

Sorbisense GWS40 Passive Sampler

Joint test report

Volatile organic compounds in groundwater



Sorbisense GWS40 Passive Sampler

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Joint test report

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	Approved by Anders Lynggaard-Jensen

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2 INTRODUCTION

This joint test report describes the implementation and the results of a test design developed for verification of the performance of an environmental technology following the NOWATECH ETV method.

The verification is a joint verification with the US EPA ETV scheme and the Advanced Monitoring Systems (AMS) Center, Battelle, see the verification protocol /1/ for details on organization and implications. The compliance of the test with both scheme's requirements was ensured through a process document /2/.

2.1 Verification protocol reference

This test report has been prepared in response to the test design established in the Sorbisense GWS40 Passive Sampler, verification protocol/1/.

2.2 Name and contact of vendor

Sorbisense A/S, Niels Pedersens Allé 2, DK-8830 Tjele, Denmark, phone +45 8999 2505, +45 8999 2599.

Contact: Hubert de Jonge, e-mail hubert@sorbisense.com.

The laboratory responsible for the analysis of samples (subcontractor to the vendor) was: ALcontrol Laboratories, Steenhouwerstraat 15, 3194 AG Hoogvliet, Netherlands.

Contact: Jaap Willem Hutter, e-mail j.hutter@alcontrol.nl

2.3 Name of center/test responsible

NOWATECH Water Monitoring ETV Center (NOWATECH WMC), DHI, Agern Allé 5, DK-2970 Hørsholm, Denmark.

Test responsible: Gerald Heinicke, e-mail ghe@dhigroup.com, phone +45 9516 9268.

US EPA Advanced Monitoring System Center, Battelle Memorial Institute, 505 King Avenue, Columbus, Ohio 43201-2693, US.

Test responsible: Anne M. Gregg (AMG), e-mail gregga@battelle.org, phone +1 614-424-7419.

2.4 Technical experts

The expert group assigned to this test and responsible for review of test plan and test report included:

Dietmar Müller (DM), e-mail dietmar.mueller@umweltbundesamt.at, Contaminated Sites, Umweltbundesamt, Spittelauer Lände 5, 1090 Wien, Austria, phone +43-(0)1-313 04/5913.

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Cynthia Paul (CP), e-mail paul.cindy@epa.gov, U.S. Environmental Protection Agency, 919 Kerr Research Drive, P.O. Box 1198, Ada, OK 74820, US, phone: +1 580-436-8556.

3 TEST DESIGN

The test design outlined in the test protocol is summarized in Table 1. The term “samples” is used for samples taken with the Sorbisense sampler, whereas the term “reference samples” is used for water samples taken for reference analysis, after a reference method in an accredited (ISO 17025) laboratory. Acronyms are explained in Appendix 1.

If nothing else is stated below, the standard conditions for the standpipe test performed in the laboratory included mid-range ionic strength (30-70 mS/m conductivity), a sampling period of 6 days and a sampling depth of 0.5 m (0.05 atm overpressure).

In Table 1, labels are given for each experiment and for experiments with different levels; a new label is given for each level.

The tests were carried out on chlorinated compounds, BTEX and MTBE (VOC). Due to the chloroethene being very volatile a specific set-up had to be made for tests with chloroethene, referred to as “Direct application”, in this set up was included all chlorinated compound (VOX) but not BTEX and MTBE.

Table 1 Overview of test design.

Performance parameters	Laboratory		Standpipe ¹	Field
	Direct application ²	Sample dispenser ¹		
Limit of detection (LoD)	Direct application of VOX standard dilution to samplers in 7 replicates at 5 x LoD. Triplicate reference analysis of VOX standard dilution. Exp. H	n.a. ³	7 replicate samples at 5 x LoD, spiked concentration. 7 reference samples distributed over the sampling period, in replicates of 2-3-2. Exp. J	n.a.
Precision (repeatability and reproducibility) Range of application Trueness Robustness, general	Direct application of VOX standard in 7 replicates to samplers at 10% of range. Exp. L	n.a.	Triplicate samples and three reference samples, the latter distributed over the sampling period, at 5 spiked VOC conc.: 10, 25, 50, 75, 100% of range. Exp. N, P, R, T, V	Single samples and reference samples at 3 (Sorbisense) or 4 (reference) times from a total of 5 wells at 2 sites, inherent concentrations. Exp. AA, AB, AC, AD, AE
Robustness, specific				
- Reference for the robustness test levels	n.a.	Triplicate samples at 1 spiked 50% range VOC concentration, 1 mid range ionic strength (35 mS/m) and 1 mid range sampling time (6 days) from the sample dispenser. Three reference samples distributed over the sampling period. Exp. BA	Precision test above	n.a.
- Sampling depth	n.a.	n.a.	Triplicate samples at 1 spiked VOC mid range concentration, 0.5 atm. overpressure. Three reference samples distributed over the sampling period. Exp. CA	n.a.
- Ionic strength	n.a.	Triplicate samples at 1 spiked	n.a.	n.a.

¹ Standpipe and sample dispenser experiments were done with the full VOC set without chloroethene, by addition of stock solution produced from pure chemicals.

² Direct application was done with chloroethene and the other chlorinated compounds (VOX), but without the BTEX and MTBE.

³ n.a.: not applicable.

Performance parameters	Laboratory		Standpipe ¹	Field
	Direct application ²	Sample dispenser ¹		
		<p>mid-range VOC concentration, 2 ionic strengths (10 and 100 mS/m), (6 days), from the sample dispenser.</p> <p>Three reference samples distributed over the sampling period for each ionic strength.</p> <p>Exp. DA, EA</p>		
- Sampling time	n.a.	<p>Triplicate samples at 1 spiked VOC mid range concentration, mid range ionic strength and 2 sampling times (3 and 9 days), from the sample dispenser.</p> <p>Three reference samples distributed over the sampling period for each sampling time.</p> <p>Exp. FA, GA</p>	n.a.	n.a.
- Concentration integration	n.a.	<p>Triplicate samples at a step VOC concentration, 3 concentrations (20, 50 and 80% of range), each at 1/3 of 6 days sampling period, from the sample dispenser.</p> <p>Three reference samples, each in the middle of the 2-days periods.</p> <p>Exp. HA</p>	n.a.	n.a.

3.1 Test sites

The direct application, sample dispenser and standpipe tests were conducted in the DHI laboratory building, Hørsholm, Denmark.

The field tests were carried out on contaminated sites in the Copenhagen area.

3.1.1 Types

The test sites are summarized in Table 2.

Table 2 Summary of test sites.

Scale	Address/site	Site details	VOC profile for test
Direct appl.	DHI premises	None	Chlorinated solvents (VOX)
Dispenser	DHI premises	None	All target compounds (VOC) except chloroethene
Standpipe	DHI premises	None	All target compounds (VOC) except chloroethene
Field	Søborg Hovedgade, Søborg	C8	Chlorinated solvents, BTEX, intermediary concentrations
	Søborg Hovedgade, Søborg	C11	Chlorinated solvents, BTEX, low/intermediary concentrations
	Søborg Hovedgade, Søborg	C14	Chlorinated solvents, BTEX, intermediary concentrations
	Farum Bytorv, Farum	B17	BTEX + MTBE, high concentrations
	Farum Bytorv, Farum	B18	BTEX + MTBE, low concentrations

3.1.2 Addresses

See Table 2.

3.1.3 Descriptions

See Table 2.

3.2 Tests

The test program was prepared to provide the information and to apply the approaches presented for analytical quality control for water analysis (ISO 13530) /3/ and for performance test of on-line sensors/analyzing equipment (ISO 15839) /4/. The field tests were guided by the test requirements in the Cost Agreement (pre-standard) on verification of monitoring technologies for groundwater site characterization (CEN/WS 32:2008) /5/.

The test design, as described in Table 1, included four test scales: direct application, sample dispenser, standpipe and field.

For the volatile chloroethene (vinyl chloride), the performance was tested only in a simplified laboratory design (direct application, best possible LoD, repeatability precision and trueness) and in the field (realistic reproducibility precision and robustness) due to difficulties preparing, obtaining and handling chloroethene solutions in the laboratory.

3.2.1 Test methods

No standard methods exist for testing of passive samplers for groundwater monitoring. The test methods were prepared for the purpose (see Appendix 3), with reference to the

Ground Water Sampling Technologies Verification Test Plan prepared for the US EPA ETV program /6/. Preparation of test solutions, reagents and chemicals are described in Appendix 3 as well. It should be noted that the methods in Appendix 3 are described at the detailed level of a work instruction for direct implementation in the laboratory.

For the sample dispenser tests, MilliQ water was used for preparing test solutions. For standpipe tests, groundwater (Appendix 3.7) was used for preparing test solutions.

For the sample dispenser and standpipe tests, custom-made stainless steel test devices were prepared, see below.

For direct application laboratory tests, a standard solution with chlorinated compounds only was applied to the samplers directly with a syringe, followed by equilibration and flushing with water using the sample dispenser, see Appendix 3.1 for method description (no illustration).

The sample dispenser, Figure 1 to 3, was designed as a closed system that enabled direct exposure of samplers to test solutions with known and stable VOC concentrations by conveying the test solution from a closed container by gravity, see Appendix 3.2. The container was equipped with spiking port, sampling port and magnetic stirrer to maintain homogeneous conditions in the sample container. The volume of the sample dispenser was 40 L.

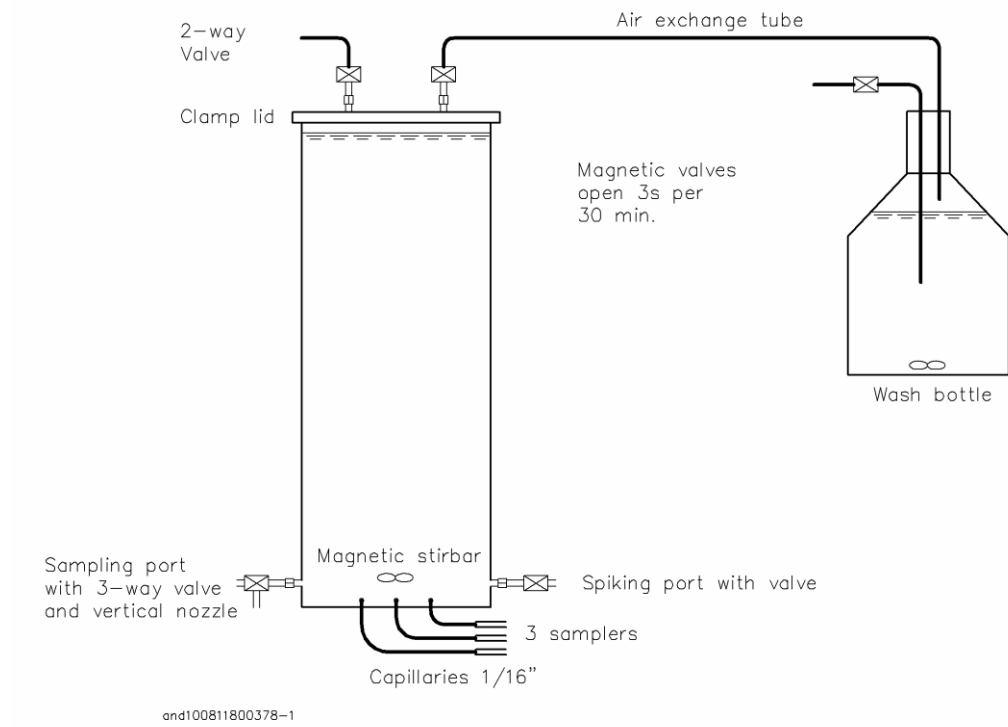


Figure 1 Sketch of sample dispenser.



Figure 2 Sample dispenser with capillaries and samplers attached.

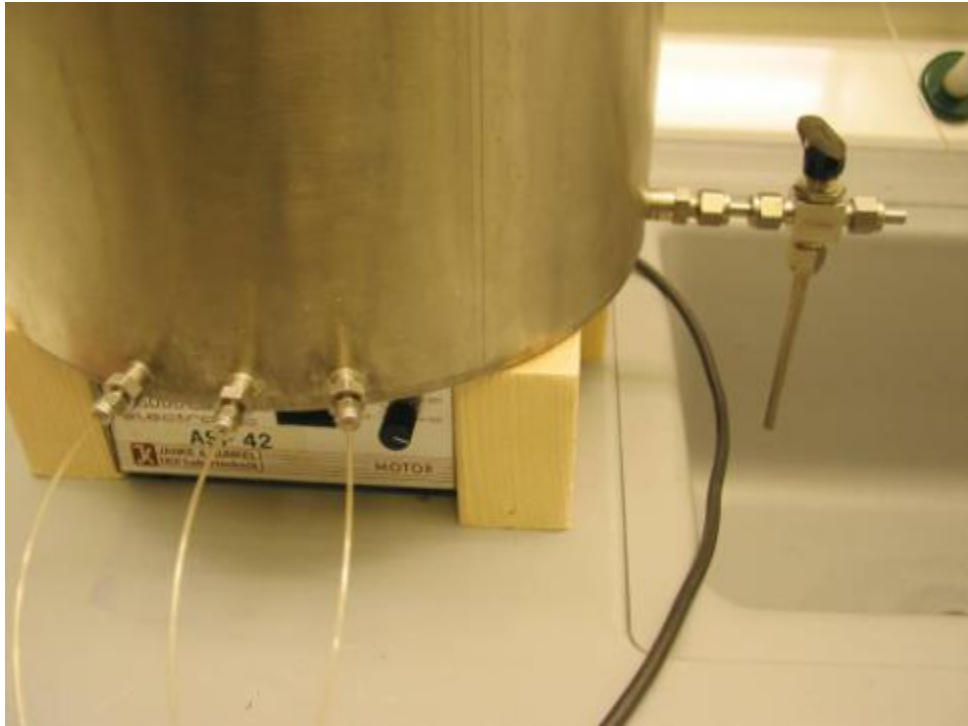
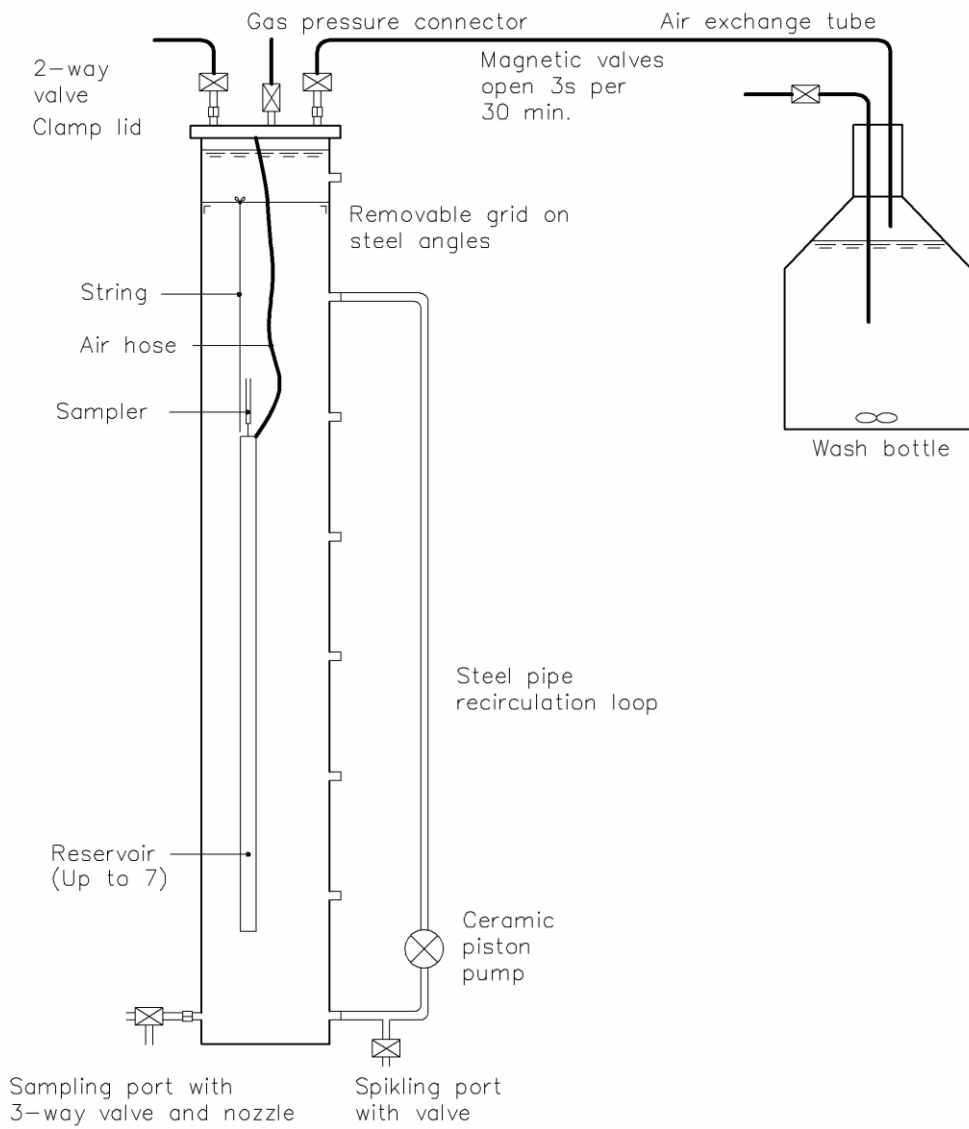


Figure 3 Detail of sample dispenser.

The standpipe test device, Figure 4, was designed as a closed container filled with test solution where the sampling system with samplers can be suspended from the top, see Appendix 3.3. Air from the sample reservoir is vented through an air hose. The container is equipped with sampling ports, and mixing is ensured through continuous pumping from top to bottom. The volume of the standpipe was 102 L and the pumping rate 27 L/h.

For both the sample dispenser and the standpipe, the air entering the container to replace dispensed liquid is saturated with VOCs at the same concentration as in the container, by using an air wash bottle.



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Figure 4 Sketch of standpipe.



Figure 5 Standpipe. The air wash bottle is in the fume cupboard.

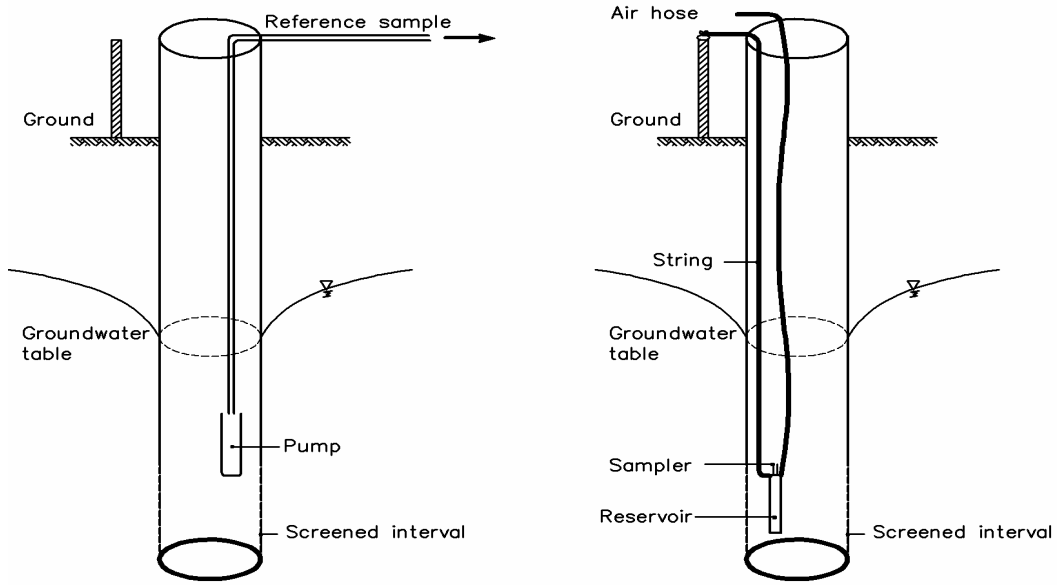


Figure 6 Detail of standpipe: recirculation pump and spiking port.

The field sampling, Figure 7, was done by suspending the sampling systems with samplers in the screened intervals in monitoring wells, see Appendix 3.4. Reference samples were taken with a reference sampling pump inserted into the well before and/or after placement of the sampling system.

The sequence of sampling and reference sampling was as follows. Initially, the well was reference sampled ensuring that fresh groundwater was found in the screened interval, followed by retrieval of the pump and installation of the sampler. After the first sampling period, the sampler was retrieved, the pump reintroduced (same pump, wiring and tubing), and a new reference sampling was done. This was continued through the 3 sampling sequences, ending with a reference sample.

Figure 7 illustrates the positioning of sampler and reference sampling pump. Figure 8 shows photos from the field.



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Figure 7 Sketch of field sampling.



Figure 8 Photos from field sampling.

For all reference samplings, a low purge sampling strategy was followed, allowing only for flushing of sampling equipment. The water quality was monitored online (pH, conductivity, temperature and oxygen). Cleaning of the well and good contact with the reservoir was obtained when stable parameters were reached. Hereafter reference samples were taken. Details of the low purge reference sampling can be found in Appendix 3.4 with reference to /7;8/ and Appendix 8.

The reference sampling was performed by a subcontractor. Their field report is included as Appendix 8 (in Danish; for explanations on the Danish text, please contact the authors of this test report).

3.2.2 **Test staff**

The test staff were: test responsible Dr. Gerald Heinicke (GHE), field responsible Mette T. Andersson (MTA) and test technician Susanne Klem (SEK).

3.2.3 **Test schedule**

The test schedule is given in Table 3. See Table 1 for identification of experiment labels.

Table 3 *Test schedule.*

Task	Period
Preparation of test plan	July 2008 - January 2009
Pre-testing dispenser	12-18 November, 2008
Direct application	18 November, 2008
Tests using dispenser	16 January - 22 March, 2009
BA	16-22 January, 2009
DA	23-29 January, 2009
EA	30 January - 5 February, 2009
FA	6-9 February, 2009
GA	10-19 February, 2009
HA	16-22 March, 2009
Set up standpipe	December 16, 2008-February 6, 2009
Test using standpipe	10 February - 23 April, 2009
J	17-23 February, 2009
N	16-22 March, 2009
R	25 March - 1 April, 2009
T	1-7 April, 2009
CA	7-13 April, 2009
V	17-23 April, 2009
Test field	12 February - 2 March, 2009
Test report draft	May-September, 2009
Test report QA	October 2009 - January 2010
Test report	February 2010

3.2.4 **Test equipment and methods**

The test equipment and methods included (working procedures):

- Laboratory sample dispenser (Appendix 3.2).
- Standpipe (Appendix 3.3).
- Field sampling (Appendix 3.4).

The laboratory and standpipe equipment have been designed and built specifically for this verification test. Equipment test procedures are described in Appendix 3.5.

Laboratory equipment procedures including cleaning and calibration were done according to ISO 17025 accreditation /9/ for the DHI laboratories under the laboratory services manual of the DHI Quality Management System /10/.

3.2.5 Type and number of samples

The types and number of samples are summarized in Table 4.

Table 4 Summary of type and number of samples. The numbers of samples, reference samples and reference analysis sent for analysis.

	Laboratory		Standpipe	Field
	Direct appl.	Dispenser		
Limit of detection	7 analyses 3 reference analyses		7 samples 7 reference samples 3 reference analyses	
Precision Range of application Trueness Robustness, general	7 analyses		15 samples 15 reference samples 5 reference analysis	15 samples 20 reference samples
Robustness, specific				
- Reference for the robustness test levels		3 samples 3 reference samples 1 reference analysis		
- Sampling depth			3 samples 3 reference samples	
- Ionic strength		6 samples 6 reference samples 2 reference analyses		
- Sampling time		6 samples 6 reference samples 2 reference analyses		
- Concentration integration		3 samples 3 reference samples 1 reference analysis		
Samples per test scale	14 analyses 3 reference analyses	18 samples 18 reference samples 6 reference analyses	25 samples 25 reference samples 7 reference analyses	15 samples 20 reference samples
Check stock solutions		5 reference analyses of stock solution (unopened vials) 1 stock dilution		
Samples totally ⁴	72 samples/analyses 86 reference samples/analyses			

⁴ Excluding reference samples from pre-testing of the sample dispenser.

The term analysis covers analysis of Sorbisense samplers that have been exposed to standard solutions by direct application. The term reference analyses covers analysis of standards and standard dilutions after a reference method in an accredited (ISO 17025) laboratory.

The analytical program included 22 reference analyses of VOC stock solutions, VOC stock dilutions, or diluted analytical standards. As the stability of the solutions proved satisfactory, the number was reduced from the originally planned 26 reference analyses.

In addition to the reference samples included in the above table, 21 reference samples controlling the test systems were taken and analyzed as described in Appendix 3.5. This included blanks taken from the sample dispenser, and the water used for the tests.

An analysis of the groundwater used in the laboratory tests was obtained from the municipal water works.

In the field, groundwater quality was analyzed in all wells.

3.2.6 Operation conditions

The operation conditions applied during the verification of the product were:

- Sampling temperature: ambient 5-25°C.
- Sampling depth: 0.5-5 m below the water surface.
- Sample volume: up to 600 mL.
- Sampling period: up to 9 days.
- Sampling replicates: 1 to 7 samplers per sampling event.

3.2.7 Operation measurements

During operation, the following operation conditions were recorded, as relevant, see Appendix 5:

- Sampling temperature: 9-22°C.
- Depth of sample intake: 0.5 m for the sample dispenser tests, 0.5 m and simulated 5 m for the standpipe tests, 1.7-4 m for the field tests.
- Sample volume: from zero (no flow) to 620 mL. The lowest sample volume for a sampler result, not discarded by the vendor, was 80 mL. Volumes over 500 mL were not determined by tracer salt analyses, but sample volumes measured manually were used.
- Sampling period: from 3 to 9 days.

3.2.8 Product maintenance

Samplers were kept in sealed bags, as delivered from the vendor, at ambient temperature until used. Opened bags with unused samplers were resealed until used and stored at 4°C.

No maintenance was prescribed for the equipment. The reservoirs were washed when a slimy layer was found on the outside after prolonged use in the standpipe.

3.2.9 **Health, safety and wastes**

The use of the product does not imply special health, safety and waste issues.

Laboratory work during testing was done according to the DHI Safety Rules that are compliant with the extensive Danish rules for safe occupational health and the European regulations of work with chemicals.

Field work was done according to the DHI rules for safe field work included in the DHI Safety Rules.

Chemicals and test solutions were discarded according to Danish regulations for chemical waste by collection and destruction, *in casu* by collection in drums followed by controlled destruction.

4 **REFERENCE ANALYSIS**

An aliquot of each test solution was submitted to an analytical laboratory for reference analysis. These samples verified the actual concentrations of the test solutions and the results were compared to the results of the product in this verification.

4.1 **Analytical laboratory**

Reference analyses were done by Eurofins Danmark A/S, Smedeskovvej 38, DK-8464 Galten, Denmark.

Contact Rita Splidt Pedersen, Eurofins Miljø A/S, +45 7022 4266.

4.2 **Analytical parameters**

The analytical parameters are given in Table 5.

Table 5 *Analytical parameters.*

Analytical parameters	
Chloroethene	Benzene
1,1-Dichloroethene	Toluene
1,2-Dichloroethenes (trans- and cis-)	Ethylbenzene
Trichloroethene	Xylenes (o- and m/p-)
Tetrachloroethene	MTBE

4.3 **Analytical methods**

The analyses were done using purge and trap gas chromatography with mass spectrometry detection in the selected ion monitoring mode (P&T GC-MS-SIM) according to the packages given in Table 6.

Table 6 Analytical packages, parameters and performance expectations from the contracted laboratory.

Analytical package	Parameter	Limit of detection µg/l	Uncertainty %
DR124 chlorinated solvents and degradation products	Trichloroethene	0.02	7.5
	Tetrachloroethene	0.02	9.2
	1,1-Dichloroethene	0.02	8.5
	trans-1,2-dichloroethene	0.02	8.2
	cis-1,2-dichloroethene	0.02	14
	Chloroethene	0.02	7.7
DR102 BTEX	Benzene	0.02	7.4
	Toluene	0.02	8.9
	Ethylbenzene	0.02	9.4
	o-Xylene	0.02	7.4
	m/p-Xylene	0.02	7.3
33145 MTBE	MTBE	0.1	7.0

The analytical method is based upon EPA Method 624 /11/ and ISO 15680 /12/ (see Appendix 2 for details).

4.4 Analytical performance requirements

The analytical performance requirements are given in Table 7.

It should be noted that the uncertainties stated by the laboratory, Table 6, include both the random error under reproducibility conditions (requirements set here for the precision under repeatability conditions) and the systematic errors (requirements set here for trueness).

For MTBE, there was concern whether the analytical laboratory would be able to satisfy the limit of detection of 0.03 µg/L, compare Table 6 and Table 7. Such a low limit of detection is generally required for the quantification of contaminants at trace concentrations in groundwater. Given the limit of detection stated by the vendor, the limit of detection available at the contracted laboratory was considered sufficient.

Table 7 Required analytical performance.

Compound	Limit of detection µg/L	Precision %	Trueness %	Range of application µg/L
Chloroethene	0.03	5	90-110	0.03-2000
1,1-Dichloroethene	0.03	5	90-110	0.03-2000
1,2-Dichloroethenes	0.03	5	90-110	0.03-2000
Trichloroethene	0.03	5	90-110	0.03-2000
Tetrachloroethene	0.03	5	90-110	0.03-2000
Benzene	0.03	5	90-110	0.03-2000
Toluene	0.03	5	90-110	0.03-2000
Ethylbenzene	0.03	5	90-110	0.03-2000
Xylenes	0.03	5	90-110	0.03-2000
MTBE	0.03	5	90-110	0.03-2000

4.5 **Preservation and storage of reference samples**

All water samples for VOC reference analysis were taken in 3x40 mL autosampler vials with Teflon lined screw caps as delivered from the laboratory contracted for reference sample analysis. The water samples were not preserved but stored cold (1-5°C) and dark until delivered to the laboratory within a maximum of 3 (in one occasion 4) days.

Stock solutions samples for reference analyses were taken in 1.5 mL capped vials and stored cold (1-5°C) and dark until delivered to the laboratory within a maximum of 3 days. Spare samples of stock solution or stock dilution were kept in the freezer at -20°C.

5 **DATA MANAGEMENT**

The data filing and archiving procedures of the DHI Quality Management System were followed.

5.1 **Data storage, transfer and control**

The data compiled and stored are summarized in Table 8.

Analytical raw data was filed and archived according to the specifications of the laboratories' quality management systems under their ISO 17025 accreditation, Eurofins for reference analysis and AIControl for sample analysis.

Table 8 *Data compilation and storage summary.*

Data type	Data media	Data recorder	Data recording timing	Data storage
Test plan and report	Protected PDF files	Test responsible, DHI	When approved by responsible	Files and archives at DHI
Test details in laboratory and field	Log book and pre-prepared forms	Technician, DHI	During collection	Files and archives at DHI
Calculations	Excel files	Test responsible, DHI	During calculations	Files and archives DHI
Analytical reports	PDF files, as accredited. With additional digit as Excel files	Test responsible, DHI	When received	Files and archives DHI

Tables with the data recorded are shown in Appendix 5.

