CENTERVILLE CITY WATER DEPARTMENT WATER AUDIT

OCTOBER 1, 2011 TO SEPTEMBER 30 2012

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Executive Summary

We think the water audit was very helpful in finding where our water goes and where the losses are. The unaccounted for water in our system is not really lost water, it's just not metered water. Randy and I have confirmed that we have no major water leaks. There may be some small drip leaks in our system, but it's more likely that the leaks are from water taps or leaky toilets in resident's houses. In the Water Meter area we talk about the three factors of meters. On a ¾" or 1" water meter, which is the size of most of our water meters, there can be 6.3 to 6.5 ounces per minute flow pass through the meter and not be registered. It's even worse on larger meters. We feel there could be as much as 112 GPM being used in our system that is going through the water meters and not being registered. Randy, in checking water usage in different zones, has come up with an average of .02 gallons per minute per residential meter which would equate to between 112 and 120 GPM. This water was monitored throughout our system from 1:00 a.m. to 4:00 a.m. This backs up our theory that most of the 112 GPM is going into resident's houses. You can read more how this was done in Appendix 4.

Some other areas we found, like the Non- bill, we now have an accounting of how water was used and how much is being consumed. One of these areas was irrigation watering using culinary water to water the lawns at the Park's Department Building. Our finding was that they are doing a great job. In the month of August they put down 5.1 inch of water onto their landscaping. Dave Rice, who works for Weber Basin Water in their water conservation, told me how much water should have been put down. He stated that our Parks Department has done a great job, because they should have used about one to one and half inches more than that. So it seems that we are doing well in that area.

The large percentage of water usage was water that was billed. It was 85.55% of the total water usage. We feel good about where we are at on the water meters we are using. It's not worth changing out water meters with a percentage of 99.24, which is well within AWWA, American Water Work Association, standards. This would leave us with primary uses of remaining 14.5%.

Island View Reservoir Leak

The process in finding this leak has been interesting. In the beginning we did a reservoir check on all the reservoirs to see if we had any significant leaks and none really showed up. The reservoir where we found the leak was the only one on our SCADA that went to the tenth (example 10.1). After we had it changed to see the hundredth spot, then it was clear that there was a problem there (example 10.15). Another indication was the usage being higher than all the other reservoirs. The normal use we have established is .0589 GPM and this tank was at 0.071 GPM. We had located the leak. It was one of two spots, the caulking or what looked like a patch on top of the existing concrete floor. After repairing the floor patch, the leak decreased about 18 GPM to 1.49 GPM. We feel the remaining leakage is because of old caulking and are planning to repair this later this year.

Fire Department

It has been very surprising to see some of the numbers come in, for example, I would have guessed that the fire department would have used more water than .032 million gallons. If we were to have

estimated that, I would have guessed a lot higher and it could have really made a difference to the outcome of the Water Audit.

For one last and final comment which will put the uncounted for water into perspective see below:

- 63.187 M.G.is equal to a hole in a pipe approximately as little as 5/8" in diameter with 80 P.S.I. running 365 day
- .02 gallons per minute per house in our system are leaks in houses. If the low flow is less than the 6.3 oz., it could equate to the 112 gallon per minute.

Things We Need to Look At

1. Is there a need to keep providing water for irrigation in the Centerville Debris Basin as well as Rick's Creek Reservoir? Is it possible we do not need to water them anymore?
2. Possibly doing a meter chamber change out may be a way of increasing our meter efficiency in the future.
3. As we size meters, try and keep them the right size, not putting in a bigger meter than necessary.
4. We need to do more education in three areas: the first being leak repairs in homes, we need to find a way that we can get customers to fix their leaks, small and large; the second is to be focused on water conservation in the homes, using less water; the third is helping people to plant water wise plants that are native to our area.
5. Do a water meter accuracy test every 5 to 7 years to see when we need to upgrade our water meters.
6. Keep changing out our 2", 3" and 4" meters as needed
7. Repair the leak at Island View Tank, which was repaired during the audit
8. Outside meters, move meter from inside the house to the curb
9. Check 100 South Reservoir caulking to see if it needs to be replaced

Things we are doing right

1. We think the biggest factors have been all the updates and waterline replacements the City has done over the last 23 years. This alone has been the best thing for water conservation. We believe trying to keep our system from being out dated and repaired has made a huge saving in time and personnel. If we had not been continuously replacing our old water mains and services, we would have had to hire one or two more personnel to help keep up with all the leaks we would have had plus the cost incurred from the repairs for waterline parts, asphalt, sand and road base. This was accomplished because the City Council and Mayor supported the repairs and replacements. If we had not done this, I wonder what our citizen's water rates would be. We know that other City's water bills are much higher than ours.
2. The SCADA has helped us to maximize power efficiency by pumping off peak and keeping our reservoirs full during the day. The water system has many redundancies which have helped us to do a much better job on the water audit. The Telemetering has helped us collect and analyze data to make the water audit more precise.

3. Keep up with the zero meter reads, meters that are not working.

4. Putting pressure transducers throughout the water system so we are able to run charts. Retime data to run the system.
5. Having a landscape ordinance in place and keeping it updated
6. I think we have been buying the right water meters for our type of water. Investing in meters that are well within AWWA Specifications and that last 30 years is a good investment.
7. We have probably saved putting in another well by replacing our water lines because of less leakage in the water system. It would be fun if we could see how much more water we would have to pump into our water system if hadn't replaced our water lines.

Water Audit Goals and Objectives

- It started out as a goal in our Water Conservation plan. The Goal was to see if we could find where all our water went and truly see how much water we could account for. Throughout this process we hoped to learn a lot about where the water goes and also find some areas in which we can do a better job in keeping track of the water and to see if there was a way to conserve water. One thing we knew going into this was that water audits are not very thorough as far as keeping track of the different water uses. Most cities and even AWWA do not go in depth to find out what the unknown factors are. They usually take the water produced minus what was sold and give a good guess of what water was used which was not metered (unknown factors) and the rest is unaccounted for water. In our steps we will try to take away the unknown factors so that we can have a true number pertaining to our water system. We will then have some numbers to use as guidelines in future water audits.
- To see if the updating of the waterlines has had a true benefit in conserving water. Over the last 23 years the City council has supported updating the water system as we replaced water lines, upgraded wells and reservoirs.
- Another one of our goals was to see if what system leaks we may have. Randy and I have always felt that we have very few water leaks, if any, that don't show up in a short period of time. Our past experience has led us to believe that our leaks always surface.
- Check out our producing water meters and make sure that they are accurate.
- Conduct a survey of our delivery water meters to see how accurate they are and that they are properly billed. To see if we need to do a massive water meter change-out to our system.
- To watch the water system over a twelve month period and study how it operates.
- To find out the cost of the unaccounted for water.
- Look hard at the way we run our water system and what we can do better.
- Judge our successes in how we have been upgrading our water system.
- To make recommendations and what course of action we need to take for our water system.
- Make a list of our top fifteen water users.

One Page Summary

Water Produced	**MG***	**%**
Well Water, Five Wells	414.7	78.98
Weber Basin Purchased	110.35	21.02
Total Water Produced	**525.05**	100%

The Accounting Of Where The Water Was Used

	MG*	**%**
Water Sold	449.19	85.55
Non billed metered water city building	2.4	0.46
Public works non-metered water	0.595	0.12
Water leaks	0.914	0.18
Reservoir's overflows	1.335	0.25
Pump lube lines	0.223	0.04
Fire flows	0.063	0.012
Fluoride / Chlorine analyzers	0.594	0.11
Water quality flushing	0.633	0.12
Fire department training and fires	0.032	0.006
Waterline jobs	0.256	0.05
Water theft	0.028	0.005
Island View Tank Leak	3.52	0.67
Water Meters		
Zero reads on water meters	0.589	0.111
Adjustment of water meter inaccuracy (AWWA Specification)	5.6	1.06
Water meter non-recording of 6.3 ounces on low flow !	59.077	11.25
Total Water Used	525.05	100%

*Million Gallons-= M.G.
! These were part of the conclusion

The Process of the Water Audit

Months prior to starting the water audit:

In the months prior to starting the water audit we did some training with our employees to help them understand what we were doing and why. We involved different departments outside the City such as Metro Fire, South Davis Sewer.

