

## Protecting Our Water – 60 Years of Service

60<sup>th</sup> Annual WCWWA Conference and Trade Show

September 23 – 26, 2008

Delta Regina Hotel

Regina, Saskatchewan



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### **WATER LOSS MANAGEMENT - WE DON'T HAVE MUCH WATER LEAKAGE – TRUE OR FALSE?**

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#### **ABSTRACT**

Water is arguably both our most vulnerable and most valuable resource. The cost to treat it and pump it to customers increases annually. Unfortunately, a great deal of our treated drinking water never makes it to the end user. In some Canadian municipalities as much as 30%, of the treated water is lost through leakage alone. However, leaks are not by any means the only source of loss.

In fact, water losses may be incurred in many other ways, not all of which can be found through a simple leak detection program. These losses may have a profound impact on a system. For example, a water supplier seeking a new source, or system expansions to meet rising demand, may be needlessly incurring these high capital costs. A Water Loss Management initiative may find system inefficiencies that will allow existing supply volumes to be recaptured for use within the customer base, eliminating or delaying the need to expand.

Reducing leakage is certainly a critical part of managing overall water losses. The perception by many water suppliers is that they have very little leakage in their distribution systems. That perception is often based on their understanding that they have a small number of water main breaks and service leaks, which rise to the surface and which they then repair.

The question is do they truly have little leakage, or do they have significant leaks that they are not aware of; leaks which have not risen to the surface. The next question is simply how you can determine when leak location and repair are an economically wise strategy. These questions and more are answered through a complete Water Loss Management initiative.

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## INTRODUCTION

Water is arguably both our most vulnerable and most valuable resource. The cost to treat it and pump it to customers increases annually. Every day, all across Canada, large quantities of drinking water are produced and pumped throughout our water systems.

Unfortunately, a great deal of our treated drinking water never makes it to the end user. In some Canadian municipalities as much as 30% of the treated water is lost through leakage alone. This water loss phenomenon can be attributed to several key concerns.

Distribution systems across the country are aging, and as they age they become less efficient. As they age, meters can become inaccurate, under-reading the volume of water that passes through them. Pipes begin to corrode, the system joints become weaker, pressure and the passage of millions of litres of water passing through the system begins to take its toll. Leaks occur throughout the system.

*“Conservative estimates from cities claim that in many jurisdictions up to 30% of all treated water goes into the ground before it reaches the tap. In Toronto, the estimates hover around eight percent, while Vancouver admits to twice as much at 15 percent. Some cities in Quebec go as high as 30 percent.” Canadian Press July 2007*

Some municipalities will say that their system is tight since no leaks surface or because their supplied Vs billed volumes are very close. In some case this is a fair evaluation. In most cases leaking water is simply disappearing into sewers or into the ground. In many cases inaccurate supply meters continue to under-read.

Some water suppliers have a passive water leak detection program in place in the belief that these reactive measures are the best possible method for managing system efficiency. Passive water leak detection has been used in Canada for over 40 years. This process is often fairly random and in the larger systems may cover only a small percentage of the system. In addition, such a program, even when using the best equipment and utilizing a concerted and consistent leak detection effort may be missing the greatest volume of water loss.

Some municipalities do slightly more active leak detection, for example, surveying their system completely every 5 years. Neither of these forms of somewhat active or totally passive leak detection programs offers an effective method of detecting and managing overall water losses. Without a benchmark utilities don't have any way of evaluating the effectiveness of their program.

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When main breaks occur today, and their appearance is increasing in frequency, they often inflict major damage to property, resulting in not only lost water but in a myriad of additional costs. As a result, municipal insurance costs related to water systems are also rising.

Leaks are not by any means the only source of loss. In fact, water losses may be incurred in many other ways, not all of which can be found through a simple leak detection program. Things like reservoir spillage, inaccurate supply meters, inaccurate demand meters, flat rate billing, and excessive unbilled public use can all contribute significantly to system losses.

Many water suppliers may be seeking new sources of water, or expanding and developing water treatment facilities to increase their available supply when a complete Water Loss Management program might actually determine that these steps are not immediately necessary.

### **WATER LOSS MANAGEMENT**

The leading municipalities in North America have now adopted International standards and protocols for Water Loss Management. A complete water loss management program is much more than leak detection. It moves a water supplier from a reactive mitigation mode to proactive prevention mode.

In the past the industry relied on roughly calculating the “unaccounted for water” (UFW) volumes to determine losses within the system. The old methods resulted in some gross underestimations of losses. By failing to show the real volumes of water losses the UFW calculations also failed to show the real costs of the losses.

