Presentation Agenda

- IRWD’s Water Loss Program Development
- Program Cost-Effectiveness
- Lessons Learned
- Conclusions
Irvine Ranch Water District Service Area

20% of Orange County
IRWD covers a large portion of central Orange County
Serve 6 cities and unincorporated County

181 Square Miles
One of top ten largest retail agencies in California

Newer Community
Newer infrastructure
Elevations from 0 to 1960 ft
Average pressure 84 PSI
Water Loss Program Development
Water Loss Program established in 1991

• Proactive Leak Detection
  – Annual average of 55 system & 60 customer side leaks
  – Cost-effective based on:
    • Avoided cost of imported water purchases
    • Cost of program implementation

• 2009 Training on AWWA water loss audit process
The Road to Real Loss Reduction

Step 1 – identify the team
Step 2 – conduct the audit
Step 3 – source meter testing
Step 4 – identify preliminary target
Step 5 – component analysis
Step 6 – assign costs
Step 7 – compile short term plan
Step 8 – implement short term plan
Step 9 – review results and revise the plan
Step 10 – recalculate component analysis w/new data
Step 11 – set goals for medium & long term reduction

- “11 steps to prepare for a leakage management program” – AWWA M36 Table 5-1
# Data Improvements Can Change Results

## Financial Performance Indicators

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>FY 13-14</th>
<th>FY 14-15</th>
<th>FY 16-17</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Non-Revenue as % by volume of Water Supplied</td>
<td>10.7%</td>
<td>7.1%</td>
<td>6.8%</td>
<td></td>
</tr>
<tr>
<td>2 Non-Revenue as percent by cost of operating system</td>
<td>14.7%</td>
<td>15.1%</td>
<td>17.1%</td>
<td>Customer retail unit cost</td>
</tr>
<tr>
<td>3 Annual cost of Apparent Losses</td>
<td>$1,275,162</td>
<td>$714,816</td>
<td>$828,315</td>
<td>Variable prod. cost</td>
</tr>
<tr>
<td>4 Annual cost of Real Losses</td>
<td>$3,756,605</td>
<td>$3,672,216</td>
<td>$3,200,547</td>
<td></td>
</tr>
</tbody>
</table>

## Operational Efficiency Performance Indicators

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>FY 13-14</th>
<th>FY 14-15</th>
<th>FY 16-17</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Apparent Losses per service connection per day</td>
<td>12.7</td>
<td>7.4</td>
<td>6.8</td>
<td>gal/conn/day</td>
</tr>
<tr>
<td>6 Real Losses per service connection per day</td>
<td>38.1</td>
<td>28.3</td>
<td>20.8</td>
<td>gal/conn/day</td>
</tr>
<tr>
<td>7 Real Losses per service connection per day per PSI</td>
<td>0.5</td>
<td>0.3</td>
<td>0.3</td>
<td>gal/conn/day/PSI</td>
</tr>
<tr>
<td>8 Unavoidable Annual Real Losses (UARL)</td>
<td>2,037</td>
<td>2,270</td>
<td>2,501</td>
<td>AF/yr</td>
</tr>
<tr>
<td>9 Current Annual Real Losses (CARL)</td>
<td>4,404</td>
<td>3,241</td>
<td>2,579</td>
<td>AF/yr</td>
</tr>
<tr>
<td>10 Infrastructure Leakage Index (CARL/UARL)</td>
<td>2.2</td>
<td>1.4</td>
<td>1.03</td>
<td></td>
</tr>
</tbody>
</table>

## Data Validity Performance Indicator

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>FY 13-14</th>
<th>FY 14-15</th>
<th>FY 16-17</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 Data Validity Score</td>
<td>75</td>
<td>78</td>
<td>76</td>
<td>scale 1-100</td>
</tr>
</tbody>
</table>

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IRWD Staff: Technical Assistance: Data Validated
Statewide Impacts of Data Improvements

- Approximately 1/3 of utilities had a significant shift.
- 62 audits changed by more than 10 gallons per connection per day between Wave 2 validated and Wave 4 validated.

Changes in Real Losses per Connection per Day
Wave 2 to Wave 4

Count of Audits

Difference (Wave 4 Result - Wave 2 Result)
# IRWD’s Water Loss Audit Recommendations

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>IRWD Implemented</th>
<th>Real Water Loss Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subtract well wastewater from production totals</td>
<td>YES</td>
<td>NO (only on paper)</td>
</tr>
<tr>
<td>Apply production meter calibration and test results on a meter-by-meter basis</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Incorporate the change in stored volume in determining Water Supplied.</td>
<td>YES</td>
<td>NO (only on paper)</td>
</tr>
<tr>
<td>Pro-rate raw billing data</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Determine Unbilled Unmetered Authorized Consumption</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Incorporate all customer rate tiers to calculate a weighted Customer Retail Unit Cost</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Calculate average system pressure using a weighted average</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Confirm the inclusion of relevant costs in the Total Annual Operating Cost</td>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>
## Component Analysis

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>IRWD Implemented</th>
<th>Real Water Loss Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish a system for tracking and incorporating estimates of development and coliform bacteria test flushing in Unbilled Unmetered Authorized Consumption.</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Track leaks discovered through proactive leak detection in aggregate tabular format, rather than in entries that must be individually and manually extracted. In future proactive leak detection assessments, IRWD will save significant time if data is collected in a single spreadsheet.</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Continue proactive leak detection survey of the potable distribution system at the current pace.</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Update the leak detection cost-benefit analysis to incorporate IRWD’s actual cost of leak detection and any changes in the value of leakage.</td>
<td>PLANNED</td>
<td>NO</td>
</tr>
<tr>
<td>Update proactive leak detection and repair records to include precise timestamps capturing leak discovery and leak containment.</td>
<td>EVALUATION PLANNED</td>
<td>NO</td>
</tr>
<tr>
<td>Consider the installation and management of pilot District Metered Areas (DMAs) to target proactive leak detection, optimize pressure, and monitor water losses more locally.</td>
<td>NO</td>
<td>NOT FOR IRWD</td>
</tr>
</tbody>
</table>
Program Cost-Effectiveness
Component Analysis of Real Losses

Total leakage is equal to 5.6% of total potable supply.
Recoverable through leak detection is 1.7%.

