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Baseline results

water reuse 3.0

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A collaboration between: Rwb Vitens EUROSTEEL Supported by: Co-funded by the Eco-innovation Initiative of the European Union

BASELINE RESULTS

1.1 Introduction

WTP Wierden is located in the eastern part of the Netherlands. The source for the production of drinking water is groundwater. The maximum yearly groundwater extraction is 8 million m^3. A simplified scheme of the WTP is shown in figure 1:

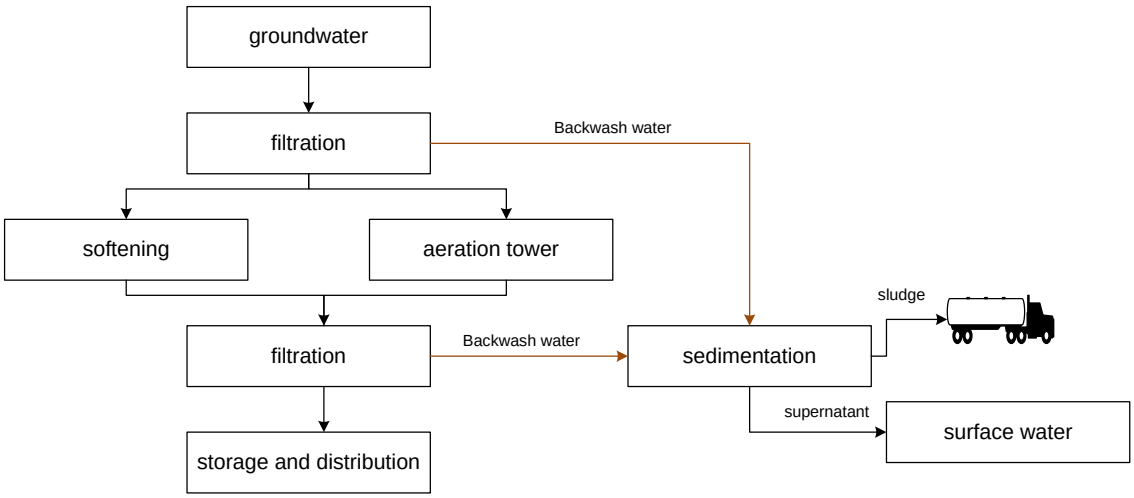

Figure 1; simplified PFD WTP Wierden, current situation

The pumped groundwater is led to the filtration step. The first filtration step removes mainly iron. After a certain time a filter is saturated with iron and need to be backwashed. The 2nd filtration step in the scheme is mainly for the removal of carry-over (after pellet softening) and manganese (after aeration). These filters has also to be backwashed after a certain period. The interval of backwashing these filters is much longer (about 7 times longer run) compared with the first filtration step. Both backwash water streams are collected in 2 sedimentation tanks. After a few hours sedimentation, the supernatant is distributed to the surface water. The collected sludge is pumped to a sludge storage, this storage is emptied once or twice a year. The annual production of backwash water can be seen in table 1.

Year	Groundwater extraction (million m^3/year)	Backwash water (m^3/year)	Loss of backwash water
2011	7,1	297,800	4,2%
2012	6,9	289,200	4,2%
2013	7,5	255,200	3,4%
2014	7,0	221,700	3,2%

Table 1. Yearly backwash losses

There are 2 reasons for the reduction of backwash water loss since 2013. In April 2013 a new well field was commissioned and together with this an optimization of the filtration step took place.

After the commissioning of the backwash water reuse installation, the simplified scheme will be as in figure 2.

