

**Best  
Management  
Practices**

**Reducing Water Distribution  
System Losses**

Developed by



**BCWWA**

for



**BRITISH  
COLUMBIA**

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# Reducing Water Distribution System Losses

As noted in *Water Use and Loss in Distribution Systems: A Best Practice by the National Guide to Sustainable Municipal Infrastructure*, “Water loss carries a significant price tag, both economic and environmental...It is therefore important to understand the ultimate fate of the water supplied to the system and how best to account for it.” To that end, utility managers must fully understand all elements of their water distribution systems and properly account for the water supplied to their systems. “Proper accounting will allow utilities to make informed decisions on operations, maintenance, capital investment, and customer service programs.”

## What is water loss?

Water into a distribution system can be either authorized consumption or water loss. Authorized consumption can be metered or unmetered, billed or unbilled. Water loss can be either *apparent loss* due to meter inaccuracies or unauthorized consumption, or *real loss* due to leakage at water service lines or breaks/leakage on mains and hydrants/laterals or at storage facilities. An important distinction for metered systems is the difference between *revenue water* and *non-revenue water*. Water loss is clearly non-revenue water, while authorized consumption is revenue water, with the exception of unbilled consumption.

## Why should BMPs be used to reduce water distribution system losses?

BMPs used to reduce water distribution system losses will not only sustain water supplies, but also reduce operating costs, improve systems hydraulics and utility efficiency, and support environmental stewardship. More specifically, using BMPs to reduce water distribution system losses:

- **increases protection of potable water supply (e.g. reduces risk of backflow);**
- **reduces environmental impacts (e.g. chlorine discharge, energy consumption, treatment chemicals and residuals, high water tables);**
- **improves public awareness of water’s value;**
- **reduces water treatment and pumping costs;**
- **reduces wastewater treatment costs;**
- **defers capital expenditures;**
- **reduces damage to infrastructure;**
- **reduces unauthorized usage;**
- **reduces potential claims due to water damage; and**
- **improves environmental stewardship as water resources become scarcer.**

A program that reflects BMPs also helps build consistency throughout the province.

## Information Links

[\*Water Use and Loss in Water Distribution Systems: A Best Practice by the National Guide to Sustainable Municipal Infrastructure \(2003\)\*](#)

[\*A Practical Approach to Water Loss Reduction\*](#)  
(PDF File)

[\*Assessing Non-Revenue Water and its Components: A Practical Approach\*](#)  
(PDF File)

[\*Managing Leakage by Managing Pressure: A Practical Approach\*](#)  
(PDF File)

[\*Leak Detection Practices and Techniques: A Practical Approach \(Dec. 2003\)\*](#)  
(PDF File)

[\*Managing Leakage by District Metered Areas: A Practical Approach\*](#)  
(PDF File)

[\*Assessing Real Water Losses: A Practical Approach\*](#)  
(PDF File)

[\*Deterioration and Inspection of Water Distribution Systems: A Best Practice by the National Guide to Sustainable Municipal Infrastructure\*](#)

[\*A Strategic Approach to Water Loss Management\*](#)  
(PDF File)

## What BMPs should be applied to small systems?

Small water systems rely on low-cost and straightforward programs to reduce distribution system losses in a timely and cost effective manner. Simple but effective steps to reduce losses are:

1. Understand your system's demand characteristics by installing and monitoring daily pump hour meters and/or flow meters at all supply sources. These records will increase your awareness of the importance of understanding water usage patterns and their associated economical, social, and environmental benefits.
2. On a monthly basis, compare water use to same month of previous years to identify unusual demand patterns.
3. If unusually high usage patterns occur, then conduct additional investigations.
4. Calculate the value of your lost water to help communicate value of additional investigation.
5. Hire an experienced consultant or contractor to conduct a water audit. Remember, the "leak" can be a running tap within a home or a faulty flow meter, not necessarily a broken water main.
6. Assess water loss reduction strategy (e.g. metering, pressure management) and select best approach.
7. Conduct necessary repairs.
8. Develop an accurate, detailed record-keeping program to register leak or break history, location, and type of previous leaks, and daily flow readings.
9. Enforce good operation and maintenance practices to prevent or minimize further leaks.
10. Continuously monitor the performance of the system for leakage.
11. Communicate the results of your investigation to your users.

### *If you need help...*

#### **Small Systems**

- **Coastal Water Suppliers Association**  
Pauline Berkman  
250-338-7796  
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- **Small Water Users Association**  
Denny Ross-Smith  
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- **Water Supply Association of BC**  
Bruce Wilson  
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## What BMPs should be applied to larger systems?

