This presentation premiered at WaterSmart Innovations

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Using AMI Data to Analyze Water Loss by Pressure Zone

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Outline

- WVWA Background and AMI project
- Water Audit
- Pressure Zone Analysis
- Template
- Next Steps

WVWA Background

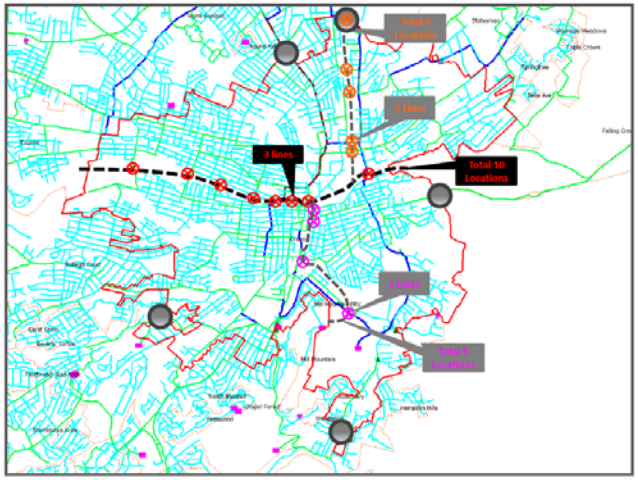
Western Virginia Water Authority

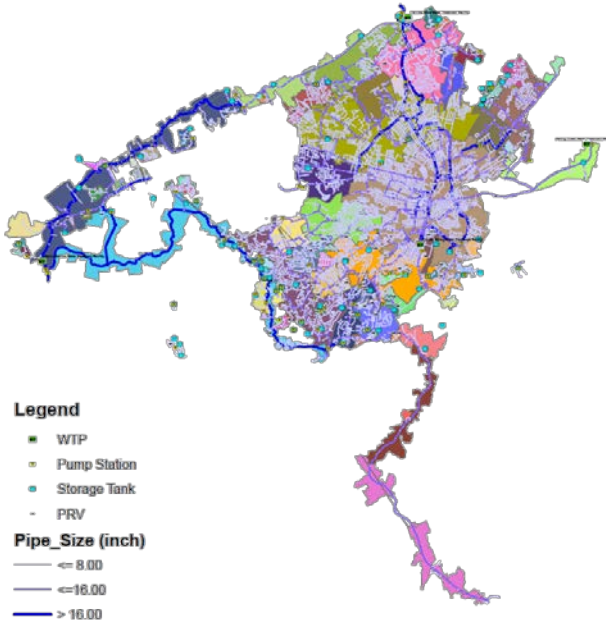
- Formed on July 1, 2004
- Consolidation of City of Roanoke and Roanoke County
- 2009 – Franklin County joined
- 2015 – Botetourt County joined
- Over 159,000 water accounts

WESTERN VIRGINIA
WATER AUTHORITY

AMI Implementation

- 2013 - Full implementation of >60,000 customer meters
- Advanced Metering Infrastructure (AMI)
- County-City merged system that has existing zone meters and at PRV and pump stations – upgraded





Additional Services

- Water loss audit
- Use of pressure zones and AMI to evaluate non-revenue water in real-time
- Prioritize leak detection activities, pipe renewal programs
- Integrated with the hydraulic model
  - Customer demand diurnal calculations
  - Live modeling (Innovyze IWLive)

Water Loss Audit

WVWA Water Audit for FY2012

- Prior to AMI program
  - $3.9million in water losses ($3M apparent, $0.9M real)
- Full meter replacement with AMI program
  - Residential (small)
  - Commercial (medium and large)
- Now water losses consist significantly of Real Losses

AWWA WLCC Free Water Audit Software: Water Balance

WAS v4.2

Water Audit Report For:	Report Yr:
Western Virginia Water Authority	FY11

Own Sources (Adjusted for known errors) 8,391.524	Water Exported 125.562	Billed Water Exported			
		Authorized Consumption 5,170.063	Billed Authorized Consumption 5,065.878	Billed Metered Consumption (inc. water exported) 5,065.275	Revenue Water 5,065.878
				Billed Unmetered Consumption 0.602	
			Unbilled Authorized Consumption 104.186	Unbilled Metered Consumption 0.000	Non-Revenue Water (NRW) 3,268.971
				Unbilled Unmetered Consumption 104.186	
	Water Supplied 8,334.849	Water Losses 3,164.786	Apparent Losses 595.683	Unauthorized Consumption 20.837	
				Customer Metering Inaccuracies 562.183	
				Systematic Data Handling Errors 12.663	
Water Imported 68.886			Real Losses 2,569.102	Leakage on Transmission and/or Distribution Mains Not broken down	
				Leakage and Overflows at Utility's Storage Tanks Not broken down	
				Leakage on Service Connections Not broken down	