6 **QUALITY ASSURANCE**

The tests were performed under the quality management system of DHI which is ISO 9001 compliant /13/, but not certified. The DHI laboratories have ISO 17025 accreditations /9/ and OECD GLP approvals /14/ for a range of tests and ISO 17025 for sampling of drinking water. As part of the ISO 17025 and GLP inspections, the procedures for

general laboratory processes, quality assurance and documentation/archiving were reviewed.

6.1 Test plan review

The test plan was subject to internal review by the verification responsible from NOWATECH WMC Verifications: senior chemist Christian Grøn. Additionally, the test plan was subject to review by the Battelle Advanced Monitoring Center quality manager (Zachary Willenberg), as well as by the US EPA ETV AMS project officer, quality manager and ETV coordinator (John McKernan, Lauren Drees and Evelyn Hazell, respectively).

External review of the test plan was done by the technical experts assigned to this verification.

6.2 Performance control – reference analysis

Reference analysis at an external laboratory comprised analysis of general chemistry and of reference samples. All reference analyses were done under the ISO 17025 accreditation of Eurofins.

The performance of Eurofins for the reference analysis was evaluated (performance evaluation audit) from laboratory quality control data for the relevant period (precision under repeatability conditions, trueness). Data for the analytical quality control of the laboratory included duplicate control samples at two concentrations (acceptance within 100%±10%) in each series and at least one blank sample per 5 samples. The data from participation in a proficiency test arranged by Analytical Products, Inc., September 2008 was evaluated for the demonstrated precision and traceability for the compounds in question for relevant matrices.

The detection limits and risks of false positives of the laboratory were controlled by submitting blank samples and low concentration samples.

The precision and trueness of the laboratory was further evaluated by analysis of stock, standard and spike solutions used for the test (22 reference analyses). The reference analysis included analysis of standards with analytical certification, diluted at DHI, and of solutions prepared from pure chemicals at DHI.

The analytical reference performance control is summarized in Table 9, with reference to Appendix 3.6 and 3.7 for information on water, standard solution (purchased standard with analytical certificate) and VOC solutions (prepared by DHI from pure chemicals).

Table 9 Summary of analytical reference performance control.

Control type	Limit of detection or blanks	Precision	Trueness
VOX standard solution	-	-	X
VOC solutions	-	X	X
Groundwater (field)	X	-	-
Laboratory quality control	X	X	X
Proficiency test	-	-	X

6.3 Test system control

The laboratory test system control included test solutions of known concentrations, traceable back to added chemicals of p.a. quality or standards with analytical certification, see Appendix 3.7 for specifications of purity, etc.

Known concentrations were used to pre-test the test design, see Appendix 3.5. The water used for preparation of solutions was controlled for contents of the target VOCs as part of the system control.

The system contamination test of the standpipe was done indirectly, with data from the LoD test. This data was also used for controlling the groundwater (municipal drinking water) for possible contents of the target VOCs.

The stability of the test concentrations was controlled continuously during the tests by taking and analyzing reference samples distributed over the sampling periods, considering the “true concentrations” based upon added amounts and the reference analyses.

The control of the field test system was done using analysis of reference samples and field blank samples.

The analytical reference performance control is summarized in Table 10. Sample dispenser blanks were MilliQ water with ionic strength controlled by adding KCl. Standpipe sample blanks were a groundwater matrix. The system contamination/blank sample reference analysis for the standpipe was controlled indirectly, by the reference samples from test J, at 5 times the LoD stated by the vendor.

Table 10 Summary of test system control.

Information/control type	Laboratory		Standpipe	Field
	Direct application	Sample dispenser		
System contamination/blank sample reference analysis	-	X	(X)	-
System contamination/field blank sample reference analysis	-	-	-	X
System trueness/spiked sample reference analysis	X	X	X	-
System variability/spiked sample reference analysis	-	X	X	-
System trueness/natural sample reference analysis	-	-	-	X
System variability/natural sample reference analysis	-	-	-	X

6.4 Data integrity check procedures

All transfer of data from printed media to digital form and between digital media were checked by spot check of not less than 5% of the data (test or field responsible). If errors were found in a spot check, all data from the transfer were checked.

6.5 Test system audits

Internal audit from DHI following the GLP audit procedure by a trained auditor was done, see the verification protocol for details.

The Battelle quality manager, Zachary Willenberg, performed a technical systems audit (TSA) during this verification and test. The purpose of this audit was to ensure that the verification test was being performed in accordance with the AMS Center quality management plan /15/, the test/quality assurance plan, published reference methods and any methods used in the tests. During the TSA, the Battelle quality manager reviewed the reference methods used, and compared actual test procedures to those specified or referenced in the plan. The Battelle quality manager also observed testing in progress, observed the reference method sample preparation and analysis, inspected documentation, and reviewed technology-specific record books. He also checked standard certifications. A TSA report was prepared, including a statement of findings and the actions taken to address any adverse findings. The AMS quality manager and the NOWATECH WMC verification responsible received a copy of Battelle's TSA report. The TSA findings were communicated to technical staff at the time of the audit.

The Battelle Quality Manager performed an audit of data quality (ADQ). This was a review of data acquisition and handling procedures and an audit of at least 10% of the data acquired in the test and verification. The Battelle Quality Manager traced the data from initial acquisition, through reduction and statistical comparisons, to final reporting. All calculations performed on the data undergoing the audit were checked.

6.6 Test report review

The test report was subject to internal review by chief engineer Anders Lynggaard-Jensen (ALJ), DHI.

External review of the test report was done by the technical experts.

7 TEST RESULTS

7.1 Test data summary

The test results are summarized below, sorted after the performance parameters investigated. To follow the path of raw data, calculation and reporting, the reader is referred to the test design (Section 3), raw data (Appendix 5), and calculation (Verification report, Section 8.1). The Excel worksheets containing the actual calculations are archived at DHI.

7.1.1 Direct application, sample dispenser and standpipe tests

The tests performed investigated the limit of detection, precision and trueness, as well as robustness against several parameters under well-defined conditions.

Limit of detection

The limit of detection (LoD) was calculated (tests H and J in Appendix 5) at 5 times the vendor-stated LoDs, see Table 11. Also negative values were included in the calculation. Both in the direct application and in the standpipe tests of LoD, one out of seven

samplers was excluded due to lack of flow through the sampler. For chloroethene (direct application) and 1,1-dichloroethene (standpipe), four out of six remaining replicates were reported as zero. It was therefore judged that the peaks of these compounds were not detected at this concentration. The LoD could accordingly not be detected at this concentration. A conservative estimate of the detection limits are instead stated as calculated from test at 10% of range concentration for direct application (chloroethene, test L, n=7) and standpipe (1,1-dichloroethene, test N, n=3). The analysis of trichloroethene from standpipe data resulted in a wide range of positive and negative values, thus the high detection limit calculated. The LoD calculated from the direct application test (H) may be regarded as a lower boundary, under best-case conditions, taking into account the sorbent and the analysis only. Under these conditions, the LoD for 1,1-dichloroethene was 1.7 µg/l, and for trichloroethene 0.3 µg/l.

Table 11 Limit of detection (µg/L). The number of replicates (n) is 6, except for chloroethene, where n=7 and 1,1-dichloroethene, where n=3.

Compound	Laboratory	Standpipe
	Direct application µg/L	µg/L
Chloroethene	<30	
1,1-Dichloroethene		<90
trans-1,2-Dichloroethene		4
cis-1,2-Dichloroethenes		4
Trichloroethene		70
Tetrachloroethene		2
Benzene		3
Toluene		4
Ethylbenzene		5
o-Xylene		4
m/p-Xylenes		3
MTBE		6

Precision

Precision was investigated in the standpipe tests by exposure of multiple samplers at several concentrations. The results are shown in Table 12. For chloroethene, precision was calculated from the direct application tests at 10% of the measurement range.

Table 12 Precision as relative standard deviation (RSD) in percent. *n* replicates in *m* tests. direct application: *n*=7, *m*=1 at 10% of range. Sample dispenser: *n*=3, *m*=5 at nominal 1000 µg/l, Standpipe: *n*=3, *m*=5 at ca. 200-2400 µg/l.

Compound	Laboratory			Standpipe	
	Direct application 10% of range RSD (%)	Sample dispenser Samplers RSD (%)	Reference RSD (%)	Samplers RSD (%)	Reference RSD (%)
Chloroethene	9.6				
1,1-Dichloroethene		6.8	9.4	11	19
trans-1,2-Dichloroethene		11	6.7	11	16
cis-1,2-Dichloroethene		11	3.1	10.2	12
Trichloroethene		14	4.2	9.1	13
Tetrachloroethene		13	9.5	8.5	19
Benzene		9.0	3.9	10.0	15
Toluene		12	3.1	9.5	13
Ethylbenzene		12	2.6	8.6	30
o-Xylene		13	3.0	8.8	18
m/p-Xylene		12	2.4	8.5	22
MTBE		10	6.4	10.6	16

Trueness

In the standpipe tests shown in Table 13, trueness varied between the five tests done at different concentrations (test N, P, R, T, V), without a correlation to concentration. The range of trueness in the standpipe was between approximately 90% and 190%. For chloroethene, the trueness from the direct application test at 10% of the measurement range is stated.

Table 13 Trueness of sampler results from the direct application and standpipe tests. *n* replicates in *m* tests. Direct application: *n*=7, *m*=1 at 10% of range. Standpipe: *n*=3, *m*=5 at ca. 200-2400 µg/l.

Compound	Laboratory	Standpipe		
	Direct application Mean %	Minimum %	Average %	Maximum %
Chloroethene	65			
1,1-Dichloroethene		78	100	156
trans-1,2-Dichloroethene		73	101	154
cis-1,2-Dichloroethene		93	129	188
Trichloroethene		77	110	141
Tetrachloroethene		94	137	196
Benzene		89	135	212
Toluene		89	131	201
Ethylbenzene		87	153	226
o-Xylene		94	139	201
m/p-Xylene		99	138	207
MTBE		103	147	252

Range of application

Limits for the range of application could not be established in the laboratory tests. Trueness did not vary systematically with concentration for the tested range.

The highest concentrations that could not be excluded as non-linear for sampler measurements after visual evaluation are given in Linear range data were not available for chloroethene, as this compound could not be included in the multiple concentration test in standpipe.

Table 14 shows linear maximum concentration with the coefficient of regression (R^2), the slope (a) and the intercept (b) of the plot of sample measurements versus reference sample measurements.

Linear range data were not available for chloroethene, as this compound could not be included in the multiple concentration test in standpipe.

Table 14 Range of application data.

Compound	Linear maximum µg/L	Standpipe Linear regression parameters		
		Coefficient R^2	Slope a	Intercept b
Chloroethene				
1,1-Dichloroethene	1,900	0.88	1.5	-350
trans-1,2-Dichloroethene	1,900	0.87	1.5	-380
cis-1,2-Dichloroethene	1,500	0.93	1.9	-360
Trichloroethene	1,700	0.97	1.5	-240
Tetrachloroethene	1,200	0.93	2.0	-350
Benzene	1,600	0.87	2.0	-390
Toluene	1,500	0.90	2.0	-430
Ethylbenzene	1,600	0.85	2.0	-270
o-Xylene	1,400	0.94	2.1	-410
m/p-Xylenes	1,300	0.92	2.2	-470
MTBE	1,700	0.82	2.3	-580

Robustness

The *robustness* of the product against variations in several parameters was investigated and expressed as an effect on trueness, given as R in Table 15.

For details on the statistical tests performed please refer to the Verification protocol /1/.

Table 15 Robustness (R, %) under controlled variations, using the sample dispenser and standpipe. R values significantly different (95% confidence level, two-sided t-test) from 100% are marked bold.

Compound	Sampe dispenser					Stand- pipe Sampling depth Deep ⁴ R %
	Ionic strength ¹		Exposure time ²		Concen- tration	
	Low R %	High R %	Short R %	Long R %	Variation ³ R %	
Chloroethene						
1,1-Dichloroethene	89	86	78	78	83	111
trans-1,2-Dichloroethene	94	121	100	102	116	112
cis-1,2-Dichloroethene	85	114	94	93	99	108
Trichloroethene	83	102	80	91	102	120
Tetrachloroethene	96	100	91	90	90	106
Benzene	80	95	80	90	108	105
Toluene	76	94	81	88	95	107
Ethylbenzene	75	87	77	96	95	101
o-Xylene	72	80	77	84	91	101
m/p-Xylenes	78	84	82	88	87	102
MTBE	67	96	68	87	82	100

¹ Low=10 mS/m, high = 100 mS/m, reference 35 mS/m

² Short= 3 days, long = 9 days, reference = 6 days

³ Successive intervals of 20%, 50% and 80% of measuring range

⁴ Deep= 5 m below surface (mbs), reference = 0.5 mbs

The test with variations in ionic strength showed lower recovery of trichloroethene, BTEX and MTBE at low ionic strength. One reason for the differences being significant between the reference level and the experiment at low conductivity is a low standard deviation in experiment at low conductivity.

The test with variation in sampling time showed lower recovery of BTEX and MTBE at short sampling times. The effect of sampling time was not systematic, since also at longer times the recovery was lower than at the reference level for most components, although not statistically significant.

The test with increasing concentration produced a trueness that was not significantly different from the trueness on the reference level, for any compound (two-sided t-test assuming unequal variances, $\alpha = 0.05$).

The robustness against sampling depth was investigated; the results are shown in Table 15. A t-test of the sampler results (two-sided t-test assuming equal variances, $\alpha = 0.05$) did not reveal a significant difference of the results at 0.5 and 5 m depth, except for one compound. Only trichloroethene exhibited a significantly higher concentration at 5 m depth.

7.1.2 Field test

Data summary

The field testing results are summarized in Table 17 - Table 21. Wells C8, C11 and C14 are located at Søborg, Denmark while B17 and B18 are located in Farum, Denmark.

Some results were below the limit of detection. To calculate the ratio between samples and reference samples and for performing a paired t-test, generic rules for handling non-detects were established, these are listed in Table 16.

Table 16 Calculation rules used for calculation of trueness.

Problem	Method/rule
4 reference samples to be compared with 3 samples	The sample result was compared to the average of the reference sample taken before and after the sample
1-2 of the 3 results to compare (2 reference samples and 1 sample) are below limit of detection	Concentrations below limit of detection were set to a value equal to half of the respective LoD
All 3 results to be compared (2 reference samples and 1 sample) below limit of detection	All concentrations below limit of detection were set to a value equal to half of the highest LoD

For some compounds the reference samples and/or the analyses of the sampler has been both above and below the limit of detection, while the limit of detection also can vary. E.g. for tran-1,2-dichloroethene the reference samples were <0.40, <0.20, 0.11 and <0.02. Then that is given as an interval that is <0.02 - < 0.40, and therefore not showing that as result above limit of detection (0.11) has been determined. The corresponding sampler results were all below limit of detection. The rules of calculation in Table 16 cause that the ratio is calculated to 1-24.

Table 17 Results from field testing, well C8.

Well C8	Ref. samples µg/L	Sampler µg/L	Ratio -
Chloroethene	0.87-1.3	<1.8-<2.9	0.88-1.3
1,1-Dichloroethene	<0.02-<0.40	<1.9-<2.9	1.0
trans-1,2-Dichloroethene	<0.02-<0.40	<1.8-<2.9	1.0-24
cis-1,2-Dichloroethene	<0.02-<0.40	<1.9-<2.9	2.2-27
Trichloroethene	<0.02-<0.40	<1.8-<2.9	1.0-15
Tetrachloroethene	<0.02-0.59	<1.8-<2.9	1.0-2.6
Benzene	640-1000	750-1600	1.2-1.7
Toluene	<0.02-0.50	3.4-9.6	22-170
Ethylbenzene	<0.02-<0.40	110-170	1,100-13,000
o-Xylene	<0.02-1.0	5.7-11	6.1-25
m/p-Xylene	<0.02-<0.40	5.0-6.5	43-500
MTBE	1.3-<2	<1.8-<2.9	0.61-1.8

Table 18 Results from field testing, well C11.

Well C11	Ref. samples µg/L	Sampler µg/L	Ratio -
Chloroethene	17-30	6.7-15	0.24-0.63
1,1-Dichloroethene	0.29-<1	<0.68-<0.83	0.82-1.1
trans-1,2-Dichloroethene	<1-1.5	1.1-2.3	0.76-2.0
cis-1,2-Dichloroethene	27-89	29-69	0.81-12
Trichloroethene	<1-2.4	<0.83-1.1	0.41-0.57
Tetrachloroethene	0.068-1.3	<0,68-<0.83	0.59-42
Benzene	167-4800	2700-5000	0.71-33
Toluene	2.2-3.6	1.8-4.7	0.61-2.0
Ethylbenzene	6.1-14	1.5-3.8	0.12-0.45
o-Xylene	0.28-<1	<0.68-<0.83	1.1-2.3
m/p-Xylene	0.75-2.2	<0.68-<0.83	0.19-0.42
MTBE	1.76-<5	1.2-2.3	1.2-1.6

Table 19 Results from field testing, well C14.

Well C14	Ref. samples µg/L	Sampler µg/L	Ratio -
Chloroethene	17-45	28-77	1.2-2.1
1,1-Dichloroethene	<0.40	<1.1-<1.3	1.0
trans-1,2-Dichloroethene	1.6-2.2	2.6-10	1.4-6.2
cis-1,2-Dichloroethene	26-58	23-186	0.45-4.8
Trichloroethene	5.9-25	3.0-21	0.19-3.1
Tetrachloroethene	4.4-18	2.6-17	0.44-3.6
Benzene	880-2300	1300-5600	0.78-3.8
Toluene	2.9-4.4	12-18	3.1-4.6
Ethylbenzene	20-35	77-92	2.6-3.3
o-Xylene	2.3-5.3	14-33	5.5-7.9
m/p-Xylene	4.2-5.9	11-54	2.2-11
MTBE	2.7-3.4	1.2-17	0.36-5.4

Table 20 Results from field testing, well B17.

Well B17	Ref. samples µg/L	Sampler µg/L	Ratio -
Chloroethene	<0.02-<0.20	<0.82-<0.92	1.0
1,1-Dichloroethene	<0.02-<0.20	<0.82-<0.92	1.0
trans-1,2-Dichloroethene	<0.02-<0.20	<0.82-<0.92	1.0
cis-1,2-Dichloroethene	<0.02-<0.20	<0.82-<0.92	1.0-29
Trichloroethene	<0.02-<0.20	<0.82-<0.92	1.0
Tetrachloroethene	<0.02-1.4	<0.82-<0.92	0.68-1.0
Benzene	<0.02-0.46	<0,92-4,2	2.0-420
Toluene	<0.02-1.4	<0.8-<0.92	0.65-1.0
Ethylbenzene	<0.02-0.14	<0.8-<0.92	1.0-5.9
o-Xylene	<0.02-0.045	<0.9-0.92	17-53
m/p-Xylene	<0.02-0.084	<0.8-<0.92	1.0-8.8
MTBE	2.9-111	3.0-50	0.83-1.4

Table 21 Results from field testing, well B18.

Well B18	Ref. samples µg/L	Sampler µg/L	Ratio -
Chloroethene	<0.02-<0.20	<0.7-<0.79	1.0
1,1-Dichloroethene	<0.02-<0.20	<0.7-<0.79	1.0
trans-1,2-Dichloroethene	<0.02-<0.20	<0.7-<0.79	1.0
cis-1,2-Dichloroethene	<0.02-<0.20	<0.7-<0.79	1.0
Trichloroethene	<0.02-<0.20	<0.7-<0.79	1.0
Tetrachloroethene	<0.02-<0.20	<0.7-<0.79	1.0
Benzene	<0.02	<0.7-<0.79	1.0
Toluene	<0.02	<0.7-<0.79	1.0
Ethylbenzene	<0.02	<0.7-<0.79	1.0
o-Xylene	<0.02	<0.7-<0.79	1.0
m/p-Xylene	<0.02	<0.7-<0.79	1.0
MTBE	<0.1	<0.7-<0.79	1.0

At first reference sampling occasion, the general groundwater chemistry was analyzed. The results are summarized in Table 22, while all data are given in Appendix 5.

The ionic strength was highest in Søborg.

Table 22 Mean groundwater chemistry at field sites.

Site	Søborg (3 wells)		Farum (2 wells)	
	Average	Standard deviation	Average	Standard deviation
	mg/L	mg/L	mg/L	mg/L
Ca	233	15	125	7.1
Mg	25	3.1	8.0	1.1
K	4.7	0.4	1.7	0.14
Na	120	36	19	2.8
Fe	5.2	2.8	1.5	0.49
Ammonium	0.77	0.14	0.46	0.53
Nitrate	<0.5	-	<0.5-0.84	-
Chloride	340	62	53	22
Fluoride	0.30	0.015	0.28	0.042
Sulphate	157	40	75	23
Bicarbonate	482	81	315	28
NVOC (DOC)	3.0	0.74	5.9	4.5
Ion strength (mol/L)	0.028	0.0012	0.012	0.00055
Field measurements				
Conductivity (µS/cm)	2,020	156	733	32
pH (-)	7.2	0.081	6.9	0.10

Sample to reference sample ratio

It was tested whether the Sorbisense sampler results were significantly different from the reference sample results in a paired t-test. The differences were significant for toluene, ethylbenzene and o-xylene, see Table 23. For all compounds the ratio between sample and reference sample is given.

Table 23 Results from paired t-test, trueness in the field. Significant difference is marked in bold.

Parameter	Ratio	Part of data below LoD %
	-	
Chloroethene	0.24-2.1	49
1,1-Dichloroethene	0.82-1.1	91
trans-1,2-Dichloroethene	0.76-24	60
cis-1,2-Dichloroethene	0.45-29	51
Trichloroethene	0.19-15	63
Tetrachloroethene	0.44-4.2	69
Benzene	0.71-420	31
Toluene	0.61-170	46
Ethylbenzene	0.12-13,000	49
o-Xylene	1.0-50	46
m/p-Xylene	0.19-500	60
MTBE	0.36-5.4	34

Precision

The precision of the measurements was expressed as the range of RSD, encountered for the wells, both for the reference samples and the samplers. In the case of values below LoD, general rules were established for the calculation and are listed in Table 24. The results are reported in Table 25.

Table 24 Calculation rules used for calculation of relative standard deviation (RSD).

Problem	Method/rule
Result below limit of detection	Concentrations below limit of detection were set to a value equal to half of the corresponding detection limit
Several results below limit of detection	RSD was not estimated with less than two values

Table 25 Relative Standard Deviation (RSD) for reference samples and samplers, as range over five wells.

	Ref. samples %	Samplers %
Chloroethene	≤ 37	≤ 51
1,1-Dichloroethene	≤ 23	n.a. ¹
trans-1,2-Dichloroethene	≤ 39	≤ 66
cis-1,2-Dichloroethene	≤ 95	≤ 113
Trichloroethene	≤ 84	≤ 88
Tetrachloroethene	≤ 84	≤ 88
Benzene	≤ 82	≤ 98
Toluene	≤ 23	≤ 51
Ethylbenzene	≤ 31	≤ 43
o-Xylene	≤ 74	≤ 39
m/p-Xylene	≤ 61	≤ 82
MTBE	≤ 39 (166)	≤ 78 (124) ²

¹ n.a. = not applicable. ² The high deviation in parenthesis is due to “drag in” of contamination into well B17 at the first reference sampling.

The high deviation in parenthesis for MTBE is due to “drag in” of contamination from the nearby gasoline contamination into well B17 at the first reference sampling, for further details see Figure 14.

The occurrence of discrepancies between samples and reference samples was investigated. A positive discrepancy was defined as an occasion when the sampler found a measurable concentration, while all reference samples were below the limit of detection. The opposite was defined as a negative discrepancy. It should be noted that a discrepancy may reflect different principles of sampling rather than error on behalf of one of the methods, see Section 7.3.5.

For the type of discrepancy with one reference sample being below LoD, a general rule was established (Table 26). The results are reported in Table 27.

Table 26 Calculation rule used for determination of discrepancy with one reference sample being <LoD.

Problem	Method and rule
Sampler result below limit of detection, while a concentration is detected in 1 of the 2 reference samples	Average of the reference sample A (value) and $\frac{1}{2}$ LoD of reference sample B (below detection limit). If average > sample LoD => negative discrepancy

In total 15 measurement sets were compared.

Both types of discrepancies occurred. Positive discrepancies occurred mainly for the three compounds with significant difference in the t-test (Table 23). Details on the identified discrepancies are shown in Table 28.

Table 27 Frequency of samples with discrepancies. Numbers in brackets (X/Y): X samples giving discrepancies out of totally Y samples.

	positive discrepancy % (no. samples)	negative discrepancy % (no. samples)
Chloroethene	0	0
1,1-Dichloroethene	0	0
trans-1,2-Dichloroethene	0	0
cis-1,2-Dichloroethene	0	0
Trichloroethene	0	7 (1/15)
Tetrachloroethene	0	0
Benzene	13 (2/15)	0
Toluene	13 (2/15)	0
Ethylbenzene	20 (3/15)	0
o-Xylene	0	0
m/p-Xylene	20 (3/15)	20 (3/15)
MTBE	0	0

Table 28 Details on discrepancies.

Compound	Discrepancy type	Reference sample µg/L	Samplers µg/L
Benzene	Sampler measured content, reference samples not (positive)	< 0.02	1.3 - 4.2
Toluene		< 0.02 - < 0.40	3.4 - 9.5
Ethylbenzene		< 0.02 - < 0.40	110 - 170
m/p-Xylene		< 0.02 - < 0.40	5.0 - 6.5
Trichloroethene	Reference samples measured content, sampler not (negative)	< 1 - 1.4	< 0.83
m/p-Xylene		< 1 - 2.2	< 0.68 - < 0.83

7.2 Test quality assurance summary

7.2.1 Sample analysis performance data

The performance of the sampler analysis was reported by the vendor as given in Table 29, assuming a water volume sampled within the range used in the verification reported here.

Table 29 Performance parameters for sampler analysis reported by the vendor.

Compound	Limit of detection µg/L	Precision %	Recovery of spike to samplers %	Maximum concentration tested µg/L
Chloroethene	0.3	16	59	170
1,1-Dichloroethene	0.3	12	79	170
1,2-Dichloroethene	0.2	11	82	170
Trichloroethene	0.2	11	92	170
Tetrachloroethene	0.2	19	103	170
Benzene	0.2	11	89	170
Toluene	0.1	10	87	170
Ethylbenzene	0.1	11	92	170
o-Xylene	0.2	10	93	170
m/p-Xylenes	0.3	10	92	170
MTBE	0.3	14	88	170

The performance data accordingly do not include the salt measurements that are used for concentration calculations in routine application of the samplers.

7.2.2 Reference analysis control data

Control data for the reference analysis are summarized in Table 30 based upon standard and stock solutions in organic solvent. Trueness that was significantly different (95% confidence level, two-sided t-test, laboratory reproducibility used in test) from 100% is indicated by a number in bold.

Table 30 Summary of reference analysis control data. Data for proficiency tests are from /16,17/. 1,1-dichloroethene results were corrected by the laboratory after completion of the test. In this table, data is stated both before and after correction.

Compound	VOX standard solution ⁵		VOC stock solution ⁶		Proficiency test Trueness %
	Repeat-ability %	Trueness %	Repeat-ability %	Trueness %	
Chloroethene	30	110			140
1,1-Dichloroethene <i>bef.</i>	10	121	1.6	132	131
1,1-Dichloroethene <i>after</i>	10	97	1.3	105	none
trans-1,2-Dichloroethene	4	112	1.4	107	110
cis-1,2-Dichloroethenes	3	109	3.7	103	102
Trichloroethene	3	105	3.1	96	95
Tetrachloroethene	2	105	2.8	96	82
Benzene			2.8	97	104
Toluene			4.4	93	101
Ethylbenzene			5.6	143	104
o-Xylene			4.9	86	103
m/p-Xylenes			4.0	101	
MTBE			2.3	85	90

For 1,1-dichloroethene and ethylbenzene, the trueness with the VOC stock solution was significantly different from 100%.

The laboratory provided data from their routine quality control samples from the period of analysis demonstrating 103 and 98% trueness, respectively for the two compounds. Subsequent control of ethylbenzene trueness with analysis of two independent solutions yielded 98-103% recovery.

Furthermore, the reference laboratory provided documentation for recent participation in a proficiency test /16/ covering VOC in drinking water with trueness data inserted into Table 30. A number in bold was indicated as unsatisfactory by the organizer of the proficiency test.

After completing the reference analysis, the reference laboratory prepared new 1,1-dichloroethene standards based upon another batch/product and used these for control analyses. Furthermore, the reference laboratory participated in an additional proficiency test /17/. The overall conclusion was that all results reported should be corrected by a factor of 0.80 for 1,1-dichloroethene, and this was subsequently applied for all test data. After the correction of 1,1-dichloroethene concentrations, the trueness of the analysis of VOX standard solution was 97%, and of the VOC stock solution analysis 105%.

The quality of the reference analyses after correction of the 1,1-dichloroethene concentrations is summarized in Table 31.

Of the 15 reference analyses of VOC stock solution, five were done on original 1.5 mL vials that had not been opened before. Those five analyses produced a trueness of 97-

⁵ The VOX standard solution was a certified standard solution, was diluted at DHI to 25 µg each VOX/L and contained only chlorinated solvents as indicated.

⁶ The VOC stock solution was prepared at DHI to 10 g each VOC/L and did not contain chloroethene.

107%, for the 11 compounds, in average 101% of the expected values stated in Table 33. The precision of these four analyses ranges from 3-11%, in average 5% (Table 31).

During the test of the product's limit of detection in the standpipe, reference samples of groundwater with concentrations around 2.5 µg/L were taken at three occasions as 2 or 3 replicates. From the triplicate, a conservative estimate of the LoD was derived, between <0.09 and <0.30 µg/l for the 11 compounds. All reference analyses of water samples taken as blanks were reported as less than the LoD (<0.02 µg/L, <0.1 µg/L for MTBE), also indicating a correct LoD reported by the laboratory.

Table 31 Summary of analytical reference performance control, after the correction of 1,1-dichloroethene concentrations. Data given as range over the tested compounds, with average in parenthesis.

Control type	Limit of detection µg/L	Precision RSD %	Trueness %
VOX standard solution	-	-	97-110 (106)
VOC stock solutions ⁷	-	3-11 (5)	97-107 (101)
Groundwater (field)	<0.09-<0.30	-	-
Laboratory quality control	0.008-0.01	5-11	93-110
Proficiency test	-	-	90-140 (106)

The analytical quality control data from the reference laboratory as obtained during the test period are compiled in Table 32.

Table 32 Compilation of reference laboratory quality control data.

