

TWAIN HARTE COMMUNITY SERVICES DISTRICT

Water & Sewer Committee Meeting

Chair: *Kathryn deGroot*

Co-Chair: *Richard Knudson*

THCSD CONFERENCE ROOM
22912 VANTAGE POINTE DR., TWAIN HARTE
May 4, 2022 8:00 a.m.

NOTICE: Public May Attend this Meeting In-Person. Facial coverings are recommended for any person attending, regardless of vaccination status.

The meeting will be accessible via ZOOM for anyone that chooses to participate virtually:

- Videoconference Link: <https://us02web.zoom.us/j/86803542401>
- Meeting ID: 868 0354 2401
- Telephone: (669) 900-6833

AGENDA

1. Review draft 20-year Vehicle/Equipment Replacement Plan.
2. Review/discuss draft Fiscal Year 2022-23 Water Fund Budget, Capital Outlay Plan and projected capital reserve levels.
3. Review/discuss draft 5-year Water Fund revenue and expense projections.
4. Review/discuss draft Fiscal Year 2022-23 Sewer Fund Budget, Capital Outlay Plan and projected capital reserve levels.
5. Review/discuss draft 5-year Sewer Fund revenue and expense projections.
6. Discuss water system water loss analysis and risk assessment.
7. Adjourn.

HOW TO VIRTUALLY PARTICIPATE IN THIS THIS MEETING

The public can virtually observe and participate in a meeting as follows:

- **Computer:** Join the videoconference by clicking the videoconference link located at the top of this agenda or on our website. You may be prompted to enter your name and email. Your email will remain private and you may enter "anonymous" for your name.

- **Smart Phone/Tablet:** Join the videoconference by clicking the videoconference link located at the top of this agenda OR log in through the Zoom mobile app and enter the Meeting ID# and Password found at the top of this agenda. You may be prompted to enter your name and email. Your email will remain private and you may enter “anonymous” for your name.
- **Telephone:** Listen to the meeting by calling Zoom at (4669) 900-6833. Enter the Meeting ID# listed at the top of this agenda, followed by the pound (#) key.

* NOTE: your personal video will be disabled and your microphone will be automatically muted.

FOR MORE DETAILED INSTRUCTIONS, CLICK [HERE](#)

SUBMITTING PUBLIC COMMENT

The public will have an opportunity to comment before and during the meeting as follows:

- **Before the Meeting:**
 - Email comments to ksilva@twainhartecsd.com, write “Public Comment” in the subject line. In the body of the email, include the agenda item number and title, as well as your comments.
 - Mail comments to THCS Board Secretary: P.O. Box 649, Twain Harte, CA 95383
- **During the Meeting:**
 - Computer/Tablet/Smartphone: Click the “Raise Hand” icon and the host will unmute your audio when it is time to receive public comment. If you would rather make a comment in writing, you may click on the “Q&A” icon and type your comment. You may need to tap your screen or click on “View Participants” to make icons visible.



- Telephone: Press *9 if to notify the host that you have a comment. The host will unmute you during the public comment period and invite you to share comments.
- In-Person: Raise your hand and the Board Chairperson will call on you.

* NOTE: If you wish to speak on an item on the agenda, you are welcome to do so during consideration of the agenda item itself. If you wish to speak on a matter that does not appear on the agenda, you may do so during the Public Comment period. Persons speaking during the Public Comment will be limited to five minutes or depending on the number of persons wishing to speak, it may be reduced to allow all members of the public the opportunity to address the Board. Except as otherwise provided by law, no action or discussion shall be taken/conducted on any item not appearing on the agenda. Public comments must be addressed to the board as a whole through the President. Comments to individuals or staff are not permitted.

MEETING ETIQUETTE

Attendees shall make every effort not to disrupt the meeting. Cell phones must be silenced or set in a mode that will not disturb District business during the meeting.

ACCESSIBILITY

Board meetings are accessible to people with disabilities. In compliance with the Americans with Disabilities Act, those requiring accommodations for this meeting should notify the District office 48 hours prior to the meeting at (209) 586-3172.

WRITTEN MEETING MATERIALS

If written materials relating to items on this Agenda are distributed to Board members prior to the meeting, such materials will be made available for public inspection on the District's website:
www.twainhartecsd.com



**TWAIN HARTE COMMUNITY SERVICES DISTRICT
20-YR VEHICLE/EQUIPMENT REPLACEMENT PLAN**

Adopted: **05/11/2022**

	Life Left	Life New	FY 22-23	FY 23-24	FY 24-25	FY 25-26	FY 26-27	FY 27-28	FY 28-29	FY 29-30	FY 30-31	FY 31-32	FY 32-33	FY 33-34	FY 34-35	FY 35-36	FY 36-37	FY 37-38	FY 38-39	FY 39-40	FY 40-41	FY 41-42
Water/Sewer (65%/35%)																						
Truck #1 (Ops Mgr) - 2019 Jeep Grand Cherokee	14	15															54,500					
Truck #2 (Utility/Goose/Plow) - 2015 Ford F350	8	15									78,200											
Truck #3 (Utility) - 2006 GMC 2500	15	15																93,500				
Truck #4 (Utility) - 2006 GMC 2500	2	15		58,000																90,300		
Truck #5 (Utility) - 2019 Ford F350	12	15													85,200							
Truck #6 (Utility/Goose) - 2018 Chevy 3500	10	15											83,050									
Mini-Excavator - 2016	20	25																				
Backhoe - 2005	13	30														135,000						
Water/Sewer (50%/50%)																						
Mobile Generator*	5	25						35,000														
Forklift*	15	25																43,000				
Sewer (100%)																						
Flush Truck - 2022 Ford F600	20	20																				
Vacuum Trailer - 2015 Pipe Hunter	18	25																			273,000	
Fire (100%)																						
C720 (Chief) - 2016 Ford Explorer	9	15										64,500										
C720A (Chief Coverage) - 2008 Chevy C15*	6	15								16,000												
U721 (Utility) - 2006 GMC Sierra 2500 Diesel	5	15						79,000														
E721 (Primary Engine) - 2005 HME SEO 1871	8	25									740,000											
E726 (Type 6) - NEW	20	20																				
E723 (Primary Engine) - 2014 International	13	20														904,400						
WT721 (Tactical Tender) - 2016 Pierce Intl.	21	25																				
Vehicles not to be Replaced																						
Flush Trailer (Trixie) - 1998 Shamrock	1	25																				
E722 (Reserve Engine) - 1986 Sparton Pumper	1	25																				
CERT FF Rehab - 2007 Intl. 4300 Ambulance	12	25																				
CERT Utility - 2004 Chevy 2500	7	25																				
TOTAL Water			\$ -	\$ 37,700	\$ -	\$ -	\$ -	\$ 17,500	\$ -	\$ -	\$ 50,830	\$ -	\$ 53,983	\$ -	\$ 55,380	\$ 87,750	\$ 35,425	\$ 82,275	\$ -	\$ 58,695	\$ -	\$ -
TOTAL Sewer			\$ -	\$ 20,300	\$ -	\$ -	\$ -	\$ 17,500	\$ -	\$ -	\$ 27,370	\$ -	\$ 29,068	\$ -	\$ 29,820	\$ 47,250	\$ 19,075	\$ 54,225	\$ -	\$ 31,605	\$ 273,000	\$ -
TOTAL Fire			\$ -	\$ -	\$ -	\$ -	\$ -	\$ 79,000	\$ -	\$ 16,000	\$ 740,000	\$ 64,500	\$ -	\$ -	\$ -	\$ 904,400	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
DISTRICT GRAND TOTAL			\$ -	\$ 58,000	\$ -	\$ -	\$ -	\$ 114,000	\$ -	\$ 16,000	\$ 818,200	\$ 64,500	\$ 83,050	\$ -	\$ 85,200	\$ 1,039,400	\$ 54,500	\$ 136,500	\$ -	\$ 90,300	\$ 273,000	\$ -

NOTES:

- All future vehicle purchases are assumed to be new vehicles, unless noted otherwise.
- Vehicle values are based on current year values with an added inflation factor of 3% per year.
- All new vehicles (excluding fire engines) are planned to be replaced every 15 years and/or 100,000 miles.
- Remaining life of existing vehicles/equipment is based on staff evaluation and will be re-evaluated each year.
- Vehicles needing consecutive years of excessive repair work may need to be replaced earlier than planned.
- Vehicles that reach their estimated useful life will be evaluated by staff to determine whether they need replacement prior to purchase of a new vehicle.

* Vehicle/equipment anticipated to be replaced with a used vehicle.

