WATER LOSS DETECTIVES

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EDITORIAL

YEAR OF THE SNAKE

Dear readers,

On February 10, 2013 The Chinese New Year of the Snake began. The Snake is said to be a mysterious, intuitive, introspective and refined sign. The 2013 year of the snake will be a favourable year for self improvement and learning which will encourage us to use our available tools, wisdom and intelligence.

The Water Loss Detective magazine reached its fifth issue and we have prepared new things for you, hopefully enjoyable. We switched to A4 page size, having in mind those of you who get only the electronic version and would probably like to easily print out copies.

The Water Loss Detectives is our means to keep the professionals interested in the water leak topics informed on the latest developments, the progress made in the implementation of various non-revenue water management solutions. Our readers are our co-workers involved in this field, students, professors, consultants and those who propose strategies for water loss management.

It's not by accident that we open this issue with the presentation of the 6th edition of the Global Leakage Summit to be held in March, in London. The world's global summit is focused on all aspects of efficiency regarding water loss prevention. We invite you to read an exclusive interview with Allan Lambert, the first chairman of the IWA Water Loss Task Force, a name well known in our professional community. Last, but not least we present you an account of the water loss management in the Balkans, which highlights the remarkable progress made by Romania in this field, a fact that we mention with pride.

We invite all WLD readers to send us their suggestions and ideas to improve the contents and to contribute with articles on the topics of water loss management. You can also find us on www.pierderiapa.forumactual.com where you could join our debates and on our facebook page. We look forward to receiving your emails on alin.anchidin@gmail.com.

We wish you a pleasant and inspiring reading!

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SUMMARY

GLOBAL LEAKAGE SUMMIT 2013

NOW IN ITS 6TH YEAR

The 6th Global Leakage Summit will be held at the Thistle Marble Arch, London, from 11-14 March 2013. The research process used by the Summit conference directors – telephone interviews with water utility practitioners - and the analysis of their responses - helps to shape the agenda. This article below highlights some of the topics that delegates want to hear discussed, the speakers who are presenting case studies, and delegate interest to date.

Now in its 6th year, the Global Leakage Summit has become a byword for delivering to delegates the latest concepts, state of the art best practices and innovative technologies on this special topic. The Summit has historically featured the most innovative and successful examples of delivering and maintaining reduced leakage levels across the world, providing high quality information shared at both a strategic and a technical level.

The 2013 Summit is no exception, collaborating with leading leakage, network and pressure management experts to bring together a stellar line-up of speakers from across the globe. Each will illustrate best practices and success from their own experiences via case study results, research findings and new technology development and implementation. The agenda will include insights into new case studies, new concepts and structured panel debates, with speakers from:

UK water companies and their regulators (Northumbrian Water, Scottish Water, Severn Trent Water, Thames Water, Wessex Water, Yorkshire Water Environment Agency, Ofwat)

European water companies (Constanta – Romania, Malta WSC, Suez Environnement, Vienna Waterworks)

International water utilities and municipalities (Ethekwini – Durban, Johannesbourg Water, Metropolitana Milanese, Philadelphia Water Department, Phnom Penh WSA, Yarra Valley Water)

Academic Institutions (Universties of Newcastle, Perugia, Sheffield and Salento)

All speakers have common aim - to offer delegates something new for maximizing water utility efficiency and driving down leakage - developing faster and more efficient leakage monitoring and management systems. The presentations have a highly technical as well as a strategic focus to ensure that delegates are able to take away solutions to the issues and challenges they are facing in their networks, including infrastructural and operational challenges.

New concepts on the 2013 agenda include: thinking again about how we value the true cost of water, alternative practices for setting leakage targets, how annual water audits provide a true picture for setting priorities, how changing management culture can radically improve efficiency.

Moving forward on implementation of established concepts includes: extending the pressure/burst relationship to assess the integrity of pipe and pipe failures, identify problem pipes and predict their remaining life, optimising system pressures to extend infrastructure

life and defer capital investment in new infrastructure, building models to assist asset management planning, taking smart networks to another level by delivering autonomous control.

New technology research and developments are: a reevaluation of the relative benefits of plastic pipes, assessing the pros and cons, and identifying the problem areas, building on established technologies to reduce leak intervention times and to identify pipe condition, using non acoustic technologies like pressure transients and time domain reflectometry to find leaks in traditionally difficult situations in networks with non-metallic large diameter pipes and low pressures.

The number of participating international delegations is constantly rising, along with the increase of high level support from the industry and with more and more new sponsors and exhibitors being confirmed. As well as delegates from UK water utilities, delegates who have registered from farther afield are from: Brazil, Canada, Chile, Ireland, Italy, Japan, Portugal, Spain and USA

For the first time, the Summit organizers have forged links with the African Water Association (AfWA), which, using funding from USAID, is supporting non revenue water (NRW) audits in 25 African water utilities across the continent. The audits are to enable utilities to minimise losses and maximize income by enabling them to: produce a water balance to identify where the losses are, prioritise tasks for reducing NRW, provide indications for strengthening the performance of their organizational and operational management structures, produce a Performance Improvement Plan for implementing the changes and improvements.

Delegations of AfWA member utilities from Ghana,Kenya, Nigeria, South Africa, Uganda and Zambia will be attending the Summit, for their senior directors and managers to gain maximum exposure to speakers, other delegates and exhibitors, collecting all shared information on the matter, in order to make their own utilities more efficient..

For the Summit agenda and more information on registration go to: *www.global-leakage-summit-2013.com*

Or contact: *Malcolm@london-business-conferences.co.uk* for individual enquiries.

LEADER OF THE 1ST INTERNATIONAL WATER ASSOCIATION WATER LOSS TASK FORCE,

ALLAN LAMBERT:

„DON'T BE AFRAID TO LISTEN TO, LEARN FROM THE EXPERIENCES OF YOUR TEAM AND OTHER PEOPLE"

AA: How serious is the issue of water loss today as compared to 10 years ago? How does Europe stand in terms of water loss management? Are the water loss reports reliable?

AL: Any country that claims to be serious about Water Loss management should be prepared to report and publish independently audited figures using best practice standard IWA terminology and Water Balance calculations of NRW and its components (Unbilled Authorised Consumption, Apparent Loss, Real Loss); Water Loss = Apparent + Real Losses. Some countries in Europe are doing this, or moving in this direction, to a greater or lesser extent – Austria, Bosnia, Cyprus, Germany, parts of Italy, Malta, Portugal, Serbia, Spain. Others are not.

In fact no-one knows how good performance really is because so little data is published, apart from %s by volume, which cannot be used for meaningful comparisons, and are easily open to abuse and manipulation. Countries and Utilities need to distinguish between basic traditional performance indicators (such as losses per km, per connection, per property) that can be used to track an individual Utility's progress (process benchmarking), and performance indicators such as ILI that are designed to compare their technical performance with others (metric benchmarking).

The Water Blueprint, launched by the European Commission in November 2012, proposed that each country should have the opportunity to choose its own performance measures for water loss management. That does not seem like progress to me; poor performance can continue to be easily hidden by those who wish to do so.

AA: Several water loss seminars and conferences were held each year in European countries, such as the LOSS WATER 2010 and 2012, the conferences in Sofia, Bulgaria, Ferrara, Italy, London, UK etc. What impact have such events on water loss strategy and management of companies that face such problems? Have successfull strategies been already implemented?

AL: These seminars and conferences are extremely important, They enable people with aspirations to improve their Water Loss management to be inspired by an ever-increasing number of international success stories based on the IWA Water Loss Specialist Group practical approaches, and to meet international colleagues who are willing to help them.

AA: What are the latest news at these conferences? What are the current trends?

AL: From my perspective, the biggest development in the last few years has been the increasing recognition of the fundamantal importance of pressure management. 12 years ago, less than half of the Countries subscribing to an IWA International Water Loss review mentioned pressure management; now there are few who do not acknowledge the multiple benefits, which include reduction of bursts, extension of asset life, and efficient use of energy, as well as the previously known reduction in night flows and leak flow rates.

AA: What is the best approach to water loss reduction and control, in your opinion? What steps need to be taken?

AL: The first step is to be honest and admit that you have a problem; then start to quantify the problem and prioritise the most appropriate sequence of actions for the particular state of each system. Don't be afraid to listen to, learn from the experiences of your team and other people. There are no 'silver bullets', no magic solutions, only gradual progress achieved through a rational professional approach by dedicated professionals, supported by management which truly recognises that water loss management is a continuous activity, for ever.

AA: Do you think DMA's are the most effective solution for water loss monitoring? What would you suggest for ring networks with many nodes of incoming and outgoing water? Is there an alternative to DMA's?

AL: DMAs have many advantages, but the 'rules' on sizing and frequency of measurements that apply in one country are not automatically transferable to others. 'Rate of Rise of unreported leakage' is a key parameter, and to gain the full benefits of active leakage control interventions, the pressure in all DMAs should be capable of being controlled, either individually or as a group of DMAs.

AA: How effective are the current technologies for leak detection for polyethylene pipes, known for poor transmission of leak sounds?

AL: This is definitely not a topic I am professionally competent to comment on – I leave that to specialist colleagues such as Stuart Hamilton and Malcolm Farley

AA: In most countries, companies try to reduce water pressure in the supply system, while in some parts of Germany, they try to replace many pipes in order to maintain high pressure (approximately 6 bar). Which approach is more realistic?

AL: Few countries have infrastructure of such a high quality as Germany; the standards for pressure at customers' premisies are generally related to height of buildings. You might find that system pressures in Germany are not always as high as you think, but as they do not publish such statistics, how are we to know? For most countries, reduction of excess pressure and stabilisation of pressure in distribution systems is likely to be an excellent water loss control strategy.

AA: How important is the leak detection staff role, considering the use of SCADA for remote pipe monitoring, leak detection and data transmission?

AL: I am full of admiration for your initiatives to improve the training and provide for leak detection staff to exchange experiences. When I worked in Operations in Welsh Water, I always tried to listen and learn from the local knowledge and ideas of leak detection staff. When I do training at Utilities now, I always try to talk to the leak detection staff whenever possible, as you can quickly find out many important facts which are not monitored by SCADA!

AA: Do you think we'll have self-repairing pipes in the future?

AL: Given the rate of technological progress, I think we will all be surprised by what is possible 10 years from now.

AA: What are your plans for 2013?