- Repair zero reads on water meters.
- Check all fire hydrants for main valves leaking.
- Training and stating the goal with the hopeful outcome.
- Fire Departments, South Davis Sewer.
- Do an accounting of non-billed water meters to make sure we have all of them.
- Testing of producing wells flow meters for accuracy.
- Parks has two drinking fountains that are not metered. One at the Cemetery and one at Community Park. We will have to estimate these for the year. If we move the meter to the curb at the Cemetery, then it could be metered.
- Founders Park has a line going down the North side that is not metered. Bruce will leave it off until 2013, but if they need it, he will let me know and we can do an estimate of the water use.

Monthly check list

- Watch for illegal connections, fire hydrants, new homes being built.
- Check all fire hydrants for main valves leaking.
- Water uses on Fluoride DEPOLOX'S, total gallons.
- Read all commercial water meters.
- Repair zero read meters (commercial meters).
- Water leak consumption and other non-accounted for totals.
- Well production and water purchased.
- Water use from contracted contactors, (like drain cleaning and street sweeping).
- Water system reservoir's overflow calculations.
- Water line job calculation of water used in filling and flushing the water lines.
- Water quality flushing.
- Fill station at Public Works, (non-metered).
- Start the testing of water meters; 5/8" X 3/4" meters total of 210 (5% the meters). 1" meters total 14, 1.5" meters total 3 meters, 2" inch meters total 2, 4" meter total 1.

Final Gathering of the Report

- Final meter readings, all meters.
- Final water uses on Fluoride DEPOLOX.
- Final water leak consumption and other non-accounted for totals.
- Final well production and water purchased totals.

- Final water uses from contracted contactors.
- Final water system reservoirs overflow calculations.
- Final water line job calculation of water used in filling and flushing the water lines.
- Final fill station at Public Works, (non-metered).
- Get final water usage for the year report.
- Gather all the data for the different areas.
- Analyze all the data for correct input.

Final Gathering of the Report (cont)

- Make adjustments.
- Make the completed report

Results of Each Area of the Water Audit

Well Water That Was Produced

During the water audit we used five different wells for producing our water. One thing we did was to go out to each well before hand and do a flow test using a new meter. We shut down the system in a zone, notifying each resident that their water would be off for a short period of time while we tested the producing meter. Then we hooked up to a fire hydrant, opened it and then started the pump. We adjusted the well's meters to the new meter and now we know that the flow meters are almost 100% accurate. During the course of the year our wells produced 414.7 million gallons of water, which was 78.98 percent of our water.

Water Purchased From Weber Basin Water Conservancy District.

During this water audit we also purchased water from Weber Basin Water Conservancy District , this audit time period we purchased 110.35 Million Gallons of water which was 21.02 percent of our water. In talking with Weber Basin about how accurate their meter was, I was told that it was very accurate and less than 1% inaccuracy.

Total Water Produced and Bought Was 525.05 Million Gallons.

Water Sold

This is water that has gone through water meters and was billed to customers. We sold 449.19 Million Gallons of water, which was 85.55% of the water we produced. Later in this report we will talk about the meters as a whole.

Non-Billed Metered Water for City Building.

These are accounts where there is no bill sent. This water provides water to government buildings and to keep the City running. All of these accounts have water meters and are kept track of through the billing process. It accounts for 2.4 Million Gallons of water or .45% of the water produced.

City Government Building	Address	Culinary or IRR	Thousand Gallons
Whitaker Home	160 North Main	C	1
Cemetery	650 East 400 South	C	8
City Hall	250 North Main	C	61
Fire Station	123 North Main	C	106
Ford Canyon Trailhead	1570 North Rick Creek way	C	3
Porter Walton Park	100 South 400 West	C	14
Community Park #1	1350 North 400 West	C	15
Community Park #2	1350 North 400 West	C	90
Freedom Hill Park	2150 North 150 East	C	17
Smoot Park	1500 North Main	C	29
Chase Trailhead	Chase and Oakridge	C	1
Park Building	689 North 1250 West	C/I	783
Rick Creek Reservoir	1500 North Carrington	I	170
Centerville Debris Basin	700 East 200 South	I	309

Public Works Building #1	655 North 1250 West	I	353
Public Works Building #2	655 North 1250 West	C	67
Public Works Building #3	655 North 1250 West	C	12
Public Works Building #4	655 North 1250 West	C	72
Public Works Building #5	655 North 1250 West	C	2
Public Works Building #6	655 North 1250 West	C	1
Center Point Theater	400 West 525 North	C	239
Island View Park	750 East 550 South	C	24
Founder Park	100 East 350 North	C	27
			2.404 M.G.

As you can see, we used four sites for irrigation purposes. We chose the Parks Building to audit how they water the lawns and we picked August, which is one of the hottest months. I recorded how much water they used, which was 5.1 inches of water for that month. I checked with David Rice at Weber Basin Water and asked what the status was for that month and he said that they should have used more water than that to keep their grass and shrubbery green, so my conclusion is that our Parks Department does a great job in conserving water.

Having said that, I think we need to look at two issues and see if we still want and/ or need to water Rick's Creek Reservoir and Centerville Sedimentation Basin. It is possible that both have plants that have been established and no long need to be watered. Between the two, If not watered, we could have saved .47 M.G. or .11%. These two items will be in the course of action plan at the end of this report.

Public Works Non- metered Water

This is water that is used to fill water tanks. From the list below you can see that there is a variety of users for non-metered water. Most of the time they fill up at the fill station on the Frontage Road and 1400 North and they use non- finish water (non -drinking water) for their uses. This water audit year, they used .595 Million Gallons or .12% from the Public Works shop, which is drinking water.

Sites	**Total Gallons**
Twin D, for cleaning drainage pipes	557,900
Street Sweeper	1,400
State Jet Truck	4,000
Surry seal contractor	8,000
Fluoride Showers	2,640
PW Fill, Parks Tanks	500
PW Fill, Kapp water line, dust control	1,100
PW Fill, Scott Kjar	700
PW Fill, Power Drill	10,300
PW Fill, SCI	900
PW Fill, Matt Com	100
PW Fill, Parson	2,000
PW Fill, Public Work Fill Tank	5,500
	595,040

Water Leaks

This is a hard area to determine exactly how much water we lost on leaks. The number represented is based on a person doing a best guess judgment on the following:

- How long has it leaked or what time did it start
- How many gallons a minute it is leaking
- When did we have the water shut off and to account for the little bit of water we keep running while we fix it.

Throughout the year we used our best accounting to come up with a good number based on the factors we had. We came up with the water loss for each leak at the time of the leak and tried to get it as close to the actual loss as we could. Some leaks are easier to figure than others, for example a pin hole leak may have leaked for a week or so before it was noticed or came to the surface. On the other hand a big leak shows up quicker and it's a little easier to estimate how much water was lost by being able to use the telemetry system. I have attached two charts, the first one shows the leaks in gallons and the second shows the number of leaks. I think that the number we have for the lost water on leaks is low, but in this report we wanted to stay with the actual numbers that were produced during the water audit with no alterations.

One other note that should be made is that in 1998, we had 50 water leaks and around 60 miles of water mains and in the 2011-12 water audit period. During the water audit time period, we had 31 water main and service line leaks and in the last five year the average for those types of leaks was 23. We have 79.14 miles of water mains and 19.79 miles of service lines in Centerville. We had an increase of 31.9% of water mains and service lines and a 41% decrease of water leaks. To put that into perspective, it is like maintaining a water main from Centerville City Hall to 3 miles past Nephi, Utah by the way of driving, not a straight line.

For a detailed accounting on water leaks see Appendix 1.

The amount of water we lost to water leaks was estimated to be .914 Million Gallons or .18%

Gallons to water leaks

Hit Lines	102,200
Main line leaks	164,370
Services	627,030
Hydrant leaks	1,500
Miscellaneous	5,760
Meter leaks	13,461

Numbers of water leaks.

Hit lines	5
Main line leaks	9
Services	22
Hydrants leaks	2
Miscellaneous	1
Meter Leaks	16

Reservoir's Overflows

This is something that we don't like to see any of, but as we set up the water audit we knew that we needed to watch this and keep track if we had any. In the Chart below you can see that we have had five incidents that SCADA or the computer caused the reservoir to overflow, all of which were a computer problem. Before this year it has been a long time since it happened or if it happened, it was maybe once every other year, which was caused by a valve sticking on or there was something that just goes wrong.