Compound	Low control concentration ⁸		High control concentration ⁹		Detection limit µg/L
	Total RSD %	Trueness %	Total RSD %	Trueness %	
Chloroethene	9.3	110	8.2	110	0.01
1,1-Dichloroethene	7.9	106	7.6	105	0.01
trans-1,2-Dichloroethene	7.7	99	5.9	104	0.008
cis-1,2-Dichloroethenes	6.5	103	7.0	103	0.01
Trichloroethene	6.2	99	5.9	102	0.01
Tetrachloroethene	9.3	99	6.0	103	0.009
Benzene	7.7	95	5.6	101	0.008
Toluene	6.7	97	5.9	101	0.008
Ethylbenzene	8.8	100	7.1	101	0.008
o-Xylene	8.0	98	5.6	101	0.008
m/p-Xylenes	9.6	98	5.3	101	0.01
MTBE	11.0	93	6.6	97	0.009

Overall, the reference analysis quality data indicated precision and trueness satisfying the requirements for most compounds but with a concern for high results for chloroethene. For ethylbenzene, an error of preparation of the stock solution was indicated.

⁷ from unopened stock solution vials only.

⁸ Low control concentration is 0.08 µg/L, 170-219 control samples.

⁹ High control concentration is 0.8 µg/L, 192-232 control samples.

7.2.3 Test system control data

Reference analysis of the water used in laboratory test and water from the test system (dispenser, after 30 minutes and after 6 days) gave results below the LoD ($<0.02 \mu\text{g/L}$, $<0.1 \mu\text{g/L}$ for MTBE) indicating no contamination of either.

Field blank reference analysis for the two field sites showed results below LoD, except for toluene in the field blank sample from the Søbørg site ($0.04 \mu\text{g/L}$, LoD $0.02 \mu\text{g/L}$). The field blank data did not indicate any substantial contamination with the VOC during field sample handling.

The stability of stock solutions was controlled with reference analyses made of aliquots distributed over the test period, see Figure 9.

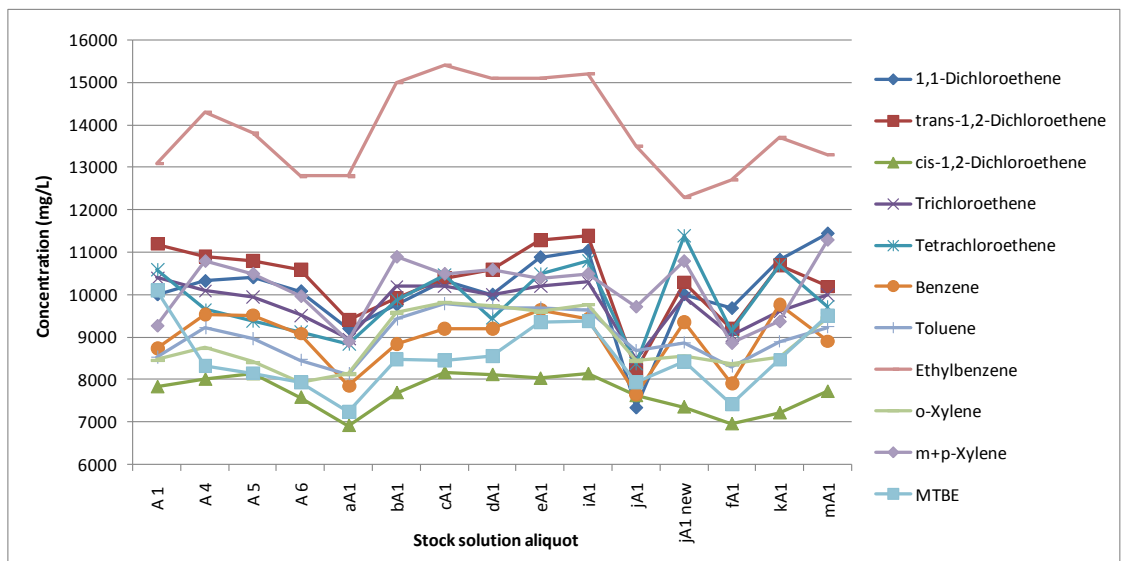


Figure 9 Reference analyses of stock solution aliquots used for spiking. The aliquot identifiers correspond to the data forms in Appendix 5.

Over the test period, the stock solution concentrations varied considerably, and for six compounds the mean reference analysis measurements were significantly different from the value calculated from added amounts and volumes of the prepared stock solutions. For these compounds, reference analysis measurements were assumed to be correct, see compounds listed as analyzed under Data source in Table 33. The expected values for the stock solution were only used to calculate expected values in the sample dispenser and the standpipe, for test system control purposes. All performance parameters were calculated against measured data from the reference analyses.

Table 33 Concentrations in the stock solution.

Compound	True value (g/L)	Data source
1,1-Dichloroethene	9.7	calculated
trans-1,2-Dichloroethene	10.1	calculated
cis-1,2-Dichloroethene	7.70	calculated
Trichloroethene	9.79	analyzed
Tetrachloroethene	9.74	calculated
Benzene	8.98	analyzed
Toluene	9.04	analyzed
Ethylbenzene	13.9	analyzed
o-Xylene	8.90	analyzed
m-Xylene	10.4	calculated
MTBE	8.52	analyzed

The dispenser laboratory test system showed stable concentrations after 6 days as measured by reference analysis, and corresponded to the expected values (Table 34, middle column). Conversely, sample measurements under reference conditions (test BA) were lower than the expected values for most compounds (Table 34, right hand column). The deviations of the sampler results from the expected values were correlated to compound volatility, but not to compound polarity, see Figure 10.

Table 34 Stability, reference sample concentrations and sample concentrations in the dispenser laboratory test system.

Compound	Laboratory Dispenser	
	Reference sample measurement after 6 days % of expected value	Sample measurement over 6 days % of expected value
Chloroethene		
1,1-Dichloroethene	107	81
trans-1,2-Dichloroethene	116	71
cis-1,2-Dichloroethene	114	90
Trichloroethene	107	70
Tetrachloroethene	97	72
Benzene	97	85
Toluene	112	81
Ethylbenzene	103	75
o-Xylene	122	90
m/p-Xylenes	88	77
MTBE	112	110

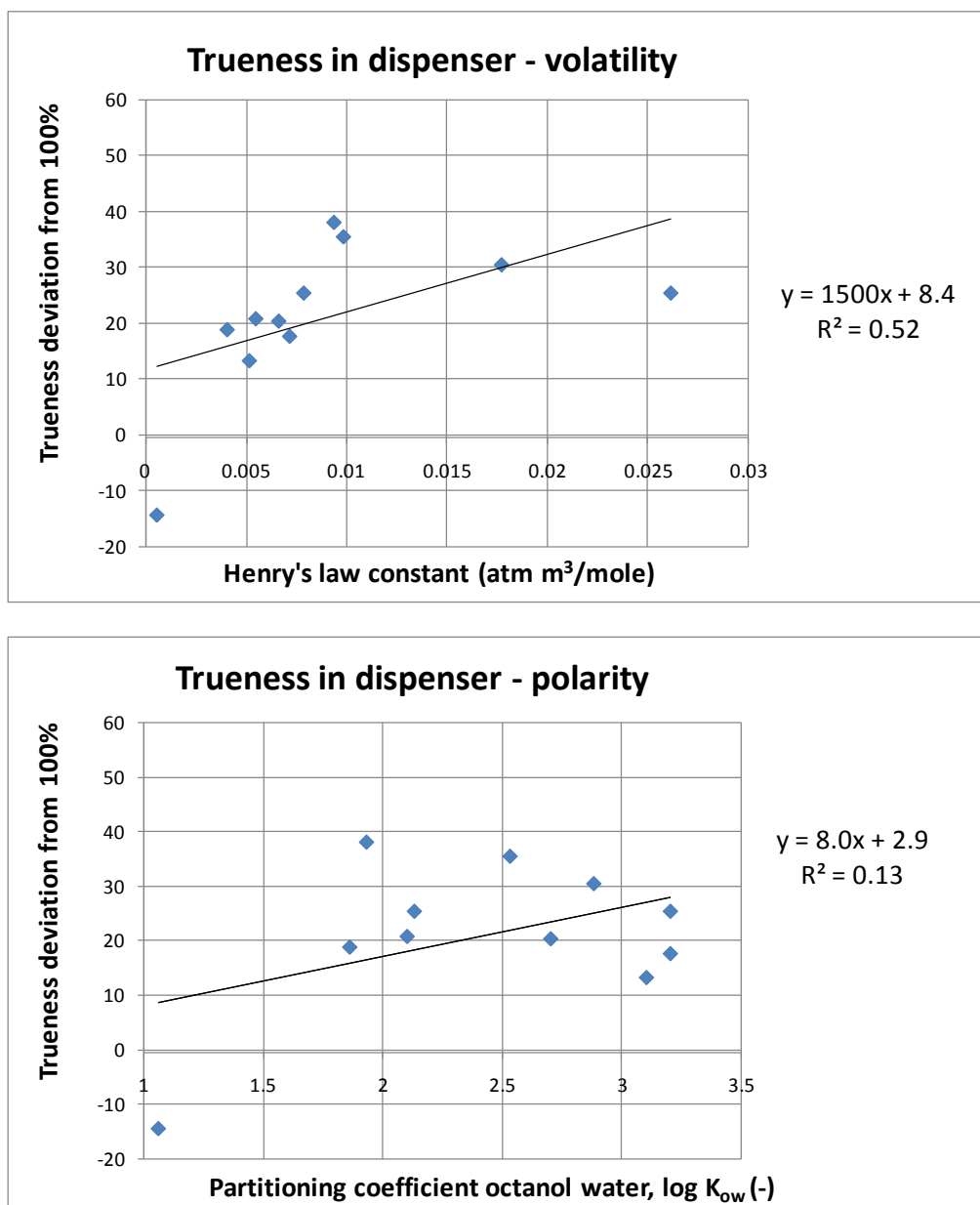


Figure 10 Deviation of trueness from 100% in dispenser against volatility and polarity of compounds.

In the dispenser, test solution from the dispenser was lead to the sampler through polymer capillaries supplied by the vendor. The plots of difference between sample measurement and true value (calculated from added amounts and volumes of the prepared stock solutions) against log K_{ow} (partitioning coefficient octanol water) and k_H (partitioning coefficient air water) did not support that loss through adsorption should be important (should exhibit inverse relationship between trueness deviation and partitioning coefficient), whereas loss of compounds by evaporation e.g. through the capillaries cannot be excluded (relationship between trueness deviation and Henry's law constant cannot be excluded). Accordingly, dispenser trueness data are not used independently but only as reference for robustness assessments.

The standpipe test system exhibited high reference sample measurements for the samples taken after 2 hours, followed by a lower and stable plateau, see Figure 11. The ini-

tial high reference sample measurements were taken to reflect incomplete mixing in the test system and subsequently, the first reference samples were taken after 4 hours.

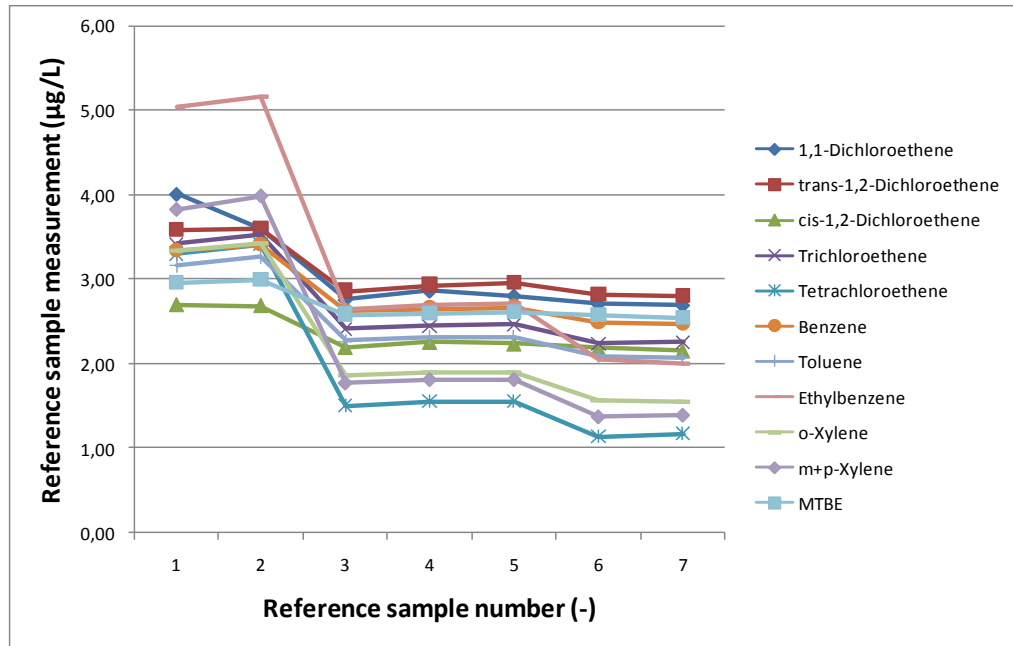


Figure 11 Reference sample measurements in standpipe at level 5 times the expected limit of detection. Samples no. 1-2 taken 2 hours after spiking, no. 3-5 taken 2 days after, no. 6-7 taken 6 days after spiking.

The mean reference sample measurements for the 5 last samples were significantly different from the true value calculated from added amounts and volumes of the prepared stock solutions for 8 of 11 compounds at a level of 5 times the expected limit of detection. The concentrations measured for the reference samples relative to the true value decreased with increasing octanol water partitioning coefficient as would be expected with adsorption of compounds to the test system or the sampling system, see Figure 12. The standpipe test system was made of the same materials as the dispenser test system with no adsorption observed, but adsorption to the sampling system with up to 7 samplers suspended in the standpipe cannot be excluded.

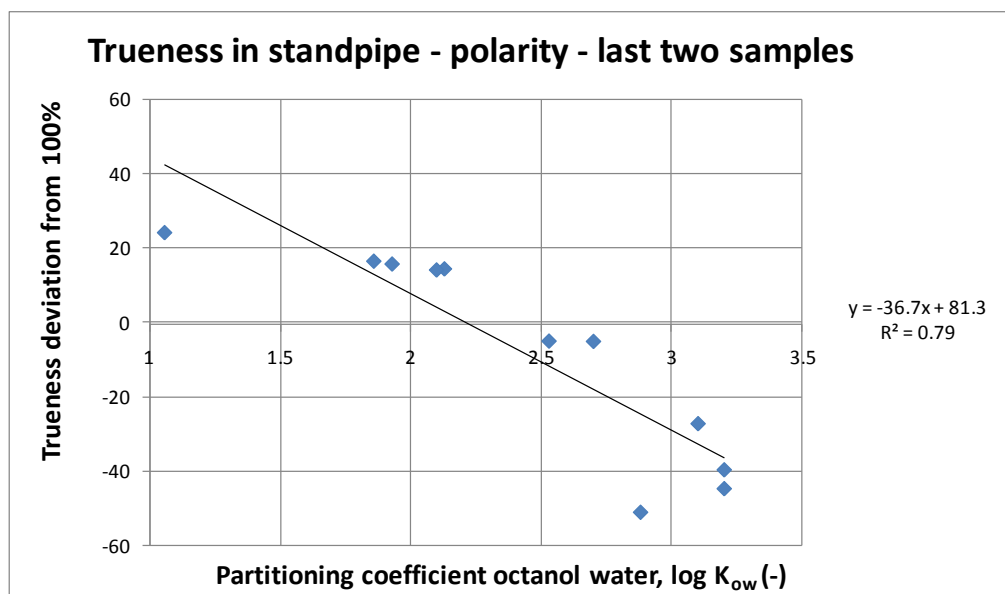


Figure 12 Deviation of trueness from 100% in standpipe against polarity of compounds at level 5 times the expected limit of detection.

As reduced test solution concentrations in the standpipe due to adsorption could not be ruled out, reference sample based concentrations were used as true values in standpipe test.

7.3 Test performance observation

7.3.1 True volumes that passed through the samplers

During the tests, the volumes passed through the samplers were determined in two ways: by tracer salt analysis as part of the product, and as a manual measurement of the collected liquid in the laboratory or in the field. In some tests, the difference was a factor of approximately two for all three replicates; see e.g. samples V and CA. The rule for which volume to use was: use the volume measured by the tracer salt method, unless the result is over range, >500 mL. In those few cases, the volumes measured in laboratory or in the field were used.

7.3.2 Direct application tests

The direct application tests H and J were the only laboratory tests that included chloroethene. After the application of the VOX analytical standard (test J) or the standard dilution (test H), the samplers were rinsed with 300 mL of water. In test H, one of the seven replicate samplers exhibited a very high hydraulic resistance. This sampler was excluded from the evaluation of data.

7.3.3 Tests using the sample dispenser

In the tests using the sample dispenser, the relative standard deviation (RSD) of samplers was higher (lower precision) than for the consecutive reference samples. In the tests using the standpipe, the samplers showed a lower RSD (better precision) than the reference samples.

7.3.4 Tests in the standpipe

The reference samples from the standpipe are not true replicates, for two reasons. Firstly, there may be a loss of concentration over time, presumably mainly due to adsorption to the plastic materials that are part of the Sorbisense set-up. Secondly, mixing

may be incomplete at the time of the first reference sampling, resulting in too high concentrations at the sampling port, see Figure 11. An indication of that can also be seen at in the test N at 10% of range (reference samples O). For the tests of trueness in the standpipe, it is judged that the variation between replicates is larger than the effect of the above-mentioned reasons for varying concentrations in the standpipe. After Amendment 3, the first sampling was 4 hours after spiking.

7.3.5 *Field test in monitoring wells*

When testing in the existing groundwater monitoring wells, some unexpected conditions arose. In some cases, action was taken. In all cases, the unexpected conditions were considered when evaluating the results.

When taking reference samples in well C14 at Søbørg Hovedgade, a black (oily?) liquid was pumped up at start of pumping. When taking up the Sorbisense equipment, it was covered with the black substance, see Figure 13. The chemical analyses did not show any significant effect of the unknown substance, and all results from the well were included in the validation.



Figure 13 Pictures of Sorbisense equipment retrieved from well C14 at Søbørg Hovedgade.

In well B17 at Farum Bytorv, it was difficult to achieve a stable water quality (measurement of pH, conductivity and oxygen) when taking reference samples from this well.

During the first reference sampling, the well was pumped over a longer period than planned in an attempt to achieve stable water quality. At the next reference samplings, the sampling was done after approximately the same pumping time as needed for the other wells to get stable water quality. Further it was not possible to place the Sorbisense equipment in planned depth due to irregularity (bend) in well casing well. All samples and 3 out of 4 reference samples were taken from approximately 1 m above planned depth.

This well was in the periphery of the contamination. The extra pumping at the first reference sampling apparently caused this sample to contain higher concentrations, mainly of MTBE, than the following reference samples. It was not possible to determine how much the difference in sampling level affected the results. The extra pumping and dragging in of contamination from the nearby gasoline hot spot has affected the results of the

first sampler, which had higher concentrations than the following samples. The measured MTBE concentrations are shown graphically in Figure 14. All results from well B17 were included in the validation.

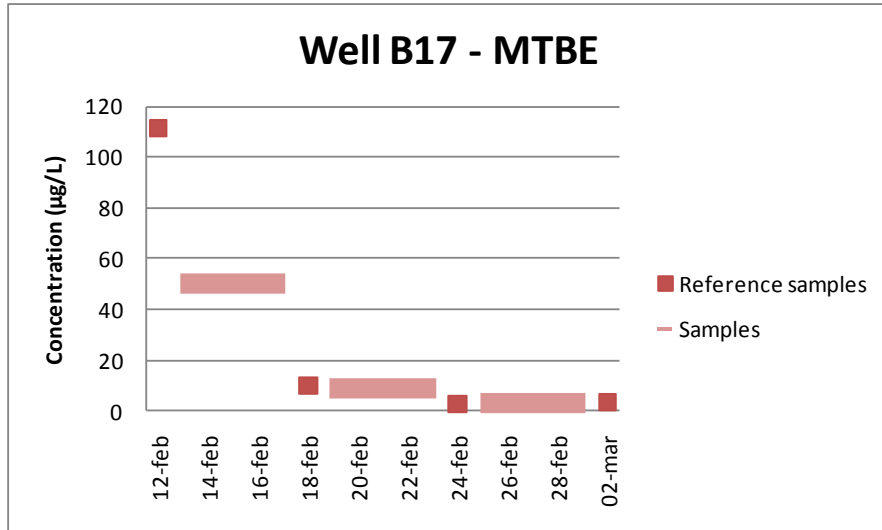


Figure 14 MTBE concentrations in well B17 over time in samplers and reference samples.

7.4 Amendments and deviations from the test plan and test protocol

There has been in total four amendments to the test plan. All amendments have been approved. These amendments were made as update of sections and appendices in the test plan. This test report therefore includes the revised sections. An overview of the sections and appendices where the amendments have caused updates is shown in Table 35.

Table 35 Overview of updates according to amendments.

No.	Section	Change
1	Test plan appendix 3.4	Reference sampling strategy in the field
2	Test plan appendix 3.10	Handling of exposed samplers
3	Test plan appendix 3.3	Time of first reference sample from standpipe
4	Test plan appendix 3.2, 3.9	Way of conducting concentration integration test HA
5	Test protocol	Use of statistical methods

During the testing, 31 deviations to the test plan were noticed. Where applicable, the test plan was updated. A list of the deviations is included in Appendix 7.

A P P E N D I X 1

Terms and definitions used in the test plan

The abbreviations and definitions used in the verification protocol and the test plan are summarized below.

Where discrepancies exist between NOWATECH and US EPA ETV terminology, definitions from both schemes are given.

Word	NOWATECH	US ETV
ADQ	Audit of data quality: An examination of a set of data after it has been collected and 100% verified by project personnel, consisting of tracing at least 10% of the test data from original recording through transferring, calculating, summarizing and reporting	
AMS Center	Advanced Monitoring Systems Center at Battelle	
Analysis	Analysis of Sorbisense samplers at the vendor identified laboratory	
Analytical laboratory	Independent analytical laboratory used to analyze reference samples	
Application	The use of a product specified with respect to matrix, target, effect and limitations	
BTEX	Benzene, toluene, ethylbenzene and xylenes	
CEN	European Committee for Standardization	
CWA	CEN Workshop agreement	
Direct application	A test design where a standard solution is applied directly to the Sorbisense samplers	
Discrepancy	Sampler resulting in measurable concentrations while all reference samples are below limit of detection or opposite reference samples with detectable content and all sampler results being below limit of detection	
DOC	Dissolved organic carbon	
DS	Danish Standard	
Effect	The way the target is affected, in this verification the measurement volatile organic contaminants	
EN	European standard	
ETV	Environmental technology verification (ETV) is an independent (third party) assessment of the performance of a technology or a product for a specified application, under defined conditions and adequate quality assurance	EPA program that develops generic verification protocols and verifies the performance of innovative environmental technologies that have the potential to improve protection of human health and the environment
Evaluation	Evaluation of test data for a technology product for performance and data quality	An examination of the efficiency of a technology
Experts	Independent persons qualified on a technology in verification or on verification	Peer reviewers appointed for a verification

Word	NOWATECH	US ETV
	cation as a process	
GC	Gas chromatography	
GLP	Good laboratory practice	
Groundwater monitoring	Baseline monitoring of groundwater quality	
GWS	Groundwater sampler	
HDPE	High density polyethylene	
ICP	Induced coupled plasma	
ISO	International Standardization Organization	
k_H	Partitioning coefficient air water	
K_{ow}	Partitioning coefficient octanol water	
Limit of detection LoD	Calculated from the standard deviation of replicate measurements at less than 5 times the detection limit evaluated. Corresponding to less than 5% risk of false blanks	
Matrix	The type of material that the product is intended for	
mbs	m below surface	
Method	Generic document that provides rules, guidelines or characteristics for tests or analysis	
MS	Mass spectrometry	
MTBE	Methyl- <i>tert</i> -butylether	
NOWATECH ETV	Nordic Water Technology Verification Centers	
NOWATECH WMC	(ETV) Water Monitoring Center at DHI	
NVOC	Non-Volatile Organic Carbon	
OECD GLP	Organisation for Economic Cooperation and Development, Good Laboratory Practice	
P&T	Purge and trap	
Performance parameters	Parameters that can be documented quantitatively in tests and that provide the relevant information on the performance of an environmental technology product	
Precision	The standard deviation obtained from replicate measurements, here measured under repeatability or reproducibility conditions	
QA	Quality assurance	
Range of application	The range from the LoD to the highest concentration with linear response	
Reference analyses	Analysis by a specified reference method in an accredited (ISO 17025) laboratory	
Reference samples	Samples taken for and analyzed by a specified reference method in an accredited (ISO 17025) laboratory	
Repeatability	The precision obtained under repeatability conditions, that is with the same measurement procedure, same	

Word	NOWATECH	US ETV
	operators, same measuring system, same operating conditions and same location, and replicate measurements on the same or similar objects over a short period of time	
Reproducibility	The precision obtained under reproducibility conditions, that is with measurements that includes different locations, operators, measuring systems, and replicate measurements on the same or similar objects	
Robustness	% variation in measurements resulting from defined changes in matrix properties	
RSD	Relative standard deviation in %	
Sample dispenser	Test device designed for controlled exposure of Sorbisense samplers to test solutions	
Sampler	Sorbisense sorbent cartridge	
Samples	Samples taken with and analyzed after the Sorbisense method	
Sampling system	The sampling reservoir and venting system used to operate the Sorbisense samplers	
SIM	Selected ion monitoring	
SM	Standard Methods for the Examination of Water and Wastewater, latest edition	
Standard	Generic document established by consensus and approved by a recognized standardization body that provides rules, guidelines or characteristics for tests or analysis	
Standpipe	Test device designed to simulate a groundwater well	
Target	The property that is affected by the product, in this verification the target performance parameters measured	
(Environmental) technology	The practical application of knowledge in the environmental area in a technology whose use is less environmentally harmful than relevant alternatives	An all-inclusive term used to describe pollution control devices and systems, waste treatment processes and storage facilities, and site remediation technologies and their components that may be utilized to remove pollutants or contaminants from, or to prevent them from entering, the environment
Trueness	The % recovery of true value obtained either from knowledge on the preparation of test solutions or from measurements with reference methods	
TSA	Technical system audit	
US EPA	United States Environmental Protection Agency	
Vendor	The party delivering the product or	The technology developer, owner, or licensee seeking verification

Word	NOWATECH	US ETV
	service to the customer	
Verification	Evaluation of product performance parameters for a specified application under defined conditions and adequate quality assurance	Establishing or proving the truth of the performance of a technology under specific, predetermined criteria, test plans and adequate data QA procedures
VOC	Volatile organic compounds, here the compounds listed as target compounds/analytical parameters	
VOX	Volatile halogenated organic compounds, here the halogenated compounds listed as target compounds/analytical parameters	
WS	Workshop (under CEN)	

A P P E N D I X 2

Reference methods and references

1 Reference analysis, VOC

Water samples are taken as 40 mL samples in autosampler vials filled completely from the bottom and allow to overflow.

A precise volume of subsample is transferred from the sampler vial to the airsparer via a sample loop and using helium as the pressure gas. The subsample is purged with helium and the purged compounds trapped on a VOCARB 3000 adsorbent, followed by thermal desorption at 240°C and transfer of desorbed compounds to the gas chromatograph (GC). GC separation is followed by selected ion monitoring and quantification against external standard.

Selectivity is ensured by applying a maximum limit of 20% deviation of mass ratios for the selected masses from reference run.

The equipment used is Tekmar Aquatek 70/Velocity XPT and Agilent 6890 GC/5973 or 5975 MS.

Standard method references are EPA Method 624.2 /11/ and ISO 15680 /12/.

2 General chemistry

Groundwater from wells in the field test will be characterized for general chemistry parameters using the below given methods. Analysis for pH and conductivity is done on-line in the field.

Parameter	Method	Parameter	Method
pH	DS 287	DOC	EN 1484
Conductivity	DS 288	Iron	SM3500C
Nitrate	EN 10304	Ammonium	DS 224
Fluoride	EN 10304	Sodium	SM3500C
Chloride	EN 10304	Potassium	SM3500C
Bicarbonate	DS 256	Calcium	SM3500C
Sulphate	EN 10304	Magnesium	SM3500C

General chemistry data for groundwater for the laboratory tests, see Appendix 3.7, will be obtained from the water work delivering the water.

3 References

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A P P E N D I X 3

In-house test methods

The in-house test methods are the detailed specifications (work instructions) of the tests to be performed including specific information on the practical work planned, Appendices 3.1 to 3.4.

The pre-testing is described in Appendix 3.5 and the check of solutions used in Appendix 3.6.

Reagents are described in Appendix 3.7 and apparatus in Appendix 3.8.

The volumes of solutions used for different experiments are summarized in Appendix 3.9.

The storage and shipping of samples is described in Appendix 3.10.

Appendix 3.1

Direct application of halogenated hydrocarbons standard to samplers

For personal safety and to avoid contamination, wear nitrile gloves for all handling of equipment.

- a) Place 7 samplers in the fume cupboard in a vial stand.
- b) Add the spike (50 μL of 24.7 $\mu\text{g}/\text{mL}$ VOX standard dilution for 5xLoD, 50 μL standard solution for 10% of range) directly into the adsorber resin of the sampler using a 50 μL gas tight syringe.
- c) Place each sampler into a separate 100 mL glass bottle with PTFE-lined screw cap.
- d) Place 3-4 of the 100 mL bottles into a 2 L wide-neck glass bottle with Teflon-lined screw cap.
- e) Let the samplers equilibrate at 4°C for 24 hours at least.
- f) Remove the samplers from the glass bottles.
- g) Connect 3 of the samplers to the sample dispenser using new 1/16'' capillaries.
- h) Convey 300 ml (collect in 500 mL graduated cylinders) of water through each sampler during approximately 4 hours. This is done in batches of 2-3 samplers, before the sample dispenser has been used with VOCs, but after the blank test of the sample dispenser.
- i) Prepare the samplers for shipping.

Appendix 3.2

Laboratory sample dispenser

For personal safety and to avoid contamination, wear nitrile gloves for all handling of equipment.

1 Preparations

- a) Start with the clean, empty dispenser, lid attached, air exchange pipe detached from the wash bottle. Make sure the stir bar in the dispenser is positioned in the middle of the dispenser bottom and rotating when stirrer is switched on.
- b) Connect the sampler capillaries to the 1/16 inch fittings. Place the ends of the capillaries above the lid of the lab dispenser to avoid leakage.
- c) Add 35 mL potassium chloride stock solution to the dispenser through the spiking port, using a 100 mL syringe with Luer lock. For the tests with different ionic strength add 10 mL for 10 mS/m or 100 mL for 100 mS/m). Rinse with 100 mL of water.
- d) Fill the dispenser with water (*see separate instruction below*).
- e) Add the VOC spike to the dispenser (*see separate instruction below*).
- f) Fill the wash bottle with water up to the 5.5 L-mark¹⁰.
- g) Add the adequate spike directly to the wash bottle (under the water surface) and close the wash bottle.
- h) Connect the exchange pipe and tighten the fittings.
- i) Start the magnetic stirrers in the wash bottle.
- j) Take down the end of the capillaries from the dispenser. Let at least 1 mL go to drain.
- k) Make sure that 30 minutes have passed since the magnetic stirrers have been started; then, connect a sampler to each capillary.
- l) Start the magnetic valve timer.
- m) Note the time and possible deviations.

