021-05-27	-	-		8.0
HFM32	26.00	31.00	3	89644	2021-05-27	<0.0005	0.0088	1.0022	8.3
HFM33	121.00	137.50	2	89645	2021-06-21	-	-		17.6
HFM33	121.00	137.50	2	89646	2021-06-21	-	-		19.5
HFM33	121.00	137.50	2	89647	2021-06-22	<0.0005	0.0016	1.0034	14.6
KFM01A	109.00	130.00	5	89549	2021-06-01	-	-		12.4
KFM01A	109.00	130.00	5	89550	2021-06-07	-	-		19.7
KFM01A	109.00	130.00	5	89551	2021-06-08	<0.0005	<0.0005	1.0016	16.3
KFM01D	429.00	438.00	2	89552	2021-06-02	-	-		14.7
KFM01D	429.00	438.00	2	89553	2021-06-02	-	-		15.0
KFM01D	429.00	438.00	2	89554	2021-06-03	<0.0005	<0.0005	1.0033	17.7
KFM01D	311.00	321.00	4	89555	2021-06-07	-	-		12.2
KFM01D	311.00	321.00	4	89556	2021-06-07	-	-		12.6
KFM01D	311.00	321.00	4	89557	2021-06-07	0.0015	0.0039	1.0026	13.1
KFM02A	490.00	518.00	3	89558	2021-05-17	-	-		12.2
KFM02A	490.00	518.00	3	89559	2021-05-18	-	-		8.8
KFM02A	490.00	518.00	3	89560	2021-05-18	<0.0005	<0.0005	1.0041	12.5
KFM02A	411.00	442.00	5	89561	2021-05-17	-	-		8.5
KFM02A	411.00	442.00	5	89562	2021-05-18	-	-		9.0
KFM02A	411.00	442.00	5	89563	2021-05-19	<0.0005	<0.0005	1.0040	12.2
KFM02B	491.00	506.00	2	89564	2021-05-19	-	-		8.7
KFM02B	491.00	506.00	2	89565	2021-05-19	-	-		9.0
KFM02B	491.00	506.00	2	89566	2021-05-20	<0.0005	0.0005	1.0041	9.1
KFM02B	410.00	431.00	4	89567	2021-05-18	-	-		9.4
KFM02B	410.00	431.00	4	89568	2021-05-19	-	-		9.2
KFM02B	410.00	431.00	4	89569	2021-05-19	<0.0005	<0.0005	1.0041	8.3

PO_4-P* = P after hydrolysis

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Id code	Secup	Seclow	Section	Sample	Sampling	PO_4-P	PO_4-P^2	Density	Temp_F
	m	m	no.	no.	Date	mg/L	mg/L	g/mL	°C
KFM03A	969.50	994.50	1	89570	2021-05-24	-	-		10.0
KFM03A	969.50	994.50	1	89571	2021-05-26	-	-		10.3
KFM03A	969.50	994.50	1	89572	2021-05-27	<0.0005	<0.0005	1.0097	8.1
KFM03A	633.50	650.00	4	89573	2021-05-25	-	-		10.5
KFM03A	633.50	650.00	4	89574	2021-05-25	-	-		12.5
KFM03A	633.50	650.00	4	89575	2021-05-27	0.0005	0.0005	1.0040	8.2
KFM04A	230.00	245.00	4	89576	2021-05-20	-	-		11.7
KFM04A	230.00	245.00	4	89577	2021-05-20	-	-		10.3
KFM04A	230.00	245.00	4	89578	2021-05-20	<0.0005	<0.0005	1.0046	10.6
KFM06A	738.00	748.00	3	89579	2021-05-18	-	-		14.9
KFM06A	738.00	748.00	3	89580	2021-05-19	-	-		12.3
KFM06A	738.00	748.00	3	89581	2021-05-20	<0.0005	0.0007	1.0054	13.6
KFM06A	341.00	362.00	5	89582	2021-05-10	-	-		10.0
KFM06A	341.00	362.00	5	89583	2021-05-10	-	-		10.8
KFM06A	341.00	362.00	5	89584	2021-05-11	<0.0005	<0.0005	1.0026	11.1
KFM06C	647.00	666.00	3	89585	2021-05-17	-	-		14.8
KFM06C	647.00	666.00	3	89586	2021-05-21	-	-		11.7
KFM06C	647.00	666.00	3	89587	2021-05-24	0.0007	0.0009	1.0040	11.5
KFM06C	531.00	540.00	5	89588	2021-05-10	-	-		10.9
KFM06C	531.00	540.00	5	89589	2021-05-10	-	-		13.4
KFM06C	531.00	540.00	5	89590	2021-05-11	<0.0005	<0.0005	1.0033	13.8
KFM07A	962.00	972.00	2	89591	2021-06-09	-	-		14.5
KFM07A	962.00	972.00	2	89592	2021-06-10	-	-		15.4
KFM07A	962.00	972.00	2	89593	2021-06-10	<0.0005	<0.0005	1.0145	14.8
KFM08A	684.00	694.00	2	89594	2021-05-31	-	-		10.0
KFM08A	684.00	694.00	2	89595	2021-05-31	-	-		10.9
KFM08A	684.00	694.00	2	89596	2021-05-31	<0.0005	0.0010	1.0046	10.2

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Id code	Secup	Seclow	Section	Sample	Sampling	PO_4-P	PO_4-P^2	Density	Temp_F
	m	m	no.	no.	Date	mg/L	mg/L	g/mL	°C
KFM08A	265.00	280.00	6	89597	2021-06-08	-	-		15.6
KFM08A	265.00	280.00	6	89598	2021-06-09	-	-		16.6
KFM08A	265.00	280.00	6	89599	2021-06-11	<0.0005	0.0009	1.0015	15.3
KFM08D	825.00	835.00	2	89600	2021-05-31	-	-		13.8
KFM08D	825.00	835.00	2	89601	2021-06-01	-	-		17.2
KFM08D	825.00	835.00	2	89602	2021-06-03	<0.0005	<0.0005	1.0074	20.5
KFM08D	660.00	680.00	4	89603	2021-06-09	-	-		16.3
KFM08D	660.00	680.00	4	89604	2021-06-11	-	-		17.0
KFM08D	660.00	680.00	4	89605	2021-06-14	<0.0005	0.0017	1.0052	14.1
KFM10A	430.00	440.00	2	89606	2021-05-26	-	-		9.5
KFM10A	430.00	440.00	2	89607	2021-05-27	-	-		7.2
KFM10A	430.00	440.00	2	89608	2021-05-28	<0.0005	0.0028	1.0043	12.3
KFM11A	690.00	710.00	2	89609	2021-06-15	-	-		12.3
KFM11A	690.00	710.00	2	89610	2021-06-16	-	-		11.1
KFM11A	690.00	710.00	2	89611	2021-06-16	<0.0005	0.0007	1.0057	14.0
KFM11A	446.00	456.00	4	89612	2021-06-10	-	-		16.0
KFM11A	446.00	456.00	4	89613	2021-06-10	-	-		15.1
KFM11A	446.00	456.00	4	89614	2021-06-10	<0.0005	<0.0005	1.0033	14.7
KFM12A	270.00	280.00	3	89615	2021-06-08	-	-		10.4
KFM12A	270.00	280.00	3	89616	2021-06-08	-	-		11.5
KFM12A	270.00	280.00	3	89617	2021-06-08	0.0008	0.0014	1.0017	10.8
KFR01	44.65	62.30	1	89660	2021-11-09	-	-		9.7
KFR01	44.65	62.30	1	89661	2021-11-10	-	-		10.1
KFR01	44.65	62.30	1	89662	2021-11-10	<0.0005	<0.0005	1.0014	10.0
KFR02	119.24	136.24	2	89666	2021-09-07	-	-		12.3
KFR02	119.24	136.24	2	89667	2021-09-08	-	-		12.5
KFR02	119.24	136.24	2	89668	2021-09-10	<0.0005	0.0024	1.0027	12.4

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Id code	Secup	Seclow	Section	Sample	Sampling	PO_4-P	PO_4-P*	Density	Temp_F
	m	m	no.	no.	Date	mg/L	mg/L	g/mL	°C
KFR02	81.24	118.24	3	89674	2021-09-13	<0.0005	<0.0005	1.0026	12.4
KFR02	43.24	80.24	4	89675	2021-09-07	-	-		12.0
KFR02	43.24	80.24	4	89676	2021-09-08	-	-		12.3
KFR02	43.24	80.24	4	89677	2021-09-10	<0.0005	<0.0005	1.0015	12.2
KFR101	279.50	341.76	1	89648	2021-06-22	-	-		12.4
KFR101	279.50	341.76	1	89649	2021-06-23	-	-		11.5
KFR101	279.50	341.76	1	89650	2021-06-23	<0.0005	0.0011	0.9994	12.9
KFR102A	423.00	443.00	2	89651	2021-06-16	-	-		10.5
KFR102A	423.00	443.00	2	89652	2021-06-17	-	-		10.3
KFR102A	423.00	443.00	2	89653	2021-06-18	<0.0005	<0.0005	1.0022	11.1
KFR102A	214.00	219.00	5	89654	2021-06-16	-	-		9.8
KFR102A	214.00	219.00	5	89655	2021-06-16	-	-		10.4
KFR102A	214.00	219.00	5	89656	2021-06-17	<0.0005	<0.0005	1.0016	11.2
KFR104	333.00	454.57	1	89657	2021-06-15	-	-		18.9
KFR104	333.00	454.57	1	89658	2021-06-17	-	-		17.6
KFR104	333.00	454.57	1	89659	2021-06-18	0.0013	0.0026	0.9993	24.1
KFR105	265.00	306.80	1	89678	2021-11-10	-	-		8.9
KFR105	265.00	306.80	1	89679	2021-11-11	-	-		9.0
KFR105	265.00	306.80	1	89680	2021-11-15	<0.0005	<0.0005	1.0013	9.3
KFR106	260.00	300.13	1	89681	2021-06-14	-	-		9.4
KFR106	260.00	300.13	1	89682	2021-06-14	-	-		9.1
KFR106	260.00	300.13	1	89683	2021-06-14	<0.0005	0.0026	1.0006	9.5
KFR106	143.00	259.00	2	89684	2021-06-14	-	-		9.3
KFR106	143.00	259.00	2	89685	2021-06-15	-	-		8.7
KFR106	143.00	259.00	2	89686	2021-06-15	<0.0005	0.0005	1.0025	9.6

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Table A3-2. Trace elements - 2021

Id code	Secup	Seclow	Section	Sample	Sampling	Ag	Al	As	B	Ba	Cd	Cr	Cu	Co	Hg	Ni	Mo	Nb
	m	m	no.	no.	date	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
HFM01	33.50	45.50	2	89620	2021-06-04	<0.05	5.15	0.276	372	21.8	<0.003	0.158	<0.1	0.0355	<0.002	0.271	11.7	0.0241
HFM02	38.00	48.00	2	89623	2021-06-03	<0.05	3.97	0.134	235	25.3	0.0039	0.205	<0.1	0.0299	<0.002	0.229	8.05	0.0251
HFM04	57.90	65.90	2	89626	2021-05-18	<0.05	4.35	0.114	194	39.9	0.0040	0.365	<0.1	0.0403	<0.002	0.2340	3.42	0.0744
HFM13	159.00	175.60	1	89629	2021-05-31	<0.50	2.90	<0.5	517	74.80	<0.05	0.436	<0.5	<0.05	<0.002	<0.5	3.71	0.0129
HFM15	85.00	99.50	1	89632	2021-05-26	<0.05	16.0	0.155	68.1	28.7	0.0060	0.220	0.109	0.0316	<0.002	0.255	9.85	0.0293
HFM16	54.00	67.00	2	89635	2021-05-12	<0.05	4.44	0.582	297	24.6	<0.007	0.273	<0.1	0.0372	<0.002	0.276	24.4	0.0232
HFM21	22.00	32.00	3	89638	2021-06-09	<0.05	3.16	0.128	174	36.8	<0.002	0.195	<0.1	0.0335	<0.002	0.213	7.35	0.0263
HFM27	46.00	58.00	2	89641	2021-05-28	<0.3	5.65	<0.5	341	31.1	<0.02	0.166	<0.2	0.0261	<0.002	0.214	9.40	0.0162
HFM32	26.00	31.00	3	89644	2021-05-27	<0.3	1.83	1.34	611	62.7	<0.02	0.561	<0.2	0.0282	<0.002	<0.2	12.5	0.0089
HFM33	121.00	137.50	2	89647	2021-06-22	<0.3	4.36	0.883	590	69.1	<0.02	0.423	<0.2	0.0335	<0.002	0.76	4.12	0.0169
KFM01A	109.00	130.00	5	89551	2021-06-08	<0.3	7.98	<0.5	706	82.5	<0.02	0.105	<0.2	<0.02	<0.002	0.243	28.0	0.0066
KFM01D	429.00	438.00	2	89554	2021-06-03	0.923	3.44	<0.5	617	637	<0.02	0.0905	<0.2	<0.02	<0.002	0.428	<0.2	0.0106
KFM01D	311.00	321.00	4	89557	2021-06-07	<0.3	2.21	<0.5	622	422	<0.02	0.213	<0.2	0.0215	<0.002	<0.2	4.8	0.0105
KFM02A	490.00	518.00	3	89560	2021-05-18	<0.5	2.34	<0.5	590	93.9	<0.05	0.249	<0.5	0.0736	<0.002	<0.5	94.2	0.0120
KFM02A	411.00	442.00	5	89563	2021-05-19	<0.5	3.62	<0.5	642	85.3	<0.05	0.180	<0.5	0.0591	<0.002	<0.5	15.2	0.0115
KFM02B	491.00	506.00	2	89566	2021-05-20	<0.5	2.99	<0.5	581	97.8	<0.05	0.109	<0.5	0.144	<0.002	<0.5	6.04	0.0140
KFM02B	410.00	431.00	4	89569	2021-05-19	<0.5	1.48	<0.5	628	86.0	<0.05	0.184	<0.5	0.0557	<0.00	<0.5	6.29	0.0113
KFM03A	969.50	994.50	1	89572	2021-05-27	<0.5	18.2	<0.5	849	1020	<0.05	0.583	<0.5	<0.05	<0.002	0.852	9.12	0.0456
KFM03A	633.50	650.00	4	89575	2021-05-27	<0.5	4.21	<0.5	1020	155	<0.05	0.314	<0.5	<0.05	<0.002	<0.5	23.3	<0.01
KFM04A	230.00	245.00	4	89578	2021-05-20	<0.5	1.30	<0.5	539	105	<0.05	0.210	<0.5	2.14	<0.002	<0.5	76.7	0.0137
KFM06A	738.00	748.00	3	89581	2021-05-20	<0.5	0.908	<0.5	736	386	<0.1	0.229	<0.5	<0.05	<0.002	<0.5	341	0.0283
KFM06A	341.00	362.00	5	89584	2021-05-11	<0.3	1.91	7.50	912	228	<0.06	0.875	<0.2	0.21	<0.002	0.607	187	0.0124
KFM06C	647.00	666.00	3	89587	2021-05-24	<0.5	2.56	1.03	892	371	<0.05	0.103	<0.5	<0.05	<0.002	<0.5	28.7	0.0291
KFM06C	531.00	540.00	5	89590	2021-05-11	<0.3	1.53	<0.5	950	111	0.0307	0.051	0.238	<0.02	<0.002	0.330	55.3	0.0125
KFM07A	962.00	972.00	2	89593	2021-06-10	<0.5	5.30	<0.5	735	560	<0.05	25.4	0.608	0.0772	<0.002	6.98	10.7	0.0671
KFM08A	684.00	694.00	2	89596	2021-05-31	<0.5	1.63	2.72	686	363	<0.05	0.238	<0.5	<0.05	<0.002	<0.5	33.5	0.0239
KFM08A	265.00	280.00	6	89599	2021-06-11	<0.3	3.53	<0.5	837	391	<0.02	0.536	<0.2	0.0298	<0.002	0.438	8.95	0.0084
KFM08D	825.00	835.00	2	89602	2021-06-03	<0.5	2.35	<0.5	676	230	<0.05	<0.1	<0.5	<0.05	<0.002	1.32	35.7	0.0241
KFM08D	660.00	680.00	4	89605	2021-06-14	<0.5	1.67	0.890	647	521	<0.05	0.432	<0.5	<0.05	<0.002	0.897	31.4	0.0255

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Id code	Secup	Seclow	Section	Sample	Sampling	Ag	Al	As	B	Ba	Cd	Cr	Cu	Co	Hg	Ni	Mo	Nb
	m	m	no.	no.	date	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
KFM10A	430.00	440.00	2	89608	2021-05-28	<0.5	1.68	<0.5	670	70.3	<0.05	0.149	<0.5	<0.05	<0.002	<0.5	2.82	0.0116
KFM11A	690.00	710.00	2	89611	2021-06-16	<0.5	2.38	<0.5	781	2390	<0.05	0.2580	<0.5	<0.05	<0.002	<0.5	24.0	0.0274
KFM11A	446.00	456.00	4	89614	2021-06-10	<0.3	2.30	<0.5	908	92.3	0.0204	0.0837	<0.2	<0.02	<0.002	0.205	14.10	0.0099
KFM12A	270.00	280.00	3	89617	2021-06-08	<0.3	3.95	1.81	765	548	<0.02	0.0849	<0.2	0.0918	<0.002	0.261	9.37	0.0163
KFR01	44.65	62.30	1	89662	2021-11-10	<0.3	3.52	<0.5	729	55.1	<0.02	<0.04	<0.2	<0.02	<0.002	<0.2	4.16	0.0082
KFR02	119.24	136.24	2	89668	2021-09-10	<0.3	3.18	<0.5	753	157	0.0927	0.0854	<0.2	<0.02	<0.002	0.262	3.02	0.0386
KFR02	81.24	118.24	3	89674	2021-09-13	<0.3	3.58	<0.5	807	142	0.0319	0.0457	<0.2	<0.02	<0.002	0.211	2.76	0.0291
KFR02	43.24	80.24	4	89677	2021-09-10	<0.3	2.68	<0.5	929	133	0.0412	0.0854	<0.2	<0.02	<0.002	<0.2	2.33	0.0245
KFR101	279.50	341.76	1	89650	2021-06-23	<0.05	4.49	0.849	854	564	<0.002	0.11	0.125	0.0316	<0.002	0.613	3.74	0.0054
KFR102A	423.00	443.00	2	89653	2021-06-18	<0.3	3.93	<0.5	926	111	<0.02	0.1250	<0.2	<0.02	<0.002	0.232	4.30	0.0110
KFR102A	214.00	219.00	5	89656	2021-06-17	<0.3	2.81	<0.5	756	103	<0.02	0.0822	<0.2	<0.02	<0.002	<0.2	5.08	0.0080
KFR104	333.00	454.57	1	89659	2021-06-18	<0.3	3.70	<0.5	871	251	<0.02	0.150	<0.2	0.0252	<0.0020	0.753	11.7	0.0055
KFR105	265.00	306.80	1	89680	2021-11-15	<0.3	3.53	<0.5	890	112	<0.02	<0.04	<0.2	<0.02	<0.002	<0.2	2.30	0.0091
KFR106	260.00	300.13	1	89683	2021-06-14	<0.3	6.28	<0.5	766	361	0.259	0.252	<0.2	0.0344	<0.002	1.70	6.18	0.0079
KFR106	143.00	259.00	2	89686	2021-06-15	<0.3	4.70	<0.5	75	75	<0.02	0.0606	<0.2	0.0378	<0.002	0.990	5.67	0.0128

- = Not analysed

< "value" = below the reporting limit

Id code	Secup	Seclow	Section	Sample	Sampling	Pb	Pd	Se	Sn	V	Zn	U	Th	Rb	Zr	Sb	Cs
	m	m	no.	no.	date	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
HFM01	33.50	45.50	2	89620	2021-06-04	0.0232	<0.008	<0.3	<0.05	1.38	0.752	-	-	7.26	7.45	0.0141	0.216
HFM02	38.00	48.00	2	89623	2021-06-03	<0.01	<0.006	<0.3	<0.05	1.18	0.283	-	-	5.93	6.30	0.0173	0.171
HFM04	57.90	65.90	2	89626	2021-05-18	<0.01	0.0210	<0.3	<0.05	1.02	0.210	-	-	8.54	6.96	0.0108	0.213
HFM13	159.00	175.60	1	89629	2021-05-31	<0.3	<0.01	<2	<0.5	0.356	4.87	-	-	46.1	0.355	<0.1	1.90
HFM15	85.00	99.50	1	89632	2021-05-26	0.0118	<0.01	<0.3	<0.05	1.11	0.203	-	-	6.78	11.5	0.0211	62.7
HFM16	54.00	67.00	2	89635	2021-05-12	0.0158	0.0258	<0.3	<0.05	1.70	0.862	-	-	5.91	6.61	0.0432	0.0603
HFM21	22.00	32.00	3	89638	2021-06-09	0.0111	0.0193	<0.3	0.0610	0.859	0.380	-	-	8.59	4.13	0.0135	0.145
HFM27	46.00	58.00	2	89641	2021-05-28	<0.1	<0.005	<2	<0.3	0.461	<0.8	-	-	19.5	2.94	<0.1	0.859
HFM32	26.00	31.00	3	89644	2021-05-27	<0.1	<0.005	<2	<0.3	0.186	<0.8	-	-	35.0	0.475	<0.1	0.902
HFM33	121.00	137.50	2	89647	2021-06-22	0.104	0.00609	<2	<0.3	0.254	2.21	-	-	47.8	0.260	<0.1	1.56
KFM01A	109.00	130.00	5	89551	2021-06-08	<0.1	0.00969	<2	<0.3	0.365	1.82	-	-	48.8	<0.1	<0.1	0.760
KFM01D	429.00	438.00	2	89554	2021-06-03	<0.1	0.00657	<2	<0.3	0.230	0.950	-	-	40.0	<0.1	<0.1	2.69
KFM01D	311.00	321.00	4	89557	2021-06-07	<0.10	0.00963	<2	<0.3	0.263	<0.8	-	-	40.1	<0.1	<0.1	0.477
KFM02A	490.00	518.00	3	89560	2021-05-18	<0.3	0.0383	8.97	<0.5	0.125	<2	138	<0.2	62.2	<0.2	<0.1	1.52
KFM02A	411.00	442.00	5	89563	2021-05-19	<0.3	0.0140	26.0	<0.5	0.228	<2	-	-	383	<0.2	<0.1	92.3
KFM02B	491.00	506.00	2	89566	2021-05-20	<0.3	<0.01	11.0	<0.5	0.197	<2	-	-	57.8	<0.2	<0.1	1.81
KFM02B	410.00	431.00	4	89569	2021-05-19	<0.3	0.0119	14.7	<0.5	0.262	<2	-	-	65.6	<0.2	<0.1	3.68
KFM03A	969.50	994.50	1	89572	2021-05-27	<0.3	<0.01	<2	<0.5	0.234	4.46	-	-	29.6	<0.2	<0.1	0.611
KFM03A	633.50	650.00	4	89575	2021-05-27	<0.3	<0.01	<2	<0.5	0.221	<2	15.0	<0.2	36.6	<0.2	<0.1	2.41
KFM04A	230.00	245.00	4	89578	2021-05-20	<0.3	0.0399	11.8	<0.5	0.238	<2	-	-	40.6	<0.2	<0.1	1.40
KFM06A	738.00	748.00	3	89581	2021-05-20	<0.3	0.0630	6.61	<0.5	0.251	<2	-	-	27.4	<0.2	<0.1	0.474
KFM06A	341.00	362.00	5	89584	2021-05-11	<0.1	0.0334	13.0	<0.3	0.154	1.26	-	-	23.2	0.191	1.07	0.212
KFM06C	647.00	666.00	3	89587	2021-05-24	<0.3	0.0119	<2	<0.5	0.210	<2	-	-	14.4	<0.2	0.222	0.405
KFM06C	531.00	540.00	5	89590	2021-05-11	<0.1	0.0301	12.9	<0.3	0.244	<0.8	-	-	30.9	<0.1	<0.1	0.745
KFM07A	962.00	972.00	2	89593	2021-06-10	<0.3	<0.01	<2	<0.5	0.344	5.26	-	-	39.1	<0.2	0.204	0.797
KFM08A	684.00	694.00	2	89596	2021-05-31	<0.3	<0.01	<2	<0.5	0.190	<2	-	-	26.7	<0.2	<0.1	0.446
KFM08A	265.00	280.00	6	89599	2021-06-11	<0.1	0.0115	<2	<0.3	0.313	<0.8	-	-	30.8	<0.1	<0.1	0.278
KFM08D	825.00	835.00	2	89602	2021-06-03	<0.3	<0.01	<2	<0.5	0.296	2.15	-	-	14.6	<0.2	0.321	0.289
KFM08D	660.00	680.00	4	89605	2021-06-14	<0.3	0.0155	<2	<0.5	0.289	<2	0.287	<0.2	17.2	<0.2	0.143	0.262

- = Not analysed < "value" = below the reporting limit

Id code	Secup m	Seclow m	Section no.	Sample no.	Sampling date	Pb µg/L	Pd µg/L	Se µg/L	Sn µg/L	V µg/L	Zn µg/L	U µg/L	Th µg/L	Rb µg/L	Zr µg/L	Sb µg/L	Cs µg/L
KFM10A	430.00	440.00	2	89608	2021-05-28	<0.3	<0.01	<2	<0.5	0.169	<2	-	-	56.6	<0.2	<0.1	0.870
KFM11A	690.00	710.00	2	89611	2021-06-16	<0.3	<0.01	<2	<0.5	0.256	<2	-	-	16.2	<0.2	<0.1	0.303
KFM11A	446.00	456.00	4	89614	2021-06-10	<0.1	0.00606	<2	<0.3	0.230	1.42	-	-	12.4	<0.1	<0.1	0.304
KFM12A	270.00	280.00	3	89617	2021-06-08	<0.1	<0.005	<2	<0.3	0.264	<0.8	-	-	13.1	<0.1	0.140	0.256
KFR01	44.65	62.30	1	89662	2021-11-10	<0.1	<0.005	<2	<0.3	0.288	<0.8	-	-	13.6	0.138	<0.1	0.366
KFR02	119.24	136.24	2	89668	2021-09-10	<0.1	<0.01	<2	<0.3	0.275	2.16	-	-	16.9	<0.2	<0.1	0.463
KFR02	81.24	118.24	3	89674	2021-09-13	<0.1	<0.01	<2	<0.3	0.245	1.81	-	-	15.3	<0.2	<0.1	0.455
KFR02	43.24	80.24	4	89677	2021-09-10	<0.1	<0.01	<2	<0.3	0.193	1.78	-	-	12.2	<0.2	<0.1	0.323
KFR101	279.50	341.76	1	89650	2021-06-23	0.0163	<0.001	2.16	<0.05	0.260	0.560	-	-	10.3	<0.03	0.126	0.262
KFR102A	423.00	443.00	2	89653	2021-06-18	<0.1	<0.005	<2	<0.3	0.309	0.917	-	-	16.9	0.173	<0.1	0.327
KFR102A	214.00	219.00	5	89656	2021-06-17	<0.1	<0.005	<2	<0.3	0.215	<0.8	-	-	18.4	<0.1	<0.1	0.397
KFR104	333.00	454.57	1	89659	2021-06-18	<0.1	0.00617	<2	<0.3	0.246	4.60	-	-	7.56	<0.1	<0.1	0.125
KFR105	265.00	306.80	1	89680	2021-11-15	<0.1	<0.005	<2	<0.3	0.324	<0.8	-	-	12.1	<0.1	<0.1	0.318
KFR106	260.00	300.13	1	89683	2021-06-14	<0.1	<0.005	<2	<0.3	0.224	1.76	12.3	<0.1	16.4	<0.1	0.380	0.365
KFR106	143.00	259.00	2	89686	2021-06-15	<0.1	<0.005	<2	<0.3	0.199	0.936	24.8	<0.1	25.8	<0.1	<0.1	0.677