AL: To continue to try to help as many people as possible to become better at water loss control, through dissemination of practical approaches based on understanding of fundamental principles that are internationally applicable. Just now I'm close to finishing an upgrade of my website (www.leakssuite.com) to provide many free papers, articles, Guidelines, software, blogs etc to anyone who is interested.

As an independent consultant, to continue to challenge anyone who attempts to hide poor performance behind flawed statistics, and to set an example by refusing to assign copyright of any of my work to publishers who seek to limit the free spread of knowledge to wider audiences.

AA: How was the Water Loss Task Force established?

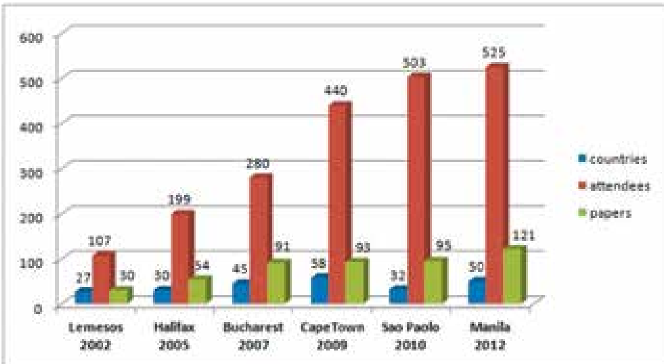
AL: In 1995 the Operations and Maintenance Committee of the IWA, chaired by Dr Wolfram Hirner (Germany) established a Water Loss Task Force (WLTF) with 2 objectives

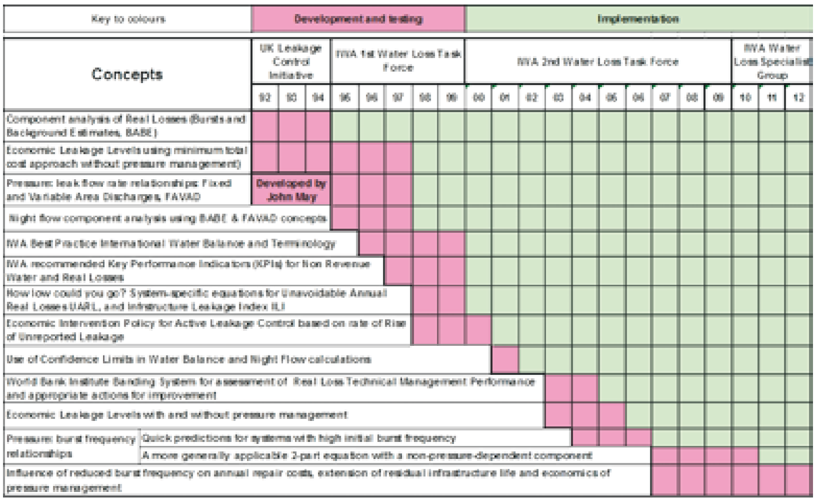
a) To recommend a standard international terminology for calculation of real and apparent losses from water balance

b) To review Performance Indicators (PIs) for international comparisons of losses in water supply systems

The membership of the 1st WLFT was Allan Lambert (UK, Chair), Timothy.G. Brown (representing American WWA), Masanori Takizawa (Tokyo Waterworks and JapanWWA) and Dieter Weimer (Neckarwerke Stuttgart, and DVGW Germany). The WLTF consulted colleagues in many countries before reporting their findings in a paper in AQUA Magazine* (Dec. 1999) and an IWA Blue Pages* (Oct. 2000). The Water Balance and Performance Indicators were also included in the IWA Publication 'Performance Indicators for Water Supply Systems' (1st Edition, July 2000). The conclusions were presented at an IWA Conference 'Systematic Approach to Leakage Control and Water Distribution System Management' at Brno in May 2001, after which the Task Force was scheduled to end and disband.

However, some of the leakage specialist attending the Brno Conference had already started to use the IWA Water Balance and new Performance Indicators, including the Infrastructure Leakage Index (ILI). They were so enthusiastic about these practical concepts that they volunteered to form a 2nd Water Loss Task Force, to ensure that the new approaches were promoted internationally, and to work together to gain a better understanding of many technical aspects of water loss control that were not properly understood. And the rest, as they say, is history – under the leadership of Ken Brothers (Canada), Bambos Charoulambous (Cyprus) and Tim Waldron (Australia). The success of the WLTF was recognised when it became the Water Loss Specialist Group, in 2010.





** Copies of these papers will be available for free download from the 'Free Papers and PPTs' webpage at www.leakssuite.com from 1st March 2013.*

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NEW ELEMENTS CONCERNING THE OPTIMAL SIZING OF WATER SUPPLY INSTALLATIONS

Conceiving a water distribution network, which observes all quality and performance criteria, imposed by the current quality standards, during its entire lifespan (and sometimes including the time period after its retirement, involves a great deal of responsibility. [1], [4].

In order to comply with all of the requirements of a such a high performance build, the optimal design of such a water distribution network requires the following to be met:

- establishing a flexible scheme, which permits connections to alternative sources (i.e. toilets being supplied by water that is either pre-treated waste water or even storm water;
- establishing a proper endowment of the quality level of the required sanitary comfort and the general goal of the entire construction;
- the optimal choice regarding the positioning and path of the equipment, based on stability requirements, on optimal economy and functionality, and last but not least on the acoustic, technological and aesthetic attributes in accordance with other installations;
- the optimal choice of construction materials, equipment, objects and reinforcement elements (fittings), so that all these combined shall concur toward assuring the optimal functionality of the entire system, encompassing minimal consumption in regards to material and energy, as well as minimal exploitation and maintenance costs during the entire system's lifespan, all of these thing being insured without any potential damage to manpower or the environment itself;
- to ensure the correct sizing of all of the components, based on strict and complex criteria, which takes into account the full weight of every imposed requirement, and furthermore the contribution of each component within the installation toward the global result of the system;
- the optimal provision, regarding interconnections with other installations towards ensuring a largely controllable, adjustable and even self-adjustable functionality.

It can be noted, that in truth, the optimal design presents itself with two distinctive aspects, which are quality and quantity.

Utilizing the optimization criteria in the sizing of water supply installations

One of the objectives regarding the optimal planning of a water supply installation represents the optimal sizing of the installation's encompassing elements, so that the full weight of the quality and/or quality requirement, and furthermore, the own contribution toward the final result, of each and every element is taken into account [2], [4], [6].

To this day, the optimal sizing of a water supply installation has enjoyed from an outstanding attention from the engineering world, and it has come to be very concrete in accordance with the sizing calculation of the water distribution networks, respectively, establishing the diameters and needed pressure levels, all of these attributes having a basis in economic criteria.

In the case of the optimal sizing of pipe networks, cost-effective, simple, or compound energetic criteria have been used, which are to take into account the full investment that is necessary in the realization of the whole network, the cost raised by the energy which is needed to fuel the pumps, exploitation costs, overall energy consumption etc.

In the following [1], [3], [6], the criteria regarding optimization which have been used to this day will be elaborated on, and furthermore, be added upon with a new criterion which shall permit the removal of the so called „maximum allowable speeds" from the sizing calculations. It is to mention that these speeds are not standardized in a differentiated fashion in accordance with the material of the pipes, their diameter or even the configuration of the installation's path itself for that matter..

The necessary investment for an installation built of N_T pipe sections, is achieved by the sum of all the investments needed by all encompassing pipes in the following relation:

$$C_c = \sum_{i=1}^{N_T} \left(a_i + b_i \cdot D_i^{\alpha i}\right) \cdot L_i \,[UM] \qquad (1)$$

In which a, b, α represent cost coefficients, depending on the material the pipe is made of, and D_i, L_i represent the diameter and respectively the length of the section i.

The investment for the pumping station is as follows:

$$C_p = \frac{9{,}81}{\eta} \cdot f \cdot \sigma \cdot Q_p \left(\sum h_{ri} + H_g + H_u\right) \,[UM] \qquad (2)$$

In which:
σ is an above par factor which factors into account the installed power reserve;
h – the global yield of the pumping station [%];
f – the installation cost of the power unit [UM];
Q_p – the pumped debit (output) [mc/h];
h_{ri} – the sum of the pressure drop over the disadvantaged path;
H_g – the pressure of use at the disadvantaged point of use.

The yearly cost of energy needed for pumping is determined by:

$$C_e = W_e \cdot k_w = \frac{9{,}81}{\eta} \cdot 730 \cdot k_w \cdot \tau \cdot \sum_1^{12} \Phi_k \cdot Q_p \cdot \left(\sum h_{ri} + H_g + H_u\right)[UM] \quad (3)$$

In which:
We – energy used for pumping water [kWh];
kw – the rate (cost) of electrical energy [UM];
t – Tp/8760 pumping coefficient (relative duration of the pumping);
Tp – the effective number of hours the pumping takes per year;
– the ratio between the monthly debit and the pumped debit [mc/h];

$$\left(\sum \Phi_k = 10{,}44 \text{ pentru ansamblul de cladiri}\right);$$

The yearly exploitation costs are calculated as such:

$$C_{ex} = p_1 \times C_c + p_2 \times C_p + C_e \quad (4)$$

In which, p_1, p_2 are repair costs, maintenance and periodic revisions for the pipes, respectively for the pumping station.

The yearly costs for investment and exploitation can be defined by a multicriterial relation:

$$C_{an} = \beta_0 \cdot \left(C_c + C_p\right) + C_{ex}; \quad \beta_0 = \frac{1}{T_r} [UM] \quad (5)$$

In which, T_r - the timespan of the exploitation.

The full, actualized, cost can be determined by the relation:

$$C_{ac} = C_c + C_p + \frac{\left(1+\beta_0\right)^t - 1}{\beta_0 \left(1+\beta_0\right)^t} \cdot C_{ex} \quad [UM] \quad (6)$$

And are considered over the entire time of exploitation T_r.

Energy that is embedded within the network is expressed under a binominal form, in which a_e, b_e şi a_e are cost coefficients of the energy needed in exploitation:

$$C_i = \sum_{i=1}^{N_r} \left(a_e + b_e \cdot D_i^{\alpha_e}\right) \cdot L_i \quad (7)$$

The energy consumption of the network, summing up the energy embedded within the network and the one needed for the actual exploitation of the network is determined by the relation:

$$W_t = \left(\beta_o + p_1\right) \cdot W_c + W_e \quad (8)$$

In which:
Wt is the energy embedded within the network [kwh];
We – energy used for pumping the water [kwh].

Over the customization of the parameters of the objective function, customized functions can be obtained.

