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COMMISSIONERS

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AZ CORP COMMISSION
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Arizona Corporation Commission
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AUG 11 2009

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IN THE MATTER OF THE APPLICATION OF
THE BURLINGTON NORTHERN AND
SANTA FE RAILWAY COMPANY DBA
AUBREY WATER COMPANY FOR
APPROVAL OF A PERMANENT WATER
RATE INCREASE.

DOCKET NO. W-03476A-06-0425

**NOTICE OF FILING AUBREY
WATER COMPANY WATER
LOSS ASSESSMENT AND
REQUEST FOR STAFF
REPORT AND PROPOSED
ORDER**

Snell & Wilmer

LLP
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On May 13, 2009, the Burlington Northern and Santa Fe Railway Company, doing business as Aubrey Water Company ("Aubrey Water" or the "Company"), filed with the Arizona Corporation Commission ("Commission") a Petition to Amend Decision No. 69379 Pursuant to A.R.S. §40-252 (the "Petition"). The Petition requested that the Commission:

1. Permit Aubrey Water to immediately implement the permanent rate increase authorized by the Commission in Decision 69379 dated March 22, 2007 (the "Decision");
2. Revise the condition set forth in the Decision that requires Aubrey Water to reduce water loss on its system to 10 percent or less; and
3. Make a finding that the Company has complied with the Decision by establishing and maintaining its books and records in compliance with the NARUC USOA.

1 At the Commission's May 28, 2009, staff meeting, the Commission voted to re-
2 open the Decision pursuant to A.R.S. §40-252 to consider the relief requested in the
3 Petition. The Commission directed that Utilities Division Staff ("Staff") evaluate the
4 Petition and file a Staff Report and Proposed Order regarding the Company's requested
5 relief to be considered by the Commission at a future Open Meeting.

6 Following the May 28, 2009, staff meeting, representatives of Aubrey Water
7 provided information to Staff regarding the Company's efforts to reduce water loss to
8 comply with the Decision. Aubrey Water also commissioned its outside consultant, Ray
9 Jones of Aricor Water Solutions ("Aricor"), to conduct a comprehensive water loss
10 assessment of its water system. Aricor produced the attached Aubrey Water Company
11 Water Loss Assessment dated July 16, 2009 (the "Assessment"), a copy of which was
12 previously provided to Staff.¹ The Assessment demonstrates that since 2005, Aubrey
13 Water has reduced its water loss by approximately 60% from the 43.1% noted in the
14 Decision to approximately 17% for the twelve months ending May 2009.

15 On the basis of the foregoing, Aubrey Water requests that Staff prepare and file its
16 Staff Report and Proposed Order recommending that the Commission grant the
17 Company's Petition and amend the Decision to allow the Company to immediately
18 implement the rate increase authorized in by the Decision in 2007.

19 DATED this 11th day of August, 2009.

20 SNELL & WILMER L.L.P.

21
22 By 
23 Jeffrey W. Crockett
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28 Attorneys for Aubrey Water Company

¹ Aubrey Water requests that the Commission consider this comprehensive Assessment as its 2009 Water Loss Analysis Program Progress Report to the extent the Commission deems that a report is still required to be filed as a compliance item pursuant to the Decision.

1 ORIGINAL and 13 copies of the foregoing
2 filed this 11th day of August, 2009, with:
3
4 Docket Control
5 ARIZONA CORPORATION COMMISSION
6 1200 West Washington Street
7 Phoenix, Arizona 85007
8
9 COPIES of the foregoing hand-delivered
10 this 11th day of August, 2009, to:
11
12 Steve Olea, Director
13 Utilities Division
14 ARIZONA CORPORATION COMMISSION
15 1200 West Washington Street
16 Phoenix, Arizona 85007
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18 Lyn Farmer, Chief Administrative Law Judge
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**AUBREY WATER COMPANY
Water Loss Assessment**

July 16, 2009

Prepared for:
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Expires 6-30-2012

ARICOR
Water Solutions

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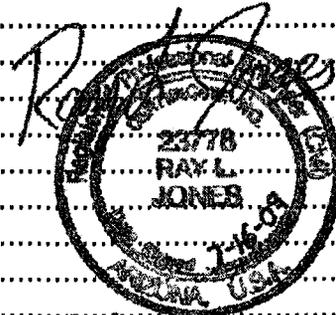
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Appendix 1 – AWWA Water Audit Worksheet
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1. Introduction

1.1 Purpose

Aubrey requested the water loss assessment to support its ongoing efforts to comply with the water loss requirements of Arizona Corporation Commission (ACC) Decision No. 69379. After a meeting with ACC Staff on June 18, 2009, Aubrey agreed to provide this report to Staff in support of its May 13, 2009 Petition to Amend Decision No. 69379.

1.2 Scope of Work

ARICOR Water Solutions was retained by Aubrey Water Company¹ to conduct a water loss assessment for its water system. The water loss assessment scope included the following tasks.

- Contacting management of Southwestern Utility Management, Inc. to obtain their assessment of water loss and to obtain billing records and other records to assist in determining likely sources of water loss.
- Visiting the water system in Seligman, Arizona to physically evaluate and identify likely sources of water loss.
- In conjunction with the on-site manager/operator, identifying likely sources of water loss to physically assess and estimate the actual water loss associated with each potential source.
- Performing a water audit using the IWA/AWWA² Water Audit Method.
- Preparing a report documenting findings and recommendations.

¹ Aubrey Water Company is the trade name used by BN Leasing Corporation the owner of the water system. BN Leasing Corporation is a wholly owned subsidiary of the BNSF Railway Company, the entity that contracted with ARICOR Water Solutions LC to prepare the water loss assessment.

² The International Water Association (IWA) and the American Water Works Association (AWWA).

2. Background

2.1 Aubrey Water Company

2.1.1 General

Aubrey Water Company (Aubrey) operates a public water supply system serving approximately 300 connections in and near Seligman, Arizona. Seligman is located in Yavapai County at the junction of historic Route 66 and Interstate 40, approximately 70 miles west of Flagstaff and 170 miles northwest of Phoenix (Figure 2.1).

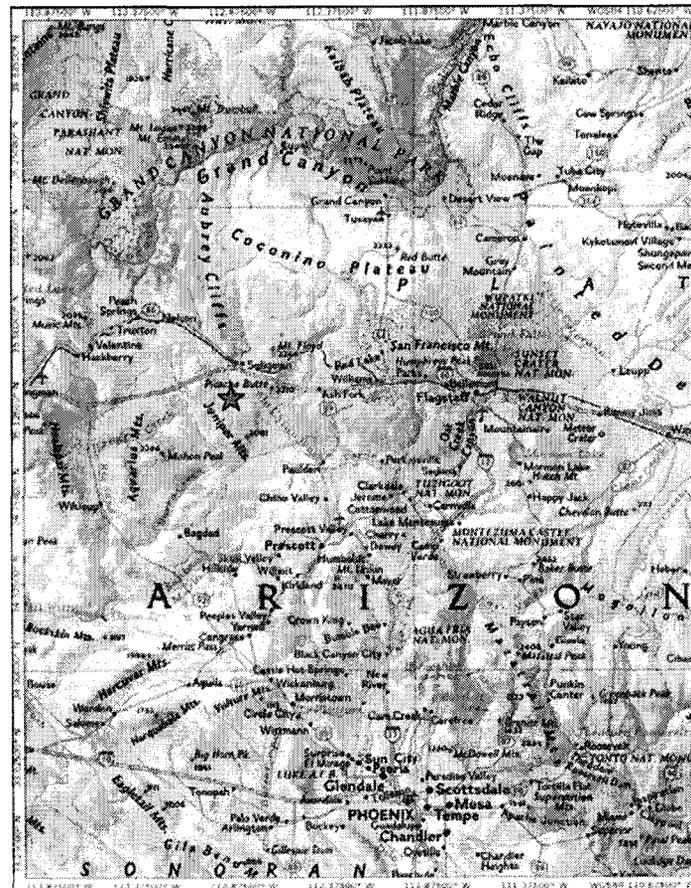


Figure 2.1 - Location Map

The water system was originally installed to supply steam engines and the Seligman railroad depot. Over time the system was expanded to include providing potable water service to the community (BNSF Railway Company, 2008).

The current system includes two wells, two storage tanks, two pump stations, a chlorination system, a telemetry system, a raw water transmission system and a distribution system. All customer connections are metered.

Figure 2.2 is a schematic map of the water system layout (BNSF Railway Company, 2008).

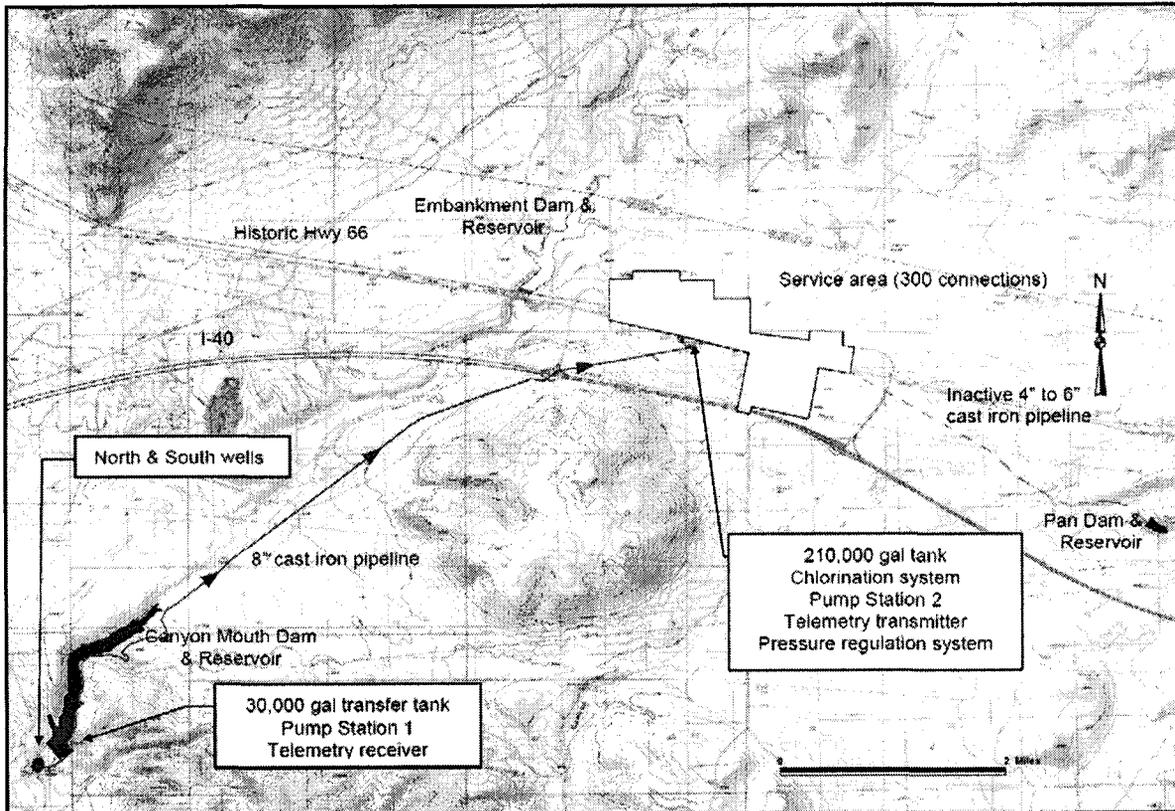


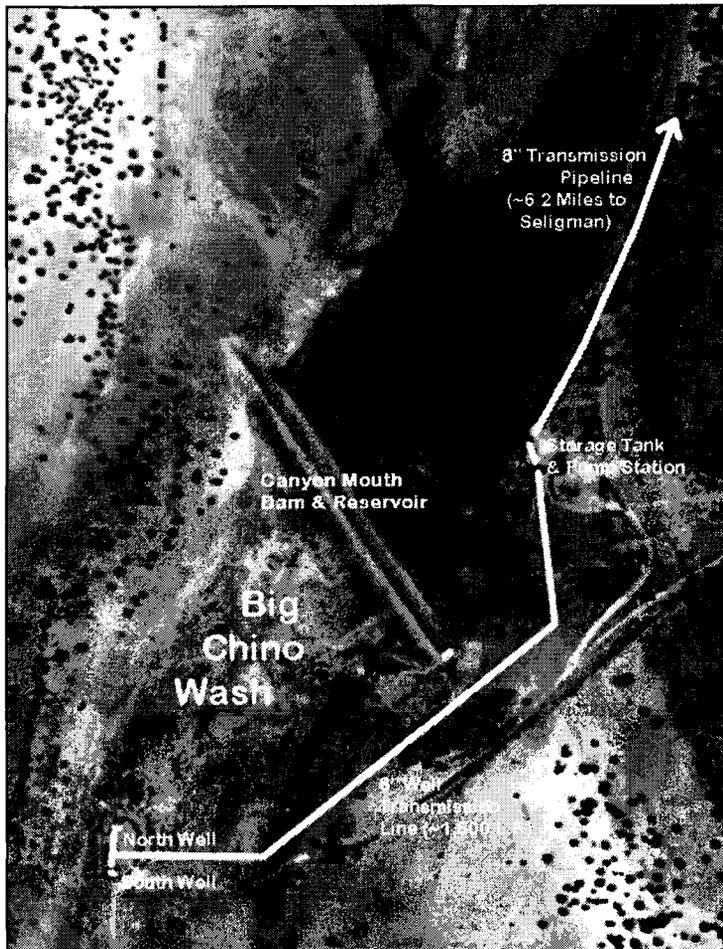
Figure 2.2 - Water System Schematic

2.1.2 Source of Supply and Transmission System

Seligman is located in the upper portion of the Big Chino Sub-Basin of the Verde River Basin. The upper portion of the Big Chino Sub-Basin consists primarily of consolidated crystalline and sedimentary rocks (Arizona Department of Water Resources, 2007). These consolidated materials yield little to no groundwater, making it impractical to drill groundwater wells in and around Seligman.

