SUSTAINABLE GROUNDWATER MONITORING SYSTEM OF EAST-VIRU COUNTY, ESTONIA

Norwegian Financial Mechanism project 52/2006-EE0010
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Authors:
L. Bityukova, R. Vaher, H. Schvede,
M. Bitjukov
Institute of Geology at Tallinn University of Technology

Monitoring of the groundwater pollution from point sources

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1. INTRODUCTION

This study was carried out in the frame of the Norwegian Financial Mechanism project 52/2006-EE0010 “Sustainable groundwater monitoring system of East-Viru County, Estonia” coordinated by the Ministry of Environment of Estonia.
One of the main aims of this project was get the objective information regarding groundwater state in Ida-Virumaa in the areas of active oil shale mining and processing, to estimate the impact on the groundwater composition and evaluate the contamination from the solid waste in the great amount disposed after oil shale thermal processing and burning. This project initiated by the Ministry of Environment of Estonia oriented on the implementation of the Water Framework Directive, the new Groundwater Directive of EU, as well as the Environmental Monitoring Law of Estonia.
After revision of the existing situation and identification of the gaps in the available groundwater monitoring system the project was aimed on its development. For that new monitoring wells were installed and equipped by the automatic monitoring devices. Obtained data were used for the hydrogeological and hydrochemical modeling in the mining areas, of the deeper (Cambrian-Vendian) aquifer and local pollution sources. New hydrochemical data obtained in this project permitted to develop and verify as regional as local hydrogeological and hydrochemical models.

Groundwater monitoring is the periodic sampling and analysis of changes in groundwater level and concentrations of chemical constituents, it forms one part of the geoecological monitoring sector. Dependent on the aim, monitoring can be divided into regional monitoring, point source monitoring, single aquifer monitoring, etc.
Information obtained through groundwater monitoring is needed for:

1) the assessment of the chemical status of a groundwater formation or a group of groundwater formations.

2) the assessment of the long term chemical changes in groundwater, derived from natural processes as well as anthropogenic influences.

Groundwater monitoring is essential in providing information to groundwater models, where the variables change continuously with respect to time.

One of the main aims of the project is the groundwater monitoring near the point source polluters. This monitoring included the observation of the previously drilled wells, drilling of new wells, monitoring of polluting organic compounds and chemical elements.

In Ida-Virumaa the main point source polluters generally associated with processing oil shale. From the groundwater pollution standpoint the most hazardous contamination is caused by activities which deal with the thermal processing of oil shale (mainly at Kiviõli Keemiatööstus situated in Kiviõli and Viru Keemia Grupp, situated in Kohtla-Järve) and combustion of oil shale at two world largest thermal power plants (Balti and Eesti), situated near to Narva and burned the oil shale for the electricity and heat production. Other potential point source polluters are much smaller, such as thermal power plant in Ahtme (and others), Narva Õlitehas, and other smaller businesses or are already closed as Sillamäe radioactive waste depository.

In the current project, groundwater monitoring was conducted in the area of Kiviõli Keemiatööstus and Viru Keemia Grupp and also on the industrial territories of the Balti and Eesti Thermal Power Plants. Groundwater wells are sampled three times per year: in spring, when the groundwater head is at its maximum, in summer when the groundwater level is at its lowest point and again in autumn when rainwater causes the increase in the groundwater level.

The sampling incorporated the following procedures:

a) The depth to the water table was determined using an electronic dip-meter;
b) Prior to sampling the wells were purged by pumps (MP-1) and temperature, electrical conductivity (EC), pH and O_2 content were measured simultaneously by HQ Series Portable Meter (Hach HQ40d multi). The accuracy of the temperature measurements was 0.1 ^{o}C, Electrical Conductivity – 1 mS/cm, pH – 0.01, O_2 content – 0.01 mg/L.
   The parameters were visually displayed and readings were recorded after pumping out of purge water, measuring the water level at the same time. Where the recharge capacity of the formation was slow, the necessary volume of water was pumped out by changing the pump to a less powerful one (Comet 24 V). The services were provided conform to DIN 38402-A13 and following to the Instruction (Proovivõtumeetodid, 2002)

c) Once the measured parameters were stabilized, groundwater samples were then taken in glass bottles (1L x 2 + 0.5 L) for organic compounds measurements and in 2 headspace HS-Vials (50 ml) for the volatile organics testing. The bottles and vials were specially cleaned and provided for the sampling by the GBA Gesellschaft fur Bioanalitik Hamburg MBH (Pinnerberg, Germany). Samples were described for presence of colour, smell, floating sediments and foam. In terms of appropriate preservation measures for the volatiles $CuSO_4$ was added into the vials prior to the shipment. The water samples were stored in refrigerators at 4 ^oC and ship in special cold storage boxes. The samples were analysed in the GBA Gesellschaft fur Bioanalitik Hamburg MBH (Pinnerberg, Germany) Laboratory for 121 organic compounds including monoaromatic hydrocarbons, volatile halogenated hydrocarbons, PAHs, chlorobensens, and phenols. The services were provided conform to DIN EN ISO/ICE 17025 accreditation standards.

For inorganic component analysis the water sample was taken in one headspace HS-Vials (50 ml) and filtered through a 0.45 mm filter. After filtering the samples were acidified with the ultrapure concentrated nitric-acid HNO_3 up to pH=2. The water samples were stored in refrigerators and sent using the TNT Express Worldwide post for analyses to the Certificated Acme Analytical Laboratories Ltd. (Vancouver, Canada). The Acme Lab Ltd. implemented a quality system compliant with the International Standards Organization (ISO) 9001 Model for Quality Assurance and ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories and operates a Quality Management System with the requirements of ISO 9001:2008. In the Acme Lab the water samples were analyzed by an ICP-MS technique for 70 major and trace elements.

Compared to earlier studies, the current project enables the monitoring of much wider range of constituents. As a result, the presence and level of wider range of new organic compounds (which determination was not possible earlier) are measured in analysed groundwater samples. For the first time a wider range of trace elements are analysed, including elements hazardous for humans.

The obtained results are presented in Tables 3-5, 11-13, 19-21 for organic compounds and in Tables 6-8, 14-16 and 22-24 for major and trace elements.

2. Groundwater monitoring near Kiviõli Oil shale Processing Plant

2.1. Geological settings

The Kiviõli area is flat, very slightly dipping to the north (north-east). The ground surface elevation ranges from 45 to 51 m a.s.l. Near the Chemical factory (Kiviõli Keemiatööstuse OÜ) located now two large semi-coke mounds. The deposition of semi-coke to oldest landfill was finished in the 1975. Now the semi-coke deposition takes place near to new landfills.

The Kiviõli area is located on the North-Estonian limestone plateau on the distance approximately 8 km from the Cliff (Klint). The semi-coke heaps are located in southern part of the Kiviõli area. In the south-east of the investigation area underground oil shale mining had taken place.

The thickness of the Quaternary deposits in Kiviõli area is very small and reaches 4 m in north-west. The information about the thickness of the Quaternary covers under the semi-coke heaps, is limited. At first the thickness of the natural Quaternary cover was 0.5–3 m, but it has been considerably changed in the result of oil shale mining, and formation of waste depositories. In vicinity of the semi-coke heaps the underlying rocks are presented mainly by loam or sandy loam. In the north-west of Kiviõli area the tills are overlain by up to 3 m thick bed of glaciolacustrine clay and silt, and these in turn by fen peat. In the southern part the natural till bed is often covered with technogenous soils.

The first from surface *Quaternary aquifer (Q)* is presented by peat, clayey and sandy loam and moraine and has low the thickness (from 0.5 up to 4 m). By this reason the water filling of the quaternary deposit has a very local character. The filtration coefficient varies in the limits of 0.0n-1m/d. Due to low thickness of quaternary deposits the rainfall and melted snow filters directly to the carbonate rocks of Kukruse Stage or accumulates in the boggy areas where the infiltration is limited by the clay and loam with very low filtration properties.

The next, *Keila-Kukruse aquifer (O_3kl-O_3kk)* is presented by very fissured limestone with thickness of 3-12 m. The water table has the depth 1-2 m in the northern part of studied area and increase up to 10-12 m (43-45m a.s.l.) to the south. The coefficient of filtration varies from 10 up to 25 m/d. The high jointing of the carbonates causes their high water filling. The water of this aquifer is not protected from the pollution.

Lasnamäe–Kunda aquifer (O_2ls-O_{1-2}kn) is represented by limestone, domerites and dolomites with thickness of 20 m. The depth of bedding is 20-25 m from the surface. The water table is on the depth of 2-3.5 m in the north and increases in the south. It is combining with

groundwater level of Keila-Kukruse aquifer in the area of underground mining (43-45 m a.s.l.).

Cambrian-Ordovician aquifer (O_1pk-$Є_1$ts) is presented by the sand- and siltstones and lie on the depth of 45-50 m under ground surface. The thickness of the aquifer is up to 30 m. The water is under pressure. The difference in piesometric level of Lasnamäe–Kunda aquifer showed that Lower Ordovician aquitard protect well the water of this aquifer from the inflow of pollutants. The water from this aquifer is used for the water supply of Kiviõli.

2.2 Results of monitoring

In the area of Kiviõli Keemiatööstus the groundwater of the Ordovician (O), Ordovician-Cambrian (O-C) and Cambrian-Vendian (C-V) aquifers are monitored. Figure 1 illustrated location of wells studied. Totally the groundwater from 12 wells was sampled: two from them opened Ordovician aquifer, six - Ordovician-Cambrian and four - Cambrian-Vendian aquifers (Table 1).

The depth of the wells opening the deepest *Cambrian-Vendian (C-V)* aquifer in this area reaches down to 250m and wells were installed drilled approximately 50 years ago. The wells are equipped by the special constantly installed pumps, which allow pumping of groundwater at the earth surface. The groundwater level is 70-71 m and measured one time per year by the specialist from the Environmental department of the Kiviõli Oil shale Processing Plant. Variation of main physical-chemical parameters prior groundwater sampling was not significant (Fig. 2). TDS concentration of groundwater is stable from spring to autumn and varies slightly between 425 to 453 mg/l. Similarly, pH shows stable results, being between slightly alkaline (pH = 7.5-7.9) in spring and in autumn (pH = 7.7-7.8) period, with a slight decrease in summer (pH is stable - 7.4) (Table 2). The groundwater of Cambrian-Vendian aquifer is characterised by higher values of TDS relative to upper aquifer independent on the season when the sampling was carried out (Fig. 3). The pH of water was also higher than in upper aquifer, especially in spring and autumn. In summer time the pH of the Cambrian-Vendian aquifer is similar to pH of the Ordovician-Cambrian aquifer in autumn. No correlation between TDS values and pH, temperature and O_2 content was revealed in groundwater of the Ordovician and Cambrian-Vendian aquifers.

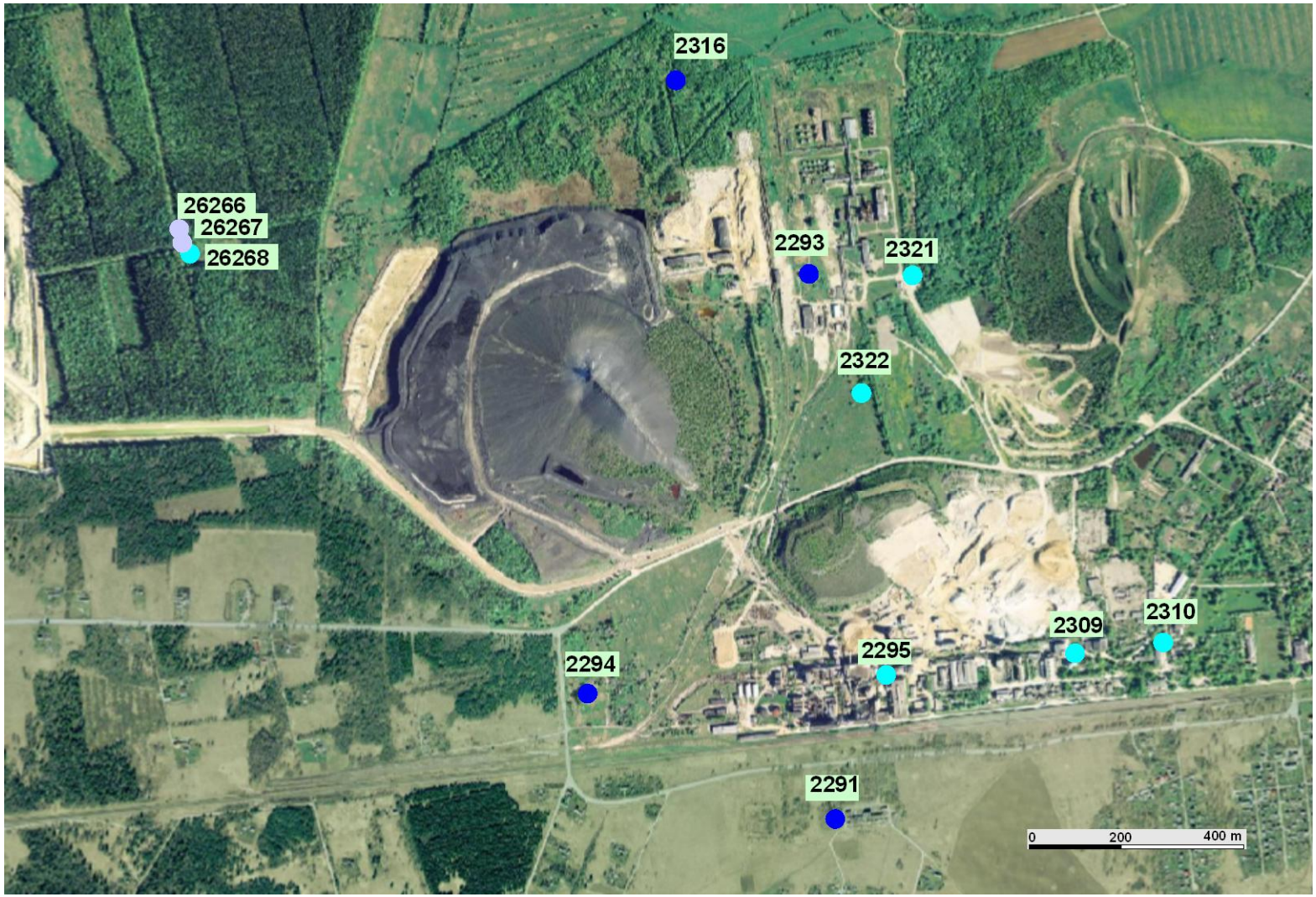

Fig. 1. Location of monitoring wells near waste landfills in Kiviõli area

Legend: grey circles - wells opened Ordovician aquifer; blue circles – wells opened Ordovician –Cambrian aquifer; dark blue circles – wells opened Cambrian – Vendian aquifer.

Table 1. Monitoring wells in the Kiviõli area

Well number		Index of aquifer	Depth, m	Year of instal-lation	Year of reno-vation	Location	Groundwater level	Coordinates Lambert-Est		Owner
Cadaster	Passport							x	y	
2291	558	Є - V	262.3	1958	not	Kiviõli (OSP & C) Plant	70.0	6582833	667146	Kiviõli (OSP & C) Plant
2293	A-146-B	Є - V	246.0	1962	not	Kiviõli (OSP & C) Plant	70.0	6584184	667108	Kiviõli (OSP & C) Plant
2294	A-7/1255	Є - V	245.0	1962	not	Kiviõli (OSP & C) Plant	71.0	6583142	666511	Kiviõli (OSP & C) Plant
2316	5470	Є - V	250.0	1984	not	Kiviõli (OSP & C) Plant	71,0	666748	6584705	Kiviõli (OSP & C) Plant
2295	1/1851	O - Є	75.0	1965	not	Kiviõli (OSP & C) Plant, territory of Electrical Power Plant (Power station)	23.0	6583197	667264	Kiviõli (OSP & C) Plant
2309	3553	O - Є	75.0	1973	not	Kiviõli (OSP & C) Plant (old boiler-house)	24.0	6583272	667748	Kiviõli (OSP & C) Plant
2310	3554	O - Є	75.0	1973	not	Kiviõli (OSP & C) Plant (old boiler-house)	24,0	667985	6583357	Kiviõli (OSP & C) Plant
2321	5158/5	O - Є	75.0	1982	not	Kiviõli (OSP & C) Plant (new formalin plant)	21.0	6584220	667321	Kiviõli (OSP & C) Plant
2322	5158/6	O - Є	75.0	1983	not	Kiviõli (OSP & C) Plant (new formalin plant)	22.0	6583895	667205	Kiviõli (OSP & C) Plant
26268		O - Є	75.0	2010	not	Kiviõli quarry	10.2	6584308	665497	Ministry of Env.
26266		O	15.0	2010	not	Kiviõli quarry	3.4	6584219	665494	Ministry of Env.
26267		O	40.0	2010	not	Kiviõli quarry	3.0	6584298	665500	Ministry of Env.

Table -2. Water table and physical parameters of the groundwater from the Ordovician (O), Ordovician-Cambrian (O-C) and Cambrian-Vendian (C-V) aquifers in monitoring wells near waste landfills in Kiviõli area

			Well											
		Cadaster number	**2291**	**2293**	**2294**	**2316**	**2295**	**2309**	**2310**	**2321**	**2322**	**26268**	**26266**	**26267**
		aquifer	C-V	V	C-V	C-V	O-C	O-C	O-C	O-C	O-C	O-C	O	O
	sampling													
6.-7.05.2010	I	TDS, mg/L	429,8	448,0	434,3		350,3	371,3		372,0	392,5			
	I	pH	7,5	7,5	7,9		7,7	6,9		7,0	7,2			
22.06.2010	II	TDS, mg/L	425,4		429,4	456,6	353,5	369,2						
	II	pH	7,4		7,4	7,4	7,4	7,1						
8.09.2010	III	TDS, mg/L	432,0		433,5	446,0	356,0	370,0	402,3			1914,5	1556,6	1098,4
	III	pH	7,7		7,8	7,7	7,6	7,4	7,5			6,9	6,9	7,3

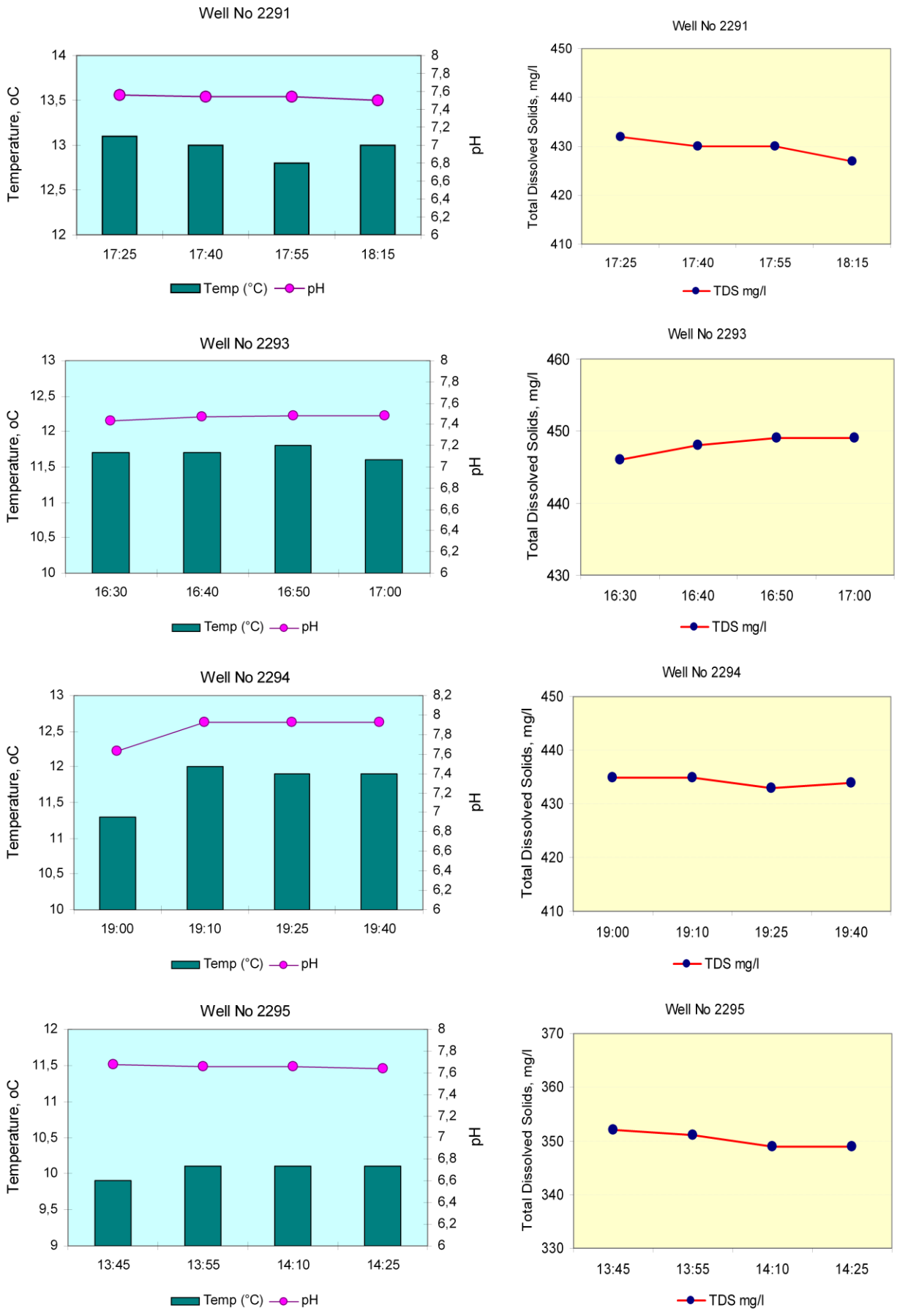

Fig. 2. Variation of pH, temperature and Total Dissolved Solids contents in the monitoring wells prior sampling of groundwater in Kiviõli.