The following criteria have been used for the water supply networks which use pumping: the yearly minimum cost criterion, the actual minimum cost criterion and the minimum energy consumption criterion

Proposals regarding updating of the criteria

In order to have an optimal sizing, with regard to the new habitat strategy, it is imposed adding onto the aforementioned criteria with other, as essential ones [4], [6], [7]. The acoustic criterion, determined by quantitative terms, according to which, to each and every pipe (material, diameter, length) is given an own size in accordance with noise and vibration transmission and furthermore, in a similar fashion, the local resistance — which is intended to improve the normative requirements for design, by which the maximum allowable speeds are unique, regardless of the material, the network's configuration etc.

The acoustic criterion is materialized by the additional cost of investment (depending on material, diameter, length) necessary for dampening the noise transmission within the installation:

$$\mathbf{C_z = \sum_{i=1}^{N_r} \left(a_z + b_z \cdot D_i^{\alpha_z}\right) \cdot L_i}, \quad (9)$$

In which $\mathbf{a_z, b_z, \alpha_z}$ depend by the material.

If the qualitative aspects, regarding the insurance of stability in exploitation by avoiding corrosion and deposit (depending on the nature of the material) are also followed, all of it can be exprimed through a binominal law:

$$\mathbf{C_s = \sum_{i=1}^{N_r} \left(a_s + b_s \cdot D_i^{\alpha_s}\right) \cdot L_i} \quad (10)$$

If the influences of all the criteria regarding the used material are fused together, the *global coefficient* of the network can be established:

$$\mathbf{C_g = \sum_{i=1}^{N_r} \left[\left(a_i + a_e + a_z + a_s\right) + \left(b_i + b_e + b_z + b_s\right) \cdot D_i^{\alpha_i + \alpha_e + \alpha_z + \alpha_s}\right] \cdot L_i} \quad (11)$$

On the basis of all the aforementioned criteria, a complex, multicriterial function can be established, like so:

$$\mathbf{F_c = \eta_1 \sum_{i=1}^{N_r} \left(a + b \cdot D_i^{\alpha}\right) \cdot L_i + \Psi \sum_{j=1}^{N_p} Q_{p_1} \left(\sum h_i + H_g + H_u\right) \cdot L_j} \quad (12)$$

where the following notations have been made:

$$\Psi = \frac{9{,}81}{\eta}\left(f \cdot \sigma \cdot \eta_2 + 730\Gamma_a \cdot e \cdot \tau \sum_{1}^{12} \Phi_k\right) \quad (13)$$

$$\Gamma_a = \frac{(1+\beta_o)^t - 1}{\beta_o (1+\beta_o)^t} \quad (14)$$

$$\eta_1 = \Gamma_a \cdot p_1;\ \eta_2 = \Gamma_a \cdot p_2 + \frac{t}{T_r} \quad (15)$$

$$a = a_i + a_e + a_z + a_s \quad (16)$$

$$b = b_i + b_e + b_z + b_s \quad (17)$$

$$\alpha = \alpha_i + \alpha_e + \alpha_z + \alpha_s \quad (18)$$

This function has the advantage of allowing the increase of precision in evaluations regarding optimization – comprising both quantitative as well as qualitative aspects of the design process regarding water supply installations. All of this, furthemore, allows the design process to be dynamic.

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CHANGES IN WATER LOSS MANAGEMENT IN WESTERN BALKAN REGION

Abstract
The aim of this paper is to present current situation, experiences and development of activities regarding water loss management in the region of the Western Balkan. Particular focus will be given to the following countries; Croatia, Bosnia and Herzegovina, and Serbia.

Keywords
Water loss management, strategy development, performance indicators, education

INTRODUCTION

In the 90's Western Balkan region (ex Yugoslavia) was affected besides economical downturn with war activities. All this in combination had tremendous negative impact on water distribution infrastructure condition and as a result rise of water losses.

Individual distribution systems are relatively small and dedicated to separate municipalities or large town and cities. For example in Croatia we have some 100 utilities supplying water for a total population of 4.3 M but only Zagreb, the capital city, has one utility responsible for a 850K population. Similar situation we have in Bosnia and Herzegovina with Sarajevo and in Serbia with Belgrade.

In average, NRW is between 40 and 50%. Conditions of the infrastructure are poor due to many reasons (war damages, lack of preventive maintenance, limited or no investments in rehabilitation, low revenue water prices, etc.). Above all, an increasing problem is the lack of educated workforce.

In the second half of the 90's, the rehabilitation of the whole region started, with a huge financial support from the international institutions, such as EU funds, World Bank, EBRD and others. From numerous donations and loan programs significant investments were done into the water distribution infrastructure but still this had little or no effect on water losses levels. Many utilities needed technology for water loss control and in particular leakage detection, but in most cases what remained was old practice in water losses understanding and approach in problem solving (NRW in % as the main indicator, leaks anticipated as the cause of the losses problem etc.).

In the last decade we have witnessed a slow, but definite rise in understanding of water loss importance in the region and in parallel with that acceptance of IWA WLTF approach.

Many utilities recognized this new approach as beneficial and numerous cases have shown that the water loss issue can be tackled with relatively simple and fast implementing programs and strategies. IWA WLTF approach proved to be also economically feasible.

Now we have strong development evident on different levels in the region and few examples will be presented showing success accomplished and obstacles faced, which can be an example for others.

CROATIA

Since the end of the 90's, there has been an evident slow rise in understanding the importance of water losses. A couple of utilities started with measures like zoning, pressure management and active leakage control, but most utilities operated their systems without a dedicated water loss control policy. Due to the fact that the country's water reserves are one of the largest in Europe and the government policy focuses on the expansion of the water distribution infrastructure, investments in water loss control were sporadic and evident only in rare cases, where some utilities had limited sources of water or high rise in consumption demand.

Following examples can be underlined:

- Water utility in town Rijeka (700 km network); strong industrial and tourist centre on northern Adriatic coast. The company started a dedicated water loss control project in the beginning of 1990 implementing zoning, remote monitoring, pressure control and leak detection. Succeeded in reduction of NRW from over 40% to below 20 % in 10 years and maintained this level until today.
- Water utility Istarski Vodovod (1000 km network); large system covering almost whole Istria peninsula – strongest tourist region in Croatia. From mid 90's the company has had dedicated activities including system analysis, ALC equipment purchase, zoning, pressure control. Now, the NRW is below 20% (first utility who started with use of insertion flowmeters for DMA control in Croatia in late 90's)
- Water utility Zagreb (3000 km network); capital of Croatia; The utility started its own water loss program with development of advanced hydraulic mathematic modelling in mid 90's but lost some momentum until recently when IWA methodology was implemented in 2008 (featuring tests of advanced pressure control application and system analysis). Now, preparations and strategy definitions for comprehensive active water loss control program are under way.
- Water utility Ivakop (300 km network); The small system near Zagreb started in late 90's zoning policy with use of simple mechanical meters but on a large scale (some 30 locations in relatively small network – then 150 km pipelines) and until today, they expanded the monitoring system (53 measuring locations, 51 DMA zones, 4 PMA zones) with excellent results (ILI 1.4, NRW in 2010. 19%).

First serious changes started with local conference organized by the association of water utilities held in 1998 dedicated to the subject of water losses. Interesting to note is that a couple of experts came from Europe to present papers. Also it is interesting to remember that in this beginning period in town Dubrovnik well known company Bristol Water Services conducted NRW audit (financed by the donations from EU).

In the last 10 years we have slow but definite growth regarding advanced water loss control with many utilities starting to use, besides recognized standard measures like zoning, pressure control and ALC, also new IWA

WLTF methodology on standardization and performance indicators. In 2007 we had another very successful conference (with over 450 participants from the whole region) about water loss issues where IWA methodology was officially introduced for the first time, and also several case studies were discussed. Now, over 20 utilities have data analysis done with use of IWA methodology. In one case we have utility that integrated IWA methodology performance indicators in their ISO9001 standard and planned improvements in water loss control are not anymore presented as change of NRW % but as reduction of ILI.

Latest changes on the horizon show recognition of water loss importance on national (governmental) level. Association of water utilities has encouraged water utilities to start using IWA methodology since 2009 and, from July 2010, Croatia has new regulations regarding policy of concessions payments for the water extracted by the water utilities. Concession price has 4 categories values relevant to the water losses coefficient based on 4 World Bank Institute categories and IWA WLSG Infrastructure Leakage Index.

We present herewith the translation of the specific paragraph section regarding concession values related with coefficient of losses:

- 0.80 HRK for a cubic meter (1 m^3) of water delivered, if the ratio of actual and technically acceptable losses (hereinafter referred to as the coefficient of loss) in the public water supply in this area is greater than 8;
- 0.76 HRK for a cubic meter (1 m^3) of water delivered, if the coefficient of loss in the public water supply in this area is between 4 and 8;
- 0.72 HRK for a cubic meter (1 m^3) of water delivered, if the coefficient of loss in the public water supply in this area is between 2 and 4;
- 0.64 HRK for a cubic meter (1 m^3) of water delivered, if the coefficient of loss in public water supply system in this area is below 2

This new legislation will for sure motivate Croatian utilities to start changing situation about water losses issue. Currently utilities have few years moratorium on this law that should be used for preparations and improvements.

Another important development is related with initiation of dedicated Training and Competence Centre in water utility in town Karlovac (tcc-karlovac.org). This centre is result of cooperation between German and

Croatian governments with aim to establish regular education of water utilities employees. One of strategic trainings is related with Water Loss Management and Leak detection.

SERBIA

Deficits in municipal planning capacities represent the critical bottleneck for catching up with infrastructure modernization and development. Consequently, available central government funds and credit lines provided by international financing institutions are not being fully utilized, due to the lack of quality project preparation.

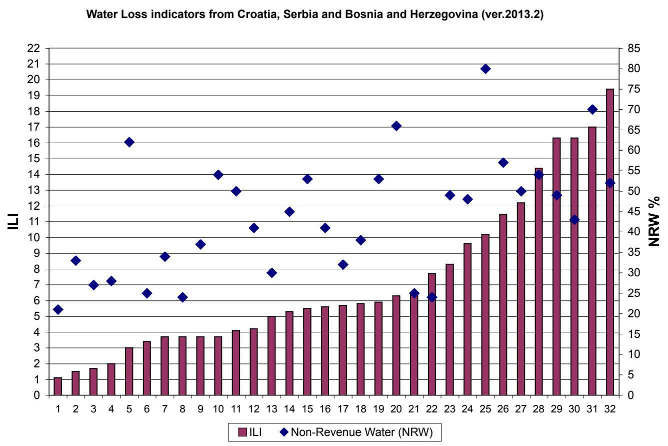
In addition, recent economic and financial crisis has forced many Serbian municipalities to postpone new infrastructure investments. An alternative in many cases may be to focus on the modernization of existing facilities, especially where such investments are paying back via reduced operating cost.

