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Hydrogeochemical groundwater monitoring

Results from water sampling in the Forsmark area 2020

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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 2020 campaign includes 40 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, with some exceptions, cleaned before sampling.

Many different parameters were analysed during the sampling in 2020. 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. As observed in previous sampling campaigns high pH values were also recorded in some of the monitored borehole sections in 2020. The agreement between the pH- and 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 is generally stable from year to year and no significant changes occur.

In 2018 and 2019 the pumping volumes were adjusted and increased to volumes larger than plug flow volumes in some additional sections compared to measurements before 2017.

Sammanfattning

Denna rapport dokumenterar hydrokemisk övervakning av djupt grundvatten inom Forsmarksområdet där Projekt Kärnbränsleförvaret samt Projekt SFR-Utbyggnad ingår. Provtagningen som utförts under 2020 inkluderar 40 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 provtagningen.

Många olika parametrar analyserades under provtagningen 2020. Uppmätta värden för huvudkomponenter, mindre förekommande ämnen, spårämnen och isotoper presenteras i rapportens bilagor. Den relativa laddningsbalansen ligger inom acceptabla gränser för de samtliga prov. Som observerats under tidigare mätkampanjer förekommer höga uppmätta pH-värden i ett par borrhålssektioner även under 2020. Överenstämmelsen mellan pH- och EC-värden uppmätta i fält och på laboratorium är generellt bra. Med hänsyn till kloridkoncentrationerna är grundvattensammansättningen i de provtagna sektionerna generellt stabila från år till år och inga signifikanta förändringar har observerats.

Under 2018 och 2019 justerades och ökades pumpvolymerna i ytterligare ett par sektioner jämfört med innan 2017 till volymer större än pluggflöden.

Contents

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 2020. The long-term hydrochemical monitoring programme for percussion-drilled and core-drilled boreholes aims at creating 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 are 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-20-022). 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
Hydrokemiskt övervakningsprogram av hammar- och kärnborrhål 2020	AP SFK 20-022	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	12.0 and 13.0
Kvalitetsparametrar för kemianalyser – SKB:s kemiklasser, aktuella detektions-, rapporteringsgränser samt mätosäkerheter	SKBdoc id1494275	1.0

The field work conducted during the 2020 campaign was entirely planned and performed by Geosigma while SKB determined which boreholes and sections were to be sampled. SKB also managed the laboratory analysis of the obtained samples. For more detailed information of the division of tasks see Activity plan AP SFK 20-022.

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 40 borehole sections, representing 20 core drilled boreholes and 10 percussion drilled boreholes, are included in the hydrochemical monitoring program of groundwater in the bedrock, Figure 1-1 and Table 1-2. One new section, KFR01:1, was added to the program during 2016.

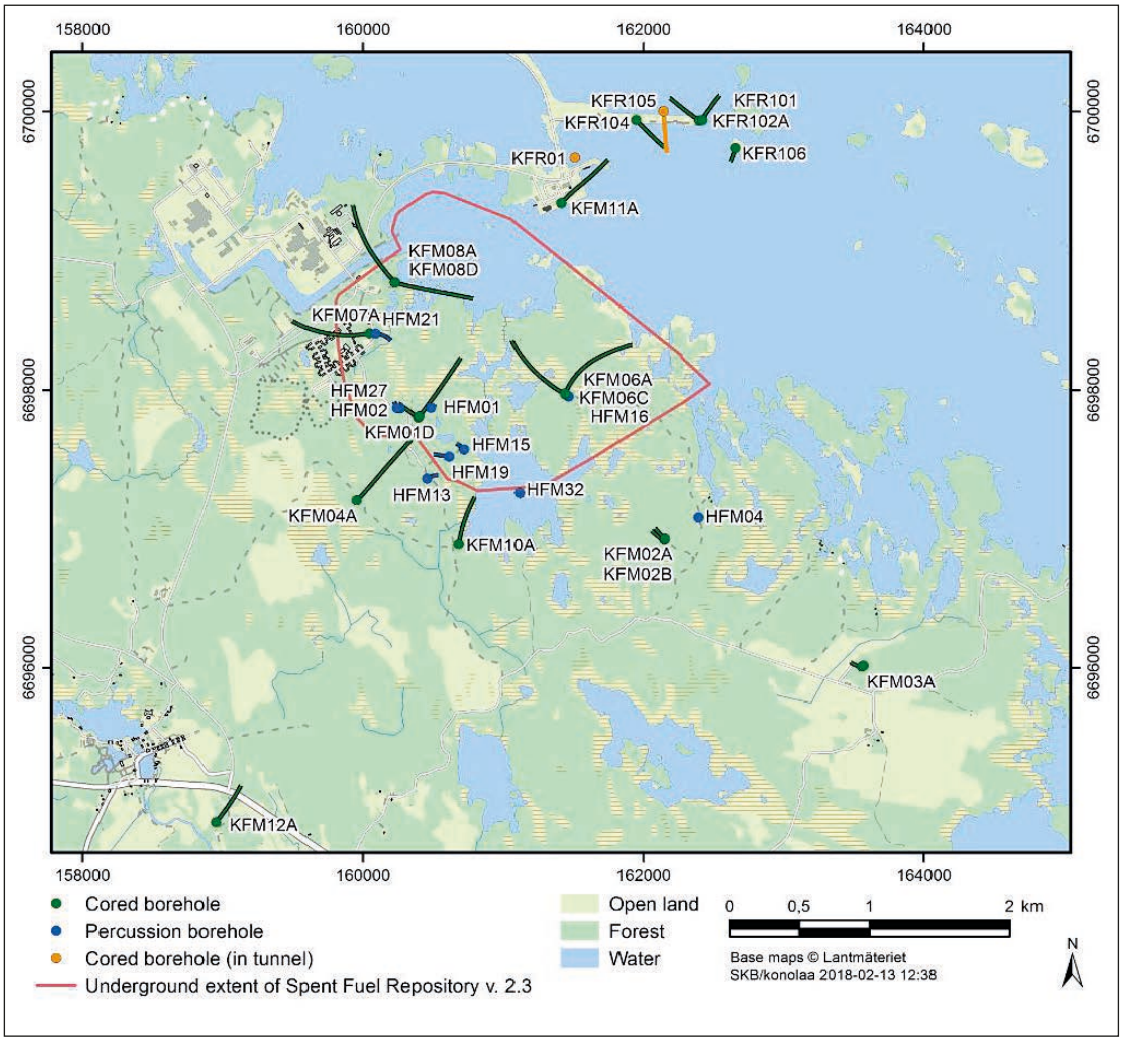

Figure 1-1. *General overview of the Forsmark area and the boreholes included in the hydrochemical monitoring program for groundwater. The (telescopic) cored boreholes and the percussion boreholes within the monitoring program are marked with green and blue filled circles, respectively. Tunnel boreholes are marked with orange filled circles.*

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

In 2020 drilling of new boreholes (KFR118-121) were performed (Table 1-3) with following injection tests (Table 1-4). These boreholes were not included in the monitoring program, but the activities could influence the water of pressure in other boreholes included in the monitoring program.

Other activities in the area during the year 2020 can be found in Sicada.

Table 1-3. Drilling of new boreholes in 2020.

Borehole	Start date	Stop date
KFR117	2020-04-28	2020-05-04
KFR118	2020-05-04	2020-05-07
KFR119	2020-05-13	2020-05-17
KFR120	2020-05-18	2020-05-30
KFR121	2020-06-01	2020-06-16

Table 1-4. Injection tests in 2020.

Borehole	Start date	Stop date
KFR117	2020-06-22	2020-06-24
KFR118	2020-06-24	2020-06-25
KFR119	2020-06-25	2020-06-26
KFR120	2020-08-24	2020-08-26

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 groundwater 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.

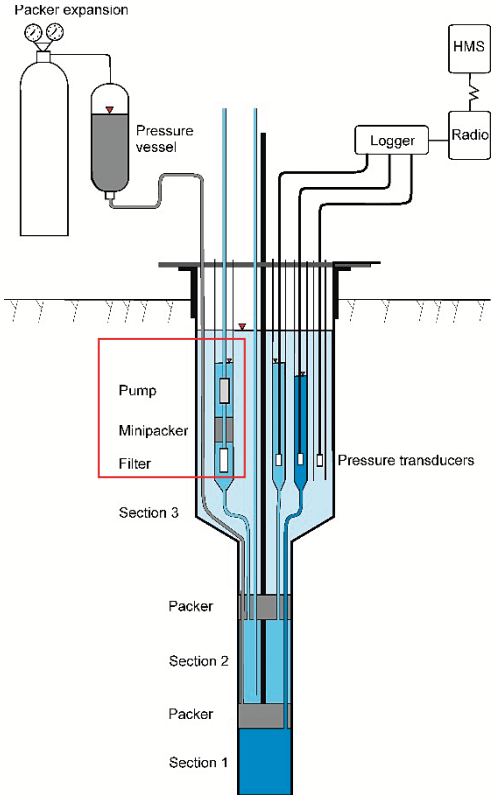

Figure 2-1. *Installations in a borehole test section with connected standpipes and monitoring equipment. The installation is permanent in the borehole, except for the pump and filter (marked with the red box), which are used in the standpipe at the pumping/sampling occasions.*

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, allowing the gas to evacuate. For more information, 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 2020-campaign includes all of the 41 borehole sections within the monitoring program. 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 2020.

Borehole [Id-code: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
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

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

3.2 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 internal analyses as well as for analyses by consulted laboratories generally follows 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. Content of analyses within sampling series within the monitoring programme of deep groundwater 2020 in Forsmark.

Constituent	Bottle[1)]/Volume	Preparation	Comment
pH_F, EC_F, temperature	-	-	On-line measurement in the field.
pH_L, EC_L, alkalinity	250–500 mL	-	Analysis within 24 h.
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.
d^2H, $d^{18}O$	100 mL	-	-
Uranine	60 mL, Dark bottle		-.
HS^-	2 x 120 mL glass Winkler bottles	Conserved with 0.5 mL 1 M ZnAc and 0.5 mL 1 M 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	2 x 250 mL	Filtered with 0,4 µm filter	
Archive	3 x 60 mL	Filtered with 0.4 µm filter Conserved with 1 mL HNO_3.	Suprapure acid is used for conservation.
Archive	1 000 mL	-	
^3H	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, NO_2, NO_3, NO_2+NO_3 and PO_4−P	250 mL	Filtered with 0,4 µm 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 0,4 µm filter	U and Th only included for samples in sections KFM02A:3, KFM03A:4, KFR106:1 and KFR106:2.
U/Th-isotopes	1 000 mL	-	-
^{36}Cl	100–500 mL		Some selected sections

[1)] Constituents determined in the different SKB chemistry classes.

Class I: Constituents in brown cells are included in the class I.

Class II: Constituents in brown and green cells are included in the class II.

Class II+: Constituents in brown, green and grey cells are included in the class II+.

Class III: Constituents in brown, green, grey and purple cells are included in the class III.

Class III+: Constituents in brown, green, grey, purple and orange cells are included in the class III+.

Blue cells contain additional constituents as complement to class III in some selected sections.

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

3.3 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 2020. 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 and KFR01 (tunnel boreholes) are not connected to standpipes, so no cleaning is needed.
- KFM02A, KFM02B, KFM04A and KFM07A were not cleaned due to lack of time before the start of the campaign.

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.

3.4 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 2011–2019, generally each series consisted of three samples distributed with respect to pumped "plug-flow volumes" (including also the volume of the tube connecting to the section). The term "plug-flow volume" refers to the theoretical volume that has to be withdrawn in order to remove the exchangeable water present in the borehole section and get samples with 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 2011–2020. Corresponding plug flow volumes for each borehole section are listed in Appendix 3.

Due to time constraints, the adequate water volumes according to the plug flow calculations were not always removed. In KFR101:1, KFR102A:2, KFR104:1 and KFR106:2 the plug flow volumes were based on less than 100 % formation water. In KFM08D:2 and HFM02:2 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 in Appendix 2.

The sample procedure for the 2020 campaign 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 Appendices 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 2020

In 2020, each series consisted of three samples. Sampling was conducted in 40 borehole sections included in the monitoring program. HFM19 was omitted due to deflated borehole packers.

During the 2020 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 a pump stops in HFM15:1, KFM01D:2 and HFM04:2 and KFR102A:5. 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 in, see Section 3.5.

Table 3-3. Sections where planned pumped volumes in sampling campaign in 2020 differ from normally used 1.5, 3 and 5 pf.

Borehole [Id-code: section no.]	Sample 1	Sample 2	Sample 3
KFM06A:3	3 pf	+2 pf[1)]	+2 pf
KFM06C:3	115 L[3)]	+100 L	+100 L
KFM11A:2	300 L	+150 L	+150 L
KFR01:1	3 sv[2)]	5 sv	7 sv

[1)] pf = plug flow volumes. Corresponding volume in litre for each section are found in Appendix 6.

[2)] sv = Section volumes.

[3)] L = Litre.

Table 3-4. Collected samples and analyses performed within the monitoring program 2020.

Borehole [Id-code: section no.]	Sample No in series	Chemistry class		
		Sample 1	Sample 2	Sample 3
KFM01A:5	79121–79123	II,b+	II,b+	III, b–d, h
KFM01D:2	79124–79126	II,b+	II,b+	III, b–d, h
KFM01D:4	79127–79129	II,b+	II,b+	III, b–d, h
KFM02A:3	79130–79132	II,b+	II,b+	III, b–d, h, f[1)]
KFM02A:5	79133–79135	II,b+	II,b+	III, b–d, h, f[1)]
KFM02B:2	79136–79138	II,b+	II,b+	III, b–d, h
KFM02B:4	79139–79141	II,b+	II,b+	III, b–d, h
KFM03A:1	79142–79144	II,b+	II,b+	III, b–d, h
KFM03A:4	79145–79147	II,b+	II,b+	III, b–d, h
KFM04A:4	79148–79150	II,b+	II,b+	III, b–d, h
KFM06A:3	79151–79153	II,b+	II,b+	III, b–d, h
KFM06A:5	79154–79156	II,b+	II,b+	III, b–d, h
KFM06C:3	79157–79159	II,b+	II,b+	III, b–d, h
KFM06C:5	79160–79162	II,b+	II,b+	III, b–d, h
KFM07A:2	79163–79165	II,b+	II,b+	III, b–d, h
KFM08A:2	79166–79168	II,b+	II,b+	III, b–d, h
KFM08A:6	79169–79171	II,b+	II,b+	III, b–d, h
KFM08D:2	79172–79174	II,b+	II,b+	III, b–d, h
KFM08D:4	79175–79177	II,b+	II,b+	III, b–d, h
KFM10A:2	79178–79180	II,b+	II,b+	III, b–d, h
KFM11A:2	79181–79183	II,b+	II,b+	III, b–d, h
KFM11A:4	79184–79186	II,b+	II,b+	III, b–d, h
KFM12A:3	79187–79189	II,b+	II,b+	III, b–d, h
HFM01:2	79190–79192	II,b+	II,b+	III, b–d, h
HFM02:2	79193–79195	II,b+	II,b+	III, b–d, h
HFM04:2	79196–79198	II,b+	II,b+	III, b–d, h
HFM13:1	79199–79201	II,b+	II,b+	III, b–d, h
HFM15:1	79202–79204	II,b+	II,b+	III, b–d, h
HFM16:2	79205–79207	II,b+	II,b+	III, b–d, h
HFM21:3	79208–79210	II,b+	II,b+	III, b–d, h
HFM27:2	79211–79213	II,b+	II,b+	III, b–d, h
HFM32:3	79214–79216	II,b+	II,b+	III, b–d, h
KFR101:1	79217–79219	II,b+	II,b+	III, b–d, h[2)]
KFR102A:2	79220–79222	II,b+	II,b+	III, b–d, h
KFR102A:5	79223–79225	II,b+	II,b+	III, b–d, h
KFR104:1	79226–79228	II,b+	II,b+	III, b–d, h[2)]
KFR106:1	79235–79237	II,b+	II,b+	III, b–d, h, f[1) 2)]
KFR106:2	79238–79240	II,b+	II,b+	III, b–d, h, f[1) 2)]
KFR01:1	79229–79231	II,b+	II,b+	III, b–d, h[2)]
KFR105	79232–79234	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-20-022 with the following nonconformities.

Pumping procedures

- Pump stops occurred in HFM15:1, KFM01D:2, HFM04:2 and KFR102A:5.
- For some sections (e.g.KFM08D:2, HFM02:2, HFM13:1 and KFR106:2) the pumped volume before the first sample was lower than planned (see Appendix 2) because the pump started with a lower flow than planned (the first flow measurement after pump start took place when the first sample was collected but the flow was probably lower already from start).
- For KFM02A:3 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. For KFR105:1 the first, second and third sample the removed volumes were substantially larger than planned due to sick leave for an employee.
- Flow rates are difficult to adjust when gas-lift pumping is used. Therefore, pumped volumes are higher or lower than planned for some of the sections (i.e. KFR104:1) pumped with this kind of pump.

Sampling

- Sampling was not performed in HFM19:1 during 2020 due to that the borehole packer pressure was released.

Analyses

- For KFM01A:5 there is no $NO_2{-}N{+}NO_3{-}N$ result presented by the laboratory.

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 within the acceptable limit of ± 5 %.

Trace elements and the isotopes d^2H, $d^{18}O$ and ^3H were determined in the last sample in each series (see Appendix 3). In 2019 and 2020 analysis of Ag, As, B, Nb, Rb, Zr, Sb, Cs and Nd was added in some 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 laboratory measurements and field measurements of pH and EC are compared in Figure 4-1 and Figure 4-2 respectively.

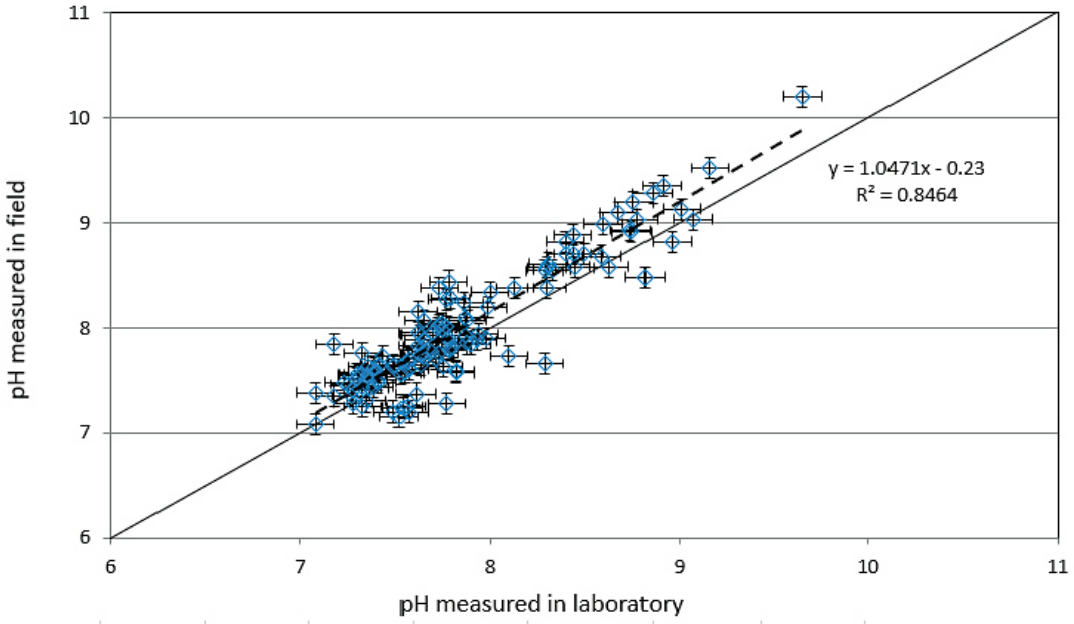

Figure 4-1. *Comparison between laboratory measurements and field measurements of pH. The laboratory measurements are performed at 25 °C and the field measurements are performed at the actual water temperature. The dashed line is the linear fit.*

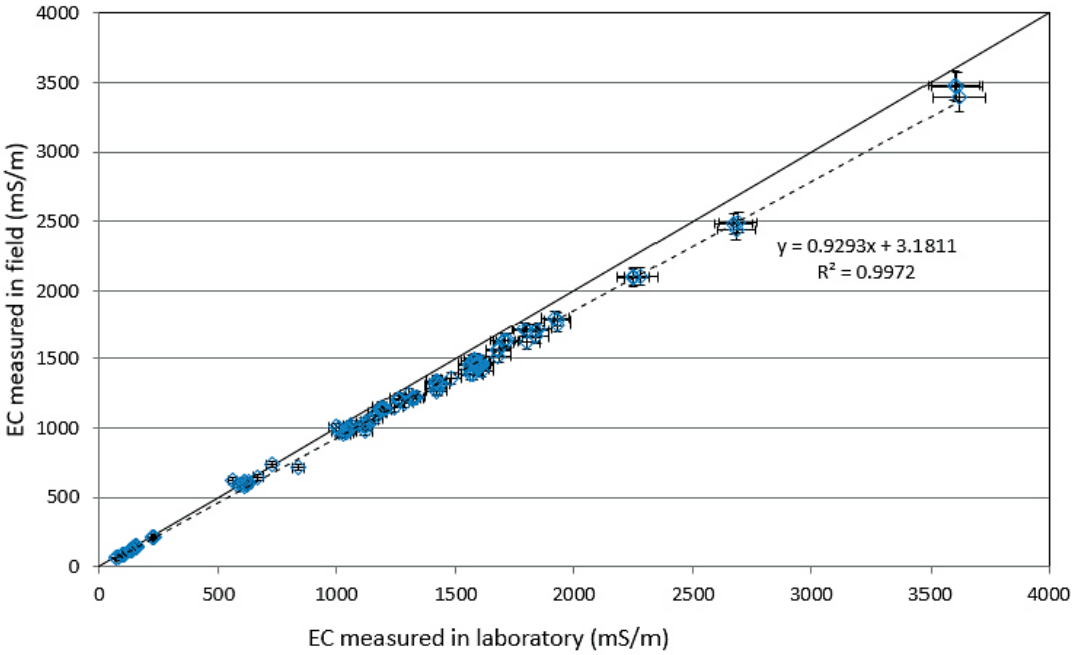

Figure 4-2. *Comparison between laboratory measurements and field measurements of EC. All values are corrected to the conductivity at 25 °C. The dashed line is the linear fit.*

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. Since the pH values measured in field is measured at a lower temperature, the pH measured in the laboratory should generally be lower due to the inversely proportional relationship between pH and temperature. The data indicates, on the contrary, that the pH measured in the field is slightly higher than the pH measured in the laboratory and the temperature effect seems to have a lower impact than the CO_2 uptake at higher pH values.

As previously observed in some of the monitored boreholes (see e.g. Ragvald 2016, 2018), some high pH values were also recorded in 2020, 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 (Föhlinger 2021). 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). In some sections the measured pH value continues to increase each year. In other sections 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.

4.2 Chloride

Figure 4-3 to Figure 4-9 present chloride concentrations in collected samples from hydrochemical monitoring 2020 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 4-8;d), e), f); and Figure 4-9) also include data from earlier studies.

Within each sample series (increasing plug flow volumes), the chloride concentrations were generally quite stable in 2020. The exceptions are KFR104:1 (within the analytical uncertainty), and KFR106:1 for which the chloride concentrations increased with pumped volumes. For KFR106:1, also sodium, calcium, magnesium and sulphate increased.

In 2016 the detected lower chloride concentration in KFR106:1 and KFR104:1 was supposed to be due to smaller pumping volumes (Ragvald 2018). The last years values in KFR106:1 varies from year to year. In KFR104:1 the decrease continues, but with a slight increase in 2019 (Föhlinger 2021). Comparing chloride concentrations and pumping volumes for 2014–2020 indicates that it in these sections they might be correlated to each other.

In both sections in KFM06C the chloride concentrations in 2018 differs from the other years (within the analytical uncertainty), both before and compared to 2020. The reason is unclear.

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

The chloride concentration in KFM11A:4 increased between 2015 and 2017. In the following years (2018–2020) the concentrations have decreased each year but in 2020, it is still higher than in 2015 (within the analytical uncertainty).

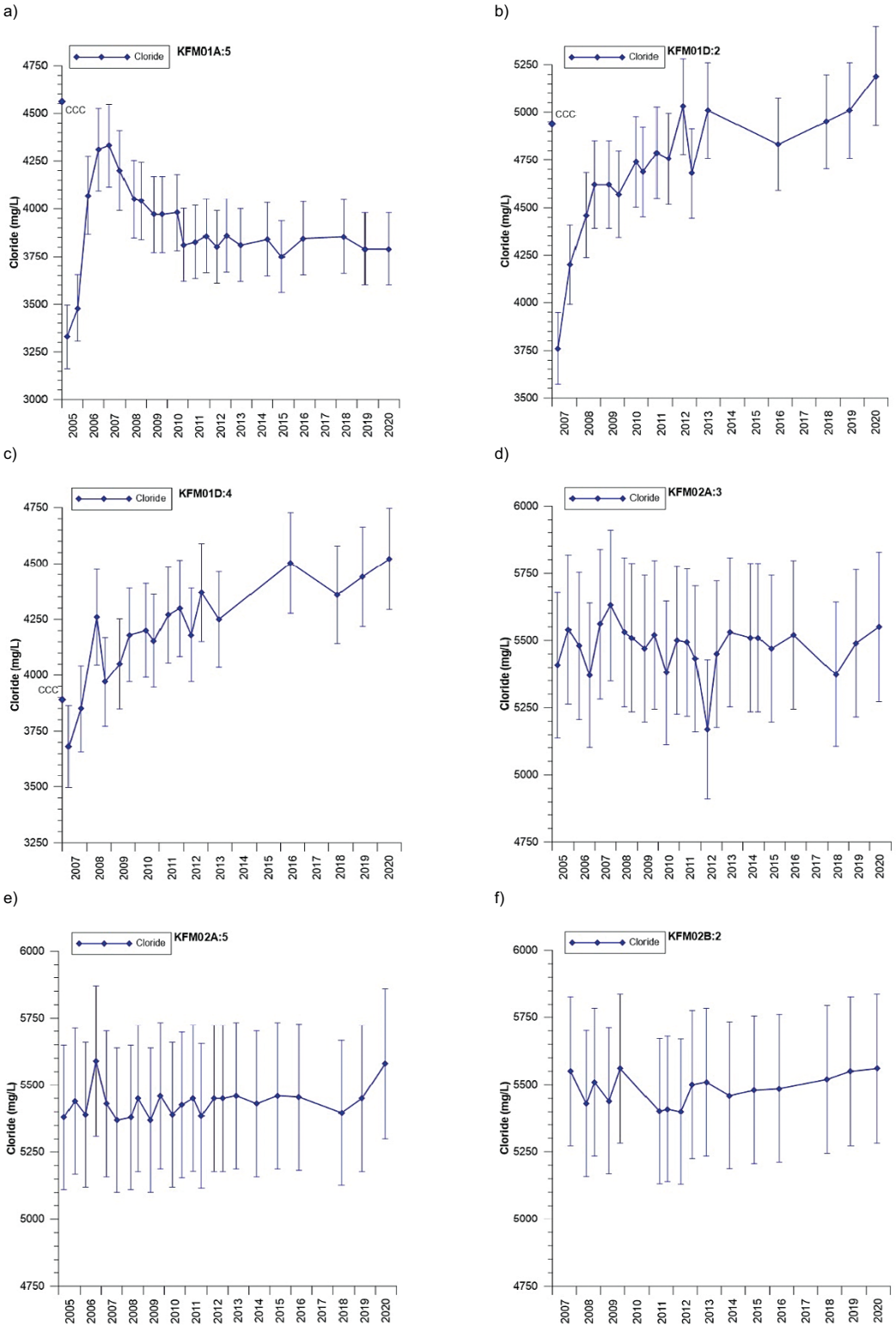

Figure 4-3. *Chloride concentrations in collected samples from hydrochemical monitoring 2005 to 2020 and from the initial complete chemical characterisation (CCC). The data points for CCC are placed on the y-axes with no correlation to date on x-axis.*

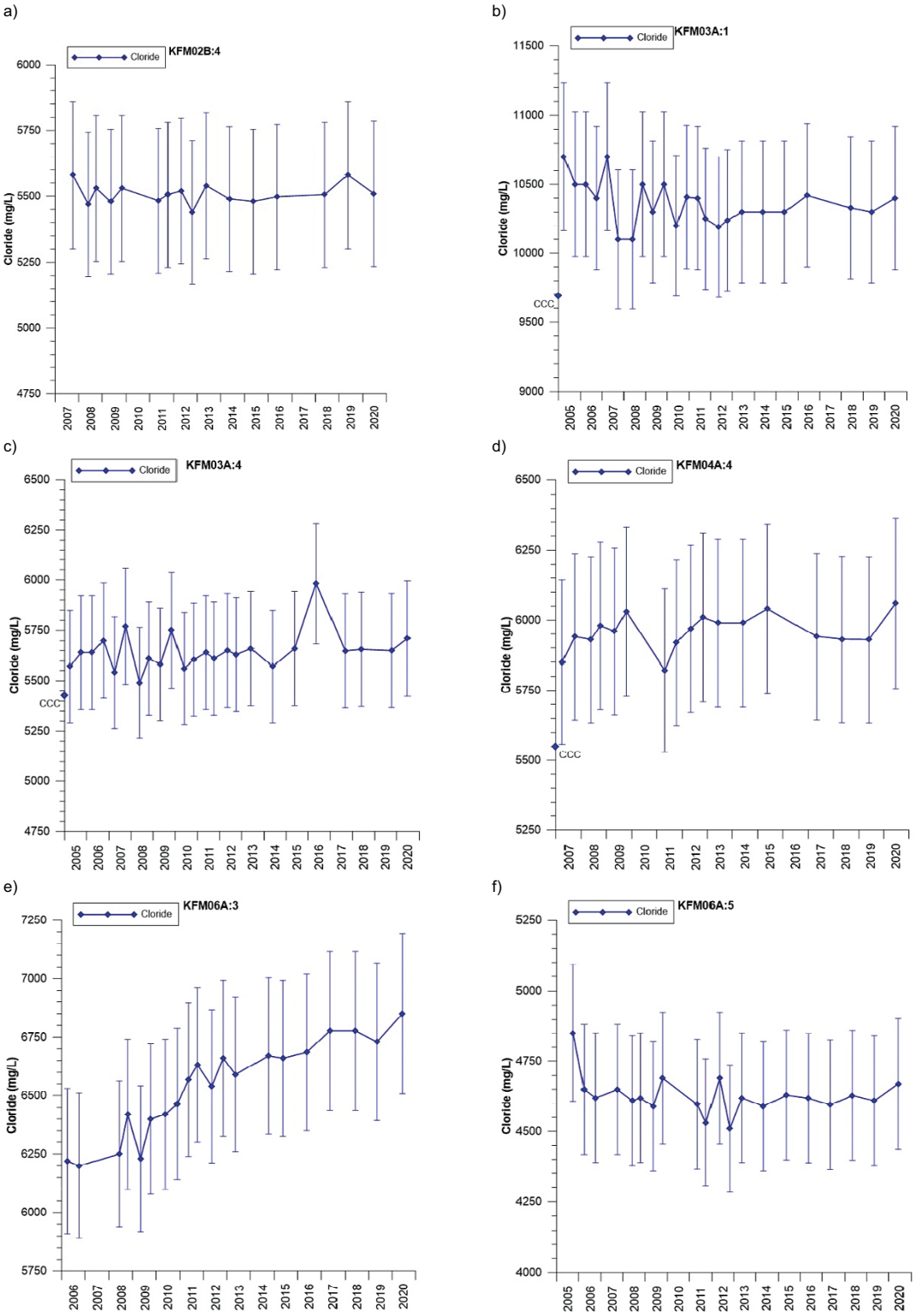

Figure 4-4. *Chloride concentrations in collected samples from hydrochemical monitoring 2005 to 2020 and from the initial complete chemical characterisation (CCC). The points for CCC are placed on the y-axes with no correlation to date on x-axis.*

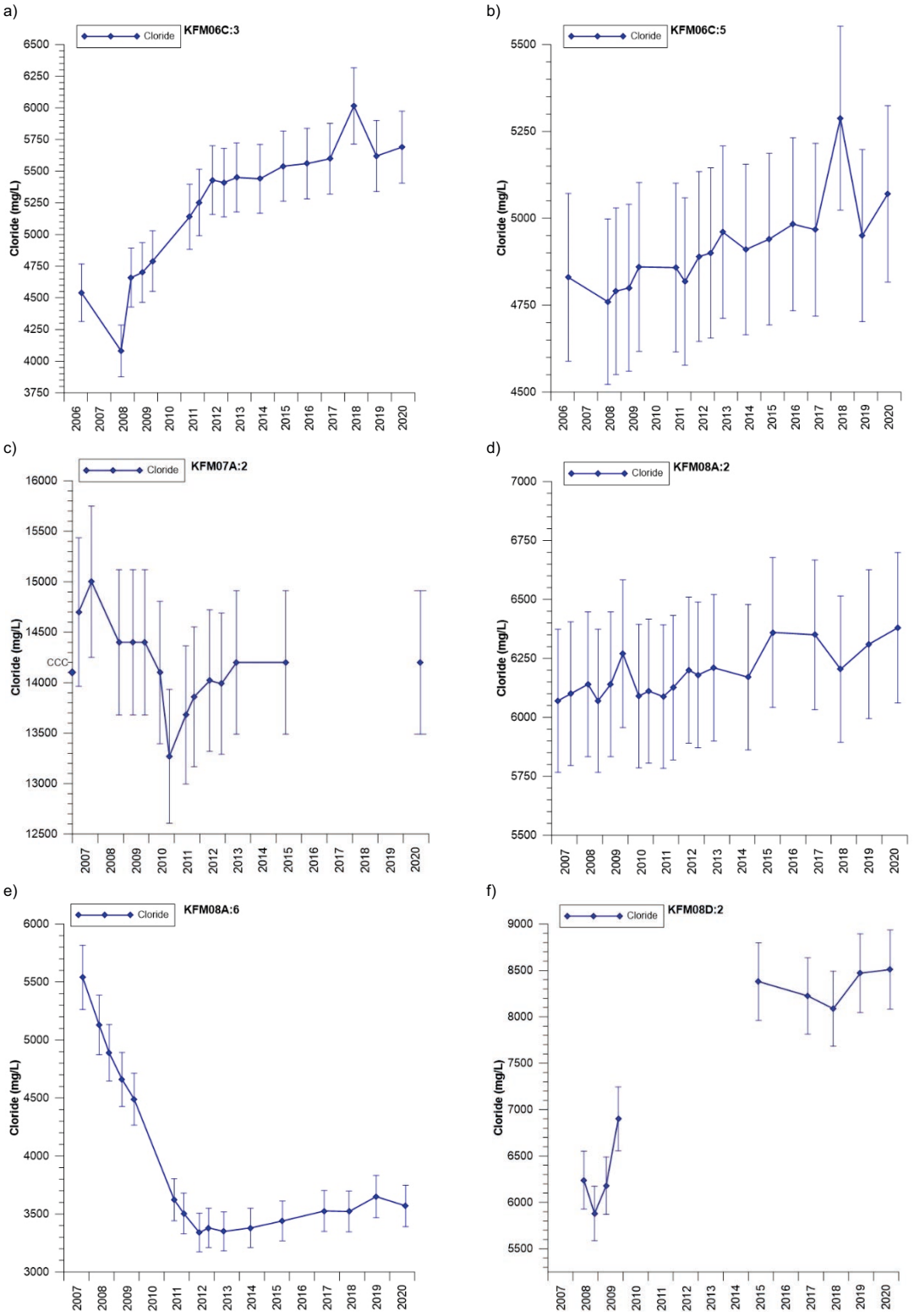

Figure 4-5. *Chloride concentrations in collected samples from hydrochemical monitoring 2005 to 2020 and from the initial complete chemical characterisation (CCC). The points for CCC are placed on the y-axes with no correlation to date on x-axis.*

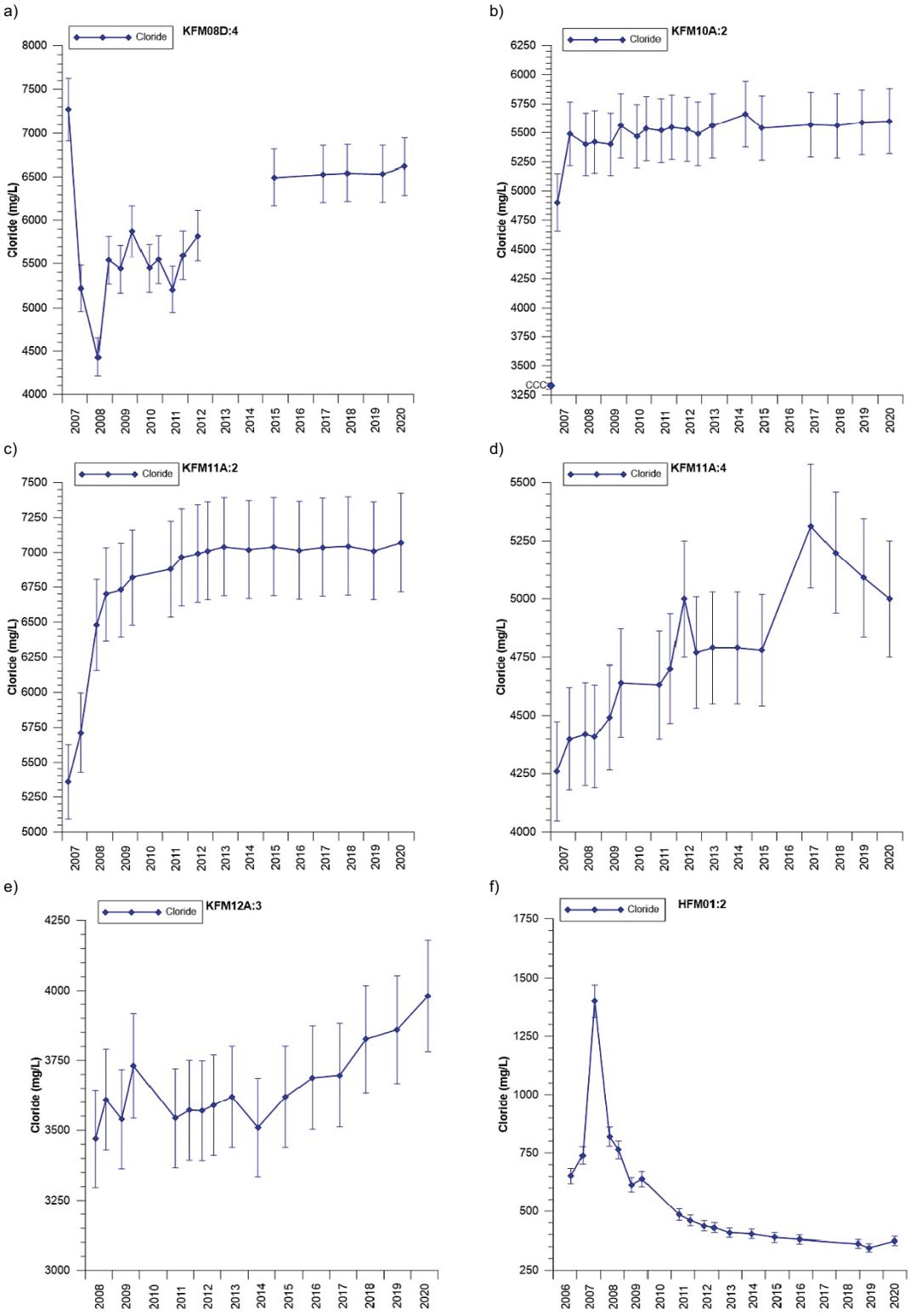

Figure 4-6. *Chloride concentrations in collected samples from hydrochemical monitoring 2005 to 2020 and from the initial complete chemical characterisation (CCC). The data points for CCC are placed on the y-axes with no correlation to date on x-axis.*