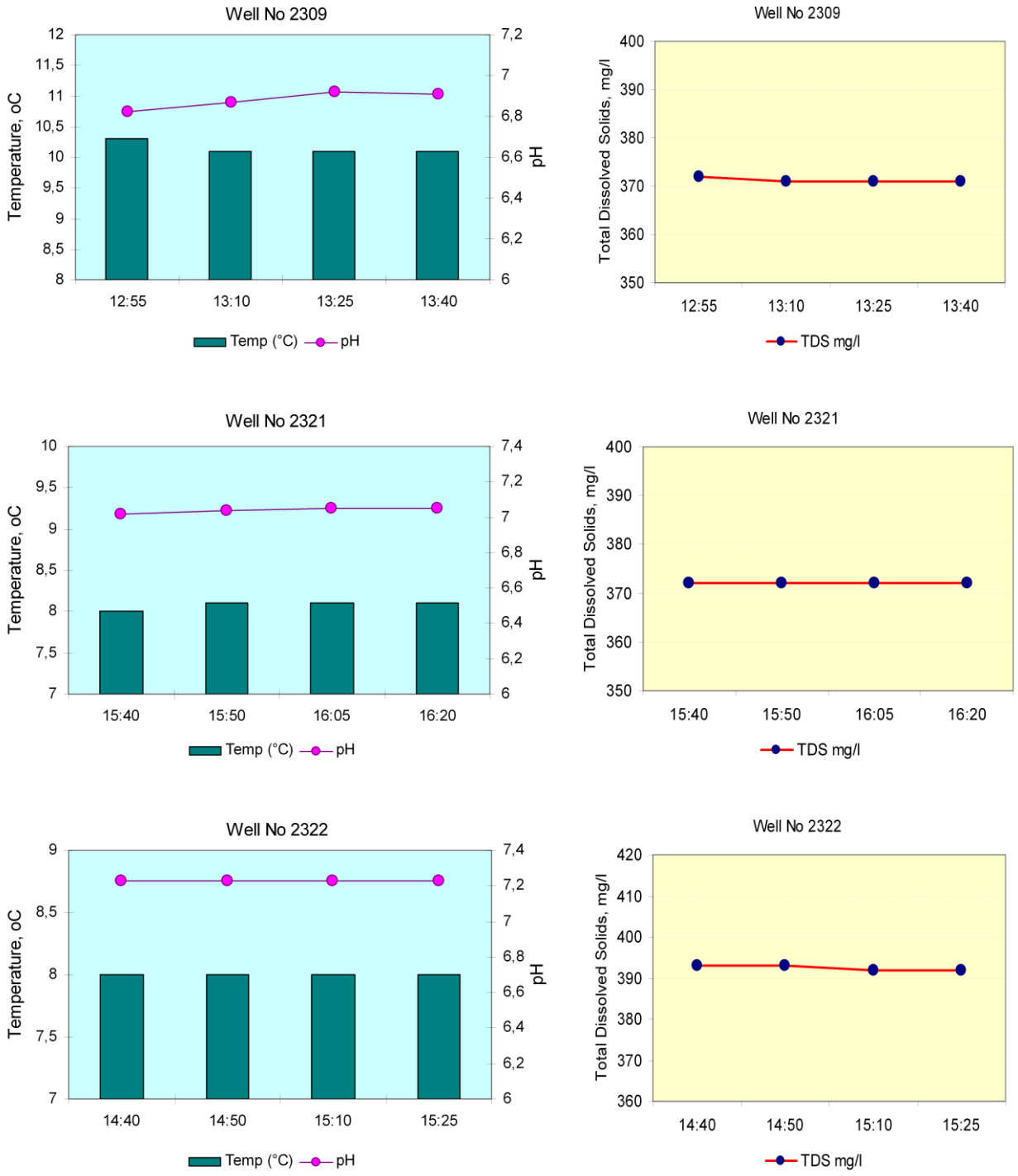

Fig. 2. Variation of pH, temperature and Total Dissolved Solids contents in the monitoring wells prior sampling of groundwater in Kiviõli (continued).

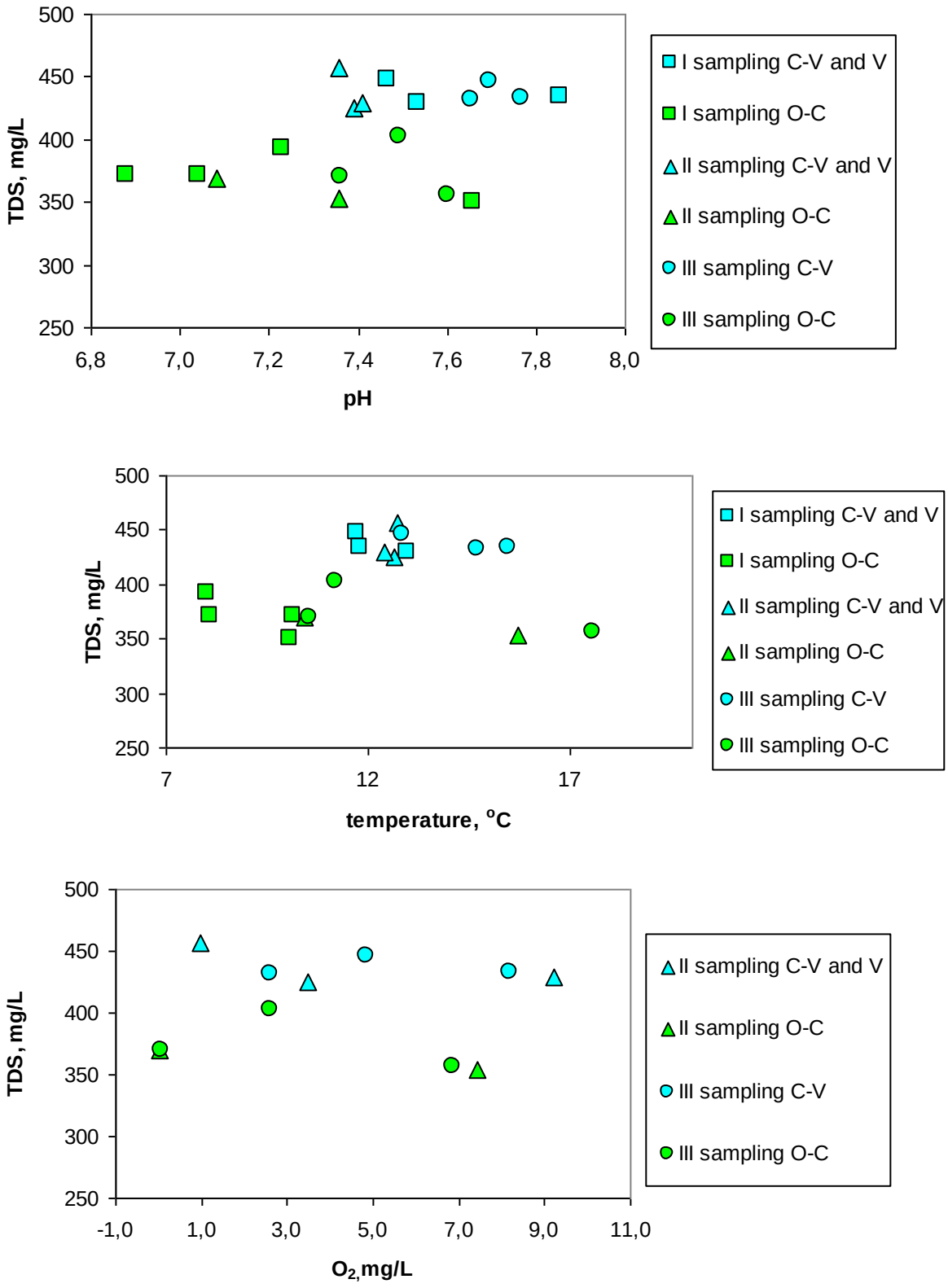

Fig. 3. Variation of TDS depending on pH, temperature and oxygen content in the groundwater of Ordovician-Cambrian (O-C) and Cambrian-Vendian (C-V) aquifers from monitoring wells near waste landfills in Kiviõli area

The water temperature varied in the limits of 12-17 ^{o}C and increased from spring to autumn. The temperature and pH stabilised very quickly (usually during 10-15 min) from starting of groundwater pumping.

Water quality in the Cambrian-Vendian (C-V) aquifer is good. Only in one well (nr 2294) traces of PAH (Naphthalene) were found in spring and autumn (Tables 3-5). In all other three monitoring wells the concentration of determined compounds are less than the laboratory detection limit (0.1 or 0.01 μg/l dependent on the determinant), which is much less than the legal permitted values set to hazardous substances (Pinnase..., 2004).

Trace elements concentrations in the Cambrian-Vendian aquifer are in the limits of Permitted values estimated for the groundwater (Pinnase..., 2004). The groundwater from this aquifer is characterised by the values of Ba, Cl, Mg, Na and V that are higher relative to the water from the Ordovician-Cambrian that reflects the specific geochemical features of groundwater composition formation in these aquifers (Tables 6-8).

Ordovician-Cambrian (O-C) aquifer is monitored at six wells, which open the formations at 75m (Fig. 1 and Table 1). Five wells were drilled during the period of 1965-1983 and one (nr 26268 - PA-11-1) was installed in 2010. Groundwater level in this formation is 22-24m, only in the well 26268 installed for the groundwater monitoring near to Kiviõli quarry it is 10.2m. TDS shows stable results in almost all the studied boreholes and in all three seasons sampled. The maximal value of TDS was estimated as 402.3 mg/L and minimal (350.3 mg/L) was determined the spring in the well nr. 2295. Only in one instance (well no 22628), drilled in summer 2010, the TDS was very high (1914.5 mg/l) (Fig. 2). This might be explained by the short time left for the stabilisation of the groundwater chemical composition after the drilling. This assumption is confirmed by the high concentration of TDS in other wells (opened upper aquifer) drilled during the same period and situated close to well no 22628.

The pH values varied from slightly acidic (the maximal value 7.7 in spring in well nr. 2295) to slightly alkaline (6.9 in spring (well 2309) and in autumn, well 26268) and are lower than in deeper aquifer. The temperature ranges from 7 oC in May to 17 oC in July and September (in the well 2295).

Tracers of PAHs are found in spring in two boreholes (2294 and 2309) (Table 3). There was revealed Naphtalene, in the amount of 0.026μg/L and 0.019μg/L respectively, that is significantly lower Estonian Permitted values for the groundwater (Pinnase..., 2004).

In all other four monitoring wells the concentration of determined compounds is less than the detection limit, which is much less than the allowed limits set for hazardous substances in groundwater (Pinnase..., 2004).

In summer in all monitoring wells opened the Ordovician-Cambrian aquifer no organic contamination has been detected in the collected water samples. In autumn the low amount (0.026 μg/L) of Naphtalene (PAH) was found in the well nr. 2309 but it is much lower than the level of contamination declared as hazardous (Pinnase..., 2004).

From the large spectrum of measured chemical elements the groundwater of Ordovician-Cambrian (O-C) aquifer have higher concentrations of B, K, Li, Mg, Rb and S in comparison with deeper aquifer (Tables 6-8). Estimated concentration for all measured elements are lower that Permitted values for trace elements according to Regulation (Pinnase..., 2004).

In summer of 2010 in Kiviõli area three new observation wells (cad. Nr 26266, 26267 and 26268 were installed). The wells Nr 26266 and 26267 have the depth 15 and 30m respectively, and opened the Keila-Kukruse (O_3kl–kk) and Lasnämae- Kunda (O_2ls–kn) aquifers. All of these wells are situated farthest from the semi-coke waste heaps but on the outskirts of the new quarry.

The shallowest *Ordovician (O) aquifers* are characterised by stable, near neural pH (6.9-7.3), however compared to deeper aquifers the pH in the Ordovician aquifer is little lower (Fig. 2). The TDS contents measured in these wells, 1556.6 and 1098.4 mg/L in the Keila-Kukruse and Lasnämae-Kunda aquifers respectively, are characterised by high values that could be explained by the short time running from wells installation that was not enough for the finest particles deposition.

These wells show no indications of contamination with organic compounds (Tables 3-5). All organic compounds that were tested in these wells in autumn of 2010 are less than the detection limit, which is much less than the allowed limits set for hazardous substances in groundwater (Pinnase..., 2004).

The groundwater the Keila-Kukruse and Lasnämae-Kunda aquifers is characterised by higher relative to deeper aquifers values of Ca, Cl, Br, K, Mg, Na, P, S and Sr (Tables 6-8). It could be noted that from quite a number of chemical elements measured in the groundwater the Permitted values are estimated only for 17 from them. At the same time estimated values of these chemical elements for the Ordovician (O) aquifer does not exceed the Permitted values for groundwater estimated according to Estonian Regulations (Pinnase..., 2004).

Table 3. Organic compounds concentrations in groundwater from the monitoring wells in Kiviõli area (May 2010)

Compound	Unit	DTL	Wells						
			2291	2293	2294	2295	2309	2321	2322
Mono aromatic hydrocarbons									
Benzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Ethylbenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Toluene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
o-Xylene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
m/p-Xylene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Xylenes (sum)	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Styrene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
1,2,4-Trimethylbenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
1,3,5-Trimethylbenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
n-Propylbenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Isopropylbenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
n-Butylbenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
sec-Butylbenzene 1	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
tert-Butylbenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
p-Isopropyltoluene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Volatile halogenated HCs									
Tetrachloromethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
1,2 Dichloroethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
1, 1, 1 -Trichloroethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
1, 1,2-Trichloroethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Trichloroethanes (sum)	µg/L	0.1	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
1, 1, 1,2-Tetrachloroethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
1, 1,2,2-Tetrachloroethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Tetrachloroethanes (sum)	µg/L	0.1	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Trichloroethene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Tetrachloroethene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
1,2-Dichloropropane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
1,3-Dichloropropane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
1,2,3-Trichloropropane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
1,1 -Dichloropropylene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
cis 1,3-Dichloropropylene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
trans 1,3-Dichloropropylene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
1,3-Dichloropropylenes (sum)	µg/L	0.1	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Dibromomethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
1,2-Dibromoethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Tribromomethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Bromodichloromethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Dibromochloromethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
1,2-Dibromo-3-chloropropane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Bromobenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1

Table 3. Organic compounds concentrations in groundwater from the monitoring wells in Kiviõli area (May 2010) (continued)

Compound	Unit	DTL	Wells						
			2291	**2293**	**2294**	**2295**	**2309**	**2321**	**2322**
Sum PAH (EPA)	µg/L		n.d.	n.d.	0.026	n.d.	0.019	n.d.	0.013
Sum PAH (cancerogenic)	µg/L		n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Naphthalene	µg/L	0.01	<0,010	<0,010	0.026	<0,010	0.019	<0,010	0.013
Acenaphthylene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Acenaphthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Fluorene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Phenanthrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benz(a)anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Chrysene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(b)fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(k)fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(a)pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Indeno(1,2,3-cd)pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Dibenz(ah)anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(g,h,i)perylene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Sum Chlorobenzenes	µg/L		n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
1-Chlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,4-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,2-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3,5-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,4-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,3-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,4,5-/1,2,3,5-Tetrachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,3,4-Tetrachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Pentachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Hexachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Sum PCB (6)	µg/L		n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum PCB (7)	µg/L		n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
PCB 28	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 52	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 101	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 118	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 153	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 138	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 180	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010

Table 3. Organic compounds concentrations in groundwater from the monitoring wells in Kiviõli area (May 2010) (continued)

Compound	Unit	DTL	Wells						
			2291	**2293**	**2294**	**2295**	**2309**	**2321**	**2322**
Chloronitrobenzenes									
o/p-Chloronitrobenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
m-Chloronitrobenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Monochloronitrobenzenes (sum)	µg/L	0,1	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2,3/3,4 -Dichloronitrobenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,4-Dichloronitrobenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,5-Dichloronitrobenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
3,5-Dichloronitrobenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Dichloronitrobenzenes (sum)	µg/L		n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum Chlorophenols	µg/L								
2-Chlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
3-Chlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
4-Chlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,6-Dichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,4/2,5-Dichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
3,5-Dichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,3-Dichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
3,4-Dichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,4,6-Trichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,3,6-Trichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,3,5-Trichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,4,5-Trichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,3,4-Trichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
3,4,5-Trichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,3,5,6-Tetrachlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,3,4,6-Tetrachlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,3,4,5-Tetrachlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Pentachlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
4-Chloro-3-methylphenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Phenols	µg/L								
Phenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
o-Cresol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
m-Cresol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
p-Cresol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Cresoles (sum)	µg/L								
2,6-Dimethylphenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,5-Dimethylphenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,4-Dimethylphenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
3,5-Dimethylphenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
3,4-Dimethylphenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
o-Ethylphenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
m-Ethylphenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Resorcine	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,5dimethylresorcine	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
5 methylresorcine	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Thymol, 5-Methyl-2-isopropyl-1-pheno	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1

Table 4. Chemical compound concentrations in groundwater from the monitoring wells in Kiviõli area (July, 2010)

Compound	Unit	DTL	Wells				
			2291	**2294**	**2295**	**2309**	**2316**
Mono aromatic hydrocarbons							
Benzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Toluene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Ethylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
o-Xylene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
m-,p-Xylene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
BTEX	µg/L	0.1	n.d.	n.d.	n.d.	n.d.	n.d.
Styrene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
1,2,4-Trimethylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
1,3,5-Trimethylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
n-Propylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
iso-Propylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
n-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
tert.-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
sec.-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
p-Isopropyltoluene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Volatile halogenated HCs							
1,1,1-Trichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Tetrachloromethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
1,2-Dichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Trichloroethene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
1,1,2-Trichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Tetrachloroethene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
1,2-Dichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Dibromochloromethan	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Bromodichloromethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Dibromoethane, (1,2-)	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
1,1,1,2-Tetrachloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
1,1,2,2-Tetrachloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
1,3-Dichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
cis-1,3-Dichloropropene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
trans-1,3-Dichloropropene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Tribromomethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
1,2-dibromo-3-chloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Trichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
1,1-Dichloro-1-propene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Dibromomethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Bromobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10

Table 4. Chemical compound concentrations in groundwater from the monitoring wells in Kiviõli area (July, 2010) (continued)

Compound	Unit	DTL	Wells				
			2291	**2294**	**2295**	**2309**	**2316**
Sum PAH (EPA)			n.d.	n.d.	n.d.	n.d.	n.d.
Sum PAH (cancerogenic)			n.d.	n.d.	n.d.	n.d.	n.d.
Naphthalene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Acenaphthylene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Acenaphthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Fluorene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Phenanthrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Benz(a)anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Chrysene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(b)fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(k)fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(a)pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Indeno(1,2,3-cd)pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Dibenz(ah)anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(g,h,i)perylene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Sum Chlorobenzenes	µg/L	0.01	n.d.	n.d.	n.d.	n.d.	n.d.
1-Chlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
1,3-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
1,4-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
1,2-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
1,3,5-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,4-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,3-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,4,5-/1,2,3,5-Tetrachloroben	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,3,4-Tetrachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Pentachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Hexachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
Sum PCB (6)			n.d.	n.d.	n.d.	n.d.	n.d.
Sum PCB (7)			n.d.	n.d.	n.d.	n.d.	n.d.
PCB 28	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 52	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 101	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 118	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 153	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 138	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 180	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010

Table 4. Chemical compound concentrations in groundwater from the monitoring wells in Kiviõli area (July, 2010) (continued)

Compound	Unit	DTL	Wells				
			2291	**2294**	**2295**	**2309**	**2316**
Chloronitrobenzenes							
o-/p-Chloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
m-Chloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,3-/3,4-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,4-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,5-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
3,5-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Chlorophenols							
2-Chlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
3-Chlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
4-Chlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,6-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,4/2,5-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
3,5-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,3-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
3,4-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,4,6-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,6-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,4,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,4-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
3,4,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,5,6-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,4,6-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,4,5-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Pentachlorphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
4-Chloro-3-methylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Phenols		0.1					
Phenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
o-Cresol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
m-Cresol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
p-Cresol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,6-Xylenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,5-Xylenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,4-Xylenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
3,5-Xylenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2-Ethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
3-Ethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
4-Ethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Resorcinol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
2,5-Dimethylresorcinol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
5-Methylresorcinol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10
Thymol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10

Table 5. Chemical compound concentrations in groundwater from the monitoring wells in Kiviõli area (September, 2010)

Compound	Unit	DTL	Wells								
			2291	**2294**	**2295**	**2309**	**2316**	**2310**	**PA-11-1**	**26266**	**26267**
Mono aromatic hydrocarbons											
Benzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Toluene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Ethylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
o-Xylene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
m-,p-Xylene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
BTEX	µg/L	0.1	n.d.	n.d.	n.d.	n.d.	n.n.	n.d.	n.d.	n.d.	n.d.
Styrene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,2,4-Trimethylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3,5-Trimethylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
n-Propylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
iso-Propylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
n-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
tert.-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
sec.-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
p-Isopropyltoluen	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Volatile halogenated HCs			n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
1,1,1-Trichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Tetrachloromethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,2-Dichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Trichloroethene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,1,2-Trichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Tetrachloroethene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,2-Dichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibromochloromethan	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Bromodichloromethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibromoethane, (1,2-)	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,1,1,2-Tetrachloroethan	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,1,2,2-Tetrachloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3-Dichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Trichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,1-Dichloro-1-propene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
cis-1,3-Dichloropropene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
trans-1,3-Dichloropropene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibromomethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Tribromomethan	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,2-dibromo-3-chloropropa	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Brombensen	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10

Table 5. Chemical compound concentrations in groundwater from the monitoring wells in Kiviõli area (September, 2010) (continued)

Compound	Unit	DTL	Wells								
			2291	**2294**	**2295**	**2309**	**2316**	**2310**	**PA-11-1**	**26266**	**26267**
Sum PAH (EPA)			n.d.	n.d.	n.d.	0.026	n.d.	n.d.	n.d.	n.d.	n.d.
Sum PAH (cancerogenic)			n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Naphthalene	µg/L	0.01	<0,010	<0,010	<0,010	0.026	<0,010	<0,010	<0,010	<0,010	<0,010
Acenaphthylene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Acenaphthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Fluorene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Phenanthrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benz(a)anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Chrysene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(b)fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(k)fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(a)pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Indeno(1,2,3-cd)pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Dibenz(ah)anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(g,h,i)perylene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Sum Chlorobenzenes	µg/L	0.01	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
1-Chlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,4-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,2-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3,5-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,4-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,3-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,4,5-/1,2,3,5-Tetrachlorol	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,3,4-Tetrachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Pentachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Hexachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Sum PCB (6)			n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum PCB (7)			n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
PCB 28	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 52	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 101	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 118	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 153	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 138	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 180	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010

Table 5. Chemical compound concentrations in groundwater from the monitoring wells in Kiviõli area (September, 2010) (continued)

Compound	Unit	DTL	Wells								
			2291	**2294**	**2295**	**2309**	**2316**	**2310**	**PA-11-1**	**26266**	**26267**
Chloronitrobenzenes											
o-/p-Chloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
m-Chloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3-/3,4-Dichloronitrobenze	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,4-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,5-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
3,5-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Chlorophenols			n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2-Chlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
3-Chlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
4-Chlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,6-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,4/2,5-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
3,5-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
3,4-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,4,6-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,6-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,4,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,4-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
3,4,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,5,6-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,4,6-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,4,5-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Pentachlorphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
4-Chloro-3-methylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Sum Alkylphenols		0.1	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Phenols	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
o-Cresol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
m-Cresol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
p-Cresol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,6-Xylenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,5-Xylenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,4-Xylenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
3,5-Xylenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2-Ethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
3-Ethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
4-Ethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Resorcinol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,5-Dimethylresorcinol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
5-Methylresorcinol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Thymol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10

