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February 19, 2009

VIA HAND DELIVERY

Ms. Renee Jenkins
Public Utilities Commission of Ohio
Administration/Docketing
180 East Broad Street, 13th Floor
Columbus, OH 43215-3793

RECEIVED-DOCKETING DIV
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PUCO

Re: **Case Nos. 08-1233-WS-UNC and 07-1112-WS-AIR**
Ohio American Water Company
Stipulation Page No. 7, ¶13D 3

Dear Ms. Jenkins:

Pursuant to the Commission's November 12, 2008 Opinion and Order in Case No. 07-1112-WS-AIR, and to the Stipulation and Recommendation, page 7, paragraph 13D 3 Ohio American Water Company committed to prepare cost-benefit studies outlining known and potential causes of unaccounted-for-water in the following systems: Ashtabula, Aurora East, Blacklick, Huber Ridge and Marion. The parties agreed to extend the due date to February 19, 2009.

Attached are the cost-benefit studies for Ashtabula, Aurora East, Blacklick, Huber Ridge and Marion. Ohio American Water Company submits that it has fulfilled its responsibilities with respect to the first part of paragraph 13D 2, page 7 of the Stipulation.

If there are any questions, please call me at the number listed above.

Sincerely,

Sally W. Bloomfield

Sally W. Bloomfield

Attachments

cc: Parties of Record (w/Attachments via regular U.S. Mail)

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Report - Ashtabula System Unaccounted For Water Cost-Benefit Study

1.0 INTRODUCTION

This report is being submitted as agreed to by Ohio American Water Company (Ohio American or Company) in accordance with the Stipulation filed on September 4, 2008 (Stipulation) paragraph 13 D 3 in Case No. 07-1112-WS-AIR. The Company agreed that it would perform a cost-benefit study for five systems that had an unaccounted for water rate in excess of 15% for four quarters or more. Ashtabula was one of the five systems. Commitment No. 13 D 3 provided that the cost-benefit study would outline the known and potential causes for each named system, include remedial actions and timelines for remedying the causes of the unaccounted for water (UFW) and determine the cost for achieving a 15% UFW level and the investment cost for achieving the greatest benefit for the investment.

It should be recognized that leakage occurs in all water distribution systems. It should also be acknowledged that leakage in any water distribution system can never be totally eliminated and there is no reasonable expectation that such is possible. However leakage should be managed and addressed in systematic, cost-effective programs rather than ineffective expenditures which can far exceed the value of the unaccounted for water recovered or the cost burden to the customer who ultimately pays for leak management programs.

2.0 METHODOLOGY

The purpose of the cost-benefit study is to determine system performance and explain the economic level of leakage for each district. The Company used the guidelines provided in the American Water Works Association Manual 36 (AWWA M36). The AWWA water loss control committee has developed international standards for water audit and loss reduction strategies and an index, the Infrastructure Leakage Index (ILI) that assigns numbers to ranges varying from acceptable or unavoidable leakage to leakages that are potentially controlled by various active leakage control (ALC) methods. Costs are assigned to these control methods so that a company may estimate the cost of achieving given levels of reduced leakage. This Study uses the AWWA M36 methodology to estimate the cost-benefits of various actions it could take to reduce the UFW in the Ashtabula system.

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3.0 SYSTEM DESCRIPTION

The Ashtabula water system is comprised of approximately 202 miles of water mains with 12,637 service connections. The system covers a service area that has a relatively constant elevation. The average operating pressure is 60 PSI. The Ashtabula system produces its own water.

Table I summarizes Ashtabula's rolling 12 month (January 2008 – December 2008) average for water usage: system delivery, sales, authorized Non-Revenue Water (NRW), and Unaccounted for Water (UFW).

TABLE 1
ASHTABULA WATER DATA

Water Usage	Volume (MG)	% of System Delivery
Sales	1,603.85	80.5%
Authorized Non-Revenue Water (NRW)	42.37	2.1%
Unaccounted For Water (UFW)	346.65	17.4%
System Delivery	1992.88	100%

Based on the 12 month rolling average, at the end of December 2008, the Ashtabula water system had a calculated Unaccounted For Water (UFW) of 17.4%.

3.1 Known & Potential Sources of Water Losses

Non revenue water or NRW usage is water usage that has been approved for a specific reason. Examples of authorized NRW usage include, but are not limited to:

- Water used for fire fighting
- Flushing water mains
- Street cleaning
- Water consumption at public buildings or facilities not in customer billing
- Sewer cleaning
- Water used for tank/tower cleaning
- Known surfacing leaks (such as main breaks, service leaks and other leaks where the volume of water loss can be estimated by professional experience and judgment).

While the above water uses may not produce revenue, the water usage in the respective application is accounted for by reasonable professional estimates or calculations.

Unaccounted for Water (UFW) is water that is lost to unknown uses. Examples of UFW include but are not limited to:

- Theft of water
- Non-surfacing leaks
- Unknown surfacing leaks

Because a water system is made up of physical components such as pipes, pipe fittings, valves, fire hydrants, etc., there are numerous locations and means for water to be lost from the water system.

Examples of potential sources of water losses include:

Fire Hydrants & Their Watch Valves	Leakage at the shut off foot valve, leakage at the connections, and leakage at the valve stem packing.
Sample Stations	Leakage at the valve and pipe connections
Customer's Services	Leakage at pressure taps, corporation stop, curb stop valve, service line connections or service line
Water Mains & Fittings	Leakage at pipe fittings joints such as tees, elbows, pressure taps, etc.
Water Main Valves	Leakage at operating stem packing gland, connections to pipe

The Company has an ongoing policy of responding to reported water losses such as tank/tower overflows, fire hydrant damage and surfacing leaks (such as water main breaks, valve leakage, leaking service connections) within the prescribed response time period outlined in the Stipulation.

Studies have documented that because of the large exposure of the cumulative total of private water service lines, customers' water service lines and appurtenances can be a major source of unidentified water loss through leakage.

4.0 EVALUATION OF WATER SYSTEM LOSSES

To evaluate the water system losses using the guidelines in the AWWA M36 Publication Rewrite, the following parameters of the Ashtabula water system were used.

TABLE 2

ASHTABULA WATER SYSTEM INFORMATION

Description of Ashtabula Water System	12/2008 Statistics
Length of Mains	202 miles
Number of service connections	12,636
Number of service connections per mile	63
Distance customer meters are located from the main	40 feet
Percent of time that the system is pressurized	100%
Average system pressure	60 PSI
System Delivery (from Table 1)	1992.88 MG

4.1 TECHNICAL INDEX OF REAL LOSSES (TIRL)

The TIRL is a performance indicator of the total volume of losses in a water system (or UFW) expressed in gallons per service connection per day.

TABLE 3

CALCULATION OF TECHNICAL INDEX OF REAL LOSSES (TIRL)

Annual Volume of Real Losses or UFW (from Table 1)	346.65 MG / year
Average Daily Real Losses	0.95 MG / day or 949,734 gals/day
Number of Service Connections (from Table 2)	12,636
Technical Index of Real Losses (TIRL)	75.16 gals/day per service connection

4.2 UNAVOIDABLE ANNUAL REAL LOSS (UARL)

UARL is the level of leakage that could be achieved at a given pressure if there were **no** financial or economic constraints on the leakage control program.

UARL = ([5.39 x Lm] + [0.15 x Nc] + [7.47 x Lp]) x PSI

Where: Lm is the length of water mains in miles
Nc is the number of service connections
Lp is the total length of pipe between the main and the customer's meter in feet
PSI is the systems average operating pressure
5.39 is an Equation Constant used in AWWA M36
0.15 is an Equation Constant used in AWWA M36
7.47 is an Equation Constant used in AWWA M36

UARL is in gallons per day

Based on the above formula, the calculated UARL for Ashtabula is 222,383 gallons per day (gpd)(81.2 MG per year) or 17.59 gpd per service connection

4.3 INFRASTRUCTURE LEAKAGE INDEX (ILI)

The Infrastructure Leakage Index (ILI) is defined as the ratio of the TIRL to the UARL or:

ILI = TIRL / UARL

In the Ashtabula water system the ILI is 4.27 (4.27 = 75.16 / 17.59).

In a perfect world, the ideal ILI to be achieved is 1.0. An ILI of 1.0 indicates that actual unaccounted for water losses equal the theoretical background water leakage of the water system.

An Infrastructure Leakage Index (ILI) close to or approaching 1.0, demonstrates that a successful leakage management policy is being implemented.

An acceptable economic value of ILI is dependent upon the water system's specific marginal cost for the water loss. However, typical ILI values range between 1.5 and 2.5.

The difference between Real Water Losses and the Unavoidable Annual Real Loss (UARL) represents the maximum potential reduction in unaccounted for water.

In the Ashtabula water system the maximum potential reduction in unaccounted for water is determined by the following equation:

Real Losses – UARL = Potential Reduction in Unaccounted for Water

346.65 MGY – 81.2 MGY = 265.45 MGY

5.0 UNIT COST OF LEAKAGE

In determining the annual cost of water losses the 2008 year cost to produce water was used. This cost only includes fuel, power, and chemical cost.

TABLE 4

CALCULATION OF UNIT COST OF LEAKAGE

Fuel & Power	$181.05 per MG
Chemical	$46.00 per MG
Incremental Unit Cost of Water Production	$227.05 per MG

This potential water loss reduction of 265.45 MG represents a potential dollar value of $60,270.42 assuming a production cost of $227.05 per MG (265.45 MGY X $227.05 per MG).

However this calculation and cost recovery assumes that any leak reduction program would reduce leakage to the UARL absolute minimum which is not probable.

Staff has requested a cost-benefit analysis showing a reduction of leakage to a requested 15%. The value of the water of the UFW to be recovered by reducing the UFW from 17.4% to 15% (a reduction of 2.4%) is calculated in Table 5.

TABLE 5

CALCULATION OF VALUE OF WATER RECOVERED

System Delivery	1992.88 MG
Incremental Reduction of UFW (from 17.4% to 15%)	2.4%
UFW to be recovered	47.829 MG (2.4% X 1992.88 MG)
Production Cost of Water	$227.05 per MG
Value of Recovered UFW	$10,859 per year

6.0 ECONOMIC LEVEL OF LEAKAGE

The economic level of leakage is the amount of leakage with the overall lowest annual cost when considering the cost of lost water and the cost of implementing active leakage control (ALC) program.