The water that was wasted this year was 1.335 million gallons or 0.25%

RESERVOIR OVERFLOW

DATE	Problem	ESTIMATED GALS.
December 5, 2011	Telemetering lock up	254,113
July 29, 2012	Computer shut down for an update, 100 So, PLR	600,480
August 13, 2012	100 South , Telemetering lock up	144,000
August 15, 2012	GST Telemetering lock up	83,598
August 15, 2012	RCR Telemetering Lock up	180,900
August 21, 2012	GST Telemetering lock up	72,000
	TOTAL AMOUNT	**1,335,091**

Pump Lube Lines

These are water lines connected to the pumps to lube the shaft of the pump before it starts. This water is water that has been pumped up into the system before and then goes back down the well to lube the shaft. After the pump has started the lube lines shut off. We currently have only two sites that do this. Also note that we had a solenoid go bad and it dumped 207,000 gallons back down the well, we account for this in this area.

The water used for this was .223 million gallons or 0.04 %

Sites	Total Gallons
Church Well	6,098
Carrington Well	9,908
Leak on solenoid line	207,360
	223,366

Fire Flows

Fire flows are done for many purposes. This year we only did fire flows if they were needed. This helped us come up with a closer number for accounted water for the water audit. The fire flows we did this year were done for new building structures or for new hydrants that were put in. A statement should also be made that this year does not reflect a normal year for fire flows. It normally would be a lot higher than what we had during this audit.

Fire Flows	Total Gallons
Hydrant Number	
Legacy	6,360
Legacy	9,600
765	7,000
1826	7,000
1961	5,200
1851	14,200
765	14,200
	63,560

Fluoride and Chlorine Analyzers

When we put fluoride into our water we put in analyzers to monitor the residuals of both fluoride and chlorine. These take water from out of the system and measure how much of each constituent is in the water. We use these to help us keep the right amount of both fluoride and chlorine in our water. However, the water is wasted. It is a necessary function that needs to take place. Last year we monitored it and now we have a number to use when we may need it. In 2011-12 water audit, we used 0.594 million gallons of water, which is 0.11% of the water we produce.

For a detailed accounting see appendix two.

Water Quality Flushing

Water quality flushing is done to help maintain good quality drinking water; we have areas that we need to flush to keep the water fresh and drinkable. This year we did not get a chance to do as much as we would have like to do, so I would rate it a little below normal. In the Fire Flow section we have a picture of a hydrant being flushed, water quality flushing is done the same way. The water is flushed until it looks clean and drinkable and it has flushed long enough to remove the stagnant water. This year we used .633 million gallons of water to flush lines, that is 0.12% of the water we produced. For a detailed accounting see Appendix Three.

Fire Department Training and Fires

This had a surprising result for us. I gave the Fire Department a fire hydrant meter and asked them to use it when they trained on any Centerville City fire hydrants. At the end of the year we received it back and they had only used 8,200 gallons of water. This was surprising until I called Jeff Bassett at Metro Fire and found out that they do most of their training in Bountiful at Viewmont High School where they have a lot more room. The only fire this year, where they hooked onto fire hydrants, was the brush fire at about 1825 North. We were able to get a very accurate number on how much they used, which was 24,000 gallons.

So for this area the Fire Department used .032 million gallon or 0.006% of our water during our water audit.

Water Line Jobs

This year we had a normal year for water main installations. When you install or replace a water line you could lose the water in the pipe you are replacing plus the water used to fill it up and flush it. This year we kept a very close watch on this and whenever possible, we used a water meter to account for the water. The other method was to do a calculation on how much water it would take to fill up the new line. We feel we are very accurate in the numbers we came up with. The water used in this area was 0.256 million gallon or 0.05% of the water we produce.

Water line Job	Total Gallons
1825 North 300 East	16,768
200 South water line	3,500
Lyon Well Repair	1,500
Rick Creek well Repair	1,000
Fire hydrant repair	500
100 South water line	500
100 South water line	6,200
Sewer District water line	3,000
Land Rover	20,000
Main Street water line	203,085
	256,053

Water Theft

This was surprising to us. Before we started the water audit we went out and looked for any meter jumpers that we had in the system. We pulled all the meter jumpers, one of which was someone living in a home. As you can see in the picture below that a lot of meter jumpers were from a time when there was not much building going on. For years we have told contactors that they must have a meter set before they take water. One other area we have been watching is people hooking up to fire hydrants. The water total for this is 0.028 million gallons or 0.005% of the water we produced. The other picture I have included is one where people have caused a problem when they use meter jumpers.

Island View Tank Leak

As we were still trying to find out where we were losing 3.52 million gallons or .67%, which is around 6.68 GPM, we went back to our reservoir flow charts and found that our Island View Tank's use was a little higher in gallons per minute per home. It was .071 GPM per customer and the average was .065 GPM. So we decided to do a leak test on the reservoir to see if we were losing water there.

We first checked the reservoir and the transmission line and found it was leaking. Then we turned off the reservoir and found the leak to be in the tank. Depending on what the depth of the water in the tank was as to how much water was leaking. The calculation was 6 to 8 GPM depending on how deep the water was in the tank. We drained the tank and cleaned it, then did an inspection. We found two areas we are worried about and need to be fixed. One was the caulking and the second was a patch of concrete that was put over the top of the reservoir floor. We will be obtaining some bids to get these one of the problems repaired. The first problem area was around the tank's inlet and outlet. By replacing the concrete around these areas we hoped that it would reduce or even stop the leak in the tank. After making the concrete repairs, we ran another test and found the leak to be approximately 1.49 gallons per minute. So by repairing the concrete we reduced the leak from 17 to 18 GPM to 1.49 GPM. In the future we will also replace the caulking in the tank and feel that this should take care of the 1.49 GPM leak.

Water Meters

In this area we have three factors that come into play: Zero meter reads on water meters, AWWA water meter accuracy and what we call real low flow water use, the 6.3 ounce per minute.

Zero Reads

Zero reads on meters. This is where a meter is not working and the read has stopped for some reason. During the water audit year we paid close attention to this and were able to keep it to a low number. The repairs were made quickly and then we used the homes past year's water use for the estimate. The water that was estimated was 0.589 million gallon or .111% of our water that was produced.

You can look at the charts for this in Appendix 5

AWWA Water Meter Accuracy

We used the AWWA standard in testing the water meters. We tested 5% of the City's water meters from ¾" to our largest, which is 4". The field tests used the medium flows and we found the following results:

- ¾" water meters were 99.24% accurate
- 1" water meters were 99.15% accurate
- 1.5" water meters were 99.32% accurate
- 2" water meters were 99.21% accurate
- 4" water meters were 97.50% accurate, keeping in mind that we only tested one meter and this meter was in service for a long period of time. We also changed out 3 of our 4" meters, so we have seen the accuracy go up since the test. We have only a few left to go.

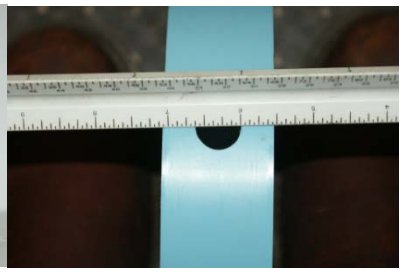
To make the meter 100% accurate, the water used in this area was 5.6 million gallons or 1.12%. You can also look at Appendix 6 for more information.

As we were drawing to a close of the water audit we came up with a total of 63.187 million gallons, or 12.03% of the water we produce, as unaccounted water. That was about 120 GPM leak in our system at 80 PSI with a 5/8" hole. We looked into two areas; one being water meter non-recording (listed below) and the other was Island View Reservoir leak, which has now been repaired. It was leaking 6.68 GPM or 3.52 million gallons per year, which is .67%.

Water Meter Non-recording

This is the real number that we want on the water audit. I have read a lot of water audits done by a lot of systems and the magic number seems to be 12% of unaccounted for water. So we hoped that our number would be close or lower. So we started looking to see if we missed anything and we found one area that we will talk about in Appendix Four and Appendix Five.