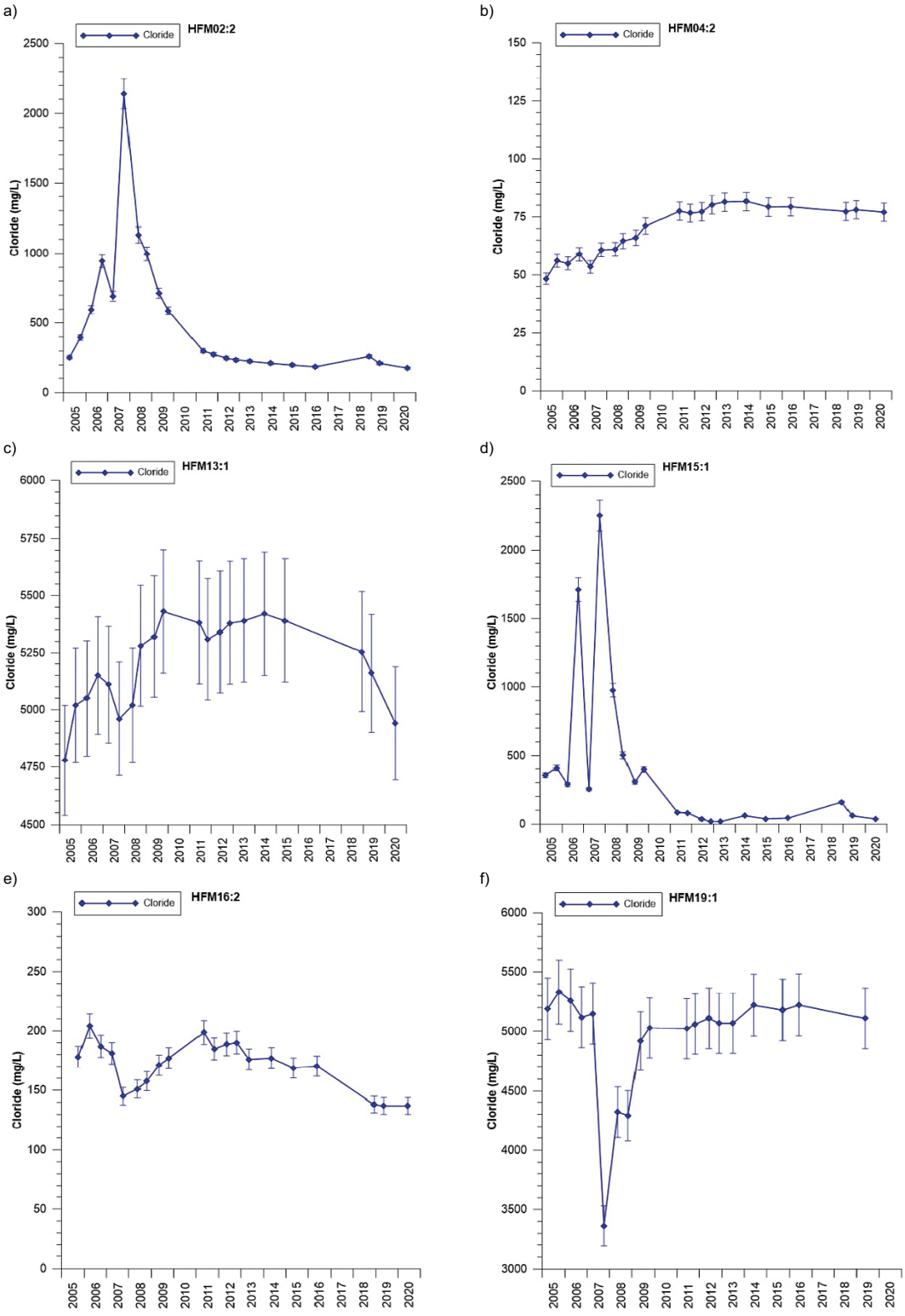

Figure 4-7. *Chloride concentrations in collected samples from hydrochemical monitoring 2005 to 2020.*

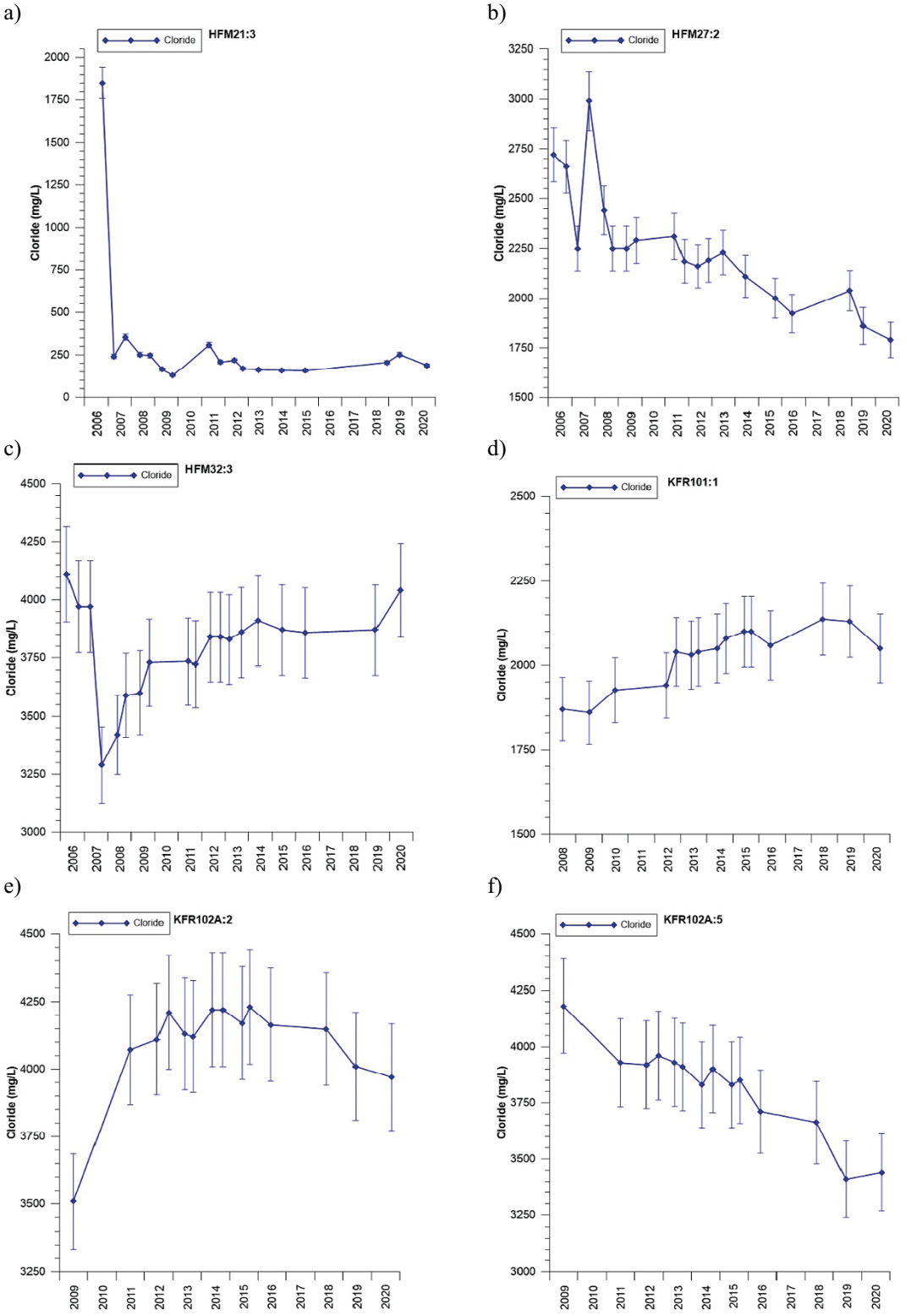

Figure 4-8. *Chloride concentrations in collected samples from hydrochemical monitoring 2005 to 2020.*

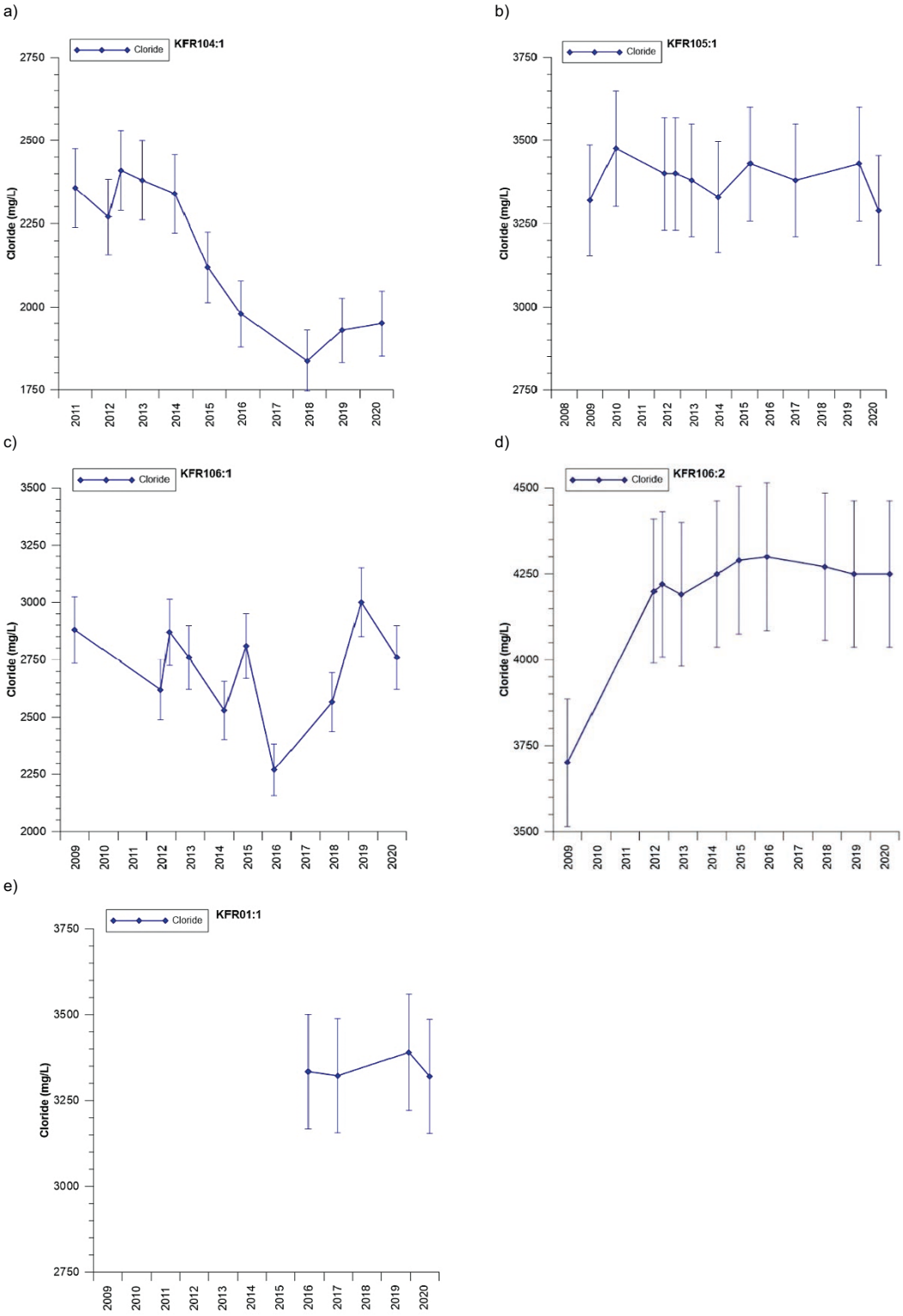

Figure 4-9. *Chloride concentrations in collected samples from hydrochemical monitoring 2005 to 2020.*

5 Summary and discussions

A total of 40 borehole sections included in the monitoring program were sampled during the 2020 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 2020 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. As observed in previous sampling campaigns high pH values were also recorded in some of the monitored borehole sections in 2020. 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 are present within the analytical error, except for KFM06A:3, while significant decreasing trends are present for HFM27:2 and KFR102A:5, with differences larger than the analytical error. For HFM13:1, the trend is weak and within the analytical error.

Increasing trend	KFM01D:2, KFM01D:4, KFM06A:3, KFM06C:3, KFM12A:3
Decreasing trend	HFM13:1, HFM27:2, KFR102A:5

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

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Appendix 1

Overview of the monitoring programmes 2005–2020

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 (13)	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 from all sections	Series of 3 samples from all sections	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 from all sampled sections	Series of 3 samples from all sampled sections	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 from all sampled sections	Series of 3 samples from all sampled sections	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 from all sampled sections	Series of 3 samples from all sampled sections	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 from all sampled sections	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) KFM07A:2 was omitted.
9) No cleaning in KFM03A:1, KFM11A:2, HFM01:2 and HFM32:3 due to various reasons.
10) 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 2017–2020.

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 some sections. [7]	KFM08D:2 and 4 (borehole equipment in PEEK)	**Spring:** Class II, b+ and III, d–h, h **Autumn:** -
2018	22 [6]	8	Series of 3 samples from all sampled sections	Series of 3 samples from all sampled sections	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 some sections. [8]	KFM08D:2 and 4 (borehole equipment in PEEK)	**Spring:** Class II, b+ and III, d–h, h **Autumn:** Class II, b+ and III, d–h, h
2019	30 [8]	2	Series of 3 samples from all sampled sections	Series of 3 samples from all sampled sections	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 4 (borehole equipment in PEEK)	**Spring:** Class II, b+ and III, d–h, h **Autumn:** Class II, b+ and III, d–h, h
2020	32	0	Series of 3 samples from all sampled sections	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 4 (borehole equipment in PEEK)	**Spring:** Class 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) No cleaning in HFM32, KFM08D due to various reasons.

4) 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.

5) 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.

6) HFM32:3, HFM19:1, KFM07A:2 were omitted.

7) 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.

8) Changed pump volume in KFM06A:5, KFM06A:3, KFM06C:5, KFM06C:3, KFM08A:2, KFM08D:4, KFM08D:2, KFM11A:2.

9) No cleaning in KFM08D.

10) No cleaning in HFM32:3, KFM08D, KFM02A, KFM02B, KFM04A, KFM07A

11) Changed pump volume in KFM06A:3,KFM06C:3, KFM11A:2.

Table A1-4. Overview of the monitoring program at the SFR-site 2012–2020.

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 from all sections	Series of 3 samples from all sections	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 from sampled sections	Series of 3 samples from sampled sections	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 from sampled sections	Series of 3 samples from sampled sections	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 from sampled sections	Series of 3 samples from sampled sections	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 from sampled sections	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 from all sampled sections	No sampling performed during autumn	in all samples	-	no	-	no	Plug flow volumes (1.5, 3, 5) except KFR01:1.	**Spring:** Class II, b+ and III, d–h, h **Autumn:** -
2018	7 [5)]	0	Series of 3 samples from all sampled sections	No sampling performed during autumn	In all except in KFR01	-	last sample in series in KFR106:1 and KFR106:2	-	Cleaning[2)] in all sections except KFR01, KFR106.	Plug flow volumes (1.5, 3, 5) except KFR01:1.	**Spring:** Class 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 were omitted.

Table A1-5. Overview of the monitoring program at the SFR-site 2019–2020.

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 from all sampled sections	Series of 3 samples from sampled sections	in all samples	in all samples	last sample in series in KFR106:1 and KFR106:2	-	Cleaning2) 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 from all sampled sections	No sampling performed during autumn	In all samples	-	last sample in series in KFR106:1, KFR106:2	-	Cleaning2) 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:** -

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 were omitted.

Appendix 2

Sampling information

Table A2-1. Sampling information in 2020.

Id-code: 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	1 day 17 h 48 min	190		476	-	-	Yes
					139.5	146	2020-06-29	79121	
					279	387	2020-06-30	79122	
					465	465	2020-06-30	79123	
KFM01D:2	3.3	24.5	4 days 7 h 1 min	85		199	-	-	Yes
					24	38	2020-06-25	79124	One pump stop occurred between the second and third sample in the series
					48	64	2020-06-25	79125	
					80	83	2020-06-29	79126	
KFM01D:4	9	12.3	0 days 6 h 50 min	255		104	-	-	Yes
					27	26	2020-07-02	79127	
					54	54	2020-07-02	79128	
					90	95	2020-07-02	79129	
KFM02A:3	14.1	33.4	1 day 7 h 56 min	108		208	-	-	No
					63	74	2020-06-11	79130	
					126	176	2020-06-12	79131	
					210	198	2020-06-12	79132	
KFM02A:5	11.9	31.8	3 days 4 h 41 min	204		941	-	-	No
					273	286	2020-06-15	79133	
					546	591	2020-06-16	79134	
					910	931	2020-06-17	79135	
KFM02B:2	12.8	15	1 day 5 h 34 min	329		583	-	-	No
					90	95	2020-06-10	79136	
					180	186	2020-06-10	79137	
					300	571	2020-06-11	79138	

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 stop has 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 include all pumping.

Table A2-1. Sampling information in 2020, continued.

Id-code: 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
KFM02B:4	10.5	21	1 day 7 h 25 min	521		982	-	-	No
					286.5	307	2020-06-17	79139	
					573	865	2020-06-18	79140	
					955	966	2020-06-18	79141	
KFM03A:1	27.7	31.5	4 days 16 h 15 min	64		432	-	-	Yes
					118.5	123	2020-06-22	79142	
					237	307	2020-06-24	79143	
					395	426	2020-06-25	79144	
KFM03A:4	18.2	18.6	1 day 3 h 10 min	206		335	-	-	No
					43.5	44	2020-06-24	79145	
					87	99	2020-06-24	79146	
					145	321	2020-06-25	79147	
KFM04A:4	6.8	18.7	0 days 7 h 45 min	203		94	-	-	No
					24	25	2020-06-22	79148	
					48	49	2020-06-22	79149	
					80	85	2020-06-22	79150	
KFM06A:3	21.1	13.6	3 days 0 h 42 min	60		263	-	-	Yes
					84[4]	94	2020-06-09	79151	
					140[4]	169	2020-06-10	79152	
					196[4]	253	2020-06-11	79153	
KFM06A:5	9.9	22.4	1 day 7 h 47 min	156		298	-	-	Yes
					39	46	2020-06-08	79154	
					78	84	2020-06-08	79155	
					130	274	2020-06-09	79156	

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 stop has 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 include all pumping.

4) The planned volumes are higher than the normal plug flow volumes due to previous high pH values

Table A2-1. Sampling information in 2020, continued.

Id-code: 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
KFM06C:3	18.5	23.5	11 days 2 h 57 min	22		351	-	-	Yes
					115[4]	115	2020-06-08	79157	
					215[4]	225	2020-06-12	79158	
					315[4]	343	2020-06-15	79159	
KFM06C:5	15.3	11.1	1 day 7 h 8 min	146		273	-	-	Yes
					42	56	2020-06-08	79160	
					84	100	2020-06-08	79161	
					140	265	2020-06-09	79162	
KFM07A:2	27.4	13.9	1 day 13 h 20 min	121		271	-	-	Yes
					57.00	97	2020-08-31	79163	
					114.00	143	2020-08-31	79164	
					190.00	264	2020-09-01	79165	
KFM08A:2	19.6	13.9	0 days 7 h 0 min	308		129	-	-	No
					33	36	2020-08-17	79166	
					66	69	2020-08-17	79167	
					110	114	2020-08-17	79168	
KFM08A:6	7.7	16.3	4 days 0 h 21 min	246		1421	-	-	Yes
					388.5	415	2020-08-18	79169	
					777	844	2020-08-19	79170	
					1295	1411	2020-08-21	79171	
KFM08D:2	0	0	4 days 7 h 51 min	18		111	-	-	No
					49.5	47	2020-08-25	79172	
					99	71	2020-08-26	79173	
					165	105	2020-08-28	79174	

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 stop has 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 include all pumping.

4) The planned volumes are higher than the normal plug flow volumes due to previous high pH values.

Table A2-1. Sampling information in 2020, continued.

Id-code: 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
KFM08D:4	18.9	22	5 days 11 h 54 min	152		1206	-	-	Yes
					352.5	391	2020-08-17	79175	
					705	767	2020-08-19	79176	
					1175	1196	2020-08-21	79177	
KFM10A:2	12.4	13.9	2 days 12 h 46 min	198		723	-	-	Yes
					187.5	191	2020-06-16	79178	
					375	414	2020-06-17	79179	
					625	714	2020-06-18	79180	
KFM11A:2	19.8	25.2	2 days 8 h 14 min	190		641	-	-	No
					300[4]	333	2020-06-30	79181	
					450[4]	585	2020-07-01	79182	
					600[4]	634	2020-07-01	79183	
KFM11A:4	12.9	12.3	0 days 7 h 57 min	274		131	-	-	Yes
					31.5	35	2020-07-01	79184	
					63	68	2020-07-01	79185	
					105	118	2020-07-01	79186	
KFM12A:3	7.9	13.6	0 days 8 h 36 min	252		130	-	-	Yes
					34.5	38	2020-08-20	79187	
					69	68	2020-08-20	79188	
					115	120	2020-08-20	79189	
HFM01:2	1.5	36.5	4 days 4 h 7 min	275		1654	-	-	Yes
					459	463	2020-06-29	79190	
					918	918	2020-06-30	79191	
					1530	1645	2020-07-02	79192	

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 stop has 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 include all pumping.

4) The planned volumes are higher than the normal plug flow volumes due to previous high pH values.

Table A2-1. Sampling information in 2020, continued.

Id-code: 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
HFM02:2	1.6	31.3	2 days 23 h 1 min	274		1 168	-	-	No
					357	308	2020-08-18	79193	
					714	643	2020-08-19	79194	
					1 190	1 158	2020-08-20	79195	
HFM04:2	2.2	26.1	23 days 2 h 17 min	310		1 120	-	-	No
					154.5	171	2020-07-02	79196	First attempt was interrupted by pump stop after first sample. As second attempt was made one month later. Due to vacation, the first sample was resampled.
HFM04:2	2.2	26.1	1 day 9 h 47 min	310		1 120	-	-	
					154.5	198	2020-08-24	81776	
					309	337	2020-08-24	79197	
					515	634	2020-08-25	79198	
HFM13:1	5	45.6	8 days 13 h 54 min	211		2 606	-	-	No
					772.5	716	2020-06-23	79199	
					1 545	1 514	2020-06-26	79200	No
					2 575	2 592	2020-06-29	79201	
HFM15:1	2.9	31.8	12 days 3 h 41 min	198		1 218	-	-	One pump stop occurred between the second
					174	312	2020-06-15	79202	and third sample in the series
					348	384	2020-06-15	79203	
					580	595	2020-06-26	79204	Pressure increase in HFM15:2 during pumping
HFM16:2	2	39	2 days 22 h 41 min	1 035		4 388	-	-	No
					1 260	1 312	2020-06-09	79205	
					2 520	2 671	2020-06-10	79206	
					4 200	4 353	2020-06-11	79207	

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 stop has 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 include all pumping.

Table A2-1. Sampling information in 2020, continued.

Id-code: 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
HFM21:3	1.5	30.8	2 days 10 h 34 min	225		791	-	-	No
					201	219	2020-08-24	79208	
					402	447	2020-08-25	79209	
					670	776	2020-08-26	79210	
HFM27:2	2	36.5	4 days 0 h 47 min	195		1 132	-	-	No
					333	348	2020-08-24	79211	
					666	663	2020-08-25	79212	
					1 110	1 124	2020-08-27	79213	
HFM32:3	1.4	18	0 days 7 h 45 min	350		163	-	-	-
					43.5	43	2020-06-23	79214	
					87	87	2020-06-23	79215	
					145	149	2020-06-23	79216	
KFR101:1	3.51	80.1	1 day 17 h 58 min	155		389	-	-	No
					109.5[5]	113	2020-08-18	79217	
					219[5]	325	2020-08-19	79218	
					365[5]	380	2020-08-19	79219	
KFR102A:2	12	25.6	2 days 9 h 45 min	313		1 086	-	-	Yes
					291[5]	286	2020-09-16	79220	
					582[5]	630	2020-09-17	79221	
					970[5]	1 077	2020-09-18	79222	
KFR102A:5	6.05	7.97	1 day 12 h 28 min	205		363	-	-	Yes
					78	81	2020-09-15	79223	One pump stop occurred between the first
					156	197	2020-09-16	79224	and second sample in the series
					260	265	2020-09-16	79225	

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 stop has 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 include all pumping.

5) Plug flow volume representing < 100 % formation water, see Table A6-2.

Table A2-1. Sampling information in 2020, continued.

Id-code: 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
KFR104:1	9.42	199	7 days 3 h 10 min	54		550	-	-	Yes
					90[5]	169	2020-08-26	79226	
					180[5]	325	2020-08-28	79227	
					300[5]	541	2020-08-31	79228	
KFR106:1	7.35	174	0 days 9 h 30 min	151		86	-	-	No
					24	24	2020-09-01	79235	
					48	48	2020-09-01	79236	
					80	79	2020-09-01	79237	
KFR106:2	4.04	490	1 day 8 h 25 min	133		259	-	-	No
					82.5[5]	70	2020-09-01	79238	
					165[5]	193	2020-09-02	79239	
					275[5]	251	2020-09-02	79240	
KFR01:1	0.8	39.6	1 day 0 h 25 min	620		908	-	-	No
					121[4]	121	2020-08-31	79229	
					202[4]	229	2020-08-31	79230	
					283[4]	884	2020-09-01	79231	
KFR105:1	13.3	179	17 days 4 h 58 min	681		16 886	-	-	Yes
					1 044	15 006	2020-09-15	79232	
					2 088	15 851	2020-09-16	79233	
					3 480	16 870	2020-09-17	79234	

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 stop has 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 include all pumping.

4) The planned volumes are higher than the normal plug flow volumes due to previous high pH values.

5) Plug flow volume representing < 100 % formation water, see Table A6-2.

Appendix 3

Water Composition

Table A3-1. Water composition 2020.

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
HFM01	33.50	45.50	2	79190	2020-06-29	−1.89	409	13.20	44.2	13.8	486.0	374	168	58	1.5	2.60	5.85	0.300			0.0743	0.0124
HFM01	33.50	45.50	2	79191	2020-06-30	−0.68	419	13.30	44.1	13.8	486.0	371	167	58	1.5	2.60	5.84	0.302			0.0731	0.0124
HFM01	33.50	45.50	2	79192	2020-07-02	−0.71	420	13.40	44.9	14.0	484.0	374	173	59	1.6	2.70	5.90	0.311	0.110	0.047	0.0738	0.0127
HFM02	38.00	48.00	2	79193	2020-08-18	1.09	253	11.10	39.8	12.6	446.0	189	59	20	0.77	2.00	6.42	0.285			0.0768	0.0119
HFM02	38.00	48.00	2	79194	2020-08-19	0.68	245	11.20	40.8	12.9	449.0	183	58	20	0.75	1.90	6.50	0.300			0.0799	0.0120
HFM02	38.00	48.00	2	79195	2020-08-20	0.52	243	11.00	39.1	12.5	449.0	178	57	20	0.74	1.90	6.43	0.294	0.300	0.300	0.0773	0.0119
HFM04	58.00	66.00	2	79196	2020-07-02	1.35	180	7.20	32.2	8.36	422.0	77	41	14	0.34	1.80	6.81	0.389			0.0841	0.0095
HFM04	58.00	66.00	2	81776	2020-08-24	1.40	178	7.08	32.5	8.47	419.0	75	39	14	0.32	1.80	6.83	0.396			0.0831	0.0107
HFM04	58.00	66.00	2	79197	2020-08-24	−0.05	173	6.88	31.0	8.17	417.0	76	40	14	0.32	1.80	6.67	0.377			0.0801	0.0098
HFM04	58.00	66.00	2	79198	2020-08-25	0.38	176	6.95	31.0	8.14	418.0	77	40	14	0.32	1.90	6.69	0.374	0.380	0.360	0.0798	0.0101
HFM13	159.00	173.00	1	79199	2020-06-23	−0.11	1820	24.70	1170	206	125.0	5090	496	158	23.0	1.10	7.23	3.580			2.150	0.0552
HFM13	159.00	173.00	1	79200	2020-06-26	−1.07	1810	24.40	1140	202	128.0	5120	480	155	23.0	1.10	7.25	3.540			2.140	0.0556
HFM13	159.00	173.00	1	79201	2020-06-29	0.33	1790	24.20	1140	201	128.0	4940	476	154	22.0	1.10	7.24	3.560	3.700	3.600	2.140	0.0560
HFM15	85.00	95.00	1	79202	2020-06-15	0.69	73.4	6.50	75.0	8.47	374.0	39	20	7	0.24	0.80	7.25	1.080			0.194	0.0043
HFM15	85.00	95.00	1	79203	2020-06-15	0.21	72.8	6.37	74.8	8.40	374.0	40	20	7	0.26	0.83	7.23	1.070			0.192	0.0042
HFM15	85.00	95.00	1	79204	2020-06-26	0.64	72.9	6.32	73.5	8.23	373.0	37	20	7	0.25	0.82	7.21	1.060	1.030	1.030	0.188	0.0046
HFM16	54.00	67.00	2	79205	2020-06-09	1.66	268	6.70	30.8	7.39	470.0	136	86	30	0.52	2.50	6.34	0.403			0.0749	0.0105
HFM16	54.00	67.00	2	79206	2020-06-10	1.14	264	6.69	31.1	7.37	471.0	135	87	30	0.25	2.50	6.33	0.414			0.0754	0.0105
HFM16	54.00	67.00	2	79207	2020-06-11	1.39	266	6.72	30.8	7.35	469.0	137	84	29	0.52	2.50	6.35	0.414	0.430	0.400	0.0754	0.0107
HFM21	22.00	32.00	3	79208	2020-08-24	1.25	271	13.50	53.7	15.7	485.0	189	104	38	0.92	1.50	7.04	0.657			0.131	0.0171
HFM21	22.00	32.00	3	79209	2020-08-25	1.12	271	13.40	53.0	15.5	487.0	187	107	38	0.92	1.60	6.88	0.656			0.130	0.0171
HFM21	22.00	32.00	3	79210	2020-08-26	1.17	273	13.50	52.1	15.3	489.0	187	108	38	0.92	1.60	6.93	0.644	0.640	0.640	0.127	0.0172
HFM27	46.00	58.00	2	79211	2020-08-24	−1.46	942	31.20	289	83.0	308.0	1910	253	94	6.4	1.50	6.18	1.850			0.505	0.0324
HFM27	46.00	58.00	2	79212	2020-08-25	−0.05	944	31.10	284	81.9	307.0	1840	268	93	6.8	1.40	6.23	1.820			0.497	0.0321
HFM27	46.00	58.00	2	79213	2020-08-27	−0.20	916	30.60	276	81.8	311.0	1790	247	91	6.2	1.50	6.20	1.780	1.850	1.840	0.481	0.0306

RCB % = Rel. charge balance error %.

< “value” = value below reporting limit.

Table A3-1. Water composition 2020, continued.

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
HFM32	26.00	31.00	3	79214	2020-06-23	−1.04	1900	65.20	449	167	202.0	3950	395	130	14.9	1.20	5.47	4.490			0.798	0.0588
HFM32	26.00	31.00	3	79215	2020-06-23	−1.05	1910	65.40	447	166	202.0	3960	408	130	15.3	1.20	5.45	4.440			0.801	0.0605
HFM32	26.00	31.00	3	79216	2020-06-23	−2.20	1890	65.30	450	166	200.0	4040	401	131	15.0	1.20	5.46	4.490	4.600	4.300	0.809	0.0604
KFM01A	109.00	130.00	5	79121	2020-06-29	0.83	1730	19.60	669	108	67.4	3900	234	77	16.4	1.30	8.32	0.225			0.506	0.0313
KFM01A	109.00	130.00	5	79122	2020-06-30	0.80	1710	18.70	684	103	67.8	3880	237	79	16.5	1.40	8.51	0.301			0.509	0.0373
KFM01A	109.00	130.00	5	79123	2020-06-30	0.91	1660	19.20	684	102	68.6	3790	238	80	16.5	1.30	8.52	0.323	0.340	0.330	0.513	0.0379
KFM01D	429.00	438.00	2	79124	2020-06-25	0.39	1740	10.90	1370	29.3	20.4	5080	96	30	35.0	1.20	10.90	< 0.1			0.0811	0.0280
KFM01D	429.00	438.00	2	79125	2020-06-25	0.19	1730	10.70	1370	29.4	19.0	5080	90	33	32.0	1.20	10.90	< 0.1			0.0886	0.0290
KFM01D	429.00	438.00	2	79126	2020-06-29	−0.52	1720	10.20	1410	27.7	18.0	5190	95	40	32.0	1.10	10.80	0.0177	< 0.02	< 0.02	0.0949	0.0296
KFM01D	311.00	321.00	4	79127	2020-07-02	0.81	1710	11.50	1190	42.8	16.1	4670	169	52	32.0	1.40	10.80	0.264			0.218	0.0311
KFM01D	311.00	321.00	4	79128	2020-07-02	0.13	1690	12.80	1110	53.5	18.5	4580	174	59	26.0	1.30	11.40	0.380			0.252	0.0332
KFM01D	311.00	321.00	4	79129	2020-07-02	1.13	1720	13.90	1100	57.1	20.1	4520	176	62	24.0	1.20	11.60	0.469	0.490	0.490	0.271	0.0343
KFM02A	490.00	518.00	3	79130	2020-06-11	−0.41	2300	41.00	960	240	127.0	5570	530	174	21.0	1.30	7.14	1.300			1.870	0.0468
KFM02A	490.00	518.00	3	79131	2020-06-12	−0.37	2290	40.00	967	240	127.0	5560	503	175	20.0	1.30	6.96	1.510			1.960	0.0481
KFM02A	490.00	518.00	3	79132	2020-06-12	−0.17	2290	40.20	975	240	127.0	5550	480	176	19.4	1.30	6.95	1.560	1.630	1.600	1.980	0.0487
KFM02A	411.00	442.00	5	79133	2020-06-15	0.27	2020	23.80	1210	204	93.7	5460	433	149	22.0	1.20	7.38	0.631			1.680	0.6540
KFM02A	411.00	442.00	5	79134	2020-06-16	−0.14	2040	23.70	1190	204	94.4	5500	456	150	23.0	1.20	7.47	0.656			1.700	0.5970
KFM02A	411.00	442.00	5	79135	2020-06-17	−0.62	2030	24.10	1210	206	94.4	5580	410	152	21.0	1.20	7.52	0.690	0.720	0.710	1.740	0.5330
KFM02B	491.00	506.00	2	79136	2020-06-10	2.53	2470	44.70	986	261	122.0	5550	556	189	21.0	1.40	9.25	3.420			2.010	0.0598
KFM02B	491.00	506.00	2	79137	2020-06-10	−0.97	2330	41.60	933	246	118.0	5650	496	179	19.0	1.40	8.60	3.640			1.950	0.0546
KFM02B	491.00	506.00	2	79138	2020-06-11	0.27	2350	41.20	949	247	121.0	5560	495	181	19.2	1.30	8.36	4.150	4.200	4.100	2.020	0.0549
KFM02B	410.00	431.00	4	79139	2020-06-17	−0.96	2160	26.70	1110	218	103.0	5660	485	158	22.0	1.30	8.67	1.810			1.890	0.0821
KFM02B	410.00	431.00	4	79140	2020-06-18	0.10	2140	26.60	1130	218	93.8	5540	504	159	23.0	1.30	8.51	1.900			1.920	0.0889
KFM02B	410.00	431.00	4	79141	2020-06-18	0.34	2150	26.50	1120	219	104.0	5510	438	159	20.0	1.30	8.55	1.910	2.020	2.020	1.940	0.0900
KFM03A	969.50	994.50	1	79142	2020-06-22	−0.82	2380	9.18	3720	7.91	7.0	10400	60	16	105.0	1.10	5.41	< 0.100			0.0268	0.0242
KFM03A	969.50	994.50	1	79143	2020-06-24	−3.10	2290	8.71	3590	7.58	6.1	10500	56	16	97.0	1.10	4.77	< 0.100			0.0233	0.0228
KFM03A	633.50	650.00	4	79145	2020-06-24	0.39	1950	17.20	1560	55.6	18.4	5740	202	66	36.0	1.40	6.79	0.390			0.308	0.0281

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Table A3-1. Water composition 2020, continued.

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
KFM03A	633.50	650.00	4	79146	2020-06-24	0.22	1940	16.40	1560	54.5	16.9	5740	211	67	36.0	1.40	6.53	0.401			0.295	0.0285
KFM03A	633.50	650.00	4	79147	2020-06-25	0.70	1950	15.40	1570	53.4	15.8	5710	198	68	34.0	1.40	6.21	0.349	0.370	0.370	0.277	0.0283
KFM03A	969.50	994.50	1	79144	2020-06-25	−0.47	2380	8.84	3760	7.91	6.1	10400	57	17	99.0	1.10	4.90	0.043	0.047	0.043	0.0242	0.0241
KFM04A	230.00	245.00	4	79148	2020-06-22	0.21	2060	27.50	1440	239	97.7	5990	470	170	26.0	0.87	6.54	1.410			2.670	0.0589
KFM04A	230.00	245.00	4	79149	2020-06-22	−0.13	2030	27.50	1450	238	98.8	6000	517	170	29.0	0.91	6.63	1.580			2.700	0.0577
KFM04A	230.00	245.00	4	79150	2020-06-22	−0.28	2050	27.60	1450	240	98.4	6060	477	170	27.0	0.92	6.65	1.660	1.740	1.740	2.740	0.0585
KFM06A	341.00	362.00	5	79154	2020-06-08	0.83	1590	15.40	1250	41.8	25.7	4620	114	38	29.0	1.00	5.60	0.229			0.228	0.0484
KFM06A	341.00	362.00	5	79155	2020-06-08	0.75	1580	12.90	1270	39.4	27.3	4640	113	36	30.0	1.10	5.84	0.367			0.247	0.0496
KFM06A	341.00	362.00	5	79156	2020-06-09	1.92	1630	10.80	1310	39.6	27.6	4670	116	37	32.0	1.10	5.48	0.407	0.420	0.410	0.239	0.0516
KFM06A	738.00	748.00	3	79151	2020-06-09	0.22	1910	10.10	2200	17.0	12.1	6780	105	34	51.0	1.20	6.72	< 0.1			0.170	0.0381
KFM06A	738.00	748.00	3	79152	2020-06-10	0.74	1910	9.52	2230	15.6	10.9	6760	103	34	49.0	1.30	6.39	< 0.1			0.155	0.0380
KFM06A	738.00	748.00	3	79153	2020-06-11	0.41	1940	9.52	2230	15.2	11.6	6850	99	33	49.0	1.30	6.37	0.070	0.080	0.070	0.146	0.0372
KFM06C	531.00	540.00	5	79160	2020-06-08	0.33	1780	16.00	1270	82.3	37.4	5000	230	86	24.0	0.83	4.96	0.172			0.490	0.0428
KFM06C	531.00	540.00	5	79161	2020-06-08	0.00	1770	15.60	1290	82.0	39.5	5050	246	87	26.0	0.86	5.06	0.204			0.521	0.0419
KFM06C	647.00	666.00	3	79157	2020-06-08	0.93	1640	6.63	1850	17.8	19.1	5690	67	22	42.0	1.10	3.26	< 0.1			< 0.02	0.0313
KFM06C	531.00	540.00	5	79162	2020-06-09	0.19	1770	15.00	1310	85.4	37.0	5070	233	89	25.0	0.90	5.21	0.220	0.230	0.200	0.551	0.0450
KFM06C	647.00	666.00	3	79158	2020-06-12	1.14	1670	6.34	1850	16.9	15.4	5710	67	22	44.0	1.20	3.96	< 0.1			0.0347	0.0317
KFM06C	647.00	666.00	3	79159	2020-06-15	1.88	1680	6.28	1880	16.5	14.0	5690	72	22	46.0	1.20	4.07	0.0166	< 0.02	< 0.02	0.0549	0.0322
KFM07A	962.00	972.00	2	79163	2020-08-31	−0.12	3170	12.10	5260	17.9	11.4	14200	106	35	136.0	0.97	3.70	< 0.1			0.0365	0.0775
KFM07A	962.00	972.00	2	79164	2020-08-31	−0.42	3200	12.40	5240	18.2	10.7	14300	103	35	135.0	1.00	3.80	< 0.1			0.0449	0.0782
KFM07A	962.00	972.00	2	79165	2020-09-01	−0.72	3150	13.20	5180	18.4	9.8	14200	104	35	135.0	1.00	3.87	0.0501	0.026	0.022	0.0569	0.0774
KFM08A	684.00	694.00	2	79166	2020-08-17	−0.25	1740	10.60	2060	10.2	13.3	6330	81	26	50.0	1.10	4.87	< 0.1			0.0461	< 0.02
KFM08A	684.00	694.00	2	79167	2020-08-17	−0.88	1740	10.80	2030	9.92	12.2	6360	74	25	49.0	1.20	5.50	< 0.1			0.0676	< 0.02
KFM08A	684.00	694.00	2	79168	2020-08-17	−1.44	1730	11.30	2010	9.89	11.2	6380	73	25	49.0	1.20	5.77	0.0471	0.047	0.045	0.0821	0.0208
KFM08A	265.00	280.00	6	79169	2020-08-18	−0.15	1360	14.20	864	58.3	58.7	3630	196	70	17.0	1.20	7.34	1.050			0.562	0.0332
KFM08A	265.00	280.00	6	79170	2020-08-19	−0.33	1380	14.10	865	59.0	56.9	3680	196	70	16.8	1.10	7.03	1.110			0.574	0.0349
KFM08A	265.00	280.00	6	79171	2020-08-21	1.04	1380	14.20	861	60.2	57.5	3570	204	72	16.9	1.10	6.74	1.150	1.190	1.170	0.578	0.0354

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Table A3-1. Water composition 2020, continued.