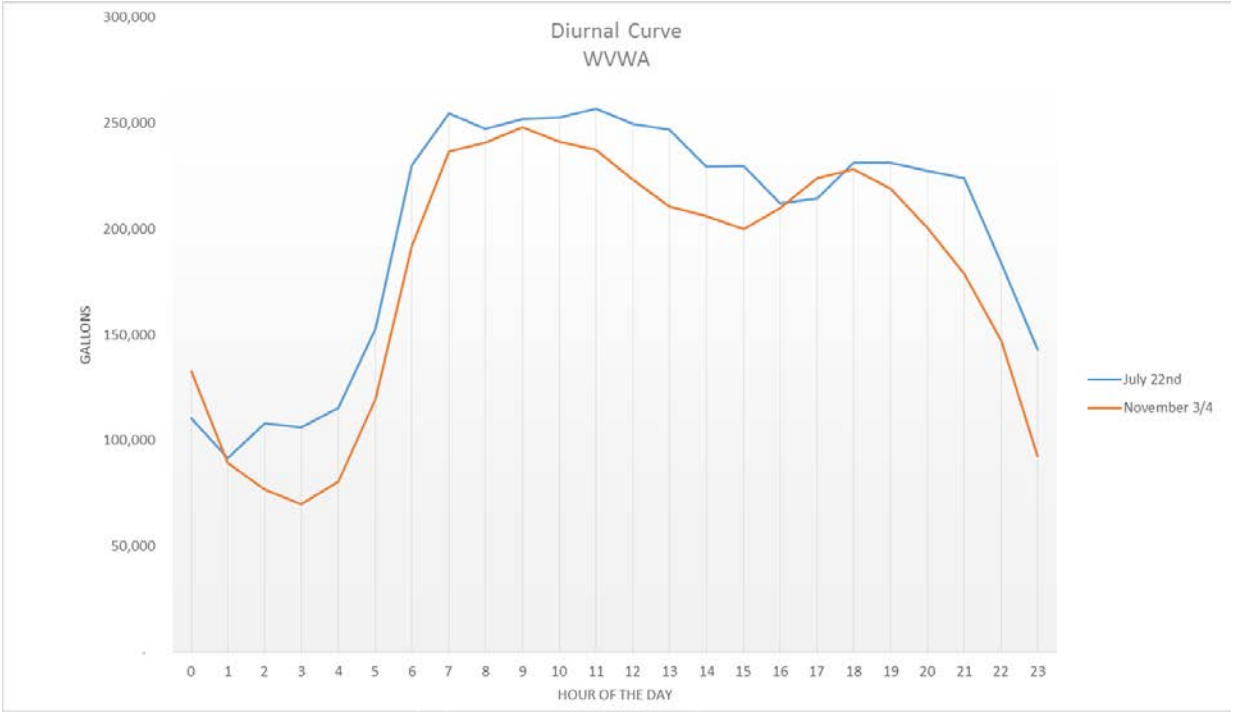
Water Audit Recommendations

- Perform annual AWWA water loss audits
- Conduct plant production meter accuracy tests
- Use AMI with bulk metering and SCADA to evaluate and prioritize real loss control activities
- Implement leak detection and repair program
  - Select program
  - Determine economic level of leakage (and intervention level)

Customer Demand Diurnal

Calculate a Customer Demand Diurnal

- Endless possibilities
- What makes sense, what is useful
  - Seasonal, system-wide
    - November 3-4
    - July 22