- = Not analysed < "value" = below the reporting limit

Table A3-3. Isotopes I (H-, O- and C-isotopes) - 2021

Id code	Secup	Seclow	Section	Sample	Sampling	δ ^{2}H	^{3}H	δ ^{18}O
	m	m	no.	no.	date	dev SMOW ‰	TU	dev SMOW ‰
HFM01	33.50	45.50	2	89618	2021-06-01	-75.3	-	-10.09
HFM01	33.50	45.50	2	89619	2021-06-02	-76.0	-	-10.28
HFM01	33.50	45.50	2	89620	2021-06-04	-76.0	2.7	-10.26
HFM02	38.00	48.00	2	89621	2021-06-01	-82.4	-	-11.42
HFM02	38.00	48.00	2	89622	2021-06-02	-82.3	-	-11.40
HFM02	38.00	48.00	2	89623	2021-06-03	-82.6	4.0	-11.57
HFM04	58.00	66.00	2	89624	2021-05-17	-83.0	-	-11.60
HFM04	58.00	66.00	2	89625	2021-05-17	-83.2	-	-11.69
HFM04	58.00	66.00	2	89626	2021-05-18	-83.0	4.4	-11.55
HFM13	159.00	173.00	1	89627	2021-05-25	-71.6	-	-9.57
HFM13	159.00	173.00	1	89628	2021-05-28	-71.4	-	-9.43
HFM13	159.00	173.00	1	89629	2021-05-31	-72.0	<0.8	-9.51
HFM15	85.00	95.00	1	89630	2021-05-24	-85.2	-	-11.97
HFM15	85.00	95.00	1	89631	2021-05-25	-85.7	-	-12.03
HFM15	85.00	95.00	1	89632	2021-05-26	-85.4	6.0	-11.99
HFM16	54.00	67.00	2	89633	2021-05-10	-80.7	-	-11.02
HFM16	54.00	67.00	2	89634	2021-05-11	-80.2	-	-11.02
HFM16	54.00	67.00	2	89635	2021-05-12	-80.2	2.7	-11.02
HFM21	22.00	32.00	3	89636	2021-06-07	-82.6	-	-11.56
HFM21	22.00	32.00	3	89637	2021-06-08	-82.3	-	-11.54
HFM21	22.00	32.00	3	89638	2021-06-09	-82.1	4.5	-11.35
HFM27	46.00	58.00	2	89639	2021-05-25	-73.7	-	-10.05
HFM27	46.00	58.00	2	89640	2021-05-26	-74.2	-	-10.04
HFM27	46.00	58.00	2	89641	2021-05-28	-74.3	1.7	-10.03

- = Not analysed

< "value" = below the reporting limit

Id code	Secup	Seclow	Section	Sample	Sampling	$\delta^{2}H$	^{3}H	$\delta^{18}O$
	m	m	no.	no.	date	dev SMOW ‰	TU	dev SMOW ‰
HFM32	26.00	31.00	3	89642	2021-05-27	-66.1	-	-8.62
HFM32	26.00	31.00	3	89643	2021-05-27	-66.3	-	-8.51
HFM32	26.00	31.00	3	89644	2021-05-27	-65.9	0.8	-8.61
HFM33	121.00	137.50	2	89645	2021-06-21	-66.0	-	-8.69
HFM33	121.00	137.50	2	89646	2021-06-21	-66.4	-	-8.60
HFM33	121.00	137.50	2	89647	2021-06-22	-66.5	<0.8	-8.68
KFM01A	109.00	130.00	5	89549	2021-06-01	-89.2	-	-11.94
KFM01A	109.00	130.00	5	89550	2021-06-07	-89.7	-	-11.93
KFM01A	109.00	130.00	5	89551	2021-06-08	-89.9	<0.8	-12.04
KFM01D	429.00	438.00	2	89552	2021-06-02	-73.0	-	-10.82
KFM01D	429.00	438.00	2	89553	2021-06-02	-73.5	-	-10.74
KFM01D	429.00	438.00	2	89554	2021-06-03	-73.7	<0.8	-10.69
KFM01D	311.00	321.00	4	89555	2021-06-07	-77.3	-	-11.20
KFM01D	311.00	321.00	4	89556	2021-06-07	-75.9	-	-10.74
KFM01D	311.00	321.00	4	89557	2021-06-07	-75.2	<0.8	-10.59
KFM02A	490.00	518.00	3	89558	2021-05-17	-66.0	-	-8.65
KFM02A	490.00	518.00	3	89559	2021-05-18	-67.0	-	-8.89
KFM02A	490.00	518.00	3	89560	2021-05-18	-66.3	<0.8	-8.77
KFM02A	411.00	442.00	5	89561	2021-05-17	-75.9	-	-10.08
KFM02A	411.00	442.00	5	89562	2021-05-18	-75.5	-	-10.04
KFM02A	411.00	442.00	5	89563	2021-05-19	-75.0	<0.8	-10.03
KFM02B	491.00	506.00	2	89564	2021-05-19	-64.9	-	-8.60
KFM02B	491.00	506.00	2	89565	2021-05-19	-65.1	-	-8.65
KFM02B	491.00	506.00	2	89566	2021-05-20	-65.0	<0.8	-8.68
KFM02B	410.00	431.00	4	89567	2021-05-18	-71.3	-	-9.68
KFM02B	410.00	431.00	4	89568	2021-05-19	-71.8	-	-9.58
KFM02B	410.00	431.00	4	89569	2021-05-19	-71.6	<0.8	-9.47

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Id code	Secup	Seclow	Section	Sample	Sampling	$\delta^{2}H$	^{3}H	$\delta^{18}O$
	m	m	no.	no.	date	dev SMOW ‰	TU	dev SMOW ‰
KFM03A	969.50	994.50	1	89570	2021-05-24	-96.2	-	-13.70
KFM03A	969.50	994.50	1	89571	2021-05-26	-96.0	-	-13.72
KFM03A	969.50	994.50	1	89572	2021-05-27	-96.2	<0.8	-13.77
KFM03A	633.50	650.00	4	89573	2021-05-25	-84.7	-	-11.75
KFM03A	633.50	650.00	4	89574	2021-05-25	-84.7	-	-11.79
KFM03A	633.50	650.00	4	89575	2021-05-27	-84.2	<0.8	-11.68
KFM04A	230.00	245.00	4	89576	2021-05-20	-70.0	-	-9.30
KFM04A	230.00	245.00	4	89577	2021-05-20	-70.1	-	-9.34
KFM04A	230.00	245.00	4	89578	2021-05-20	-70.1	<0.8	-9.38
KFM06A	738.00	748.00	3	89579	2021-05-18	-81.9	-	-11.94
KFM06A	738.00	748.00	3	89580	2021-05-19	-81.7	-	-11.90
KFM06A	738.00	748.00	3	89581	2021-05-20	-81.5	<0.8	-11.92
KFM06A	341.00	362.00	5	89582	2021-05-10	-88.1	-	-12.07
KFM06A	341.00	362.00	5	89583	2021-05-10	-89.1	-	-12.21
KFM06A	341.00	362.00	5	89584	2021-05-11	-88.3	<0.8	-12.12
KFM06C	647.00	666.00	3	89585	2021-05-17	-93.7	-	-12.98
KFM06C	647.00	666.00	3	89586	2021-05-21	-93.6	-	-13.08
KFM06C	647.00	666.00	3	89587	2021-05-24	-94.4	<0.8	-13.31
KFM06C	531.00	540.00	5	89588	2021-05-10	-81.9	-	-11.33
KFM06C	531.00	540.00	5	89589	2021-05-10	-82.2	-	-11.33
KFM06C	531.00	540.00	5	89590	2021-05-11	-81.9	<0.8	-11.22
KFM07A	962.00	972.00	2	89591	2021-06-09	-87.2	-	-12.90
KFM07A	962.00	972.00	2	89592	2021-06-10	-87.7	-	-13.06
KFM07A	962.00	972.00	2	89593	2021-06-10	-87.6	<0.8	-13.19
KFM08A	684.00	694.00	2	89594	2021-05-31	-92.6	-	-12.99
KFM08A	684.00	694.00	2	89595	2021-05-31	-91.8	-	-12.91
KFM08A	684.00	694.00	2	89596	2021-05-31	-90.4	<0.8	-12.95

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Id code	Secup	Seclow	Section	Sample	Sampling	$\delta^{2}H$	^{3}H	$\delta^{18}O$
	m	m	no.	no.	date	dev SMOW ‰	TU	dev SMOW ‰
KFM08A	265.00	280.00	6	89597	2021-06-08	-100.5	-	-13.35
KFM08A	265.00	280.00	6	89598	2021-06-09	-100.3	-	-13.44
KFM08A	265.00	280.00	6	89599	2021-06-11	-100.1	<0.8	-13.37
KFM08D	825.00	835.00	2	89600	2021-05-31	-81.0	-	-11.77
KFM08D	825.00	835.00	2	89601	2021-06-01	-81.5	-	-11.95
KFM08D	825.00	835.00	2	89602	2021-06-03	-81.1	<0.8	-11.83
KFM08D	660.00	680.00	4	89603	2021-06-09	-83.3	-	-12.03
KFM08D	660.00	680.00	4	89604	2021-06-11	-83.8	-	-12.24
KFM08D	660.00	680.00	4	89605	2021-06-14	-84.2	<0.8	-11.95
KFM10A	430.00	440.00	2	89606	2021-05-26	-64.7	-	-8.41
KFM10A	430.00	440.00	2	89607	2021-05-27	-64.7	-	-8.60
KFM10A	430.00	440.00	2	89608	2021-05-28	-64.7	<0.8	-8.60
KFM11A	690.00	710.00	2	89609	2021-06-15	-86.7	-	-11.98
KFM11A	690.00	710.00	2	89610	2021-06-16	-86.5	-	-12.14
KFM11A	690.00	710.00	2	89611	2021-06-16	-86.4	<0.	-11.95
KFM11A	446.00	456.00	4	89612	2021-06-10	-90.6	-	-12.22
KFM11A	446.00	456.00	4	89613	2021-06-10	-90.7	-	-12.41
KFM11A	446.00	456.00	4	89614	2021-06-10	-91.1	<0.8	-12.34
KFM12A	270.00	280.00	3	89615	2021-06-08	-112.9	-	-15.45
KFM12A	270.00	280.00	3	89616	2021-06-08	-112.1	-	-15.17
KFM12A	270.00	280.00	3	89617	2021-06-08	-112.6	0.8	-15.14
KFR01	44.65	62.30	1	89660	2021-11-09	-76.5	-	-10.17
KFR01	44.65	62.30	1	89661	2021-11-10	-76.7	-	-10.24
KFR01	44.65	62.30	1	89662	2021-11-10	-76.4	-	-10.15
KFR02	119.24	136.24	2	89666	2021-09-07	-88.1	-	-11.74
KFR02	119.24	136.24	2	89667	2021-09-08	-88.8	-	-11.83
KFR02	119.24	136.24	2	89668	2021-09-10	-89.7	-	-12.12

- = Not analysed

< "value" = below the reporting limit

Id code	Secup	Seclow	Section	Sample	Sampling	$\delta^{2}H$	^{3}H	$\delta^{18}O$
	m	m	no.	no.	date	dev SMOW ‰	TU	dev SMOW ‰
KFR02	81.24	118.24	3	89674	2021-09-13	-91.5	-	-12.12
KFR02	43.24	80.24	4	89675	2021-09-07	-113.4	-	-15.21
KFR02	43.24	80.24	4	89676	2021-09-08	-113.3	-	-15.22
KFR02	43.24	80.24	4	89677	2021-09-10	-112.5	-	-15.11
KFR101	279.50	341.76	1	89648	2021-06-22	-112.3	-	-15.19
KFR101	279.50	341.76	1	89649	2021-06-23	-112.3	-	-15.14
KFR101	279.50	341.76	1	89650	2021-06-23	-112.2	<0.8	-15.19
KFR102A	423.00	443.00	2	89651	2021-06-16	-89.5	-	-12.11
KFR102A	423.00	443.00	2	89652	2021-06-17	-89.6	-	-12.15
KFR102A	423.00	443.00	2	89653	2021-06-18	-89.8	<0.8	-12.14
KFR102A	214.00	219.00	5	89654	2021-06-16	-81.9	-	-10.88
KFR102A	214.00	219.00	5	89655	2021-06-16	-81.9	-	-10.87
KFR102A	214.00	219.00	5	89656	2021-06-17	-82.0	<0.8	-10.93
KFR104	333.00	454.57	1	89657	2021-06-15	-107.3	-	-14.46
KFR104	333.00	454.57	1	89658	2021-06-17	-107.0	-	-14.32
KFR104	333.00	454.57	1	89659	2021-06-18	-107.4	<0.8	-14.36
KFR105	265.00	306.80	1	89678	2021-11-10	-101.3	-	-13.54
KFR105	265.00	306.80	1	89679	2021-11-11	-100.8	-	-13.27
KFR105	265.00	306.80	1	89680	2021-11-15	-101.1	-	-13.53
KFR106	260.00	300.13	1	89681	2021-06-14	-112.8	-	-15.13
KFR106	260.00	300.13	1	89682	2021-06-14	-109.2	-	-14.67
KFR106	260.00	300.13	1	89683	2021-06-14	-108.9	<0.8	-14.65
KFR106	143.00	259.00	2	89684	2021-06-14	-82.7	-	-10.99
KFR106	143.00	259.00	2	89685	2021-06-15	-82.5	-	-10.90
KFR106	143.00	259.00	2	89686	2021-06-15	-82.6	<0.8	-11.06

- = Not analysed < "value" = below the reporting limit

Table A3-4. Isotopes II (U- and Th-isotopes) - 2021

Id code	Secup	Seclow	Section	Sample	Sampling	^{238}U	^{235}U	^{234}U	^{232}Th	^{230}Th
	m	m	no.	no.	date	mBq/kg	mBq/kg	mBq/kg	mBq/kg	mBq/kg
KFM02A	490.00	518.00	3	89560	2021-05-18	1.56	0.06	3.15	*	*
KFM03A	633.50	650.00	4	89575	2021-05-27	0.18	0.01	0.28	*	0.00104
KFR106	260.00	300.10	1	89683	2021-06-14	0.15	0.01	0.31	0.00004	0.00027
KFR106	143.00	259.00	2	89686	2021-06-15	0.30	0.02	0.92	0.00034	0.00060

- = Not analysed
*Below detection limit of the analysis

Appendix 4 Pressure registrations during pumping and sampling, HMS system

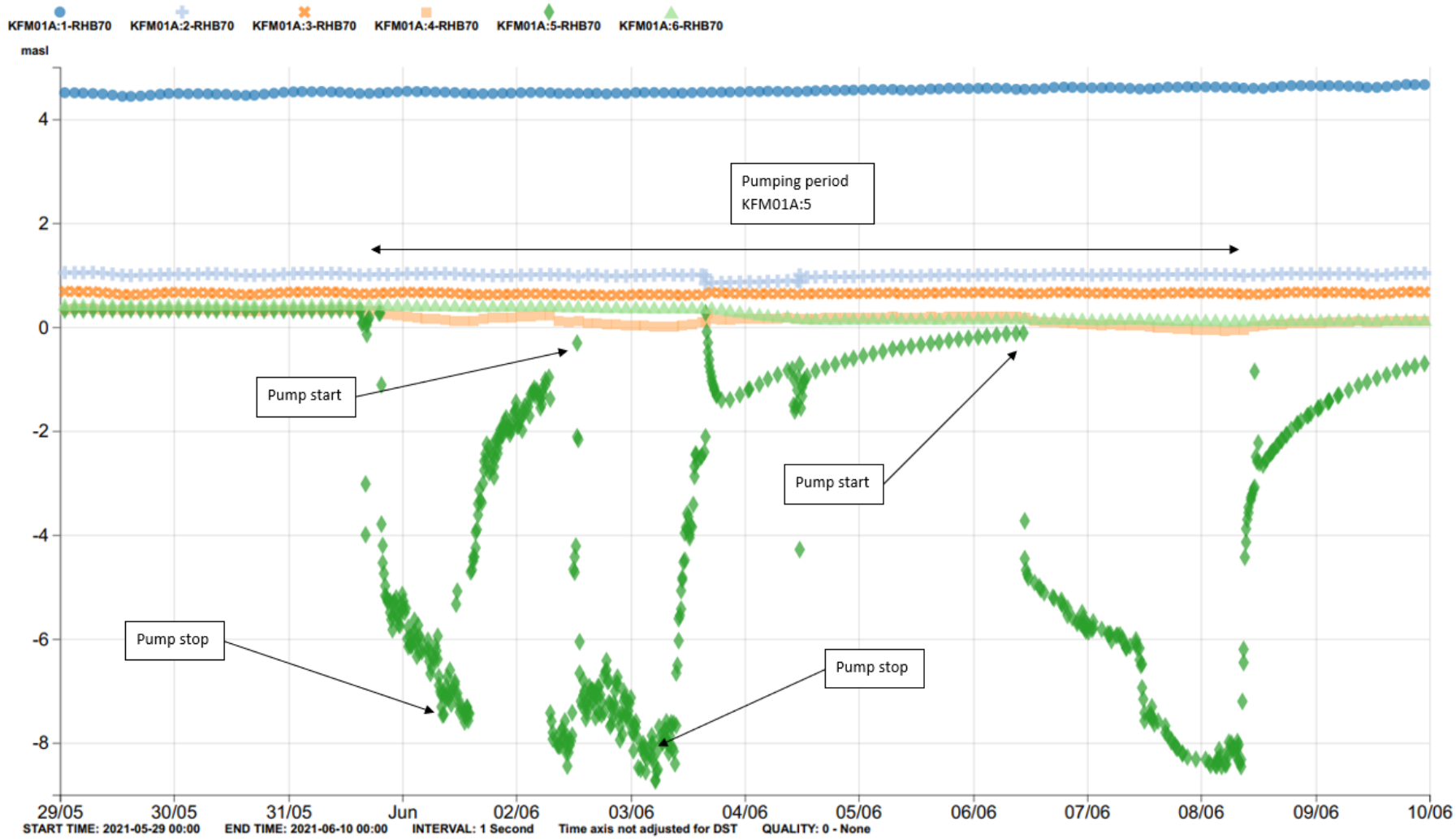

Figure A4-1. *Pumping and drawdown in KFM01A:5 in May-June 2021. A small responses was observed in section 4. During the pumping period, two pump stops occurred.*

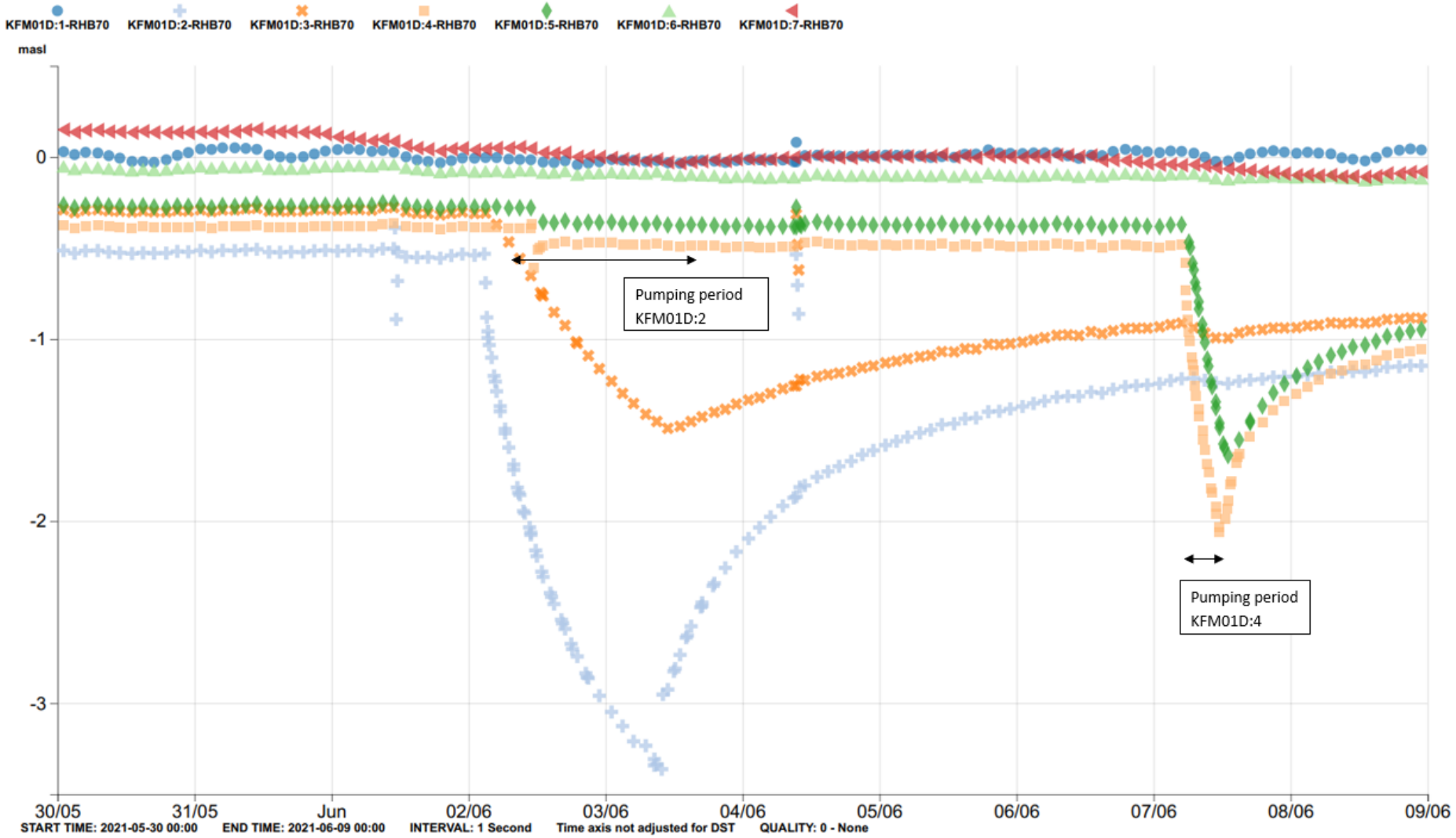

Figure A4- 2*. Pumping and drawdown in KFM01D:2 and KFM01D:4 in June 2021. Section KFM01D:3 was affected by the pumping in KFM01D:2. Sections KFM01D:5, KFM01D:2 and KFM01D:3 were affected by the pumping in KFM01D:4.*

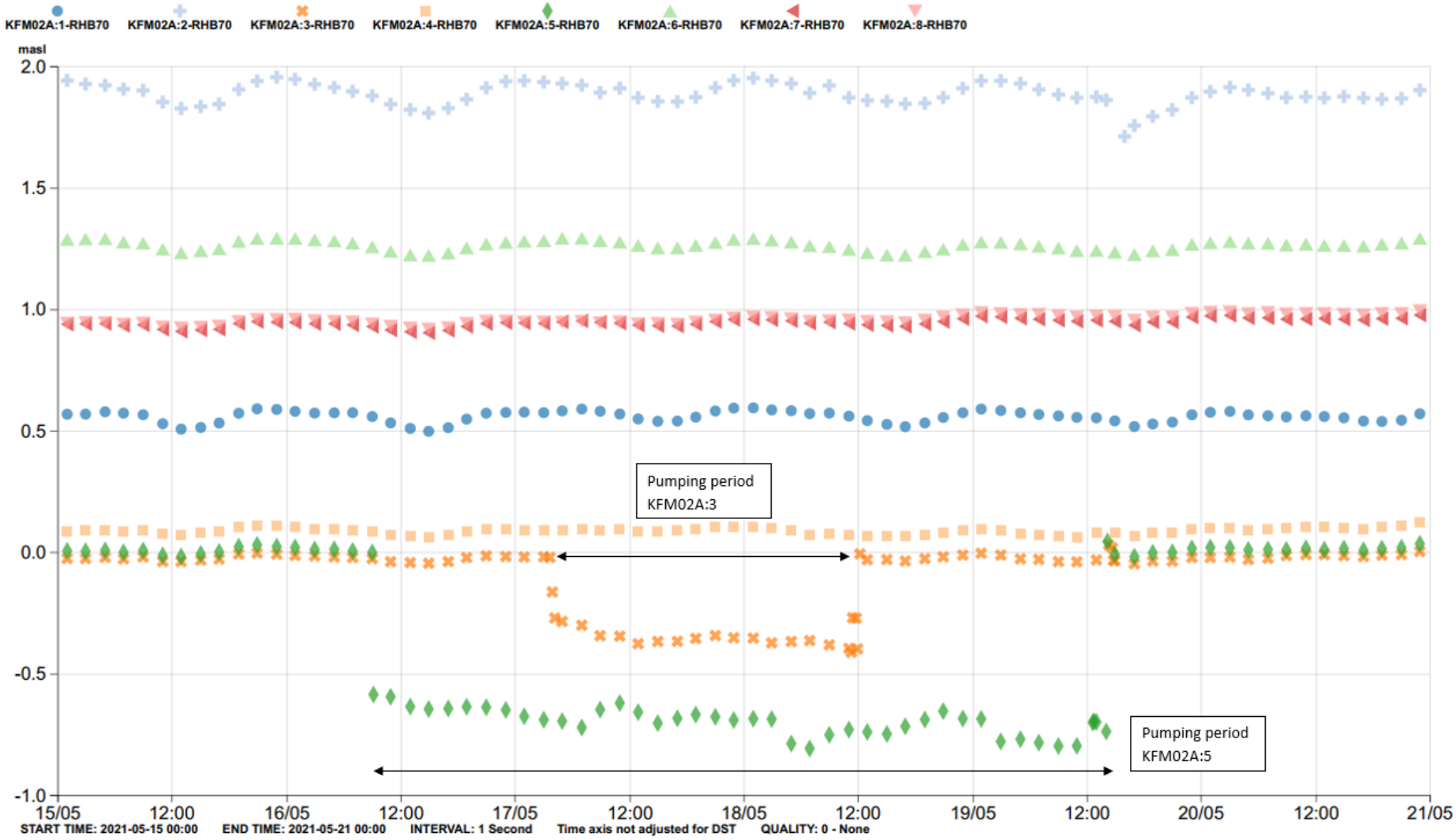

Figure A4- 3. *Pumping and drawdown in KFM02A:3 :5 and KFM02A in May 2021. No other sections in KFM02A were affected.*