Twain Harte Community Services District
2022/2023 ANNUAL BUDGET

	WATER			SEWER			FIRE			PARK			ADMIN			TOTAL
	Approved	Requested	% Diff	Approved	Requested	% Diff	Approved	Requested	% Diff	Approved	Requested	% Diff	Approved	Requested	% Diff	PROJECTED
Revenue																
Service Charges	\$ 1,487,008	\$ 1,483,420	0%	\$ 1,139,135	\$ 1,138,433	0%	\$ -	\$ -	0%	\$ -	\$ -	0%	\$ -	\$ -	0%	\$ 2,621,854
Fees	18,180	18,180	0%	14,820	14,820	0%	-	-	0%	5,000	5,000	0%	-	-	0%	38,000
Taxes & Assessments	114,813	114,944	0%	-	-	0%	1,220,450	1,243,536	2%	141,017	144,607	3%	-	-	0%	1,503,087
Grants & Donations	1,500,371	1,500,000	0%	200,771	-	-100%	321,339	280,368	-13%	570,301	1,395,475	145%	-	-	0%	3,175,843
Other Revenue	7,425	13,700	85%	5,075	2,100	-59%	210,990	25,500	-88%	4,100	600	-85%	24,998	1,000	-96%	42,900
Total Program Revenue	\$ 3,127,797	\$ 3,130,245	0%	\$ 1,359,801	\$ 1,155,353	-15%	\$ 1,752,779	\$ 1,549,404	-12%	\$ 720,418	\$ 1,545,682	115%	\$ 24,998	\$ 1,000	-96%	\$ 7,381,684
Admin Revenue Allocation	11,749	470	-96%	6,250	250	-96%	4,500	180	-96%	2,500	100	-96%	(24,998)	(1,000)	-96%	-
GRAND TOTAL REVENUE	\$ 3,139,546	\$ 3,130,715	0%	\$ 1,366,051	\$ 1,155,603	-15%	\$ 1,757,279	\$ 1,549,584	-12%	\$ 722,918	\$ 1,545,782	114%	\$ -	\$ -	0%	\$ 7,381,684
Operating Expenses																
Salaries	\$ 328,291	\$ 316,439	-4%	\$ 180,236	\$ 177,705	-1%	\$ 609,557	\$ 571,785	-6%	\$ 5,151	\$ 5,106	-1%	\$ 364,866	\$ 396,872	9%	\$ 1,467,907
Benefits	176,937	184,819	4%	97,474	103,373	6%	244,824	277,885	14%	2,915	3,121	7%	168,525	196,088	16%	765,287
Equip, Auto, Maint, & Repairs	149,700	139,000	-7%	76,300	75,400	-1%	136,050	108,700	-20%	47,250	42,850	-9%	16,600	21,200	28%	387,150
Materials & Supplies	45,800	48,600	6%	5,900	5,900	0%	9,700	10,200	5%	1,600	1,500	-6%	4,750	4,250	-11%	70,450
Outside Services	254,400	253,550	0%	215,900	17,950	-92%	50,300	27,750	-45%	4,400	4,500	2%	25,900	26,400	2%	330,150
Other (Utilities, Prop/Liab Ins, TUD)	169,084	183,150	8%	516,100	521,300	1%	103,600	96,950	-6%	27,950	27,200	-3%	69,250	72,350	4%	900,950
Debt Service	188,769	188,614	0%	16,994	16,976	0%	84,586	-	-100%	-	-	0%	-	-	0%	205,590
Total Program Expenses	\$ 1,312,981	\$ 1,314,172	0%	\$ 1,108,903	\$ 918,604	-17%	\$ 1,238,617	\$ 1,093,271	-12%	\$ 89,267	\$ 84,277	-6%	\$ 649,890	\$ 717,159	10%	\$ 4,127,483
Administrative Cost Allocation	305,448	337,065	10%	162,473	179,290	10%	116,980	129,089	10%	64,989	71,716	10%	(649,890)	(717,159)	10%	-
GRAND TOTAL OPERATING EXPENSES	\$ 1,618,429	\$ 1,651,237	2%	\$ 1,271,376	\$ 1,097,894	-14%	\$ 1,355,597	\$ 1,222,360	-10%	\$ 154,256	\$ 155,993	1%	\$ -	\$ -	0%	\$ 4,127,484
TOTAL OPERATING BALANCE	\$ 1,521,117	\$ 1,479,478		\$ 94,675	\$ 57,709		\$ 401,682	\$ 327,225		\$ 568,662	\$ 1,389,788		\$ -	\$ -		
Capital Expenses																
Capital Outlay	1,707,550	2,072,400	21%	454,100	300,300	-34%	515,100	663,500	29%	604,791	1,417,400	134%	-	-	0%	4,453,600
Adminstrative Capital Allocation	-	-	0%	-	-	0%	-	-	0%	-	-	0%	-	-	0%	-
Total Capital Expenses	\$ 1,707,550	\$ 2,072,400	21%	\$ 454,100	\$ 300,300	-34%	\$ 515,100	\$ 663,500	29%	\$ 604,791	\$ 1,417,400	134%	\$ -	\$ -		\$ 4,453,600
GRAND TOTAL EXPENSES	\$ 3,325,979	\$ 3,723,637	12%	\$ 1,725,476	\$ 1,398,194	-19%	\$ 1,870,697	\$ 1,885,860	1%	\$ 759,047	\$ 1,573,393	107%	\$ -	\$ -	0%	\$ 8,581,084
Transfer To/(From) Reserve	\$ (186,433)	\$ (592,922)		\$ (359,425)	\$ (242,591)		\$ (113,418)	\$ (336,275)		\$ (36,129)	\$ (27,612)		\$ -	\$ -		\$ (1,199,400)

Twain Harte Community Services District
2022-2023 ANNUAL BUDGET
WATER - REVENUE

BUDGET ITEM	BUDGET		CHANGE		REASON FOR CHANGE
	21/22 Approved	22/23 Requested	\$	%	
Service Charges					
Water Service Charge	\$ 1,487,008	\$ 1,483,420	\$ (3,588)	0%	Due to reduced consumption
TOTAL SERVICE CHARGES	\$ 1,487,008	\$ 1,483,420	\$ (3,588)	0%	
Fees					
Late Fee	\$ 10,000	\$ 10,000	\$ -	0%	
Door Notice Fee	2,700	2,700	-	0%	
Hookup Fees	3,500	3,500	-	0%	
Reconnection Fees	900	900	-	0%	
Property Transfer Fee	1,000	1,000	-	0%	
Returned Check Fee	80	80	-	0%	
TOTAL FEES	\$ 18,180	\$ 18,180	\$ -	0%	
Taxes & Assessments					
Secured & Unsecured Taxes	\$ 37,000	\$ 37,153	\$ 153	0%	
Davis Grunsky Assessment	77,813	77,791	(22)	0%	
TOTAL TAXES & ASSESSMENTS	\$ 114,813	\$ 114,944	\$ 131	0%	
Grants & Donations					
Grant Revenue - Misc	\$ 1,500,371	\$ 1,500,000	\$ (371)	0%	
Grant Revenue - Wells			\$ -	0%	
TOTAL GRANTS & DONATIONS	\$ 1,500,371	\$ 1,500,000	\$ (371)	0%	
Other Revenue					
Miscellaneous Revenue	\$ -	\$ 11,000	\$ 11,000	11000%	TUD Water Purchase
Interest Revenue	4,500	2,700	(1,800)	-40%	Lower than expected earnings
Lease Revenue			-	0%	
Sale of Assets	2,925	-	(2,925)	-100%	
TOTAL OTHER REVENUE	\$ 7,425	\$ 13,700	\$ 6,275	85%	
GRAND TOTAL REVENUE	\$ 3,127,797	\$ 3,130,245	\$ 2,447	0%	
Admin Transfer Out	\$ 11,749	\$ 470	\$ (11,279)		
GRAND TOTAL WITH ADMIN	\$ 3,139,546	\$ 3,130,715	\$ (8,832)	0%	

Twain Harte Community Services District
2022-2023 ANNUAL BUDGET

WATER - EXPENSES

BUDGET ITEM	BUDGET		CHANGE		REASON FOR CHANGE
	21/22 Approved	22/23 Requested	\$	%	
Salaries - 51XXX					
Regular Time	\$ 273,427	\$ 271,687	(1,740)	-1%	
Standby Pay	17,605	18,785	1,180	7%	
Overtime	23,000	15,000	(8,000)	-35%	
Sick Leave/Vacation Pay	7,161	6,300	(861)	-12%	
Intern Stipend	1,560	0	(1,560)	-100%	
Uniform Allowance	4,462	3,438	(1,024)	-23%	
Cell Phone Stipend	1,076	1,229	153	14%	
TOTAL SALARIES	\$ 328,291	\$ 316,439	\$ (11,852)	-4%	
Benefits - 52XXX					
Health & Vision Insurance	\$ 70,615	\$ 76,555	5,940	8%	
HRA Reimbursement	30,514	27,055	(3,459)	-11%	
CALPERS Retirement	42,092	42,262	169	0%	
FICA	20,354	19,619	(735)	-4%	
Medicare	4,760	4,588	(172)	-4%	
Workers Comp	7,150	13,593	6,443	90%	
Unemployment Ins/ETT	1,452	1,147	(305)	-21%	
TOTAL BENEFITS	\$ 176,937	\$ 184,819	\$ 7,882	4%	
Equipment, Automotive, Maintenance & Repairs					
Equipment Maintenance & Repair	\$ 6,000	\$ 8,450	2,450	41%	
Facilities Maintenance & Repair					
Source of Supply	14,500	8,500	(6,000)	-41%	
Pumping	5,900	6,250	350	6%	
Water Treatment	25,400	28,500	3,100	12%	
Transmission & Distribution	35,500	37,500	2,000	6%	
General & Administrative	1,500	1,300	(200)	-13%	
Vehicle Maintenance & Repair	10,000	7,500	(2,500)	-25%	
Janitorial Cleaning Fees	1,900	1,900	-	0%	
Fuel	18,000	19,600	1,600	9%	
Equipment Under \$5,000	28,700	17,500	(11,200)	-39%	
Personal Protective Equipment	2,300	2,000	(300)	-13%	
TOTAL EQUIP, AUTO, MAINT & REPAIRS	\$ 149,700	\$ 139,000	\$ (10,700)	-7%	

Twain Harte Community Services District
2022-2023 ANNUAL BUDGET

WATER - EXPENSES

BUDGET ITEM	BUDGET		CHANGE		REASON FOR CHANGE
	21/22 Approved	22/23 Requested	\$	%	
Materials & Supplies - 54XXX					
Office Supplies	\$ 1,200	\$ 1,200	-	0%	
Postage	4,800	4,900	100	2%	
Food Supplies	400	400	-	0%	
Chemical Supplies	39,000	41,800	2,800	7%	
Janitorial Supplies	400	300	(100)	-25%	
TOTAL MATERIALS & SUPPLIES	\$ 45,800	\$ 48,600	\$ 2,800	6%	
Outside Services - 55XXX					
Legal Fees	4,000	4,000	-	0%	
IT Services	1,900	1,700	(200)	-11%	
Engineering Services	244,000	244,000	-	0%	
Medical Exams	800	550	(250)	-31%	
Other Professional Services	3,700	3,300	(400)	-11%	
TOTAL OUTSIDE SERVICES	\$ 254,400	\$ 253,550	\$ (850)	0%	
Other - 56XXX					
Utilities	\$ 42,100	\$ 43,400	1,300	3%	
Phone/Communications	6,400	6,500	100	2%	
Computer Licenses & Maintenance	11,800	12,000	200	2%	
Property/Liability Insurance	32,000	32,600	600	2%	
Property Tax	450	450	-	0%	
Memberships/Publications/Subscriptions	11,234	12,000	766	7%	
Licenses & Certifications	1,100	1,400	300	27%	
Training, Conferences & Travel	5,100	10,100	5,000	98%	
Uncollectable accounts	1,500	500	(1,000)	-67%	
Advertising & Public Education	2,800	1,400	(1,400)	-50%	
Laboratory Fees	19,300	20,300	1,000	5%	
Regulatory Fees	9,400	9,900	500	5%	
Purchased Water	20,000	26,500	6,500	33%	
Bank & Credit Card Fees	5,900	6,100	200	3%	
TOTAL OTHER	\$ 169,084	\$ 183,150	\$ 14,066	8%	
Debt Service - 58XXX					
Interest on Long Term Debt	\$ 30,171	\$ 24,889	(5,282)	-18%	
Principal on Long Term Debt	158,598	163,725	5,126	3%	
TOTAL DEBT SERVICE	\$ 188,769	\$ 188,614	\$ (156)	0%	
GRAND TOTAL EXPENSES					
	\$ 1,312,981	\$ 1,314,172	\$ 1,191	0%	
Admin Transfer Out	\$ 305,448	\$ 337,065	\$ 31,617		
GRAND TOTAL WITH ADMIN	\$ 1,618,429	\$ 1,651,237	\$ 32,808	2%	