Due to the lack of groundwater in and around Seligman, Aubrey obtains its water from two wells located approximately 6.2 miles southwest of Seligman. The wells are located on the edge of the historic flow channel of the Big Chino Wash on the northeastern margin of a basin and fill aquifer consisting of unconsolidated sediments (Arizona Department of Water Resources, 2007). The wells are located 850 feet downstream of

the Canyon Mouth Dam. The Canyon Mouth Dam was constructed in 1916 to provide a



source of water for railroad steam engines. The Canyon Mouth Reservoir is the seventh largest reservoir in the Verde River Basin (Arizona Department of Water Resources, 2007).

The BNSF Railway Company holds pre-1919 prior appropriation rights to the flows of the Big Chino Wash and has asserted its rights³, through filings in accordance with the Water Rights Registration Act of 1974 and requirements of the General Adjudication of the Gila River System⁴ (BNSF Railway Company, 2008). Considering the location of the North and South Wells, the water withdrawn by Aubrey is likely to be adjudicated, at least in part, surface water of the Big Chino Wash.

Aubrey has designated the production wells the North Well and the South Well. The wells were drilled in 1948 and 1946,

Figure 2.3 - Source of Supply

respectively. Raw water extracted from the wells meets all drinking water requirements without treatment. Both wells have a capacity⁵ of 200 gallons per minute and are equipped with 20hp submersible pump/motors capable of producing 160 gallons per minute.

³ To the extent that any water withdrawn from the Aubrey wells is surface water, the BNSF Railway Company asserts that the withdrawal constitutes a change in the point of diversion from the Canyon Mouth Reservoir.

⁴ Maricopa Superior Court Proceedings, "In re the General Adjudication of All Rights to Use Water in the Gila River System and Source, Nos. W-1, W-2, W-3 & W-4, consolidated, Verde Adjudication"

⁵ All capacities and distances referenced in this report are approximate.

The wells are located 100 feet apart and are operated on a lead/lag basis, with the wells rarely pumping simultaneously. The lead and lag wells are alternated periodically to allow for approximately equal usage over the course of a year. Either well operating alone can meet the peak day demand of Aubrey's water system.

The North and South Wells pump water through 1,500 LF of 8" diameter cast iron piping to a 30,000 gallon transfer tank. Water is withdrawn from the transfer tank and pumped through an 8" diameter cast iron pipeline approximately 6.2 miles to a 210,000 gallon storage tank located in Seligman.

The ages of the 1,500 LF well transmission line, 30,000 gallon transfer tank, and transfer pump station are unknown. Based on physical examination of the transfer pump station and storage tank, it is estimated that they were constructed around 1960. The pump house is considerably older, as it housed pumps and equipment used to pump water for steam engines prior to being used for the current transfer pump station. The 1,500 LF well transmission line is believed to be constructed at the same time as the wells in 1946-1948.

The final component of the water transmission system is an approximately 6.2 mile long 8" diameter cast iron pipeline from the transfer pump station at the Canyon Mouth Reservoir to a potable water storage tank located in Seligman. The line is believed to have been installed in 1916 concurrent with construction of Canyon Mouth Dam.

Table 2.1 lists the major components of the water supply and transmission system for Aubrey Water Company.

Table 2.1 - Water Supply and Transmission Facilities

Component	Year Constructed	Description
South Well	1946	437' deep with 200 gpm capacity. Equipped with 20hp submersible pump and motor with 160 gpm output.
North Well	1948	380' deep with 200 gpm capacity. Equipped with 20hp submersible pump and motor with 160 gpm output.
Well Transmission Line	~1946	~1,500 LF of 8" diameter cast iron pipe.
Transfer Storage Tank	~1960	30,000 gallon welded steel ground storage tank.
Pump House	~1916	32' x 38' corrugated steel on wood frame with concrete floor.
Transfer Pump Station	~1960	Two 25hp Fairbanks-Morse booster pumps and one 50hp Berkley booster pump.
Transmission Line	1916	~32, 655 LF of 8" diameter cast iron pipe.

2.1.3 Distribution System

The Aubrey distribution system consists of a 210,000 gallon ground storage tank, a booster pump station and a networked system of piping. Figure 2.4 provides an overview of the Aubrey water service area.

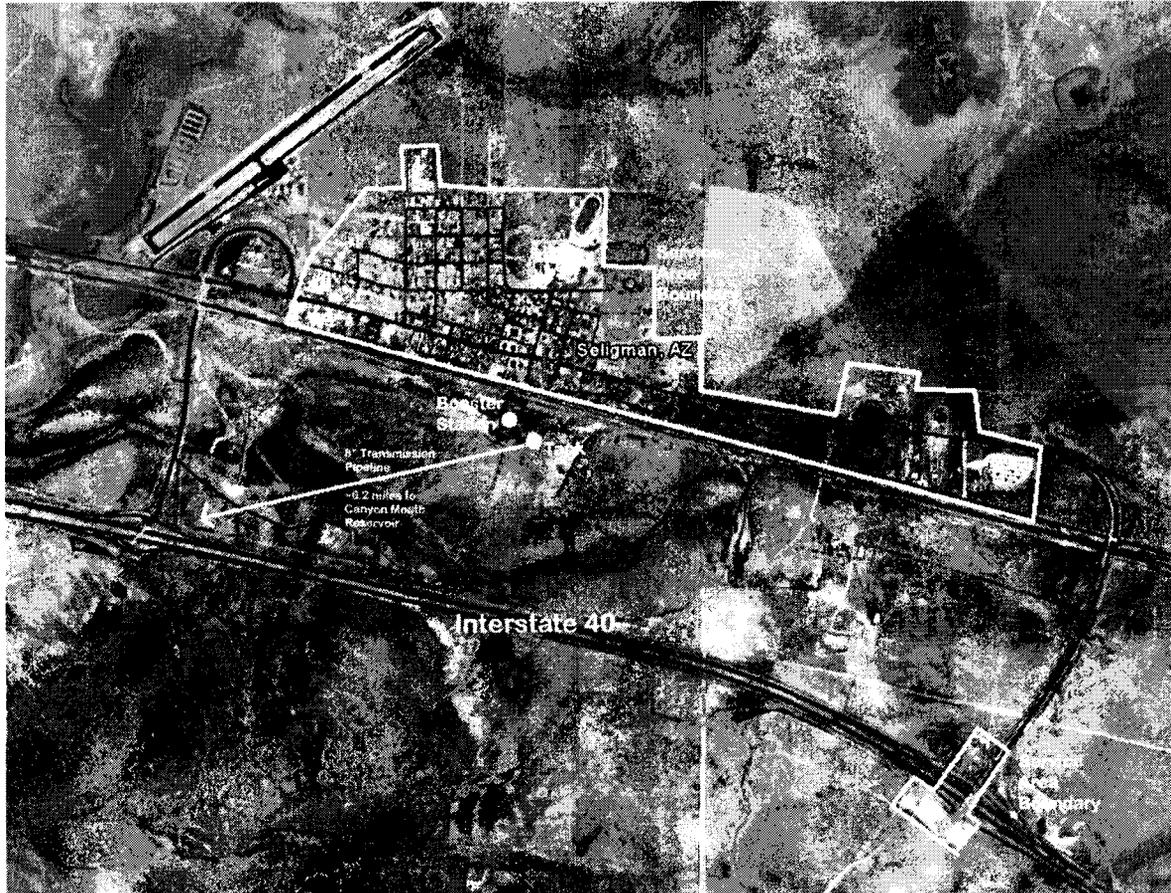


Figure 2.4 - Aubrey Water Service Area

The 210,000 gallon ground storage tank is 24' in diameter and 60' tall. It is riveted steel construction and is installed on a concrete pad. The construction date of the tank is unknown. It is believed to have been constructed prior to 1960 and may be as old as 1930's vintage.

The booster pump station consists of a 15hp booster pump, a 30hp booster pump, a 3,000-gallon hydropneumatic tank, and a liquid chlorination system. The pumps and chlorination system are housed in a wood frame building with the hydropneumatic tank located outside. The booster station is believed to have been constructed in 1960, based on a date cast in the concrete foundation for the hydropneumatic tank.

The pipe network serving Seligman consists of a network of 48,000 LF of piping installed primarily in the street right of ways. The piping ranges from 1" diameter to 6" diameter. All customer connections are metered with meters ranging in size from 5/8"x 3/4" to 2" in size.

An estimated breakdown of piping by size is provided in Table 2.2 (BNSF Railway Company, 2008).

Table 2.2 - Estimated Pipe Lengths by Size

Material	Estimated Length
6" and 4" Steel and Cast Iron	15,600 ft
6" PVC	4,800 ft
4" PVC	9,600 ft
2½" Galvanized Steel	1,480 ft
2" PVC	3,560 ft
2" Galvanized Steel	1,200 ft
1½" Galvanized Steel	5,200 ft
1¼" Galvanized Steel	3,100 ft
1" Galvanized Steel	3,600 ft
TOTAL	48,140 ft

The age of individual segments of piping is unknown. It is believed that portions of the system nearest the railroad may have been constructed in the early 1900s to serve railway owned buildings. It is believed that the system was expanded to the downtown area in the early 1930s. The majority of the system serving residential areas is believed to have been constructed between 1940 and 1970, concurrent with the development of the various additions to Seligman.

2.1.4 Management and Operations

Aubrey subcontracts management and operation of the water system. Southwestern Utility Management, Inc. provides billing and accounting services and John L. Kennedy is the on-site representative and certified operator for the system⁶.

2.2 ACC Proceedings

2.2.1 2006 Rate Case

On June 30, 2006, Aubrey filed an application with the ACC for a permanent rate increase. During the course of processing the case, ACC staff noted that Aubrey reported a water loss of 43.1%⁷ for the period May 2005 through December 2005 (Staff - Arizona Corporation Commission, 2007). On March 22, 2007 the ACC issued

⁶ Mr. Kennedy is an ADEQ certified Grade 2 Water Distribution System Operator.

⁷ Lost water was calculated by comparing metered sales to total production.

Order No. 69379 granting a permanent rate increase upon Aubrey's compliance with several conditions, including "that the Company (Aubrey) has met Staff's time limits for water loss and has reduced water loss on their system to 10 percent." The Commission further ordered Aubrey to comply with ACC Staff's recommendations regarding submittal and implementation of a Water Loss Analysis Program for Aubrey. The ACC Staff's recommendations are summarized as follows:

- Aubrey shall submit a Water Loss Analysis Program to Staff.
- Aubrey shall implement the Water Loss Analysis Program and prepare a Progress Report indicating the status of implementation of each recommendation.
- Aubrey shall monitor its water system and prepare a Monitoring Report documenting water loss in its system.
- Progress Reports and Monitoring Reports shall be filed each January and July beginning January 2008 until two consecutive Monitoring Reports show a water loss of less than 10 percent.
- If water loss is not reduced to less than 10 percent by December 31, 2008, Aubrey shall prepare a Revised Water Loss Analysis Program to achieve acceptable water loss.

2.2.2 Water Loss Compliance Filings

Aubrey filed its Water Loss Analysis Program on December 28, 2007 outlining a five-step plan to reduce water loss. The five steps are summarized as follows:

1. Replace production meter on South Well.
2. Install meter on coin operated standpipe.
3. Implement water meter replacement program to replace inaccurate customer water meters.
4. Inspect transmission and distribution system infrastructure for leaks and repair as indicated.
5. Replace production meter on North Well, if needed.

On January 31, 2008, July 31, 2008 and January 30, 2009, Aubrey filed combined Progress and Monitoring Reports to ACC Staff. The reports document the following progress in implementing the Water Loss Analysis Program.

- South Well production meter replaced on 11/27/07.
- Meter installed on coin operated standpipe on 5/5/08.
- Master meter installed on 8" water transmission main on 5/21/08.
- North Well production meter replaced on 8/11/08.
- 28 customer meters replaced.
- 2 meters installed on unmetered connections.
- 33 main line valves replaced.

- 13 main line leaks repaired.
- 1 hydrant replaced.
- 4 hydrant locks installed.

On May 13, 2009 Aubrey filed a Revised Water Analysis Program containing the following components.

1. Replace transfer pump station.
2. Evaluate and track water loss in 6½ mile transmission line upon replacement of transfer pump station.
3. Continue water meter replacement program.
4. Replace 1,300 lineal feet of 4" distribution main, as financial resources permit.
5. Evaluate standpipe metering.
6. Removal of unused meters and relocation of certain meters.
7. Use line tracing to better monitor for leaks.
8. Continue inspection of distribution system for leaks.
9. ARICOR Water Solutions to complete detailed water loss analysis and provide recommendations to ACC.
10. Continue to file Progress Reports and Monitoring Reports each January and July until two consecutive Monitoring Reports show a water loss of less than 10 percent.

2.2.3 Petition to Amend Decision 69379

On May 13, 2009 Aubrey filed a Petition to Amend Decision No. 69379 pursuant to A.R.S. §40-252. The Petition requested that the ACC permit Aubrey to immediately implement the permanent rate increase authorized by ACC Decision No. 69379 and to revise the condition requiring Aubrey to reduce water loss to 10 percent or less.

2.2.4 Review of Data Reported to ACC

Aubrey has reported production, sales and lost water data to the ACC Staff with the submittal of its Water Loss Analysis Program and with each of its three Monitoring Reports. The data was compiled by the system manager, Southwestern Utility Management, Inc. (SUM), from meter readings and billing records. ACC Staff noted that discrepancies existed in the data from report to report. Table 2.3 below summarizes all of the data reported to ACC Staff, indicating the report which contained the data. Discrepancies in the data are indicated by color coding. SUM indicated that the discrepancies resulted from the correction of previous errors in reported data.

