KING COUNTY WATER DISTRICT NO. 90
KING COUNTY, WASHINGTON

RESOLUTION NO. 1087

A RESOLUTION of the Board of Commissioners of King County Water District No. 90, King County, Washington, adopting a Water Loss Control Action Plan.

WHEREAS, the District owns and operates a municipal water system including the supply, treatment, storage, and distribution of potable water to residential and commercial customers; and

WHEREAS, the District, pursuant to WAC 246-290 et al., has implemented, and will continue to implement, a water loss control program to investigate and reduce water loss throughout the system;

WHEREAS, the District has created a Water Loss Control Action Plan, which updates the District's 2015 Water System Plan;

NOW, THEREFORE, BE IT RESOLVED by the Board of Commissioners of King County Water District No. 90, King County, Washington, as follows:

SECTION 1: The District hereby adopts the Water Loss Control Action Plan attached hereto as an update to the District's 2015 Water System Plan.

ADOPTED by the Board of Commissioners of King County Water District No. 90, King County, Washington, at a regular open public meeting thereof on the 17th day of November 2020.

11/18/20
Byron Murgatroyd, President

11/18/20
Pete Eberle, Vice-President

11/19/20
Sam Amira, Secretary

I.INTRODUCTION

King County Water District No. 90 (District) is a Special Purpose District that owns and operates a municipal water system including supply, treatment, storage, and distribution of potable water to residential and commercial customers. The District provides water service to an area of approximately 6 square miles and maintains more than 182 miles of pipe, 1,065 fire hydrants, and 8,150 water meters. Because of the inherent complexity of a large water system with aging infrastructure, the District has implemented a water loss control program to investigate and reduce the water lost throughout the distribution system.

The District has prepared this Water Loss Control Action Plan (WLCAP) in accordance with Washington Administrative Code (WAC) 246-290-820. This Plan supplements the District's 2015 Water System Plan. This document summarizes the District's progress in minimizing distribution system leakage (DSL) and includes planned activities for further reducing water loss.

Starting in 2018, the District's DSL started to slowly creep above 10.0 percent. The rolling 3-year average was 10.7 percent as of December 31, 2018. By December 31, 2019 the 3-year average of 11.57%. If the 3-year average DSL is greater than 10 percent, the District must have a written water loss control plan. In addition to reducing water loss, the implementation of this plan may help reduce costs to the Water Utility. The District is committed to decreasing water loss and strives to reduce DSL to 10 percent or less (3-year average) by 2025.

II.OVERVIEW OF WATER LOSS

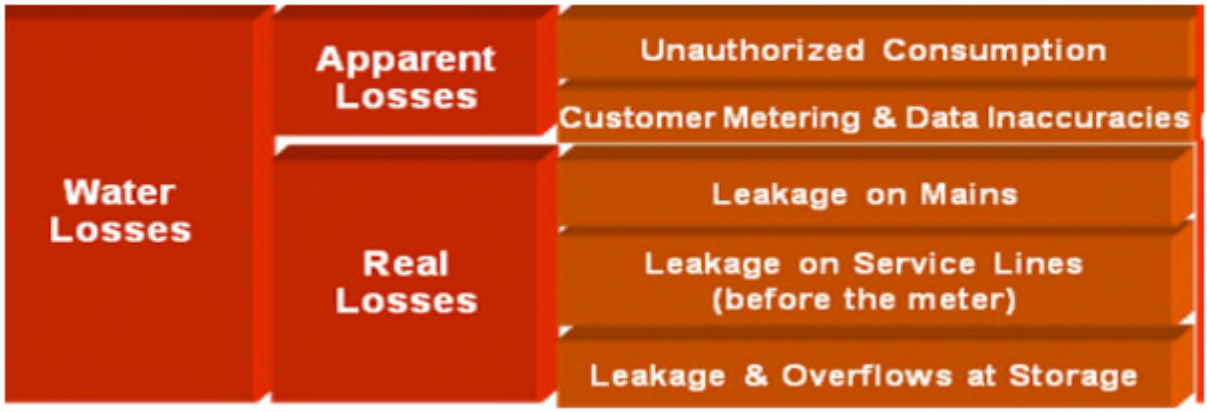
Water system inefficiencies increase the cost of service to customers and may lead to increased raw water demands that negatively impact the natural environment. Water system audits and water loss control are valuable water management strategies that can improve the efficiency of water production and delivery in water systems of all sizes.