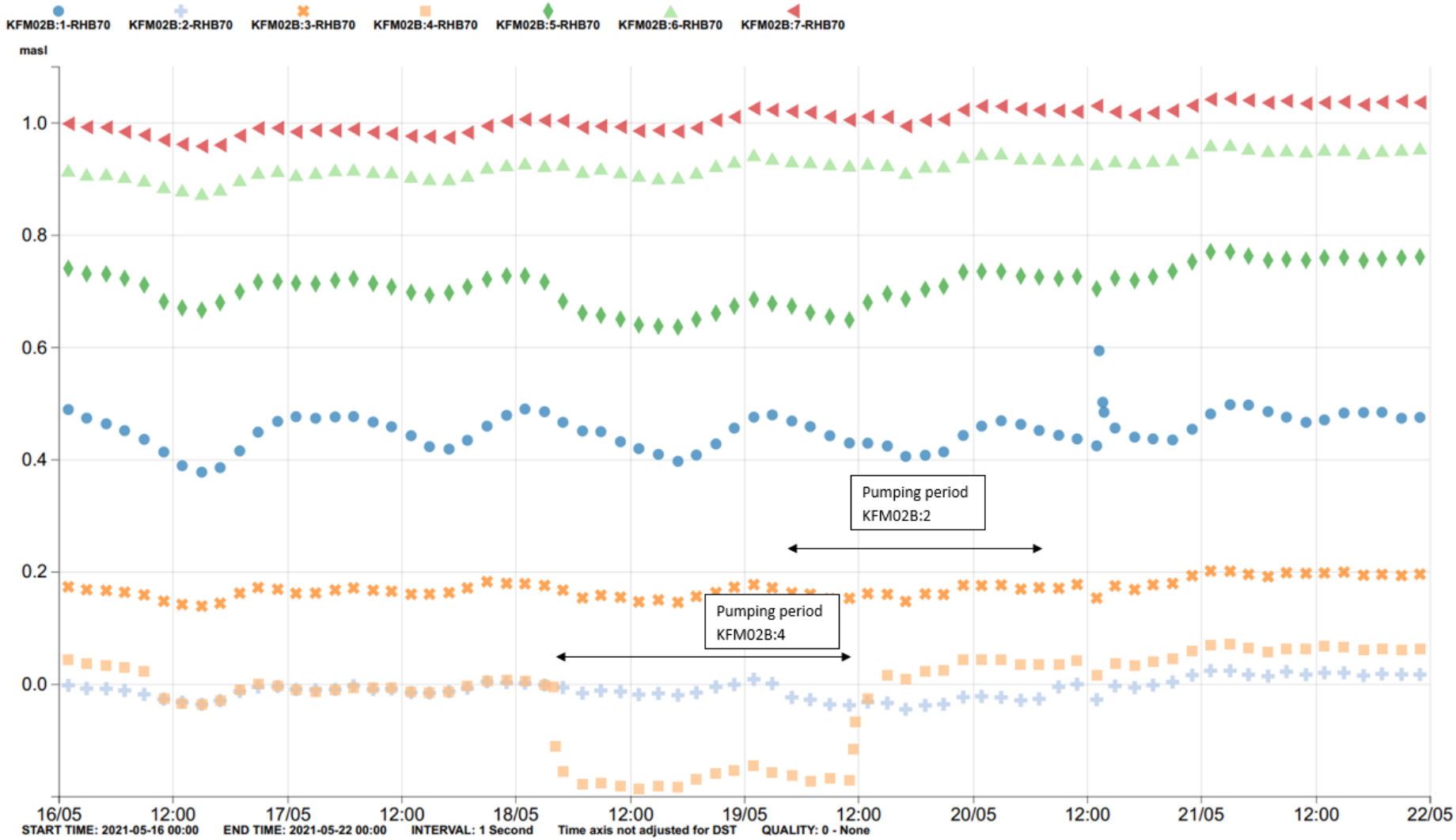

Figure A4- 4. *Pumping and drawdown in KFM02B:2 and KFM02B:4 in May 2021. Section KFM02B:5 was affected by the pumping in KFM02B:4.*

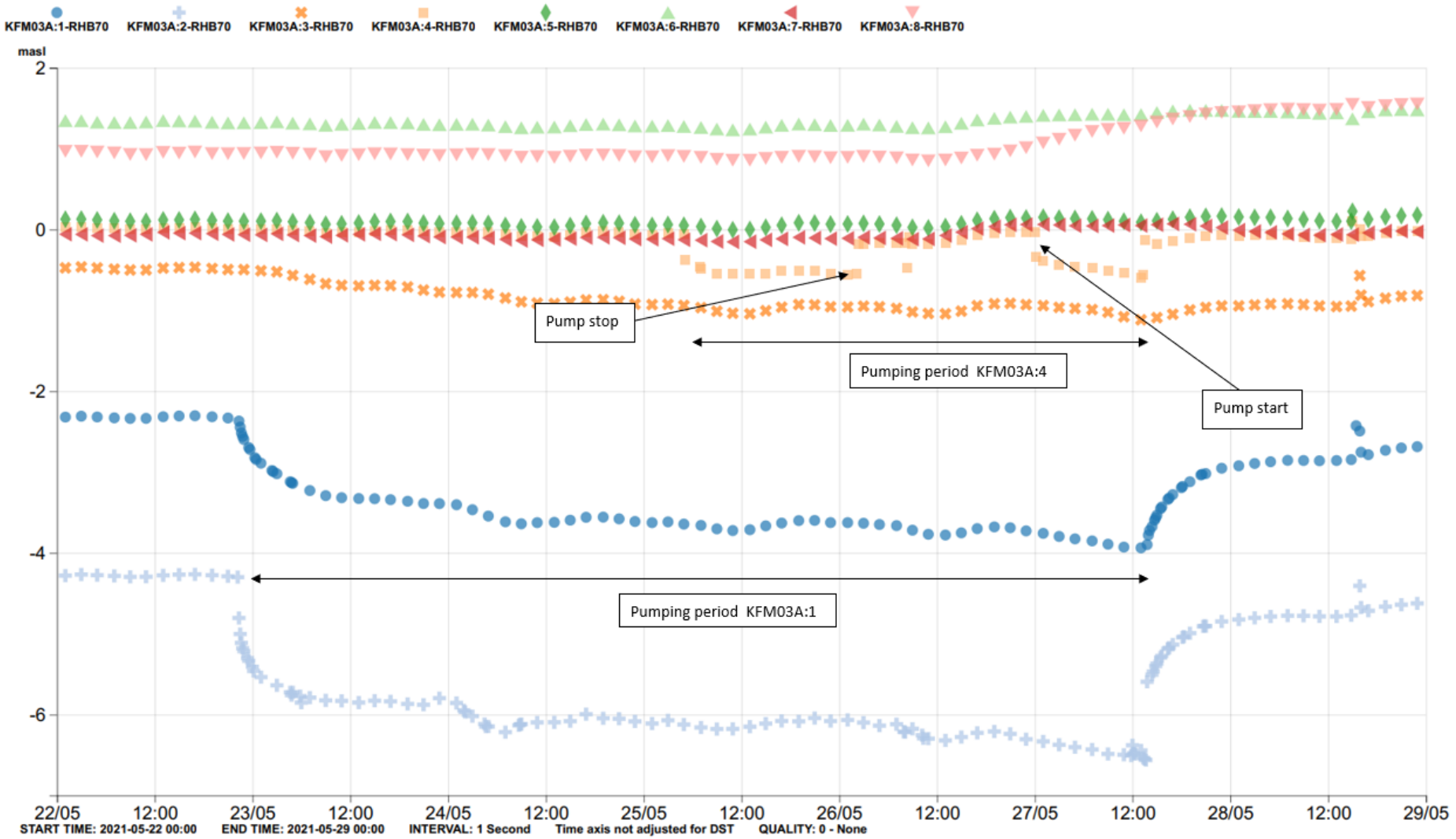

Figure A4- 5. *Pumping and drawdown in KFM03A:1 and KFM03A:4 in May 2021. The pressure response observed in KFM03A:2 during pumping in KFM03A:1 may be caused by a leaking connection in the equipment between sections KFM03A:1 and KFM03A:2 rather than a connected fracture system. A small response was also seen in KFM03A:3. None of the sections were affected by the pumping in KFM03A:4. During the pumping period for KFM03A:4 a pump stop occurred.*

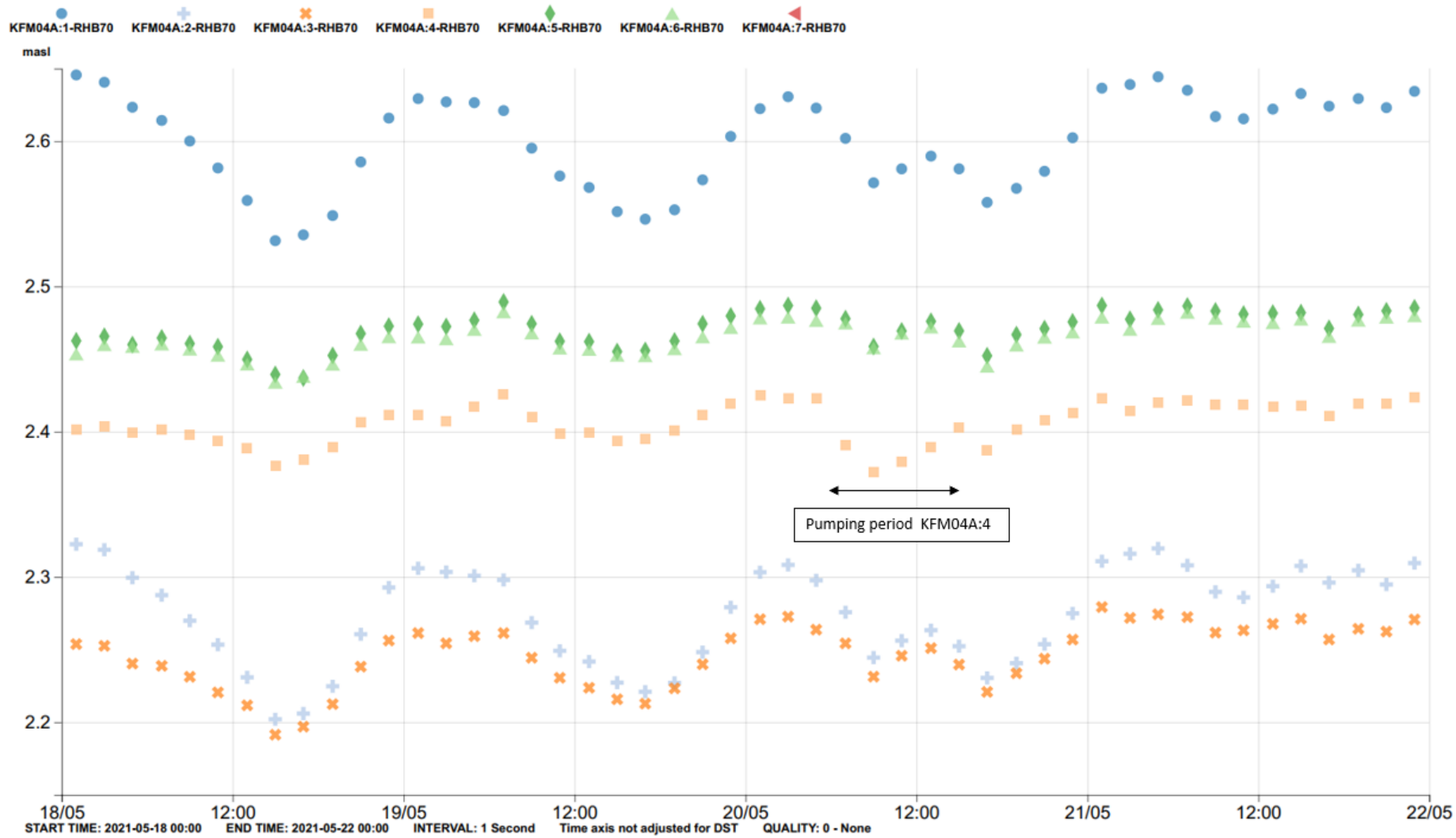

Figure A4- 6. *Pumping and drawdown in KFM04A:4 in May 2021. No sections in KFM04A were significantly affected by the pumping. Data for section KFM04A:7 is not present in the graph due to problems with the pressure transducer.*

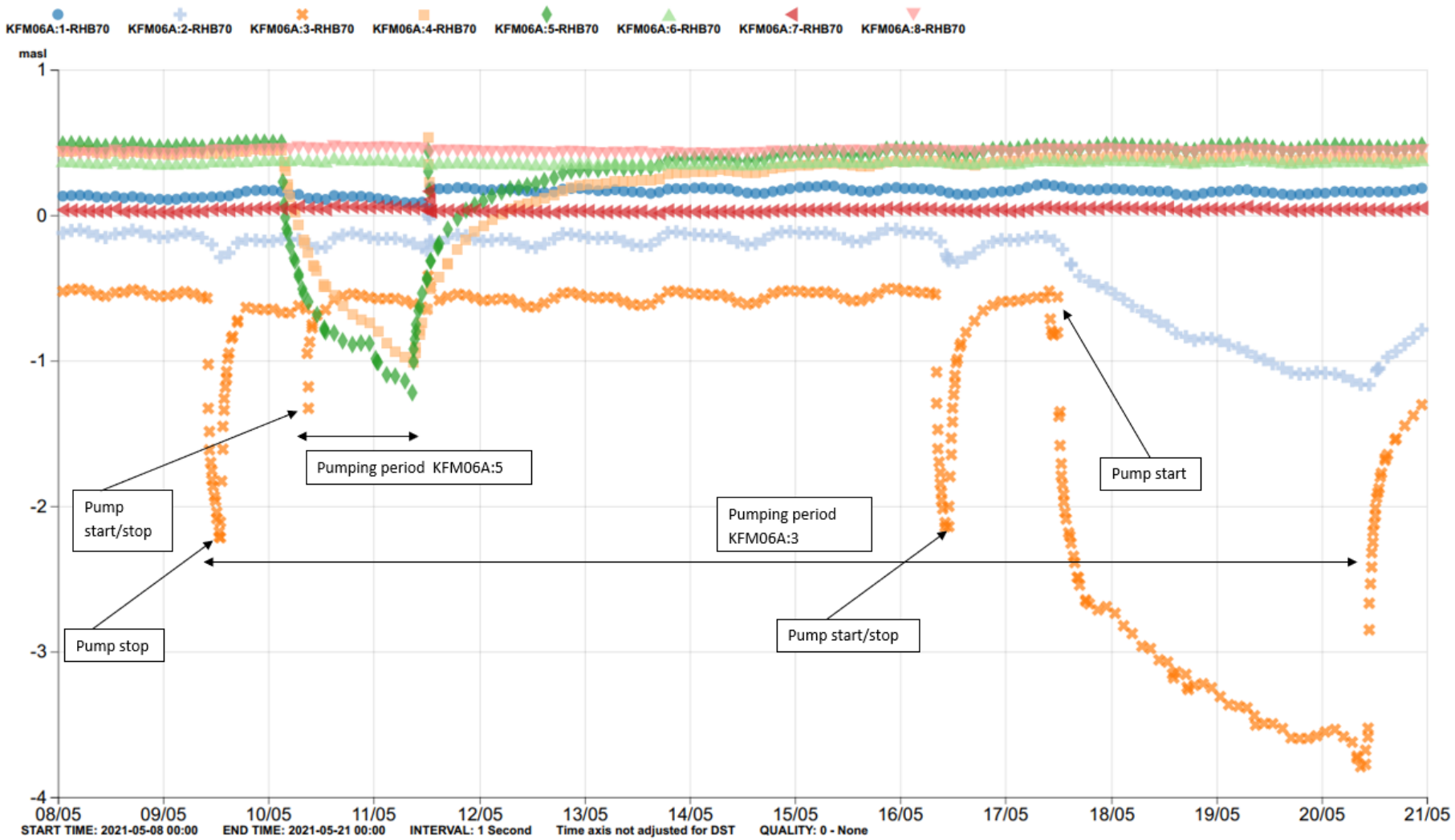

Figure A4- 7. *Pumping and drawdown in KFM06A:3 and KFM06A:5 in May 2021. Section KFM06A:2 was affected by the pumping in KFM06A:3. KFM06A:4 was effected by the pumping in section KFM06A:5. During the pumping period for KFM06A:3, several pump stops occurred.*

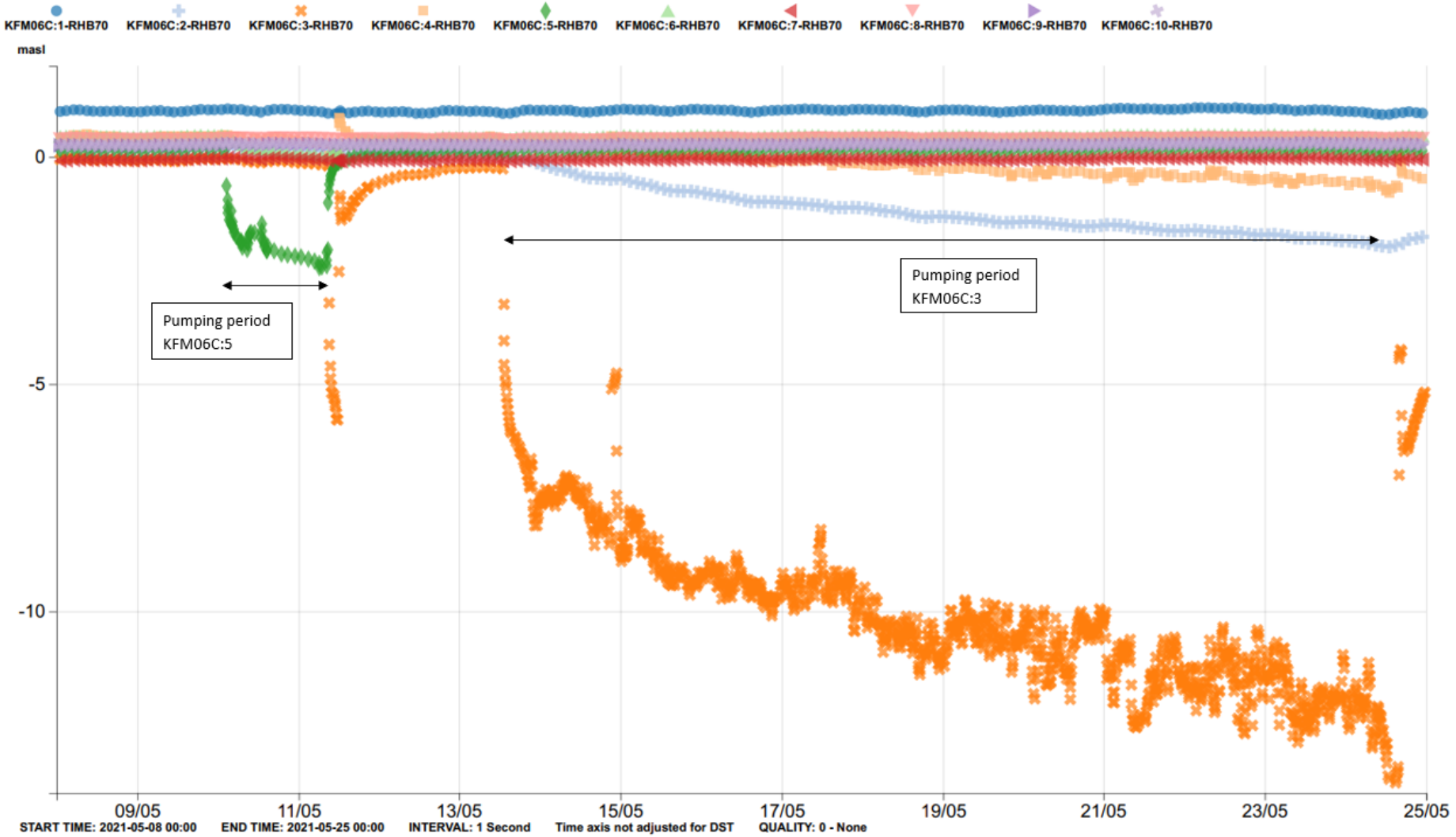

Figure A4- 8. *Pumping and drawdown in KFM06C:3 and KFM06C:5 in May 2021. Sections KFM06C:2 and KFM06C:4 were affected by the pumping in section KFM06C:3. The pumping in section KFM06C:5 caused a response in KFM06C:6. For a more detailed plot of the pumping in KFM06C:5, see Figure A4-9. The pumping rate in both sections had to be adjusted several times which can be seen in the graph. In KFM06C:5, two pump stops that were not detected in the field can be seen. Total pressure recovery had not occurred at the time for these stops.*

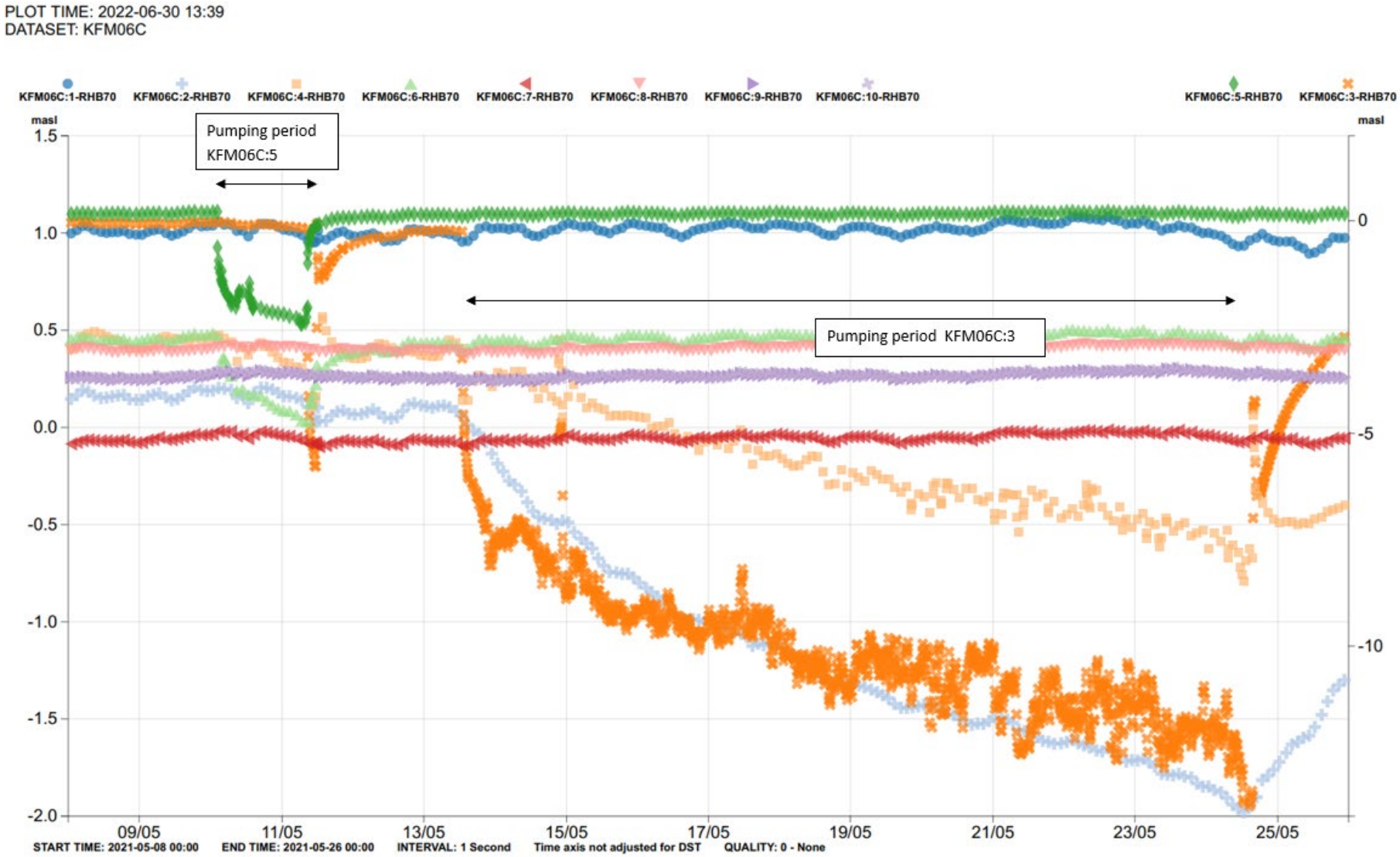

Figure A4- 9. *Pumping and drawdown in KFM06C:3 and KFM06C:5 in May 2021. The pumping in section KFM06C:5 caused a response in KFM06C:6.*