In order to validate the production data, the corrected well production data reported to ACC Staff was compared to well production calculated from meter readings recorded by the system operator from December 2007 through December 2008. The results of the

comparison are reported in Table 2.4. The review indicates that the revised production data reported to the ACC is valid with no discrepancies being noted.

Table 2.3 - Data Reported to ACC Staff

Month	Year	South Well Pumpage	North Well Pumpage	Total Well Pumpage	Metered Water Sales	Coin Standpipe Sales	Total Sales	Lost Water		Data Source
								Lost Water	Monthly Percentage	
Apr	2007			4,938,300			4,055,728	882,572	17.87%	Exhibit A to 12/28/07 Water Loss Analysis Program
May	2007			5,641,700			5,215,545	426,155	7.55%	Exhibit A to 12/28/07 Water Loss Analysis Program
June	2007			6,308,400			5,602,515	705,885	11.19%	Exhibit A to 12/28/07 Water Loss Analysis Program
July	2007			5,408,300			4,968,985	439,315	8.12%	Exhibit A to 12/28/07 Water Loss Analysis Program
Aug	2007						4,404,245			Exhibit A to 12/28/07 Water Loss Analysis Program
Sept	2007						3,554,720			Exhibit A to 12/28/07 Water Loss Analysis Program
Oct	2007						2,905,459			Exhibit A to 12/28/07 Water Loss Analysis Program
Nov	2007									
Dec	2007			3,461,900			2,773,760	688,140	19.88%	1-31-08 Progress and Monitoring Report
Dec	2007	3,460,400	1,000	3,461,400	2,487,140	264,000	2,751,140	710,260	26.52%	7-31-08 Progress and Monitoring Report
Jan	2008	300	3,043,600	3,043,900	2,128,120	251,400	2,379,520	664,380	21.83%	7-31-08 Progress and Monitoring Report
Feb	2008	2,528,000	500	2,528,500	2,129,215	248,000	2,377,215	151,285	5.98%	7-31-08 Progress and Monitoring Report
Feb	2008	2,944,300	500	2,944,800	2,129,215	248,000	2,377,215	567,585	19.27%	1-30-09 Progress and Monitoring Report
Mar	2008	426,200	2,419,815	3,895,200	2,419,815	352,000	2,771,815	1,123,385	28.84%	7-31-08 Progress and Monitoring Report
Mar	2008	9,700	3,469,000	3,478,700	2,419,815	352,000	2,771,815	706,885	20.32%	1-30-09 Progress and Monitoring Report
Apr	2008	3,761,900	22,300	3,784,200	2,855,520	372,000	3,227,520	556,680	14.71%	7-31-08 Progress and Monitoring Report
May	2008	496,000	4,637,400	5,133,400	4,195,340	416,000	4,611,340	522,060	10.17%	7-31-08 Progress and Monitoring Report
June	2008	5,482,100	1,026,600	6,508,700	5,365,220	564,520	5,929,740	578,960	8.90%	7-31-08 Progress and Monitoring Report
July	2008	5,406,200	672,100	6,078,300	5,148,343	478,910	5,627,253	451,047	7.42%	1-30-09 Progress and Monitoring Report
Aug	2008	1,309,400	4,819,900	6,129,300	5,134,816	435,940	5,570,756	558,544	9.11%	1-30-09 Progress and Monitoring Report
Sept	2008	2,607,000	2,184,700	4,791,700	3,756,644	431,590	4,188,234	603,466	12.59%	1-30-09 Progress and Monitoring Report
Oct	2008	543,800	3,435,100	3,978,900	2,782,913	342,450	3,125,363	853,537	21.45%	1-30-09 Progress and Monitoring Report
Nov	2008	1,155,200	1,844,700	2,999,900	1,848,717	320,730	2,169,447	830,453	27.68%	1-30-09 Progress and Monitoring Report
Dec	2008		3,073,100	3,073,100	2,025,830	256,610	2,282,440	790,660	25.73%	1-30-09 Progress and Monitoring Report

Indicates reported data that was updated by later corrected data
Indicates Corrected Data

Table 2.4 - Comparison of Reported Production Data to Meter Readings

Month	Year	From Meter Readings			SUM - Reported Data		
		South Well Pumpage	North well Pumpage	Total Well Pumpage	South Well Pumpage	North well Pumpage	Total Well Pumpage
December	2007	3,460,400	1,000	3,461,400	3,460,400	1,000	3,461,400
January	2008	300	3,043,600	3,043,900	300	3,043,600	3,043,900
February	2008	2,944,300	500	2,944,800	2,944,300	500	2,944,800
March	2008	9,700	3,469,000	3,478,700	9,700	3,469,000	3,478,700
April	2008	3,761,900	22,300	3,784,200	3,761,900	22,300	3,784,200
May	2008	496,000	4,637,400	5,133,400	496,000	4,637,400	5,133,400
June	2008	5,482,100	1,026,600	6,508,700	5,482,100	1,026,600	6,508,700
July	2008	5,406,200	672,100	6,078,300	5,406,200	672,100	6,078,300
August	2008	1,309,400	4,819,900	6,129,300	1,309,400	4,819,900	6,129,300
September	2008	2,607,000	2,184,700	4,791,700	2,607,000	2,184,700	4,791,700
October	2008	543,800	3,435,100	3,978,900	543,800	3,435,100	3,978,900
November	2008	1,155,200	1,844,700	2,999,900	1,155,200	1,844,700	2,999,900
December	2008	-	3,073,100	3,073,100	-	3,073,100	3,073,100

In order to validate the sales data reported to ACC Staff, SUM provided raw billing data from the computerized billing system for the period December, 2007 through December, 2008. The raw billing data was analyzed to determine metered sales for

each month of the 13-month period. The raw billing data was adjusted to include hydrant meter sales recorded outside of the computerized billing system and to include coin standpipe sales (Billing Record Sales). The Billing Record Sales are presented in Table 2.5.

Table 2.5 - Sales Data from Billing Records

Month	Year	Data From Billing Records				Data from SWUM			Adjusted Metered Sales from Billing Records
		[1] Regular Bills	[2] Out of Cycle Bills	[3] Billed Usage [1] + [2]	[4] Usage Adjustments	[5] Metered Sales [3] + [4]	[6] Metered Usage Billed outside of Billing System	[7] Coin Standpipe Sales	
Dec	2007	2,487,140	-	2,487,140	(28,020)	2,459,120		264,000	2,723,120
Jan	2008	2,128,120	1,290	2,129,410	-	2,129,410		251,400	2,380,810
Feb	2008	2,129,215	5,050	2,134,265	-	2,134,265		248,000	2,382,265
Mar	2008	2,419,815	-	2,419,815	(10,635)	2,409,180		352,000	2,761,180
Apr	2008	2,855,610	-	2,855,610	-	2,855,610		372,000	3,227,610
May	2008	4,195,340	2,260	4,197,600	(740)	4,196,860		416,000	4,612,860
June	2008	5,365,220	-	5,365,220	-	5,365,220		564,520	5,929,740
July	2008	5,148,343	-	5,148,343	(15,520)	5,132,823		478,910	5,611,733
Aug	2008	4,912,683	-	4,912,683	(30,000)	4,882,683	72,906	435,940	5,391,529
Sept	2008	3,641,694	2,410	3,644,104	(92,000)	3,552,104		431,590	3,983,694
Oct	2008	2,782,623	2,240	2,784,863	-	2,784,863		342,450	3,127,313
Nov	2008	1,916,827	-	1,916,827	(20,000)	1,896,827		320,730	2,217,557
Dec	2008	2,019,020	2,860	2,021,880	-	2,021,880		256,610	2,278,490

Table 2.6 - Sales Data Reconciliation

Month	Year	[1] Adjusted Metered Sales from Billing Records	[2] Metered Sales from Reports to ACC	[3] Difference in Metered Sales [2] - [1]	[4] Usage Adjustments from Billing Records	[5] Out of Cycle Bills from Billing Records	[6] Total Reconciled Items [4] + [5]	[7] Unreconciled Systematic Error [3] + [6]
Dec	2007	2,723,120	2,751,140	28,020	(28,020)	-	(28,020)	-
Jan	2008	2,380,810	2,379,520	(1,290)	-	1,290	1,290	-
Feb	2008	2,382,265	2,377,215	(5,050)	-	5,050	5,050	-
Mar	2008	2,761,180	2,771,815	10,635	(10,635)	-	(10,635)	-
Apr	2008	3,227,610	3,227,520	(90)	-	-	-	(90)
May	2008	4,612,860	4,611,340	(1,520)	(740)	2,260	1,520	-
June	2008	5,929,740	5,929,740	-	-	-	-	-
July	2008	5,611,733	5,627,253	15,520	(15,520)	-	(15,520)	-
Aug	2008	5,391,529	5,570,756	179,227	(30,000)	-	(30,000)	149,227
Sept	2008	3,983,694	4,188,234	204,540	(92,000)	2,410	(89,590)	114,950
Oct	2008	3,127,313	3,125,363	(1,950)	-	2,240	2,240	290
Nov	2008	2,217,557	2,169,447	(48,110)	(20,000)	-	(20,000)	(68,110)
Dec	2008	2,278,490	2,282,440	3,950	-	2,860	2,860	6,810
13-Month Totals		46,627,901	47,011,783	383,882	(196,915)	16,110	(180,805)	203,077
Percent				0.82%	-0.42%	0.03%		0.44%

The Billing Record Sales were compared to the metered sales reported to the ACC Staff. The results are shown in Table 2.6. The review of the data indicates that metered sales

reported to ACC Staff exceeded Billing Record Sales by 383,882 gallons or 0.82% for the 13-month period (column 3). Further analysis of the data indicates that the metered sales reported to the ACC Staff did not include usage adjustments and out of cycle bills. After reconciling usage adjustments and out of cycle bills, the remaining unreconciled difference is 203,077 gallons or 0.44% for the 13-month period (column 7). SUM has reviewed its billing data and reports and is now in agreement that the Billing Record Sales is the correct sales data for the Aubrey system.

The difference in data reported to the ACC and the Billing Record Sales is small (0.82% variance) and has minimal impact on reported lost water. The small variance indicates that SUM and the on-site representative are doing an effective job of collecting and reporting data. Nevertheless, the data review indicates lost water reporting should be improved to include usage adjustments and out of cycle billings. Additionally, steps should be taken to reduce the remaining systematic reporting error. Figure 2.5 compares the lost water percentages using the data reported to the ACC and the Billing Record Data. Table 2.7 is a tabular presentation of the data. Corrected lost water data in the same format as originally submitted to the ACC is provided in Appendix 2.

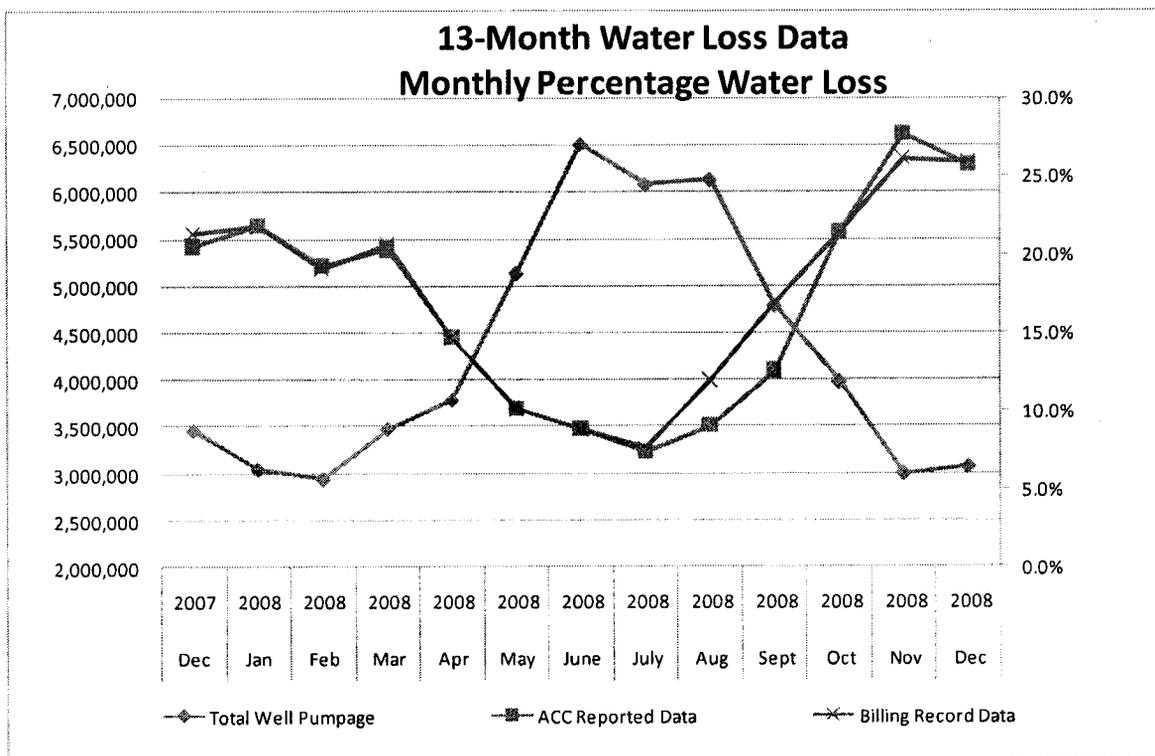


Figure 2.5 - Water Loss Data Comparison

Table 2.7 – Water Loss Data Comparison

		[1]	[2]	[3]	[4]	[5]	[6]	[7]
Month	Year	Total Well Pumpage	Metered Sales from Reports to ACC	Billing Record Metered Sales	Lost Water using Data Reported to ACC [2] - [1]	Lost Water using Billing Record Metered Sales [3] - [1]	Monthly Percentage using Data Reported to ACC [6] / [1]	Monthly Percentage using Billing Record Metered Sales [7] / [1]
Dec	2007	3,461,400	2,751,140	2,723,120	710,260	738,280	20.5%	21.3%
Jan	2008	3,043,900	2,379,520	2,380,810	664,380	663,090	21.8%	21.8%
Feb	2008	2,944,800	2,377,215	2,382,265	567,585	562,535	19.3%	19.1%
Mar	2008	3,478,700	2,771,815	2,761,180	706,885	717,520	20.3%	20.6%
Apr	2008	3,784,200	3,227,520	3,227,610	556,680	556,590	14.7%	14.7%
May	2008	5,133,400	4,611,340	4,612,860	522,060	520,540	10.2%	10.1%
June	2008	6,508,700	5,929,740	5,929,740	578,960	578,960	8.9%	8.9%
July	2008	6,078,300	5,627,253	5,611,733	451,047	466,567	7.4%	7.7%
Aug	2008	6,129,300	5,570,756	5,391,529	558,544	737,771	9.1%	12.0%
Sept	2008	4,791,700	4,188,234	3,983,694	603,466	808,006	12.6%	16.9%
Oct	2008	3,978,900	3,125,363	3,127,313	853,537	851,587	21.5%	21.4%
Nov	2008	2,999,900	2,169,447	2,217,557	830,453	782,343	27.7%	26.1%
Dec	2008	3,073,100	2,282,440	2,278,490	790,660	794,610	25.7%	25.9%
Calendar Year 2008		51,944,900	44,260,643	43,904,781	7,684,257	8,040,119	14.8%	15.5%

