Reply to specific comments:

- Page 2 line 25; I agree, proposed alternative:

Water age is an important aspect of water quality in a DWDS as it influences disinfectant residual, disinfection by-products, nitrification, bacterial regrowth, corrosion, sedimentation, temperature, taste and odour (EPA 2002)

- Page 3 lines 5-15; proposed to add the following:

In the traditional approach of top-down demand allocation the cross correlation is assumed to be equal to 1 and the auto correlation is usually high because a time step of 15 min or 1 h is used. A cross correlation of 1 results in a limited number of flow direction reversals in a network model. A high auto correlation means that the flow over the day is relatively constant and the model will show no periods with stagnant water and maybe a limited number of times with turbulent flow. In case the actual flows are not strongly correlated flow direction reversals and periods of stagnancy and turbulent flows will occur. A traditional approach in demand allocation may therefore underestimate maximum travel times and dispersion.

- Page 4 line 10; proposed to add the following references:

Low leakage is common in the Netherlands (Beuken et al. 2006; Geudens 2008).

- Page 5 line 1; we will add this clarifying remark

- Page 5 line 10; Weibull distribution

The Weibull distribution is a standard probability distribution. We have stated the number of values that the fit was based on, and we have given the values of the parameters *a* and *b*, including their accuracy.

- Page 5 lines 17-21; Figure 3 is a result of the EC-measurements, but not a result of the water age measurements. We propose to leave it in the results section. We will clarify the method of determining water age from the EC-pulses. The weighted mean is actually the centroid, but not for the whole pulse.

In Figure 3, the time at which the ascending and descending tails of the measured pulse pass, is determined by finding the absolute value of 61 mS/m. These times are denoted t_a and t_d respectively. The centroid between t_a and t_d is also determined and is called t_c. Water age is defined as the difference between t_a at the booster station and t_a at the measurement location; id. for t_d and t_c. [figure 3 will show these t_a, t_d and t_c.].

- Page 6 line 3; the correction factor is in fact the base demand (which is in Table 2), we will rephrase.

- Page 6 lines 8-12; The reason is that SIMDEUM does not provide demand patterns (yet) for beach clubs and hotels. Mind that for the hotels we used the measured DMP_{hotel} and **not $DMP_{booster}$**. We will add the explanation.
- Page 6 (and Table2); 67% is determined by SIMDEUM demand patterns of households, 10% of the total demand is determined by $DMP_{booster}$ (viz. for beach clubs); 10% of the total demand is determined by DMP_{hotel}, and 13% of the total demand is determined by DMP_{hotel} + variable base demand. In my opinion 20% (and not 33%) of the total demand is deterministic.

- Page 6 line 23; yes, we used the measured patterns, see page 5 lines 6-8. We will emphasize the 5 minutes time step here as well

- Page 7 line 3; just because … We did check in earlier unpublished studies that 10 was enough.

- Page 7 lines 17-18; we agree. We propose to change this. We will compare the average of the results of the $Model_{BU}$ and the result of the $Model_{TD}$ with the measured data and determine ME, RMSE. We also determine how many of these modelled water ages are within 10 minutes of the measured water ages. To show the added value of the 10 different runs, the latter measure of accuracy was also applied to the 95% confidence interval of the $Model_{BU}$. [see also Table 4]

The measured water age at three locations and different times on the day was compared to the modelled water age in the two network modes. The difference between (the average of) the model and the measurement is expressed by the Mean Error (*ME*), Root Mean Square Error (*RMSE*), and coefficient of determination R^2. The absolute values of *ME* and *RMSE* are expressed in hours; the relative values are percentages of the measured travel times. Also, the percentage of the model values that differ less than 10 minutes from the measured value is calculated. For the $Model_{TD}$, this percentage is calculated for the average modelled values. For the $Model_{BU}$, this percentage is calculated for the average modelled values and for the total of the 10 different runs.

- Page 8 line 20; the reviewer is correct. Especially at the end of the stretch, there is only stagnant water and laminar flows, closer to the booster station there is turbulent flow during peak demands. We will add some thoughts on this aspect.