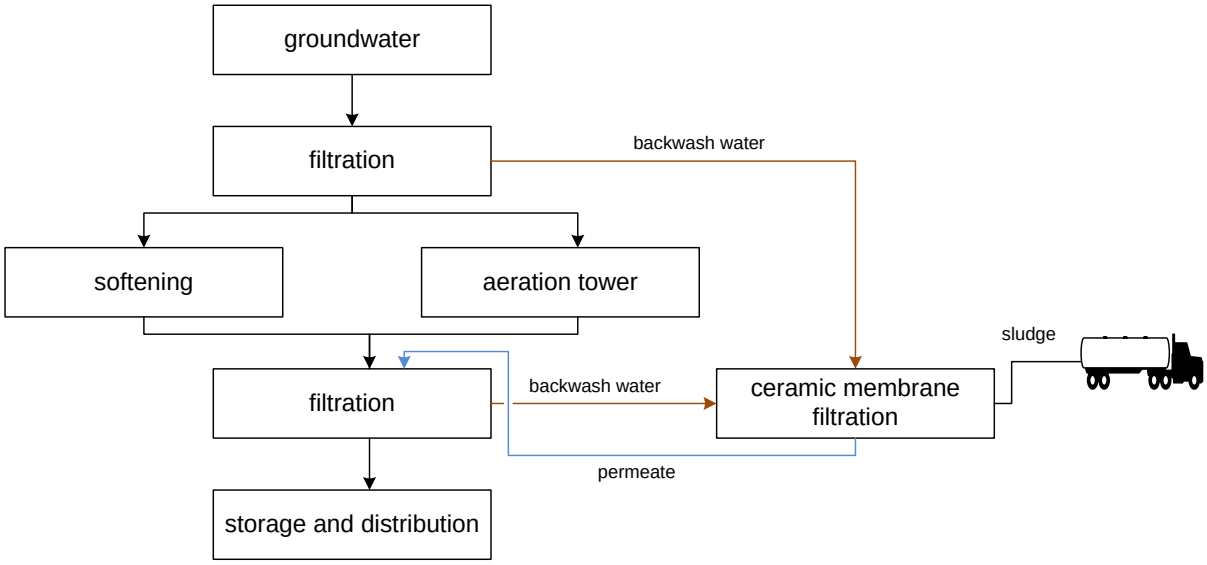

Figure 2; simplified PFD WTP Wierden, future situation

In this situation most of the backwash water (estimation is 98%) mentioned in table 1 will be reused. Because of this, less groundwater has to be extracted to have the same amount of drinking water to distribute. Therefore the expected reduction of energy will be mainly in the reduction of groundwater extraction.

1.2 Monitoring energy

Since the commissioning of the new well field (april 1st 2013), the energy consumption of each well field is monitored. The energy consumption of the well fields can be seen in table 2:

	Well, set 1 and 2	Well, set 3 and 4	Well, set 5	Well, set 6	Well, set 7	Well, set 8 and 9	total well fields
2013 (from April 1st)	89.212	436.987	54.862	101.850	43.293	176.214	902.418
2014	93.294	399.224	148.996	129.928	91.064	202.467	1.064.973

Table 2. Energy consumption well fields (in kWh)

One of the expected benefits will be a reduction of energy needed. In the current situation a part of the pumped groundwater

	Total energy (kWh) well fields	Total distributed water (m^3)	Energy needed for extraction of groundwater/ product (kWh/m3)
2014	1.064.973	6.799.889	0,16

Table 3 Energy use groundwater extraction

1.3 Monitoring water quality

After the realization of the re-use installation, the effluent will be led to two filters (second filtration step, numbers 11 en 21. After this filtration step the water is storaged for distribution. The current effluent water quality of these filters and the distributed water can be seen in appendix A. Starting point (and expectation) is that the quality on each point is not going to change after realization re-use installation.

The quality of the supernatant discharged to the surface water meets the standards of the licensing authority: visible clean, oxygen >5mg/l, pH between 6 en 9.

1.4 Monitoring sludge production

The amount of sludge production is related with the iron content in the groundwater. The permit for groundwater extraction is before and after re-use of backwash water 8.0 Mm3/year. Therefore the amount of sludge will be the same before and after re-using backwash water. The only parameter which can make a difference is the dry matter content of the sludge. A higher content of dry matter leads to less sludge, lower transportation costs and (possible) better commercial opportunities. Although sludge has some economic value (approximately 10 euro/metric ton, depending on client), the costs for transportation are higher, so a reduction of sludge will be economic more interesting. The amount of produced sludge can be seen in table 4.

	sludge (metric tons/year)	dry matter content (%)
2012	751,4	10.8
2013	548,0	11.1
2014	760,4	11.7

Table 4; sludge production current situation

For most costumers the dry matter content must be > 8%. The average dry matter content is quite high, focusing into each separate truck transport shows options for improvement, see figure 3.