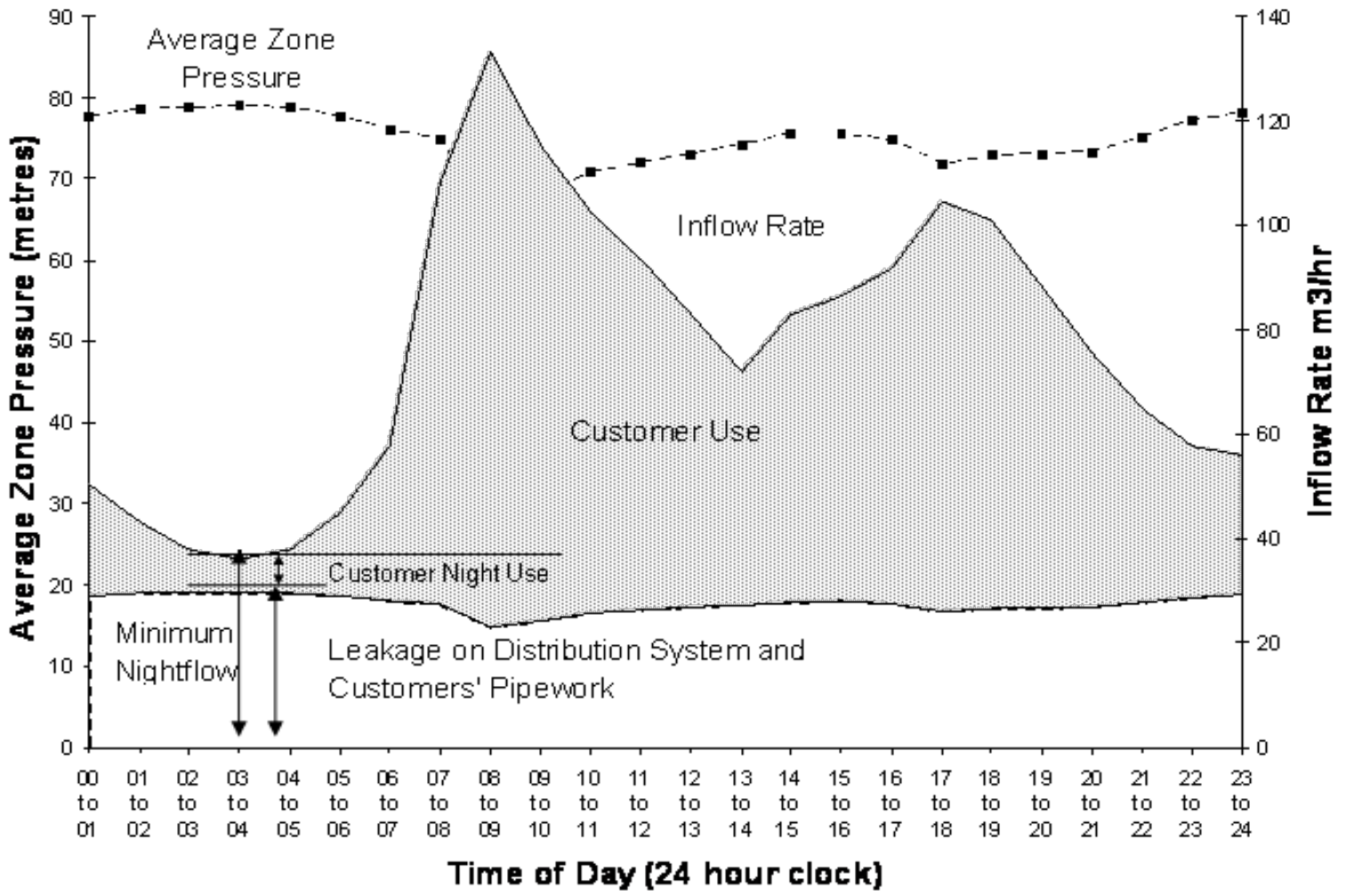


Pressure Zone Analysis

Objective of Zone Analysis

- Determine for each pressure zone
  - Level of non-metered water use
  - Nature of non-metered water use
- Using hourly flows into and out of each zone from bulk meters on AMI
- Using hourly consumption from AMI
- Using SCADA on tank levels in zones
- Create template for use in other zones

Objective of Zonal Analysis



Tasks

- Define Zones using GIS and hydraulic model
  - Verify zone meters are in place to define flow in and out
  - Identify customer meters in the zone
  - Inventory zone statistics
    - Pipe materials, age
    - Break history
    - Customer connections and type
    - Historic pressure ranges

Tasks

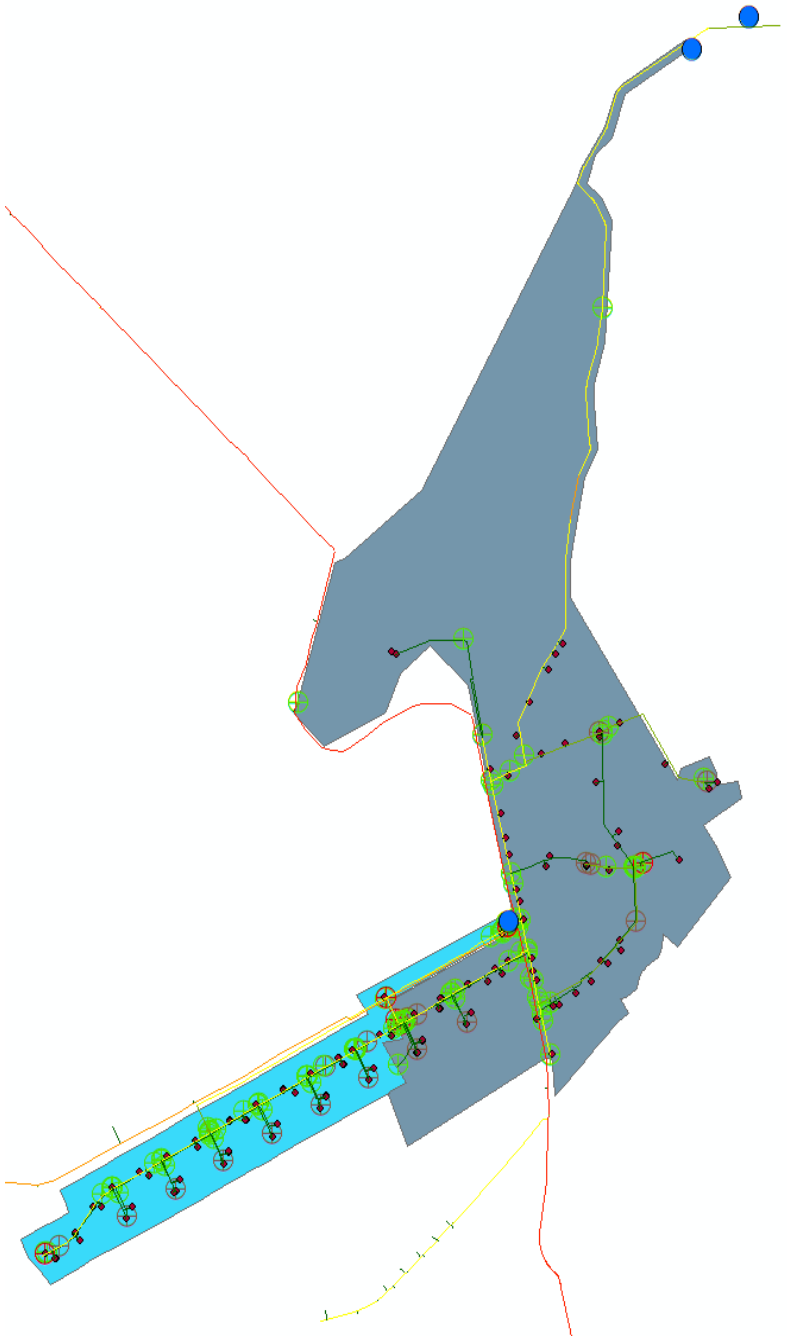
- Evaluate zones
  - Determine hourly customer consumption from AMI
  - Determine net inflow to zone
    - Bulk meters in (AMI)
    - Bulk meters out (AMI)
    - Hourly tank level changes (SCADA)
  - Evaluate hourly difference
  - Compare to system pressures (if available)
  - Determine the nature of the difference (if possible)
- Prioritize zones
  - Determine zones with highest water losses

Tasks

- Develop water loss intervention plans
  - Real loss reduction
    - Leak detection
    - Pressure management
    - Use of hydraulic model
    - Component analysis
  - Apparent loss reduction
    - Hydrant locks
    - Illicit connections/bypasses
    - Flushing uses

Output Summary

- General information
- Analysis information
- Notes
- Pie chart summary
- Detailed hourly chart
- Map