Today we no longer look to the older more simplistic calculations of “unaccounted for water” to help make system decisions. True water loss management requires the use of more modern and sophisticated methods. The International Water Association (IWA) methodology has been adopted by the American Water Works Association (AWWA) and will soon be released in a new Water Audit and Leak Detection Manual (M36). This process focuses on determining the volume of non-revenue water by accounting for all revenue water.

This complete Water Loss Management program begins with a thorough plan which helps define the system flow and determines a benchmarking process for the utility. That benchmarking information can be used to measure and quantify improvements in the system. Benchmarking also allows the utility to compare its’ performance with that of comparable systems elsewhere.

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The IWA/AWWA method involves undertaking a complete water audit and balance. The information gathered and analyzed using software and experienced interpretation offers a water utility some solid and critical information about the system and overall water losses. The results will indicate the most cost effective measures that need to be implemented to reduce water losses.

Often the water balance and audit results will show that a significant volume of treated water is being lost in leakage or “real water losses”, however additional sources of loss such as source meter inaccuracies, customer meter under registration and unknown connections are often highlighted by the water balance.

Specific information gathered in the planning phase also identifies the most cost effective approach to controlling all of the losses. With this encompassing strategy in hand and the accurate and detailed results to use as the basis of action planning, a utility has the necessary tools for both system improvement planning and for prioritizing actions.

It is clear that traditional approaches, such as passive leak detection programs can rarely provide the best value across all areas of a system, and would be highly unlikely to have an opportunity to find all of the sources of a utility’s water losses. A complete Water Loss Management Plan clearly identifies how your municipality can best proceed toward a safe, efficient, cost effective and sustainable water supply.

Water Loss Management initiatives can have incredible results. Sometimes the return on investment is almost immediate. For example, one water supplier in Ontario was ready to finance and build a new water treatment plant until Hetek provided them with the results of their Water Loss Management initiative. The data clearly indicated that this expansion was not needed. Through a system repair and monitoring project they were able to recapture enough lost water to ensure that additional supply facilities will not be needed for more than 20 years. In another case under-reading customer meters were replaced thereby increasing revenues and eliminating what the utility thought was a leakage problem. In yet another case simply changing certain practices and educating utility workers eliminated the major source of lost water.

Although this presentation is focused on the value of a well designed water loss management process, the primary focus of this paper is on just one of the major components of a water loss management program, proactive leakage control.

Once the Water Loss Management process of a water audit and water balance has determined the value and volume of “real water losses” or the true leakage numbers, the utility can undertake a precise and comprehensive program of pro-active leakage control.

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## PROACTIVE LEAKAGE CONTROL

Essentially there are just three major types of leaks.

- **Reported leaks** – these come to the surface, are detected and repaired.
- **Unreported leaks** – these do not surface readily, and may never surface, but can be economical to find and repair.
- **Background leakage** – these leaks do not surface and are not economical to find or to repair.

Each type of leak poses particular challenges. Every water supplier is faced with all three types of leaks to varying degrees. Regardless of the size of the water supplier handling leakage effectively is an important part of managing overall water losses.

Let's look at these common types of water supply system leaks one at a time.

### Reported Leaks

Reported leaks may be quite catastrophic. Large main breaks, leaks that affect property and safety are not only sources of significant water loss, but can be sources of significant liability as well. In turn this means they represent increases in insurance fees and coverage costs. Since main breaks often mean significant damage is incurred by residents or businesses, these reported leaks may also adversely affect the relationship between the utility and its' customer base.

### Unreported Leaks

Unreported leaks are a drain on the economy of the system. For example, the water supplier may have a fairly significant volume of drinking water leaking into a storm sewer. This is lost revenue, and in a passive leak detection program it may not easily be found and it is highly unlikely to surface. Let's look at an example.

### *Unreported, Non-Surfacing Leak: What did it cost?*

At smaller utility in Ontario Hetek discovered a 4" water main was leaking into a sanitary sewer. The leak had gone unnoticed for at least 2 years.

The lost Water and Sewer charges per day totaled \$134.72.