As it would be expected, as water losses increase, the dollar value associated with the water losses will increase. Also as more stringent methods of active leakage control are

implemented, the value of lost water should decrease but the cost associated with the ALC program will increase.

Therefore, the fundamental question which must be answered is: Does the value (cost) of the recovered UFW losses exceed the cost of implementing an Active Leak Control program? If not, then there is no financial benefit to the ratepayers since they will, in fact, be paying more money to implement an ALC program which does not cover its cost in the value of UFW recovered.

6.1 COST OF IMPLEMENTING ACTIVE LEAK CONTROL (ALC)

There are four (4) general levels-of-effort for an Active Leak Control (ALC) program. The ALC Alternatives range from reactive (fix leaks in a timely manner when they are identified) to more complex and expensive activities such as installation of area water meters and sub-metering to identify water usage in limited water distribution areas.

Table 6 presents common ALC alternatives.

TABLE 6

ACTIVE LEAKAGE CONTROL (ALC) ALTERNATIVES

ALC Alternative Levels	Reactive Leakage Control	Leak Detection and Sounding	Sub-Area Metering[1]	Metering in a Smaller than Sub-Area
A (Lowest)	X			
B	X	X		
C	X	X	X	
D (Highest)	X	X	X	X

Pressure control in the water distribution system is considered an active leakage control alternative. Since the Ashtabula water system operates as a single pressure zone at a relatively low average pressure, implementing a pressure control program could adversely affect fire flows and customer pressures. Therefore pressure control is not a feasible ALC alternative for the Ashtabula system.

Each ALC alternative has an associated capital cost as well as an operation and maintenance (O&M) implementation cost. As the complexity of the ALC Alternatives increases from A (lowest level) to D (highest level) the associated implementation costs (capital and O&M) increase.

1 Placing a meter on a main or portion of the main to detect leaks along the specific area of a main.

Table 7 presents a summary of ALC strategies and their estimated cost for the purpose of budgeting. However, if an ALC program is implemented a more detailed evaluation costs will need to be made.

TABLE 7
ACTIVE LEAK CONTROL (ALC) ALTERNATIVES
ESTIMATED ANNUAL COST

ALC Strategy	ALC Strategy	Description	Estimated Capital Cost	Estimated Annual Operating and Maintenance Cost
A	Reactive Leakage Control	Limited to fixing only leaks that can be seen. No leak detection work is performed.	$0	$0
B	Leak Detection and Sounding Survey	Using leak noise detection equipment to locate and pinpoint leaks.	$0	$55,500 [2]
C	Sub-Area Metering	Isolating area's of the water system so that the flow into the area can be monitored and the level of leakage can be determined.	$71,250[3]	$50,000[4]
D	Metering in a Sub Sub Area	Isolating smaller area's within the Sub-Areas so that even smaller levels of leakage can be identified.	$0	$125,000[5]

The ALC alternative actions should be cumulative. ALC alternative D would include A, B and C alternatives and their associated activities. Hence, the cost of the higher ALC alternatives must have the lower alternative activity cost added.

6.2 TARGET LEAKAGE LEVELS

To establish the most appropriate ALC, it is necessary to estimate the decrease in ILI that can be expected by implementing each level of ALC. There are no formal guidelines for quantifying the reduction of leakage by implementing each method of ALC. Table 8 summarizes the approach for estimating the reduction in ILI, the target level of leakage, and the TIRL for each of the ALC alternatives.

[2] Based on $250 per mile of water main and a $5,000 mobilization fee
[3] Based on a capital cost of $100,000 per Sub-Area annualized for 10 years, assuming an interest rate of 7 percent (assumed $100,000 per Sub-Area and 5 Sub-Area)
[4] Based on $10,000 per Sub-Area times the number of Sub-Areas
[5] on $5000 per Sub Sub-Area, assuming approximately 500 properties per Sub Sub-Area

TABLE 8

SUMMARY OF TARGET LEAKAGE LEVELS

ALC Alternative	Description	Current ILI	Expected ILI*	Current TIRL		Expected TIRL*	
				gals/day per service connections	MGY	gals/serv conn/day	MGY
A	Reactive Leakage Control	4.27	5	75.16	346.65	87.95	405.64
B	Reactive Leakage Control		3			52.79	243.47
	Leak Detection and Sounding						
C	Reactive Leakage Control		2			35.23	162.49
	Leak Detection and Sounding						
	District Metering						
D	Reactive Leakage Control		1.5			26.34	121.48
	Leak Detection and Sounding						
	District Metering						
	Step Testing						

* Expected ILI and Expected TIRL is the level that the ILI and TIRL is expected to reach over time with consideration to the respective ALC strategies that are implemented

6.3 Evaluation of the Cost of Implementing an ALC Program to the Value of Loss Water Recovered

The value of the UFW potentially recovered by reducing the UFW from 346.65 MG per year, (Table 1), to a UARL of 81.2 MG per year, (Section 4.2 conclusion), was calculated to be $60,270, (Section 5). However, in order to achieve the Unavoidable Annual Real Loss (UARL) a minimum investment of $230,500 per year O&M cost, (Table 7 Operating and maintenance column), would be incurred and a minimum capital cost of $71,250, (Table 7 Capital cost column), would be invested.

There is no positive cost-benefit in reducing Ashtabula water system's UFW losses to the 81.2 MG per year UARL level.

In Section 5.0 the value of the UFW potentially recovered by reducing the UFW losses from the existing 17.4% to 15% (of System Delivery) was calculated to be $10,859.

The minimum effective annual O&M investment cost in an ALC program is estimated to be $55,500 per year. Hence, there is no positive cost-benefit for reducing the current Ashtabula UFW losses from 17.8% to 15%.

7.0 Conclusions & Recommendations

Based on the information and data presented above, the following conclusions are made:

1) The current Ashtabula ILI is 4.27.

2) The cost of implementing an Active Leak Control (ALC) program reducing the Ashtabula ILI to a value lower than 4.27 exceeds the value of the water that would potentially be recovered from the ALC program.

3) To reduce a 346.65 MG per year water loss worth $60,270 to the UARL background leakage level of 81.2 mg per year would require an investment of approximately $301,750.

4) The value of the water recovered by lowering the Ashtabula UFW water loss from 17.4% to 15% is $10,859.

5) The cost to lower the Ashtabula UFW loss from 17.4% to 15% would require a minimum investment of $55,500 per year.

The following Recommendations are presented:

1) The Company should continue its Level A ALC program in the Ashtabula water system.

2) The Company should continue to investigate and repair as found both reported and/or suspected leaks consistent with the time frame outlined in the Stipulation.

3) The Company should continue to monitor UFW in the Ashtabula water system and report its findings to the Staff on a quarterly basis.

4) The Company should re-evaluate the cost-effectiveness of implementing additional levels of an ALC program above the current level A once per year. This re-evaluation should be conducted once per year in January for the preceding calendar year and the report submitted to the Staff by March 1st of the following year.

Report - Aurora System Unaccounted For Water Cost-Benefit Study

1.0 INTRODUCTION

This report is being submitted as agreed to by Ohio American Water Company (Ohio American or Company) in accordance with the Stipulation filed on September 4, 2008 (Stipulation) paragraph 13 D 3 in Case No. 07-1112-WS-AIR. The Company agreed that it would perform a cost-benefit study for five systems that had an unaccounted for water rate (UFW) in excess of 15% for four quarters or more. Aurora was one of the five systems. Commitment No. 13 D 3 provided that the cost-benefit study would outline the known and potential causes for each named system, include remedial actions and timelines for remedying the causes of the unaccounted for water (UFW) and determine the cost for achieving a 15% UFW level and the investment cost for achieving the greatest benefit for the investment.

It should be recognized that leakage occurs in all water distribution systems. It should also be acknowledged that leakage in any water distribution system can never be totally eliminated and there is no reasonable expectation that such is possible. However leakage should be managed and addressed in systematic, cost-effective programs rather than ineffective expenditures which can far exceed the value of the unaccounted for water recovered or the cost burden to the customer who ultimately pays for leak management programs.

2.0 METHODOLOGY

The purpose of the cost-benefit study is to determine system performance and explain the economic level of leakage for each district. The Company used the guidelines provided in the American Water Works Association Manual 36 (AWWA M36). The AWWA water loss control committee has developed international standards for water audit and loss reduction strategies and an index, the Infrastructure Leakage Index (ILI) that assigns numbers to ranges varying from acceptable or unavoidable leakage to leakages that are potentially controlled by various active leakage control (ALC) methods. Costs are assigned to these control methods so that a company may estimate the cost of achieving given levels of reduced leakage. This Study uses the AWWA M36 methodology to estimate the cost-benefits of various actions it could take to reduce the UFW in the Aurora system.

3.0 SYSTEM DESCRIPTION

The Aurora water system is comprised of approximately 3 miles of water mains with 315 service connections. The system covers a service area that has a relatively constant elevation. The average operating pressure is 60 PSI. The Aurora system produces its own water.

Table I summarizes Aurora's rolling 12 month (January 2008 – December 2008) average for water usage: system delivery, sales, authorized Non-Revenue Water (NRW), and Unaccounted for Water (UFW).

TABLE 1
AURORA WATER DATA

Water Usage	Volume (MG)	% of System Delivery
Sales	14.754	83.2%
Authorized Non-Revenue Water (NRW)	0.712	4.0%
Unaccounted For Water (UFW)	2.264	12.8%
System Delivery	17.73	100%

Based on the 12 month rolling average, at the end of December 2008, the Aurora water system had a calculated Unaccounted For Water (UFW) of 12.8%.

3.1 Known & Potential Sources of Water Losses

Non revenue water or NRW usage is water usage that has been approved for a specific reason. Examples of authorized NRW usage include, but are not limited to:

- Water used for fire fighting
- Flushing water mains
- Street cleaning
- Water consumption at public buildings or facilities not in customer billing
- Sewer cleaning
- Water used for tank/tower cleaning
- Known surfacing leaks (such as main breaks, service leaks and other leaks where the volume of water loss can be estimated by professional experience and judgment).

While the above water uses may not produce revenue, the water usage in the respective application is accounted for by reasonable professional estimates or calculations.