Water loss in the distribution system can be attributed to a combination of real loss and apparent loss of water, both of which must be carefully assessed to create the most effective water loss reduction program.

According to the AWWA Water Loss Control Manual 1, real loss involves the physical loss of water from the distribution system up to the point of customer metering. This includes leaks, breaks, and overflows which can be caused by a variety of reasons such as: pressure, corrosion, incorrect materials, weather, and poor maintenance. In real loss situations, the amount of leakage can be exacerbated by rate of flow and duration of the leak.

Apparent loss consists of unauthorized water use and all inaccuracies associated with customer and production metering. Examples of apparent loss include errors in water flow measurement, errors in water accounting, and unauthorized usage (theft).

Figure 1: IWA/AWWA Water Audit Method and Apparent vs. Real Losses



Problems associated with water loss can be both technical and financial in nature. The technical issue with water loss is that the customer does not receive all of the water supplied by the Utility. Financially, water loss is a problem because not all of the water reaching the end user is properly measured or paid for.

There are some water uses that the District does not bill for, such as water used during the draining and cleaning of District-owned water tanks and reservoirs. These unbilled water uses are known as authorized consumption. The combination of real losses, apparent losses, and authorized consumption is called non-revenue water. The District's WLCAP includes measures to reduce both real and apparent water loss and describes examples of the District's authorized consumption.

Water Loss Control Plan - Apparent Loss Component

Unauthorized Consumption: Ways to minimize unauthorized consumption include, but are not limited to, reassessing policy and regulations for permitted water supply services, public education on theft, cooperation with other entities to report violations, better trained meter readers, theft bounties or rewards, more secure hydrant locks, etc.