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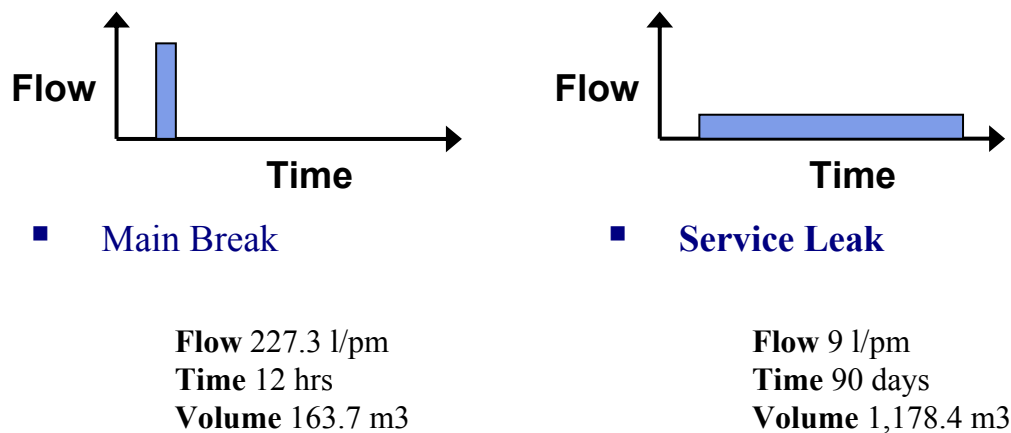
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Over a single year that represents a loss of \$49,172.80. This single leak accounted for significant revenue losses; imagine the effect of multiple unreported leaks pouring potable water into sewers or other receptors that reduce the likelihood of ever having the leak surface.

Although a major main break can be spectacular an unreported service leak can actually result in a greater water loss. This is shown in Figure 1.

*Figure 1: Leak Losses Compared*



## Background Leakage

Background leaks occur in every system. The challenge lies in knowing where they are located, and monitoring those background leaks to ensure that as soon as they are large enough to be economical to repair they can be addressed. Clearly it is critical to repair them long before they turn into a large revenue loss or a more catastrophic surfacing leak.

## Proactive Leakage Control

The foundation of a proactive leakage control program is the *District Metered Area* or DMA. They can be set up as a permanent installation, or put in place as a temporary measure. The DMA provides a water supplier with a constant flow of data, comprehensive information about the performance and status of the system. This information allows a utility to make the best and most cost-effective pro-active repair choices.

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Simply stated a District Metered Area is a method of quantifying the flow of water into a district or distinct area within a water supply system. Meters and data loggers record the flow of water into and out of the DMA. This allows for the establishment of the Minimum Night Flow which can then be compared to an estimate of flow or demand for the area.

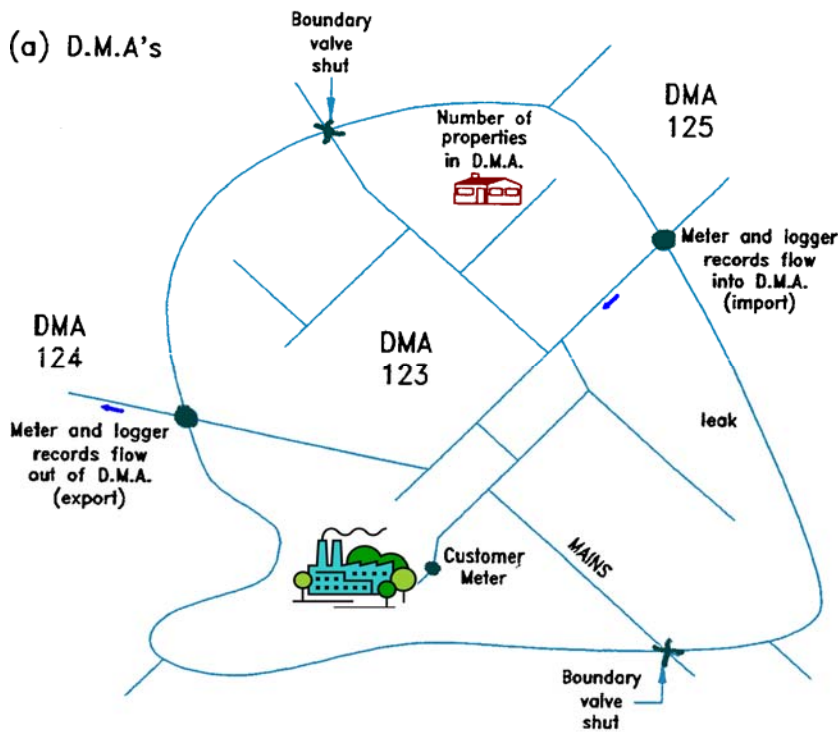


Figure II – Typical DMA

The Minimum Night Flow into a DMA is monitored between 1:00 am and 4:00 am, the normal period of lowest use. The results of the comparison between the legitimate demand level and the actual flow form the basis of the leakage targeting.