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
KFM08D	660.00	680.00	4	79175	2020-08-17	−0.24	1830	7.43	2130	8.18	7.6	6590	71	25	50.0	1.20	5.80	< 0.1			0.0809	0.0233
KFM08D	660.00	680.00	4	79176	2020-08-19	−0.35	1830	7.01	2150	7.67	7.0	6640	69	24	50.0	1.20	5.31	< 0.1			0.0801	0.0234
KFM08D	660.00	680.00	4	79177	2020-08-21	−0.32	1820	7.16	2150	7.17	7.0	6620	68	24	50.0	1.20	5.05	0.0504	0.050	0.050	0.0773	0.0248
KFM08D	825.00	835.00	2	79172	2020-08-25	−1.27	2170	4.93	2840	1.05	26.3	8470	143	46	70.0	1.20	4.19	< 0.1			< 0.02	0.0278
KFM08D	825.00	835.00	2	79173	2020-08-26	−2.45	2220	5.51	2890	2.32	19.3	8860	142	46	70.0	1.10	4.00	< 0.1			< 0.02	0.0281
KFM08D	825.00	835.00	2	79174	2020-08-28	−1.33	2180	5.20	2840	2.38	12.0	8510	140	46	69.0	1.10	4.08	0.005	< 0.02	< 0.02	0.004	0.0282
KFM10A	430.00	440.00	2	79178	2020-06-16	−0.10	2200	31.40	1120	217	102.0	5550	570	198	20.0	1.10	7.33	2.440			1.310	0.0599
KFM10A	430.00	440.00	2	79179	2020-06-17	0.05	2200	31.20	1120	217	102.0	5530	562	199	19.8	1.20	7.32	2.580			1.360	0.0601
KFM10A	430.00	440.00	2	79180	2020-06-18	0.11	2230	31.30	1130	219	94.0	5600	560	199	19.1	1.20	7.21	2.710	2.750	2.740	1.410	0.0599
KFM11A	690.00	710.00	2	79181	2020-06-30	−0.68	2070	8.50	2300	15.4	10.9	7330	114	35	53.0	1.20	4.78	< 0.1			0.0476	0.0485
KFM11A	690.00	710.00	2	79182	2020-07-01	−0.41	2070	8.30	2300	15.2	9.5	7290	107	35	53.0	1.20	4.70	< 0.1			0.0486	0.0482
KFM11A	446.00	456.00	4	79184	2020-07-01	−0.42	1590	5.86	1590	21.3	9.6	5190	247	85	25.0	1.10	3.66	< 0.1			0.0534	0.0479
KFM11A	446.00	456.00	4	79185	2020-07-01	2.17	1630	5.90	1610	21.7	8.0	5010	260	86	26.0	1.10	3.89	< 0.1			0.0593	0.0489
KFM11A	690.00	710.00	2	79183	2020-07-01	1.42	2090	8.34	2310	15.3	9.2	7070	101	35	55.0	1.20	4.75	0.0815	0.090	0.080	0.0494	0.0478
KFM11A	446.00	456.00	4	79186	2020-07-01	2.46	1610	6.16	1640	21.8	7.6	5000	241	87	24.0	1.10	3.94	0.0587	0.060	0.060	0.0628	0.0505
KFM12A	270.00	280.00	3	79187	2020-08-20	0.29	1060	6.89	1260	35.3	28.3	3890	60	21	26.0	0.78	4.01	0.106			0.368	0.0453
KFM12A	270.00	280.00	3	79188	2020-08-20	−0.80	1070	6.86	1270	35.3	29.9	4010	65	21	28.0	0.78	3.85	0.103			0.388	0.0460
KFM12A	270.00	280.00	3	79189	2020-08-20	−0.58	1060	7.02	1270	36.5	31.2	3980	59	21	27.0	0.78	3.79	0.113	0.110	0.110	0.418	0.0450
KFR101	279.50	341.80	1	79217	2020-08-18	0.41	820	4.53	409	31.9	60.1	1990	51	19	10.5	1.40	5.05	0.268			0.474	0.0332
KFR101	279.50	341.80	1	79218	2020-08-19	1.04	843	4.59	416	33.0	61.8	2010	55	20	10.5	1.40	5.09	0.346			0.483	0.0336
KFR101	279.50	341.80	1	79219	2020-08-19	−0.43	828	4.71	416	33.0	61.7	2050	55	20	10.6	1.40	5.08	0.360	0.360	0.350	0.484	0.0334
KFR102A	214.00	219.00	5	79223	2020-09-15	1.46	1570	8.78	626	107	85.7	3460	289	103	13.2	1.20	5.43	0.336			0.410	0.0456
KFR102A	214.00	219.00	5	79224	2020-09-16	1.63	1570	8.80	627	104	87.0	3440	291	103	13.2	1.20	5.31	0.389			0.434	0.0465
KFR102A	214.00	219.00	5	79225	2020-09-16	2.31	1600	8.89	629	104	86.5	3440	295	102	13.3	1.20	5.30	0.405	0.410	0.410	0.438	0.0445
KFR102A	423.00	443.00	2	79220	2020-09-16	2.08	1530	8.03	996	83.6	39.2	3980	252	87	18.0	1.20	5.38	0.6510			0.441	0.0482
KFR102A	423.00	443.00	2	79221	2020-09-17	2.78	1530	8.14	1020	82.8	38.7	3960	243	87	18.1	1.30	5.38	0.7100			0.454	0.0480
KFR102A	423.00	443.00	2	79222	2020-09-18	3.07	1530	8.42	1040	82.0	38.1	3970	241	86	18.4	1.30	5.34	0.7490	0.770	0.770	0.458	0.0457

RCB % = Rel. charge balance error %.

< “value” = value below reporting limit.

Table A3-1. Water composition 2020, continued.

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
KFR104	333.00	454.60	1	79226	2020-08-26	0.77	755	3.53	409	5.27	23.9	1 830	41	14	10.1	1.50	3.97	< 0.02			0.003	0.0211
KFR104	333.00	454.60	1	79227	2020-08-28	0.76	770	3.55	430	7.12	23.3	1 880	49	21	10.1	1.50	4.08	< 0.02			0.006	0.0223
KFR104	333.00	454.60	1	79228	2020-08-31	0.61	789	3.64	445	8.56	22.1	1 950	57	20	10.3	1.50	4.34	0.009	< 0.02	< 0.02	0.010	0.0234
KFR106	260.00	300.10	1	79235	2020-09-01	1.44	937	10.20	414	54.5	118.0	2 120	94	40	9.7	1.50	4.74	0.039			0.206	0.0382
KFR106	260.00	300.10	1	79236	2020-09-01	2.06	1 010	10.20	480	61.8	116.0	2 330	111	42	10.3	1.50	5.03	0.102			0.277	0.0385
KFR106	143.00	259.00	2	79238	2020-09-01	−1.89	1 680	14.80	706	164	115.0	4 170	338	118	15.1	1.20	5.46	0.923			1.020	0.0555
KFR106	260.00	300.10	1	79237	2020-09-01	1.20	1 120	9.80	594	70.2	89.6	2 760	145	49	12.4	1.40	5.11	0.393	0.410	0.410	0.375	0.0434
KFR106	143.00	259.00	2	79239	2020-09-02	−1.27	1 710	14.80	741	169	112.0	4 240	377	119	16.6	1.20	5.49	1.140			1.060	0.0575
KFR106	143.00	259.00	2	79240	2020-09-02	−1.58	1 690	14.90	744	170	111.0	4 250	339	118	15.4	1.20	5.45	1.130	1.210	1.210	1.060	0.0561
KFR01	44.65	62.30	1	79229	2020-08-31	0.06	1 500	8.87	580	117	103.0	3 350	380	124	13.1	1.10	4.36	0.433			0.607	0.0573
KFR01	44.65	62.30	1	79230	2020-08-31	0.48	1 520	8.93	576	117	104.0	3 340	353	125	12.3	1.10	4.40	0.460			0.615	0.0566
KFR01	44.65	62.30	1	79231	2020-09-01	0.40	1 510	9.26	570	117	105.0	3 320	356	125	12.3	1.10	4.37	0.439	0.450	0.450	0.619	0.0556
KFR105	265.00	306.81	1	79232	2020-09-15	1.73	1 380	6.50	735	100	86.5	3 350	262	91	12.1	1.20	4.83	0.687			1.420	0.0563
KFR105	265.00	306.81	1	79233	2020-09-16	1.56	1 380	6.53	734	100	87.1	3 360	261	91	12.1	1.20	4.82	0.682			1.410	0.0558
KFR105	265.00	306.81	1	79234	2020-09-17	2.26	1 370	6.61	731	99.8	87.1	3 290	261	92	12.1	1.20	4.86	0.681	0.710	0.700	1.410	0.0557

RCB % = Rel. charge balance error %.

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Table A3-1. Water composition 2020, continued.

Id-code	Secup m	Seclow m	Sec no.	Sample no.	Sampling Date	Sr mg/L	I^- mg/L	pH_L	pH_F	TOC mg/L	DOC mg/L	HS^- mg/L	Uranine µg/L	EC_L mS/m	EC_F mS/m	NO_2-N mg/L	NO_3-N mg/L	NH_4-N mg/L	NO_2-N+ NO_3-N mg/L
HFM01	33.50	45.50	2	79190	2020-06-29	0.292		7.98	7.90	10.7	10.8	0.058	1.90	219.0	209.5				
HFM01	33.50	45.50	2	79191	2020-06-30	0.294		7.94	7.94	10.6	10.7	0.045	2.10	220.0	209.9				
HFM01	33.50	45.50	2	79192	2020-07-02	0.299	0.0109	7.93	7.88	10.8	11.1	0.042	2.00	226.0	208.4	< 0.0002	0.0005	0.7100	0.0005
HFM02	38.00	48.00	2	79193	2020-08-18	0.291		7.82	7.57	12.3	12.1	0.035	1.80	139.0	135.7				
HFM02	38.00	48.00	2	79194	2020-08-19	0.298		7.82	7.59	12.0	11.9	0.032	1.90	135.0	132.2				
HFM02	38.00	48.00	2	79195	2020-08-20	0.287	< 0.0100	7.78	7.79	12.3	12.1	0.038	1.90	135.0	120.8	< 0.0002	< 0.0003	0.4470	< 0.0003
HFM04	58.00	66.00	2	79196	2020-07-02	0.268		7.79	7.80	11.0	11.2	0.046	1.60	95.0	90.7				
HFM04	58.00	66.00	2	81776	2020-08-24			7.74	7.98	11.0	11.3	0.046	1.60	95.0	87.4				
HFM04	58.00	66.00	2	79197	2020-08-24	0.255		7.78	7.90	11.0	11.2	0.044	1.60	94.0	86.3				
HFM04	58.00	66.00	2	79198	2020-08-25	0.254	0.0209	7.69	7.77	11.2	10.9	0.042	1.70	95.0	88.9	< 0.0002	0.0017	0.5330	0.0017
HFM13	159.00	173.00	1	79199	2020-06-23	12.500		7.37	7.43	1.9	2.1	0.030	0.80	1480.0	1357.0				
HFM13	159.00	173.00	1	79200	2020-06-26	12.300		7.23		1.8	1.8	0.025	0.60	1460.0					
HFM13	159.00	173.00	1	79201	2020-06-29	12.300	0.0508	7.23	7.48	2.0	1.9	0.020	0.70	1430.0	1319.0	< 0.0002	< 0.0003	1.4600	< 0.0003
HFM15	85.00	95.00	1	79202	2020-06-15	0.316		7.08	7.08	9.2	9.1	0.120	1.20	72.0	68.5				
HFM15	85.00	95.00	1	79203	2020-06-15	0.313		7.18	7.35	9.2	8.7	0.110	1.70	71.0	65.7				
HFM15	85.00	95.00	1	79204	2020-06-26	0.307	0.0054	7.24		9.2	9.2	0.110	1.40	71.0		< 0.0002	0.0005	0.3080	0.0006
HFM16	54.00	67.00	2	79205	2020-06-09	0.274		7.90	7.84	14.2	14.8	0.082	2.70	129.0	123.1				
HFM16	54.00	67.00	2	79206	2020-06-10	0.274		7.88	7.85	14.4	14.4	0.068	2.30	129.0	123.4				
HFM16	54.00	67.00	2	79207	2020-06-11	0.274	0.0089	7.79	8.28	14.4	14.4	0.069	2.30	130.0	123.9	< 0.0002	< 0.0003	0.6870	< 0.0003
HFM21	22.00	32.00	3	79208	2020-08-24	0.307		7.64	7.75	10.0	10.0	0.034	1.70	154.0	145.5				
HFM21	22.00	32.00	3	79209	2020-08-25	0.303		7.56	7.68	10.0	10.2	0.039	1.90	150.0	145.5				
HFM21	22.00	32.00	3	79210	2020-08-26	0.299	0.0128	7.71	7.70	10.1	10.4	0.038	1.80	152.0	143.6	< 0.0002	< 0.0003	0.4370	< 0.0003
HFM27	46.00	58.00	2	79211	2020-08-24	2.010		7.50	7.65	6.3	6.3	0.032	1.60	629.0	607.0				
HFM27	46.00	58.00	2	79212	2020-08-25	1.990		7.55	7.57	6.3	6.4	0.034	1.40	621.0	595.0				
HFM27	46.00	58.00	2	79213	2020-08-27	1.930	0.0217	7.53	7.56	6.4	6.8	0.031	1.50	612.0	582.0	< 0.0002	< 0.0003	1.4300	< 0.0003

pH_L; EC_L = Laboratory measurements of pH and EC.

pH_F; EC_F = Field measurements of pH and EC.

< “value” = value below reporting limit.

Table A3-1. Water composition 2020, continued.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling Date	Sr mg/L	I^- mg/L	pH_L	pH_F	TOC mg/L	DOC mg/L	HS^- mg/L	Uranine µg/L	EC_L mS/m	EC_F mS/m	NO_2-N mg/L	NO_3-N mg/L	NH_4-N mg/L	NO_2-N+ NO_3-N mg/L
HFM32	26.00	31.00	3	79214	2020-06-23	3.33		7.27	7.35	3.4	3.5	0.230	0.70	1 190.0	1 140.0				
HFM32	26.00	31.00	3	79215	2020-06-23	3.34		7.28	7.28	3.5	3.4	0.110	0.70	1 190.0	1 150.0				
HFM32	26.00	31.00	3	79216	2020-06-23	3.34	0.0532	7.08	7.38	3.3	3.3	0.069	0.70	1 200.0	1 137.0	< 0.0002	< 0.0003	2.1400	< 0.0003
KFM01A	109.00	130.00	5	79121	2020-06-29	6.19		7.77	8.01	1.7	1.7	0.330	29.00	1 140.0	1 055.0				
KFM01A	109.00	130.00	5	79122	2020-06-30	6.06		7.74	8.04	1.8	1.8	0.270	31.00	1 120.0	1 039.0				
KFM01A	109.00	130.00	5	79123	2020-06-30	6.03	0.0622	7.73	8.02	1.7	1.7	0.230	33.00	1 110.0	1 019.0	< 0.0002	< 0.0003	0.8010	
KFM01D	429.00	438.00	2	79124	2020-06-25	16.50		8.29	7.66	2.4	2.3	2.100	14.00	1 420.0	1 284.0				
KFM01D	429.00	438.00	2	79125	2020-06-25	16.50		8.10	7.73	2.1	2.1	2.200	13.60	1 420.0	1 267.0				
KFM01D	429.00	438.00	2	79126	2020-06-29	16.80	0.1570	7.78	8.44	2.3	2.1	3.600	12.60	1 420.0	1 337.0	< 0.0002	< 0.0003	0.2490	< 0.0003
KFM01D	311.00	321.00	4	79127	2020-07-02	13.60		7.73	8.38	1.7	1.6	0.260	7.80	1 320.0	1 209.0				
KFM01D	311.00	321.00	4	79128	2020-07-02	12.60		7.77	8.27	1.8	1.8	0.200	12.00	1 310.0	1 211.0				
KFM01D	311.00	321.00	4	79129	2020-07-02	12.10	0.1220	7.62	8.15	2.0	2.1	0.150	13.80	1 280.0	1 178.0	< 0.0002	< 0.0003	0.4350	< 0.0003
KFM02A	490.00	518.00	3	79130	2020-06-11	9.13		7.28	7.41	1.8	1.7	0.220	6.80	1 590.0	1 470.0				
KFM02A	490.00	518.00	3	79131	2020-06-12	9.15		7.33	7.25	1.6	1.5	0.150	6.70	1 570.0	1 482.0				
KFM02A	490.00	518.00	3	79132	2020-06-12	9.18	0.0873	7.35	7.30	1.5	1.5	0.130	6.80	1 580.0	1 479.0	< 0.0002	0.0006	2.6200	0.0007
KFM02A	411.00	442.00	5	79133	2020-06-15	13.00		7.30	7.56	1.3	1.3	0.230	13.90	1 560.0	1 425.0				
KFM02A	411.00	442.00	5	79134	2020-06-16	12.90		7.39	7.61	1.1	1.1	0.160	38.00	1 560.0	1 388.0				
KFM02A	411.00	442.00	5	79135	2020-06-17	13.00	0.1300	7.30	7.52	1.9	1.1	0.160	33.00	1 560.0	1 455.0	< 0.0002	0.0004	1.7000	0.0006
KFM02B	491.00	506.00	2	79136	2020-06-10	9.15		7.49	7.63	1.5	1.6	0.100	1.80	1 600.0	1 484.0				
KFM02B	491.00	506.00	2	79137	2020-06-10	8.61		7.33	7.56	1.5	1.5	0.100	1.90	1 610.0	1 470.0				
KFM02B	491.00	506.00	2	79138	2020-06-11	8.64	0.5510	7.36	7.52	1.4	1.4	0.071	2.10	1 610.0	1 456.0	< 0.0002	< 0.0003	2.7200	< 0.0003
KFM02B	410.00	431.00	4	79139	2020-06-17	11.60		7.39	7.44	1.1	1.2	0.110	3.60	1 570.0	1 394.0				
KFM02B	410.00	431.00	4	79140	2020-06-18	11.70		7.36	7.63	1.1	1.1	0.079	3.90	1 580.0	1 449.0				
KFM02B	410.00	431.00	4	79141	2020-06-18	11.80	0.1030	7.40	7.58	1.1	1.1	0.082	4.00	1 580.0	1 491.0	< 0.0002	< 0.0003	1.9800	< 0.0003
KFM03A	969.50	994.50	1	79142	2020-06-22	44.00		7.63	7.75	0.5	0.5	0.160	0.50	2 670.0	2 480.0				
KFM03A	969.50	994.50	1	79143	2020-06-24	42.80		7.87	7.93	0.5	0.7	0.097	< 0.50	2 690.0	2 490.0				
KFM03A	633.50	650.00	4	79145	2020-06-24	19.60		7.18	7.84	0.9	0.9	0.390	2.60	1 610.0	1 460.0				

pH_L; EC_L = Laboratory measurements of pH and EC.

pH_F; EC_F = Field measurements of pH and EC.

< “value” = value below reporting limit.

Table A3-1. Water composition 2020, continued.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling Date	Sr mg/L	I^- mg/L	pH_L	pH_F	TOC mg/L	DOC mg/L	HS^- mg/L	Uranine µg/L	EC_L mS/m	EC_F mS/m	NO_2-N mg/L	NO_3-N mg/L	NH_4-N mg/L	NO_2-N+ NO_3-N mg/L
KFM03A	633.50	650.00	4	79146	2020-06-24	19.60		7.33	7.76	0.8	0.7	0.130	2.50	1590.0	1452.0				
KFM03A	633.50	650.00	4	79147	2020-06-25	19.80	0.1500	7.44	7.73	0.6	0.6	0.096	2.20	1610.0	1413.0	< 0.0002	< 0.0003	0.1480	< 0.0003
KFM03A	969.50	994.50	1	79144	2020-06-25	44.60	0.4170	7.77	7.28	0.5	< 0.3	0.078	0.60	2680.0	2440.0	< 0.0002	< 0.0003	0.0156	< 0.0003
KFM04A	230.00	245.00	4	79148	2020-06-22	16.60		7.31	7.55	1.2	1.1	0.350	1.60	1680.0	1520.0				
KFM04A	230.00	245.00	4	79149	2020-06-22	16.50		7.26	7.46	1.1	1.1	0.220	1.60	1680.0	1569.0				
KFM04A	230.00	245.00	4	79150	2020-06-22	16.60	0.0719	7.33	7.43	1.1	1.1	0.170	1.50	1680.0	1559.0	< 0.0002	0.0011	1.5300	0.0011
KFM06A	341.00	362.00	5	79154	2020-06-08	15.80		8.33	8.55	1.5	1.5	0.270	18.00	1300.0	1244.0				
KFM06A	341.00	362.00	5	79155	2020-06-08	16.10		8.00	8.34	1.4	1.3	0.140	16.00	1320.0	1220.0				
KFM06A	341.00	362.00	5	79156	2020-06-09	16.50	0.1530	7.86	8.23	1.4	1.1	0.077	14.50	1330.0	1225.0	< 0.0002	< 0.0003	0.1760	< 0.0003
KFM06A	738.00	748.00	3	79151	2020-06-09	26.90		8.30	8.57	0.9	1.0	0.074	26.00	1840.0	1657.0				
KFM06A	738.00	748.00	3	79152	2020-06-10	27.20		8.31	8.61	0.9	0.9	0.072	24.00	1840.0	1704.0				
KFM06A	738.00	748.00	3	79153	2020-06-11	27.40	0.2420	8.40	8.82	1.1	1.0	0.088	23.00	1850.0	1713.0	< 0.0002	0.0010	0.1390	0.0010
KFM06C	531.00	540.00	5	79160	2020-06-08	14.80		7.99	8.19	1.6	1.9	0.210	43.00	1420.0	1338.0				
KFM06C	531.00	540.00	5	79161	2020-06-08	14.80		7.88	8.07	1.4	1.4	0.230	42.00	1430.0	1314.0				
KFM06C	647.00	666.00	3	79157	2020-06-08	23.40		9.16	9.52	1.0	1.1	0.250	11.50	1560.0	1449.0				
KFM06C	531.00	540.00	5	79162	2020-06-09	15.10	0.1000	7.87	8.10	1.2*	2.5*	0.220	42.00	1430.0	1315.0	< 0.0002	0.0032	0.4410	0.0032
KFM06C	647.00	666.00	3	79158	2020-06-12	23.30		8.78	9.03	0.9	1.0	0.160	10.40	1560.0	1458.0				
KFM06C	647.00	666.00	3	79159	2020-06-15	23.60	0.2150	8.63	8.58	0.7	1.0	0.140	9.90	1570.0	1384.0	< 0.0002	< 0.0003	0.0920	0.0003
KFM07A	962.00	972.00	2	79163	2020-08-31	68.00		8.86	9.28	1.6	1.2	0.380	0.90	3600.0	3480.0				
KFM07A	962.00	972.00	2	79164	2020-08-31	67.50		8.76	9.19	0.8	0.8	0.390	0.90	3620.0	3390.0				
KFM07A	962.00	972.00	2	79165	2020-09-01	67.20	0.4350	8.68	9.09	1.3	1.4	0.460	0.90	3610.0	3470.0	< 0.0002	< 0.0003	0.0058	< 0.0003
KFM08A	684.00	694.00	2	79166	2020-08-17	25.40		8.75	8.91	0.8	0.7	0.120	9.70	1720.0	1630.0				
KFM08A	684.00	694.00	2	79167	2020-08-17	25.20		8.59	8.68	0.8	0.8	0.070	10.10	1700.0	1631.0				
KFM08A	684.00	694.00	2	79168	2020-08-17	25.10	0.2660	8.45	8.57	0.8	0.8	0.058	10.30	1710.0	1626.0	< 0.0002	< 0.0003	0.0709	< 0.0003
KFM08A	265.00	280.00	6	79169	2020-08-18	10.60		7.63	7.74	1.4	1.4	0.088	6.00	1060.0	999.0				
KFM08A	265.00	280.00	6	79170	2020-08-19	10.60		7.42	7.65	1.4	1.3	0.071	5.80	1050.0	994.0				
KFM08A	265.00	280.00	6	79171	2020-08-21	10.60	0.1250	7.64	7.82	1.3	1.3	0.067	5.80	1060.0	1019.0	< 0.0002	< 0.0003	0.3170	< 0.0003

pH_L; EC_L = Laboratory measurements of pH and EC.

pH_F; EC_F = Field measurements of pH and EC.

< "value" = value below reporting limit.

* possibly affected sample (DOC >> TOC).

Table A3-1. Water composition 2020, continued.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling Date	Sr mg/L	I^- mg/L	pH_L	pH_F	TOC mg/L	DOC mg/L	HS^- mg/L	Uranine µg/L	EC_L mS/m	EC_F mS/m	NO_2-N mg/L	NO_3-N mg/L	NH_4-N mg/L	NO_2-N+ NO_3-N mg/L
KFM08D	660.00	680.00	4	79175	2020-08-17	26.00		8.30	8.38	0.5	0.6	< 0.019	23.00	1790.0	1713.0				
KFM08D	660.00	680.00	4	79176	2020-08-19	26.20		8.13	8.38	0.4	0.4	< 0.019	23.00	1800.0	1706.0				
KFM08D	660.00	680.00	4	79177	2020-08-21	26.30	0.2460	8.29	8.54	0.5	0.4	< 0.019	21.00	1800.0	1615.0	< 0.0002	< 0.0003	0.0683	< 0.0003
KFM08D	825.00	835.00	2	79172	2020-08-25	33.50		9.65	10.20	2.0*	6.1*	< 0.019	0.70	2250.0	2105.0				
KFM08D	825.00	835.00	2	79173	2020-08-26	34.00		8.91	9.35	0.7*	14.3*	0.025	0.60	2280.0	2099.0				
KFM08D	825.00	835.00	2	79174	2020-08-28	33.40	0.3190	9.07	9.03	0.5	0.7	< 0.019	0.60	2250.0	2093.0	< 0.0002	0.0015	0.0124	0.0015
KFM10A	430.00	440.00	2	79178	2020-06-16	11.90		7.65	7.72	1.4	1.5	0.120	1.50	1590.0	1429.0				
KFM10A	430.00	440.00	2	79179	2020-06-17	11.90		7.40	7.59	1.5	1.5	0.110	1.40	1600.0	1454.0				
KFM10A	430.00	440.00	2	79180	2020-06-18	12.00	0.0355	7.57	7.60	1.4	1.4	0.110	1.30	1590.0	1447.0	< 0.0002	< 0.0003	1.2800	< 0.0003
KFM11A	690.00	710.00	2	79181	2020-06-30	31.60		8.60	8.99	< 0.3	< 0.3	0.150	0.50	1920.0	1802.0				
KFM11A	690.00	710.00	2	79182	2020-07-01	31.60		8.44	8.88	< 0.3	< 0.3	0.130	< 0.50	1930.0	1747.0				
KFM11A	446.00	456.00	4	79184	2020-07-01	22.70		8.74	8.93	1.0	0.8	0.210	1.80	1420.0	1333.0				
KFM11A	446.00	456.00	4	79185	2020-07-01	23.20		8.50	8.70	0.7	0.7	0.130	1.90	1420.0	1328.0				
KFM11A	690.00	710.00	2	79183	2020-07-01	31.70	0.2370	8.40	8.70	< 0.3	< 0.3	0.130	0.50	1930.0	1790.0	< 0.0002	< 0.0003	0.0628	< 0.0003
KFM11A	446.00	456.00	4	79186	2020-07-01	23.30	0.1090	8.44	8.70	0.7	0.7	0.160	1.80	1410.0	1311.0	< 0.0002	< 0.0003	0.0285	< 0.0003
KFM12A	270.00	280.00	3	79187	2020-08-20	19.60		7.80	7.82	0.7	0.9	0.300	1.40	1120.0	975.0				
KFM12A	270.00	280.00	3	79188	2020-08-20	19.70		7.65	7.89	0.6	0.7	0.230	1.30	1120.0	1016.0				
KFM12A	270.00	280.00	3	79189	2020-08-20	19.50	0.1280	7.57	7.70	0.7	0.7	0.130	1.40	1120.0	1015.0	< 0.0002	0.0008	0.0413	0.0009
KFR101	279.50	341.80	1	79217	2020-08-18	6.75		7.75	7.63	1.7	2.5	0.480	< 0.50	605.0	592.0				
KFR101	279.50	341.80	1	79218	2020-08-19	6.87		7.63	7.64	1.4	1.2	0.340	< 0.50	611.0	613.0				
KFR101	279.50	341.80	1	79219	2020-08-19	6.82	0.1080	7.55	6.17	2.2	1.7	0.300	< 0.50	612.0	612.0	< 0.0002	0.0004	0.0482	0.0004
KFR102A	214.00	219.00	5	79223	2020-09-15	9.88		7.70	7.95	1.3	1.2	0.320	0.90	1050.0	980.0				
KFR102A	214.00	219.00	5	79224	2020-09-16	9.90		7.65	7.88	1.3	1.3	0.240	0.90	1050.0	996.0				
KFR102A	214.00	219.00	5	79225	2020-09-16	9.93	0.0749	7.62	7.95	1.2	1.2	0.240	0.80	1050.0	993.0	< 0.0002	< 0.0003	0.0783	< 0.0003
KFR102A	423.00	443.00	2	79220	2020-09-16	14.70		7.65	8.07	0.7	0.7	0.260	< 0.50	1160.0	1068.0				
KFR102A	423.00	443.00	2	79221	2020-09-17	15.10		7.72	8.00	0.7	0.8	0.220	< 0.50	1170.0	1113.0				
KFR102A	423.00	443.00	2	79222	2020-09-18	15.30	0.1080	7.63	7.93	0.8	0.7	0.210	< 0.50	1190.0	1126.0	< 0.0002	0.0010	0.0345	0.0010

pH_L; EC_L = Laboratory measurements of pH and EC.

pH_F; EC_F = Field measurements of pH and EC.

SICADA_17_037.

< “value” = value below reporting limit.

* possibly affected sample (DOC >> TOC).

Table A3-1. Water composition 2020, continued.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling Date	Sr mg/L	I^- mg/L	pH_L	pH_F	TOC mg/L	DOC mg/L	HS^- mg/L	Uranine µg/L	EC_L mS/m	EC_F mS/m	NO_2-N mg/L	NO_3-N mg/L	NH_4-N mg/L	NO_2-N+ NO_3-N mg/L
KFR104	333.00	454.60	1	79226	2020-08-26	6.88		9.01	9.13	1.3	1.1	1.500	1.10	560.0	621.0				
KFR104	333.00	454.60	1	79227	2020-08-28	7.19		8.96	8.82	1.1	0.8	1.100	1.30	580.0	590.0				
KFR104	333.00	454.60	1	79228	2020-08-31	7.37	0.0894	8.82	8.48	2.0	1.5	0.630	1.30	594.0	590.0	< 0.0002	< 0.0003	0.0180	< 0.0003
KFR106	260.00	300.10	1	79235	2020-09-01	6.52		7.73	7.76	5.4	4.4	3.100	0.60	668.0	646.0				
KFR106	260.00	300.10	1	79236	2020-09-01	7.57		7.78	7.87	3.1*	4.8*	2.500	0.70	725.0	736.0				
KFR106	143.00	259.00	2	79238	2020-09-01	9.09		7.36	7.55	1.6	1.9	0.450	0.60	1240.0	1147.0				
KFR106	260.00	300.10	1	79237	2020-09-01	9.39	0.0830	7.62	7.83	3.8	2.7	1.600	1.20	838.0	715.0	< 0.0002	< 0.0003	0.1370	< 0.0003
KFR106	143.00	259.00	2	79239	2020-09-02	9.49		7.41	7.50	1.7	1.6	0.460	0.60	1260.0	1199.0				
KFR106	143.00	259.00	2	79240	2020-09-02	9.53	0.0483	7.41	7.48	1.3	1.2	0.360	0.60	1260.0	1213.0	< 0.0002	< 0.0003	0.2060	< 0.0003
KFR01	44.65	62.30	1	79229	2020-08-31	8.95		7.52	7.15	1.4*	5.3*	< 0.019	< 0.50	1040.0	970.0				
KFR01	44.65	62.30	1	79230	2020-08-31	8.86		7.49	7.20	1.4*	5.4*	< 0.019	< 0.50	1040.0	965.0				
KFR01	44.65	62.30	1	79231	2020-09-01	8.75	0.0320	7.57	7.20	2.3	1.8	< 0.019	< 0.50	1030.0	955.0	< 0.0002	< 0.0003	0.2190	< 0.0003
KFR105	265.00	306.81	1	79232	2020-09-15	11.60		7.56	7.25	0.8	1.0	< 0.019	< 0.50	1010.0	970.0				
KFR105	265.00	306.81	1	79233	2020-09-16	11.60		7.54	7.24	0.9		< 0.019	< 0.50	1010.0	1000.0				
KFR105	265.00	306.81	1	79234	2020-09-17	11.60	0.0524	7.61	7.37	0.9	0.9	< 0.019	< 0.50	1000.0	1006.0	< 0.0002	< 0.0003	0.0118	< 0.0003

pH_L; EC_L = Laboratory measurements of pH and EC.

pH_F; EC_F = Field measurements of pH and EC.

< “value” = value below reporting limit.

* possibly affected sample (DOC >> TOC).

Table A3-1. Water composition 2020, continued.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling Date	PO_4-P mg/L	PO_4-P[2] mg/L	P mg/L	Temp_F
HFM01	33.50	45.50	2	79190	2020-06-29				14.7
HFM01	33.50	45.50	2	79191	2020-06-30				12.4
HFM01	33.50	45.50	2	79192	2020-07-02	0.0635	0.0819		12.7
HFM02	38.00	48.00	2	79193	2020-08-18				18.0
HFM02	38.00	48.00	2	79194	2020-08-19				17.1
HFM02	38.00	48.00	2	79195	2020-08-20	0.0312	0.0403		13.4
HFM04	58.00	66.00	2	79196	2020-07-02				10.5
HFM04	58.00	66.00	2	81776	2020-08-24				10.1
HFM04	58.00	66.00	2	79197	2020-08-24				11.0
HFM04	58.00	66.00	2	79198	2020-08-25	0.0119	0.0192		8.6
HFM13	159.00	173.00	1	79199	2020-06-23				14.4
HFM13	159.00	173.00	1	79200	2020-06-26				
HFM13	159.00	173.00	1	79201	2020-06-29	< 0.0005	< 0.0005		14.1
HFM15	85.00	95.00	1	79202	2020-06-15				10.4
HFM15	85.00	95.00	1	79203	2020-06-15				13.7
HFM15	85.00	95.00	1	79204	2020-06-26	0.0011	0.0067		
HFM16	54.00	67.00	2	79205	2020-06-09				8.9
HFM16	54.00	67.00	2	79206	2020-06-10				7.9
HFM16	54.00	67.00	2	79207	2020-06-11	0.0543	0.0733		8.0
HFM21	22.00	32.00	3	79208	2020-08-24				16.0
HFM21	22.00	32.00	3	79209	2020-08-25				15.0
HFM21	22.00	32.00	3	79210	2020-08-26	0.0074	0.0202		14.9
HFM27	46.00	58.00	2	79211	2020-08-24				13.7
HFM27	46.00	58.00	2	79212	2020-08-25				16.8
HFM27	46.00	58.00	2	79213	2020-08-27	< 0.0005	0.0140		12.2

PO_4-P* = P after hydrolysis.

< “value” = value below reporting limit.

Table A3-1. Water composition 2020, continued.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling Date	PO_4-P mg/L	PO_4-P^2 mg/L	P mg/L	Temp_F
HFM32	26.00	31.00	3	79214	2020-06-23				13.9
HFM32	26.00	31.00	3	79215	2020-06-23				19.3
HFM32	26.00	31.00	3	79216	2020-06-23	< 0.0005	0.0082		15.3
KFM01A	109.00	130.00	5	79121	2020-06-29				15.0
KFM01A	109.00	130.00	5	79122	2020-06-30				13.0
KFM01A	109.00	130.00	5	79123	2020-06-30	< 0.0005	< 0.0005		13.8
KFM01D	429.00	438.00	2	79124	2020-06-25				28.0
KFM01D	429.00	438.00	2	79125	2020-06-25				27.3
KFM01D	429.00	438.00	2	79126	2020-06-29	0.0008	0.0012		17.8
KFM01D	311.00	321.00	4	79127	2020-07-02				13.1
KFM01D	311.00	321.00	4	79128	2020-07-02				11.8
KFM01D	311.00	321.00	4	79129	2020-07-02	0.0014	0.0046		11.9
KFM02A	490.00	518.00	3	79130	2020-06-11				14.7
KFM02A	490.00	518.00	3	79131	2020-06-12				13.0
KFM02A	490.00	518.00	3	79132	2020-06-12	< 0.0005	< 0.0005		15.6
KFM02A	411.00	442.00	5	79133	2020-06-15				11.6
KFM02A	411.00	442.00	5	79134	2020-06-16				14.2
KFM02A	411.00	442.00	5	79135	2020-06-17	< 0.0005	< 0.0005		12.5
KFM02B	491.00	506.00	2	79136	2020-06-10				9.7
KFM02B	491.00	506.00	2	79137	2020-06-10				11.9
KFM02B	491.00	506.00	2	79138	2020-06-11	< 0.0005	< 0.0005		9.7
KFM02B	410.00	431.00	4	79139	2020-06-17				10.7
KFM02B	410.00	431.00	4	79140	2020-06-18				9.9
KFM02B	410.00	431.00	4	79141	2020-06-18	< 0.0005	< 0.0005		10.5
KFM03A	969.50	994.50	1	79142	2020-06-22				16.3
KFM03A	969.50	994.50	1	79143	2020-06-24				20.0
KFM03A	633.50	650.00	4	79145	2020-06-24				13.0

PO_4-P* = P after hydrolysis.

< “value” = value below reporting limit.

Table A3-1. Water composition 2020, continued.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling Date	PO_4-P mg/L	PO_4-P^2 mg/L	P mg/L	Temp_F
KFM03A	633.50	650.00	4	79146	2020-06-24				14.3
KFM03A	633.50	650.00	4	79147	2020-06-25	< 0.0005	0.0005		12.6
KFM03A	969.50	994.50	1	79144	2020-06-25	< 0.0005	< 0.0005		30.8
KFM04A	230.00	245.00	4	79148	2020-06-22				13.1
KFM04A	230.00	245.00	4	79149	2020-06-22				12.8
KFM04A	230.00	245.00	4	79150	2020-06-22	< 0.0005	< 0.0005		12.5
KFM06A	341.00	362.00	5	79154	2020-06-08				14.8
KFM06A	341.00	362.00	5	79155	2020-06-08				13.5
KFM06A	341.00	362.00	5	79156	2020-06-09	< 0.0005	< 0.0005		15.2
KFM06A	738.00	748.00	3	79151	2020-06-09				20.8
KFM06A	738.00	748.00	3	79152	2020-06-10				18.8
KFM06A	738.00	748.00	3	79153	2020-06-11	0.0006	0.0009		13.9
KFM06C	531.00	540.00	5	79160	2020-06-08				15.7
KFM06C	531.00	540.00	5	79161	2020-06-08				15.2
KFM06C	647.00	666.00	3	79157	2020-06-08				19.1
KFM06C	531.00	540.00	5	79162	2020-06-09	0.0010	0.0017		16.7
KFM06C	647.00	666.00	3	79158	2020-06-12				21.0
KFM06C	647.00	666.00	3	79159	2020-06-15	0.0009	0.0013		26.3
KFM07A	962.00	972.00	2	79163	2020-08-31				9.7
KFM07A	962.00	972.00	2	79164	2020-08-31				12.7
KFM07A	962.00	972.00	2	79165	2020-09-01	< 0.0005	0.0135		13.3
KFM08A	684.00	694.00	2	79166	2020-08-17				13.7
KFM08A	684.00	694.00	2	79167	2020-08-17				15.7
KFM08A	684.00	694.00	2	79168	2020-08-17	0.0010	0.0030		14.9
KFM08A	265.00	280.00	6	79169	2020-08-18				13.8
KFM08A	265.00	280.00	6	79170	2020-08-19				15.4
KFM08A	265.00	280.00	6	79171	2020-08-21	< 0.0005	0.0008		11.9

PO_4-P* = P after hydrolysis.

< “value” = value below reporting limit.

Table A3-1. Water composition 2020, continued.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling Date	PO_4-P mg/L	PO_4-P^2 mg/L	P mg/L	Temp_F
KFM08D	660.00	680.00	4	79175	2020-08-17				18.5
KFM08D	660.00	680.00	4	79176	2020-08-19				17.3
KFM08D	660.00	680.00	4	79177	2020-08-21	< 0.0005	0.0006		20.9
KFM08D	825.00	835.00	2	79172	2020-08-25				17.2
KFM08D	825.00	835.00	2	79173	2020-08-26				17.3
KFM08D	825.00	835.00	2	79174	2020-08-28	< 0.0005	0.0008		15.0
KFM10A	430.00	440.00	2	79178	2020-06-16				14.2
KFM10A	430.00	440.00	2	79179	2020-06-17				13.1
KFM10A	430.00	440.00	2	79180	2020-06-18	< 0.0005	0.0028		12.3
KFM11A	690.00	710.00	2	79181	2020-06-30				14.9
KFM11A	690.00	710.00	2	79182	2020-07-01				11.3
KFM11A	446.00	456.00	4	79184	2020-07-01				12.5
KFM11A	446.00	456.00	4	79185	2020-07-01				15.2
KFM11A	690.00	710.00	2	79183	2020-07-01	< 0.0005	0.0006		12.8
KFM11A	446.00	456.00	4	79186	2020-07-01	< 0.0005	< 0.0005		14.1
KFM12A	270.00	280.00	3	79187	2020-08-20				13.9
KFM12A	270.00	280.00	3	79188	2020-08-20				13.1
KFM12A	270.00	280.00	3	79189	2020-08-20	< 0.0005	< 0.0005		13.7
KFR101	279.50	341.80	1	79217	2020-08-18				12.2
KFR101	279.50	341.80	1	79218	2020-08-19				15.2
KFR101	279.50	341.80	1	79219	2020-08-19	< 0.0005	0.0011		14.6
KFR102A	214.00	219.00	5	79223	2020-09-15				13.2
KFR102A	214.00	219.00	5	79224	2020-09-16				12.7
KFR102A	214.00	219.00	5	79225	2020-09-16	< 0.0005	< 0.0005		12.2
KFR102A	423.00	443.00	2	79220	2020-09-16				9.6
KFR102A	423.00	443.00	2	79221	2020-09-17				9.3
KFR102A	423.00	443.00	2	79222	2020-09-18	< 0.0005	< 0.0005		8.6

Table A3-1. Water composition 2020, continued.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling Date	PO_4-P mg/L	PO_4-P^2 mg/L	P mg/L	Temp_F
KFR104	333.00	454.60	1	79226	2020-08-26				20.0
KFR104	333.00	454.60	1	79227	2020-08-28				15.6
KFR104	333.00	454.60	1	79228	2020-08-31	0.0019	0.0028		12.7
KFR106	260.00	300.10	1	79235	2020-09-01				12.2
KFR106	260.00	300.10	1	79236	2020-09-01				11.0
KFR106	143.00	259.00	2	79238	2020-09-01				13.4
KFR106	260.00	300.10	1	79237	2020-09-01	< 0.0005	0.0012		9.6
KFR106	143.00	259.00	2	79239	2020-09-02				12.0
KFR106	143.00	259.00	2	79240	2020-09-02	< 0.0005	0.0008		15.6
KFR01	44.65	62.30	1	79229	2020-08-31				10.3
KFR01	44.65	62.30	1	79230	2020-08-31				10.6
KFR01	44.65	62.30	1	79231	2020-09-01	< 0.0005	< 0.0005		11.2
KFR105	265.00	306.81	1	79232	2020-09-15				11.2
KFR105	265.00	306.81	1	79233	2020-09-16				10.0
KFR105	265.00	306.81	1	79234	2020-09-17	< 0.0005	< 0.0005		9.6

PO_4-P* = P after hydrolysis.