Twain Harte Community Services District
2022-2023 ANNUAL BUDGET

WATER - EXPENSES

BUDGET ITEM	BUDGET		CHANGE		REASON FOR CHANGE
	21/22 Approved	22/23 Requested	\$	%	
Capital Outlay - 57XXX					
FH Improvements	15,000	15,000	-	0%	
Admin Office Roof Replacement	23,500		(23,500)	-100%	
SCADA Upgrade	285,000	300,000	15,000	5%	Rollover into new FY + Increases
Vantage Pt. Equipment Structure			-	0%	
Cedar Pines Pressure Zone Upgrades	0	350,000	350,000	350000%	
Truck #1 Replacement	5,850		(5,850)	-100%	
Truck #3 Replacement	39,000	32,400	(6,600)	-17%	Rollover into New FY
Snow Plow	4,200		(4,200)	-100%	
WTP Motor Control Center Upgrade	60,000	100,000	40,000	67%	Rollover into new FY + Increases
MG Tank #2 Rehabilitation & Recoat	1,275,000	1,275,000	-	0%	Rollover into New FY
TOTAL CAPITAL OUTLAY	\$ 1,707,550	\$ 2,072,400	\$ 364,850	21%	
GRAND TOTAL WITH CAPITAL	\$ 3,325,979	\$ 3,723,637	\$ 397,658	12%	

5-YEAR CAPITAL OUTLAY PLAN

Water Fund - FY 22/23

	Previously Expended	Projected FY 21-22	Requested FY 22-23	FY 23-24	FY 24-25	FY 25-26	FY 26-27	Out Years 6 to 10	TOTAL
Well #3 - Sherwood Forest ³	\$ 335,700	\$ 3,568							\$ 339,268
Truck #1 Replace (35% Sewer) ³		\$ 5,839							\$ 5,839
Snow Plow (50/50 Sewer) ³		\$ 4,129							\$ 4,129
Admin Office Roof Replacement ^{3,5}		\$ 21,780							\$ 21,780
Truck #3 Replace (35% Sewer) ³		\$ 6,518	\$ 32,400						\$ 38,918
WTP Motor Control Center Upgrade ⁴		\$ 49,000	\$ 100,000						\$ 149,000
FH Improvements		\$ -	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000	\$ 75,000	\$ 150,000
SCADA Upgrade ⁴		\$ -	\$ 300,000						\$ 300,000
Million Gallon Tank #2 Rehab/Recoat ^{4,6}		\$ -	\$ 1,275,000						\$ 1,275,000
Cedar Pines Pressure Zone Upgrades			\$ 350,000						\$ 350,000
Manzanita Ct Waterline Upgrade				\$ 160,000					\$ 160,000
Golf Club Dr. Line Extension				\$ 75,000					\$ 75,000
Cedar Drive Main Extension				\$ 35,000					\$ 35,000
Truck #4 Replace (35% Sewer)				\$ 37,700					\$ 37,700
Emergency Response Trailer (50% S)				\$ 5,000					\$ 5,000
Sherwood Forest Water System Upgrade ⁷				\$ 400,000	\$ 3,000,000				\$ 3,400,000
Rehab/Recoat Black Oak Tanks					\$ 200,000				\$ 200,000
Rebed Treatment Filters					\$ 85,000				\$ 85,000
Shadybrook Dredging/Bypass						\$ 50,000	\$ 300,000		\$ 350,000
High Pressure Pipe/Lateral Replacement						\$ 200,000	\$ 200,000	\$ 1,000,000	\$ 1,400,000
Recoat Sherwood Tank								\$ 75,000	\$ 75,000
Vehicle/Equipment Replacement								\$ 68,330	\$ 68,330
TOTAL CAPITAL OUTLAY	\$ 335,700	\$ 90,834	\$ 2,072,400	\$ 727,700	\$ 3,300,000	\$ 265,000	\$ 515,000	\$ 1,218,330	\$ 8,524,964

NOTES:

- 1 Vehicle/Equipment replacement items match the THCS D Vehicle/Equipment Replacement Plan.
- 2 An inflation factor of 3% per year has been applied to future capital costs.
- 3 Project completed or anticipated to be completed in previous fiscal year.
- 4 Entire project was budgeted in previous fiscal year. New budget requests represent anticipated unspent funds and will be adjusted to reflect actuals at mid-year.
- 5 Water fund portion of shared \$50,000 project
- 6 Project costs 100% covered by DWR grant
- 7 Project anticipated to be 100% grant funded

FY 22-23 Water Fund Capital Reserves Analysis

FY 21-22 Starting Capital Reserve	\$ 1,287,875
FY 21-22 Anticipated Operational Surplus	\$ 246,117
FY 21-22 Anticipated Capital Outlay	\$ (90,834)
FY 22-23 Operating Surplus (Est. 4/28)	\$ 1,479,478
<u>FY 22-23 Capital Outlay</u>	<u>\$ (2,072,400)</u>
Capital Reserve Balance	\$ 850,236

Twain Harte Community Services District

WATER

FIVE YEAR PROJECTIONS

	20/21	21/22	22/23	23/24	24/25	25/26	26/27
	Actuals	Budget	Estimate	Estimate	Estimate	Estimate	Estimate
Current Revenue							
Service Charges	\$ 1,481,865	\$ 1,487,008	\$ 1,483,420	\$ 1,483,420	\$ 1,483,420	\$ 1,483,420	\$ 1,483,420
Fees	20,362	18,180	18,180	13,320	13,320	13,320	13,320
Taxes & Assessments	110,533	114,814	114,944	37,896	38,654	39,427	40,216
Grants & Donations	101,280	225,371	1,500,000	400,000	3,000,000	-	-
Other Revenue	12,470	7,425	13,700	13,700	13,700	13,700	13,700
Total Program Revenue	\$ 1,726,510	\$ 1,852,798	\$ 3,130,245	\$ 1,948,337	\$ 4,549,095	\$ 1,549,868	\$ 1,550,656
Administrative Cost Allocation	399	11,749	470	484	499	514	529
GRAND TOTAL REVENUE	\$ 1,726,909	\$ 1,864,547	\$ 3,130,715	\$ 1,948,821	\$ 4,549,594	\$ 1,550,382	\$ 1,551,185
Expenses							
Salaries	\$ 315,199	\$ 328,291	\$ 316,439	\$ 328,569	\$ 342,565	\$ 357,430	\$ 367,908
Benefits	154,807	176,937	184,819	193,490	201,557	210,477	217,193
Equip, Auto, Maint, & Repairs	114,848	149,700	139,000	129,780	133,673	137,684	141,814
Materials & Supplies	38,086	45,800	48,600	50,058	51,560	53,107	54,700
Outside Services	79,912	254,400	253,550	27,347	28,167	29,012	29,882
Other	143,540	169,084	183,150	183,495	188,999	194,669	200,509
Debt Service	188,912	188,769	188,614	114,297	114,297	114,297	114,297
Total Program Expenses	\$ 1,035,304	\$ 1,312,981	\$ 1,314,172	\$ 1,027,035	\$ 1,060,818	\$ 1,096,675	\$ 1,126,304
Administrative Cost Allocation	265,903	305,449	337,065	326,445	336,564	346,851	357,120
TOTAL OPERATING EXPENSES	\$ 1,301,207	\$ 1,618,430	\$ 1,651,237	\$ 1,353,480	\$ 1,397,382	\$ 1,443,526	\$ 1,483,424
Total Operating Balance	\$ 425,702	\$ 246,117	\$ 1,479,478	\$ 595,341	\$ 3,152,211	\$ 106,855	\$ 67,761
Capital Expenses							
Capital Outlay	55,794	90,834	2,072,400	727,700	3,300,000	265,000	515,000
Total Capital Expenses	55,794	90,834	2,072,400	727,700	3,300,000	265,000	515,000
GRAND TOTAL EXPENSES	\$ 1,357,001	\$ 1,709,264	\$ 3,723,637	\$ 2,081,180	\$ 4,697,382	\$ 1,708,526	\$ 1,998,424
TRANSFER TO/(FROM) RESERVE	\$ 369,908	\$ 155,283	\$ (592,922)	\$ (132,359)	\$ (147,789)	\$ (158,145)	\$ (447,239)
Capital Reserve Balance	\$ 1,287,875	\$ 1,372,170	\$ 853,687	\$ 721,328	\$ 562,564	\$ 392,883	\$ (64,330)