2 Filling the dispenser with water

- a) Attach one end of the PTFE tube to the vertical nozzle of the sampling port. Attach the other end to the water tap (MilliQ).
- b) Open the two-way valve in the lid of the dispenser.
- c) Open the sampling port valve. Open the water tap to fill the dispenser until water overflows from the open two-way valve.
- d) Close the water tap. Close the spiking port valve.
- e) Remove the PTFE tube and close the open ends with tinfoil.
- f) Drain 200 mL of water from the dispenser through the sampling port. Measure conductivity and temperature in the drained water.
- g) Continue with step 1e.

3 Addition of spike to the lab dispenser

- a) Start the dispenser's magnetic stirrer.
- b) Open a stock solution vial with appropriate volume.
- c) Fill the appropriate amount into the suitable gastight syringe with Luer lock, with needle attached.

¹⁰ Removed "using the PTFE tubing" after comment in Battelle's audit report.

- d) Remove the needle from the syringe and connect the syringe to the dispenser's spiking port.
- e) Open the spiking port valve and add the contents to dispenser.
- f) Close the spiking port valve and remove the syringe.
- g) Attach the needle and fill syringe with methanol. Detach the needle and add also the methanol to the dispenser.
- h) Close the spiking valve, and remove the syringe.
- i) Fill a 100 mL syringe with Luer lock with water. Add the water to the dispenser. Close the spiking port valve and remove the syringe.
- j) Close the two-way valve in the lid of the dispenser.
- k) Continue with step 1f.

4 During exposure

- a) Control the amount of liquid that has passed through each sampler after ½ the sampling time and full sampling time by collecting in pre-weighed 1000 mL bottles.
- b) Take water phase sample from the dispenser after 2 hours, ½ the sampling time and full sampling time, following the *sampling instruction*.

5 Reference sampling instructions

- a) Wipe the vertical nozzle of the sample tap with acetone-soaked paper tissue. Rinse the nozzle with water from a bottle, dry with paper tissue.
- b) Set the magnetic valves to open.
- c) Open the sample tap and drain 25 mL to waste.
- d) Place the nozzle in a 40 mL P&T vial, open the sample valve by approximately 45 degrees and fill the vial slowly from below. Let the sample overflow for at least 3 seconds. Close the sample tap, and close the vial.
- e) Repeat c) for the 2 following P&T vials.
- f) Start the magnetic valve timer.
- g) Repeat a) to clean the nozzle after sampling.
- h) Store cold 1-5°C and dark for no more than 3 days and transfer to laboratory.

6 End of exposure

- a) Stop both magnetic stirrers.
- b) Open the two-way valve in the lid of the dispenser.
- c) Drain the dispenser through the sample tap, into containers for disposal¹¹.
- d) Remove the samplers and send them for analysis.
- e) Detach the air exchange pipe from the wash bottle¹² and tilt the container towards the sample tap to empty completely.
- f) Detach the magnetic valve from the other side of the wash bottle.
- g) Empty the wash bottle. Attach the air exchange pipe lightly until next use.

¹¹ Changed according to deviation no. 4.

¹² Whenever detaching the connections of the wash bottle, detach the nut on the steel side of the fitting, not on the glass side.

Appendix 3.3

Standpipe

1 Preparations

Wear nitrile gloves for all handling of equipment.

- a) Mount the needed number of samplers with samplers into the empty standpipe. Tighten with the provided strings.
- b) Connect the air hoses¹³ to the lid.
- c) Close the standpipe.
- d) Open the two-way valve in the lid of the standpipe.
- e) Fill the standpipe from the bottom with groundwater, using PTFE tubing, until water overflows from the open two-way valve.
- f) Stop the water flow, close the sampling port valve and remove the PTFE tubing.
- g) Drain 200 mL from the standpipe. Measure conductivity and temperature in the drained water.
- h) Start the circulation pump.
- i) Add the spike to the standpipe (*see separate instruction*).
- j) Fill the wash bottle with water up to the 5.5 L-mark¹⁴.
- k) Add an adequate spike directly to the wash bottle (under the water surface) and close the wash bottle.
- l) Connect the air exchange pipe.
- m) Start the magnetic stirrer in the wash bottle. Start the magnetic valve timer.
- n) Note the time and possible deviations.

2 Addition of spike to the standpipe

- a) Make sure the magnetic valves are closed.
- b) Open a stock solution vial with appropriate volume.
- c) Fill the appropriate amount into the suitable gastight syringe with Luer lock, with needle attached.
- d) Remove the needle from the syringe and connect the syringe to the standpipe's spiking port.
- e) Open the spiking port valve and add the contents to standpipe.
- f) Close the spiking port valve and remove the syringe.
- g) Attach needle and fill syringe with methanol. Add to standpipe¹⁵.
- h) Close the spiking valve, remove syringe.
- i) Fill a 100 mL syringe with Luer lock with water¹⁶. Add the water to the dispenser. Close the spiking port valve and remove the syringe.
- j) Close the two-way valve in the lid of the standpipe.
- k) Continue with step 1h.

¹³ Deviation no. 14.

¹⁴ Removed "using the PTFE tubing" after comment in Battelle's audit report.

¹⁵ g) and h) added as deviation no. 7.

¹⁶ From test J on, the rinsing was done 10 times with a 10 mL syringe (deviation no. 8).

3 During the exposure

Take water phase sample from the dispenser after 4 hours¹⁷, ½ the sampling time and full sampling time, following the *sampling instruction*.

4 Reference sampling instructions

- a) Wipe the vertical nozzle of the sample tap with acetone-soaked paper tissue. Rinse the nozzle with water from a bottle, dry with paper tissue.
- b) Set the magnetic valves to open.
- c) Open the sample tap and drain 25 mL to waste.
- d) Place the nozzle in a 40 mL P&T vial, open the sample valve by approximately 45 degrees and fill the vial slowly from below. Let the sample overflow for at least 3 seconds. Close the sample tap, and close the vial.
- e) Repeat c) for the 2 following P&T vials.
- f) Start the magnetic valve timer.
- g) Repeat a) to clean the nozzle after sampling.
- h) Store cold 1-5°C and dark for no more than 3 days and transfer to laboratory.

5 End of exposure

- a) Stop the magnetic stirrer in the air wash bottle.
- b) Stop the recirculation pump.
- c) Open the two-way valve in the lid of the standpipe.
- d) Remove the air exchange pipe.
- e) Drain the standpipe into containers for disposal, using the sample tap.
- f) Open the standpipe and take up the sampler.
- g) Remove the samplers and send them for analysis.
- h) Measure the sampled water volume by collecting in 1000 mL pre-weighed glass bottles and weighing.
- i) Tilt the container towards the sample tap to empty completely.
- j) Empty the wash bottle. Attach the air exchange pipe lightly.

¹⁷ Amendment no. 3.

Appendix 3.4

Field sampling

1 Data compilation

First planning step includes data compilation in order to allow for the detailed planning:

Full Address	Well identification	Well registration number	Contact, name, phone, e-mail
Søborg Hovedgade 17-19, Søborg	B103	201.5848	Region Hovedstaden, Jens Lerche Mortensen, +45 4820 5333, jens.lerche.mortensen@regionh.dk
Søborg Hovedgade 17-19, Søborg	C8	201.5855	Region Hovedstaden, Jens Lerche Mortensen, +45 4820 5333, jens.lerche.mortensen@regionh.dk
Søborg Hovedgade 17-19, Søborg	C11	201.5851	Region Hovedstaden, Jens Lerche Mortensen, +45 4820 5333, jens.lerche.mortensen@regionh.dk
Søborg Hovedgade 17-19, Søborg	C14	201.5858	Region Hovedstaden, Jens Lerche Mortensen, +45 4820 5333, jens.lerche.mortensen@regionh.dk
Farum Bytorv 76, Farum	B17	193.2277	Jord•Miljø, Charlotte Juhl Søegaard, +45 3582 0402, cjs@jordmil.dk
Farum Bytorv 76, Farum	B18	193.2278	Jord•Miljø, Charlotte Juhl Søegaard, +45 3582 0402, cjs@jordmil.dk

Well identification	Filter (mbs) ¹⁸	Diameter (mm)	Groundwater table (mbs)	Geology
C8	11.5-15	63	8.86	Sand
C11	7-13	63	8.9	Sand
C14	6-13	63	9.48	Sand
B17	8.2-15.2	63	9.3	Sand
B18	8.3-15.3	63	9.2	Sand

2 Reference sampling strategy

The second planning step is to select the reference sampling strategy and to select the sampling (0.5-5 mbgwt¹⁹) and reference sampling positions. All selected wells are monitoring wells. The position of the sampler and reference sampling is therefore based on geology, groundwater level and knowledge of contamination (PID monitoring during drilling).

¹⁸ mbs: meter below surface.

¹⁹ mbgwt: m below groundwater table.

Well identification	Sampler position (mbs)	Sampler position to in well groundwater table distance (m)	Reference sampling position (mbs)
C8	13	4.1	13
C11	11	2.1	11
C14	11.5	2	11.5
B17	12	2.7	12
B18	12	2.8	12

3 Sampling

The sampling is done as follows:

- a) Mount a sampling system with a sampler in the well at the selected depth.
- b) Secure the position with the provided string.
- c) Leave the sampler in position for 6 days.
- d) Take up the sampler.
- e) Remove the sampler and send it for analysis.
- f) Repeat twice.

The reference sampling is done as follows, for monitoring wells:

- a) Lower the pump into the well to the selected depth.
- b) The pump is pulled slowly approximately 0.5 m up and down from the selected depth, to remove old water, etc. while pumping at low yield.
- c) The pre-pumping will be done as micro pre-pumping. The pumping must be so low that the draw down is less than 10 cm, if not possible the maximum flow is 0.5 l/minute.
- d) During clean-up, pre-pumping and sampling indicator parameters (pH, dissolved oxygen, conductivity) are measured and noticed every 3-5 minutes.
- e) Samples are taken when pH and conductivity are stable.
- f) The groundwater level is measured before placement of pump, during pre-pumping with an interval of 0.5-5 minutes as well as just before sampling.
- g) Just before sampling the pump is throttled down, ensuring that the groundwater level is rising (measurement). Pump yield is 0.1 l/minute or as minimum so low that the groundwater level is rising.
- h) Fill sample containers from the bottom and allow to overflow minimum 2 times ensuring no head space in the containers, where required. Samples bottles for metal analyses contain conservation media and are only to be filling 90%, no overflow due to loss of conservation media.
- i) Store and preserve samples as prescribed and send to the laboratory.

Reference sampling is done before, between and after each sampling, totally 4 times.

Field blanks are prepared during the first reference sampling at each site. Water is transferred to sample bottles on site and the samples are stored, transported and analyzed as reference samples.

Sampling is done using a Grundfos MP1 pump equipped with 8/10 mm Teflon tubes. The same pump and tube will be used exclusively for the same well every time. The

pumps will not be used for other purposes in between the reference samplings. Pumps are cleaned before first use, new Teflon tubing is used.

Indicator parameters (pH, dissolved oxygen, conductivity, temperature) are measured in a flow through on-line cell.

Appendix 3.5

Pre-testing

Laboratory sample dispenser.

Objective	Test design	Samples
Blank test	Dispenser filled with water	Triplicate reference samples 1) of water, 2) from dispenser directly 30 minutes after addition, and 3) from dispenser after 6 days
VOC stability in dispenser	Dispenser filled with water, spiked to 5xLoD	Triplicate samples 1) of 0.1 g/L VOC solution, 2) from dispenser 30 minutes after addition, and 3) from dispenser after 6 days

Appendix 3.6

Preparation of solutions for reference analysis

1 10 g/L VOC stock solution

Check of concentrations is done initially and each time a subsample is taken out for use.

Initial testing is done by filling a 1,5 mL capped vial with stock solution at -20°C, using a low-flow pipette. Close vial. Produce triplicate vials in this way. Place each of the 1 mL capped vials in a larger capped vial. Store cold 1-5°C and dark for no more than 3 days and transfer to laboratory with information of concentration range.

Check during use: after using part the stock solution in the vial for spiking, fill one 1,5 mL capped vials with the solution using a gas-tight syringe. Close the vial and place it in a larger capped vial. Store cold 1-5°C and dark for no more than 3 days and transfer to laboratory with information on concentration range. Produce 2 more vials and keep at -20°C for possible future reference.

2 0.1 g/L VOC solution

Check during use is done after using part the solution in the vial for spiking by transferring 1 mL to a cap vial using a low-flow pipette. Close vial, shake well. Produce triplicate vials in this way. Close the vials and place each in a larger capped vial. Store cold 1-5°C and dark for no more than 3 days and transfer to laboratory with information of concentration range.

3 VOX Standard dilution

Check during use is done after using part the stock solution in the 6 mL vial with VOX standard dilution for spiking. Fill three 1.5 mL capped vials with the solution using a gas-tight syringe. Close the vials and place them in a P&T vial. Store cold 1-5°C and dark for no more than 3 days and transfer to laboratory with information of concentration range.

Appendix 3.7

Reagents

1 Water

Laboratory grade water from Millipore system with electrical conductivity below 10 MΩ/cm. Dissolved organic carbon below 0.1 mg/L and target VOC below the limit of detection 0.02 µg/L is expected and verified in first blank test series.

2 Groundwater

Potable water as obtained from the supply network at DHI. Groundwater characteristics are as follows:

Parameter	Value	Parameter	Value
pH	7.6	DOC	1.5 mg C/L
Conductivity	71 mS/m	Iron	0.02 mg/L
Nitrate	2.4 mg/L	Ammonium	0.058 mg/L
Fluoride	0.62 mg/L	Sodium	30 mg/L
Chloride	44 mg/L	Potassium	3.8 mg/L
Bicarbonate	340 mg/L	Calcium	85 mg/L
Sulphate	21 mg/L	Magnesium	22 mg/L

Target VOC is below the limit of detection 0.02 µg/L.

3 VOX standard

Standard solution “QTM Volatile Halocarbons Mix” produced by Supelco, purchased from Sigma-Aldrich, product number 48001, lot number LB59726, with analytical certificate, MFG date July 2008, nominal concentrations as follows (among other VOCs):

Compound	Nominal concentration µg/L
Chloroethene	1998
1,1-Dichloroethene	2000
trans-1,2-Dichloroethene	2000
cis-1,2-Dichloroethene	1951
Trichloroethene	2000
Tetrachloroethene	2000

4 Chemicals

Compound	Producer	Quality	Purity	Batch
1,1-Dichloroethene	Supelco	Analytical standard	99.9%	LB56468
trans-1,2-Dichloroethene	Supelco	Analytical standard	99.9%	LB57511
cis- 1,2-Dichloroethene	Fluka	Analytical standard	99.7%	7333X
Trichloroethene	Fluka	Puriss. p.a.	>99.5%	1368013
Tetrachloroethene	Supelco	Analytical standard	99.9%	LB56979
Benzene	Fluka	Puriss. p.a.	99.9%	1369911
Toluene	Fluka	Puriss. p.a.	>99.7%	1392028
Ethylbenzene	Fluka	Puriss. p.a.	>99.0%	1388758
m-Xylene	Fluka	Puriss. p.a.	>99.0%	1399073
o-Xylene	Fluka	Puriss. p.a.	>99.0%	1406896
MTBE	Fluka	Puriss. p.a.	>99.5%	1399802
Methanol	Fluka	Puriss. p.a. For trace analysis of chlorinated hydrocarbons	≥99.8%	1379978
Potassium chloride	Fluka	Puriss. p.a.	>99.5%	80150

5 10 g/L VOC stock solution

Prepare a 10 g/L solution of each target VOC as follows:

- Fill a 250 mL volumetric flask (with glass stopper) with methanol, refrigerate to -20°C and mark the level.
- Keep 210 mL methanol in the volumetric flask, place on ice in fume cupboard.
- Add the volume indicated below of each chemical using low flow pipettes, starting with the highest boiling compound and keeping the pipette below the methanol surface while emptying. Close the flask after each addition.
- Refrigerate flask to -20°C.
- Fill the volumetric flask to the new mark with methanol refrigerated to -20°C.
- Shake by hand until no phase difference is visible.
- Distribute the stock solution into 1.5, 3.5 and 10 ml capped vials using a low flow pipette. Check cap tightness (tight when cannot be twisted), wrap with aluminium foil and place in freezer, -20°C.

Compound	µL pipetted	Density g/L	µg pipetted	Concentration g/L
Chloroethene	-	-	-	-
1,1-Dichloroethene	2 000	1.218	2 436 000	9.74
trans-1,2-Dichloroethene	2 000	1.2565	2 513 000	10.05
cis-1,2-Dichloroethene	1 500	1.2837	1 925 550	7.70
Trichloroethene	1 750	1.4642	2 562 350	10.25
Tetrachloroethene	1 500	1.6227	2 434 050	9.74
Benzene	2 750	0.87865	2 416 288	9.67
Toluene	2 750	0.8669	2 383 975	9.54
Ethylbenzene	2 750	0.867	2 384 250	9.54
o-Xylene	2 750	0.8802	2 420 550	9.68
m-Xylene	3 000	0.8642	2 592 600	10.37
MTBE	3 250	0.74	2 405 000	9.62

6 0.1 g/L VOC solution

Prepare a 0.1 g/L solution from the 10g/L solution as follows, directly before use.

- a) Open a 1.5 mL vial of 10 g/L stock solution.
- b) Fill a 10 mL capped vial with 10 mL of methanol using a low flow pipette at $20^{\circ}\text{C}\pm 2^{\circ}\text{C}$.
- c) Add 100 μL of 10 g/L stock solution using a gas tight syringe with cemented needle, keep needle under methanol surface while emptying.
- d) Close the vial, check for tightness.
- e) Shake by hand.
- f) Use after letting the solution equilibrate at room temperature for 1 hour.

7 24.7 $\mu\text{g/L}$ VOX standard dilution for direct application

Prepare a 24.7 $\mu\text{g/mL}$ stock solution of halogenated hydrocarbons as follows:

- a) Add 6 mL of methanol to a 6 mL cap vial using a low flow pipette.
- b) Transfer 75 μL of the 2000 $\mu\text{g/mL}$ volatile hydrocarbon standard to the cap vial using a 50 μL gas tight syringe, keeping the needle below the methanol surface while emptying.
- c) Close the vial, check for tightness.
- d) Shake by hand.
- e) Use after letting the solution equilibrate at room temperature for 1 hour.

8 205 g/L KCl stock solution

Prepare a 205 g/l stock solution of potassium chloride:

- a) Place a 1000 mL volumetric flask with 200 mL of water.
- b) Weigh the flask with water.
- c) Add portions of KCl dried at 105°C overnight and shake well.
- d) When all 205 g of KCl is dissolved, allow the solution to equilibrate to room temperature.
- e) Fill the flask to the mark.
- f) Transfer to a 1000 mL glass bottle and close with a blue cap screw lid.

Appendix 3.8

Apparatus

1 Glass syringes and adapters

- a) 1 gas tight glass syringe with stainless steel Luer-lock, 2.5 mL.
- b) 1 gas tight glass syringe with stainless steel Luer-lock, 5 mL.
- c) 1 gas tight glass syringe with stainless steel Luer-lock, 10 mL.
- d) 1 stainless steel Luer/Luer adapter with valve, each for lab dispenser and standpipe.
- e) 6 needles with Luer adapter, 22 ga (0.394 mm ID).
- f) 1 gas tight syringes with fixed needle, 25 μ L.
- g) 2 gas tight syringes with fixed needle, 50 μ L.
- h) 1 gas tight syringe with fixed needle, 100 μ L.
- i) 1 gas tight syringe with fixed needle, 500 μ L.
- j) 1 gas tight syringe with fixed needle, 1000 μ L.
- k) Glass syringe with Luer lock, 100 mL.

2 Glassware

- a) Volumetric flasks 250 mL and 1000 mL with glass stopper.
- b) Low flow glass pipettes at 250, 500, 7500, 1000, 1250, 1500, 2000 and 2500 μ L.
- c) 3 stir bars, glass coated.
- d) Capped vials for 1.5, 3.5, and 10 mL, caps with PTFE seals.
- e) 25 mL Erlenmeyer flask with mark.
- f) 200 mL Erlenmeyer flask with mark.
- g) 1000 mL bottle with blue screw cap.
- h) 1000 mL bottles with red screw cap.
- i) 500 mL graduated cylinders.

3 Miscellaneous

- a) Micropipettes with tips at 100 μ L, 1 mL and 5 mL.
- b) Dedicated, water flushed PTFE tubes, 8x6 mm diameter.
- c) Nitrile gloves.

4 Field

- a) Grundfos MP1 pump.
- b) Transformer box.
- c) 220 V generator.
- d) Dedicated, water flushed 10 mm PTFE tubes.
- e) On-line flow through devices (WTW) for monitoring of indicator parameters (pH, dissolved oxygen, conductivity).

Appendix 3.9

Spike volumes and solutions

Experiment	Lab dispenser or standpipe (mL)	Wash bottle (mL)	Solution
H	0.050	---	VOX standard dilution
L	0.050	---	VOX standard
BA	4.00	0.55	10 g/L VOC stock solution
DA	4.00	0.55	10 g/L VOC stock solution
EA	4.00	0.55	10 g/L VOC stock solution
FA	4.00	0.55	10 g/L VOC stock solution
GA	4.00	0.55	10 g/L VOC stock solution
HA, first step ²⁰	1.50	0.2	10 g/L VOC stock solution
HA, second step	2.50	0.35	10 g/L VOC stock solution
HA, third step	2.00	0.30	10 g/L VOC stock solution
J	2.50	0.125	0.1 g/L VOC solution
N	2.00	0.10	10 g/L VOC stock solution
P	5.00	0.25	10 g/L VOC stock solution
R	10.00	0.50	10 g/L VOC stock solution
T	15.00	0.80	10 g/L VOC stock solution
V	20.00	1.00	10 g/L VOC stock solution
CA	10.00	0.50	10 g/L VOC stock solution

²⁰ Changes to test HA spiking volumes are part of Amendment no. 4.

Appendix 3.10

Managing, storing and shipping of samples/samplers

1 Managing samples

- a) Prior to each individual test, the sampling responsible (test technician or field responsible) labels the correct type and number of sample vials, according to information in the test plan and the data forms. For cap vials, only the labels are prepared, to avoid contamination.
- b) The test responsible checks the array of labeled sample bottles and labels against the test plan and the data forms.
- c) After sampling, the sampling responsible takes a photo of the sample vials and sends the photo to the test responsible immediately.
- d) The sampling responsible stores the sample vials.
- e) The test responsible prepares a requisition for analysis, and sends it to the sampling responsible.
- f) The sampling responsible ships the samples, and making sure that they are sent within the maximum stated storage time.
- g) The sampling responsible informs the test responsible immediately when the samples have been sent.
- h) The sampling responsible keeps a copy of the requisition with a note of the date of shipping.

2 Sample storing, reference samples

Water samples are taken in 40 mL P&T vials. Samples are stored cold 1-5°C and dark for no more than 3 days prior to transfer to the laboratory.

3 Sample storing, samplers

Samplers are equipped with protective caps in both ends, placed in transportation tubes and stored cold 1-5°C and dark for no more than 3 days prior to transfer to the laboratory²¹.

4 Sample shipping, reference samples

Water samples (P&T vials) are sent in cooling boxes with cooling elements. Cap vials with stock solution or stock dilution are placed individually into a P&T vial and may be sent in a non-isolated package, with one cooling element.

5 Sample shipping, samplers

Samplers are packed in the transport tubes in a cardboard box with a cooling element. Samplers are shipped with a courier service, with maximum 48 hours transport time.

²¹ Amendment no. 2.

A P P E N D I X 4

In-house analytical methods

None

A P P E N D I X 5

Test data report

A Check of 10 g/L VOC stock solution, reference analyses, unopened vial.

Compound	Concentration mg/L						
	Date	Dec. 1, 2008 A1	<i>Not taken</i> A2	<i>Not taken</i> A3	Jan. 8, 2009 A4	Jan. 8, 2009 A5	Jan. 8, 2009 A6
1,1-Dichloroethene		10,000			10,320	10,400	10,080
trans-1,2-Dichloroethene		11,200			10,900	10,800	10,600
cis-1,2-Dichloroethene		7,840			8,020	8,150	7,590
Trichloroethene		10,400			10,100	9,950	9,520
Tetrachloroethene		10,600			9,660	9,390	9,130
Benzene		8,740			9,550	9,530	9,090
Toluene		8,530			9,230	8,970	8,460
Ethylbenzene		13,100			14,300	13,800	12,800
o-Xylene		8,460			8,750	8,410	7,930
m/p-Xylene		9,270			10,800	10,500	9,970
MTBE		10,100			8,320	8,160	7,940

aA Check of 10 g/L VOC stock solution, reference analyses, used in test BA. Spare vials are not sent for analysis, but kept in the freezer.

Compound	Concentration mg/L			
	Date Jan. 15, 2009	Usage Date aA1	Spare Vial aA2	Spare Vial aA3
1,1-Dichloroethene		9,200		
trans-1,2-Dichloroethene		9,410		
cis-1,2-Dichloroethene		6,920		
Trichloroethene		8,960,		
Tetrachloroethene		8,840,		
Benzene		7,850		
Toluene		8,130		
Ethylbenzene		12,800		
o-Xylene		8,140		
m/p-Xylene		8,900		
MTBE		7,250		

bA Check of 10 g/L VOC stock solution, reference analyses, used in test DA. Spare vials are not sent for analysis, but kept in the freezer.

Compound	Concentration mg/L		
	Usage Date bA1	Spare Vial bA2	Spare Vial bA3
Date Jan. 23, 2009			
1,1-Dichloroethene	9,760		
trans-1,2-Dichloroethene	9,920		
cis-1,2-Dichloroethene	7,700		
Trichloroethene	10,200		
Tetrachloroethene	9,880		
Benzene	8,850		
Toluene	9,430		
Ethylbenzene	15,000		
o-Xylene	9,570		
m/p-Xylene	10,900		
MTBE	8,490		

cA Check of 10 g/L VOC stock solution, reference analyses, used in test EA. Spare vials are not sent for analysis, but kept in the freezer.

Compound	Concentration mg/L		
	Usage Date cA1	Spare Vial cA2	Spare Vial cA3
Date Jan. 30, 2009			
1,1-Dichloroethene	10,300		
trans-1,2-Dichloroethene	10,400		
cis-1,2-Dichloroethene	8,180		
Trichloroethene	10,200		
Tetrachloroethene	10,481		
Benzene	9,210		
Toluene	9,800		
Ethylbenzene	15,400		
o-Xylene	9,810		
m/p-Xylene	10,500		
MTBE	8460		

dA Check of 10 g/L VOC stock solution, reference analyses, used in test FA. Spare vials are not sent for analysis, but kept in the freezer.

Compound	Concentration mg/L		
	Usage Date dA1	Spare Vial dA2	Spare Vial dA3
Date Feb. 6, 2009			
1,1-Dichloroethene	10,000		
trans-1,2-Dichloroethene	10,600		
cis-1,2-Dichloroethene	8,130		
Trichloroethene	10,000		
Tetrachloroethene	9,450		
Benzene	9,210		
Toluene	9,710		
Ethylbenzene	15,100		
o-Xylene	9,741		
m/p-Xylene	10,600		
MTBE	8,560		

eA Check of 10 g/L VOC stock solution, reference analyses, used in test GA. Spare vials are not sent for analysis, but kept in the freezer.

Compound	Concentration mg/L		
	Usage Date eA1	Spare Vial eA2	Spare Vial eA3
Date Feb. 10, 2009			
1,1-Dichloroethene	10,900		
trans-1,2-Dichloroethene	11,300		
cis-1,2-Dichloroethene	8,040		
Trichloroethene	10,200		
Tetrachloroethene	10,500		
Benzene	9,660		
Toluene	9,690		
Ethylbenzene	15,100		
o-Xylene	9,600		
m/p-Xylene	10,400		
MTBE	9,360		

fA Check of 10 g/L VOC stock solution, reference analyses, used in test HA for 20% of range. Spare vials are not sent for analysis, but kept in the freezer.

Compound	Concentration mg/L		
	Usage Date fA1	Spare Vial fA2	Spare Vial fA3
Date Mar. 16, 2009			
1,1-Dichloroethene	9,680		
trans-1,2-Dichloroethene	9,210		
cis-1,2-Dichloroethene	6,960		
Trichloroethene	9,040	not	not
Tetrachloroethene	9,150	enough	enough
Benzene	7,910	stock	stock
Toluene	8,310	left	left
Ethylbenzene	12,700		
o-Xylene	8,360		
m/p-Xylene	8,860		
MTBE	7,440		

gA Check of 10 g/L VOC stock solution, reference analyses, used in test HA for 50% of range. Spare vials are not sent for analysis, but kept in the freezer.

Compound	Concentration mg/L		
	Usage Date gA1	Spare Vial gA2	Spare Vial gA3
Date: Mar. 18, 2009			
1,1-Dichloroethene			
trans-1,2-Dichloroethene			
cis-1,2-Dichloroethene			
Trichloroethene	not	not	not
Tetrachloroethene	sent	enough	enough
Benzene	to	stock	stock
Toluene	analysis	left	left
Ethylbenzene			
o-Xylene			
m/p-Xylene			
MTBE			

hA Check of 10 g/L VOC stock solution, reference analyses, used in test HA for 80% of range. Spare vials are not sent for analysis, but kept in the freezer.

Compound	Concentration mg/L		
	Usage Date hA1	Spare Vial hA2	Spare Vial hA3
Date Mar. 20, 2009			
1,1-Dichloroethene			
trans-1,2-Dichloroethene			
cis-1,2-Dichloroethene			
Trichloroethene	not	not	not
Tetrachloroethene	sent	enough	enough
Benzene	to	stock	stock
Toluene	analysis	left	left
Ethylbenzene			
o-Xylene			
m/p-Xylene			
MTBE			

iA Check of 10 g/L VOC stock solution, reference analyses, used in test N. Spare vials are not sent for analysis, but kept in the freezer.

Compound	Concentration mg/L		
	Usage Date iA1	Spare Vial iA2	Spare Vial iA3
Date Feb. 17, 2009			
1,1-Dichloroethene	11,000		
trans-1,2-Dichloroethene	11,400		
cis-1,2-Dichloroethene	8,150		
Trichloroethene	10,300		
Tetrachloroethene	10,800		
Benzene	9,432		
Toluene	9,657		
Ethylbenzene	15,200		
o-Xylene	9,760		
m/p-Xylene	10,500		
MTBE	9,379		

jA Check of 10 g/L VOC stock solution, reference analyses, used in test P, first attempt. Spare vials are not sent for analysis, but kept in the freezer.