- The first thing we found was that 6.3 to 6.5 ounces of water per minute could pass through a water meter and not register, note the pictures at the left and center. We must remember that AWWA specification for a low flow through a water meter is a 1/4 gallon per minute, which is 32 ounces. So if someone has a small leak in their home, it would more than likely not register until the leak gets bigger. To back this up Randy did some testing of zones where he was able to do two things; see if we have any leaks in our system and to come up with a number that would show how much water was used per household
- The middle of the night use was .02 GPM per house, which would be 112.4 GPM throughout the whole system. The picture on the right side illustrates this. As we broke down the water system into zones, we found that we did not have any large leaks. If we did have a leak, it would have to be a drip. The cost of the unaccounted water is $6,000.00 per year, which is the cost to produce it.



Also see Appendix 4 for water usage full report.

As we were studying the reason for non-recorded water, we found something very interesting, you could put a meter in a test bench and set the flow way down to where the meter stops, but there was still measurable water going through the meter without it registering. We tested different meters and in the ones we checked, we found that all meters have this problem. The average was 6.3 ounce per minute. When Randy did his study the two matched closely and the result was that the water going through the meters were small leaks in people's homes. **The water lost in this area is 59.077 million gallons or 11.25%.** Please refer to Appendix 4 for the full report.

Top Fifteen Water Users

	Users	MG	Notes
1	Centerville Mobile Estates	4.04	
2	US Dev.Comm. Irrigation	3.83	
3	Home Depot	3.44	
4	Pheasantbrook	3.08	For three month they were running only one meter
5	IN-N-Out	2.79	
6	Legacy Apt. Unit A	2.48	Next year they will be the highest, this was only for two months
7	Cedar Spring B	2.39	
8	R B One Stop	2.21	
9	Biotron Lab	1.73	
10	Wal-Mart	1.63	
11	Riviera Homes	1.35	
12	Centerville Market Place	1.32	
13	Legacy Apt. Unit B	1.08	
14	Zeponie Pizza	1.12	The last two month their bill has been high, we are checking it out
15	McDonalds	0.82	
	Total	**33.3**	**or 6.34%**

Leak Detection

To see if the findings that we had were correct and accurate, Randy and I decided to have the area that we used for the calibration zone of water consumption tested for leaks. We hired American Leak Detection to go through an area, which consisted of 15 fire hydrants, 1.33 miles of water mains, 134 water services, and 12 valves. For the full report of the water leak detection you can go to Appendix 8.

American Leak Detection only found one leak, which was at 2134 North Park Hills Drive. It was a meter yoke leaking and it was leaking on the house side of the meter yoke (setter) in the meter box. We had one of our employees take a measurement of the amount of water leaking and it was four ounces per minute. However, the meter was not moving on the low flow indicator while it was leaking. The meter was tightened and the leak stopped. This confirms our conclusion that water can pass through the water meter at low flows and not be detected. It makes the calibration number that we had throughout the City to be very accurate and a good number for our water system to use. If we decide to have a leak detection program, this would help us determine which area to choose by running a test of each zone before we start with the program.

Appendix 1

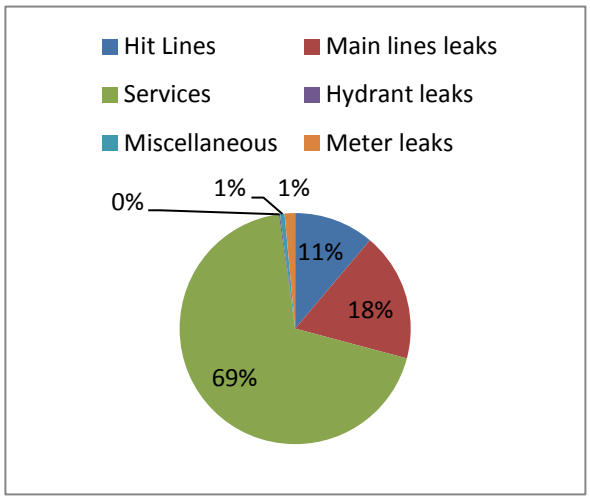
2012 Estimated Total Gallons Lost to Water Leaks

Date	Type of Leak	FH	Misc.	Meter	Total Gals
10/1/2011	Service line leak				1,590
10/1/2011	PRV leak in pit		X		5,760
10/8/2011	Freeze plate leak			X	1,561
10/10/2011	Hydrant leak	X			1,000
10/15/2011	Hit line 340 East				150
10/15/2011	Leak				13,500
10/18/2012	Freeze plate leak			X	150
10/18/2011	Flare leak				630
10/27/2011	Freeze plate leak			X	300
11/1/2011	Hydrant leak	X			500
11/2011	Leak				19,000
11/8/2011	Leak				2,500
12/4/2011	1334 North Main				34,000
12/6/2011	308 East 600 North				11,000
12/20/2011	Freeze plate leak			X	2,000
12/22/2011	538 West Creek view				7,000
12/27/2011	Hit line				66,000
12/28/2011	Willmar Circle				13,000
1/17/2012	Freeze plate leak			X	2,000
1/23/2012	Cedar Spring meter yoke leak				200
2/12/2012	Hit line				2,000
2/15/2012	Freeze plate leak			X	1,340
3/3/2012	1358 North Deerfield				38,100
3/15/2012	Freeze plate leak			X	700
3/15/2012	Freeze plate leak			X	300
3/18/2012	1200 North 400 East				7,200
3/27/2012	Hit line				33,750
4/25/2012	Greenfields Meter box				2,000
4/25/2012	Greenfields Meter box				2,000
5/11/2012	1700 North main				10,380
5/12/2012	Freeze plate leak			X	540
5/21/2012	Shop leak				6,000
5/22/2012	Freeze plate leak			X	230
6/4/2012	100 North 335 East				570
6/4/2012	Deerfield loop line				1,700
6/8/2012	680 North 302 East				300
6/8/2012	1889 North 150 East				720
6/12/2012	1387 North 400 West				6,800
7/3/2012	Greenfields Meter box				1,360
7/6/2012	1423 North 400 West				483,840
7/7/2012	Greenfields Meter box				3,500
7/23/2012	610 North Roland way			X	3,500

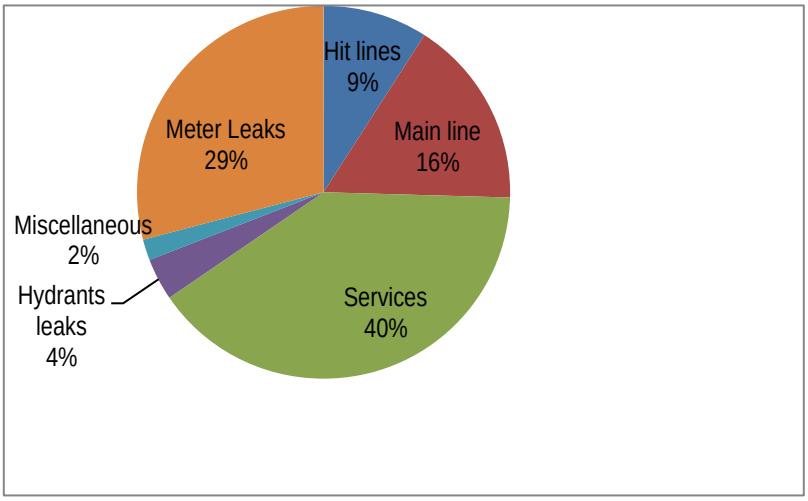
2012 Estimated Total Gallons Lost to Water Leaks cont.					
8/2/2012	Freeze plate leak			X	100
8/2/2012	325 North Main				11,520
8/2/2012	505 gallop Circle				16,000
8/8/2012	1262 North Deerfield				33,750
8/13/2012	Freeze plate leak			X	150
9/13/2012	Freeze plate leak			X	250
9/13/2012	Freeze plate leak			X	300
9/13/2012	Freeze plate leak			X	40
9/13/2012	Hose over due to a leak				2,000
	Total				**914,321**

Gallons From Water Leaks

Hit Lines	102,200
Main lines leaks	164,370
Services	627,030
Hydrant leaks	1,500
Miscellaneous	5,760
Meter leaks	13,461



Types of Water Leaks.	
Hit lines	5
Main line	9
Services	22
Hydrants leaks	2
Miscellaneous	1



