*Water Utility Journal* 2: 45-49, 2011.


# Pressure management and active leakage control in particular DMA (Lisiche) in the city of Skopje, FYROM

B. Ristovski
*P.E. Water Supply and Sewerage-Skopje, Veljko Vlahovic 11, 1000 Skopje, FYROM*
*e-mail: bojan.ristovski@vodovod-skopje.com.mk*

**Abstract:** Water losses in the system are a phenomenon that all water production and supply utilities are faced with. With regards to the water supply companies in Republic of Macedonia, leakage has been identified as a serious problem with excessive leakage levels in many parts of the country exceeding the revenue water. The water losses in water supply companies in Macedonia are generally in the range between 40-65% of the system inputs. The city of Skopje is mainly supplied by gravity from the Rasche 1 spring, with average input in the system of around 4500 l/s through two main pipe lines of 1600 mm in diameter. Additional quantity of water is entering the system from capping Rasche 2 and Pumping station with installing capacity of 2x500 l/s (2x75kW), and especially in summer period, from well areas Nerezi and Lepenec with total capacity of 1450 l/s. The paper refers to case study which implemented two of four well known IWA WLTF recommended strategies: Active Leakage Control and Pressure Management in particular DMA "Lisiche".

**Key words:** pressure reduction, DMA management, leak detection

## 1. PROJECT: PRESSURE REDUCING MANAGEMENT AND ACTIVE LEAKAGE CONTROL

This case study refers to water loss reduction activities in one of the low pressure zones DMA Lisiche (Figure 1) which supplies water in the settlement Lisiche, Ostrovska and village Gorno Lisiche, with around 4150 households, 4630 water meters, total length of water pipes - 33 km, number of connection - 3450, mostly houses without buildings.

