An Approach to Determining the True Value of Lost Water: California's Avoided Cost Model

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Introduction

North America is beginning to revise its methods for assessing network water losses to correspond to the new International Water Association (IWA) Water Balance and Performance Indicator methodology. This activity is a response to the leadership of the American Water Works Association's Water Loss Control Committee, which is in the process of revising its previously published training materials on non-revenue water management. A new manual has been written and will soon be published, entitled *Water Audits and Loss Control Programs (M36)*, which provides detailed instruction on proper water audit methods using a complete water balance. It eliminates the term "unaccounted for water", and provides information on the latest methods for curbing non-revenue water losses. Accompanying the new soon-to-be-published M36 Manual is an Excel spreadsheet, which has already been completed and is downloadable at www.waterwiser.org. The spreadsheet allows the user to compute the pieces of the water balance and to refine the data as the data are validated. This new manual and spreadsheet will help North American utilities to address both apparent losses due to metering errors and real losses of water in the network itself.

Because of this recent development, a few states are beginning to look at the IWA methods from a regulatory perspective. Some examples are:

- The State of Texas enacted legislation in 2003 (House Bill 3338) which now requires that all water utilities in Texas undertake a full system water audit every five years using the IWA methodology and to submit a report showing the audit results to the Texas Water Development Board. The first set of water audits were filed by Texas water utilities in December, 2006 and the results are now being analyzed by Water Board staff.
- The State of Washington has developed draft regulations requiring that water utilities address water loss recovery using the IWA methodology; the draft regulations have been issued for formal comment before adoption.
- The California Public Utilities Commission has developed draft regulations requiring that private investor-owned water utilities undertake water audits every three years when the utilities file for revenue rate adjustments before the Commission; the draft regulations have been issued for formal comment before adoption.
- The California Urban Water Conservation Council is currently revising its Best Management Practice #3, *System Water Audits and Leak Detection.* This Best Management Practice is being revised to follow the IWA water balance audit methodology and to require that cost-effective water loss recovery strategies be undertaken by the participating water utilities.

California's Approach

California has a set of fourteen Best Management Practices for water conservation and demand management, which are outlined in a Memorandum of Understanding signed by over 320 utilities and other organizations throughout the State. By signing the memorandum, the water utility pledges a "good faith effort" to implement all of the best management practices that are cost-effective. That is, if the cost of any best practice is below the expected marginal incremental cost of adding new water supplies, then the measure is considered cost-effective. In California, new supply costs vary widely across the state, depending upon the region, but because of the relative unavailability of new water supply options, particularly in the more arid regions, the investment costs for new water are such that all the Best Management Practices are cost-effective, even those requiring plumbing and appliance retrofits in customer homes.

The Best Management Practices have quite specific language clarifying procedures for implementation, deadlines for completion, and benchmarks for interim compliance. The memorandum also requires water utilities to report their progress on implementing Best Management Practices to the Council every two years. The data of these reports are directly entered into a web-enabled database, and the results are rolled up into aggregate totals for reporting to the State Water Resources Control Board, the regulatory agency in California which manages water quality and water rights. If a water utility wishes to apply for state and federal revolving loan funding for water treatment or wastewater treatment expansions, the utility must certify that it is implementing the fourteen Best Management Practices that are cost-effective.

One of the Best Management Practices concerns water loss. It was drafted in 1991 based on a 10% "unaccounted-for water" standard of allowable water loss, and it references the AWWA M36 Manual as the guidance for completing full system water audits. However, since 1991 the practice has failed in its intended implementation. The language created a process of annual "pre-screening system audits" to determine if a full-scale water audit was warranted; this pre-screen created an opportunity for evasion. If a simple calculation of dividing the metered sales plus other verifiable uses by the total supply into the system yielded a calculation equal to or more than 0.9, then nothing further from the utility was required. Hence, water utilities quickly figured out that simple manipulation of data could yield the desired answer and thus avoid the expense of a full audit and other leakage activity, despite the potential paybacks of doing so.

Beginning in 2004, the Council began to examine how to revise this practice to reflect the new methodology developed by the IWA and to provide greater incentive for utilities to undertake water loss management programs. The term "unaccounted-for water" will be eliminated from the practice, as the referenced IWA water balance will require that all water be accounted for. Appropriate performance indicator benchmarks will eventually be developed, once some data is gathered from California water utilities to determine the current level of current apparent and real losses and what a reasonable set of performance benchmarks thus might be.

But properly assessing the level of leakage and accurately validating it are not enough. A measuring method must be determined of how much non-revenue water and leakage should be economically recoverable. The cost-effectiveness standard existing in the other best management practices needs to be applied to this water loss control practice as well; the water utility should be required to undertake all actions for apparent and real water loss recovery that are cost-effective. What is at issue is: how to properly define "cost-effective."

Defining Economic Level of Leakage

Much discussion is presently occurring on this topic world wide. Farley and Trow (2003)[6] define the economic level of leakage (ELL) as that "level of leakage below which it is not cost-effective to make further investment, or use additional resources, to drive leakage down further. In other words, the value of the water saved is less than the cost of making the further reduction." They further define the calculation of the ELL to include the cost of water (variable operating costs as well as capital investment costs), the short-term costs of leakage reduction, burst repair costs, and the net present value of the investment which is planned for leakage reduction measures.[7]

Fanner, Thornton, Liemberger and Sturm (2007)[8] also discuss the valuation of water for the economic level of leakage. "If a utility has limited water resource availability to supply new demands, and has plans to invest in the construction of new water resource/treatment capacity, which could be deferred by a real loss reduction program, the marginal cost of this capital deferment should also be included in the value of water lost. The value of the marginal cost of capital deferment is usually much larger than the marginal production and distribution components, due to the high capital cost of developing new capacity."