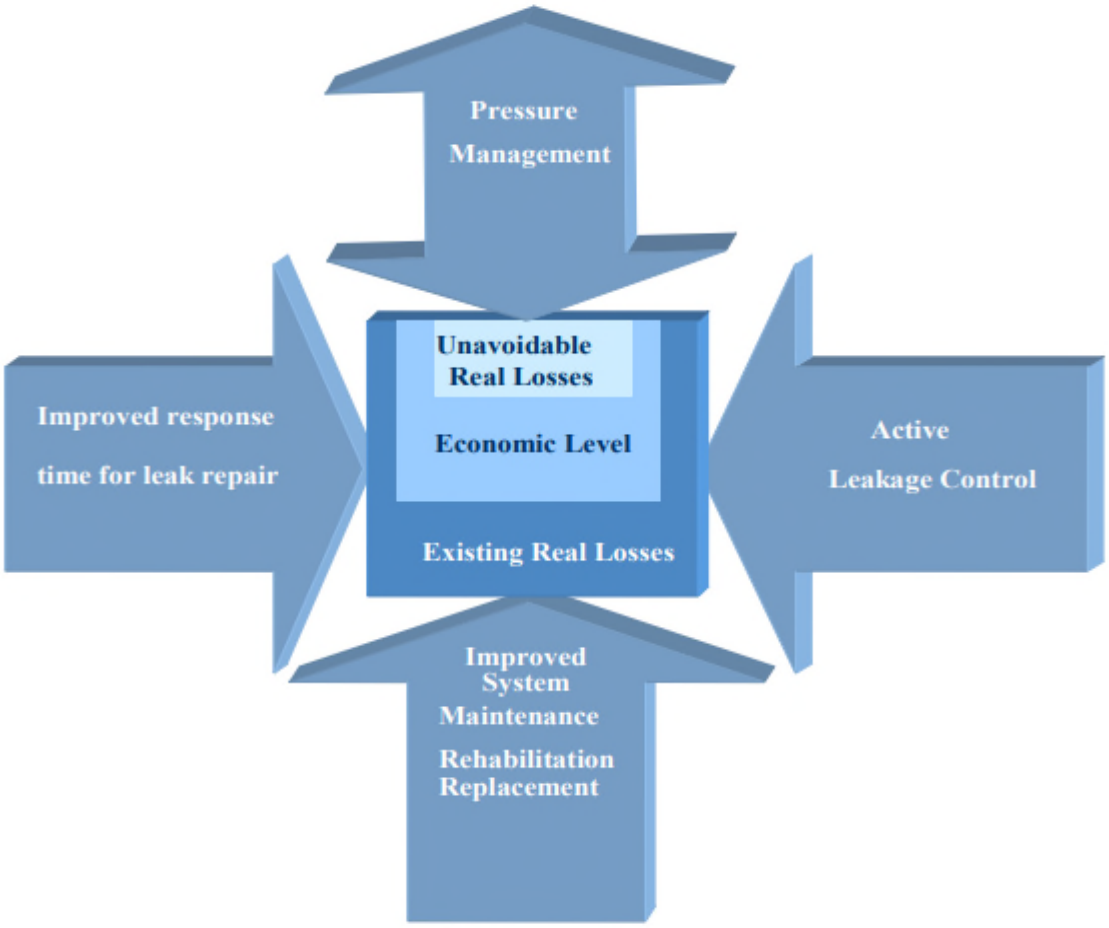
Customer Metering: Solutions to minimize inaccuracies are to operate a proper meter testing and replacement program, utilize a meter sizing program rather than having meters chosen by cost, periodic review of the usage compared to meter sizing to determine if a different size or type of meter is more appropriate, etc.

Data Inaccuracies: These are errors occurring between the point of data input as meter readings and the data output or archived in customer billing systems. Errors include billing system entry errors, account adjustments, invalid zero consumption readings, meter rollover, meter change out, etc. Solutions to minimize errors include enhanced QA/QC on data entry, switching from manual to automated meter readings (AMR), enhanced software, and detailed comparisons of water production to water billed over time.

Water Loss Control Plan - Real Loss Component

While revenue recovery is more related to reduction of apparent losses, an effective real loss reduction program can also contribute to the water system's financial improvement. Real loss reduction not only reduces day-to-day operational costs by reducing the amount of water needed to produce and distribute (usually through pumping), it can also reduce overall system demand and defer costly capital improvements in production and distribution infrastructure or water resources expansion. Direct savings from real loss reduction is calculated using the production (and pumping) cost of water, but the financial benefits extend beyond this direct calculation. Activities can include pressure management to reduce background leakage, improved response time for leak/break repair, an active leak detection and management program, and proactive asset maintenance and rehabilitation.

Figure 2: The Four-Pillar Approach to the Control of Real Losses



Source: AWWA Manual M36, *Water Audits and Loss Control Programs* (2014).

Proactive leakage management is designed to control the real portion of water loss, which includes leaks on mains and service lines and overflows at storage facilities.

Pressure Management The average system pressure is a particularly important parameter in calculating the unavoidable annual real losses (UARL), and system pressure is by far the greatest influencing factor for leakage in a distribution system. All systems are unique, and the pressure will vary based on the average geographic size of the system, the elevation changes, the demand patterns, and other local considerations.

Implementing Pilot Programs for Leakage Management Recommendations include investment in additional leak detection resources and strategies such as in-house crews, equipment, contractors, and operational changes including active pressure management. When evaluating the feasibility of each option and selecting the best tools for the system, it is necessary to determine the potential payback associated with each option. Pilot programs such as:

- District Metered Areas - metering each pressure zone for consumption to be analyzed for extraneous water usage to locate specific areas of pipe leakage. Each zone's usage will be compared with customer consumption in the same zone or neighborhood to identify which zones need further investigation
- Leak Noise Loggers - Loggers record leak noise data for later analysis of potential leak occurrences.