Table 6. Chemical element concentrations in groundwater from the monitoring wells in Kiviõli area (May 2010)

Elements	Units	DTL	Wells						
			2291	**2293**	**2294**	**2295**	**2309**	**2321**	**2322**
Ag	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Al	ppb	1	4	5	4	4	4	4	4
As	ppb	0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Au	ppb	0.05	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
B	ppb	5	157	156	166	567	577	567	574
Ba	ppb	0.05	1958.97	2390.40	2126.67	444.29	450.70	110.21	490.96
Be	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bi	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Br	ppb	5	1720	1766	1704	781	1423	1654	2412
Ca	*ppm*	0.05	42.11	47.00	40.25	41.43	41.38	44.61	49.23
Cd	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ce	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cl	*ppm*	1	165	173	171	42	56	56	72
Co	ppb	0.02	4.50	0.11	0.15	0.37	0.07	0.06	0.09
Cr	ppb	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cs	ppb	0.01	0.02	0.01	0.01	0.01	0.01	<0.01	0.01
Cu	ppb	0.1	0.6	0.5	0.4	0.4	0.3	9.4	0.5
Dy	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Er	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Eu	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fe	ppb	10	81	44	16	63	81	128	<10
Ga	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Gd	ppb	0.01	0.02	0.01	0.02	<0.01	<0.01	<0.01	<0.01
Ge	ppb	0.05	0.37	0.43	0.43	0.12	0.09	0.10	0.07
Hf	ppb	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Hg	ppb	0.1	0.7	0.2	0.2	<0.1	<0.1	<0.1	<0.1
Ho	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
In	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
K	*ppm*	0.05	7.06	7.67	7.16	12.17	11.69	11.86	14.95
La	ppb	0.01	0.02	0.03	0.03	<0.01	<0.01	<0.01	<0.01
Li	ppb	0.1	10.2	9.8	10.0	26.4	27.0	24.7	24.1
Lu	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mg	*ppm*	0.05	15.17	16.92	14.66	28.71	30.93	31.16	34.02
Mn	ppb	0.05	76.60	65.20	72.09	43.86	47.75	52.35	47.55
Mo	ppb	0.1	0.7	0.8	0.6	0.3	0.3	0.3	0.3
Na	*ppm*	0.05	111.90	109.42	110.69	70.72	74.96	70.98	65.79
Nb	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nd	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ni	ppb	0.2	4.4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
P	ppb	20	<20	203	54	34	74	27	27
Pb	ppb	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	<0.1
Pd	ppb	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

Table 6. Chemical element concentrations in groundwater from the monitoring wells in Kiviõli area (May 2010) (continued)

Elements	Units	DTL	Wells						
			2291	**2293**	**2294**	**2295**	**2309**	**2321**	**2322**
Pr	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pt	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Rb	ppb	0.01	2.64	2.75	2.52	4.32	4.28	3.84	4.49
Re	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Rh	ppb	0.01	0.02	0.03	0.02	0.03	0.03	0.02	0.02
Ru	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
S	*ppm*	1	<1	<1	<1	20	18	15	14
Sb	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sc	ppb	1	<1	<1	<1	<1	<1	<1	<1
Se	ppb	0.5	6.0	6.0	5.9	3.0	5.7	6.3	8.8
Si	ppb	40	3063	3004	2972	3273	3242	3019	2892
Sm	ppb	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Sn	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sr	ppb	0.01	643.97	714.92	623.83	652.76	650.70	617.25	697.16
Ta	ppb	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Tb	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Te	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Th	ppb	0.05	0.08	0.06	<0.05	<0.05	<0.05	<0.05	<0.05
Ti	ppb	10	<10	<10	<10	<10	<10	<10	<10
Tl	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tm	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
U	ppb	0.02	<0.02	0.04	<0.02	0.05	0.08	0.15	0.07
V	ppb	0.2	0.6	0.7	0.7	<0.2	<0.2	<0.2	0.2
W	ppb	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Y	ppb	0.01	0.02	0.02	0.02	0.01	0.01	<0.01	0.01
Yb	ppb	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zn	ppb	0.5	214.2	122.4	134.6	113.5	105.4	19.0	99.6
Zr	ppb	0.02	0.02	0.02	<0.02	0.02	0.04	0.08	0.03

Table 7. Chemical element concentrations in groundwater from the monitoring wells in Kiviõli area (July, 2010)

Elements	Unit	DTL	Wells				
			2291	**2294**	**2295**	**2309**	**2316**
Ag	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Al	ppb	1	9	9	<1	<1	7
As	ppb	0.5	2.4	1.2	<0.5	<0.5	0.9
Au	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
B	ppb	5	250	183	745	680	166
Ba	ppb	0.05	2649.9	2960	47.34	46.39	3824.2
Be	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bi	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Br	ppb	5	1859	1976	883	1530	2301
Ca	*ppm*	0.05	43.33	45.27	44.93	45.84	48.06
Cd	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ce	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cl	*ppm*	1	190	207	46	59	226
Co	ppb	0.02	0.06	0.07	<0.02	<0.02	0.08
Cr	ppb	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cs	ppb	0.01	0.02	0.02	0.02	0.01	0.01
Cu	ppb	0.1	0.6	0.7	1.4	0.4	0.7
Dy	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Er	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Eu	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fe	ppb	10	<10	<10	<10	<10	18
Ga	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Gd	ppb	0.01	0.01	0.02	<0.01	<0.01	0.02
Ge	ppb	0.05	0.39	0.5	0.12	0.11	0.67
Hf	ppb	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Hg	ppb	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ho	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
In	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
K	*ppm*	0.05	7.18	7.54	13.08	12.17	8.68
La	ppb	0.01	0.02	0.02	<0.01	<0.01	0.01
Li	ppb	0.1	10.8	10.5	28.2	27.3	11.2
Lu	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mg	*ppm*	0.05	16.47	16.59	31.5	33.28	19.52
Mn	ppb	0.05	65.54	71.97	33.95	38.96	72.31
Mo	ppb	0.1	0.6	0.6	0.4	0.3	0.8
Na	*ppm*	0.05	122.13	119.69	74.97	77.88	116.27
Nb	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nd	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ni	ppb	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
P	ppb	20	<20	<20	<20	<20	<20

Table 7. Chemical element concentrations in groundwater from the monitoring wells in Kiviõli area (July, 2010) (continued)

Elements	Unit	DTL	Wells				
			2291	**2294**	**2295**	**2309**	**2316**
Pb	ppb	0.1	<0.1	0.4	<0.1	<0.1	<0.1
Pd	ppb	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Pr	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pt	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Rb	ppb	0.01	2.88	3.13	4.3	4.26	2.94
Re	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Rh	ppb	0.01	0.02	0.02	0.02	0.02	0.02
Ru	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
S	*ppm*	1	<1	<1	20	18	<1
Sb	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sc	ppb	1	<1	<1	<1	<1	<1
Se	ppb	0.5	5.8	6.7	2.7	5	5.8
Si	ppb	40	3797	4124	3572	3642	3994
Sm	ppb	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Sn	ppb	0.05	<0.05	<0.05	<0.05	<0.05	0.05
Sr	ppb	0.01	655.79	710.47	625.74	618.35	930.59
Ta	ppb	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Tb	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Te	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Th	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ti	ppb	10	<10	<10	<10	<10	<10
Tl	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tm	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
U	ppb	0.02	<0.02	<0.02	0.04	0.06	<0.02
V	ppb	0.2	0.9	0.9	<0.2	0.2	0.7
W	ppb	0.02	<0.02	<0.02	0.06	<0.02	<0.02
Y	ppb	0.01	0.03	0.03	<0.01	<0.01	0.04
Yb	ppb	0.01	0.01	0.02	<0.01	<0.01	0.02
Zn	ppb	0.5	153.8	139.1	1.3	4.3	130.2
Zr	ppb	0.02	0.03	0.04	<0.02	0.04	0.06

Table 8. Chemical element concentrations in groundwater from the monitoring wells in Kiviõli area (September, 2010)

Elements	Unit	DTL	Wells								
			2291	**2294**	**2295**	**2309**	**2316**	**2310**	**PA-11-1**	**26266**	**26267**
Ag	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.5	<0.5
Al	ppb	1	15	17	14	7	7	4	<10	<10	<10
As	ppb	0.5	5.6	6.2	7.2	3.2	0.8	<0.5	<5	<5	<5
Au	ppb	0.05	<0.05	<0.05	<0.05	<0.05	0.08	<0.05	<0.5	<0.5	<0.5
B	ppb	5	524	507	1022	965	150	666	737	369	901
Ba	ppb	0.05	2938	2945.6	277.4	561.03	2786.1	168.92	131.2	292.6	283.4
Be	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.5	<0.5
Bi	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.5	<0.5
Br	ppb	5	1889	1895	1013	1642	2392	2018	32570	26007	19841
Ca	*ppm*	0.05	43.59	43.98	46.96	46.2	46.98	51.19	348.2	441.9	225.6
Cd	ppb	0.05	<0.05	<0.05	0.28	0.34	<0.05	<0.05	7.2	<0.5	<0.5
Ce	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1
Cl	*ppm*	1	204	202	49	74	198	82	629	494	384
Co	ppb	0.02	0.07	0.14	0.06	0.04	0.05	<0.02	<0.2	0.9	<0.2
Cr	ppb	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5
Cs	ppb	0.01	0.03	0.03	0.03	0.02	0.02	0.02	0.2	0.2	<0.1
Cu	ppb	0.1	1.6	2.3	1	0.8	0.8	1	5	7	3
Dy	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1
Er	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1
Eu	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1
Fe	ppb	10	<10	<10	<10	<10	<10	<10	<100	<100	<100
Ga	ppb	0.05	0.06	0.06	0.05	<0.05	<0.05	<0.05	<0.5	<0.5	<0.5
Gd	ppb	0.01	0.02	0.02	<0.01	<0.01	0.02	<0.01	<0.1	<0.1	<0.1
Ge	ppb	0.05	0.43	0.51	0.13	0.13	0.49	0.14	<0.5	<0.5	<0.5
Hf	ppb	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	<0.2	<0.2
Hg	ppb	0.1	<0.1	<0.1	<0.1	<0.1	0.3	<0.1	<1	<1	<1
Ho	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1
In	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1
K	*ppm*	0.05	8.9	9.78	13.23	13.22	9.16	13.67	265.6	222.5	151.8
La	ppb	0.01	0.02	0.02	<0.01	<0.01	0.01	<0.01	<0.1	<0.1	<0.1
Li	ppb	0.1	12.2	10.3	27.4	30	9.9	28.3	66	44	49
Lu	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1
Mg	*ppm*	0.05	16.67	17.02	33.66	34.33	18.11	39.11	84.8	56.9	73.4
Mn	ppb	0.05	65.25	62.4	37.73	40.72	67.38	43.79	148.5	183.2	67.8
Mo	ppb	0.1	0.6	1.2	0.3	0.3	0.7	0.3	<1	3	<1
Na	*ppm*	0.05	121.48	120.96	80.12	82.94	110.06	82.8	323.7	146	209.1
Nb	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1
Nd	ppb	0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.1	<0.1	<0.1
Ni	ppb	0.2	<0.2	0.2	<0.2	<0.2	<0.2	<0.2	<2	8	<2
P	ppb	20	<20	<20	<20	<20	<20	<20	795	341	<200

Table 8. Chemical element concentrations in groundwater from the monitoring wells in Kiviõli area (September, 2010) (continued)

Elements	Unit	DTL	Wells								
			2291	**2294**	**2295**	**2309**	**2316**	**2310**	**PA-11-1**	**26266**	**26267**
Pb	ppb	0.1	0.1	<0.1	9.5	16.9	<0.1	<0.1	51	<1	<1
Pd	ppb	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<2	<2
Pr	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1
Pt	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1
Rb	ppb	0.01	3.57	3.82	4.85	4.47	3.83	4.62	48.1	45.6	28.3
Re	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1
Rh	ppb	0.01	0.03	0.03	0.02	0.03	0.02	0.03	<0.1	<0.1	<0.1
Ru	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.5	<0.5
S	*ppm*	1	<1	<1	21	18	2	20	262	236	153
Sb	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.7	<0.5	<0.5
Sc	ppb	1	<1	<1	<1	<1	<1	<1	<10	<10	<10
Se	ppb	0.5	6.4	6.3	3.4	5.6	5.1	6.9	72	57	46
Si	ppb	40	4402	4184	4494	4127	3697	3812	4740	4510	5228
Sm	ppb	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	<0.2	<0.2
Sn	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.5	<0.5
Sr	ppb	0.01	698.07	663.51	651.16	685.8	758.01	756.26	1758.1	1109.2	1640.3
Ta	ppb	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	<0.2	<0.2
Tb	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1
Te	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.5	<0.5
Th	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.5	<0.5
Ti	ppb	10	<10	<10	<10	<10	<10	<10	<100	<100	<100
Tl	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1
Tm	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1
U	ppb	0.02	<0.02	<0.02	0.05	0.06	<0.02	0.05	0.7	5	0.2
V	ppb	0.2	0.7	0.9	0.3	0.3	0.4	0.3	2	<2	<2
W	ppb	0.02	0.03	0.06	0.03	<0.02	<0.02	<0.02	<0.2	<0.2	<0.2
Y	ppb	0.01	0.03	0.03	0.02	0.02	0.03	<0.01	<0.1	<0.1	<0.1
Yb	ppb	0.01	0.02	0.02	<0.01	<0.01	0.02	<0.01	<0.1	<0.1	<0.1
Zn	ppb	0.5	124.5	195.5	88.5	121.8	80.2	10.8	17	10	7
Zr	ppb	0.02	0.05	0.05	0.14	0.1	0.03	0.08	0.3	0.3	<0.2

3. Groundwater monitoring near waste landfills in Kohtla-Järve

3.1 Geological settings

Quaternary deposits in the region consist of glacial deposits, represented mainly by tills, while glaciofluvial deposits consist of clays, silts and sands. These deposits are occasionally overlaid by soil and peat. Thickness of the Quaternary deposits in the study area is 3-4m. The ground surface elevation ranges from 48-49m a.s.l. The height of semi-coke landfill in north western plateau area is 18-20m, increasing towards the peaks of the piles, reaching the height of 100-120m. The landfill are situated on natural soils and with the ground elevation some 150-170m a.s.l.

The total thickness of Ordovician (O_2ls-O_1vl) carbonate rocks in this area is ca 40m. Carbonate rocks contain the Silurian-Ordovician aquifer system with the Lasnamäe- Kunda aquifer; aquifer is unconfined and vulnerable to contamination. Groundwater from the aquifer is used some 850m south for domestic use in left hand side of Vahtsepa ditch and in the northwest in Kohtla council area. Groundwater level descends to the west. The average height of water level was 46.0…48.87 m a.s.l.

The Silurian-Ordovician aquifer system consists of Lower-Ordovician Volhov (O_1vl), Latorp (O_1lt), Varangu (O_1vr) and Pakerord (O_1pk) formations, which are represented by limestones, marls, siltstones, clays and argillite, with the total thickness ca 4-5m.

The Lower-Ordovician Pakerort Stage and Cambrian consist of sandstones and siltstones with the total thickness ca 20m. Groundwater in the sandstones and siltstones forms the Ordovician-Cambrian aquifer, potentiometric surface descends from west to northwest. In 2004, groundwater levels were 41.83 – 44.25m a.s.l., while being 3.71 – 6.81m deeper than in Lasnamäe-Kunda Stage. The aquifer system is extensively used in portable water supply. The aquifer is confined and quite well protected from contamination; however tectonic faults, out of service boreholes and mines in the overlying aquitard may form a pathway for contamination.

Lükati-Lontova aquitard (C_1lk– C_1ln, know as the Lontova aquitard) is formed by siltstones in the Lower-Cambrian, in Lükati and Lontova Stage. The total thickness of the aquitard is ca 75m.

Voronka aquifer (V_2vr thickness 30m), is the upper part of Cambrian-Vendian aquifer system, and is formed by sandstones and siltstones and is situated some 140m deep from the ground level.

Voronka aquifer is underlies by a 30m thick aquitard (Kotlin aquitard V_2kt), formed from siltstones and clays from the Vendian System, in Kotlin Stage. Kotlin aquitard is spread all over the eastern-Estonia.

The Kotlin aquitard is underlies by the Gdov aquifer (V_2gd), consisting of sandstones and silts. The Gdov aquifer, with the thickness ca 50m forms the lower part of the Cambrian-Vendian aquifer systems. The Cambrian-Vendian aquifer system is well protected from contamination derived from ground level and is the most important source of portable water supply in the northern Estonia.

3.2 Results of monitoring

In the area of Viru Keemia Grupp groundwater in Ordovician (O) and Ordovician-Cambrian (O-C) aquifers are monitored. Wells in the area were drilled in 1991-1997 and renovated in 2003 (Fig. 4). Wells opening the Ordovician-Cambrian (O-C) aquifer reach the depths of 50-60m and the depths of wells opening the Ordovician aquifer are between 20-40m (Table 9).

Variation of pH in the wells prior sampling demonstrated some decrease in the beginning of pumping and as a rule is stabilized quickly, during 10-15 minutes from starting of pumping. The Total Dissolved Solids content was also stable or reached stable values after short time (5-15 minutes) after pumping (Fig.5).

Groundwater level in the *Ordovician-Cambrian* formation varies significantly between the seasons. Groundwater level is higher in summer, but in some wells (nr 19545 and 19549) situated in the territory of the company and in the vicinity of the spoil heaps the difference in the water levels in spring and summer, and in summer and autumn respectively practically absent. The pH in the Ordovician-Cambrian aquifer is stable, with the maximum 7.9 and minimum 7.2 and shows little variability between the seasons (Table 10). Generally the groundwater of this aquifer in all monitored wells demonstrated slightly alkaline pH. The TDS values are low, varied in the limits of 280-510 mg/l and are very stable in all sampled boreholes during three seasons.

As is visible from the Fig.6, the groundwater of the Ordovician-Cambrian aquifer is characterised by the higher variability of the temperature and very stable O_2 content in comparison with upper aquifer.

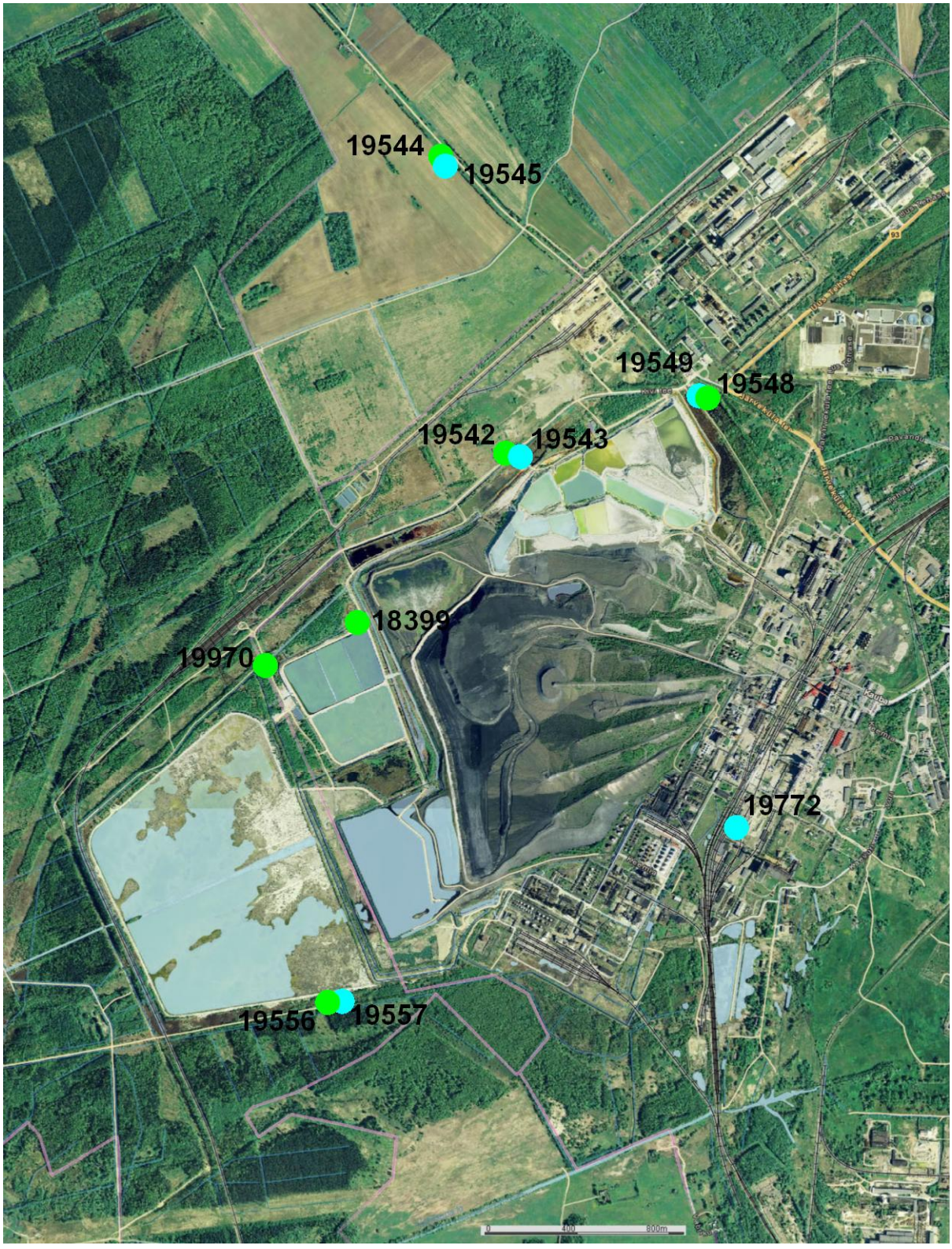

Fig. 4. Location of monitoring wells near waste landfills in Kohtla-Järve.

Legend: green circles – wells opened Ordovician aquifer; blue circles – wells opened Ordovician -Cambrian aquifer.