Appendix 2

Analyzer Equipment

Sites	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	TOTAL
PHB	5,952	5,760	5,952	5,952	5,568	5,952	4,710	5,952	5,760	5,952	5,952	5,760	69,22
RCB	4,880	4,723	4,880	4,880	4,566	4,880	5,400	4,880	4,725	4,870	4,880	4,723	58,28
Carr. Well	5,252	5,083	5,252	5,252	4,914	5,252	5,670	5,252	5,083	5,250	5,252	5,080	62,59
RCW	5,580	5,400	5,580	5,580	5,220	5,580	5,760	5,580	5,510	5,580	5,540	5,100	66,01
CHW	4,880	4,723	4,880	4,880	4,566	4,880	4,710	4,880	4,726	4,860	4,880	4,720	57,58
LW	4,555	4,408	4,555	4,555	4,261	4,555	4,410	4,555	4,508	4,550	4,550	4,417	53,87
CW	4,880	4,723	4,880	4,880	4,000	4,000	4,710	4,880	4,723	4,758	4,882	4,710	56,02
IV Booster	4,211	4,075	4,211	4,211	3,939	4,211	4,080	4,211	4,075	4,225	4,211	4,275	49,93
Weber	4,555	4,075	4,555	4,555	4,261	4,555	4,410	4,512	4,150	4,555	4,555	4,475	53,21
Total	44745	42970	44745	44745	41295	43865	43860	44702	43260	44600	44702	43260	**526,74**

ANALYZER FLUSH TESTING

69147886	CW *	**Meter 1**			**Beginning Read**		**End Read**		**Total**				
19787155	LW	**Meter 2**			0		43,793		43,793				
11088524	CHW	**Meter 3**			1,053		1,057		4,000				
62745635	RCW	**Meter 4**			136		147		11,000				
42002124	CRTN	**Meter 5**			624		626		2,000				
					804		810		6,000				
							Total		**66,793**		**Grand Total**		**593,542**

* Note, this was used when we put the small well back in line trying to clean it up so we could TV it, also for clean up the well house.

Appendix 3

WATER QUALITY FLUSHING

Date	Address or Hydrant #	Total Gals.
10/8/2011	118 East 1700 North	4,000
10/18/2011	1350 North 209 East	18,100
10/21/2011	Water Quality Flushing	800
3/1/2012	Water Quality Flushing	7,000
3/1/2012	Water Quality Flushing	3,000
3/1/2012	Water Quality Flushing	9,100
3/15/2012	192 East Briarwood	2,500
3/15/2012	800 North Main	8,000
3/26/2012	444 East 540 North	3,200
4/1/2012	April Water Quality Flushing	155,464
6/1/2012	June Water Quality Flushing	121,839
6/21/2012	Casa Loma	2,000
6/21/2012	1825 North	14,000
6/26/2012	562 West 925 North	3,500
7/1/2012	Greenfields	4,000
7/3/2012	July Water Quality Flushing	28,709
7/3/2012	1825 North 300 East PRV	28,709
8/1/2012	1259 August Water Quality Flushing	2,500
8/1/2012	1519 August Water Quality Flushing	3,700
8/1/2012	1050 August Water Quality Flushing	9,130
8/1/2012	1306 August Water Quality Flushing	4,000
8/1/2012	1309 August Water Quality Flushing	11,200
8/1/2012	1319 August Water Quality Flushing	24,000
8/1/2012	1354 August Water Quality Flushing	1,200
8/1/2012	1210 August Water Quality Flushing	1,300
8/1/2012	1757 August Water Quality Flushing	3,000
8/1/2012	1243 August Water Quality Flushing	4,600
8/1/2012	1259 August Water Quality Flushing	3,900
8/1/2012	1178 August Water Quality Flushing	5,300
8/1/2012	1159 August Water Quality Flushing	3,560
8/1/2012	1163 August Water Quality Flushing	17,360
8/1/2012	1162 August Water Quality Flushing	2,380
8/1/2012	1161 August Water Quality Flushing	2,400
8/8/2012	1143 August Water Quality Flushing	1,313
8/8/2012	1145 August Water Quality Flushing	1,425
8/8/2012	1139 August Water Quality Flushing	2,258
8/8/2012	1123 August Water Quality Flushing	2,632
8/8/2012	1121 August Water Quality Flushing	5,536
8/8/2012	1135 August Water Quality Flushing	2,047
8/8/2012	1114 August Water Quality Flushing	2,000
8/8/2012	44244 August Water Quality Flushing	1,778

8/8/2012	1197 August Water Quality Flushing	2,030
8/8/2012	1095 August Water Quality Flushing	2,000
8/8/2012	1093 August Water Quality Flushing	1,600
8/8/2012	7079 August Water Quality Flushing	1,918
8/8/2012	1064 August Water Quality Flushing	2,304
8/8/2012	1059 August Water Quality Flushing	2,204
8/8/2012	1067 August Water Quality Flushing	1,500
8/8/2012	1752 August Water Quality Flushing	2,080
8/8/2012	1709 August Water Quality Flushing	1,695
8/8/2012	1727 August Water Quality Flushing	1,600
8/9/2012	321 East 500 North	1,160
8/11/2012	523 Willow Valley Drive	700
8/12/2012	September Water Quality Flushing	1,875
8/22/2012	1667 August Water Quality Flushing	2,175
8/22/2012	1652 August Water Quality Flushing	2,312
8/22/2012	1645 August Water Quality Flushing	2,000
8/22/2012	1649 August Water Quality Flushing	1,545
8/22/2012	1609 August Water Quality Flushing	1,348
8/22/2012	1589 August Water Quality Flushing	1,560
8/22/2012	1588 August Water Quality Flushing	1,692
8/22/2012	1594 August Water Quality Flushing	1,410
8/22/2012	1596 August Water Quality Flushing	2,466
8/22/2012	1602 August Water Quality Flushing	2,473
8/22/2012	1627 August Water Quality Flushing	3,330
8/22/2012	DFH-1 August Water Quality Flushing	2,808
8/22/2012	DFH-2 August Water Quality Flushing	3,225
8/22/2012	1084 August Water Quality Flushing	2,880
8/22/2012	1044 August Water Quality Flushing	2,910
8/22/2012	1054 August Water Quality Flushing	3,100
8/22/2012	1026 August Water Quality Flushing	3,487
8/22/2012	1004 August Water Quality Flushing	3,318
8/22/2012	20964 August Water Quality Flushing	3,622
9/5/2012	September Water Quality Flushing	3,864
9/5/2012	950 North 536 West	1,300
9/5/2012	550 North 150 West	3,431
9/13/2012	Water Quality Flushing	3,948
9/13/2012	Water Quality Flushing	3,655
9/14/2012	Water Quality Flushing	2,655
9/14/2012	700 South 62 West	2,350
9/14/2012	202 North 100 East	2,470
9/14/2012	202 North 850 East	2,178
9/14/2012	1881 North 300 East	2,082
9/17/2012	Water Quality Flushing	2,251
		632,951

Appendix 4

Water Usage Report

Prepared By:

Randy Randall

11/12/12

Goal and Objectives:

1. Determine nightly water consumption (during a three-hour period) from each reservoir and within each pressure zone. This is to quantify the City's lowest water consumption.
2. Find lowest instantaneous flow within each pressure zone and lowest instantaneous usage in the entire water system. This is to determine the magnitude of any continuous loss within the distribution system.
3. Determine if system-wide minimum instantaneous flow represents an average flow to each customer below meters' detectable limits. This is to determine if baseline water usage is within customers' homes and businesses or within the distribution system itself.

Procedure to accomplish goal 1:

(Testing was started on Saturday afternoon and completed early Sunday morning so that system recovery could take place on Sunday, thus utilizing off-peak power rates.)

1. Fill all city reservoirs to capacity.
2. Shut off all well pumps and booster pumps in the system.
3. Shut off all valves allowing water transfer between pressure zones. No additional water can enter the system and no water can transfer from one reservoir or pressure zone to another.
4. Let the system run overnight.
5. Analyze water system logs to find the consecutive three-hour interval with the lowest consumption system-wide.
6. For each reservoir's usage during this three-hour period, interpolate the water consumption based on level change in the respective reservoir.
7. Divide total usage by the number of customers connected to each reservoir to determine average usage per customer for the three-hour period. See typical chart for details.