Figure II shows a typical DMA set up where boundary valves can be shut off and the in-flow and out-flow of water are metered.

Designing and monitoring District Metered Areas within the system allows the utility to prioritize the allotment of resources, directing the use of budgets and workers effectively. They allow a utility to quantify leak volumes in areas where there is generally a high

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level of leakage rather than spend unnecessary time and money in areas of low leakage. They can also help to determine the level of economic intervention and suggest alternative methods of leakage control like pressure modulation within the system. In short, the DMA allows a water supplier to manage the distribution system effectively and efficiently.

Let's look at some examples of what can be accomplished in different sizes of water systems using a DMA.

### Example of DMA Benefits – Large System

A larger system, installed 65 Temporary DMA's. Leaks within those DMA's were pinpointed and repaired.

The savings amounted to a total of 7,650 m<sup>3</sup> / day, or 118 m<sup>3</sup> / day / DMA (43,000 m<sup>3</sup> / year)

**The cost savings amounted to \$9,180 / day.** (Based on a retail price of \$1.20 per m<sup>3</sup>)

A total of \$908,000 was required to maintain 65 DMA's over 6 years, with a total of **\$415 / day spent!** (This cost figure includes leak repair.)

### Example of DMA Benefits – Smaller System

The Canadian Forces Base at Kingston is a smaller water system. This project yielded excellent results and offered the system an opportunity to capture significant savings.

- Target Savings Phase1+Phase2 = \$214,000
- Achieved Savings Phase1+Phase2 = \$317,809
- Program Costs Phase1+Phase2 = \$271,543 (including cost of repairs)
- Paid back the cost in 10 months
- \$46,266 additional savings in 1st year
- Prevent annual loss of \$317,809 hereafter with maintenance of the program.

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### Permanent Vs Temporary

One issue to consider is the value of temporary vs permanent DMA's in managing leakage within a system. For some utilities where infrastructure is uniformly new, or where budget considerations dictate the implementation of DMA's, the choice to use a rotating or temporary series of DMA's is sometimes considered. This is also a good way to test the concept and to determine the real value of the DMA approach to leak control. Many of the utilities who choose a temporary DMA solution eventually make some or all of them permanent. There is clear value in the permanent DMA.

With a temporary DMA in place, leaks could run for an average of six months before being detected. This approach will certainly result in higher volumes of lost water and may even result in a more catastrophic main break situation which may be more costly by far than the actual loss of potentially billable water resources.

With a permanent DMA you have immediate awareness of leakage. This may be particularly valuable in areas of the community with higher leakage potential and is certainly valuable in any system where water losses have an impact on revenue and water available supply.

### CONCLUSION

Leak reduction is certainly an important issue for every water supplier to consider. Pinpointing the leak location is vital to successfully reducing the costs associated with repairs. Measuring the effectiveness of leak detection and repair requires accurate monitoring of the flow, before and after the leak repair. Understanding when and where it is economically viable to repair leaks is an even greater challenge. Leak management appears simple but the proper steps leading up to successful repairs are more complex than they appear. It is also wise to remember that leak management may not be the best place to begin to manage water losses.

In fact it is a far wiser investment to begin at the beginning, undertaking an overall Water Loss Management initiative as the best way to manage the water distribution system effectively and efficiently. By spending time and money on a well developed Water Loss Management plan as the first step, a water utility can save significant time and money later. The plan will indicate how best to prioritize actions for the quickest payback possible, whether that is fixing leaks, dealing with meter accuracy or developing best management practices to reduce losses.

Although software and data sheets can provide a wide range of information, incomplete

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or misinterpreted data can send you off in the wrong direction. Inaccurate or incomplete data may for example, indicate a leakage problem when there is actually very little leakage, or it may indicate low leakage when the reality is that leakage is very high. A solid plan carried out using the best equipment and data collection tools and interpreted by experts with experience in the field will yield reliable and accurate results.

Managing water losses means more than just detecting leaks, it means understanding every aspect of the system from the point where your raw water arrives to the delivery point where the customers use takes over. Water Loss Management offers a wide range of benefits. A plan will help the utility reduce revenue losses and reduce legal and insurance costs associated with surfacing leaks. The “found” water may delay the need for system expansion or the challenges of finding a new source of supply. The results allow the utility to operate in harmony with the conservation policies in place, and a more efficient and effective system enhances the organizations public image and increases public trust.