Table 9. Monitoring wells in Kohtla-Järve area

Well number		Opened aquifer	Depth, m	Year of instal-lation	Year of reno-vation	Location	Coordinates Lambert-Est		Owner
Passport	Cadaster						x	y	
00602g	19542	O_2ls-$O_{1-2}kn$	24	1991	2003	Electric power station, 0,5 km to the north from waste landfill	682709	6589275	VKG Energia (KJ Soojus)
00603g	19543	O_1pk-$Є_1ts$	49	1991	2003	Electric power station, 0,5 km to the north from waste landfill	682943	6589130	VKG Energia (KJ Soojus)
00604	19544	O_2ls-$O_{1-2}kn$	25	1991	2003	Electric power station, 1,5 km to the north from waste landfill	682443	6590304	VKG Energia (KJ Soojus)
00605	19545	O_1pk-$Є_1ts$	50	1991	2003	Electric power station, 1,5 km to the north from waste landfill	682486	6590278	VKG Energia (KJ Soojus)
00608g	19548	O_2ls-$O_{1-2}kn$	31	1991	2003	Electric power station, the north-east part of waste landfill	683934	6589364	VKG Energia (KJ Soojus)
00609g	19549	O_1pk-$Є_1ts$	55	1991	2003	Electric power station, the north-east part of waste landfill	683678	6589258	VKG Energia (KJ Soojus)
00616g	19556	O_2ls-$O_{1-2}kn$	38	1991	2003	the south-west from waste landfill	681852	6586334	VKG Energia (KJ Soojus)
PA-617	19557	O_1pk-$Є_1ts$	60	1991	2003	the south-west from waste landfill	681877	6586300	VKG Energia (KJ Soojus)
PA-25H	19772	O_1pk-$Є_1ts$	55,0	1997	not	VKG Industrial area	683720	6587433	Viru Keemia Grupp AS
PA-622	18399	O_2ls-$O_{1-2}kn$	17,4	1997	2003	VKG waste landfill	682237	6588307	Viru Keemia Grupp AS
	19970	O_2ls-$O_{1-2}kn$				VKG waste landfill	681731	6587990	Viru Keemia Grupp AS

Table 10. Water table and physical parameters of the groundwater from the Ordovician and Ordovician-Cambrian aquifers in monitoring wells near Kohtla-Järve waste landfill

			Well										
		Cadaster number	**18399**	**19542**	**19544**	**19556**	**19548**	**19970**	**19772**	**19543**	**19545**	**19549**	**19557**
		aquifer	O_2ls-$O_{1-2}kn$						O_1pk-$Є_1ts$				
	sampling												
6.-8.05.2010	I	water table	6,25	2,58	3,89	2,48	5,82	3,5	12,81	7,28	10,89	10,99	6,39
	I	TDS, mg/L	2528,6	1144,1	282,9	455,6	733,3	1234,2	279,1	314,3	289,6	310,8	510,1
	I	pH	11,1	7,3	7,3	7,1	6,9	7,1	7,9	7,5	7,7	7,6	7,2
8.-22.07.2010	II	water table	4,85	1,60	3,75	2,61	3,22	2,75	8,40	6,80	13,30	10,13	6,08
	II	TDS, mg/L	2697,5	1144,4	293,8	795,7	460,1	1286,3	280,4	300,5	288,1	310,0	421,2
	II	pH	10,77	6,81	6,95	6,66	6,90	6,97	7,59	7,64	7,56	7,35	7,26
6.-8.09.2010	III	water table	6,20	4,80	6,85	3,81	9,87	3,82	13,23	8,10	13,30	12,83	7,63
	III	TDS, mg/L	2484,0	1336,4	336,6	768,5	459,0	1199,4	284,4	306,5	288,1	303,4	501,9
	III	pH	11,1	7,1	7,2	6,9	7,1	7,1	7,8	7,5	7,6	7,6	7,2

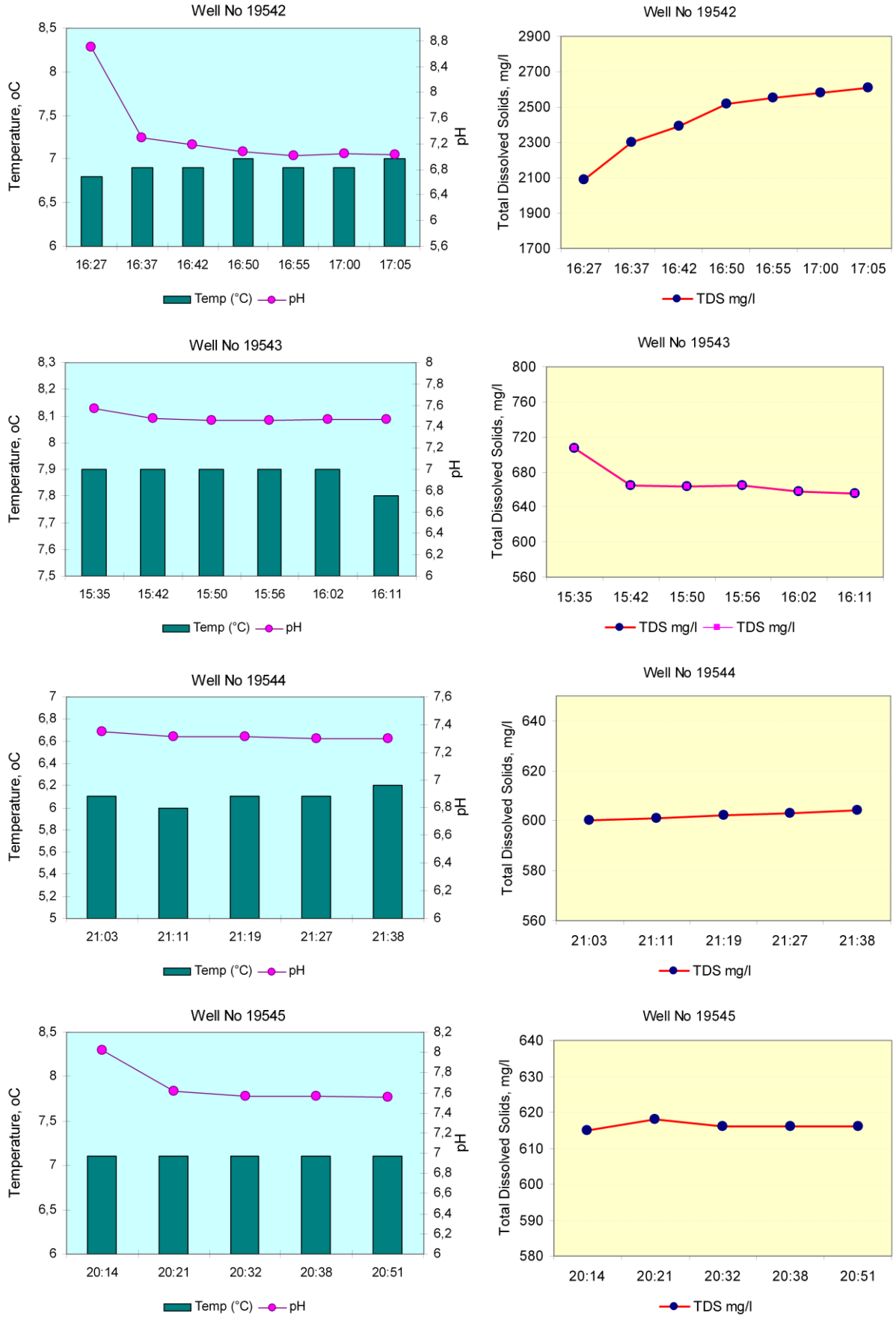

Fig. 5. Variation of pH, temperature and Total Dissolved Solids contents in the monitoring wells prior sampling of groundwater in Kohtla-Järve.

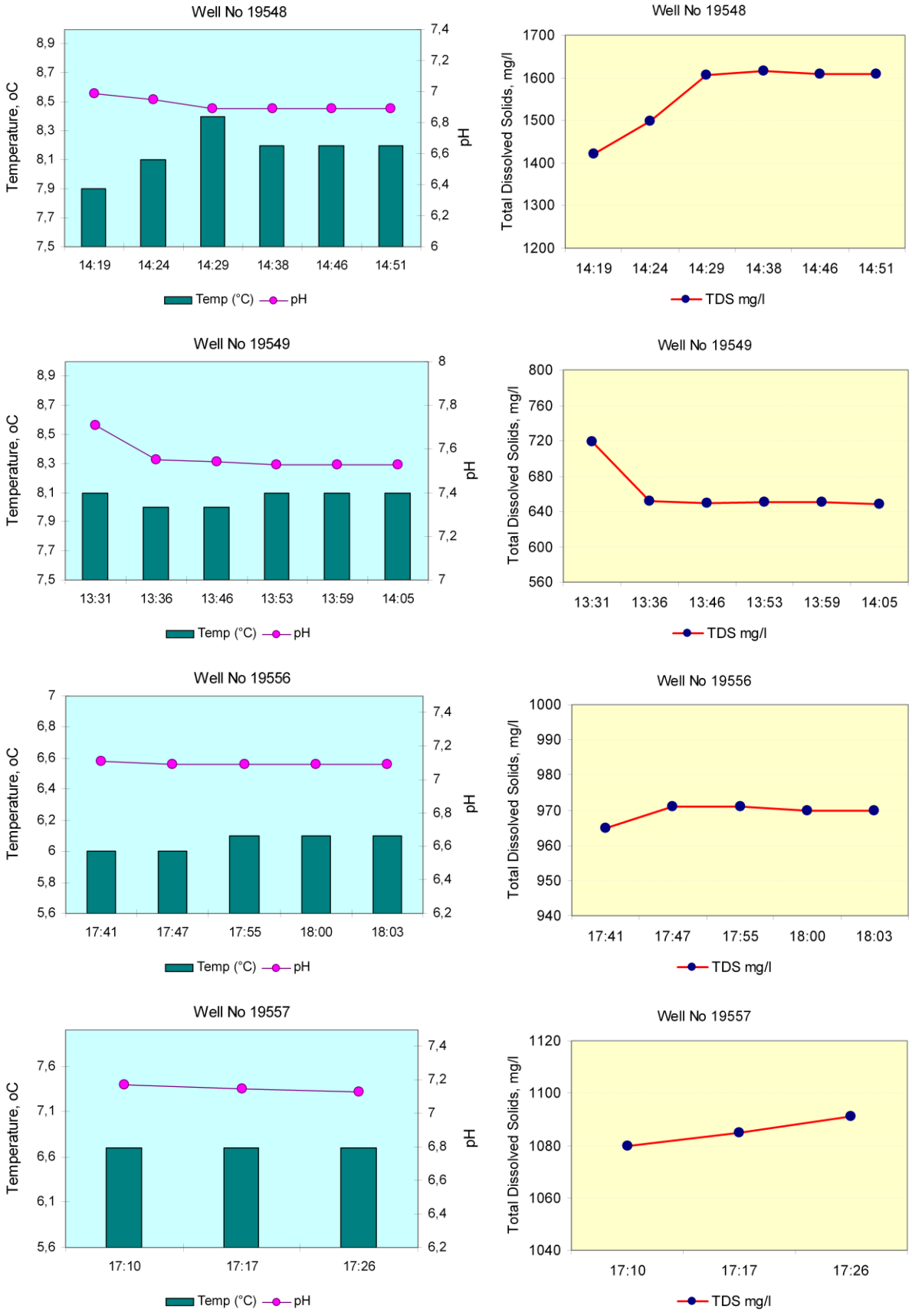

Fig. 5. Variation of pH, temperature and Total Dissolved Solids contents in the monitoring wells prior sampling of groundwater in Kohtla-Järve (continued).

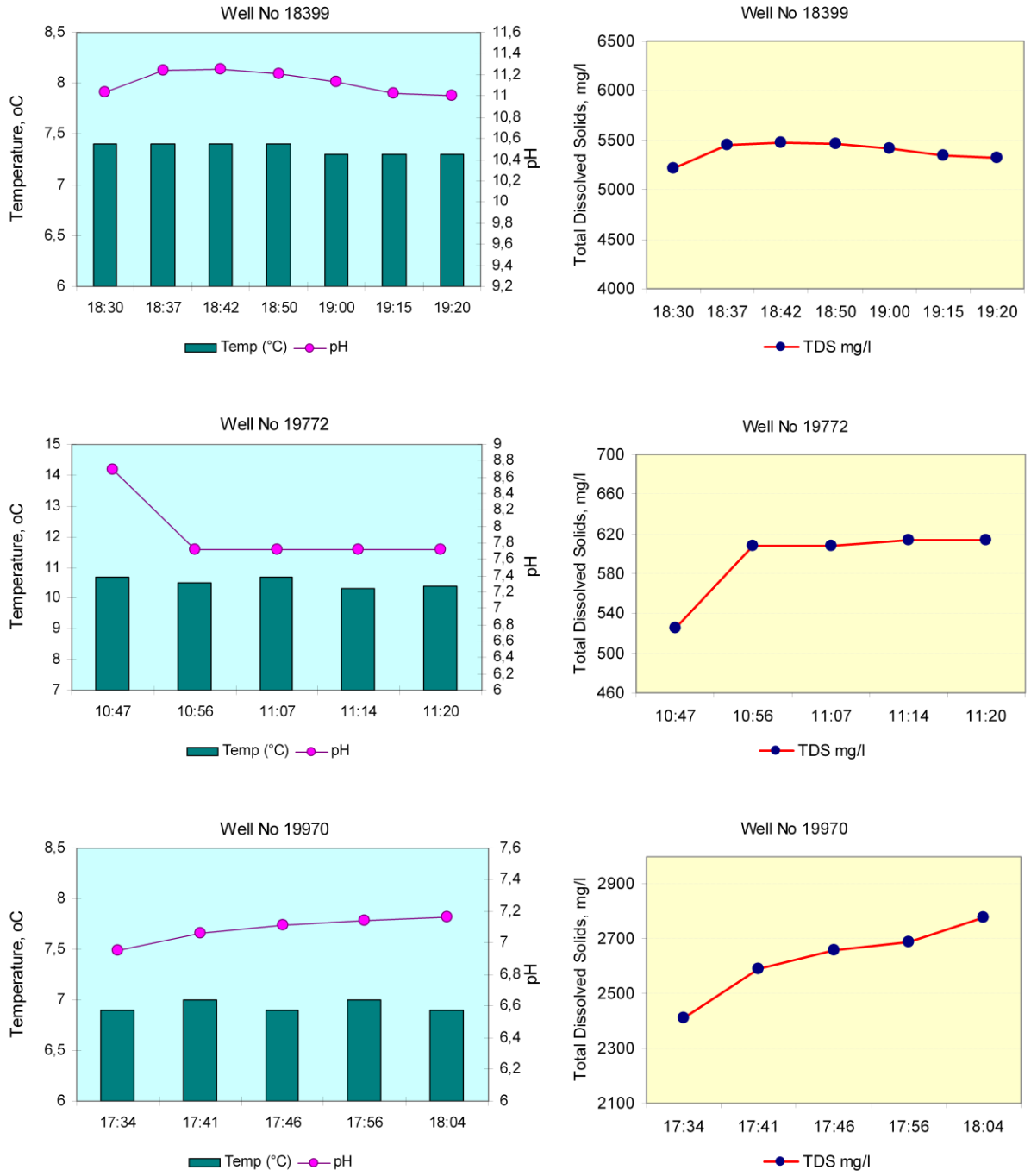

Fig. 5. Variation of pH, temperature and Total Dissolved Solids contents in the monitoring wells prior sampling of groundwater in Kohtla-Järve (continued).

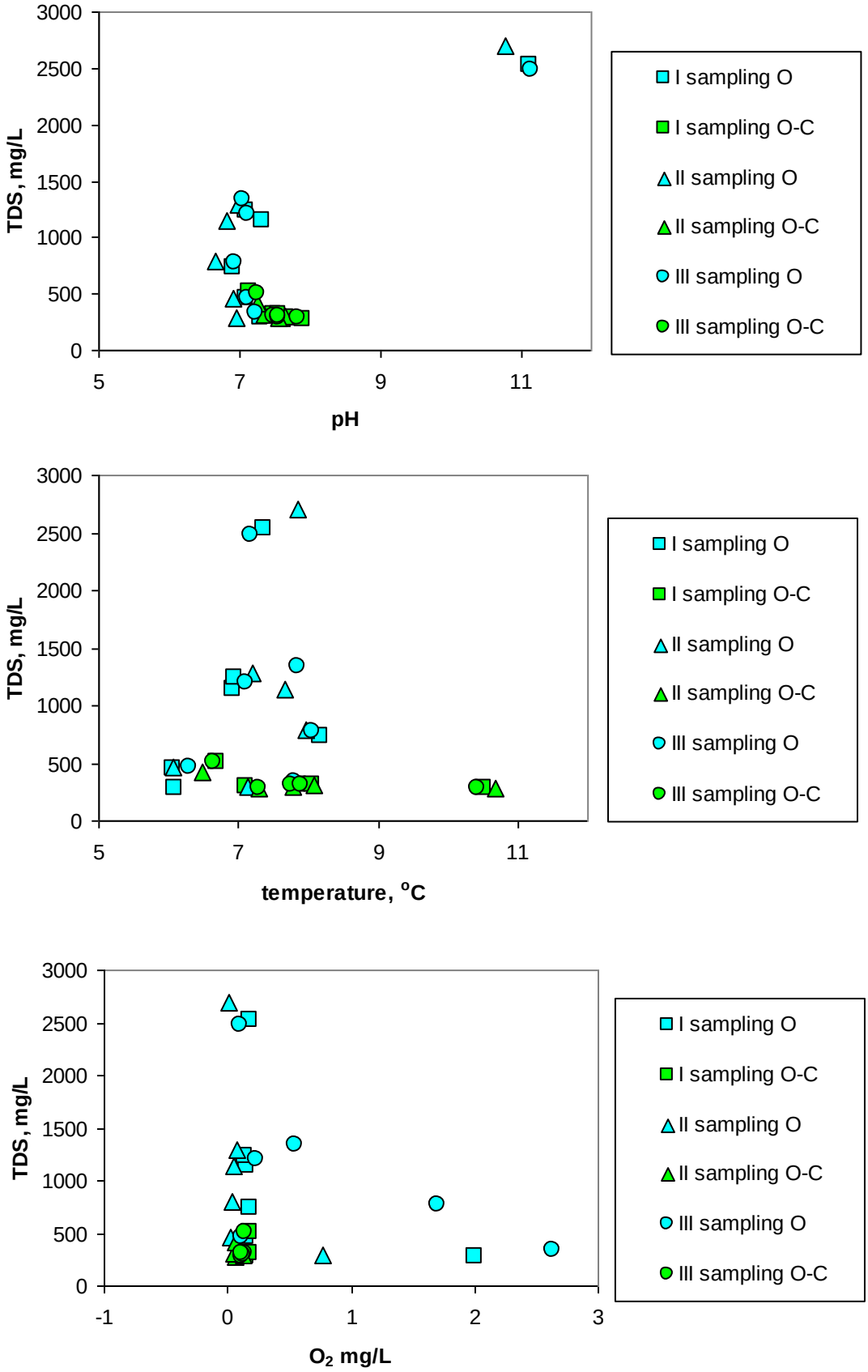

Fig. 6. Variation of TDS depending on pH, temperature and oxygen content in the groundwater of Ordovician (O) and Ordovician-Cambrian (O-C) water aquifers from monitoring wells near aste landfills in Kohtla-Järve area

The concentration of all analysed organic compounds in the Ordovician-Cambrian aquifer is less than the detection limits, which is much less than the allowed limits set to hazardous substances in groundwater (Pinnase..., 2004). Only in one well (No 19543) in the sample taken in autumn the sum of the akylphenols reached 93.8μg/L. This group of organic compounds is presented widely in the groundwater from well 19543, but the concentrations of all detected akylphenols in autumn are lower than the allowed limits (Tables 11-13).

Trace elements in the Ordovician-Cambrian aquifer occurred in the concentration that are lower Permitted values (Pinnase..., 2004) estimated for groundwater. As the specific feature characterised groundwater of this aquifer could be noted the concentrations of B, Ba, U and Sr that exceeded significantly those in the groundwater of upper Ordovician aquifer.

The Ordovician aquifer shows a more extensive contamination. Maximum pH is 11.1 in the well 18399 situated in the northern part of the semi-coke spoil heap. In the rest of the wells the pH is 6.7-7.2. The Total Dissolved Solids content is significantly higher in the groundwater of upper, Ordovician (O) aquifer in comparison with Ordovician-Cambrian (O-C) aquifer (Fig.6). Maximum TDS (1200-2700 mg/l) were estimated for the northern and eastern area of the semi-coke spoil heap. In other wells TDS varied between approximately 450-800 mg/l and 1km away from the spoil heap decreased up to 300 mg/l (Table 10). The variation of TDS in the wells depending on the season is very slight. Only in two wells TDS value was significantly lower in spring (well 19556)relative to other seasons and for the well 19548 the opposite regularity was revealed. The highest values of O_2 (2.0 mg/l – 0.77 mg/L- 2.6 mg/L) were measured in groundwater from the well 19544 (during the sampling period from spring to autumn) and in the well 19548 in autumn (1.7 mg/L). Any regularity between TDS values and pH, temperature or O_2 contents in the groundwater characterised by various TDS values were not observed (Fig.6).

Groundwater in Ordovician aquifer is characterised by a wide variability in organic compound concentration, depending on the distance to spoil heap. Wells no 18399 and 19970 contained the maximum concentration of monoaromatic hydrocarbons BTEX (158.4μg/L and 324.4μg/L respectively), sum of PAHs (2.21 and 0.641 μg/L), phenols (11216.9 μg/L and 1458.4 μg/L) and chlorophenols (2-chlorophenol -0.48 and 0.16 μg/L, 3-chlorophenol – 0.21μg/L, 4-chlorophenol-0.15 μg/L and 4-chloro-3-methylphenol – 0.25μg/L) respectively, in spring (Tables 11-13). PAHs were presented by naphthalene – 2.21 μg/L and 0.03 μg/L, acenaphthylene – 0.066 and 0.29 μg/L, phenanthene – 0.047 and 0.051 μg/L, fluoranthene - 0.066 μg/L, benzaanthracene -

0.014 μg/L. All estimated values are substantially lower the Permitted Limits values (Pinnases…, 2004).

The concentration of BTEX exceeded the limits tens of times and phenols up to hundreds times. The phenols are presented in the samples collected in spring by wide range of the compounds that included phenol (3700 μg/L and 120 μg/L in the wells 18399 and 19970 respectively, Cresols (in the sum 4840 μg/L and 334 μg/L), two-basic phenols (542 μg/L and 218 μg/L), resorcines (711 μg/L and 157.2 μg/L) and other compounds (Table 11). In the well 19542 the phenols were found in small amount (the sum is 4. 78 μg/L).

Generally the content of main organic contaminants in summer and autumn in the wells where the contamination was revealed is comparable, in spring the level of contamination is relatively lower nevertheless the relevant limits for the phenols in the wells 18399 and 19970 were exceeded several times.

Measurement of chemical element contents in the groundwater of Ordovician aquifer revealed the higher level of the Ca, Br, As, Cl, Mo and Se relative to water of the deeper aquifer in the area near waste landfills in Kohtla-Järve. The elements contents showed similar concentrations in the samples collected during sampling period from spring till autumn. The above-mentioned elements demonstrated elevated concentrations in the shallower aquifer especially in the groundwater from the wells located towards water flow direction that suppose these elements leaching from solid semi-coke waste. At the same time the revealed concentrations of these elements are lower than Permitted Limit values for the groundwater (Pinnases…, 2004) excepting Se that estimated values exceed the Permitted values in the wells located at the shortest distance from semi-coke landfills (Tables 14-16) .