Results:

Five tests measuring the lowest consumption over a three-hour period were conducted. The typical customer usage for these three-hour periods was 0.059 gpm. This usage can be attributed mainly to water softener regeneration (average water-softener regeneration consumes 20 gpm) and night-time bathroom usage (average toilet-tank refill consumes 2-3 gpm). This includes base-line water consumption, discussed below.

Procedure to accomplish goal 2:

1. Approximate the lowest flow within each pressure system and implement a method to measure this flow.

a. For one system, the installed flow measuring equipment has sufficient low-end accuracy to measure this flow. In this case, the pressure regulator installed in-line with this flow meter was adjusted to increase the down-stream system pressure (by 5 psi) such that all other sources of water to the system (other feed pressure regulators) remained closed. Thus all water being fed to the system was directed through this flow meter.

b. For systems without this level of accuracy, a bypass feed with more accurate flow measuring instrumentation was installed through which small demands could be met. Once again, the pressure regulator on this system was adjusted such that the down-stream pressure supplied by this regulator was 5 psi higher than the pressure that could be supplied by any other feed regulator in the system. In low-flow situations, the down-stream pressure could be maintained by this bypass and all system flow was directed through this regulator. The flow through this bypass could be accurately measured and recorded. For higher demands, however, the system demand exceeded the deliverable flow through this regulator, the down-stream pressure dropped to its normal level, and the main pressure regulator opened to meet the high-flow demand.

i. Due to the unavailability of a practical, continuously-transmitting flow meter, a standard positive displacement flow meter yoke was installed with one data-logging pressure meter installed upstream and downstream. The size of flowmeter installed was adjusted until a reasonably measurable differential pressure (2.5-7 psi) was established during the lowest flow situation. Once this meter was sized correctly, the pressure differential was recorded throughout the night. This pressure differential was later recreated while the flow through the meter was read. From this, the lowest flow was extrapolated. The lowest flow measured through this setup corresponds to around 0.02 gpm per customer. With this method, it was possible to see individual demands switching on and off (i.e. the logs reveal exactly when a toilet is flushed or a water softener cycle is run). When none of these demands were observed, the lowest baseline water consumption was 0.02 gpm.

ii.

Conclusions:

Of the 0.059 gpm average used per customer during the lowest-flow condition in the system, 0.039 gpm can be accounted for through legitimate usage (toilet and water softener regeneration, etc.). The cycling on and off of these demands was easily seen in the data log. This is 219 gpm for the entire system. The balance, 0.02 gpm, equates to leaked water in the system. This amount is well below the measuring limit of all meters used in the system (0.25 gpm), so this water is unrecorded use; it is impossible to track down where this water goes, but it can be confidently stated that the majority is leaked on the customer's side of their water meters. The total leaked water equates to 112.4 gpm for the entire system. The system consumes between one and two million gallons per day. Water leakage is not a very large issue.

The majority of water used in the system is not leaked before it reaches the customers. The system trending observed by the South Davis Sewer District also supports the conclusion that very little water produced and distributed in the city is not collected by the sewer system, thus very little is unaccounted for.

Irrigation waste easily represents more than the 112.4 gpm loss within the system; irrigation loss is magnitudes worse than these losses. In general, the greatest waste of water resources is from irrigation waste, and efforts directed toward decreasing irrigation waste will have the greatest effect on conservation.

Also, if water system leakage was an issue, many soft spots and potholes would be observed within the city. This issue is not seen throughout the city. The consolidation of soils within Centerville is very tight, so when water leaks, it quickly exits through the surface and is accompanied by sink holes and caverns. These occur quickly when water leaks develop and

are quickly discovered and fixed.

Furthermore, when water leaks do occur (when water percolates to the surface), the city, as a matter of policy, tests the water for fluoride (culinary water is fluoridated). 90% of the water that surfaces is non-fluoridated and is traced to leaks in the two secondary water systems in the city.

During these tests it was discovered that two of the city's pressure zones (zones 1 and 2-B) had significantly higher baseline usages than the rest of the city (0.07 gpm per connection compared to 0.02 gpm). This area contains all of Centerville's business and commercial district, so this higher usage was attributed to commercial users. However, a second set of tests was conducted in which the commercial areas were isolated from the rest of the pressure zone during the test. The results remained unchanged; these zones still had a higher baseline usage than the rest of the city even without the commercial users. These pressure systems service several condominium communities where water is paid for through a collective HOA. The substantially higher baseline usage can be attributed to less concern by consumers about water waste from leaking faucets, toilets, etc. and shows that the system leakage, if any, is far overshadowed by the leakage within consumers' homes.

The annual cost to produce120 gpm (losses determined in this study plus other meter inaccuracies) is around $6,000 (see attached cost breakdown). The monetary cost is also not that great.

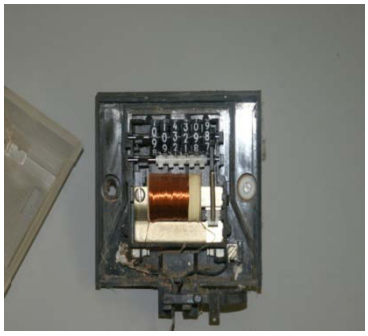
The pressure zones in the city vary in size and makeup. The results of this study show that, despite the difference in size between the pressure zones, the average and baseline usages measured are consistent throughout the city. These average and baseline usages were measured several times in several ways for each pressure zone and the results remained consistent throughout. The consistent low level of these values throughout the city and throughout all the tests shows that there are no substantial leakage problems in the water system in the city.

Appendix 5

ZERO READS

Address	Inside	Outside	Problem	Meter Read	# of Days not Working	Average Usage
1433 North 300 West		X	Bad Chamber	1099	19	5,000
1404 North 300 West		X	Bad Chamber	1086	30	14,000
1085 North Oakridge		X	Bad Chamber	924	30	3,000
325 East Ford Canyon		X	Change meter	1	21	6,000
752 South 650 East	X		Change meter*	2599	10	8,000
1751 North Country Cr.	X		Change meter*	158	30	5,000
64 West 1600 North	X		Change meter*	359	36	5,000
247 West Tobe Drive	X		Change meter*	1669	31	3,000
319 West 1850 North	X		Bad Chamber*	3528	28	3,500
217 East Peach Tree		X	Bad Chamber			14,000
529 North 800 West		X	Bad Chamber	2469		260,000
1907 North 400 West	X		Bad Chamber*	4138		36,000
1786 North Country Cr.	X		Bad Chamber*	1999		36,000
1825 North 289 East	X		Bad Chamber*	1399		36,000
775 South 393 West	X		Bad Chamber*	2398		20,000
92 West Common Way		X	Bad Chamber	514		42,000
1481 North 400 West		X	Bad Chamber	514		42,000
21 West Pheasant Brook		X	Bad Chamber			20,000
385 North 100 East		X	Bad Chamber	3528		30,000
					Total	**588,500**

* Means that we changed the meter to a new touch read pad and it may or may have not been a bad chamber, it could have been wiring etc.



Appendix 6

WATER METER ACCURACY

3/4 Meter	Address	Est. Age of Meter	Field Test Results	% of Accuracy	
1	101 West 1500 North	30	9.8	1.020408163	
2	127 West 1500 North	30	10.1	0.99009901	
3	684 North 800 West	30	10	1	
4	762 South 250 West	30	9.9	1.01010101	
5	644 West Creek view	30	10.4	0.961538462	
6	590 West Creek view	30	9.9	1.01010101	
7	578 West Creek view	30	9.85	1.015228426	
8	348 West Tobe Drive	30	10.19	0.981354269	
9	336 West Tobe Drive	30	10	1	
10	314 West Tobe Drive	30	10.19	0.981354269	
11	274 West Tobe Drive	30	9.8	1.020408163	
12	524 West Mountain View	30	9.9	1.01010101	
13	Address Unknown	30	10.01	0.999000999	
14	780 South 44 West	15	10.21	0.979431929	
15	780 South 62 West	15	10.001	0.99990001	
16	780 South 74 West	15	10.53	0.949667616	
17	780 South 104 West	15	10	1	
18	780 South 118 West	15	10.001	0.99990001	
19	780 South 132 West	15	10.51	0.951474786	
20	780 South 146 West	15	10.08	0.992063492	
21	150 West 776 South	15	10.02	0.998003992	
22	150 West 836 South	15	10.12	0.988142292	
23	150 West 852 South	15	10.04	0.996015936	
24	150 West 866 South	15	10.06	0.994035785	
25	850 South 117 West	15	10.471	0.955018623	
26	850 South 49 West	15	10.025	0.997506234	
27	850 South 18 West	15	10.1	0.99009901	
28	850 South 50 West	15	10.011	0.998901209	
29	850 South 118 West	15	10	1	
30	850 South 134 West	15	10.001	0.99990001	
31	780 South 99 West	15	10.04	0.996015936	
32	780 South 115 West	15	10.08	0.992063492	
33	780 South 81 West	15	10	1	
34	780 South 31 West	15	10.02	0.998003992	
35	780 South 15 West	15	10.17	0.983284169	
36	1825 North 663 West	12	10.17	0.983284169	
37	1825 North 643 West	12	10.06	0.994035785	
38	1825 North 617 West	12	10.28	0.972762646	
39	1875 North 681 West	12	10.005	0.99950025	