- **Background leakage** – modeled with infrastructure and pressure information
- **Unreported leakage** – estimated with proactive leak detection and repair records
- **Reported leakage** – estimated with reported leak repair records
- **Hidden leakage** – leftover volume running unsurfaced and undiscovered

Where there is water there will be leakage.

FY 14-15 Leakage Profile
Economic Intervention Frequency (how often leak detection is performed) minimizes the combined cost of leakage and leak detection.
Getting from Detection to Water Savings

**Leak Detection**
- Acoustic (IRWD)
- In-pipe
- Remote

**Identify Potential Leak**
- Walk 4-6 miles per day
- Drive main arterials
- Pipelines, hydrants, valves, angle stops, air vacs, meters

**Repair**
- Scheduled within 48 hours
- Customers notified
- Record estimated water loss

**Pinpoint Leak**
- Listen at contact point
- Turn off water
- Pull meter and listen again
Cost Effective Programs for IRWD

• Proactive leak detection – acoustic method

<table>
<thead>
<tr>
<th>Recoverable Leakage (Based on FY 14/15)</th>
<th>Variable Production Cost</th>
<th>Total Value of Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>997 AF</td>
<td>$1,133/AF</td>
<td>$1.1 Million</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recovered Leakage</th>
<th>Variable Production Cost</th>
<th>Value of Recovered Leakage</th>
<th>Annual Program Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>316 AF</td>
<td>$1,133</td>
<td>$358,028</td>
<td>$257,595</td>
</tr>
</tbody>
</table>

• AMI $40 million – not cost effective
• DMAs – not cost effective
• New focus is on Apparent Losses
  – Revenue recovery not real water loss
  – Over $500,000 recovered in less than a year
Statewide Variable Production Costs

Significant Variability

1. Cost Structure
   • Cost of water
   • System infrastructure
   • Data collection
   • Data analysis
   • Program implementation

2. What Costs Are Included
Correlations?

Financial Characteristics and Normalized Water Losses

- Water Losses per Connection per Day (gallon/day)
- Variable Production Cost
- Total Cost to Operate System (x$1,000)
### Volumetric Water Loss

<table>
<thead>
<tr>
<th>Volume of Loss</th>
<th>Pros</th>
<th>Cons (assumes good data)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Non-revenue as percentage by volume of Water Supplied</td>
<td>• Relatively Simple</td>
<td>• Volatile, subject to change based on supply changes</td>
</tr>
<tr>
<td>2 Total volume of Real Losses</td>
<td>• Relatively Simple</td>
<td>• Not a comparable metric.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Does not account for differences in systems/infrastructure/costs</td>
</tr>
<tr>
<td>3 Real losses by connection per day (gal/conn/day)</td>
<td>• Relatively Simple, accounts for some agency variability</td>
<td>• Not a comparable metric.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Does not account for differences in systems/infrastructure/costs</td>
</tr>
<tr>
<td>4 Real losses by connection per day per psi (gal/conn/day/psi)</td>
<td>• Relatively Simple, accounts for some agency variability, Normalizes data</td>
<td>• Pressure can be a complicated calculation</td>
</tr>
</tbody>
</table>
Problems with Percentages

Comparison Between Normalized and Percentage Performance Indicators

NRW per Connection per Day (gal/con/day)

Percent Non-Revenue Water by Water Supplied
California Real Losses

Real Losses per Conn. per Day

Count

0 25 50 75 100 125 150 175

Real Losses per Conn. per Day

Count

0 100 200 300 400 500

Agencies with only “realistic” results

All Agencies
Real Loss Per PSI

Real Losses per Conn. per Day per PSI

Count

0 20 40

1 2

Real Losses per Conn. per Day per PSI

Count

0 50 100 150 200

0.0 2.5 5.0 7.5 10.0

Agencies with only “realistic” results

All Agencies
Correlations?

System Characteristics and Normalized Water Losses

Water Losses per Connection per Day (gal/con/day)

Count of Service Connections

Miles of Mains

System Pressure (PSI)

Analysis shows no correlations based on system characteristics
• Water loss program implementation is a process and needs to be phased in
  – Component Analysis critical step in the process to understand where to target
• Data quality improvements can change results with no change in real water loss
  – Training and technical assistance are key
• Agency cost-effectiveness determines which aspect of water loss should be pursued
  – Continue leak detection program
  – New focus on apparent loss reduction
Conclusions

• Significant variability in agencies statewide
  – Systems, infrastructure, costs, etc.
  – Resources, starting point
• Cost-effectiveness is unique to each agency
• Data quality will improve over time
• Potential metrics for volumetric standard
  – Example: 75% of median gal/conn/day/psi
  – Example: % of non-revenue water
• Phased approach to standards
  – Start simple with a cyclical review process
Questions

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