Thus, a proper measure for valuing real loss recovery in a supply-short region should be the marginal incremental new supply cost. In a region where additional investment is necessary for treatment capacity additions, the proper measure for valuing real loss recovery should be the marginal cost of capital deferment. As an example, the city of Toronto, Ontario is valuing its real water losses at the retail cost of water to the customer, because of the sizable capital cost investment of $88 million dollars CAN for a new water treatment plant which might be avoided with a successful water loss recovery program.

Where a utility system is not experiencing shortages, or is not planning any new water supply additions or other capital investment in the future, the economic level of leakage is likely to be only the variable operating cost of the system. Thus, the city of Philadelphia, Pennsylvania values its real losses at its system's variable operating cost, principally because it has surplus water, its demand is declining, and there are no foreseeable plans to invest in new supply capacity or treatment.

Using An Avoided Cost Model

In California, the arid climate, current drought, and supply shortage conditions warrant a stronger approach than that of Philadelphia. The current draft of the revised water loss Best Management Practice recommends that apparent losses be valued at the retail price of water, and that real (physical) water losses be valued at the avoided cost, or marginal incremental cost, of supply – not at the variable production cost. This recommendation is being made to encourage water utilities to properly value water loss recovery in the development of their water resource supply planning portfolios.

But how to determine the avoided marginal cost? In 2006, the California Urban Water Conservation Council finished work on an Avoided Cost model, funded by the

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[6] Malcolm Farley and Stuart Trow, *Losses in Water Distribution Networks,* IWA Publishing, 2003, page 54.

[7] Ibid, pages 57-58

[8] Paul Fanner, Julian Thornton, Roland Liemberger, and Reinhard Sturm, *Evaluating Water Loss and Planning Loss Reduction Strategies,* American Water Works Association Research Foundation, 2007, page 106

U.S. Environmental Protection Agency and the U.S. Bureau of Reclamation. This model is also provided on a CD in an integrated water supply planning project report published by the American Water Works Association Research Foundation[9]. The model conducts an analysis of the utility supply options and costs, and determines the utility's avoided cost of supply as well as the on-margin cost. These values, expressed in dollars per unit of volume, can be creatively used to benchmark appropriate water conservation programs, including water loss recovery intervention strategies. The standard being considered in California would require that all leakage intervention strategies priced below the value of avoided cost of supply be fully undertaken by the water utility, with a fixed time period required for that recovery.

How does the model work? The model is an Excel spreadsheet that estimates both short-run avoided costs and long-run avoided costs. **Short-run avoided costs** are the costs that are immediately avoided by the water utility due to the reduced water production that results from the conservation-induced demand reductions. **Long-run avoided costs** are those costs which reflect deferral and/or downsizing of planned supply or facility additions and expansions. The model estimates the economic value to the water utility of these conservation-induced investment modifications, and estimates each year's avoided costs for user-defined peak and off-peak seasons.

The excel spreadsheet has a number of pages, some of which have user-supplied inputs, and some of which are calculated by the model itself. The sheets are as follows:

- ***Common Assumptions Sheet.*** The inputs here are the analysis start year, planning horizon, cost-reference year, peak season start and end dates, projected interest rate, inflation rate, units of measurement, and other info, as entered by the user;
- ***Demands Sheet.*** A seasonal demand forecast of demands at the customer meter, in either volumes or flows, as entered by the user;
- ***Variable Operating Costs and Revenues Sheet.*** Costs such as power, chemicals, purchases, variable labor costs, etc and revenues such as hydropower, as entered by the user;
- ***On-Margin Probabilities Sheet.*** Identification of what system components "on the margin" which would be cut back in response to demand reductions, as entered by the user;
- ***Short-run Avoided Costs Sheet.*** Model calculation of the variable operating costs (no user inputs);
- ***Planned System Additions Sheet.*** System additions planned which could be subject to downsizing or deferral, as entered by the user;
- **Seasonal Multipliers Sheet.** For systems with seasonal storage, the degree to which costs are seasonally avoided, as entered by the user;
- ***Potential Avoided Costs in On-Line Year***. Model calculation of annualized cost of planned addition, annualized deferred cost, annualized downsized cost, and potential avoided cost (no user inputs);
- ***Avoided Capital and Fixed Operations and Maintenance Costs.*** Model calculation (no user inputs);
- ***Total Long-Run Avoided Costs.*** Model calculation (no user inputs);

[9] Thomas Chesnutt, Gary Fiske, Janice Beecher, and David Pekelney, *Water Efficiency Programs for Integrated Water Management,* American Water Works Association Research Foundation, 2007.

- ***Total Direct Utility Avoided Costs Sheet.*** Model calculation (no user inputs); and
- ***Non-Water Utility Avoided Costs Sheet.*** Model calculation (no user inputs)

The results from the Council's avoided cost model can be productively used to analyze whether water loss recovery intervention strategies are cost-effective for the utility to undertake. If the cost of the water loss recovery program is lower than the utility's short-run or long-run avoided costs of water, then the water loss recovery programs are cost-effective to run and should be undertaken.

Requiring that utilities run the model to determine their true short-run and long-run avoided costs offers several advantages:

1. It establishes a common understanding of terms;
2. It provides a uniform methodology for determining avoided cost across different utilities; and
3. It allows a level comparison of economic levels of leakage across utilities.

The Avoided Cost Model is downloadable from the Technical Resources page of the California Urban Water Conservation Council website:

www.cuwcc.org