General and Analysis Information

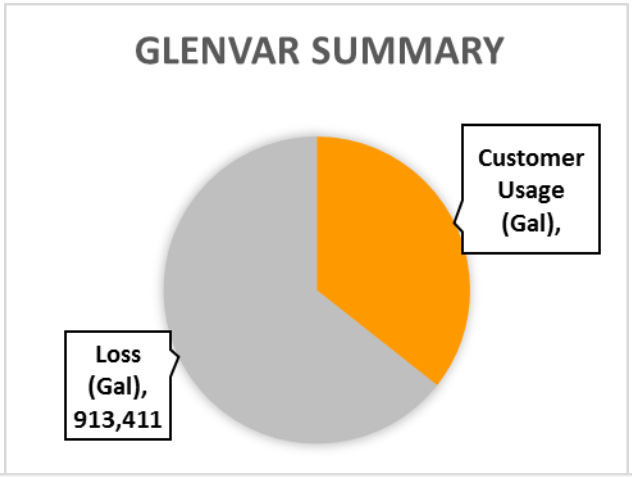
General

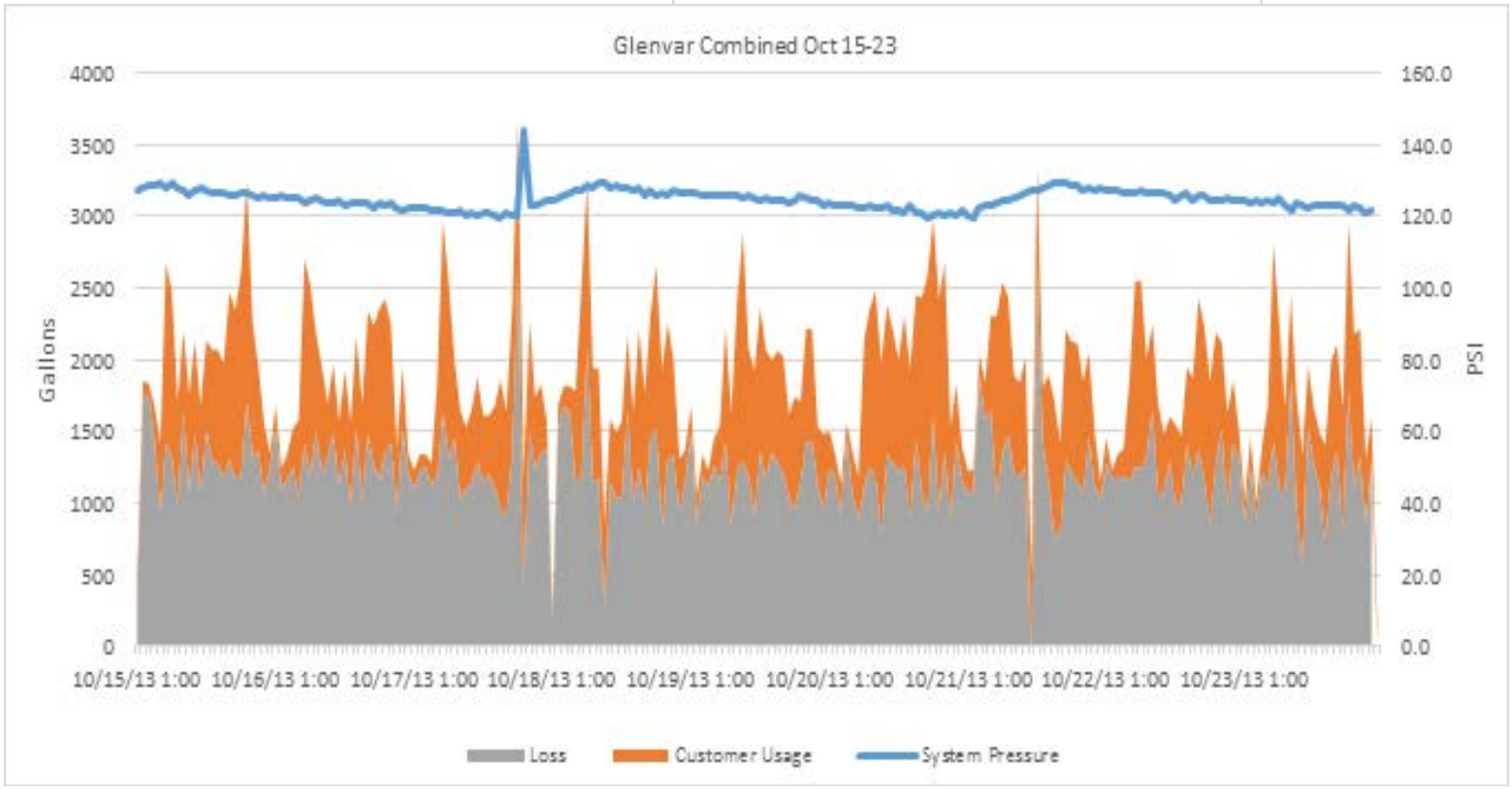
Name	Glenvar-Lower and Upper
DMA	39 and 40
Area Code	1400 and 1659
Connections	133
Tank	Yes

Analysis

Period	Oct 15-Nov 14
Percent Loss	64%
Total Real Losses (Gal/Day)	29,465
Losses per Connection (Gal/Day)	221.54
Cost of Water ($/Gal)	$0.31
Value of Real Losses ($/day)	$9,134.11

Charts


GLENVAR SUMMARY
Customer Usage (Gal),
Loss (Gal), 913,411


Glenvar Combined Oct 15-23
Gallons
PSI
4000
3500
3000
2500
2000
1500
1000
500
0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
10/15/13 1:00
10/16/13 1:00
10/17/13 1:00
10/18/13 1:00
10/19/13 1:00
10/20/13 1:00
10/21/13 1:00
10/22/13 1:00
10/23/13 1:00
Loss
Customer Usage
System Pressure

