Appendix 6. Reduction of natural effects

To facilitate the detection of human effects on the water table and hydraulic head, numerical methods to reduce natural variation from the monitoring data. Four natural effects are treated: natural fluctuation of groundwater level, sea level fluctuation, earth tide effect, and atmospheric pressure effect. The latter two of these only apply to hydraulic head in packed-off deep drillholes.

A6.1 Groundwater level and sea level fluctuation

The natural fluctuation of groundwater is treated by a method introduced in the annual Monitoring Report for 2009 (Vaittinen et al. 2010). The method relies on calculating a reference groundwater fluctuation as a function of time by combining groundwater level monitoring data from selected measuring points: eleven shallow bedrock holes OL-L2, -L3, -L4, -PA1, -PP1, -PP2, -PP5, -PP6, -PP9, -PP31, and -PR1, and the uppermost L4 sections of six multilevel piezometers OL-EP1, -EP2, -EP4, -EP5, -EP6, and -EP7. Data from OL-PP10 was also used until 2011, but more recent data is not suitable for this purpose because of the disturbing effect of the rock piling area close to the drillhole. Figure A6-1 presents the obtained reference fluctuation for the years 2001–2017. In addition to the natural fluctuation of the groundwater table, some monitoring points are affected by the sea level. Sea level data for Rauma, provided by the Finnish Meteorological Institute (2017), are used as a reference to assess this effect. The variation range of natural fluctuation is from −1.6 m to 0.8 m, and that of the sea level from −0.8 m to 0.7 m.

The reduction of natural fluctuation is carried out by multiplying the reference groundwater fluctuation or sea level with a proportionality coefficient that is specific to the time series in question, and subtracting the resulting estimated contribution of the natural effect from the data. The minimum, maximum and mean values of the coefficients for both groundwater fluctuation and sea level variation are given in Table A6-1. Tables A6-2 to A6-6 present the coefficients for each monitored hole and packer section. The hydrological circumstances of five observation tubes and one shallow hole are assessed to have permanently changed in such a way that the coefficients have changed as well, so two coefficients have been applied. Hydrological circumstances may have changed due to construction or due to changes within the monitoring section. Also, in some monitoring sections of deep OL-KR drillholes that intersect the modelled HZ20 system (or are locally connected to it), the effect of the natural fluctuation of groundwater has been noticed to have diminished or ceased around year 2008. According to the current interpretation, the reason of this change is the packing-off in June 2008 of drillhole OL-KR7, which was the last open drillhole penetrating the HZ20 system in the central part of the investigation area.

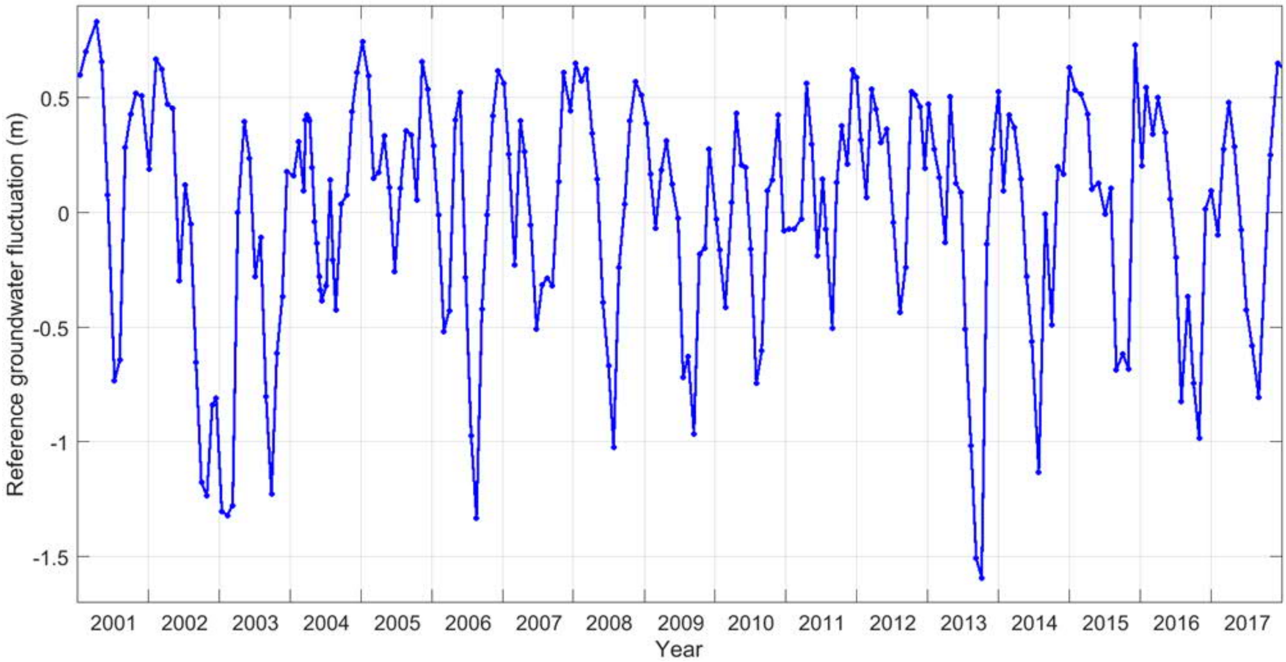

Figure A6-1. *Reference groundwater level fluctuation during 2001–2017, scale corresponding to fluctuation in shallow drillhole OL-PR1.*

A6.2 Earth tide effect

The small fluctuation of the gravity field due to the periodically varying positions of the Moon and the Sun with respect to Earth causes crustal deformations called earth tides that have an observable effect on the pressure of groundwater. In the hydraulic head data from packed-off deep drillholes, the peak-to-peak amplitude of this effect can be up to 10 cm of head, enough to notably disturb the detection and analysis of human-induced hydraulic responses. In order to reduce the tidal effect from the data, a correction has been applied on the basis of the vertical component of the tidal acceleration, calculated for the location of Olkiluoto by the TSoft computer programme by Van Camp and Vauterin (2005). Figure A6-2 presents two graphs of the calculated tidal acceleration a_T to illustrate the complicated daily, monthly, and annual variation of the effect.

The tide correction is based on an assumption that in a given drillhole section, the contribution of the tidal effect to the hydraulic head h can be expressed as $h_T(t) = C_T a_T(t-\tau)$, where C_T is a proportionality factor and τ a time lag between the tidal acceleration and its effect on the head. These two parameters are section-specific and assumed to remain constant over time. The applied h_T is a simplification of a more general form

$$h_T(t) = \int_{\tau=0}^{\infty} C_T(\tau) a_T(t-\tau) d\tau \qquad \text{(A6-1)}$$

that allows for the entire history of a_T contributing to the tidal effect. In this model, the weight function C_T should be determined for all values of the time lag separately for each packer section, which was judged unfeasible. Even with the simple model, a satisfactory reduction of the tidal effect was achieved in most cases.

To find C_T and τ for each head data series, the procedure illustrated in Figure A6-3 was followed. As the dominant frequencies in the tidal effect are about one and two periods in a day, it was useful to first cancel out variations at much longer time scales from the data. This was done by constructing a piecewise linear function (black curve in the graph) that connects the values of the raw head data (blue) with time intervals of three days, and calculating their difference to obtain a levelled data series h_L (green) that still exhibits the tidal oscillation. Then, numerical iteration is applied to find a value of τ that maximises the expression

$$C = \frac{\sum_i \left(h_L(t_i) a_T(t_i - \tau)\right)}{\sum_i \left(a_T(t_i - \tau)^2\right)} \qquad \text{(A6-2)}$$

in other words, to find such a time lag of the tidal effect that the corresponding vector component in the head data, measured at points of time t_i, is as large as possible. To avoid unnecessary summation of large numbers of opposite signs that may cause numerical errors, the levelled head data h_L was used instead of the raw data, and the mean value of a_T over the years 2006–2009, 367.79 nm/s^2, was subtracted from the values given by the TSoft program. The resulting C is used as C_T to evaluate the tidal effect h_T (thin red curve in the example graph), which can then be subtracted from the data to produce the tide-corrected data (red curve with dots). In the example, C_T = 3.2835×10^4 s^2 and τ = 1.9651 h. The values of C_T and τ for all studied packer sections are given in Appendix 6, and the mean, minimum, and maximum of C_T in Table A6-1.