In summary, the Production, Sales and Water Loss data reported to the ACC was compared to source data. No differences were identified in the production data. The metered sales data reconciled to within 0.82 percent, indicating a low level of systematic reporting error. The differences were partially caused by the failure to report usage adjustments and out of cycle billings. After reconciling usage adjustments and out of cycle billings, 0.44 percent of the difference in metered sales remained unreconciled. The low level of reporting error for the metered sales data has little impact on the reported lost water percentage and indicates that SUM and on-site representative are doing an effective job of collecting and reporting data.

3. Water Loss Assessment

The water loss assessment conducted for Aubrey consisted of two basic steps – a detailed system review followed by a water audit. The two step approach provides a comprehensive assessment of water loss at Aubrey and provides a sound basis for evaluating the appropriateness and effectiveness of Aubrey's loss control efforts and identifying and prioritizing recommended future action by Aubrey.

3.1 System Review

The system review for Aubrey consisted of two tasks.

- Reviewing Aubrey's processes and practices for collecting and producing production data and customer billing records to validate integrity of data used for lost water reporting.
- In conjunction with the on-site representative, visiting the water system to physically evaluate and identify likely sources of water loss and estimate the actual water loss associated with each potential source.

3.1.1 Data Integrity

In order to evaluate data integrity, the on-site representative and system manager were contacted to obtain an understanding of the processes used to collect and produce both production and billing data. Production data and billing data are discussed separately below.

Production Data

The on-site representative maintains a well log which records meter readings for the wells and 8" master meter approximately three times per week. At the beginning of the customer meter reading cycle, the on-site representative records reading for the wells and master meter and provides those readings to the system manager, SUM. SUM calculates system production from the meter readings. SUM inputs the calculated production data into an excel spreadsheet for reporting purposes.

The production data was validated by comparing the data reported by SUM to the production calculated from the meter readings recorded by the on-site representative. The results of the comparison are reported in Table 3.1. The review indicates that the production data reported by SUM is generally valid, with the only discrepancy occurring in February 2009. The February 2009 discrepancy appears to be the result of input error when transferring the calculated production into the Excel spreadsheet. SUM has updated its records to reflect the correct production data for February, 2009.

Table 3.1 - Production Data Validation

Month	Year	From Meter Readings			SUM - Reported Data			Difference		
		South Well Pumpage	North well Pumpage	Total Well Pumpage	South Well Pumpage	North well Pumpage	Total Well Pumpage	South Well Pumpage	North well Pumpage	Total Well Pumpage
December	2007	3,460,400	1,000	3,461,400	3,460,400	1,000	3,461,400	-	-	-
January	2008	300	3,043,600	3,043,900	300	3,043,600	3,043,900	-	-	-
February	2008	2,944,300	500	2,944,800	2,944,300	500	2,944,800	-	-	-
March	2008	9,700	3,469,000	3,478,700	9,700	3,469,000	3,478,700	-	-	-
April	2008	3,761,900	22,300	3,784,200	3,761,900	22,300	3,784,200	-	-	-
May	2008	496,000	4,637,400	5,133,400	496,000	4,637,400	5,133,400	-	-	-
June	2008	5,482,100	1,026,600	6,508,700	5,482,100	1,026,600	6,508,700	-	-	-
July	2008	5,406,200	672,100	6,078,300	5,406,200	672,100	6,078,300	-	-	-
August	2008	1,309,400	4,819,900	6,129,300	1,309,400	4,819,900	6,129,300	-	-	-
September	2008	2,607,000	2,184,700	4,791,700	2,607,000	2,184,700	4,791,700	-	-	-
October	2008	543,800	3,435,100	3,978,900	543,800	3,435,100	3,978,900	-	-	-
November	2008	1,155,200	1,844,700	2,999,900	1,155,200	1,844,700	2,999,900	-	-	-
December	2008	-	3,073,100	3,073,100	-	3,073,100	3,073,100	-	-	-
January	2009	2,755,900	4,800	2,760,700	2,755,900	4,800	2,760,700	-	-	-
February	2009	270,100	2,329,800	2,599,900	2,339,800	270,100	2,609,900	2,069,700	(2,059,700)	10,000
March	2009	2,853,700	388,600	3,242,300	2,853,700	388,600	3,242,300	-	-	-
April	2009	914,700	2,471,300	3,386,000	914,700	2,471,300	3,386,000	-	-	-
May	2009	4,828,000	219,000	5,047,000	4,828,000	219,000	5,047,000	-	-	-

Master Meter Data

In May of 2008 Aubrey installed an 8" master meter at the end of the 6.2 mile transmission main from the well field to the 210,000 gallon storage tank in Seligman. The meter was installed as a part of Aubrey's Water Loss Analysis Program to allow water loss in the transmission main to be separated from water loss in the distribution system. Table 3.2 compares the metered deliveries to the distribution system to metered well production.

Table 3.2 - Comparison of Well Production to System Deliveries

Month	Year	Total Well Pumpage	8" Master Meter Usage	Difference
June	2008	6,508,700	6,710,000	201,300
July	2008	6,078,300	6,389,000	310,700
August	2008	6,129,300	6,259,000	129,700
September	2008	4,791,700	4,966,000	174,300
October	2008	3,978,900	3,626,000	(352,900)
November	2008	2,999,900	2,978,000	(21,900)
December	2008	3,073,100	3,047,000	(26,100)
January	2009	2,760,700	2,801,000	40,300
February	2009	2,599,900	2,563,000	(36,900)
March	2009	3,242,300	3,339,000	96,700
April	2009	3,386,000	3,392,000	6,000
May	2009	5,047,000	5,223,000	176,000

The readings indicate more water deliveries to the system than is produced in some months and less water than is produced in other months. On balance, the data is inconclusive and water loss in the transmission main remains unknown. Possible causes for the inconclusive data include inaccurate metering and unmetered reverse flows⁸.

Billing Data

At the beginning of each month the on-site representative manually reads all of the meters in the Aubrey system. The meter readings are recorded on a printout of the service locations in the Aubrey system. The source data is maintained on computer by the on-site representative. The meters are normally read over a two day period. Once all meters are read, the on-site representative inputs the customer readings (and well readings) into the computer file and transmits the file electronically to SUM. SUM manually inputs the readings into their computerized billing system. The readings are validated for high or low usage and reread requests are made as needed. Billing is typically completed by mid month. SUM manually records billed sales volumes in an excel spreadsheet for reporting.

In order to validate the sales data reported by SUM, raw billing data from the computerized billing system for the period December, 2007 through May, 2009 was obtained from SUM. The raw billing data was analyzed to determine metered sales for each month. The raw billing data was adjusted to include hydrant meter sales recorded outside of the computerized billing system and to include coin standpipe sales (Billing Record Sales). The Billing Record Sales are presented in Table 3.3.

Table 3.3 - Sales Volumes from Billing Records

Month	Year	Data From Billing Records				Data from SUM			
		[1] Regular Bills	[2] Out of Cycle Bills	[3] Billed Usage [1] + [2]	[4] Usage Adjustments	[5] Metered Sales [3] + [4]	[6] Metered Usage Billed outside of Billing System	[7] Coin Standpipe Sales	[8] Adjusted Metered Sales from Billing Records
Dec	2007	2,487,140	-	2,487,140	(28,020)	2,459,120		264,000	2,723,120
Jan	2008	2,128,120	1,290	2,129,410	-	2,129,410		251,400	2,380,810
Feb	2008	2,129,215	5,050	2,134,265	-	2,134,265		248,000	2,382,265
Mar	2008	2,419,815	-	2,419,815	(10,635)	2,409,180		352,000	2,761,180
Apr	2008	2,855,610	-	2,855,610	-	2,855,610		372,000	3,227,610
May	2008	4,195,340	2,260	4,197,600	(740)	4,196,860		416,000	4,612,860
June	2008	5,365,220	-	5,365,220	-	5,365,220		564,520	5,929,740
July	2008	5,148,343	-	5,148,343	(15,520)	5,132,823		478,910	5,611,733
Aug	2008	4,912,683	-	4,912,683	(30,000)	4,882,683	72,906	435,940	5,391,529
Sept	2008	3,641,694	2,410	3,644,104	(92,000)	3,552,104		431,590	3,983,694
Oct	2008	2,782,623	2,240	2,784,863	-	2,784,863		342,450	3,127,313
Nov	2008	1,916,827	-	1,916,827	(20,000)	1,896,827		320,730	2,217,557
Dec	2008	2,019,020	2,860	2,021,880	-	2,021,880		256,610	2,278,490
Jan	2009	1,646,770	22,000	1,668,770	(54,380)	1,614,390		253,250	1,867,640
Feb	2009	1,787,810	21,040	1,808,850	(105,550)	1,703,300		290,230	1,993,530
Mar	2009	2,083,660	15,000	2,098,660	(11,890)	2,086,770		306,510	2,393,280
Apr	2009	2,283,360	330	2,283,690	(330)	2,283,360		315,000	2,598,360
May	2009	3,992,960	1,220	3,994,180	-	3,994,180		472,870	4,467,050

⁸ Reverse flow could be caused from water draining from the tank to supply leakage in the transmission main when the transfer pump station is not operating. The 8" meter is not designed to meter reverse flows.

The Billing Record Sales were compared to the metered sales reported by SUM. The results are shown in Table 3.4.

Table 3.4 - Sales Volume Reconciliation

		[1]	[2]	[3]	[4]	[5]	[6]	[7]
		Adjusted Metered Sales from Billing Records	Metered Sales from Reports to ACC	Difference in Metered Sales [2] - [1]	Usage Adjustments from Billing Records	Out of Cycle Bills from Billing Records	Total Reconciled Items [4] + [5]	Unreconciled Systematic Error [3] + [6]
Month	Year							
Dec	2007	2,723,120	2,751,140	28,020	(28,020)	-	(28,020)	-
Jan	2008	2,380,810	2,379,520	(1,290)	-	1,290	1,290	-
Feb	2008	2,382,265	2,377,215	(5,050)	-	5,050	5,050	-
Mar	2008	2,761,180	2,771,815	10,635	(10,635)	-	(10,635)	-
Apr	2008	3,227,610	3,227,520	(90)	-	-	-	(90)
May	2008	4,612,860	4,611,340	(1,520)	(740)	2,260	1,520	-
June	2008	5,929,740	5,929,740	-	-	-	-	-
July	2008	5,611,733	5,627,253	15,520	(15,520)	-	(15,520)	-
Aug	2008	5,391,529	5,570,756	179,227	(30,000)	-	(30,000)	149,227
Sept	2008	3,983,694	4,188,234	204,540	(92,000)	2,410	(89,590)	114,950
Oct	2008	3,127,313	3,125,363	(1,950)	-	2,240	2,240	290
Nov	2008	2,217,557	2,169,447	(48,110)	(20,000)	-	(20,000)	(68,110)
Dec	2008	2,278,490	2,282,440	3,950	-	2,860	2,860	6,810
Jan	2009	1,867,640	1,900,020	32,380	(54,380)	22,000	(32,380)	-
Feb	2009	1,993,530	2,078,040	84,510	(105,550)	21,040	(84,510)	-
Mar	2009	2,393,280	2,390,170	(3,110)	(11,890)	15,000	3,110	-
Apr	2009	2,598,360	2,633,160	34,800	(330)	330	-	34,800
May	2009	4,467,050	4,465,830	(1,220)	-	1,220	1,220	-
Totals		59,947,761	60,479,003	531,242	(369,065)	75,700	(293,365)	237,877
Percent				0.89%	-0.62%	0.13%		0.40%

The review of the data indicates that reported metered sales exceeded metered sales derived from the billing data by 531,242 gallons or 0.89% (column 3). Further analysis of the data indicates that the metered sales reported by SUM did not include usage adjustments and out of cycle bills. After reconciling usage adjustments and out of cycle bills, the remaining unreconciled difference is 237,877 gallons or 0.40% (column 7). SUM has reviewed its billing data and reports and is now in agreement that the Billing Record Sales is the correct sales data for the Aubrey system.