Improved Response Time for Leak Repair In determining resource requirements, the District must also consider the amount of effort required to address emergency and work order responses, and how this effort may be reduced through increased proactive leak detection activity. To effectively manage real water loss, the District will need to determine an appropriate level of investment in repair crews and equipment to maintain its desired response goal.

Leak Detection The frequency of leak detection system surveys varies within the industry, with some large utilities targeting a cycle time of one year. For each system, a more readily attainable goal such as three to five years is an appropriate target. As the system's data collection and evaluation process improves to allow a more accurate assessment of real versus apparent losses, the applicability of a targeted leak detection cycle can be revisited, and the leak survey frequency adjusted accordingly.

III.ONGOING ACTIVITIES

Calculate DSL on a Quarterly Basis

The District currently calculates DSL on a quarterly basis for staff and Commissioners review. Additionally, DSL is calculated for annual report requirements such as the annual Water Use Efficiency (WUE). This frequent reporting will assist the District in understanding water loss trends so that efforts to reduce DSL can be monitored and improved.

Consumption Meters

The District provides water service metering for all customers. Consumption meters are categorized as large water meters (1 1/2-inches or larger) and small water meters (1-inch and smaller). All large meters are tested and repaired (as needed). The District inspects and calibrates all large meters on a three-year rotating basis. Small meters are repaired and replaced on an as-needed basis or every 20 years, whichever comes first.

As of June 2020, the District has replaced 37% of its meter with Ultrasonic meters. At this time there are an additional (2,505) meters (31%) of the District meters are older than 15 years and are

anticipated to be under-registering by somewhere between 10% to 30% depending on total consumption through the meter. Many old positive displacement-type meters with degrading accuracy have been replaced with ultrasonic meters, which are more accurate across their entire flow range.

Leak Detection and Water Main Replacement

For the past 20 years, the District has had a proactive leak detection program. Each year, the District continues to conduct acoustic leak detection on District water mains and repairs these leaks as needed. Leak detection testing location, date, time, name of personnel performing the test, and results of the test are recorded in the District's asset management system. Personnel using the leak detection equipment are trained through classes. Leak detection equipment goes in for maintenance services on a yearly basis.

Hydrant Repairs and Replacements

The District aims to reduce water loss caused by deteriorating or malfunctioning fire hydrants. Hydrants with damaged rubber seat rings or imbedded rocks are especially at risk of non-revenue water loss. The District repairs or replaces hydrants showing signs of deterioration during routine inspections or in response to calls about visible hydrant leaks. The District will also repair or replace hydrants that are found to be leaking during acoustic testing.

Location of Unauthorized Connections

The District aims to reduce unauthorized water usage. If a District employee notices suspicious alteration of a water meter during normal site visits, the potential unauthorized use will be reported, assessed, and fixed. The District also responds to reports of suspicious connections received from residents. Additionally, the District's WLCAP includes measures to reduce both real and apparent water loss, and also describes examples of the District's authorized consumption.

Ultrasonic meter contains a tamper detection alarm.

If a resident attempts to alter a water meter, an alarm is triggered, sending an alert to the Meter Reading Staff. The District can then investigate the cause of the alarm and assess whether any repairs to the water meter are necessary.

Storage Facility Overflow Protection

By utilizing alarms and overflow pipes, the District protects against water loss caused by the overfilling of water storage facilities. When the water level reaches storage capacity, a sensor is triggered, resulting in the shut off of inflow pumps. The excessive water level also triggers a "high level alarm," which travels through SCADA communication systems in order to ensure that the alarm signal is received by Field Staff. For each alarm triggered, field staff will respond by conducting a field inspection to locate and fix any issues.

