North American Water Loss Conference
2017

Guidance on Implementing an Effective Water Loss Control Plan

Water Research Foundation Project 4695
Progress Update

December 5, 2017  Session 21
ACKNOWLEDGEMENTS

Participating Utilities

Albuquerque – Bernalillo County Water Utility Authority  American Water
Austin Water  Consolidated Utility District of Rutherford County
Eastern Municipal Water District  Greater Cincinnati Water Works
Halifax Water  Nashville Metro Water Services

Principal Investigator – Gary B. Trachtman, PE (Arcadis U.S., Inc.)
Co-Principal Investigator – Alan S. Wyatt
Research Team – Stephen Davis, PE, BCEE (Metering Technology Consultants, LLC)
George Kunkel, Jr., PE (Kunkel Water Efficiency Consulting)

WRF Project Manager – Maureen Hodgins
Project Advisory Committee

- Alex Gerling, American Water Works Association
- John Greer, Office of the Comptroller of the Treasury (TN)
- Tejal Kshatriya, Water Conservation, Fort Worth, TX
- Chris Leauber, Water & Wastewater Authority of Wilson County (TN)
- Sue Mosburg, Sweetwater Authority, Chula Vista, CA
- Kartiki Naik, California State Water Resources Control Board
- Reinhard Sturm, Water Systems Optimization
Project Background and Objective

Project Timeline April 2017 – November 2018

Project Funding: $143,052 ($99,203 from WRF)

**Objective:** Create a peer-reviewed Guidance Manual and Decision Framework(s) to help North American water utilities develop an actionable, cost-effective and defensible water loss reduction and control plan, that aligns with the utilities’ strategic goals, water resource management concerns and local circumstances, and is based on lessons of experience from leading North American water utilities – large and small.
## Project Schedule

### WRF 4695 ~ Guidance on Implementing an Effective Water Loss Control Plan - Proposed Research Project Schedule

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
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<th>DEC</th>
<th>JAN</th>
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<tbody>
<tr>
<td>1</td>
<td>Collect Utility Data and Practices</td>
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<td>2</td>
<td>Valuations</td>
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<td>3</td>
<td>Prepare/Approve Outline of Final Deliverables</td>
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<td>4</td>
<td>Prepare Draft Guidance Manual and Decision Framework(s)</td>
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<td>5</td>
<td>Vet Draft/Finalize Guidance Manual</td>
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<td>6</td>
<td>WRF-Hosted Webinar</td>
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**Key**
- Kickoff Meeting with WRF & PAC
- Periodic Progress Reports (Summary Review w/ PAC at AWWA ACE17)
- Conference Call w WRF & PAC
- Draft Report
- Draft Outline Review w/WRF & PAC, or Draft Report Review with WRF, PAC & Utility Participants
- Final Report (include review by Utility Participants)
- WRF-hosted Webinar

**Note:** Progress Reports 2 and 3 include Technical Summary
Existing Guidance helps a water utility:
- Quantify, validate and place a monetary value on non-revenue water through “top-down” auditing and (for real losses) “bottom-up” analysis
- Start evaluating the cost-effectiveness of candidate activities for apparent and real loss control
- Consider actionable performance indicators and realistic targets

WRF 4695 Guidance Manual will help a water utility complete the planning cycle:

Water Loss Control Program Planning

1. Assess Water Loss Volumes, Values & Validity
2. Set Objectives and Targets
3. Identify and Screen Possible Interventions
4. Assemble Plan, Get Approval and Resources
5. Implement Plan and Monitor Continuously
6. Assess Results, Refine/Adjust/Communicate Plan

Real loss control has benefited from developing technologies, but…

- Basis for preparing optimal apparent loss control programs is under-developed

Performance targets for real and apparent loss control could be more meaningful for utilities and stakeholders

More guidance is needed on:

- Financial or economic valuation for estimating benefits
- Assessing candidate interventions, selecting the most promising activities, reaching targets
- Assembling financially attractive activities into a multi-faceted, optimal plan
Guidance Manual Content

- **Introduction and Overview**
  - Organization of Manual
  - How to Use this Manual

- **Situational Assessment**
  - What is Your Water Loss Condition?
  - Application of Protocol

- **Strategic Objectives**
  - Coordination with Organizational Goals
  - Drivers, Key Indicators, Setting Targets