Corrected lost water data in the same format used for submittal to the ACC is provided in Appendix 2. Table 3.5 and Figure 3.1 present tabular and graphical summary of corrected production, sales and lost water data.

The difference in data reported by SUM and the Billing Record Sales is small and has minimal impact on lost water calculations. The small variance indicates that SUM and the on-site representative are doing an effective job of collecting and reporting data. Nevertheless, the data review indicates lost water reporting should be improved to include usage adjustments and out of cycle billings. Additionally, steps should be taken to eliminate the remaining systematic error.

Table 3.5 - 18-Month Water Loss Data

Month	Year	Total Well Pumpage	Total Sales	Non-Revenue Water (Volume)	Non-Revenue Water (Percentage)	Non-Revenue Water (12-Month Rolling Average)
Dec	2007	3,461,400	2,723,120	738,280	21.3%	
Jan	2008	3,043,900	2,380,810	663,090	21.8%	
Feb	2008	2,944,800	2,382,265	562,535	19.1%	
Mar	2008	3,478,700	2,761,180	717,520	20.6%	
Apr	2008	3,784,200	3,227,610	556,590	14.7%	
May	2008	5,133,400	4,612,860	520,540	10.1%	
June	2008	6,508,700	5,929,740	578,960	8.9%	
July	2008	6,078,300	5,611,733	466,567	7.7%	
Aug	2008	6,129,300	5,391,529	737,771	12.0%	
Sept	2008	4,791,700	3,983,694	808,006	16.9%	
Oct	2008	3,978,900	3,127,313	851,587	21.4%	
Nov	2008	2,999,900	2,217,557	782,343	26.1%	15.3%
Dec	2008	3,073,100	2,278,490	794,610	25.9%	15.5%
Jan	2009	2,760,700	1,867,640	893,060	32.3%	16.0%
Feb	2009	2,599,900	1,993,530	606,370	23.3%	16.2%
Mar	2009	3,242,300	2,393,280	849,020	26.2%	16.5%
Apr	2009	3,386,000	2,598,360	787,640	23.3%	17.1%
May	2009	5,047,000	4,467,050	579,950	11.5%	17.3%

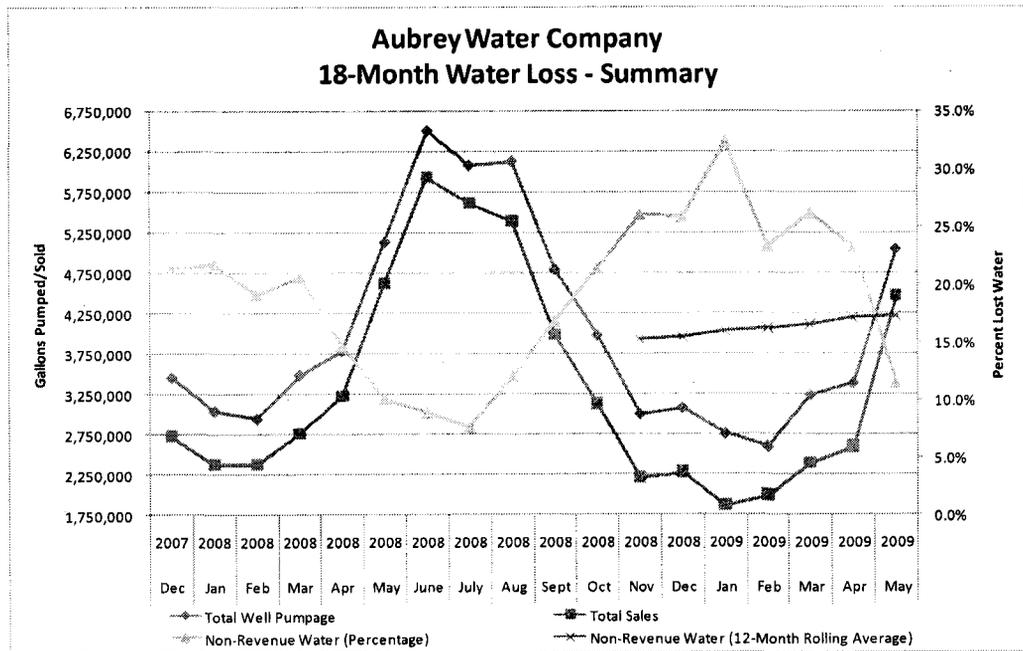


Figure 3.1 - 18-Month Water Loss Data

SUM and the on-site representative indicate that occasional errant meter readings are unavoidable (due to the depth of installed meters) and can result in overbilling of customers, leading to adjustments in the following months. A detailed examination of the raw billing data indicates that on multiple occasions over reads occurred. In some instances the error was corrected in same month. In other cases the error was corrected in the next month up to several months later. In other instances the error was not corrected. Instead, the customer received zero usage bills until the actual meter reading caught up to the over read and usage began to again accrue. The relatively frequent meter reading errors and the resulting need to make billing adjustments are likely to be a significant contributor to the fluctuation of lost water data on a monthly basis. In addition, the meter reading errors and the resulting need to make billing adjustments is a likely contributor to the unreconciled systematic error noted above.

3.1.2 Physical System Evaluation

In order to determine where to focus an on-site physical system evaluation, calendar year 2008 billing data was analyzed to breakdown usages by customer class and meter size. Table 3.6 details the billing data breakdown.

Table 3.6 - Summary 2008 Billing Data Analysis

	Number of Meters	Pct	Regular Bills (gallons)	Adjustments (gallons)	Total Metered Usage (gal)	Pct
Total Sales	293	100.00%	39,530,620	-168,895	39,361,725	100.00%
Residential Sales	237	80.89%	17,048,790	-189,287	16,859,503	42.83%
Commercial Sales	56	19.11%	22,481,830	23,620	22,505,450	57.18%
Commercial Breakdown						
LOAD COUNT			18,000	0		
3" METER	4	1.37%	3,011,000	0	3,011,000	7.65%
2" METER	5	1.71%	3,007,500	0	3,007,500	7.64%
1 1/2" METER	4	1.37%	2,865,530	0	2,865,530	7.28%
1" METER	2	0.68%	162,670	0	162,670	0.41%
5/8" METER	41	13.99%	13,417,130	23,620	13,440,750	34.15%
	56	19.11%	22,481,830	23,620	22,487,450	57.13%
1" - 3" METERS	15	5.12%	9,046,700	0	9,046,700	22.98%
1.5" - 3" METERS	13	4.44%	8,884,030	0	8,884,030	22.57%

The analysis indicates that commercial accounts represent only 20 percent of the total number accounts but nearly 60 percent of all sales. This is an unusually large percentage of commercial accounts and an extremely large percentage of commercial sales, particularly for a small water system. The disproportionate number of

commercial accounts and high level of commercial sales reflect several unique characteristics of the Company's service area summarized as follows.

- Extensive commercial facilities exist to serve the traveling public using Interstate 40 and historic Route 66.
- Several livestock operations receive water service from the Company.
- The BNSF Railway, ADOT, El Paso Natural Gas and Yavapai County maintain operations in or near Seligman related to maintenance of their respective facilities.
- The Company provides standpipe service to a coin operated standpipe and other standpipe meters supporting extensive water hauling to rural development located outside of the Company's service area.

These unique characteristics result from the remoteness of Company's service area and the lack of groundwater in and around the Company's service area.

Based on the 2008 billing data analysis and other considerations, the physical system evaluation focused on the following items.

- Site visit to all major facilities including the well sites, the transfer pump station, the 8" master meter, the 210,000 gallon storage tank, and the distribution system pump station.
- Physical Inspection and evaluation of the standpipe sales station.
- Physical Inspection of all commercial accounts with meters 1-inch and larger.
- Review of any known areas of past distribution system leakage.

Major Facilities

Site visits to all major facilities were conducted on May 18th, 2009. All sites were observed to be generally well maintained and fully operable. A summary of the observations from the site visits to major facilities is presented below.

- North and South Well
 - Wells operating in automatic mode
 - Each well equipped with turbine meter
 - South Well – 3" AMCO T3000
 - North Well – 3" Hersey Horizon
 - Piping at each well provided recommended straight pipe length of 5 pipe diameters upstream and 3 pipe diameters downstream of the meter
 - No lost water concerns noted
- Transfer Pump Station
 - Pump station operating in automatic mode
 - No leakage observed at 22,000 gallon tank

- Pump station is unmetered
- Pump station is not equipped with any surge (water hammer control)
- Significant leakage observed at shaft seals of both primary pumps
- 8" Master Meter
 - 8" Hersey Horizon turbine meter
 - Meter installed with recommended straight pipe length of 5 pipe diameters upstream and 3 pipe diameters downstream
 - Normal flow of approximately 200 gallons per minute is within low flow range of meter but on lower end of range (30 – 3,500gpm)
- 210,000 gallon Storage Tank
 - Tank equipped with inoperable altitude valve
 - No check valve on supply line – water may reverse flow into transmission main
 - Very minor seepage observed at base of tank
- Distribution system pump station
 - Pump station operating in automatic mode
 - Pump station is unmetered
 - Pump station equipped with 3,000 gallon hydropneumatic tank for surge control and to prevent pump cycling
 - Minor leakage observed at seal of primary pump

Standpipe Sales Station

Aubrey supplies water at a standpipe sales station to support significant water hauling to rural development located outside of the Aubrey's service area. To meet this demand, Aubrey has installed a coin operated standpipe to service small commercial haulers and individual haulers and a four-station dedicated commercial standpipe for use by large commercial haulers and Yavapai County. Figure 3.2 is a picture of the standpipe sales station.

The coin operated standpipe is operated by a timer set to provide 50 gallons per quarter deposited to equal Aubrey's standpipe rate of \$5.00 per 1,000 gallons. The standpipe is equipped with a 1-inch meter installed in May, 2008 that is used for reporting water sales.

On May 18th, 2009 the filling of a 2,000 gallon tank truck at the coin operated standpipe was observed. The driver inserted 42 quarters to purchase 2,100 gallons of water. The tank filled at an observed rate of 64 gallons per minute. The driver stopped the standpipe when the tank began to overflow. The meter registered 2,087 gallons delivered. Based on these observations the coin operated standpipe is accurately dispensing and measuring water sold.

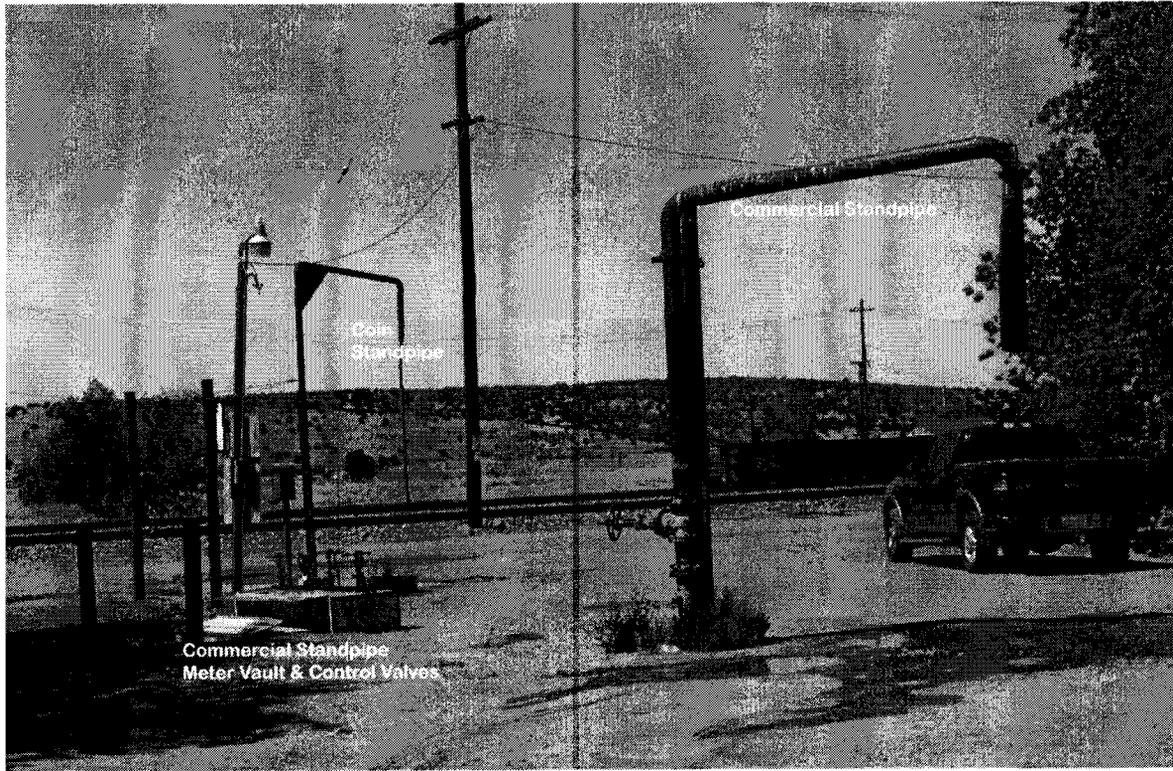


Figure 3.2 - Standpipe Overview

The dedicated commercial standpipe is equipped with four valves and four meters feeding a common standpipe. Each valve and meter is assigned to a customer who locks the valve to prevent usage by other haulers. When a hauler arrives he unlocks and opens his valve to fill the tank truck. The meter records the flow and is billed monthly along with all other customer accounts.