Unaccounted for Water (UFW) is water that is lost to unknown uses. Examples of UFW include but are not limited to:

- Theft of water
- Non-surfacing leaks
- Unknown surfacing leaks

Because a water system is made up of physical components such as pipes, pipe fittings, valves, fire hydrants, etc., there are numerous locations and means for water to be lost from the water system.

Examples of potential sources of water losses include:

Fire Hydrants & Their Watch Valves	Leakage at the shut off foot valve, leakage at the connections, and leakage at the valve stem packing.
Sample Stations	Leakage at the valve and pipe connections
Customer's Services	Leakage at pressure taps, corporation stop, curb stop valve, service line connections or service line
Water Mains & Fittings	Leakage at pipe fittings joints such as tees, elbows, pressure taps, etc.
Water Main Valves	Leakage at operating stem packing gland, connections to pipe

The Company has an ongoing policy of responding to reported water losses such as tank/tower overflows, fire hydrant damage and surfacing leaks (such as water main breaks, valve leakage, and leaking service connections) within the prescribed response time period outlined in the Stipulation.

Studies have documented that because of the large exposure of the cumulative total of private water service lines, customers' water service lines and appurtenances can be a major source of unidentified water loss through leakage.

4.0 EVALUATION OF WATER SYSTEM LOSSES

To evaluate the water system losses using the guidelines in the AWWA M36 Publication Rewrite, the following parameters of the Aurora water system were used.

TABLE 2

AURORA WATER SYSTEM INFORMATION

Description of Aurora Water System	12/2008 Statistics
Length of Mains	3 miles
Number of service connections	315
Number of service connections per mile	105
Distance customer meters are located from the main	43 feet
Percent of time that the system is pressurized	100%
Average system pressure	60 PSI
System Delivery (from Table 1)	17.73 MG

4.1 TECHNICAL INDEX OF REAL LOSSES (TIRL)

The TIRL is a performance indicator of the total volume of losses in a water system (or UFW) expressed in gallons per service connection per day.

TABLE 3

CALCULATION OF TECHNICAL INDEX OF REAL LOSSES (TIRL)

Annual Volume of Real Losses or UFW (from Table 1)	2.264 MG / year
Average Daily Real Losses	0.0062 MG / day or 6,202 gals/day
Number of Service Connections (from Table 2)	315
Technical Index of Real Losses (TIRL)	19.69 gals/day per service connection

4.2 UNAVOIDABLE ANNUAL REAL LOSS (UARL)

UARL is the level of leakage that could be achieved at a given pressure if there were **no** financial or economic constraints on the leakage control program.

UARL = ([5.39 x Lm] + [0.15 x Nc] + [7.47 x Lp]) x PSI

Where: Lm is the length of water mains in miles
Nc is the number of service connections
Lp is the total length of pipe between the main and the customer's meter in feet
PSI is the systems average operating pressure

5.39 is an Equation Constant used in AWWA M36
0.15 is an Equation Constant used in AWWA M36
7.47 is an Equation Constant used in AWWA M36
UARL is in gallons per day

Based on the above formula, the calculated UARL for Aurora is 4,958 gallons per day (gpd)(1.81 MG per year) or 15.74 gpd per service connection

4.3 INFRASTRUCTURE LEAKAGE INDEX (ILI)

The Infrastructure Leakage Index (ILI) is defined as the ratio of the TIRL to the UARL or:

ILI = TIRL / UARL

In the Aurora water system the ILI is 1.25 (3.31 = 19.69 / 15.74).

In a perfect world, the ideal ILI to be achieved is 1.0. An ILI of 1.0 indicates that actual unaccounted for water losses equal the theoretical background water leakage of the water system.

An Infrastructure Leakage Index (ILI) close to or approaching 1.0, demonstrates that a successful leakage management policy is being implemented.

An acceptable economic value of ILI is dependent upon the water system specific marginal cost for the water loss. However, typical ILI values range between 1.5 and 2.5.

The difference between Real Water Losses and the Unavoidable Annual Real Loss (UARL) represents the maximum potential reduction in unaccounted for water.

In the Aurora water system the maximum potential reduction in unaccounted for water is determined by the following equation:

Real Losses – UARL = Potential Reduction in Unaccounted for Water

2.264 MGY – 1.81 MGY = 0.454 MGY

5.0 UNIT COST OF LEAKAGE

In determining the annual cost of water losses the 2008 year cost to produce water was used. This cost only includes fuel, power, and chemical cost.

TABLE 4

CALCULATION OF UNIT COST OF LEAKAGE

Fuel & Power	$82.33 per MG
Purchased Water	$3,143.69 per MG
Incremental Unit Cost of Water Production	$3,226.02 per MG

This potential water loss reduction of 0.454 MG represents a potential dollar value of $1,464.61 assuming a production cost of $3226.02 per MG (0.454 MGY X $3226.02 per MG).

However this calculation and cost recovery assumes that any leak reduction program would reduce leakage to the UARL absolute minimum which is not probable.

Staff has requested a cost-benefit analysis showing a reduction of leakage to a requested 15%. The Aurora water system UFW is currently below 15%. Table 5 shows that cost savings of water reduction per percent in the Aurora district

TABLE 5

CALCULATION OF VALUE OF WATER RECOVERED

System Delivery	17.73 MG
Incremental Reduction of UFW per 1%	1%
UFW to be recovered	0.1773 MG (1% X 17.73 MG)
Production Cost of Water	$3226.02 per MG
Value of Recovered UFW per 1% Reduction	$572 per year

6.0 ECONOMIC LEVEL OF LEAKAGE

The economic level of leakage is the amount of leakage with the overall lowest annual cost when considering the cost of lost water and the cost of implementing active leakage control (ALC) program.

As it would be expected, as water losses increase, the dollar value associated with the water losses will increase. Also as more stringent methods of active leakage control are implemented, the value of lost water should decrease but the cost associated with the ALC program will increase.

Therefore, the fundamental question which must be answered is: Does the value (cost) of the recovered UFW losses exceed the cost of implementing an Active Leak Control program? If not, then there is no financial benefit to the rate payers since they will, in fact, be paying more money to implement an ALC program which does not cover its cost in the value of UFW recovered.

6.1 COST OF IMPLEMENTING ACTIVE LEAK CONTROL (ALC)

There are four (4) general levels-of-effort for an Active Leak Control (ALC) program. The ALC Alternatives range from reactive (fix leaks in a timely manner when they are identified) to more complex and expensive activities such as installation of area water meters and sub-metering to identify water usage in limited water distribution areas.

Table 6 presents common ALC alternatives.

TABLE 6

ACTIVE LEAKAGE CONTROL (ALC) ALTERNATIVES

ALC Alternative Levels	Reactive Leakage Control	Leak Detection and Sounding	Sub-Area Metering[1]	Metering in a Smaller than Sub-Area
A (Lowest)	X			
B	X	X		
C	X	X	X	
D (Highest)	X	X	X	X

Pressure control in the water distribution system is considered an active leakage control alternative. Since the Aurora water system operates as a single pressure zone at a relatively low average pressure, implementing a pressure control program could adversely affect fire flows and customer pressures. Therefore pressure control is not a feasible ALC alternative for the Aurora system.

Each ALC alternative has an associated capital cost as well as an operation and maintenance (O&M) implementation cost. As the complexity of the ALC Alternatives increases from A (lowest level) to D (highest level) the associated implementation costs (capital and O&M) increase.

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1 Placing a meter on a main or portion of the main to detect leaks along the specific area of a main.

Table 7 presents a summary of ALC strategies and their estimated cost for the purpose of budgeting. However, if an ALC program is implemented a more detailed evaluation costs will need to be made.

TABLE 7
ACTIVE LEAK CONTROL (ALC) ALTERNATIVES
ESTIMATED ANNUAL COST

ALC Strategy	ALC Strategy	Description	Estimated Capital Cost	Estimated Annual Operating and Maintenance Cost
A	Reactive Leakage Control	Limited to fixing only leaks that can be seen. No leak detection work is performed.	$0	$0
B	Leak Detection and Sounding Survey	Using leak noise detection equipment to locate and pinpoint leaks.	$0	$5,750[2]
C	Sub-Area Metering	Isolating area's of the water system so that the flow into the area can be monitored and the level of leakage can be determined.	$14,250[3]	$10,000[4]
D	Metering in a Sub Sub Area	Isolating smaller area's within the Sub-Areas so that even smaller levels of leakage can be identified.	$0	$25,000[5]

The ALC alternative actions should be cumulative. ALC alternative D would include A, B and C alternatives and their associated activities. Hence, the cost of the higher ALC alternatives must have the lower alternative activity cost added.

6.2 TARGET LEAKAGE LEVELS

To establish the most appropriate ALC, it is necessary to estimate the decrease in ILI that can be expected by implementing each level of ALC. There are no formal guidelines for quantifying the reduction of leakage by implementing each method of ALC. Table 8 summarizes the approach for estimating the reduction in ILI, the target level of leakage, and the TIRL for each of the ALC alternatives.

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2 Based on $250 per mile of water main and a $5,000 mobilization fee

3 Based on a capital cost of $100,000 per Sub-Area annualized for 10 years, assuming an interest rate of 7 percent (assumed $100,000 per Sub-Area and 1 Sub-Area)

4 Based on $10,000 per Sub-Area times the number of Sub-Areas

5 Based on $5000 per Sub Sub-Area, assuming approximately 100 properties per Sub Sub-Area

TABLE 8
SUMMARY OF TARGET LEAKAGE LEVELS

ALC Alternative	Description	Current ILI	**Expected** ILI*	Current TIRL gals/day per service connections	Current TIRL MGY	**Expected** TIRL* gals/serv conn/day	**Expected** TIRL* MGY
A	Reactive Leakage Control	1.25	5	19.69	2.264	78.78	9.05
B	Reactive Leakage Control Leak Detection and Sounding		3			47.30	5.44
C	Reactive Leakage Control Leak Detection and Sounding District Metering		2			31.47	3.62
D	Reactive Leakage Control Leak Detection and Sounding District Metering Step Testing		1.5			23.64	2.72

* Expected ILI and Expected TIRL is the level that the ILI and TIRL is expected to reach over time with consideration to the respective ALC strategies that are implemented

6.3 Evaluation of the Cost of Implementing an ALC Program to the Value of Loss Water Recovered

The value of the UFW potentially recovered by reducing the UFW from 2.264 MG per year, (Table 1), to a UARL of 1.81 MG per year, (Section 4.2 conclusion), was calculated to be $1,464.61, (Section 5). However, in order to achieve the Unavoidable Annual Real Loss (UARL) a minimum investment of $40,750 per year O&M cost, (Table 7 Operating and maintenance column), would be incurred and a minimum capital cost of $14,250, (Table 7 Capital cost column), would be invested.