Compound	Concentration mg/L		
	Usage Date Date jA1	Spare Vial Vial jA2	Spare Vial Vial jA3
Date Feb. 24, 2009			
1,1-Dichloroethene	7,340		
trans-1,2-Dichloroethene	8,220		
cis-1,2-Dichloroethene	7,630		
Trichloroethene	8,480		
Tetrachloroethene	8,380		
Benzene	7,650		
Toluene	8,690		
Ethylbenzene	13,500		
o-Xylene	8,450		
m/p-Xylene	9,720		
MTBE	7,950		

jA_{new} Check of 10 g/L VOC stock solution, reference analyses, used in test P. Spare vials are not sent for analysis, but kept in the freezer.

Compound	Concentration mg/L		
	Usage Date Date jA1 _{new}	Spare Vial Vial jA2 _{new}	Spare Vial Vial jA3 _{new}
Date Mar. 10, 2009			
1,1-Dichloroethene	10,000		
trans-1,2-Dichloroethene	10,300		
cis-1,2-Dichloroethene	7,360		
Trichloroethene	9,930		
Tetrachloroethene	11,400		
Benzene	9,360		
Toluene	8,870		
Ethylbenzene	12,300		
o-Xylene	8,560		
m/p-Xylene	10,800		
MTBE	8,440		

kA Check of 10 g/L VOC stock solution, reference analyses, used in test R. Spare vials are not sent for analysis, but kept in the freezer.

Compound	Concentration mg/L		
	Usage Date kA1	Spare Vial kA2	Spare Vial kA3
Date Mar. 26, 2009			
1,1-Dichloroethene	10,800		
trans-1,2-Dichloroethene	10,700		
cis-1,2-Dichloroethene	7,220		
Trichloroethene	9,610		not
Tetrachloroethene	10,700		enough
Benzene	9,780		stock
Toluene	8,900		left
Ethylbenzene	13,700		
o-Xylene	8,510		
m/p-Xylene	9,370		
MTBE	8,470		

IA Check of 10 g/L VOC stock solution, reference analyses, used in test T. Spare vials are not sent for analysis, but kept in the freezer.

Compound	Concentration mg/L		
	Usage Date IA1	Spare Vial IA2	Spare Vial IA3
Date: not taken			
1,1-Dichloroethene			
trans-1,2-Dichloroethene			
cis-1,2-Dichloroethene			
Trichloroethene	not	not	not
Tetrachloroethene	enough	enough	enough
Benzene	stock	stock	stock
Toluene	left	left	left
Ethylbenzene			
o-Xylene			
m/p-Xylene			
MTBE			

mA Check of 10 g/L VOC stock solution, reference analyses, used in test V. Spare vials are not sent for analysis, but kept in the freezer.

Compound	Concentration mg/L		
	Usage Date mA1	Spare Vial mA2	Spare Vial mA3
Date Apr. 20, 2009. un-opened stock vial sent for analysis, since not enough used stock left			
1,1-Dichloroethene	11,400		
trans-1,2-Dichloroethene	10,200		
cis-1,2-Dichloroethene	7,730		
Trichloroethene	10,000	not	not
Tetrachloroethene	9,720	enough	enough
Benzene	8,910	stock	stock
Toluene	9,240	left	left
Ethylbenzene	13,300		
o-Xylene	9,440		
m/p-Xylene	11,300		
MTBE	9,500		

nA Check of 10 g/L VOC stock solution, reference analyses, used in test CA. Spare vials are not sent for analysis, but kept in the freezer.

Compound	Concentration mg/L		
	Usage Date nA1	Spare Vial nA2	Spare Vial nA3
Date: not taken, see deviation nr. 27			
1,1-Dichloroethene			
trans-1,2-Dichloroethene			
cis-1,2-Dichloroethene			
Trichloroethene			
Tetrachloroethene			
Benzene			
Toluene			
Ethylbenzene			
o-Xylene			
m/p-Xylene			
MTBE			

B Check of 0.1 g/L VOC solution, reference analyses, used in lab dispenser pre-testing.

Compound	Concentration mg/L		
	Preparation Date	Not taken	Not taken
	B1	B2	B3
Date Nov. 18, 2008			
1,1-Dichloroethene	93.6		
trans-1,2-Dichloroethene	107		
cis-1,2-Dichloroethene	75.3		
Trichloroethene	100		
Tetrachloroethene	102		
Benzene	83.7		
Toluene	83.3		
Ethylbenzene	128		
o-Xylene	82.7		
m/p-Xylene	90		
MTBE	98.4		

aB Check of 0.1 g/L VOC solution, reference analyses, used in test J.

Compound	Concentration mg/L		
	Preparation Date	Preparation Date	Preparation Date
	aB1	aB2	aB3
Date Feb. 10, 2009			
1,1-Dichloroethene	102	96.0	97.6
trans-1,2-Dichloroethene	99.7	97.9	99.9
cis-1,2-Dichloroethene	86.1	83.4	85.7
Trichloroethene	96.2	93	94.5
Tetrachloroethene	95.9	93.1	95.1
Benzene	91.1	90.7	91.4
Toluene	86.2	83.9	86.6
Ethylbenzene	141	138	137
o-Xylene	89.4	87.5	88
m/p-Xylene	95.8	95.7	96.3
MTBE	88.3	88	88

C Check of VOX standard dilution, reference analyses.

Compound	Concentration mg/L		
	Preparation Date	Preparation Date	Preparation Date
	C1	C2	C3
Date Nov. 18, 2008			
Chloroethene	17.8	32.8	31.2
1,1-Dichloroethene	21.3	26.2	24.1
trans-1,2-Dichloroethene	26.6	28.9	27.2
cis-1,2-Dichloroethene	25.9	27.1	25.5
Trichloroethene	26.2	26.4	24.9
Tetrachloroethene	26.4	26.0	25.2

aD Check of MiliQ water from tap.

Compound	Concentration µg/L		
	Sample 1 aD1	Sample 2 aD2	Sample 3 aD3
Date Nov. 12, 2008			
Chloroethene	<0.0200	<0.0200	<0.0200
1,1-Dichloroethene	<0.0200	<0.0200	<0.0200
trans-1,2-Dichloroethene	<0.0200	<0.0200	<0.0200
cis-1,2-Dichloroethene	<0.0200	<0.0200	<0.0200
Trichloroethene	<0.0200	<0.0200	<0.0200
Tetrachloroethene	<0.0200	<0.0200	<0.0200
Benzene	<0.0200	<0.0200	<0.0200
Toluene	<0.0200	<0.0200	<0.0200
Ethylbenzene	<0.0200	<0.0200	<0.0200
o-Xylene	<0.0200	<0.0200	<0.0200
m/p-Xylene	<0.0200	<0.0200	<0.0200
MTBE	<0.100	<0.100	<0.100

bD Check of water from lab dispenser sample tap after 30 minutes.

Compound	Concentration µg/L		
	Sample 1 bD1	Sample 2 bD2	Sample 3 bD3
Date Nov. 12, 2008			
Chloroethene	<0.0200	<0.0200	<0.0200
1,1-Dichloroethene	<0.0200	<0.0200	<0.0200
trans-1,2-Dichloroethene	<0.0200	<0.0200	<0.0200
cis-1,2-Dichloroethene	<0.0200	<0.0200	<0.0200
Trichloroethene	<0.0200	<0.0200	<0.0200
Tetrachloroethene	<0.0200	<0.0200	<0.0200
Benzene	<0.0200	<0.0200	<0.0200
Toluene	<0.0200	<0.0200	<0.0200
Ethylbenzene	<0.0200	<0.0200	<0.0200
o-Xylene	<0.0200	<0.0200	<0.0200
m/p-Xylene	<0.0200	<0.0200	<0.0200
MTBE	<0.100	<0.100	<0.100

D Check of water from lab dispenser sample tap after 6 days

Compound	Concentration µg/L		
	Sample 1 D1	Sample 2 D2	Sample 3 D3
Date Nov. 18, 2008			
Chloroethene	<0.0200	<0.0200	<0.0200
1,1-Dichloroethene	<0.0200	<0.0200	<0.0200
trans-1,2-Dichloroethene	<0.0200	<0.0200	<0.0200
cis-1,2-Dichloroethene	<0.0200	<0.0200	<0.0200
Trichloroethene	<0.0200	<0.0200	<0.0200
Tetrachloroethene	<0.0200	<0.0200	<0.0200
Benzene	<0.0200	<0.0200	<0.0200
Toluene	<0.0200	<0.0200	<0.0200
Ethylbenzene	<0.0200	<0.0200	<0.0200
o-Xylene	<0.0200	<0.0200	<0.0200
m/p-Xylene	<0.0200	<0.0200	<0.0200
MTBE	<0.100	<0.100	<0.100

E VOC stability check of sample dispenser, reference samples after 30 minutes, see deviation no. 1.

Compound	Concentration µg/L								
	E1	E2	E3	E4	E5	E6	E7	E8	E9
Date Dec. 1, 2008									
1,1-Dichloroethene	12.4	12.6	12.5	11.4	11.6	12.1	12.5	12.6	12.7
trans-1,2-Dichloroethene	12.9	13.5	13	12.4	12.2	12.8	13.2	13.2	13.5
cis-1,2-Dichloroethene	13.2	13.3	12.9	13.2	12.8	13.2	13.8	13.9	13.8
Trichloroethene	17.3	17.8	17.3	17.5	17.1	17.7	18.3	18.2	18.2
Tetrachloroethene	12.9	13.2	12.9	13	12.8	13.2	13.8	13.6	13.6
Benzene	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Toluene	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ethylbenzene	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
o-Xylene	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
m/p-Xylene	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
MTBE	11.8	11.8	11.6	11.2	11.1	11.4	11.8	11.9	12.1

aE VOC stability check of sample dispenser, reference samples after 6 days.

Compound	Concentration µg/L		
	Sample 1 aE1	Sample 2 aE2	Sample 3 aE3
Date Dec. 7, 2008			
1,1-Dichloroethene	10.3	10.4	10.6
trans-1,2-Dichloroethene	11.4	11.7	12
cis-1,2-Dichloroethene	7.99	9.85	8.5
Trichloroethene	10.2	10.6	10.7
Tetrachloroethene	10.2	9.13	9.09
Benzene	8.38	8.69	8.98
Toluene	9.8	10.3	10.3
Ethylbenzene	14.4	14.2	14.4
o-Xylene	10.9	10.9	10.8
m/p-Xylene	9.22	9.1	9
MTBE	9.27	9.61	9.83

H LoD test direct application, samples. Raw data including values below detection limit and negative values. Note unit: µg.

Compound	Mass on sampler µg						
	ID 1008-237 H1	ID 1008-238 H2	ID 1008-239 H3	ID 1008-240 H4	ID 1008-41 H5	ID 1008-242 H6	ID 1008-243 H7
Date of spiking: Nov. 18, 2009							
Temperature: room temperature							
Chloroethene	0	0.025	0	0	0	0	0.05
1,1-Dichloroethene	0.725	0.625	1.68	0.525	0.700	0.575	0.725
trans-1,2-Dichloroethene	0.725	1.00	1.68	0.725	0.550	0.675	0.825
cis-1,2-Dichloroethene	2.05	1.55	1.48	1.38	1.33	1.28	1.35
Trichloroethene	1.88	1.53	1.48	1.40	1.38	1.35	1.38
Tetrachloroethene	2.15	1.48	1.48	1.20	1.25	1.18	1.28
Date of rinsing: Nov. 20, 2009							
mL passed for rinsing (measured)	<10	300	300	300	300	300	300
mL passed for rinsing (by tracer salt)	5	272	276	277	268	272	260

J LoD test standpipe, samples. Raw data including values below detection limit and negative values.

Compound	Concentration µg/L							Dates	Temperatures
	ID 1008-0209 J1	ID 1008-0210 J2	ID -0211 J3	ID -0212 J4	ID -0213 J5	ID -0214 J6	ID -0215 J7		
1,1-Dichloroethene	-0.22	-0.09	0.00	0.00	0.00		0.00	Set up	Set up
trans-1,2-Dichloroethene	2.88	2.33	1.24	3.73	3.60		3.83	Feb. 10, 2009	13.6°C
cis-1,2-Dichloroethene	3.10	1.96	0.62	1.37	1.46		0.92	Sampled	Sampled
Trichloroethene	16.61	3.83	0.93	-20.39	-22.05		-29.83	Feb. 16, 2009	21.6°C
Tetrachloroethene	1.99	1.59	1.24	2.74	2.48		2.64	Pressure head	External
Benzene	2.35	1.55	1.12	2.56	2.54		2.45	at set-up	pressure
Toluene	4.43	2.71	3.42	2.49	2.25		1.98	50 cm	0 bar
Ethylbenzene	2.66	2.33	1.24	4.23	3.94		3.56	-	-
o-Xylene	1.55	1.68	0.62	3.36	2.70		2.90	Conductivity	-
m/p-Xylene	2.22	1.87	0.93	3.23	2.25		2.64	at set-up	-
MTBE	5.98	2.80	2.18	4.10	4.28		4.62	69.8 mS/m	-
<i>mL sampled (measured)</i>	105	276	n.a	206	209	no flow	388	-	-
<i>mL sampled (by tracer salt)</i>	113	268	80	201	222	5	189	-	-

K LoD standpipe, reference samples.

Compound	Concentration µg/L						
	Sample 1 Feb. 10, 2009 K1	Sample 2 Feb. 10 K2	Sample 3 Feb. 13 K3	Sample 4 Feb. 13 K4	Sample 5 Feb. 13 K5	Sample 6 Feb. 16 K6	Sample 7 Feb. 16 K7
1,1-Dichloroethene	4.02	3.60	2.76	2.86	2.81	2.71	2.70
trans-1,2-Dichloroethene	3.59	3.61	2.87	2.94	2.96	2.83	2.81
cis-1,2-Dichloroethene	2.70	2.69	2.20	2.26	2.24	2.19	2.16
Trichloroethene	3.42	3.53	2.42	2.45	2.47	2.25	2.26
Tetrachloroethene	3.31	3.42	1.50	1.55	1.55	1.14	1.17
Benzene	3.35	3.42	2.63	2.66	2.68	2.49	2.48
Toluene	3.17	3.27	2.27	2.32	2.32	2.09	2.07
Ethylbenzene	5.04	5.17	2.65	2.69	2.72	2.06	2.00
o-Xylene	3.34	3.43	1.87	1.90	1.91	1.58	1.56
m/p-Xylene	3.83	3.99	1.78	1.82	1.82	1.38	1.40
MTBE	2.97	3.00	2.59	2.60	2.62	2.58	2.55

L Precision direct application, 10% of range, samples. Note unit: 100 µg represents 200 µg/L in 500 mL.

Compound	Mass on sampler µg						
	ID 1008-230 L1	ID 1008-231 L2	ID 1008-232 L3	ID 1008-233 L4	ID 1008-234 L5	ID 1008-235 L6	ID 1008-236 L7
Date of spiking Nov. 18, 2009							
Temperature: room temp.							
Chloroethene	69.8	68.3	71.1	63.9	66.8	65.1	52.4
1,1-Dichloroethene	71.8	72.6	71.2	73.1	75.6	70.0	66.3
trans-1,2-Dichloroethene	71.8	72.6	71.2	73.0	75.6	70.0	66.3
cis-1,2-Dichloroethene	100	102	105	103	103	102	103
Trichloroethene	90.8	94.3	101	100	99.8	98.6	97.9
Tetrachloroethene	84.0	89.1	94.2	94.2	95.7	93.1	91.0
Date of rinsing: Nov. 20-21							
mL passed for rinsing (measured)	300	300	300	300	300	300	300
mL passed for rinsing (by tracer salt)	288	279	261	242	259	267	271

N Precision standpipe 10% of range, samples.

Compound	Concentration µg/L			Dates	Temperatures
	ID 1008-0216 N1	ID 1008-0217 N2	ID 1008-0218 N3		
1,1-Dichloroethene	158	148	179	Set up	Set up
trans-1,2-Dichloroethene	186	185	227	Feb. 17, 2009	20.7°C
cis-1,2-Dichloroethene	152	156	185	Sampled	Sampled
Trichloroethene	146	142	171	Feb. 23, 2009	21.6°C
Tetrachloroethene	129	122	152	Pressure head	External
Benzene	154	157	191	at set-up	pressure
Toluene	148	150	183	50 cm	0 bar
Ethylbenzene	186	165	224	-	-
o-Xylene	139	145	174	Conductivity	-
m/p-Xylene	148	148	181	at set-up	-
MTBE	178	192	227	71.0 mS/m	-
<i>mL sampled (measured)</i>	588	140	351	-	-
<i>mL sampled (by tracer salt)</i>	87	168	318	-	-

O Precision standpipe 10%, reference samples.

Compound	Concentration µg/L		
	Sample 1	Sample 2	Sample 3
	Date: Feb. 17, 2009 O1	Date: Feb. 20, 2009 O2	Date: Feb. 23, 2009 O3
1,1-Dichloroethene	289	174	161
trans-1,2-Dichloroethene	295	160	165
cis-1,2-Dichloroethene	210	151	170
Trichloroethene	265	160	175
Tetrachloroethene	210	116	101
Benzene	251	156	158
Toluene	233	161	147
Ethylbenzene	322	200	141
o-Xylene	214	141	133
m/p-Xylene	221	143	121
MTBE	244	165	172

P Precision standpipe 25%, samples.

Compound	Concentration µg/L			Dates	Temperatures
	ID 1008-0866 P1	ID 1008-0867 P2	ID 1008-0868 P3		
1,1-Dichloroethene	517	461	464	Set up	Set up
trans-1,2-Dichloroethene	524	461	466	Mar. 10, 2009	14.0°C
cis-1,2-Dichloroethene	600	520	532	Sampled	Sampled
Trichloroethene	627	556	559	Mar.16, 2009	Not recorded
Tetrachloroethene	505	465	477	Pressure head	External
Benzene	691	610	620	at set-up	pressure
Toluene	610	551	554	50 cm	0 bar
Ethylbenzene	764	716	737	-	-
o-Xylene	592	537	544	Conductivity	-
m/p-Xylene	597	541	554	at set-up	-
MTBE	709	619	636	68.4 mS/m	-
<i>mL sampled (measured)</i>	336	245	217	-	-
<i>mL sampled (by tracer salt)</i>	240	212	191	-	-

Q Precision standpipe 25%, reference samples.

Compound	Concentration µg/L		
	Sample 1 Date: Mar. 10, 2009 Q1 _{new}	Sample 2 Date: Mar. 13, 2009 Q2	Sample 3 Date: Mar. 16, 2009 Q3
1,1-Dichloroethene	621	507	466
trans-1,2-Dichloroethene	607	492	612
cis-1,2-Dichloroethene	480	401	448
Trichloroethene	580	467	501
Tetrachloroethene	383	315	350
Benzene	529	448	475
Toluene	508	436	438
Ethylbenzene	582	336	255
o-Xylene	433	400	407
m/p-Xylene	522	453	441
MTBE	568	468	526

R Precision standpipe 50%, samples.

Compound	Concentration µg/L			Dates	Temperatures
	ID 1008-0872 R1	ID 1008-0873 R2	ID 1008-0874 R3		
1,1-Dichloroethene	722	723	877	Set up	Set up
trans-1,2-Dichloroethene	715	716	865	Mar. 25, 2009	13.1°C
cis-1,2-Dichloroethene	776	792	904	Sampled	Sampled
Trichloroethene	767	772	894	Apr. 1, 2009	21.0°C
Tetrachloroethene	677	635	742	Pressure head	External
Benzene	918	973	1,061	at set-up	pressure
Toluene	784	770	948	50 cm	0 bar
Ethylbenzene	1,142	1,120	1,268	-	-
o-Xylene	784	763	882	Conductivity	-
m/p-Xylene	784	753	885	at set-up	-
MTBE	952	1,013	1,113	70.4 mS/m	-
<i>mL sampled (measured)</i>	324	372	406	-	-
<i>mL sampled (by tracer salt)</i>	291	303	349	-	-

S Precision standpipe 50%, reference samples.

Compound	Concentration µg/L		
	Sample 1 Date: Mar. 26, 2009 S1	Sample 2 Date: Mar 29, 2009 S2	Sample 3 Date: Apr. 1, 2009 S3
1,1-Dichloroethene	912	904	1,128
trans-1,2-Dichloroethene	1,080	1,000	1,070
cis-1,2-Dichloroethene	800	745	782
Trichloroethene	904	871	898
Tetrachloroethene	649	650	686
Benzene	841	818	1,010
Toluene	848	871	829
Ethylbenzene	1,070	1,130	1,020
o-Xylene	718	794	716
m/p-Xylene	756	800	673
MTBE	903	851	928

T Precision standpipe 75%, samples.

Compound	Concentration µg/L			Dates	Temperatures
	ID 1008-0875 T1	ID 1008-0876 T2	ID 1008-0877 T3		
1,1-Dichloroethene	1,445	1,629	1,788	Set up	Set up
trans-1,2-Dichloroethene	1,439	1,607	1,779	Apr 1, 2009	12.2°C
cis-1,2-Dichloroethene	1,640	1,738	1,895	Sampled	Sampled
Trichloroethene	1,749	1,886	1,998	Apr. 7, 2009	20.1°C
Tetrachloroethene	1,408	1,541	1,611	Pressure head	External
Benzene	1,901	2,032	2,239	at set-up	pressure
Toluene	1,767	1,886	1,949	50 cm	0 bar
Ethylbenzene	2,348	2,524	2,599	-	-
o-Xylene	1,624	1,722	1,821	Conductivity	-
m/p-Xylene	1,660	1,779	1,867	at set-up	-
MTBE	1,938	2,035	2,227	70.9 mS/m	-
<i>mL sampled (measured)</i>	312	231	172	-	-
<i>mL sampled (by tracer salt)</i>	222	177	109	-	-

U Precision standpipe 75%, reference samples.

Compound	Concentration µg/L		
	Sample 1 Date: April 1, 2009 U1	Sample 2 Date: April 4, 2009 U2	Sample 3 Date: April 7, 2009 U3
1,1-Dichloroethene	1,830	1,400	1,690
trans-1,2-Dichloroethene	1,750	1,510	1,660
cis-1,2-Dichloroethene	1,230	1,410	1,260
Trichloroethene	1,470	1,440	1,510
Tetrachloroethene	965	919	1,060
Benzene	1,640	1,400	1,590
Toluene	1,270	1,300	1,420
Ethylbenzene	1,340	1,730	1,810
o-Xylene	871	1,230	1,230
m/p-Xylene	880	1,380	1,180
MTBE	1,470	1,400	1,620

V Precision standpipe 100%, samples.

Compound	Concentration µg/L			Dates	Temperatures
	ID 0209-0091 V1	ID 0209-0092 V2	ID 0209-0093 V3		
1,1-Dichloroethene	3,267	2,913	2,653	Set up	Set up
trans-1,2-Dichloroethene	3,263	2,877	2,664	Apr 17, 2009	15.2°C
cis-1,2-Dichloroethene	3,195	2,879	2,563	Sampled	Sampled
Trichloroethene	2,568	2,511	2,150	Apr. 23, 2009	not recorded
Tetrachloroethene	2,330	2,391	2,106	Pressure head	External
Benzene	3,777	3,585	3,116	at set-up	pressure
Toluene	3,250	3,144	2,725	50 cm	0 bar
Ethylbenzene	3,829	3,838	3,376	-	-
o-Xylene	2,848	2,889	2,453	Conductivity	-
m/p-Xylene	2,809	2,859	2,485	at set-up	-
MTBE	4,688	4,288	3,769	70.9 mS/m	-
<i>mL sampled (measured)</i>	246	281	252	-	-
<i>mL sampled (by tracer salt)</i>	129	169	158	-	-

X Precision standpipe 100%, reference samples.

Compound	Concentration µg/L		
	Sample 1 Date: April 17, 2009 X1	Sample 2 Date: April 20, 2009 X2	Sample 3 Date: April 23, 2009 X3
1,1-Dichloroethene	2,000	2,020	1,630
trans-1,2-Dichloroethene	2,050	2,070	1,610
cis-1,2-Dichloroethene	1,720	1,620	1,250
Trichloroethene	1,680	1,980	1,450
Tetrachloroethene	998	1,510	968
Benzene	1,740	1,810	1,390
Toluene	1,430	1,800	1,300
Ethylbenzene	1,580	2,040	1,270
o-Xylene	1,120	1,810	1,150
m/p-Xylene	1,220	1,650	1,070
MTBE	2,030	1,920	1,110

AA Precision field, samples, and groundwater chemistry.

Well number C8		Concentration µg/L						
Samples Compound	Start	ID 1008-0830 AA1	ID 1008-0835 AA2	ID 1008-0833 AA3				
Chloroethene		<1.9	<1.8	<2.9				
1,1-Dichloroethene		<1.9	<1.9	<2.9				
trans-1,2-Dichloroethene		<1.9	<1.10	<2.9				
cis-1,2-Dichloroethene		<1.9	<1.11	<2.9				
Trichloroethene		<1.9	<1.12	<2.9				
Tetrachloroethene		<1.9	<1.13	<2.9				
Benzene		1,115	748	1,638				
Toluene		3.4	9.55	6.06				
Ethylbenzene		169	110	132				
o-Xylene		5.7	10.9	7.48				
m/p-Xylene		6.5	5.33	4.99				
MTBE		1.9	<1.8	<2.9	AA General chemistry			
L passed (measured)		0.14	0.10	0.10	Parameter	Value	Parameter	Value
L passed (tracer salt)		0.104	0.113	0.070	pH	7.0±0.02	DOC	2.7 mg C/L
Date set up	12-Feb				Conductivity	200±14 mS/m	Iron	6.4 mg/L
Date sampled		18-Feb	24-Feb	2-Mar	Oxygen	0.33±0.32 mg/L	Ammonium	0.79 mg/L
Depth water table set up, mbs	9.05				Nitrate	<0.50 mg/L	Sodium	110 mg/L
Depth water table sampling, mbs		9.06	9.09	9.06	Fluoride	0.28 mg/L	Potassium	4.4 mg/L
Depth top sampler, mbs	13				Chloride	410 mg/L	Calcium	250 mg/L
Depth bottom well, mbs	14.67				Bicarbonate	430 mg/L	Magnesium	26 mg/L
Quality of water in reservoir		Clear	Clear	Clear	Sulphate	120 mg/L		

AA Precision field, reference samples.

Well number C8 Compound	Concentration µg/L			
	Sample 1 Date 12-Feb AA4	Sample 2 Date 18-Feb AA5	Sample 3 Date 24-Feb AA6	Sample 4 Date 2-Mar AA7
Chloroethene	0.903	1.17	0.87	1.34
1,1-Dichloroethene	<0.40	<0.20	<0.02	<0.02
trans-1,2-Dichloroethene	<0.40	<0.20	0.11	<0.02
cis-1,2-Dichloroethene	<0.40	0.398	0.0967	<0.02
Trichloroethene	<0.40	<0.20	0.186	<0.02
Tetrachloroethene	<0.40	<0.20	0.59	<0.02
Benzene	1,040	642	-	951
Toluene	<0.40	<0.20	<0.02	0.502
Ethylbenzene	<0.40	<0.20	<0.02	<0.02
o-Xylene	1.04	0.851	<0.02	0.816
m/p-Xylene	<0.40	<0.20	<0.02	<0.02
MTBE	<2	1.18	1.78	1.26

AB Precision field, samples, and groundwater chemistry.

Well number C11		Concentration µg/L			The well was located near a remediation pump which operates between defined water levels and can therefore stop and start during the period of sampling. This results in variation in water level in the well			
Samples		ID 1008-0814	ID 1008-0813	ID 1008-0821				
Compound	Start	AB1	AB2	AB3				
Chloroethene		6.65	15.4	7.19				
1,1-Dichloroethene		< 0.83	<0.7	<0.68				
trans-1,2-Dichloroethene		1.77	2.29	1.10				
cis-1,2-Dichloroethene		29.08	67.7	68.7				
Trichloroethene		< 0.83	1.06	0.931				
Tetrachloroethene		< 0.83	<0.7	<0.68				
Benzene		3,341	4,996	2,734				
Toluene		1.77	4.74	2.54				
Ethylbenzene		3.63	3.84	1.52				
o-Xylene		< 0.83	0.74	<0.68				
m/p-Xylene		< 0.83	<0.7	<0.68				
MTBE		2.28	2.04	1.18	AB General chemistry			
L passed (measured)		0.28	0.40	0.35	Parameter	Value	Parameter	Value
L passed (tracer salt)		0.241	0.306	0.295	pH	6.8±0.04	DOC	3.8 mg C/L
Date set up	12-Feb				Conductivity	210±13 mS/m	Iron	2.0 mg/L
Date sampled		18-Feb	24-Feb	2-Mar	Oxygen	0.74±0.25 mg/L	Ammonium	0.62 mg/L
Depth water table set up, mbs	9.10				Nitrate	<0.50 mg/L	Sodium	160 mg/L
Depth water table sampling, mbs		9.02	8.86	8.61	Fluoride	0.31 mg/L	Potassium	5.2 mg/L
Depth top sampler, mbs	11				Chloride	290 mg/L	Calcium	220 mg/L
Depth bottom well, mbs	12.94				Bicarbonate	580 mg/L	Magnesium	22 mg/L
Quality of water in reservoir		Clear	Clear	Clear	Sulphate	200 mg/L		

Marked in brown: Concentration indicative due to interfering components

AB Precision field, reference samples.

Well number C11 Compound	Concentration µg/L			
	Sample 1 Date 12-Feb AB4	Sample 2 Date 18-Feb AB5	Sample 3 Date 24-Feb AB6	Sample 4 Date 2-Mar AB7
Chloroethene	17	19.5	29.6	29.9
1,1-Dichloroethene	<1	0.290	0.461	0.372
trans-1,2-Dichloroethene	<1	1.26	1.37	1.53
cis-1,2-Dichloroethene	39.8	27.4	81.7	88.7
Trichloroethene	<1	1.35	2.41	2.14
Tetrachloroethene	1.3	<0.20	0.0684	<0.4
Benzene	4,600	4,760	-	167
Toluene	3.63	2.15	2.5	2.58
Ethylbenzene	6.12	10.1	13.9	10.7
o-Xylene	<1	0.284	0.343	<0.4
m/p-Xylene	<1	1.48	2.16	0.749
MTBE	<5	1.95	1.76	<2

AC Precision field, samples, and groundwater chemistry.