- **Action Planning**
  - ID and Screen Candidate Activities
  - Supply Meters, Apparent and Real Loss Control

- **Implementation**
  - Monitor, Track, & Document Results, Costs, Benefits
  - Evaluate, Adjust, Communicate, Review

- **Appendices**
  - Worked Example
  - NRW Performance Indicators – WADI Dataset
  - Sensitivity Analysis of Optimal NRW Model
  - Cost Data and Valuation of Water Loss Control Activities
  - Brief Utility Case Studies by Selected Cohort
Additional Guidance Manual Content

**Situational Assessment**
- Beginner, Intermediate, Advanced Levels
- Suitable Valuation Methods for Water Loss Volumes

**Action Planning**
- New Research in SF Resd’l Low Flow Water Demand
- Water Meter Life Cycle Cost Analysis
- Role of AMR/AMI in Water Loss Control
- Financial Analysis of Pressure Management Projects

**Implementation**
- Assessing and Overcoming Barriers
- Communicating the Water Loss Control Plan to Stakeholders
External Influences on Water Loss Control Planning

Different Perspectives Share Common Ground

Communicating the Plan and Performance

“There are numerous metrics for water loss included in the required water audit report, but it was decided to use one that could be more easily understood by the public. In the end, unadjusted total water loss (measured as Total Percent (%) Water Loss) was selected because it conveys to the public a sense of the magnitude of loss in comparison with the infrastructure leakage index (IL), which is more effective—from a utility’s perspective—at quantifying water loss but remains largely indecipherable to the layman.”

Detailed Water Loss–related data, plus responses to these Key Questions:

• How is your Water Loss Control Plan integrated with your strategic plan (including water resource development, asset management, conservation, etc.)?

• How do you set performance targets and benchmark your processes and activities?

• How do you place a monetary value on water savings and, if employed, what are the ramifications of applying alternative valuations?

• What data do you use to evaluate candidate activities, costs and volumetric loss reductions?
Additional Key Questions:

• How do you allocate resources for implementation of activities – in-house or outsourced?
• What financial assessments did you use to formulate and justify your water loss control program?
• What specific tools or methods do you use that have not been promoted by AWWA, but appear to be useful?
• What costs were incurred and what benefits were achieved, compared to expectations?
• What are your utility’s future activities and refinements for water loss control?
## What Assessment Protocol Should a Water Utility Employ?

### Table 2.3-2 – Categorization of Water Utilities for Selection of Assessment Protocol

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Beginner</th>
<th>Intermediate</th>
<th>Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years of Validated Audit Completed</td>
<td>None or one</td>
<td>Three to five</td>
<td>Greater than five</td>
</tr>
<tr>
<td>Data Validity Score</td>
<td>Less than 51</td>
<td>Between 50 and 71</td>
<td>Greater than 71</td>
</tr>
<tr>
<td>Level of Validation Used</td>
<td>Level 1</td>
<td>Level 2</td>
<td>Level 3</td>
</tr>
<tr>
<td>NRW Management Experience</td>
<td>Activities not underway or just beginning</td>
<td>Activities underway for less than five years</td>
<td>Activities underway for over five years</td>
</tr>
<tr>
<td>NRW Management Plan in Place?</td>
<td>No</td>
<td>Probably only a “loose” plan</td>
<td>Yes – with objectives, ongoing activities, and monitoring</td>
</tr>
</tbody>
</table>

## Conducting a Situational Assessment - 1

### SITUATIONAL ASSESSMENT PROTOCOL - THREE LEVELS

<table>
<thead>
<tr>
<th>Step</th>
<th>Purpose</th>
<th>Assessment Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Review Water Audit and Validation</strong></td>
<td>Determine Volumes and Values of NRW Components and Level of Audit Validity</td>
<td>Beginner: Annual Use and Analysis of Results from Standard AWWA Free Water Audit Software</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intermediate: Simple trends of NRW components for years with validated data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advanced: Detailed trends of NRW components, NRW sub-components and Finances for years with validated data</td>
</tr>
<tr>
<td><strong>2. Conduct Trend Analysis</strong></td>
<td>Detect changes in NRW volumes and values; identify problems; spot data errors</td>
<td>Beginner: Simple trends of NRW components for years with validated data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intermediate: Trends of NRW components and Finances for years with validated data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advanced: Detailed trends of NRW components, NRW sub-components and Finances for years with validated data</td>
</tr>
<tr>
<td><strong>3. Conduct Uncertainty Analysis</strong></td>
<td>Determine statistical confidence of volumes and values of NRW Components</td>
<td>Beginner: (Skip this step)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intermediate: Use Lookup Tables or Perform statistical Uncertainty Analysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advanced: Perform statistical Uncertainty Analysis</td>
</tr>
<tr>
<td><strong>4. Benchmark Current Performance</strong></td>
<td>Benchmark current performance on NRW components to help set program objectives</td>
<td>Beginner: Benchmark primary NRW components – real loss and apparent loss</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intermediate: Benchmark NRW primary components and sub – components of – real loss and apparent loss</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advanced: Benchmark NRW primary components and NRW sub – components – real loss and apparent loss, using cohort data</td>
</tr>
</tbody>
</table>