Twain Harte Community Services District
2022/2023 ANNUAL BUDGET

	WATER			SEWER			FIRE			PARK			ADMIN			TOTAL
	Approved	Requested	% Diff	Approved	Requested	% Diff	Approved	Requested	% Diff	Approved	Requested	% Diff	Approved	Requested	% Diff	PROJECTED
Revenue																
Service Charges	\$ 1,487,008	\$ 1,483,420	0%	\$ 1,139,135	\$ 1,138,433	0%	\$ -	\$ -	0%	\$ -	\$ -	0%	\$ -	\$ -	0%	\$ 2,621,854
Fees	18,180	18,180	0%	14,820	14,820	0%	-	-	0%	5,000	5,000	0%	-	-	0%	38,000
Taxes & Assessments	114,813	114,944	0%	-	-	0%	1,220,450	1,243,536	2%	141,017	144,607	3%	-	-	0%	1,503,087
Grants & Donations	1,500,371	1,500,000	0%	200,771	-	-100%	321,339	280,368	-13%	570,301	1,395,475	145%	-	-	0%	3,175,843
Other Revenue	7,425	13,700	85%	5,075	2,100	-59%	210,990	25,500	-88%	4,100	600	-85%	24,998	1,000	-96%	42,900
Total Program Revenue	\$ 3,127,797	\$ 3,130,245	0%	\$ 1,359,801	\$ 1,155,353	-15%	\$ 1,752,779	\$ 1,549,404	-12%	\$ 720,418	\$ 1,545,682	115%	\$ 24,998	\$ 1,000	-96%	\$ 7,381,684
Admin Revenue Allocation	11,749	470	-96%	6,250	250	-96%	4,500	180	-96%	2,500	100	-96%	(24,998)	(1,000)	-96%	-
GRAND TOTAL REVENUE	\$ 3,139,546	\$ 3,130,715	0%	\$ 1,366,051	\$ 1,155,603	-15%	\$ 1,757,279	\$ 1,549,584	-12%	\$ 722,918	\$ 1,545,782	114%	\$ -	\$ -	0%	\$ 7,381,684
Operating Expenses																
Salaries	\$ 328,291	\$ 316,439	-4%	\$ 180,236	\$ 177,705	-1%	\$ 609,557	\$ 571,785	-6%	\$ 5,151	\$ 5,106	-1%	\$ 364,866	\$ 396,872	9%	\$ 1,467,907
Benefits	176,937	184,819	4%	97,474	103,373	6%	244,824	277,885	14%	2,915	3,121	7%	168,525	196,088	16%	765,287
Equip, Auto, Maint, & Repairs	149,700	139,000	-7%	76,300	75,400	-1%	136,050	108,700	-20%	47,250	42,850	-9%	16,600	21,200	28%	387,150
Materials & Supplies	45,800	48,600	6%	5,900	5,900	0%	9,700	10,200	5%	1,600	1,500	-6%	4,750	4,250	-11%	70,450
Outside Services	254,400	253,550	0%	215,900	17,950	-92%	50,300	27,750	-45%	4,400	4,500	2%	25,900	26,400	2%	330,150
Other (Utilities, Prop/Liab Ins, TUD)	169,084	183,150	8%	516,100	521,300	1%	103,600	96,950	-6%	27,950	27,200	-3%	69,250	72,350	4%	900,950
Debt Service	188,769	188,614	0%	16,994	16,976	0%	84,586	-	-100%	-	-	0%	-	-	0%	205,590
Total Program Expenses	\$ 1,312,981	\$ 1,314,172	0%	\$ 1,108,903	\$ 918,604	-17%	\$ 1,238,617	\$ 1,093,271	-12%	\$ 89,267	\$ 84,277	-6%	\$ 649,890	\$ 717,159	10%	\$ 4,127,483
Administrative Cost Allocation	305,448	337,065	10%	162,473	179,290	10%	116,980	129,089	10%	64,989	71,716	10%	(649,890)	(717,159)	10%	-
GRAND TOTAL OPERATING EXPENSES	\$ 1,618,429	\$ 1,651,237	2%	\$ 1,271,376	\$ 1,097,894	-14%	\$ 1,355,597	\$ 1,222,360	-10%	\$ 154,256	\$ 155,993	1%	\$ -	\$ -	0%	\$ 4,127,484
TOTAL OPERATING BALANCE	\$ 1,521,117	\$ 1,479,478		\$ 94,675	\$ 57,709		\$ 401,682	\$ 327,225		\$ 568,662	\$ 1,389,788		\$ -	\$ -		
Capital Expenses																
Capital Outlay	1,707,550	2,072,400	21%	454,100	300,300	-34%	515,100	663,500	29%	604,791	1,417,400	134%	-	-	0%	4,453,600
Adminstrative Capital Allocation	-	-	0%	-	-	0%	-	-	0%	-	-	0%	-	-	0%	-
Total Capital Expenses	\$ 1,707,550	\$ 2,072,400	21%	\$ 454,100	\$ 300,300	-34%	\$ 515,100	\$ 663,500	29%	\$ 604,791	\$ 1,417,400	134%	\$ -	\$ -		\$ 4,453,600
GRAND TOTAL EXPENSES	\$ 3,325,979	\$ 3,723,637	12%	\$ 1,725,476	\$ 1,398,194	-19%	\$ 1,870,697	\$ 1,885,860	1%	\$ 759,047	\$ 1,573,393	107%	\$ -	\$ -	0%	\$ 8,581,084
Transfer To/(From) Reserve	\$ (186,433)	\$ (592,922)		\$ (359,425)	\$ (242,591)		\$ (113,418)	\$ (336,275)		\$ (36,129)	\$ (27,612)		\$ -	\$ -		\$ (1,199,400)

Twain Harte Community Services District
2022-2023 ANNUAL BUDGET
SEWER - REVENUE

BUDGET ITEM	BUDGET		CHANGE		REASON FOR CHANGE
	21/22 Approved	22/23 Requested	\$	%	
Service Charges					
Sewer Service Charge	1,139,135	1,138,433	(702)	0%	
TOTAL SERVICE CHARGES	\$ 1,139,135	\$ 1,138,433	\$ (702)	0%	
Fees					
Late Fee	\$ 7,000	\$ 7,000	\$ -	0%	
Door Notice Fee	2,700	2,700	-	0%	
Hookup Fees	2,000	2,000	-	0%	
Reconnection Fees	1,800	1,800	-	0%	
Inspection Fees	200	200	-	0%	
Property Transfer Fee	1,000	1,000	-	0%	
Returned Check Fee	120	120	-	0%	
TOTAL FEES	\$ 14,820	\$ 14,820	\$ -	0%	
Grants & Donations					
Grant Revenue-Sewer Planning Grant	197,650		\$ (197,650)	-100%	Estimated remainder of the grant
Grant Revenue-Misc	3,121		\$ (3,121.00)	-100%	Covid Relief
TOTAL GRANTS & DONATIONS	\$ 200,771	\$ -	\$ (200,771)	-100%	
Other Revenue					
Interest Revenue	3,500	2,100	(1,400)	-40%	Lower than expected earnings
Sale of Assets	1,575		(1,575)	-100%	Sale of Truck #1 to Fire
Other	-	-	-	0%	
TOTAL OTHER REVENUE	\$ 5,075	\$ 2,100	\$ (2,975)	-59%	
GRAND TOTAL REVENUE	\$ 1,359,801	\$ 1,155,353	\$ (204,448)	-15%	
Admin Transfer Out	\$ 6,250	\$ 250	\$ (6,000)		
GRAND TOTAL WITH ADMIN	\$ 1,366,051	\$ 1,155,603	\$ (210,448)		

Twain Harte Community Services District
2022-2023 ANNUAL BUDGET

SEWER - EXPENSES

BUDGET ITEM	BUDGET		CHANGE		REASON FOR CHANGE
	21/22 Approved	22/23 Requested	\$	%	
Salaries - 51XXX					
Regular Time	\$ 147,541	\$ 146,285	(1,256)	-1%	
Standby Pay	17,605	18,785	1,180	7%	
Overtime	6,600	6,600	0	0%	
Sick Leave/Vacation Pay	3,971	3,500	(471)	-12%	
Intern Stipend	1,560	0	(1,560)	-100%	
Uniform Allowance	2,371	1,863	(508)	-21%	
Cell Phone Stipend	588	672	84	14%	
TOTAL SALARIES	\$ 180,236	\$ 177,705	\$ (2,531)	-1%	
Benefits - 52XXX					
Health & Vision Insurance	\$ 38,223	\$ 41,469	3,246	8%	
HRA Reimbursement	16,549	14,658	(1,892)	-11%	
CALPERS Retirement	22,616	22,623	6	0%	
FICA	11,175	11,018	(157)	-1%	
Medicare	2,613	2,577	(37)	-1%	
Workers Comp	5,400	10,300	4,900	91%	
Unemployment Ins/ETT	897	731	(167)	-19%	
TOTAL BENEFITS	\$ 97,474	\$ 103,373	\$ 5,900	6%	
Equipment, Automotive, Maintenance & Repairs					
Equipment Maintenance & Repair	\$ 7,100	\$ 8,250	1,150	16%	
Facilities Maintenance & Repair					
Lift Station	7,900	7,900	0	0%	
Collections	31,900	23,200	(8,700)	-27%	
General & Administrative	900	800	(100)	-11%	
Vehicle Maintenance & Repair	7,600	6,100	(1,500)	-20%	
Janitorial/Cleaning Fees	1,100	1,100	0	0%	
Fuel	8,700	10,800	2,100	24%	
Equipment Under \$5,000	9,100	15,600	6,500	71%	
Personal Protective Equipment	2,000	1,650	(350)	-18%	
TOTAL EQUIP, AUTO, MAINT & REPAIRS	\$ 76,300	\$ 75,400	\$ (900)	-1%	

Twain Harte Community Services District
2022-2023 ANNUAL BUDGET

SEWER - EXPENSES

BUDGET ITEM	BUDGET		CHANGE		REASON FOR CHANGE
	21/22 Approved	22/23 Requested	\$	%	
Materials & Supplies - 54XXX					
Office Supplies	\$ 900	\$ 800	\$ (100)	-11%	
Postage	4,300	4,400	100	2%	
Food Supplies	300	300	0	0%	
Janitorial Supplies	400	400	0	0%	
TOTAL MATERIALS & SUPPLIES	\$ 5,900	\$ 5,900	\$ -	0%	
Outside Services - 55XXX					
Legal Fees	\$ 1,500	\$ 1,500	\$ -	0%	
IT Services	1,300	1,200	(100)	-8%	
Engineering Services	12,000	12,000	0	0%	
Medical Exams	400	350	(50)	-13%	
Other Professional Services	200,700	2,900	(197,800)	-99%	Sewer System Planning Grant completed in 21.22
TOTAL OUTSIDE SERVICES	\$ 215,900	\$ 17,950	\$ (197,950)	-92%	
Other - 56XXX					
Utilities	\$ 5,900	\$ 5,900	\$ -	0%	
Phone/Communications	3,000	2,500	(500)	-17%	
Computer Licenses & Maintenance	10,400	10,600	200	2%	
Property/Liability Insurance	19,200	23,600	4,400	23%	Due to a rate increase and new equipment
Property Tax			0	0%	
Dues & Memberships	5,800	5,400	(400)	-7%	
Licenses & Certifications	2,000	1,100	(900)	-45%	
Training, Conferences & Travel	3,800	8,000	4,200	111%	Class A License Training
Uncollectable accounts	1,500	500	(1,000)	-67%	
Advertising & Public Education	2,800	1,400	(1,400)	-50%	
Regulatory Fees	500	500	0	0%	
Sewer Service Charge	456,200	456,200	0	0%	
Bank & Credit Card Fees	5,000	5,600	600	12%	
TOTAL OTHER	\$ 516,100	\$ 521,300	\$ 5,200	1%	
Debt Service - 58XXX					
Interest on Long Term Debt	\$ 1,853	\$ 1,282	\$ (571)	-31%	
Principal on Long Term Debt	15,141	15,694	553	4%	
TOTAL DEBT SERVICE	\$ 16,994	\$ 16,976	\$ (18)	0%	
GRAND TOTAL EXPENSES	\$ 1,108,903	\$ 918,604	\$ (190,299)	-17%	
Admin Transfer Out	\$ 162,473	\$ 179,290	\$ 16,817	10%	
GRAND TOTAL WITH ADMIN	\$ 1,271,376	\$ 1,097,894	\$ (173,482)	-14%	