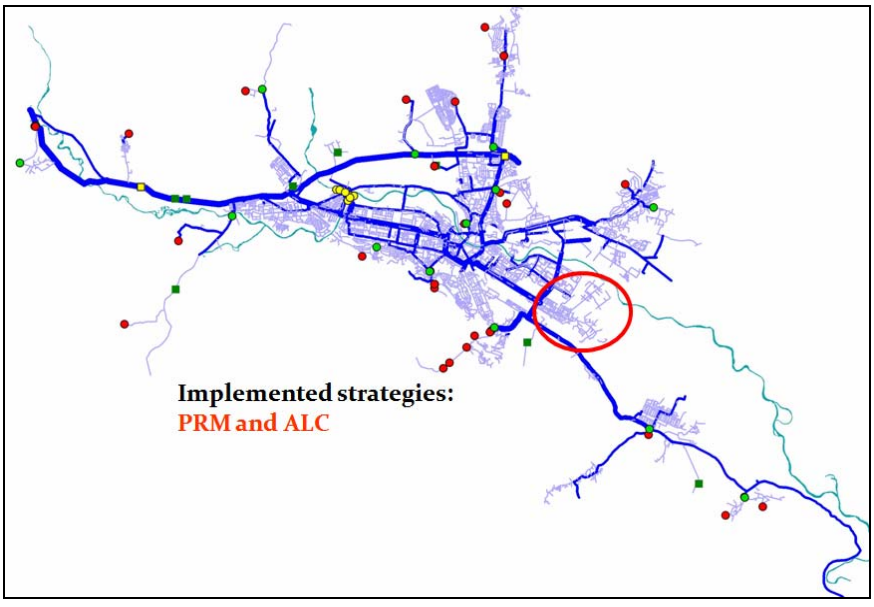



*Figure 1. Water supply system DMA Lisiche*

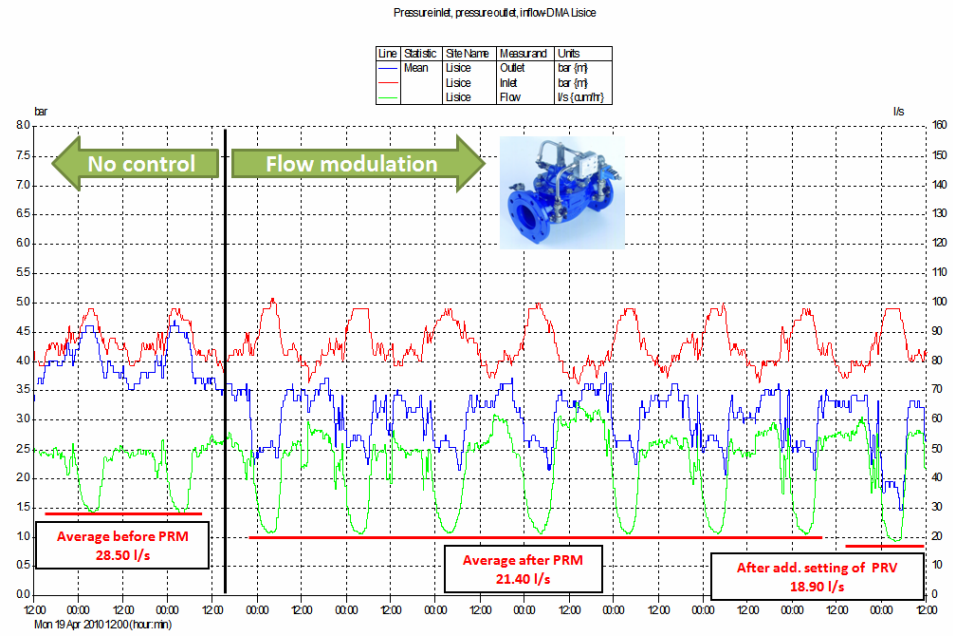
### *1.1 Pressure reducing management - Stage 1*

The first stage of this project is related to water loss reduction through Pressure Management. Based on the analysis carried out on site and previously logged pressure in several locations in DMA, which showed exceed night pressure, it was concluded that its reduction on the inlet point was allowed, which enabled installation of a pressure reduction valve Ø 200 mm on the main Ø 200 mm cast iron pipe.

The installed PRV is diaphragm (globe) type with possibility for flow and time modulation through a controller. A battery operated electromagnetic flow meter and GSM remote data monitoring device have been also installed in the PRV chamber (Figure 2).

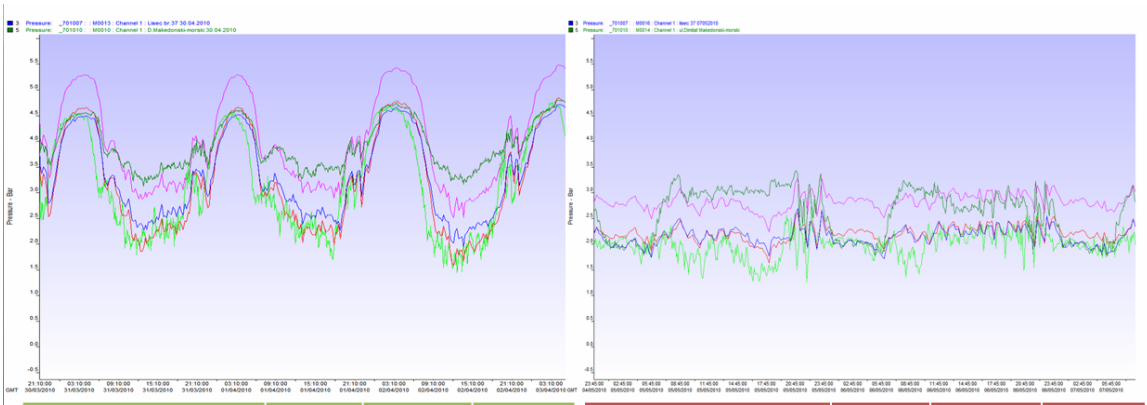
*Figure 2. Flow meter and PRV chamber*

After installation of PRV, the registered minimum night flow has been reduced from 28.50 l/s (102.6 $m^3$/h) to 18.90 l/s (68.04 $m^3$/h), showed on Graph 1, which means decreased of MNF for 9.60 l/s (34.56 $m^3$/h or decreased MNF for 33.69%) and approx. daily savings of 885 $m^3$ (with calculated NDF of 25.59).