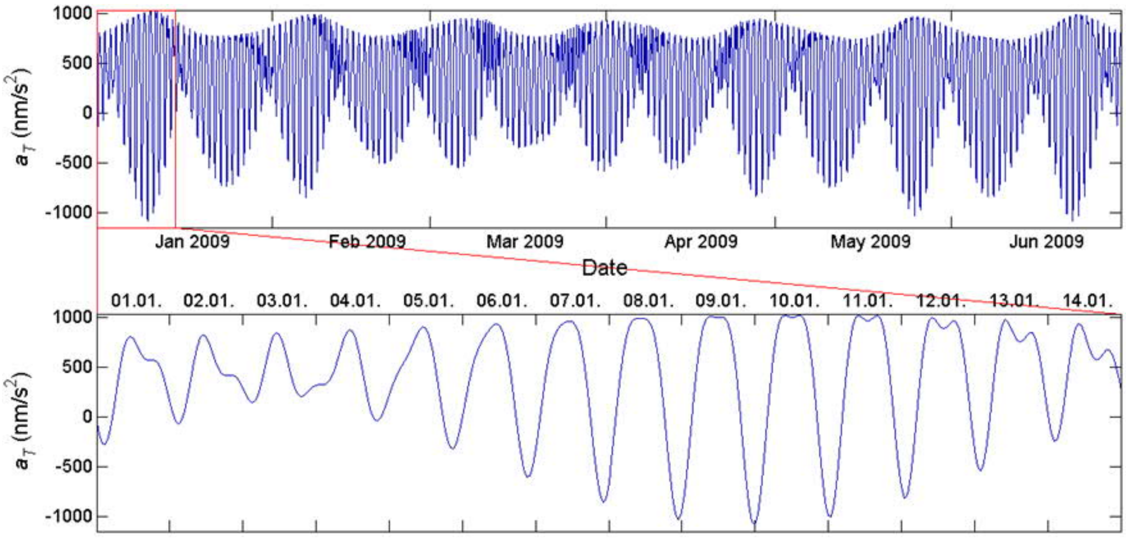

Figure A6-2. *Vertical tidal acceleration in Olkiluoto during the first six months (upper panel) and during the first two weeks (lower panel) of 2009, calculated by the TSoft program.*

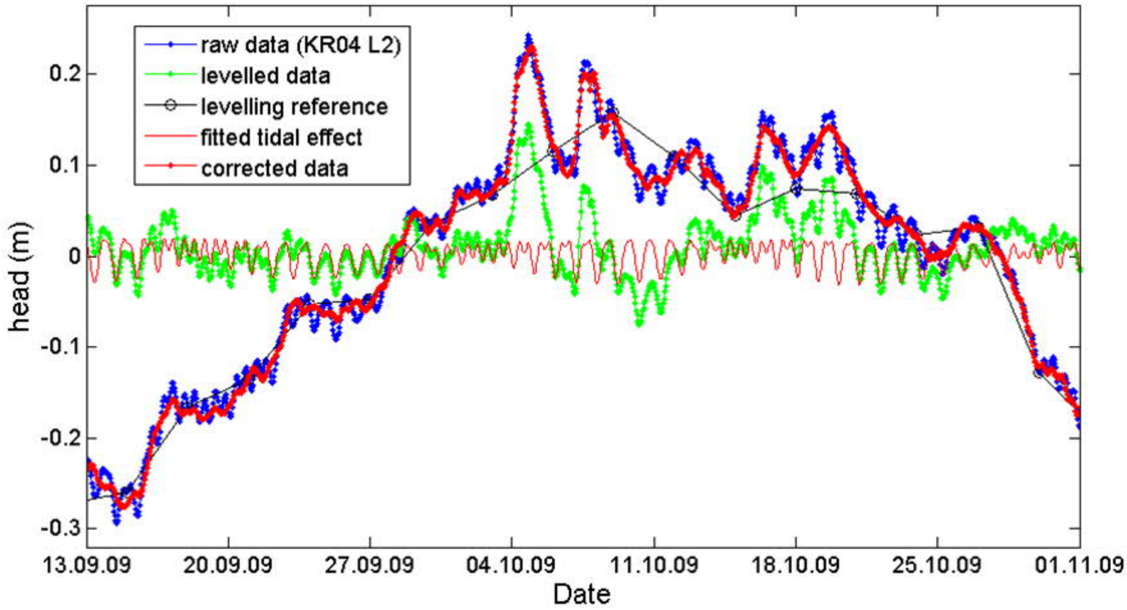

Figure A6-3. *Example of the earth tide correction.*

A6.3 Atmospheric pressure effect

The pressure gauges used for measuring the hydraulic head are designed to analogously cancel out the atmospheric pressure so that the acquired reading is strictly proportional to the height of the water column above the gauge in the measuring tube. That height, however, also responds to the atmospheric pressure, by an amount that varies between drillholes but appears in every case to be directed so that when the pressure increases, the water level decreases, and vice versa. An obvious physical explanation to the effect is that because of the compressibility of water, its density depends slightly on pressure. When the narrow (inner cross-section of order 4 cm^2) measuring tube is the only volume where the groundwater mass connected to a measuring section can expand, even minute changes of water density can cause an observable change in the water level.

The pressure effect on the measured head was modelled and corrected by a method very similar to earth tides. As the typical time scale of pressure variation in the weather data obtained in Olkiluoto is a few days, the head and atmospheric pressure data were both first levelled by subtracting piecewise linear functions, based on data at the same points of time with intervals of seven days. The obtained levelled head data $h_L(t_i)$ and pressure data $p_L(t_i)$ were then used to calculate a pressure effect coefficient

$$C_P = \frac{\sum_i \left(h_L(t_i)\, p_L(t_i)\right)}{\sum_i \left(p_L(t_i)^2\right)}. \qquad \text{(A6-3)}$$

As the possibility of a delayed effect had to be taken into account, the calculation was repeated with the pressure data shifted in time by an amount increasing in steps of one hour (the frequency of weather observations). The coefficient with the largest absolute value and the corresponding delay in hours were stored for the calculation of the pressure correction of the head data. The obtained parameter values are given in Table A6-3. Figure A6-4 presents an example of determining the pressure effect. The data, plotted in blue, are the head in section L2 of drillhole OL-KR9 in January–March 2009 after the subtraction of natural fluctuation, earth tide effect correction, and levelling. The red curve is the levelled atmospheric pressure, multiplied by 0.05178 m/kPa and shifted by 1 hour to the right to achieve the best fit to the data. Apparently, in this case most of the fluctuations in the time scale of a few days can be explained by the atmospheric pressure effect.

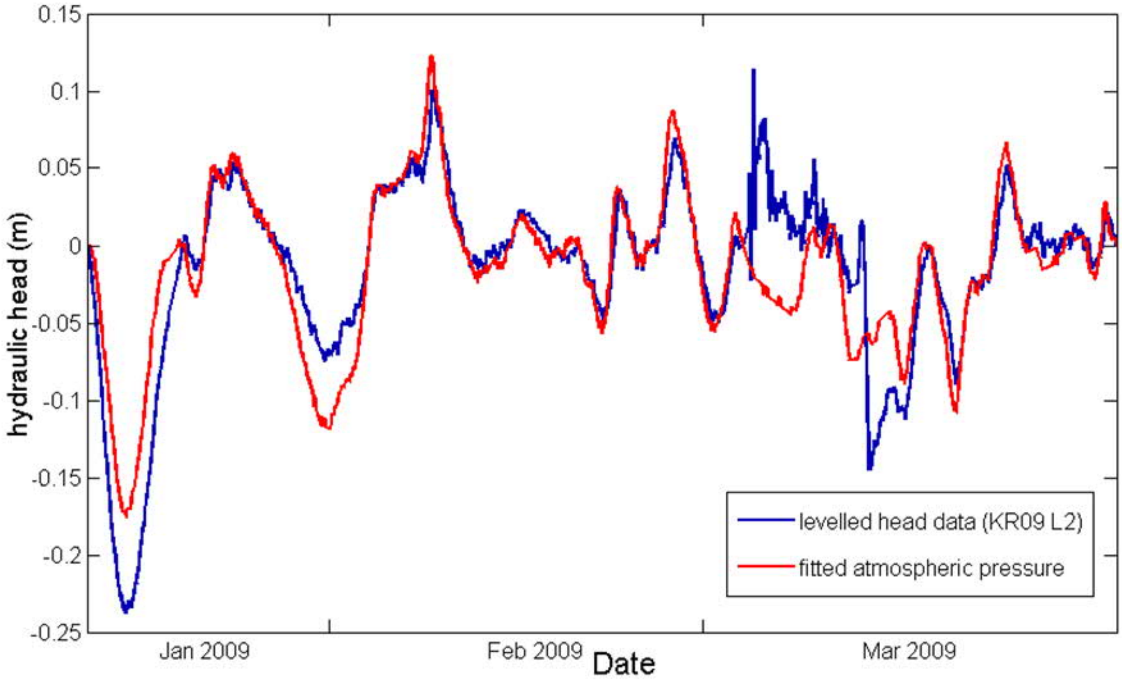

Figure A6-4. *Example of the calculation of coefficients for the atmospheric pressure correction.*

Table A6-1 presents the mean, minimum, and maximum values of the coefficients for the reduction of natural effects from data collected from different measuring locations. Empty cells indicate that the reductions of tidal and atmospheric pressure effects are only applicable to packed-off deep drillholes with automatic recording. Coefficients have not been determined for open deep drillholes. The following corrections and additions to the reduction coefficients have been made when processing the data of 2017:

- OL-KR10: parameters for the new packer configuration installed in 2017
- OL-KR11: earth tide and atmospheric pressure corrections change in sections L1 and L4 on 19.3.2015, and in section L4 on 5.1.2016
- OL-KR13: earth tide correction changes on 26.5.2014 and 5.5.2015
- OL-KR14: parameters for the packer configuration installed in 2017
- OL-KR55: correction parameter for natural groundwater fluctuation determined
- OL-L7/1–3: correction parameters for natural groundwater fluctuation determined

Table A6-1. *Minimum, maximum, and mean values of the coefficients for the reduction of natural groundwater fluctuation, sea level variation, earth tide effect, and atmospheric pressure effect.*

Reduction term		Observation tubes	Shallow bedrock holes	Multilevel piezometers	Packed-off deep drillholes
Groundwater fluctuation	mean	0.9244	0.8611	0.7014	0.5373
	min	0.1721	0.2191	0.2513	0
	max	2.0284	1.8447	1.7064	1.5365
Sea level (non-zero values)	mean	0.4661	0.6368	0.3285	0.3579
	min	0.1646	0.0967	0.0353	0.0985
	max	0.9013	0.9000	0.6555	0.8586
Tidal effect (10^3 s^2)	mean				26.408
	min				0
	max				75.302
Atmospheric pressure effect (mm/kPa)	mean				24.293
	min				−67.7725
	max				94.600

Table A6-2. Correction parameters for the multilevel piezometers.