< “value” = value below reporting limit.

Table A3-2. Trace elements 2020.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling date	Ag µg/L	Al µg/L	As µg/L	B µg/L	Ba µg/L	Cd µg/L	Cr µg/L	Cu µg/L	Co µg/L	Hg µg/L	Ni µg/L	Mo µg/L	Nb µg/L
HFM01	33.50	45.50	2	79192	2020-07-02	< 0.05	2.86	0.244	377	19.6	0.0081	0.374	0.103	0.0359	< 0.002	0.230	11.6	0.0294
HFM02	38.00	48.00	2	79195	2020-08-20	< 0.05	2.28	0.157	231	27.0	0.0026	0.427	< 0.1	0.0292	< 0.002	0.247	7.46	0.0370
HFM04	58.00	66.00	2	79198	2020-08-25	< 0.05	3.77	0.114	196	40.1	< 0.002	0.265	0.168	0.0322	< 0.002	0.104	3.36	0.0639
HFM13	159.00	173.00	1	79201	2020-06-29	< 0.3	0.497	< 0.5	523	67.1	< 0.02	1.24	< 0.2	< 0.02	< 0.002	0.369	3.73	0.0150
HFM15	85.00	95.00	1	79204	2020-06-26	< 0.05	16.4	0.176	73.9	37.0	0.0109	0.282	0.102	0.0255	< 0.002	0.305	9.10	0.0348
HFM16	54.00	67.00	2	79207	2020-06-11	< 0.05	3.58	0.523	298	25.2	0.0148	0.148	< 0.1	0.0272	< 0.002	0.104	22.6	0.0223
HFM21	22.00	32.00	3	79210	2020-08-26	< 0.05	2.56	0.322	213	37.7	< 0.002	0.258	< 0.1	0.0446	< 0.002	0.231	7.41	0.0275
HFM27	46.00	58.00	2	79213	2020-08-27	< 0.3	6.40	0.511	356	32.5	< 0.02	0.354	< 0.2	0.0255	< 0.002	0.593	8.80	0.0165
HFM32	26.00	31.00	3	79216	2020-06-23	< 0.3	2.36	1.46	616	60.0	< 0.02	0.246	< 0.2	0.0262	< 0.002	0.308	12.4	0.0117
KFM01A	109.00	130.00	5	79123	2020-06-30	< 0.3	1.19	< 0.5	733	90.9	0.0436	0.252	< 0.2	< 0.02	< 0.002	< 0.2	26.5	0.0098
KFM01D	429.00	438.00	2	79126	2020-06-29	< 0.3	8.24	< 0.5	624	644	< 0.02	0.265	< 0.2	< 0.02	< 0.002	0.301	0.436	0.0198
KFM01D	311.00	321.00	4	79129	2020-07-02	< 0.3	1.03	< 0.5	661	475	< 0.02	0.222	< 0.2	< 0.02	< 0.002	0.235	4.58	0.0159
KFM02A	490.00	518.00	3	79132	2020-06-12	< 0.5	2.78	< 0.5	587	94.9	0.0748	0.250	< 0.5	0.0672	< 0.002	0.571	90.1	0.0150
KFM02A	411.00	442.00	5	79135	2020-06-17	< 0.5	6.43	< 0.5	663	78.8	< 0.05	0.228	< 0.5	0.0877	< 0.002	< 0.5	14.3	0.0152
KFM02B	491.00	506.00	2	79138	2020-06-11	< 0.5	2.94	< 0.5	600	99.2	< 0.05	0.128	< 0.5	0.1380	< 0.002	0.600	6.84	0.0125
KFM02B	410.00	431.00	4	79141	2020-06-18	< 0.5	2.06	< 0.5	643	83.3	< 0.05	0.148	< 0.5	< 0.05	< 0.002	< 0.5	6.19	0.0162
KFM03A	633.50	650.00	4	79147	2020-06-25	< 0.5	8.36	< 0.5	1010	158	< 0.05	0.213	< 0.5	< 0.05	< 0.002	< 0.5	22.5	0.0181
KFM03A	969.50	994.50	1	79144	2020-06-25	< 0.5	20.2	< 0.5	857	1000	< 0.05	0.134	< 0.5	< 0.05	< 0.002	< 0.5	9.17	0.0501
KFM04A	230.00	245.00	4	79150	2020-06-22	< 0.5	4.86	< 0.5	545	103	0.0585	< 0.1	< 0.5	1.5300	< 0.002	< 0.5	58.2	0.0163
KFM06A	341.00	362.00	5	79156	2020-06-09	< 0.3	5.38	7.71	939	229	0.2030	0.139	0.391	0.2060	< 0.002	0.430	198	0.0183
KFM06A	738.00	748.00	3	79153	2020-06-11	< 0.5	< 0.7	0.649	746	385	0.3680	0.189	< 0.5	< 0.05	< 0.002	< 0.5	362	0.0279
KFM06C	531.00	540.00	5	79162	2020-06-09	< 0.3	0.508	< 0.5	978	111	0.0471	0.280	< 0.2	< 0.02	< 0.002	0.329	54.2	0.0151
KFM06C	647.00	666.00	3	79159	2020-06-15	< 0.5	0.887	1.01	892	374	< 0.05	< 0.1	< 0.5	< 0.05	< 0.002	< 0.5	32.5	0.0240
KFM07A	962.00	972.00	2	79165	2020-09-01	< 0.5	3.34	3.88	701	563	< 0.05	0.279	< 0.5	0.0574	< 0.002	0.954	9.19	0.0397
KFM08A	684.00	694.00	2	79168	2020-08-17	< 0.5	1.49	3.59	691	382	< 0.05	0.450	< 0.5	< 0.05	< 0.002	0.605	37.7	0.0193
KFM08A	265.00	280.00	6	79171	2020-08-21	< 0.3	2.96	< 0.5	855	423	< 0.02	0.233	< 0.2	0.0225	< 0.002	0.383	9.12	0.0080
KFM08D	660.00	680.00	4	79177	2020-08-21	< 0.5	1.99	1.32	667	536	< 0.05	0.318	< 0.5	< 0.05	< 0.002	1.030	31.6	0.0186
KFM08D	825.00	835.00	2	79174	2020-08-28	< 0.5	2.14	1.88	682	234	< 0.05	< 0.1	< 0.5	< 0.05	< 0.002	0.993	34.7	0.0285
KFM10A	430.00	440.00	2	79180	2020-06-18	< 0.5	0.845	< 0.5	668	70.0	< 0.05	0.788	< 0.5	< 0.05	< 0.002	< 0.5	3.25	0.0129

< “value” = result less than reporting limit.

Table A3-2. Trace elements 2020, continued.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling date	Ag µg/L	Al µg/L	As µg/L	B µg/L	Ba µg/L	Cd µg/L	Cr µg/L	Cu µg/L	Co µg/L	Hg µg/L	Ni µg/L	Mo µg/L	Nb µg/L
KFM11A	690.00	710.00	2	79183	2020-07-01	< 0.5	3.14	< 0.5	791	254	< 0.05	0.252	< 0.5	< 0.05	< 0.002	< 0.5	24.8	0.0294
KFM11A	446.00	456.00	4	79186	2020-07-01	< 0.3	0.494	< 0.5	918	98.8	< 0.02	1.40	< 0.2	< 0.02	< 0.002	0.696	14.8	0.0141
KFM12A	270.00	280.00	3	79189	2020-08-20	< 0.3	2.84	1.51	772	557	< 0.02	0.112	< 0.2	0.0955	< 0.002	0.296	8.98	0.0109
KFR101	279.50	341.80	1	79219	2020-08-19	< 0.3	8.56	< 0.5	887	590	0.29	0.236	< 0.2	0.0738	< 0.002	1.20	3.37	< 0.005
KFR102A	214.00	219.00	5	79225	2020-09-16	< 0.3	4.76	< 0.5	795	108	< 0.02	0.445	< 0.2	0.0211	< 0.002	< 0.2	5.92	0.0073
KFR102A	423.00	443.00	2	79222	2020-09-18	< 0.3	5.97	< 0.5	936	113	< 0.02	0.276	0.258	< 0.02	< 0.002	< 0.2	5.16	0.0107
KFR104	333.00	454.60	1	79228	2020-08-31	< 0.3	2.29	< 0.5	898	262	< 0.02	0.0905	< 0.2	< 0.02	< 0.002	0.310	12.2	< 0.005
KFR106	260.00	300.10	1	79237	2020-09-01	< 0.3	6.38	0.529	788	350	0.0296	0.137	< 0.2	< 0.02	< 0.002	0.580	6.02	0.0101
KFR106	143.00	259.00	2	79240	2020-09-02	< 0.3	3.06	0.598	757	77.3	< 0.02	0.278	< 0.2	0.0449	< 0.002	1.33	5.93	0.0069
KFR01	44.65	62.30	1	79219	2020-09-01	< 0.3	2.16	< 0.5	712	57.3	< 0.02	0.0916	< 0.2	< 0.02	< 0.002	0.394	4.5000	< 0.005
KFR105	265.00	306.81	1	79234	2020-09-17	< 0.3	1.10	< 0.5	875	119	< 0.02	0.117	0.235	< 0.02	< 0.002	0.206	2.3500	0.0077

< “value” = result less than reporting limit.

Table A3-2. Trace elements 2020, continued.

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
HFM01	33.50	45.50	2	79192	2020-07-02	0.0290	0.0562	< 0.5	< 0.05	1.18	< 0.2
HFM02	38.00	48.00	2	79195	2020-08-20	0.0197	0.0187	0.814	< 0.05	1.07	0.232
HFM04	58.00	66.00	2	79198	2020-08-25	0.0232	0.0199	0.603	0.108	0.879	0.396
HFM13	159.00	173.00	1	79201	2020-06-29	< 0.1	0.0129	< 3	< 0.3	0.106	< 0.8
HFM15	85.00	95.00	1	79204	2020-06-26	0.0150	0.0882	< 0.5	< 0.05	0.989	< 0.2
HFM16	54.00	67.00	2	79207	2020-06-11	0.0130	0.0319	< 0.5	< 0.05	1.52	0.334
HFM21	22.00	32.00	3	79210	2020-08-26	0.0216	0.0181	4.45	< 0.05	0.757	0.223
HFM27	46.00	58.00	2	79213	2020-08-27	< 0.1	0.0136	11.4	< 0.3	0.302	0.893
HFM32	26.00	31.00	3	79216	2020-06-23	< 0.1	0.00559	< 3	< 0.3	0.0899	< 0.8
KFM01A	109.00	130.00	5	79123	2020-06-30	0.538	0.0114	< 3	< 0.3	0.039	< 0.8
KFM01D	429.00	438.00	2	79126	2020-06-29	< 0.1	0.0195	< 3	< 0.3	0.428	7.10
KFM01D	311.00	321.00	4	79129	2020-07-02	< 0.1	0.0105	< 3	< 0.3	0.0821	< 0.8
KFM02A	490.00	518.00	3	79132	2020-06-12	< 0.3	0.0463	< 3	< 0.5	0.101	< 2
KFM02A	411.00	442.00	5	79135	2020-06-17	< 0.3	0.0130	< 3	< 0.5	< 0.05	< 2
KFM02B	491.00	506.00	2	79138	2020-06-11	< 0.3	0.0156	16.1	< 0.5	< 0.05	< 2
KFM02B	410.00	431.00	4	79141	2020-06-18	< 0.3	0.0165	< 3	< 0.5	0.0712	< 2
KFM03A	633.50	650.00	4	79147	2020-06-25	< 0.3	0.0165	< 3	< 0.5	0.349	< 2
KFM03A	969.50	994.50	1	79144	2020-06-25	< 0.3	0.0185	< 3	< 0.5	0.305	< 2
KFM04A	230.00	245.00	4	79150	2020-06-22	< 0.3	0.0822	< 3	< 0.5	0.407	< 2
KFM06A	341.00	362.00	5	79156	2020-06-09	< 0.1	0.0678	< 3	< 0.3	0.0603	4.91
KFM06A	738.00	748.00	3	79153	2020-06-11	< 0.3	0.110	< 3	< 0.5	0.0589	< 2
KFM06C	531.00	540.00	5	79162	2020-06-09	< 0.1	0.0746	< 3	< 0.3	0.0773	0.831
KFM06C	647.00	666.00	3	79159	2020-06-15	< 0.3	< 0.01	< 3	< 0.5	< 0.05	< 2
KFM07A	962.00	972.00	2	79165	2020-09-01	< 0.3	< 0.01	86.2	< 0.5	0.107	3.35
KFM08A	684.00	694.00	2	79168	2020-08-17	< 0.3	0.0344	26.3	< 0.5	0.0817	< 2
KFM08A	265.00	280.00	6	79171	2020-08-21	< 0.1	< 0.005	13.8	< 0.3	0.0973	< 0.8
KFM08D	660.00	680.00	4	79177	2020-08-21	< 0.3	0.0379	28.9	< 0.5	0.0547	2.88
KFM08D	825.00	835.00	2	79174	2020-08-28	< 0.3	0.0555	44.4	< 0.5	0.113	3.90
KFM10A	430.00	440.00	2	79180	2020-06-18	< 0.3	< 0.01	< 3	< 0.5	0.0609	< 2

< “value” = result less than reporting limit.

Table A3-2. Trace elements 2020, continued.

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
KFM11A	690.00	710.00	2	79183	2020-07-01	< 0.3	0.0119	< 3	< 0.5	< 0.05	< 2
KFM11A	446.00	456.00	4	79186	2020-07-01	< 0.1	0.0151	< 3	< 0.3	0.0315	0.902
KFM12A	270.00	280.00	3	79189	2020-08-20	< 0.1	0.0262	17.9	< 0.3	0.122	< 0.8
KFR101	279.50	341.80	1	79219	2020-08-19	< 0.1	< 0.005	15.1	< 0.3	0.0925	< 0.8
KFR102A	214.00	219.00	5	79225	2020-09-16	< 0.1	0.00778	< 3	< 0.3	0.289	< 0.8
KFR102A	423.00	443.00	2	79222	2020-09-18	< 0.1	0.0102	< 3	< 0.3	0.308	< 0.8
KFR104	333.00	454.60	1	79228	2020-08-31	< 0.1	0.0145	8.73	< 0.3	0.0716	< 0.8
KFR106	260.00	300.10	1	79237	2020-09-01	< 0.1	< 0.005	18.4	< 0.3	0.101	< 0.8
KFR106	143.00	259.00	2	79240	2020-09-02	< 0.1	0.00758	18.0	< 0.3	0.0590	< 0.8
KFR01	44.65	62.30	1	79219	2020-09-01	< 0.1	0.0157	15.7	< 0.3	0.0591	< 0.8
KFR105	265.00	306.81	1	79234	2020-09-17	< 0.1	0.0075	2.68	< 0.3	0.0306	< 0.8

< “value” = result less than reporting limit.

Table A3-2. Trace elements 2020, continued.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling date	U µg/L	Th µg/L	Rb µg/L	Zr µg/L	Sb µg/L	Cs µg/L	Nd µg/L
HFM01	33.50	45.50	2	79192	2020-07-02			7.31	10.1	0.0149	0.208	
HFM02	38.00	48.00	2	79195	2020-08-20			6.11	6.36	0.0192	0.185	0.0745
HFM04	58.00	66.00	2	79198	2020-08-25			8.40	5.80	0.0140	0.218	0.145
HFM13	159.00	173.00	1	79201	2020-06-29			44.8	0.284	< 0.1	1.820	
HFM15	85.00	95.00	1	79204	2020-06-26			7.63	12.8	0.0263	82.30	
HFM16	54.00	67.00	2	79207	2020-06-11			5.74	6.88	0.0409	0.0671	
HFM21	22.00	32.00	3	79210	2020-08-26			8.74	4.28	0.0189	0.159	0.122
HFM27	46.00	58.00	2	79213	2020-08-27			20.2	2.00	< 0.1	0.883	0.0901
HFM32	26.00	31.00	3	79216	2020-06-23			35.9	0.439	< 0.1	0.915	
KFM01A	109.00	130.00	5	79123	2020-06-30			49.0	0.206	< 0.1	0.781	
KFM01D	429.00	438.00	2	79126	2020-06-29			41.8	< 0.1	< 0.1	2.77	
KFM01D	311.00	321.00	4	79129	2020-07-02			43.2	0.142	< 0.1	0.534	
KFM02A	490.00	518.00	3	79132	2020-06-12	147	< 0.2	61.2	< 0.3	< 0.1	1.51	
KFM02A	411.00	442.00	5	79135	2020-06-17			396	< 0.3	< 0.1	95.6	
KFM02B	491.00	506.00	2	79138	2020-06-11			53.4	< 0.3	0.116	1.72	
KFM02B	410.00	431.00	4	79141	2020-06-18			63.1	< 0.3	< 0.1	3.80	
KFM03A	633.50	650.00	4	79147	2020-06-25	16.5	< 0.2	36.5	< 0.3	< 0.1	2.36	
KFM03A	969.50	994.50	1	79144	2020-06-25			29.2	< 0.3	0.165	0.623	
KFM04A	230.00	245.00	4	79150	2020-06-22			39.1	< 0.3	< 0.1	1.38	
KFM06A	341.00	362.00	5	79156	2020-06-09			22.7	< 0.1	1.370	0.244	
KFM06A	738.00	748.00	3	79153	2020-06-11			28.2	< 0.3	< 0.1	0.499	
KFM06C	531.00	540.00	5	79162	2020-06-09			29.3	< 0.1	< 0.1	0.698	
KFM06C	647.00	666.00	3	79159	2020-06-15			14.9	< 0.3	0.273	0.412	
KFM07A	962.00	972.00	2	79165	2020-09-01			39.4	< 0.3	0.407	0.884	< 0.05
KFM08A	684.00	694.00	2	79168	2020-08-17			28.0	< 0.3	0.156	0.525	< 0.05
KFM08A	265.00	280.00	6	79171	2020-08-21			30.7	< 0.1	< 0.1	0.283	0.3190
KFM08D	660.00	680.00	4	79177	2020-08-21			17.2	< 0.3	0.179	0.248	< 0.05
KFM08D	825.00	835.00	2	79174	2020-08-28			15.3	< 0.3	0.560	0.310	< 0.05
KFM10A	430.00	440.00	2	79180	2020-06-18			54.6	< 0.3	< 0.1	0.839	

< “value” = result less than reporting limit.

Table A3-2. Trace elements 2020, continued.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling date	U µg/L	Th µg/L	Rb µg/L	Zr µg/L	Sb µg/L	Cs µg/L	Nd µg/L
KFM11A	690.00	710.00	2	79183	2020-07-01			16.4	< 0.3	< 0.1	0.299	
KFM11A	446.00	456.00	4	79186	2020-07-01			12.4	< 0.1	< 0.1	0.318	
KFM12A	270.00	280.00	3	79189	2020-08-20			13.1	< 0.1	0.179	0.267	0.0530
KFR101	279.50	341.80	1	79219	2020-08-19			10.6	0.210	0.104	0.315	0.0696
KFR102A	214.00	219.00	5	79225	2020-09-16			17.2	< 50	< 0.1	0.412	0.146
KFR102A	423.00	443.00	2	79222	2020-09-18			16.9	< 50	< 0.1	0.367	0.118
KFR104	333.00	454.60	1	79228	2020-08-31			7.34	0.128	< 0.1	0.158	< 0.02
KFR106	260.00	300.10	1	79237	2020-09-01	12.2	< 0.2	15.6	0.120	< 0.1	0.385	0.111
KFR106	143.00	259.00	2	79240	2020-09-02	28.2	< 0.2	24.6	0.137	< 0.1	0.636	0.286
KFR01	44.65	62.30	1	79219	2020-09-01			14.5	0.156	< 0.1	0.373	0.136
KFR105	265.00	306.81	1	79234	2020-09-17			11.5	< 50	< 0.1	0.314	0.422

< “value” = result less than reporting limit.

Table A3-3. Isotopes I (H-, O- and C-isotopes) 2020.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling date	δ ^{2}H dev SMOW	^{3}H TU	δ ^{18}O dev SMOW
HFM01	33.50	45.50	2	79190	2020-06-29	−75.2		−10.25
HFM01	33.50	45.50	2	79191	2020-06-30	−75.1		−10.24
HFM01	33.50	45.50	2	79192	2020-07-02	−75.5	3.6	−10.25
HFM02	38.00	48.00	2	79193	2020-08-18	−82.5		−11.77
HFM02	38.00	48.00	2	79194	2020-08-19	−82.3		−11.53
HFM02	38.00	48.00	2	79195	2020-08-20	−82.1	4.3	−11.36
HFM04	58.00	66.00	2	79196	2020-07-02	−82.5		−11.46
HFM04	58.00	66.00	2	81776	2020-08-24	−82.8		−11.68
HFM04	58.00	66.00	2	79197	2020-08-24	−83.5		−11.76
HFM04	58.00	66.00	2	79198	2020-08-25	−83.3	3.0	−11.78
HFM13	159.00	173.00	1	79199	2020-06-23	−71.5		−9.47
HFM13	159.00	173.00	1	79200	2020-06-26	−71.3		−9.64
HFM13	159.00	173.00	1	79201	2020-06-29	−71.1	< 0.8	−9.58
HFM15	85.00	95.00	1	79202	2020-06-15	−84.8		−11.99
HFM15	85.00	95.00	1	79203	2020-06-15	−84.2		−11.87
HFM15	85.00	95.00	1	79204	2020-06-26	−85.5	5.4	−11.84
HFM16	54.00	67.00	2	79205	2020-06-09	−80.3		−11.20
HFM16	54.00	67.00	2	79206	2020-06-10	−80.4		−11.18
HFM16	54.00	67.00	2	79207	2020-06-11	−80.5	2.8	−11.26
HFM21	22.00	32.00	3	79208	2020-08-24	−81.2		−11.22
HFM21	22.00	32.00	3	79209	2020-08-25	−81.6		−11.39
HFM21	22.00	32.00	3	79210	2020-08-26	−81.5	3.7	−11.31
HFM27	46.00	58.00	2	79211	2020-08-24	−73.9		−10.23
HFM27	46.00	58.00	2	79212	2020-08-25	−74.3		−10.18
HFM27	46.00	58.00	2	79213	2020-08-27	−75.0	1.2	−10.16

< “value” = result less than reporting limit.

Table A3-3. Isotopes I (H-, O- and C-isotopes) 2020, continued.

Id-code	Secup M	Seclow m	Section no.	Sample no.	Sampling date	δ ^{2}H dev SMOW	^{3}H TU	δ ^{18}O dev SMOW
HFM32	26.00	31.00	3	79214	2020-06-23	−66.8		−8.75
HFM32	26.00	31.00	3	79215	2020-06-23	−66.1		−8.49
HFM32	26.00	31.00	3	79216	2020-06-23	−67.0	< 0.8	−8.65
KFM01A	109.00	130.00	5	79121	2020-06-29	−88.4		−11.95
KFM01A	109.00	130.00	5	79122	2020-06-30	−89.1		−11.98
KFM01A	109.00	130.00	5	79123	2020-06-30	−89.4	< 0.8	−11.96
KFM01D	429.00	438.00	2	79124	2020-06-25	−73.2		−10.70
KFM01D	429.00	438.00	2	79125	2020-06-25	−73.0		−10.58
KFM01D	429.00	438.00	2	79126	2020-06-29	−73.4	< 0.8	-10.73
KFM01D	311.00	321.00	4	79127	2020-07-02	−76.0		−10.91
KFM01D	311.00	321.00	4	79128	2020-07-02	−75.0		−10.72
KFM01D	311.00	321.00	4	79129	2020-07-02	−75.5	< 0.8	−10.69
KFM02A	490.00	518.00	3	79130	2020-06-11	−67.0		−9.02
KFM02A	490.00	518.00	3	79131	2020-06-12	−66.8		−8.89
KFM02A	490.00	518.00	3	79132	2020-06-12	−66.3	< 0.8	−8.96
KFM02A	411.00	442.00	5	79133	2020-06-15	−75.8		−10.20
KFM02A	411.00	442.00	5	79134	2020-06-16	−76.2		−10.15
KFM02A	411.00	442.00	5	79135	2020-06-17	−75.6	< 0.8	−10.03
KFM02B	491.00	506.00	2	79136	2020-06-10	−65.3		−8.75
KFM02B	491.00	506.00	2	79137	2020-06-10	−65.0		−8.73
KFM02B	491.00	506.00	2	79138	2020-06-11	−64.8	< 0.8	−8.69
KFM02B	410.00	431.00	4	79139	2020-06-17	−72.7		−9.62
KFM02B	410.00	431.00	4	79140	2020-06-18	−71.3		−9.50
KFM02B	410.00	431.00	4	79141	2020-06-18	−72.5	< 0.8	−9.74
KFM03A	969.50	994.50	1	79142	2020-06-22	−95.6		−13.64
KFM03A	969.50	994.50	1	79143	2020-06-24	−95.9		−13.67
KFM03A	633.50	650.00	4	79145	2020-06-24	−84.0		−11.67

< “value” = result less than reporting limit.

Table A3-3. Isotopes I (H-, O- and C-isotopes) 2020, continued.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling date	δ ^{2}H dev SMOW	^{3}H TU	δ ^{18}O dev SMOW
KFM03A	633.50	650.00	4	79146	2020-06-24	−84.3		−11.62
KFM03A	633.50	650.00	4	79147	2020-06-25	−84.3	1.6	−11.72
KFM03A	969.50	994.50	1	79144	2020-06-25	−95.8	< 0.8	−13.59
KFM04A	230.00	245.00	4	79148	2020-06-22	−70.2		−9.36
KFM04A	230.00	245.00	4	79149	2020-06-22	−70.0		−9.20
KFM04A	230.00	245.00	4	79150	2020-06-22	−70.0	< 0.8	−9.23
KFM06A	341.00	362.00	5	79154	2020-06-08	−88.0		−12.14
KFM06A	341.00	362.00	5	79155	2020-06-08	−88.7		−12.23
KFM06A	341.00	362.00	5	79156	2020-06-09	−89.1	< 0.8	−12.33
KFM06A	738.00	748.00	3	79151	2020-06-09	−81.0		−11.90
KFM06A	738.00	748.00	3	79152	2020-06-10	−80.6		−11.81
KFM06A	738.00	748.00	3	79153	2020-06-11	−81.0	< 0.8	−11.84
KFM06C	531.00	540.00	5	79160	2020-06-08	−81.3		−11.20
KFM06C	531.00	540.00	5	79161	2020-06-08	−81.8		−11.25
KFM06C	647.00	666.00	3	79157	2020-06-08	−93.0		−13.01
KFM06C	531.00	540.00	5	79162	2020-06-09	−81.4	4.3	−11.28
KFM06C	647.00	666.00	3	79158	2020-06-12	−93.3		−13.04
KFM06C	647.00	666.00	3	79159	2020-06-15	−93.7	< 0.8	−12.84
KFM07A	962.00	972.00	2	79163	2020-08-31	−87.1		−13.14
KFM07A	962.00	972.00	2	79164	2020-08-31	−87.7		−13.11
KFM07A	962.00	972.00	2	79165	2020-09-01	−87.2	< 0.8	−13.03
KFM08A	684.00	694.00	2	79166	2020-08-17	−92.2		−12.98
KFM08A	684.00	694.00	2	79167	2020-08-17	−91.6		−13.31
KFM08A	684.00	694.00	2	79168	2020-08-17	−91.3	< 0.8	−13.35
KFM08A	265.00	280.00	6	79169	2020-08-18	−100.5		−13.84
KFM08A	265.00	280.00	6	79170	2020-08-19	−101.1		−13.79
KFM08A	265.00	280.00	6	79171	2020-08-21	−100.2	< 0.8	−13.73

< “value” = result less than reporting limit.

Table A3-3. Isotopes I (H-, O- and C-isotopes) 2020, continued.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling date	δ ^{2}H dev SMOW	^{3}H TU	δ ^{18}O dev SMOW
KFM08D	660.00	680.00	4	79175	2020-08-17	−84.7		−12.50
KFM08D	660.00	680.00	4	79176	2020-08-19	−84.7		−11.97
KFM08D	660.00	680.00	4	79177	2020-08-21	−83.9	< 0.8	−12.03
KFM08D	825.00	835.00	2	79172	2020-08-25	−80.8		−11.80
KFM08D	825.00	835.00	2	79173	2020-08-26	−80.6		−11.88
KFM08D	825.00	835.00	2	79174	2020-08-28	−80.5	< 0.8	−11.82
KFM10A	430.00	440.00	2	79178	2020-06-16	−64.8		−8.78
KFM10A	430.00	440.00	2	79179	2020-06-17	−65.7		−8.65
KFM10A	430.00	440.00	2	79180	2020-06-18	−65.2	< 0.8	−8.69
KFM11A	690.00	710.00	2	79181	2020-06-30	−85.8		−12.07
KFM11A	690.00	710.00	2	79182	2020-07-01	−86.1		−12.12
KFM11A	446.00	456.00	4	79184	2020-07-01	−90.6		−12.29
KFM11A	446.00	456.00	4	79185	2020-07-01	−90.7		−12.41
KFM11A	690.00	710.00	2	79183	2020-07-01	−85.9	< 0.8	−12.14
KFM11A	446.00	456.00	4	79186	2020-07-01	−90.9	< 0.8	−12.25
KFM12A	270.00	280.00	3	79187	2020-08-20	−112.4		−15.31
KFM12A	270.00	280.00	3	79188	2020-08-20	−113.3		−15.31
KFM12A	270.00	280.00	3	79189	2020-08-20	−113.2	3.8	−15.43
KFR101	279.50	341.80	1	79217	2020-08-18	−111.2		−15.14
KFR101	279.50	341.80	1	79218	2020-08-19	−111.6		−15.14
KFR101	279.50	341.80	1	79219	2020-08-19	−111.2	< 0.8	−15.23
KFR102A	214.00	219.00	5	79223	2020-09-15	−84.3		−11.19
KFR102A	214.00	219.00	5	79224	2020-09-16	−83.6		−11.16
KFR102A	214.00	219.00	5	79225	2020-09-16	−83.9	2.2	−11.19
KFR102A	423.00	443.00	2	79220	2020-09-16	−89.7		−11.99
KFR102A	423.00	443.00	2	79221	2020-09-17	−89.7		−12.09
KFR102A	423.00	443.00	2	79222	2020-09-18	−89.7	< 0.8	−12.06

< “value” = result less than reporting limit.

Table A3-3. Isotopes I (H-, O- and C-isotopes) 2020, continued.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling date	δ ^{2}H dev SMOW	^{3}H TU	δ ^{18}O dev SMOW
KFR104	333.00	454.60	1	79226	2020-08-26	−108.1		−14.51
KFR104	333.00	454.60	1	79227	2020-08-28	−108.0		−14.42
KFR104	333.00	454.60	1	79228	2020-08-31	−108.1	0.8	−14.55
KFR106	260.00	300.10	1	79235	2020-09-01	−110.8		−14.72
KFR106	260.00	300.10	1	79236	2020-09-01	−109.8		−14.53
KFR106	143.00	259.00	2	79238	2020-09-01	−81.9		−10.76
KFR106	260.00	300.10	1	79237	2020-09-01	−111.2	0.9	−14.67
KFR106	143.00	259.00	2	79239	2020-09-02	−82.3		−10.86
KFR106	143.00	259.00	2	79240	2020-09-02	−82.3	< 0.8	−10.79
KFR01	44.65	62.30	1	79229	2020-08-31	−76.3		−10.26
KFR01	44.65	62.30	1	79230	2020-08-31	−76.2		−10.16
KFR01	44.65	62.30	1	79231	2020-09-01	−76.7	2.7	−10.04
KFR105	265.00	306.81	1	79232	2020-09-15	−101.0		−13.49
KFR105	265.00	306.81	1	79233	2020-09-16	−101.3		−13.39
KFR105	265.00	306.81	1	79234	2020-09-17	−101.3	0.9	−13.51

< “value” = result less than reporting limit.

Table A3-3. Isotopes I (H-, O- and C-isotopes) 2020, continued.

Id-code	Secup m	Seclow m	Section no.	Sample no.	Sampling date	^{238}U mBq/kg	^{235}U mBq/kg	^{234}U mBq/kg	^{232}Th mBq/kg	^{230}Th mBq/kg
KFM02A	490.00	518.00	3	79132	2020-06-12	1556.00	65.89	3144.50	0.140	0.140
KFRM03A	633.50	650.00	4	79145	2020-06-25	191.30	7.44	299.20	0.290	0.400
KFR106	260.00	300.10	1	79237	2020-09-01	144.70	5.32	306.80	0.150	0.520
KFR106	143.00	259.00	2	79240	2020-09-02	302.90	11.76	937.50	0.290	0.760

Appendix 4

Pressure registrations during pumping and sampling, HMS system

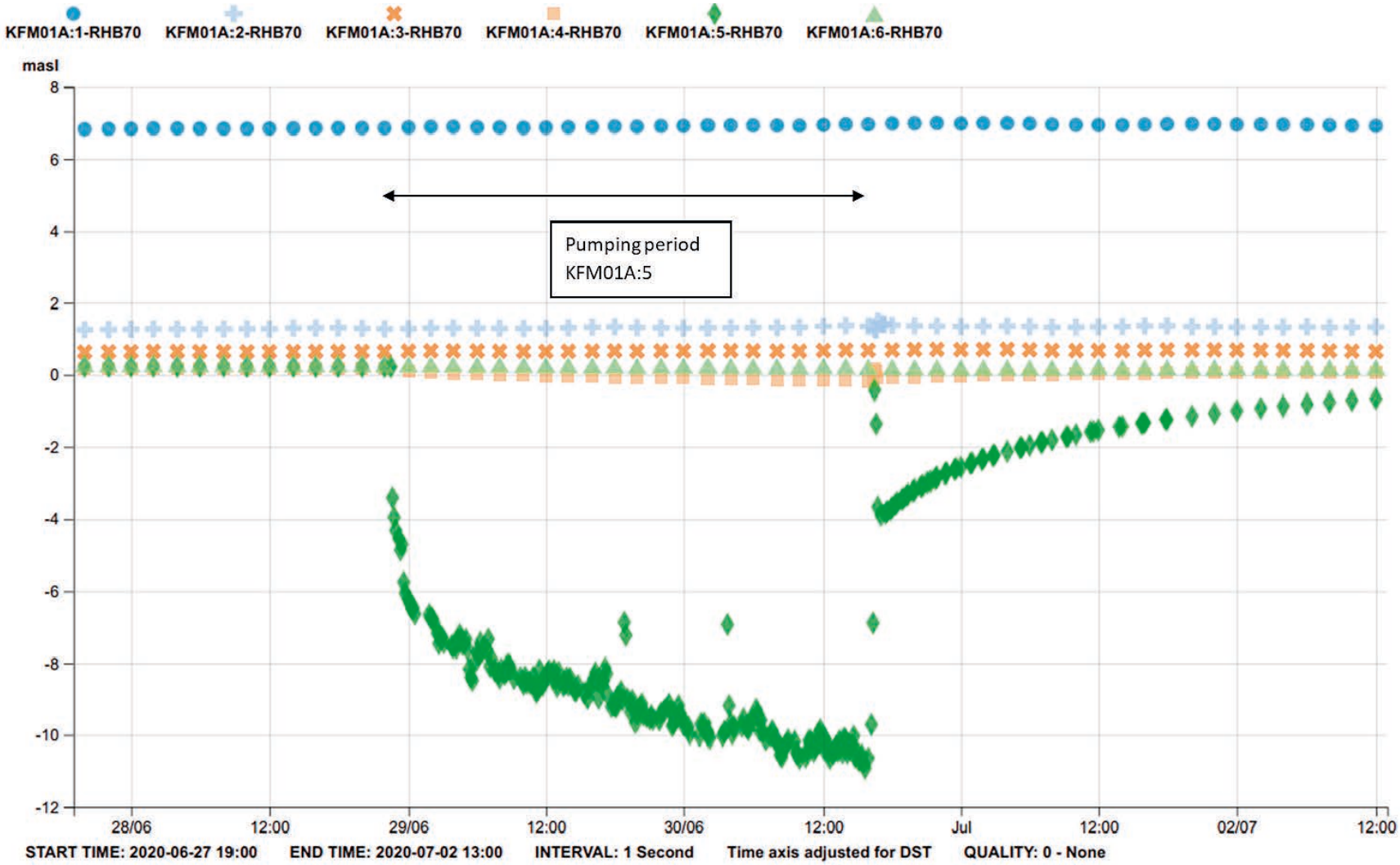

Figure A4-1. Pumping and drawdown in KFM01A:5 in June 2020. A small response was observed in section 4. See next figure for a more detailed plot.