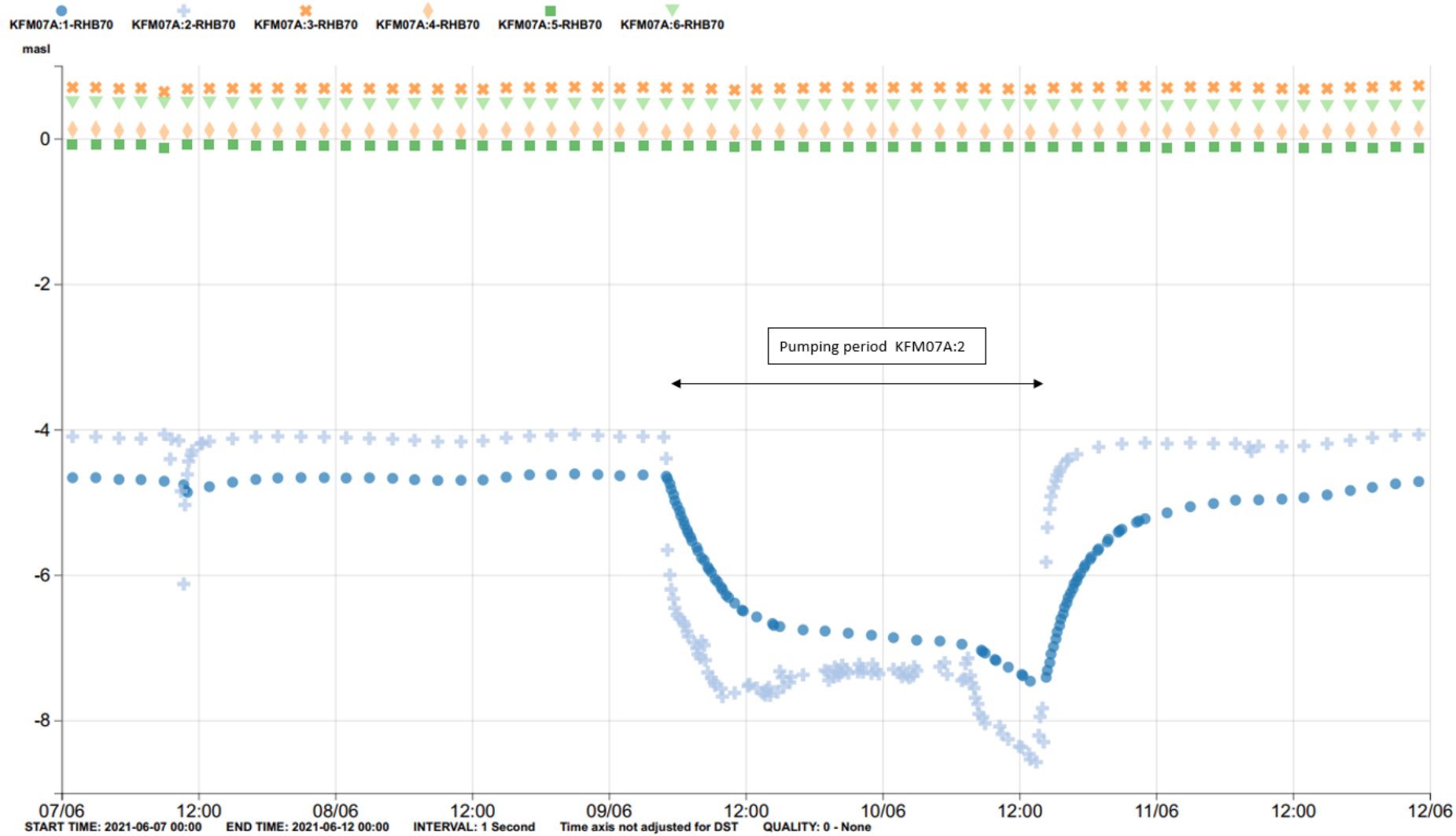

Figure A4- 10. *Detailed plot of pumping and drawdown in KFM07A:2 in June 2021. The pumping in section KFM07A:2 caused a response in KFM07A:1.*

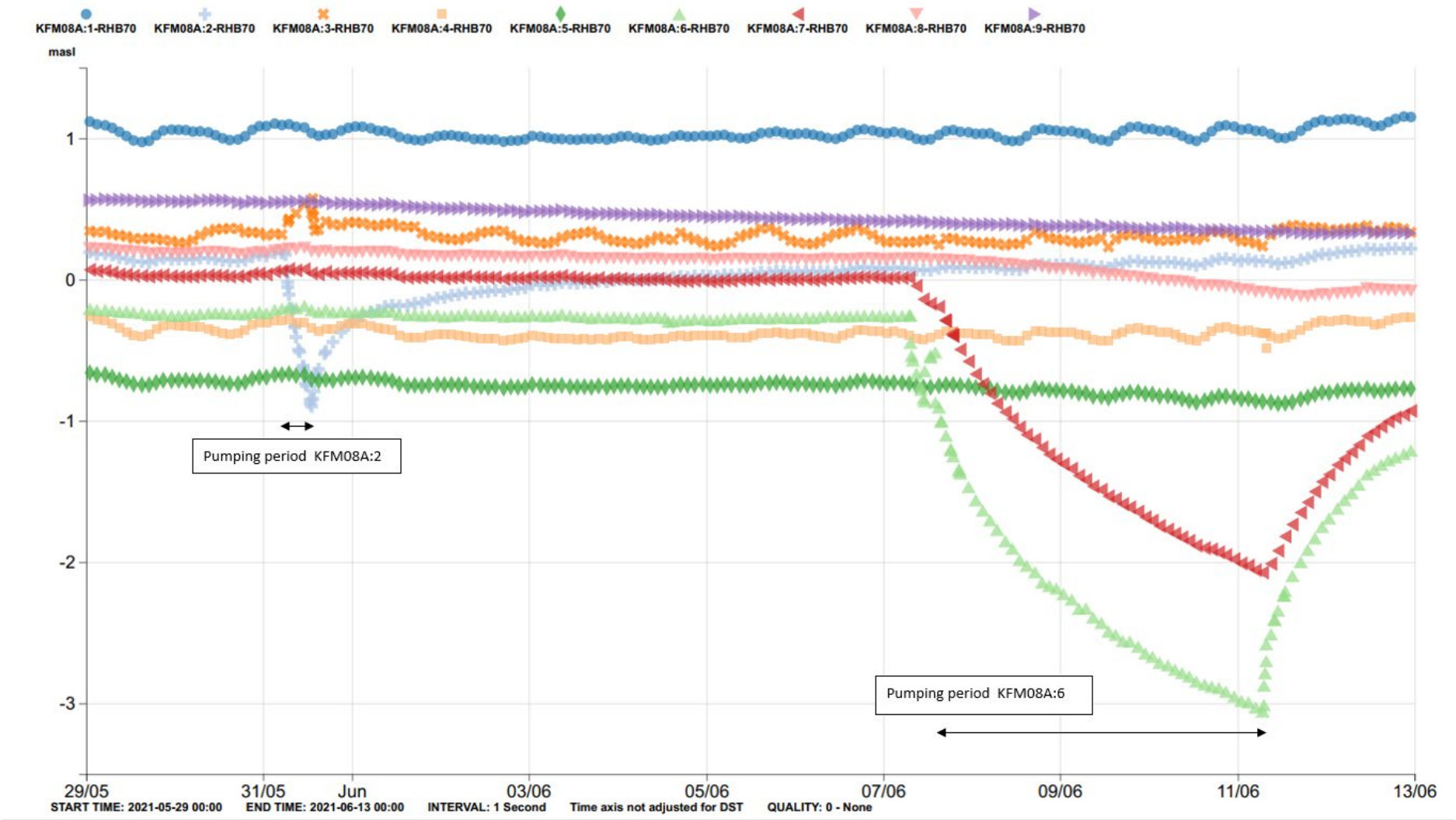

Figure A4- 11. *Detailed plot of pumping and drawdown in KFM08A:6 and KFM08A:2 in May-June 2021. The pumping in section KFM08A:6 caused a response in KFM08A:5, KFM08A:7 and KFM08A:8. Pumping in section KFM08A:2 caused a inverted response in KFM08A:3, which also can be seen during earlier campaigns. A short pumpstop occurred in KFM08A:6 soon after the pump start.*

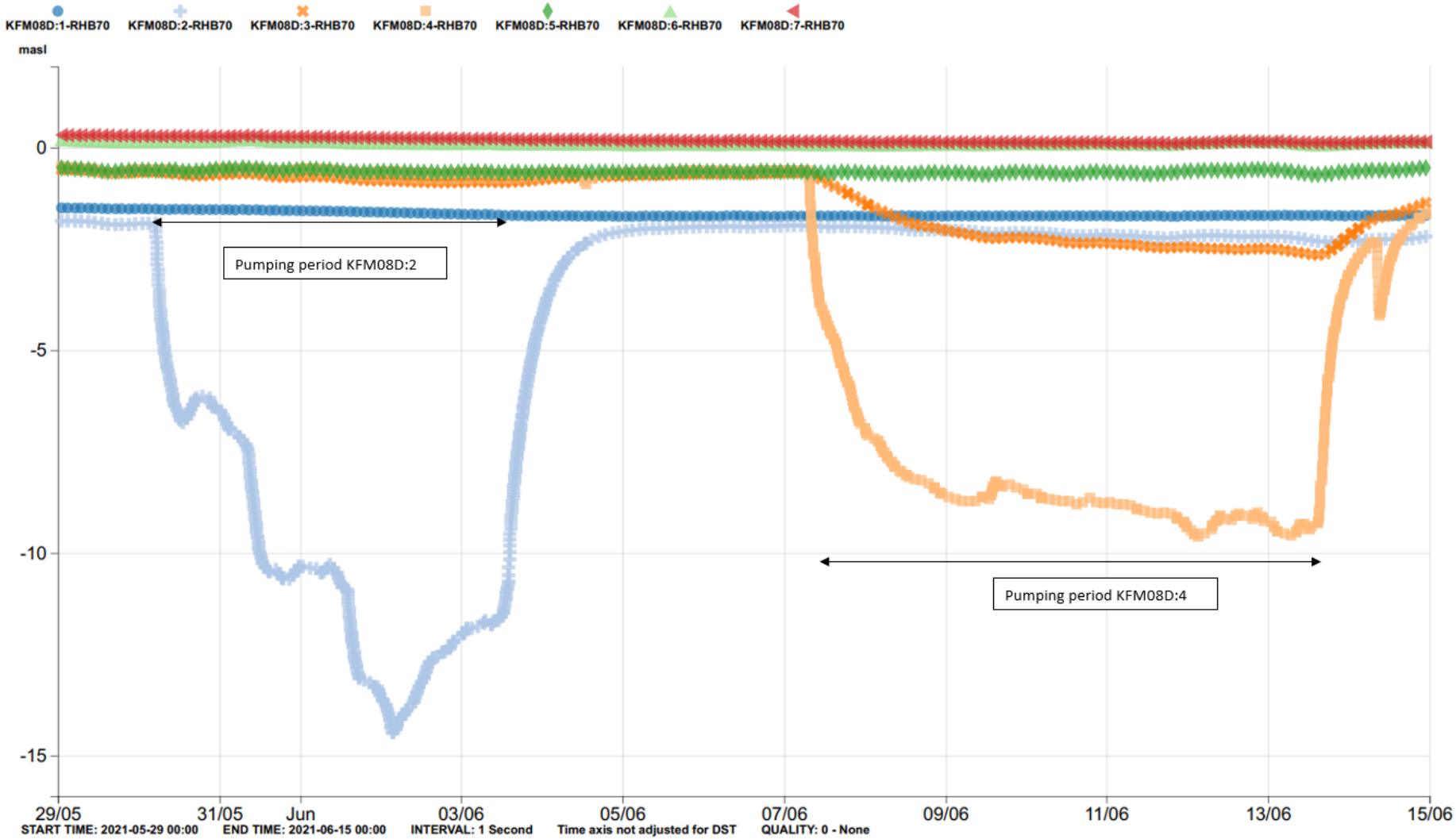

Figure A4- 12. *Detailed plot of pumping and drawdown in KFM08D:2 and KFM08D:4 in May-June 2021. The pumping in section KFM08D:4 caused a response in KFM08D:3. Pumping in KFM08D:2 caused a response in KFM08D:3.*

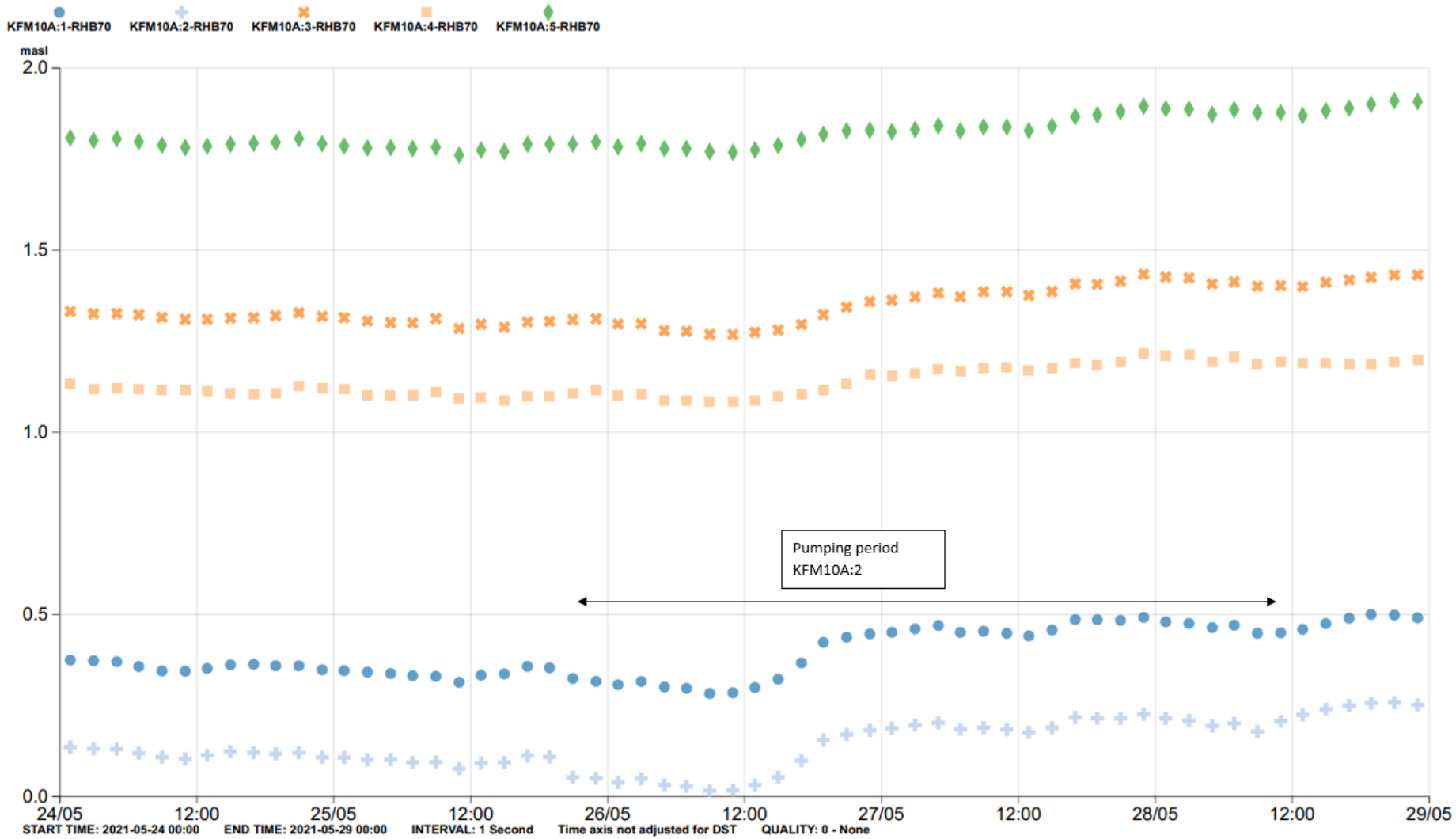

Figure A4- 13. *Detailed plot of pumping and drawdown in KFM10A:2 in May 2021. No visible responses in the other sections occurred during pumping.*

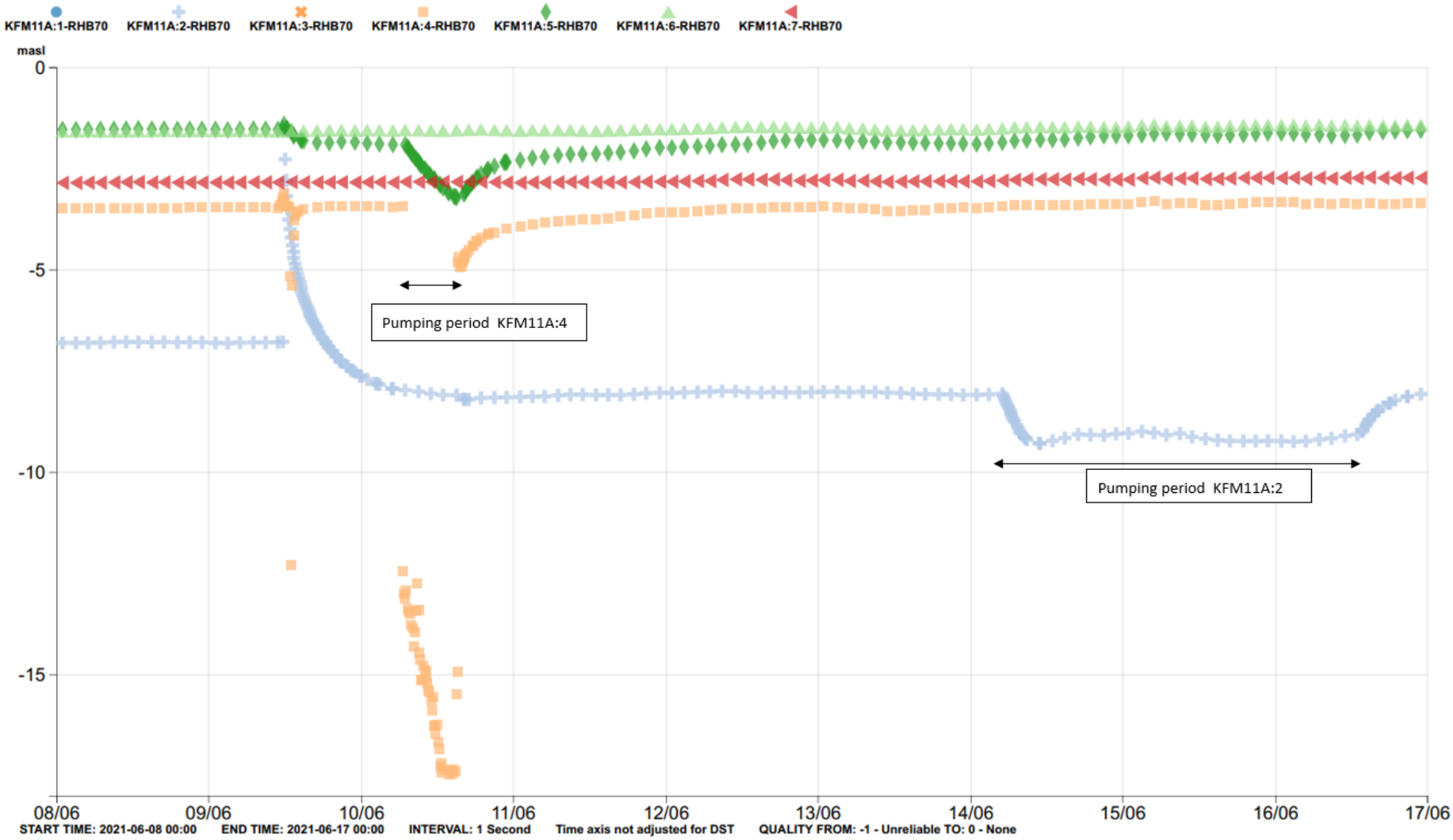

Figure A4- 14. *Pumping and drawdown in KFM11A:2 and KFM11A:4 in June 2021. Pumping in section KFM011A:4 caused a response in KFM11A:5, while no sections were significantly affected by the pumping in KFM11A:2. Data for section KFM11A:1 and KFM11A:3 is missing in the graph due to technical problems with the pressure transducers.*

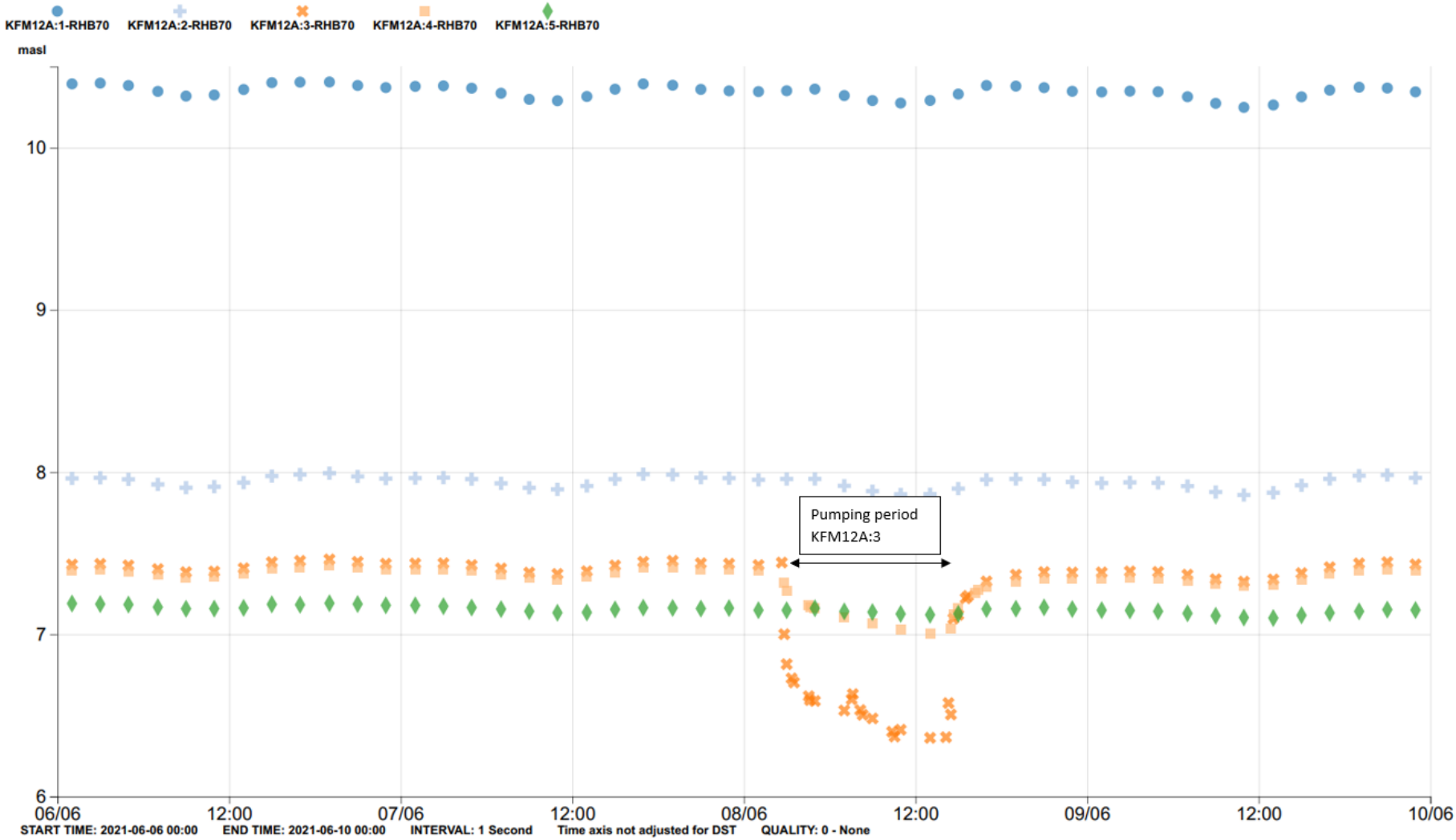

Figure A4- 15*. Pumping and drawdown in KFM12A:3 in June 2021. The pumping in section KFM12A:3 caused a response in KFM12A:4.*

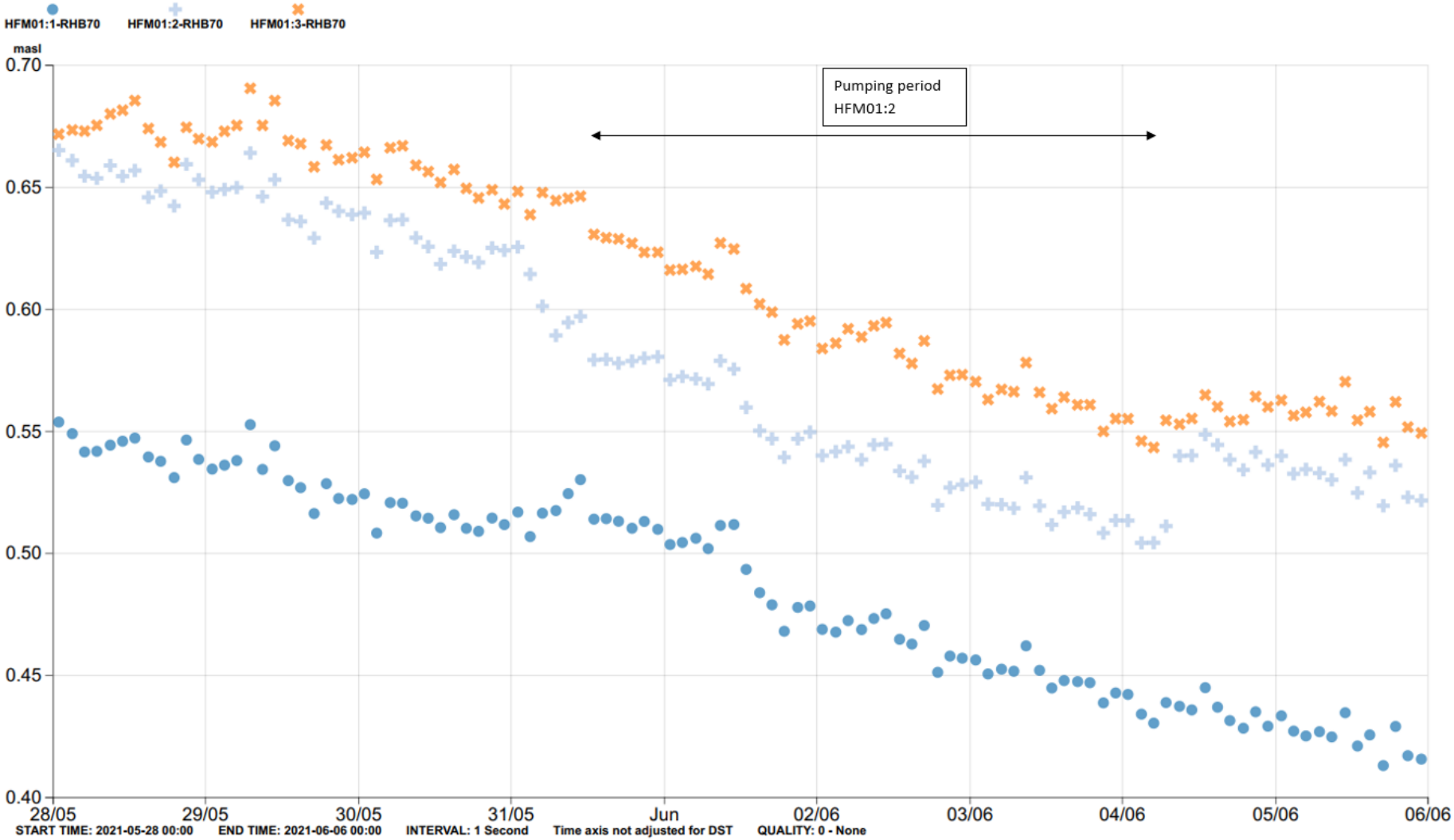

Figure A4- 16. *Pumping and drawdown in HFM01:2 in June 2021. A possible pressure response was observed in section HFM01:3.*