There is no positive cost-benefit in reducing Aurora water system's UFW losses to the 1.81 MG per year UARL level.

In Section 5.0 the value of the UFW potentially recovered by reducing the UFW losses by 1% (of System Delivery) was calculated to be $572.

The minimum effective annual O&M investment cost in an ALC program that could effectively achieve that level of UFW is estimated to be $55,000 per year. Hence, there is no positive cost-benefit for reducing the current Aurora UFW losses by even 1%.

7.0 Conclusions & Recommendations

Based on the information and data presented above, the following conclusions are made:

1) The current Aurora ILI is 1.25.

2) The cost of implementing an Active Leak Control (ALC) program reducing the Aurora ILI to a value lower than 1.25 exceeds the value of the water that would potentially be recovered from the ALC program.

3) To reduce a 2.264 MG per year water loss worth $1,464.61 to the UARL background leakage level of 1.81 mg per year would require an investment of approximately $55,000.

4) The value of the water recovered by lowering the Aurora UFW water by 1% is $572.

5) The cost to lower the Aurora UFW loss by 1.0% would require a minimum investment of $55,000 per year.

The following Recommendations are presented:

1) The Company should continue its Level A ALC program in the Aurora water system.

2) The Company should continue to investigate and repair as found both reported and/or suspected leaks consistent with the time frame outlined in the Stipulation.

3) The Company should continue to monitor UFW in the Aurora water system and report its findings to the Staff on a quarterly basis.

4) The Company should re-evaluate the cost-effectiveness of implementing additional levels of an ALC program above the current level A once per year. This re-evaluation should be conducted once per year in January for the preceding calendar year and the report submitted to the Staff by March 1st of the following year.

Report – Blacklick System Unaccounted For Water Cost-Benefit Study

1.0 INTRODUCTION

This report is being submitted as agreed to by Ohio American Water Company (Ohio American or Company) in accordance with the Stipulation filed on September 4, 2008 (Stipulation) paragraph 13 D 3 in Case No. 07-1112-WS-AIR. The Company agreed that it would perform a cost-benefit study for five systems that had an unaccounted for water rate in excess of 15% for four quarters or more. Blacklick was one of the five systems. Commitment No. 13 D 3 provided that the cost-benefit study would outline the known and potential causes for each named system, include remedial actions and timelines for remedying the causes of the unaccounted for water (UFW) and determine the cost for achieving a 15% UFW level and the investment cost for achieving the greatest benefit for the investment.

It should be recognized that leakage occurs in all water distribution systems. It should also be acknowledged that leakage in any water distribution system can never be totally eliminated and there is no reasonable expectation that such is possible. However leakage should be managed and addressed in systematic, cost-effective programs rather than ineffective expenditures which can far exceed the value of the unaccounted for water recovered or the cost burden to the customer who ultimately pays for leak management programs.

2.0 METHODOLOGY

The purpose of the cost-benefit study is to determine system performance and explain the economic level of leakage for each district. The Company used the guidelines provided in the American Water Works Association Manual 36 (AWWA M36). The AWWA water loss control committee has developed international standards for water audit and loss reduction strategies and an index, the Infrastructure Leakage Index (ILI) that assigns numbers to ranges varying from acceptable or unavoidable leakage to leakages that are potentially controlled by various active leakage control (ALC) methods. Costs are assigned to these control methods so that a company may estimate the cost of achieving given levels of reduced leakage. This Study uses the AWWA M36 methodology to estimate the cost-benefits of various actions it could take to reduce the UFW in the Blacklick system.

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3.0 SYSTEM DESCRIPTION

The Blacklick water system is comprised of approximately 27.7 miles of water mains with 2,899 service connections. The system covers a service area that has a relatively constant elevation. The average operating pressure is 50 PSI. Blacklick system produces its own water.

Table 1 summarizes Blacklick's rolling 12 month (January 2008 – December 2008) average for water usage: system delivery, sales, authorized Non-Revenue Water (NRW), and Unaccounted for Water (UFW).

TABLE 1
BLACKLICK WATER DATA

Water Usage	Volume (MG)	% of System Delivery
Sales	183.746	70.3%
Authorized Non-Revenue Water (NRW)	19.689	7.5%
Unaccounted For Water (UFW)	57.827	22.1%
System Delivery	261.262	100%

Based on the 12 month rolling average, at the end of December 2008, the Blacklick water system had a calculated Unaccounted For Water (UFW) of 22.1%.

3.1 Known & Potential Sources of Water Losses

Non revenue water or NRW usage is water usage that has been approved for a specific reason. Examples of authorized NRW usage include, but are not limited to:

- Water used for fire fighting
- Flushing water mains
- Street cleaning
- Water consumption at public buildings or facilities not in customer billing
- Sewer cleaning
- Water used for tank/tower cleaning
- Known surfacing leaks (such as main breaks, service leaks and other leaks where the volume of water loss can be estimated by professional experience and judgment).

While the above water uses may not produce revenue, the water usage in the respective application is accounted for by reasonable professional estimates or calculations.

Unaccounted for Water (UFW) is water that is loss to unknown uses. Examples of UFW include but are not limited to:

- Theft of water
- Non-surfacing leaks
- Unknown surfacing leaks

Because a water system is made up of physical components such as pipes, pipe fittings, valves, fire hydrants, etc., there are numerous locations and means for water to be loss from the water system.

Examples of potential sources of water losses include:

Fire Hydrants & Their Watch Valves	Leakage at the shut off foot valve, leakage at the connections, and leakage at the valve stem packing.
Sample Stations	Leakage at the valve and pipe connections
Customer's Services	Leakage at pressure taps, corporation stop, curb stop valve, service line connections or service line
Water Mains & Fittings	Leakage at pipe fittings joints such as tees, elbows, pressure taps, etc.
Water Main Valves	Leakage at operating stem packing gland, connections to pipe

The Company has an ongoing policy of responding to reported water losses such as tank/tower overflows, fire hydrant damage and surfacing leaks (such as water main breaks, valve leakage, and leaking service connections) within the prescribed response time period outlined in the Stipulation.

Studies have documented that because of the large exposure of the cumulative total of private water service lines, customers' water service lines and appurtenances can be a major source of unidentified water loss through leakage.

4.0 EVALUATION OF WATER SYSTEM LOSSES

To evaluate the water system losses using the guidelines in the AWWA M36 Publication Rewrite, the following parameters of the Blacklick water system were used.

TABLE 2
BLACKLICK WATER SYSTEM INFORMATION

Description of Blacklick Water System	12/2008 Statistics
Length of Mains	27.7 miles
Number of service connections	2,899
Number of service connections per mile	102
Distance customer meters are located from the main	100 feet
Percent of time that the system is pressurized	100%
Average system pressure	50 PSI
System Delivery (from Table 1)	261.262 MG

4.1 TECHNICAL INDEX OF REAL LOSSES (TIRL)

The TIRL is a performance indicator of the total volume of losses in a water system (or UFW) expressed in gallons per service connection per day.

TABLE 3
CALCULATION OF TECHNICAL INDEX OF REAL LOSSES (TIRL)

Annual Volume of Real Losses or UFW (from Table 1)	57.8 MG / year
Average Daily Real Losses	0.158 MG / day or 158,000 gals/day
Number of Service Connections (from Table 2)	2,899
Technical Index of Real Losses (TIRL)	54.5 gals/day per service connection

4.2 UNAVOIDABLE ANNUAL REAL LOSS (UARL)

UARL is the level of leakage that could be achieved at a given pressure if there were no financial or economic constraints on the leakage control program.

UARL = ([5.39 x Lm] + [0.15 x Nc] + [7.47 x Lp]) x PSI

Where: Lm is the length of water mains in miles
Nc is the number of service connections

Lp is the total length of pipe between the main and the customer's meter in feet
PSI is the systems average operating pressure
5.39 is an Equation Constant used in AWWA M36
0.15 is an Equation Constant used in AWWA M36
7.47 is an Equation Constant used in AWWA M36
UARL is in gallons per day

Based on the above formula, the calculated UARL for Blacklick is 66,258 gallons per day (gpd) (24.2 MG per year) or 22.9 gpd per service connection

4.3 INFRASTRUCTURE LEAKAGE INDEX (ILI)

The Infrastructure Leakage Index (ILI) is defined as the ratio of the TIRL to the UARL or:

$$ILI = TIRL / UARL$$

In the Blacklick water system the ILI is 2.4 (2.4 = 54.5 / 22.9).

In a perfect world, the ideal ILI to be achieved is 1.0. An ILI of 1.0 indicates that actual unaccounted for water losses equal the theoretical background water leakage of the water system.

An Infrastructure Leakage Index (ILI) close to or approaching 1.0, demonstrates that a successful leakage management policy is being implemented.

An acceptable economic value of ILI is dependent upon the water system specific marginal cost for the water loss. However, typical ILI values range between 1.5 and 2.5.

The difference between Real Water Losses and the Unavoidable Annual Real Loss (UARL) represents the maximum potential reduction in unaccounted for water.

In the Blacklick water system the maximum potential reduction in unaccounted for water is determined by the following equation:

Real Losses – UARL = Potential Reduction in Unaccounted for Water

57.8 MGY – 24.2 MGY = 33.6 MGY

5.0 UNIT COST OF LEAKAGE

In determining the annual cost of water losses the 2008 year cost to produce water was used. This cost only includes fuel, power, and chemical cost.

TABLE 4

CALCULATION OF UNIT COST OF LEAKAGE

Fuel & Power	$233.78 per MG
Chemical	$230.39 per MG
Incremental Unit Cost of Water Production	$464.17 per MG

This potential water loss reduction of 33.6 MG represents a potential dollar value of $15,596 assuming a production cost of $464.17 per MG (33.6 MGY X $464.17 per MG).

However this calculation and cost recovery assumes that any leak reduction program would reduce leakage to the UARL absolute minimum which is not probable.

Staff has requested a cost-benefit analysis showing a reduction of leakage to a requested 15%. The value of the water of the UFW to be recovered by reducing the UFW from 22.1% to 15% (a reduction of 7.1%) is calculated in Table 5.