*Graph 1. Inlet and outlet pressure and Inflow in the zone with indicated min. night flow before and after PRM*

Graphs and tables below (Figure 3) show the efficiency of PRM comparing the pressure data in several locations within the examined area.



| Pressure measurement point /Period (30.03-03.04.2010) | Max. (bar) | Min. (bar) | Avg. (bar) |
|---|---|---|---|
| Gornovranovska 24 | 4.745 | 1.441 | 3.139 |
| Todor Cangov 22/14 | 4.784 | 1.578 | 3.197 |
| Lisec 37 | 4.657 | 1.951 | 3.315 |
| Todor Cangov 21/12 | 5.431 | 2.520 | 3.959 |
| Dimitar Makedonski (Morski) | 4.745 | 3.127 | 3.899 |

| Pressure measurement point /Period (05.05-07.05.2010) | Max. (bar) | Min. um (bar) | Avg. (bar) |
|---|---|---|---|
| Gornovranovska 24 | 2.824 | 1.255 | 1.982 |
| Todor Cangov 22/14 | 2.647 | 1.637 | 2.203 |
| Lisec 37 | 2.696 | 1.716 | 2.144 |
| Todor Cangov 21/12 | 3.294 | 2.235 | 2.830 |
| Dimitar Makedonski (Morski) | 3.431 | 1.745 | 2.606 |

*Figure 3. Pressure data before and after PRM*

### *1.2 Active leakage control - Stage 2*

This part of the project is addressed to Active leakage control for additional decrease the water loss in the monitored DMA Lisiche, which required establishment of sub-District Metered Areas as an adequate method for leakage control. These activities were based on: field flow measurements, methodology for leakage assessment, network modeling, as well as systematic inspection of water supply network.

The examined DMA- Lisiche is divided into three sub-DMAs (Figure 4). The established sub-DMAs are actually temporal and the flow on the appropriate inlets and outlets was monitored with mobile ultrasonic flow meters.

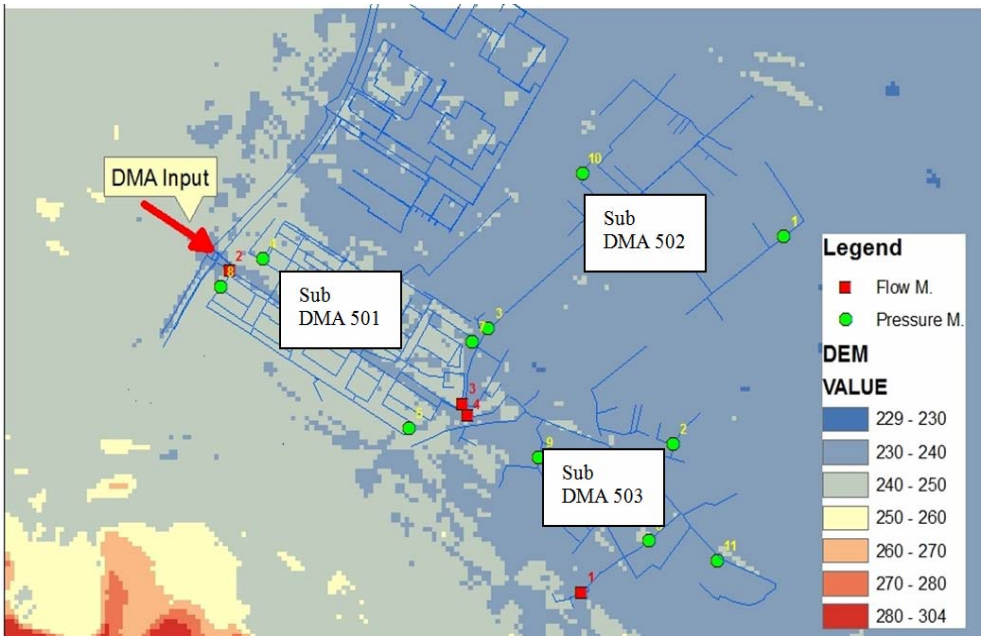



*Figure 4. DMA Lisiche divided into sub DMA's*

Water Loss Methodology used in this project is shown in Figure 5.