Label	Section top, m	Section bottom, m	Natural fluctuation	Sea level	Factors determined, year
EP01 L1	93.4	103	?		2009
EP01 L2	62.9	69.2	?		2009
EP01 L3	36.5	44	?		2009
EP01 L4	3.2	14.4	1.3628		2010
EP02 L1	93.5	101.5	0.5058		2014
EP02 L2	62.5	69.7	0.3843		2010
EP02 L3	34.5	40.5	0.7462		2010
EP02 L4	2.2	15.5	0.8034		2010
EP03 L1	93.4	103.77	0.7601		2010
EP03 L2	68.4	75	?		2010
EP03 L3	36.4	42.4	0.7622		2010
EP03 L4	6.1	17.4	?		2010
EP04 L1	93.1	103.4	0.4912	0.6555	2010
EP04 L2	63.4	71.5	0.422	0.0353	2010
EP04 L3	34	41.4	0.4925	0.6249	2010
EP04 L4	3.5	14.4	1.7064		2010
EP05 L1	93.7	103.7	0.5379		2010
EP05 L2	70.8	78	0.5395		2010
EP05 L3	36.7	46.3	0.5857		2010
EP05 L4	5.5	19.7	0.7199		2010
EP06 L1	93.5	103.1	0.6673		2010
EP06 L2	65.5	74.8	0.7804		2010
EP06 L3	37.5	46.3	0.8315		2010
EP06 L4	3.7	14.5	1.3521		2010
EP07 L1	91.6	102.6	0.2513	0.178	2010
EP07 L2	63.6	73.4	0.4212	0.3008	2010
EP07 L3	39.6	46.5	0.4872	0.2619	2010
EP07 L4	4.3	15.6	0.522	0.243	2010

Table A6-3. Correction parameters for the packed-off deep drillholes.

Label	Top, m	Bottom, m	Baseline head, m	Refer. head, m	Error margins		Natural fluctuation	Sea level	Earth tide		Atmosph. Pressure		Factors determined, year
					Up, m	Down, m			Factor, $10^3 s^2$	Delay, h	Factor, mm/kPa	Delay, h	
OL-KR01 L1	764.4	775.0	10.2		0.5	0.5	0	0.2245	2.129	3.849	11.968	34	2011
after 1.8.2011							?	?	?	?	?	?	2011
OL-KR01 L2	609.4	626.8	6.4		0.4	0.4	0	?	34.810	1.184	42.373	4	2009
OL-KR01 L3	532.6	545.0	4.9		0.3	0.3	0	?	41.119	1.030	36.285	1	2009
OL-KR01 L4	524.4	528.4	4.9		0.3	0.3	0	?	38.114	0.921	38.086	1	2009
OL-KR01 L5	311.2	336.8	5.1		0.5	0.5	?	?	28.453	2.469	33.640	4	2011
after 1.12.2010									14.079	2.675	16.345	3	2011
OL-KR01 L6	151.2	156.8	5.2		0.2	0.2	0.8221	0	16.363	0.705	22.732	0	2009
OL-KR01 L7	102.8	115.2	4.9		0.2	0.2	0.7972	0	22.321	0.381	22.625	0	2009
OL-KR01 L8	40.0	68.4	5.5		0.2	0.2	0.9233	0	20.667	0.951	16.864	0	2009
after packing off in 2015													
OL-KR01 L1	761.0	775.0	10.2		0.5	0.5	?	?	0.000	0.000	0.000	0	2016
OL-KR01 L2	606.0	620.0	6.4		0.4	0.4	?	?	38.585	0.502	33.046	2	2016
OL-KR01 L3	521.0	550.0	4.9		0.3	0.3	?	?	51.626	0.479	36.587	2	2016
OL-KR01 L4	311.0	345.0	5.1		0.5	0.5	?	?	28.617	2.243	28.135	7	2016
OL-KR01 L5	256.0	290.0	5.3		0.4	0.4	?	?	34.202	1.491	28.263	7	2016
OL-KR01 L6	151.0	155.0	5.2		0.2	0.2	0.8221	?	17.204	-0.460	25.667	11	2016
OL-KR01 L7	101.0	115.0	4.9		0.2	0.2	0.7972	?	23.396	-0.566	21.025	11	2016
OL-KR01 L8	41.0	75.0	5.5		0.2	0.2	0.9233	?	22.768	0.292	25.010	11	2016
OL-KR02 L1	876.0	1052.0	17.5		3.0	3.0	0	0.3138	50.019	1.067	71.287	0	2009
OL-KR02 L2	596.0	610.0	6		1.0	1.0	0	0.2523	49.532	0.882	36.207	1	2009
OL-KR02 L3	501.0	510.0	4		0.3	0.3	0	0.1254	10.712	2.685	21.963	12	2009
OL-KR02 L4	286.0	295.0	4.4		0.5	0.5	0.7702	0	39.400	1.622	40.799	1	2009
OL-KR02 L5	236.0	240.0	4.2		0.3	0.3	0.787	0	33.581	0.550	22.195	0	2009
OL-KR02 L6	106.0	115.0	4.3		0.2	0.2	0.8309	0	31.309	0.728	30.923	1	2009
OL-KR02 L7	76.0	90.0	5.4		0.2	0.2	0.7025	0	18.506	0.454	7.874	0	2009
OL-KR02 L8	40.0	50.0	5		0.2	0.2	0.9353	0	6.806	3.752	6.470	4	2009

OL-KR03 L1	469.2	473.2	3		0.3	0.3	0		26.393	3.053	39.586	4	2009
OL-KR03 L2	399.2	468.2	3.2		0.3	0.3	0		22.383	3.203	36.030	4	2009
OL-KR03 L3	380.8	398.2	3.2		0.3	0.3	0		49.330	1.183	41.700	1	2009
OL-KR03 L4	339.2	343.2	3		0.5	0.5	0		46.236	1.402	39.565	1	2009
OL-KR03 L5	242.6	253.2	3.2		0.3	0.3	0.2797		30.583	3.052	35.696	4	2009
after 1.1.2006							0.2124						2009
after 29.1.2010							0						2017
OL-KR03 L6	126.0	241.6	2.8		0.3	0.3	0.4072		20.824	3.516	26.937	4	2009
after 1.1.2006							0.332						2009
OL-KR03 L7	116.0	125.0	2.7		0.3	0.3	0.4408		26.801	1.170	21.258	1	2009
after 1.1.2006							0.3396						2009
OL-KR03 L8	40.0	90.0	2.6		0.2	0.2	0.445		0.534	4.891	0.000	0	2009
after 1.1.2006							0.3844						2009
OL-KR04 L1	586.0	870.0		8	3.0	3.0	?		46.028	1.291	46.675	1	2009
OL-KR04 L2	481.0	585.0	5.5		0.5	0.5	?		32.835	1.965	37.301	4	2009
OL-KR04 L3	351.0	380.0	5.8		0.5	0.5	?		45.891	1.447	22.866	2	2009
OL-KR04 L4	296.0	325.0	5.5		1.0	1.0	?		43.573	1.735	23.310	1	2009
OL-KR04 L5	106.0	120.0	6.2		0.3	0.3	0.5317		22.420	0.288	13.253	0	2009
OL-KR04 L6	76.0	85.0	6.1		0.3	0.3	0.5233		22.906	0.181	12.464	0	2009
OL-KR04 L7	40.0	75.0	5.9		0.3	0.3	0.5525		0.886	5.698	0.000	0	2009
OL-KR05 L1	457.2	476.2	3.1		0.4	0.4	0.1515	0.4130	48.319	1.129	33.438	1	2009
OL-KR05 L2	404.0	419.6	2.6		0.4	0.4	0.1790	0.3170	31.151	3.127	36.745	4	2009
OL-KR05 L3	277.2	284.6	2.5		0.3	0.3	0.2146	0.3601	40.405	0.902	23.939	1	2009
OL-KR05 L4	267.2	276.2	2		0.3	0.3	0.3436	0.2583	26.237	2.398	28.541	1	2009
OL-KR05 L5	202.2	207.8	2		0.3	0.3	0.5750	0.2821	26.312	1.326	9.223	1	2009
OL-KR05 L6	100.6	126.2	4.1		0.2	0.2	0.7318	0	27.774	0.495	15.714	0	2009
OL-KR05 L7	64.0	99.6	4		0.2	0.2	0.8080	0	25.221	0.404	13.968	0	2009
OL-KR05 L8	40.0	63.0	5		0.2	0.2	0.8530	0	6.576	4.260	14.953	7	2009
OL-KR06 Open													