TABLE 5

CALCULATION OF VALUE OF WATER RECOVERED

System Delivery	261.262 MG
Incremental Reduction of UFW (from 22.1% to 15%)	7.1%
UFW to be recovered	18.5 MG (7.1% X 261.262 MG)
Production Cost of Water	$464.17 per MG
Value of Recovered UFW	$8,587 per year

6.0 ECONOMIC LEVEL OF LEAKAGE

The economic level of leakage is the amount of leakage with the overall lowest annual cost when considering the cost of lost water and the cost of implementing active leakage control (ALC) program.

As it would be expected, as water losses increase, the dollar value associated with the water losses will increase. Also as more stringent methods of active leakage control are

implemented, the value of lost water should decrease but the cost associated with the ALC program will increase.

Therefore, the fundamental question which must be answered is: Does the value (cost) of the recovered UFW losses exceed the cost of implementing an Active Leak Control program? If not, then there is no financial benefit to the ratepayers since they will, in fact, be paying more money to implement an ALC program which does not cover its cost in the value of UFW recovered.

6.1 COST OF IMPLEMENTING ACTIVE LEAK CONTROL (ALC)

There are four (4) general levels-of-effort for an Active Leak Control (ALC) program. The ALC Alternatives range from reactive (fix leaks in a timely manner when they are identified) to more complex and expensive activities such as installation of area water meters and sub-metering to identify water usage in limited water distribution areas.

Table 6 presents common ALC alternatives.

TABLE 6

ACTIVE LEAKAGE CONTROL (ALC) ALTERNATIVES

ALC Alternative Levels	Reactive Leakage Control	Leak Detection and Sounding	Sub-Area Metering[1]	Metering in a Smaller than Sub-Area
A (Lowest)	X			
B	X	X		
C	X	X	X	
D (Highest)	X	X	X	X

Pressure control in the water distribution system is considered an active leakage control alternative. Since the Blacklick water system operates as a single pressure zone at a relatively low average pressure, implementing a pressure control program could adversely affect fire flows and customer pressures. Therefore pressure control is not a feasible ALC alternative for the Blacklick system.

Each ALC alternative has an associated capital cost as well as an operation and maintenance (O&M) implementation cost. As the complexity of the ALC Alternatives increases from A (lowest level) to D (highest level) the associated implementation costs (capital and O&M) increase.

[1] Placing a meter on a main or portion of the main to detect leaks along the specific area of a main.

Table 7 presents a summary of ALC strategies and their estimated cost for the purpose of budgeting. However, if an ALC program is implemented a more detailed evaluation costs will need to be made.

TABLE 7
ACTIVE LEAK CONTROL (ALC) ALTERNATIVES
ESTIMATED ANNUAL COST

ALC Strategy	ALC Strategy	Description	Estimated Capital Cost	Estimated Annual Operating and Maintenance Cost
A	Reactive Leakage Control	Limited to fixing only leaks that can be seen. No leak detection work is performed.	$0	$0
B	Leak Detection and Sounding Survey	Using leak noise detection equipment to locate and pinpoint leaks.	$0	$10,500[2]
C	Sub-Area Metering	Isolating area's of the water system so that the flow into the area can be monitored and the level of leakage can be determined.	$14,250[3]	$10,000[4]
D	Metering in a Sub Sub Area	Isolating smaller area's within the DMA's so that even smaller levels of leakage can be identified.	$0	$25,000[5]

The ALC alternative actions should be cumulative. ALC alternative D would include A, B and C alternatives and their associated activities. Hence, the cost of the higher ALC alternatives must have the lower alternative activity cost added.

6.2 TARGET LEAKAGE LEVELS

To establish the most appropriate ALC, it is necessary to estimate the decrease in ILI that can be expected by implementing each level of ALC. There are no formal guidelines for quantifying the reduction of leakage by implementing each method of ALC. Table 8 summarizes the approach for estimating the reduction in ILI, the target level of leakage, and the TIRL for each of the ALC alternatives.

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[2] $200 /mile plus $5,000 mobilization fee

[3] Purchase/rental of metering equipment

[4] Installation costs, data collection and management costs

[5] Labor costs for extensive field work

TABLE 8

SUMMARY OF TARGET LEAKAGE LEVELS

<table>
<tr><th rowspan="2">ALC Alternative</th><th rowspan="2">Description</th><th rowspan="2">Current ILI</th><th rowspan="2">Expected ILI*</th><th colspan="2">Current TIRL</th><th colspan="2">Expected TIRL*</th></tr>
<tr><th>gals/day per service connections</th><th>MGY</th><th>gals/serv conn/day</th><th>MGY</th></tr>
<tr><td>A</td><td>Reactive Leakage Control</td><td rowspan="11">2.4</td><td>5</td><td rowspan="11">54.5</td><td rowspan="11">57.8</td><td>114</td><td>121</td></tr>
<tr><td rowspan="2">B</td><td>Reactive Leakage Control</td><td rowspan="2">3</td><td rowspan="2">68.6</td><td rowspan="2">72.6</td></tr>
<tr><td>Leak Detection and Sounding</td></tr>
<tr><td rowspan="3">C</td><td>Reactive Leakage Control</td><td rowspan="3">2</td><td rowspan="3">45.7</td><td rowspan="3">48.4</td></tr>
<tr><td>Leak Detection and Sounding</td></tr>
<tr><td>District Metering</td></tr>
<tr><td rowspan="4">D</td><td>Reactive Leakage Control</td><td rowspan="4">1.5</td><td rowspan="4">34.3</td><td rowspan="4">36.3</td></tr>
<tr><td>Leak Detection and Sounding</td></tr>
<tr><td>District Metering</td></tr>
<tr><td>Step Testing</td></tr>
<tr><td colspan="8">* Expected ILI and Expected TIRL is the level that the ILI and TIRL is expected to reach over time with consideration to the respective ALC strategies that are implemented</td></tr>
</table>

6.3 Evaluation of the Cost of Implementing an ALC Program to the Value of Loss Water Recovered

In Section 5.0 the value of the UFW potentially recovered by reducing the UFW from 57.8 MG per year to a UARL of 24.2 MG per year was calculated to be $15,596. However, in order to achieve the Unavoidable Annual Real Loss (UARL) a minimum investment of $45,500 per year O&M cost would be incurred and a minimum capital cost of $14,250 or would be invested.

There is no positive cost-benefit in reducing Blacklick water system's UFW losses to the 24.2 MG per year UARL level.

In Section 5.0 the value of the UFW potentially recovered by reducing the UFW losses from the existing 22.1% to 15% (of System Delivery) was calculated to be $8,587.

The minimum effective annual O&M investment cost in an ALC program is estimated to be $34,750 per year. Hence, there is no positive cost-benefit for reducing the current Blacklick UFW losses from 22.1% to 15%.

7.0 Conclusions & Recommendations

Based on the information and data presented above, the following conclusions are made:

1) The current Blacklick ILI is 2.4.

2) The cost of implementing an Active Leak Control (ALC) program reducing the Blacklick ILI to a value lower than 2.4 exceeds the value of the water that would potentially be recovered from the ALC program.

3) An investment of approximately $59,475 is required to reduce 13.3 MG per year water loss worth $15,596 to the UARL background leakage level of 24.2 MG per year.

4) The value of the water recovered by lowering the Blacklick UFW water loss from 22.1% to 15% is $8,587.

5) The cost to lower the Blacklick UFW loss from 22.1% to 15% would require a minimum investment of $34,750 per year.

The following Recommendations are presented:

1) The Company should continue its Level A ALC program in the Blacklick water system.

2) The Company should continue to investigate and repair as found both reported and/or suspected leaks consistent with the time frame outlined in the Stipulation.

3) The Company should continue to monitor UFW in the Blacklick water system and report its findings to the Staff on a quarterly basis.

4) The Company re-evaluates the cost-effectiveness of implementing additional levels of an ALC program above the current level A once per year. This re-evaluation should be conducted once per year in January for the preceding calendar year and the report submitted to the Staff by March 1st of the following year.

Report - Huber Ridge System Unaccounted For Water Cost-Benefit Study

1.0 INTRODUCTION

This report is being submitted as agreed to by Ohio American Water Company ("Ohio American" or "Company") in accordance with the Stipulation filed on September 4, 2008 ("Stipulation") paragraph 13 D 3 in Case No. 07-1112-WS-AIR. The Company agreed that it would perform a cost-benefit study for five systems that had an unaccounted for water rate in excess of 15% for four quarters or more. Huber Ridge was one of the five systems. Commitment No. 13 D 3 provided that the cost-benefit study would outline the known and potential causes for each named system, include remedial actions and timelines for remedying the causes of the unaccounted for water ("UFW") and determine the cost for achieving a 15% UFW level and the investment cost for achieving the greatest benefit for the investment.

It should be recognized that leakage occurs in all water distribution systems. It should also be acknowledged that leakage in any water distribution system can never be totally eliminated and there is no reasonable expectation that such is possible. However leakage should be managed and addressed in systematic, cost-effective programs rather than ineffective expenditures which can far exceed the value of the unaccounted for water recovered or the cost burden to the customer who ultimately pays for leak management programs.

2.0 METHODOLOGY

The purpose of the cost-benefit study is to determine system performance and explain the economic level of leakage for each district. The Company used the guidelines provided in the American Water Works Association Manual 36 ("AWWA M36"). The AWWA water loss control committee has developed international standards for water audit and loss reduction strategies and an index, the Infrastructure Leakage Index ("ILI") that assigns numbers to ranges varying from acceptable or unavoidable leakage to leakages that are potentially controlled by various active leakage control ("ALC") methods. Costs are assigned to these control methods so that a company may estimate the cost of achieving given levels of reduced leakage. This Study uses the AWWA M36 methodology to estimate the cost-benefits of various actions it could take to reduce the UFW in the Huber Ridge system.

3.0 SYSTEM DESCRIPTION

The Huber Ridge water system is comprised of approximately 21.9 miles of water mains with 2,230 service connections. The system covers a service area that has a relatively constant elevation. The average operating pressure is 50 PSI. Huber Ridge system produces its own water.

Table I summarizes Huber Ridge's rolling 12 month (January 2008 – December 2008) average for water usage: system delivery, sales, authorized Non-Revenue Water (NRW), and Unaccounted for Water (UFW).