Way through these obstacles was identified through inter-municipal cooperation developed and supported by German development agency GIZ (previously GTZ).

During 2010 and with extension into 2011 is in implementation project related with raising awareness regarding water loss management according to IWA WLSG methodology. Activities involved are promotional presentations, workshops, water network audits, training of employees from utilities, on-field education, webinars and visitation of good example case studies (even between different countries). Altogether 8 utilities were directly involved with participating personnel from another 20 utilities and led by a water loss expert as a main consultant and trainer.

As part of this achievements is also establishment of new association of professionals from the water sector in Serbia – IPM, that should help water utilities in their future cooperation but also to promote efforts and achievements with aim to raise public awareness and seek political support and financial assistance from different donation programs and associations.

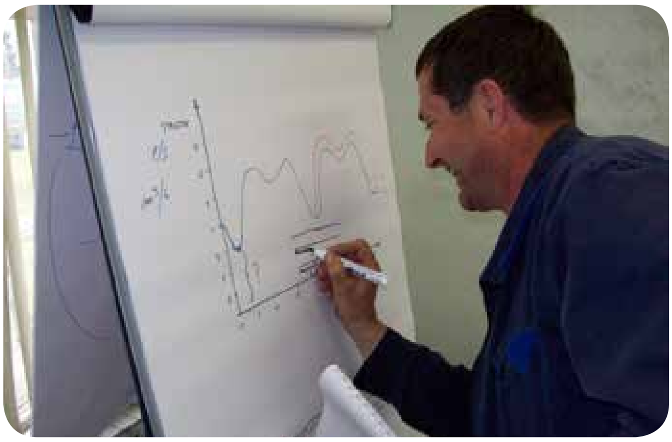
Further development was achieved with introduction of UNHabitat program GWOPA (Global Water Operators Partnership) in South East Europe with IPM association as its local representative. The water loss issue is recognized as one of the key areas where this specific program can achieve largest benefits for local water utilities.



Following the Workshop of Water Operators' Partnerships for South East Europe (WOP-SEE), held in Ferrara, Italy, during the Water Loss Europe 2012 conference, one of the conclusions was that "WOP-SEE Water Loss Working Group" should be established. The purpose of the WG is to further improve coordination of professionals, utilities, associations, NGO's, universities, implementing agencies, donors and all other stakeholders interested to learn from each other and to support promotion of this issue in SEE.

It is also important to emphasize contribution from Association of Water Technology and Sanitary Engineering (association of water and wastewater utilities and other contributors) through two publications released in 2010 and 2011 related with current operation and management practices where in case of water loss control was promoted and presented IWA WLSG methodology. They also publish a regular bimonthly magazine where water loss issue is often a topic (including translation of selected articles from Water21 magazine published by IWA) .

For the end regarding available publications in Serbia it is interesting to mention that IWA WLSG District Meter



Areas Guidance Notes is translated into Serbian language in 2008 (Faculty of Civil Engineering in Belgrade).

This knowledge transfer availability together with the introduction of active cooperation between utilities, creates solid foundations for the future improvements in the field of water loss control in Serbia.

BOSNIA AND HERZEGOVINA

Water utilities in Bosnia and Herzegovina are still struggling with numerous problems related with political and economical issues. Despite existing problems, a couple of utilities have shown progress and some of them with international recognition of achieved results (Gracanica water utility – advanced pressure control case study from 2005).

As a bright point in dim situation in this country is establishment of a training facility near Sarajevo, supported by international organisations and through donation from one large equipment manufacturer. Here on training site people from water utilities have opportunity to test leakage detection equipment, measuring instruments and other applications.

IMPORTANT HAPPENINGS IN OTHER COUNTRIES in the REGION

Romania

The Romanian Water Association through the Water Training Center and with the support of a host company organizes on a yearly basis a regional Leak Detection Competition. The 5th event of this kind took place in May 2012. During the first four editions the number of participanting companies increased from 5 to 19. The teams gathered and competed to find out who could track down leaks better and faster. This annual competition helps raising awareness on the water loss issues, shared by utilities all around the region, and provides a great opportunity for them to learn from one another. After the competition, the teams always want to know „how did they do it?"and this leads to some great peer learning.

Bulgaria

For the last 4 years the Bulgarian Water Association organized the International Conference on Water Loss Reduction in Water Supply Systems, considered to be the major annual water loss event in the Balkan region. This year's conference in November 2012 (5th) will document available know-how and best practices and will recommend new approaches for more efficient management in the field of water with a focus on water loss reduction. The conference is supported by the European Water Resources Association (EWRA). It is aimed at decision-makers, experts in the water supply sector and water supply operators as well as at companies - producers or distributors of the respective equipment.

CONCLUSION

This brief situation overview in mentioned countries of the Balkan region clearly shows that positive momentum is already in motion.

Different experiences and achievements certainly can be of benefit to all utilities and people in our region, especially in these countries where we also use very similar languages.

We have a wide range of different situations and success stories in water loss control.

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200,000 CM WATER SAVED PER YEAR

EPAL'S STRUGGLE AGAINST LEAKS GOES ON

The repair of a single leakage at ZMC 3280 Sidónio Pais involved recovery of about 200,000 m^3/year.

The ZMC 3280 Sidónio Pais was implemented on December 20th, 2007, in the central area of Lisbon, more precisely between the Marquês de Pombal roundabout, Av. Fontes Pereira de Melo and Av. António Augusto Aguiar, covering about 10 km of distribution network, 2,700 customers (50% domestic and 50% non-domestic) and 560 registered extensions - figure 1.

The first intervention of leakage detection realised in this distribution area occurred approximately one year after the implementation (November 2008), with the detection and repair of 7 water leakages and the recovery of about 15 m^3/hour, equal to 130,000 m^3/year.

In the course of work carried out at Av. 5 de Outubro Pipeline, performed between October 2011 and April 2012, and in order to minimize the impact on the water supply to the customers of Zona Alta, some valves were opened at the border of this ZMC, thus preventing effective control of this area of the city, at the level of water losses during this period.

After completion of this work, the boundaries of this ZMC were replaced, as it became necessary for the EPAL leak detection team to perform new works.

After carrying out the sealing tests for the ZMC borders and macro location of the existing trails, it was possible to considerably decrease the intervention area, enclosing it between Av. António Augusto Aguiar (side of even numbers) and Rua Filipe Folque. The challenge facing the Monitoring Unit (DGA/MON) leak detection team was to find one or more breaks responsible for the flow rate of about 24m^3/hour - estimated amount for the marked area.

Leak detection works were carried out in that area, involving all the methods and equipment available for this purpose. A leak was detected in the Fibre cement pipe of ND 150 mm, at Av. António Augusto Aguiar, next to no. 76.

After repairing the leak, the minimum ZMC flow rate decreased by nearly 23m^3/hour (200,000 m^3/year), thus normalizing performance of ZMC 3280 Sidónio Pais.

It is thus evident that the water distribution network requires active monitoring of losses and continuously implemented work generates visible and significant efficiency gains for organizations.

This case involving the ZMC 3280 shows that the company cannot rest in the "struggle" against leaks and it has to maximise its tools, systems and know-how developed in recent years that allowed EPAL to be considered a national leader in this area.

Article courtesy of Aguas Livres, property of EPAL Grupo Aguas de Portugal

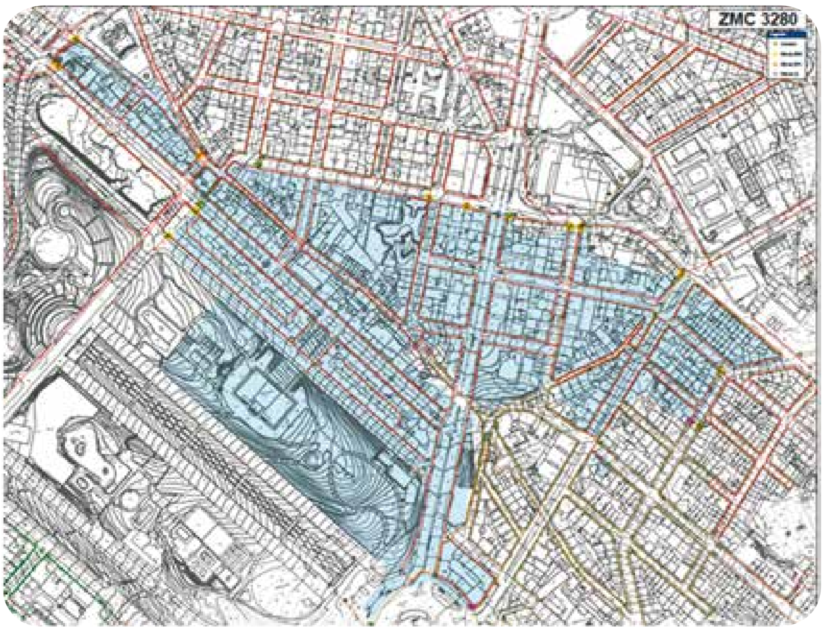

FIGURE 1 - ZMC 3280 Sidónio Pais Plan

I2O WATER HELPS A ROMANIAN COMPANY TO REDUCE LEAKAGE

The British company i2O Water has spent much of the last decade developing solutions to help some of the world's leading water companies reduce leakage and burst frequency, while maintaining customer service, through optimized pressure.

The company developed solutions for pressure management in water networks that help water companies such as Veolia, Severn Trent etc. to improve the performance of their networks /reduced leakage, burst frequency and operational expenses/, while maintaining agreed customer service levels.

THE CHALLENGE

Since 2011 i2O Water already has some experience with a Romanian company too, located in one of the top ten largest cities. The population there is 250,000 and the pumping station, located at elevations 16 m higher than the city's center, supplies around 75,000 residents.

The challenge for the i2O's team was to:

- Optimise the pumping station by maintaining the minimum level of pressure;
- No compromise to water supply;
- Reduce overall leakage and energy consumption from the pumps.

The average estimated leakage levels in the zone prior to the trial were 7 Ml/d, with energy consumption of 1,700 kWh/d. The leakage levels were almost 40%.