Well number C14		Concentration µg/L						
Samples Compound	Start	ID 1008-0824 AC1	ID 1008-0816 AC2	ID 1008-0823 AC3				
Chloroethene		27.8	77.3	59.7				
1,1-Dichloroethene		< 1.2	<1.1	<1.30				
trans-1,2-Dichloroethene		10.3	4.96	2.60				
cis-1,2-Dichloroethene		186	32.9	23.2				
Trichloroethene		3.04	21.0	7.79				
Tetrachloroethene		12.2	16.7	2.60				
Benzene		1,288	5,586	4,443				
Toluene		12.3	18.1	12.3				
Ethylbenzene		77.2	91.5	81.1				
o-Xylene		33.2	25.5	14.1				
m/p-Xylene		54.0	18.1	11.4				
MTBE		1.16	17.3	15.1	AC General chemistry			
L passed (measured)		0.15	0.19	0.15	Parameter	Value	Parameter	Value
L passed (tracer salt)		0.173	0.176	0.154	pH	7.0±0.02	DOC	2.4 mg C/L
Date set up	12-Feb				Conductivity	190±4 mS/m	Iron	7.1 mg/L
Date sampled		18-Feb	24-Feb	2-Mar	Oxygen	0.18±0.02 mg/L	Ammonium	0.89 mg/L
Depth water table set up, mbs	9.56				Nitrate	<0.50 mg/L	Sodium	91 mg/L
Depth water table sampling, mbs		9.58	9.60	9.59	Fluoride	0.30 mg/L	Potassium	4.5 mg/L
Depth top sampler, mbs	11.3				Chloride	320 mg/L	Calcium	230 mg/L
Depth bottom well, mbs	12.32				Bicarbonate	440 mg/L	Magnesium	28 mg/L
Quality of water in reservoir		Slightly cloudy Black sand on top	Clear Black sand on top	Clear Black sand on top	Sulphate	150 mg/L		

Marked in brown: Concentration indicative due to interfering components

AC Precision field, reference samples.

Well number C14 Compound	Concentration µg/L			
	Sample 1 Date 12-Feb AC4	Sample 2 Date 18-Feb AC5	Sample 3 Date 24-Feb AC6	Sample 4 Date 2-Mar AC7
Chloroethene	16.8	30.6	44.5	38.9
1,1-Dichloroethene	<0.40	<0.40	<0.4	<0.4
trans-1,2-Dichloroethene	1.61	1.71	2.15	1.68
cis-1,2-Dichloroethene	51.3	25.6	57.6	44.6
Trichloroethene	25.2	6.83	6.62	5.93
Tetrachloroethene	17.9	4.77	4.4	7.3
Benzene	1,020	2,280	1,440	882
Toluene	4.41	3.54	4.38	2.87
Ethylbenzene	20.1	26.8	34.6	28.2
o-Xylene	5.3	3.69	2.77	2.34
m/p-Xylene	4.17	5.93	5.75	4.51
MTBE	3.14	3.35	3.08	2.72

AD Precision field, samples, and groundwater chemistry.

Well number B17		Concentration µg/L						
Samples Compound	Start	ID 1008-0812 AD1	ID 1008-0819 AD2	ID 1008-0817 AD3				
Chloroethene		< 0.82	<0.9	<0.92				
1,1-Dichloroethene		< 0.82	<0.9	<0.92				
trans-1,2-Dichloroethene		< 0.82	<0.9	<0.92				
cis-1,2-Dichloroethene		< 0.82	<0.9	<0.92				
Trichloroethene		< 0.82	<0.9	<0.92				
Tetrachloroethene		< 0.82	<0.9	<0.92				
Benzene		4.24	1.34	<0.92				
Toluene		< 0.8	<0.9	<0.92				
Ethylbenzene		< 0.8	<0.9	<0.92				
o-Xylene		0.92	<0.9	<0.92				
m/p-Xylene		< 0.8	<0.9	<0.92				
MTBE		50.1	8.87	2.99	AD General chemistry			
L passed (measured)		0.26	0.25	0.19	Parameter	Value	Parameter	Value
L passed (tracer salt)		0.244	0.231	0.217	pH	7.1±0.02	DOC	9.0 mg C/L
Date set up	12-Feb				Conductivity	74±5 mS/m	Iron	1.1 mg/L
Date sampled		18-Feb	24-Feb	2-Mar	Oxygen	0.15±0.06 mg/L	Ammonium	0.086 mg/L
Depth water table set up, mbs	9.30				Nitrate	<0.50 mg/L	Sodium	21 mg/L
Depth water table sampling, mbs		9.29	9.31	9.23	Fluoride	0.25 mg/L	Potassium	1.8 mg/L
Depth top sampler, mbs	11.0				Chloride	68 mg/L	Calcium	130 mg/L
Depth bottom well, mbs	15.03				Bicarbonate	330 mg/L	Magnesium	8.8 mg/L
Quality of water in reservoir		Clear	Clear	Clear	Sulphate	58 mg/L		

AD Precision field, reference samples.

Well number B17 Compound	Concentration µg/L			
	Sample 1 Date 12-Feb AD4	Sample 2 Date 18-Feb AD5	Sample 3 Date 24-Feb AD6	Sample 4 Date 2-Mar AD7
Chloroethene	<0.02	<0.20	<0.02	<0.02
1,1-Dichloroethene	<0.02	<0.20	<0.02	<0.02
trans-1,2-Dichloroethene	<0.02	<0.20	<0.02	<0.02
cis-1,2-Dichloroethene	<0.02	<0.20	<0.02	0.021
Trichloroethene	<0.02	<0.20	<0.02	<0.02
Tetrachloroethene	<0.02	<0.20	<0.02	1.35
Benzene	<0.02	<0.02	<0.02	0.460
Toluene	<0.02	<0.02	<0.02	1.41
Ethylbenzene	<0.02	<0.02	<0.02	0.14
o-Xylene	<0.02	0.0248	<0.02	0.045
m/p-Xylene	<0.02	<0.02	<0.02	0.084
MTBE	111	9.79	2.86	3.55

AE Precision field, samples, and groundwater chemistry.

Well number B18		Concentration µg/L						
Samples Compound	Start	ID 1008-0811 AE1	ID 1008-0818 AE2	ID 1008-0815 AE3				
Chloroethene		< 0.79	<0.7	<0.72				
1,1-Dichloroethene		< 0.79	<0.7	<0.72				
trans-1,2-Dichloroethene		< 0.79	<0.7	<0.72				
cis-1,2-Dichloroethene		< 0.79	<0.7	<0.72				
Trichloroethene		< 0.79	<0.7	<0.72				
Tetrachloroethene		< 0.79	<0.7	<0.72				
Benzene		< 0.79	<0.7	<0.72				
Toluene		< 0.79	<0.7	<0.72				
Ethylbenzene		< 0.79	<0.7	<0.72				
o-Xylene		< 0.79	<0.7	<0.72				
m/p-Xylene		< 0.79	<0.7	<0.72				
MTBE		< 0.79	<0.7	<0.72	AE General chemistry			
L passed (measured)		0.29	0.31	0.34	Parameter	Value	Parameter	Value
L passed (tracer salt)		0.254	0.286	0.279	pH	7.3±0.02	DOC	2.7 mg C/L
Date set up	12-Feb				Conductivity	73±0.5 mS/m	Iron	1.8 mg/L
Date sampled		18-Feb	24-Feb	2-Mar	Oxygen	0.09±0.01 mg/L	Ammonium	0.83 mg/L
Depth water table set up, mbs	9.18				Nitrate	<0.50 mg/L	Sodium	17 mg/L
Depth water table sampling, mbs		9.19	9.21	9.13	Fluoride	0.31 mg/L	Potassium	1.6 mg/L
Depth top sampler, mbs	12				Chloride	37 mg/L	Calcium	120 mg/L
Depth bottom well, mbs	15.10				Bicarbonate	300 mg/L	Magnesium	7.2 mg/L
Quality of water in reservoir		Clear	Clear	Clear	Sulphate	91 mg/L		

AE Precision field, reference samples.

Well number B18 Compound	Concentration µg/L			
	Sample 1 Date 12-Feb AE4	Sample 2 Date 18-Feb AE5	Sample 3 Date 24-Feb AE6	Sample 4 Date 2-Mar AE7
Chloroethene	<0.02	<0.20	<0.02	<0.02
1,1-Dichloroethene	<0.02	<0.20	<0.02	<0.02
trans-1,2-Dichloroethene	<0.02	<0.20	<0.02	<0.02
cis-1,2-Dichloroethene	<0.02	<0.20	<0.02	<0.02
Trichloroethene	<0.02	<0.20	<0.02	<0.02
Tetrachloroethene	<0.02	<0.20	<0.02	<0.02
Benzene	<0.02	<0.02	<0.02	<0.02
Toluene	<0.02	<0.02	<0.02	<0.02
Ethylbenzene	<0.02	<0.02	<0.02	<0.02
o-Xylene	<0.02	<0.02	<0.02	<0.02
m/p-Xylene	<0.02	<0.02	<0.02	<0.02
MTBE	<0.1	<0.1	<0.1	<0.1

AF Field blind.

Compound	Farum blind 1	Farum blind 2	Søborg blind 1	Søborg blind 2
	µg/L	µg/L	µg/L	µg/L
Chloroethene	<0.02	-	<0.02	-
1,1-Dichloroethene	<0.02	-	<0.02	-
trans-1,2-Dichloroethene	<0.02	-	<0.02	-
cis-1,2-Dichloroethene	<0.02	-	<0.02	-
Trichloroethene	<0.02	-	<0.02	-
Tetrachloroethene	<0.02	-	<0.02	-
Benzene	<0.02	-	<0.02	-
Toluene	<0.02	-	0.0435	-
Ethylbenzene	<0.02	-	<0.02	-
o-Xylene	<0.02	-	<0.02	-
m/p-Xylene	<0.02	-	<0.02	-
MTBE	<0.1	-	<0.1	-

Farum blind 2 and Søborg blind 2 have not been analyzed since there was not detected any content in Farum and Søborg blind 1.

BA Reference robustness lab dispenser, samples.

Compound	Concentration µg/L			Dates	Temperatures
	ID 1008-0194 BA1	ID 1008-0195 BA2	ID 1008-0196 BA3		
1,1-Dichloroethene	714	755	840	Set up	Set up
trans-1,2-Dichloroethene	631	697	812	Jan. 16, 2009	20.8°C
cis-1,2-Dichloroethene	634	690	748	Sampled	Sampled
Trichloroethene	631	681	744	Jan. 22, 2009	22.3°C
Tetrachloroethene	663	697	734	Pressure head	External
Benzene	733	768	796	at set-up	pressure
Toluene	711	737	737	55 cm	0 bar
Ethylbenzene	1,030	1,056	1,044	-	-
o-Xylene	770	812	810	Conductivity	-
m/p-Xylene	775	814	818	at set-up	-
MTBE	889	941	971	34.2 mS/m	-
<i>mL sampled (measured)</i>	242	346	437	-	-
<i>mL sampled (by tracer salt)</i>	243	308	393	-	-

BB Reference robustness lab dispenser, reference samples.

Compound	Concentration µg/L		
	Sample 1 Date: Jan. 16, 2009 BB1	Sample 2 Date: Jan. 19, 2009 BB2	Sample 3 Date: Jan. 22, 2009 BB3
1,1-Dichloroethene	1,100	1,020	984
trans-1,2-Dichloroethene	1,230	1,170	1,060
cis-1,2-Dichloroethene	876	838	840
Trichloroethene	1,120	1,070	1,000
Tetrachloroethene	1,090	1,050	874
Benzene	1,000	958	943
Toluene	890	878	978
Ethylbenzene	1,400	1,360	1,440
o-Xylene	908	888	963
m/p-Xylene	988	949	987
MTBE	802	791	855

CA Sampling depth robustness standpipe, samples.

Compound	Concentration µg/L			Dates	Temperatures
	ID 1008-0820 CA1	ID 1008-0822 CA2	ID 1008-0825 CA3		
1,1-Dichloroethene	855	839	872	Set up	Set up
trans-1,2-Dichloroethene	858	839	867	Apr 7, 2009	12.9°C
cis-1,2-Dichloroethene	876	847	942	Sampled	Sampled
Trichloroethene	965	929	1,020	Apr. 13, 2009	21.2°C
Tetrachloroethene	727	687	760	Pressure head	External
Benzene	1,016	990	1,079	at set-up	pressure
Toluene	900	826	961	50 cm	0.45 ± 0.05 bar
Ethylbenzene	1,163	1,179	1,236	-	-
o-Xylene	811	762	872	Conductivity	-
m/p-Xylene	828	754	886	at set-up	-
MTBE	1,013	973	1,088	70.5 mS/m	-
<i>mL sampled (measured)</i>	590	297	507	-	-
<i>mL sampled (by tracer salt)</i>	347	252	374	-	-

CB Sampling depth robustness standpipe, reference samples.

Compound	Concentration µg/L		
	Sample 1 Date: April 7, 2009 CB1	Sample 2 Date: April 10, 2009 CB2	Sample 3 Date: April 13, 2009 CB3
1,1-Dichloroethene	1,590	1,130	1,020
trans-1,2-Dichloroethene	1,610	1,130	1,070
cis-1,2-Dichloroethene	1,270	886	851
Trichloroethene	1,490	1,110	1,040
Tetrachloroethene	1,130	749	798
Benzene	1,570	1,060	993
Toluene	1,440	1,020	960
Ethylbenzene	1,980	1,210	1,160
o-Xylene	1,320	907	894
m/p-Xylene	1,320	1,140	1,110
MTBE	1,600	1,040	941

DA Ionic strength robustness lab dispenser, 10 mS/cm, samples.

Compound	Concentration µg/L			Dates	Temperatures
	ID 1008-0197 DA1	ID 1008-0198 DA2	ID 1008-0199 DA3		
1,1-Dichloroethene	641	643	646	Set up	Set up
trans-1,2-Dichloroethene	607	593	605	Jan. 23, 2009	21.0°C
cis-1,2-Dichloroethene	581	542	566	Sampled	Sampled
Trichloroethene	551	533	512	Jan. 29, 2009	21.7°C
Tetrachloroethene	606	586	558	Pressure head	External
Benzene	605	590	578	at set-up	pressure
Toluene	603	597	577	55 cm	0 bar
Ethylbenzene	817	817	786	-	-
o-Xylene	616	613	599	Conductivity	-
m/p-Xylene	659	660	638	at set-up	-
MTBE	722	705	645	10.1 mS/m	-
<i>mL sampled (measured)</i>	340	288	323	-	-
<i>mL sampled (by tracer salt)</i>	335	295	330	-	-

DB Ionic strength robustness lab dispenser, 10 mS/cm, reference samples.

Compound	Concentration µg/L		
	Sample 1 Date: Jan. 23, 2009 DB1	Sample 2 Date: Jan. 26, 2009 DB2	Sample 3 Date: Jan. 29, 2009 DB3
1,1-Dichloroethene	1,040	936	944
trans-1,2-Dichloroethene	1,080	1,010	1,010
cis-1,2-Dichloroethene	803	802	831
Trichloroethene	1,020	1,000	1,010
Tetrachloroethene	927	867	868
Benzene	934	938	946
Toluene	971	966	984
Ethylbenzene	1,450	1,440	1,470
o-Xylene	948	966	984
m/p-Xylene	1,010	1,010	1,030
MTBE	854	924	935

EA Ionic strength robustness lab dispenser, 100 mS/cm, samples.

Compound	Concentration µg/L			Dates	Temperatures
	ID 1008-0200 EA1	ID 1008-0201 EA2	ID 1008-0202 EA3		
1,1-Dichloroethene	663	739	611	Set up	Set up
trans-1,2-Dichloroethene	844	952	744	Jan. 30, 2009	21.7°C
cis-1,2-Dichloroethene	780	875	669	Sampled	Sampled
Trichloroethene	650	820	546	Feb. 5, 2009	21.6°C
Tetrachloroethene	605	862	519	Pressure head	External
Benzene	741	838	618	at set-up	pressure
Toluene	736	930	540	55 cm	0 bar
Ethylbenzene	925	1,379	692	-	-
o-Xylene	638	936	524	Conductivity	-
m/p-Xylene	653	977	558	at set-up	-
MTBE	1,032	1,178	831	98.0 mS/m	-
<i>mL sampled (measured)</i>	604	551	448	-	-
<i>mL sampled (by tracer salt)</i>	over range	over range	over range	-	-

EB Ionic strength robustness lab dispenser, 100 mS/cm, reference samples.

Compound	Concentration µg/L		
	Sample 1 Date: Jan. 30, 2009 EB1	Sample 2 Date: Feb. 2, 2009 EB2	Sample 3 Date: Feb. 5, 2009 EB3
1,1-Dichloroethene	1,100	1,100	944
trans-1,2-Dichloroethene	1,140	1,160	1,070
cis-1,2-Dichloroethene	841	859	821
Trichloroethene	1,030	1,080	1,000
Tetrachloroethene	1,000	1,010	875
Benzene	976	997	958
Toluene	974	999	980
Ethylbenzene	1,530	1,560	1,540
o-Xylene	988	1,010	1,010
m/p-Xylene	1,050	1,070	1,040
MTBE	939	929	887

FA Sampling time robustness lab dispenser, 3 days, samples.

Compound	Concentration µg/L			Dates	Temperatures
	ID 1008-0203 FA1	ID 1008-0204 FA2	ID 1008-0205 FA3		
1,1-Dichloroethene	673	685	655	Set up	Set up
trans-1,2-Dichloroethene	750	761	732	Feb. 6, 2009	22.1°C
cis-1,2-Dichloroethene	680	688	656	Sampled	Sampled
Trichloroethene	564	569	544	Feb. 9, 2009	21.8°C
Tetrachloroethene	649	665	626	Pressure head	External
Benzene	676	686	667	at set-up	pressure
Toluene	689	690	686	55 cm	0 bar
Ethylbenzene	943	942	942	-	-
o-Xylene	699	709	711	Conductivity	-
m/p-Xylene	740	751	749	at set-up	-
MTBE	767	800	823	36.3 mS/m	-
<i>mL sampled (measured)</i>	259	314	254	-	-
<i>mL sampled (by tracer salt)</i>	264	332	274	-	-

FB Ionic strength robustness lab dispenser, 3 days, reference samples.

Compound	Concentration µg/L		
	Sample 1 Date: Feb. 6, 2009 FB1	Sample 2 Date: Feb. 7, 2009 FB2	Sample 3 Date: Feb. 8, 2009 FB3
1,1-Dichloroethene	1,070	1,180	1,190
trans-1,2-Dichloroethene	1,160	1,240	1,210
cis-1,2-Dichloroethene	882	897	899
Trichloroethene	1,080	1,110	1,090
Tetrachloroethene	929	1,050	1,080
Benzene	1,020	1,090	1,090
Toluene	1,040	1,060	1,060
Ethylbenzene	1,610	1,620	1,630
o-Xylene	1,050	1,070	1,060
m/p-Xylene	1,110	1,130	1,120
MTBE	941	1,060	1,050

GA Sampling time robustness lab dispenser, 9 days, samples.

Compound	Concentration µg/L			Dates	Temperatures
	ID 1008-0206 GA1	ID 1008-0207 GA2	ID 1008-0208 GA3		
1,1-Dichloroethene	585	631	691	Set up	Set up
trans-1,2-Dichloroethene	590	770	865	Feb. 10, 2009	21.4°C
cis-1,2-Dichloroethene	561	605	793	Sampled	Sampled
Trichloroethene	499	542	815	Feb. 19, 2009	21.6°C
Tetrachloroethene	551	584	752	Pressure head	External
Benzene	604	747	826	at set-up	pressure
Toluene	579	756	838	55 cm	0 bar
Ethylbenzene	1,006	1,149	1,264	-	-
o-Xylene	590	803	895	Conductivity	-
m/p-Xylene	632	825	914	at set-up	-
MTBE	830	964	1,094	34.4 mS/m	-
<i>mL sampled (measured)</i>	373	459	618	-	-
<i>mL sampled (by tracer salt)</i>	405	451	over range	-	-

GB Ionic strength robustness lab dispenser, 9 days, reference samples.

Compound	Concentration µg/L		
	Sample 1 Date: Feb. 10, 2009 GB1	Sample 2 Date: Feb. 14, 2009 GB2	Sample 3 Date: Feb. 19, 2009 GB3
1,1-Dichloroethene	1,260	1,110	904
trans-1,2-Dichloroethene	1,280	1,200	1,040
cis-1,2-Dichloroethene	924	867	821
Trichloroethene	1,140	1,070	1,010
Tetrachloroethene	1,140	1,010	903
Benzene	1,090	1,030	933
Toluene	1,090	1,010	1,000
Ethylbenzene	1,700	1,550	1,520
o-Xylene	1,100	1,020	999
m/p-Xylene	1,170	1,060	1,060
MTBE	1,080	960	887

HA Concentration integration robustness, lab dispenser, samples.

Compound	Concentration µg/L			Date & time	Temperatures
	ID 1008-0869 HA1	ID 1008-0870 HA2	ID 1008-0871 HA3		
1,1-Dichloroethene	669	389	686	Start 20%	Set up
trans-1,2-Dichloroethene	740	466	853	Mar. 16, 2009 at 15:45	21.0°C
cis-1,2-Dichloroethene	675	409	790	Step to 50%	Sampled
Trichloroethene	673	417	771	Mar. 18 at 16:30	21.3°C
Tetrachloroethene	485	374	739	Step to 80%	Pressure head
Benzene	774	477	900	Mar. 20 at 16:00	at set-up
Toluene	751	418	855	Sampled	55 cm
Ethylbenzene	1,084	573	1,206	Mar. 22 at 15:45	-
o-Xylene	767	426	868		External
m/p-Xylene	826	450	924	Conductivity	pressure
MTBE	851	478	959	at set-up	0 bar
<i>mL sampled (measured)</i>	562	414	520	34.2 mS/m	-
<i>mL sampled (by tracer salt)</i>	over range	461	over range		-

HB Concentration integration robustness, lab dispenser, reference samples.

Compound	Concentration µg/L		
	Sample 1 Date: Mar. 17, 2009 HB1	Sample 2 Date: Mar. 19, 2009 HB2	Sample 3 Date: Mar. 21, 2009 HB3
1,1-Dichloroethene	355	968	1,500
trans-1,2-Dichloroethene	369	974	1,550
cis-1,2-Dichloroethene	300	826	1,240
Trichloroethene	361	996	1,520
Tetrachloroethene	324	853	1,430
Benzene	343	902	1,300
Toluene	327	912	1,440
Ethylbenzene	487	1,350	2,200
o-Xylene	342	897	1,370
m/p-Xylene	390	1,050	1,670
MTBE	334	870	1,260

A P P E N D I X 6

Data management

In general, the data filing and archiving procedures of the DHI Quality Management System were followed.

All data recording and reporting was done in English, communication with Danish external and internal was partly in Danish.

Data storage, transfer and control

The data was compiled and stored as summarized in Table 36.

Analytical raw data was filed and archived according to the specifications of the laboratories quality management systems under their ISO 17025 accreditation and were thus not the concern of DHI staff.

Table 36 Data compilation and storage summary.

Data type	Data media	Data recorder	Data recording timing	Data storage
Test plan and report	Protected PDF files	Test responsible, DHI	When approved	Files and archives at DHI
Test details in laboratory and field	Log book and pre-prepared forms	Technician, DHI	During collection	Files and archives at DHI
Calculations	Excel files	Test responsible, DHI	During calculations	Files and archives DHI
Analytical reports	Paper	Test responsible, DHI	When received	Files and archives DHI

Implementation

All e-mail communication was filed in the Outlook Exchange folders, see below structure.

The DHI person receiving an e-mail (to field, not cc field) filed the e-mail. The DHI person sending an e-mail used the “send and file” option and thereby ensured prompt filing of all e-mails sent. There was generally no need to widespread cc when sending e-mails, unless specific action or communication is required.

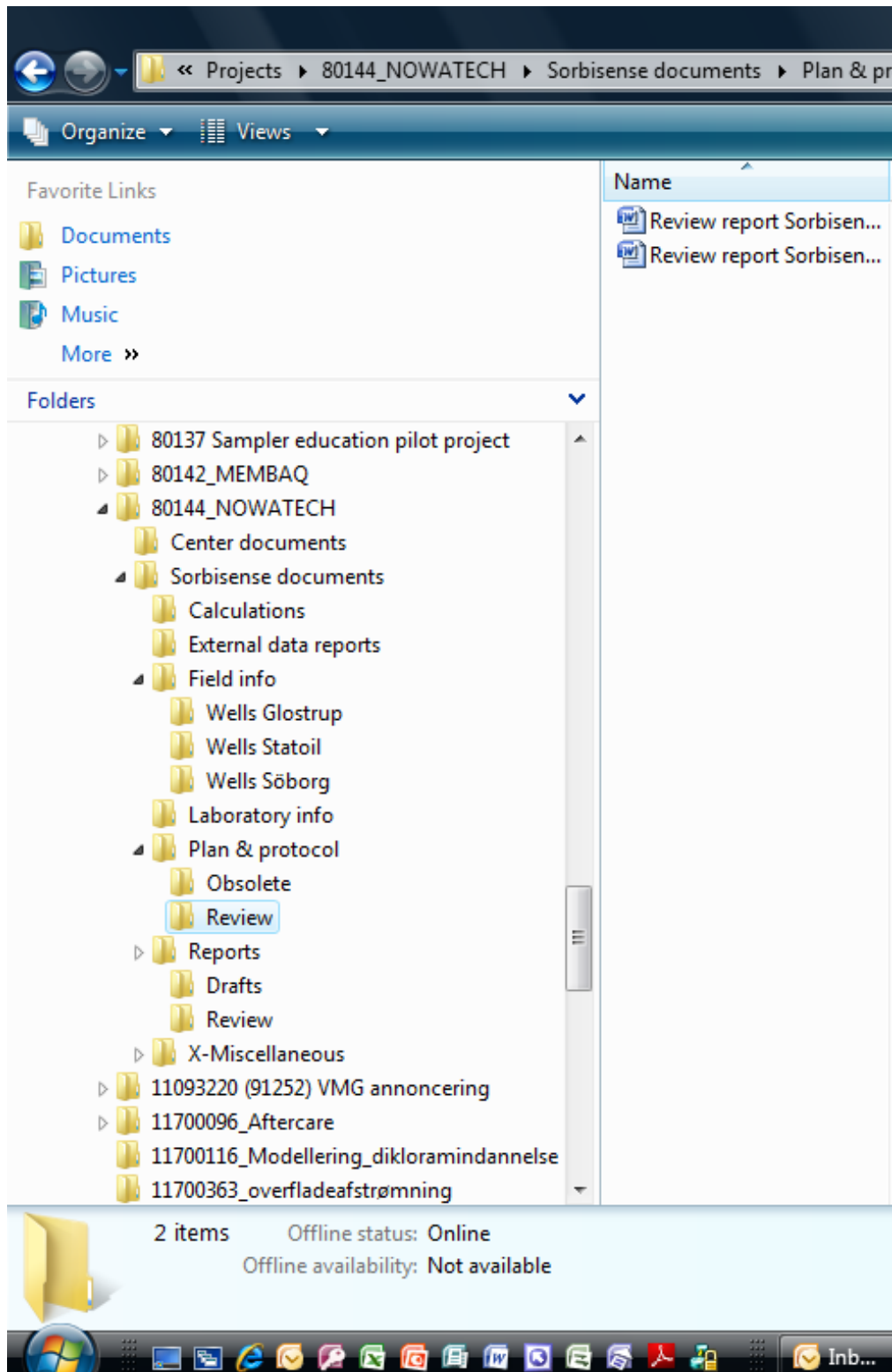
All paper communication was immediately filed in the binder established by GHE and available at his office. The title page of the binder resembled the folder structure at dkstor, see below.

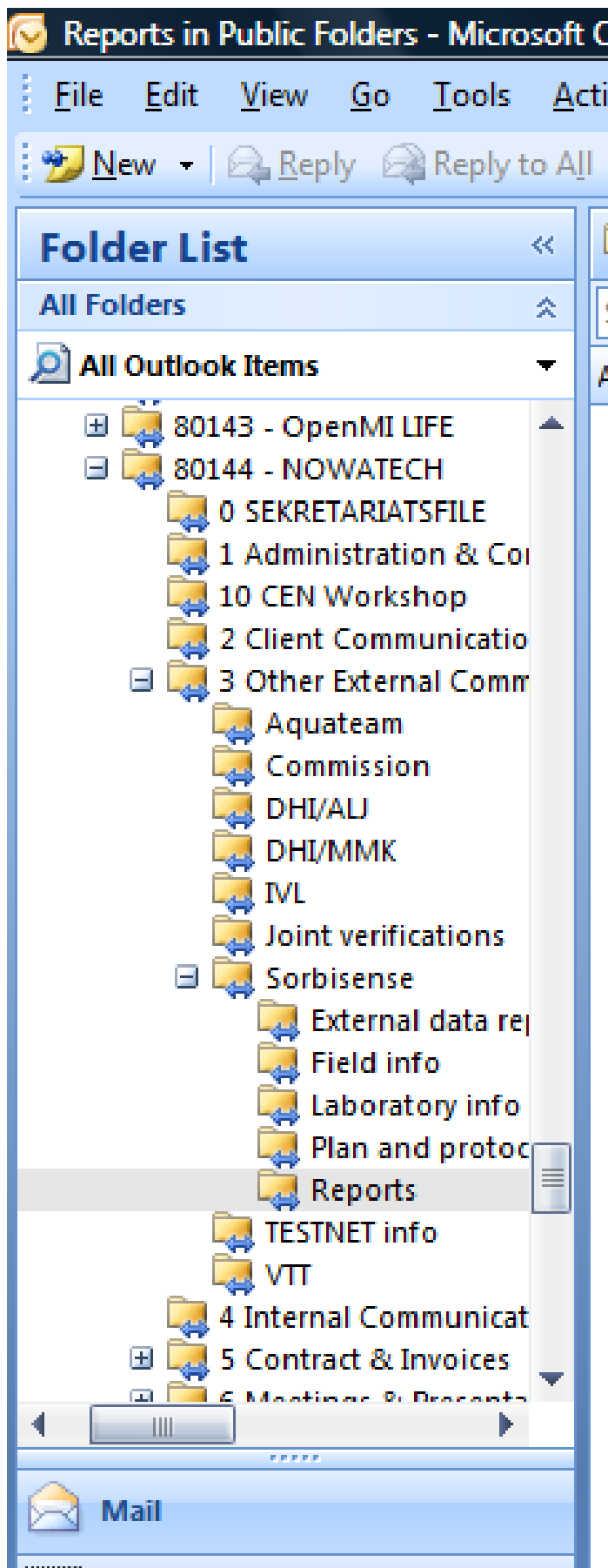
All recordings during testing in the laboratory or in the field were done in water proof writing in hardback log-books with all pages numbered page/total page number. The log books were filed with the staff member using them until the testing was completed, then with GHE and available at his office.

All data needed for the tests were recorded in the data sheets available from Appendix 5 of the Test Plan. The format was Word tables, Excel worksheets or paper sheets as decided by GHE as test responsible. The outline and format were mandatory and could only be deviated from by recording a deviation with justification.

All calculations were done using Excel spreadsheets with names identifying the contents and with headings and notes explaining the calculations.

All electronic files are stored at dkstor in the folder structure shown below. File names were constructed to identify the contents. Subfolders were established as found convenient, while again constructing folder names that identify the contents. When working away from network connection (offline), copies of files were used on own PC, but the server version was updated immediately after returning to network connection.