Twain Harte Community Services District
2022-2023 ANNUAL BUDGET

SEWER - EXPENSES

BUDGET ITEM	BUDGET		CHANGE		REASON FOR CHANGE
	21/22 Approved	22/23 Requested	\$	%	
Capital Outlay - 57XXX					
SCADA Upgrade	\$ 85,000	\$ 100,000	\$ 15,000	18%	Rollover into new FY + Increases
Vantage Pt. Equip Structure	\$ 77,000		\$ (77,000)	-100%	
Admin Office Roof Replacement	12,500		(12,500)	-100%	
Sewer Main Re-Lining/Replacement	0	75,000	75,000	75000%	
TH School Sewer Re-Alignment	15,850		(15,850)	-100%	
Vantage Pointe Equipment Cover	0	83,000	83,000	83000%	
Manhole Smart Covers	11,400		(11,400)	-100%	
Snow Plow	4,200		(4,200)	-100%	
Truck #1 Replacement	3,150		(3,150)	-100%	
Truck #3 Replacement	21,000	17,300	(3,700)	-18%	Rollover into new FY
Sewer Jetter Replacement	174,000		(174,000)	-100%	
I&I Manhole Repair/Replacement	20,000	25,000	5,000	25%	Rollover into new FY
Mono Sewer Line Replacement	30,000		(30,000)	-100%	
TOTAL CAPITAL OUTLAY*	\$ 454,100	\$ 300,300	\$ (153,800)	-34%	
GRAND TOTAL WITH CAPITAL	\$ 1,725,476	\$ 1,398,194	\$ (327,282)	-19%	

5-YEAR CAPITAL OUTLAY PLAN

Sewer Fund - FY 22/23

	Previously Expended	Projected FY 21-22	Requested FY 22-23	FY 23-24	FY 24-25	FY 25-26	FY 26-27	Out Years 6 to 10	TOTAL
Mono Sewer Line Replacement ³		\$ 26,500							\$ 26,500
Manhole Smart Covers ³		\$ 11,388							\$ 11,388
TH School Sewer Re-alignment ³		\$ 15,850							\$ 15,850
Truck #1 Replace (65% W) ³		\$ 3,145							\$ 3,145
Snow Plow (50/50 split w/water) ³		\$ 4,129							\$ 4,129
New Sewer Jetter ³		\$ 172,097							\$ 172,097
Admin Office Roof Replacement ^{3,5}		\$ 11,585							\$ 11,585
Truck #3 Replace (65% W) ⁴		\$ 3,638	\$ 17,300						\$ 20,938
I&I Manhole Repair/Replacement ⁴		\$ 12,500	\$ 25,000						\$ 37,500
SCADA Upgrade ⁴		\$ -	\$ 100,000						\$ 100,000
Vantage Pointe Equipment Cover ^{4,6}		\$ -	\$ 83,000						\$ 83,000
Sewer Main Re-Lining/Replacement		\$ -	\$ 75,000	\$ 75,000	\$ 75,000	\$ 75,000	\$ 75,000	\$ 375,000	\$ 750,000
Emergency Response Trailer				\$ 5,000					\$ 5,000
Truck #4 Replace (65% W)				\$ 20,300					\$ 20,300
Sequoia Dr - 6" Replacement				\$ 60,000					\$ 60,000
TH Pipeline Replacement Project ⁷				\$ 490,000	\$ 4,000,000				\$ 4,490,000
Cresta/Oakview - 6" Replacement					\$ 80,000	\$ 500,000			\$ 580,000
East Ave/Cedar Pines - 8" Replacement							\$ 400,000		\$ 400,000
Little Fuller/Virgina - 6" Replacement									\$ 80,000
Big Pine - 6" Replacement									\$ 40,000
Sherwood Forest Sewer ⁸								\$ 3,575,000	\$ 3,575,000
Vehicle/Equipment Replace								\$ 44,870	\$ 44,870
TOTAL CAPITAL OUTLAY	\$ -	\$ 260,832	\$ 300,300	\$ 650,300	\$ 4,155,000	\$ 575,000	\$ 475,000	\$ 3,994,870	\$ 10,531,302

NOTES:

- 1 Vehicle/Equipment replacement items match the THCS D Vehicle/Equipment Replacement Plan.
- 2 An inflation factor of 3% per year has been applied to future capital costs.
- 3 Project completed or anticipated to be completed in previous fiscal year.
- 4 Entire project was budgeted in previous fiscal year. New budget requests represent anticipated unspent funds and will be adjusted to reflect actuals at mid-year.
- 5 Sewer fund portion of shared \$50,000 project
- 6 Sewer fund portion of shared \$124,000 project
- 7 This project is anticipated to be 100% SWRCB grant funded
- 8 This project is a new sewer system that will require a special assessment and property owner vote

FY 22-23 Sewer Fund Capital Reserves Analysis

FY 21-22 Starting Capital Reserve	\$ 1,012,633
FY 21-22 Anticipated Operational Surplus	\$ 94,675
FY 21-22 Anticipated Capital Outlay	\$ (260,832)
FY 22-23 Operating Surplus (Est. 4/28)	\$ 57,709
<u>FY 22-23 Capital Outlay</u>	<u>\$ (300,300)</u>
Capital Reserve Balance	\$ 603,885

Assumes no additional operational savings

Twain Harte Community Services District

SEWER

FIVE YEAR PROJECTIONS

	20/21	21/22	22/23	23/24	24/25	25/26	26/27
	Actuals	Budget	Projections	Projections	Projections	Projections	Projections
Revenue							
Service Charges	\$ 1,136,279	\$ 1,139,135	\$ 1,138,433	\$ 1,138,433	\$ 1,138,433	\$ 1,138,433	\$ 1,138,433
Fees	12,907	14,820	14,820	13,380	13,380	13,380	13,380
Taxes & Assessments	-	-	-	-	-	-	-
Grants & Donations	158,093	200,771	-	490,000	4,000,000	-	-
Other Operating Revenue	8,295	5,075	2,100	2,100	2,100	2,100	2,100
Total Program Revenue	\$ 1,315,574	\$ 1,359,801	\$ 1,155,353	\$ 1,643,913	\$ 5,153,913	\$ 1,153,913	\$ 1,153,913
Administrative Cost Allocation	212	6,250	250	258	265	273	281
GRAND TOTAL REVENUE	\$ 1,315,786	\$ 1,366,051	\$ 1,155,603	\$ 1,644,171	\$ 5,154,178	\$ 1,154,186	\$ 1,154,194
Expenses							
Salaries	\$ 185,136	\$ 180,236	\$ 177,705	\$ 184,292	\$ 191,900	\$ 199,981	\$ 205,663
Benefits	88,441	97,474	103,373	108,054	112,420	117,245	120,883
Equip, Auto, Maint, & Repairs	39,742	76,300	75,400	67,362	69,383	71,464	73,608
Materials & Supplies	4,713	5,900	5,900	6,077	6,259	6,447	6,641
Outside Services	169,013	215,900	17,950	18,489	19,043	19,614	20,203
Other	501,536	516,100	521,300	531,789	547,743	564,175	581,100
Debt Service	17,011	16,994	16,976	17,478	17,478	17,478	17,478
Total Program Expenses	\$ 1,005,592	\$ 1,108,904	\$ 918,604	\$ 933,540	\$ 964,225	\$ 996,405	\$ 1,025,576
Administrative Cost Allocation	141,438	162,473	179,290	173,641	179,024	184,495	189,958
TOTAL OPERATING EXPENSES	\$ 1,147,030	\$ 1,271,377	\$ 1,097,894	\$ 1,107,181	\$ 1,143,249	\$ 1,180,900	\$ 1,215,534
Total Operating Balance	\$ 168,756	\$ 94,674	\$ 57,709	\$ 536,990	\$ 4,010,929	\$ (26,714)	\$ (61,339)
Capital Expenses							
Capital Outlay	60,758	260,832	300,300	650,300	4,155,000	575,000	475,000
Admin Capital Transfer							
Total Capital Expenses	60,758	260,832	300,300	650,300	4,155,000	575,000	475,000
GRAND TOTAL EXPENSES	\$ 1,207,788	\$ 1,532,209	\$ 1,398,194	\$ 1,757,481	\$ 5,298,249	\$ 1,755,900	\$ 1,690,534
TRANSFER TO/(FROM) RESERVE	\$ 107,998	\$ (166,158)	\$ (242,591)	\$ (113,310)	\$ (144,071)	\$ (601,714)	\$ (536,339)
Capital Reserve Balance	\$ 1,012,632	\$ 829,318	\$ 584,405	\$ 471,095	\$ 318,008	\$ (293,119)	\$ (838,117)

25 April 2022

Technical Memorandum

To: Mr. Tom Trott, General Manager, Twain Harte Community Services District
From: Kirk Olsen and Dana Strahan, Kennedy/Jenks Consultants, Inc.
CC: Jennifer Lau Larsen, P.E., Kennedy/Jenks Consultants, Inc.
Subject: Twain Harte Water System Evaluation – Water Loss Findings and Recommendations
K/J 2168020*00

1.0 Introduction

To address excessive water loss observed in the distribution system, Twain Harte Community Services District (District) is conducting a water system assessment and water audit to identify problematic areas within their distribution system. This work is being funded through an agreement with the State Water Resource Control Board (State Water Board, Agreement No. D20-02030). Kennedy Jenks (KJ) was contracted by the District to assist with this work.

This technical memorandum documents the findings of the water system assessment and water loss audit conducted by KJ, including:

- Annual water loss audits for the years 2019 and 2020 using the American Water Works Association (AWWA) Free Water Audit Software and District meter and GIS data analysis;
- Field work including an assessment on a small area in the District that is generally representative of the system and inspection of a pressure reducing station;
- Remaining useful life assessment of distribution system infrastructure;
- General recommendations for distribution system infrastructure replacement and upgrades and opportunities for operational improvements.

2.0 Water Loss Evaluation and Condition Assessment

The following is a brief overview of the methodology implemented for the water loss assessment:

1. Background information review: KJ reviewed available water production data, District production and customer meter data, soil surveys, District water system GIS data, and record drawings.