On May 18, 2009 the use of each of the four standpipes by its assigned hauler was observed. Table 3.7 presents the results of the observations including a calculation of meter accuracy.

Table 3.7 - Results of Commercial Standpipe Observation

Service Id	Hauler/Account	Tank Size	Source	Beginning Read	Ending Read	Metered Delivery (gallons)	Meter Accuracy
921	Alan Van Moppes	1,200	Driver Estimate	28390870	28392050	1,180	98.3%
922	Troy Young	2,000	Tank Nameplate	8072840	8074740	1,900	95.0%
923	Michael Harmon	2,000	ARICOR Estimate	11108840	11110640	1,800	90.0%
924	Yavapai County	300	Calculated	8490540	8490770	230	76.7%
	Overall Accuracy	5,500				5,110	92.9%

Due to the need to estimate and or calculate tank size in three instances, the accuracy of the testing should be considered ± 5.0 percent, meaning the station accuracy could be as high as 98% or as low as 88%.

The meters installed at this site are six-inch Badger saddle meters. The exact age of the meter installation is unknown. It is believed that the meter installation was installed in the early 1990s, making the meters nearly 20 years old. Adequate runs of straight pipe upstream and downstream of the meters have been provided. However, the manual control valves used to throttle standpipe flow are approximately 60-inches upstream of the meters creating the potential for inaccuracy caused by vortexing.

Large Commercial Meters

On May 18th, 2009 each of the commercial water meters 1-inch or greater in diameter was physically observed. Based on billing system data, eleven meters (excluding the standpipes) met this criteria. However, based on the on-site operators knowledge a total 22 commercial meters (excluding the standpipes) were located and observed. Table 3.8 below classifies the meters by size, approximate date of installation and type.

Table 3.8 - Large Commercial Meters by Size and Type

Size	Hersey Positive Displacement Meter	Neptune T-10 Positive Displacement Meter	Precision Multi-jet Meter	Other Manufacturer or Type	Totals
	2008-2009	1997-2007	1991-1997	Older	
1-inch	0	3	0	3	6
1.5 inch	0	3	2	1	6
2-inch	3	6	1	0	10
Totals	3	12	3	4	22
Percentage	14%	55%	14%	18%	

A summary of other observations from the physical observation of the large commercial meters is presented below.

- Nearly all of the meters were installed at significant depth. The meters appeared to be installed at the depth of the main.
- The depth of the meters makes meter reading and meter change out difficult.
- Typically the services were isolated with gate valves, rather than meter stops.
- Eight commercial meters were listed in billing records as residential meters⁹.
- A visible leak was detected on the customer side of the meter serving the Seligman KOA (Service ID 360). The leak was not being registered by the meter. The KOA is served by a Precision Multi-jet meter¹⁰.

⁹ SUM has been provided data for correction in billing system.

¹⁰ Customer had been previously advised of leakage and asked to repair customer piping.

Distribution System

On May 18th, 2009 several areas of the distribution system where recent main repairs occurred were observed. All areas appeared to be free of leakage at the time of observation. The on-site representative identified a 1,300 ft section of 4" steel water main on the south side of Chino St. from Indian Ave. to 1st Ave. where several main line leaks had been repaired in close proximity to each other. This section of water main has been recommended for replacement in Aubrey's current Water Loss Analysis Program.

3.2 Water Audit

3.2.1 Methodology

The water loss audit was performed using the IWA/AWWA Water Audit Method¹¹ as detailed in *Manual of Water Supply Practices – M36, Water Audits and Loss Control Programs* published by the American Water Works Association.

The IWA/AWWA Water Audit Method (AWWA Water Audit) recognizes that effective water loss control by a water provider provides multiple benefits, including better use of available water resources, optimizing revenue recovery, minimizing distribution system disruptions, generating reliable performance data, and reducing the potential for contamination (American Water Works Association, 2009). The AWWA Water Audit advances the concept that all water should be quantified, via measurement or estimate, as either authorized consumption or losses – no water is *unaccounted-for*¹².

The results of the AWWA Water Audit are presented in the form of a water balance (AWWA Water Balance). The AWWA Water Balance establishes rational terms and definitions for classifying water audit data. The AWWA Water Balance is presented in Figure 3.3. The terms used in the AWWA Water Balance and their definitions are presented in Table 3.9.

¹¹ The International Water Association (IWA) and the American Water Works Association (AWWA) drew on the best practices included in the various water audit methods in use worldwide, including the United States, to assemble a best management practice methodology for water loss assessment and control. In 2003, the AWWA's Water Loss Control Committee published the report "Applying Worldwide Best Management Practices in Water Loss Control" in *Journal AWWA*. In 2009, the AWWA published *Manual of Water Supply Practices – M36, Water Audits and Loss Control Programs* explaining the IWA/AWWA water audit methodology and documenting loss control techniques that can be implemented for a sustainable water loss control program (American Water Works Association, 2009).

¹² The AWWA recommends that water utilities, state agencies, and drinking water stakeholders avoid the use of the imprecise term *unaccounted-for water*.

The AWWA Water Audit includes the calculation of a standard set of performance indicators, allowing a realistic assessment of the impact of water loss on a utility's performance. Historically utilities have relied, sometimes solely, on the imprecise unaccounted-for water percentage, which usually took some form of the amount of water losses over system input volume (American Water Works Association, 2009)¹³.

Figure 3.3 - AWWA Water Balance

System Input Volume	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption	Revenue Water	
			Billed Coin Sales		
			Billed Unmetered Consumption (water billed based on load count)		
	Water Losses	Unbilled Authorized Consumption	Unbilled Authorized Consumption	Unbilled Unmetered Consumption (flushing, firefighting)	Non-Revenue Water
				Unauthorized Consumption (theft)	
		Apparent Losses	Apparent Losses	Customer Metering Inaccuracies	
				Systematic Data Handling Errors	
Real Losses	Real Losses	Leakage and Overflows			

Note: Modified to eliminate terms/categories not applicable to Aubrey

¹³ Aubrey and the ACC have been using this unaccounted-for water percentage as the sole method to evaluate Aubrey's lost water performance. Aubrey and the ACC have considered all water that was not billed as lost water in making the calculation.

Table 3.9 - AWWA Water Balance Terms and Definitions

Water Balance Component	Definition
System Input Volume	The annual volume input to the water supply system.
Authorized Consumption	The annual volume of metered and/or unmetered water taken by registered customers, the water supplier, and others who are authorized to do so.
Water Losses	The difference between System Input Volume and Authorized Consumption, consisting of Apparent Losses plus Real Losses.
Apparent Losses	Unauthorized Consumption, all types of metering inaccuracies and systematic data handling errors.
Real Losses	The annual volumes lost through all types of leaks, breaks, and overflows of mains, service reservoirs, and service connections, up to the point of customer metering.
Revenue Water	The components of System Input Volume that are billed and produce revenue.
Nonrevenue Water	The sum of Unbilled Authorized Consumption, Apparent Losses, and Real Losses. Also, this value can be determined as the difference between System Input Volume and Billed Authorized Consumption.

There are a number of flaws associated with focusing solely on the percentage of unaccounted-for water, including:

- The calculation of this percentage has been widely inconsistent, making reliable performance comparisons impossible.
- The calculation is highly sensitive to the level of consumption in the water utility. Accordingly, the percentage of loss varies with seasonal demands even if actual losses have not changed.
- The calculation does not segregate apparent losses and real losses.
- The calculation provides no information of water volumes or cost.
- The calculation does not take into account the physical characteristics of the water system such as system pressure or length of mains per customer.

The AWWA Water Audit standard set of Performance Indicators are presented in Table 3.10.

Table 3.10 - AWWA Water Audit - Performance Indicators

Function	Level	Performance Indicator	Comments
Financial	1 Basic	Non-Revenue Water by Volume [Volume of Non-Revenue Water as a percentage of System Input Volume]	Easily calculated, limited value, should not be used as a measure of operational efficiency
Financial	3 Detailed	Non-Revenue Water by Cost [Value of Non-Revenue Water as a percentage of the annual cost of running the system]	Good Financial Indicator
Operational	1 Basic	Apparent Losses [gal/service connection/d]	Basic but meaningful, easy to calculate
Operational	2 Basic	Real Losses [gal/service connection/d] for urban systems or [gal/mi of mains/d] for rural systems	Best of traditional performance indicators, useful for target setting, limited use for comparisons between systems.
Operational	2 Intermediate	Real Losses [gal/service connection/d/psi] for urban systems or [gal/mi of mains/d/psi] for rural systems	Useful for comparison between systems.
Operational	3 Detailed	Unavoidable Annual Real Losses [UARL (gal) = (5.41Lm + 0.15Nc + 7.5Lc) x P] Lm=length of water mains Nc=number of service connections Lc=length of unmetered private service connections P=average system pressure	Theoretical reference representing the technical low limit of leakage if best technology applied.
Operational	3 Detailed	Infrastructure Leakage Index (ILI) [ILI = CARL / UARL]	Ratio of Current Annual Real Losses (CARL) to Unavoidable Annual Real Losses (UARL); best indicator for comparisons between systems.

3.2.2 Water Audit Period

The Aubrey water audit is based on the most recent 12-months of data, June 2008 through May 2009. A one-year period was chosen to eliminate the impact of seasonal variations in water demand. The most recent 12-months was chosen because the data is believed to be better than the data for the 2008 calendar year due to the installation of a meter on the coin operated standpipe and replacement of the North Well meter in May and August of 2008, respectively.

3.2.3 Basic System Data

Basic system data was collected as prescribed by the AWWA Water Audit. The collected data is summarized in Table 3.11.

Table 3.11 - Basic System Data

DISTRIBUTION SYSTEM BASIC DATA			
SYSTEM TYPE		Combined raw water transmission and distribution system	
INFRASTRUCTURE DATA		FINANCIAL DATA	
6.2	Miles of transmission mains	\$ 153,738	Total costs to operate the water supply system
9.1	Miles of distribution mains	\$ 2.62	Customer retail unit rate (\$/1,000 gal) - applied to Apparent Losses
15.3	Total miles of mains (Lm)	\$ 0.6085	Variable cost to produce the next unit of water (\$/1,000 gal) - applied to Real Losses
300	Total number of service connections (Nc)	Financial Data is based on Calendar Year 2008 data obtained from Southwestern Utility Management, Inc.	
70	Average Operating Pressure (psi) - Distribution		
55	Average Operating Pressure (psi) - Transmission		
64	Weighted Average Operating Pressure (psi)		

This data reveals a unique characteristic of the Aubrey water system. Aubrey's system includes a lengthy transmission main to import water from its distant well field. This transmission pipeline represents over 40% of Aubrey's installed pipe footage and is the largest diameter pipe in its system. Expectedly, the long transmission line causes Aubrey to have a low service density¹⁴. Utilities with low service densities will typically experience more leakage per connection than a system with higher service density.

3.2.4 System Input Volume

The water supply for Aubrey is supplied by two wells, the North Well and the South Well. The production of these wells represents the System Input Volume for the Aubrey System. Since both wells are metered, the production of the wells was determined using meter readings taken by the system operator and is summarized in Table 3.12.

¹⁴ Service density is defined as the number of service connections divided by the total miles of piping.

Table 3.12 - System Input Volume

Month	Year	From Meter Readings		
		South Well	North well	Total Well
		Pumpage	Pumpage	Pumpage
June	2008	5,482,100	1,026,600	6,508,700
July	2008	5,406,200	672,100	6,078,300
August	2008	1,309,400	4,819,900	6,129,300
September	2008	2,607,000	2,184,700	4,791,700
October	2008	543,800	3,435,100	3,978,900
November	2008	1,155,200	1,844,700	2,999,900
December	2008	-	3,073,100	3,073,100
January	2009	2,755,900	4,800	2,760,700
February	2009	270,100	2,329,800	2,599,900
March	2009	2,853,700	388,600	3,242,300
April	2009	914,700	2,471,300	3,386,000
May	2009	4,828,000	219,000	5,047,000
12-Month Total		28,126,100	22,469,700	50,595,800

The next step in the AWWA Water Audit process is to adjust the metered production to account for meter reading errors, meter inaccuracy and changes in tank storage. The South Well meter was replaced in November 2007 and the North Well meter was replaced in August 2008. Given the age of the South Well meter the metered usage from that meter is considered accurate. The North Well meter may have been under metering production in the June and July. However, there is insufficient data to determine what if any adjustment should be made. Additionally, the South Well was used as the lead well in June and July, reducing the impact of any North Well metering error. Accordingly no adjustment is made for meter inaccuracy. There were no meter reading errors and tank storage is minimal in the Aubrey system, making any further adjustment unnecessary.

3.2.5 Billed Authorized Consumption

Billed sales as reported by SUM will be used for the AWWA Water Audit. This data has been compared to raw data from billing records and found to reconcile favorably. Table 3.13 details the usage data used in the AWWA Water Audit.

Table 3.13 - Billed Authorized Consumption

Month	Year	Metered Sales from Billing Data	Metered Usage Billed outside of Billing System	Coin Standpipe Sales	Billed Authorized Consumption
June	2008	5,365,220	-	564,520	5,929,740
July	2008	5,132,823	-	478,910	5,611,733
Aug	2008	4,882,683	72,906	435,940	5,391,529
Sept	2008	3,552,104	-	431,590	3,983,694
Oct	2008	2,784,863	-	342,450	3,127,313
Nov	2008	1,896,827	-	320,730	2,217,557
Dec	2008	2,021,880	-	256,610	2,278,490
Jan	2009	1,614,390	-	253,250	1,867,640
Feb	2009	1,703,300	-	290,230	1,993,530
Mar	2009	2,086,770	-	306,510	2,393,280
Apr	2009	2,283,360	-	315,000	2,598,360
May	2009	3,994,180	-	472,870	4,467,050
12-Month Totals		37,318,400	72,906	4,468,610	41,859,916

3.2.6 Non-Revenue Water

Non-Revenue water is the volume of water that a utility places into the distribution system that is not billed and does not generate revenue for the utility. Non-Revenue Water can be calculated by subtracting the Billed Authorized Consumption from the System Input Volume. For Aubrey, Non-Revenue Water equals 8,735,884 gallons for the 12-month period¹⁵.