The trial location had three variable speed pumps and two Critical Points (CPs). CP1 adjacent to several tall buildings where the minimum pressure required was 36 m. CP2 was located at feed in to a sub Pressure Managed Zone with a minimum required pressure of 37 m.

THE SOLUTION

TThe i2O Water installed their system in the middle of March, 2011. It was set to maintain the pre-existing fixed delivery pressure in order to collect valuable flow and pressure information. The controller required power and three 4 - 20 mA connections to the existing variable speed pump control system. Two of the connections provided the manifold flow and pressure input, used for both logging and control purposes. The third connection was used to supply the existing pump control system with target manifold pressure through the 'remote set-point' interface.

The first phase of the optimisation involved identification and resolution of potential issues across the network and with the pumping systems. After eight weeks all identifiable issues had been resolved, including repair of the burst mains, valve operations and improvements in the existing pump control system.

In the middle of May the pump control system was transitioned into fully optimised profile, with delivery pressure varying to maintain the required levels of pressure at the two Control Points.

THE RESULTS

The company managed to stabilize and omptimize the pump control. The pressure at Control Points varied by no more than 1.5 m throughout course of a day. The customer service has been improved with a reduction of total daily flow and leakage. The variation in water demand was managed and controlled automatically by the system. Just an example: increases in peak flow from 178 l/s on 12th June 2011 to 243 l/s on 19th June 2011 was met by an increases in pump outlet pressure, with a steady increase from 23 m to 29 m. Critical point variation remained stable, however, at the required level to ensure customers supplies were maintained.

Here are the summarized results:

10% saving on leakage reduction /0.7 Ml/d/;

20% reduction in energy consumption /330 kWh/d/;

EUR 8,500 total power cost savings delivered from trial in one zone.

BENEFITS

Both energy and chemical costs have been reduced from the reduction of the raw water abstraction and treatment. Consistent and continuous level of water service to the customers in the region is maintained. The burst frequency has been reduced through reduction and control of the network's pressures through smooth optimised pumping. As a result of the intelligent learning of the network's pressure and flow characteristics customer can remotely identify burst mains to carry out efficient and timely repairs. The reduction of the labour-intensive task of identifying and locating bursts led to additional cost savings. The operating valves within the network improved the localised pressures and have resolved a number of local network performance issues through providing an improved understanding of how the system works. The engineers are now able to review and manage the network performance from anywhere they are able to access mobile communications.

FOR MORE INFORMATION: WWW.I2OWATER.COM

TOWARDS INCREASED WATER AND ENERGY EFFICIENCIES IN WATER DISTRIBUTION SYSTEMS

CHALENGES OF THE ICEWATER PROJECT

The ICeWATER project is an EU FP7 project that aims for the development of new ICT strategies for management and operation of Water Distribution Networks (WDN). Present article aims at presenting the aim of the project which along with the major challenges that needs to be addressed throughout the project time. In order to test the methods developped in the project, two water supply systems of two European cities were selected as case study, the city of Milan (in Italy) and the city of Timisoara (in Romania). One of the main objective of the project is to perform a reduction of energy consumption due to the high pumping requirements in the Milan water systems. The second objective is to reduce water losses in the pipes in Timisoara. Along with these two main objectives, water quality problems will also be investigated(e.g: residual chlorine in the pipes). The project aims, as well, to develop demand analysis and forecast rhat will lead to dynamic pricing, which has a beneficial effect on the consumption pattern.

Three particular substructures are integrated in the project: Sensors (Data), WDN and User Interfaces for operational and managerial matters. The project calls for implementation of state of the art sensor technologies in pilot areas and for the linkage with operational control rooms in both utilities. For the simulation of the WDN's a Gradient Algorithm will be used. For the optimization approaches, both heuristic and non-heuristic optimization techniques will be applied.

ICeWater

The communication system will be developed to match current standards in data transmission and aiming to increase efficiency of the water systems. Finally for the operational and managerial matters a decision support system (DSS) will be made available for operators to tackle the location of leakages and scheduling of pumping in the water system. E DSS will allow for decision making based on Return of Investment (ROI) for pipe replacement and intervention..

Keywords: water supply system, optimisation, leakages

Ioana POPESCU
UNESCO-IHE

SAVE THE DATE, 7-8 NOV. 2013, TIMISOARA, ROMANIA

INTERNATIONAL CONFERENCE
ENVIRONMENTAL RESEARCH AND TECHNOLOGY

eco impuls 2013

ECOIMPULS – AN IMPULSE FOR SUSTAINABLE DEVELOPMENT

Ever since the beginnings of its development, human society has remodeled its natural environment out of the desire to improve its quality of life. However, the creation of this “artificial” environment, intended to serve the current needs of the human population, has led to significant destruction of our terrestrial habitat, to such an extent that we are now faced with a true “ecological crisis”. If we want our civilization to have any chances of survival, we must act as quickly as possible to protect the quality of the surrounding environment. How? Through limitation of the negative impact our activities have on it. Through the development of sustainable solutions which will contribute to stopping the on-going degradation of nature and to improving the current situation.

The International Conference on Environmental Research and Technology – ECO IMPULS 2013, scheduled to be held in Timișoara/Romania on the 7th and 8th of November 2013, represents a small contribution to the efforts being made worldwide in this matter. Reducing the impact of civilization on the environment is one of the main priorities of experts in this field - through the development of clean technologies, by increasing the efficiency and reliability of systems, as well as by using renewable energy sources. The proposed topics address a range of current issues including: “Water in a changing world”, “ZERO waste cities”, “Energy – beyond the conventional”. In the hope these are subjects of interest to you, we look forward to welcoming you at this year’s conference!

For further information please contact us on aquademica@aquademica.ro


A.L.EX.
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EPISODE 1
ROMAN ERA
WE NEED TO BUILT NEW AQUEDUCTS, TO SEEK FOR NEW SOURCES ! WE ARE LOW ON WATER RESOURCES !
MY CICERO HAS DIED!
HIS FISH DIED!
WE'D BETTER NAME FRONTINUS AS WATER DETECTIVE !
THE REPORT SAYS THAT WATER IS STOLEN TROUGH ILLEGAL CONNECTIONS, CALIX CHANGE, BROKEN PIPES, DAMAGED CULVERTS! FRONTINUS SUGGESTS US TO USE A STICK IN ORDER TO HEAR THE PIPE LOOSES !
frontinus
DE AQUAEDUCTU
THE IDEEA OF PIPELINE LISTENING MUST REMAIN A STATE SECRET! I DON'T WANT PEOPLE TO KNOW THAT IT'S SO EASY TO FIND A LEAK. AFTER WE DEFEAT THE DACIANS WE'LL TAKE CARE OF WATER LOOSES.
BADILA MIHAI - GRAFICIAN BADILAMIHAI.BLOGSPOT.RO

SYRINIX - CASE STUDY

Syrinix is a British company that is a leader in developing smart pipeline monitoring technology. Its products are building a growing reputation among water companies, infrastructure managers, major water-consuming businesses and industry regulators for their ability to improve the management of water pipelines.

Syrinix, based at the Hethel engineering centre in Norwich, was spun out from the University of East Anglia (UEA) in 2004. The company's focus is developing world-leading water infrastructure monitoring technology. Investors in Syrinix include Iceni Seedcorn Fund, Carbon Connections, UEA, the London Business Angels EIS Fund and the Low Carbon Innovation Fund. In 2011 the company won the clean tech investment of the year award from the British Business Angels Association, the government-backed trade association which promotes and supports early stage industries and investment in the UK. The award recognises innovative and successful new businesses in the environmental sector.

The Syrinix TrunkMinder system, used extensively by Thames Water and Crossrail, permanently monitors critical pipelines and trunk mains to provide water companies with constant pipe status updates including locating the smallest of leaks and early burst alerts. Using detailed research undertaken by Isle Utilities, the technology and innovation consultancy, with three major UK water utilities, Syrinix's TrunkMinder system is shown to provide a pay back on the investment of purchasing and installing within three years.

Stuart Moss, Head of TAG, Isle Utilities explained: "Interviewing 3 major UK water utilities showed that the costs of bursts on critical trunk mains quickly mount up once analysed in detail. The research study showed a potential sub-3 year payback period which highlights the important role TrunkMinder has to play in reducing bursts on these critical pipes and in turn avoiding the significant costs and disruption that can result".

The sub-three year payback of Syrinix's innovative and highly effective system was calculated based on savings made as a result of deployment. These included reduction in leak detection teams on trunk mains, dealing with leaks rather than bursts in a proactive manner, reduction in water lost from trunk mains, improved customer and operational service, reduced damage to third party property and TrunkMinder-related insurance savings among several other factors (full list available on request). It represents welcome news to pipeline operators around the world, as they struggle to improve network infrastructure, embrace innovation, work smarter and meet targets, in a climate of financial belt-tightening in which the bottom line packs the weightiest punch.

The Return On Investment (ROI) of the TrunkMinder system is of particular benefit withIn the UK water sector, where companies can find it difficult to adopt new technology due to the five year Asset Management Plan (AMP) periods imposed by the government regulator OFWAT. Being sure of the financial return from a proven product means water companies can be innovative without the risk.

Syrinix CEO James Dunning added: 'The water sector is facing considerable challenges going into the AMP 6 price review. Leakage generally and, more specifically, high profile bursts in critical locations have come to be key levers in the maintenance of public confidence in the sector. Meanwhile, reducing leakage and avoiding major bursts by replacing pipelines is no longer an option except in the most extreme instances. From the viewpoint of the water utility CEO's, the challenge and opportunity is to embrace innovations like TrunkMinder as a means of aspiring to greater network resilience without increasing customer bills.'

Trunk mains bursts currently represent a huge loss of water, energy and money, in the UK and globally. In the United States alone, an average of 700 water main breaks occur every day, totalling 250,000 per year (Environmental Protection Agency, Source: IBM). Syrinix TrunkMinder provides a way to cut the losses, and keep the money with its sub-three year payback period.

Case Study

Client: Thames Water
Location: London
Date: 2006

The site was selected specifically to test the efficacy of the vibro-acoustic monitoring as the environment was particularly noisy. Apart from several retail outlets, a bus route and a major Thames Water operational site which generated significant traffic movement and volumes, the site lay directly under the flight path of a major airport, one of the busiest in the world. Major sporting events are also held at the adjacent England Rugby headquarters at Twickenham stadium Two adjacent lengths of pipe were monitored for a period of 8 months. Before the trial commenced, Thames Water had surveyed one of the lengths by other means and located two separate leaks (Leaks 1 and 2).