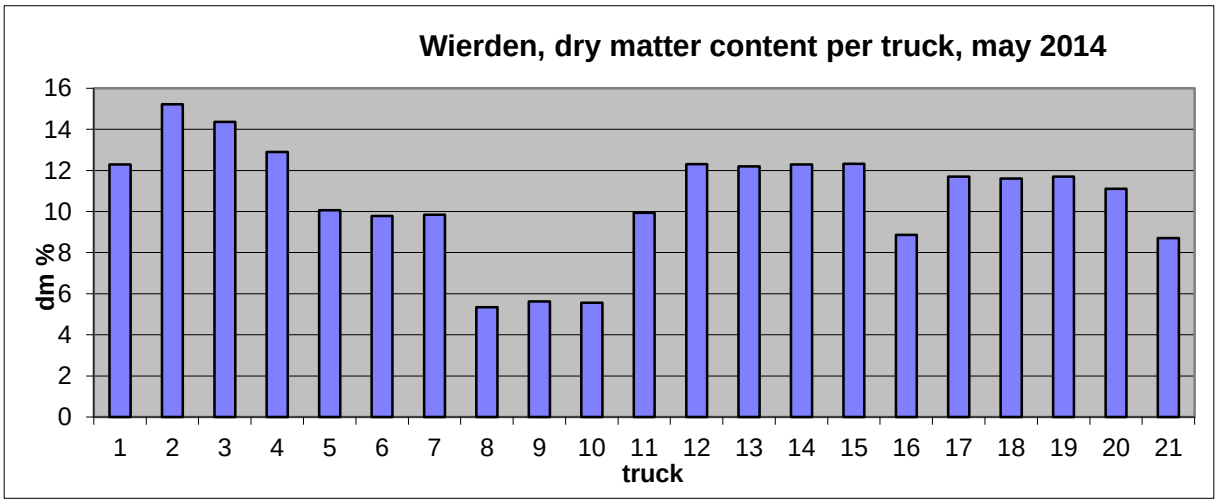

Figure 3; dry matter per truck

1.5 Chemical use

For sedimentation of the sludge in the sedimentation tank dosing of flocculant is necessary. Before 2014 PAC was used as flocculant. Since May 2014 FeCl is used. The dosage is about 20 mg/l. Pilot studies has shown that with introduction of backwash water re-use a reduction of flocculant is possible. In the future situation the FeCl dosage will be about 4 mg/l. Table 5 shows the dosage since the introduction of FeCL.

Iron chloride dosing		
Backwash water production 15-5-2014 till 31-12-2014	140188	m3
Iron chloride dosage	2807	kg
dosage	19,6	mg/l

Table 5 Iron chloride dosing

1.6 Operational / user experience

In the current situation the weekly time spent at backwash water sedimentation and sludge removal is 1 hour /week.

Appendix A Water quality

Second filtration step

Laboratory code	sampling point	sample date	sample time	Iron (mg/l)	Manganese (mg/l)	pH (lab)	Oxygen (mg/l)	Ammonium (mg/l)	Nitrite (mg/l)	Turbidity (NTU)
V1401004918	Effluent NF 11	03-02-14	10:41	0,01	0,005		12	0,03	0,01	0,1
V1402015215	Effluent NF 11	06-03-14	14:58	0,01	0,005		11,4	0,03	0,01	0,1
V1403027382	Effluent NF 11	31-03-14	11:26	0,01	0,005		11,6	0,03	0,01	0,1
V1404041432	Effluent NF 11	29-04-14	10:38	0,01	0,005	7,74	10,9	0,03	0,02	0,1
V1405053581	Effluent NF 11	27-05-14	12:11	0,01	0,005	7,61	10,8	0,03	0,01	0,11
V1406065806	Effluent NF 11	25-06-14	9:35	0,01	0,005	7,73	11,1	0,05	0,01	0,1
V1406079036	Effluent NF 11	22-07-14	9:50	0,01	0,005	7,63	11,1	0,03	0,01	0,12
V1408098393	Effluent NF 11	21-08-14	10:39	0,01	0,005	7,75	11,3	0,03	0,01	0,21
V1408100819	Effluent NF 11	15-09-14	10:46	0,01	0,005	7,57	11,2	0,03	0,01	0,15
V1409116167	Effluent NF 11	21-10-14	13:20	0,016	0,005	7,64	10,8	0,03	0,01	0,35
V1410127153	Effluent NF 11	10-11-14	11:30	0,01	0,005	7,61	11,2	0,03	0,01	0,1
V1411139889	Effluent NF 11	08-12-14	11:08	0,01	0,005	7,6	11,1	0,03	0,01	0,1
V1412155245	Effluent NF 11	05-01-15	11:00	0,01	0,005	7,57	11,7	0,03	0,01	0,1
V1401004919	Effluent NF 21	03-02-14	10:41	0,01	0,005		11,6	0,03	0,01	0,12
V1402015216	Effluent NF 21	06-03-14	14:59	0,01	0,005		11,3	0,03	0,01	0,1
V1403027383	Effluent NF 21	31-03-14	11:27	0,01	0,005		11,3	0,03	0,01	0,11
V1404041433	Effluent NF 21	29-04-14	10:39	0,01	0,005	7,43	10,7	0,03	0,01	0,1
V1405053582	Effluent NF 21	27-05-14	12:12	0,01	0,005	7,57	10,9	0,03	0,01	0,1
V1406065807	Effluent NF 21	25-06-14	9:35	0,01	0,005	7,56	11,3	0,03	0,01	0,14
V1406079037	Effluent NF 21	22-07-14	9:49	0,01	0,005	7,51	11,1	0,03	0,01	0,14
V1408098394	Effluent NF 21	21-08-14	10:37	0,01	0,005	7,63	11,3	0,03	0,01	0,1
V1408100820	Effluent NF 21	15-09-14	10:45	0,01	0,005	7,67	11,1	0,03	0,01	0,1
V1410127154	Effluent NF 21	10-11-14	11:32	0,01	0,005	7,62	11,3	0,03	0,01	0,1
V1411139890	Effluent NF 21	08-12-14	11:09	0,01	0,005	7,58	11,6	0,03	0,01	0,12
V1412155246	Effluent NF 21	05-01-15	11:01	0,01	0,005	7,66	11,9	0,03	0,01	0,1