Prioritized list of selected 16 zones

WWA DISTRICT METERING AND ZONAL ANALYSIS

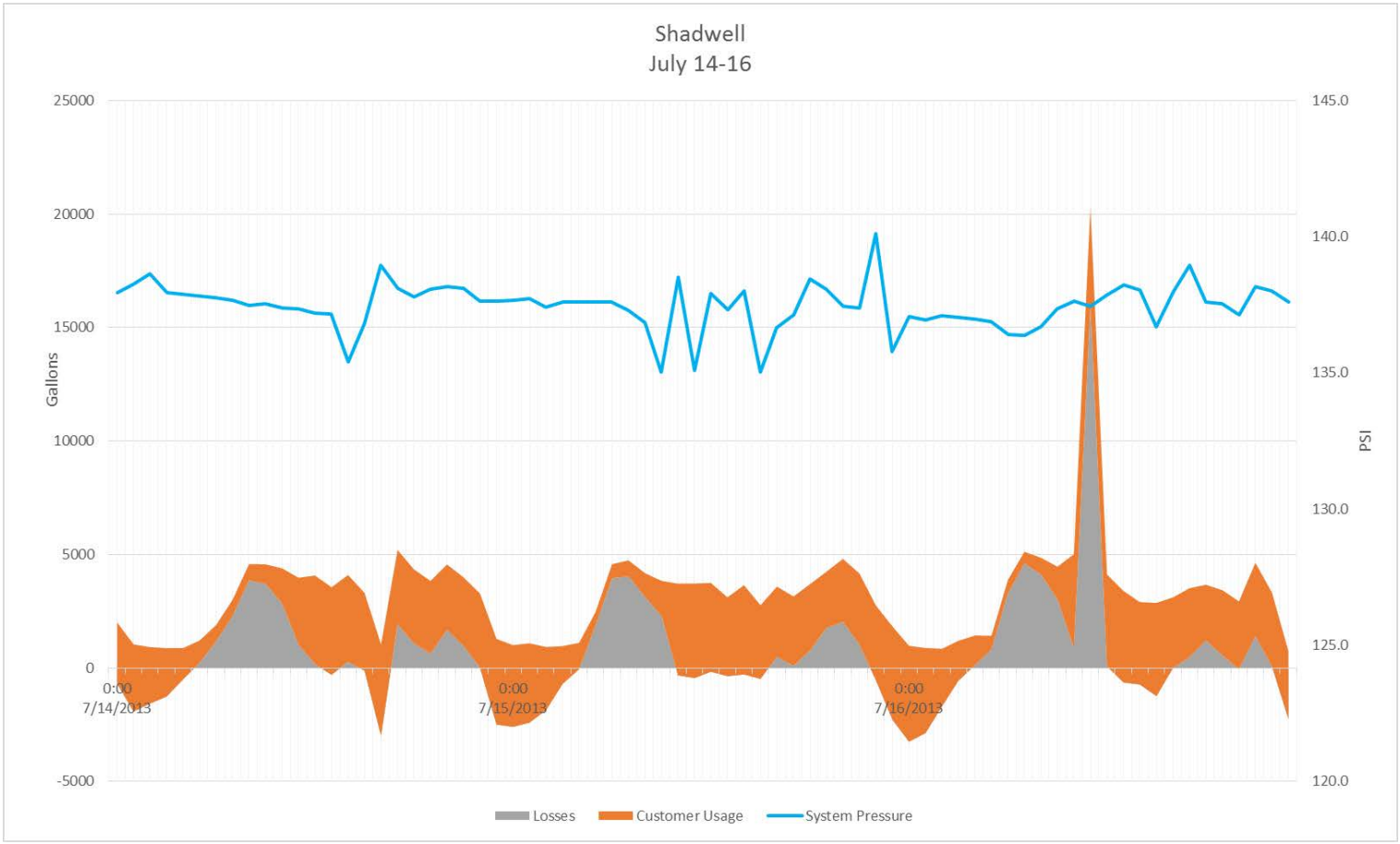
Table 1 General Information Regarding DMA Zones Analyzed

Name	Alleghany	Arlington Forest	Chapel Forest	Cherokee Hills	Coachman	Glenvar Combined	Glenvar Lower	Glenvar Upper	Homewood	Labellevue	Labellevue & Coachman	Roselawn	Roselawn & Homewood	Round Hill	Shadwell	Tyler Road
DMA	7	8	1	2	43	39/40	39	40	20	42	42/43	21	21/20	29	1	33
Area Code	1355	1640	1600	1410	1625/1839	1400/1659	1400	1650/1649	1650	1329/1338/ 1468	1329/1338/1468/ 1625/1839	1616	1616/1650	1300/1350	1247/1350/1357/ 1476/1570	1370
Connections	84	52	35	187	52	133	67	66	47	203	254	213	259	88	421	200
Length of Water Mains (miles)	1.82	1.03	1.26	4.67	1.30	5.21	2.01	3.28	1.33	5.19	6.49	6.72	8.05	1.89	12.46	5.63
Connection Density (con/mile)	46.11	50.57	27.7	40.08	40.13	25.51	33.38	20.14	35.27	39.11	39.14	31.71	32.17	46.5	33.79	51.54
Historic Breaks per Mile	2.2	12.6	4.7	7.9	5.4	10.7	11.5	10.1	2.3	14.6	12.8	4.8	4.3	9.0	4.17	12.6
Tank	No	Yes (2)	No	Yes (1)	Yes (1)	Yes (1)	No	Yes (1)	No	Yes (4)	Yes (5)	Yes	Yes	Yes (PT)	Yes (1)	No