40	1875 North 539 West	12	10.02	0.998003992	
41	1875 North 455 West	12	10.08	0.992063492	
42	1875 North 456 West	12	10	1	
43	1875 North 584 West	12	10.07	0.993048659	
44	1875 North 682 West	12	10.07	0.993048659	
45	1875 North 722 West	12	10.061	0.993936984	
46	1875 North 776 West	12	10.141	0.986096046	
47	1875 North 733 West	12	10.001	0.99990001	
48	1875 North 735 West	12	10.011	0.998901209	
49	1875 North 697 West	12	10.06	0.994035785	
50	1875 North 661 West	12	10.021	0.997904401	
51	1975 North 623 West	12	10	1	
52	1825 North 744 West	12	10.081	0.991965083	
53	400 West 2102 North	18	10.011	0.998901209	
54	2128 North 400 West	18	10.091	0.990982063	
55	400 West 2144 North	18	10.07	0.993048659	
56	400 West 2127 North	18	10.09	0.991080278	
57	400 West 2115 North	18	10.06	0.994035785	
58	400 West 2101 North	10	10.08	0.992063492	
59	400 West 2089 North	10	10.03	0.997008973	
60	400 West 2073 North	10	10	1	
61	400 West 2063 North	10	10.01	0.999000999	
62	100 North 248 East	30	10.01	0.999000999	
63	315 East 100 North	30	10.06	0.994035785	
64	100 North 335 East	30	10.62	0.941619586	
65	242 East Center	30	10.11	0.989119683	
66	22 East 100 North	30	10.02	0.998003992	
67	Island View 156 South	10	10.09	0.991080278	
68	Island View 184 South	10	10.03	0.997008973	
69	Island View 244 South	10	10.001	0.99990001	
70	Island View 294 South	10	10.04	0.996015936	
71	Island View 362 South	10	10.041	0.995916741	
72	458 South Island view	10	10.35	0.966183575	
73	Island View 492 South	10	10.001	0.99990001	
74	Island View 512 South	15	10.06	0.994035785	
75	Island View 532 South	15	10.02	0.998003992	
76	Island View 582 South	15	10.08	0.992063492	
77	Island View 602 South	25	10	1	
78	Island View 614 South	25	10.032	0.996810207	
79	Island View 648 South	25	10.021	0.997904401	
80	868 East Island View Circle	25	10.051	0.994925878	
81	874 East Island View Circle	25	10.05	0.995024876	
82	Island View 665 South	25	10.06	0.994035785	
83	Island View 651 South	25	10.025	0.997506234	

84	Island View 649 South	25	10.235	0.97703957	
85	Island View 637 North	25	10.212	0.97924011	
86	Island View 629 South	25	10.24	0.9765625	
87	Island View 617 South	25	10.01	0.999000999	
88	Island View 611 South	25	10.08	0.992063492	
89	Island View 587 South	25	10.225	0.97799511	
90	111 West Village SQ.	10	10.36	0.965250965	
91	101 West Village RD	10	10.112	0.988924051	
92	81 West Village RD	10	10.3	0.970873786	
93	61 West Village RD	10	10.02	0.998003992	
94	51 West Village RD	10	10.051	0.994925878	
95	31 West Village RD	10	10	1	
96	949 North Village RD	10	10.085	0.991571641	
97	22 West Common Way	10	10.312	0.969743988	
98	32 West Common Way	10	10.38	0.963391137	
99	42 West Common Way	10	10.04	0.996015936	
100	62 West Common Way	10	10.3	0.970873786	
101	102 West Common Way	10	10	1	
102	112 West Common Way	10	10.02	0.998003992	
103	936 North 140 West	10	10	1	
104	956 North 140 West.	10	10.07	0.993048659	
105	200 North 56 West	12	10.02	0.998003992	
106	200 North 62 West	12	10.08	0.992063492	
107	200 North 68 West	12	10.02	0.998003992	
108	200 North 173 West	12	10.03	0.997008973	
109	200 North 169 West	12	10.001	0.99990001	
110	200 North 163 West	12	10.061	0.993936984	
111	200 North 147 West	12	10.001	0.99990001	
112	200 North 141 West	12	10.1	0.99009901	
113	200 North 135 West	12	10.12	0.988142292	
114	200 North 129 West	12	10.18	0.982318271	
115	200 North 115 West	12	10.101	0.99000099	
116	200 North 109 West	12	10.001	0.99990001	
117	200 North 97 West	12	10.11	0.989119683	
118	200 North 99 West	12	10.181	0.982221786	
119	200 North 87 West	12	10.041	0.995916741	
120	200 North 83 West	12	10.06	0.994035785	
121	200 North 77 West	12	10.11	0.989119683	
122	200 North 73 West	12	10.11	0.989119683	
123	200 North 67 West	12	10.261	0.974563883	
124	900 North 355 West	15	10.161	0.984155103	
125	900 North 305 West	15	10.09	0.991080278	
126	900 North 295 west	15	10.061	0.993936984	
127	900 North 285 West	15	10.001	0.99990001	
128	900 North 275 West	15	10.06	0.994035785	
129	900 North 265 West	15	10.17	0.983284169	

130	900 North 225 West	15	10	1	
131	900 North 205 West	15	10.13	0.987166831	
132	900 North 183 West	15	10.111	0.989021857	
133	887 North Bonita Way	30	10.05	0.995024876	
134	871 North Bonita Way	30	10.08	0.992063492	
135	819 North Bonita Way	30	10.1	0.99009901	
136	755 North Bonita Way	30	10	1	
137	87 East Bonita Way	30	10.231	0.977421562	
138	63 East Bonita Way	30	10	1	
139	68 East Bonita Way	30	10.061	0.993936984	
140	82 East Bonita Way	30	10.18	0.982318271	
141	672 North Bonita Way	30	10.121	0.98804466	
142	742 North Bonita Way	30	10.01	0.999000999	
143	770 North Bonita Way	30	10	1	
144	798 North Bonita Way	30	10.001	0.99990001	
145	836 North Bonita Way	30	10.2	0.980392157	
146	864 North Bonita Way	30	10	1	
147	888 North Bonita Way	30	10.001	0.99990001	
148	218 East 900 North	30	10.011	0.998901209	
149	264 East 900 North	30	10.02	0.998003992	
150	286 East 900 North	30	10.1	0.99009901	
151	360 East 900 North	30	10.06	0.994035785	
152	1465 North 389 West	20	10.01	0.999000999	
153	1465 North 357 West	20	10.04	0.996015936	
154	1465 North 341 West	20	10.07	0.993048659	
155	1465 North 301 West	20	10.1	0.99009901	
156	1465 North 292 West	20	10.01	0.999000999	
157	1465 North 316 West	20	10.01	0.999000999	
158	1465 North 384 West	20	10.02	0.998003992	
159	1400 North 543 West	15	10.01	0.999000999	
160	1400 North 501 West	15	10.02	0.998003992	
161	1400 North 493 West	15	10.021	0.997904401	
162	1400 North 492 West	15	10.09	0.991080278	
163	1400 North 520 West	15	10.101	0.99000099	
164	1450 North 359 West	15	10.36	0.965250965	
165	1450 North 355 West	15	10.04	0.996015936	
166	1407 North 300 West	15	10.01	0.999000999	
167	1397 North 300 West	15	10.071	0.992950055	
168	1414 North 300 West	15	10.02	0.998003992	
169	1422 North 300 West	15	10.1	0.99009901	
170	1446 North 300 West	17	10.1	0.99009901	
171	1450 North 255 West	17	10.01	0.999000999	
172	1450 north 109 West	17	10.02	0.998003992	
173	140 North 87 West	17	10.04	0.996015936	
174	1427 North 50 West	17	10.06	0.994035785	
175	1422 North 50 West	17	10	1	