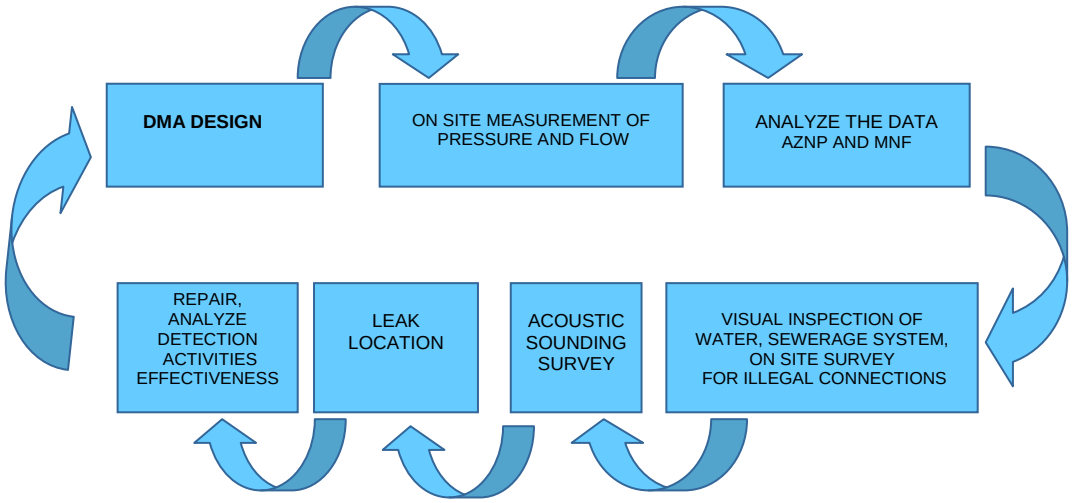



*Figure 5. Water Loss Methodology*

For modeling the water distribution network, regarding the analyzed DMA, the Bentley software product WaterGEMS V8i was used. After finishing the model building process, in order to adjust the model to better match the actual behavior of the water distribution system, Darwin Calibrator Module in WaterGEMS was used. In this calibration process, the observed field data (flow and pressure) were imported in the calibration study, that is the starting point for all calibration operations. Using the Darwin Calibrator Module we were able to detect Leakage Node in the model, via the Demand tab that allows selection of the demand adjustment groups (which were defined in the Calibration Study) as well as the parameters-ex. setting the emitter coefficient intervals that were used during this optimized run, shown in Figure 6.