OL-KR07 L1	291.0	811.0	5.8		0.3	0.3	0		30.276	3.302	33.075	1	2009
OL-KR07 L2	181.0	290.0	5.6		0.5	0.5	?		35.198	2.231	27.588	5	2009
OL-KR07 L3	81.0	180.0	6		0.3	0.3	0.5608		26.911	1.391	22.743	0	2009
OL-KR07 L4	40.0	80.0	6		0.3	0.3	0.6569		8.726	4.375	10.819	3	2009
after packing off in 2015													
OL-KR07 L1	426.0	811.0		8	4.0	4.0	?	?	29.082	2.151	0.000	0	2016
OL-KR07 L2	406.0	425.0	4.8		1.0	1.0	erroneous data since Nov. 2017						2018
OL-KR07 L3	261.0	310.0	5.8		0.3	0.3	?	?	33.783	0.262	33.137	4	2016
OL-KR07 L4	231.0	260.0	5.7		0.3	0.3	?	?	34.440	0.182	32.285	4	2016
OL-KR07 L5	191.0	230.0	4.5		0.5	0.5	?	?	34.532	0.196	32.278	4	2016
OL-KR07 L6	106.0	130.0	6		0.3	0.3	0.6569	?	21.119	1.285	17.309	8	2016
OL-KR07 L7	71.0	105.0	6		0.3	0.3	0.6569	?	4.612	2.133	0.000	0	2016
OL-KR07 L8	36.0	70.0	6		0.3	0.3	0.6569	?	9.267	2.829	25.065	11	2016
OL-KR08 L1	540.5	564.5	8		2.0	2.0	?		28.980	0.986	41.628	1	2009
OL-KR08 L2	245.5	259.5	7.2		1.0	1.0	0.4914		29.708	0.038	15.835	0	2009
OL-KR08 L3	70.5	84.5	6.5		0.3	0.3	0.6023		25.791	-0.154	15.283	0	2009
OL-KR08 L4	19.5	59.5	7.5		1.0	1.0	0.7034		17.506	0.377	18.265	0	2009
OL-KR09 L1	564.8	568.8	6.7		0.5	0.5	0		35.787	1.166	48.570	1	2009
OL-KR09 L2	519.8	525.4	6.2		0.5	0.5	0		29.699	2.921	51.783	1	2009
OL-KR09 L3	468.2	482.2	6		0.5	0.5	0		35.706	0.850	12.653	1	2009
OL-KR09 L4	279.6	282.2	6		0.3	0.3	0		38.835	1.098	41.504	1	2014
OL-KR09 L5	139.6	150.2	6.1		0.3	0.3	0.4866		21.050	-0.098	15.157	0	2011
OL-KR09 L6	83.0	138.6	5		0.3	0.3	0.6402		34.687	0.190	17.467	0	2011
OL-KR09 L7	40.0	82.0	5.1		0.2	0.2	0.6983		22.259	0.441	13.503	0	2011
OL-KR10 L1	522.6	614.0		6	0.7	0.7	?		3.695	4.319	14.447	12	2009
OL-KR10 L2	497.6	501.6	6.3		0.5	0.5	?		26.261	3.832	15.450	4	2009
OL-KR10 L3	395.0	430.0		5	0.7	0.7	?		32.515	2.818	38.711	4	2009
OL-KR10 L4	365.0	370.0		5	0.7	0.7	?		28.565	3.790	16.457	4	2011
OL-KR10 L5	325.0	430.0	5.6		0.4	0.2	?		38.462	1.481	14.344	0	2009

OL-KR10 L6	246.0	270.0	5.6		0.4	0.2	0.9963		44.182	1.134	27.029	5	2009
after 1.5.2008							0						2014
OL-KR10 L7	56.0	85.0		6	0.7	0.7	0.7937		11.533	2.194	9.040	2	2009
OL-KR10 L8	40.0	55.0	6.2		0.2	0.2	0.6442		13.594	3.475	9.776	3	2009
after packing off in 2017													
OL-KR10 L1	506.0	614.4					?		5.869	4.117	22.869	10	2018
OL-KR10 L2	496.0	505.0					?		0.000	0.000	0.000	0	2018
OL-KR10 L3	451.0	460.0					?		0.000	0.000	25.560	6	2018
OL-KR10 L4	396.0	430.0					?		30.986	4.279	30.009	0	2018
OL-KR10 L5	321.0	335.0					?		28.755	-5.278	0.000	0	2018
OL-KR10 L6	246.0	270.0	5.6		0.4	0.2	0		44.182	1.134	27.029	5	2014
OL-KR10 L7	106.0	120.0					?						2018
OL-KR10 L8	96.8	105.0					?		10.480	1.769	0.000	0	2018
OL-KR11 L1	949.1	1002.0	20.5		1.0	1.0	0		43.850	4.541	0.000	0	2011
OL-KR11 L2	629.1	948.1	8.5		1.0	1.0	0	0.2456	10.731	2.386	22.265	15	2011
OL-KR11 L3	597.5	628.1	7.6		0.5	0.5	?		?	?	?	?	2011
OL-KR11 L4	415.9	419.9	5.8		0.5	0.5	?		?	?	?	0	2011
OL-KR11 L5	277.5	281.5	5.3		0.5	0.5	0		27.313	1.854	40.958	5	2011
OL-KR11 L6	211.0	213.1	5.1		0.5	0.5	?		?	?	?	0	2011
OL-KR11 L7	124.5	126.6	5		0.7	0.7	0.537		26.422	-0.298	19.393	0	2011
OL-KR11 L8	122.8	123.5	4.2		0.5	0.5	?		?	?	?	0	2011
after packing off in 2013													
OL-KR11 L1	936.0	1002.0	20.5		1.0	1.0	0	0.1700	10.691	3.010	19.954	8	2014
after 15.11.2013								0					
after 19.3.2015									75.302	1.365	60.375	1	2018
OL-KR11 L2	616.0	635.0	8.5		1.0	1.0	0		0.000	0.000	2.011	14	2014
OL-KR11 L3	411.0	430.0	7.6		0.5	0.5	0		26.406	3.743	40.953	9	2014
OL-KR11 L4	311.0	375.0		3*	2.0*	0.5*	0		23.181	3.543	33.351	11	2014
after 19.3.2015									0.000	0.000	18.675	24	2018
after 5.1.2016									21.210	3.054	34.683	6	2018
OL-KR11 L5	271.0	310.0		3.5*	1.0*	1.0*	0		36.456	2.808	37.000	5	2014
OL-KR11 L6	206.0	220.0	5.1		0.5	0.5	0.5331		12.514	4.474	21.350	6	2016

OL-KR11 L7	124.4	135.0	5		0.7	0.7	0.4466		33.173	0.951	21.496	0	2016
OL-KR11 L8	123.0	123.4	4.2		0.5	0.5	0.6?		0.000	0.000	0.000	0	2014
OL-KR12 L1	702.0	756.0	13		3.0	3.0	0		52.175	2.689	49.581	1	2011
after 1.2.2006									1.187	5.445	94.600	0	2011
after 30.8.2006											7.677	3	2011
after 1.1.2008											3.783	37	2011
OL-KR12 L2	664.0	666.0	9		2.0	2.0	0		?	?	?	?	2009
OL-KR12 L3	529.0	618.0	6.6		0.3	0.3	0.1218		33.887	2.621	40.547	6	2009
OL-KR12 L4	364.0	368.0	5		0.5	0.5	0		18.174	3.280	38.508	6	2009
OL-KR12 L5	290.6	349.6	6.2		0.3	0.3	0.5151		15.400	4.154	24.726	3	2011
OL-KR12 L6	85.6	99.6	5.2		0.1	0.1	0.8302		22.594	0.268	13.877	3	2009
OL-KR12 L7	50.6	69.6	7		0.3	0.3	0.9437		23.932	0.063	15.613	2	2009
OL-KR12 L8	40.0	49.6	7		0.1	0.1	0.9636		8.674	0.809	9.511	6	2009
OL-KR13 L1	445.5	500.0	3.6		0.5	0.5	0		39.387	2.030	41.365	2	2014
after 26.5.2014									0.000	0.000	0.000	0	2018
after 5.5.2015									50.049	1.808	0.000	0	2018
OL-KR13 L2	405.5	414.5	3.8		0.3	0.3	0.277		47.800	1.119	42.233	1	2009
OL-KR13 L3	360.5	364.5	3.7		0.3	0.3	0.3011		48.603	0.842	42.614	1	2009
OL-KR13 L4	210.5	219.5	4.3		0.3	0.3	0.7267		34.792	0.456	23.310	0	2009
OL-KR13 L5	9.5	89.5	5		0.3	0.3	0.6653		13.640	-0.127	8.366	3	2009
OL-KR14 Open													2009
OL-KR14 L1	436.0	508.0					?		21.163	2.854	23.556	10	2018
OL-KR14 L2	326.0	335.0					?		7.235	3.577	23.299	9	2018
OL-KR14 L3	176.0	190.0					?		40.025	0.005	0.000	0	2018
OL-KR14 L4	46.0	80.0					0.6465		15.403	1.565	0.000	0	2018
OL-KR15 L1	446.0	460.0	5.6		0.5	0.5	0.3398		44.516	1.618	41.872	1	2009
OL-KR15 L2	241.0	245.0	5.3		0.5	0.5	0.5239		14.605	2.710	33.872	5	2009
after 19.8.2015											-67.773	0	2017