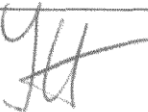






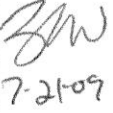


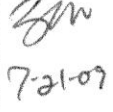


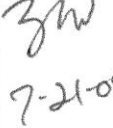
A P P E N D I X 7

Deviations and amendments

Deviation report

Sorbisense GWS40 passive sampler test plan

Deviation number	Experiment label Test Plan Table 1	Test method step Test Plan Appendix 3	Deviation	Cause	Impact assessment	Corrective action, if any	Date	Signature test or field responsible	Date	Signature verification responsible	Date	Signature Battelle AMS QM
1	Pre-testing	Sample labeling and sending	<p>Samples E1 to B3 (should be 3x3 P&T vials) were sent as A1 to A3, B1 to B2 and E1 to E3 (9x1 P&T vials).</p> <p>Samples A and B were sent as "10 g/L" and "0.09 g/L" as single samples instead of triplicates</p>	Error/misunderstanding while labeling. Pre-testing was done before appendix 3.10 §1 was formulated.	<p>Samples E1 to E3 lack data for BTEX.</p> <p>Sample A2 and A3, B2 and B3 are lacking (single instead of triplicate samples).</p> <p>No significant impact on overall verification</p>	3 more vials of unopened stock solution were sent for analysis as A4 to A6	1/12 2008	 (GHE)	9/2 07		7-21-07	 7-21-07

Deviation number	Experiment label Test Plan Table 1	Test method step Test Plan Appendix 3	Deviation	Cause	Impact assessment	Corrective action, if any	Date	Signature test or field responsible	Date	Signature verification responsible	Date	Signature Battelle AMS QM
2	BA, DA	3.2 §1c	Used 10 mL syringe instead of 100 ml syringe	Delivery of 100 mL syringe is delayed by several weeks	No significant impact.		16/1 and 23/1 2009		9/1/09		7-21-09	 7-21-09
3	All lab tests	3.10 §3	Samplers are stored at room temperature	Instruction printed on the sampler package states 5-26 °C.	No impact.	Handwritten change in all test plan copies	from 22/1 2009		9/1/09		7-21-09	 7-21-09
4	All tests with lab dispenser	3.2 §3c&d 6	Samplers are removed before draining the dispenser (swop steps c and d)	To avoid air being sucked backwards through the sampler, and to avoid liquid with lower concentration entering the sampler	No impact	Handwritten change in all test plan copies	from 22/1 2009		9/1/09		7-21-09	 7-21-09





Deviation number	Experiment label Test Plan Table 1	Test method step Test Plan Appendix 3	Deviation	Cause	Impact assessment	Corrective action, if any	Date	Signature test or field responsible	Date	Signature verification responsible	Date	Signature Battelle AMS QM
5	GA, J	3.10 §4	Cap vials with stock solution or stock dilution packed in bubble plastic and PE bottles instead of a P&T vial	To minimize the risk of damage during transport	No impact	No action	10/2 2009	GA (GHE)	1/2 09	J	2/13/09	JW (ZJW)
6	J	3.3 §1 b	Stainless steel nut and 2 ferrules dropped into standpipe	Were too loosely attached to the lid before mounting the hoses.	No impact	Used new nut and ferrules, Did not retrieve the ones dropped into the standpipe	10/2 2009	GA	1/2 09	J	2/13/09	JW
7	J	After 3.3 §2 f	Rinsed syringe and spiking port with methanol	This step has been omitted from the standpipe test plan.	Improved addition of the spike	Done as in app. 3.2 §2 g&h. Added 2 steps to app. 3.3, amendment.	10/2 2009, from 10/2 2009	GA	1/2 09	J	2/13/09	JW










deviation,

changed in
printed versions.

Deviation number	Experiment label Test Plan Table 1	Test method step Test Plan Appendix 3	Deviation	Cause	Impact assessment	Corrective action, if any	Date	Signature test or field responsible	Date	Signature verification responsible	Date	Signature Battelle AMS QM
8	J	After 3.3 §2 g	100 mL syringe broke while passing rinse water through the spiking port	Back-pressure from the standpipe and vibration from the pump	Only ca. 60 mL of water added. Some mL of water drained through port before it was closed. No significant impact.	None. From now on, the 10 mL gas-tight syringe will be used	10/2 2009, from 10/2 2009	<i>GH</i>	10/2 09	<i>S</i>	2/13/09	<i>JW</i>







Deviation number	Experiment label Test Plan Table 1	Test method step Test Plan Appendix 3	Deviation	Cause	Impact assessment	Corrective action, if any	Date	Signature test or field responsible	Date	Signature verification responsible	Date	Signature Battelle AMS QM
9	AA4-AE4	3.10	No pictures were taken	Did not realize pictures had to be taken for field samples	If trouble with identifying the samples should occur at the lab we do not have pictures as evidence	Take pictures at next field sampling	12/2-09	MTA	1/5/09	[Signature]	7-21-09	Zhw
10	AC4 and AD4	3.4	Sampler not placed in specified depth. Well B17 sampler is placed 11 mbs instead of 12 mbs Well C14 sampler is placed 11.3 mbs instead of 11.5 mbs	Not physically possible to place at specified depth	B17 reference sample is taken 1 m from sample. Can be a different water type C14 no impact.	Have in mind when evaluating results. Next sampling campaign depth of reference samples are changed accordingly	12/2 2009	MTA	1/5/09	[Signature]	7-21-09	Zhw
11	AE4	3.4	The exact program was not	Well B18 was the first well	Can have a minor effect on the	Have in mind when evaluating	12/2 2009	MTA	1/5/09	[Signature]	7-21-09	Zhw

Deviation number	Experiment label Test Plan Table 1	Test method step Test Plan Appendix 3	Deviation	Cause	Impact assessment	Corrective action, if any	Date	Signature test or field responsible	Date	Signature verification responsible	Date	Signature Battelle AMS QM
			followed in details and the pumping time was long.	reference-sampled. The equipment and the sampling method were studied.	reference samples	results.						
12	AD4-AD7 <i>all 4 sampling days</i>	3.4	Well B17 Reference sample was not taken at stable pH and conductivity	There must be different water types at the depth of the pump	It is not possible to get stable values from the near surroundings of the well.	Have in mind when evaluating results.	12/2- 2009 18/2 24/2 2/3	MTA	1/5 09 		7-21-09	
13	AA4-AE4	3.4	Reference sampling. Filling bottles from the bottom and overflowing twice was not fully done.	Pump flow was very low and stopped some times. Quick sampling was needed. Having tube in bottom of	Can affect parameters where aeration is unwanted	Have in mind when evaluating results. Focus on next reference sampling will be to improve this.	12/2 2009	MTA	1/5 09 		7-21-09	







Deviation number	Experiment label Test Plan Table 1	Test method step Test Plan Appendix 3	Deviation	Cause	Impact assessment	Corrective action, if any	Date	Signature test or field responsible	Date	Signature verification responsible	Date	Signature Battelle AMS QM
14	All standpipe tests	3.3 §1b	Wrong wording	Not corrected earlier	none	Changed <i>air exchange pipes</i> to <i>air hoses</i> in all test plan copies	17/2		7-21-09		7-21-09	
15	J	3.3 §5f	1 reservoir found completely filled with water, including the air hose	Leakage, cause unidentified	1008-214: Tracer salt shows no washout. Number of replicate samplers in test J is down to 6.	The reservoir will not be used in further tests.	16/2		7-21-09		7-21-09	
16	J	3.3 §5g	4 samplers were removed without identifying the reservoirs for volume measurement	By Mistake: followed the test plan (sampling), but did not check for next step (measure volume)	Maybe not possible to identify sample volume in reservoirs for sample 210, 211 and 213. No major impact.	Measured volumes in the unidentified reservoirs anyway, for comparison with tracer salt results.	16/2		7-21-09		7-21-09	










Deviation number	Experiment label Test Plan Table 1	Test method step Test Plan Appendix 3	Deviation	Cause	Impact assessment	Corrective action, if any	Date	Signature test or field responsible	Date	Signature verification responsible	Date	Signature Battelle AMS QM
17	N	3.3 §11	2 Glass heads for wash bottle cracked while handling, also the spare head	By accident. Fragile material.	Minor VOC loss from wash bottle. An effect on concentration in standpipe is unlikely. Such effect would show in reference samples O 1-3.	Sealed the fittings with parafilm. Ordered more heads.	17/2	<i>GH</i>	1/5/05	<i>S</i>	7-21-05	<i>ZLW</i>







Deviation number	Experiment label Test Plan Table 1	Test method step Test Plan Appendix 3	Deviation	Cause	Impact assessment	Corrective action, if any	Date	Signature test or field responsible	Date	Signature verification responsible	Date	Signature Battelle AMS QM
18	AA7-AC7 Well C8, C11, C14	3.10	Pictures was not taken of these samples	DHI person was not on location when ref. samples were taken	No impact, since the samples are registered correctly at Eurofins		2/3	MTA	4/5/09	S	7-21-09	BJW
19	AA4-AE7 Field reference sampling	Appendix 3.4	The sampled water was headed by the pump and online temperature measurements are therefore not reflecting the temperature in the well	The low flow during sampling caused that the pump was heating the pumped water (higher flow will cool down the pump).	Online parameters have to be stable before sampling. This was not impacted. There is a risk that volatile compound are lost during sampling	Samples were carefully taken. Have to be in mind when evaluating results.	12/2 18/2 24/2 2/3	MTA	4/5/09	S	7-21-09	BJW
20	P (1 st attempt)	3.3	Noticed that wash bottle had was turned the	By mistake. Direction was not	Lost ca. 2 L. of liquid.	Test was suspended when it turned out	27/2	YH	4/5/09	S	7-21-09	BJW

Deviation number	Experiment label Test Plan Table 1	Test method step Test Plan Appendix 3	Deviation	Cause	Impact assessment	Corrective action, if any	Date	Signature test or field respon- sible	Date	Signa- ture verify- cation respon- sible	Date	Signa- ture Battelle AMS QM
			wrong way.	stated explicitly in test plan		that samplers with wrong hydraulic resistance were used.						
21	P (2 nd attempt)	3.3	30-60 minutes after spiking, a leakage occurred at the spiking port	Probably loosened due to vibration from the pump	Lost ca. 3 Liters. Uncertainty whether high concentration liquid was lost so shortly after spiking	Test was aborted . Tightened all fittings on the standpipe before proceeding	6/3		7/5/09		7-21-09	
22	P (3 rd attempt)	3.3	Observation that surface of reservoirs appears to be slimy at end of test.	Growth of a biofilm?	Risk for aerobic biodegradation of VOCs.	Check of VOC loss vs. K_{ow} does not indicate biodegradation, rather adsorption. Disinfection of standpipe and reservoirs with ca. 25 mg/l of free	16/3 observation 25/3 chlorination.		7/5/09		7-21-09	

Deviation number	Experiment label Test Plan Table 1	Test method step Test Plan Appendix 3	Deviation	Cause	Impact assessment	Corrective action, if any	Date	Signature test or field respon- sible	Date	Signa- ture verify- cation respon- sible	Date	Signa- ture Battelle AMS QM
						<p>chlorine by addition of sodium hypochlorite for 5 hours. Rinsed the standpipe and reservoirs with water.</p> <p>From now on, the standpipe is filled with water passed through a sterile filter (Sartobran P sterile capsule, Sartorius, 0.45 µm + 0.2 µm)</p>						

Deviation number	Experiment label Test Plan Table 1	Test method step Test Plan Appendix 3	Deviation	Cause	Impact assessment	Corrective action, if any	Date	Signature test or field responsible	Date	Signature verification responsible	Date	Signature Battelle AMS QM
23	R	3.3 § 1	Filled the standpipe to ca. ¾ with water before inserting the reservoirs	Setting up the test alone. The water level gives buoyancy.	No impact on results	none	From 26/3 on		7/5/09		7-21-09	387W
24	R	3.3 § 2	Taken only 2 vials of leftover stock solution. None sent to analysis	Limited volume left from test R startup. Decided to cut down on reference analysis in accordance with test plan chapter 3.2.5	none	none	26/3		7/5/09		7-21-09	387W
25	R	3.10 §2	Sample S1 was sent after 4 days of storage instead of max 3.	to minimize the sending of single samples to Eurofins.	None, the samples contain relatively high concentration	none	30/3		7/5/09		7-21-09	387W

Deviation number	Experiment label Test Plan Table 1	Test method step Test Plan Appendix 3	Deviation	Cause	Impact assessment	Corrective action, if any	Date	Signature test or field responsible	Date	Signature verification responsible	Date	Signature Battelle AMS QM
					of 1 mg/L.							
26	V & CA	3.3	Started test CA (1 mg/L, with pressure) instead of V (2 mg/L.) that was due according to test schedule	Only 2 samplers on stock with the correct hydraulic resistance	No impact	none	7/4		7/5/09		7-21-09	
27	CA	3.3 §2	No stock solution taken for reference analysis nA1 to nA3	The 10 mL syringe broke, and the remaining stock solution was spilled	No analysis of stock used in test CA possible.	Sent stock solution vial kA1, taken 26/3 for analysis to check reference lab performance.	7/4		7/5/09		7-21-09	
28	CA	3.3 §3	Sample CB1 taken after 2 hours instead of 4	Latest possible sample pick-up time before Easter	The standpipe is not completely mixed after 2 hours, as we have seen in the 2-hour-samples	None.	7/4		7/5/09		7-21-09	

Deviation number	Experiment label Test Plan Table 1	Test method step Test Plan Appendix 3	Deviation	Cause	Impact assessment	Corrective action, if any	Date	Signature test or field responsible	Date	Signature verification responsible	Date	Signature Battelle AMS QM
					taken before test P.							
29	CA	3.10 §2	Sample CB2 was sent after 4 days of storage instead of max 3.	Easter holidays 9-13/4	None, the samples contain a high concentration of 1 mg/L	none	14/4		7/5/09		7-21-09	88W
30	V	3.3 §2	Used 5-mL gas tight syringe instead of 10 mL.	10 mL syringe broken	none	none	17/4		7/5/09		7-21-09	89W
31	V	3.3§2	No stock solution taken for reference analysis	Only small amount of stock solution left in the 10 mL cap vials	Taking the remainder would result in a high risk for VOC loss to the headspace.	Sent an unopened 1,5 mL stock solution vial as mA1 to check reference lab performance.	17/4		7/5/09		7-21-09	88W

AMENDMENT

TESTING DOCUMENT TITLE AND DATE: Sorbisense GWS40 Passive Sampler

AMENDMENT NUMBER: 1

DATE OF REVISED PART: 09-02-2009

PARTS TO BE CHANGED/REVISED: Section 3.1.1 and 3.2.1 part on field sampling, appendix 3.4. Tables in Appendix 5, will be adapted to the new situations when they are to be used during the field testing.

CHANGE/REVISION:

Reference to revised parts. The essentials of the change is that a low purge reference sampling strategy with a dedicated sampling pump is chosen instead of reference sampling with permanent, continuously pumped.

REASON FOR CHANGE: It proved impossible to use the wells originally chosen because of access restrictions caused by the installation dimensions. The new wells are monitoring wells at the same sites.

ORIGINATED BY:

Mette Tjener Andersson

DHI WMC Test Responsible for Field

Mette Andersson

DATE 10.2.2009

APPROVED BY:

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DHI WMC Internal Auditor

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10/2-09

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10/2 2009

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AMENDMENT

TESTING DOCUMENT TITLE AND DATE: Sorbisense GWS40 Passive Sampler

AMENDMENT NUMBER: 2

DATE OF REVISED PART: 16-02-2009

PARTS TO BE CHANGED/REVISED: Appendix 3.10 §3 and §5

CHANGE/REVISION:

Appendix 3.10 §3: Samplers are equipped with protective caps in both ends, placed in transportation tubes and stored cold 1-5°C and dark for no more than 3 days prior to transfer to the laboratory.

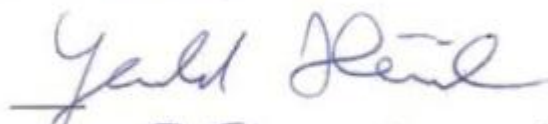
Appendix 3.10 §5: Samplers are packed in the transport tubes in a cardboard box with a cooling element. Samplers are shipped with a courier service, with max 48 hr transport time.

REASON FOR CHANGE: All handling and shipping of Sorbisense samplers has so far been done at ambient temperature. However, Sorbisense wishes to implement cooled storage and shipping for the remaining of ETV test, to rule out losses due to high storage temperature as a source of error.

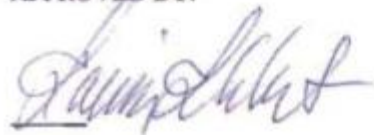
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Gerald Heinicke

DHI WMC Test Responsible


DATE 17 February, 2009 02/09

APPROVED BY:



DHI WMC Internal Auditor

18.2.2009

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AMENDMENT

TESTING DOCUMENT TITLE AND DATE: Sorbisense GWS40 Passive Sampler

AMENDMENT NUMBER: 3

DATE OF REVISED PART: February 24, 2009

PART TO BE CHANGED/REVISED: Appendix 3.3 §3

CHANGE/REVISION:

The first reference sample from the standpipe is taken after 4 hours, instead of 2. This applies from test P.

REASON FOR CHANGE:

Tests J and N show incomplete mixing in the standpipe after 2 hours, with concentrations about double of what was expected. The change will make it possible to also use the first reference samples in the calculations.

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DHI WMC Test Responsible

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Gerald Heinicke
Feb. 26, 2009

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AMENDMENT

VERIFICATION DOCUMENT TITLE AND DATE: Sorbisense GWS40 Passive Sampler, joint verification protocol.

AMENDMENT NUMBER: 5

DATE OF REVISED PART: September 24, 2009

PART TO BE CHANGED/REVISED: Table 7 Calculations used for the test results

CHANGE/REVISION:

Four additional statistical methods were used in the evaluation of the test results.

- 1) Precision for datasets with up to three replicates was calculated as relative standard deviation with the method stated in the verification protocol (first row in table below). For datasets with more than three replicates, the relative standard deviation was calculated with the method shown in the second row of the table.

Precision (repeatability or reproducibility), as relative standard deviation, RSD	$D_i = x_{i\max} - x_{i\min} $ $\bar{x}_i = \frac{\sum x_i}{n}$ $d_i = \frac{D_i}{\bar{x}_i}$ $\bar{d} = \frac{\sum d_i}{m}$ $RSD = \frac{\bar{d} * 100}{1.693} \%$	<p>D_i is the range at level i $x_{i\min}$ and $x_{i\max}$ are the lowest and highest measurements at level i d_i is the relative range at level i \bar{d} is the mean relative range for all m levels Used with three replicates, $i=3$ in x_i</p>
Precision (repeatability or reproducibility), as relative standard deviation, RSD	$\bar{x}_i = \frac{\sum x_i}{n}$ $s_i = \frac{\sum (x_i - \bar{x}_i)^2}{n - 1}$ $RSD = \frac{s_i}{x_i}$	<p>\bar{x}_i is the mean n is number of measurements s_i is standard deviation Used with more than three replicates, $i>3$ in x_i</p>

- 2) For reporting the results of the field measurement, Ratio was used.

Ratio, Ra	$Ra_i = \frac{x_i}{\bar{y}_{i,j}} \times 100\%$	<p>x_i is one sample measurement $\bar{y}_{i,j}$ is the mean of the reference sample measurement done before and after the sample measurement Used for field measurements</p>
-----------	---	---

3) A test of significance of mean difference was applied to the results of the field measurements.

Test of significance of mean difference	$t_{0.975(f)} > \frac{ \bar{d} }{s_d} \sqrt{n}$	<p>A paired t-test was applied. $t_{0.975(f)}$ is Student's t-factor for two-sided test at 95% confidence level. n is number of measurements \bar{d} is the mean difference between the concentrations of the two methods. s_d standard deviation on the difference between methods</p>
---	---	---

4) For the comparison of two means, a t-test assuming unequal variances was used instead of the test assuming equal variances.

Test of mean against mean value	$\frac{ \bar{x}_i - \bar{y}_i }{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} > t_{0.975(v)}$ $df = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}{\left(\frac{s_1^2/n_1}{n_1 - 1}\right) + \left(\frac{s_2^2/n_2}{n_2 - 1}\right)}$ $s_i = \frac{\sum (x_i - \bar{x}_i)^2}{n - 1}$	<p>This t-test assumes unequal variances and calculates the degrees of freedom from the datasets. s_i is the standard deviation of dataset i, with n_i replicates.</p>
---------------------------------	--	---

REASON FOR CHANGE:

The changes in the application of statistical methods are more appropriate for the results of the verification testing. Specifically:

- 1) The second method is more powerful than the first for datasets with a larger number of replicates.
- 2) Robustness was reported as the ratio between the mean value obtained for the robustness variation and the mean value obtained under reference conditions, since it was not possible to reliably state a true concentration in the wells.
- 3) For each compound, a paired t-test was applied to check the hypothesis that the difference between sampler results and reference sample results in the field was zero.
- 4) The method assuming unequal variances is more appropriate because the variance varied between datasets.

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September 30, 2009

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A P P E N D I X 8

Field report

Validering af passiv vandprøvetager fra Sorbisense

Vandprøvetagning med MP1 pumpe i Farum og Søborg

GEO projekt nr. 32294
Rapport 1, 2009-03-10

Sammenfatning

GEO er af DHI, Institute for Water, Environment and Health, blevet anmodet om at udtage vandprøver med MP1 pumpe fra i alt 5 miljøtekniske borer i Farum og Søborg.

Vandprøvetagningen er udført i forbindelse med validering af en passiv vandprøvetager (SorbiCell) fra firmaet Sorbisense. Vandprøverne er udtaget ved lav pumpeydelse efter proceduren for mikroforpumpning. Metodebeskrivelse for prøvetagningen er vedlagt i anneks A.

Vandprøvetagningen er udført 4 gange med 6 dages mellemrum i perioden 12. februar til 2. marts 2009. Under prøvetagningen er der løbende registreret iltindhold, ledningsevne, pH og temperatur. Resultater fra feltmålingerne er vedlagt i anneks B.

De anvendte pumpeydelse under forpumpningen var på mellem 1,2 og 1,8 liter pr. minut, og de tilsvarende sænkninger i de 5 borer var på mellem 3 og 15 cm med et gennemsnit på 8 cm. Prøvetagningsinstruksens krav om en maksimal sænkning under forpumpningen på ca. 0,1 m vurderes dermed generelt at være overholdt.

Under selve prøvetagningen blev pumpeydelsen i borerne droslet ned til mellem 0,4 og 0,8 liter pr. minut, hvorved vandstanden i borerne steg. Prøvetagningsinstruksens krav om at prøvetagningen skulle foretages under stigende vandstanden i borerne vurderes dermed også at være opfyldt.

Deres ref.:
GEO projekt nr. 32294, Rapport 1, 2009-03-10 - Vandprøvetagning i Farum og Søborg for DHI

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Indhold

1	Indledning	3
2	Vandprøvetagningens udførelse	3
	2.1 Generelt.....	3
	2.2 Materialer og metoder	4
3	Konklusion.....	6

Anneks

- A Prøvetagningsinstruks for vandprøvetagningen
- B Skemaer med feltmålinger og -observationer under prøvetagningen

1 Indledning

GEO er af DHI, Institute for Water, Environment and Health, blevet anmodet om at udtage vandprøver med MP1 pumpe fra i alt 5 miljøtekniske borer i Farum og Søborg. Vandprøvetagningen er udført 4 gange med 6 dages mellemrum.

Vandprøvetagningen er udført i forbindelse med validering af en passiv vandprøvetager (SorbiCell) fra firmaet Sorbisense. GEOs andel i valideringen består kun i at udtage vandprøverne med MP1 pumpe, og herunder måle og registrere feltparametrene iltindhold, ledningsevne, pH og temperatur. DHI står for levering af prøvetagningsemballage, kemiske analyser samt håndtering af Sorbicellerne.

Indeværende rapport omfatter en beskrivelse af proceduren for vandprøvetagningen, samt resultaterne fra feltmålingerne ved prøvetagningen.

2 Vandprøvetagningens udførelse

2.1 Generelt

Der er udtaget vandprøver fra de 2 borer B17 og B18 på Statoil servicestationen på Farum Bytorv 76 i Farum, samt fra de 3 borer C8, C11 og C14 ved Søborg Hovedgade 17-29 i Søborg. Data for borerne, prøvetagningsdybder mv. fremgår af tabel 1, som er udarbejdet af DHI.

Lokalitet	Farum		Søborg		
	B17	B18	C8	C11	C14
DGU nr.	193.2277	193.2278	201.5855	201.5851	201.5858
Dybde grundvand (ro) m u.t.	9,32	9,24	8,86	8,9	9,48
Dybde filtersætning m u.t.	8,2-15,2	8,3-15,3	11,5-15	7-13	6-13
Prøvetagningsdybde m u.t.	11 (12*)	12	13	11	11,3 (11,5*)
Afstand top af forerør til terræn (cm)	10	14	10	25	8,5
Prøvetagningsdybde m u. top af forerør	11,9	11,86	12,9	10,75	11,42
SorbiCell nr.	043-102	043-102	043-103	043-102	043-102
Placering af SorbiCelle	Top	Top	Top	Top	Top
Afstand fra Sorbicelle til bund af boring (m)	3,2	3,3	2	2	1,5
Vand over Sorbicelle (m)	2,7	2,8	4,1	2,1	2

Tabel 1. Data for borerne, prøvetagningsdybder mv. Skemaet er udarbejdet af DHI.

* Prøvetagningsdybde anvendt ved den første prøvetagningsrunde den 12/2.

Deres ref.:

GEO projekt nr. 32294, Rapport 1, 2009-03-10 - Vandprøvetagning i Farum og Søborg for DHI 3/6

Vandprøverne fra de 5 boringer blev udtaget 4 gange med 6 dages mellemrum. Prøverne blev udtaget den 12/2, 18/2, 24/2 og 2/3 2009.

2.2 Materialer og metoder

Generelt

Vandprøverne skulle udtages med MP1 pumpe ved lav pumpeydelse ("Mikroforpumpning"), som beskrevet i kapitel 7 i "Håndbog i prøvetagning af jord og grundvand" (Amternes Videncenter for Jordforurening (AVJ), Teknik og Administration, rapport nr. 3 2003).

De ved prøvetagningen anvendte materialer og metoder er nærmere beskrevet i prøvetagningsinstruksen, som er vedlagt i anneks A. Inden prøvetagningen blev denne prøvetagningsinstruks godkendt af DHI. Under hele prøvetagningsprojektet førte rekvirenten, Mette Tjener Andersson fra DHI, tilsyn med prøvetagningen.

Prøvetagningsdybder

De anvendte prøvetagningsdybder i boringerne fremgår af tabel 1. Ved den første prøvetagning var prøvetagningsdybden i boringerne B17 og C14 hhv. 12 og 11,5 m u.t. Men da det ikke var muligt at placere Sorbicellerne så dybt i disse 2 boringer blev vandprøverne ved de efterfølgende prøvetagninger udtaget hhv. 11 og 11,3 m u.t.

Pumpeydelse og sænkning

Ifølge prøvetagningsinstruksen skulle følgende 2 krav vedrørende pumpeydelsen og vandstanden så vidt muligt overholdes:

1. Pumpeydelsen under forpumpningen skal være tilstrækkelig lav til at den maksimale sænkning i boringen generelt ikke overstiger 0,1 m.
2. Pumpeydelsen under prøvetagningen skal neddrosles så vandstanden i boringen stiger under prøvetagningen.

Ved den første prøvetagningsrunde d. 12/2 blev det indledningsvis forsøgt at forpumpe med en ydelse på under ca. 0,5 l/min. Men hver gang pumperne blev droslet ned til en ydelse på under 0,5 l/min. slog pumperne fra efter kort tid. Det kunne herved konstateres, at MP1 pumperne ikke kunne køre stabilt ved en så lav ydelse.

Årsagen hertil vurderes at være dels, at MP1 pumpen ikke er specielt designet til at pumpe med en så lav ydelse, og dels at der var for stor flow-modstand ved de pågældende løftehøjder på mellem 11 og 13 m og i den anvendte målegris. For at reducere flow-modstanden under pumpningen blev målegrisen derfor udskiftet med en 0,5 liters red-cap prøveflaske, som herefter blev anvendt som målegris. Sonderne til måling af feltparametrene iltindhold, ledningsevne, pH og temperatur blev placeret i toppen af flasken, og vandet fra boringen blev udledt i bunden af flasken, og løb ud over flaskens

top. Denne ændring af prøvetagningsproceduren blev godkendt af Mette Tjener Andersson fra DHI.

De aktuelle pumpeydelse og pejleresultater under forpumpning og prøvetagning fremgår af feltskemaerne i anneks B. De tilsvarende beregnede sænkninger i boringerne fremgår af tabel 2.

Boring	Prøvedato	Sænkning ved forpumpning (cm)	Sænkning ved prøvetagning (cm)
B17 (Farum)	12-02-2009	8	3
	18-02-2009	10	2
	24-02-2009	11	2
	02-03-2009	12	4
B18 (Farum)	12-02-2009	11	3
	18-02-2009	12	1
	24-02-2009	13	2
	02-03-2009	15	4
C8 (Søborg)	12-02-2009	3	0
	18-02-2009	3	0
	24-02-2009	4	1
	02-03-2009	5	3
C11 (Søborg)	12-02-2009	-	-
	18-02-2009	5	2
	24-02-2009	5	2
	02-03-2009	4	2
C14 (Søborg)	12-02-2009	8	4
	18-02-2009	6	3
	24-02-2009	5	1
	02-03-2009	5	2

Tabel 2. Sænkning af vandstanden i boringerne under forpumpning og prøvetagning. Pejledata er vedlagt i anneks B.

Under forpumpningen af boringerne blev der generelt pumpet med ydelser på mellem 1,2 og 1,8 liter pr. minut. Ved disse ydelser var sænkningerne i boringerne i Farum på mellem 8 og 15 cm, med et gennemsnit på 11,5 cm, jf. tabel 2. Tilsvarende var sænkningerne i boringerne i Søborg på mellem 3 og 8 cm med et gennemsnit på 4,8 cm. Prøvetagningsinstruksens krav om en maksimal sænkning under forpumpningen på ca. 0,1 m vurderes dermed generelt at være overholdt.

Under selve prøvetagningen blev pumpeydelsen i borerne droslet ned til mellem 0,4 og 0,8 liter pr. minut. Derved steg vandstanden i borerne, så sænkningen under prøvetagningen kun var mellem på mellem 0 og 4 cm. Prøvetagningsinstruksens krav om, at prøverne skulle udtages under stigende vandstand, vurderes dermed også at være overholdt.

3 Konklusion

GEO har 4 gange i perioden 12. februar til 2. marts 2009 udtaget vandprøver med MP1 pumper fra 5 borer i Farum og Søborg. Vandprøverne er udtaget ved lav pumpeydelse efter proceduren for mikroforpumpning.

De anvendte pumpeydelse under forpumpningen var på mellem 1,2 og 1,8 liter pr. minut, og de tilsvarende sænkninger i de 5 borer var på mellem 3 og 15 cm med et gennemsnit på 8 cm. Prøvetagningsinstruksens krav om en maksimal sænkning under forpumpningen på ca. 0,1 m vurderes dermed generelt at være overholdt.