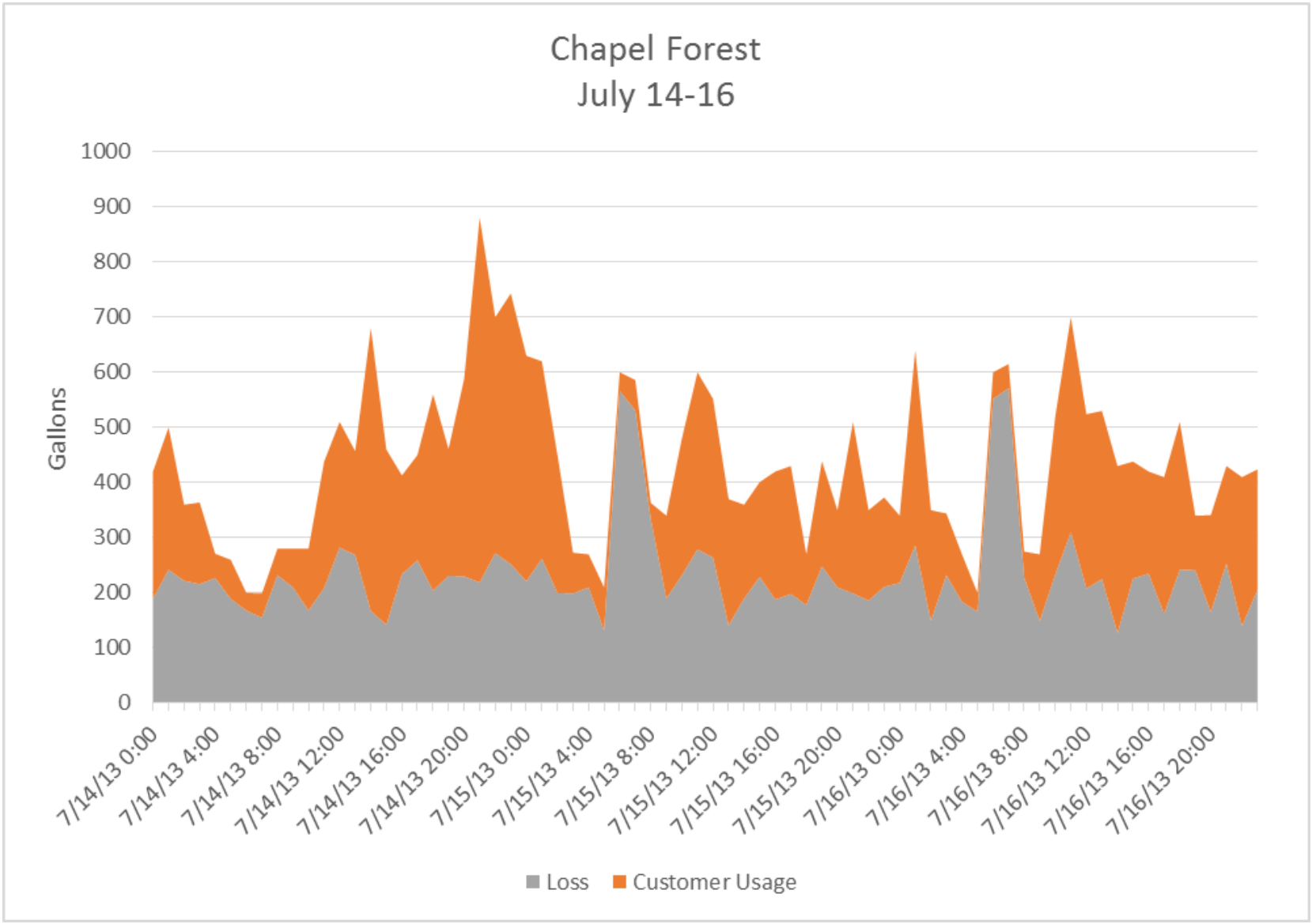
Table 2 Preliminary Results of Analyses

Name	Alleghany	Arlington Forest	Chapel Forest	Cherokee Hills	Coachman	Glenvar Combined	Glenvar Lower	Glenvar Upper	Homewood	Labellevue	Labellevue & Coachman	Roselawn	Roselawn & Homewood	Round Hill	Shadwell	Tyler Road
Time Period	Nov. 3-17	Nov. 3-17	July 14-27	Oct 15-Nov 14	Oct 15-Nov 14	Oct 15-Nov 14	Oct 15-Nov 14	Oct 15-Nov 14	Nov. 3-17	Oct 15-Nov 14	Oct 15-Nov 14	Nov. 3-17	Nov. 3-17	Nov. 3-17	Oct 15-Nov 14	Oct 15-Nov 14
Period Length (Days)	15	15	14	31	31	31	31	31	15	31	31	15	15	15	13	26
Percent Loss	-23%	95%	49%	-156%	-83%	64%	-23%	80%	4%	-4810%	-5850%	17%	18%	10%	18%	36%
Total Real Losses (Gal/Day)	-2,039	103,053	5,342	-15,872	-3,187	29,465	-1,639	31,156	331	-32,872	-38,267	8,187	8,518	1,127	13,486	18,041
Losses (Gal/Connection/Day)	-24	1999	153	-85	-61	222	-24	472	7	-162	-151	38	33	13	32	65
Cost of Water ($/1000Gal)	$0.31	$0.31	$0.31	$0.31	$0.31	$0.31	$0.31	$0.31	$0.31	$0.31	$0.31	$0.31	$0.31	$0.31	$0.31	$0.31
Value of Real Losses ($/day)	-$0.63	$32.23	$1.66	-$4.92	-$0.99	$9.13	-$0.51	$9.66	$0.10	-$10.19	-$11.86	$2.54	$2.64	$0.35	$4.18	$5.87
Value of Real Losses ($/year)	-$230.69	$11,762.27	$606.48	-$1,795.95	-$360.58	$3,333.95	-$185.43	$3,525.31	$37.45	-$3,719.43	-$4,329.96	$926.35	$963.80	$127.54	$1,525.99	$2,143.12
Further Investigation Needed	Yes	Yes	No	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No