If the water rises above the trigger point and the shutoff of the inflow pump fails, an outlet located above the sensor allows for excess water to exit the storage facility through an overflow pipe. Overflow pipes carry extra water into the closest suitable facility.

Visible Reported Leakage

The District currently records, assesses, and investigates all reports of leaks. During normal business hours, residents can report visual evidence of leaks in the form of a phone call or email sent directly to the District office. After hours, residents may call the District's 24-hour answering service to report possible leaks.

Production Meters
All of the District's sources of supply are metered via production meters. This includes all of the District-owned production wells and water purchased from Seattle Public Utilities (SPU).

Fixing and Replacing Inaccurate Meters
As part of the WLCAP implementation, the District has been more aggressive in finding and fixing stuck registers. Registers that have been stuck for an extended period of time can result in the gathering of inaccurate customer water consumption data.

In 2018, the District completed an audit of large meters. One meter was found that had a register programmed to read at the wrong resolution, therefore under-registering by a factor of 10. This meter was adjusted so that all of the water consumed through it is properly accounted for.

Utility Billing
The District's Utility Billing program is called Inhance. Meter reading reports from Neptune 360 and Inhance provide the District with reports that help to detect meter issues and customer leaks. An audit of the utility billing process has been ongoing for several years to verify the accuracy of the system's information, recording and reporting. In the past, this audit has helped to identify stuck meters and registers that are programmed at the wrong resolution. Auditing the system will likely be an ongoing process, coordinated between office staff and the meter readers.

Continuous Consumption Customer Notification
High rates of water use during "off-hours" may be a sign of unintentional continuous consumption. The District has developed a program to identify and educate customers about this water usage. When a water meter shows signs of excessive continuous consumption, the District is alerted by Neptune360 Meter Reader system and water maintenance staff will physically check the meter. If the meter is working correctly yet still showing continuous consumption, District staff will provide the resident with recommendations to fix the issue by using a door hanger, making a phone call or sending an email.

Mapping of Leak Repair Locations
The District currently records main breaks and leaks and maps their locations using GIS. This practice aids in prioritization of main replacement projects, thereby contributing to the most efficient allocation of resources for minimizing DSL.

IV.ESTIMATED AUTHORIZED USES
The following are authorized metered and unmetered water uses that must be subtracted from water produced along with customer consumption to determine the DSL. For each of the estimated authorized uses there is also a description of how the District is currently estimating this usage. Authorized Consumption is defined by WAC 246-290-820 and WAC 246-290-010.

Water Main, Blow Off, and Hydrant Flushing
Field Staff use hydrant meters to measure water discharged during flushing activities. This consumption is documented within the GIS system (and manually) with other authorized water uses.

Water Quality Analyzer Flow & Sample Stands

The District continuously measures the pH and free chlorine residual of treated water to ensure high water quality, which requires continually flowing water from a sample tap. The analyzer data is recorded manually on the District's "Unaccounted for Water Report".

The District has 16 sample stands, 3 are non-flowing and 10 are continuous flow. Beginning in 2018, the District changed its sample stand standard and began installing non-flowing sample stands. In some cases, in line meters have been installed to capture the continuous flow of existing sample stands. Nonmetered sample stand flow is estimated and entered into the District's "Unaccounted for Water Report".

Draining and Cleaning of Water Tanks and Reservoirs

The District currently records the amount of water used in the draining and cleaning of District-owned water tanks and reservoirs.

East Side Fire and Rescue and Renton Regional Fire Authority (Fire Station #16)

In 2018, the District installed a new in-line meter to account for water used during firefighting training activities from hydrants at the facility. The remaining two unmetered hydrants are tagged to indicate that they may be used for emergency purposes only.