TABLE 1
HUBER RIDGE WATER DATA

Water Usage	Volume (MG)	% of System Delivery
Sales	145.912	74.0%
Authorized Non-Revenue Water (NRW)	16.311	8.2%
Unaccounted For Water (UFW)	35.217	17.8%
System Delivery	197.440	100%

Based on the 12 month rolling average, at the end of December 2008, the Huber Ridge water system had a calculated Unaccounted For Water (UFW) of 17.8%.

3.1 Known & Potential Sources of Water Losses

Non revenue water or NRW usage is water usage that has been approved for a specific reason. Examples of authorized NRW usage include, but are not limited to:

- Water used for fire fighting
- Flushing water mains
- Street cleaning
- Water consumption at public buildings or facilities not in customer billing
- Sewer cleaning
- Water used for tank/tower cleaning
- Known surfacing leaks (such as main breaks, service leaks and other leaks where the volume of water loss can be estimated by professional experience and judgment).

While the above water uses may not produce revenue, the water usage in the respective application is accounted for by reasonable professional estimates or calculations.

Unaccounted for Water (UFW) is water that is loss to unknown uses. Examples of UFW include but are not limited to:

- Theft of water
- Non-surfacing leaks
- Unknown surfacing leaks

Because a water system is made up of physical components such as pipes, pipe fittings, valves, fire hydrants, etc., there are numerous locations and means for water to be loss from the water system.

Examples of potential sources of water losses include:

Fire Hydrants & Their Watch Valves	Leakage at the shut off foot valve, leakage at the connections, and leakage at the valve stem packing.
Sample Stations	Leakage at the valve and pipe connections
Customer's Services	Leakage at pressure taps, corporation stop, curb stop valve, service line connections or service line
Water Mains & Fittings	Leakage at pipe fittings joints such as tees, elbows, pressure taps, etc.
Water Main Valves	Leakage at operating stem packing gland, connections to pipe

The Company has an ongoing policy of responding to reported water losses such as tank/tower overflows, fire hydrant damage and surfacing leaks (such as water main breaks, valve leakage, and leaking service connections) within the prescribed response time period outlined in the Stipulation.

Studies have documented that because of the large exposure of the cumulative total of private water service lines, customers' water service lines and appurtenances can be a major source of unidentified water loss through leakage.

4.0 EVALUATION OF WATER SYSTEM LOSSES

To evaluate the water system losses using the guidelines in the AWWA M36 Publication Rewrite, the following parameters of the Huber Ridge water system were used.

TABLE 2
HUBER RIDGE WATER SYSTEM INFORMATION

Description of Huber Ridge Water System	12/2008 Statistics
Length of Mains	21.9 miles
Number of service connections	2,230
Number of service connections per mile	102
Distance customer meters are located from the main	100 feet
Percent of time that the system is pressurized	100%
Average system pressure	50 PSI
System Delivery (from Table 1)	197.44 MG

4.1 TECHNICAL INDEX OF REAL LOSSES (TIRL)

The TIRL is a performance indicator of the total volume of losses in a water system (or UFW) expressed in gallons per service connection per day.

TABLE 3
CALCULATION OF TECHNICAL INDEX OF REAL LOSSES (TIRL)

Annual Volume of Real Losses or UFW (from Table 1)	35.2 MG / year
Average Daily Real Losses	0.096 MG / day or 96,440 gals/day
Number of Service Connections (from Table 2)	2,230
Technical Index of Real Losses (TIRL)	43.3 gals/day per service connection

4.2 UNAVOIDABLE ANNUAL REAL LOSS (UARL)

UARL is the level of leakage that could be achieved at a given pressure if there were **no** financial or economic constraints on the leakage control program.

UARL = ([5.39 x Lm] + [0.15 x Nc] + [7.47 x Lp]) x PSI

Where: Lm is the length of water mains in miles
Nc is the number of service connections

Lp is the total length of pipe between the main and the customer's meter in feet
PSI is the systems average operating pressure
5.39 is an Equation Constant used in AWWA M36
0.15 is an Equation Constant used in AWWA M36
7.47 is an Equation Constant used in AWWA M36
UARL is in gallons per day

Based on the above formula, the calculated UARL for Huber Ridge is 59,980 gallons per day (gpd) (21.9 MG per year) or 26.9 gpd per service connection

4.3 INFRASTRUCTURE LEAKAGE INDEX (ILI)

The Infrastructure Leakage Index (ILI) is defined as the ratio of the TIRL to the UARL or:

$$ILI = TIRL / UARL$$

In the Huber Ridge water system the ILI is 1.6 (1.6 = 43.3 / 26.9).

In a perfect world, the ideal ILI to be achieved is 1.0. An ILI of 1.0 indicates that actual unaccounted for water losses equal the theoretical background water leakage of the water system.

An Infrastructure Leakage Index (ILI) close to or approaching 1.0, demonstrates that a successful leakage management policy is being implemented.

An acceptable economic value of ILI is dependent upon the water system specific marginal cost for the water loss. However, typical ILI values range between 1.5 and 2.5.

The difference between Real Water Losses and the Unavoidable Annual Real Loss (UARL) represents the maximum potential reduction in unaccounted for water.

In the Huber Ridge water system the maximum potential reduction in unaccounted for water is determined by the following equation:

Real Losses – UARL = Potential Reduction in Unaccounted for Water

35.2 MGY – 21.9 MGY = 13.3 MGY

5.0 UNIT COST OF LEAKAGE

In determining the annual cost of water losses the 2008 year cost to produce water was used. This cost only includes fuel, power, and chemical cost.

TABLE 4

CALCULATION OF UNIT COST OF LEAKAGE

Fuel & Power	$233.78 per MG
Chemical	$230.39 per MG
Incremental Unit Cost of Water Production	$464.17 per MG

This potential water loss reduction of 13.3 MG represents a potential dollar value of $6,173 assuming a production cost of $464.17 per MG (13.3 MGY X $464.17 per MG).

However this calculation and cost recovery assumes that any leak reduction program would reduce leakage to the UARL absolute minimum which is not probable.

Staff has requested a cost-benefit analysis showing a reduction of leakage to a requested 15%. The value of the water of the UFW to be recovered by reducing the UFW from 17.8% to 15% (a reduction of 2.8%) is calculated in Table 5.

TABLE 5

CALCULATION OF VALUE OF WATER RECOVERED

System Delivery	197.440 MG
Incremental Reduction of UFW (from 17.8% to 15%)	2.8%
UFW to be recovered	5.530 MG (2.8% X 197.440 MG)
Production Cost of Water	$464.17 per MG
Value of Recovered UFW	$2,567 per year

6.0 ECONOMIC LEVEL OF LEAKAGE

The economic level of leakage is the amount of leakage with the overall lowest annual cost when considering the cost of lost water and the cost of implementing active leakage control (ALC) program.

As it would be expected, as water losses increase, the dollar value associated with the water losses will increase. Also as more stringent methods of active leakage control are

implemented, the value of lost water should decrease but the cost associated with the ALC program will increase.

Therefore, the fundamental question which must be answered is: Does the value (cost) of the recovered UFW losses exceed the cost of implementing an Active Leak Control program? If not, then there is no financial benefit to the rate payers since they will, in fact, be paying more money to implement an ALC program which does not cover its cost in the value of UFW recovered.

6.1 COST OF IMPLEMENTING ACTIVE LEAK CONTROL (ALC)

There are four (4) general level-of-efforts for an Active Leak Control (ALC) program. The ALC Alternatives range from reactive (fix leaks in a timely manner when they are identified) to more complex and expensive activities such as installation of area water meters and sub-metering to identify water usage in limited water distribution areas.

Table 6 presents common ALC alternatives.

TABLE 6

ACTIVE LEAKAGE CONTROL (ALC) ALTERNATIVES

ALC Alternative Levels	Reactive Leakage Control	Leak Detection and Sounding	Sub-Area Metering[1]	Metering in a Smaller than Sub-Area
A (Lowest)	X			
B	X	X		
C	X	X	X	
D (Highest)	X	X	X	X

Pressure control in the water distribution system is considered an active leakage control alternative. Since the Huber Ridge water system operates as a single pressure zone at a relatively low average pressure, implementing a pressure control program could adversely affect fire flows and customer pressures. Therefore pressure control is not a feasible ALC alternative for the Huber Ridge system.

Each ALC alternative has an associated capital cost as well as an operation and maintenance (O&M) implementation cost. As the complexity of the ALC Alternatives increases from A (lowest level) to D (highest level) the associated implementation costs (capital and O&M) increase.

[1] Placing a meter on a main or portion of the main to detect leaks along the specific area of a main.

Table 7 presents a summary of ALC strategies and their estimated cost for the purpose of budgeting. However, if an ALC program is implemented a more detailed evaluation costs will need to be made.

TABLE 7

ACTIVE LEAK CONTROL (ALC) ALTERNATIVES

ESTIMATED ANNUAL COST

ALC Strategy	ALC Strategy	Description	Estimated Capital Cost	Estimated Annual Operating and Maintenance Cost
A	Reactive Leakage Control	Limited to fixing only leaks that can be seen. No leak detection work is performed.	$0	$0
B	Leak Detection and Sounding Survey	Using leak noise detection equipment to locate and pinpoint leaks.	$0	$10,500[2]
C	Sub-Area Metering	Isolating area's of the water system so that the flow into the area can be monitored and the level of leakage can be determined.	$14,250[3]	$10,000[4]
D	Metering in a Sub Sub Area	Isolating smaller area's within the DMA's so that even smaller levels of leakage can be identified.	$0	$25,000[5]

The ALC alternative actions should be cumulative. ALC alternative "D" would include A, B and C alternatives and their associated activities. Hence, the cost of the higher ALC alternatives must have the lower alternative activity cost added.

6.2 TARGET LEAKAGE LEVELS

To establish the most appropriate ALC, it is necessary to estimate the decrease in ILI that can be expected by implementing each level of ALC. There are no formal guidelines for quantifying the reduction of leakage by implementing each method of ALC. Table 8 summarizes the approach for estimating the reduction in ILI, the target level of leakage, and the TIRL for each of the ALC alternatives.