Client Drivers

TrunkMinder had been under development for a number of years as a result of a collaborative research project between Thames Water and Syrinix. Principle drivers for Thames Water in developing the technology were:

FIGURE 1 - ZMC 3280 Sidónio Pais Plan

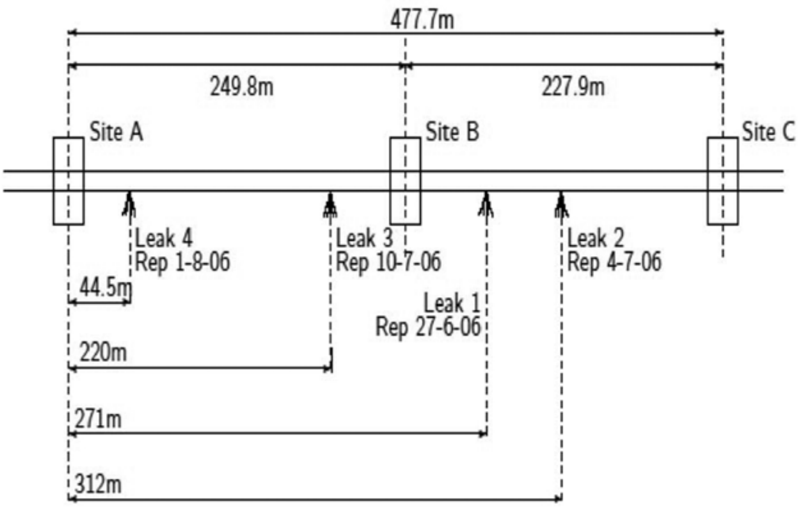

FIGURE 1 - ZMC 3280 Sidónio Pais Plan

FIGURE 2 - IMC Graphic on the minimal flow rate and total daily net of ZMC 3280

• The ability to identify leaks including small emerging and emergent leaks that can be the precursor to a catastrophic failure

• The immediate detection of bursts

• The ability to record and analyse real-time operational conditions within their critical infrastructure

• The ability to pinpoint leaks and bursts to within 1m on site

Scope

In order to determine the effectiveness of the technology a long term trial was arranged for TrunkMinder in a particularly challenging environment where there were previously surveyed leaks along a stretch of critical trunk main. Three TrunkMinder units were deployed in Twickenham on a 33” diameter Kew 2 strategic cast-iron main. The units were deployed between January and August 2006.

During the trial the remaining length was also surveyed by other means and two further small leaks were detected (Leaks 3 and 4). The locations of these leaks were not made known to Syrinix. Site installation work was completed without incident which demonstrated the relative simplicity when compared to other proprietary systems. The units come with pre-fitted cable tails which improves quality and reliability and reduce the need for on-site specialist work in sometimes harsh environments.

Field Results

The existing leaks were detected by the TrunkMinder system and located in accordance with the independent results. A burst event was detected which took place almost a mile downstream of the trial site.

Conclusion

The trial was a significant success for both Thames Water and TrunkMinder in that:

• It proved the capabilities of the system

• It provided performance data which allowed subsequent refinements, enhancements and optimisation to both hardware and software elements as well as reliability

• It provided granular data for pressure transient analysis which is now offered as a complimentary service to TrunkMinder

• It provided the platform for full commercial deployment

• It demonstrated the application of on-line tools available for Clients

STUDIES AND PROCEDURES OF WATER LOSS REDUCTION IN THE WATER SUPPLY SYSTEM OF THE TOWN OF VIDIN

Abstract: *This paper is assessing the current level of the losses in the water supply system of the city of Vidin based on an established methodology by the world practice. Calculations of water balance for the whole city and water balance month by month for certain pilot areas were performed. The volumes of the water losses are presented in different units, which facilitates the comparasion with results obtained in other cities in Bulgaria and abroad. The infrastructure leakage index has been obtained, which describes correctly the state of the real water losses. Measurements for the minimum night flow have been carried out in the district metered areas, its component being analysed and the values of the physical night losses in the water supply system calculated.*
Keywords: *water balance, performance indicators, infrastructure leakage index, district metered area, minimum night flow*

Information on the water supply system in Vidin

The water supply system of Vidin is maintained and managed by the town's water utility - Water Supply and Sewerage Ltd. It provides services to 50 000 inhabitants. The water source of the town is a Ranney-type well located near the village of Slanotran. From here, water is pumped out into the system and is delivered partially to 8 small settlements before reaching the distribution system. The pressure in the system is about 3 atm. The whole length of the pipes is approx. 140 km, of which 25 km are water mains and 115 km distribution pipes. The service connections are nearly 4000. The asbestos-cement pipes represent 65% of all pipes, while 30% are cast iron and steel pipes. Almost all service connections are made of galvanized pipes with the exception of the replaced and newly-made connections.

Measurements and analyses

Pressure management in the water supply system of Vidin

In April 2003 the water utility introduced a mechanism for pressure management in the water distribution system and management of the water flow at the outlet of the pumping station at Slanotran. By then, due to the reduced water consumption in the night, the pressure at the pump station's outlet had risen to 5.2 atm, which was also the approximate value of the free head in the system. In case of maximum consumption it had been reduced to approx. 2.7 atm. This situation has been changed with the help of an adjustable frequency drive (inverter) connected to the pump delivering water to the town. Through a pulse transmitter in the frequency drive, the pump receives a signal from a manometer located in the town center. The rotating speed of the pump wheel has been adjusted to maintain a constant pressure of 3 atm in the system. When receiving a signal from the town that the pressure has risen by more than 0.1 atm and that this value is being retained for more than 10 seconds the frequency drive reduces the speed of the pump and the water flow respectively so that in the center of the town the pressure will return to the set value of 3 atm. Through the application of this scheme of head regulation, the maximum pressure at the pump station outlet is slightly over 4 atm, while the pressure in the system is maintained within 2.5 – 3.5 atm.

The outcomes of the successful pressure management in the water supply system of Vidin are shown in Tables 1 and 2, and Fig. 1 and 2 below.

year		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	
Water supplied		7412671	6020967	6247549	5907474	5428071	5018590	4948390	5005884	4650456	4623280	m3/year
		235.1	190.9	198.1	187.3	172.1	159.1	156.9	158.7	147.5	146.6	l/sec
Billed consumption		2132127	2017843	2020202	1943722	1924454	1911970	1947175	1941391	1848713	1821292	m3/year
		67.61	63.99	64.06	61.64	61.02	60.63	61.74	61.56	58.62	57.75	l/sec
for population		1572476	1524195	1483053	1456400	1456318	1450410	1471495	1457614	1442366	1428158	m3/year
		49.86	48.33	47.03	46.18	46.18	45.99	46.66	46.22	45.74	45.29	l/sec
for companies		559651	493647	537149	487322	468136	461560	475680	483777	406347	393134	m3/year
		17.75	15.65	17.03	15.45	14.84	14.64	15.08	15.34	12.89	12.47	l/sec
Non-revenue water		5280544	4003124	4227347	3963752	3503617	3106620	3001215	3064403	2801743	2801988	m3/year
		167.44	126.94	134.06	125.69	111.10	98.51	95.17	97.17	88.84	88.85	l/sec

Table 1. Water flows of Vidin

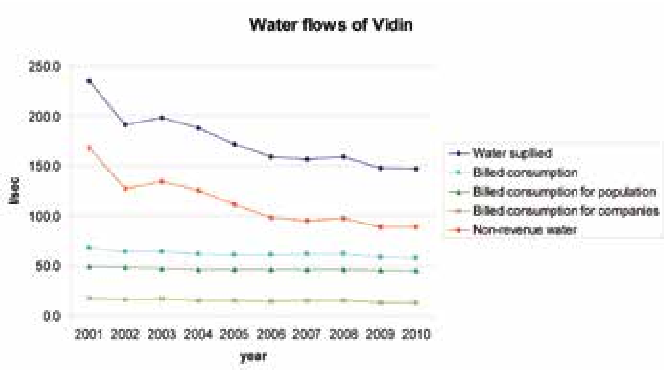

Figure1. Water flows of Vidin

year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
total number	316	331	330	294	271	243	274	270	258	232
service pipes	112	128	156	114	115	103	91	101	116	106
water mains	204	203	174	180	156	140	183	169	142	126
D<=150	123	109	120	118	97	104	96	95	98	78
D>150-=300	27	22	9	26	15	13	41	23	13	12
D>300	54	72	45	36	44	23	46	51	31	36
Frequency of bursts per km	2.187	2.291	2.284	2.035	1.876	1.682	1.897	1.869	1.786	1.606

Table 2. Distribution of reported bursts in Vidin

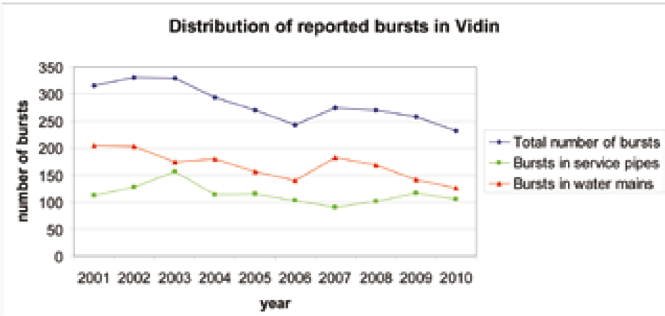

Figure 2. Distribution of reported bursts in Vidin

2003	2008		
L0, l/sec	L1, l/sec	L1/L0=	0.80
204.9	163.3	P1/P0=	0.78
P0, m	P1, m	N=	0.96
52.0	40.8		

Table 3. Assessment of the exponent N of Vidin

Fig.1 explicitely shows the volume reduction of the supplied water flows after the introduction of the pressure management system. In 2003, as much as 6 250 000 m^3 have been delivered to the town, while in 2010 the volume is 4 600 000 m^3, or 26% less. In spite of the demographic crisis in the region it is obvious that the consumption reduction rate is not proportional to the supplied water reduction rate. This means that the volume of the water loss is considerably decreased. Fig.2 illustrates the number and frequency reduction of the failures, from 330 in 2003 to 232 in 2010, or 30% less.

Table 3 shows the calculation of the exponent N according to the equation:

L0/L1=(P0/P1)^N

where L_0 is the water volume supplied to the city of Vidin in 2003, L_1 is the supplied water volume in 2008, P_0 is the pressure at the pump station outlet in 2003, and P_1 is the same in 2008. The calculated value of **N** is 0.96, provided the equation is applied for the whole water supply system. It is very close to **N**=1.00, which is the internationally accepted value in studies of pressure reduction benefits in systems composed by various types of pipes.