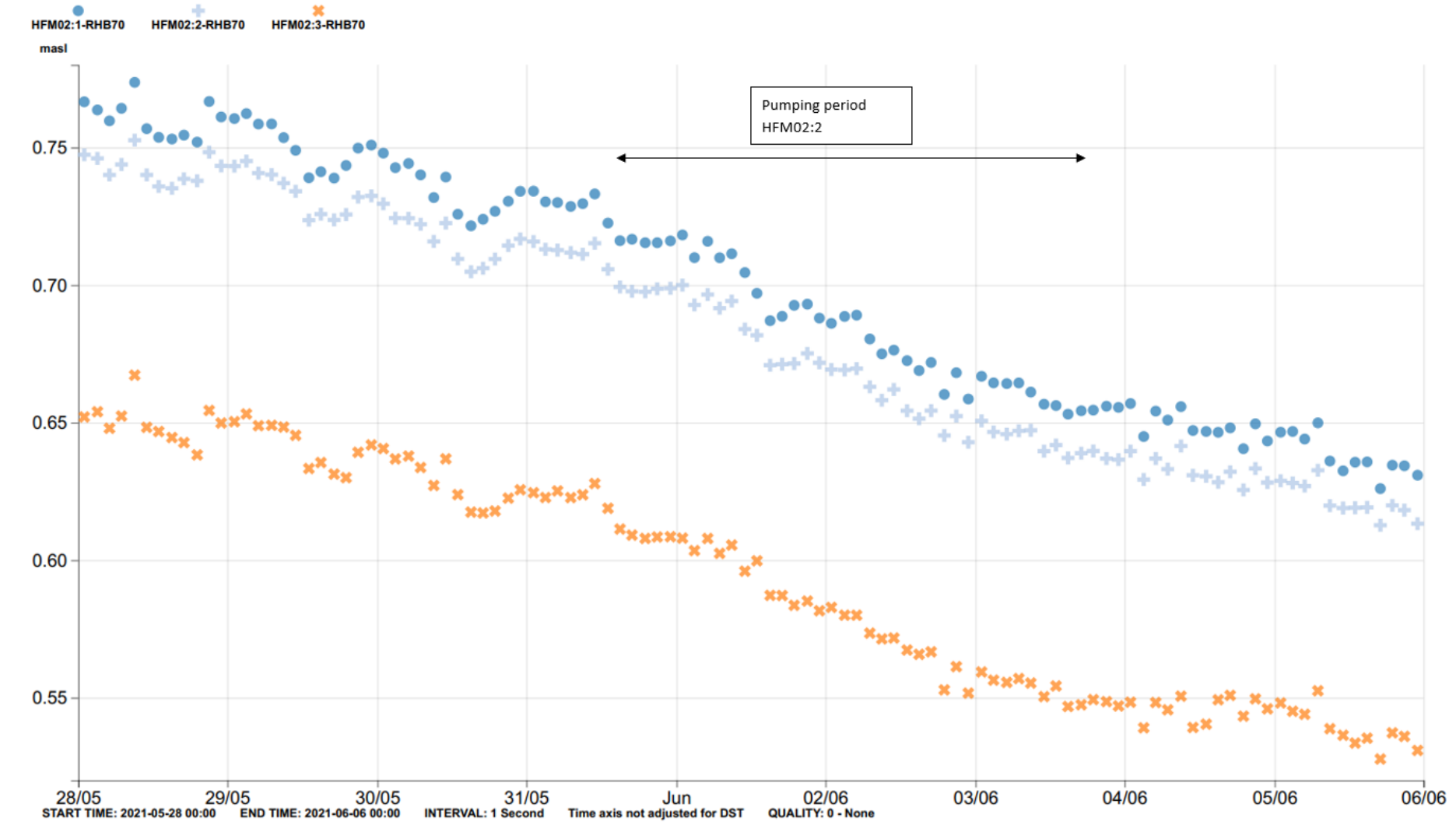

Figure A4- 17. *Pumping in HFM02:2 in June 2021. No significant drawdown was observed in any of the borehole sections in HFM02.*

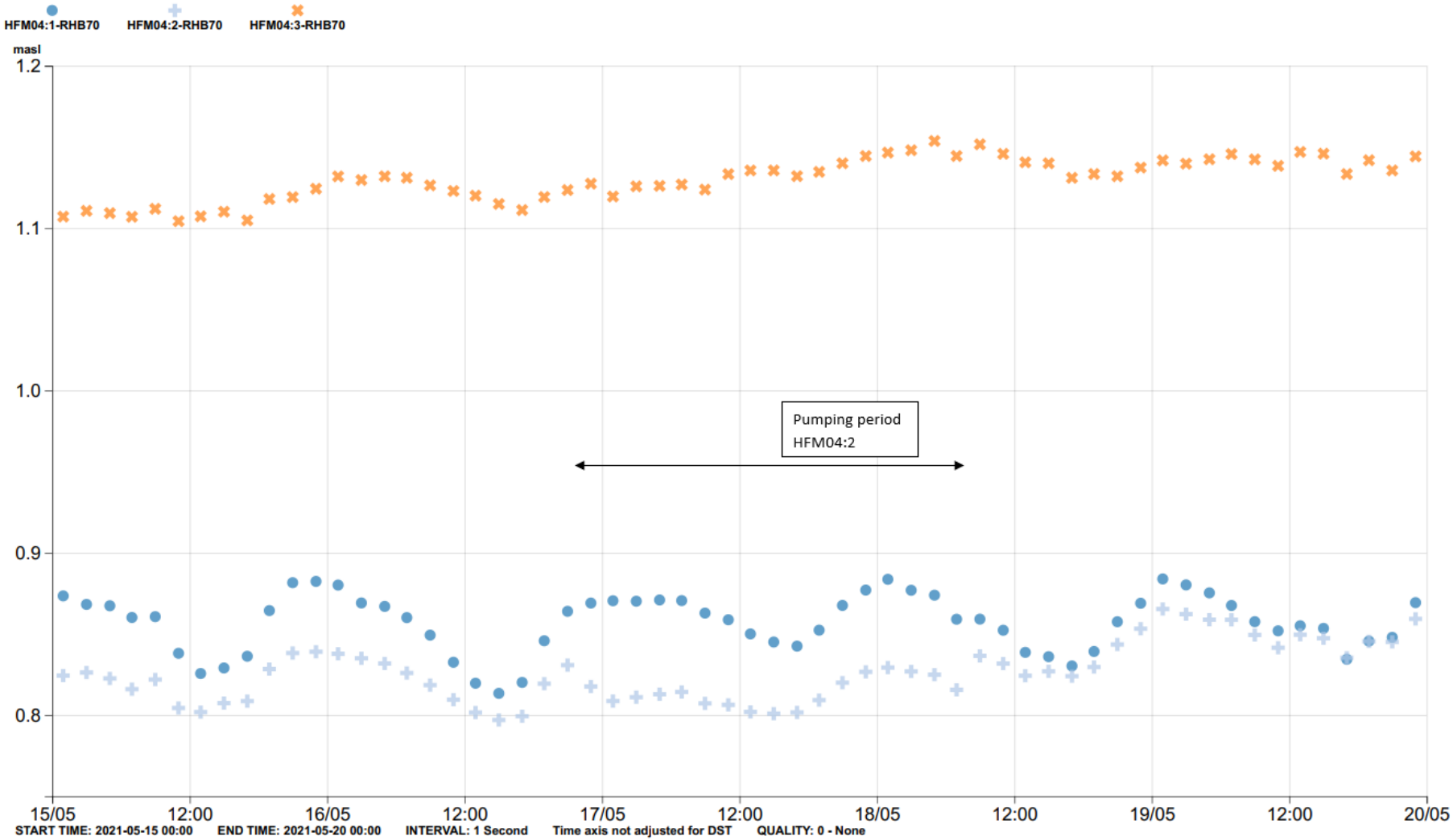

Figure A4- 18. *Pumping in HFM04:2 in May 2021. No significant drawdown was seen in any section during the pumping period in HFM04.*

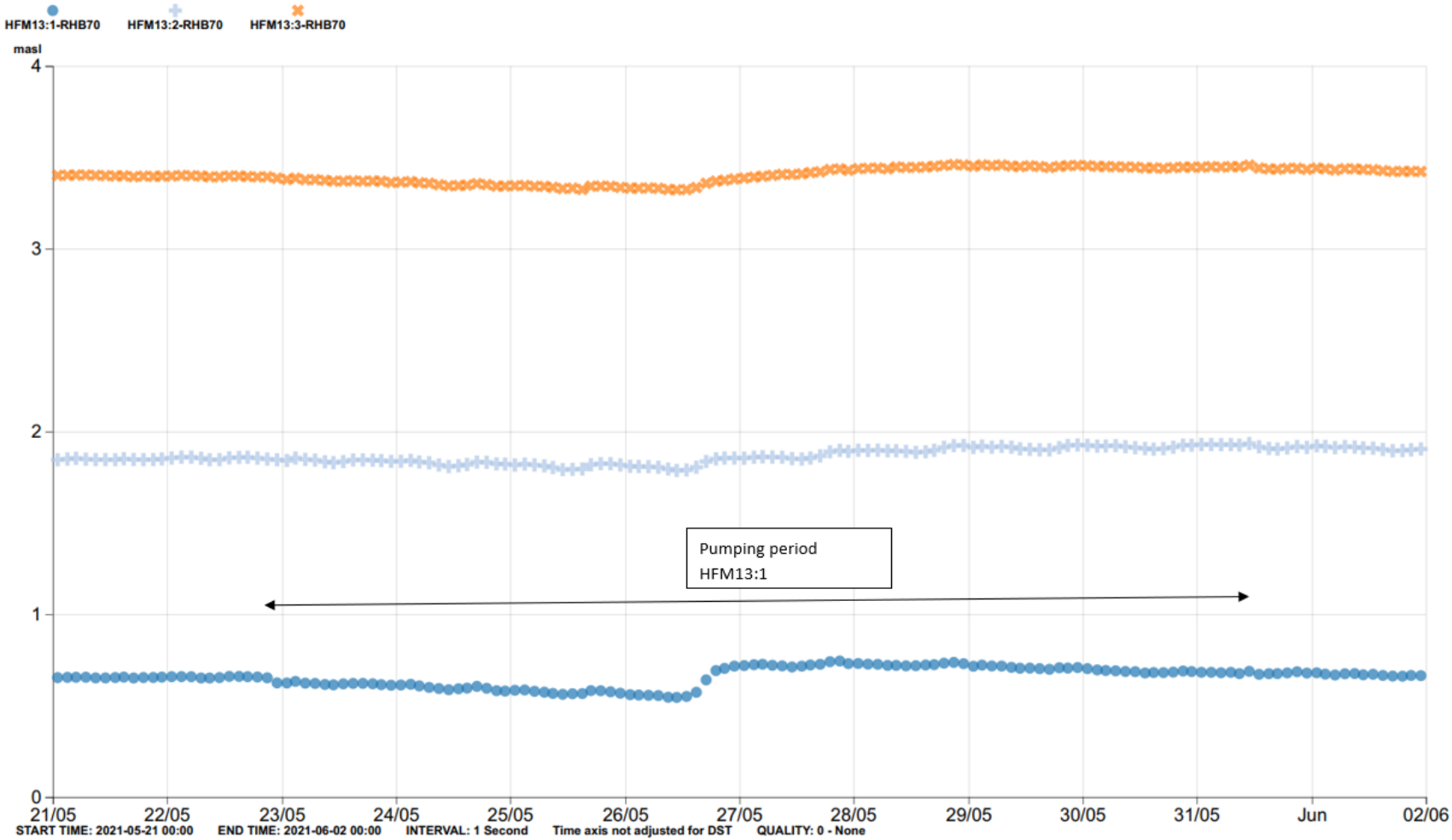

Figure A4- 19. *Pumping in HFM13:1 in May 2021. No significant drawdown was seen in any section during the pumping period in HFM13.*

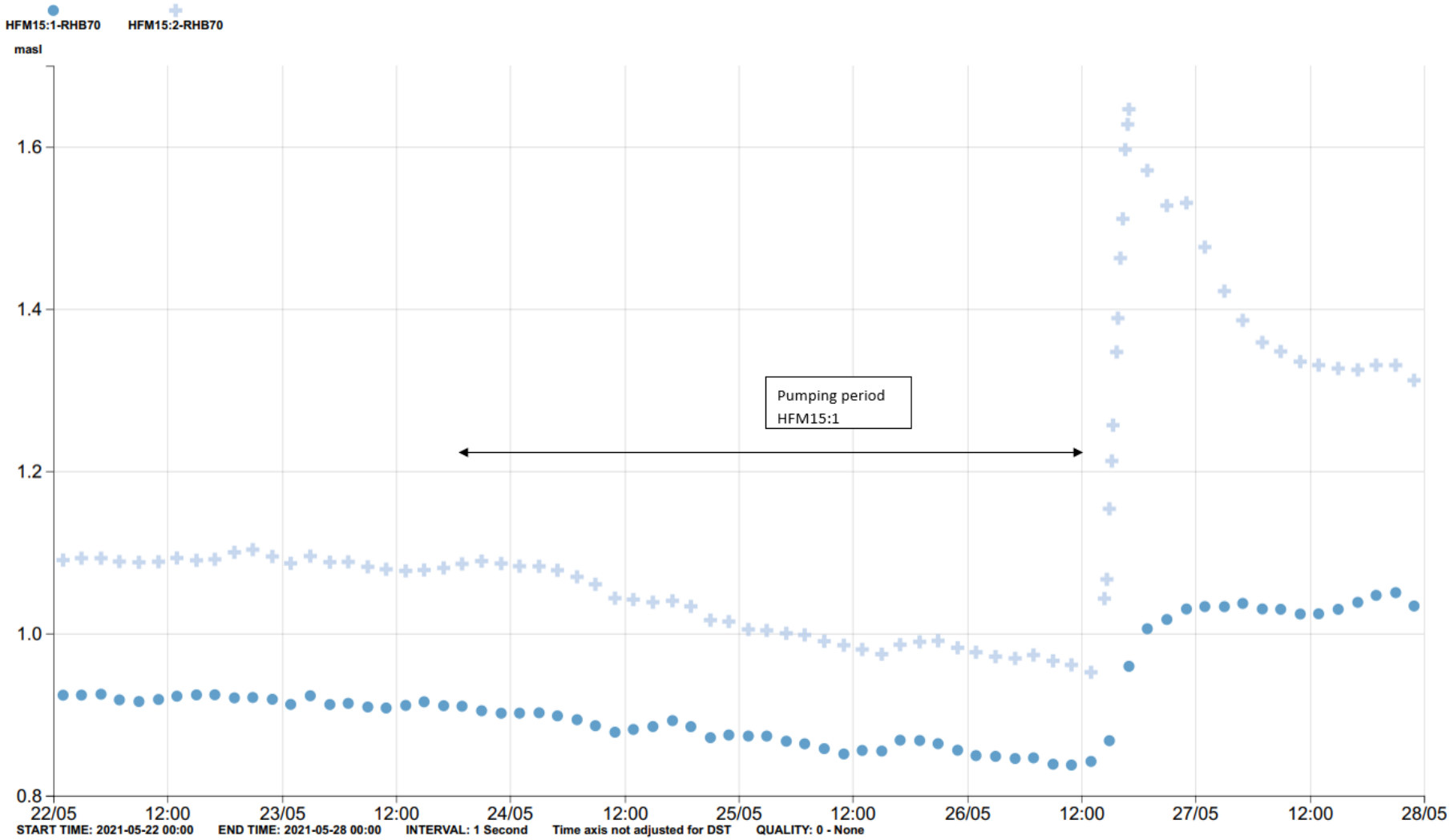

Figure A4- 20. *Pumping in HFM15:1 in May 2021. A response in HFM15:2 is seen. The strong increase in HFM15:1 and HFM15:2 around the time of the pump stop is explained by heavy rain which coincides with the pump stop. HFM15:2 has strong and fast responses to rain fall.*

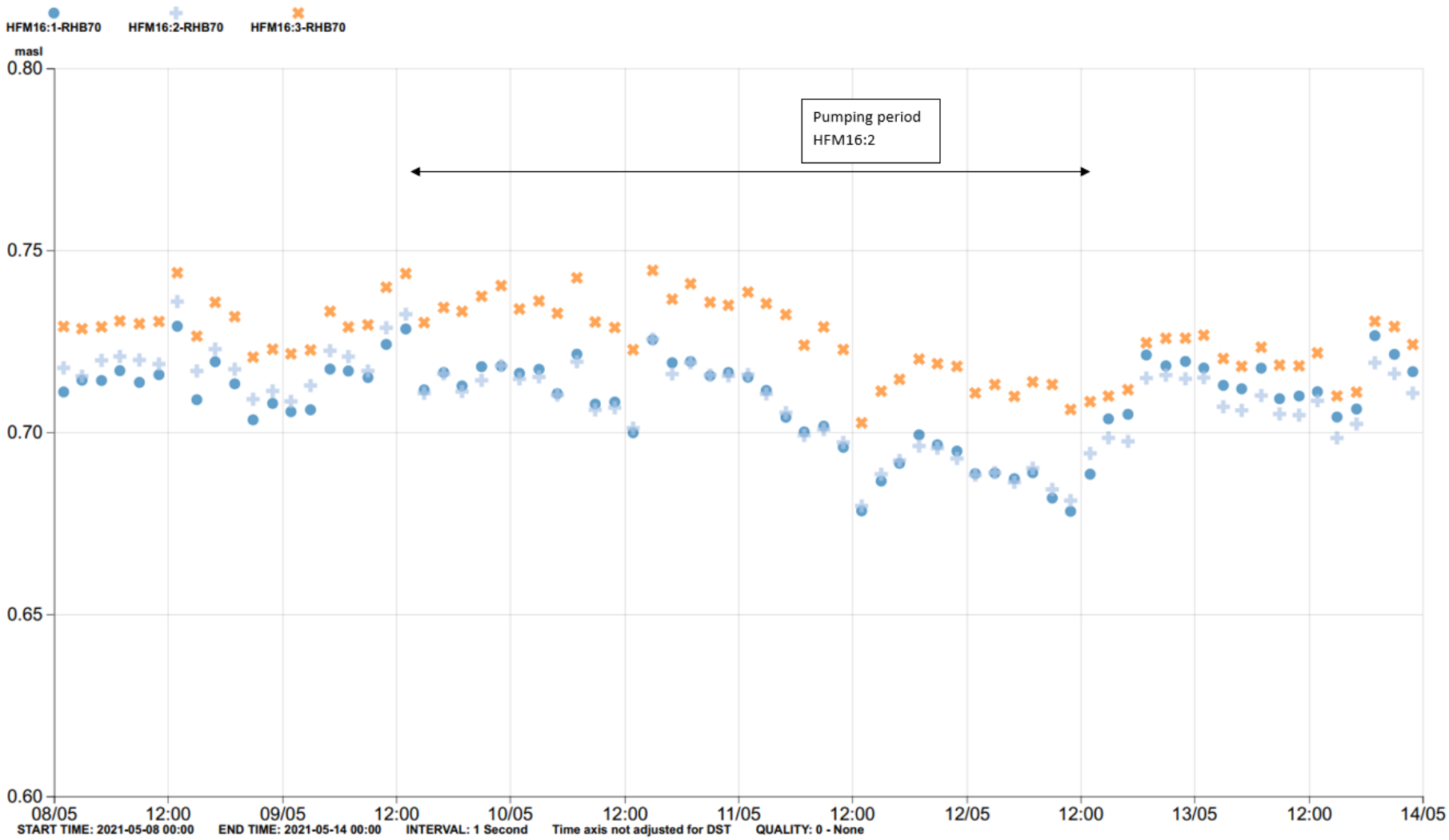

Figure A4- 21. *Pumping in HFM16:2 in May 2021. A response is seen in HFM16:1.*

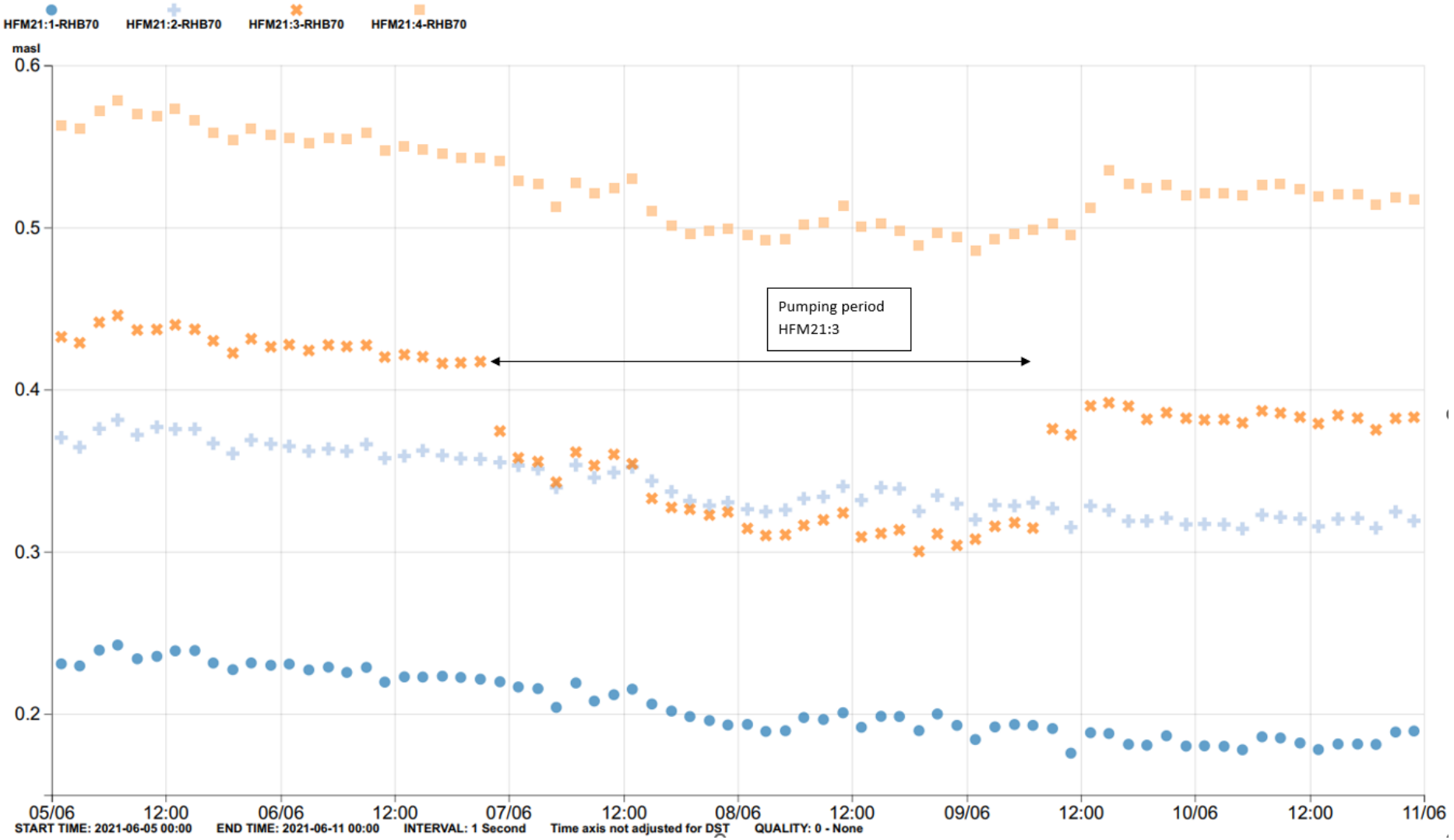

Figure A4- 22. *Pumping in HFM21:3 in June 2021. A small drawdown was also observed in HFM21:4.*

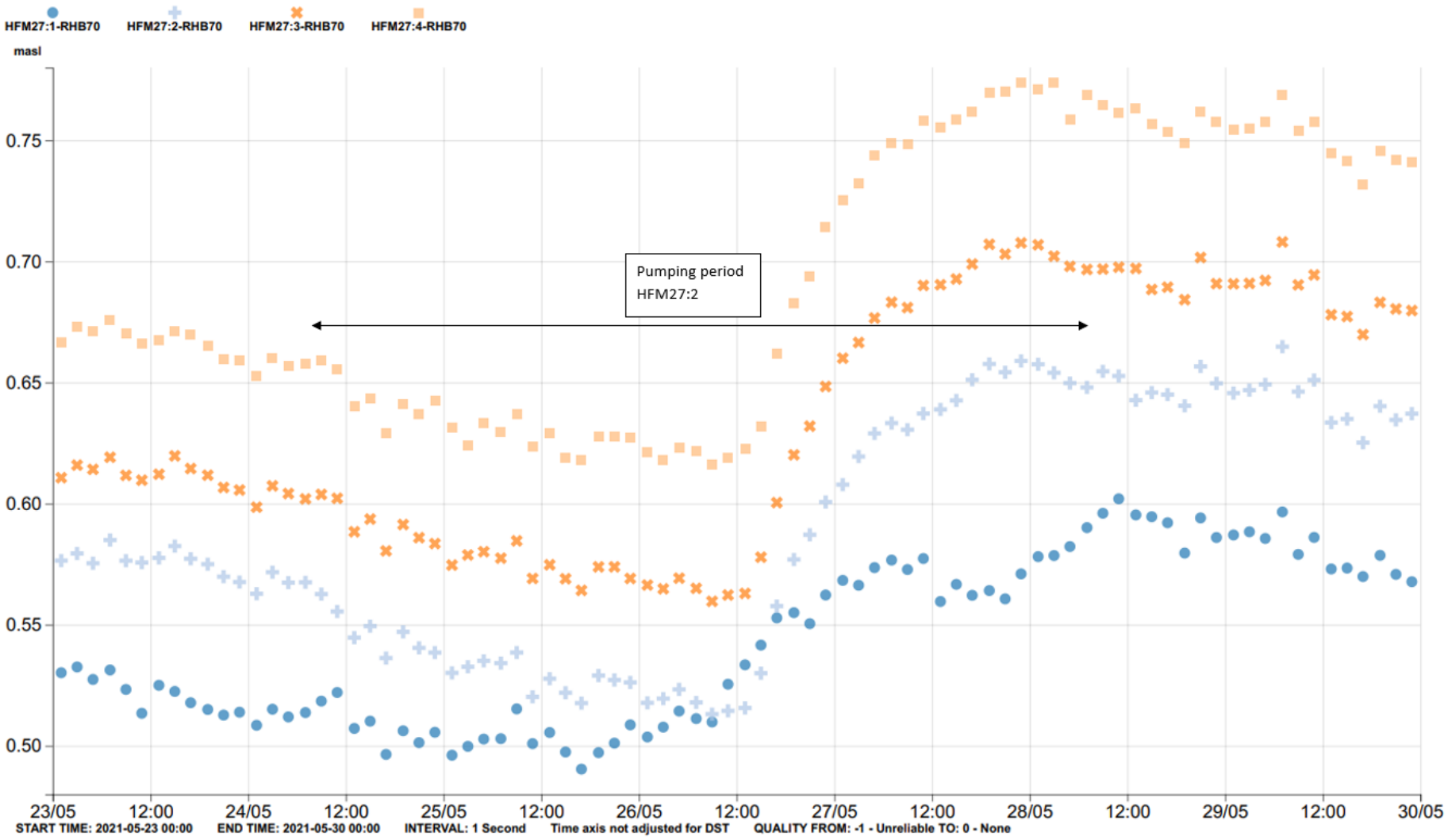

Figure A4- 23. *Pumping in HFM27:2 in May 2021. No significant drawdown was observed in any of the borehole sections in HFM27.*