### Conducting a Situational Assessment - 2

<table>
<thead>
<tr>
<th><strong>5. Assess Apparent Loss in Detail</strong></th>
<th>Identify sources and causes of apparent loss components to help select reduction strategies</th>
<th>Basic Analysis on Small Meter Inaccuracy;</th>
<th>Basic Analysis on Systematic Data Handling Error (SDHE), Representative Small Meter Inaccuracy and Unauthorized Use.</th>
<th>Detailed Analysis on SDHE, Large and Small Meter Inaccuracy, and Unauthorized Use.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6. Assess Real Loss in Detail</strong></td>
<td>Identify sources and causes of real loss components to help select reduction strategies</td>
<td>Quadrant Analysis</td>
<td>Quadrant Analysis &amp; LCA Analysis of the entire system</td>
<td>Quadrant Analysis &amp; LCA Analysis of the entire system over time, and by Zone or DMA</td>
</tr>
<tr>
<td><strong>7. Conduct Practices Assessment</strong></td>
<td>Identify current practices underway and gaps in the Program portfolio of practices</td>
<td>Simple Checklist (TBD)</td>
<td>Practices Rating based on Validity Score and BMPs for Real and Apparent Losses (TBD)</td>
<td>Practices Rating based on Validity Score and BMPs for Real and Apparent Losses (TBD) – correlate with NRW performance (TBD)</td>
</tr>
</tbody>
</table>

Trend Analysis – “The Big Picture”

Trend Analysis
Leakage Components & Performance Indicators

## Responses from Participating Utilities

### Real Loss Management Practices

<table>
<thead>
<tr>
<th>Location and Year of Latest Validated Audit</th>
<th>SITUATIONAL CONDITIONS</th>
<th>PRACTICES RELATED TO THE FOUR PILLARS OF REAL LOSS REDUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABCWUA (CY 2016)</td>
<td>Connection Density, Cons./Mile 63</td>
<td>Current Average Pressure, psi 68</td>
</tr>
<tr>
<td>Consolidated Utility District - Rutherford (FY2016)</td>
<td>39</td>
<td>84</td>
</tr>
<tr>
<td>Eastern Municipal Water District (FY13/14)</td>
<td>68</td>
<td>75</td>
</tr>
<tr>
<td>Austin Water CY2016</td>
<td>59</td>
<td>77</td>
</tr>
<tr>
<td>Halifax Water FY2016</td>
<td>80</td>
<td>71</td>
</tr>
<tr>
<td>Greater Cincinnati Water Works (FY 2016)</td>
<td>78</td>
<td>94</td>
</tr>
<tr>
<td>Nashville - Metro Water Services (FY15-16)</td>
<td>63</td>
<td>85</td>
</tr>
</tbody>
</table>

Real Loss Performance + System Data Identifies Management Opportunities

Then track asset type performance (mains, services, etc.) vs. expenditures

Guidance for Defining Apparent Losses

Decision Framework for Apparent Loss Determination from Meter Inaccuracy

Coordinating Drivers, Objectives, Target-Setting and Water Loss Control Programs

Coordination of WRF 4695 with Related Initiatives

- Evolving Regulatory Programs
- AWWA WLCC Performance Indicator Task Force & FWAS Update

Guidance for Selecting Actionable Performance Indicators and Setting Targets
Future Guidance Needs?

- Root Causes of Water Loss
- Identifying Meaningful Performance Indicators
- Water-Energy Nexus
- Business Case and Implementation Guidance
- Applying Performance Indicators Effectively
- Communicating NRW Status and Earning Support for WLC Programs
THANK YOU!!

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