Laboratoria code	sampling point	sample date	sample time	Iron (mg/l)	Manganese (mg/l)	pH(lab)	Oxygen (mg/l)	Hydrogencarbonate (mg/l)	Ammonium (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	EC 20C	Turbidity (NTU)	Color(mg Pt/Co)	Coli 37 (n/100 ml)	Coli 44 (n/100 ml)	CFU 22 (n/ ml)	Aluminium (mg/l)	Aeromonas (n/100 ml)	Carbon dioxide (mg/l)
V1401004925	Distribution	03-02-14	9:23	0,01	0,005	7,97	10,7	139	0,03	0,01		45,7	0,34		1	1	1		10	2,8
V1401007294	Distribution	10-02-14	9:23															2		
V1401007295	Distribution	10-02-14	9:41			7,84	11,2	141				46,2	0,25		1	1	1			3,8
V1401009927	Distribution	19-02-14	8:34			7,9	11	135				44	0,34		1	1	1			3,1
V1402012570	Distribution	26-02-14	11:06			7,88	10,2	137				43	0,22		1	1	1			3,3
V1402015222	Distribution	06-03-14	15:23	0,01	0,005	7,95	11,4	140	0,03	0,01		45,1	0,33		1	1	1		10	2,9
V1402018365	Distribution	13-03-14	12:38			7,91	11,1	152				47,8	0,39		1	1	1			3,5
V1402021092	Distribution	18-03-14	9:27			7,95	10,2	155				47	0,2		1	1	1			3,2
V1403024368	Distribution	26-03-14	9:13			7,86	11,1	133				45,1	0,17		1	1	4			3,4
V1403027389	Distribution	31-03-14	11:23	0,01	0,005	7,88	10,7	140	0,03	0,01	7,08	45,4	0,29	3	1	1	1	2	10	3,4
V1403036640	Distribution	09-04-14	8:33			7,92	11,3	141				45,3	0,16		1	1	3			2,9
V1403036645	Distribution	14-04-14	11:01			7,85	10,7	147				46,5	0,14		1	1	1			3,8
V1403037927	Distribution	23-04-14	8:27			7,87	11,5	132				45,1	0,23		1	1	1			3,3
V1404040680	Distribution	29-04-14	10:55	0,01	0,005	7,86	10,6	136	0,03	0,01		44,8	0,21		1	1	1		10	3,3
V1404044059	Distribution	07-05-14	12:31			7,89	10,6	137				44,8	0,18		1	1	6			3,1
V1404047627	Distribution	14-05-14	11:05			7,95	11,4	143				45,9	0,3		1	1	2			3
V1404050377	Distribution	21-05-14	8:49			7,92	11	136				44,8	0,16		1	1	2			3
V1405053505	Distribution	27-05-14	13:32	0,01	0,005	7,93	10,8	151	0,03	0,01		45,3	0,34		1	1	1		10	3,3
V1405056281	Distribution	03-06-14	13:39			7,9	10,7	138				44,6	0,19		1	1	1			3,2
V1405059374	Distribution	10-06-14	10:14			7,85	10,8	131				46	0,22		1	1	1			3,3
V1405063232	Distribution	17-06-14	10:28			7,89	11,3	133				45,1	0,24		1	1	1			3,2
V1406065731	Distribution	25-06-14	10:24	0,02	0,005	7,82	10,4	140	0,03	0,04	8,07	44,6	0,31	5,1	1	1	1	2	10	3,9
V1406069239	Distribution	02-07-14	9:21			7,87	10,5	141				45,1	0,32		1	1	2			3,5
V1406072259	Distribution	09-07-14	10:40			7,9	10,7	150				46,1	0,24		1	1	1			3,5
V1406076223	Distribution	15-07-14	14:12			7,88	10,1	146				44,8	0,18		1	1	1			3,5
V1406078963	Distribution	22-07-14	10:01	0,01	0,005	7,8	10,4	130	0,03	0,01		42,9	0,28		1	1	2		10	3,8
V1407081729	Distribution	28-07-14	9:42			7,86	11	140				45	0,22		1	1	1			3,5
V1407084451	Distribution	05-08-14	10:39			7,89	11,6	140				45,6	0,31		1	1	1			3,3
V1407087479	Distribution	14-08-14	10:38			7,86	10,8	135				44,2	0,18		1	1	3			3,4
V1408092516	Distribution	27-08-14	10:39			7,91	10,8	148				46,2	0,28		1	1	2			3,2
V1408094736	Distribution	02-09-14	12:24			7,9	10,5	150				45,7	0,29		1	1	3			3,5