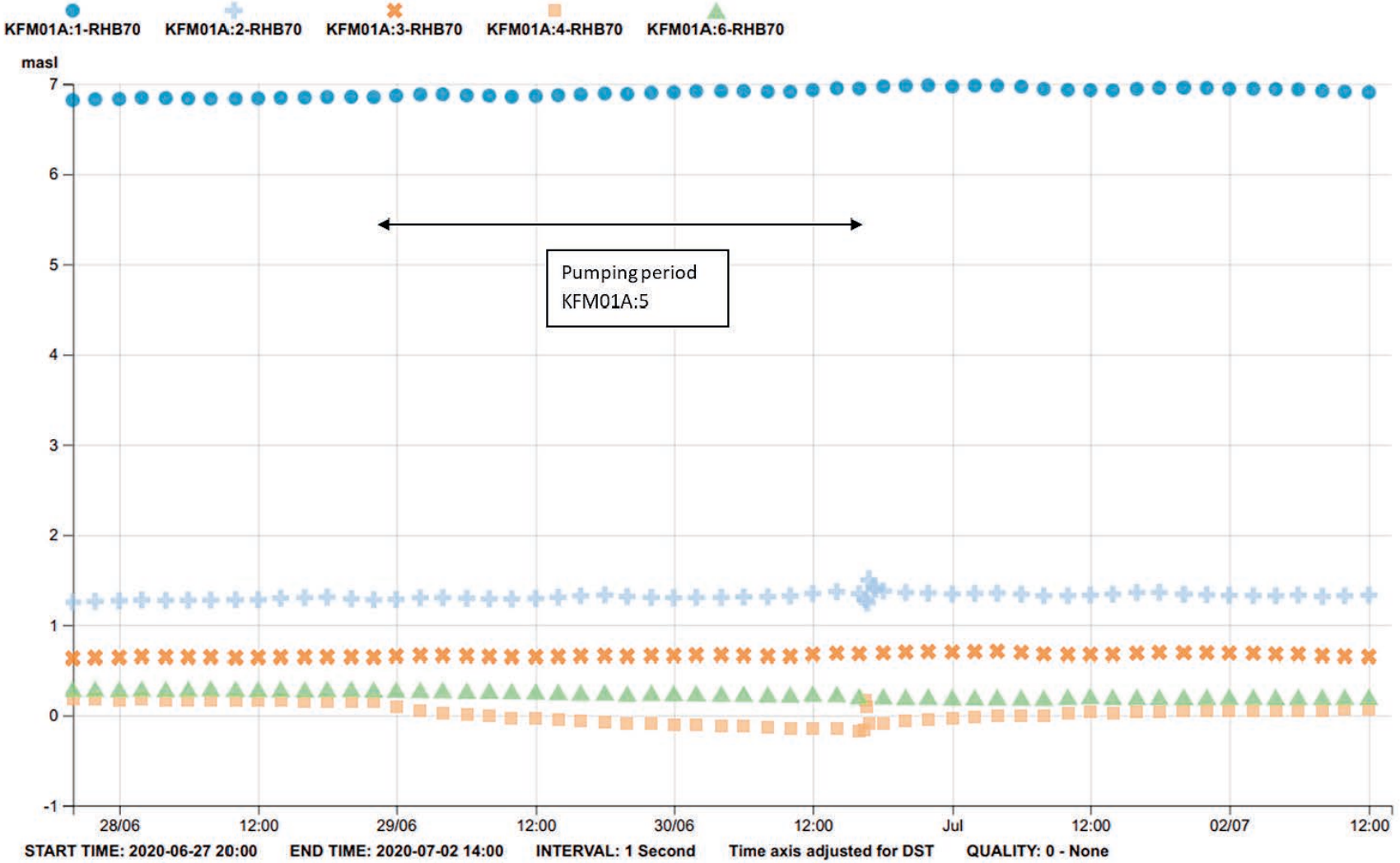

Figure A4-2. *Detailed plot of pumping and drawdown in other sections than KFM01A:5 in June 2020. The pumping in KFM01A:5 caused a small drawdown in KFM01A:4.*

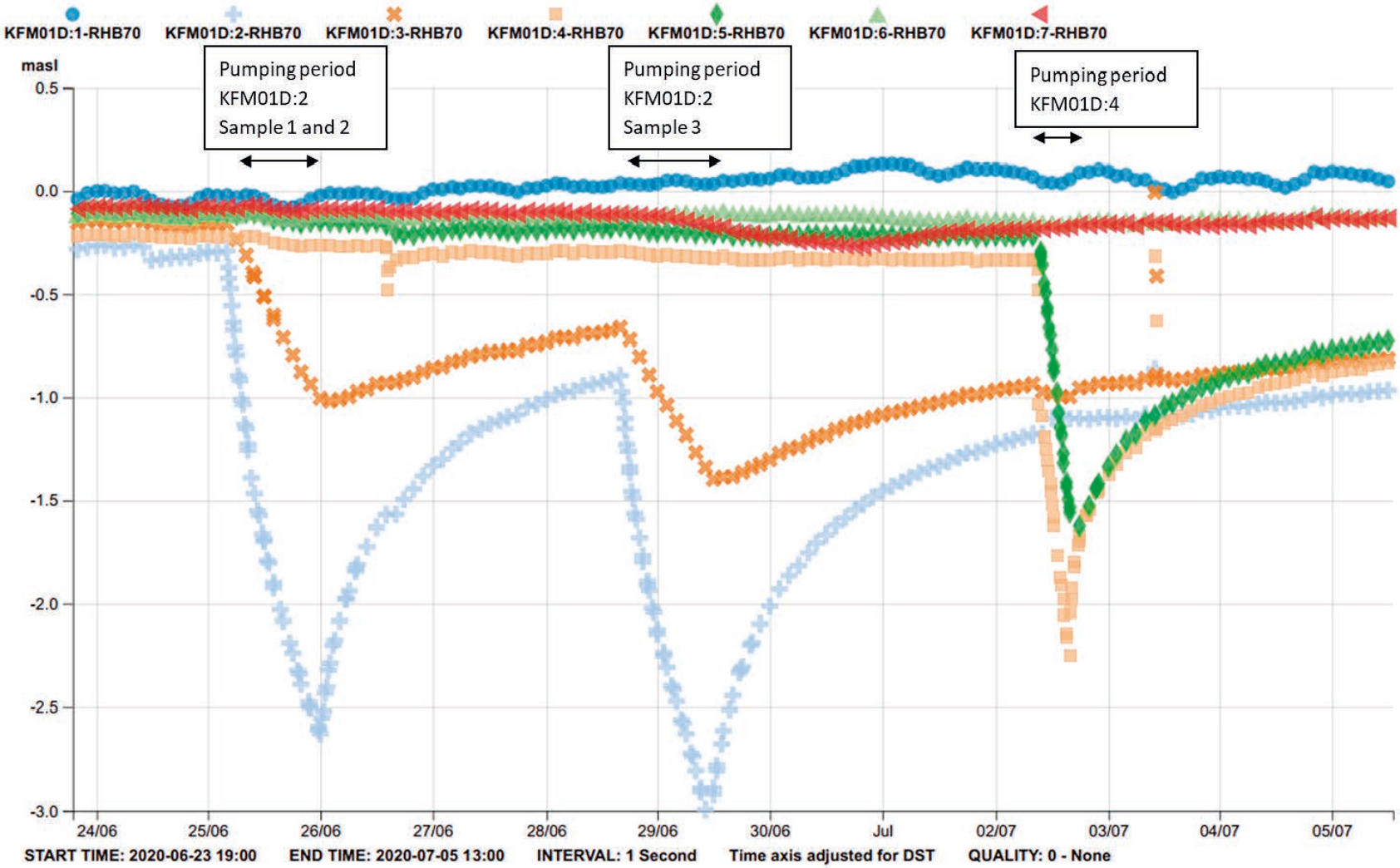

Figure A4-3. *Pumping and drawdown in KFM01D:2 in June 2020 and in KFM01D:4 in July 2020. Section KFM01D:3 was affected by the pumping in KFM01D:2. Section KFM01D:5 was affected by the pumping in KFM01D:4. The pressure chances 2020-07-03 in section 3–5 were due to deflating of the mini-packers.*

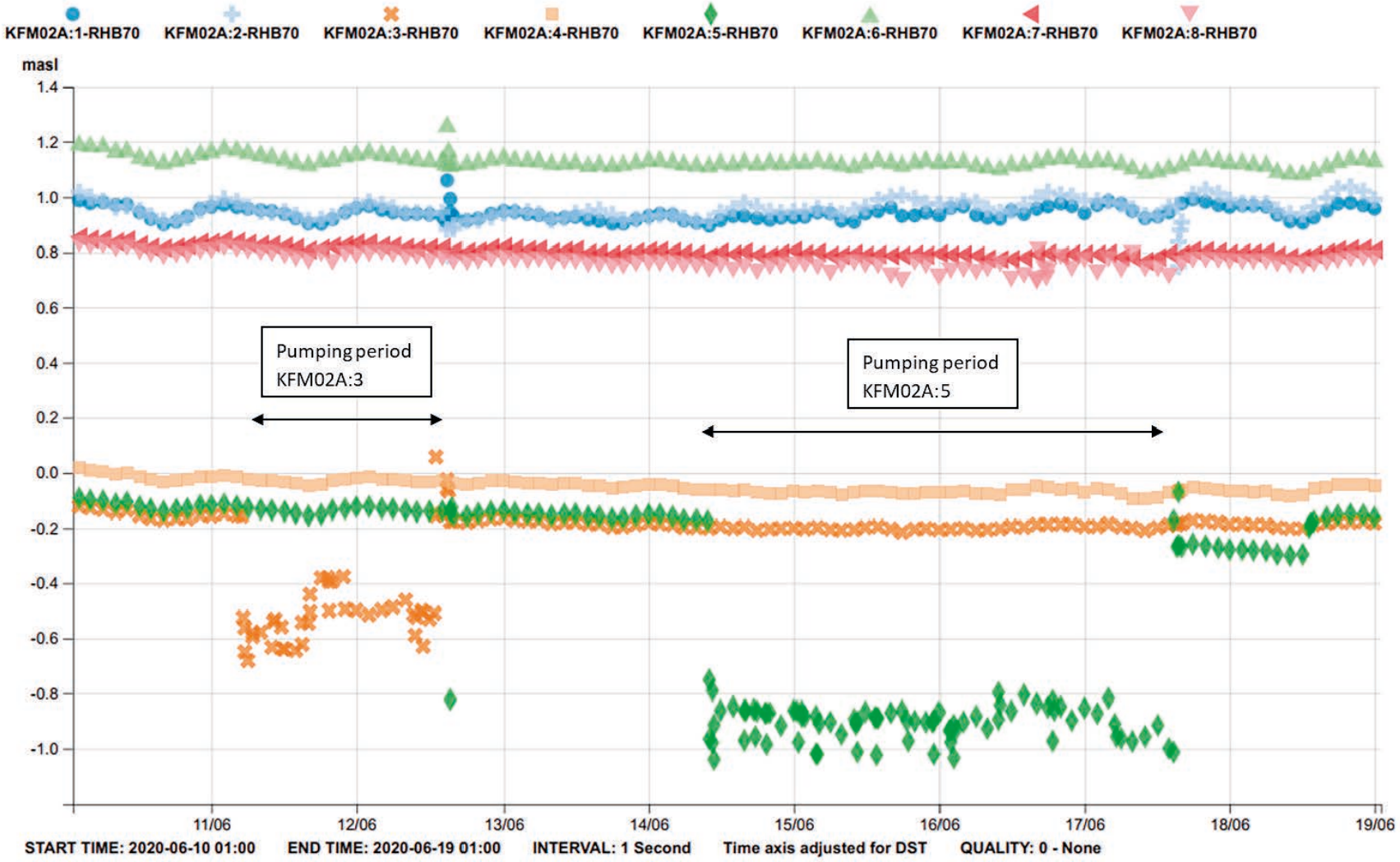

Figure A4-4. *Pumping and drawdown in KFM02A:5 and KFM02A:3 in June 2020. No other sections were affected.*

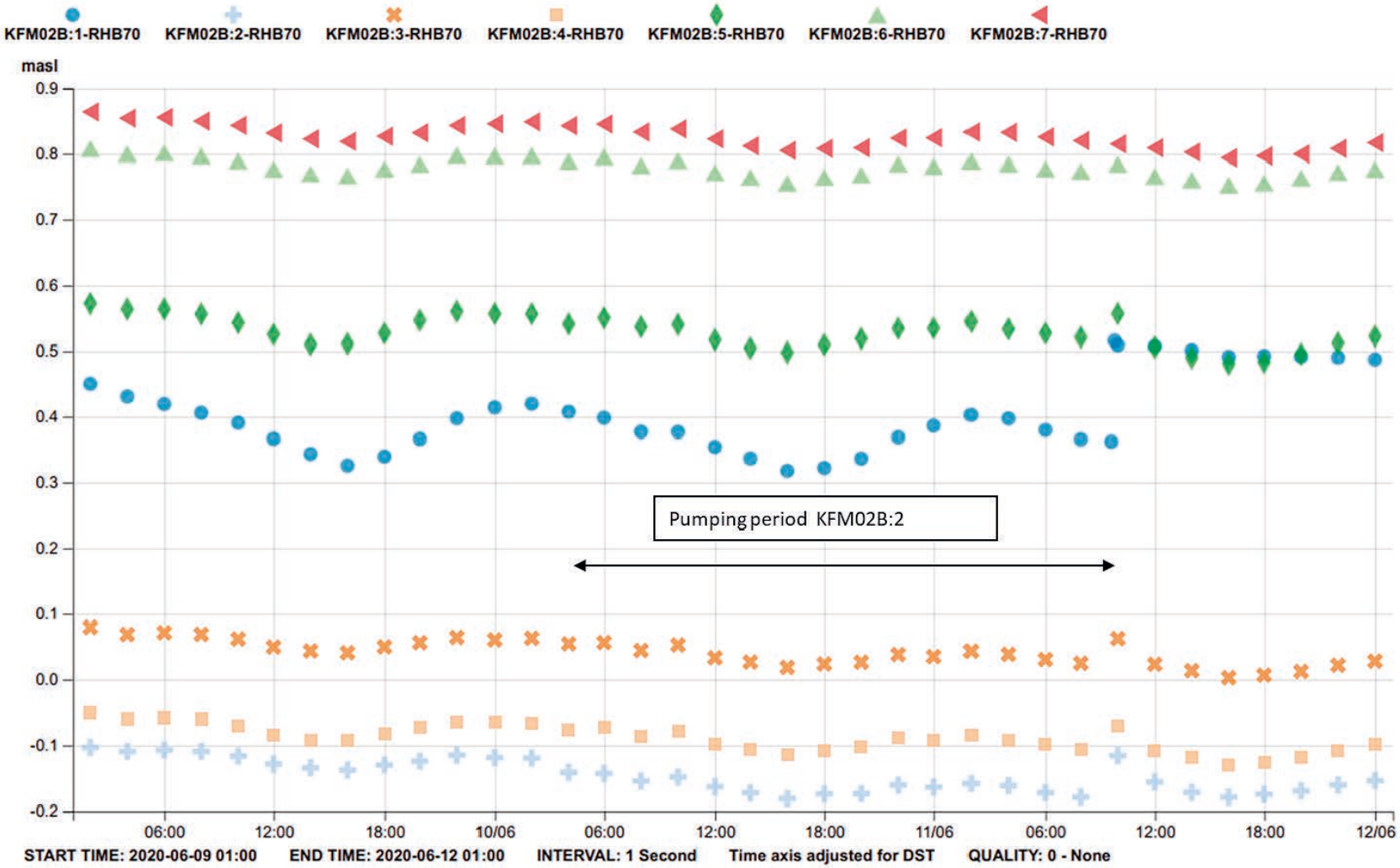

Figure A4-5. *Pumping and drawdown in KFM02B:2 in June 2020. No (?) sections were affected.*

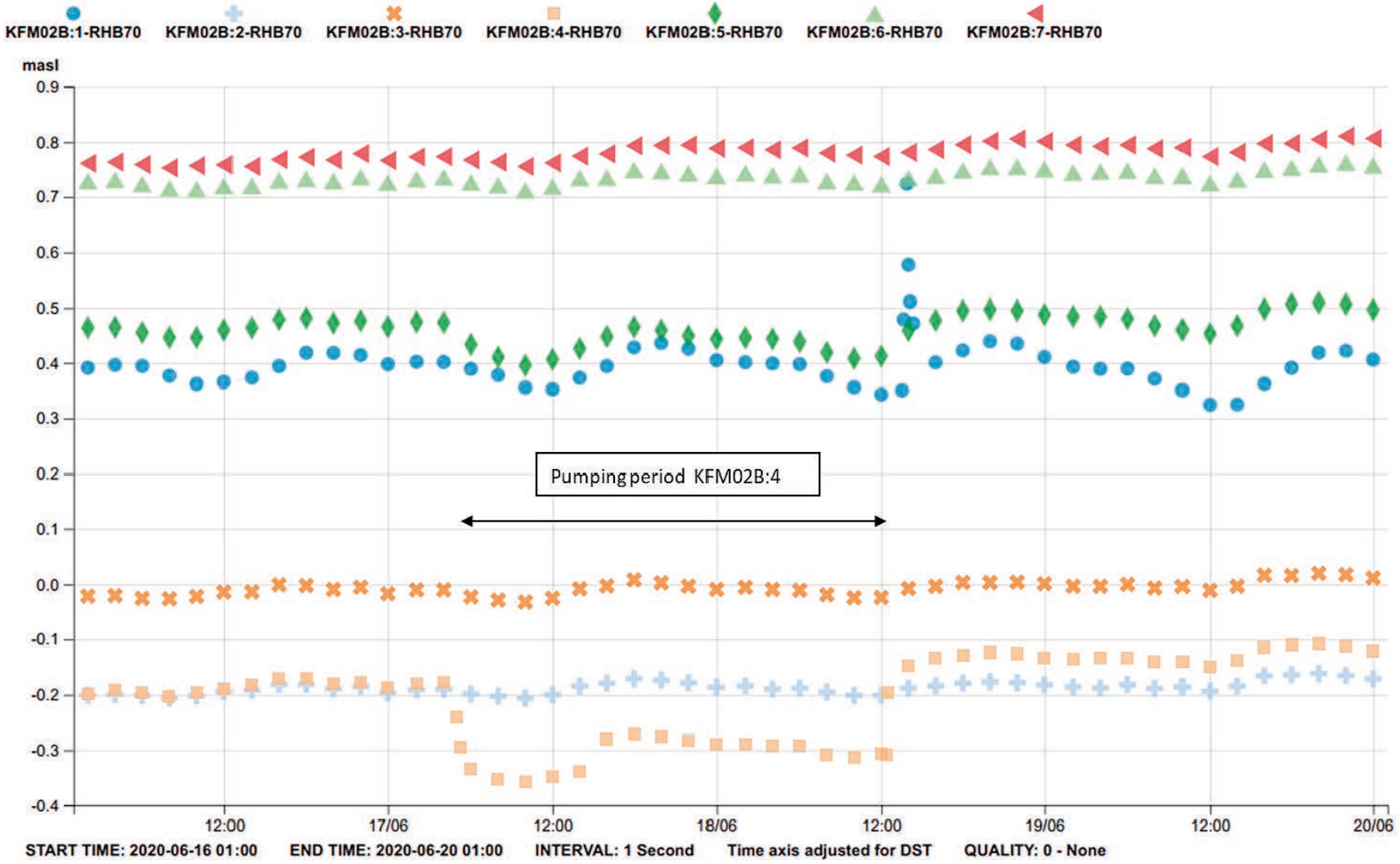

Figure A4-6. *Pumping and drawdown in KFM02B:4 in June 2020. No other sections were affected.*

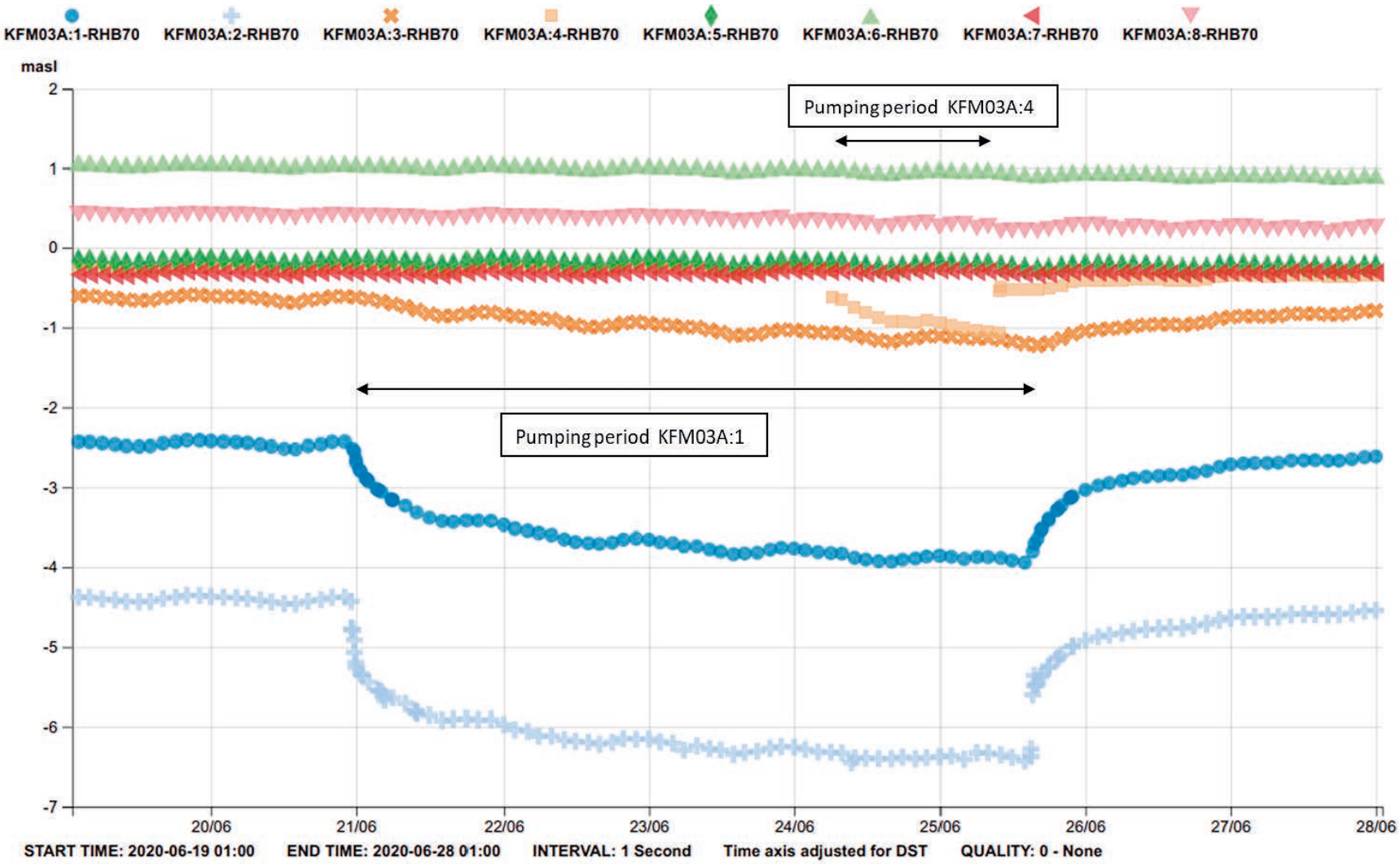

Figure A4-7. *Pumping and drawdown in KFM03A:1 and KFM03A:4 in June 2020. The pressure response observed in KFM03A:2 during pumping in KFM03A:1 may be caused by a leaking connection in the equipment between sections KFM03A:1 and KFM03A:2 rather than a connected fracture system. A small response was also seen in KFM03A:3.*

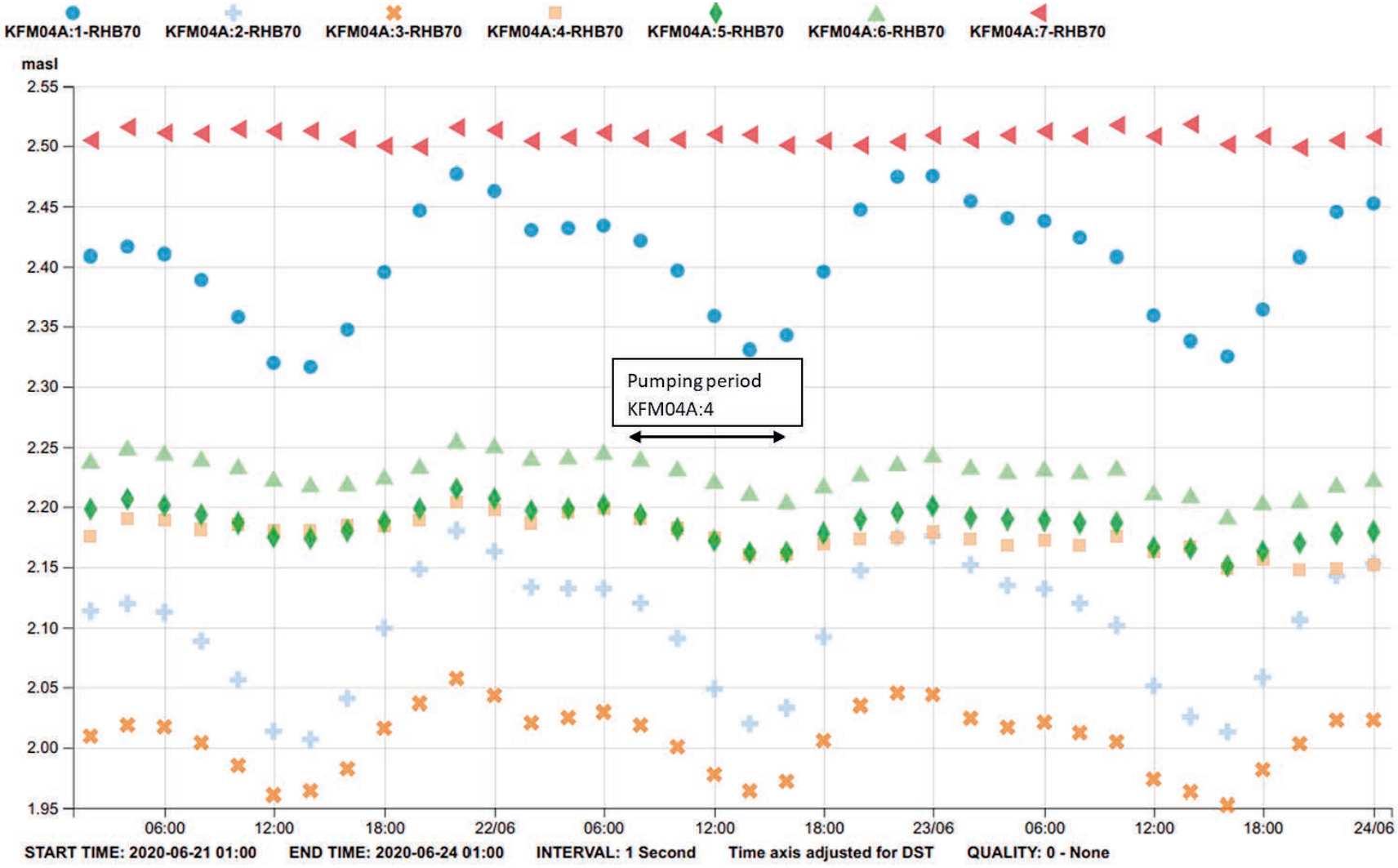

Figure A4-8. *Pumping and drawdown in KFM04A:4 in June 2020. No (?) sections were significantly affected by the pumping.*

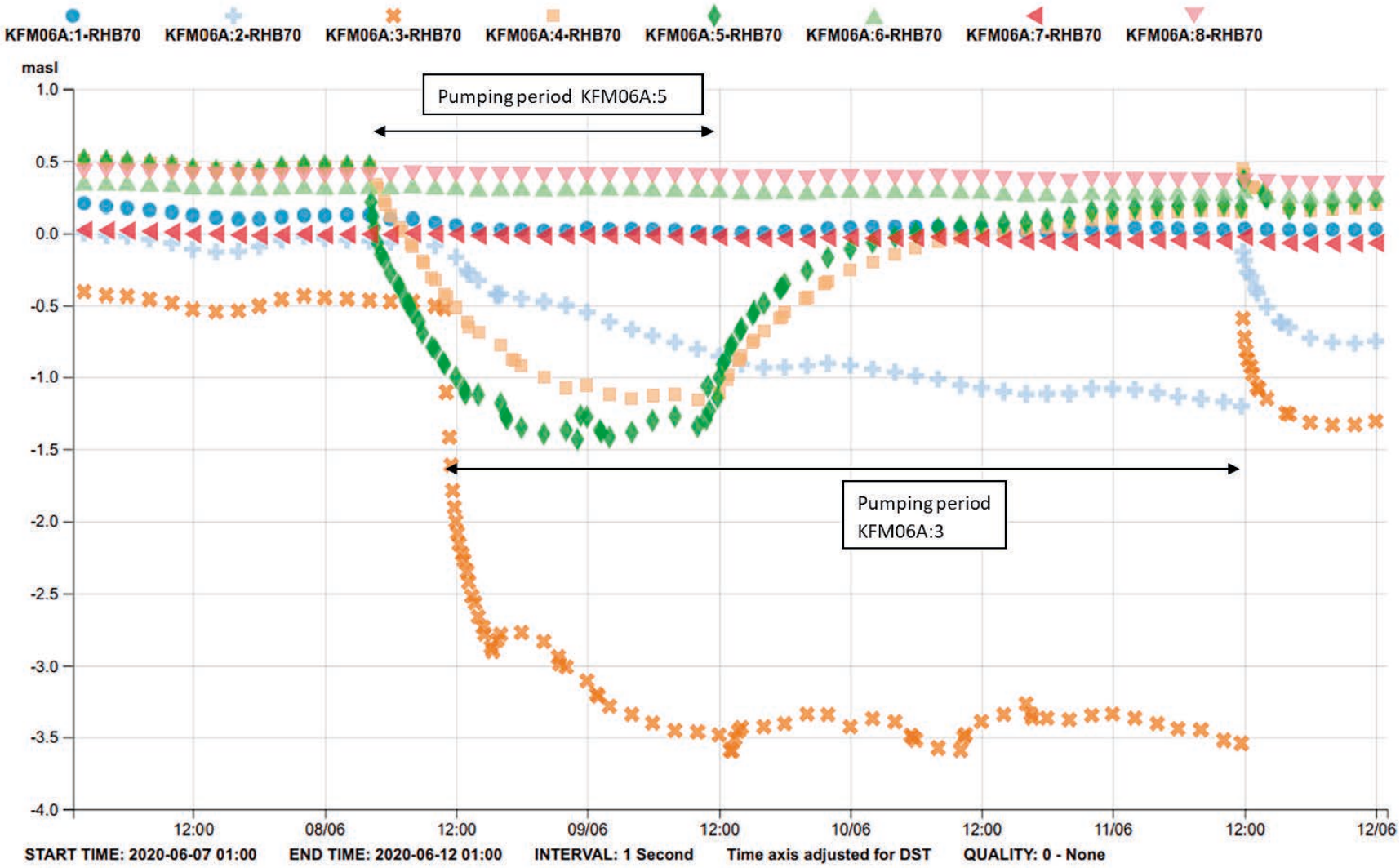

Figure A4-9. *Pumping and drawdown in KFM06A:3 and KFM06A:5 in June 2020. Section KFM06A:2 was affected by the pumping in KFM06A:3. KFM06A:4 was effected by the pumping in section KFM06A:5.*

Figure A4-10. *Pumping and drawdown in KFM06C:3 and KFM06C:5 in June 2020. Sections KFM06C:2 and KFM06C:4 were affected by the pumping in section KFM06C:3. The pumping in section KFM06C:5 causes a response in KFM06C:6. For a more detailed plot of the pumping in KFM06C:5, see next figure. The pumping rate in both sections had to be adjusted several times which could be seen in the graph. In KFM06C:5 two pump stops that were not detected in the field could be seen. Total pressure recovery had not occurred at these stops.*

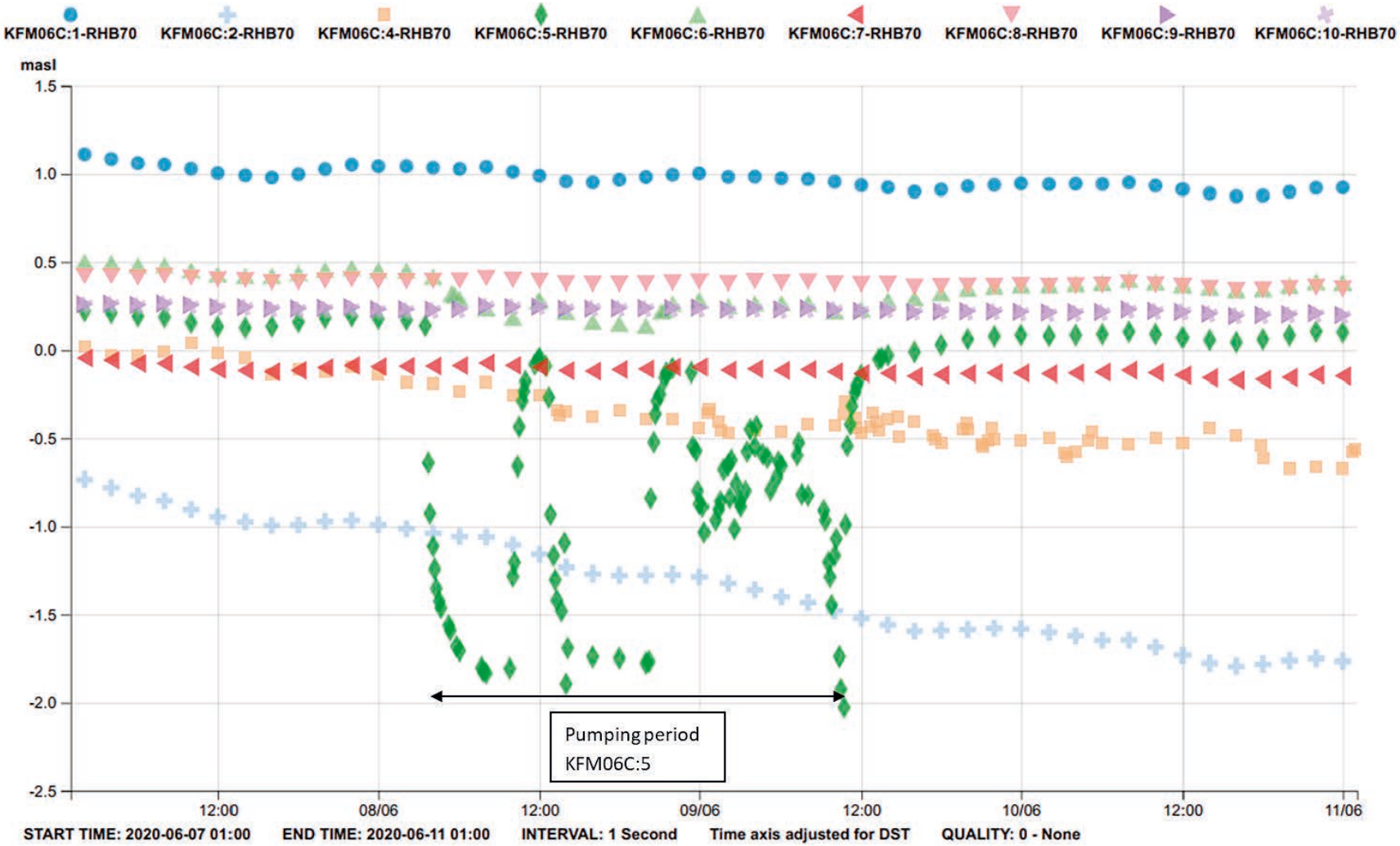

Figure A4-11. *Detailed plot of pumping and drawdown in KFM06C:5 in June 2020. The pumping in section KFM06C:5 causes a response in KFM06C:6. Observe that KFM06C:3 was pumped during the same time, see Figure A4-10. In KFM06C:5 two pump stops that was not detected in the field could be seen. Total pressure recovery had not occurred at these stops.*

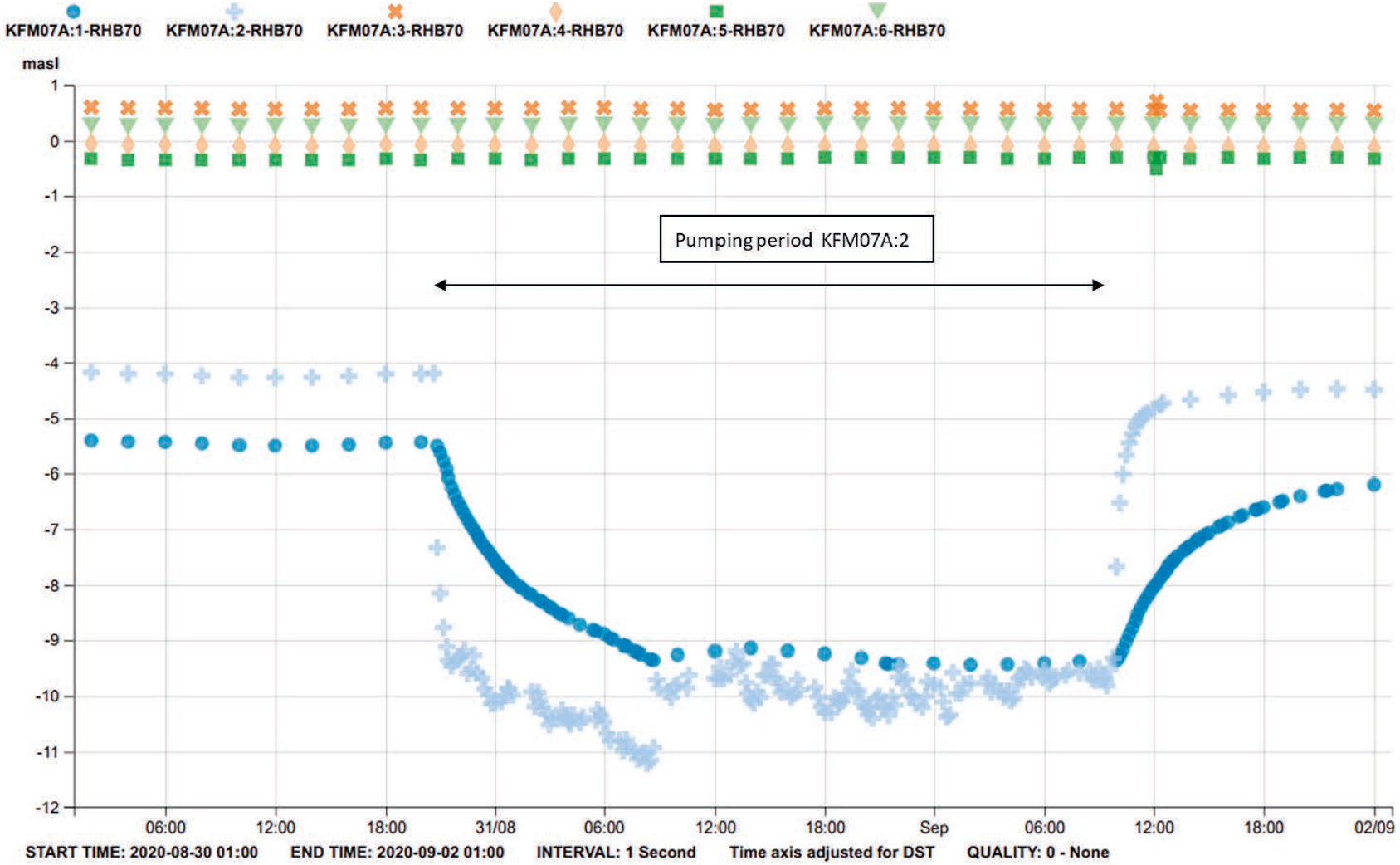

Figure A4-12. *Detailed plot of pumping and drawdown in KFM07A:2 in August/September 2020. The pumping in section KFM07A:2 caused a response in KFM07A:1.*

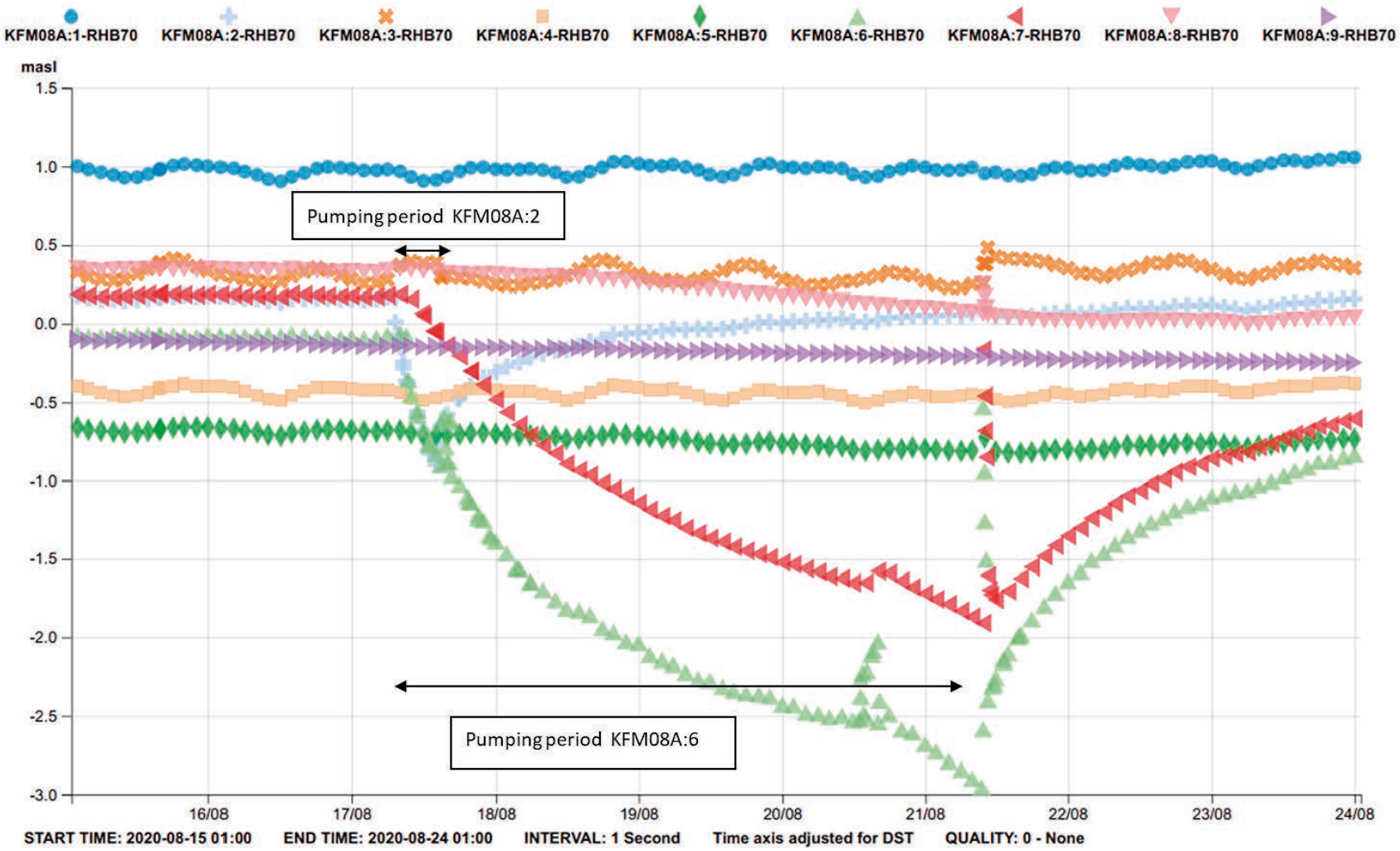

Figure A4-13. *Detailed plot of pumping and drawdown in KFM08A:6 and KFM08A:2 in August 2020. The pumping in section KFM08A:6 caused a response in KFM08A:7. For a more detailed plot of the pumping in KFM08A:2, see next figure.*