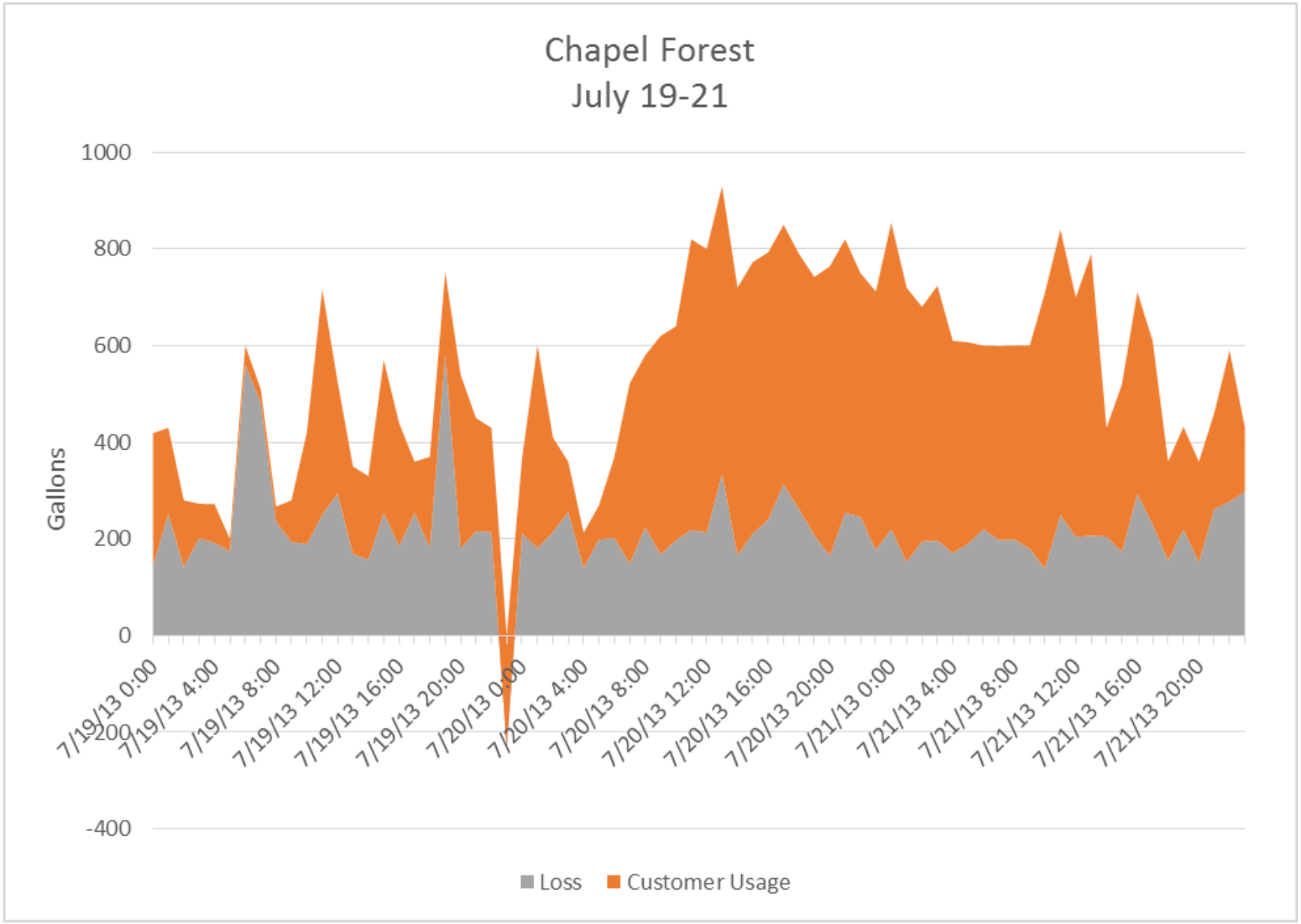
Others


Shadwell
July 14-16
25000
20000
15000
10000
5000
0
-5000
Gallons
145.0
140.0
135.0
130.0
125.0
120.0
PSI
0:00
7/14/2013
0:00
7/15/2013
0:00
7/16/2013
Losses
Customer Usage
System Pressure

Others


Chapel Forest
July 14-16
Gallons
1000
900
800
700
600
500
400
300
200
100
0
7/14/13 0:00
7/14/13 4:00
7/14/13 8:00
7/14/13 12:00
7/14/13 16:00
7/14/13 20:00
7/15/13 0:00
7/15/13 4:00
7/15/13 8:00
7/15/13 12:00
7/15/13 16:00
7/15/13 20:00
7/16/13 0:00
7/16/13 4:00
7/16/13 8:00
7/16/13 12:00
7/16/13 16:00
7/16/13 20:00
Loss
Customer Usage