OL-KR15 L3	116.0	145.0	6.4		0.2	0.2	0.8369		24.821	1.552	18.936	0	2009
after 1.6.2010									12.137	3.805			2011
OL-KR15 L4	66.0	75.0	6.6		0.2	0.2	0.9596		20.574	0.828	13.388	0	2009
OL-KR15 L5	51.0	65.0	6.6		0.2	0.2	0.9488		14.162	0.758	10.440	0	2009
OL-KR15 L6	40.0	50.0	6.8		0.2	0.2	0.8959		14.675	1.298	9.908	0	2009
OL-KR15B L1	17.0	31.0		6.8	0.2	0.2	1.1135		11.178	0.542	18.624	0	2010
OL-KR15B L2	4.5	16.0		6.8	0.2	0.2	1.1146		9.200	0.830	17.386	0	2010
OL-KR16 L1	143.0	170.2		5.6	0.7	0.7	0.9456		28.175	0.920	26.145	5	2009
after 1.8.2008							0						2014
OL-KR16 L2	113.0	142.0		6.2	0.7	0.7	0.9682		37.450	1.173	29.345	1	2009
after 1.8.2008							0.5						2014
OL-KR16 L3	83.0	112.0		6.3	0.7	0.7	1.0139		22.586	1.536	24.599	1	2009
after 1.8.2008							0.5						2014
after 25.8.2015									5.724	3.668			2017
after 12.6.2016									13.537	4.276			2017
after 13.9.2016									0.000	0.000	0.000	0	2017
after 24.11.2016											16.662	14	2017
OL-KR16 L4	63.0	82.0		6.4	0.7	0.7	1.033		19.814	0.828	13.633	0	2009
OL-KR16 L5	53.0	62.0		6.6	0.7	0.7	1.0278		16.093	0.673	11.510	0	2009
OL-KR16 L6	40.0	52.0		6.8	0.7	0.7	1.0165		13.781	0.970	11.097	0	2009
after 25.8.2015											-53.385	0	2017
OL-KR16B L1	21.0	35.0		6.8	0.2	0.2	1.1419		10.950	0.547	19.005	0	2010
OL-KR16B L2	4.5	20.0		6.8	0.2	0.2	0.9284		6.048	1.690	18.779	0	2010
OL-KR17 L1	122.0	157.1		6.2	0.7	0.7	0.8602		35.165	-0.194	15.044	0	2016
OL-KR17 L2	97.0	111.0		6	0.7	0.7	0.7739		27.332	1.496	39.728	1	2016
OL-KR17 L3	82.0	96.0		6	0.7	0.7	0.7869		23.506	1.784	39.994	1	2014
OL-KR17 L4	67.0	71.0		6.8	0.7	0.7	0.9829		14.325	0.283	11.000	0	2014
OL-KR17 L5	52.0	66.0		6.8	0.7	0.7	0.9997		14.281	0.367	10.987	0	2014
OL-KR17 L6	40.0	51.0		6.8	0.7	0.7	0.9716		13.191	0.638	11.145	0	2014
OL-KR17B L1	11.0	30.0		7	0.2	0.2	1.0887		8.149	1.063	18.150	0	2010
OL-KR17B L2	4.1	10.0		8.5	0.4	0.4	1.5365		0.936	1.744	14.547	0	2010

OL-KR18 L1	89.0	125.5		6.6	0.7	0.7	0.9383		19.023	2.623	30.022	4	2009
OL-KR18 L2	74.0	83.0		6.6	0.7	0.7	0.9461		19.972	0.844	13.231	0	2009
OL-KR18 L3	59.0	63.0		6.7	0.7	0.7	0.9679		15.237	1.122	10.743	0	2009
OL-KR18 L4	54.0	58.0		6.7	0.7	0.7	0.9605		14.516	0.890	10.219	0	2009
OL-KR18 L5	40.0	53.0		6.7	0.7	0.7	0.9767		13.958	1.098	10.336	0	2009
OL-KR18B L1	24.0	45.5		6.8	0.2	0.2	1.1003		12.858	0.447	19.512	0	2010
OL-KR18B L2	14.0	23.0		6.9	0.2	0.2	1.1557		11.725	0.479	18.934	0	2010
OL-KR18B L3	6.5	13.0		6.8	0.2	0.2	1.1071		13.938	0.443	19.351	0	2010
OL-KR19 L1	454.0	468.0		3.3	0.3	0.3	0	0.2636	49.906	0.456	36.565	0	2009
OL-KR19 L2	319.0	328.0		2.4	0.3	0.3	0.2059	0.6504	38.358	0.755	29.896	0	2011
OL-KR19 L3	249.0	263.0		2.6	0.3	0.3	0.6618	0.3268	42.584	1.743	39.565	2	2011
OL-KR19 L4	199.0	213.0		2.5	0.3	0.3	0.5314		52.946	0.195	42.621	1	2009
OL-KR19 L5	144.0	153.0		2.6	0.3	0.3	0.5798		42.891	0.249	40.327	1	2009
OL-KR19 L6	69.0	108.0		3	0.3	0.3	0.5757		24.274	-0.021	40.058	1	2009
OL-KR19 L7	54.0	58.0		3.5	0.3	0.3	0.777		20.590	-0.382	28.025	3	2009
OL-KR19 L8	40.0	53.0		3.4	0.3	0.3	0.7943		14.238	0.010	27.512	3	2009
OL-KR20 L1	460.0	474.0	3.4		0.5	0.5	0.2873		35.283	2.467	37.058	4	2009
OL-KR20 L2	410.0	434.0	3.2		0.5	0.5	0.3388		34.505	2.263	37.921	1	2009
OL-KR20 L3	185.0	194.0	4.6		0.2	0.2	0.5269		24.147	2.953	32.747	4	2009
after 8.12.2015									5.287	5.622	20.336	15	2017
OL-KR20 L4	140.0	144.0	4.8		0.2	0.2	0.5931		13.248	4.321	31.204	5	2009
OL-KR20 L5	110.0	114.0	5.2		0.2	0.2	0.8136		17.353	0.629	9.472	0	2009
OL-KR20 L6	65.0	109.0	5.3		0.2	0.2	0.7962		22.038	0.279	15.739	0	2009
OL-KR20 L7	40.0	64.0	5.3		0.2	0.2	0.8599		14.410	1.209	12.528	1	2009
OL-KR21 Open													
OL-KR22 L1	415.0	444.0					0.5?		34.503	2.089	?	?	2016
OL-KR22 L2	380.0	399.0					0.5?		35.496	2.096	?	?	2016
OL-KR22 L3	40.6	379.0					0.5?		33.354	2.027	?	?	2016