Memorandum

Mr. Tom Trott, General Manager, Twain Harte Community Services District
25 April 2022
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2. Water loss audit: Available customer meter data, production meter data, and District-estimated water losses were logged in the AWWA Free Water Audit Software for the years 2019 and 2020. The AWWA water loss spreadsheets are intended to give the District a high-level understanding of their non-revenue water and inform the implementation of cost-effective strategies to mitigate water loss.
3. Meter analysis: District production (pump and tank) meter data were compared against customer metered billing areas to identify specific zones of high water loss.
4. Leak data analysis: Leak data from the GIS system was reviewed and analyzed to investigate the cause(s) of the District's losses. The District's GIS does not differentiate between leaks and breaks, therefore for the purposes of this TM, leaks include breaks. Leak frequency data (number of leaks per year per thousand feet of pipe) was compared against the 2018 AWWA Utility Benchmarking Survey.
5. Field work: With the assistance of District staff, KJ conducted a field water loss analysis in a small portion of the District's service area on November 1, 2021, November 15, 2021, and January 24, 2022. These field visits included working with District staff and in-house leak detection equipment to locate potential water leaks and observe the condition of the distribution infrastructure.

Unless otherwise specified, this TM uses the term "water loss" to refer to real water loss, which is the physical water loss from the distribution system, as opposed to loss due to meter or data inaccuracies or water theft. Real losses can occur due to leaks, pipe breaks, or overflows.

3.0 Water Loss Audit

KJ conducted AWWA Water Audits for the 2019- and 2020-years using District-provided Electronic Annual Reports (EARs), available meter data, authorized non-revenue water (logged at the water treatment plant and through the fire department), and leak data collected in the field by District staff. The AWWA Water Audit reporting worksheets can be found in Attachments A and B. Table 1 summarizes the results of the AWWA Water Audits

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Table 1: AWWA Water Audit Results for 2019 and 2020

Year	Water Supplied (MG) ¹	Authorized Consumption (MG) ¹	Water Losses (MG) ²	Apparent Losses (MG) ³	Real Losses (MG) ⁴	Real Losses/per service connection/day (gal/conn/day)	Non-Revenue Water (% of Water Supplied) ⁵
2019	78.2	56.1	22.1	0.3	21.8	38.05	29.1%
2020	79.7	62.0	17.7	0.4	17.3	30.02	22.9%

¹ Obtained from EARs and District meter data.

² Water Supplied minus Authorized Consumption.

³ Sum of customer metering inaccuracies, systematic data handling errors, and unauthorized consumption, which is estimated using a default percentage given by the AWWA Water Audit Software (0.25%) and multiplying by the total Water Supplied.

⁴ Water Supplied minus Authorized Consumption minus Apparent Losses.

⁵ Water Losses plus Unbilled Metered plus Unbilled Unmetered as a percent of the Water Supplied.

4.0 Leak Frequency Analysis

KJ utilized the customer water meter data and District tank and pump station meter data to track areas of high water loss in the system. Figure 1 shows leak data entered into the District's GIS overlaying the District's pressure zones, pipelines, and pressure reducing stations. Table 2: summarizes the leak data recorded in the District's GIS system as of November 2021.

The data in Table 2 excludes what is referred to in the GIS database as "historical leak" which only contain location data and correlate with events prior to the District fully integrating with GIS. The increase in total leaks in 2021 is likely due to better record keeping compared to previous years and the District inputting data that had not yet been logged from previous years. A large fraction of the leaks that were logged each year did not include water loss volume data, and the water loss volume data that was recorded varied greatly year to year. Therefore, a high-level estimate was conducted with the following assumptions based partially on the GIS data as well as discourse with District operations staff:

- Average leak flow rate = 5 gallons per minute (GPM)
- Average leak duration = 2 weeks (20,160 minutes)
- Leaks occur mainly on service laterals (mostly 1-inch)
- System pressure range = 20 pounds per square inch (psi) to over 160 psi
- 48 leaks per year (as in 2021)

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Table 2: Summary of District GIS Leak Data (as of 10/28/21)

Year	Number of Leaks ¹	Number of Leaks with Data ¹	Mean Flow Rate (GPM)	Median Flow Rate (GPM)	Mean Leak Duration (min.)	Median Leak Duration (min.)
2019	27	17	168.6	3	7420	1440
2020 ²	24	17	23.2	13	7470	1440
2021 ³	48	16	37.9	9	4320	4337

¹ Multiple leak entries consisted of location data only and did not include additional data needed to estimate the size of the leak such as flow rate or duration.

² Some leak durations in 2020 were written in the comment section of the data point and did not match the value of the numerical duration data. The leak durations were changed to match the comments as best as possible for this dataset.

³ The majority of the leaks in 2021 were logged on 9/16/21 and 9/20/21 which correspond to the start of the KJ leak survey. Most of these leaks did not have any data or comments and were assumed to have occurred during 2021. November and December data was not available for this analysis.

Based on this analysis, the estimated total loss over the course of a year is nearly 5 million gallons, significantly less than the District's total water loss. Assuming that the number of leaks is not significantly underestimated (based on the analysis in Section 4.1 below), this implies that the average leak flow rate and/or leak duration are significantly underreported.

4.1 Comparison with AWWA Benchmarking

Data from the *2018 AWWA Utility Benchmarking Performance Management for Water and Wastewater* Report was used to evaluate the District's performance against other systems throughout the United States. These benchmarks are based on a survey of water systems who self-reported data about their systems in 2018. Table 3 presents the AWWA benchmark data for number of leaks in 2018.

Based on the total length of pipe recorded in the District's GIS of 46 miles, the District's median leaks/breaks per 100 miles of pipe is well above the normal bounds of the benchmarks:

- 2019: 58.7
- 2020: 52.2
- 2021: 104.3

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Table 3: 2018 AWWA Benchmarking Data: Combined Leaks and Breaks/100 miles of Pipe (Table 4-4C)

	75 th Percentile	Median	25 th percentile	Sample Size	Confidence ¹	Count ²
Water Utilities	4.7	12.5	19.2	41	2.8	26
Combined utilities – water operations	11.8	18.2	36.4	76	2.7	53

¹ Confidence based on utility rating the question, “Record the number of combined leaks and breaks from water mains during the reporting period,” from 1 to 4; 1 being low confidence and 4 being high confidence.

² Total number of utilities that completed the confidence survey.

Source: AWWA, *2018 AWWA Utility Benchmarking Performance Management for Water and Wastewater*, Table 4-4C, 2018, p. 96.

Since the number of leaks and breaks seen in the system are significantly greater than the benchmarks, it enforces that the leaks are likely to be surfacing.

Table 4 shows the AWWA benchmark data for real losses per service connection per day (gal/connection/day). The District’s losses per service connection per day in Table 1 is near the median of the survey data. The high-level estimation of the leak losses in Section 4.0 (5 million gallons) would break down to approximately 8 gal/service connection/day, which is low in comparison to the utility survey data in Table 4. The high number of leaks in the system, but relatively average real losses per connection shows again that the leaks are likely surfacing for the District and that accurate accounting of the leak data would likely close the gap between the estimated losses from the GIS leak data and the actual losses experienced by the District.

Table 4: 2018 AWWA Benchmarking Data: Aggregate Data of AWWA Water Audit Software (Table 4-9)

	75 th Percentile	Median	25 th percentile	Sample Size
Water Utilities	21.2	32.3	38.7	22
Combined utilities – water operations	24.8	41.8	78.0	41

Source: AWWA, *2018 AWWA Utility Benchmarking Performance Management for Water and Wastewater*, Table 4-9, 2018, p. 105.

4.2 Subsystem Analysis

Analysis of District leak data on a subsystem basis was limited by the hydraulics and operations of the distribution system. As seen on Figure 1, Pressure Zone 4, also known as the Sherwood Forest area, is the only subsystem area that is served by its own tank. The remaining pressure

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zones all share tanks and production meters. Therefore a subsystem leak analysis was conducted for Pressure Zone 4 only.

Pressure Zone 4 experiences a high-frequency of leaks/breakages; however, analysis shows that it accounted for only 0.3 MG of real losses, which is a small fraction of the real losses in the entire distribution system. Based on review of the data and field observations, leaks/breaks in the Sherwood Forest area are likely showing themselves quickly and thus getting fixed quickly.

5.0 Field Leak Survey

This section details the field work that was conducted with the District staff and the conditions found in the field.

5.1 Preparatory work

Prior to entering the field, KJ conducted a short leak survey using the District's GIS system to determine where to target field leak detection efforts. Lilac Terrace, a small neighborhood in southern Twain Harte, was selected for the following reasons:

- It provided a large range of pressures between 45-140psi across the area. See Attachment C for the pressure logger plot in the Lilac Terrace area (there is approximately a 135 ft drop in elevation across 850 ft of distance between the pressure loggers);
- The steep elevations in the area can help hide leaks as they may easily follow tree roots or run down into fissures in the ground;
- The distribution infrastructure is primarily asbestos cement (AC) pipe that was installed 39 years prior, is made of a brittle material that can easily break, and is nearing the end of its useful life;
- There were no leaks reported in the neighborhood, but a multitude of leaks had been reported in the water mains and laterals in the surrounding area.

Therefore, it was suspected that there could be leaks in the neighborhood that had not yet come to surface or been detected by the District.

5.2 Summary of Field Work and Observations

The following is a list of activities that KJ completed during the field visits:

- Deployed and validated client-owned leak detection equipment and pressure loggers in the system and confirmed equipment effectiveness.
 - Applied leak detection equipment at known leaks in the system for both wide range leak detection and the pinpointing function. See Figure 1 for leak locations that were investigated.

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- Leak detection equipment was validated using leaks present in the system at the time of the initial field visit. Places where leaks were detected with the equipment aligned with service laterals.
- Pressure loggers were placed in the system prior to field work for precursory data collection.
- During field work, the pressure loggers were placed in leak survey area to observe any transient pressure spikes or drops.
- Updated software for the leak detection equipment.
- Observed and discussed distribution infrastructure with operators (i.e. pressure reducing stations, lateral and main breaks, pressures, tanks, pump stations).
- Leaks observed on initial field visit were leaking for over a month before repair.
- Water lost through leaks in the system may be underestimated by field staff during reporting. Both the rate of flow and duration of the leaks may be underestimated in field reports. Some of the lateral leaks in their GIS show that they occurred and were fixed within the same day which is unlikely.
- Leak detection equipment is outdated and no longer supported by the original equipment manufacturer (OEM). Functionality of equipment is reduced due to the lack of support (e.g. software attempts to connect to non-functioning web address for GPS and map data)

5.3 System Infrastructure Conditions

The following describes the system infrastructure conditions contributing to leaks that were observed during the field work or discussed with operators for the buried parts of the system.

- High pressures exist throughout the system, especially in the valley areas.
- Single pressure zones can encompass large pressure variations. The Million Gallon Zone (MGZ) contains pressures that range from 21 to 165 psi per the 2019 modeling study conducted by KJ.
- Pressure reducing station was examined and in good condition. See Attachment D for a photo of the pressure reducing station.
- Valves, hydrants, and lateral locations were not accurate in the GIS system. Some locations of the valves and lengths of piping were found to be off by a significant amount.
- Service laterals are patched up to 3 times before being replaced.