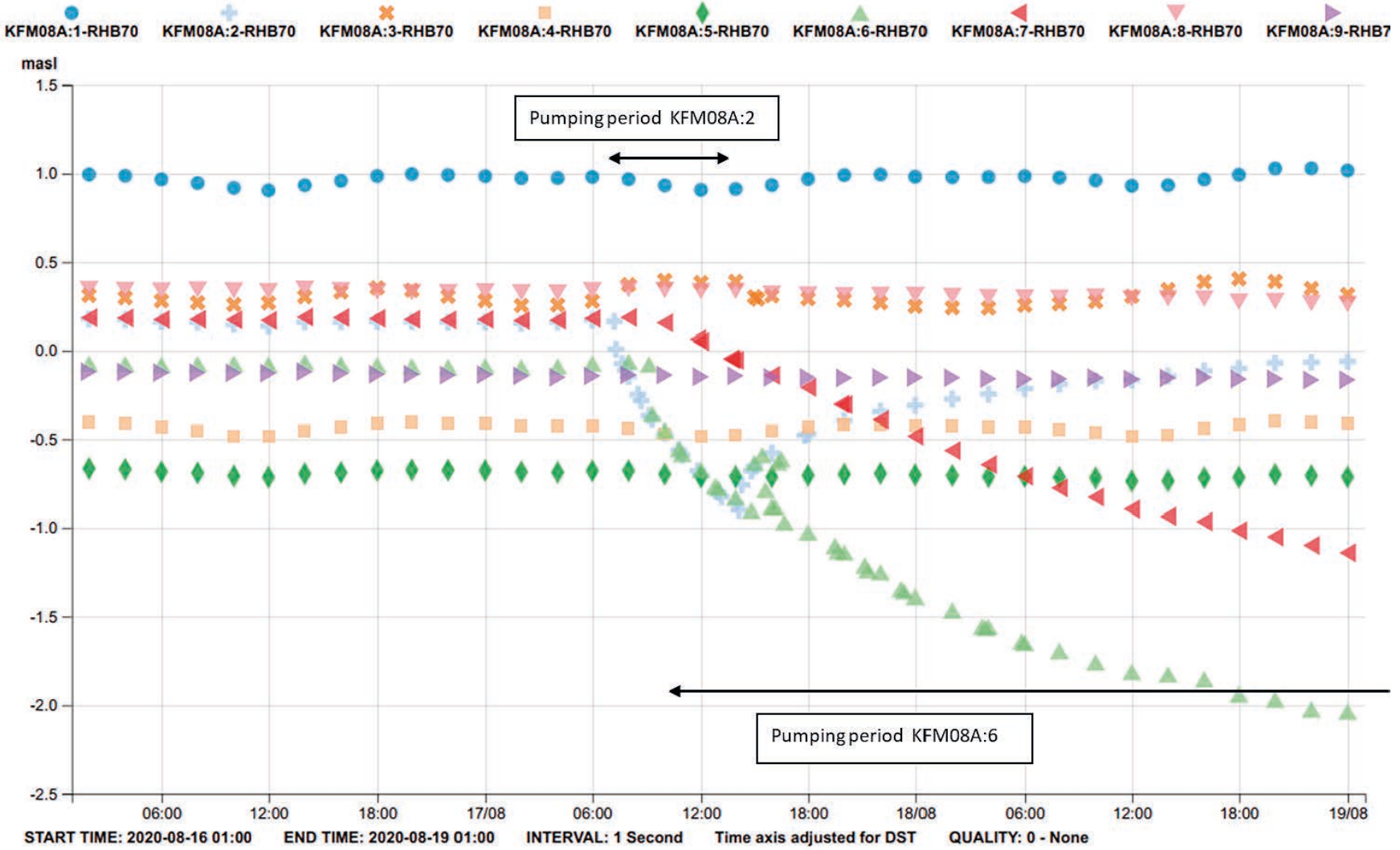

Figure A4-14. *Detailed plot of pumping and drawdown in KFM08A:2 in August 2020. None of the other sections were significantly affected by the pumping.*

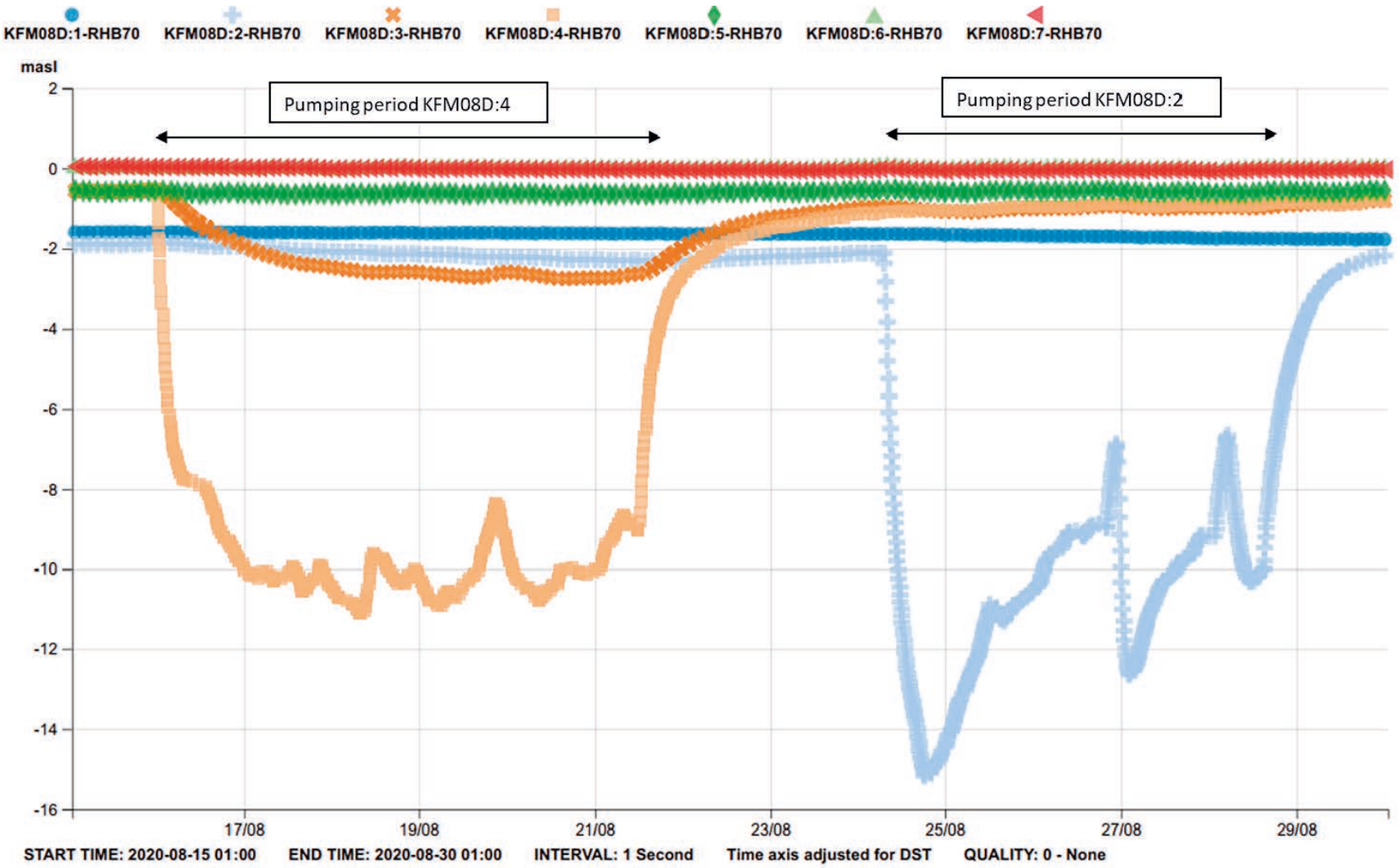

Figure A4-15. *Detailed plot of pumping and drawdown in KFM08D:2 and KFM08D:4 in August 2020. The pumping in section KFM08D:4 causes a response in KFM08D:3. The pumping rate in both sections had to be adjusted several times which could be seen in the graph.*

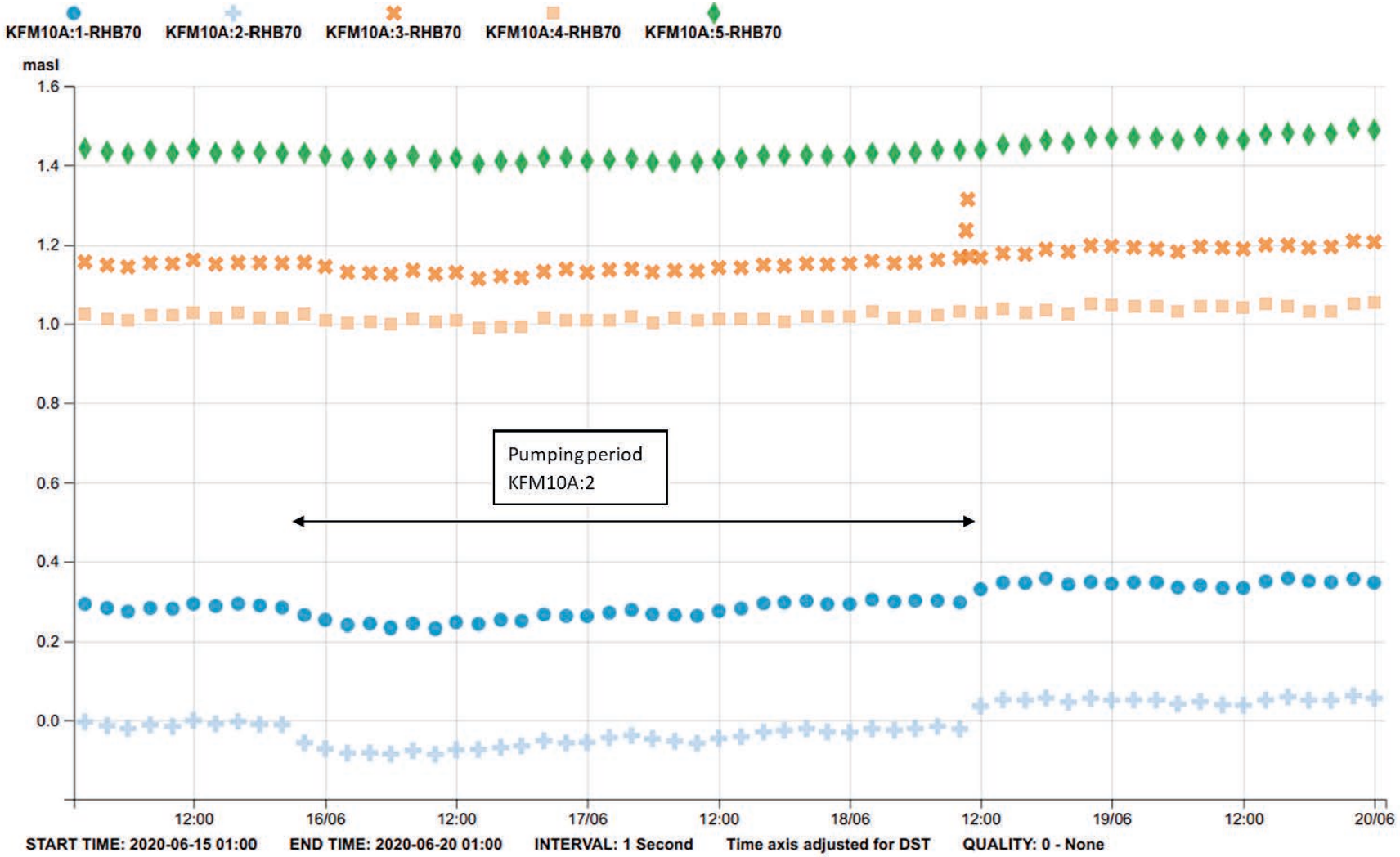

Figure A4-16. *Detailed plot of pumping and drawdown in KFM10A:2 in June 2020. A small response in KFM10A:1 may be plausible.*

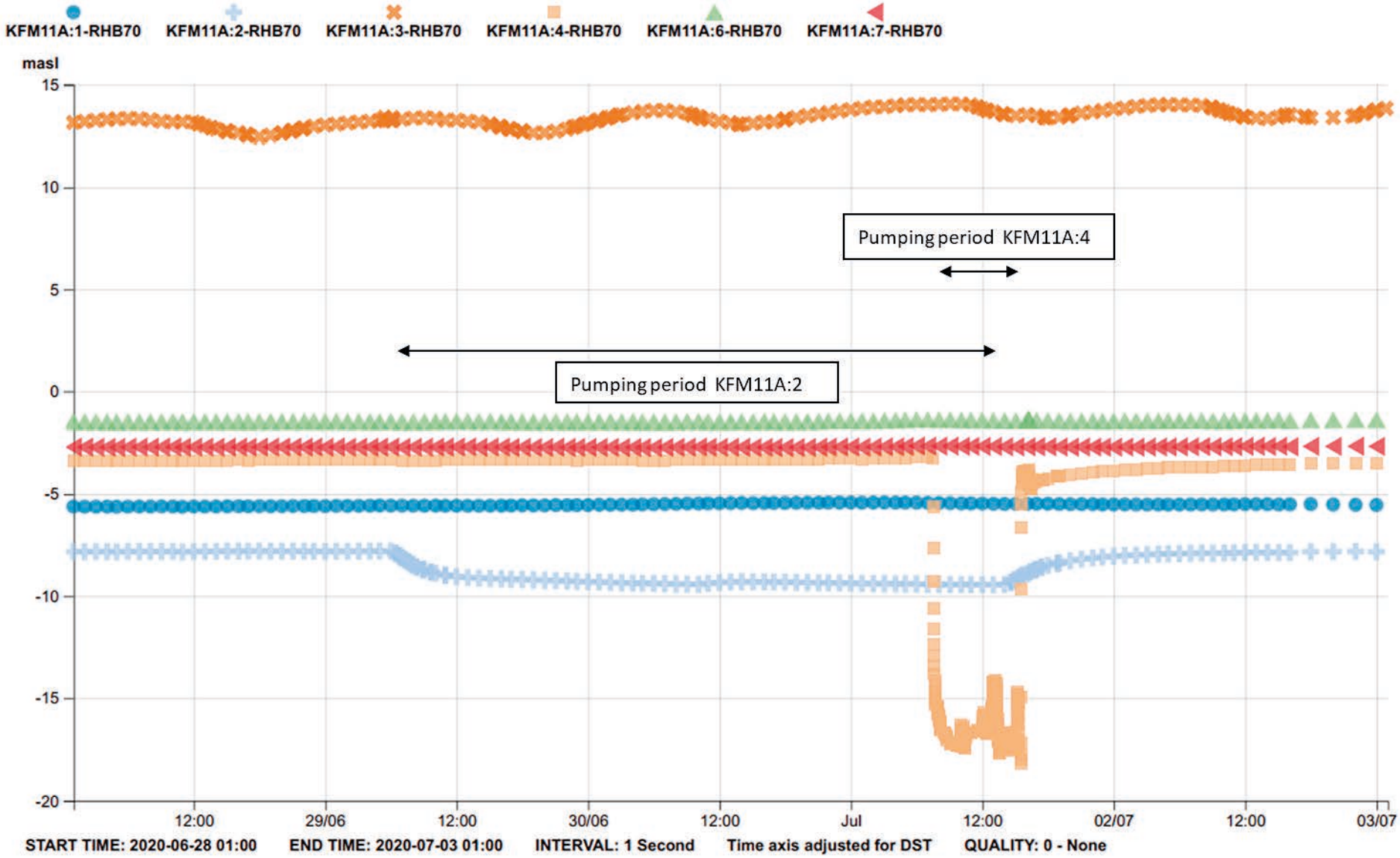

Figure A4-17. *Pumping and drawdown in KFM11A:2 and KFM11A:4 in June 2020. No data are available for section 5 due to problems with the pressure transducer. In previous years, the pumping in section KFM011A:4 had caused a response in KFM11A:5.*

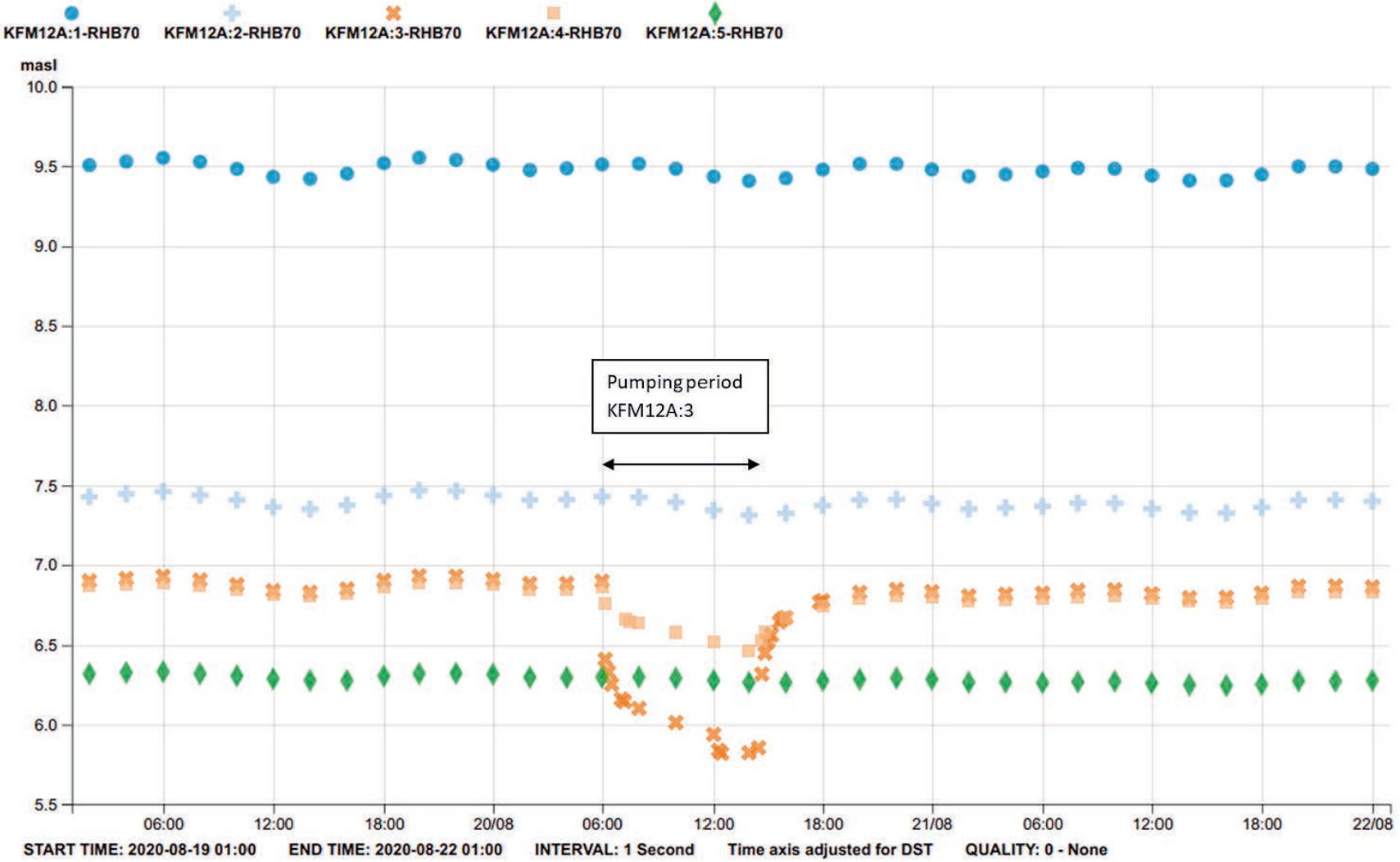

Figure A4-18. *Pumping and drawdown in KFM12A:3 in August 2020. The pumping in section KFM12A:3 caused a response in KFM12A:4.*

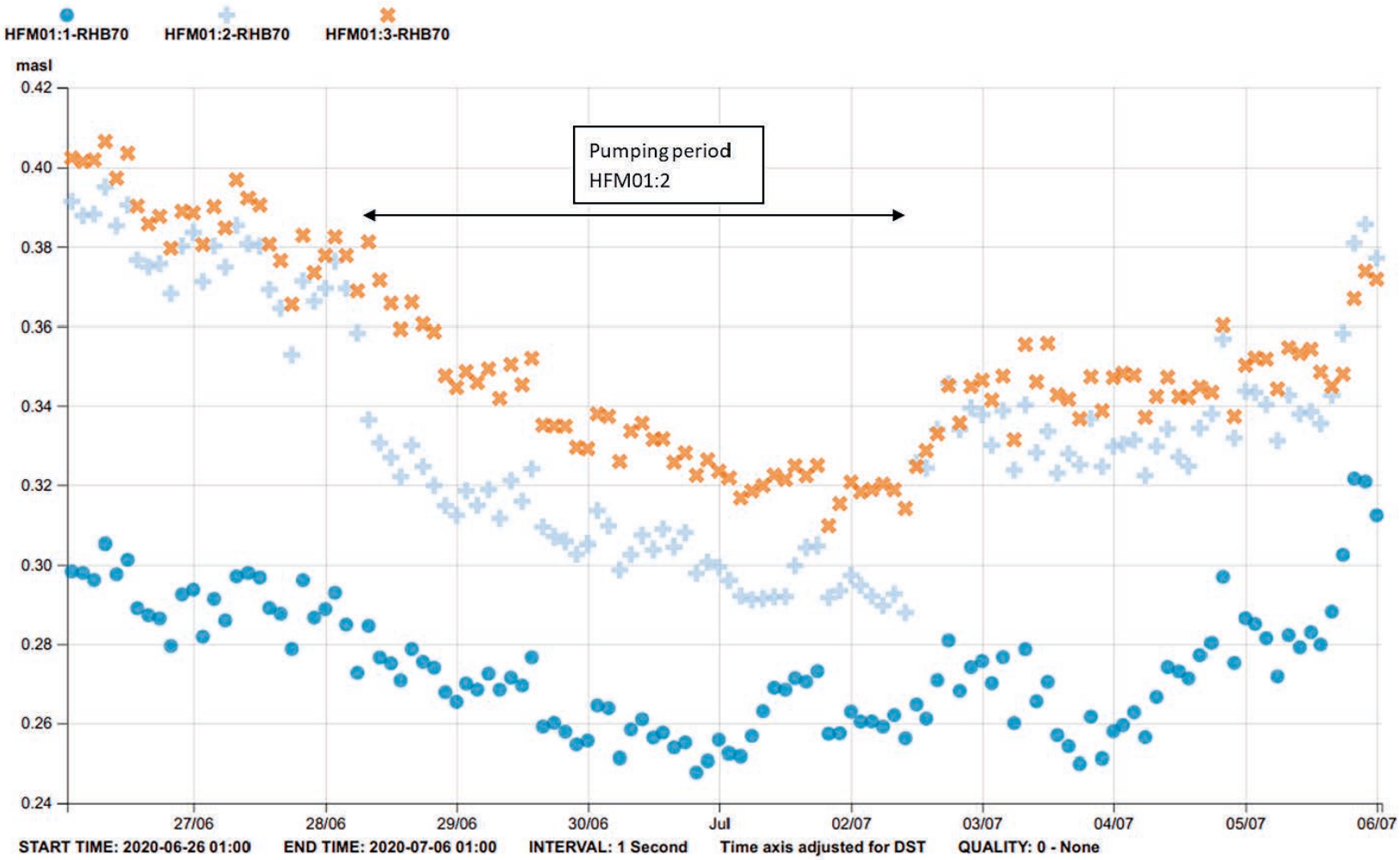

Figure A4-19. *Pumping and drawdown in HFM01:2 in June 2020. A possible pressure response was observed in section HFM01:3.*

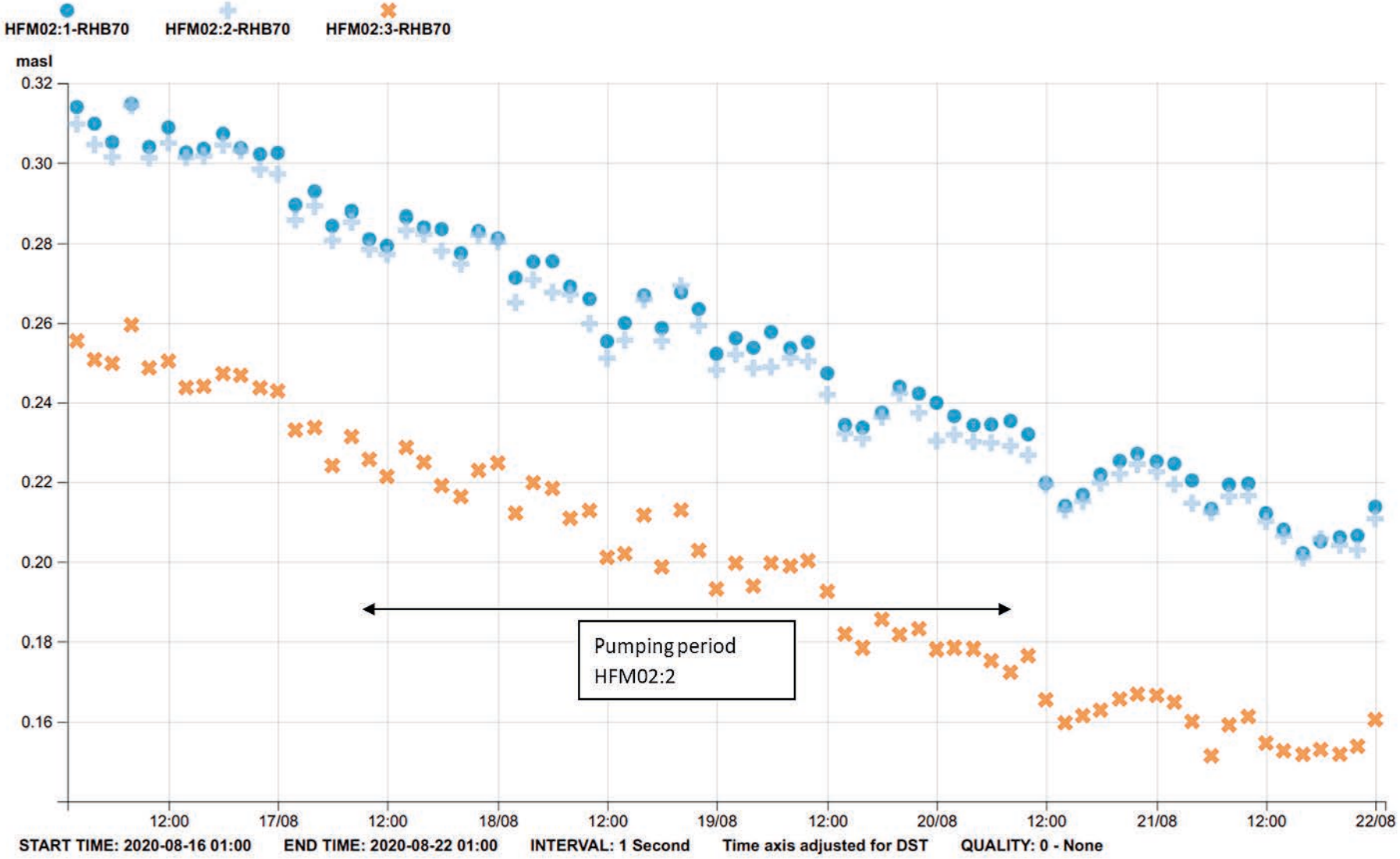

Figure A4-20. *Pumping in HFM02:2 in August 2020. No significant drawdown was observed in any of the borehole sections.*

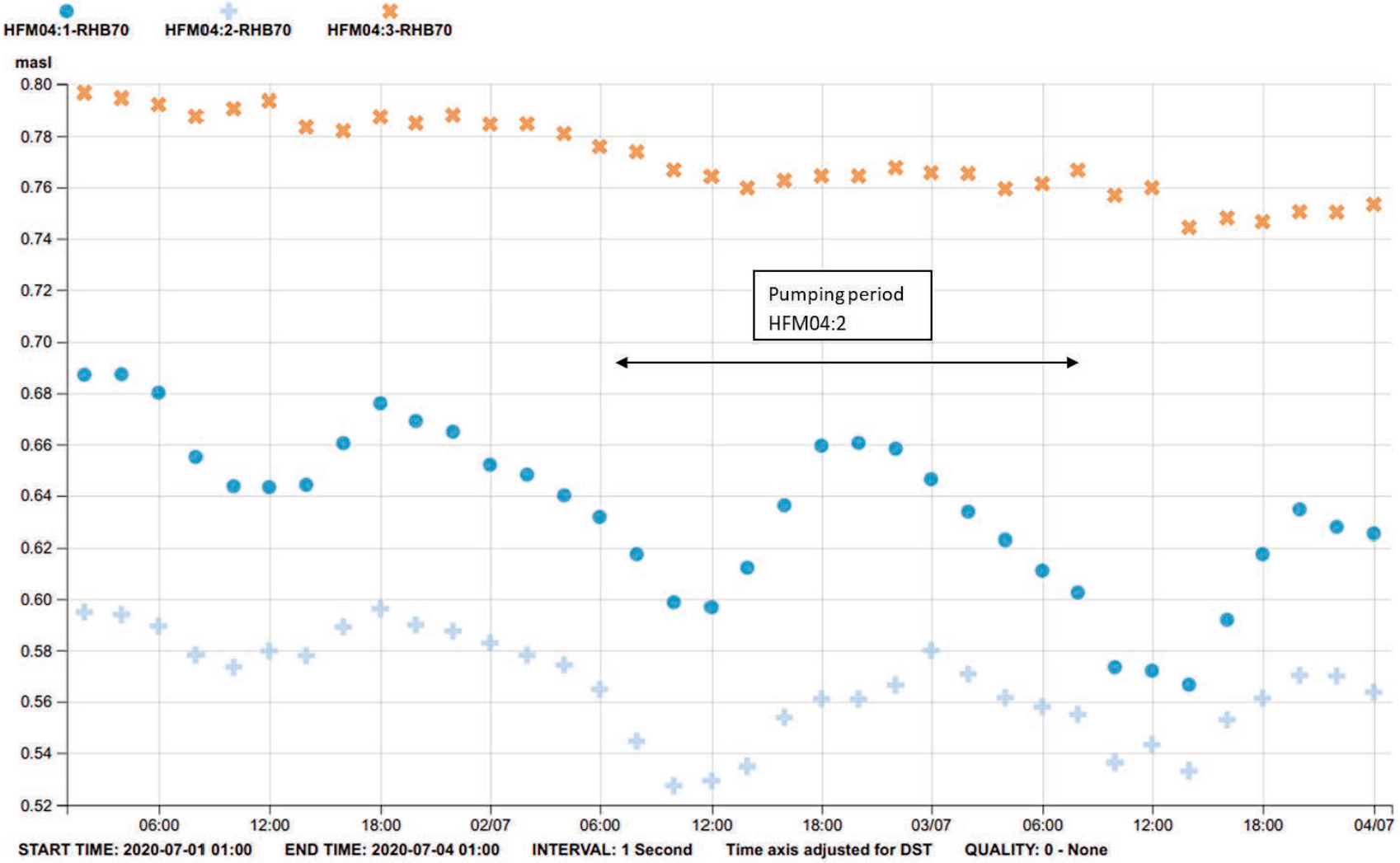

Figure A4-21. *Pumping in HFM04:2 in June 2020. No significant drawdown was seen in any section at pump start. A pump stop occurred after the first sample. The pumping was repeated in August 2020, see Figure A4-22.*

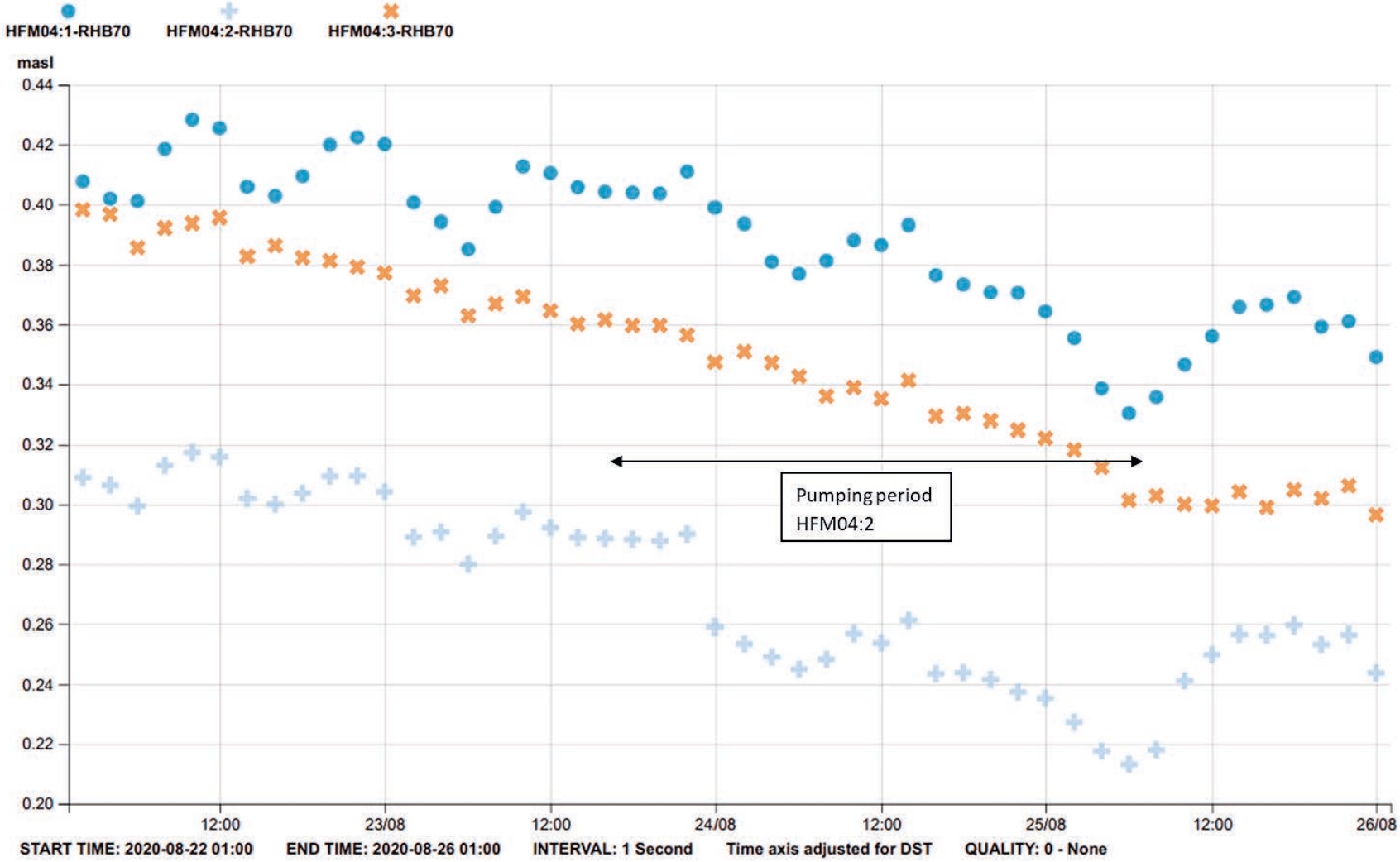

Figure A4-22. *Pumping in HFM04:2 in August 2020. No significant drawdown was seen in any section at pump start.*

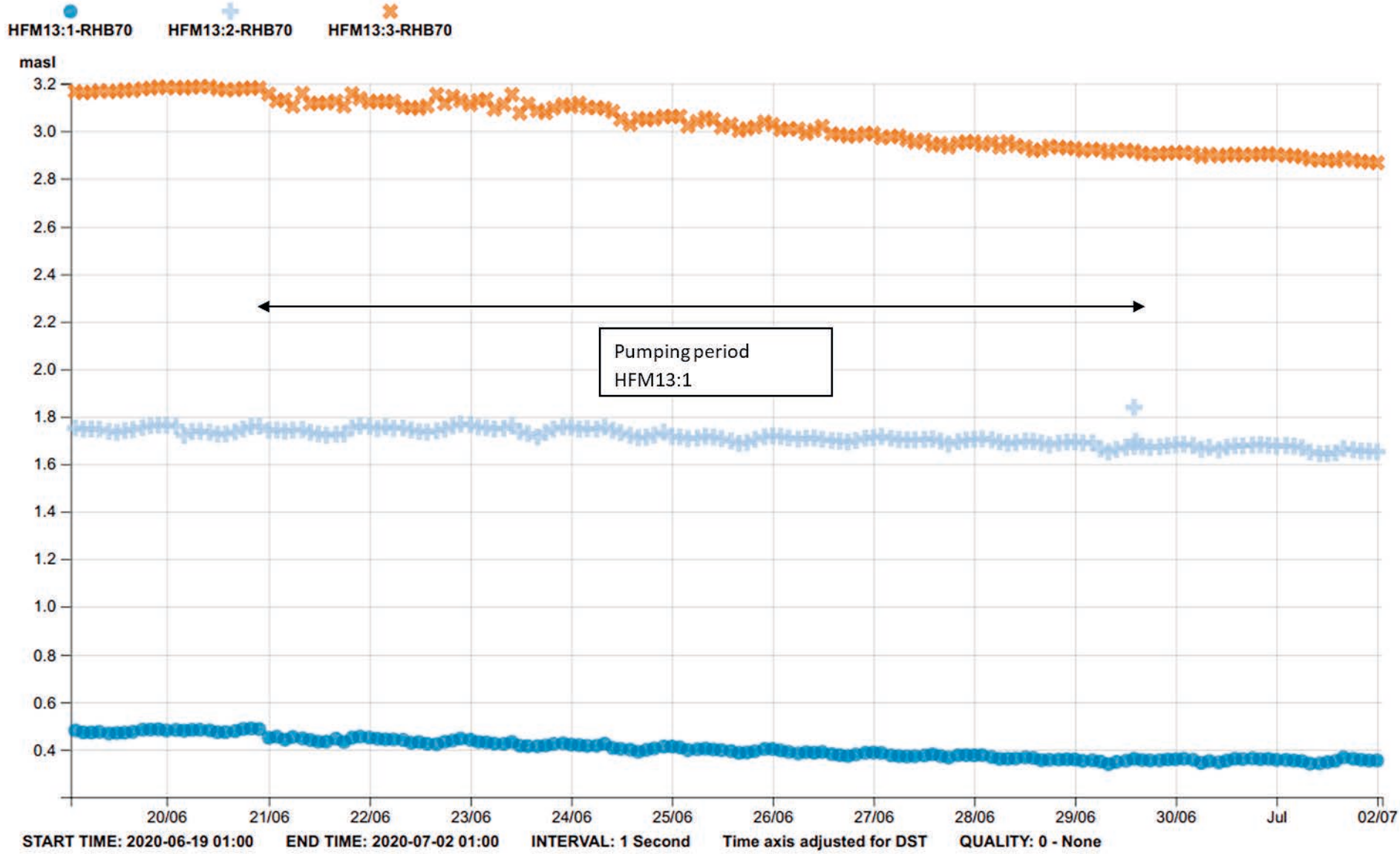

Figure A4-23. *Pumping in HFM13:1 in June 2020. No significant drawdown was seen in any section at pump start.*

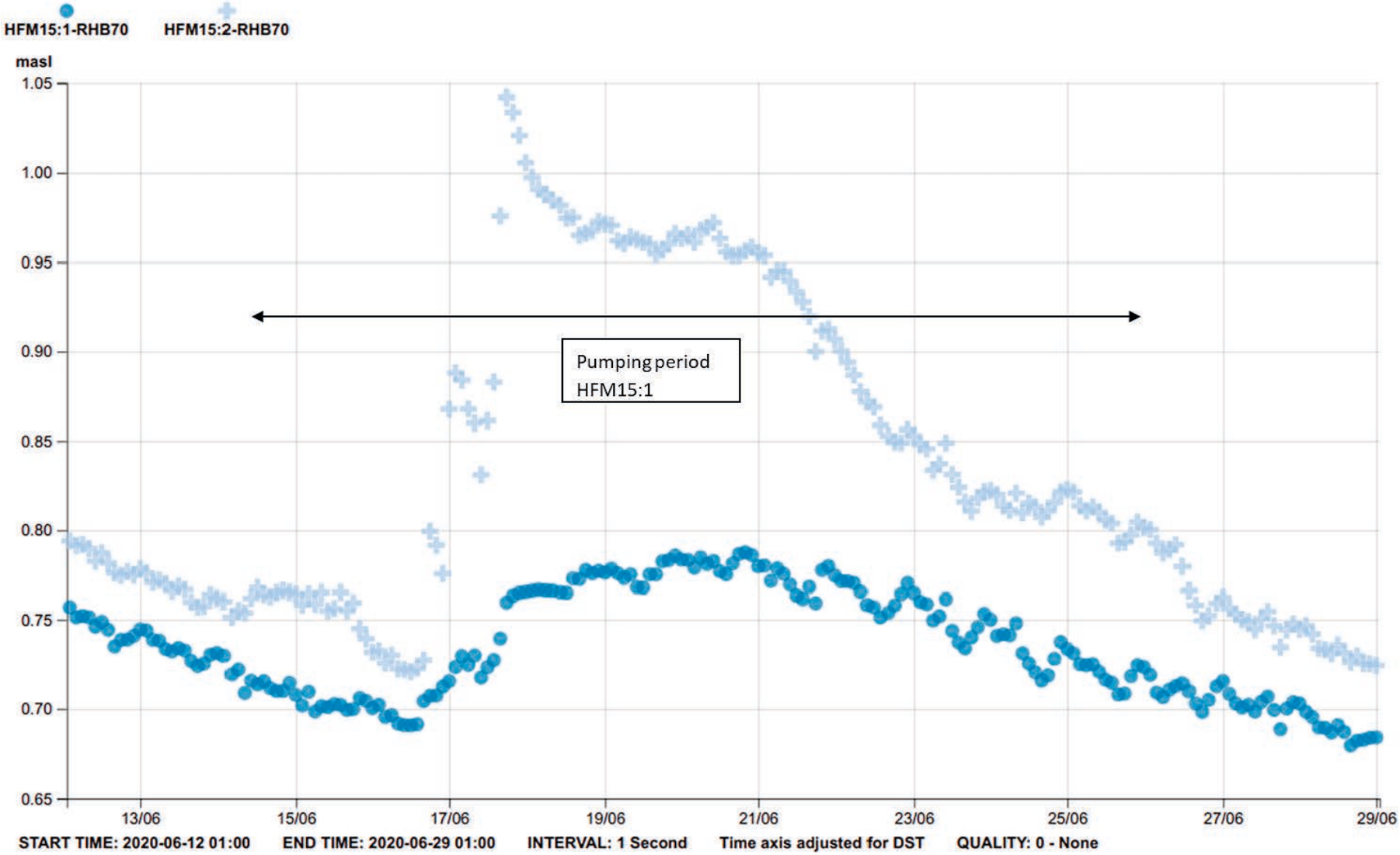

Figure A4-24. *Pumping in HFM15:1 during June 2020. The pressure increase in HFM15:2 during pumping was also seen in 2018 but not in 2019.*