The pressure management programme adopted by the Vidin water utility is quite beneficial – besides the system's failures reduction, the annual power consumption has been reduced by approx. 76 000 kWh as a consequence of reduced water volumes in the periods of minimum intake.

2.2. Calculation of the water balance for the town of Vidin, with confidence intervals, ILI, performance indicators of the system

The water balance has been calculated on the basis of the system input volume. Each component of the balance possesses its own confidence interval (Table 4). Part of the parameters needed for balance calculation are assessed and contain uncertainty. Even the metered data are subject to errors. In order to reach better clarity of the final results used by the water utility to define priority actions for water loss reduction, it is necessary to make assessment and acceptance of standard deviation or standard error for each parameter [10]. It represents the difference between the accepted and the actual value, expressed in percentage. The assessment is made by experts in the field, information supplied by technical teams of the water utility, published sources describing other similar characteristics and analyses for the ways and methods for obtaining the data used.

For calculation of a confidence interval which includes the components of the water balance, on the basis of an expert assessment, it is assumed that they follow the law of Gauss for the normal distribution of variables. It is assumed that the set values of the standard error in percentage corresponds to 95% confidence interval, which means that the parameter in question has 5% probability not to fall in the assumed interval, or it possesses 5% level of significance.

Name of components	m3	Conf. limits,%	Volume (+;-)	Volume^2
Pumping station "Slanotrun"	5854595	2.0%	117092	13710513046
Pumping station "Kos"	29341	2.0%	587	344358
Pumping station "Major Uzunovo"	641954	2.0%	12839	164841975
District "Nov pat"	423596	2.0%	8472	71773428
village "Slana bara"	27200	2.0%	544	295936
village "Novoseltzi"	21910	2.0%	438	192019
village "Akatzievo"	6060	2.0%	121	14689
village "Ruptzi"	15620	2.0%	312	97594
village "Inovo"	69170	2.0%	1383	1913796
village "Kapitanovtzi"	55145	2.0%	1103	1216388
Water supplied	4623281	2.6%	118115	13951203229
Own sources	4623281	2.6%	118115	13951203229
Water imported	0	0.0%	0	0
Water supplied	4623281	2.6%	118115	13951203229
Billed water exported	0	0.0%	0	0
Billed metered consumption	1821292	5.0%	91065	8292761373
Billed unmetered consumption	0	0.0%	0	0
Billed authorised consumption	1821292	5.0%	91065	8292761373
Revenue water	1821292	5.0%	91065	8292761373
Non-revenue water	2801989	5.3%	149144	22243964603
Unbilled metered authorised consumption	11352	3.0%	341	115981
Unbilled unmetered authorised consumption	8425	10.0%	843	709806
Unbilled authorised consumption	19777	4.6%	909	825787
Authorised consumption	1841069	4.9%	91069	8293587161
Water losses	2782212	5.4%	149147	22244790390
Customer metering under-registration	91065	50.0%	45532	2073190343
Unauthorised consumption	462328	50.0%	231164	53436818012
Apparent losses	553393	42.6%	235606	55510008356
Leakage on transmission mains	445764	50.0%	222882	49676354721
Leakage and overflows at reservoirs	0	50.0%	0	0
Leakage on distribution mains	1002969	50.0%	501484	251486545773
Lekage on service connections	780087	50.0%	390043	152133836332
Real losses	2228819	12.5%	278845	77754798746

Table 4. Water balance of Vidin for 2010 with confidence limits

Initially, the table-measured components with their assumed confidence intervals have been introduced, and afterwards, the sought components and their intervals have been calculated with the help of a mean-square error, which means to find out the root of the sum of the squares of the known parameters' deviations. The obtained value corresponds to the confidence interval of the parameter studied. After completing the calculations for the water balance, the real water losses, on the basis of which the performance indicators are determined, are approx. 2 230 000 m^3 per year, and we can assume with 95% probability that they could have values from 1 950 000 m^3 to 2 510 000 m^3. This outcome is reached after we have assumed the volume of the apparent water losses. As it is demonstrated in Table 4, they have a standard error of 42.6%, which means that the water utility has to make more efforts in the future to study and obtain more correct data leading to a reduction of the confidence interval for this component, thereby reaching higher accuracy in the analysis of the real losses.

For this volume of the real water losses obtained from the calculated water balance for Vidin for 2010, Table 5 illustrates the performance indicators of the water supply system, and the Infrastructural Leakage Index (ILI) is calculated [1],[2].

Volume of real losses per year:	2228819.30	m^3/year
Daily avarage real losses:	6106.35	m^3/day
Number of service connections:	4000	number
Real water loss performance indicators	1527	l/connection.day
	49645	l/km of mains
	46	l/connection.day.m head
Avarage network pressure:	33	m
Connection density	33	number/km mains
Unavoidable annual real losses components		
1.Total lenght of the water mains (km)		
123	2214	l/day.m.head
2.Number of service connections		
4000	3200	l/day.m.head
Unavoidable annual real water losses	5414	l/day.m.head
Unavoidable annual real water losses for the network pressure	178662	l/day
	45	l/connection.day
The Ifrastructure leakage index (ILI):	34.2	
Number of reported bursts on water network per year:	232	number/year
Frequency of bursts on mains and services:	1.89	number/km mains.year

Table 5. Water loss performance indicators and ILI of Vidin

The calculated ILI for Vidin is 34.2. This value exceeds twice the limit above which is class D of the World Bank Institute's classification of water supply systems according to their ILI, the respective text reads as follows: "bad maintenance and bad condition of the system, and there is a need of starting immediate procedures for real water loss reduction" [2], [3]. The value of ILI for Vidin is at a medium level compared to the values for other towns in the country which are within a wide scope – from 4.3 for Smolyan and 6.8 for Ruse to 52.6 for Varna and 111.8 for Vratsa. These outcomes and analyses would have been with a greater weight after the initial realization of measures related to the assessment and reduction of the apparent (economic) water losses. Their more precise determination would have brought about right conclusions about the magnitude of ILI.

Measurements have been carried out for the monthly input water flow and the minimum nightly water volume delivered to three small pilot zones in Vidin – Boninia, Panonia, Geo Milev, as well as DMA Akdjamia. The results indicate a low volume of the real losses, and the value of ILI is about 10, which is 3 times less than the one for the town in general. This difference could mean that the value of the real losses is considerably less than the one calculated for the water balance of the town, which, in turn, leads to the conclusion that the assumption for the apparent losses is underestimated. This means that a more in-depth study of the incorrect measurement and the illegal use of water is needed. The related volumes may be found to be higher than the ones from leakages and failures in the system.

Measurements of the minimum night flow in DMA Akdjamia and analysis of its components

DMA Akdjamia has been established as a pilot zone in 2011. The total length of the pipes is 10 165 m. There are 573 service connections (SC), mainly to one-family houses with a density of 56,4 SC per kilometer of the system. The population is approx. 3100. The zone is supplied through Ø 110 mm connection from Ø 600 mm steel main. A DN 100 mechanical water meter having a mechanism for recording the water flow with attached data logger is installed. The results which represent water volumes in 15 min intervals are processed by special software, and afterwards presented in Excel format.

Each night the values of the water volumes between 00:00 and 06:00 o'clock have been studied and the measured minimum night flow (MNFmeas.) is determined as the least measured value for a 15-min period. The calculations and analyses are demonstrated in Table 7, while the adopted parameters are shown in Table 6.

Assessed household night use	0.49	l/person.hour
Background losses		
On water mains	40	l/km mains.hour (50m head)
	21.2	l/km mains.hour (30 head)
On service connections	4	l/connections.hour (50m head)
	2.1	l/connections.hour (30m head)
Median flow rate of unreported burst		
Burst on water main	2500	l/hour (50m head)
	1325	l/hour (30m head)
Burst on service connection	1600	l/hour (50m head)
	848	l/hour (30m head)

Table 6. Basic parameters for analyzing MNF

The value of the customer (useful) night usage of 0.49 l/inhabitant has been determined after studying the consumption between 02:00 and 04:00 in 12 residential houses in Vidin. The value of the hidden leakages in mains and service connections have been accepted in [9] Report E – Interpreting Measured Night Flows as average background losses (ICF=2). The lost water volume in case of unreported failures in mains or service connections has been defined in the same source and serves for comparison in obtaining the rate of the night losses and carrying out of assessment of the number of the assumed failures . All values are reduced to the operational pressure in the water supply system in the town – 30 m, through the application of the pressure correction factor (PCF) mentioned in Report E [6],[9].

	MNF (measured)		SDCF	MNF (calculated)		Household night use		Background losses		Real losses	
day	l/hour	m3/hour	-	l/hour	m3/hour	l/hour	m3/hour	l/hour	m3/hour	l/hour	m3/hour
06.8.2011	8400	8.400	1.060	8902	8.902	4612	4.612	1430	1.430	2860	2.860
07.8.2011	8400	8.400	1.060	8902	8.902	4612	4.612	1430	1.430	2860	2.860
08.8.2011	5600	5.600	1.060	5935	5.935	3519	3.519	1430	1.430	985	0.985
09.8.2011	7600	7.600	1.060	8054	8.054	4612	4.612	1430	1.430	2012	2.012
10.8.2011	8800	8.800	1.060	9326	9.326	4612	4.612	1430	1.430	3283	3.283
11.8.2011	8400	8.400	1.060	8902	8.902	4612	4.612	1430	1.430	2860	2.860
12.8.2011	8400	8.400	1.060	8902	8.902	4612	4.612	1430	1.430	2860	2.860
13.8.2011	8000	8.000	1.060	8478	8.478	4612	4.612	1430	1.430	2436	2.436
14.8.2011	4800	4.800	1.060	5087	5.087	2226	2.226	1430	1.430	1430	1.430
15.8.2011	3600	3.600	1.060	3815	3.815	1519	1.519	1430	1.430	866	0.866
16.8.2011	4000	4.000	1.060	4239	4.239	1519	1.519	1430	1.430	1290	1.290
17.8.2011	4000	4.000	1.060	4239	4.239	1519	1.519	1430	1.430	1290	1.290
18.8.2011	3600	3.600	1.060	3815	3.815	1519	1.519	1430	1.430	866	0.866

Table 7. Analysis of MNF during the nights 06.08.2011-18.08.2011

For more precise calculations and and analysis of the MNF's components, a measurement duration correction factor (SDCF) has been used [9]. With its help, the 15-min log is truly transformed to an hourly flow (MNFcalc.), with enclosed data for customer night usage and background losses. The value of the factor has been obtained after evaluation of 17 observations for the inlet minimum night flows.