Table 11 Organic compounds concentrations in groundwater from the monitoring wells in Kohtla-Järve area (May 2010)

Compound	Unit	DTL	Wells										
			19542	**19543**	**19544**	**19545**	**19548**	**19549**	**19556**	**19557**	**18399**	**19970**	**19972**
Mono aromatic hydrocarbons													
Benzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	140	300	<0,1
Ethylbenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	0,70	1,3	<0,1
Toluene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	15	20	<0,1
o-Xylene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	1,7	1,8	<0,1
m/p-Xylene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	1,0	1,3	<0,1
Xylenes (sum)	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	2,7	3,1	<0,1
Styrene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
1,2,4-Trimethylbenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
1,3,5-Trimethylbenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
n-Propylbenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
Isopropylbenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
n-Butylbenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
sec-Butylbenzene 1	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
tert-Butylbenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
p-Isopropyltoluene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
Volatile halogenated HCs													
Tetrachloromethane	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
1,2 Dichloroethane	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
1, 1, 1 -Trichloroethane	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
1, 1,2-Trichloroethane	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
Trichloroethanes (sum)	µg/L	0,1	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
1, 1, 1,2-Tetrachloroethane	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
1, 1,2,2-Tetrachloroethane	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
Tetrachloroethanes (sum)	µg/L	0,1	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

Table 11 Organic compounds concentrations in groundwater from the monitoring wells in Kohtla-Järve area (continued) (May 2010)

Compound	Unit	DTL	Wells										
			19542	**19543**	**19544**	**19545**	**19548**	**19549**	**19556**	**19557**	**18399**	**19970**	**19972**
Trichloroethene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	1,0	<0,1
Tetrachloroethene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
1,2-Dichloropropane	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
1,3-Dichloropropane	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
1,2,3-Trichloropropane	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
1,1 -Dichloropropylene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
cis 1,3-Dichloropropylene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
trans 1,3-Dichloropropylene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
1,3-Dichloropropylenes (sum)	µg/L	0,1	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
1,2-Dibromoethane	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
Tribromomethane	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
Bromodichloromethane	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
Dibromochloromethane	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
1,2-Dibromo-3-chloropropane	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
Bromobenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<1	<0,1
Sum PAH (EPA)	µg/L		0,052	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	2,21	0,641	n.d.
Sum PAH (cancerogenic)	µg/L		n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Naphthalene	µg/L	0,01	0,033	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	2,1	0,3	<0,1
Acenaphthylene	µg/L	0,01	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	0,066	0,29	<0,1
Acenaphthene	µg/L	0,01	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Fluorene	µg/L	0,01	0,019	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Phenanthrene	µg/L	0,01	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	0,047	0,051	<0,1
Anthracene	µg/L	0,01	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,011	<0,1	<0,1
Fluoranthene	µg/L	0,01	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,066	<0,1	<0,1
Pyrene	µg/L	0,01	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Benz(a)anthracene	µg/L	0,01	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,014	<0,1	<0,1
Chrysene	µg/L	0,01	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1

Table 12 Organic compounds concentrations in groundwater from the monitoring wells in Kohtla-Järve area (May 2010) (continued)

Compound	Unit	DTL	Wells										
			19542	**19543**	**19544**	**19545**	**19548**	**19549**	**19556**	**19557**	**18399**	**19970**	**19972**
Benzo(b)fluoranthene	µg/L	0,01	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Benzo(k)fluoranthene	µg/L	0,01	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Benzo(a)pyrene	µg/L	0,01	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Indeno(1,2,3-cd)pyrene	µg/L	0,01	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Dibenz(ah)anthracene	µg/L	0,01	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Benzo(g,h,i)perylene	µg/L	0,01	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Sum Chlorobenzenes	µg/L		n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
1-Chlorobenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
1,3-Dichlorobenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
1,4-Dichlorobenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
1,2-Dichlorobenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
1,3,5-Trichlorobenzene	µg/L	0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
1,2,4-Trichlorobenzene	µg/L	0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
1,2,3-Trichlorobenzene	µg/L	0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
1,2,4,5-/1,2,3,5-Tetrachlorobenz	µg/L	0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
1,2,3,4-Tetrachlorobenzene	µg/L	0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Pentachlorobenzene	µg/L	0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Hexachlorobenzene	µg/L	0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Sum PCB (6)	µg/L		n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum PCB (7)	µg/L		n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
PCB 28	µg/L	0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
PCB 52	µg/L	0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
PCB 101	µg/L	0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
PCB 118	µg/L	0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
PCB 153	µg/L	0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
PCB 138	µg/L	0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
PCB 180	µg/L	0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01

Table 11 Organic compounds concentrations in groundwater from the monitoring wells in Kohtla-Järve area (May 2010) (continued)

Compound	Unit	DTL	Wells										
			19542	**19543**	**19544**	**19545**	**19548**	**19549**	**19556**	**19557**	**18399**	**19970**	**19972**
Chloronitrobenzenes													
o/p-Chloronitrobenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
m-Chloronitrobenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Monochloronitrobenzenes (su	µg/L	0,1	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2,3/3,4 -Dichloronitrobenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,4-Dichloronitrobenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,5-Dichloronitrobenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
3,5-Dichloronitrobenzene	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Dichloronitrobenzenes (sum)	µg/L		n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum Chlorophenols	µg/L												
2-Chlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	0,48	0,16	<0,1
3-Chlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	0,21	<0,10	<0,1
4-Chlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	0,15	<0,10	<0,1
2,6-Dichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,4/2,5-Dichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
3,5-Dichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,3-Dichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
3,4-Dichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,4,6-Trichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,3,6-Trichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,3,5-Trichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,4,5-Trichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,3,4-Trichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
3,4,5-Trichlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,3,5,6-Tetrachlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,3,4,6-Tetrachlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
2,3,4,5-Tetrachlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Pentachlorophenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
4-Chloro-3-methylphenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	0,25	<0,1	<0,1

Table 11 Organic compounds concentrations in groundwater from the monitoring wells in Kohtla-Järve area (May 2010) (continued)

Compound	Unit	DTL	Wells										
			19542	**19543**	**19544**	**19545**	**19548**	**19549**	**19556**	**19557**	**18399**	**19970**	**19972**
Phenols	µg/L												
Phenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	3700	120	<0,1
o-Cresol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	890	140	<0,1
m-Cresol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	3500	170	<0,1
p-Cresol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	450	24	<0,1
Cresoles (sum)	µg/L												
2,6-Dimethylphenol	µg/L	0,1	1,5	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	62	41	<0,1
2,5-Dimethylphenol	µg/L	0,1	0,3	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	360	110	<0,1
2,4-Dimethylphenol	µg/L	0,1	2,3	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	120	67	<0,1
3,5-Dimethylphenol	µg/L	0,1	0,27	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	530	260	<0,1
3,4-Dimethylphenol	µg/L	0,1	0,41	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	380	180	<0,1
o-Ethylphenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	120	59	<0,1
m-Ethylphenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	390	28	<0,1
Resorcine	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	32	2,2	<0,1
2,5dimethylresorcine	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	343	143	<0,1
5 methylresorcine	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	336	112	<0,1
Thymol, 5-Methyl-2-isopropyl-1-phenol	µg/L	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	3,9	2,2	<0,1

Table 12 Chemical compound concentrations in groundwater from the monitoring wells in Kohtla-Järve area (July, 2010)

Compound	Unit	DTL	Wells								
			18399	**19542**	**19543**	**19544**	**19545**	**19548**	**19549**	**19970**	**19772**
Mono aromatic hydrocarbons											
Benzene	µg/L	0.1	170	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	240	<0,10
Toluene	µg/L	0.1	26	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	19	<0,10
Ethylbenzene	µg/L	0.1	0.70	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	0.90	<0,10
o-Xylene	µg/L	0.1	1.7	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	1.1	<0,10
m-,p-Xylene	µg/L	0.1	1.2	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	0.90	<0,10
BTEX	µg/L	0.1	200	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	260	n.d.
Styrene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,2,4-Trimethylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3,5-Trimethylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
n-Propylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
iso-Propylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
n-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
tert.-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
sec.-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
p-Isopropyltoluene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Volatile halogenated HCs											
1,1,1-Trichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Tetrachloromethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,2-Dichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Trichloroethene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,1,2-Trichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Tetrachloroethene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,2-Dichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibromochloromethan	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Bromodichloromethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibromoethane, (1,2-)	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,1,1,2-Tetrachloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,1,2,2-Tetrachloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3-Dichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
cis-1,3-Dichloropropene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
trans-1,3-Dichloropropene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Tribromomethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,2-dibromo-3-chloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Trichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,1-Dichloro-1-propene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibromomethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Bromobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10

Table 12 Chemical compound concentrations in groundwater from the monitoring wells in Kohtla-Järve area (July, 2010) (continued)

Compound	Unit	DTL	Wells								
			18399	**19542**	**19543**	**19544**	**19545**	**19548**	**19549**	**19970**	**19772**
Sum PAH (EPA)			1.4	n.d.	n.d.	n.d.	n.d.	0.014	n.d.	0.088	n.d.
Sum PAH (cancerogenic)			n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Naphthalene	µg/L	0.01	1.4	<0,010	<0,010	<0,010	<0,010	0.014	<0,010	0.088	<0,010
Acenaphthylene	µg/L	0.01	<0,020	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Acenaphthene	µg/L	0.01	<0,030	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Fluorene	µg/L	0.01	<0,020	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,025	<0,010
Phenanthrene	µg/L	0.01	<0,040	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,020	<0,010
Anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,020	<0,010
Fluoranthene	µg/L	0.01	<0,050	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benz(a)anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Chrysene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(b)fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(k)fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(a)pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Indeno(1,2,3-cd)pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Dibenz(ah)anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(g,h,i)perylene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Sum Chlorobenzenes	µg/L	0.01	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
1-Chlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,4-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,2-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3,5-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,4-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,3-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,4,5-/1,2,3,5-Tetrachloroben	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,3,4-Tetrachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Pentachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Hexachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Sum PCB (6)			n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum PCB (7)			n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
PCB 28	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 52	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 101	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 118	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 153	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 138	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 180	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010

Table 12 Chemical compound concentrations in groundwater from the monitoring wells in Kohtla-Järve area (July, 2010) (continued)

Compound	Unit	DTL	Wells								
			18399	19542	19543	19544	19545	19548	19549	19970	19772
Chloronitrobenzenes											
o-/p-Chloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
m-Chloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3-/3,4-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,4-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,5-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
3,5-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Chlorophenols											
2-Chlorophenol	µg/L	0.1	0.60	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	0.19	<0,10
3-Chlorophenol	µg/L	0.1	0.23	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
4-Chlorophenol	µg/L	0.1	0.17	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,6-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,4/2,5-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
3,5-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
3,4-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,4,6-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,6-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,4,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,4-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
3,4,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,5,6-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,4,6-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,4,5-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Pentachlorphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
4-Chloro-3-methylphenol	µg/L	0.1	0.24	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Phenols		0.1									
Phenol	µg/L	0.1	4000	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	140	<0,10
o-Cresol	µg/L	0.1	930	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	150	<0,10
m-Cresol	µg/L	0.1	3700	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	180	<0,10
p-Cresol	µg/L	0.1	470	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	63	<0,10
2,6-Xylenol	µg/L	0.1	57	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	40	<0,10
2,5-Xylenol	µg/L	0.1	350	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	110	<0,10
2,4-Xylenol	µg/L	0.1	120	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	70	<0,10
3,5-Xylenol	µg/L	0.1	490	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	230	<0,10
2-Ethylphenol	µg/L	0.1	120	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	62	<0,10
3-Ethylphenol	µg/L	0.1	390	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	30	<0,10
4-Ethylphenol	µg/L	0.1	46	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<8,0	<0,10
Resorcinol	µg/L	0.1	72	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	2.6	<0,10
2,5-Dimethylresorcinol	µg/L	0.1	420	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	130	<0,10
5-Methylresorcinol	µg/L	0.1	2900	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	260	<0,10
Thymol	µg/L	0.1	4.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	2.3	<0,10

Table 13 Chemical compound concentrations in groundwater from the monitoring wells in Kohtla-Järve area (September, 2010)

Compound	Unit	DTL	Wells										
			18399	19542	19543	19544	19545	19548	19549	19970	19772	19556	19557
Mono aromatic hydrocarbons													
Benzene	µg/L	0.1	220	12	<0,10	<0,10	<0,10	12	<0,10	250	<0,10	<0,10	<0,10
Toluene	µg/L	0.1	29	0.9	<0,10	<0,10	<0,10	0.3	<0,10	19	<0,10	<0,10	<0,10
Ethylbenzene	µg/L	0.1	0.7	0.3	<0,10	<0,10	<0,10	<0,10	<0,10	0.9	<0,10	<0,10	<0,10
o-Xylene	µg/L	0.1	1.6	0.2	<0,10	<0,10	<0,10	<0,10	<0,10	0.9	<0,10	<0,10	<0,10
m-,p-Xylene	µg/L	0.1	1.2	0.4	<0,10	<0,10	<0,10	0.3	<0,10	1.1	<0,10	<0,10	<0,10
BTEX	µg/L	0.1	250	14	n.d.	n.d.	n.d.	13	n.d.	270	n.d.	n.d.	n.d.
Styrene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,2,4-Trimethylbenzene	µg/L	0.1	<0,10	9.3	<0,10	<0,10	<0,10	9.7	<0,10	<0,10	<0,10	<0,10	<0,10
1,3,5-Trimethylbenzene	µg/L	0.1	<0,10	7.7	<0,10	<0,10	<0,10	8.5	<0,10	<0,10	<0,10	<0,10	<0,10
n-Propylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
iso-Propylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
n-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
tert.-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
sec.-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
p-Isopropyltoluen	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Volatile halogenated HCs			n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
1,1,1-Trichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Tetrachloromethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,2-Dichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Trichloroethene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,1,2-Trichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Tetrachloroethene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,2-Dichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibromochloromethan	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Bromodichloromethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibromoethane, (1,2-)	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,1,1,2-Tetrachloroethan	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,1,2,2-Tetrachloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3-Dichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Trichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,1-Dichloro-1-propene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
cis-1,3-Dichloropropene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
trans-1,3-Dichloropropene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibromomethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Tribromomethan	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,2-dibromo-3-chloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Brombensen	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10

Table 13 Chemical compound concentrations in groundwater from the monitoring wells in Kohtla-Järve area (September, 2010) (continued)

Compound	Unit	DTL	Wells										
			18399	**19542**	**19543**	**19544**	**19545**	**19548**	**19549**	**19970**	**19772**	**19556**	**19557**
Sum PAH (EPA)			3.15	0.282	n.d.	n.d.	n.d.	n.d.	n.d.	0.39	0.38	n.d.	n.d.
Sum PAH (cancerogenic)			n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Naphthalene	µg/L	0.01	3.1	0.26	<0,010	<0,010	<0,010	<0,010	<0,010	0.39	0.38	<0,010	<0,010
Acenaphthylene	µg/L	0.01	0.024	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Acenaphthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Fluorene	µg/L	0.01	0.023	0.022	<0,010	<0,010	<0,010	<0,010	<0,010	<0,020	<0,050	<0,010	<0,010
Phenanthrene	µg/L	0.01	<0,030	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,020	<0,010	<0,010
Anthracene	µg/L	0.01	<0,030	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,020	<0,010	<0,010
Fluoranthene	µg/L	0.01	<0,080	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,020	<0,010	<0,010
Pyrene	µg/L	0.01	<0,030	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,020	<0,010	<0,010
Benz(a)anthracene	µg/L	0.01	<0,020	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,020	<0,010	<0,010
Chrysene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(b)fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(k)fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(a)pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Indeno(1,2,3-cd)pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Dibenz(ah)anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Benzo(g,h,i)perylene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Sum Chlorobenzenes	µg/L	0.01	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
1-Chlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,4-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,2-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3,5-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,4-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,3-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,4,5-/1,2,3,5-Tetrachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
1,2,3,4-Tetrachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Pentachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Hexachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Sum PCB (6)			n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum PCB (7)			n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
PCB 28	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 52	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 101	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 118	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 153	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 138	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
PCB 180	µg/L	0.01	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010

Table 13 Chemical compound concentrations in groundwater from the monitoring wells in Kohtla-Järve area (September, 2010) (continued)

Compound	Unit	DTL	Wells										
			18399	19542	19543	19544	19545	19548	19549	19970	19772	19556	19557
Chloronitrobenzenes			.	.	.	.	.	.	.	.	.	.	.
o-/p-Chloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
m-Chloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3-/3,4-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,4-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,5-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
3,5-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Chlorophenols			0.99	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0.15	n.d.	n.d.	n.d.
2-Chlorophenol	µg/L	0.1	0.66	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	0.15	<0,10	<0,10	<0,10
3-Chlorophenol	µg/L	0.1	0.19	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
4-Chlorophenol	µg/L	0.1	0.14	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,6-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,4/2,5-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
3,5-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
3,4-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,4,6-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,6-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,4,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,4-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
3,4,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,5,6-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,4,6-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,4,5-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Pentachlorphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
4-Chloro-3-methylphenol	µg/L	0.1	0.24	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Sum Alkylphenols		0.1	10000	n.d.	93.8	n.d.	n.d.	n.d.	n.d.	547	n.d.	n.d.	n.d.
Phenols	µg/L	0.1	4000	<0,10	31	<0,10	<0,10	<0,10	<0,10	13	<0,10	<0,10	<0,10
o-Cresol	µg/L	0.1	830	<0,10	13	<0,10	<0,10	<0,10	<0,10	77	<0,10	<0,10	<0,10
m-Cresol	µg/L	0.1	3300	<0,10	27	<0,10	<0,10	<0,10	<0,10	17	<0,10	<0,10	<0,10
p-Cresol	µg/L	0.1	420	<0,10	3.6	<0,10	<0,10	<0,10	<0,10	18	<0,10	<0,10	<0,10
2,6-Xylenol	µg/L	0.1	57	<0,10	2	<0,10	<0,10	<0,10	<0,10	35	<0,10	<0,10	<0,10
2,5-Xylenol	µg/L	0.1	340	<0,10	3.5	<0,10	<0,10	<0,10	<0,10	84	<0,10	<0,10	<0,10
2,4-Xylenol	µg/L	0.1	120	<0,10	1.6	<0,10	<0,10	<0,10	<0,10	59	<0,10	<0,10	<0,10
3,5-Xylenol	µg/L	0.1	470	<0,10	4.9	<0,10	<0,10	<0,10	<0,10	190	<0,10	<0,10	<0,10
2-Ethylphenol	µg/L	0.1	110	<0,10	2	<0,10	<0,10	<0,10	<0,10	50	<0,10	<0,10	<0,10
3-Ethylphenol	µg/L	0.1	350	<0,10	4.4	<0,10	<0,10	<0,10	<0,10	3.5	<0,10	<0,10	<0,10
4-Ethylphenol	µg/L	0.1	46	<0,10	0.75	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Resorcinol	µg/L	0.1	52	<0,10	0.66	<0,10	<0,10	<0,10	<0,10	0.94	<0,10	<0,10	<0,10
2,5-Dimethylresorcinol	µg/L	0.1	320	<0,10	1.2	<0,10	<0,10	<0,10	<0,10	71	<0,10	<0,10	<0,10
5-Methylresorcinol	µg/L	0.1	2000	<0,10	8.3	<0,10	<0,10	<0,10	<0,10	82	<0,10	<0,10	<0,10
Thymol	µg/L	0.1	3.4	<0,10	0.14	<0,10	<0,10	<0,10	<0,10	1.8	<0,10	<0,10	<0,10

Table 14 Chemical element concentrations in groundwater from the monitoring wells in Kohtla-Järve area (May, 2010)

Elements	Units	DTL	Wells										
			19542	19543	19544	19545	19548	19549	19556	19557	18399	19970	19772
Ag	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05
Al	ppb	1	9	12	9	24	5	3	4	3	23	6	4
As	ppb	0.5	1.6	<0.5	<0.5	<0.5	0.8	<0.5	1.0	0.9	21	9.2	<0.5
Au	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05
B	ppb	5	47	534	66	558	238	740	517	499	155	59	813
Ba	ppb	0.05	99.68	194.22	96.74	571.74	223.93	468.10	247.42	293.24	439.3	1123.72	499.32
Be	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05
Bi	ppb	0.05	0.08	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	0.10	<0.05
Br	ppb	5	11515	472	57	143	5290	98	300	323	24479	19565	86
Ca	*ppm*	0.05	254.68	59.81	101.21	48.20	199.85	43.01	144.37	151.14	4.0	143.37	30.64
Cd	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05
Ce	ppb	0.01	0.02	0.11	0.03	0.11	<0.01	<0.01	0.01	<0.01	0.4	0.07	<0.01
Cl	*ppm*	1	232	15	3	5	136	6	25	41	577	433	6
Co	ppb	0.02	0.14	0.07	0.05	0.27	0.16	0.07	0.07	0.07	0.5	0.15	0.46
Cr	ppb	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	1.0	<0.5
Cs	ppb	0.01	0.48	0.02	<0.01	0.02	0.04	0.01	0.01	0.03	0.9	0.20	0.03
Cu	ppb	0.1	2.1	0.6	1.3	0.8	1.0	0.3	1.1	1.2	1	0.9	0.5
Dy	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.1	0.01	<0.01
Er	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.1	0.01	<0.01
Eu	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
Fe	ppb	10	362	98	<10	291	620	<10	<10	<10	<100	981	38
Ga	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05
Gd	ppb	0.01	<0.01	0.02	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.1	0.02	<0.01
Ge	ppb	0.05	<0.05	0.21	<0.05	0.14	0.12	0.19	0.10	0.17	<0.5	0.21	0.12
Hf	ppb	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	<0.02	<0.02
Hg	ppb	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	2	<0.1	<0.1

Table 14 Chemical element concentrations in groundwater from the monitoring wells in Kohtla-Järve area (May, 2010) (continued)