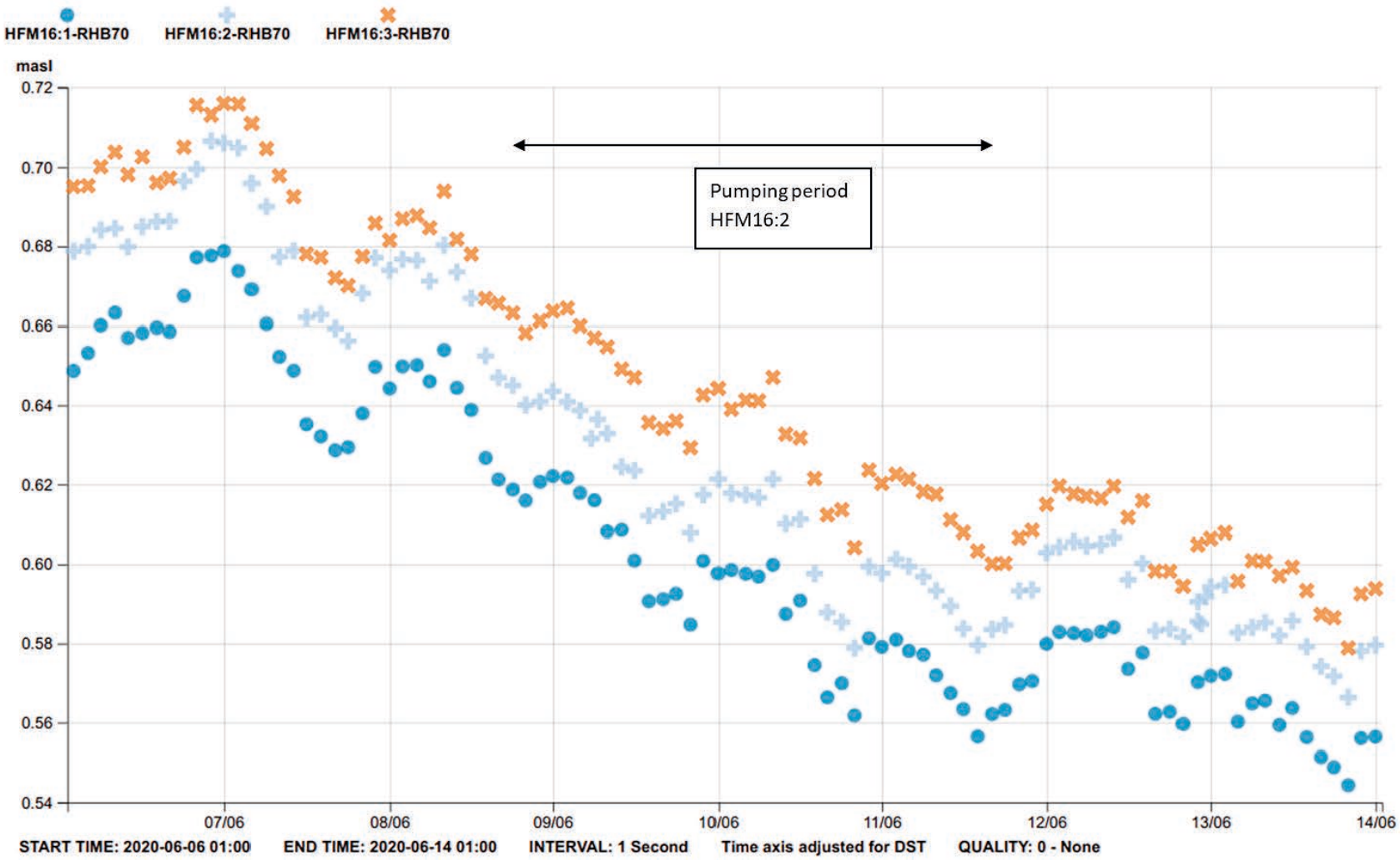

Figure A4-25. *Pumping in HFM16:2 in June 2020. No significant drawdown was observed in any of the borehole sections.*

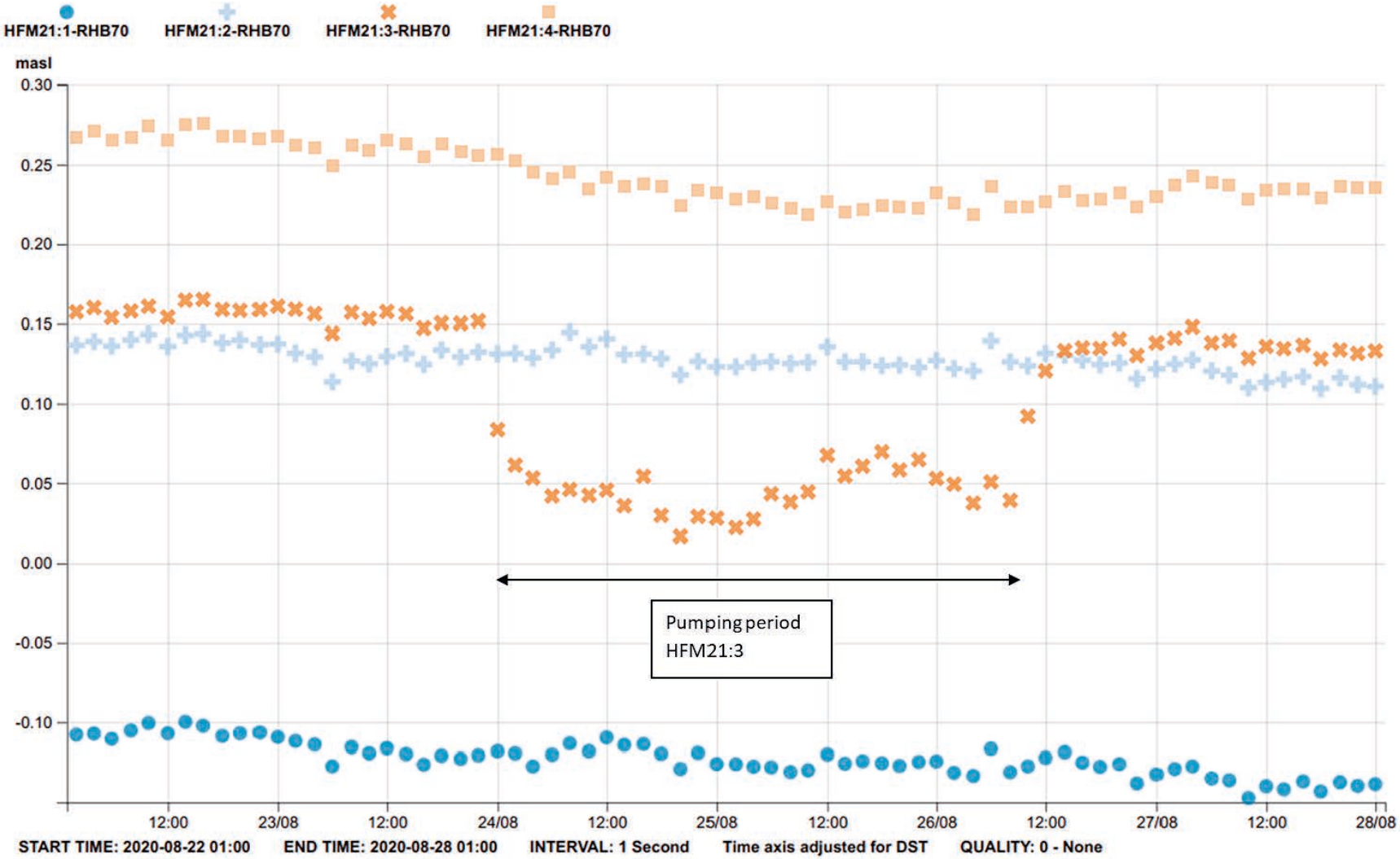

Figure A4-26. *Pumping in HFM21:1 in August 2020. No significant drawdown was observed in any of the borehole sections.*

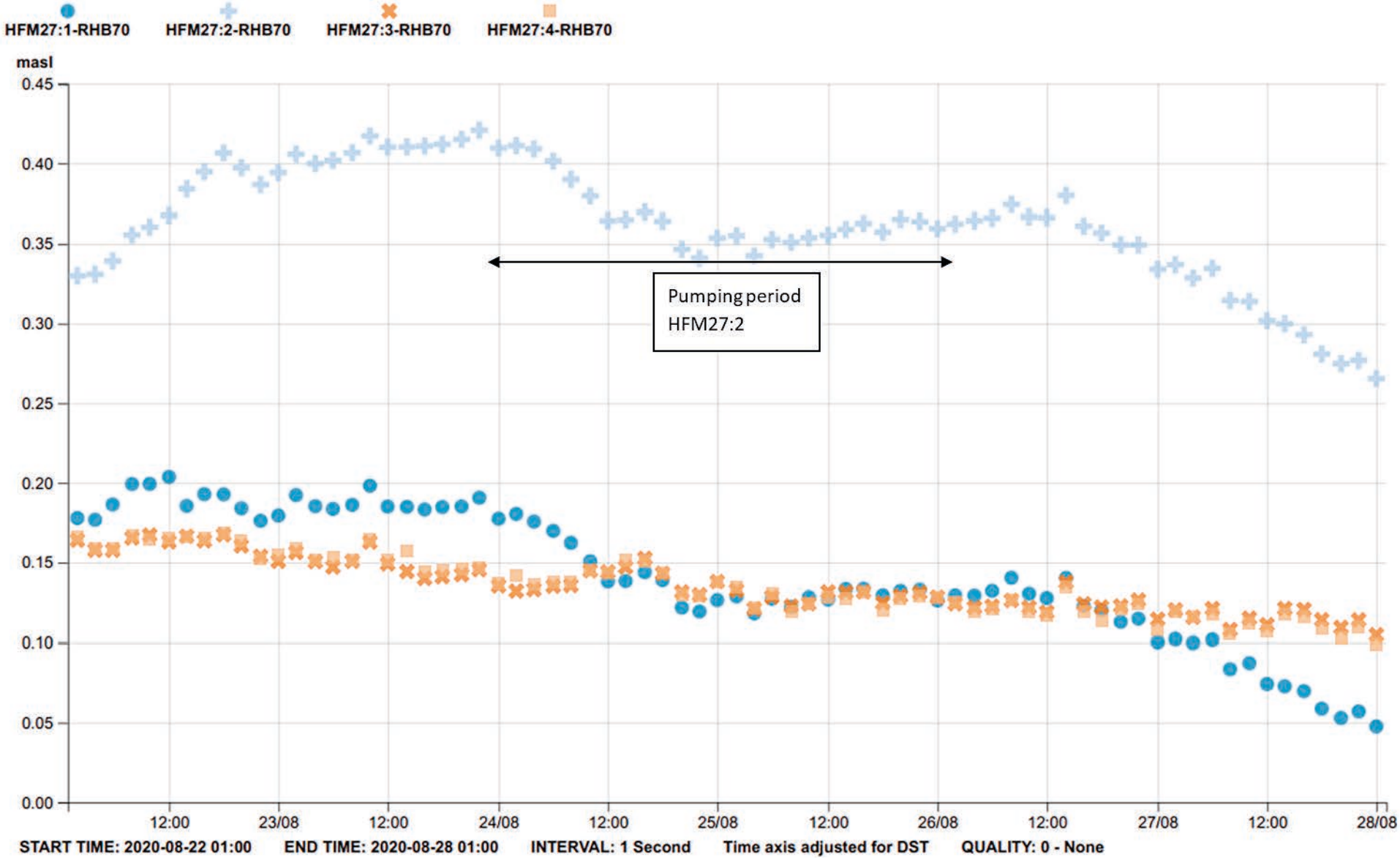

Figure A4-27. *Pumping in HFM27:2 in August 2020. No significant drawdown was observed in any of the borehole sections.*

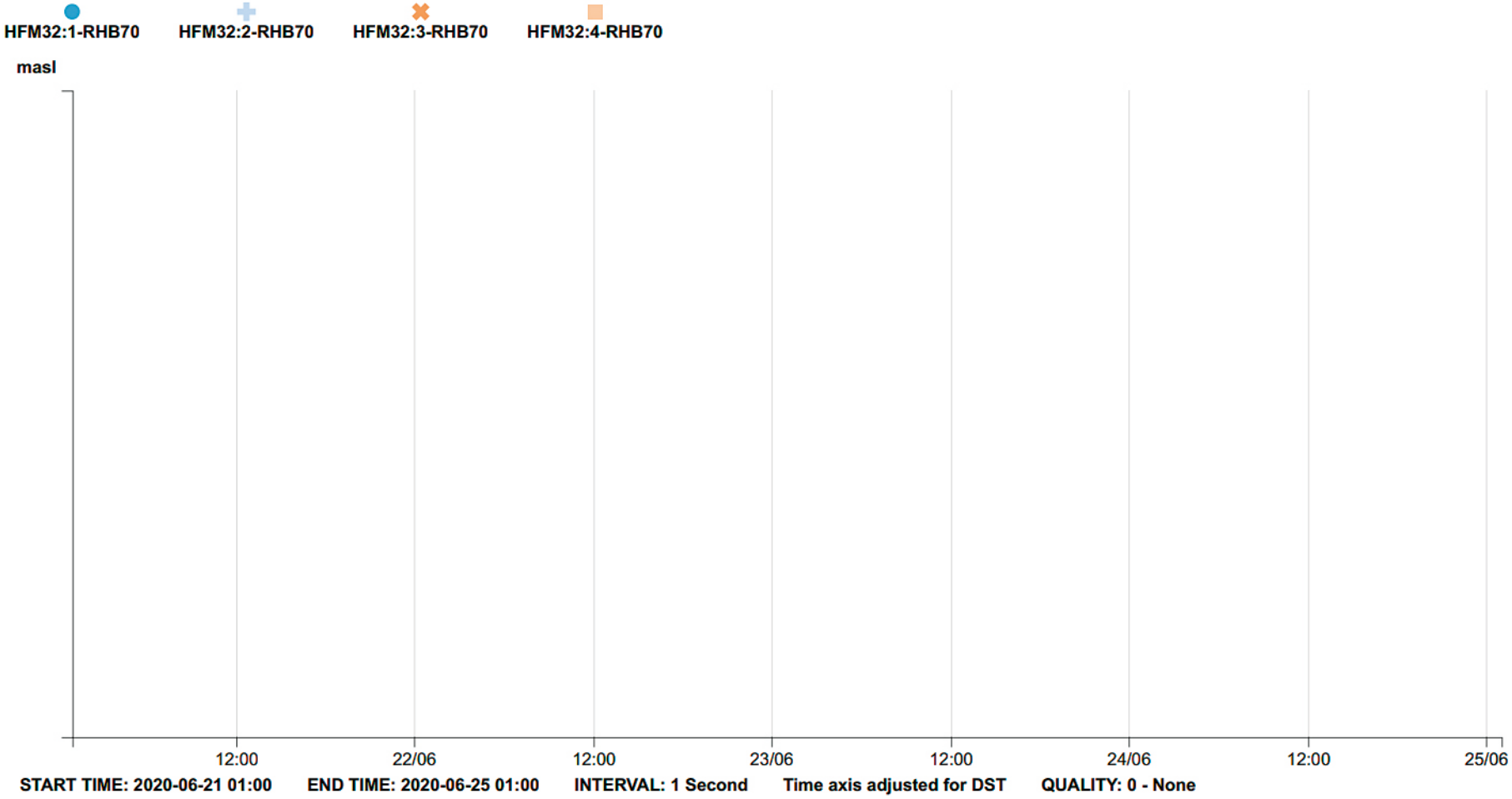

Figure A4-28. *Pumping and minor drawdown in HFM32:3 in June 2020. No reliable data available during pumping due to logger problem.*

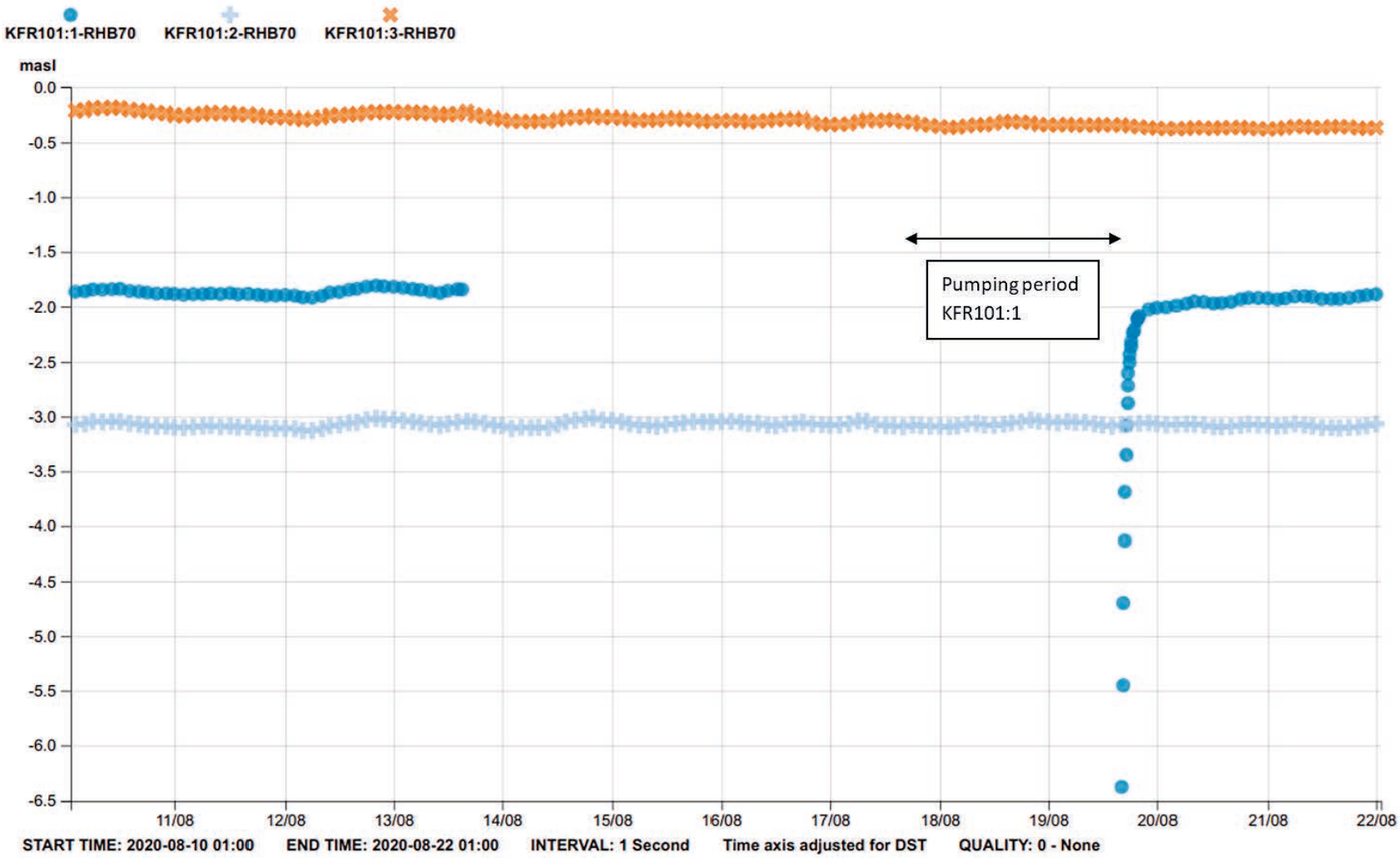

Figure A4-29. *Pumping in KFR101:1 in August 2019. The pressure transducer in KFR101:1 was removed during the pumping. No significant drawdown was noted in any other section.*

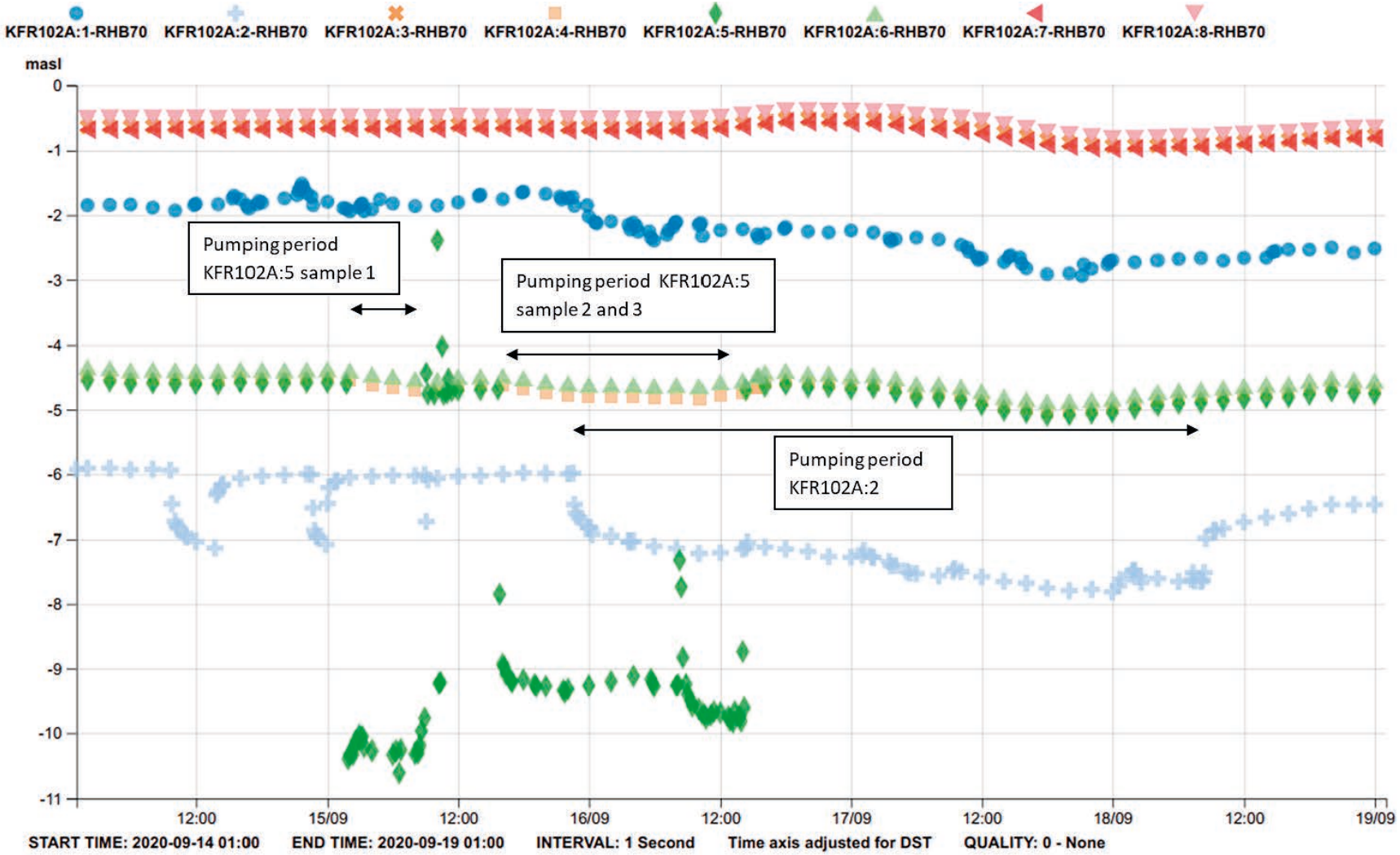

Figure A4-30. *Pumping and drawdown in KFR102A:2 and KFR102A:5 in September 2020. A response in KFR102A:1 was observed during pumping in KFR102:2. Possible responses in KFR102A:4 and KFR102A:6 were observed during pumping in KFR102A:5. Several attempts were made in KFR102A:2 before pumping was successful.*

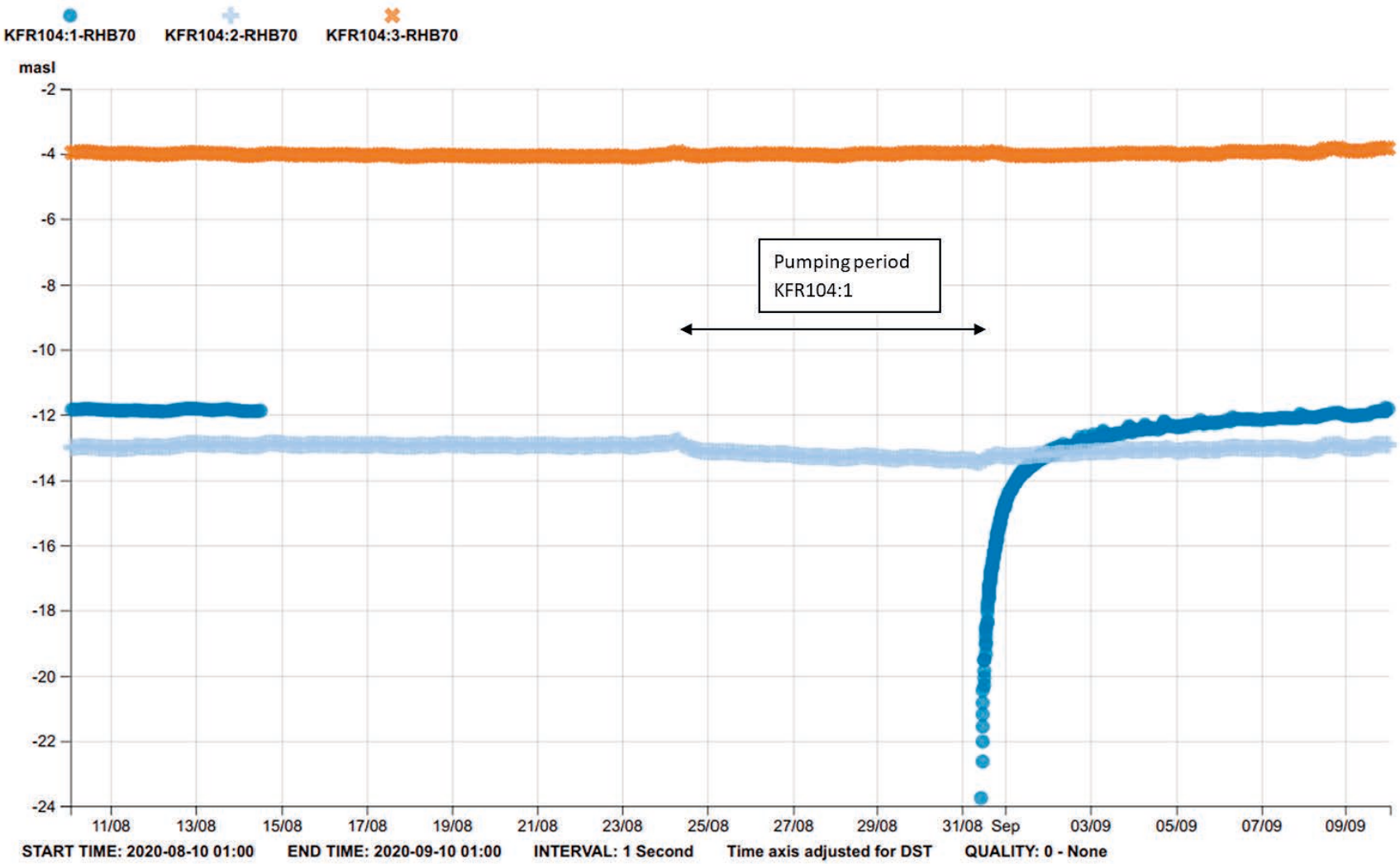

Figure A4-31. *Pumping in KFR104:1 in August 2020. The pressure transducer in KFR104:1 was removed during the pumping. A response was seen in section KFR104:2.*

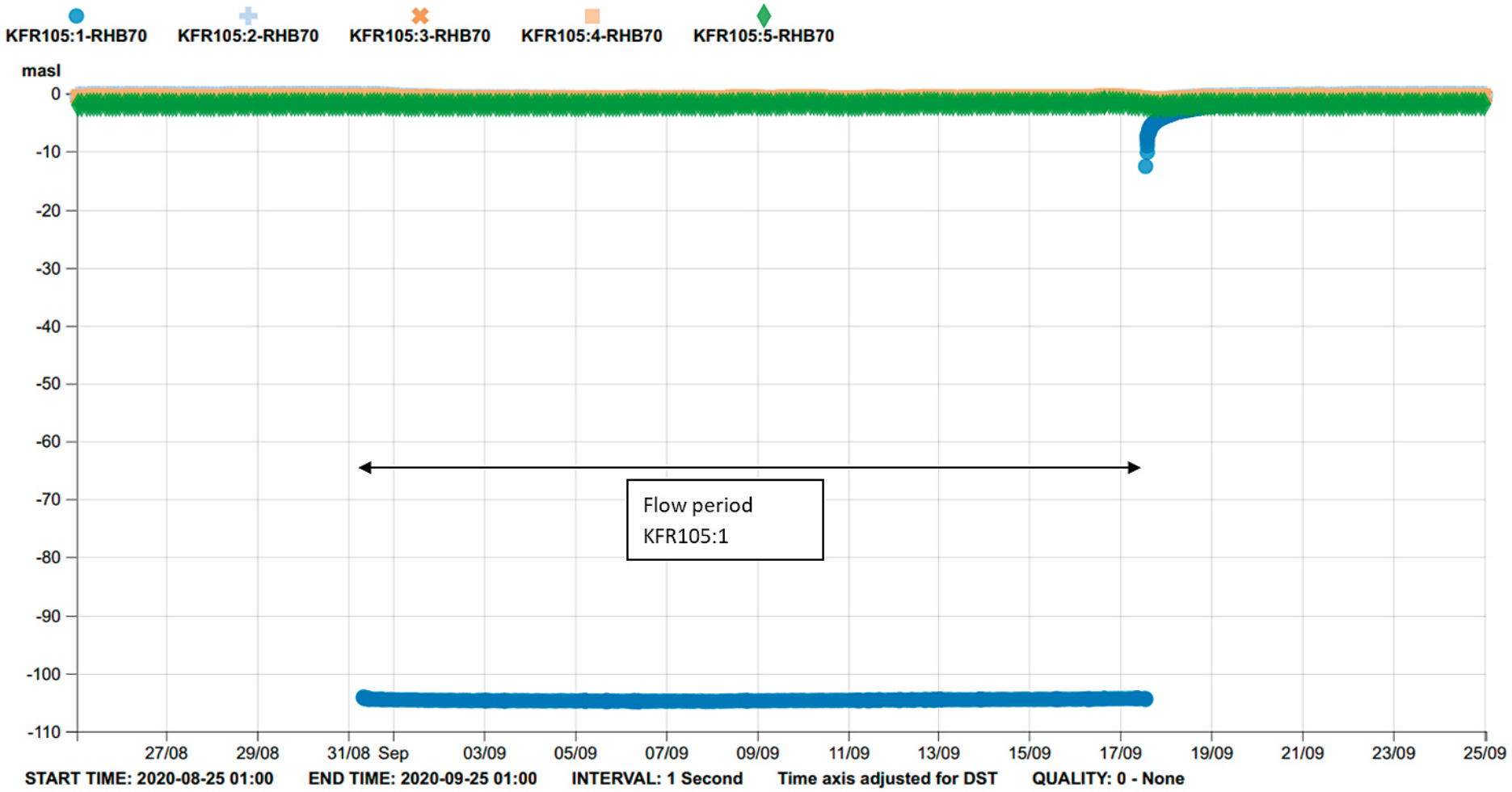

Figure A4-32. *Flow period in KFR105:1 in September 2020. See detailed plot in next figure.*

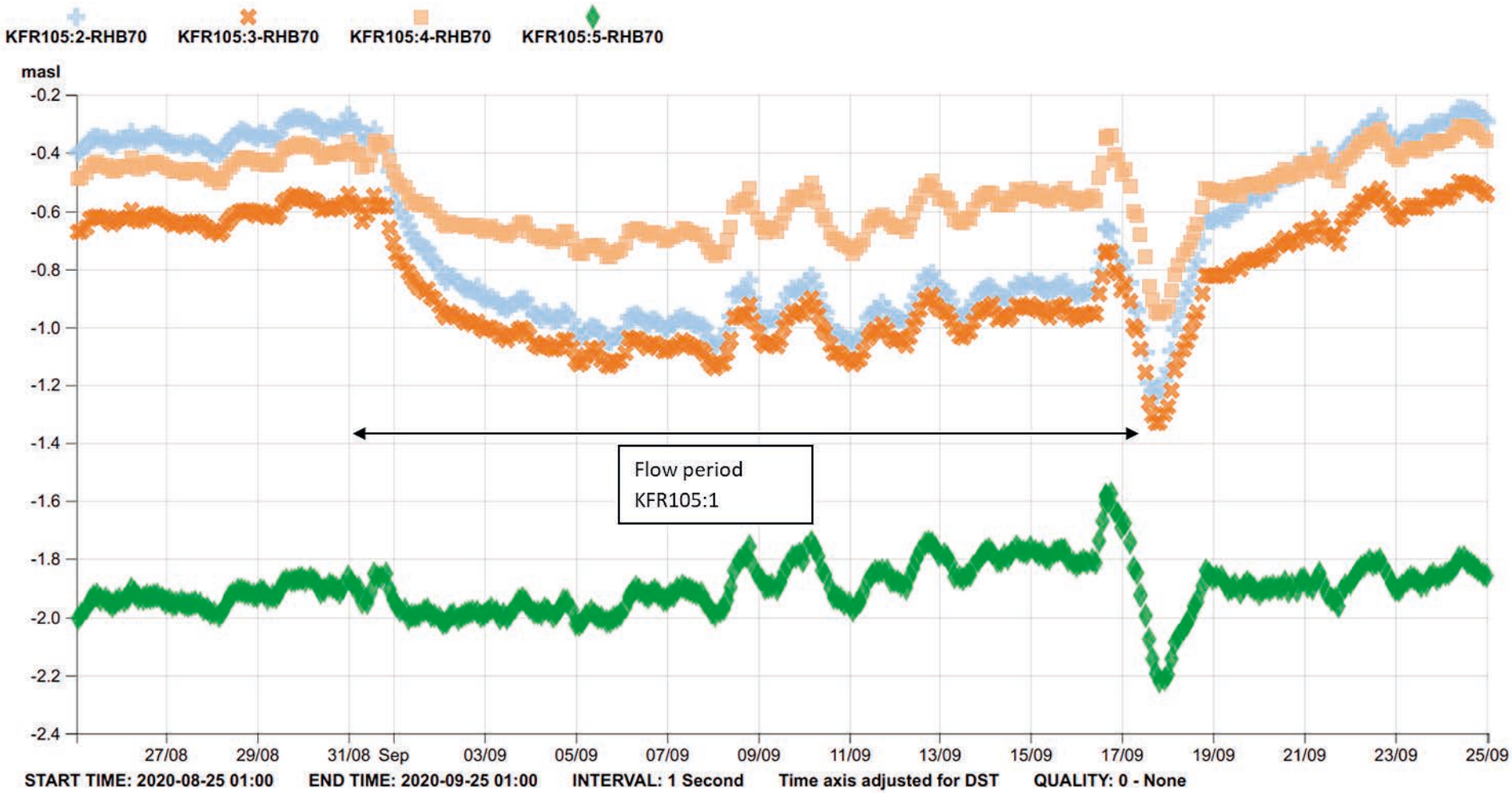

Figure A4-33. *Detailed plot of flow period and drawdown in other sections than KFR105:1 in September 2020. The efflux in KFR105:1 caused a drawdown in KFR105:2, KFR105:3 and KFR105:4.*

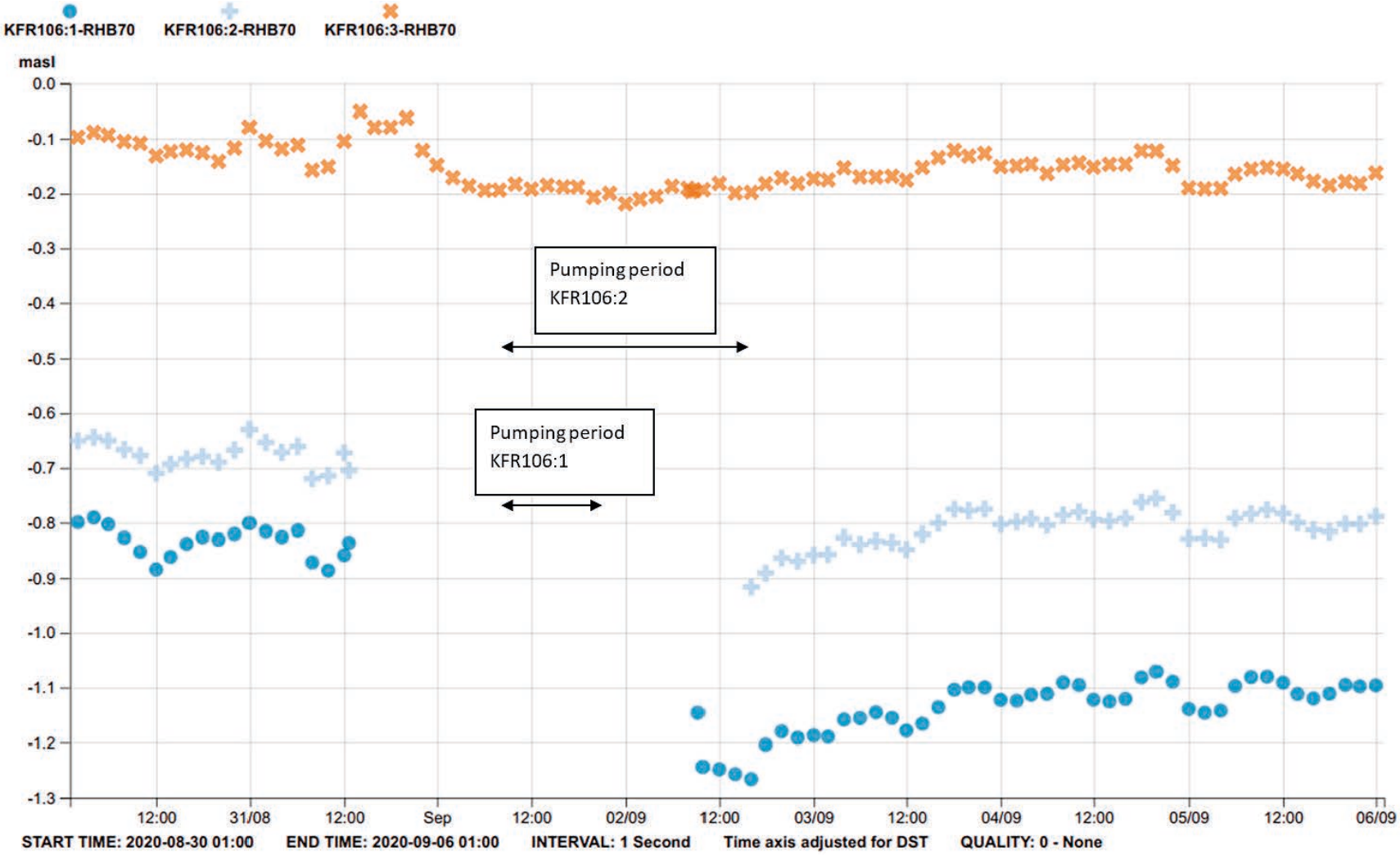

Figure A4-34. *Pumping in KFR106:1 and KFR106:2 in August/September 2020. The pressure transducers in the pumped sections were removed during the pumping. KFR106:3 was not affected.*