after packing off in 2007													
OL-KR22 L1	419.4	428.4		6.2	0.7	0.7	0?		41.849	1.718	35.631	0	2009
OL-KR22 L2	389.4	393.4		5.8	0.7	0.7	?		42.841	1.788	34.779	0	2009
OL-KR22 L3	146.0	155.0		5.7	0.7	0.7	0.4945		21.806	0.218	10.498	1	2009
OL-KR22 L4	96.0	120.0		6	0.7	0.7	0.4401		20.838	0.240	13.492	0	2009
OL-KR22 L5	86.0	95.0		6	0.7	0.7	0.4481		21.542	0.432	13.326	0	2009
OL-KR22 L6	76.0	85.0		6	0.7	0.7	0.6215		22.366	0.115	14.690	0	2009
OL-KR22 L7	56.0	75.0		6.2	0.7	0.7	0.4165		21.242	0.400	13.868	0	2009
OL-KR22 L8	40.0	55.0		6.6	0.7	0.7	0.4003		15.073	0.162	13.357	0	2009
OL-KR23 L1	424.0	460.0	6.5		1.5	0.3	0.6809		33.867	1.013	28.223	5	2009
after 1.7.2008							0						2014
OL-KR23 L2	360.0	399.0	6.4		1.0	0.3	0.7139		33.723	2.028	33.054	0	2009
after 1.7.2008							0						2014
OL-KR23 L3	170.0	199.0	6.2		0.4	0.4	0.6389		28.032	0.313	12.562	0	2009
OL-KR23 L4	130.0	139.0	6.1		0.3	0.3	0.8373		26.076	0.393	13.915	0	2009
OL-KR23 L5	75.0	104.0	6.5		0.3	0.3	0.8145		20.570	0.609	11.898	0	2009
OL-KR23 L6	65.0	74.0	6.3		0.3	0.3	0.8206		24.370	0.029	14.445	0	2009
OL-KR23 L7	40.0	64.0	7		0.2	0.2	0.7565		18.182	2.678	16.746	0	2009
OL-KR24 Closed													
OL-KR25 L1	387.0	605.0	6.2		1.0	1.0	?		39.778	1.206	29.488	4	2011
OL-KR25 L2	357.0	386.0	6		1.0	1.0	?		31.975	2.202	?	0	2011
OL-KR25 L3	337.0	356.0	5.5		0.7	0.7	?		32.457	1.851	39.688	8	2011
OL-KR25 L4	106.0	126.0	5.6		0.3	0.3	0.3663		29.819	0.347	14.258	0	2009
OL-KR25 L5	91.0	105.0	5.6		0.3	0.3	0.4534		21.273	1.002	13.273	0	2009
OL-KR25 L6	66.0	80.0	5.6		0.3	0.3	0.4579		19.392	0.951	12.429	0	2009
OL-KR25 L7	51.0	65.0	5.6		0.3	0.3	0.4623		19.469	0.942	10.775	0	2009
OL-KR25 L8	40.0	50.0	5.8		0.3	0.3	0.3887		10.011	3.679	6.807	3	2009
OL-KR26 Open													

OL-KR27 L1	501.0	510.0		6.7	0.7	0.7	?		33.308	0.970	29.271	1	2009
OL-KR27 L2	421.0	430.0		6.7	0.7	0.7	?		46.394	0.643	43.241	1	2009
OL-KR27 L3	256.0	265.0		6.1	0.7	0.7	0.5547		30.397	0.010	14.319	0	2016
OL-KR27 L4	206.0	210.0		6.9	0.7	0.7	0.5054		30.680	-0.593	17.139	0	2016
OL-KR27 L5	126.0	135.0		6.8	0.7	0.7	0.5401		49.572	0.238	23.130	0	2016
OL-KR27 L6	81.0	105.0		6.9	0.7	0.7	1.0139		36.930	-0.072	32.949	1	2016
OL-KR27 L7	56.0	75.0		6.8	0.7	0.7	1.029		33.214	-0.140	31.116	1	2016
OL-KR27 L8	40.0	55.0		6.7	0.7	0.7	1.0462		30.070	0.029	36.121	1	2016
OL-KR28 L1	516.0	525.0		6.7	0.7	0.7	?		52.202	0.747	36.627	1	2009
OL-KR28 L2	441.0	450.0		6.1	0.7	0.7	0.8987		36.000	1.113	17.898	0	2013
after 1.1.2009							0						2014
OL-KR28 L3	386.0	395.0		6.1	0.7	0.7	0.7233		34.794	1.019	15.646	0	2013
after 1.1.2009							0						2014
OL-KR28 L4	161.0	180.0		5.9	0.7	0.7	0.5027		23.960	-0.051	11.993	0	2009
OL-KR28 L5	146.0	160.0		5.9	0.7	0.7	0.4978		23.164	0.109	12.577	0	2009
OL-KR28 L6	126.0	145.0		5.8	0.7	0.7	0.4966		23.479	0.096	12.551	0	2009
OL-KR28 L7	86.0	95.0					0.5?		22.141	0.862	32.343	5	2009
OL-KR28 L8	40.0	85.0					1?		4.017	6.439	0.000	0	2009
after packing off in June, 2011													
OL-KR28 L1	571.0	656.0					no GWMS data						
OL-KR28 L2	561.0	570.0					no GWMS data						
OL-KR28 L3	516.0	530.0		6.7	0.7	0.7	no GWMS data						
OL-KR28 L4	441.0	450.0		6.1	0.7	0.7	0		36.000	1.113	17.898	0	2014
OL-KR28 L5	386.0	395.0		6.1	0.7	0.7	0		34.794	1.019	15.646	0	2014
OL-KR28 L6	331.0	335.0					no GWMS data						
OL-KR28 L7	126.0	180.0		5.9	0.7	0.7	0.5567		24.281	0.418	20.604	2	2013
OL-KR28 L8	40.0	95.0		6	0.7	0.7	0.5221		9.034	5.435	11.953	9	2013
OL-KR29 L1	800.0	867.0		8	0.7	0.7	0.0508	0.2170	29.037	1.636	40.161	1	2009
OL-KR29 L2	601.0	800.0		3.7	0.7	0.7	0.0398	0.2559	7.737	4.284	28.486	18	2009
OL-KR29 L3	521.0	580.0		1.5	0.7	0.7	0.1013	0.3580	29.483	1.372	29.842	1	2009

OL-KR29 L4	301.0	350.0		6.3	1	1	0.6059	0	29.316	1.333	27.089	5	2009
after 23.6.2008							0.4						2014
OL-KR29 L5	251.0	255.0		6.3	1	1	0.5632	0	32.729	1.455	11.149	1	2009
after 23.6.2008							0.4						2014
OL-KR29 L6	161.0	180.0		6.3	1	1	0.6183	0	29.741	0.874	22.218	5	2009
after 23.6.2008							0.3						2014
OL-KR29 L7	96.0	110.0		5	0.7	0.7	0.5422	0	24.243	0.869	16.077	0	2009
OL-KR29 L8	40.0	65.0		5.3	0.7	0.7	0.7902	0	19.493	1.566	18.643	0	2009
after packing off in November, 2016													
OL-KR29 L1	761.0	800.0		6.2	1	1	?	?	35.220	-0.483	52.661	2	2017
OL-KR29 L2	741.0	760.0		6.2	1	1	?	?	0.000	0.000	0.000	0	2017
OL-KR29 L3	581.0	600.0		1.6	1	1	?	?	33.462	0.355	32.642	8	2017
OL-KR29 L4	551.0	580.0		1.5	1	1	?	?	29.664	-0.513	39.812	0	2017
OL-KR29 L5	301.0	350.0		6.3	1	1	?		32.642	-0.355	43.237	2	2017
OL-KR29 L7	66.0	110.0		5	0.7	0.7	?		24.976	-0.621	21.419	5	2017
OL-KR30 Open													
OL-KR31 Open													
OL-KR32 Open													
OL-KR33 Open													
OL-KR34 Open													
OL-KR35 Open													
OL-KR36 Open													
OL-KR37 L1	270.6	274.6					?						2009
OL-KR37 L2	225.6	234.6		5.5	0.7	0.7	?		?	?	?	?	2009
OL-KR37 L3	165.6	179.6		5	0.7	0.7	0.5257		23.762	0.332	23.457	5	2009
OL-KR37 L4	115.6	139.6		5	0.7	0.7	0.5608		24.382	0.172	14.456	0	2009
OL-KR37 L5	39.6	59.6		5.1	0.7	0.7	0.6131		18.602	1.889	14.564	1	2009
OL-KR38 Closed													

OL-KR39 L1	469.3	503.0		3.3	0.7	0.7	0	0.0985	1.517	3.812	0.000	0	2009
OL-KR39 L2	399.3	408.3		3.3	0.7	0.7	0.05	0.1311	24.969	3.600	35.927	4	2009
OL-KR39 L3	374.3	383.3		2.6	0.7	0.7	0.06	0.1324	18.188	3.978	31.340	5	2009
OL-KR39 L4	134.3	158.3		4.8	0.7	0.7	0.9383	0	26.161	0.739	1.697	0	2009
OL-KR39 L5	104.3	113.3		5	0.7	0.7	0.8586	0	25.363	0.244	5.885	0	2009
OL-KR39 L6	79.3	88.3		5	0.7	0.7	0.872	0	23.305	0.377	7.794	0	2009
OL-KR39 L7	59.3	73.3		5	0.7	0.7	0.8761	0	21.205	0.205	6.830	0	2009
OL-KR39 L8	39.3	58.3		5.1	0.7	0.7	0.8692	0	13.715	0.509	9.004	0	2009
after 11.10.2011													
OL-KR39 L1	440.0	503.0					?	?	?	?	?	?	2011
OL-KR39 L2	395.0	409.0					?	?	?	?	?	?	2011
OL-KR39 L3	375.0	384.0					?	?	?	?	?	?	2016
OL-KR39 L4	135.0	159.0					0.9383	0	26.161	0.739	23.413	0	2016
OL-KR39 L5	105.0	114.0					0.8586	0	25.363	0.244	21.113	0	2016
OL-KR39 L6	80.0	89.0					0.872	0	23.305	0.377	20.446	0	2016
OL-KR39 L7	60.0	74.0					0.8761	0	21.205	0.205	20.802	2	2016
OL-KR39 L8	39.0	59.0					0.87	0	11.498	0.933	20.211	2	2016
OL-KR40 L1	1005.0	1030.0		15	3	3	0?		32.199	1.433	25.641	2	2017
OL-KR40 L2	785.0	794.0		9	1	1	0?		62.826	2.006	49.311	3	2017
OL-KR40 L3	600.0	614.0		7	1	1	0?		44.711	0.829	26.718	0	2017
OL-KR40 L4	385.0	404.0		4.6	0.5	0.5	0?		63.284	0.788	44.107	2	2017
OL-KR40 L5	280.0	289.0		6.1	0.5	0.5	0.4158		41.375	0.722	24.426	2	2017
OL-KR40 L6	125.0	129.0		3.2	0.5	0.5	0.5616		47.141	0.404	21.634	2	2017
OL-KR40 L7	70.0	124.0		3	0.5	0.5	0.9063		37.814	2.428	20.048	2	2017
OL-KR40 L8	40.2	69.0		2.7	0.5	0.5	0.925		0.000	0.000	0.000	0	2017
OL-KR41 Open													
OL-KR42 Open													
OL-KR43 Open													
OL-KR44 L1	766.0	800.0		8.5	1	1	0		33.415	3.175	40.617	4	2011
OL-KR44 L2	666.0	705.0		7.5	1	1	0		40.547	2.204	34.563	0	2011