Under selve prøvetagningen blev pumpeydelsen i borerne droslet ned til mellem 0,4 og 0,8 liter pr. minut, hvorved vandstanden i borerne steg. Prøvetagningsinstruksens krav om at prøvetagningen skulle foretages under stigende vandstanden i borerne vurderes dermed også at være opfyldt.

ANNEKS A

Prøvetagningsinstruks for vandprøvetagning

**Projekt 32294 – Vandprøvetagning i
Farum og Søborg for DHI**

Sag 32294 Vandprøvetagning i Farum og Søborg for DHI

Prøvetagningsinstruks

Generelt:

- Der skal udtages 5 vandprøver ved "mikroforpumpning" med ved brug af MP1-pumper, teflonslanger og målegris.
- De 5 prøver skal udtages 4 gange med 6 dages mellemrum, dvs. der i alt skal udtages 20 prøver i løbet af de 4 uger projektet forløber.
- De 5 prøver skal så vidt muligt udtages på samme dag.
- Prøverne skal udtages **torsdag 12/2, onsdag 18/2, tirsdag 24/2 og mandag 2/3**.
- Af de 5 prøver skal 3 prøver udtages ved Søborg Hovedgade 17-29 i Søborg, og 2 prøver udtages ved Statoil på Farum Hovedgade 76 i Farum.
- Data om lokalisering, boringsudbygning og prøvetagningsdybder findes i den orange mappe.

Formål:

Formålet med prøvetagningen er at udtage vandprøver ved en meget lav pumpeydelse (0,2-0,4 l/min.) fra en bestemt dybde i filterne. Den lave pumpeydelse skal sikre at grundvandet strømmer stille og roligt ind i filtret fra et smalt prøvetagningsinterval.

Vandprøverne er forurenede med flygtige kulbrinter (benzin/olie, MTBE, klorerede kulbrinter).

Pumpe:

Der skal anvendes én specifik MP1 pumpe til hver boring, og den samme pumpe og slange skal anvendes til samme boring ved hver af de 4 prøvetagningsrunder. De 5 benyttede pumper og slanger må ikke anvendes til andre formål under forløbet af projektet.

Pumper og slanger opbevares i separate rene klare plastposer imellem prøvetagningerne.

Rengøring af pumper:

Inden første prøvetagning skal pumperne vaskes udvendigt med børste, og pumpes igennem med rent lunkent vand.

Slange:

Hver af de 5 pumper skal monteres med en ny 8/10 mm teflonslange. Slangerne genanvendes til samme boring ved hver prøvetagningsrunde.

Målegris:

Under forpumpning skal vandet løbe gennem en målegris, hvori der er monteret sonder til registrering af ledningsevne, pH, temperatur og ilt-indhold.

Målesonderne skal være kalibreret og kontrolleret inden brug.

løbende registreres ledningsevne, pH, temperatur og ilt-indhold. Online parametrene skal registreres hver 3.-5. minut og straks nedskrives i skema (skemaer findes i orange mappe).

Placering af pumpe:

Pumpen skal forsigtigt placeres i filtret således, at pumpernes vandindtag er ud for de dybder der er opført i den orange mappe.

Pumpen trækkes langsomt lidt op og ned omkring prøvetagningspunktet for at fjerne gammelt vand, og evt. udfældningsprodukter i filtret, ca ½ m over og under prøvetagningspunktet. Der måles også med målegris under denne procedure.

Pejling:

Vandstanden i boringen skal pejles inden placering af pumpe, under forpumpning med 0,5 - 5 minutters interval, samt lige inden prøvetagningen.

Forpumpning:

- Forpumpningen skal ske ved **mikroforpumpning** (bekrevet s. 89 i "Håndbog i prøvetagning af jord og grundvand" fra AVJ).
- Der skal forpumpes med en tilstrækkelig lav ydelse til at sænkningen af vandspejlet i pumpeboringen **generelt ikke overstiger 0,1 m**.
- Under forpumpningen ledes vandet gennem målegrisen, og **hvert 3. - 5. minut** skal ledningsevne, pH, temperatur og ilt-indhold registreres, og straks nedskrives i feltskemaerne i den orange mappe.

Kriterier for stop af forpumpning:

Vandprøverne kan udtages når **ledningsevne** og **pH** er stabilt i 3 på hinanden følgende målinger.

Stabil ledningsevne = +/- 3% variation.

Stabilt pH = +/- 0,1

(Stabilt ilt-indhold = +/- 0,3 mg O₂/liter).

Prøvetagning:

Lige før prøvetagningen skal pumpeydelsen drosles ned så **vandspejlet i pumpeboringen stiger, og vandprøven udtages under stigende vandspejl**. Vandprøven udtages efter at der er oppumpet mindst 1 liter efter neddrosling af pumpen.

Vandspejlsstigningen under prøvetagningen skal dokumenteres ved pejlinger som skal noteres, og pumpeydelsen skal måles og noteres på feltskemaet.

Fyldning af prøveflasker:

Prøvetagningsslangen føres ned til bunden af flasken, og flasken fyldes helt op under en stille vandstrømning. Flaskerne fyldes så mindst 2 voluminer løber over inden slangen fjernes og flasken lukkes.

Flaskerne udstyres med labels.

ANNEKS B

**Skemaer med feltmålinger
og -observationer ved
vandprøvetagningen**

**Projekt 32294 – Vandprøvetagning i
Farum og Søborg for DHI**

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/02/12				
Boring: B17		DGU-nr.: 193.2277		Filterniveau (m.u.mp.): 8,2 – 15,2				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 15,03						
Pumpning	Kl.	Pumpe- dybde (m.u.mp.)	Pejling/af- sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vand- mængde	pH	Temp. (°C)	Lednings- evne (μ S/cm)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
	11:25		9,30									Målepunkt = terræn
Start	11:30	12,0	9,30	2,0		8,09	11,9	704	0,66	-	130	Uklar rødlig okker farve
	11:35	11,5	9,36	1,2		7,27	13,6	699	0,26	-	128	do.
	11:40	12,5	9,37	1,2		7,18	14,0	686	0,16	-	129	Let uklar, svag farve
	11:45	12,0	9,35	1,2		7,20	14,5	691	0,40	-	130	do.
	11:55	12,0	9,36	1,2		7,13	14,7	688	0,15	-	135	Klar, der er meget fint sand i
	12:10	12,0	9,38	1,2		7,12	14,7	714	0,12	-	135	boringen, svært at holde den
	12:15	12,0	9,35	1,2		7,10	14,7	713	0,13	-	135	lave ydelse, pumpe slår fra
	12:25	12,0	9,38	1,2		7,12	14,8	739	0,10	-	135	do.
	12:27	12,0	9,38	1,2		7,13	14,5	763	0,09	-	135	do.
	12:33	12,0	9,37	1,2		7,11	14,4	769	0,09	-	135	do.
Stop	12:44	12,0	9,33	0,8	Ca. 90 l	7,11	14,2	797	0,14	-	125	Klar, prøve taget

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/02/18				
Boring: B17		DGU-nr.: 193.2277		Filterniveau (m.u.mp.): 8,2 – 15,2				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 15,03						
Pumpning	Kl.	Pumpe- dybde (m.u.mp.)	Pejling/af- sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vand- mængde	pH	Temp. (°C)	Lednings- evne (μ S/cm)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	11:58	11,5	9,29	1,2		9,15	8,9	718	3,73	-	128	Uklar rødlig okker farve
	12:02	11,5	9,34	1,2		7,15	13,7	686	0,40	-	128	do.
	12:05	10,5	9,33	1,8		7,12	13,9	693	0,37	-	136	Let uklar, svag farve, fint sand
	12:10	11,0	9,38	1,8		7,10	13,6	666	0,22	-	136	Let uklar
	12:15	11,0	9,41	1,6		7,14	13,6	673	0,14	-	133	Klar, fint sand i vandet
	12:18	11,0	9,39	1,6		7,11	11,7	548	0,14	-	133	do. led.evne usikker
	12:26	11,0	9,39	1,6		7,13	13,8	715	0,11	-	133	do.
	12:33	11,0	9,39	1,6		7,12	13,8	731	0,11	-	133	do.
	12:44	11,0	9,31	0,6		7,12	13,7	751	0,10	-	124	do . + prøve
Stop	12:48				Ca. 60 l							

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/02/24				
Boring: B17		DGU-nr.: 193.2277		Filterniveau (m.u.mp.): 8,2 – 15,2				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 15,03						
Pumpning	Kl.	Pumpe- dybde (m.u.mp.)	Pejling/af- sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vand- mængde	pH	Temp. (°C)	Lednings- evne (μ S/cm)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	11:22	11,0	9,31	1,2		8,06	9,8	738	3,59		128	Uklar, rødlig okker farve
	11:26	11,0	9,35	1,8		7,15	13,5	672	1,07		133	do. lidt fint sand
	11:32	11,5	9,38	1,8		7,11	14,1	686	0,28		133	Let uklar, fint sand
	11:40	10,5	9,38	1,9		7,08	14,9	675	0,54		135	Klar
	11:44	11,0	9,41	1,9		7,11	13,8	684	0,14		135	do.
	11:50	11,0	9,42	1,9		7,11	13,8	692	0,12		135	do.
	11:56	11,0	9,33	0,8		7,12	13,6	715	0,23		125	do . + prøve
Stop	12:00				Ca. 60 l							

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/03/02				
Boring: B17		DGU-nr.: 193.2277		Filterniveau (m.u.mp.): 8,2 – 15,2				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 15,03						
Pumpning	Kl.	Pumpedybde (m.u.mp.)	Pejling/af-sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vandmængde	pH	Temp. (°C)	Lednings-evne ($\mu\text{S}/\text{cm}$)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	8:15	11,0	9,23	1,8		7,86	10,9	682	1,5		135	Uklar, rødlig-gul okker farve
	8:20	11,5	9,32	1,6		7,17	13,2	661	0,18		133	Let uklar, fint sand
	8:25	10,5	9,31	1,6		7,28	15,3	673	0,19		133	Næsten klar, lidt fint sand
	8:30	11,0	9,32	1,6		7,26	16,3	667	0,21		134	Klar
	8:35	11,0	9,33	1,6		7,14	13,6	674	0,11		134	do.
	8:40	11,0	9,35	1,6		7,15	13,4	692	0,10		134	do.
	8:45	11,0	9,27	0,9		7,16	13,4	687	0,11		125	do . + prøve
Stop	8:50				Ca. 50 l							

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/02/12				
Boring: B18		DGU-nr.: 193.2278		Filterniveau (m.u.mp.): 8,3 – 15,3				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 15,10						
Pumpning	Kl.	Pumpe- dybde (m.u.mp.)	Pejling/af- sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vand- mængde	pH	Temp. (°C)	Lednings- evne ($\mu\text{S}/\text{cm}$)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
	8:32		9,18									Målepunkt = terræn
Start	9:05	12,0	9,18	0,5		7,49	18,2	768	4,01	-	126	Kan ikke bruge målegris ved
	9:55	12,0	9,26	1,0		7,31	16,3	723	0,18	-	135	Så lav ydelse. Der er brugt tid
	10:08	12,0	9,29	1,2		7,29	14,5	723	0,14	-	130	På at teste systemet og ind-
	10:15	12,0	9,29	1,2		7,65	14,6	729	0,06	-	130	køre det. Under forpump.
	10:23	12,0	9,29	1,2		7,68	14,6	728	0,05	-	130	Har pumpe været i samme
	10:31	12,0	9,29	1,2		7,26	14,6	729	0,05	-	130	dybde. Der er pumpet
	10:35	12,0	9,29	1,2		7,26	14,6	732	0,06	-	130	væsentligt flere liter end
	10:50	12,0	9,21	0,6	ca. 90 l	7,28	16,5	731	0,10	-	122	planlagt. Klart vand. Prøvetagn.
												Målegris opgivet, flaske er
												herefter anvendt som gris.
Stop	10:58				Ca. 95 l							

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/02/18				
Boring: B18		DGU-nr.: 193.2278		Filterniveau (m.u.mp.): 8,3 – 15,3				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 15,10						
Pumpning	Kl.	Pumpe- dybde (m.u.mp.)	Pejling/af- sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vand- mængde	pH	Temp. (°C)	Lednings- evne ($\mu\text{S}/\text{cm}$)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	13:02	12,0	9,19	1,8		7,82	8,9	761	1,59	-	135	Let uklar rød-gul farve
	13:05	12,0	9,31	2,0		7,29	13,7	720	0,29	-	138	do.
	13:10	12,5	9,31	1,8		7,29	13,9	709	0,28	-	134	Let uklar
	13:14	11,5	9,31	1,8		7,25	13,6	731	0,17	-	134	Klar
	13:20	12,0	9,31	1,8		7,26	13,6	711	0,11	-	134	do.
	13:25	12,0	9,31	1,8		7,25	11,7	716	0,09	-	134	do.
	13:30	12,0	9,31	1,8		7,32	13,8	718	0,08	-	134	do.
	13:35	12,0	9,31	1,8		7,33	13,8	720	0,08	-	134	do.
	13:38	12,0	9,31	1,8		7,29	13,7	721	0,08	-	134	do.
	13:40	12,0	9,20	0,6		7,25	13,7	721	0,10	-	123	Klar +prøve
Stop	13:42				Ca. 75 l							

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/02/24				
Boring: B18		DGU-nr.: 193.2278		Filterniveau (m.u.mp.): 8,3 – 15,3				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 15,10						
Pumpning	Kl.	Pumpe- dybde (m.u.mp.)	Pejling/af- sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vand- mængde	pH	Temp. (°C)	Lednings- evne (μ S/cm)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	12:10	12,0	9,21	1,8		9,03	11,2	1183	1,83	-	135	Let uklar rød-gul farve
	12:14	12,0	9,32	1,8		7,45	13,5	725	0,22	-	135	do.
	12:18	12,5	9,34	1,8		7,29	13,8	716	0,13	-	135	Let uklar
	12:24	11,5	9,33	1,8		7,26	13,8	724	0,13	-	135	Klar
	12:30	12,0	9,34	1,8		7,25	13,8	725	0,11	-	135	do.
	12:35	12,0	9,34	1,8		7,24	13,9	731	0,09	-	135	do.
	12:38	12,0	9,23	0,6		7,29	13,8	729	0,10	-	124	Klar +prøve
Stop	12:42				Ca. 50 l							

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/03/02				
Boring: B18		DGU-nr.: 193.2278		Filterniveau (m.u.mp.): 8,3 – 15,3				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 15,10						
Pumpning	Kl.	Pumpe-dybde (m.u.mp.)	Pejling/af-sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vand-mængde	pH	Temp. (°C)	Lednings-evne ($\mu\text{S}/\text{cm}$)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	9:00	12,0	9,13	1,8		8,78	11,1	760	0,96	-	135	Let uklar rød-gul farve
	9:05	12,0	9,23	1,8		7,51	13,1	732	0,23	-	135	do.
	9:10	12,5	9,27	1,8		7,34	13,8	719	0,22	-	135	Uklar ingen farve
	9:15	11,5	9,28	1,8		7,30	14,2	751	0,14	-	135	Klar
	9:20	12,0	9,28	1,8		7,27	13,8	732	0,08	-	135	do.
	9:25	12,0	9,28	1,8		7,27	13,8	733	0,08	-	135	do.
	9:30	12,0	9,28	1,8		7,26	13,9	734	0,08	-	122	do.
	9:35	12,0	9,17	0,6		7,28	14,1	732	0,07	-		Klar +prøve
Stop	9:40				Ca. 66							

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/02/12				
Boring: C8		DGU-nr.: 201.5855		Filtterniveau (m.u.mp.): 11,5 – 15,0				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 14,67						
Pumpning	Kl.	Pumpe- dybde (m.u.mp.)	Pejling/af- sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vand- mængde	pH	Temp. (°C)	Lednings- evne (μ S/cm)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	13:48	13,0	9,05	1,8		8,44	9,8	1970	1,38	-	130	Felt målingerne er foretaget
	13:52	13,0	9,08	1,5		7,06	13,7	2013	0,31	-	128	I 500 ml redcap flaske
	13:58	13,5	9,08	1,5		6,88	14,2	2041	0,42	-	128	Dette gælder for alle boringer
	14:04	12,5	9,08	1,2		7,07	14,1	2017	0,36	-	125	
	14:10	13,0	9,08	1,2		7,00	14,8	2045	0,30	-	125	
	14:14	13,0	9,08	1,2		6,99	14,7	2067	0,29	-	125	
	14:20	13,0	9,08	1,2		7,01	14,8	2071	0,27	-	125	
	14:25	13,0	9,08	1,2		7,01	14,8	2091	0,30	-	125	
	14:31	13,0	9,04	0,8		7,00	15,6	2069	0,80	-	120	Klar prøve udtaget
Stop	14:34				Ca. 55 l							

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/02/18				
Boring: C8		DGU-nr.: 201.5855		Filterniveau (m.u.mp.): 11,5 – 15,0				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 14,67						
Pumpning	Kl.	Pumpe- dybde (m.u.mp.)	Pejling/af- sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vand- mængde	pH	Temp. (°C)	Lednings- evne (μ S/cm)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	8:18	13,0	9,06	1,5		7,68	10,5	2043	2,67	-	126	Let uklar, rådden lugt
	8:21	13,0	9,08	1,5		7,05	13,8	2171	0,48	-	126	do.
	8:26	13,5	9,09	1,5		6,90	14,7	2176	0,29	-	126	Klar, svag rådden lugt
	8:30	12,5	9,09	1,5		6,94	14,4	2159	0,25	-	126	Let uklar, grumset +lugt
	8:35	13,0	9,09	1,5		6,96	15,1	2148	0,20	-	126	Klar, svag rådden lugt
	8:40	13,0	9,09	1,5		6,95	15,2	2149	0,19	-	126	do.
	8:45	13,0	9,06	0,8		6,96	15,1	2150	0,18	-	120	do. prøve udtaget
Stop	8:48				Ca. 45 l							

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/02/24				
Boring: C8		DGU-nr.: 201.5855		Filterniveau (m.u.mp.): 11,5 – 15,0				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 14,67						
Pumpning	Kl.	Pumpe- dybde (m.u.mp.)	Pejling/af- sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vand- mængde	pH	Temp. (°C)	Lednings- evne (μ S/cm)	Itt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	8:08	13,0	9,09	1,8		8,52	9,1	1868	5,40	-	130	Let uklar, rådden lugt
	8:12	13,0	9,13	1,5		7,13	13,4	1971	0,37	-	128	do.
	8:18	13,5	9,13	1,5		7,04	13,9	1852	0,24	-	128	do.
	8:24	12,5	9,13	1,5		7,04	13,8	1783	0,19	-	128	Klar, let rådden lugt
	8:30	13,0	9,13	1,5		7,03	14,5	1812	0,18	-	128	do.
	8:35	13,0	9,13	1,5		7,01	14,8	1831	0,19	-	128	do.
	8:39	13,0	9,13	1,5		7,01	14,9	1824	0,19	-	128	do.
	8:44	13,0	9,10	0,6		7,00	15,1	1833	0,17	-	120	do. prøve udtaget
Stop	8:46				Ca. 57 l							

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/03/02				
Boring: C8		DGU-nr.: 201.5855		Filterniveau (m.u.mp.): 11,5 – 15,0				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 14,68						
Pumpning	Kl.	Pumpe- dybde (m.u.mp.)	Pejling/af- sækning (m.u.mp.)	Ydelse (l/min)	Pumpet vand- mængde	pH	Temp. (°C)	Lednings- evne (μ S/cm)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	11:12	13,0	9,06	1,8		8,94	9,8	1530	3,04	-	130	Uklar, rådden lugt
	11:15	13,0	9,11	1,8		7,53	11,8	1720	0,58	-	130	do.
	11:20	13,5	9,11	1,8		6,99	14,4	2081	0,19	-	130	Let uklar rådden lugt
	11:30	12,5	9,11	1,8		6,99	14,5	2082	0,19	-	130	Klar, let rådden lugt
	11:40	13,0	9,11	1,8		7,20	14,5	2100	0,14	-	130	do.
	11:45	13,0	9,11	1,8		7,10	14,5	2112	0,13	-	130	do.
	11:50	13,0	9,11	1,8		7,00	14,5	2113	0,13	-	130	do.
	11:55	13,0	9,09	0,6		6,99	15,5	2121	0,16	-	122	do. prøve udtaget
	11:59				Ca. 80 l							

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/02/12				
Boring: C11		DGU-nr.: 201.5851		Filterniveau (m.u.mp.): 7,0 – 13,0				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 12,94						
Pumpning	Kl.	Pumpe- dybde (m.u.mp.)	Pejling/af- sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vand- mængde	pH	Temp. (°C)	Lednings- evne ($\mu\text{S}/\text{cm}$)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	15:58	11,0	9,10*	1,4		7,19	11,2	1860	2,31	-	130	Uklar rødlig okker farve
	16:01	11,0	9,08	1,4		6,80	13,4	1882	0,60	-	130	do.
	16:06	10,5	9,16**	1,4		6,76	14,2	1933	0,40	-	130	Let uklar ingen farve
	16:12	11,5	9,16**	1,8		6,78	13,8	2015	0,38	-	130	Let uklar ingen farve
	16:20	11,0	9,08	1,4		6,76	14,1	2029	0,36	-	130	Klar
	16:24	11,0	9,08	1,4		6,77	14,1	2032	0,37	-	130	do.
	16:30	11,0	9,08	1,4		6,78	14,1	2041	0,36	-	130	do.
	16:38	11,0	9,04	0,6		6,78	16,0	1998	0,95	-	120	do. prøve udtaget
Stop	16:42				Ca. 60 l							

* Muligvis fejl, skulle muligvis være 9,01 m u. mp. ** Muligvis fejl, skulle muligvis være 9,06 m u. mp.

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/02/18				
Boring: C11		DGU-nr.: 201.5851		Filterniveau (m.u.mp.): 7,0 – 13,0				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 12,94						
Pumpning	Kl.	Pumpe-dybde (m.u.mp.)	Pejling/af-sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vand-mængde	pH	Temp. (°C)	Lednings-evne ($\mu\text{S}/\text{cm}$)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	10:38	11,0	9,02	1,4		8,58	9,1	2065	3,02	-	128	Let uklar, svag rødlig farve
	10:42	11,0	9,06	1,4		7,16	9,8	2028	0,56	-	128	do.
	10:48	10,5	9,07	1,4		6,76	10,7	2029	0,34	-	128	Klar
	10:52	11,5	9,06	1,4		6,72	15,4	2000	0,50	-	128	do.
	10:57	11,0	9,06	1,4		6,75	14,7	2087	0,39	-	128	do.
	11:02	11,0	9,07	1,4		6,74	14,4	2089	0,35	-	128	do.
	11:08	11,0	9,07	1,4		6,78	14,4	2090	0,36	-	128	do.
	11:13	11,0	9,04	0,6		6,75	15,1	2078	0,41	-	121	do. prøve udtaget
Stop	11:17				Ca. 50 l							

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/02/24				
Boring: C11		DGU-nr.: 201.5851		Filterniveau (m.u.mp.): 7,0 – 13,0				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 12,94						
Pumpning	Kl.	Pumpe- dybde (m.u.mp.)	Pejling/af- sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vand- mængde	pH	Temp. (°C)	Lednings- evne (μ S/cm)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	10:10	11,0	8,86	1,4		7,70	10,2	2149	2,35	-	128	Let uklar, svag rødlig farve
	10:14	11,0	8,90	1,4		6,80	13,3	2128	0,61	-	128	do.
	10:20	11,5	8,91	1,4		6,78	14,1	2163	0,64	-	128	Næsten klar
	10:25	10,5	8,91	1,4		6,71	14,5	2135	0,82	-	128	Klar
	10:30	11,0	8,91	1,4		6,71	14,3	2194	0,74	-	128	do.
	10:35	11,0	8,91	1,4		6,72	14,3	2192	0,71	-	128	do.
	10:42	11,0	8,91	1,4		6,76	14,3	2201	0,71	-	128	do.
	10:45	11,0	8,88	0,6		6,78	14,8	2197	0,69	-	121	do. prøve udtaget
Stop	10:48				Ca. 50 l							

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/03/02				
Boring: C11		DGU-nr.: 201.5851		Filterniveau (m.u.mp.): 7,0 – 13,0				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 12,94						
Pumpning	Kl.	Pumpe- dybde (m.u.mp.)	Pejling/af- sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vand- mængde	pH	Temp. (°C)	Lednings- evne ($\mu\text{S}/\text{cm}$)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	12:15	11,0	8,61	1,4		8,10	9,2	2262	4,3	-	128	Let uklar, rødgul farve
	12:20	11,0	8,66	1,4		6,86	13,4	2227	0,48	-	128	do.
	12:25	10,5	8,66	1,4		6,82	14,0	2231	1,01	-	128	Klar
	12:30	11,5	8,65	1,4		6,86	14,0	2260	1,10	-	128	do.
	12:40	11,0	8,65	1,4		6,83	14,0	2272	1,06	-	128	do.
	12:45	11,0	8,65	1,4		6,84	14,1	2289	0,97	-	128	do.
	12:50	11,0	8,65	1,4		6,84	14,0	2291	0,92	-	128	do.
	12:55	11,0	8,63	0,6		6,84	14,7	2301	0,92	-	122	do. prøve udtaget
Stop	12:58				Ca. 60 l							

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/02/12				
Boring C14		DGU-nr.: 201.5858		Filterniveau (m.u.mp.): 6,0 – 13,0				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 12,32						
Pumpning	Kl.	Pumpedybde (m.u.mp.)	Pejling/af-sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vandmængde	pH	Temp. (°C)	Lednings-evne ($\mu\text{S}/\text{cm}$)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	14:48	11,5	9,56	1,4		8,23	9,7	11213	2,74	-	130	Sort, kraftig olielugt
	14:52	11,5	9,71	1,4		7,02	14,1	2032	0,42	-	130	Grå, kraftig olie lugt
	14:56	11,0	9,72	1,4		6,96	15,0	1935	0,21	-	130	Delvis klar, m. sorte flager
	15:02	12,0	9,63	1,4		6,98	14,8	1909	0,17	-	130	og svagere olie lugt
	15:10	11,5	9,64	1,4		6,98	14,9	1878	0,15	-	130	do.
	15:15	11,5	9,64	1,4		6,98	14,9	1874	0,14	-	130	do.
	15:18	11,5	9,64	1,4		6,97	14,9	1877	0,14	-	130	Klar, svarlig olie lugt
	15:28	11,5	9,60	0,8		6,99	16,0	1821	0,20	-	123	do. prøve udtaget
Stop	15:30				Ca. 60 l							

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/02/18				
Boring C14		DGU-nr.: 201.5858		Filterniveau (m.u.mp.): 6,0 – 13,0				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 12,32						
Pumpning	Kl.	Pumpedybde (m.u.mp.)	Pejling/afsænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vandmængde	pH	Temp. (°C)	Lednings-evne ($\mu\text{S}/\text{cm}$)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	9:10	11,3	9,58	1,4		7,84	9,4	2146	1,73	-	128	Oliefilm, sort kraftig olielugt
	9:15	11,3	9,64	1,4		6,98	14,5	1882	0,42	-	128	Grå svagere olielugt
	9:20	10,8	9,64	1,4		6,95	15,3	1829	0,27	-	128	do.
	9:25	11,8	9,64	1,4		6,97	13,4	1925	0,16	-	128	Sort svag olielugt
	9:30	11,3	9,64	1,4		6,95	16,6	1858	0,17	-	128	Let sort +lugt
	9:40	11,3	9,64	1,4		7,35	15,5	1863	0,19	-	128	let uklar +lugt
	9:50	11,3	9,64	1,4		6,96	15,3	1876	0,18	-	128	Klar +lugt
	9:55	11,3	9,64	1,4		6,95	15,3	1879	0,18	-	128	Klar +lugt
	9:56	11,3	9,61	0,6		6,94	15,4	1873	0,17	-	124	Klar +lugt, prøve udtaget
Stop	9:59				Ca. 70 l							

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/02/24				
Boring C14		DGU-nr.: 201.5858		Filterniveau (m.u.mp.): 6,0 – 13,0				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 12,32						
Pumpning	Kl.	Pumpe- dybde (m.u.mp.)	Pejling/af- sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vand- mængde	pH	Temp. (°C)	Lednings- evne (μ S/cm)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	8:56	11,5	9,60	1,5		7,73	9,5	2139	2,53	-	129	Uklar grå olielugt
	9:00	11,5	9,65	1,5		7,01	14,0	1982	0,38	-	129	do.
	9:04	12,0	9,64	1,5		6,94	15,1	1976	0,24	-	129	Let uklar, olielugt
	9:10	11,0	9,65	1,5		6,93	15,3	1875	0,27	-	129	do.
	9:15	11,3	9,65	1,5		6,94	15,2	1921	0,18	-	129	do. lidt oliefilm
	9:20	11,3	9,65	1,5		6,94	15,5	1894	0,18	-	129	do.
	9:30	11,3	9,65	1,5		7,11	15,5	1900	0,17	-	129	Klar +lugt
	9:42	11,3	9,65	1,5		6,97	15,5	1900	0,17	-	129	do.
	9:45	11,3	9,61	0,4		6,98	15,6	1900	0,18	-	123	do. prøve udtaget
Stop	9:48				Ca.75 l							

VANDPRØVETAGNING

Prøvetagningsrapport

Projekt navn: Vandprøvetagning, Farum og Søborg		Projekt nr.: 32294		Udført af: MCK/NCH				Dato: 2009/03/02				
Boring C14		DGU-nr.: 201.5858		Filterniveau (m.u.mp.): 6,0 – 13,0				Diameter (mm): 63				
Anvendt pumpe: MP1		Slangemateriale: Teflon 8X10				Bund (m.u.mp.): 12,32						
Pumpning	Kl.	Pumpedybde (m.u.mp.)	Pejling/af-sænkning (m.u.mp.)	Ydelse (l/min)	Pumpet vand-mængde	pH	Temp. (°C)	Lednings-evne ($\mu\text{S}/\text{cm}$)	Ilt (mg/l)	Redox (mV)	Hz	Bemærkninger (farve og lugt af prøve)
												Målepunkt = terræn
Start	10:08	11,3	9,59	1,5		11,5	10,2	2328	2,3	-	128	Sort, olielugt
	10:12	11,3	9,64	1,5		7,04	14,1	2036	0,50	-	128	do.
	10:16	11,0	9,64	1,5		6,97	15,2	1872	0,20	-	128	Uklar, grå olielugt
	10:25	12,0	9,63	1,5		6,97	15,2	1896	0,17	-	128	do.
	10:30	11,3	9,64	1,5		6,98	15,3	1883	0,16	-	128	Let uklar grålig olielugt
	10:35	11,3	9,64	1,5		6,96	15,3	1898	0,15	-	128	Klar, svagere olielugt
	10:40	11,3	9,64	1,5		7,00	15,4	1897	0,15	-	128	do.
	10:45	11,3	9,64	1,5		6,97	15,3	1891	0,15	-	128	do.
	10:55	11,3	9,61	0,5		6,98	15,7	1909	0,16	-	123	do. prøve udtaget
	10:59				Ca. 75 l							