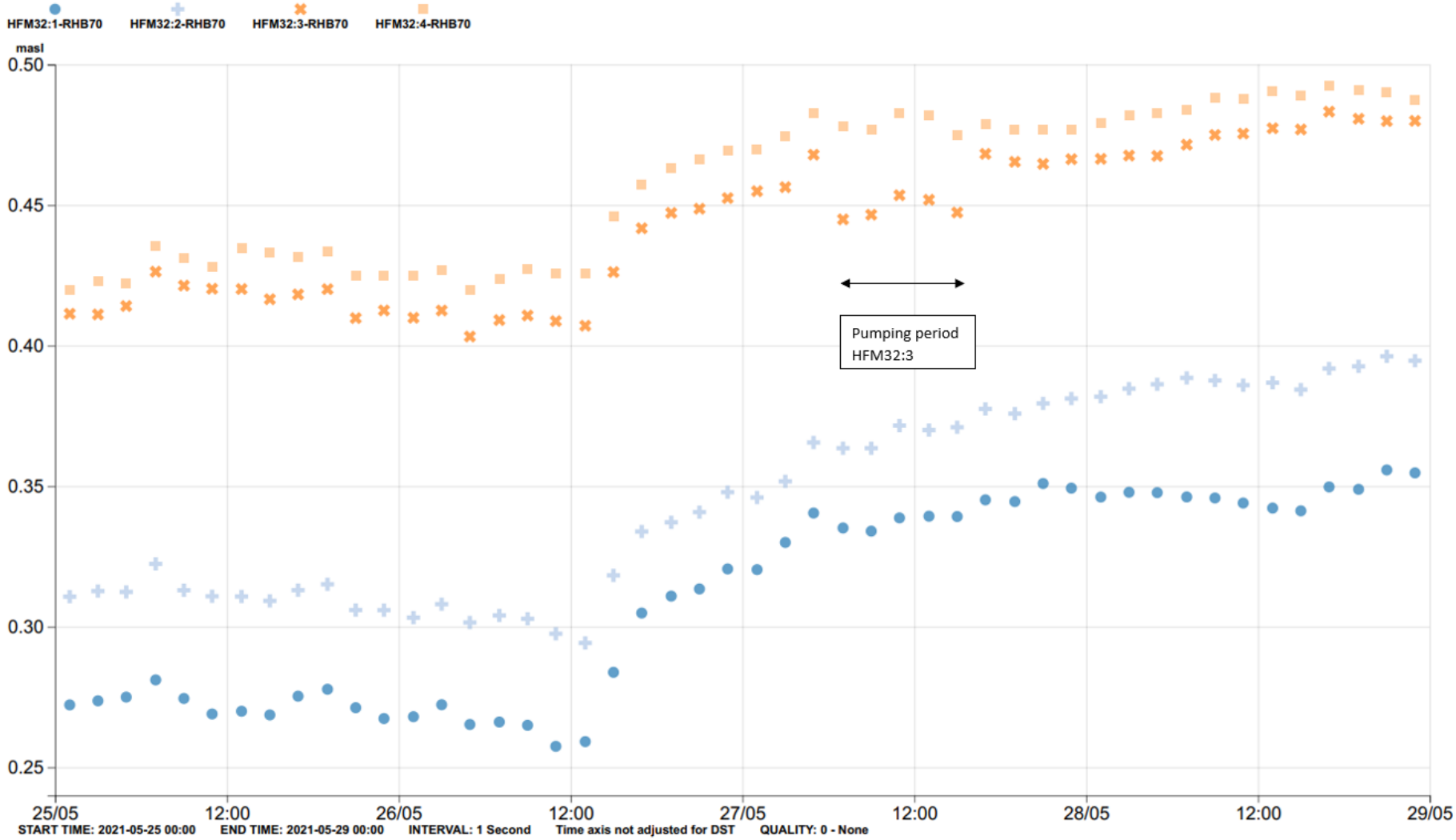

Figure A4- 24. Pumping and minor drawdown during pumping in HFM32:3 in May 2021. No significant responses were observed in HFM32.

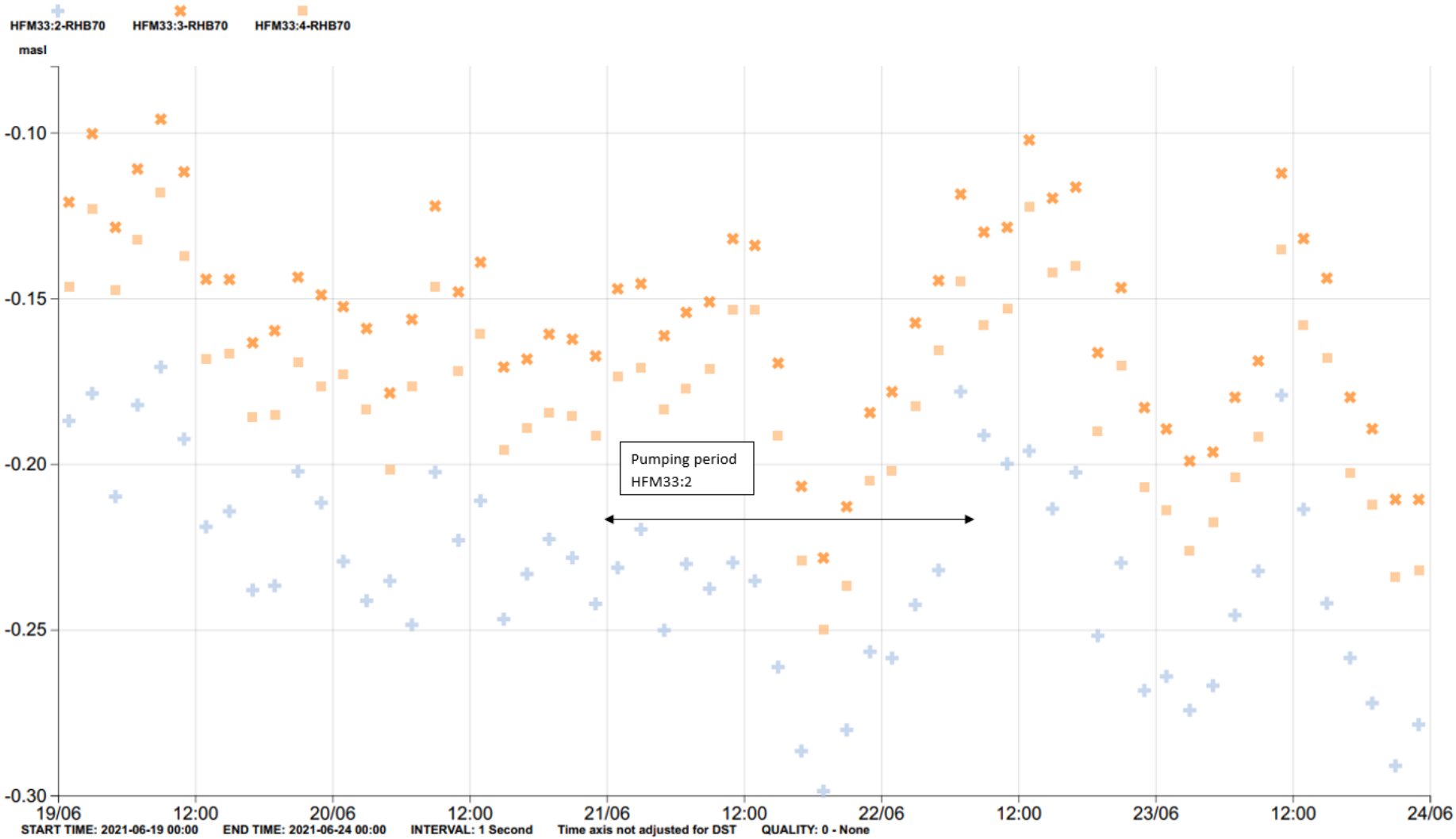

Figure A4- 25*. Pumping in HFM33:2 in June 2021. No significant responses were observed in HFM33.*

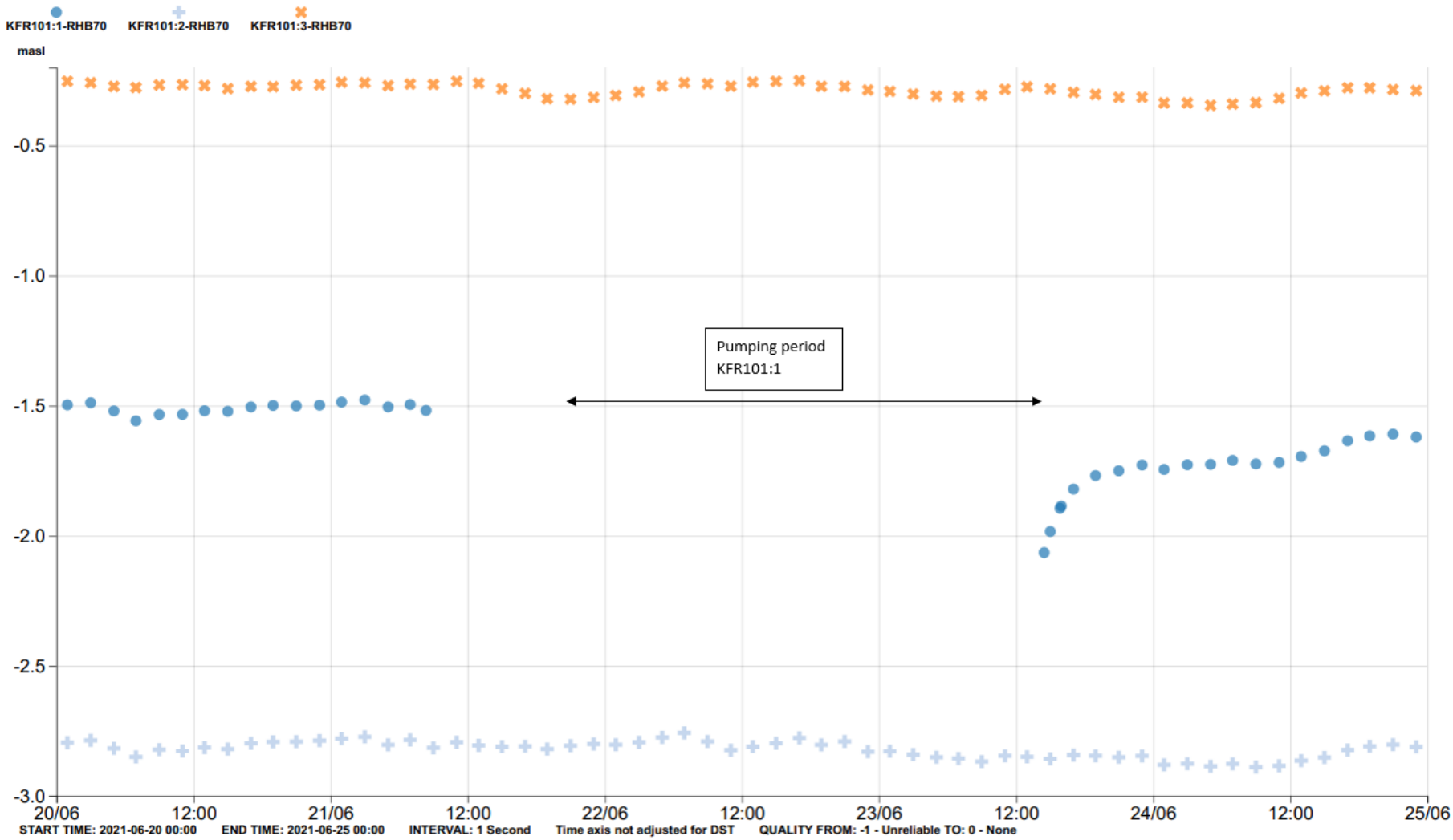

Figure A4- 26. *Pumping in KFR101:1 in June 2021. The pressure transducer in KFR101:1 was removed during the pumping. No significant drawdown was noted in any other section in KFR101.*

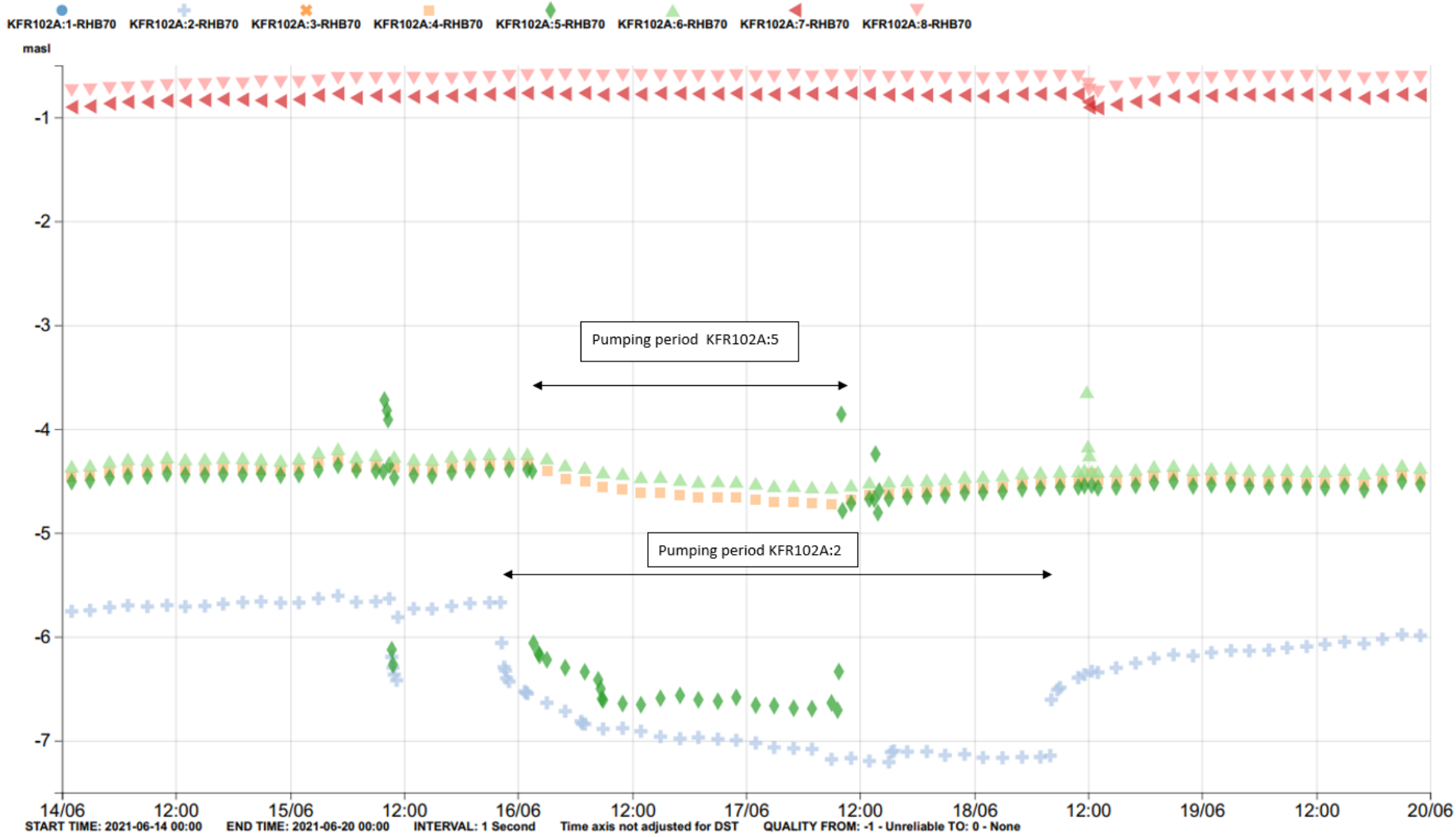

Figure A4- 27. *Pumping and drawdown in KFR102A:2 and KFR102A:5 in June 2021. During the 2020 campaign a response in KFR102A:1 was observed during pumping in KFR102:2. In 2021, no pressure data was available for KFR102A:1 and KFR102A:3. Responses in KFR102A:4 and KFR102A:6 were observed during pumping in KFR102A:5.*

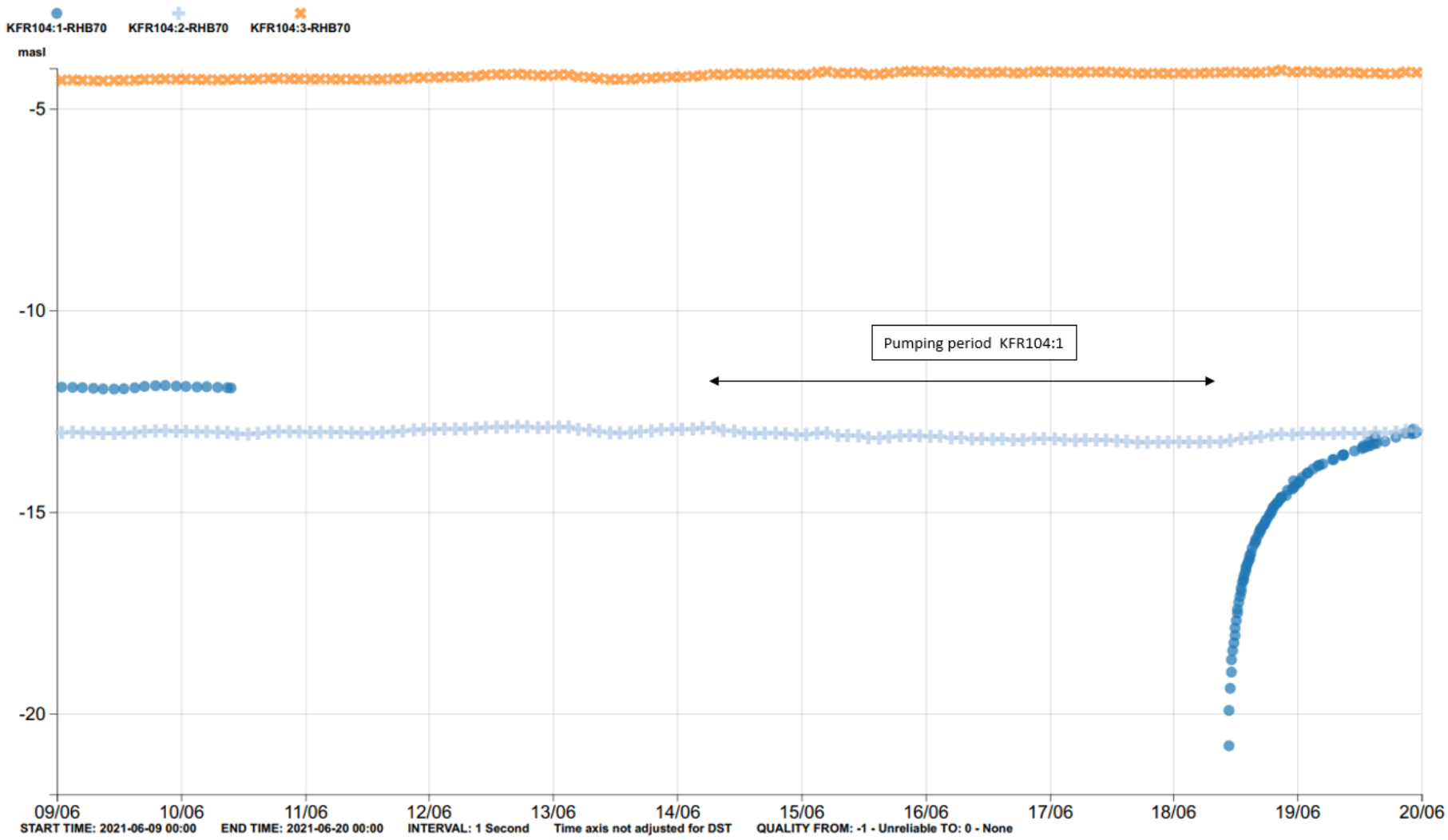

Figure A4- 28. *Pumping in KFR104:1 in June 2021. The pressure transducer in KFR104:1 was removed during the pumping. A possible response can be seen in KFR104:2.*

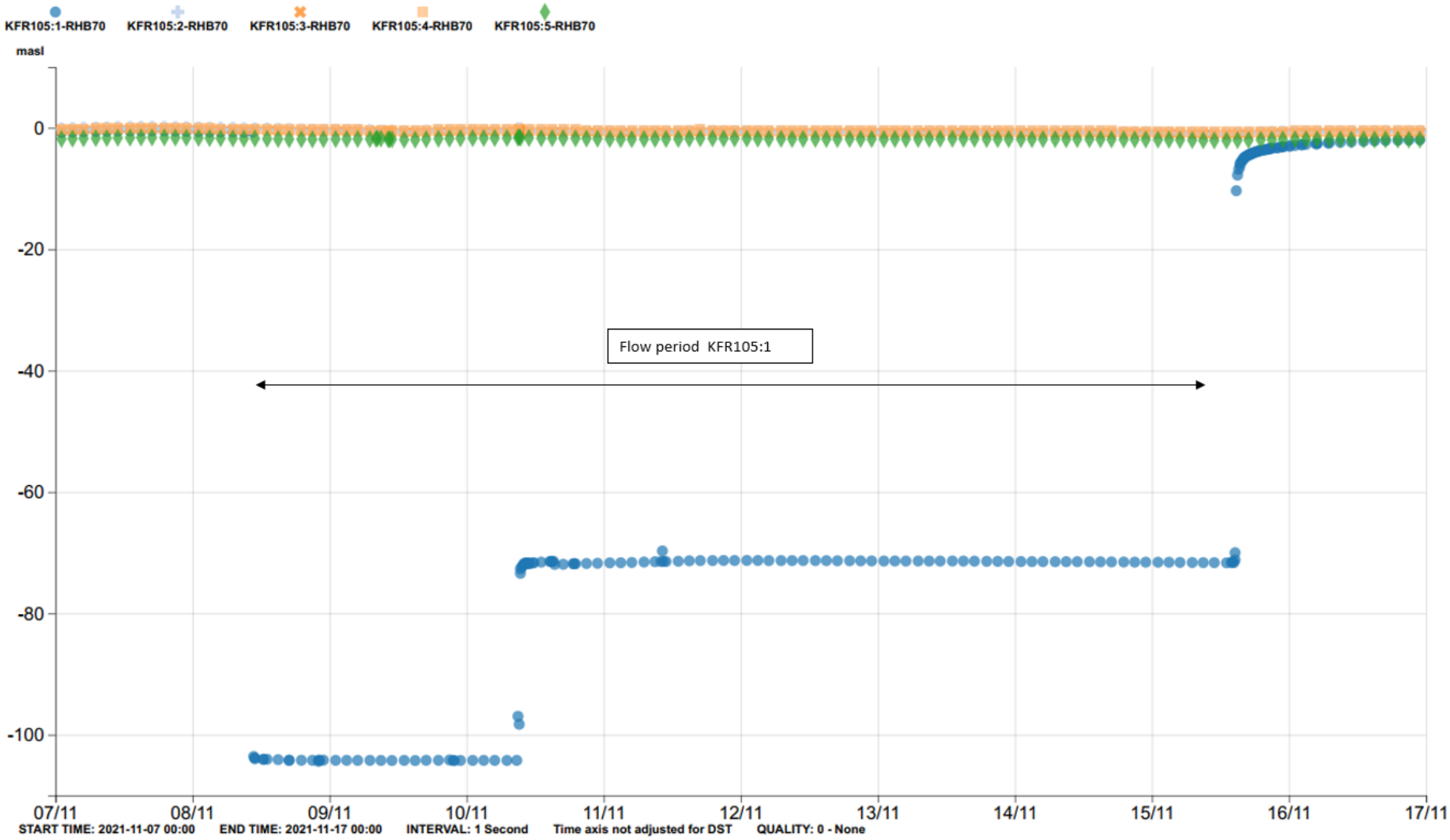

Figure A4- 29. *Flow period in KFR105:1 in November 2021. A plot with different scale is seen in Figure A4-30.*