176	1428 North 50 West	17	10.061	0.993936984	
177	1436 North 50 West	17	10.151	0.985124618	
178	1450 North 13 west	17	10.071	0.992950055	
179	2050 North 46 East	17	10.001	0.99990001	
180	2050 North 56 East	17	10.091	0.990982063	
181	1390 North 66 East	17	10	1	
182	2050 North 88 East	17	10.001	0.99990001	
183	2050 North 98 East	17	10.041	0.995916741	
184	2050 North 101 East	17	10.12	0.988142292	
185	2050 North 59 East	17	10.01	0.999000999	
186	Old Haul Road 16 East	15	10.021	0.997904401	
187	Old Haul Road 36 East	15	10.1	0.99009901	
188	Rolling Hills Drive 2116 North	25	10	1	
189	Rolling Hills Drive 2132 North	25	10.011	0.998901209	
190	Rolling Hills Drive 2134 North	25	10.241	0.976467142	
191	213 West 925 North	15	10.281	0.972668028	
192	159 West 925 North	15	10.09	0.991080278	
193	119 West 925 North	15	10.171	0.983187494	
194	107 West 925 North	15	10.06	0.994035785	
195	120 West 925 North	15	10.04	0.996015936	
196	338 West 925 North	15	10.01	0.999000999	
197	Kagie Circle 955 North	15	10.09	0.991080278	
198	Kagie Circle 969 North	15	10.03	0.997008973	
199	1945 North 725 West	25	10.31	0.969932105	
200	37 West Jersey Circle	25	10.06	0.994035785	
201	50 West Jersey Circle	25	10.03	0.997008973	
202	Milky Way 92 West	25	10.24	0.9765625	
203	Milky Way 108 West	25	10.081	0.991965083	
204	Milky Way 124 West	25	10	1	
205	Milky Way 156 West	25	10.111	0.989021857	
206	Milky Way 167 West	25	10.001	0.99990001	
207	Milky Way 149 West	25	10.14	0.986193294	
208	Milky Way 95 West	25	10.04	0.996015936	
209	Milky Way 77 West	25	10.001	0.99990001	
210	1750 North 54 West	20	10.01	0.999000999	
211	1750 North 54 West	20	10.02	0.998003992	
212	1781 North 300 West	20	10	1	
213	1787 North 300 West	20	10	1	
214	1767 North 300 West	20	10.04	0.996015936	
215	1750 North 263 West	20	10.08	0.992063492	
216	1750 North 237 West	20	10.001	0.99990001	
217	1750 North 209 West	20	10.161	0.984155103	
218	1750 North 91 West	20	10.14	0.986193294	
219	1750 North 53 West	20	10	1	

220	1750 North 35 West	20	10.031	0.99690958	
221	1950 North 284 West	25	10.03	0.997008973	
222	1900 North 284 West	25	10.03	0.997008973	
			2237.107	220.3281932	
				0.992469339	
				99.24	Overall

*These meters where test at a medium flow of 2 gpm, the meter we tested against was at 100.2 at a medium flow

* AWWA water Meter Accuracy is 98.5 to 101.5

*5% of the 3/4" meter where tested

BENCH TESTING OF INSIDE METERS

3/4" Meter	Low Flow Read	Med. Flow Read	High Flow Read	Over all Accuracy	
	1/4 GPM	2 GPM	20 GPM		
1	100%	102%	99.40%	100.40%	10
MFR Test	98%	101%	99.90%	99.63%	
2	99%	99%	99.30%	99.10%	12
3	101.50%	100%	99.50%	100.33%	6
4	10%	101%	84.20%	65.06%	7
5	101%	96%	95%	97.33%	6
MFR Test	99.60%	101.30%	98.70%	99.96%	
6	98%	101%	97.20%	98.73%	5
7	0%	101.50%	30%	43.83%	5
8	99%	98%	97.50%	98.16%	
MFR Test	96%	100%	99.90%	98.63%	
9	100%	100%	97%	99%	
MFR Test	98%	101.50%	100.30%	99.93%	
10	100%	98%	97%	98.33%	
11	98.50%	102%	99.30%	99.93%	
MFR Test	97%	100%	99.80%	98.93%	
12	99%	101%	97.80%	99.26%	5
MFR Test	96%	99.50%	99.30%	98.26%	Tota
Total Avg	83.83%	99.95%	91.10%	91.62%	Difference
				Calculated into Million gallons in water loss in sales due to register's, .254	

*Water meters out of specification

*AWWA specification are 98.5% to 101.5%

*The Blue area is the difference between the meter in the home and the outside register. The 254 Thousand gallon represen water lost in the communications sending the pulse from the meter to the outside register.

* Most all of these meters are over 30 years old.

*MFR test is what the test was when it left the factory.

WATER METER ACCURACY

1" Meter	Address		Est. Age of Meter	Field test Results	% of Accuracy	
1	201 East 1200 North	Bench Test	30	10.104	0.989707047	
2	121 West 1750 North	Bench Test	20	10.04	0.996015936	
3	161 East 1200 South	Bench Test	30	10.11	0.989119683	
4	234 South 360 West		10	10.22	0.978473581	
5	264 South 360 West		10	10.07	0.993048659	
6	294 South 360 West		10	10	1	
7	280 West 375 South		10	10.08	0.992063492	
8	280 West 353 South		10	10.131	0.987069391	
9	280 West 337 South		10	10.04	0.996015936	
10	220 West 131 South		15	10.111	0.989021857	
11	220 West 93 South		15	10	1	
12	280 West 27 South		15	10.08	0.992063492	
13	280 West 64 South		15	10.01	0.999000999	
14	280 West 86 South		10	10.2	0.980392157	
				141.196	13.88199223	
					0.991570874	
					99.15%	Overall

*These meters where test at a medium flow of 2 gpm, the meter we tested against was at 100.2 at a medium flow

* AWWA water Meter Accuracy is 98.5 to 101.5 *Water meters out of specification

*5% of the 1" meter where tested

BENCH TEST

1" Meter	Low Flow Read	Med. Flow Read	High Flow Read	% of Accuracy	Address
1	98	99	80	92.33%	201 East 1200 North
2	98	99	99	98.66%	121 West 1750 North
3	99	98	98	98.33%	161 East 1200 North

1.5" Meter	Low Flow Read	Med. Flow Read	High Flow Read	% of Accuracy	Address
1	99	100.6	99	99.53%	346 West 550 North
2	99.7	99.5	99	99.40%	560 North 250 West
3	99	99.1	99	99.03%	950 North Main

2" Meter	Low Flow Read	Med. Flow Read	High Flow Read	% of Accuracy	Address
1	99.4	99.3	99	99.23%	Home Depot
2	98.7	99	98.9	99.20%	Dicks Market

4" Meter	Low Flow Read	Med. Flow Read	High Flow Read	% of Accuracy	Address
1	98	0	97	32.66%	Pheasant brook East
Same meter minus the Medium flow				97.50%	

*Water meters out of specification
*AWWA specification are 98.5% to 101.5%

Appendix Seven

Water Sold 85.55%	449.19	85.55
Non billed metered water city building .46%	2.4	0.46
Public works non Metered water .12%	0.595	0.12
Water Leaks .18%	0.914	0.18
Reservoirs overflows .25%	1.335	0.25
Pump Lube lines .04%	0.223	0.04
Fire Flows .012%	0.063	0.012
Fluoride / Chlorine analyzers .11%	0.594	0.11
Water quality flushing .12%	0.633	0.12
Fire department training and fires .006%	0.032	0.006
Waterline jobs .05%	0.256	0.05
Water theft .005%	0.028	0.005
Unaccounted for water .67%	3.52	0.67
Zero reads on water meters .111%	0.589	0.111
Adjustment of Water meter inaccuracy (AWWA Speciation) 1.06%	5.6	1.06
Water Meter non-recording of 6.3 ounces on low flow 11.25%	59.077	11.25