Elements	Units	DTL	Wells										
			19542	19543	19544	19545	19548	19549	19556	19557	18399	19970	19772
Ho	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
In	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
K	*ppm*	0.05	308.40	11.07	2.23	10.48	17.07	10.02	6.64	8.03	1527.2	435.78	9.49
La	ppb	0.01	<0.01	0.04	0.01	0.05	<0.01	<0.01	<0.01	<0.01	0.2	0.04	<0.01
Li	ppb	0.1	70.3	19.1	5.0	18.6	29.9	24.3	12.9	16.6	38	23.3	29.3
Lu	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
Mg	*ppm*	0.05	36.41	32.20	20.74	28.32	59.60	30.64	40.22	42.04	0.8	29.20	24.06
Mn	ppb	0.05	340.27	42.45	1.41	47.78	81.40	37.51	147.83	368.30	11.3	662.65	31.34
Mo	ppb	0.1	2.0	0.2	0.4	0.7	0.1	0.3	0.1	0.3	16	3.6	0.4
Na	*ppm*	0.05	74.53	30.12	2.11	47.75	49.92	54.61	16.20	28.33	129.6	73.19	69.54
Nb	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	0.02	<0.01
Nd	ppb	0.01	0.02	0.07	0.02	0.04	<0.01	<0.01	<0.01	<0.01	0.2	0.05	<0.01
Ni	ppb	0.2	<0.2	<0.2	0.9	0.3	<0.2	<0.2	<0.2	<0.2	19	1.8	<0.2
P	ppb	20	42	44	39	44	31	31	33	37	351	248	27
Pb	ppb	0.1	0.1	0.1	0.1	0.1	<0.1	<0.1	<0.1	0.1	<1	<0.1	<0.1
Pd	ppb	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<0.2
Pr	ppb	0.01	<0.01	0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
Pt	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
Rb	ppb	0.01	151.21	3.99	1.27	4.52	7.47	3.00	2.97	6.31	1166.5	150.13	3.32
Re	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
Rh	ppb	0.01	0.01	0.03	<0.01	0.02	0.02	0.02	0.02	0.03	<0.1	0.01	0.02
Ru	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05
S	*ppm*	1	165	7	13	6	69	9	65	83	78	23	7
Sb	ppb	0.05	<0.05	<0.05	0.11	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	0.08	<0.05
Sc	ppb	1	<1	<1	<1	<1	<1	<1	<1	<1	11	2	<1
Se	ppb	0.5	46.9	2.0	0.8	<0.5	21.7	<0.5	1.2	1.5	101	72.5	<0.5

Table 14 Chemical element concentrations in groundwater from the monitoring wells in Kohtla-Järve area (May, 2010) (continued)

Elements	Units	DTL	Wells										
			19542	19543	19544	19545	19548	19549	19556	19557	18399	19970	19772
Si	ppb	40	4035	3650	2716	3188	4527	3063	5997	5299	90036	17263	2998
Sm	ppb	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	<0.02	<0.02
Sn	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05
Sr	ppb	0.01	391.86	632.26	152.48	614.55	562.67	555.43	591.22	726.39	53.2	359.61	472.39
Ta	ppb	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	<0.02	<0.02
Tb	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
Te	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05
Th	ppb	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05
Ti	ppb	10	<10	<10	<10	<10	<10	<10	<10	<10	<100	<10	<10
Tl	ppb	0.01	0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
Tm	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
U	ppb	0.02	0.33	0.38	4.62	1.27	0.06	0.29	0.09	0.23	0.2	0.06	0.79
V	ppb	0.2	1.0	<0.2	0.2	<0.2	0.5	<0.2	<0.2	<0.2	41	6.2	<0.2
W	ppb	0.02	0.06	<0.02	0.02	0.26	<0.02	<0.02	0.06	0.02	0.7	0.31	0.10
Y	ppb	0.01	0.03	0.06	0.02	0.04	0.02	0.02	0.03	0.03	0.9	0.13	<0.01
Yb	ppb	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	0.02	<0.01
Zn	ppb	0.5	123.5	16.0	21.1	113.6	116.7	89.5	2.7	4.8	36	30.6	101.5
Zr	ppb	0.02	0.49	0.13	0.08	0.15	0.22	0.21	0.28	0.43	2.1	1.23	0.07

Table 15 Chemical element concentrations in groundwater from the monitoring wells in Kohtla-Järve area (July, 2010)

Elements	Unit	DTL	Wells										
			18399	**19542**	**19543**	**19544**	**19545**	**19548**	**19549**	**19970**	**19772**	**19556**	**19557**
Ag	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
Al	ppb	1	17	13	<1	2	<1	2	<1	<10	1	6	9
As	ppb	0.5	30	<5	<0.5	<0.5	0.5	1.1	<0.5	10	<0.5	1.3	1
Au	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
B	ppb	5	126	<50	516	60	537	225	770	118	798	491	862
Ba	ppb	0.05	61.1	99.9	209.66	91.14	128.55	100.39	100.58	979	97.92	219.91	100.05
Be	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	0.06	0.13
Bi	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
Br	ppb	5	26938	9535	1073	39	51	6888	184	19655	51	324	286
Ca	*ppm*	0.05	3	282	70.9	112.44	52.69	216.07	46.79	147.5	35.29	149.64	89.72
Cd	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
Ce	ppb	0.01	0.2	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Cl	*ppm*	1	569	188	25	3	4	164	10	447	4	26	32
Co	ppb	0.02	0.6	<0.2	0.03	<0.02	0.13	<0.02	0.03	<0.2	0.29	0.04	<0.02
Cr	ppb	0.5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<0.5	<0.5
Cs	ppb	0.01	0.9	0.5	0.02	<0.01	0.01	0.05	0.01	0.2	0.02	0.01	0.06
Cu	ppb	0.1	<1	2	0.4	1.2	0.2	1	0.3	1	0.4	7.6	13.8
Dy	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Er	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Eu	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Fe	ppb	10	<100	3369	142	<10	229	799	220	403	895	<10	<10
Ga	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
Gd	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Ge	ppb	0.05	<0.5	<0.5	0.26	<0.05	0.15	0.11	0.19	<0.5	0.16	0.08	0.15
Hf	ppb	0.02	<0.2	<0.2	<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	<0.02	<0.02	<0.02
Hg	ppb	0.1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<0.1	<0.1
Ho	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
In	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
K	*ppm*	0.05	1654.1	251	15.49	2.18	9.24	17.15	10.13	532.5	9.67	6.48	9.21
La	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Li	ppb	0.1	36	58	19.6	5.2	17.1	29.3	25.2	24	29.2	11.4	21.8
Lu	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Mg	*ppm*	0.05	0.6	37.7	37.07	23.77	32.16	66.42	32.79	30.9	28.82	40.59	43.07
Mn	ppb	0.05	1.9	352.5	36.03	0.53	40.9	69.35	32.1	520.2	38.86	115.42	46.15
Mo	ppb	0.1	21	2	0.3	0.6	0.6	0.1	0.3	2	0.4	0.1	1
Na	*ppm*	0.05	129.9	57.7	27.57	1.87	44.12	56.47	57.19	79.3	69	15.46	51.8
Nb	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Nd	ppb	0.01	0.2	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Ni	ppb	0.2	20	<2	<0.2	0.4	<0.2	<0.2	0.3	4	<0.2	<0.2	<0.2
P	ppb	20	255	<200	<20	<20	<20	24	<20	327	<20	<20	<20

Table 15 Chemical element concentrations in groundwater from the monitoring wells in Kohtla-Järve area (July, 2010) (continued)

Elements	Unit	DTL	Wells										
			18399	19542	19543	19544	19545	19548	19549	19970	19772	19556	19557
Pb	ppb	0.1	<1	<1	0.1	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<0.1	0.3
Pd	ppb	0.2	<2	<2	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<0.2	<0.2
Pr	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Pt	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Rb	ppb	0.01	1338.6	141.1	5.79	1.27	3.68	7.74	3.38	183.3	4.18	2.98	4.84
Re	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Rh	ppb	0.01	<0.1	<0.1	0.02	<0.01	0.02	0.02	0.02	<0.1	0.02	0.02	0.03
Ru	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
S	*ppm*	1	54	171	7	13	4	70	7	20	5	69	46
Sb	ppb	0.05	<0.5	<0.5	<0.05	0.12	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
Sc	ppb	1	<10	<10	<1	<1	<1	<1	<1	<10	<1	<1	<1
Se	ppb	0.5	88	32	3.5	0.7	<0.5	22.2	0.6	63	<0.5	1.1	1
Si	ppb	40	107965	4086	4355	3255	3394	5488	3555	21142	3798	6400	5316
Sm	ppb	0.02	<0.2	<0.2	<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	<0.02	<0.02	<0.02
Sn	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
Sr	ppb	0.01	41	349.4	643.71	153.96	585.93	513.11	536.23	296	509.84	477.03	823.45
Ta	ppb	0.02	<0.2	<0.2	<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	<0.02	<0.02	<0.02
Tb	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Te	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
Th	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
Ti	ppb	10	<100	<100	<10	<10	<10	<10	<10	<100	<10	<10	<10
Tl	ppb	0.01	<0.1	<0.1	<0.01	0.02	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Tm	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
U	ppb	0.02	<0.2	0.4	0.29	4.59	1.02	0.05	0.28	<0.2	1.3	<0.02	0.88
V	ppb	0.2	38	<2	<0.2	<0.2	<0.2	0.6	<0.2	7	<0.2	0.7	<0.2
W	ppb	0.02	0.8	<0.2	0.14	0.07	0.17	<0.02	0.08	0.2	0.21	<0.02	0.03
Y	ppb	0.01	0.4	<0.1	0.01	0.01	0.02	0.01	0.03	<0.1	<0.01	0.02	<0.01
Yb	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Zn	ppb	0.5	<5	<5	2.2	1.7	0.6	1.5	1.1	<5	1.4	8.5	4.6
Zr	ppb	0.02	2.3	0.4	0.05	0.03	0.07	0.22	0.28	0.9	0.28	0.31	0.12

Table 16 Chemical element concentrations in groundwater from the monitoring wells in Kohtla-Järve area (September, 2010)

Elements	Unit	DTL	Wells										
			18399	**19542**	**19543**	**19544**	**19545**	**19548**	**19549**	**19970**	**19772**	**19556**	**19557**
Ag	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
Al	ppb	1	25	<10	4	5	5	2	4	<10	3	3	2
As	ppb	0.5	12	5	5.1	10	2.2	1.7	2.5	19	2.6	0.6	0.8
Au	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
B	ppb	5	344	356	771	383	809	443	888	359	1229	426	524
Ba	ppb	0.05	65.3	119.7	159.78	112.14	155.73	138.8	105.3	1122.2	99.66	250.17	265.05
Be	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	0.05	<0.05	<0.5	<0.05	<0.05	<0.05
Bi	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
Br	ppb	5	29452	18505	367	74	81	8180	353	22745	82	449	399
Ca	*ppm*	0.05	5.9	261.8	56.97	127.95	49.86	211.35	46.66	157.4	28.39	149.27	152.46
Cd	ppb	0.05	<0.5	<0.5	0.13	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	0.1
Ce	ppb	0.01	0.2	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Cl	*ppm*	1	618	309	9	6	6	167	13	436	6	25	39
Co	ppb	0.02	0.4	<0.2	<0.02	0.08	2.52	0.07	<0.02	<0.2	0.34	<0.02	<0.02
Cr	ppb	0.5	<5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<0.5	<0.5
Cs	ppb	0.01	0.9	0.3	0.02	<0.01	0.02	0.05	0.01	0.2	0.03	0.01	0.03
Cu	ppb	0.1	<1	3	0.4	1.3	2.2	1.3	0.4	1	0.6	1.1	1.1
Dy	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Er	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Eu	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Fe	ppb	10	<100	<100	<10	54	19	101	<10	<100	13	<10	<10
Ga	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
Gd	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Ge	ppb	0.05	<0.5	<0.5	0.2	<0.05	0.15	0.11	0.2	<0.5	0.16	0.07	0.18
Hf	ppb	0.02	<0.2	<0.2	<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	<0.02	<0.02	<0.02
Hg	ppb	0.1	2	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<0.1	<0.1
Ho	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
In	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
K	*ppm*	0.05	1604.5	482.9	10.05	2.42	9.58	17.78	9.91	463.8	9.67	6.88	7.29
La	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Li	ppb	0.1	36	95	18.2	6.7	20	30	23.9	28	33.3	11.9	17
Lu	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Mg	*ppm*	0.05	1.2	43.3	32.91	26.15	29.36	62.93	33.31	35.9	24.03	39.71	41.54
Mn	ppb	0.05	6.7	267.9	35.22	8.39	56.06	77.82	39.66	680	29.11	236	322.42
Mo	ppb	0.1	5	2	0.2	0.3	0.9	0.2	0.3	1	0.4	0.1	0.2
Na	*ppm*	0.05	123.4	102.8	39.14	3.3	48.49	53.44	55.27	79	73.07	15.89	29.03
Nb	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Nd	ppb	0.01	0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Ni	ppb	0.2	18	<2	<0.2	<0.2	0.6	<0.2	<0.2	<2	<0.2	<0.2	<0.2
P	ppb	20	<200	<200	<20	37	26	<20	53	255	<20	<20	23

Table 16 Chemical element concentrations in groundwater from the monitoring wells in Kohtla-Järve area (September, 2010) (continued)

Elements	Unit	DTL	Wells										
			18399	19542	19543	19544	19545	19548	19549	19970	19772	19556	19557
Pb	ppb	0.1	<1	<1	7.9	<0.1	<0.1	0.3	<0.1	<1	<0.1	1.5	7.6
Pd	ppb	0.2	<2	<2	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<0.2	<0.2
Pr	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Pt	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Rb	ppb	0.01	1084.4	191.9	3.31	1.38	3.55	7.39	3.26	136	3.44	3.09	4.83
Re	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Rh	ppb	0.01	<0.1	<0.1	0.01	<0.01	0.02	0.02	0.02	<0.1	0.01	0.01	0.02
Ru	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
S	*ppm*	1	138	223	17	24	8	68	9	16	7	68	82
Sb	ppb	0.05	<0.5	<0.5	<0.05	0.13	0.07	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
Sc	ppb	1	<10	<10	<1	<1	<1	<1	<1	<10	<1	<1	<1
Se	ppb	0.5	72	41	0.8	<0.5	<0.5	19.1	0.9	50	<0.5	1.1	1
Si	ppb	40	88731	8454	4769	4389	4292	5944	4535	21366	4446	7027	5373
Sm	ppb	0.02	<0.2	<0.2	<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	<0.02	<0.02	<0.02
Sn	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
Sr	ppb	0.01	44.5	401.1	562.03	207.16	663.54	585.17	576.25	352.9	520.51	530.33	648.83
Ta	ppb	0.02	<0.2	<0.2	<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	<0.02	<0.02	<0.02
Tb	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Te	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
Th	ppb	0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05
Ti	ppb	10	<100	<100	<10	<10	<10	<10	<10	<100	<10	<10	<10
Tl	ppb	0.01	<0.1	<0.1	<0.01	0.03	0.02	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Tm	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
U	ppb	0.02	<0.2	0.2	0.46	5.79	1.53	0.09	0.31	<0.2	0.75	0.02	0.12
V	ppb	0.2	32	<2	<0.2	0.2	<0.2	0.4	<0.2	6	<0.2	<0.2	<0.2
W	ppb	0.02	0.5	<0.2	0.07	0.12	0.44	0.05	0.05	0.2	0.13	0.05	0.05
Y	ppb	0.01	0.5	<0.1	0.01	0.02	0.01	<0.01	<0.01	<0.1	<0.01	0.02	0.02
Yb	ppb	0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
Zn	ppb	0.5	12	6	1.6	2.4	7.9	5.5	2.5	5	1.9	1.9	2.4
Zr	ppb	0.02	1.3	0.3	0.25	0.39	0.21	0.34	0.36	0.8	0.2	0.24	0.51

4. Groundwater monitoring in the industrial areas of the Balti and Eesti Power Plants

In the area of the Balti and Eesti Thermal Power Plants the aim of the monitoring was to determine possible pollution by the organic contaminants at the industrial territories of both power plants. The sampling points were discussed with specialists of the Environmental Department of Narva power plants. For estimation of hydrogeological situation at the industrial territories of the Balti and Eesti Thermal Power Plants four wells were selected for observation. Two from them (10A - cad. Nr 19952 and 16A- cad. Nr. 19954) are located at the industrial area of the Balti Power Plant), two others – P-7 (cad. Nr 18125) and P-22 (cad. nr. 18135) are situated at the industrial area of the Eesti Power Plant. Location of the above-mentioned wells is showed on the Figs 7 and 8. The wells 10A (cad. Nr 19952) and 16A (cad. Nr. 19954) open the upper part of the Devonian aquifer and the wells P-7 (cad. Nr 18125) and P-22 (cad. nr. 18135) open the upper part of the Lasnamäe–Volhov aquifer.

4.1 Geological settings

At the territory of the Narva Power Plants the hydrogeological section included five groundwater aquifers: Quaternary, Middle-Devonian, Ordovician, Ordovician-Cambrian and Cambrian-Vendian.

At the industrial area of the Eesti Power Plant the most important for the observation is the Middle-Devonian aquifer.

The Middle-Devonian and Middle-Lower-Devonian aquifer systems are the main source of public water supply in southern Estonia. The Middle-Devonian Narva sporadically water bearing aquifer occurs at the Narva River and to the south from the Narva Water Resrvoir. The aquifer consists the Devonian dolostones, siltstones and marl (Perens, Vallner, 1997). The upper part is of the aquifer is weakly water-bearing, whereas the lower part serves as a regional aquitard. Groundwater is abstracted from terrigeneous material: sand- and siltstones with interlayers of clayey and dolomitized sandstone. The chemical composition of groundwater has prevailing hydrochemical HCO_3-Ca-Mg type.

The groundwater of this aquifer is vulnerable to contamination. It is in the contact with underground communications and under influence anthropogenic pollution factors. The groundwater flow is oriented to the south (Kivit, 2007).

At the industrial are of the Balti Power Plant the groundwater of the Ordovician aquifer is under observation. The Ordovician aquifer system is composed by the various fissured Middle-

Fig. 7 Location of monitoring wells on the industrial area of the Balti Power Plant. Wells opened the Ordovician (O_2ls-O_1vl) aquifer and are showed by green circles

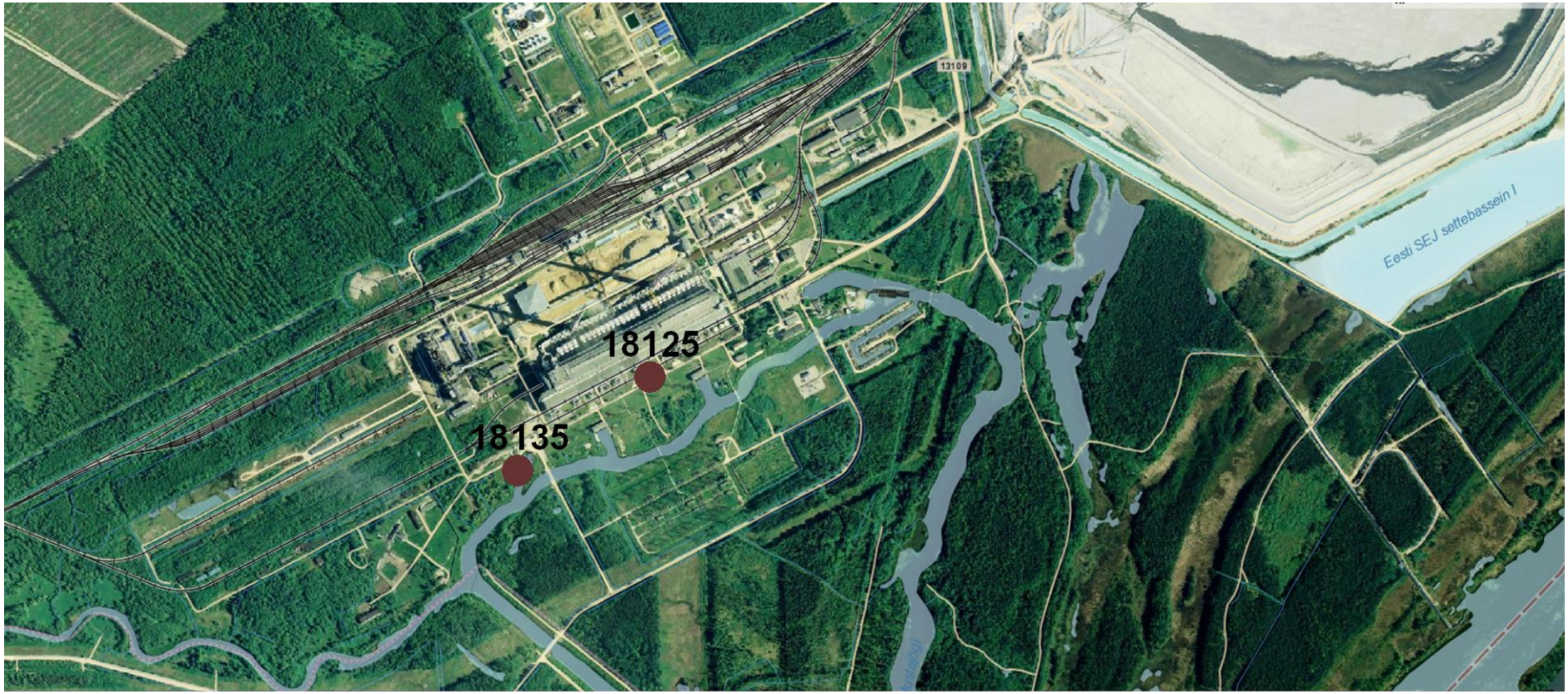

Fig. 8. Location of monitoring wells on industrial area of the Eesti Power Plant. Wells opened Devonian aquifer (D_2nr) are showed by brown circles.