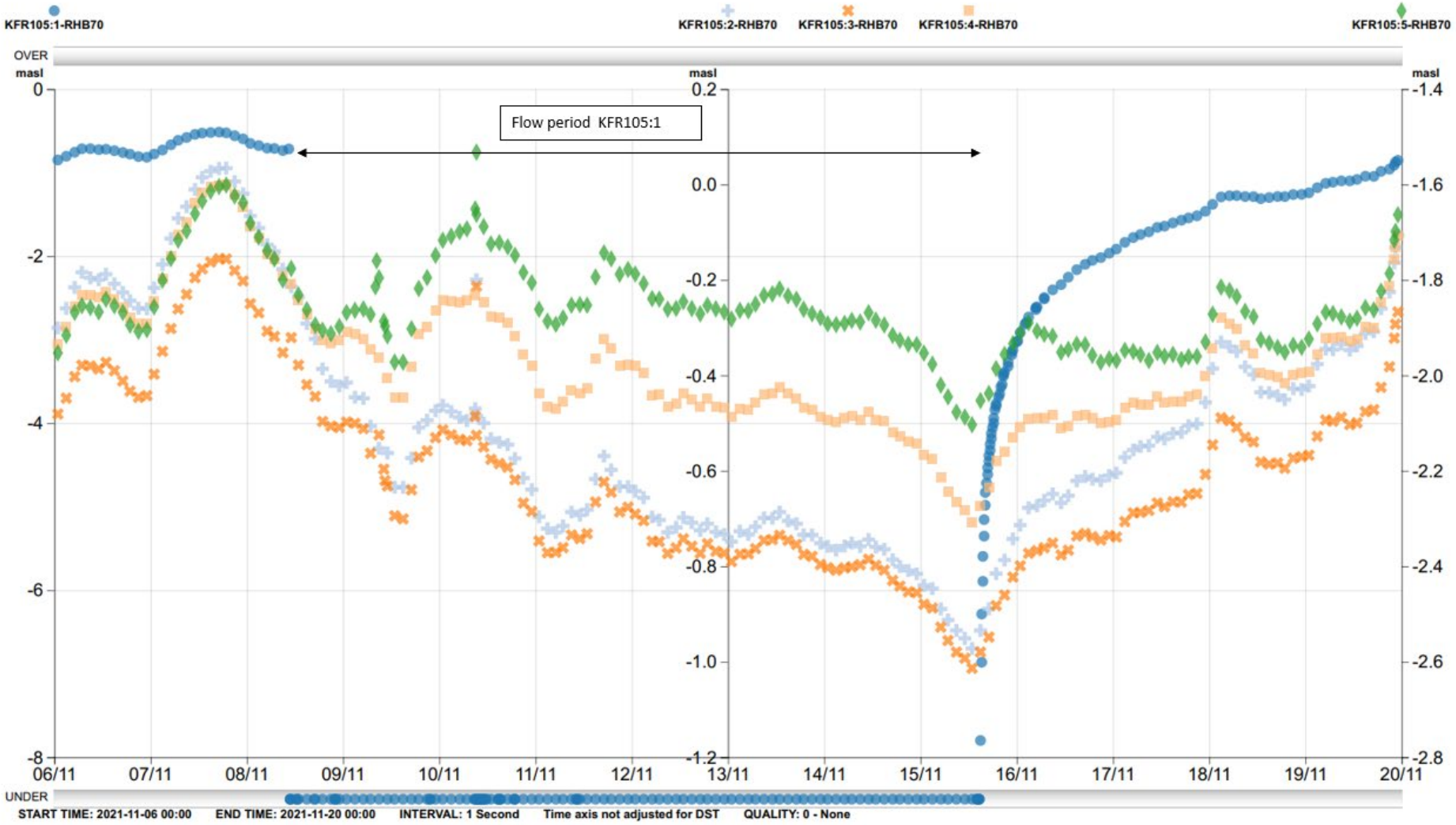

Figure A4- 30. *Flow period in KFR105:1 in November 2021. The efflux in KFR105:1 caused responses in KFR105:2, KFR105:3 and KFR105:4.*

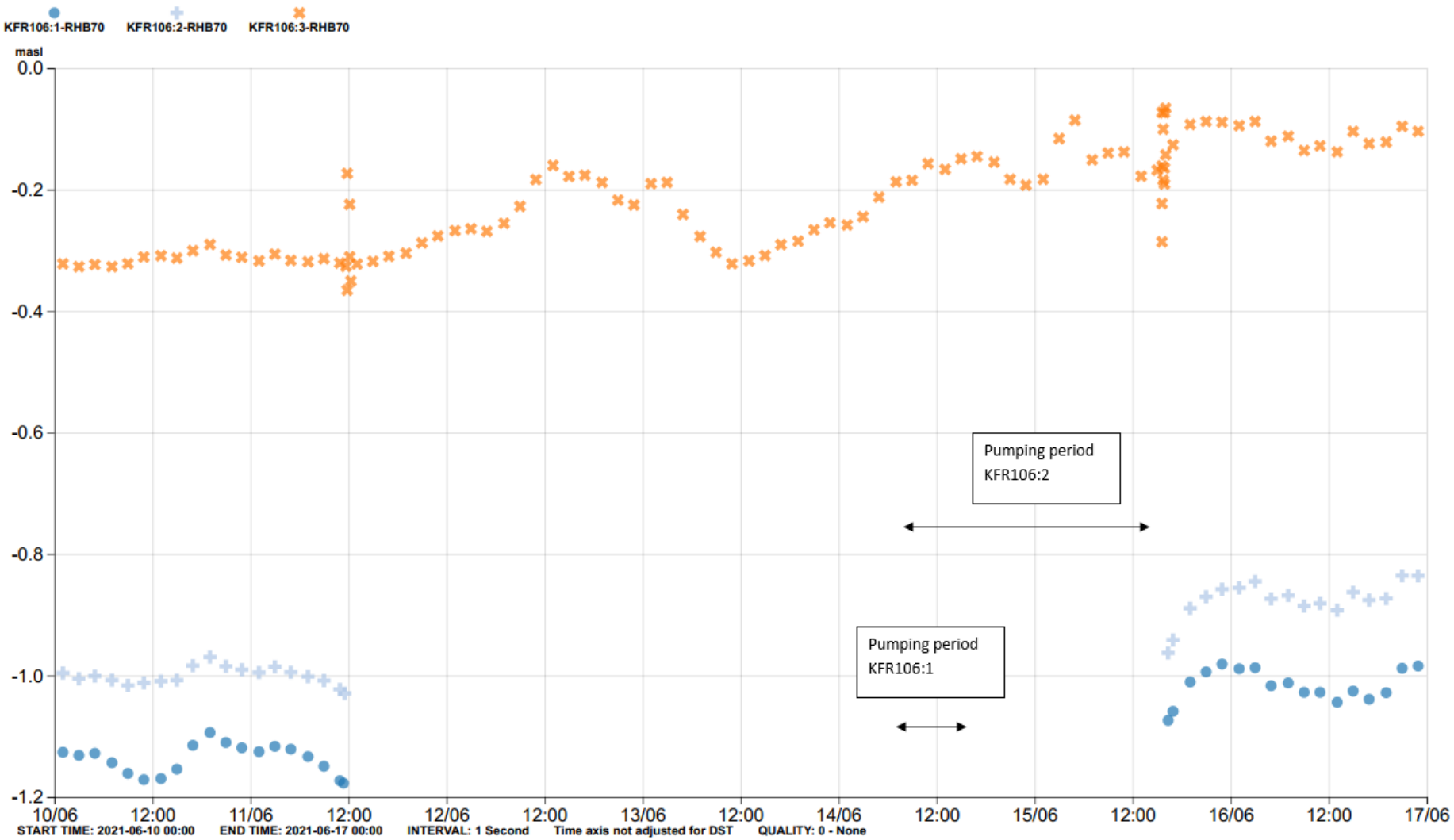

Figure A4- 31. *Pumping in KFR106:1 and KFR106:2 in June 2021. The pressure transducers in the pumped sections were removed a few days before pump start. KFR106:3 was not affected.*

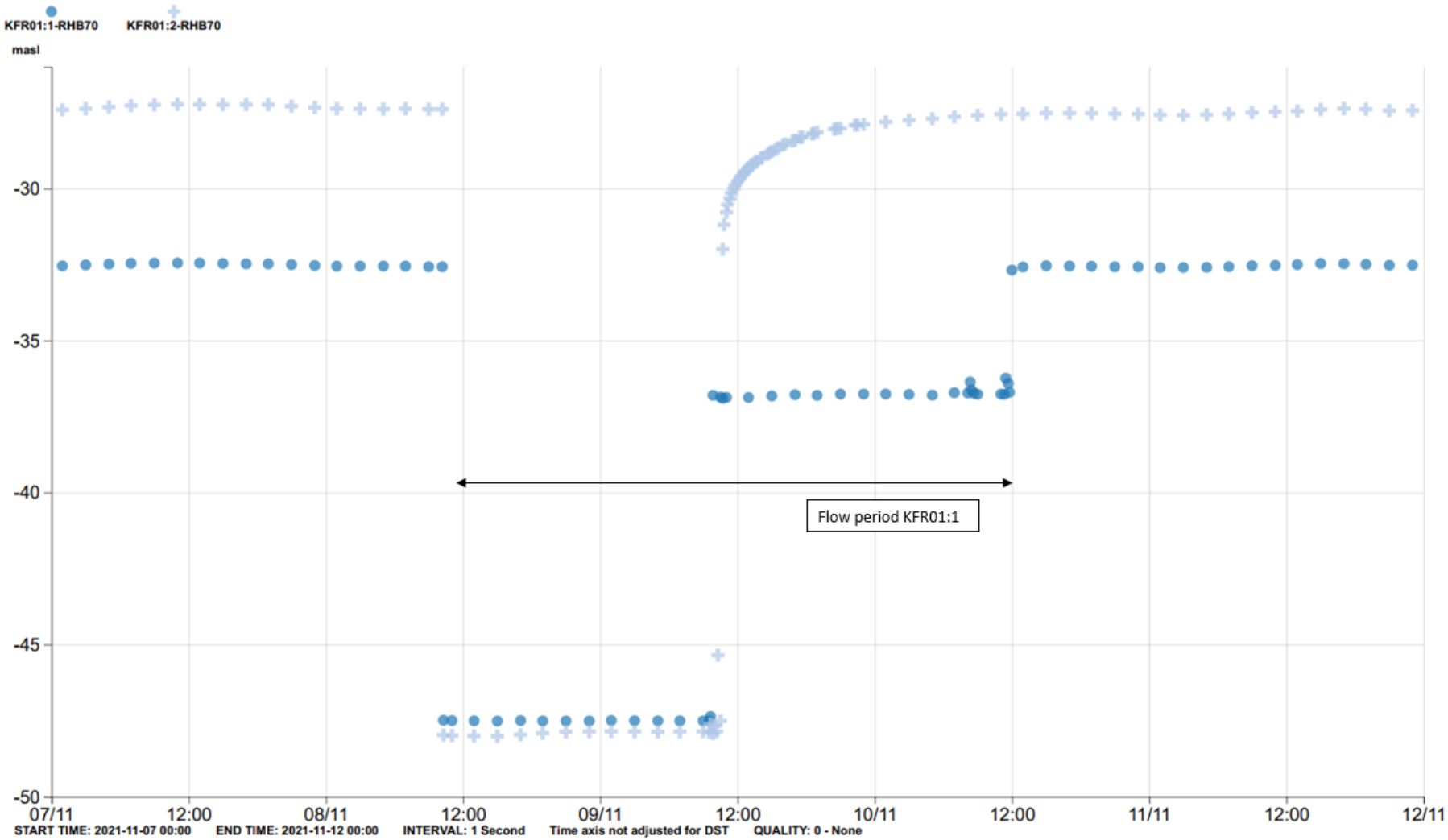

Figure A4- 32. *Flow period in KFR01:1 in November 2021. KFR01:2 was sampled at the same time in a different project between 8/11 and 9/11. At the same time KFR01:2 was closed there seem to have been a change in flow rate in KFR01:1.*

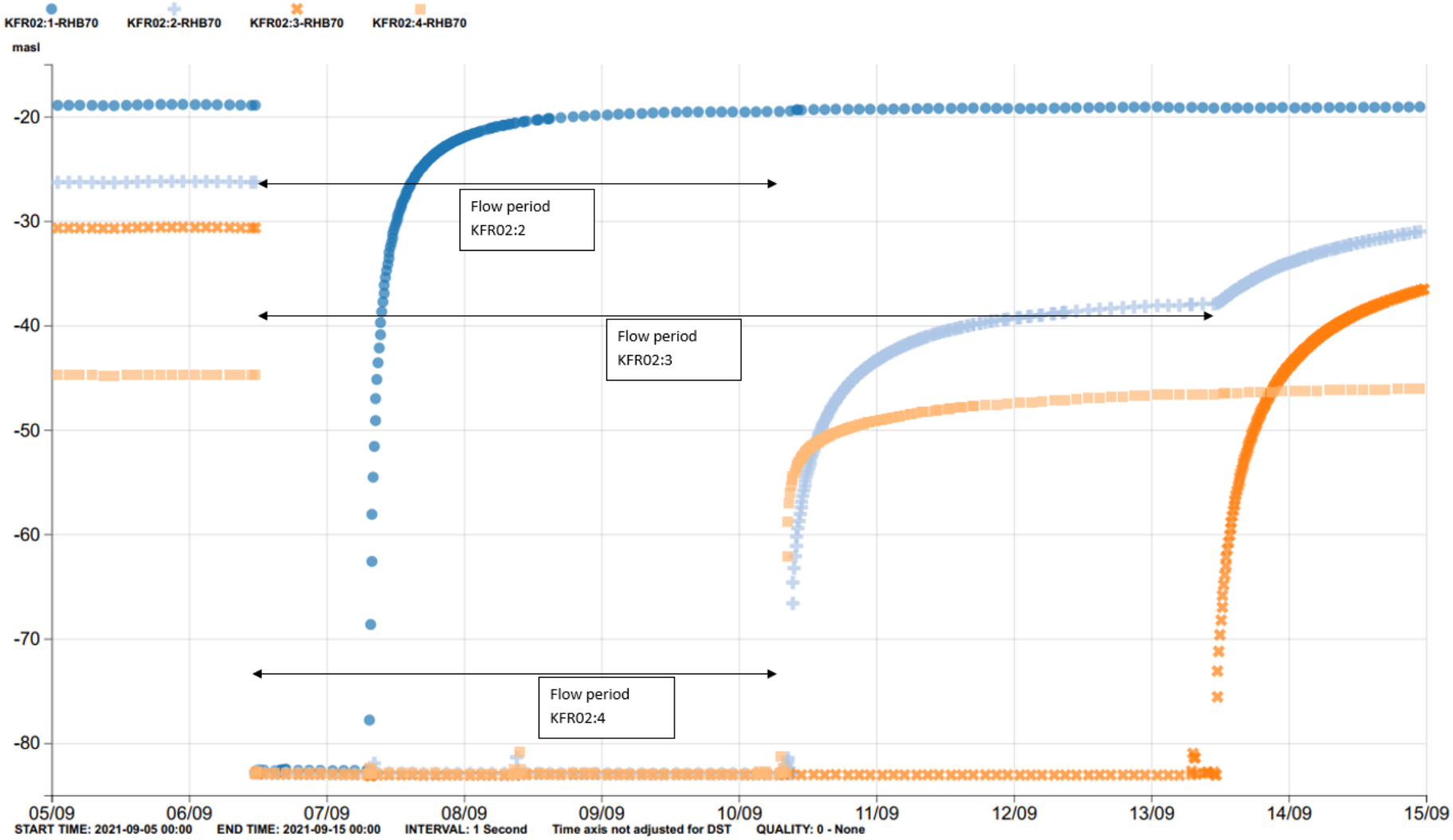

Figure A4- 33. *Flow period in KFR02:2, KFR02:3 and KFR02:4 in September 2021. Since the efflux periods are overlapping, it is difficult to see individual responses between the sections.*

Appendix 5 pH trends in some of the core drilled boreholes

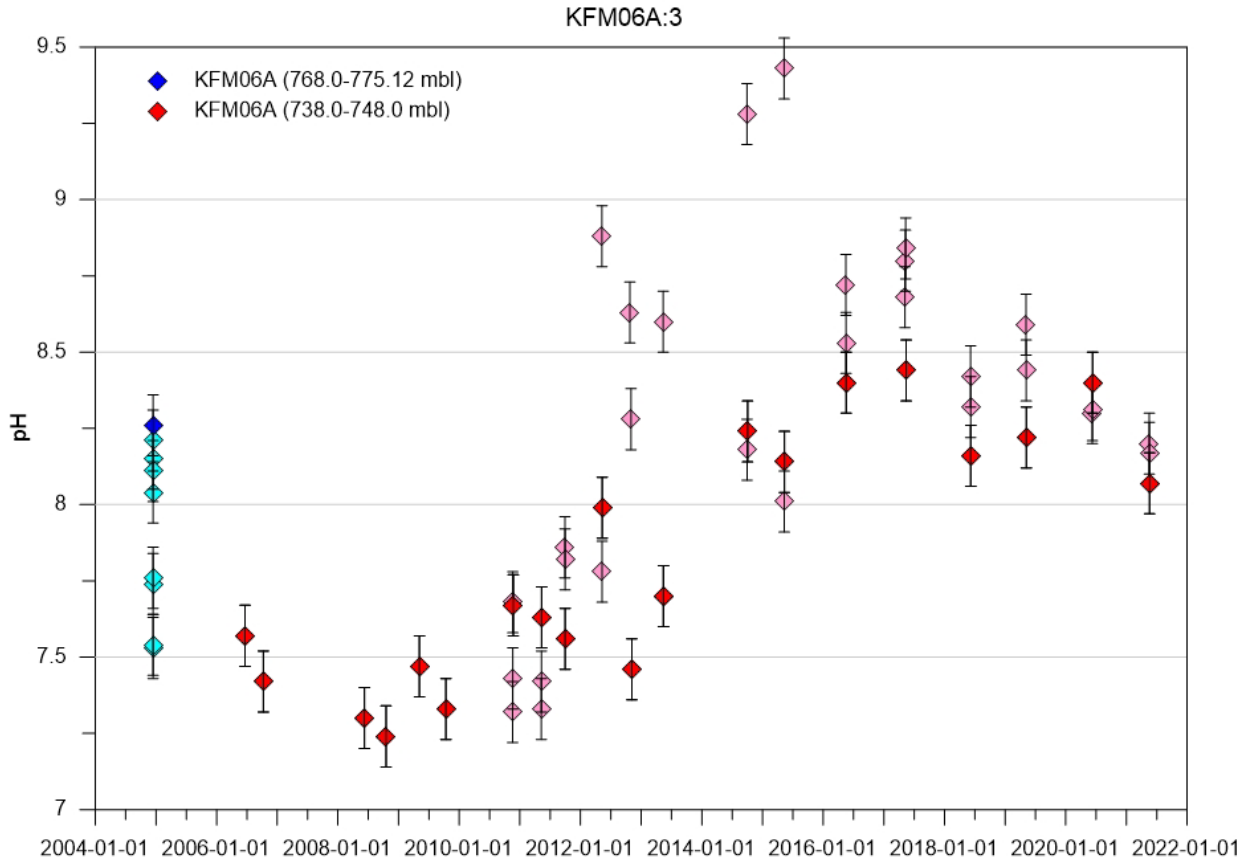

Figure A5-1. *Comparison between initial pH values from complete chemical characterisation during PLU (Forsmark site investigation; blue diamonds) and later measurements in the ongoing monitoring programme (red diamonds) for KFM06A:3. The last sample in the series (or the only sample if no series) is marked with a darker red colour. All presented pH values are measured in the laboratory at 25°C, except those from 2013 which are from field measurements.*

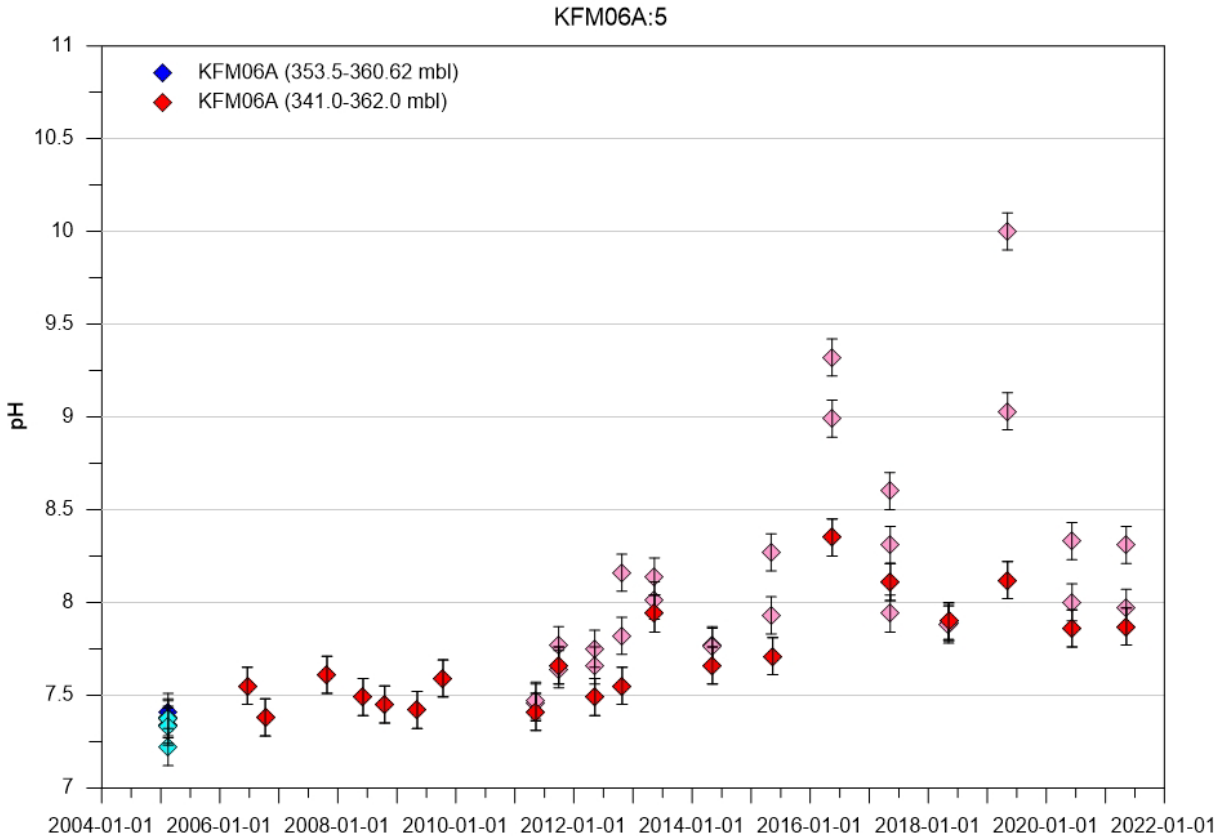

Figure A5-2. *Comparison between initial pH values from complete chemical characterisation during PLU (blue diamonds) and later measurements in the ongoing monitoring programme (red diamonds) for KFM06A:5. The last sample in the series (or the only sample if no series) is marked with a darker red colour. All presented pH values are measured in the laboratory at 25°C, except those from 2013 which are from field measurements.*

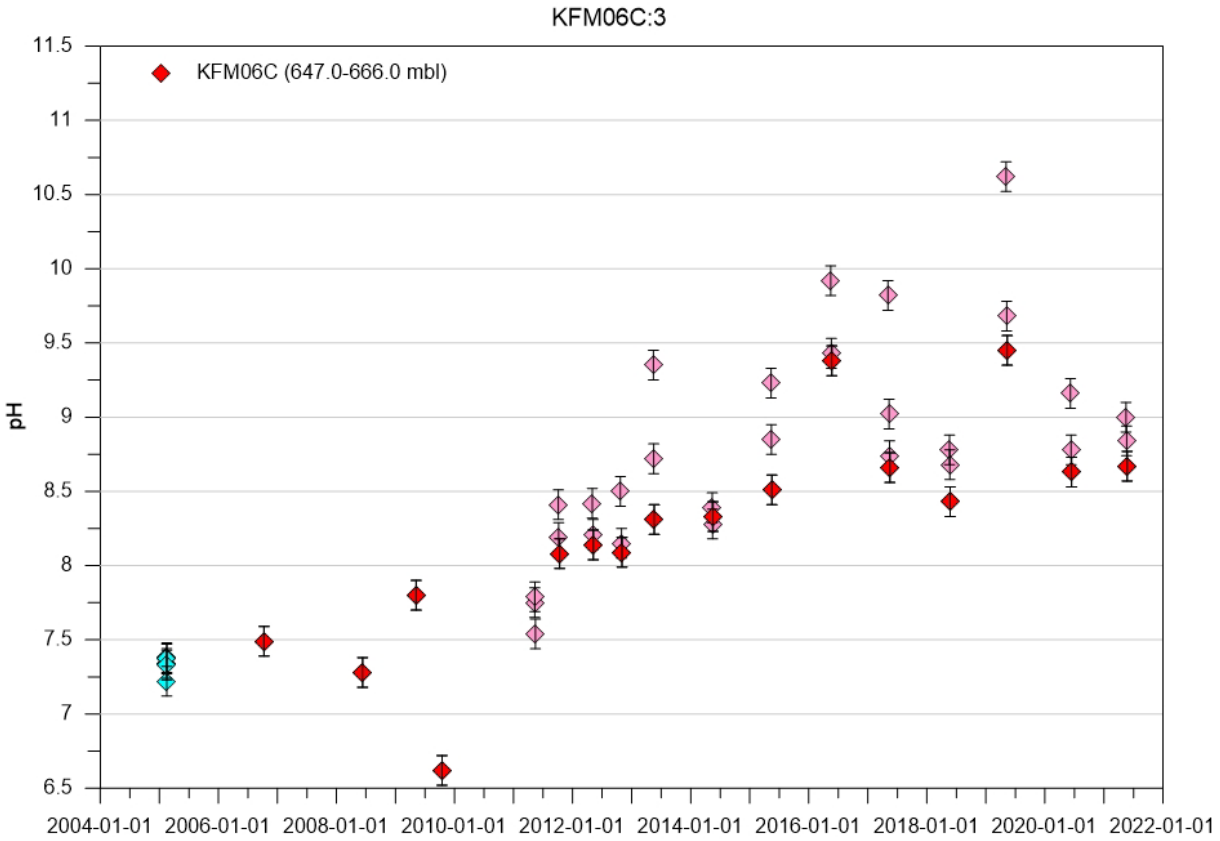

Figure A5-3. *Comparison between initial pH values from complete chemical characterisation during PLU (blue diamonds) and later measurements in the ongoing monitoring programme (red diamonds) for KFM06C:3. The last sample in the series (or the only sample if no series) is marked with a darker red colour. All the presented pH values are measured in the laboratory at 25°C, except those from 2013 and the last sample from 2015 which are from field measurements.*