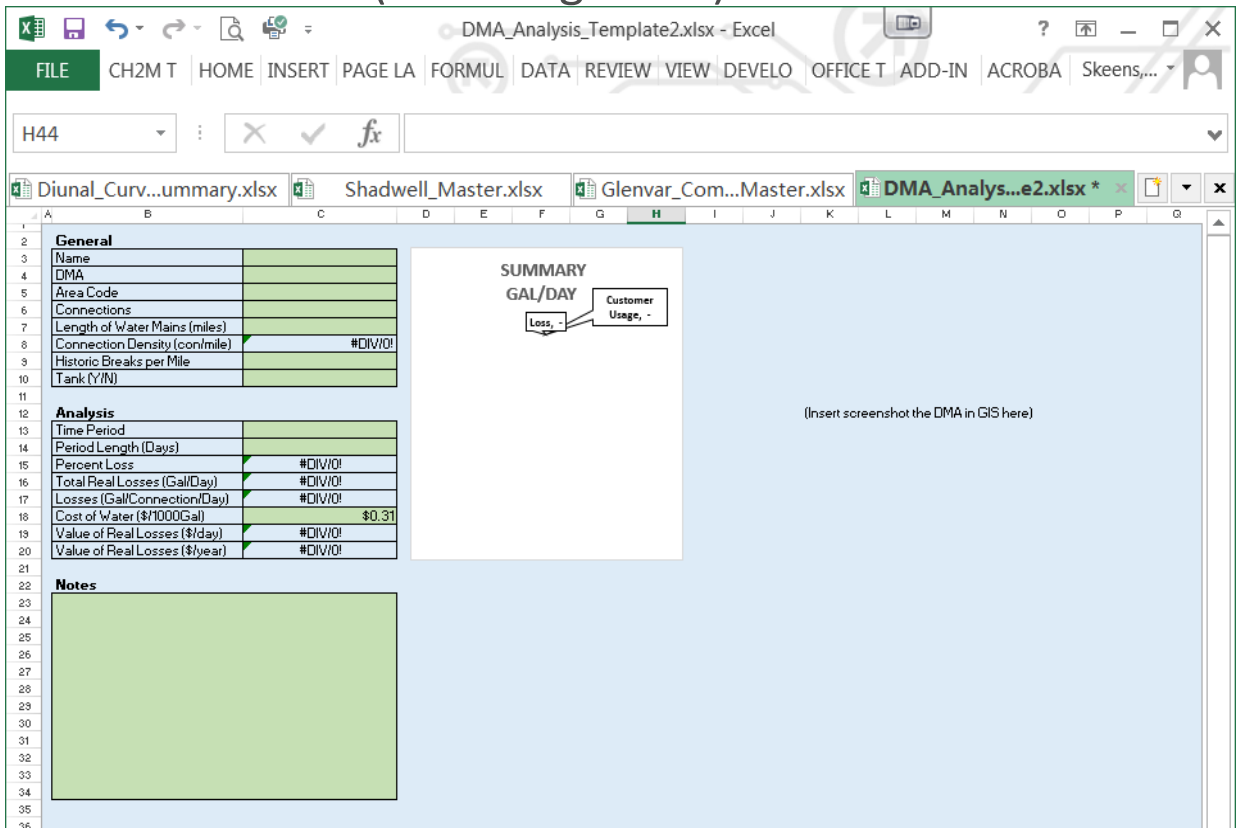
Others


Chapel Forest
July 19-21
1000
800
600
400
200
0
-200
-400
Gallons
7/19/13 0:00
7/19/13 4:00
7/19/13 8:00
7/19/13 12:00
7/19/13 16:00
7/19/13 20:00
7/20/13 0:00
7/20/13 4:00
7/20/13 8:00
7/20/13 12:00
7/20/13 16:00
7/20/13 20:00
7/21/13 0:00
7/21/13 4:00
7/21/13 8:00
7/21/13 12:00
7/21/13 16:00
7/21/13 20:00
Loss
Customer Usage

Template

Created a template for additional zone analysis with instructions

- Spreadsheet based
  - Input fields for consumption
  - Input fields for net inflow calculation (including tanks)
- Instructions



Instructions

MEMORANDUM CH2MHILL

WVWA District Metering and Pressure Zone Analysis Instructions

PREPARED FOR:	Western Virginia Water Authority
	Honeywell
PREPARED BY:	CH2M HILL
DATE:	October 6, 2016~~January 17, 2014~~

This document describes the general method and provides instructions for analyzing a district metered area (DMA) or pressure zone using the Excel template developed by CH2M HILL [filename: DMA_Analysis_Template.xlsx].

1. Identify the District Metered Area
    a. Ensure that all water entering and exiting the area is metered. For I reference, insert a screen shot of the DMA from GIS into the summary tab.
    b. Input general information into the fields shaded green on the summary tab of the template.
2. Data Analysis
    a. Identify the customer meters located within the DMA, as well as the zone flow meters
    b. Obtain the flow metering data from the AMI system
        i. Insert the DMA metering data into a new tab in the template. This will inform the user which of the meters are measuring water entering and exiting the system. It is also essential to know the size of the meter.
        ii. Import the four data columns (DateTime, SmartPoint, MeterNo, Reading) into the Raw Data tab.
        iii. Copy down the 5th column formula to round the time stamp.
        iv. Custom sort the data in ascending order: first by 'MeterNo', then by 'Time_Rounded'.
        v. Select the Raw_Data_Check tab and right click in the body of the pivot table and select refresh. Carefully review the data to identify any gaps and/or duplicates. These anomalies could skew the results of the analysis.
    c. Separate the inflow from the outflow meters from the AMI data in the Raw Data tab:
        i. Filter the raw data to display only the meters which measure water coming into the DMA.
        ii. Copy the last three columns (MeterNo, Reading, Time_Rounded) and paste (values and formats) into the 'In' tab.
            1. Note: if any water meters are 4 inches or greater, their usage values must be multiplied by 10.
        iii. Filter the raw data to display only the meters which measure water leaving the DMA.
        iv. Copy the last three columns (MeterNo, Reading, Time_Rounded) and paste (values and formats) into the 'Out' tab.

Next Steps

Next Steps

- Complete analysis of all possible zones
- Prioritize intervention activities
- Need dedicated staff

- Implement automated software
  - Meter Sense
  - Ongoing currently

Thank You

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