3.2.7 Unbilled Authorized Consumption

Unbilled Authorized Consumption includes water taken irregularly from nonaccount connections. For Aubrey Unbilled Authorized Consumption includes water used for flushing and water used by the fire department. This usage is estimated at 0.5 percent of the System Input Volume. For Aubrey this results in Unbilled Authorized Consumption of 252,979 gallons for the 12-month period.

¹⁵ Non-Revenue water is the more precise term for unaccounted-for water or lost water recommended by AWWA.

3.2.8 Apparent Losses

Apparent Losses are nonphysical losses that occur when water is delivered to an end user but is not measured or recorded accurately and therefore not billed. Apparent losses cost water utilities revenue, but do not impact the efficient use of water resources. Apparent Losses consists of

- Unauthorized Consumption or Theft
- Customer Metering Inaccuracies
- Systematic data handling errors

Unauthorized Consumption

Unauthorized consumption includes water that is taken without the consent of the water utility and can include illegal connections, buried or obscured meters, unauthorized use of hydrants, and other unauthorized uses. Aubrey has recently found and installed meters on two previously unmetered connections and installed hydrant locks on four fire hydrants to prevent unauthorized water usage. It is believed that Aubrey has good control of unauthorized consumption, so unauthorized consumption will be estimated using AWWA's recommended standard factor of 0.25 percent of System Input Volume. Accordingly, for Aubrey unauthorized consumption is estimated to be 126,490 gallons for the 12-month period.

Customer Metering Inaccuracies

Based on limited examination of large commercial meters, including the standpipe meters, metering error is likely significant for Aubrey. Approximately, 22% of the large commercial meters are greater than ten years old. It is believed that a larger percentage of the smaller commercial and residential meters will be older than ten years old and that a significant percentage is likely older than 20 years old.

Typically, operable meters are typically between 90% and 100% accurate. Considering the results of the standpipe meter observations and the estimated age of meters in the Aubrey system, 94% metering accuracy will be used for the AWWA Water Audit. The resulting Customer Metering Inaccuracy is 2,671,910 gallons for the 12-month period.

Systematic Data Handling Errors

Since verified Billing System Sales are being used in the AWWA Audit, no adjustment will be made for systematic data handling errors.

Total Apparent Losses

Total Apparent Losses are the sum of Unauthorized Consumption, Customer Metering Inaccuracies and Systematic Data Handling Errors. The Total Apparent Losses are 2,798,400 gallons for the 12-month period.

3.2.9 Real Losses

Real Losses consist of all leakage and overflows from the water system. Real Losses are calculated by subtracting Authorized Consumption and Apparent Losses from the System Input Volume. For Aubrey the Real Losses total 5,684,505 gallons for the 12-month period.

3.2.10 Audit Results

The Water Balance is presented in Table 3.14 and the calculated Performance Indicators for Aubrey are documented in Table 3.15. The full AWWA Water Audit worksheet is provided in Appendix 1.

Table 3.14 - Water Balance Results

Water Balance				
Aubrey Water Company		For the Period June '08 - May '09		
System Input Volume 50.596	Authorized Consumption 42.113	Billed Authorized Consumption 41.860	Billed Metered Consumption 37.391	Revenue Water 41.860
			Billed Coin Sales 4.469	
			Billed Unmetered Consumption (water billed based on load count) Incuded in Metered Consumption	
		Unbilled Authorized Consumption 0.253	Unbilled Unmetered Consumption (flushing, firefighting) 0.253	Non-Revenue Water 8.736
	Water Losses 8.483	Apparent Losses 2.798	Unauthorized Consumption (theft) 0.126	
			Customer Metering Inaccuracies 2.672	
			Systematic Data Handling Errors 0.000	
	Real Losses 5.685	Leakage and Overflows 5.685		

Table 3.15 - Water Audit Performance Indicators

Performance Indicators				
Category	Description	Expressed as:	Calculation	Indicator Value
Financial	Non-Revenue water by Volume	Volume of Non-Revenue Water as % of System Input Volume	(8,735,884 / 50,595,800)	17.3%
	Non-Revenue water by cost	Value of Non-Revenue Water as a % of annual cost of operation	(\$663+\$7,338+\$3,459)/\$153,738	7.5%
Operational	Water Losses	million gallons / yr	WL	8.48
	Apparent Losses	million gallons / yr	AL	2.80
	Current Annual Real Losses	million gallons / yr	CARL	5.68
	Apparent Losses Normalized	gallons/service connection/d	AL/Nc/days (2,798,400/300/365)	25.6
	Real Losses Normalized	gallons/mile of mains/d ¹	CARL/miles of main/days (5,684,505/15.3/365)	1,019.5
	Real Losses Normalized	gallons/mile of mains/d/psi ¹	CARL/miles of main/days/avg. psi (5,684,505/15.3/365/64)	15.93
	Unavoidable Annual Real Losses (UARL) ²	million gallons / yr	[(5.41Lm + 0.15Nc) x avg. psi] * 365 / 1000000	3.08
	Infrastructure Leakage Index (ILI) ³	CARL / UARL (dimensionless)	5.68 / 3.08	1.85
¹ Indicator is based on miles of mains because of Aubrey's low Service Density. The AWWA Water Audit requires the use of "miles of Mains" instead of "service connections" whenever Service Density is below 32/mile. Aubrey's Service Density is calculated as (300 service connections / 15.3 miles of pipeline)=19.6 connections/mile. ² The UARL calculation has not proven sufficiently valid for small systems with less than 3,000 service connections or a Service Density of less than 16 per mile. The number is provided for illustrative purposes. The normalized real loss figure of 924.0 gal/miles of main/d should be used to as the measure of real loss standing for Aubrey. ³ The ILI is calculated using the UARL Indicator. Accordingly, it should be considered illustrative since the UARL is not considered sufficiently valid for small systems.				

4. Analysis and Recommendations

4.1 Analysis

Aubrey has made significant progress in reducing Non-Revenue Water since the 2005 test year used in Aubrey's rate case. Based on the AWWA Water Audit, Non-Revenue Water for the most recent 12-month period was 17.3 %, a 59.9 % reduction from the 43.1 % noted in the ACC Staff Report for the rate case. Moreover, the AWWA Water Audit established the cost of Non-Revenue Water at a reasonable 7.5% of the annual cost of running the system. Significantly, the annual cost of Real Losses (leakage and overflows) was established to be an affordable and acceptable \$3,459 (Line 14, Page 2, Appendix 1).

The AWWA Water Audit estimated the Unavoidable Annual Real Losses (UARL) to be 3.08 million gallons and the Current Annual Real Losses (CARL) to be 5.68 million

gallons. This results in a calculated Infrastructure Leakage Index (ILI) of 1.85. Since the AWWA method for establishing the UARL has not been proven fully valid for systems less than 3,000 connections, the calculated ILI should not be used for leakage target setting for Aubrey. However, the ILI is nevertheless informative. An ILI of 1.85 would indicate an acceptable level of leakage control for a system with greatly limited available water resources that are costly to develop or produce (American Water Works Association, 2009). AWWA recommends an ILI target of 3.0 – 5.0 for systems, such as Aubrey, with sufficient water resources and infrastructure to meet long-term needs. Even if the UARL estimated in the AWWA Water Audit is overstated by 100% for Aubrey, the resulting ILI would be 3.69 – still well within the AWWA range of recommended ILI for Aubrey.

The AWWA Water Audit provides a realistic assessment of the impact of Water Losses on Aubrey's operational and financial performance. The AWWA Water Audit takes into consideration utility specific factors, such as the low service density for Aubrey caused by the need to import water from 6.2 miles away from the distribution system. The AWWA Water Audit was developed to decrease reliance on the historic practice of evaluating water loss with a single Non-Revenue Water percentage calculation and shift to a more robust form of analysis that is particularly applicable to a small unique system like Aubrey. In Aubrey's case, the AWWA Water Audit establishes that Aubrey's water loss control performance is acceptable, even though its Non-Revenue Water percentage is in excess of the 15% maximum normally targeted by the ACC.

4.2 Recommendations

The AWWA Water Audit is helpful in directing Aubrey's future efforts to control Water Losses. The act of compiling the data for the Audit revealed minor issues with data integrity that should be addressed. Additionally, the AWWA Water Audit indicated that Apparent Losses, primarily customer metering inaccuracies, were over twice as costly as Real Losses to Aubrey. This indicates that, as financial resources permit, Aubrey should continue its strong focus on meter replacement. Since the Audit indicates a significant amount of Real Losses exists in the Aubrey system, Aubrey should continue to identify and address leakage aggressively.

While the AWWA Water Audit provides direction, the System Review provides detailed insight into Water Loss and the actions required to continue Aubrey's track record of Water Loss reduction. Recommendations to improve data integrity, reduce Apparent Losses, reduce Real Losses and improve reporting are presented below.

4.2.1 Data Integrity

Install Meter at Transfer Pump Station - The transfer pump station should be equipped with a meter on the discharge piping to measure flow entering the transmission pipeline and provide verification of metered well production. This item should be incorporated into the existing project to replace the transfer pump station.

Verify Leakage in Transmission Line – Once the replacement of the transfer pump station is complete, leakage in the transmission line should be measured. This can be accomplished by temporarily connecting a small diameter meter from downstream of the 8" master meter to a point upstream of the 8" master meter (to meter reverse flow). With the transfer pump station turned off, the valves isolating the 8" meter should be closed to prevent reverse flow through the 8" meter. Valves isolating the small diameter meter should be opened to allow reverse flow through the small diameter meter. The rate of flow and total flow should be logged over a period of several hours to document leakage at static pressure in the transmission line.

Evaluate and Modify the 8" Master Meter Installation – Data collected to date from the 8" master meter is inconclusive. Based on the results of the transmission main leakage test (recommended above) and comparison of well metered usage and transfer pump station metered usage to the 8" master meter usage, effectiveness of the current master meter installation should be evaluated. If leakage in the transmission line is significant, it may be necessary to install a two way metering system at the 8" master meter site to accurately meter net flows out of the transmission line. The evaluation should consider downsizing the 8" master meter to better match actual flows with the normal operating range of the meter.

Evaluate Billing Procedures and Equipment – Working with the on-site representative, the system manager should review, evaluate and document the billing process from meter reading (including production meters, master meters, and coin standpipe meter) to actual billing, including out of cycle bills, adjustments, turn-on and turn-off of accounts, re-read procedures and other aspects of the billing process. Consideration should be given to developing procedures to eliminate duplicative entry of data by the on-site representative and manager and to improving validation of meter readings. Revised processes should include recording actual meter reading dates as opposed to the range of dates currently used. Upgrading of the on-site representative's computer equipment and software should be considered.

Evaluate Reporting Procedures – The system manager should review, evaluate and document reporting procedures for production data, master meter data, sales data, and lost water data provided to Aubrey. Consideration should be given to developing procedures that eliminate duplicative entry of data by constructing linked Excel workbooks and/or worksheets to produce accurate results linked to source data. Revised procedures should insure that billing adjustments and out of cycle billings are reported. Revised procedures should reduce or preferably eliminate any billings or adjustments outside of the computerized billing system. Revised procedures should incorporate reporting and documentation of any billings or adjustments performed outside of the computerized billing system.

Meter Data – Meter data maintained in the computerized billing system is incomplete and inaccurate. The system manager should work with the on-site representative to verify size of all installed meters, document manufacturer, serial number and approximate age of all meters.

4.2.2 Apparent Losses

Water Meter Replacement Program – The water meter replacement program should be continued as financial resources permit. Inoperable or obviously inaccurate meters should remain the first priority. As a second priority, commercial meters older than ten years old should be replaced. As a third priority, residential meter older than 20 years old should be replaced.

Commercial Standpipe Meters – The commercial standpipe meters are high volume meters that are nearly 20-years old. The meters should be scheduled for replacement. Due to the current configuration, replacing the meters will require modification of the standpipe assembly at significant cost. The modifications should be planned and designed by an engineer familiar with proper meter sizing and layout. Consideration should be given to rearranging the flow control valves to be downstream of the meters. The project should be scheduled as financial resources permit.

Meter Removal Program – The meter removal program should be continued. Meters that have been out of service for a period of time should be removed and the service line capped to prevent unauthorized usage or leakage.

Meter Relocation Program – When replacing a meter or when leakage is observed, to the extent practical, meters installed on customer owned piping should be relocated to the property line or other point of demarcation between the company owned piping and customer owned piping.

4.2.3 Real Losses

Replace Transfer Station Pumps – The shaft seals on the pumps at the well field transfer pump station are experiencing significant leakage. Aubrey should complete the current project to replace the leaking pumps with a new skid mounted pump station. The existing pump station does not have any provisions to control water hammer in the transmission pipeline. Since water hammer can lead to leakage in the pipeline, particularly considering the age of the transmission pipeline, appropriate equipment should be included to address water hammer.

Inspection of Water Distribution System – Continue water distribution system inspection program. The water distribution system should be regularly inspected for leaks and leaks should be repaired promptly. Inspection should include the use of pipe locating equipment to better locate the location of mains and the observation of plant growth as an indicator of leaks.

Replace Failing Water Main – Approximately 1,300 feet of 4-inch diameter steel water main located along the south side of Chino St. from Indian Ave. to 1st Ave. should be replaced. The line has experienced multiple leaks and has been repaired several times. The project should be scheduled as financial resources permit.