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V1408097838	Distribution	11-09-14	13:39			7,84	11	137				45,2	0,23		1	1	1			3,7
V1408098407	Distribution	21-08-14	10:43	0,01	0,005	7,93	10,8	155	0,03	0,01		46,3	0,25		1	1	2		10	3,3
V1408100722	Distribution	15-09-14	9:38	0,01	0,005	7,72	10,8	137	0,03	0,01		45,2	0,33		1	1	1		10	4,8
V1408103948	Distribution	24-09-14	10:31			8,03	10,5	159				46,5	0,33		1	1	2			2,7
V1409107076	Distribution	30-09-14	10:45			7,84	11,6	157				46,3	0,24		1	1	1			4,2
V1409110176	Distribution	06-10-14	12:41			7,84	10,3	151				45,1	0,31		1	1	1			4
V1409113643	Distribution	21-10-14	14:22	0,025	0,005	7,94	10,7	150	0,03	0,01	8,02	45,9	0,42	5,4	1	1	4	2	10	3,2
V1409116968	Distribution	15-10-14	11:25			7,85	10,2	150				46,5	0,32		1	1	3			3,9
V1410120468	Distribution	28-10-14	10:27			7,9	10,8	146				46,6	0,46		1	1	2			3,4
V1410126916	Distribution	10-11-14	13:03	0,01	0,005	7,8	10,5	143	0,03	0,01		45,2	0,21		1	1	7		10	4,2
V1410129967	Distribution	17-11-14	14:57			7,92	10,8	147				45,4	0,38		1	1	3			3,2
V1411133117	Distribution	25-11-14	10:03			7,9	11,2	149				46,5	0,39		1	1	1			3,5
V1411133318	Distribution	06-11-14	10:02			7,86	11,4	137				45,4	0,47		1	1	1			3,5
V1411136271	Distribution	01-12-14	12:24			7,88	11,1	150				45,9	0,26		1	1	2			3,7
V1411139632	Distribution	08-12-14	12:12	0,01	0,005	7,82	10,6	146	0,03	0,01		46,2	0,32		1	1	3		10	4,1
V1411141217	Distribution	16-12-14	11:57			7,95	9,9	144				45,5	0,25		1	1	2			3
V1411141220	Distribution	22-12-14	13:31			7,97	11,4	143				45,4	0,17		1	1	1			2,8
V1412152505	Distribution	29-12-14	10:42			7,86	11,2	146				46	0,2		1	1	1			3,7
V1412155252	Distribution	05-01-15	9:46	0,01	0,005	7,86	11,5	140	0,03	0,01	7,24	45,7	0,28	3	1	1	1	2	10	3,6
V1412155920	Distribution	12-01-15	14:26			7,96	11,2	140				44,6	0,19		1	1	1			2,8
V1412156510	Distribution	20-01-15	13:22			7,82	11,1	146				45,2	0,21		1	1	1			4,1
V1412157787	Distribution	26-01-15	11:29			7,72	10	153				46,2	0,45		1	1	1			5,4