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2 $200 per mile plus $5,000 mobilization costs

3 Purchase/rental of metering equipment and valves

4 Installation costs, data collection and management costs

5 Labor costs for extensive field work

TABLE 8
SUMMARY OF TARGET LEAKAGE LEVELS

<table>
<tr><th rowspan="2">ALC Alternative</th><th rowspan="2">Description</th><th rowspan="2">Current ILI</th><th rowspan="2">Expected ILI*</th><th colspan="2">Current TIRL</th><th colspan="2">Expected TIRL*</th></tr>
<tr><th>gals/day per service connections</th><th>MGY</th><th>gals/serv conn/day</th><th>MGY</th></tr>
<tr><td>A</td><td>Reactive Leakage Control</td><td rowspan="10">1.6</td><td>5</td><td rowspan="10">43.3</td><td rowspan="10">35.2</td><td>134.5</td><td>109.5</td></tr>
<tr><td rowspan="2">B</td><td>Reactive Leakage Control</td><td rowspan="2">3</td><td rowspan="2">80.7</td><td rowspan="2">65.7</td></tr>
<tr><td>Leak Detection and Sounding</td></tr>
<tr><td rowspan="3">C</td><td>Reactive Leakage Control</td><td rowspan="3">2</td><td rowspan="3">53.8</td><td rowspan="3">43.8</td></tr>
<tr><td>Leak Detection and Sounding</td></tr>
<tr><td>District Metering</td></tr>
<tr><td rowspan="4">D</td><td>Reactive Leakage Control</td><td rowspan="4">1.5</td><td rowspan="4">40.35</td><td rowspan="4">32.8</td></tr>
<tr><td>Leak Detection and Sounding</td></tr>
<tr><td>District Metering</td></tr>
<tr><td>Step Testing</td></tr>
<tr><td colspan="8">* Expected ILI and Expected TIRL is the level that the ILI and TIRL is expected to reach over time with consideration to the respective ALC strategies that are implemented</td></tr>
</table>

6.3 Evaluation of the Cost of Implementing an ALC Program to the Value of Loss Water Recovered

In Section 5.0 the value of the UFW potentially recovered by reducing the UFW from 35.2 MG per year to a UARL of 21.9 MG per year was calculated to be $6,173. However, in order to achieve the Unavoidable Annual Real Loss (UARL) a minimum investment of $45,500 per year O&M cost would be incurred and a minimum capital cost of $14,250 or would be invested.

There is no positive cost-benefit in reducing Huber Ridge water system's UFW losses to the 21.9 MG per year UARL level.

In Section 5.0 the value of the UFW potentially recovered by reducing the UFW losses from the existing 17.8% to 15% (of System Delivery) was calculated to be $2,567.

The minimum effective annual O&M investment cost in an ALC program is estimated to be $10,500 per year Hence, there is no positive cost-benefit for reducing the current Huber Ridge UFW losses from 17.8% to 15%.

7.0 Conclusions & Recommendations

Based on the information and data presented above, the following conclusions are made:

1) The current Huber Ridge ILI is 1.6.

2) The cost of implementing an Active Leak Control (ALC) program reducing the Huber Ridge ILI to a value lower than 1.6 exceeds the value of the water that would potentially be recovered from the ALC program.

3) An investment of approximately $59,475 is required to reduce a 13.3 MG per year water loss worth $6,173 to the UARL background leakage level of 21.9 mg per year.

4) The value of the water recovered by lowering the Huber Ridge UFW water loss from 17.8% to 15% is $2,567.

5) The cost to lower the Huber Ridge UFW loss from 17.8% to 15% would require a minimum investment of $10,500 per year.

The following Recommendations are presented:

1) The Company should continue its Level A ALC program in the Huber Ridge water system.

2) The Company should continue to investigate and repair as found both reported and/or suspected leaks consistent with the time frame outlined in the Stipulation.

3) The Company should continue to monitor UFW in the Huber Ridge water system and report its findings to the Staff on a quarterly basis.

4) The Company re-evaluates the cost-effectiveness of implementing additional levels of an ALC program above the current level A once per year. This re-evaluation should be conducted once per year in January for the preceding calendar year and the report submitted to the Staff by March 1st of the following year.

Report - Marion System Unaccounted For Water Cost-Benefit Study

1.0 INTRODUCTION

This report is being submitted as agreed to by Ohio American Water Company (Ohio American or Company) in accordance with the Stipulation filed on September 4, 2008 (Stipulation) paragraph 13 D 3 in Case No. 07-1112-WS-AIR. The Company agreed that it would perform a cost-benefit study for five systems that had an unaccounted for water rate in excess of 15% for four quarters or more. Marion was one of the five systems. Commitment No. 13 D 3 provided that the cost-benefit study would outline the known and potential causes for each named system, include remedial actions and timelines for remedying the causes of the unaccounted for water (UFW) and determine the cost for achieving a 15% UFW level and the investment cost for achieving the greatest benefit for the investment.

It should be recognized that leakage occurs in all water distribution systems. It should also be acknowledged that leakage in any water distribution system can never be totally eliminated and there is no reasonable expectation that such is possible. However leakage should be managed and addressed in systematic, cost-effective programs rather than ineffective expenditures which can far exceed the value of the unaccounted for water recovered or the cost burden to the customer who ultimately pays for leak management programs.

2.0 METHODOLOGY

The purpose of the cost-benefit study is to determine system performance and explain the economic level of leakage for each district. The Company used the guidelines provided in the American Water Works Association Manual 36 (AWWA M36). The AWWA water loss control committee has developed international standards for water audit and loss reduction strategies and an index, the Infrastructure Leakage Index (ILI) that assigns numbers to ranges varying from acceptable or unavoidable leakage to leakages that are potentially controlled by various active leakage control (ALC) methods. Costs are assigned to these control methods so that a company may estimate the cost of achieving given levels of reduced leakage. This Study uses the AWWA M36 methodology to estimate the cost-benefits of various actions it could take to reduce the UFW in the Marion system.

3.0 SYSTEM DESCRIPTION

The Marion water system is comprised of approximately 276 miles of water mains with 16,958 service connections. The system covers a service area that has a relatively constant elevation. The average operating pressure is 60 PSI. The Marion system produces its own water.

Table I summarizes Marion's rolling 12 month (January 2008 – December 2008) average for water usage: system delivery, sales, authorized Non-Revenue Water (NRW), and Unaccounted for Water (UFW).

TABLE 1
MARION WATER DATA

Water Usage	Volume (MG)	% of System Delivery
Sales	1,692.42	70%
Authorized Non-Revenue Water (NRW)	198.72	8.2%
Unaccounted For Water (UFW)	529.08	21.8%
System Delivery	2,420.226	100%

Based on the 12 month rolling average, at the end of December 2008, the Marion water system had a calculated Unaccounted for Water (UFW) of 21.8%.

3.1 Known & Potential Sources of Water Losses

Non revenue water or NRW usage is water usage that has been approved for a specific reason. Examples of authorized NRW usage include, but are not limited to:

- Water used for fire fighting
- Flushing water mains
- Street cleaning
- Water consumption at public buildings or facilities not in customer billing
- Sewer cleaning
- Water used for tank/tower cleaning
- Known surfacing leaks (such as main breaks, service leaks and other leaks where the volume of water loss can be estimated by professional experience and judgment).

While the above water uses may not produce revenue, the water usage in the respective application is accounted for by reasonable professional estimates or calculations.

Unaccounted for Water (UFW) is water that is lost to unknown uses. Examples of UFW include but are not limited to:

- Theft of water
- Non-surfacing leaks
- Unknown surfacing leaks

Because a water system is made up of physical components such as pipes, pipe fittings, valves, fire hydrants, etc., there are numerous locations and means for water to be lost from the water system.

Examples of potential sources of water losses include:

Fire Hydrants & Their Watch Valves	Leakage at the shut off foot valve, leakage at the connections, and leakage at the valve stem packing.
Sample Stations	Leakage at the valve and pipe connections
Customer's Services	Leakage at pressure taps, corporation stop, curb stop valve, service line connections or service line
Water Mains & Fittings	Leakage at pipe fittings joints such as tees, elbows, pressure taps, etc.
Water Main Valves	Leakage at operating stem packing gland, connections to pipe

The Company has an ongoing policy of responding to reported water losses such as tank/tower overflows, fire hydrant damage and surfacing leaks (such as water main breaks, valve leakage, and leaking service connections) within the prescribed response time period outlined in the Stipulation.

Studies have documented that because of the large exposure of the cumulative total of private water service lines, customers' water service lines and appurtenances can be a major source of unidentified water loss through leakage.

4.0 EVALUATION OF WATER SYSTEM LOSSES

To evaluate the water system losses using the guidelines in the AWWA M36 Publication Rewrite, the following parameters of the Marion water system were used.

TABLE 2

MARION WATER SYSTEM INFORMATION

Description of Marion Water System	12/2008 Statistics
Length of Mains	276 miles
Number of service connections	16,958
Number of service connections per mile	61
Distance customer meters are located from the main	20 feet
Percent of time that the system is pressurized	100%
Average system pressure	97 PSI
System Delivery (from Table 1)	2420.23 MG

4.1 TECHNICAL INDEX OF REAL LOSSES (TIRL)

The TIRL is a performance indicator of the total volume of losses in a water system (or UFW) expressed in gallons per service connection per day.

TABLE 3

CALCULATION OF TECHNICAL INDEX OF REAL LOSSES

Annual Volume of Real Losses or UFW (from Table 1)	529.08 MG / year
Average Daily Real Losses	1.45 MG / day or 1,449,534 gals/day
Number of Service Connections (from Table 2)	16,958
Technical Index of Real Losses (TIRL)	85.48 gals/day per service connection

4.2 UNAVOIDABLE ANNUAL REAL LOSS (UARL)

UARL is the level of leakage that could be achieved at a given pressure if there were **no** financial or economic constraints on the leakage control program.

UARL = ([5.39 x Lm] + [0.15 x Nc] + [7.47 x Lp]) x PSI

Where: Lm is the length of water mains in miles
Nc is the number of service connections
Lp is the total length of pipe between the main and the customer's meter in feet
PSI is the systems average operating pressure

5.39 is an Equation Constant used in AWWA M36
0.15 is an Equation Constant used in AWWA M36
7.47 is an Equation Constant used in AWWA M36
UARL is in gallons per day

Based on the above formula, the calculated UARL for Marion is 438,301 gallons per day (gpd) (159.98 MG per year) or 25.85 gpd per service connection

4.3 INFRASTRUCTURE LEAKAGE INDEX (ILI)

The Infrastructure Leakage Index (ILI) is defined as the ratio of the TIRL to the UARL or:

$$ILI = TIRL / UARL$$

In the Marion water system the ILI is 3.31 (3.31 = 85.48 / 25.85).