4.2.4 Reporting

Progress and Monitoring Reports – Progress and Monitoring Reports should continue to be prepared and filed with the ACC every January and July. The Monitoring Report should be updated to use water loss terminology recommended by the AWWA. The Monitoring Report should report data for the previous 12-month period rather than calendar year data. The report should include System Input Volume and Non-Revenue Water Volume for each month and in total for the 12-month period. Non-Revenue Water by Volume percentage should be reported for each month and on a 12-month rolling average basis. Reporting to the ACC should be continued until the 12-month rolling average Non-Revenue Water by Volume is below 15% for the distribution system¹⁶ for 12 consecutive months.

Separate Reporting of Transmission and Distribution System Losses – When the 8" master meter installation is verified to be accurately isolating and measuring water loss in the transmission main. Reporting should be modified to separate reporting of water losses in the transmission system and the distribution system.

5. Works Cited

American Water Works Association. (2009). *Water Audits and Loss Control Programs*. Denver: American Water Works Association.

Arizona Department of Water Resources. (2007). *Arizona Water Atlas, Volume 5*. Phoenix: Arizona Department of Water Resources.

BNSF Railway Company. (2008). *Seligman Area Water Assets Descriptive Memorandum*. Fort Worth: BNSF Railway Company.

Staff - Arizona Corporation Commission. (2007). *Staff Report Utilities Division Arizona Corporation Commission, Aubrey Water Company Docket No. W-03476A-06-0425*. Phoenix: Arizona Corporation Commission.

¹⁶ Due to the extensive transmission system serving Aubrey, the traditional ACC 15% Non-Revenue Water by Volume standard should be applied to the distribution system rather than the combined distribution system and transmission system.

APPENDIX 1

AWWA Water Audit Worksheet

WATER AUDIT BASIC DATA				
WATER AUDIT FOR THE PERIOD		June 1, 2008	TO	May 31, 2009
UTILTIY	Aubrey Water Company			
COMPILED BY	Ray L. Jones, P.E.	DATE COMPILED	June '09	
DISTRIBUTION SYSTEM BASIC DATA				
SYSTEM TYPE	Combined raw water transmission and distribution system			
INFRASTRUCTURE DATA			FINANCIAL DATA	
6.2	Miles of transmission mains	\$ 153,738	Total costs to operate the water supply system	
9.1	Miles of distribution mains	\$ 2.62	Customer retail unit rate (\$/1,000 gal) - applied to Apparent Losses	
15.3	Total miles of mains (Lm)	\$ 0.6085	Variable cost to produce the next unit of water (\$/1,000 gal) - applied to Real Losses	
300	Total number of servcie connections (Nc)	Financial Data is based on Calendar Year 2008 data obtained from Southwestern Utility Management, Inc.		
70	Average Operating Pressure (psi) - Distribution			
55	Average Operating Pressure (psi) - Transmission			
64	Weighted Average Operating Pressure (psi)			

Water Balance Calculations				
Line	Water Balance Component	Factor	Water Volume (gal)	Calculation
1	System Input Volume		50,595,800	
2	Billed Authorized Consumption		41,859,916	
3	Non-Revenue Water		8,735,884	Line 1 - line 2
4	Unbilled Authorized Consumption	0.50%	252,979	Line 1 x 0.50%
5	Authorized Consumption		42,112,895	Line 2 + Line 4
6	Water Losses (WL)		8,482,905	Line 1 - Line 5
7	AL - Unauthorized Consumption	0.25%	126,490	Line 1 x 0.25%
8	AL - Customer Metering Inaccuracy	6.0%	2,671,910	Line 2 / (1-.06) - Line 2
9	AL - Systematic Data Handling Errors		-	
10	Apparent Losses (AL)		2,798,400	Lines 7 + 8 + 9
11	CARL - Current Annual Real Losses		5,684,505	Line 6 - Line 10

WATER AUDIT BASIC DATA				
WATER AUDIT FOR THE PERIOD		June 1, 2008	TO	May 31, 2009
UTILITY	Aubrey Water Company			
COMPILED BY	Ray L. Jones, P.E.	DATE COMPILED	June '09	

Cost Calculations					
Line	Cost Component	Cost Factor		Cost	Calculation
12	Cost of Unbilled Authorized Consumption	\$ 2.62		\$ 663	Line 4 * \$2.62 /1000
13	Cost of Apparent Losses	\$ 2.62		\$ 7,338	Line 10 * \$2.62 /1000
14	Cost of Real Losses	\$ 0.6085		\$ 3,459	Line 11 * \$0.6085 /1000

Performance Indicators				
Category	Description	Expressed as:	Calculation	Indicator Value
Financial	Non-Revenue water by Volume	Volume of Non-Revenue Water as % of System Input Volume	(8,735,884 / 50,595,800)	17.3%
	Non-Revenue water by cost	Value of Non-Revenue Water as a % of annual cost of operation	(\$663+\$7,338+\$3,459)/\$153,738	7.5%
Operational	Water Losses	million gallons / yr	WL	8.48
	Apparent Losses	million gallons / yr	AL	2.80
	Current Annual Real Losses	million gallons / yr	CARL	5.68
	Apparent Losses Normalized	gallons/service connection/d	AL/Nc/days (2,798,400/300/365)	25.6
	Real Losses Normalized	gallons/mile of mains/d ¹	CARL/miles of main/days (5,684,505/15.3/365)	1,019.5
	Real Losses Normalized	gallons/mile of mains/d/psi ¹	CARL/miles of main/days/avg. psi (5,684,505/15.3/365/64)	15.93
	Unavoidable Annual Real Losses (UARL) ²	million gallons / yr	[(5.41Lm + 0.15Nc) x avg. psi] * 365 / 1000000	3.08
Infrastructure Leakage Index (ILI) ³	CARL / UARL (dimensionless)	5.68 / 3.08	1.85	

¹ Indicator is based on miles of mains because of Aubrey's low Service Density. The AWWA Water Audit requires the use of "miles of Mains" instead of "service connections" whenever Service Density is below 32/mile. Aubrey's Service Density is calculated as (300 service connections / 15.3 miles of pipeline)=19.6 connections/mile.

² The UARL calculation has not proven sufficiently valid for small systems with less than 3,000 service connections or a Service Density of less than 16 per mile. The number is provided for illustrative purposes. The normalized real loss figure of 924.0 gal/miles of main/d should be used to as the measure of real loss standing for Aubrey.

³ The ILI is calculated using the UARL Indicator. Accordingly, it should be considered illustrative since the UARL is not considered sufficiently valid for small systems.

APPENDIX 2

Corrected Lost Water Data

AUBREY WATER COMPANY
P.O. BOX 85160
TUCSON, ARIZONA 85754
(520) 623-5172

WATER LOSS REPORT
2008

South Well-Gallons Pumped PER MONTH	Year: 2008 GALLONS
12/4/07-1/1/08	3,460,400
1/1/08-2/1/08	300
2/1/08-3/1/08	2,944,300
3/1/08-4/3/08	9,700
4/3/08-5/1/08	3,761,900
5/1/08-6/2/08	496,000
6/2/08-7/1/08	5,482,100
7/1/08-8/2/08	5,406,200
8/2/08-9/2/08	1,309,400
9/2/08-10/3/08	2,607,000
10/3/08-11/3/08	543,800
11/3/08-12/1/08	1,155,200
12/1/08-1/3/09	0
TOTAL	27,176,300

North Well-Gallons Pumped PER MONTH	Year: 2008 GALLONS
12/4/07-1/1/08	1,000
1/1/08-2/1/08	3,043,600
2/1/08-3/1/08	500
3/1/08-4/3/08	3,469,000
4/3/08-5/1/08	22,300
5/1/08-6/2/08	4,637,400
6/2/08-7/1/08	1,026,600
7/1/08-8/2/08	672,100
8/2/08-9/2/08	4,819,900
9/2/08-10/3/08	2,184,700
10/3/08-11/3/08	3,435,100
11/3/08-12/1/08	1,844,700
12/1/08-1/3/09	3,073,100
TOTAL	28,230,000

TOTAL GALLONS PUMPED	Year: 2008 GALLONS
12/4/07-1/1/08	3,461,400
1/1/08-2/1/08	3,043,900
2/1/08-3/1/08	2,944,800
3/1/08-4/3/08	3,478,700
4/3/08-5/1/08	3,784,200
5/1/08-6/2/08	5,133,400
6/2/08-7/1/08	6,508,700
7/1/08-8/2/08	6,078,300
8/2/08-9/2/08	6,129,300
9/2/08-10/3/08	4,791,700
10/3/08-11/3/08	3,978,900
11/3/08-12/1/08	2,999,900
12/1/08-1/3/09	3,073,100
TOTAL	55,406,300

TOTAL GALLONS SOLD INDIVIDUAL READINGS	YEAR 2008
12/4/07-1/1/08	2,459,120
1/1/08-2/1/08	2,129,410
2/1/08-3/1/08	2,134,265
3/1/08-4/3/08	2,409,180
4/3/08-5/1/08	2,855,610
5/1/08-6/2/08	4,196,860
6/2/08-7/1/08	5,365,220
7/1/08-8/2/08	5,132,823
8/2/08-9/2/08	4,955,589
9/2/08-10/3/08	3,552,104
10/3/08-11/3/08	2,784,863
11/3/08-12/1/08	1,896,827
12/1/08-1/3/09	2,021,880
TOTAL	41,893,751

TOTAL GALLONS SOLD QUARTER MACHINE	YEAR 2008
12/4/07-1/1/08	264,000
1/1/08-2/1/08	251,400
2/1/08-3/1/08	248,000
3/1/08-4/3/08	352,000
4/3/08-5/1/08	372,000
5/1/08-6/2/08	416,000
6/2/08-7/1/08	564,520
7/1/08-8/2/08	478,910
8/2/08-9/2/08	435,940
9/2/08-10/3/08	431,590
10/3/08-11/3/08	342,450
11/3/08-12/1/08	320,730
12/1/08-1/3/09	256,610
TOTAL	4,734,150

TOTAL GALLONS SOLD	YEAR 2008
12/4/07-1/1/08	2,723,120
1/1/08-2/1/08	2,380,810
2/1/08-3/1/08	2,382,265
3/1/08-4/3/08	2,761,180
4/3/08-5/1/08	3,227,610
5/1/08-6/2/08	4,612,860
6/2/08-7/1/08	5,929,740
7/1/08-8/2/08	5,611,733
8/2/08-9/2/08	5,391,529
9/2/08-10/3/08	3,983,694
10/3/08-11/3/08	3,127,313
11/3/08-12/1/08	2,217,557
12/1/08-1/3/09	2,278,490
TOTAL	46,627,901

Date	WATER LOSS %
12/4/07-1/1/08	21.33%
1/1/08-2/1/08	21.78%
2/1/08-3/1/08	19.10%
3/1/08-4/3/08	20.63%
4/3/08-5/1/08	14.71%
5/1/08-6/2/08	10.14%
6/2/08-7/1/08	8.90%
7/1/08-8/2/08	7.68%
8/2/08-9/2/08	12.04%
9/2/08-10/3/08	16.86%
10/3/08-11/3/08	21.40%
11/3/08-12/1/08	26.08%
12/1/08-1/3/09	25.86%

AUBREY WATER COMPANY
P.O. BOX 85160
TUCSON, ARIZONA 85754
(520) 623-5172

WATER LOSS REPORT
2009

GALLONS PUMPED PER MONTH SOUTH WELL	YEAR 2009 GALLONS
1/1/09-2/3/09	2,755,900
2/3/09-3/3/09	270,100
3/3/09-4/2/09	2,853,700
4/2/09-4/29/09	914,700
4/29/09-6/1/09	4,828,000
TOTAL	14,042,500

GALLONS PUMPED PER MONTH NORTH WELL	YEAR 2009 GALLONS
1/1/09-2/3/09	4,800
2/3/09-3/3/09	2,329,600
3/3/09-4/2/09	388,600
4/2/09-4/29/09	2,471,300
4/29/09-6/1/09	219,000
TOTAL	8,670,900

TOTAL GALLONS PUMPED PER MONTH	YEAR 2009 GALLONS
1/1/09-2/3/09	2,760,700
2/3/09-3/3/09	2,599,700
3/3/09-4/2/09	3,242,300
4/2/09-4/29/09	3,386,000
4/29/09-6/1/09	5,047,000
TOTAL	22,713,400

TOTAL GALLONS SOLD INDIVIDUAL READINGS PER MONTH	YEAR 2009
1/1/09-2/3/09	1,614,390
2/3/09-3/3/09	1,703,300
3/3/09-4/2/09	2,086,770
4/2/09-4/29/09	2,283,360
4/29/09-6/1/09	3,994,180
TOTAL	16,161,270

TOTAL GALLONS SOLD QUARTER MACHINE PER MONTH	YEAR 2009
1/1/09-2/3/09	253,250
2/3/09-3/3/09	290,230
3/3/09-4/2/09	306,510
4/2/09-4/29/09	315,000
4/29/09-6/1/09	472,870
TOTAL	2,106,970

TOTAL GALLONS SOLD PER MONTH	YEAR 2009
1/1/09-2/3/09	1,867,640
2/3/09-3/3/09	1,993,530
3/3/09-4/2/09	2,393,280
4/2/09-4/29/09	2,598,360
4/29/09-6/1/09	4,467,050
TOTAL	18,268,240

Date	WATER LOSS %
1/1/09-2/3/09	32.35%
2/3/09-3/3/09	23.32%
3/3/09-4/2/09	26.19%
4/2/09-4/29/09	23.26%
4/29/09-6/1/09	11.49%