Table 17 Monitoring wells at the industrial areas of Balti and Eesti Power Plants

Well number		Index of aquifer	Depth, m	Year of instal-lation	Location	Groundwater level, spring 2010	Coordinates		Owner
							Lambert-Est		
Cadaster	Passport						x	y	
18125	P-7	D2nr	7.4	1970	Eesti Power Plant	3,52	6576886	722479	Eesti Power Plant
18135	P-22	D2nr	8.45	1976	Eesti Power Plant	5,08	6576616	722088	Eesti Power Plant
19952	10A	O	7.8	1966	Balti Power Plant	3,53	6586621	734328	Balti Power Plant
19954	16A	O	8.1	1966	Balti Power Plant	3,67	6586609	734039	Balti Power Plant

Table 18 Water table and physical parameters of the groundwater from the Devonian (Dnr_2) and Ordovician (O1vl) aquifers in monitoring wells at the industrial area of Eesti and Balti Power Plants

		Well				
		Cadaster number	**18125**	**18135**	**19952**	**19954**
		aquifer	D2nr	D2nr	O_2ls-O_1vl	O_2ls-O_1vl
	sampling					
11.05.2010	I	water table	3,52	5,08	3,53	3,67
	I	TDS , mg/L	369 ,0	386 ,8	768 ,7	945 ,3
	I	pH	7,2	7,8	7,4	6,8
12-22.07.2010	II	water table	3,10	4,30	3,35	3,42
	II	TDS , mg/L	417 ,3	370 ,6	782 ,1	830 ,4
	II	pH	6,9	7,5	7,5	6,6
7.09.2010	III	water table	4,14	4,10	3,62	3,75
	III	TDS , mg/L	308 ,7	356 ,3	882 ,3	711 ,2
	III	pH	7,0	7,8	7,7	7,1

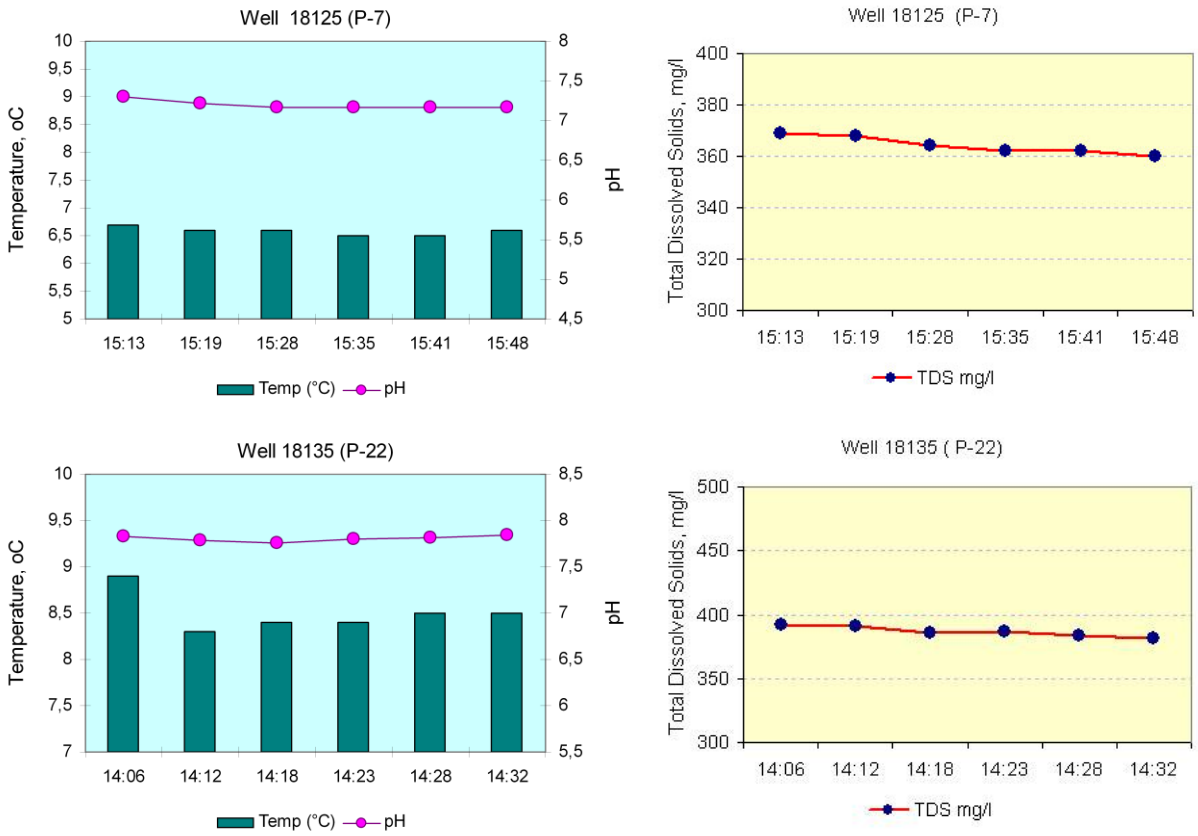

Fig. 9. Variation of pH, temperature and Total Dissolved Solids contents in the monitoring wells prior sampling of groundwater at the industrial area of the Eesti Power Plant

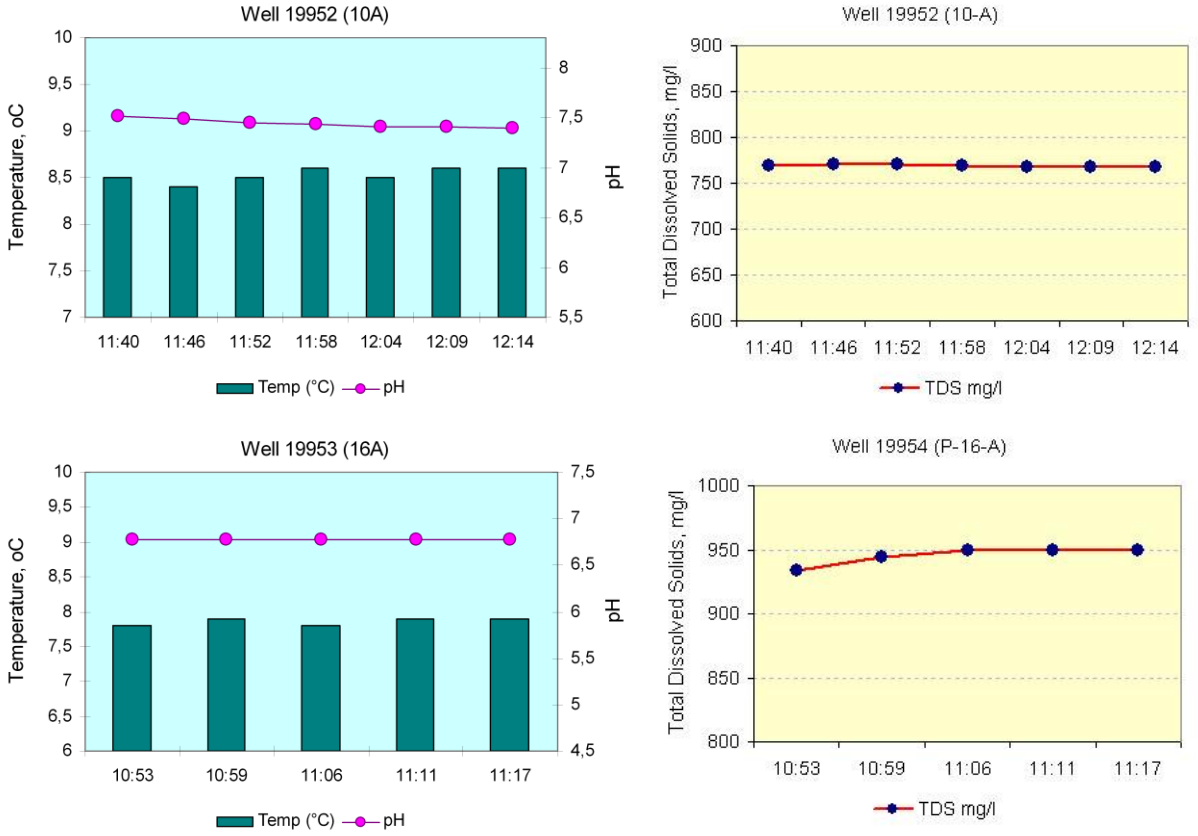

Fig. 10. Variation of pH, temperature and Total Dissolved Solids contents in the monitoring wells prior sampling of groundwater at the industrial area of the Balti Power Plant

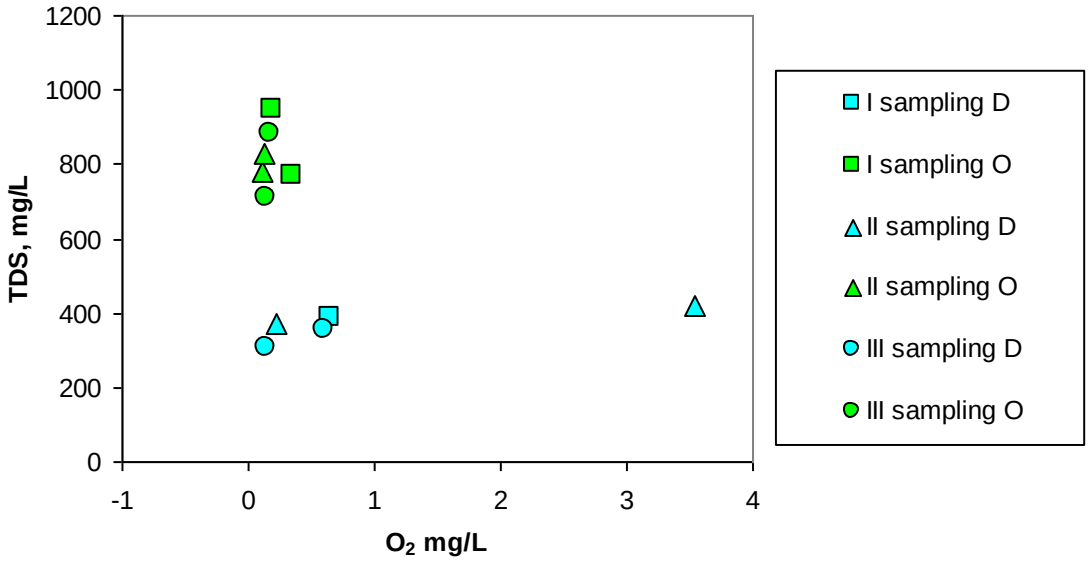

Fig. 11 Variation of TDS depending on pH, temperature and oxygen content in the groundwater of the Ordovician (O) and Devonian (D) aquifers from monitoring wells at the industrial areas of Eesti and Balti Power Plants

Ordovician limestone and dolomite with clayey interlayers. In the upper part the water bearing rocks, with a thickness of 30m, are intensively fractured and cavernous. The groundwater of this aquifer is affected by human activities.

4.2 Results of monitoring

During the period spring-autumn 2010 at the industrial area of the Eesti Power Plant the water level of the Devonian aquifer varied from 5.08m (well 18135 in the spring) up to 3.10m (well 18125 in the summer) (Table 18). The pH of groundwater wells measured prior the sampling was very close to neutral or slightly alkaline (7.16-7.84). During period spring-autumn 2010 the highest pH value was revealed in the well nr 18135. The pH value changes with seasons and the highest pH was estimated in spring and autumn. The pH values of groundwater in the well nr. 18125 were in all seasons lower than in the well 18135. The lowest pH values in both wells were measured in summer.

The Total Dissolved Solids content in both wells was the lowest in the autumn (308.7 mg/L and 356.3 mg/L); the highest values were determined in summer (417.3 mg/L) and spring (386.8 mg/L) for groundwater in the wells nr. 18125 and nr. 18135 respectively.

During the period from spring till autumn 2010 at the industrial area of the Balti Power Plant the water table of the Ordovician (O_2ls-O_1vl) aquifer in the selected wells 10A (cad. Nr 19952) and 16A (cad. Nr. 19954) varied in the limits from 3.35m (well 19952 in the summer) up to 3.75m (well 199954 in the autumn) (Table 18). The pH of groundwater wells measured prior the sampling varied from slightly acid up to slightly alkaline (6.78-7.52) and stabilized very quickly. The highest pH was determined in both wells in autumn.

The Total Dissolved Solids content was higher relative to the Devonian aquifer. In the Ordovician aquifer the TDS varied most significantly in the well nr. 19954 - from 711.2 mg/L (in autumn) up to 945.3 mg/L (in spring). In the well nr. 19952 the increasing of the TDS values from the spring till the autumn was observed, but for the well 19954 the opposite regularity was revealed.

Any correlation between the Total Dissolved Solids content and pH, O_2 content and temperature was not observed for the groundwater of both (Devonian and Ordovician) aquifers (Fig. 11).

Studies of the organic compounds in the groundwater of the Devonian aquifer ***at the industrial area of the Eesti Power Plant*** showed, that the presence of organic compounds varies with the seasons. In the industrial area of Eesti Thermal Power Plant in spring no organic compounds were determined in the water of the Devonian aquifer. In the summer period the PAHs were revealed in the water of the well nr. 18135. The content of naphthalene is 0.03 μg/L, acenaphthene - 0.016 μg/L, fluorine - 0.03 μg/L, phenanthene - 0.094 μg/L, fluoranthene - 0.019 μg/L and pyrene - 0.017 μg/L. The content of sum of the PAHs is in the amount of 0.206 μg/L that is significantly lower than the Permitted Limits values (10 μg/L) (Pinnases…, 2004). In the autumn the traces of the monoaromatic hydrocarbons (toluene in the amount of 0.1 μg/L and 0.2 μg/L and m-, p-Xylene in the amount of 0.3μg/L and 0.3μg/L) were determined in the groundwater in the wells 18125 and 18135, respectively. The sum of the occurred BTEX there are 0.4 μg/L and 0.5 μg/L, respectively. The PAHs were revealed in the amount of 0.085μg/L (the sum) only in the well 18135. Only several from PAHs are presented in the groundwater: naphthalene - 0.02 μg/L, phenanthene 0.028 μg/L, fluoranthene - 0.011 μg/L, pyrene - 0.013 μg/L and chrysene - 0.013 μg/L. All estimated values are substantially lower the Permitted Limits values (Pinnase…, 2004)

In the groundwater of the Ordovician aquifer ***at the industrial area of the Balti Power Plant*** the PAHs in the amount of 0.142 μg/L and 0.024 μg/L were determined in spring in the wells 19952 and 19954, respectively. Results showed that in spring others organic compounds were not revealed in the tested wells.

In July the contents of the PAHs (the sum 0.093μg/L and 0.020μg/L) were higher in the well 19952. In the well 19952 in the following amounts were revealed naphthalene -0.028 μg/L, acenaphthene 0.038 μg/L, fluorine 0.010 μg/L, phenanthene 0.017 μg/L. In the well 19954 the PAHs were presented only by the acenaphthene 0.020 μg/L. The phenols were determined only in the well 19952 and presented by the 2,5-dimethylresorcinol (0.88μg/L) and 5-methylresorcinol (0.38μg/L) that concentrations are less than the relevant limits.

In autumn from the whole spectrum of organic compounds only the PAHs (the sum 0.094μg/L) were determined in the well 19952. These compounds are presented by the naphthalene -0.012 μg/L, acenaphthene 0.071 μg/L, fluorine 0.011 μg/L. Others organic contaminants in the groundwater from the tested wells at the industrial area of the Balti Power Plant were not determined.

Study of trace elements concentrations in the groundwater studied showed visible difference in the composition of the Ordovician and Devonian aquifers at the territory of Eesti and Balti Power Plants. So, the water of the Ordovician aquifer are characterised by significantly higher concentrations of Br, Ca, Cl, K, Li, Na, Rb, S, Se and Sr in comparison with the Devonian groundwater independent on the season of sampling. At the same time in the Devonian aquifer the Ba values significantly exceeded those in the water from Ordovician aquifer were revealed. The concentrations of all above-mentioned elements varied not significantly from the spring till autumn and don't exceed the Permitted values declared by the Estonian regulations for groundwater (Pinnase, …, 2004).

Table 19 Organic compounds concentrations in groundwater from the monitoring wells at Eesti (wells no 18125, 18135) and Balti Power Plants industrial areas (wells no 19952 and 19954) (May 2010)

Compound	Unit	DTL	Wells			
			18125	**18135**	**19952**	**19954**
Mono aromatic hydrocarbons						
Benzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
Ethylbenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
Toluene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
o-Xylene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
m/p-Xylene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
Xylenes (sum)	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
Styrene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
1,2,4-Trimethylbenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
1,3,5-Trimethylbenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
n-Propylbenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
Isopropylbenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
n-Butylbenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
sec-Butylbenzene 1	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
tert-Butylbenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
p-Isopropyltoluene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
Volatile halogenated HCs						
Tetrachloromethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
1,2 Dichloroethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
1, 1, 1 -Trichloroethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
1, 1,2-Trichloroethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
Trichloroethanes (sum)	µg/L	0.1	n.d.	n.d.	n.d.	n.d.
1, 1, 1,2-Tetrachloroethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
1, 1,2,2-Tetrachloroethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
Tetrachloroethanes (sum)	µg/L	0.1	n.d.	n.d.	n.d.	n.d.
Trichloroethene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
Tetrachloroethene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
1,2-Dichloropropane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
1,3-Dichloropropane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
1,2,3-Trichloropropane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
1,1 -Dichloropropylene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
cis 1,3-Dichloropropylene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
trans 1,3-Dichloropropylene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
1,3-Dichloropropylenes (sum)	µg/L	0.1	n.d.	n.d.	n.d.	n.d.
Dibromomethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
1,2-Dibromoethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
Tribromomethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
Bromodichloromethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
Dibromochloromethane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
1,2-Dibromo-3-chloropropane	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
Bromobenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1

Table 19 Organic compounds concentrations in groundwater from the monitoring wells at Eesti (wells no 18125, 18135) and Balti Power Plants industrial areas (wells no 19952 and 19954) (May 2010) (continued)

Compound	Unit	DTL	Wells			
			18125	**18135**	**19952**	**19954**
Sum PAH (EPA)	µg/L	0.01	n.d.	n.d.	0,142	0,024
Sum PAH (cancerogenic)	µg/L	0.01	n.d.	n.d.	n.d.	n.d.
Naphthalene	µg/L	0.01	<0,010	<0,010	0,026	<0,010
Acenaphthylene	µg/L	0.01	<0,010	<0,010	0,015	<0,010
Acenaphthene	µg/L	0.01	<0,010	<0,010	0,083	0,024
Fluorene	µg/L	0.01	<0,010	<0,010	0,018	<0,010
Phenanthrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Benz(a)anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Chrysene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Benzo(b)fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Benzo(k)fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Benzo(a)pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Indeno(1,2,3-cd)pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Dibenz(ah)anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Benzo(g,h,i)perylene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Sum Chlorobenzenes	µg/L	0.1	n.d.	n.d.	n.d.	n.d.
1-Chlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,3-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,4-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,2-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,3,5-Trichlorobenzene	µg/L	0.1	<0,010	<0,010	<0,010	<0,010
1,2,4-Trichlorobenzene	µg/L	0.1	<0,010	<0,010	<0,010	<0,010
1,2,3-Trichlorobenzene	µg/L	0.1	<0,010	<0,010	<0,010	<0,010
1,2,4,5-/1,2,3,5-Tetrachlorobenz	µg/L	0.1	<0,010	<0,010	<0,010	<0,010
1,2,3,4-Tetrachlorobenzene	µg/L	0.1	<0,010	<0,010	<0,010	<0,010
Pentachlorobenzene	µg/L	0.1	<0,010	<0,010	<0,010	<0,010
Hexachlorobenzene	µg/L	0.1	<0,010	<0,010	<0,010	<0,010
Sum PCB (6)	µg/L	0.01	n.d.	n.d.	n.d.	n.d.
Sum PCB (7)	µg/L	0.01	n.d.	n.d.	n.d.	n.d.
PCB 28	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 52	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 101	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 118	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 153	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 138	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 180	µg/L	0.01	<0,010	<0,010	<0,010	<0,010

Table 19 Organic compounds concentrations in groundwater from the monitoring wells at Eesti (wells no 18125, 18135) and Balti Power Plants industrial areas (wells no 19952 and 19954) (May 2010) (continued)

Compound	Unit	DTL	Wells			
			18125	**18135**	**19952**	**19954**
Chloronitrobenzenes						
o/p-Chloronitrobenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
m-Chloronitrobenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
Monochloronitrobenzenes (su	µg/L	0.1	n.d.	n.d.	n.d.	n.d.
2,3/3,4 -Dichloronitrobenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
2,4-Dichloronitrobenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
2,5-Dichloronitrobenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
3,5-Dichloronitrobenzene	µg/L	0.1	<0,1	<0,1	<0,1	<0,1
Dichloronitrobenzenes (sum)	µg/L	0.1	n.d.	n.d.	n.d.	n.d.
Sum Chlorophenols						
2-Chlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3-Chlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
4-Chlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,6-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,4/2,5-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3,5-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3,4-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,4,6-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,6-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,4,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,4-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3,4,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,5,6-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,4,6-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,4,5-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Pentachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
4-Chloro-3-methylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Phenols						
Phenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
o-Cresol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
m-Cresol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
p-Cresol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Cresoles (sum)						
2,6-Dimethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,5-Dimethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,4-Dimethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3,5-Dimethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3,4-Dimethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
o-Ethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
m-Ethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Resorcine	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,5dimethylresorcine	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
5 methylresorcine	µg/L	0.1	0,10	<0,10	<0,10	<0,10
Thymol, 5-Methyl-2-isopropyl-	µg/L	0.1	<0,10	<0,10	<0,10	<0,10

Table 20 Chemical compound concentrations in groundwater from the monitoring wells at Eesti (wells no 18125, 18135) and Balti Power Plants industrial areas (wells no 19952 and 19954) (July, 2010)

Compound	Unit	DTL	Wells			
			18125	**18135**	**19952**	**19954**
Mono aromatic hydrocarbons						
Benzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Toluene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Ethylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
o-Xylene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
m-,p-Xylene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
BTEX	µg/L	0.1	n.d.	n.d.	n.d.	n.d.
Styrene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,2,4-Trimethylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,3,5-Trimethylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
n-Propylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
iso-Propylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
n-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
tert.-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
sec.-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
p-Isopropyltoluene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Volatile halogenated HCs						
1,1,1-Trichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Tetrachloromethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,2-Dichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Trichloroethene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,1,2-Trichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Tetrachloroethene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,2-Dichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Dibromochloromethan	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Bromodichloromethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Dibromoethane, (1,2-)	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,1,1,2-Tetrachloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,1,2,2-Tetrachloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,3-Dichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
cis-1,3-Dichloropropene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
trans-1,3-Dichloropropene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Tribromomethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,2-dibromo-3-chloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Trichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,1-Dichloro-1-propene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Dibromomethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Bromobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10

Table 20 Chemical compound concentrations in groundwater from the monitoring wells at Eesti (wells no 18125, 18135) and Balti Power Plants industrial areas (wells no 19952 and 19954) (July, 2010) (continued)

Compound	Unit	DTL	Wells			
			18125	**18135**	**19952**	**19954**
Sum PAH (EPA)			n.d.	0,206	0,093	0,020
Sum PAH (cancerogenic)			n.d.	n.d.	n.d.	n.d.
Naphthalene	µg/L	0.01	<0,010	0,03	0,028	<0,010
Acenaphthylene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Acenaphthene	µg/L	0.01	<0,010	0,016	0,038	0,020
Fluorene	µg/L	0.01	<0,010	0,030	0,010	<0,010
Phenanthrene	µg/L	0.01	<0,010	0,094	0,017	<0,010
Anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Fluoranthene	µg/L	0.01	<0,010	0,019	<0,010	<0,010
Pyrene	µg/L	0.01	<0,010	0,017	<0,010	<0,010
Benz(a)anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Chrysene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Benzo(b)fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Benzo(k)fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Benzo(a)pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Indeno(1,2,3-cd)pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Dibenz(ah)anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Benzo(g,h,i)perylene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Sum Chlorobenzenes	µg/L	0.01	n.d.	n.d.	n.d.	n.d.
1-Chlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,3-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,4-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,2-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,3,5-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
1,2,4-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
1,2,3-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
1,2,4,5-/1,2,3,5-Tetrachloroben	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
1,2,3,4-Tetrachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Pentachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Hexachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Sum PCB (6)			n.d.	n.d.	n.d.	n.d.
Sum PCB (7)			n.d.	n.d.	n.d.	n.d.
PCB 28	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 52	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 101	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 118	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 153	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 138	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 180	µg/L	0.01	<0,010	<0,010	<0,010	<0,010