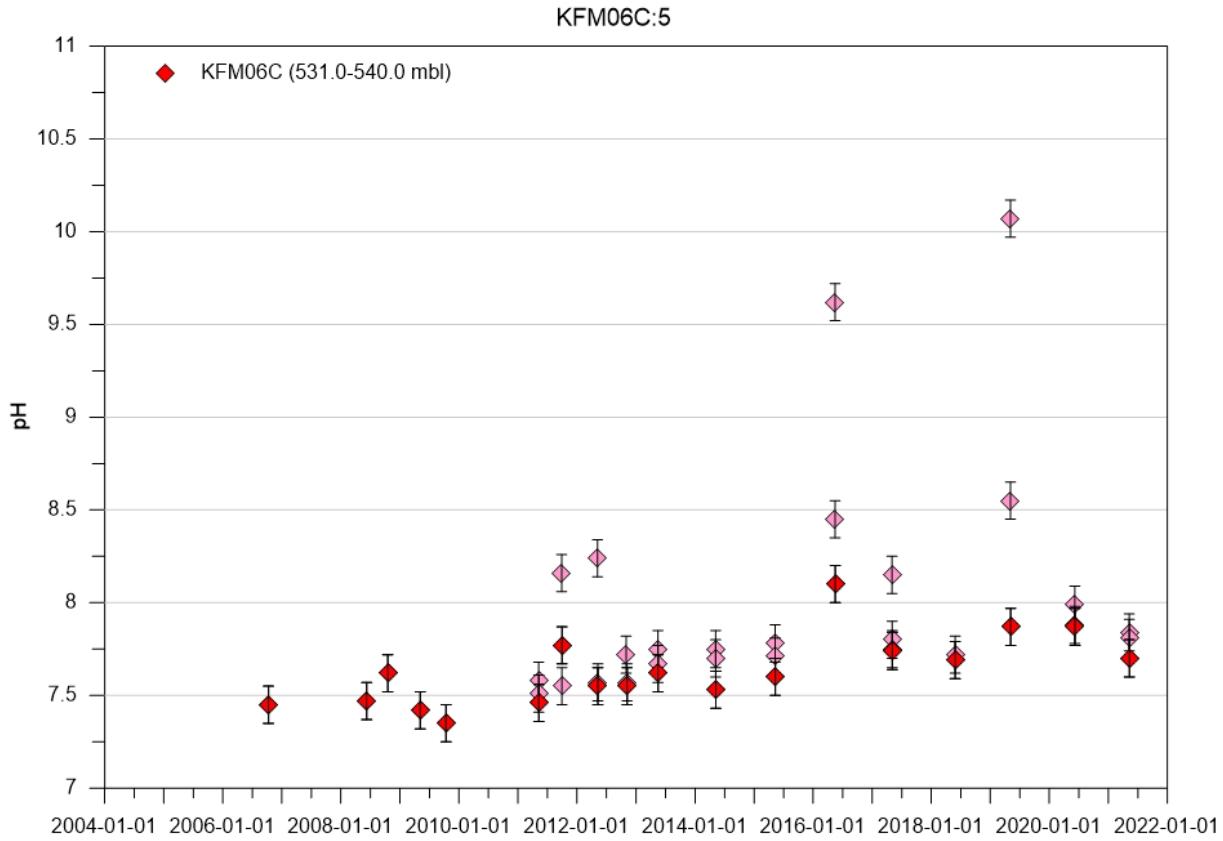

Figure A5-4. *Presentation of pH values from the ongoing monitoring programme (red diamonds) for KFM06C:5. The last sample in the series (or the only sample if no series) is marked with a darker red colour. All presented pH values are measured in the laboratory at 25°C, except those from 2013 which are from field measurements.*

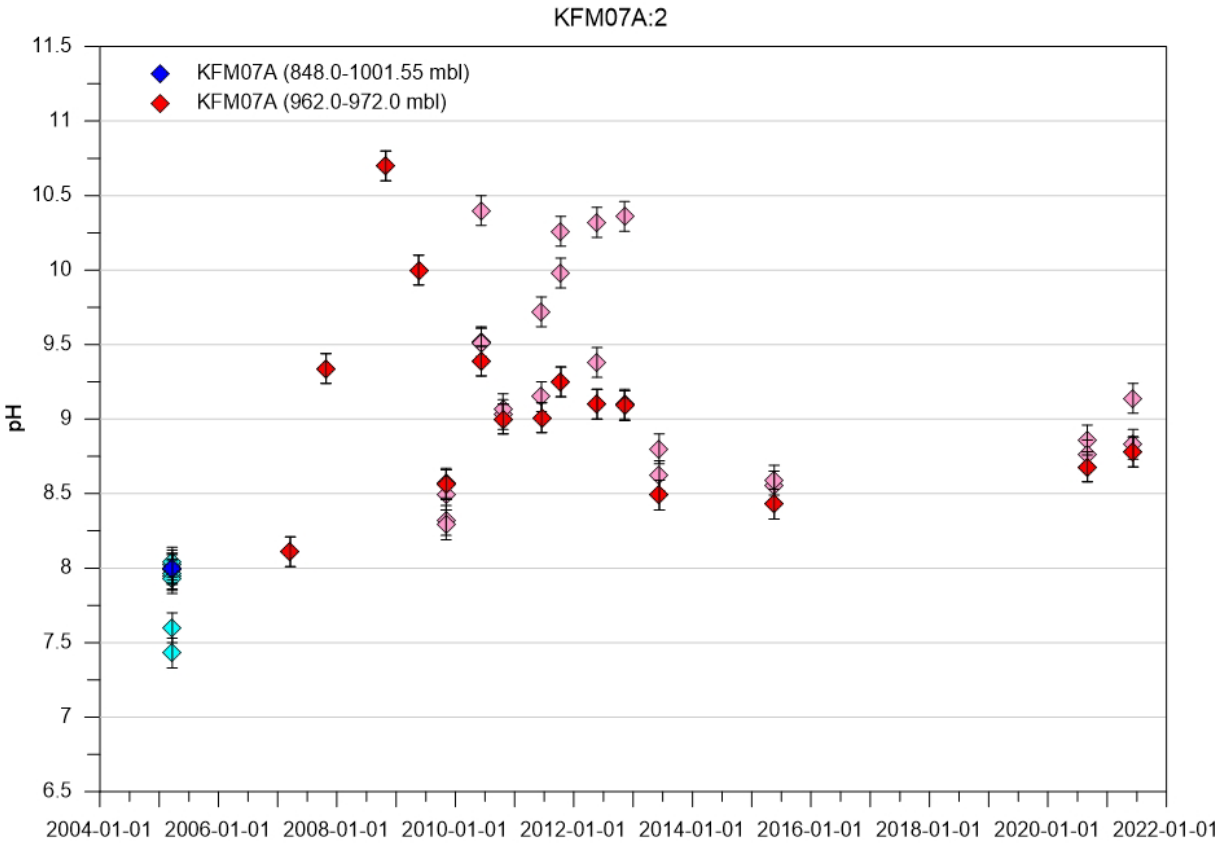

Figure A5-5. *Comparison between initial pH values from complete chemical characterisation during PLU (blue diamonds) and later measurements in the ongoing monitoring programme (red diamonds) for KFM07A:2. The last sample in the series (or the only sample if no series) is marked with a darker red colour. All presented pH values are measured in the laboratory at 25°C, except those from 2013 which are from field measurements.*

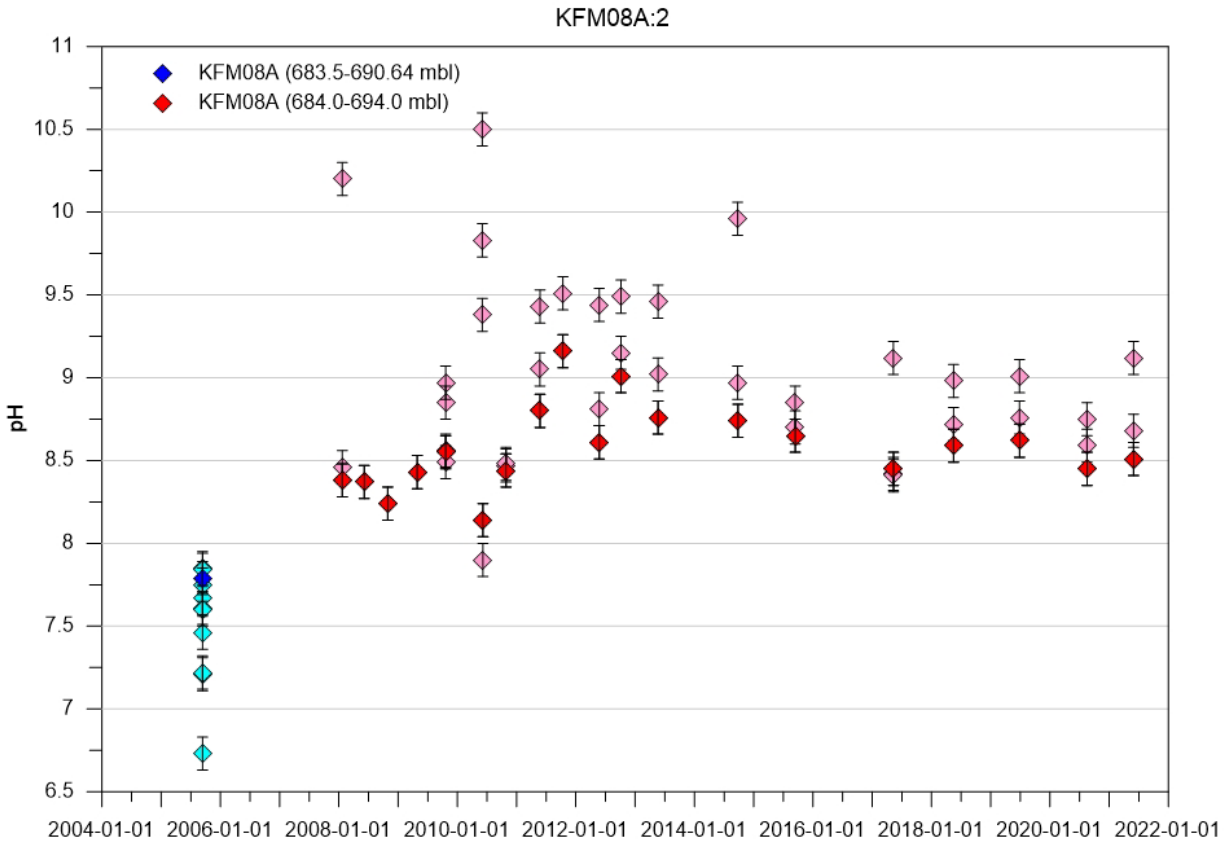

Figure A5-6. *Comparison between initial pH values from complete chemical characterisation during PLU (blue diamonds) and later measurements in the ongoing monitoring programme (red diamonds) for KFM08A:2. The last sample in the series (or the only sample if no series) is marked with a darker red colour. All presented pH values are measured in the laboratory at 25°C, except those from 2013 which are from field measurements.*

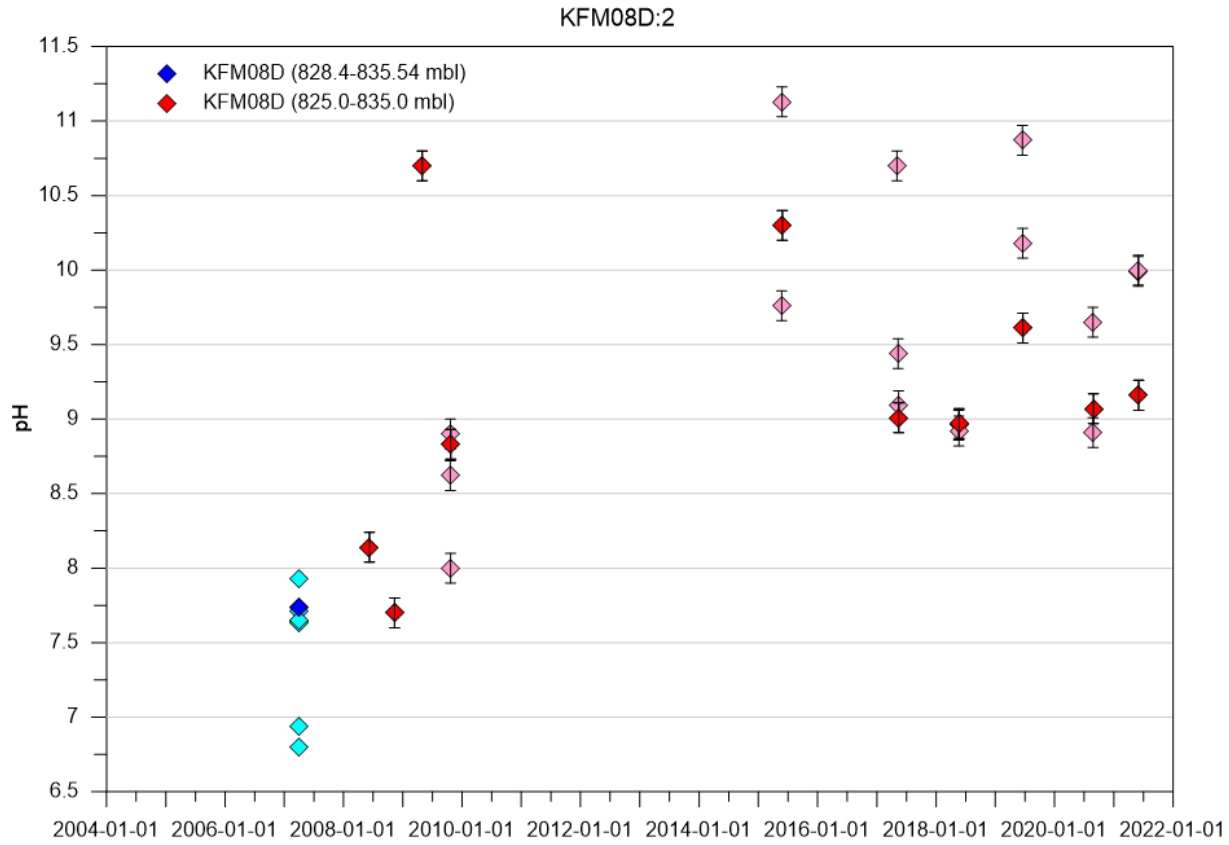

Figure A5-7. *Comparison between initial pH values from complete chemical characterisation during PLU (blue diamonds) and later measurements in the ongoing monitoring programme (red diamonds) for KFM08D:2. The last sample in the series (or the only sample if no series) is marked with a darker red colour. All presented pH values are measured in the laboratory at 25°C. This section has been omitted from the monitoring program for many years due to corrosion problems. After reinstallation of borehole equipment it was sampled again from 2015 and onwards.*

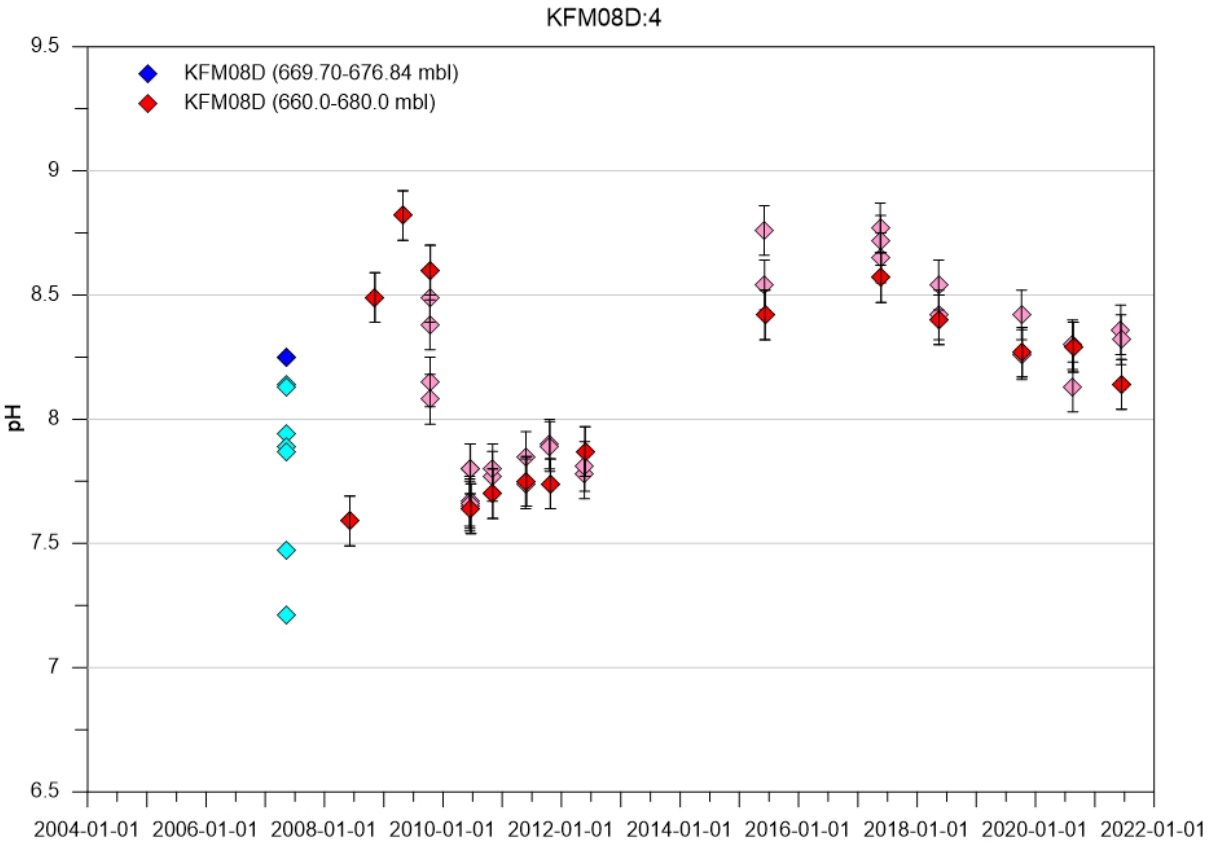

Figure A5-8. *Comparison between initial pH values from complete chemical characterisation during PLU (blue diamonds) and later measurements in the ongoing monitoring programme (red diamonds) for KFM08D:4. The last sample in the series (or the only sample if no series) is marked with a darker red colour. All presented pH values are measured in the laboratory at 25°C. This section has been omitted from the monitoring program for 2013-2014 due to corrosion problems. After reinstallation of borehole equipment it was sampled again from 2015 and onwards.*

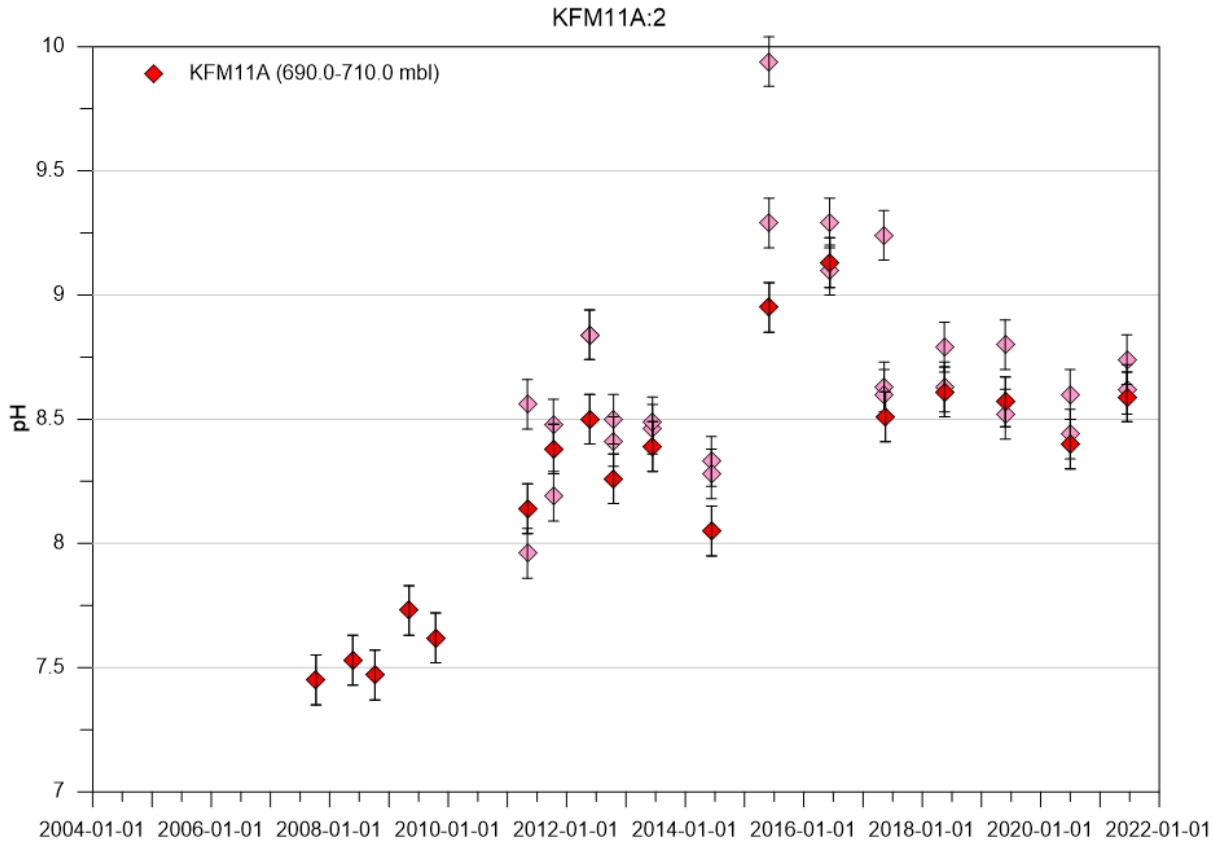

Figure A5-9. *Presentation of pH values from the ongoing monitoring programme (red diamonds) for KFM11A:2. The last sample in the series (or the only sample if no series) is marked with a darker red colour. All presented pH values are measured in the laboratory at 25°C, except those from 2013 which are from field measurements.*

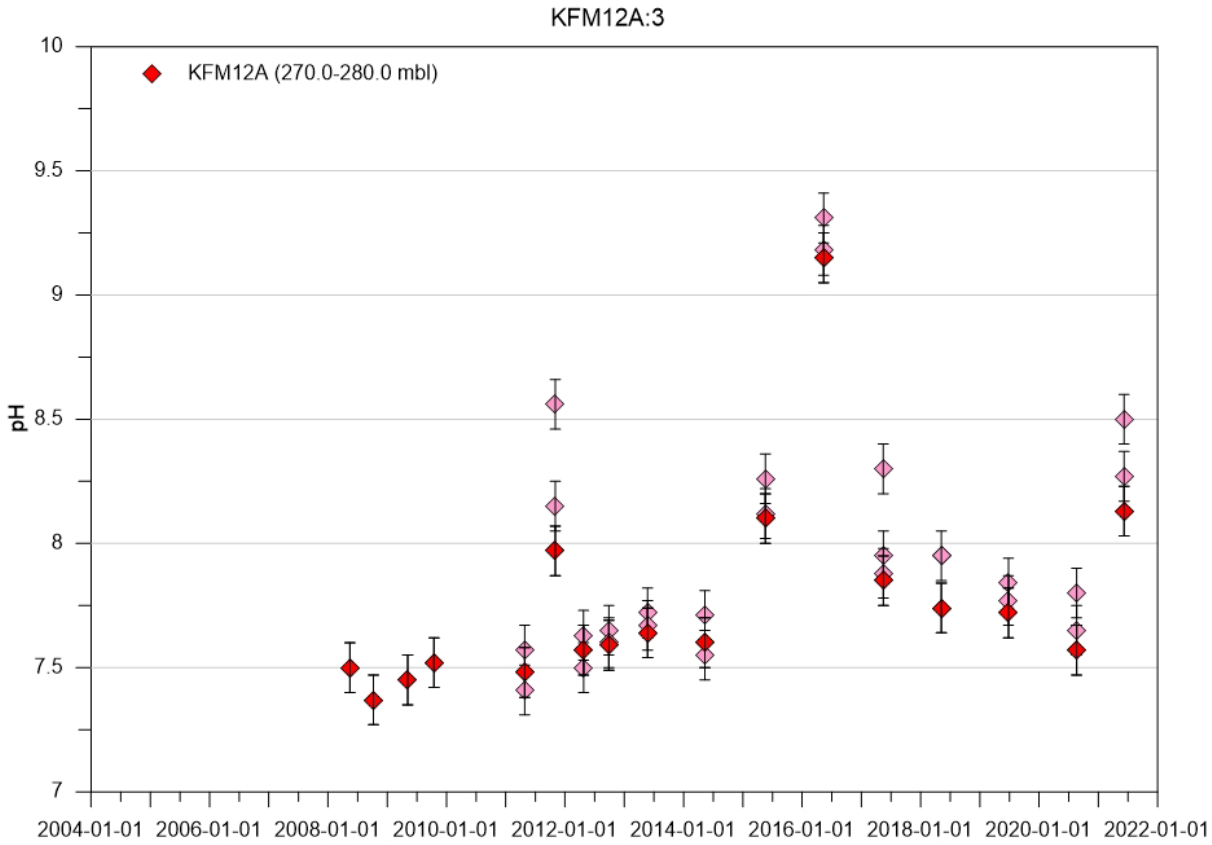

Figure A5-10. *Presentation of pH values from the ongoing monitoring programme (red diamonds) for KFM12A:3. The last sample in the series (or the only sample if no series) is marked with a darker red colour. All presented pH values are measured in the laboratory at 25°C, except those from 2013 and 2015 which are from field measurements.*

Appendix 6 Plug flow volumes

Table A6-1. Plug flow volumes

Borehole Idcode: section	Plug flow volume [L]
KFM01A:5	93
KFM01D:2	16
KFM01D:4	18
KFM02A:3	42
KFM02A:5	182
KFM02B:2	60
KFM02B:4	191
KFM03A:1	79
KFM03A:4	29
KFM04A:4	16
KFM06A:3	28
KFM06A:5	26
KFM06C:3[1)]	43
KFM06C:5[1)]	28
KFM07A:2	38
KFM08A:2	22
KFM08A:6	259
KFM08D:2	33
KFM08D:4	235
KFM10A:2	125
KFM11A:2[1)]	46
KFM11A:4	21
KFM12A:3[1)]	23
HFM01:2	306
HFM02:2	238
HFM04:2	103
HFM13:1	515
HFM15:1	116
HFM16:2	840
HFM19:1	203
HFM21:3	134
HFM27:2	222
HFM32:3	29
KFR101:1[2)]	73
KFR102A:2[2)]	194
KFR102A:5	52
KFR104:1[2)]	60
KFR106:1	16
KFR106:2[2)]	55
KFR105:1[2)]	696
KFR01:1[1)]	40
KFR02:2	42
KFR02:3	87
KFR02:4	86

[1)] Section volume
[2)] Used plug flow volumes smaller than 100% formation water, see Table A6-2.

Table A6-2. Plug flow volumes in sections where used plug flow volumes were smaller than 100 % formation water

Borehole Idcode: section	Used plug flow volume [L]	Percent formation water [%]	Volume needed for 100 % formation water [L]
KFR101:1	73	99	17881
KFR102A:2	194	100	986
KFR104:1	60	83	491
KFR105:1	696	99	2433
KFR106:2	55	89	1450