After loading of all parameters to a table, the volume of the unreported leaks in the studied DMA during the night is obtained. After 14 Aug 2011 the observations in the zone have been carried out after stopping the supply to the only big consumer, the sewer pump station, as to remove it's uneven consumption influence on the analysis of the inlet MNF. There is a difference between the target night flow and the measured one of slightly over 1 m^3. According to Table 6 this value corresponds to one or two unreported failures in the service connections or one failure in a distribution main. Given the fact that the greatest part of the pipes is made of asbestos cement, we may assume that the failures are in the service connections made predominately of galvanized and steel pipes. The detection of these failures is realized with the help of the available equipment in the water utility. After the repair works, the MNF values and the hourly consumption are determined in several consecutive days. The steady consumption level in the DMA is analysed, and any subsequent rise of this level shall be considered as a problem in the water supply system. This continuous monitoring of the inlet water flow is a very accurate means for active leakage control of the particular sector, which helps for reducing the awareness time of a failure, which leads to a reduction of the leak duration and real water loss.

Conclusion

The paper considers part of the procedures applied in fighting the water losses in the water supply system of Vidin, which have their own specificity. Widely accepted methods have been used but suited to the local environment.

The water utility has used the pressure management in the system as the main and the most useful approach for real losses reduction. The tables and graphs facilitate the understanding the advantages and efficiency of the executed project. The system input volume has been diminished by 26%, and the number of new failures – by 30%.

An annual water balance for the town has been prepared and the volume of the real water losses with a confidence interval has been obtained, thus providing better clarity how this parameter could vary. Depending on the calculated standard errors for each of the balance's components, the water utility may prioritise its activities related to their measurement and analysis.

The water loss levels have been compared using various performance indicators and ILI has been determined for the whole town; it gives the most authentic information for the system's condition.

A DMA has been established which is subject to constant monitoring through the installation of an inlet water meter with a logger for recording the results. The measured MNF is analysed on the basis of concrete measurements and assumptions for part of its components. After obtaining the MNF value the water utility is able to assess the availability of unreported leaks and failures. The comparison of the obtained nightly real losses with the difference between the supplied and the billed water for certain sector allows a correction to be made in the assumed values of the apparent water losses.

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SMART WATER METERING

THE FUTURE OF NRW REDUCTION IS TODAY'S REALITY

Over the last four years the smart meters introduced yesterday as an innovation are becoming today's standard in water metering several countries. One of the reasons for the change is the huge potential in reducing Non Revenue Water (NRW). Four main factors contribute to NRW: own use of water by the water utility (including pipe flushing after repairs), leakage, tampering of the water meters and illegal connections. Smart water metering can help address three of these main causes of NRW: leakage, tampering and illegal connections.

However the implementation of this metering technology is not straight forward. That's why it is important to bring clear answers to some key questions before considering using this technology.

What are smart water meters?

Smart water meters are flow meters which are equipped with a meter intelligent unit (MIU) which can be fixed on or built in the meter. This MIU combines several functions and includes at least a data logger, a data processor and a radio emitter.

This allows the meter to record information on the flow of water going through it by recording indexes at a determined frequency and to analyse it using the logger and data processor function. The data can be then collected remotely using the radio emitter.

The data collection can be made in three different ways:

- Walking by the meter with a radio hand held terminal
- Driving by the meter with a car equipped with a specific terminal
- Through a fixed network of radio relays ensuring continuous regular data transfer between the meter and the operation centre of the water utility.

Even if most of the smart water meters are domestic meters, this technology is also available for bulk meters. A combination of domestic and bulk smart water meters is therefore the best way to get the maximum out of this technology.

How can it reduce NRW?

Smart water meters can help to reduce NRW using the following features:

- the leakage alarm
- the synchronised index record
- the tampering alarm

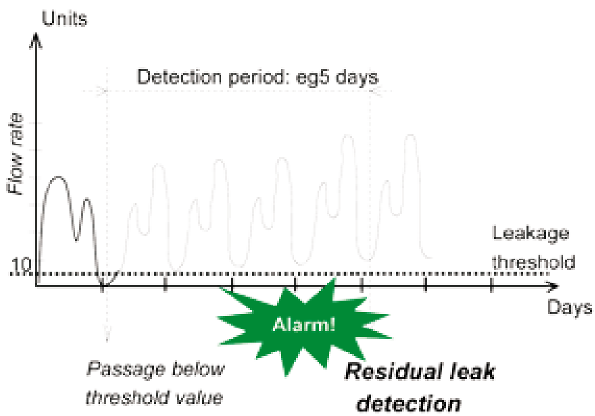
The leakage alarm

The processor of these smart water meters allows them to do some analysis of the consumption over 24 hours and calculate automatically the hourly average flow. If the lowest flows recorded over a defined period are above a determined minimum flow (generally the night flow) the meter is programmed to automatically send a leak alarm to the meter reader. (See figure below)

Figure and photographs courtesy of Elster

Synchronised index records

One of the main issues in reducing NRW is to quantify the volume lost in order to identify which district metered area (DMA) requires priority actions . Where district and domestic meters are equipped with MIUs the indexes logged can be synchronised. Consequently it is possible to compare the sum of all the domestic meters recorded consumption within this DMA with the recorded flow of the bulk meter for this DMA at the same time and therefore to identify the volume lost over an hour or any defined time period. This can also help to identify the eventual presence of illegal connections.



Tamper alarm

Another cause of NRW is meter tampering. In order to prevent this, the MIUs are equipped with sensors which detect if someone attempts to tamper with the meter and they automatically send a tamper alarm to the meter reader.

Smart water meters can be a very efficient tool, however, their use implies more than just installing meters and reading them.

How to implement a smart water metering programme?

Before starting a smart metering programme to reduce NRW, it is important to identify a target in terms of water saving /leakage reduction and define how the smart meters will contribute to achieve this target. This will allow identifying which technology is needed and therefore allocate a budget for it. This budget will have to consider the cost of the smart water meters, but also the cost for the data collection (i.e. hand held terminal, data collection and management software). The implementation of a smart metering programme also means to collect, analyse and store very large volumes of data. It is critical for a successful implementation to allow sufficient material and human resources for handling, managing and storing of these data. It is also important to include in the implementation programme for some training and a clear communication process between the people collecting the data from the smart meters, those analysing the data and the field team in charge of the identification/repair of the leaks.

Finally a key component when planning a smart metering project is the completion of a cost benefit analysis as, in some cases, the saving generated by the reduction of losses can offset the capital cost of the investment in the smart meters.

What are the other benefits of smart water metering?

In addition of helping to reduce NRW, the implementation of a smart water metering programme allows the reduction of domestic meter reading costs. I t can also allow the consumers to have the details of their water consumption and help them to save water and reduce their bills. It can also help to increase revenue collection as customers are less likely to challenge the water utility for excessive billing if they are aware of the details of their water consumption and the fact that these meters are more reliable.

As this technology is used more and more widely its costs will progressively decrease and the level of experience on its use will increase. This will allow the late joiners to benefit from the experience of the pioneers. So the question for the implementation of smart water metering in Romania is not "will water utilities implement smart water metering programmes?" but "when will water utilities implement smart water metering programmes?"

Sebastien Mellot,
Senior Advisor for Mott MacDonald, MCIWEM, CEnv, MSc Env., MIPM

MV-MAP - ANDROID APPLICATION FOR GPS TRACKING

New generation of Line Location Systems, **vLoc PRO2**, ensure fulfillment of specific everyday tasks faster and with greater precision. Expanded and improved functions succeed to make the location of buried lines an easy task even for less experienced users. Bluetooth Plug & Play and the large number of GPS receivers compatible with VLOC 2 are two additional features that ease the work in the field.

Market of smartphones and tablets is in constant development, the number of users becoming larger. MV-MAP program is compatible with track locators **vLocPRO2** series, developed for mobile devices running the Android OS. With this application the operator can store and view information needed in real time.

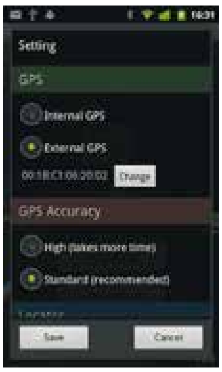
The advantages are:

- Bluetooth connection with the handset locator, allowing selection of GPS use Android device's internal or independent external GPS unit.
- All data is stored in the device and displayed in real time directly in the field.
- Data files are stored in KML format and can be easily viewed in programs such as Google Earth.
- E-mail function allows direct transmission of files stored immediately after the locality.

It's free and can be downloaded from the application store Android Market Google Play.

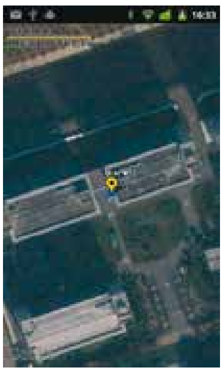
Seba KMT

Home screen



Settings screen

GPS signal reception



Placing location on map

Presenting a route

NEW WEB SITE FOR THE WATER LOSS COMMUNITY

www.waterloss.com.ba is the new website created, at September 2012, by Djevad Koldžo, NRW expert from Bosnia and Herzegovina, who is also the site administrator. The site is engaged with all aspects in relation to loss reduction and there are many useful information such as the one about real losses (Classification, Measurement, Determination, Sound Leak Detection and pressure management), Water Balance methodology (IWA recommendations, Basic elements, Performance Indicators and WB management), Apparent losses and Equipment (Flow, Pressure, Pipe locators and Sound Leak Detection).

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www.waterloss.com.ba aims to facilitate transfer of knowledge about methodology for water losses reduction to those responsible for managing water supply systems in order to reduce the impact of water losses, develop and implement applicable strategies and to select the most effective methods and tools to reduce losses.

Therefore, the first objective of www.waterloss.com.ba is to provide a good understanding of water losses so that answers can be found to the following questions: where does the system lose water, how is water lost, why is it lost and how much of it is lost?

Among other things, two software tools made by Đevad Koldžo, CalcuLEAKator and LEAK REPORT, can be found on this site and are available for free download..CalcuLEAKator is intended for the water balance and performance indicators calculation, while LEAK REPORT is database intended for failure registration in Water supply system.