VI.PLANNED ACTIVITIES FOR FURTHER REDUCING DISTRIBUTION SYSTEM LOSS

The District will continue to implement its Ongoing Activities, stated above, as part of the WLCAP. In order to further minimize DSL within the District's system, several additional actions or areas of focus have been identified. In order of priority, these include:

Advanced Metering Infrastructure System

The District is planning the deployment of an AMI system in the next 5 years. An AMI system will involve installing data collectors on antennas or towers throughout the District's service area. The District suspects that some of its non-revenue water could be from incorrect meter reads, or meters that were stuck or calibrated incorrectly. Having an AMI system will improve the accuracy and efficiency of meter reading; improves the comparison of production to consumption; and better detects stuck meters, meter tampering, and water theft. Another benefit of the AMI system is that it provides more time for operations and maintenance staff to perform maintenance on meters on a more regular schedule; thus, contributing to the lowering of DSL. Utility Billing also relies on the AMI system and electronically transmitted meter reads to increase meter reading for better billing accuracy.

Active Pipe and Leakage Testing Program

Leaking pipes within the distribution system can lead to higher DSL. It is recommended that the District identifies and fixes leaking pipes by continuing its leak detection program and performing leakage location testing with a listening device. Testing should occur during a time when households are using little water, such as in the middle of the night.

District Metered Areas (DMA)

The District is working toward metering each pressure zone in order for consumption to be analyzed for extraneous water usage to locate specific areas of pipe leakage. Each zone's usage

will be compared with customer consumption in the same zone or neighborhood to identify which zones need further investigation. After the zones of highest off-peak consumption are reported, it is recommended that a consultant with a listening device investigate the potential sources of leaks along the District's distribution pipes. Pipes found to be leaking during the investigation can be fixed or replaced to prevent further water loss.

In creating District Metered Areas (DMA), a portion of the distribution system is temporarily or permanently re-configured to measure all inflows at one or two entry points to an isolated area on a continuous basis. The inflows would then be compared to the sum of customer meters within the isolated area to determine potential leakage.

Leak Noise Loggers

The use of leak noise loggers as a method for reducing the run time of unreported leakage is becoming more common. These devices are programmed to listen for leak signatures during low demand periods, typically during overnight hours when vehicular traffic is generally at a minimum. They record leak noise data for later analysis of potential leak occurrences. Leak noise loggers complement the conventional leak survey and detection methods while utilizing a fraction of the manpower required using conventional leak detection equipment. These devices, which are typically placed in valve boxes on top of valve operators at intervals of approximately 1,000 feet, allow the operator to pinpoint the precise location of the leak. Leak noise loggers may also be used in conjunction within District Metered Areas (DMA) although this might represent a duplicate level of active leakage control.

Fund the District's Hydrant Replacement Program

Leaking fire hydrants may be a large contributor to the District's water loss. Hydrants with aging rubber seal rings or imbedded rocks are particularly at risk of non-revenue water loss through leakage. These leaks can be investigated using a listening device.

Active testing would allow the District to better understand which hydrants are leaking, when visual evidence is lacking. Currently hydrants are checked for deteriorating or ineffective parts only during routine inspections, on a three-year rotating basis, or when the District is notified of a leak. The District has developed an annual hydrant replacement program set to begin in 2021. The 2020-2025 Capital Spending Plan includes $175,000 to replace 15 fire hydrants.

Metering for Non-Training Firefighting Activities

The District does not currently have a way to ensure the estimate of the amount of water used for non-training firefighting activities, is accurate. These uses can significantly contribute to DSL and therefore should be accurately recorded. In the past, to help with accounting for this water loss, the field staff has discussed with the fire department the need to estimate and report non-training firefighting activities. This would require fire department personnel to record information following each event and submit monthly reports to the District's staff. Each report would include the duration of firefighting activities and number of hydrants used so that an approximate flow can be calculated. The District rarely receives these reports from local firefighting activities.

AWWA Free Water Audit Software vs. 5.0

The District will utilize American Water Works Association (AWWA) Free Water Audit Software to track water loss. The AWWA Free Water Audit Software includes multiple worksheets in a spreadsheet file. The first worksheet provides instructions and administrative inputs. The majority

of data is entered on the second worksheet, the Reporting worksheet, which prompts the user to enter standard water supply information such as the volume of water supplied, customer consumption, distribution attributes and quantities of losses.