### **1. Conduct Initial Research**

- Research successful programs in other communities
- Identify short- and long-term operational benefits/savings (e.g. purchase or procurement of water, energy reduction, reduced overtime)
- Identify short- and long-term environmental benefits/savings
- Examine benefits of a staged approach

### **2. Build Program Framework**

- Identify objectives and targets
- Identify participants and their roles
- Outline responsibilities
- Develop protocols/templates
- Create preliminary budget
- Set preliminary schedule
- Prepare business plan
- Evaluate and refine plan (ongoing)

### **3. Garner Support and Funding**

- Present business plan to senior staff and council or board (include rationale, liability considerations, recommended approach, and funding requirements)
- Provide frequent updates (ongoing)

### **4. Create Communication Plan and Materials**

- Identify internal and external audiences' specific communication needs
- Prepare a written plan
- Educate all appropriate staff about reducing water distribution system losses
- Access/prepare information and education materials for external audiences
- Educate external audiences (e.g. about cottage "bleeders" for frost control)
- Evaluate and refine plan (ongoing)

## 5. Develop and Implement Action Plan

- Introduce a pilot program
- Conduct water audit
- Develop a water balance model
- Identify areas of most probable high leakage
  - break and leak records
  - age of pipe material
  - high-risk areas
  - night flow testing by areas
  - customer complaints
  - service connections
- Determine requirements
  - target leakage rate
  - sound system, leak noise correlation, etc.
  - identify required equipment and personnel OR service provider
- Interpret results
- Measure losses
- Repair leakage
- Perform economic analysis
- Assess program
- Refine program and implement

## 6. Develop and Implement Capital Works Plan

- Identify new areas to be planned as water management districts, with water-loss design protocols
  - metered by a source area (zone metered)
  - plan infrastructure replacement to achieve some objective
- Identify new areas to be planned as water management districts, with water-loss design
- Ensure understanding that universal metering is not necessarily a requirement in water loss management
- Develop an approved product list for equipment
- Conduct appropriate pressure zone design
- Develop appropriate meter protocol (no meter reader required)
- Recognize that loss reduction is an integral part of demand side management
- Recognize that a pressure management program translates into prolonged system life
- Establish a break and leak record system
- Give attention to how connection at main is designed (materials choices)

## *If you need help...*

### Large Systems

- **Phil Karlsson**  
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- **Don Miller**  
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- **Ron Weismiller**  
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## *Recommended Reading...*

### ***The Manual of Water Supply Practices: Water Audits and Leak Detection (1999)***

American Water Works Association  
(303-794-7711) [www.awwa.org](http://www.awwa.org)

### ***Standard Components of Water Balance for Transmission of Distribution Systems (2001)***

International Water Association  
[www.iwahq.org.uk](http://www.iwahq.org.uk)

## Inspecting your water distribution system

As noted in *Deterioration and Inspection of Water Distribution Systems: A Best Practice by the National Guide to Sustainable Municipal Infrastructure*, “Water distribution systems should be designed, constructed, operated and maintained to deliver an adequate supply of water in a safe, cost-effective and reliable manner.” To that end, they must “develop a clear understanding of water main deterioration processes. This understanding will allow municipalities to implement mitigation measures in a timely manner so as to extend the useful service life of the systems to an optimum length of time and thereby minimize the overall economic, social and environmental costs of water distribution system operation.”

Deterioration—which becomes evident through impaired water quality, reduced hydraulic capacity, high leakage rates, or frequent breaks—can be minimized using a two-phase approach.

“The first phase involves a preliminary assessment of the structural condition, hydraulic capacity, leakage and water quality on a system-wide basis using data that should be collected by every municipality on a routine basis. A preliminary assessment of water main breaks, customer complaints, unaccounted for water, and data on routine sampling and inspection, which should be conducted each year, will identify both trends and the need for more detailed investigations.

“The second phase involves a more detailed investigation of specific problems based on an evaluation of the level of service, economics, risk and benefits.”

## Inspection benefits

As outlined in *A Best Practice by the National Guide to Sustainable Municipal Infrastructure*, monitoring the deterioration of water distribution systems helps:

- maintain water quality in the system;
- improve or enhance maintenance and capital planning;
- identify urgent repair and replacement needs;
- update the system condition inventory;
- facilitate strategic planning and cost-effective inspection;
- provide input to risk analyses;
- facilitate asset management programs;
- show due diligence;
- provide input to design standards and construction specifications;
- minimize energy input requirements in the north;
- improve asset planning and prioritization of non-critical mains;
- facilitate risk management of critical mains;
- allow lifetime prediction of water assets for asset management; and
- provide feedback on manufacturing and installation problems.

## Conducting a Water Audit

To properly account for their water, utilities should conduct water balances or audits, which enable them to “determine the water supplied, consumed, and lost in the distribution system” and to “calculate what that lost water is costing.” A water balance/audit should be conducted yearly using a water distribution system flow chart, which identifies water supplied to the system and water used and lost within the system. “As each task is addressed, the information on water use and loss becomes more complete.”

Strategies to reduce water loss include:

- on-line source water metering;
- consumption metering;
- leak detection and repair;
- water efficiency/conservation;
- valve maintenance;
- pressure management;
- infrastructure renewal;
- pricing (water rates);
- speed and quality of repairs;
- bylaw enforcement and system inspection;
- zone metering and direct metered areas;
- design standards for construction methods and materials;
- a supervisory control and data acquisition (SCADA) system;
- nighttime flow analysis; and
- distribution system modeling.

Deciding which strategies to use “will depend on the condition of the local infrastructure and the areas where water loss is occurring.”