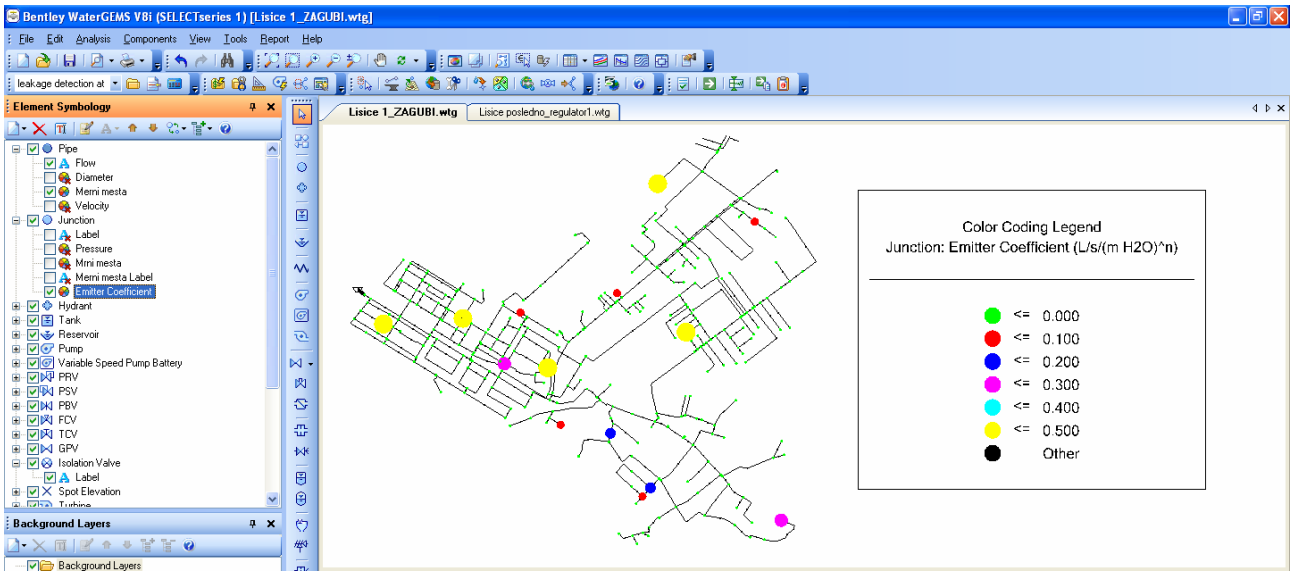
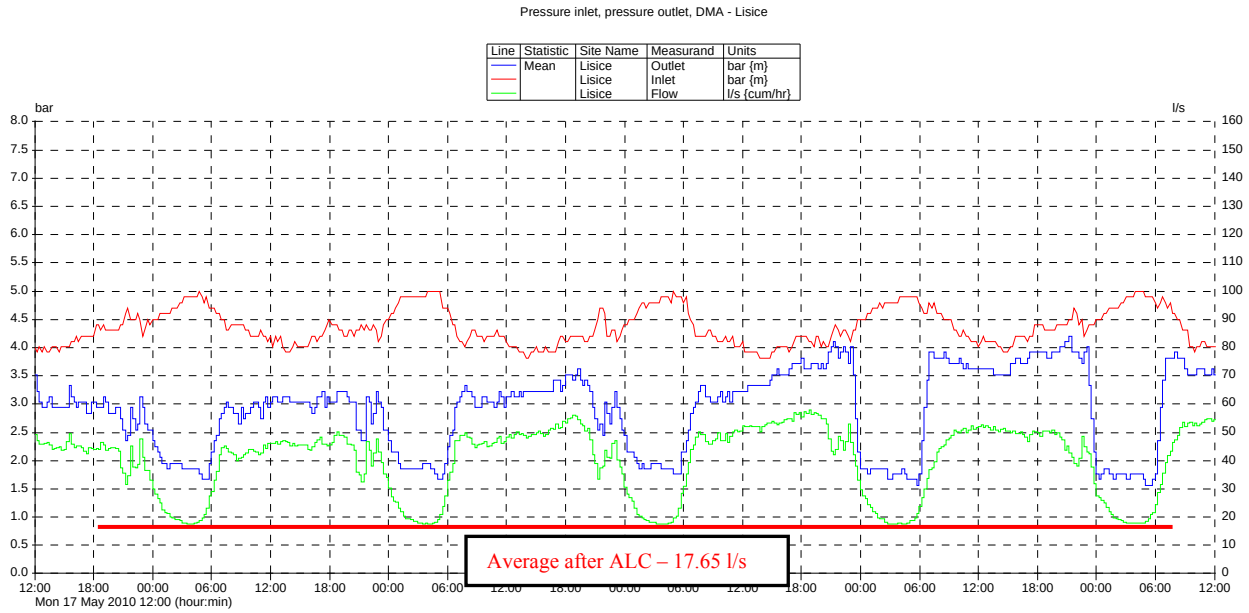



*Figure 6. Detected leakage nodes in the DMA, considering the generated Emitter coefficient, using the Darwin Calibrator Module in WaterGEMS*

Applying the strategy showed in Figure 6, minimum night flow has decreased to 17.65 l/s (Graph 2).




*Graph 2. Inlet and outlet pressure and Inflow in the zone with indicated min. night flow*

## 2. CONCLUSION

With Implementation of PRM and ALC in the particular DMA, the achieved savings are as follows: 10.85 l/s (39.06 $m^3$/h) and approx. daily saving of 1000 $m^3$/day.

In order to decrease the apparent losses, for the first time in Skopje water supply system, existing water meters have been replaced with new one C class with Automatic Meter Reading system. We replaced almost 1400 water meters in total in one sub DMA's (around 30% of all in DMA Lisiche).