Table 20 Chemical compound concentrations in groundwater from the monitoring wells at Eesti (wells no 18125, 18135) and Balti Power Plants industrial areas (wells no 19952 and 19954) (July, 2010) (continued)

Compound	Unit	DTL	Wells			
			18125	**18135**	**19952**	**19954**
Chloronitrobenzenes						
o-/p-Chloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
m-Chloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3-/3,4-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,4-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,5-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3,5-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Chlorophenols						
2-Chlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3-Chlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
4-Chlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,6-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,4/2,5-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3,5-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3,4-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,4,6-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,6-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,4,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,4-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3,4,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,5,6-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,4,6-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,4,5-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Pentachlorphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
4-Chloro-3-methylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Phenols		0.1				
Phenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
o-Cresol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
m-Cresol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
p-Cresol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,6-Xylenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,5-Xylenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,4-Xylenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3,5-Xylenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2-Ethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3-Ethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
4-Ethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Resorcinol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,5-Dimethylresorcinol	µg/L	0.1	<0,10	<0,10	0,88	<0,10
5-Methylresorcinol	µg/L	0.1	<0,10	<0,10	0,38	<0,10
Thymol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10

Table 21 Chemical compound concentrations in groundwater from the monitoring wells at Eesti (wells no 18125, 18135) and Balti Power Plants industrial areas (wells no 19952 and 19954) September, 2010)

Compound	Unit	DTL	Wells			
			18125	**18135**	**19952**	**19954**
Mono aromatic hydrocarbons						
Benzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Toluene	µg/L	0.1	0,1	0,2	<0,10	<0,10
Ethylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
o-Xylene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
m-,p-Xylene	µg/L	0.1	0,3	0,3	<0,10	<0,10
BTEX	µg/L	0.1	0,4	0,5	n.d.	n.d.
Styrene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,2,4-Trimethylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,3,5-Trimethylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
n-Propylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
iso-Propylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
n-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
tert.-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
sec.-Butylbenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
p-Isopropyltoluen	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Volatile halogenated HCs			n.d.	n.d.	n.d.	n.d.
1,1,1-Trichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Tetrachloromethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,2-Dichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Trichloroethene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,1,2-Trichloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Tetrachloroethene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,2-Dichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Dibromochloromethan	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Bromodichloromethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Dibromoethane, (1,2-)	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,1,1,2-Tetrachloroethan	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,1,2,2-Tetrachloroethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,3-Dichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Trichloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,1-Dichloro-1-propene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
cis-1,3-Dichloropropene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
trans-1,3-Dichloropropene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Dibromomethane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Tribromomethan	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,2-dibromo-3-chloropropane	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Brombensen	µg/L	0.1	<0,10	<0,10	<0,10	<0,10

Table 21 Chemical compound concentrations in groundwater from the monitoring wells at Eesti (wells no 18125, 18135) and Balti Power Plants industrial areas (wells no 19952 and 19954) (September, 2010) (continued)

Compound	Unit	DTL	Wells			
			18125	**18135**	**19952**	**19954**
Sum PAH (EPA)			n.d.	0,085	0,094	n.d.
Sum PAH (cancerogenic)			n.d.	0,013	n.d.	n.d.
Naphthalene	µg/L	0.01	<0,010	0,02	0,012	<0,010
Acenaphthylene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Acenaphthene	µg/L	0.01	<0,010	<0,010	0,071	<0,010
Fluorene	µg/L	0.01	<0,010	<0,010	0,011	<0,010
Phenanthrene	µg/L	0.01	<0,010	0,028	<0,010	<0,010
Anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Fluoranthene	µg/L	0.01	<0,010	0,011	<0,010	<0,010
Pyrene	µg/L	0.01	<0,010	0,013	<0,010	<0,010
Benz(a)anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Chrysene	µg/L	0.01	<0,010	0,013	<0,010	<0,010
Benzo(b)fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Benzo(k)fluoranthene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Benzo(a)pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Indeno(1,2,3-cd)pyrene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Dibenz(ah)anthracene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Benzo(g,h,i)perylene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Sum Chlorobenzenes	µg/L	0.01	n.d.	n.d.	n.d.	n.d.
1-Chlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,3-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,4-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,2-Dichlorobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
1,3,5-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
1,2,4-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
1,2,3-Trichlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
1,2,4,5-/1,2,3,5-Tetrachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
1,2,3,4-Tetrachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Pentachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Hexachlorobenzene	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
Sum PCB (6)			n.d.	n.d.	n.d.	n.d.
Sum PCB (7)			n.d.	n.d.	n.d.	n.d.
PCB 28	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 52	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 101	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 118	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 153	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 138	µg/L	0.01	<0,010	<0,010	<0,010	<0,010
PCB 180	µg/L	0.01	<0,010	<0,010	<0,010	<0,010

Table 21 Chemical compound concentrations in groundwater from the monitoring wells at Eesti (wells no 18125, 18135) and Balti Power Plants industrial areas (wells no 19952 and 19954) (September, 2010) (continued)

Compound	Unit	DTL	Wells			
			18125	18135	19952	19954
Chloronitrobenzenes						
o-/p-Chloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
m-Chloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3-/3,4-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,4-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,5-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3,5-Dichloronitrobenzene	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Chlorophenols			n.d.	n.d.	n.d.	n.d.
2-Chlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3-Chlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
4-Chlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,6-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,4/2,5-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3,5-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3,4-Dichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,4,6-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,6-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,4,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,4-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3,4,5-Trichlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,5,6-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,4,6-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,3,4,5-Tetrachlorophenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Pentachlorphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
4-Chloro-3-methylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Sum Alkylphenols		0.1	n.d.	n.d.	n.d.	n.d.
Phenols	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
o-Cresol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
m-Cresol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
p-Cresol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,6-Xylenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,5-Xylenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,4-Xylenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3,5-Xylenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2-Ethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
3-Ethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
4-Ethylphenol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Resorcinol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
2,5-Dimethylresorcinol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
5-Methylresorcinol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10
Thymol	µg/L	0.1	<0,10	<0,10	<0,10	<0,10

Table 22 Chemical element concentrations in groundwater from the monitoring wells at the industrial areas of Narva Power Plants (May,2010)

Elements	Units	DTL	Eesti Power Plant		Balti Power Plant	
			Wells			
			18125	**18135**	**19952**	**19954**
Ag	ppb	0.05	<0.05	<0.05	<0.05	<0.05
Al	ppb	1	2	13	4	2
As	ppb	0.5	0.7	<0.5	<0.5	0.9
Au	ppb	0.05	<0.05	<0.05	<0.05	<0.05
B	ppb	5	48	74	171	47
Ba	ppb	0.05	156.59	310.54	136.87	57.12
Be	ppb	0.05	<0.05	<0.05	<0.05	<0.05
Bi	ppb	0.05	<0.05	<0.05	<0.05	<0.05
Br	ppb	5	233	134	3525	3594
Ca	*ppm*	0.05	110.14	74.52	169.50	241.84
Cd	ppb	0.05	<0.05	<0.05	<0.05	<0.05
Ce	ppb	0.01	0.03	0.07	0.02	0.02
Cl	*ppm*	1	33	14	77	179
Co	ppb	0.02	0.34	0.17	0.05	<0.02
Cr	ppb	0.5	<0.5	<0.5	<0.5	<0.5
Cs	ppb	0.01	0.01	0.01	0.07	0.02
Cu	ppb	0.1	1.2	15.6	1.3	1.4
Dy	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Er	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Eu	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Fe	ppb	10	341	914	23	1708
Ga	ppb	0.05	<0.05	<0.05	<0.05	<0.05
Gd	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Ge	ppb	0.05	<0.05	0.05	0.14	0.12
Hf	ppb	0.02	<0.02	<0.02	<0.02	<0.02
Hg	ppb	0.1	<0.1	<0.1	<0.1	<0.1
Ho	ppb	0.01	<0.01	<0.01	<0.01	<0.01
In	ppb	0.01	<0.01	<0.01	<0.01	<0.01
K	*ppm*	0.05	15.43	4.66	160.90	35.46
La	ppb	0.01	0.01	0.03	<0.01	<0.01
Li	ppb	0.1	1.9	5.3	32.9	40.1
Lu	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Mg	*ppm*	0.05	33.74	40.38	38.82	92.07
Mn	ppb	0.05	878.61	60.25	477.74	492.69
Mo	ppb	0.1	2.1	0.6	0.2	1.1
Na	*ppm*	0.05	14.47	47.08	36.10	54.90
Nb	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Nd	ppb	0.01	0.01	0.03	<0.01	<0.01

Table 22 Chemical element concentrations in groundwater from the monitoring wells at the industrial areas of Narva Power Plants (May,2010) (continued)

Elements	Units	DTL	Eesti Power Plant		Balti Power Plant	
			Wells			
			18125	**18135**	**19952**	**19954**
Ni	ppb	0.2	0.6	0.8	<0.2	<0.2
P	ppb	20	63	51	192	50
Pb	ppb	0.1	<0.1	1.4	0.4	0.8
Pd	ppb	0.2	<0.2	<0.2	<0.2	<0.2
Pr	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Pt	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Rb	ppb	0.01	12.83	2.30	104.02	16.10
Re	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Rh	ppb	0.01	<0.01	<0.01	0.02	0.01
Ru	ppb	0.05	<0.05	<0.05	<0.05	<0.05
S	*ppm*	1	28	10	117	97
Sb	ppb	0.05	0.10	0.07	<0.05	<0.05
Sc	ppb	1	<1	<1	<1	1
Se	ppb	0.5	1.4	0.8	13.9	14.5
Si	ppb	40	4476	2518	7291	11654
Sm	ppb	0.02	<0.02	<0.02	<0.02	<0.02
Sn	ppb	0.05	<0.05	0.12	<0.05	<0.05
Sr	ppb	0.01	146.20	142.77	586.59	412.83
Ta	ppb	0.02	<0.02	<0.02	<0.02	<0.02
Tb	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Te	ppb	0.05	<0.05	<0.05	<0.05	<0.05
Th	ppb	0.05	<0.05	<0.05	<0.05	<0.05
Ti	ppb	10	<10	<10	<10	<10
Tl	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Tm	ppb	0.01	<0.01	<0.01	<0.01	<0.01
U	ppb	0.02	4.94	2.42	0.21	0.87
V	ppb	0.2	0.7	<0.2	0.5	0.6
W	ppb	0.02	0.03	<0.02	0.13	0.03
Y	ppb	0.01	0.02	0.03	0.01	<0.01
Yb	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Zn	ppb	0.5	2.5	54.5	2.4	3.1
Zr	ppb	0.02	0.09	0.02	0.11	0.09

Table 23 Chemical element concentrations in groundwater from the monitoring wells at the industrial areas of Narva Power Plants (July, 2010)

Elements	Unit	DTL	Wells			
			18125	**18135**	**19952**	**19954**
Ag	ppb	0.05	<0.05	<0.05	<0.05	<0.05
Al	ppb	1	165	152	2	159
As	ppb	0.5	13	13,1	0,9	8,4
Au	ppb	0.05	<0.05	<0.05	<0.05	<0.05
B	ppb	5	524	445	191	379
Ba	ppb	0.05	855,36	399,12	121,79	113,15
Be	ppb	0.05	<0.05	<0.05	<0.05	<0.05
Bi	ppb	0.05	<0.05	<0.05	<0.05	<0.05
Br	ppb	5	129	91	4538	3128
Ca	*ppm*	0.05	71,08	128,18	186,88	230,99
Cd	ppb	0.05	0,06	0,05	<0.05	<0.05
Ce	ppb	0.01	0,06	0,1	<0.01	0,05
Cl	*ppm*	1	13	35	111	146
Co	ppb	0.02	0,19	0,63	<0.02	0,05
Cr	ppb	0.5	<0.5	<0.5	<0.5	<0.5
Cs	ppb	0.01	<0.01	<0.01	0,08	0,04
Cu	ppb	0.1	1,4	1,7	1,9	2,3
Dy	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Er	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Eu	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Fe	ppb	10	2115	1582	<10	3297
Ga	ppb	0.05	<0.05	0,11	<0.05	0,09
Gd	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Ge	ppb	0.05	0,25	0,07	0,13	0,14
Hf	ppb	0.02	<0.02	<0.02	<0.02	<0.02
Hg	ppb	0.1	<0.1	<0.1	<0.1	<0.1
Ho	ppb	0.01	<0.01	<0.01	<0.01	<0.01
In	ppb	0.01	<0.01	<0.01	<0.01	<0.01
K	*ppm*	0.05	4,84	7,67	151,3	30,1
La	ppb	0.01	0,03	0,04	<0.01	0,02
Li	ppb	0.1	4,2	2,4	26,6	36,4
Lu	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Mg	*ppm*	0.05	41,18	40,72	42,61	89,41
Mn	ppb	0.05	158,94	1459,21	314,32	388,61
Mo	ppb	0.1	1,7	2,5	0,5	1
Na	*ppm*	0.05	42,24	18,12	46,13	51,61
Nb	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Nd	ppb	0.01	0,02	0,04	<0.01	0,03

Table 23 Chemical element concentrations in groundwater from the monitoring wells at the industrial areas of Narva Power Plants (July, 2010) (continued)

Elements	Unit	DTL	Wells			
			18125	**18135**	**19952**	**19954**
Ni	ppb	0.2	0,9	1,6	<0.2	<0.2
P	ppb	20	<20	80	170	63
Pb	ppb	0.1	0,3	0,2	<0.1	0,5
Pd	ppb	0.2	<0.2	<0.2	<0.2	<0.2
Pr	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Pt	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Rb	ppb	0.01	1,7	4,81	95,53	13,23
Re	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Rh	ppb	0.01	<0.01	<0.01	0,02	0,01
Ru	ppb	0.05	<0.05	<0.05	<0.05	<0.05
S	*ppm*	1	4	30	147	90
Sb	ppb	0.05	0,06	0,1	<0.05	<0.05
Sc	ppb	1	<1	<1	<1	2
Se	ppb	0.5	<0.5	<0.5	14,9	10,6
Si	ppb	40	3376	5744	7721	13480
Sm	ppb	0.02	<0.02	<0.02	<0.02	<0.02
Sn	ppb	0.05	<0.05	<0.05	<0.05	<0.05
Sr	ppb	0.01	127,39	138,36	539,42	344,83
Ta	ppb	0.02	<0.02	<0.02	<0.02	<0.02
Tb	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Te	ppb	0.05	<0.05	<0.05	<0.05	<0.05
Th	ppb	0.05	<0.05	<0.05	<0.05	<0.05
Ti	ppb	10	<10	<10	<10	<10
Tl	ppb	0.01	<0.01	0,01	<0.01	<0.01
Tm	ppb	0.01	<0.01	<0.01	<0.01	<0.01
U	ppb	0.02	0,69	4,94	0,24	0,58
V	ppb	0.2	<0.2	0,3	0,4	0,5
W	ppb	0.02	0,08	0,12	0,14	0,06
Y	ppb	0.01	0,04	0,05	<0.01	0,02
Yb	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Zn	ppb	0.5	108	204,6	4,2	176,6
Zr	ppb	0.02	0,36	0,15	0,28	0,37

Table 24 Chemical element concentrations in groundwater from the monitoring wells at the industrial areas of Narva Power Plants (September, 2010)

Elements	Unit	DTL	Wells			
			18125	**18135**	**19952**	**19954**
Ag	ppb	0.05	<0.05	<0.05	<0.05	<0.05
Al	ppb	1	2	3	2	2
As	ppb	0.5	2,8	0,6	7,6	1,1
Au	ppb	0.05	<0.05	<0.05	<0.05	<0.05
B	ppb	5	428	438	369	261
Ba	ppb	0.05	156,15	375,63	112,19	49,84
Be	ppb	0.05	<0.05	<0.05	<0.05	0,05
Bi	ppb	0.05	<0.05	<0.05	<0.05	<0.05
Br	ppb	5	1000	346	7333	5492
Ca	*ppm*	0.05	99,12	76,49	209,36	149,16
Cd	ppb	0.05	<0.05	<0.05	<0.05	1,55
Ce	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Cl	*ppm*	1	36	20	143	109
Co	ppb	0.02	0,37	0,06	<0.02	<0.02
Cr	ppb	0.5	<0.5	<0.5	<0.5	<0.5
Cs	ppb	0.01	0,02	0,02	0,07	0,03
Cu	ppb	0.1	2,3	2,2	1,9	2,4
Dy	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Er	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Eu	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Fe	ppb	10	21	21	<10	<10
Ga	ppb	0.05	0,05	<0.05	<0.05	<0.05
Gd	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Ge	ppb	0.05	0,06	0,08	0,1	0,1
Hf	ppb	0.02	<0.02	<0.02	<0.02	<0.02
Hg	ppb	0.1	0,1	0,1	<0.1	<0.1
Ho	ppb	0.01	<0.01	<0.01	<0.01	<0.01
In	ppb	0.01	<0.01	<0.01	<0.01	<0.01
K	*ppm*	0.05	14,22	8,38	149,14	86,71
La	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Li	ppb	0.1	5,1	7,3	20,2	31,3
Lu	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Mg	*ppm*	0.05	29,34	40,23	42,73	51,1
Mn	ppb	0.05	967,98	61,96	586,27	345,78
Mo	ppb	0.1	4,6	1,4	0,8	11
Na	*ppm*	0.05	17,89	47,53	50,15	40,19
Nb	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Nd	ppb	0.01	<0.01	<0.01	<0.01	<0.01

Table 24 Chemical element concentrations in groundwater from the monitoring wells at the industrial areas of Narva Power Plants (September, 2010) (continued)

Elements	Unit	DTL	Wells			
			18125	**18135**	**19952**	**19954**
Ni	ppb	0.2	0,4	<0.2	<0.2	<0.2
P	ppb	20	85	39	297	52
Pb	ppb	0.1	<0.1	<0.1	<0.1	20,9
Pd	ppb	0.2	<0.2	<0.2	<0.2	<0.2
Pr	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Pt	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Rb	ppb	0.01	6,59	4,11	82,28	25,37
Re	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Rh	ppb	0.01	<0.01	<0.01	0,01	<0.01
Ru	ppb	0.05	<0.05	<0.05	<0.05	<0.05
S	*ppm*	1	22	14	171	99
Sb	ppb	0.05	0,08	<0.05	<0.05	<0.05
Sc	ppb	1	<1	<1	<1	<1
Se	ppb	0.5	2,7	0,9	16,1	11,4
Si	ppb	40	7151	4361	6415	7831
Sm	ppb	0.02	<0.02	<0.02	<0.02	<0.02
Sn	ppb	0.05	<0.05	0,11	<0.05	<0.05
Sr	ppb	0.01	193,99	161,6	554,58	236,09
Ta	ppb	0.02	<0.02	<0.02	<0.02	<0.02
Tb	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Te	ppb	0.05	<0.05	<0.05	<0.05	<0.05
Th	ppb	0.05	<0.05	<0.05	<0.05	<0.05
Ti	ppb	10	<10	<10	<10	<10
Tl	ppb	0.01	0,03	<0.01	<0.01	<0.01
Tm	ppb	0.01	<0.01	<0.01	<0.01	<0.01
U	ppb	0.02	3,16	0,96	0,4	2,84
V	ppb	0.2	0,5	<0.2	0,6	0,4
W	ppb	0.02	0,04	0,02	0,21	0,12
Y	ppb	0.01	0,01	<0.01	<0.01	<0.01
Yb	ppb	0.01	<0.01	<0.01	<0.01	<0.01
Zn	ppb	0.5	4,2	6	3,6	6,4
Zr	ppb	0.02	0,1	0,03	0,2	0,04

CONCLUSIONS

- Realisation of this project permitted to obtain new data regarding the chemical composition of groundwater in the vicinities of the landfills located near to two largest enterprises of oil shale industry specialised on the oil shale thermal processing (Kiviõli Oil shale Processing Plant and Viru Keemia Group) and at the industrial areas of the Eesti and Balti Power Plants.

- The geochemical database including main physical-chemical parameters for groundwater, 121 organic compounds and 70 major and trace elements measured in each groundwater sample collected from 27 wells was completed.

- Obtained geochemical data significantly enlarged the number of measured organic compounds and chemical elements that permits to get much more additional information about groundwater composition and possible contaminants in comparison with previous studies.

- Pollution of the groundwater in the main aquifers and spatial extend of the contaminants near the landfills accumulated large amount hazardous solid waste was evaluated.

- Study showed that in the Kiviõli area the good status of the groundwater of the Cambrian-Vendian aquifer could be declared in any seasons (from spring to autumn). The tracers of the organic compounds were revealed in the groundwater of Ordovician-Cambrian aquifer but determined values are significantly lower Estonian Permitted values for the groundwater (Pinnase..., 2004). The groundwater of Ordovician-Cambrian (O-C) aquifer have higher concentrations of B, K, Li, Mg, Rb and S in comparison with deeper aquifer where significantly higher concentrations of Ba, Cl and Na were determined.

- In the area of landfills in Kohtla-Järve the groundwater in Ordovician aquifer is characterised by a wide variability in organic compound concentrations, depending on the distance to spoil heap. The values of the BTEX and phenols substantially exceeded the maximum acceptable concentrations were estimated in the groundwater from

Ordovician aquifer. Generally the lower level of organic contaminants was observed in spring.

The concentration of all analysed organic compounds in the Ordovician-Cambrian aquifer is much less than the allowed limits set to hazardous substances in groundwater (Pinnase..., 2004).

As the specific feature characterised groundwater of Ordovician-Cambrian aquifer could be noted the concentrations of B, Ba, U and Sr that exceeded significantly those in the groundwater of upper Ordovician aquifer.

- The pollution of the vulnerable D_2nr and O_2ls-O_1vl aquifers at the territory of the Eesti and Balti Power plants was evaluated. At the industrial area of the Eesti Power Plant no contaminants were found in spring but in the summer and autumn the PAHs and BTEX in the trace amount were occurred in the Devonian aquifer.

  At the industrial area of the Balti Power Plant in the Ordovician aquifer low level of PAHs occurred during the whole sampling period in the amounts significantly lower Permitted values. From other classes of organic compounds the phenols were determined in the samples taken in the summer.

  The groundwater of Ordovician aquifer is characterised by the higher concentrations of Ca, Cl, K, Li, Na, Rb, S, Se and Sr relative to the water of the Devonian aquifer.

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