- Page 9 line 9; with the new Table 4 some new conclusions are drawn that are more fair.

The average and 95% confidence interval of the water age from the $Model_{BU}$ and the water age from the $Model_{TD}$ with $DMP_{booster}$ were compared with the measured water ages. The two models predict the water age well, with an *ME* and *RMSE* of less than 30%. The $Model_{BU}$ shows lower *ME* and *RMSE* than the $Model_{TD}$. The 95% confidence interval of the $Model_{BU}$ presents much more data points within 10 min from the measured water age than the average of both the $Model_{BU}$ and the $Model_{TD}$. The calculated R^2 is not a meaningful value for either model, and therefore it is not shown in the table.

- Page 10 line 15; flow velocities in the $Model_{BU}$ are often larger than in the $Model_{TD}$. We will rephrase.

- Table 1; we will add this column. The reviewer has miscalculated: the average travel time is 150/24 is approximately 6 hours.

Diameter (mm)	**Length (km)**		**Volume (m^3)**
	CI	PVC	
< 100		1.4	7.8
100	1.3	0.6	14.8
150	3.4	1.1	79.1
180		0.4	12.9
225	0.9		35.0
total	5.6	3.5	149.7

- Table 2; we can add a column # x base demand for both models.

- Table 3; the average household size in Table 3 is the average number of residents per household.

- Table 4; R2 is < 1 for most cases, therefore left out; new table:

		$Model_{BU}$				**$Model_{TD}$**			
		loc. 1	**loc. 2**	**loc. 3**	**loc. 4**	**loc. 1**	**loc. 2**	**loc. 3**	**loc. 4**
Sample size		126	138	46	135	126	138	46	135
ME	absolute (h)	-0.14	-0.06	0.17	2.06	-0.27	-0.48	-1.45	-4.41
	relative (%)	-3.14	-0.99	1.76	5.91	-5.89	-8.23	-14.73	-12.63
RMSE	absolute (h)	1.42	1.42	1.65	4.05	1.85	1.77	2.47	5.68
	relative (%)	31.09	24.08	16.83	11.61	40.50	30.18	25.17	16.28
Within 10 min deviation (%)	Compared to mean	9.52	7.97	13.04	0.74	3.97	14.49	0	0.74
	Compared to 95% c.i.	64.29	79.71	100.0	77.78	N.A.	N.A.	N.A.	N.A.

- Figure 1; will add scale and dots to indicate measurement locations

- Figure 3; see comment at “Page 5 lines 17-21”.

- Figure 4; the DMP’s were used in the models: $DMP_{booster}$ was used in $Model_{TD}$ and $Model_{BU}$, DMP_{hotel} was only used in $Model_{BU}$. We will refer to Table 2.

- Figure 5; see also comment at “Page 6 (and Table2)”. We will elaborate in the caption.

- Figure 6; on Page 7 lines 23 – 25, page 8 lines 1-3 and Page 8 lines 10-13 correlation and Figure 6 are discussed. Figure 5 only allows for a visual assessment of the fit of the two patterns. Therefore, Figure 6 was added. Figure 6b shows the cross correlation between the two: 90% and no delay; Figure 6a shows that Q_{SIM} has smaller auto correlation than $Q_{booster}$ at a time lag of more than 15 minutes. We propose to leave out Figure 6, but leave in the text on the cross correlation.

- Figure 8; see comments on “Table 1”.

References

Beuken, R. H. S., Lavooij, C. S. W., Bosch, A., and Schaap, P. G. (2006). "Low leakage in the Netherlands confirmed." Water Distribution System Analysis #8, American Society of Civil Engineers, Cincinnati, Ohio, USA.

EPA. (2002). *Effects of water age on distribution system water quality*, prepared by AWWA with assistance from Economic and Engineering Services, Inc. EPA White paper.

Geudens, P. J. J. G. (2008). *Water supply statistics 2007*, Vewin, Rijswijk. 2008/83/6259.