In a perfect world, the ideal ILI to be achieved is 1.0. An ILI of 1.0 indicates that actual unaccounted for water losses equal the theoretical background water leakage of the water system.

An Infrastructure Leakage Index (ILI) close to or approaching 1.0, demonstrates that a successful leakage management policy is being implemented.

An acceptable economic value of ILI is dependent upon the water system's specific marginal cost for the water loss. However, typical ILI values range between 1.5 and 2.5.

The difference between Real Water Losses and the Unavoidable Annual Real Loss (UARL) represents the maximum potential reduction in unaccounted for water.

In the Marion water system the maximum potential reduction in unaccounted for water is determined by the following equation:

Real Losses – UARL = Potential Reduction in Unaccounted for Water

529.08 MGY – 159.98 MGY = 369.1 MGY

5.0 UNIT COST OF LEAKAGE

In determining the annual cost of water losses the 2008 year cost to produce water was used. This cost only includes fuel, power, and chemical cost.

TABLE 4

CALCULATION OF UNIT COST OF LEAKAGE

Fuel & Power	$170.05 per MG
Chemical	$356.93 per MG
Incremental Unit Cost of Water Production	$526.98 per MG

This potential water loss reduction of 369.1 MG represents a potential dollar value of $194,508.32 assuming a production cost of $526.98 per MG (369.1 MGY x $526.98 per MG).

However this calculation and cost recovery assumes that any leak reduction program would reduce leakage to the UARL absolute minimum which is not probable.

Staff has requested a cost-benefit analysis showing a reduction of leakage to a requested 15%. The value of the water of the UFW to be recovered by reducing the UFW from 21.8% to 15% (a reduction of 6.8%) is calculated in Table 5.

TABLE 5

CALCULATION OF VALUE OF WATER RECOVERED

System Delivery	2420.23 MG
Incremental Reduction of UFW (from 21.8% to 15%)	6.8%
UFW to be recovered	164.58 MG (6.8% X 2420.23 MG)
Production Cost of Water	$526.98 per MG
Value of Recovered UFW	$86,727.93 per year

6.0 ECONOMIC LEVEL OF LEAKAGE

The economic level of leakage is the amount of leakage with the overall lowest annual cost when considering the cost of lost water and the cost of implementing active leakage control (ALC) program.

As it would be expected, as water losses increase, the dollar value associated with the water losses will increase. Also as more stringent methods of active leakage control are

implemented, the value of lost water should decrease but the cost associated with the ALC program will increase.

Therefore, the fundamental question which must be answered is: Does the value (cost) of the recovered UFW losses exceed the cost of implementing an Active Leak Control program? If not, then there is no financial benefit to the ratepayers since they will, in fact, be paying more money to implement an ALC program which does not cover its cost in the value of UFW recovered.

6.1 COST OF IMPLEMENTING ACTIVE LEAK CONTROL (ALC)

There are four (4) general levels-of-effort for an Active Leak Control (ALC) program. The ALC Alternatives range from reactive (fix leaks in a timely manner when they are identified) to more complex and expensive activities such as installation of area water meters and sub-metering to identify water usage in limited water distribution areas.

Table 6 presents common ALC alternatives.

TABLE 6

ACTIVE LEAKAGE CONTROL (ALC) ALTERNATIVES

ALC Alternative Levels	Reactive Leakage Control	Leak Detection and Sounding	Sub-Area Metering[1]	Metering in a Smaller than Sub-Area
A (Lowest)	X			
B	X	X		
C	X	X	X	
D (Highest)	X	X	X	X

Pressure control in the water distribution system is considered an active leakage control alternative. Since the Marion water system operates as a single pressure zone at a relatively low average pressure, implementing a pressure control program could adversely affect fire flows and customer pressures. Therefore pressure control is not a feasible ALC alternative for the Marion system.

Each ALC alternative has an associated capital cost as well as an operation and maintenance (O&M) implementation cost. As the complexity of the ALC Alternatives increases from A (lowest level) to D (highest level) the associated implementation costs (capital and O&M) increase.

1 Placing a meter on a main or portion of the main to detect leaks along the specific area of a main.

Table 7 presents a summary of ALC strategies and their estimated cost for the purpose of budgeting. However, if an ALC program is implemented a more detailed evaluation costs will need to be made.

TABLE 7
ACTIVE LEAK CONTROL (ALC) ALTERNATIVES
ESTIMATED ANNUAL COST

ALC Strategy	ALC Strategy	Description	Estimated Capital Cost	Estimated Annual Operating and Maintenance Cost
A	Reactive Leakage Control	Limited to fixing only leaks that can be seen. No leak detection work is performed.	$0	$0
B	Leak Detection and Sounding Survey	Using leak noise detection equipment to locate and pinpoint leaks.	$0	$74,000[2]
C	Sub-Area Metering	Isolating area's of the water system so that the flow into the area can be monitored and the level of leakage can be determined.	$85,500[3]	60,000[4]
D	Metering in a Sub Sub Area	Isolating smaller area's within the Sub-Areas so that even smaller levels of leakage can be identified.	$0	$150,000[5]

The ALC alternative actions should be cumulative. ALC alternative D would include A, B and C alternatives and their associated activities. Hence, the cost of the higher ALC alternatives must have the lower alternative activity cost added.

6.2 TARGET LEAKAGE LEVELS

To establish the most appropriate ALC, it is necessary to estimate the decrease in ILI that can be expected by implementing each level of ALC. There are no formal guidelines for quantifying the reduction of leakage by implementing each method of ALC. Table 8 summarizes the approach for estimating the reduction in ILI, the target level of leakage, and the TIRL for each of the ALC alternatives.

[2] Based on $250 per mile of water main and a $5,000 mobilization fee

[3] Based on a capital cost of $100,000 per Sub-Area annualized for 10 years, assuming an interest rate of 7 percent (assumed $100,000 per Sub-Area and 6 Sub-Areas)

[4] Based on $10,000 times the number of Sub-Areas

[5] Based on $5000 per Sub Sub-Area, assuming approximately 500 properties per Sub Sub-Area

TABLE 8
SUMMARY OF TARGET LEAKAGE LEVELS

<table>
<tr><th rowspan="2">ALC Alternative</th><th rowspan="2">Description</th><th rowspan="2">Current ILI</th><th rowspan="2">**Expected** ILI*</th><th colspan="2">Current TIRL</th><th colspan="2">**Expected** TIRL*</th></tr>
<tr><th>gals/day per service connections</th><th>MGY</th><th>gals/serv conn/day</th><th>MGY</th></tr>
<tr><td>A</td><td>Reactive Leakage Control</td><td rowspan="12">3.31</td><td>5</td><td rowspan="12">85.48</td><td rowspan="12">529.08</td><td>129.33</td><td>800.5</td></tr>
<tr><td rowspan="2">B</td><td>Reactive Leakage Control</td><td rowspan="2">3</td><td rowspan="2">77.63</td><td rowspan="2">480.5</td></tr>
<tr><td>Leak Detection and Sounding</td></tr>
<tr><td rowspan="3">C</td><td>Reactive Leakage Control</td><td rowspan="3">2</td><td rowspan="3">51.78</td><td rowspan="3">320.5</td></tr>
<tr><td>Leak Detection and Sounding</td></tr>
<tr><td>District Metering</td></tr>
<tr><td rowspan="4">D</td><td>Reactive Leakage Control</td><td rowspan="4">1.5</td><td rowspan="4">38.86</td><td rowspan="4">240.53</td></tr>
<tr><td>Leak Detection and Sounding</td></tr>
<tr><td>District Metering</td></tr>
<tr><td>Step Testing</td></tr>
<tr><td colspan="8">* Expected ILI and Expected TIRL is the level that the ILI and TIRL is expected to reach over time with consideration to the respective ALC strategies that are implemented</td></tr>
</table>

6.3 Evaluation of the Cost of Implementing an ALC Program to the Value of Loss Water Recovered

The value of the UFW potentially recovered by reducing the UFW from 529.08 MG per year, (Table 1), to a UARL of 159.98 MG per year, (Section 4.2 conclusion), was calculated to be $194,508, (Section 5). However, in order to achieve the Unavoidable Annual Real Loss (UARL) a minimum investment of $284,000 per year O&M cost, (Table 7 Operating and maintenance column), would be incurred and a minimum capital cost of $85,500, (Table 7 Capital cost column), would be invested.

There is no positive cost-benefit in reducing Marion water system's UFW losses to the 159.98 MG per year UARL level.

In Section 5.0 the value of the UFW potentially recovered by reducing the UFW losses from the existing 21.8% to 15% (of System Delivery) was calculated to be $86,727.

The minimum effective annual O&M investment cost in an ALC program that could effectively achieve that level of UFW is estimated to be $134,000 per year. Hence, there is no positive cost-benefit for reducing the current Marion UFW losses from 21.8% to 15%.

7.0 Conclusions & Recommendations

Based on the information and data presented above, the following conclusions are made:

1) The current Marion ILI is 3.31.

2) The cost of implementing an Active Leak Control (ALC) program reducing the Marion ILI to a value lower than 3.31 exceeds the value of the water that would potentially be recovered from the ALC program.

3) To reduce a 529.08 MG per year water loss worth $194.508 to the UARL background leakage level of 159.98 mg per year would require an investment of approximately $370,000.

4) The value of the water recovered by lowering the Marion UFW water loss from 21.8% to 15% is $86,727.

5) The cost to lower the Marion UFW loss from 21.8% to 15% would require a minimum investment of $134,000 per year.

The following Recommendations are presented:

1) The Company should continue its Level A ALC program in the Marion water system.

2) The Company should continue to investigate and repair as found both reported and/or suspected leaks consistent with the time frame outlined in the Stipulation.

3) The Company should continue to monitor UFW in the Marion water system and report its findings to the Staff on a quarterly basis.

4) The Company re-evaluates the cost-effectiveness of implementing additional levels of an ALC program above the current level A once per year. This re-evaluation should be conducted once per year in January for the preceding calendar year and the report submitted to the Staff by March 1st of the following year.