It should be noted that it requires several years of conducting water audits to provide more accurate data for audit inputs. The primary goal of reducing real losses is represented by the infrastructure leakage index (ILI) and the real loss key performance indicators of:

- Gallons/service connections/day
- Gallons/mile/day

These key performance indicators are calculated by the AWWA water audit software.

Interpreting software results

Based on the data entered and the validity scores given to each data entry, the software calculates the values of the performance indicators for the utility. Of these outputs, five parameters stand out in importance: 1) Infrastructure leakage index (ILI), 2) data validity score, 3) priority areas for attention, 4) operational basic real losses and 5) operational apparent losses.

1) Data Validity Score is a rating of the District's confidence and accuracy of data entered into the software on a scale from 0 to 100. A lower score means the data is less reliable and the District would need to focus on improving data inputs.
    a. *The District's 2019 Data Validity Score is 78*
    b. *Goals for improving Data Validity Score*
        i. *Refine data collection practices*
        ii. *Refine and enhance ongoing programs based upon economic justification*
        iii. *Conduct detailed planning of comprehensive improvements for metering, billing, and infrastructure management*
        iv. *Establish mid-range (5 year) apparent and real loss reduction goals*
        v. *Perform benchmarking – ILI is meaningful in comparing real loss standing.*
2) Infrastructure Leakage Index (ILI) is the ratio of current annual losses to unavoidable annual real losses. When the data validity score is high and the audit is validated, an ILI close to one (1) indicates the District's real losses are close to the unavoidable annual real loss levels and further reductions in real water losses might not be cost effective.
    a. *The District's 2019 ILI score is 1.50*
3) Priority Areas for Attention are listed in order of "suggested" importance with the first being the area identified by the software that the District should focus on to improve the water audit data for the next year. Addressing these items will improve your ILI score but do not represent areas that need to be addressed to reduce any particular loss.
    a. *The District's 2019 Priority Areas for Attention include:*
        i. *Water Imported*
        ii. *Customer Metering Inaccuracies*
        iii. *Unathorized Consumption*
4) Operational Basic Apparent Losses is a performance indicator that assesses Apparent Losses in gal/service/connection/day.
    a. The Districts 2019 Apparent Losses per service connection per day: 13.95 gallons/connection/day.

5) Operational Basic Real Losses is a performance indicator that assesses Real Losses in gal/service/connection/day.
    a. *The District's 2019 Real Loss = 20.86 gallons/connection/day.*

Results of the Districts 2019 AWWA Free Water Audit are attached to this document for reference.

VII.SCHEDULE AND BUDGET FOR ACHIEVING DSL STANDARD

The District's goal is to maintain DSL at or below 10 percent annually and achieve a rolling 3-year average DSL at or below 10 percent to comply with regulation standards by the end of 2022.

VIII.POTENTIAL ISSUES IN IMPLEMENTATION OF WATER LOSS CONTROL

Issues may arise that could delay implementation of the activities identified in this WLCAP.

Budget

The District will continue to budget the resources necessary for these water loss control projects within the Capital Spending Plan. When additional projects arise that require a large budgeting effort, the District will work to properly address budget planning requirements.

District Metered Areas (DMA)

The District's Hydraulic Zones are maintained by 19 Pressure Reducing Stations and 8 Pump Stations. The complexity of the District's systems creates difficulty when trying to meter specific zones or neighborhoods. District staff is actively identifying zones and neighborhoods where water use can be easily captured by a flow meter and compared to customer usage within that same zone or neighborhood.

Staff Availability

Leak repair location mapping via GIS will likely continue to be most strongly impacted by staff availability.

Outside District Coordination

The District will continue to coordinate between Field Crew and outside Vendors, Customers, and Staff in order to estimate firefighting activities and continue the Billing System audit. However, additional coordination efforts often result in a longer implementation schedule and other issues.