OL-KR44 L3	644.0	665.0		7	1	1	0		42.257	1.917	36.018	0	2011
OL-KR44 L4	246.0	260.0		5.5	0.5	0.5	0		4.770	6.376	17.961	23	2011
OL-KR44 L5	111.0	130.0		6	0.5	0.5	0.4549		19.237	0.456	24.005	3	2011
OL-KR44 L6	96.0	110.0		6	0.5	0.5	0.4549		19.237	0.456	23.098	2	2011
OL-KR44 L7	81.0	95.0		6	0.5	0.5	0.4549		19.237	0.456	23.281	2	2011
OL-KR44 L8	40.0	55.0		6	0.5	0.5	0.4549		19.237	0.456	23.290	2	2011
OL-KR45 L1	796.0	1023.3		18	1	1	0		0.000	0.000	0.000	0	2017
after 5.11.2013											64.239	1	2017
OL-KR45 L2	606.0	610.0		5.7	0.5	0.5	0		16.681	3.102	29.585	0	2017
OL-KR45 L3	491.0	495.0		4.1	0.5	0.5	0		2.013	3.670	0.000	0	2017
OL-KR45 L4	291.0	300.0		5	0.5	0.5	0.1889		34.241	2.775	34.001	6	2017
OL-KR45 L5	156.0	200.0		3.5	0.5	0.5	1.0176		49.191	1.488	34.755	3	2017
OL-KR45 L6	116.0	130.0		3.4	0.5	0.5	1.2401		37.421	0.215	27.829	0	2017
OL-KR45 L7	66.0	115.0		3.1	0.5	0.5	1.2825		31.558	0.496	26.378	1	2017
OL-KR45 L8	40.0	65.0		3	0.5	0.5	1.2954		29.818	1.439	27.346	2	2017
OL-KR46 Open													
OL-KR47 L1	881.0	1008.8		15	1	1	0	0.6?	54.965	0.792	62.715	0	2017
OL-KR47 L2	696.0	720.0		6.3	1	1	0	0.6030	46.265	0.902	36.267	1	2017
OL-KR47 L3	531.0	560.0		3.9	0.5	0.5	0	0.5433	50.308	0.612	48.579	1	2017
OL-KR47 L4	416.0	430.0		2.1	0.5	0.5	0.0864	0.3710	25.536	3.461	38.791	6	2017
OL-KR47 L5	301.0	335.0		1.1	0.5	0.5	0.1256	0.3853	0.000	0.000	32.973	20	2017
OL-KR47 L6	216.0	225.0		0.7	0.5	0.5	0.1594	0.4931	8.043	1.718	23.881	23	2017
OL-KR47 L7	116.0	160.0		0.2	0.5	0.5	0.1166	0.7720	28.386	1.074	0.000	0	2017
OL-KR47 L8	41.4	60.0		0.1	0.5	0.5	0.1661	0.8586	13.124	0.654	0.000	0	2017
OL-KR48 Closed													
OL-KR49 L1	626.0	1050.0					0.0936		36.870	2.198	42.542	1	2014
OL-KR49 L2	616.0	625.0					0.0940		42.503	1.493	42.628	1	2014

OL-KR49 L3	531.0	535.0					0.1084		41.504	1.530	42.979	1	2014
OL-KR49 L4	341.0	410.0					0.7273		43.482	2.633	42.304	1	2014
OL-KR49 L5	276.0	340.0					0.4878		25.999	3.932	39.595	4	2014
OL-KR49 L6	141.0	175.0					1.2561		29.297	3.182	24.571	3	2014
OL-KR49 L7	81.0	120.0					1.3032		12.485	0.806	0.000	0	2014
after 6.11.2013											23.512	0	2014
OL-KR49 L8	40.0	80.0					1.3297		11.881	1.576	0.000	0	2014
after 6.11.2013											24.219	0	2014
OL-KR50 L1	801.0	940.0					0		0.000	0.000	0.000	0	2014
after 5.11.2013											78.145	0	2014
OL-KR50 L2	706.0	800.0					0		32.898	0.421	36.609	4	2014
OL-KR50 L3	426.0	450.0					?		39.902	0.247	40.064	6	2014
OL-KR50 L4	361.0	425.0					?		38.749	2.032	41.903	6	2014
OL-KR50 L5	281.0	300.0					?		65.334	0.442	45.572	6	2014
OL-KR50 L6	131.0	160.0					1.2059		46.485	-0.224	29.431	2	2014
OL-KR50 L7	76.0	85.0					1.3264		13.271	-0.163	35.606	3	2014
OL-KR50 L8	40.2	75.0					1.3667		14.355	0.223	37.059	3	2014
OL-KR51 L1	561.0	650.6					?		50.407	0.884	47.669	1	2014
OL-KR51 L2	501.0	515.0					?		17.242	4.251	38.787	9	2014
OL-KR51 L3	411.0	500.0					?		39.489	1.158	39.027	4	2014
OL-KR51 L4	286.0	300.0					?		60.269	0.606	43.187	1	2014
OL-KR51 L5	181.0	190.0					0.8878		25.755	0.097	22.332	1	2014
OL-KR51 L6	106.0	145.0					0.8734		27.249	0.189	22.692	1	2014
OL-KR51 L7	61.0	105.0					0.8220		17.034	0.684	19.922	1	2014
OL-KR51 L8	40.0	60.0					0.6599		0.000	0.000	0.000	0	2014
OL-KR52 L1	391.0	427.4					?		38.472	0.962	34.105	1	2014
OL-KR52 L2	376.0	390.0					?		44.288	0.680	43.389	1	2014
OL-KR52 L3	311.0	330.0					?		33.180	2.298	42.944	1	2014
OL-KR52 L4	186.0	235.0					0.3869		45.785	1.506	43.181	1	2014
OL-KR52 L5	166.0	185.0					0.4950		51.932	1.130	39.007	1	2014

OL-KR52 L6	96.0	125.0					0.7046		44.117	0.752	23.955	0	2014
OL-KR52 L7	76.0	95.0					0.8833		27.684	0.660	13.957	0	2014
OL-KR52 L8	40.0	75.0					0.9500		21.776	1.546	14.146	0	2014
OL-KR53 Open													
OL-KR54 L1	450.0	454.0		4.3	0.5	0.5	0		10.042	4.533	15.273	11	2017
OL-KR54 L2	365.0	369.0		4.1	0.5	0.5	0?		43.263	0.963	35.994	4	2017
OL-KR54 L3	305.0	324.0		3.4	0.5	0.5	0		13.339	3.564	19.606	9	2017
OL-KR54 L4	140.0	169.0		2.2	0.5	0.5	0.7241		48.703	0.678	37.350	3	2017
OL-KR54 L5	125.0	139.0		2.1	0.5	0.5	0.7665		49.535	0.694	37.762	4	2017
OL-KR54 L6	95.0	124.0		2	0.5	0.5	0.7722		30.169	3.153	34.414	7	2017
OL-KR54 L7	70.0	94.0		2	0.5	0.5	0.8114		28.631	2.963	33.924	8	2017
OL-KR54 L8	40.1	69.0		1.9	0.5	0.5	0.9021		7.940	4.034	27.615	17	2017
OL-KR55 L1	971.0	998.4		10	1.5	1.5	0		59.180	1.610	55.279	4	2017
OL-KR55 L2	861.0	870.0		7	2	2	0		66.802	0.926	53.446	0	2017
after Aug. 2015									0.000	0.000	0.000	0	2017
OL-KR55 L3	536.0	545.0		3.5	0.5	0.5	0?		0.000	0.000	11.056	8	2017
after Aug. 2015											5.782	24	2017
OL-KR55 L4	286.0	290.0		4	0.5	0.5	0.4241		40.406	1.248	40.061	3	2018
OL-KR55 L5	161.0	190.0		2	0.5	0.5	0.6462		40.688	0.444	38.282	4	2017
OL-KR55 L6	71.0	95.0		2.3	0.5	0.5	0.937		37.011	1.279	39.423	6	2017
OL-KR55 L7	46.0	70.0		2.4	0.5	0.5	0.9975		35.359	0.652	41.067	6	2017
OL-KR55 L8	40.3	45.0		0.5	0.5	0.5	0.7435		0.000	0.000	46.653	7	2017
after packing off in 2015													
OL-KR55 L5	156.0	190.0		2	0.5	0.5	0.8409		36.715	0.397	35.622	1	2017
OL-KR56 Open													
OL-KR57 Open													
OL-KR58 Open													

* Reference head updated in WR 2014-43

Table A6-4. Correction parameters for the OL-KRB drillholes.