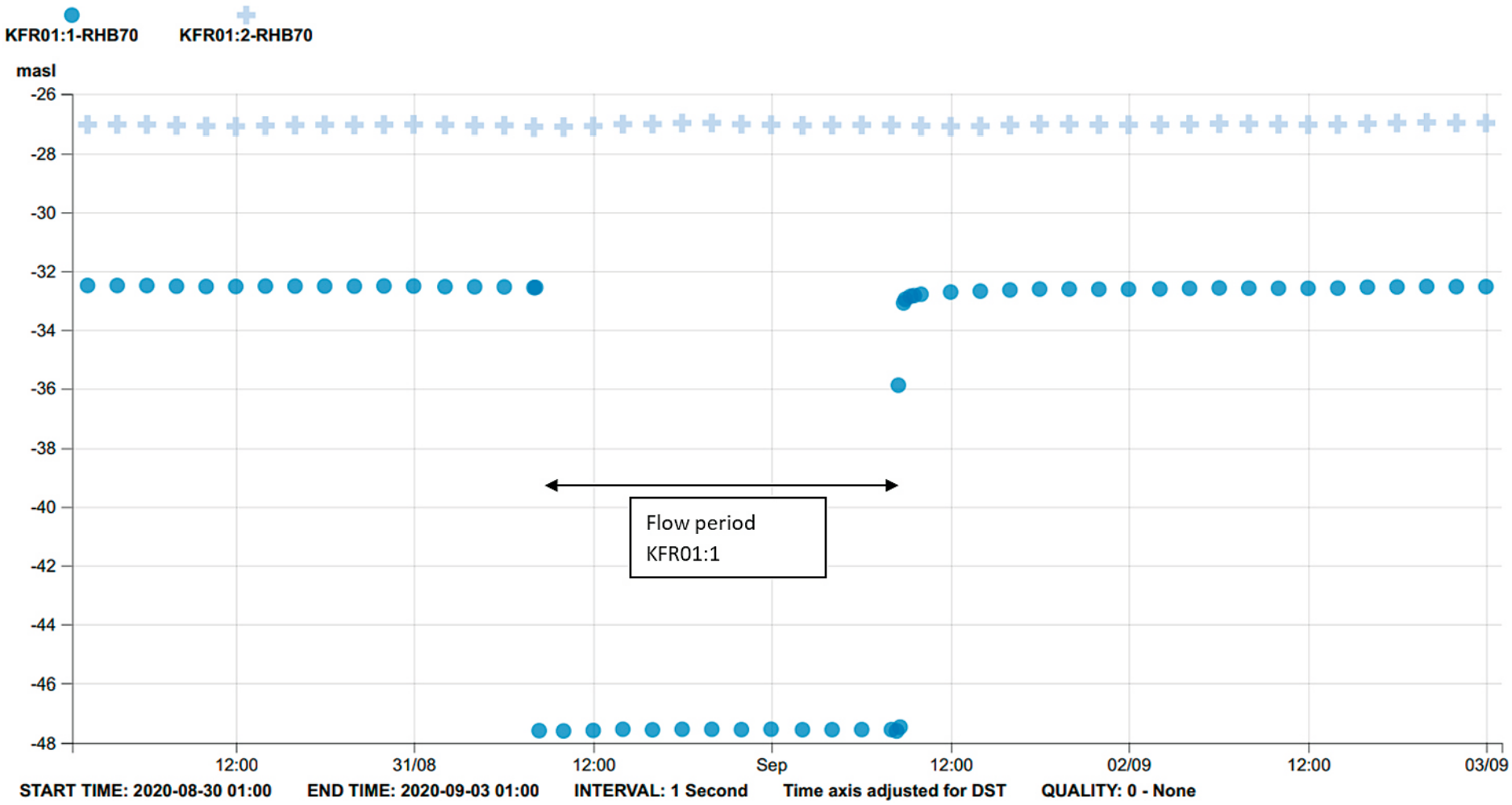

Figure A4-35. *Flow period in KFR01:1 in August 2020. KFR01:2 was not affected.*

Appendix 5

pH trends in some of the core drilled boreholes

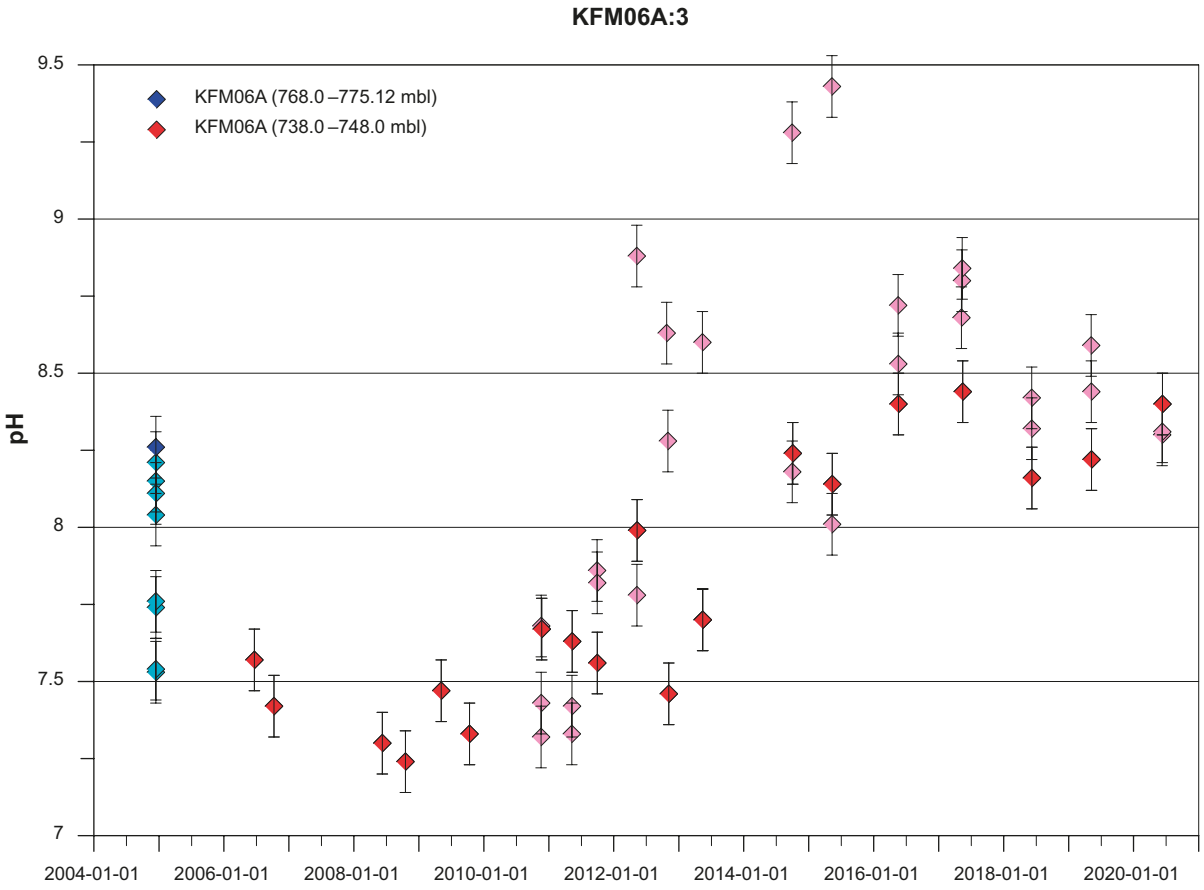

Figure A5-1. *Comparison between initial pH-values from complete chemical characterisation during PLU (Forsmark site investigation; blue diamonds) and later measurements in the ongoing monitoring programme (red diamonds) for KFM06A:3. The last sample in the series (or the only sample if no series) is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

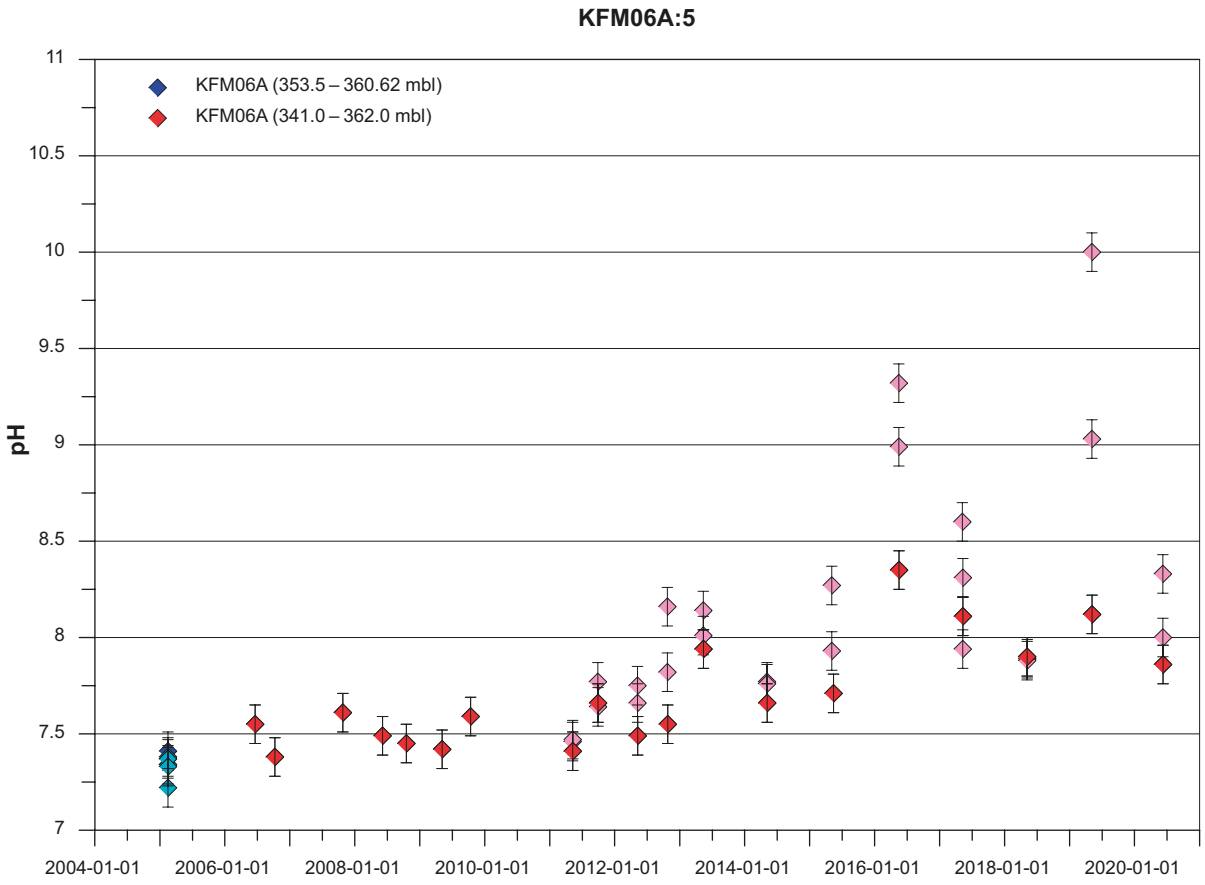

Figure A5-2. *Comparison between initial pH-values from complete chemical characterisation during PLU (blue diamonds) and later measurements in the ongoing monitoring programme (red diamonds) for KFM06A:5. The last sample in the series (or the only sample if no series) is marked with a darker red colour.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

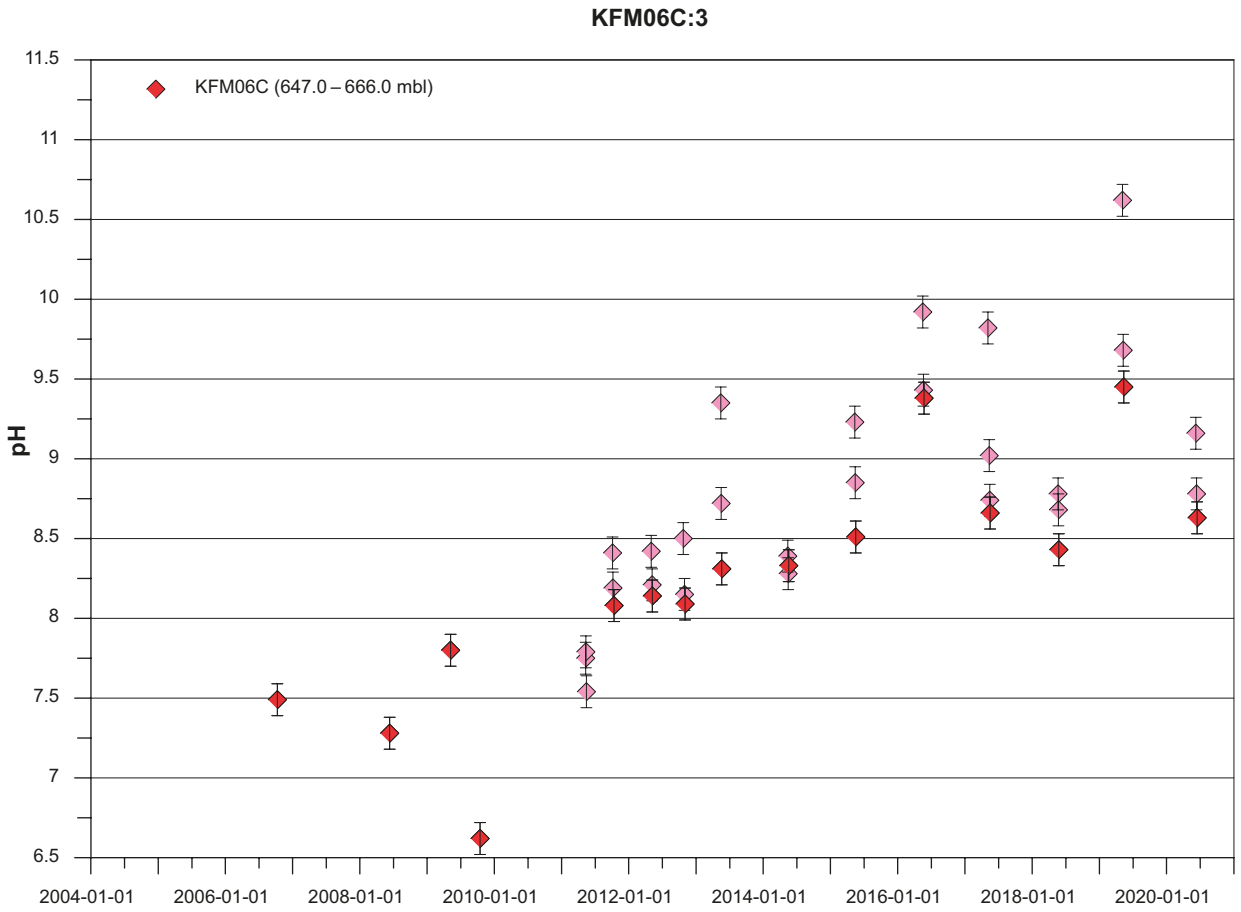

Figure A5-3. *Measurements of pH-values from the ongoing monitoring programme (red diamonds) for KFM06C:3. The last sample in the series (or the only sample if no series) is marked with a darker red colour. All the presented pH-values are measured in the laboratory at 25 °C, except those from 2013 and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

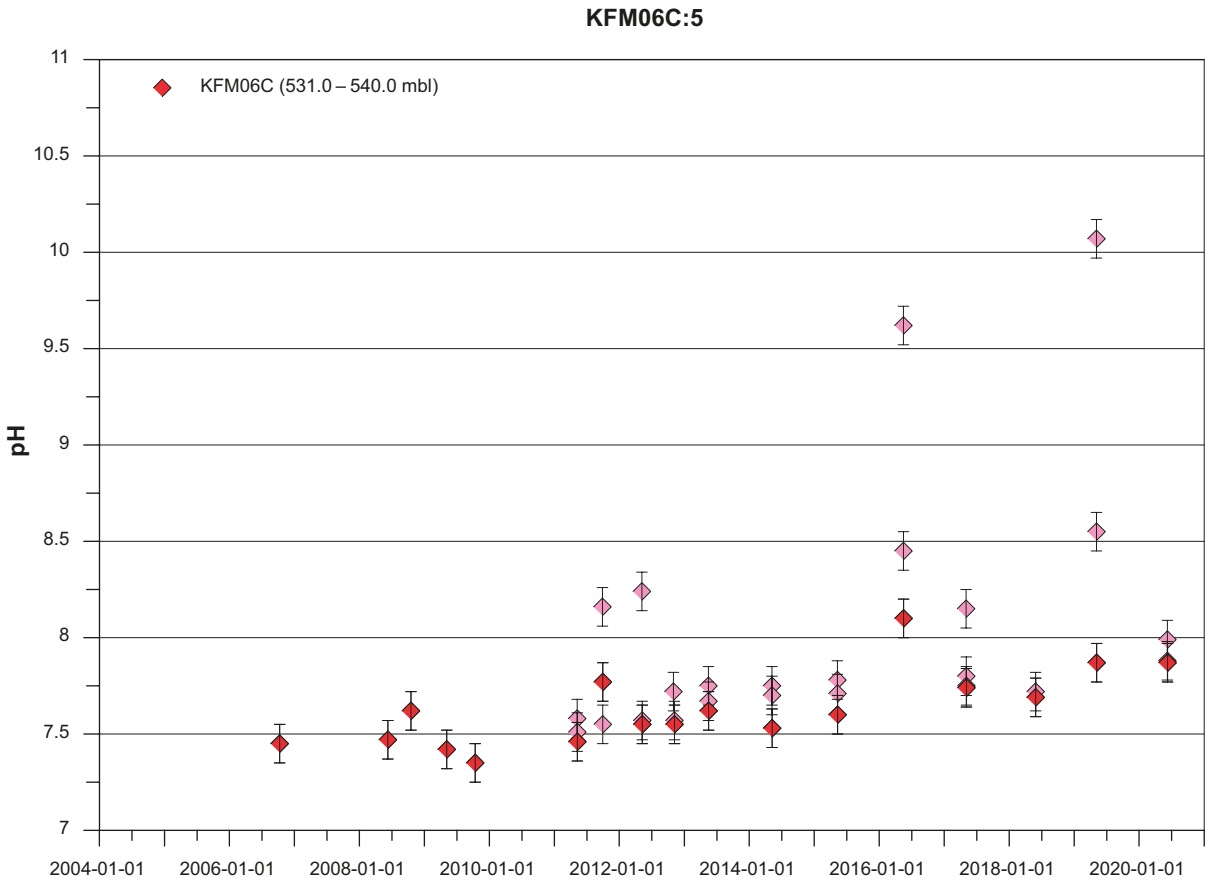

Figure A5-4. *Measurements of pH-values from the ongoing monitoring programme (red diamonds) for KFM06C:5. The last sample in the series (or the only sample if no series) is marked with a darker red colour. All the presented pH-values are measured in the laboratory at 25 °C, except those from 2013 which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

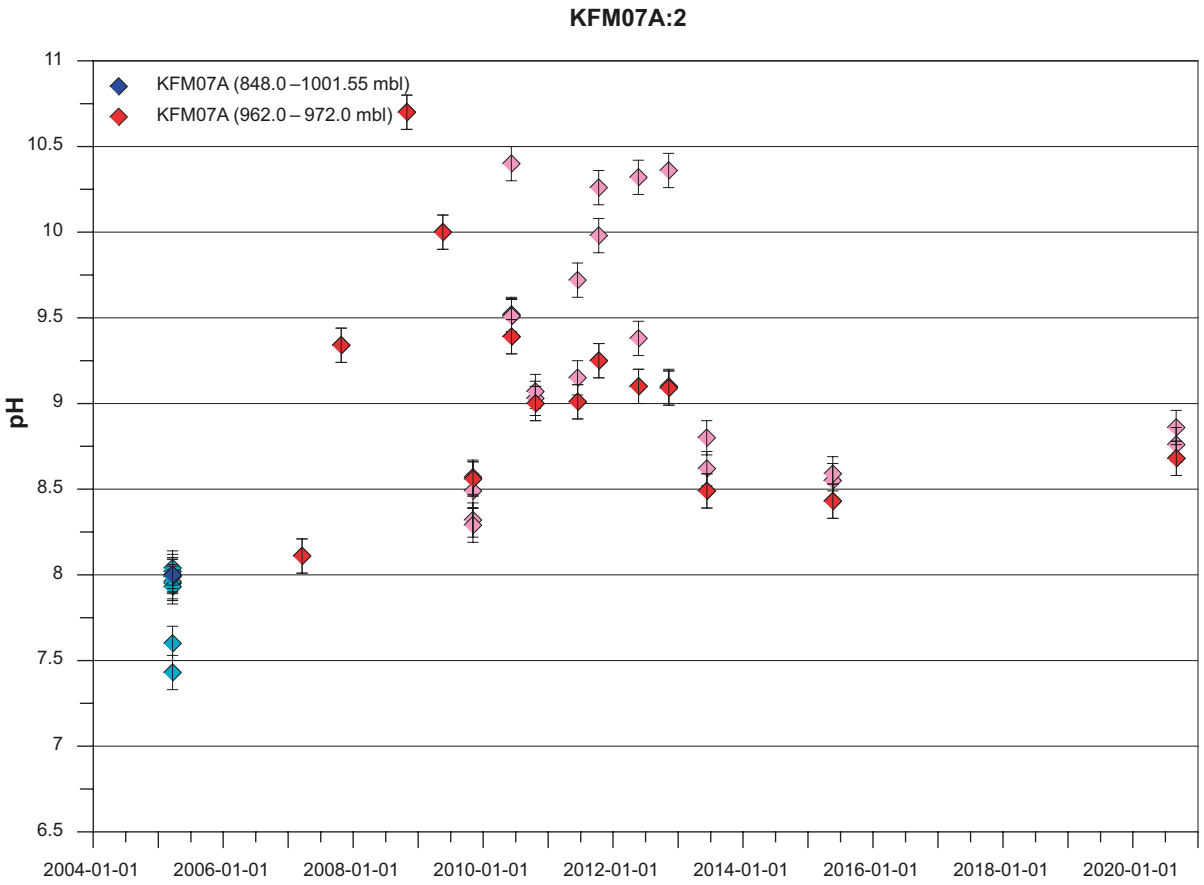

Figure A5-5. *Comparison between initial pH-values from complete chemical characterisation during PLU (blue diamonds) and later measurements in the ongoing monitoring programme (red diamonds) for KFM07A:2. The last sample in the series (or the only sample if no series) is marked with a darker red colour.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

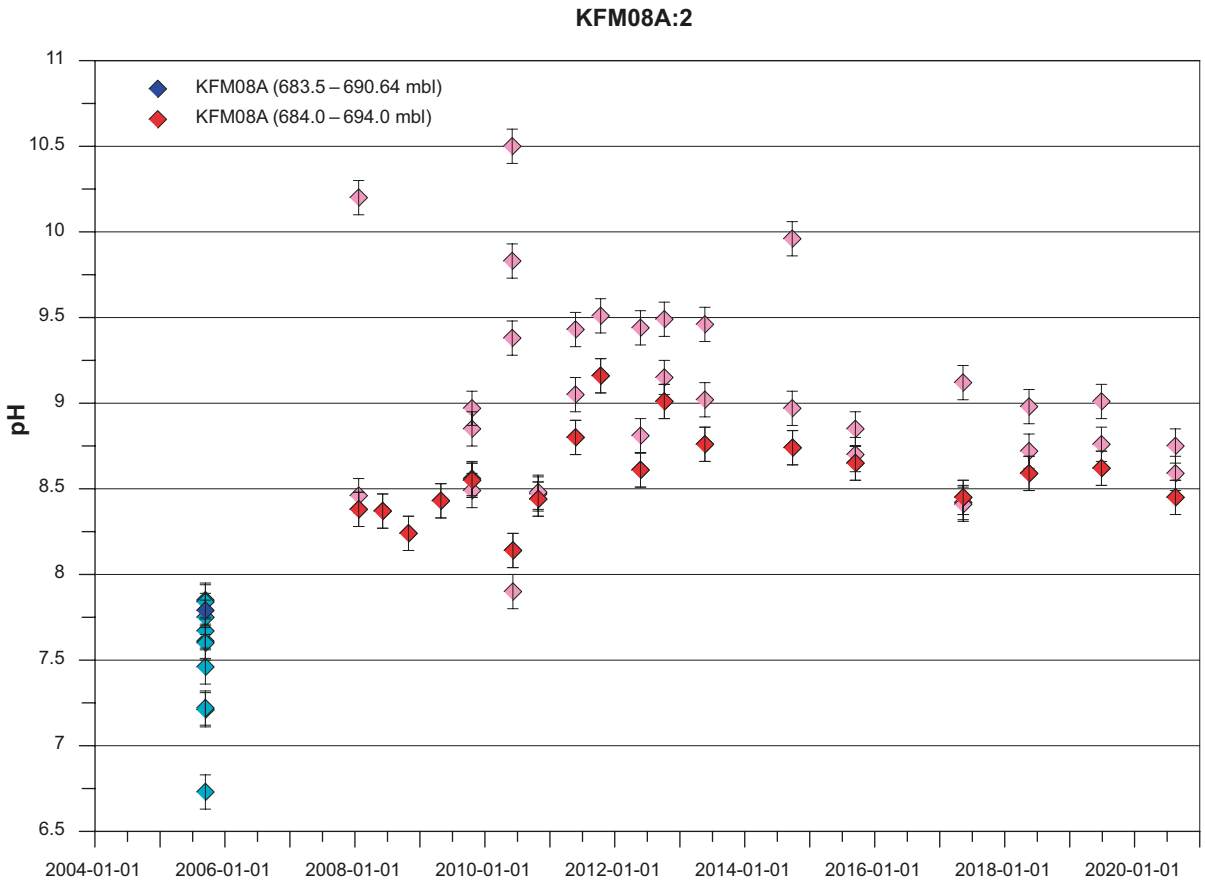

Figure A5-6. *Comparison between initial pH-values from complete chemical characterisation during PLU (blue diamonds) and later measurements in the ongoing monitoring programme (red diamonds) for KFM08A:2. The last sample in the series (or the only sample if no series) is marked with a darker red colour.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

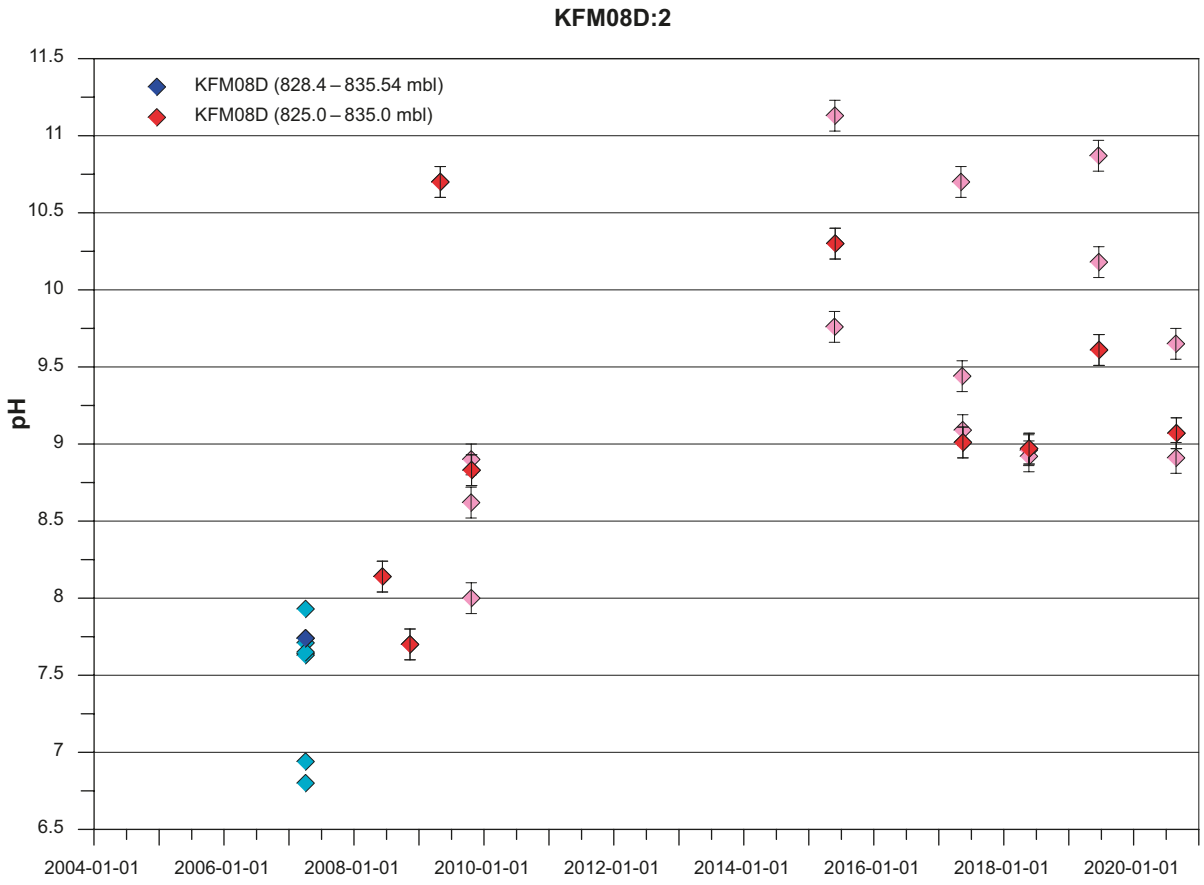

Figure A5-7. *Comparison between initial pH-values from complete chemical characterisation during PLU (blue diamonds) and later measurements in the ongoing monitoring programme (red diamonds) for KFM08D:2. The last sample in the series (or the only sample if no series) is marked with a darker red colour. All the 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.*

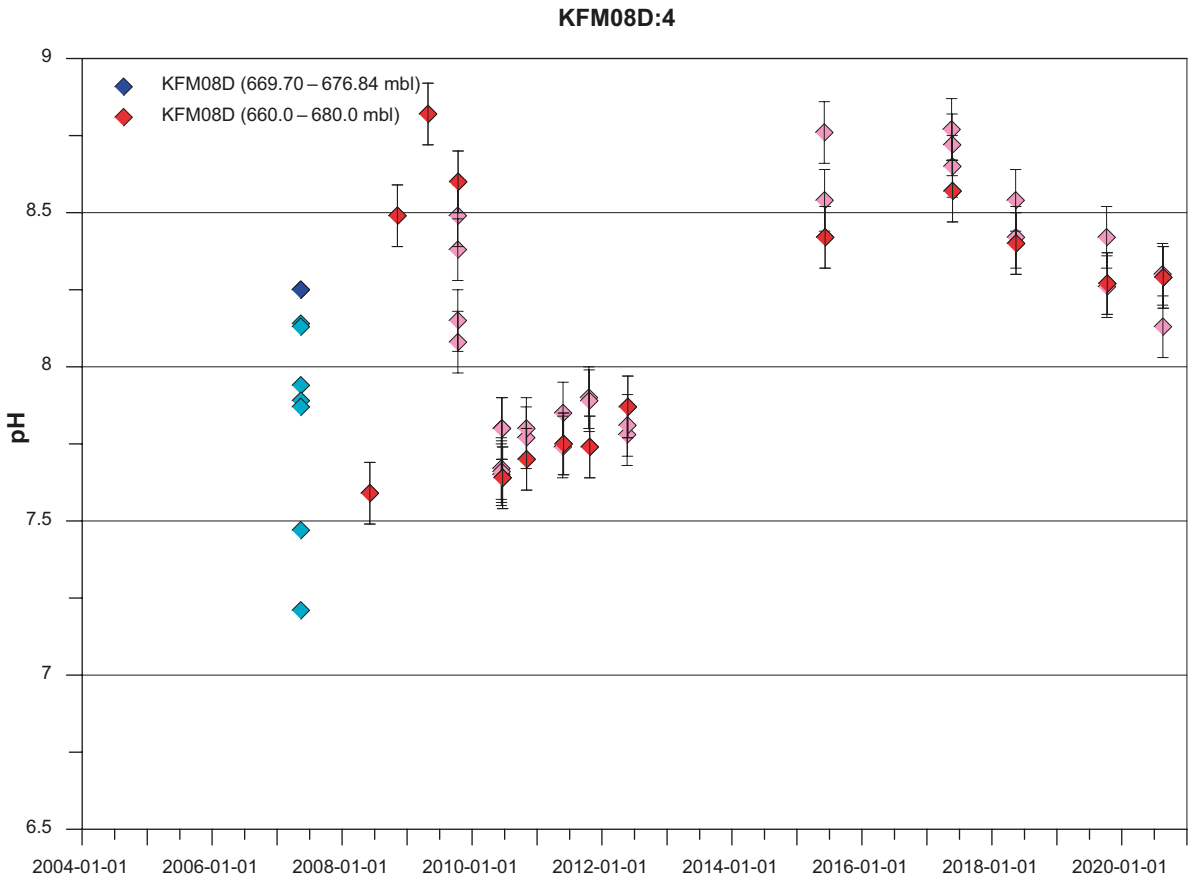

Figure A5-8. *Comparison between initial pH-values from complete chemical characterisation during PLU (blue diamonds) and later measurements in the ongoing monitoring programme (red diamonds) for KFM08D:4. The last sample in the series (or the only sample if no series) is marked with a darker red colour. All the 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.*

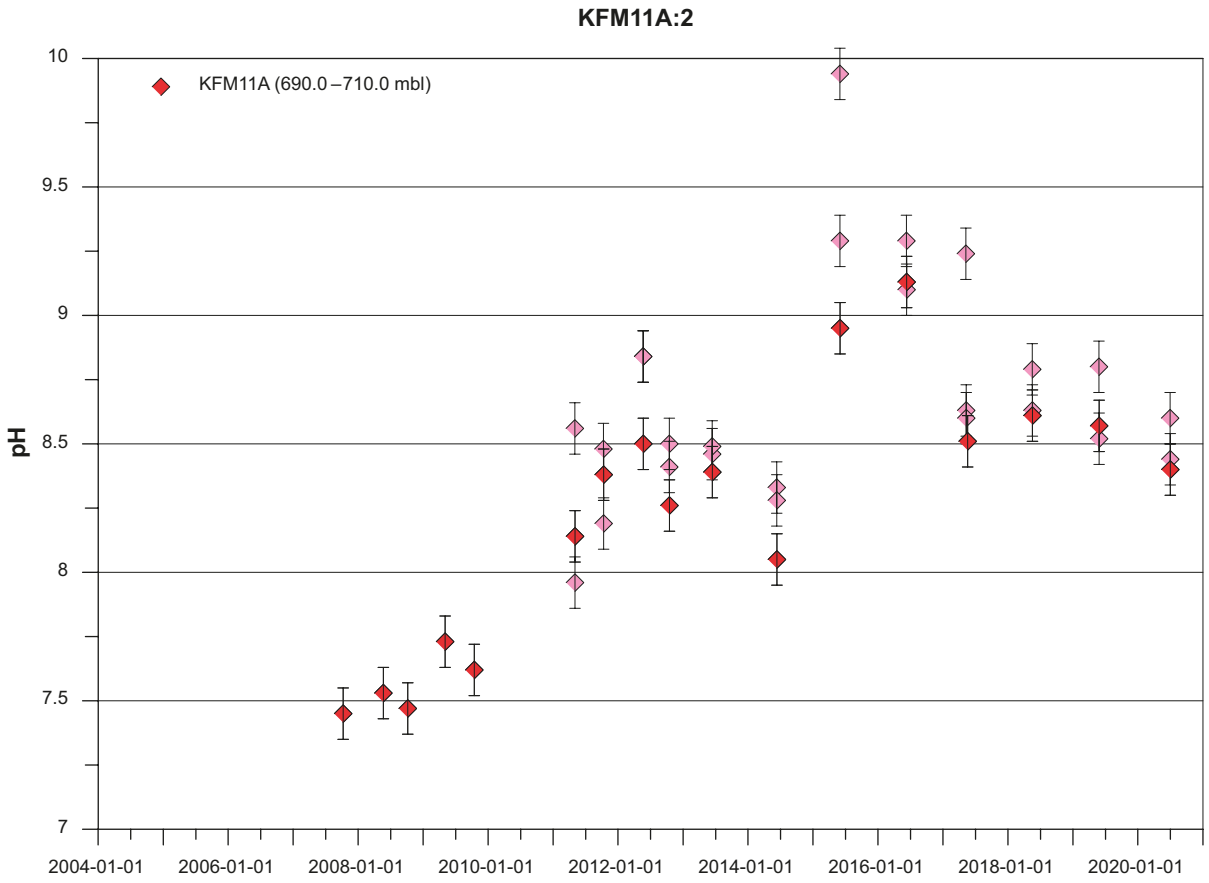

Figure A5-9. *Measurements of pH-values from the ongoing monitoring programme (red diamonds) for KFM11A:2. The last sample in the series (or the only sample if no series) is marked with a darker red colour. All the presented pH-values are measured in the laboratory at 25 °C, except those from 2013 which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

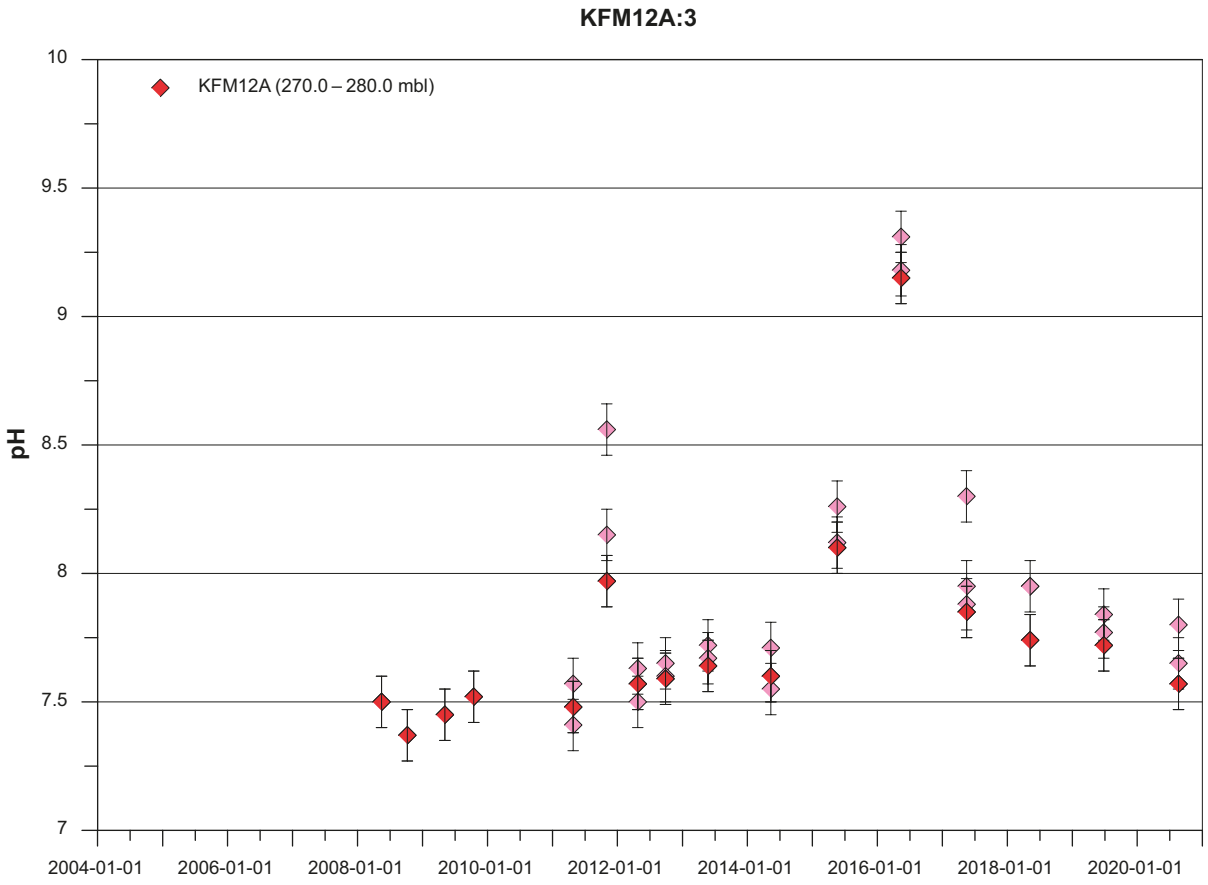

Figure A5-10. *Measurements of pH-values from the ongoing monitoring programme (red diamonds) for KFM12A:3. The last sample in the series (or the only sample if no series) is marked with a darker red colour. All the presented pH-values are measured in the laboratory at 25 °C, except those from 2013 and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

Appendix 6

Plug flow volumes

Table A6-1. Plug flow volumes.

Borehole Id-code: 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 [2)]	43
KFM06C:5 [2)]	28
KFM07A:2	38
KFM08A:2	22
KFM08A:6	259
KFM08D:2	33
KFM08D:4	235
KFM10A:2	125
KFM11A:2 [2)]	46
KFM11A:4	21
KFM12A:3 [2)]	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 [1)]	73
KFR102A:2 [1)]	194
KFR102A:5	52
KFR104:1 [1)]	60
KFR106:1	16
KFR106:2 [1)]	55
KFR105:1 [1)]	696
KFR01:1 [2)]	40

1) Used plug flow volumes smaller than 100 % formation waters, se Table A6-2.

2) Section volume.

Table A6-2. Plug flow volumes special.

Id-code: section	Used plug flow volume [L]	Percent formation water [%]	Volume needed for 100 % formation water [L]
KFR101:1	73	99	17 881
KFR102A:2	194	100	986
KFR104:1	60	83	491
KFR105:1	696	99	2 433
KFR106:2	55	89	1 450

Arkitektkopia AB, Bromma, 2022

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