Label	Section top, m	Section bottom, m	Refer. head, m	Error margins Up, m	Error margins Down, m	Natural fluctuation	Factors determined, year
OL-KR15B L1	4.5	16	6.8	0.2	0.2	1.1135	2010
OL-KR15B L2	17	31	6.8	0.2	0.2	1.1146	2010
OL-KR16B L1	4.5	20	6.8	0.2	0.2	1.1419	2010
OL-KR16B L2	21	35	6.9	0.2	0.2	0.9284	2010
OL-KR17B L1	4.1	10	7	0.2	0.2	1.0887	2010
OL-KR17B L2	11	30	8.5	0.4	0.4	1.5365	2010
OL-KR18B L1	6.5	13	6.8	0.2	0.2	1.1003	2010
OL-KR18B L2	14	23	6.9	0.2	0.2	1.1557	2010
OL-KR18B L3	24	45.5	6.8	0.2	0.2	1.1071	2010

Label	Length, m	Natural fluctuation	Sea level	Factors determined, year
OL-KR19B	45.05	1.0192		2010
OL-KR20B	45.1	0.8070		2010
OL-KR22B	45.55	0.5640		2010
OL-KR23B	45.12	0.8344		2010
OL-KR25B	44.93	0.4005		2017
OL-KR27B	45.21	1.1158		2010
OL-KR28B	45.3	0.5752		2010
OL-KR29B	45.6	0.7304		2010
OL-KR31B	45.18	0.4595		2017
OL-KR33B	45.53	0.7966		2010
OL-KR37B	45.1	0.6057		2010
OL-KR39B	45.11	1.2100		2010
OL-KR40B	45.15	0.8348		2010
OL-KR41B	45.6	1.2343		2010
OL-KR42B	45	0.6789		2010
OL-KR43B	45.01	1.0503		2010
OL-KR44B	45.05	0.6824		2010
OL-KR45B	44.75	1.0031		2010
OL-KR46B	45.16	1.1474		2010
OL-KR47B	44.31	0.2191	0.9000	2010
OL-KR50B	45.44	1.1523		2011
OL-KR52B	45.04	0.6690		2011
OL-KR53B	45.44	0.9048		2011
OL-KR55B	44.99	0.8309		2011
OL-KR57B	45.01	1.2136		2014

Table A6-5. Correction parameters for the shallow bedrock holes.

Label	Length, m	Natural fluctuation	Sea level	Factors determined, year
OL-PP1	17.5	0.6733		2009
OL-PP2	23.8	0.7277		2009
OL-PP3	14.3	0.4218		2011
OL-PP5	12.35	0.9817		2009
OL-PP6	19.5	0.5042		2009
OL-PP8	15.2	0.2533	0.8774	2009
OL-PP9	14.7	0.9556		2009
OL-PP10	12	0.5644		2009
OL-PP31	25.1	0.4651		2009
OL-PP36	12.05	0.5053	0.702	2009
OL-PP37	11.55	0.5451	0.6077	2011
OL-PP39	13.71	0.8869	0.0967	2011
OL-PP51	18	0.8326		2009
OL-PP52	18	0.8215		2011
OL-PP53	18	0.8896		2009
OL-PP54	18	0.7933		2009
OL-PP55	18	1.0967		2011
OL-PP56	54	0.9137		2009
OL-PP70	20.05	1.3605		2015
OL-PP71	21.02	1.4237		2015
OL-PP90	24.6	1.2678		2016
OL-PR1	13	1		2009
OL-PR2	13	0.8313		2009
OL-L1	c. 15	1.04772		2011
after 1.1.2006		1.84472		2011
OL-L2	c. 15	0.8769		2009
OL-L3	c. 15	0.9777		2009
OL-L4	c. 15	0.7105		2009
OL-L7/1		0.9222		2018
OL-L7/2		0.9320		2018
OL-L7/3		0.8327		2018
OL-L8	c. 15	0.4157		2009
OL-L9/1	c. 15	0.7634		2015
OL-L9/2	c. 15	1.0463		2015
OL-L9/3	c. 15	1.7229		2015
OL-L13	c. 15	1.2215		2009
OL-L14	c. 15	1.0149		2009
OL-L15	c. 15	0.2817		2009
OL-L16	c. 15	0.9814		2009
OL-L26	c. 15	0.4805		2009
OL-L27	c. 15	0.9406		2009
OL-PA1	c. 15	1.3311		2009
OL-PA2	c. 15	0.859		2009
OL-PA3/3	c. 15	0.9506		2015
OL-PA5	c. 15	0.6663		2009

OL-PP7	16.2	sparse data after May 2005
OL-PP32	22.6	no data since June 2004
OL-PP34	22.3	no data since July 2004
OL-PP35	23.6	no data since February 2004
OL-PP38	13.57	no data since April 2005
OL-PR3	30	removed
OL-PR4	30	clogged
OL-PA3/2	c. 15	no data since April 2011
OL-PA4	c. 15	clogged

Table A6-6. Correction parameters for the groundwater observation tubes.

Label	Length, m	Natural fluctuation	Sea level	Factors determined, year
OL-PVP1	3.5	0.6914		2009
after 1.7.2005		0.3583		2009
OL-PVP2	3.5	1.17		2009
OL-PVP3A	7.8	0.56		2009
OL-PVP3B	3.8	0.58		2009
OL-PVP4A	9.55	0.4468	0.2074	2009
OL-PVP4B	8	0.2994	0.3289	2009
OL-PVP5A	7.02	0.88		2009
OL-PVP5B	3.02	0.96		2009
OL-PVP6A	7.83	1.41		2009
after 1.1.2004		0.86		2009
OL-PVP6B	3.83	1.35		2009
after 1.1.2004		0.71		2009
OL-PVP7A	5.75	0.56		2009
OL-PVP8A	9.45	0.2572	0.9013	2009
OL-PVP8B	5.45	0.313	0.8613	2009
OL-PVP9A	9	1.0848	0.4076	2009
OL-PVP9B	5	1.0927	0.3914	2009
OL-PVP9C	3	1.2437	0.1646	2009
OL-PVP10A	5.5	0.44		2009
OL-PVP10B	3	0.4		2009
OL-PVP11	5.2	0.63		2009
OL-PVP12	6.3	0.18		2009
OL-PVP13	7.1	0.6297		2011
after 1.1.2006		1.3579		2011
OL-PVP14	10.4	1.64		2009
OL-PVP17	6.3	0.32		2009
OL-PVP18A	9	0.3038		2009
after 1.1.2007		0.8872		2011
OL-PVP19	17.15	0.47		2009
OL-PVP20	14.1	0.89		2009
OL-PVP21	11.6	1.8399		2010
OL-PVP22	10.1	1.6982		2010
OL-PVP23	7.4	0.6849		2010
OL-PVP24	5.8	1.5593		2010
OL-PVP25	5.9	1.3768		2010
OL-PVP26	6.5	1.0703		2010
OL-PVP27	4.6	0.8783		2010
OL-PVP28	5.7	0.585		2010
OL-PVP29	6	0.6058		2010
OL-PVP30	3.8	0.7534		2010
OL-PVP31A	6.5	0.7183		2010
OL-PVP31B	7	0.8159		2010
OL-PVP32	4.6	1.6242		2010
OL-PVP33	3.9	0.9724		2010
OL-PVP34A	7.4	0.7668		2010
OL-PVP34B	7.6	0.6147		2010
OL-PVP35	3.8	1.615		2010
OL-PVP36	5.5	1.098		2014

OL-PVP37A	12	0.929		2014
OL-PVP37B	10	0.836		2014
OL-PVP37C	9.5	0.859		2014
OL-PVP38A	14.8	1.963		2014
OL-PVP38B	13.7	1.976		2014
OL-PVP38C	12.7	2.028		2014
OL-PVP38D	11.3	1.777		2014
OL-PVP39	10.25	0.854		2015
OL-PVP40A	10.2	0.716		2015
OL-PVP40B	8.8	0.719		2015
OL-PVP41A	11.9	0.1721		2017
OL-PVP41B	8	0.1795		2017
OL-PVP42A	8	1.4146		2017
OL-PVP42B	5.85	1.5631		2017

OL-PVP18B	5	no data	