6.0 Remaining Useful Life of Distribution Infrastructure

Table 5 summarizes the major piping and appurtenances of the drinking water distribution system, their general condition and age, and provides estimates on their remaining useful life. Based on a high-level assessment using the District's GIS system and analysis in the field, nearly all components of the system have reached or are near the end of their useful lives.

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It is understood that the Pressure Zone 4 area was inherited by the District and that the infrastructure is likely some of the oldest. Additionally, it is the area with the greatest number of leaks to due frequent patching, old infrastructure, and material types.

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Table 5: Remaining Useful Life and General Conditions of Distribution System Infrastructure

Component	Age¹ (Years)	Quantity in the System	Base Expected Useful Life (years)²	Adjusted Life Expectancy (years)³	Estimated Remaining Useful Life	General Condition⁴
Transmission and Distribution Mains	39-54	30 mi	35-40	20	Exceeded	Functional, but leaks occur frequently
Service Laterals	27-55	16 mi	30-50	25	Exceeded	Functional, patched up to three times before replacement
Valves	27-55	576	35-40	40	Majority Exceeded	Described as functional and were functional in the field, 294 valves have been exercised in the last 3 years.
Customer Service Meters	12 ⁵	1584	10-15	13	Exceeded	Described as functional, no challenge testing has been conducted.
Production Meters	3	3	10-15	13	10 years	Described as functional, calibrated every 5 years.
Hydrants	39-55	209	40-60	60	Exceeded	Described as functional, 34 hydrants have been exercised in the last 3 years.

¹ Source: THCS D GIS database uses previous system as-builts. 802/1584 meters, 429/576 valves, and all hydrants have age data on the GIS database.

² Source: EPA 816-R-03-016 Small Water Systems Handbook

³ If there are few or no records of regular maintenance, then the Life Expectancy is half the base expected useful life.

⁴ General conditions based on discourse with the District and using the maintenance logs in the GIS system.

⁵ Per client discussions there was a system-wide replacement of meters around 2010-2011 which has not been captured in the GIS system

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7.0 General Recommendations

This section includes recommendations for distribution system upgrades and operational opportunities.

Based on the results of the Water Loss Evaluation and Condition Assessment, the leaks in the system are likely presenting themselves, but the flows and durations are being under reported, or not reported in the GIS database. Investigating the Lilac Terrace area with leak detection equipment allowed for confirmation that it is unlikely that there are hidden systemic leaks. Therefore, an active leak detection program throughout the District is not warranted because the system pressures and soil types in the area lend to active leaks showing themselves quickly.

It should be noted that improvements to system area pipelines may require upgrades to overall infrastructure design in accordance with current standards. For example, replacement of a length of water main may include replacing hydrants, the minimum flows and placement of which will be dictated by current standards and related Codes. In this case, the fire marshal should be contacted during the design process. Furthermore, changes in flow requirements in one area of the District's distribution system may have impacts on the overall pressure zone. Improvements recommended for implementation will be evaluated using the District's hydraulic model.

7.1 Distribution System Upgrades

The following distribution system upgrades are recommended:

- Replace mains and laterals in areas that are at high-risk for leaks. One area that is known to have exceeded the AWWA leak benchmark is the Sherwood Forest area (District Pressure Zone 4).
- Begin a cycle of replacements and upgrades to the system using the AWWA benchmarking tool and a risk matrix to prioritize future improvements.
- Break the distribution system down into smaller zones with system metering in place to measure flow into and out of each zone. Match these zones with billing codes so that water loss can be narrowed to a smaller area.
- Conduct follow-up monitoring after replacement to evaluate leak reduction.

7.2 Operational Opportunities

The following opportunities for improving Operation and Maintenance procedures were identified:

- Replace service laterals after an initial break rather than patching lateral.
- Review and update the GIS database routinely, ensuring that any addition or replacements to the system get logged immediately.

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- Update the reporting system in GIS to utilize dropdown menus including selections for pipe type (main or lateral), pipe material, and pipe size for consistency in reporting.
- Train operators to log leak data at the time of the leak.
- Conduct challenge testing on a subset of customer meters so that a set of meters fully representative of the distribution system get tested every 5 years. The District can also conduct testing of high usage meters and meters in areas of high total dissolved solids more frequently since these meters will likely require replacement ahead of the rest of the system.
- Continue existing calibration/challenge testing program for production meters and check SCADA signal calibration every 3-5 years.
- Train staff to accurately determine flow rates visually from leak points in the system.
- Create a process for staff to conduct field validation of the GIS system during routine maintenance. This should include a method for operators to record discrepancies between the GIS system and District assets while in the field as well as a method to communicate the error to the District's GIS system representative.
- Train staff to use the pressure reducing stations throughout the system.
- If the District would like to begin a leak detection program, it should be noted that the correlators are outdated, though they were confirmed to work well. However, the new versions offer far more features and are more user friendly.
- Each piece of data input into the AWWA audit was given a conservative grading score based on knowledge gained from field visits and meetings with the District. The scores on the audit allow the user to see AWWA recommendations based on any deficient areas reported. The audit primarily recommends addressing the District's metering policies. This includes regular testing the meter accuracy for the facility production and tank meters and consumer meters.

8.0 Limitations

The recommendations identified in this Technical Memo are based on the high-level visual and data assessment conducted by KJ during the field visits, discussions with operators, and through data sourced from the District. The field visits were limited to visual inspections and information provided by operators. Piping was not removed or inspected.

Figures

1. Pipeline Break and Leak History Map

Attachments

- A: AWWA Water Loss Audit 2019
 B: AWWA Water Loss Audit 2020

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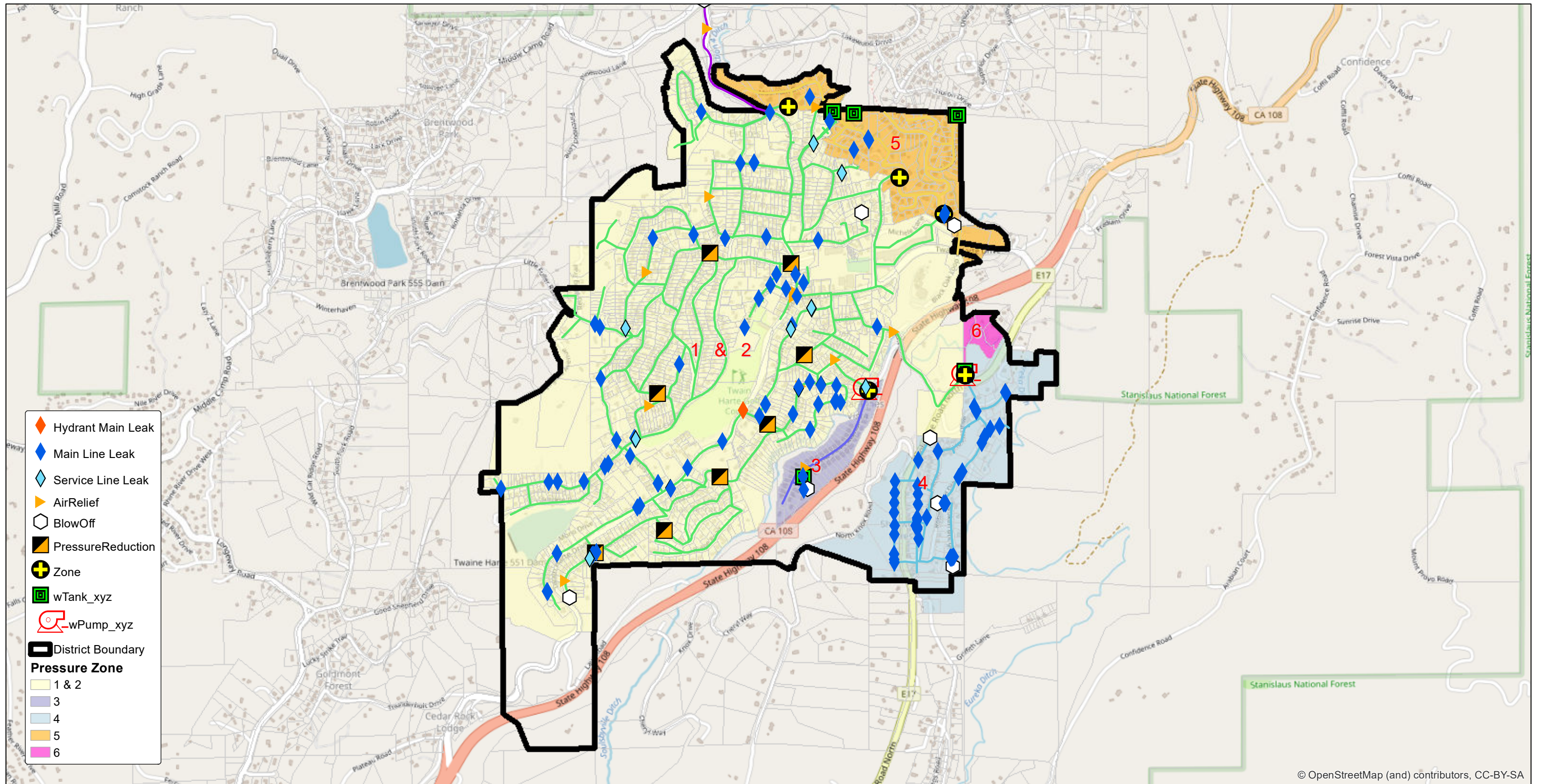
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C: Pressure Logger Data from Lilac Terrace

D: Pressure Reducing Station Photo

Figures



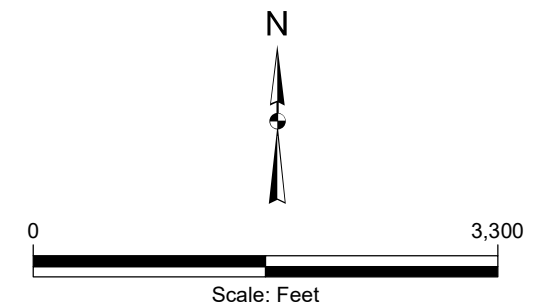
© OpenStreetMap (and) contributors, CC-BY-SA

Kennedy Jenks

Twain Harte Community Services District
 District Water System Evaluation
 and Modernization Project
 Twain Harte, California

Figure 1. Pipeline Break and Leak History

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Attachments

Attachment A

AWWA Water Loss Audit 2019

AWWA Free Water Audit Software v5.0

American Water Works Association Copyright © 2014, All Rights Reserved.

This spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water distribution systems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format, and is not meant to take the place of a full-scale, comprehensive water audit format.

Auditors are strongly encouraged to refer to the most current edition of AWWA M36 Manual for Water Audits for detailed guidance on the water auditing process and targetting loss reduction levels

The spreadsheet contains several separate worksheets. Sheets can be accessed using the tabs towards the bottom of the screen, or by clicking the buttons below.

Please begin by providing the following information

Name of Contact Person:

Email Address:

Telephone (incl Ext.):

Name of City / Utility:

City/Town/Municipality:

State / Province:

Country:

Year:

Start Date: Enter MM/YYYY numeric format

End Date: Enter MM/YYYY numeric format

Audit Preparation Date:

Volume Reporting Units:

PWSID / Other ID:

The following guidance will help you complete the Audit

All audit data are entered on the [Reporting Worksheet](#)

- Value can be entered by user
- Value calculated based on input data
- These cells contain recommended default values

Use of Option (Radio) Buttons: Pcnt: Value:

Select the default percentage by choosing the option button on the left

To enter a value, choose this button and enter a value in the cell to the right

The following worksheets are available by clicking the buttons below or selecting the tabs along the bottom of the page

<p><u>Instructions</u></p> <p>The current sheet. Enter contact information and basic audit details (year, units etc)</p>	<p><u>Reporting Worksheet</u></p> <p>Enter the required data on this worksheet to calculate the water balance and data grading</p>	<p><u>Comments</u></p> <p>Enter comments to explain how values were calculated or to document data sources</p>	<p><u>Performance Indicators</u></p> <p>Review the performance indicators to evaluate the results of the audit</p>	<p><u>Water Balance</u></p> <p>The values entered in the Reporting Worksheet are used to populate the Water Balance</p>	<p><u>Dashboard</u></p> <p>A graphical summary of the water balance and Non-Revenue Water components</p>
<p><u>Grading Matrix</u></p> <p>Presents the possible grading options for each input component of the audit</p>	<p><u>Service Connection Diagram</u></p> <p>Diagrams depicting possible customer service connection line configurations</p>	<p><u>Definitions</u></p> <p>Use this sheet to understand the terms used in the audit process</p>	<p><u>Loss Control Planning</u></p> <p>Use this sheet to interpret the results of the audit validity score and performance indicators</p>	<p><u>Example Audits</u></p> <p>Reporting Worksheet and Performance Indicators examples are shown for two validated audits</p>	<p><u>Acknowledgements</u></p> <p>Acknowledgements for the AWWA Free Water Audit Software v5.0</p>

If you have questions or comments regarding the software please contact us via email at: wlc@awwa.org



AWWA Free Water Audit Software: Reporting Worksheet

WAS v5.0
American Water Works Association
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?	Click to access definition
+	Click to add a comment

Water Audit Report for: Twain Harte Community Services District (CA5510005)
Reporting Year: 2019 1/2019 - 12/2019

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: MILLION GALLONS (US) PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

WATER SUPPLIED

----- Enter grading in column 'E' and 'J' ----->

Volume from own sources:	+	?	5	78.115	MG/Yr
Water imported:	+	?	5	0.123	MG/Yr
Water exported:	+	?	n/a	0.000	MG/Yr

Master Meter and Supply Error Adjustments

Pcnt:	+	?	?	Value:		MG/Yr
	+	?	?	Value:		MG/Yr
	+	?	?	Value:		MG/Yr

Enter negative % or value for under-registration
Enter positive % or value for over-registration

WATER SUPPLIED: 78.237 MG/Yr

AUTHORIZED CONSUMPTION

Billed metered:	+	?	5	55.515	MG/Yr
Billed unmetered:	+	?	n/a	0.000	MG/Yr
Unbilled metered:	+	?	8	0.007	MG/Yr
Unbilled unmetered:	+	?	4	0.549	MG/Yr

Click here: ?
for help using option buttons below

Pcnt:	+	?	?	Value:	0.549	MG/Yr
-------	---	---	---	--------	-------	-------

Use buttons to select percentage of water supplied
OR
value

AUTHORIZED CONSUMPTION: 56.071 MG/Yr

WATER LOSSES (Water Supplied - Authorized Consumption)

22.167 MG/Yr

Apparent Losses

Unauthorized consumption: + ? 0.196 MG/Yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

Customer metering inaccuracies:	+	?	1	0.000	MG/Yr
Systematic data handling errors:	+	?	7	0.139	MG/Yr

Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed

Apparent Losses: 0.334 MG/Yr

Pcnt:	+	?	?	Value:	0.25%	MG/Yr
-------	---	---	---	--------	-------	-------

0.00%	+	?	?	Value:		MG/Yr
0.25%	+	?	?	Value:		MG/Yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: 21.832 MG/Yr

WATER LOSSES: 22.167 MG/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 22.722 MG/Yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	+	?	4	30.0	miles
Number of <u>active</u> AND <u>inactive</u> service connections:	+	?	8	1,572	
Service connection density:	+	?	?	52	conn./mile main

Are customer meters typically located at the curbside or property line? No
Average length of customer service line: + ? 2 28.0 ft (length of service line, beyond the property boundary, that is the responsibility of the utility)

Average operating pressure: + ? 3 80.0 psi

COST DATA

Total annual cost of operating water system:	+	?	10	\$1,232,535	\$/Year
Customer retail unit cost (applied to Apparent Losses):	+	?	8	\$2.60	\$/1000 gallons (US)
Variable production cost (applied to Real Losses):	+	?	1	\$2.60	\$/Million gallons <input checked="" type="checkbox"/> Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 52 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources

2: Customer metering inaccuracies

3: Variable production cost (applied to Real Losses)



AWWA Free Water Audit Software: System Attributes and Performance Indicators

WAS v5.0

American Water Works Association.
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Water Audit Report for: **Twain Harte Community Services District (CA5510005)**
 Reporting Year: **2019** **1/2019 - 12/2019**

***** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 52 out of 100 *****

System Attributes:

	Apparent Losses:	0.334	MG/Yr
+	Real Losses:	21.832	MG/Yr
=	Water Losses:	22.167	MG/Yr

? Unavoidable Annual Real Losses (UARL): **See limits in definition** MG/Yr

Annual cost of Apparent Losses: **\$869**

Annual cost of Real Losses: **\$56,764** Valued at **Customer Retail Unit Cost**
 Return to Reporting Worksheet to change this assumption

Performance Indicators:

Financial:	{	Non-revenue water as percent by volume of Water Supplied:	29.0%	
		Non-revenue water as percent by cost of operating system:	4.8%	Real Losses valued at Customer Retail Unit Cost

Operational Efficiency:	{	Apparent Losses per service connection per day:	0.58	gallons/connection/day
		Real Losses per service connection per day:	38.05	gallons/connection/day
		Real Losses per length of main per day*:	N/A	
		Real Losses per service connection per day per psi pressure:	0.48	gallons/connection/day/psi

From Above, Real Losses = Current Annual Real Losses (CARL): **21.83** million gallons/year

? Infrastructure Leakage Index (ILI) [CARL/UARL]:

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline



**AWWA Free Water Audit Software:
User Comments**

WAS v5.0

American Water Works Association.

Use this worksheet to add comments or notes to explain how an input value was calculated, or to document the sources of the information used.

General Comment:	
-------------------------	--

Audit Item	Comment
Volume from own sources:	100% of production water is metered (from both the SWTP and the wells). Production meters are calibrated every 5 years instead of annually (marked as occasionally). To get a score above a 5, production meters must be calibrated annually.
Vol. from own sources: Master meter error adjustment:	This volume (78.115MG) came from 2019 EIR pp. 9/38. Using data from water production meter data, the total volume was found to be 79.232MG and losses from flushing, sampling, etc was found to be 0.863MG.
Water imported:	Assumed 0% for this. The effluent Cadillac meter calibration data (dated 2/28/2019) received ranged from -2.44% to 1.01% error.
Water imported: master meter error adjustment:	Obtained from 2019 EIR pp 9/38. Score assumed to be the same as Volume from own sources - 100% metered and meters calibrated every 5 years.
Water exported:	Same as above.
Water exported: master meter error adjustment:	No water exported this year per 2019 EIR.
Billed metered:	NA
Billed unmetered:	Data obtained from Customer Consumption spreadsheet. 2019 monthly customer data is missing data for two service areas so the data can not be checked. All meters are upgraded types which allow wireless communication. They have 99.7 to 99.9% read rate success. There is no meter challenge testing conducted and the meters are 10+ years old. Scoring above a 5 requires meter challenge testing
Unbilled metered:	No billed unmetered
Unbilled unmetered:	Use by the Fire suppression force is metered. The accounts total to under 10,000 gallons across the year and are insignificant.
Unbilled unmetered:	Estimated sampling volumes, flushing, and other losses in the treatment facility. Not metered, logged as estimates

Audit Item	Comment
Unauthorized consumption:	Default percentage used. Unauthorized consumption amounts are unknown (and likely small or zero from communications with the district).
Customer metering inaccuracies:	Challenge testing is not conducted on the customer meters. 0% was assumed for the inaccuracies because of this. District installs new ones as the old ones cease to function. Current meters are approx 11-12 years old.
Systematic data handling errors:	Per communications with the District.
Length of mains:	Used GIS data which is not accurate. Data is based off of as-builts from the original construction of the system and was not kept up-to-date as new assets were put in. Many of the assets are not field validated and there is error in pipe lengths and distances between valves throughout the system.
Number of active AND inactive service connections:	Obtained from 2019 EAR. District has good accounting for the metering in the area. Unlikely that they are off by many connections (if any). 2019 Monthly customer data spreadsheet was missing service areas so number of connections could not be verified compared to the 2019 EIR
Average length of customer service line:	Used GIS data for all customer service lines in the District. Again, primarily based off as-builts. GIS data has discrepancies when out in the field
Average operating pressure:	Estimated based on TM from previous Twain Harte system modeling project. Pressures vary between 20 and 165psi. 80 is an estimate
Total annual cost of operating water system:	Costs audited yearly by CPA. Data was pulled from FY 2019 report pp 19. Line item "Total Operating Expenses" under the water column.
Customer retail unit cost (applied to Apparent Losses):	Per Resolution #16-04, the rate for FY18-19 is \$2.23, however the fiscal year ends in mid July at which point it would switch to \$2.38. Two tier rate structure, the low tier is \$2.23/2.38 and the high tier is \$3.58/3.74. For this analysis \$2.23 and 3.58 were used and the weighted average cost was calculated based on excess water usage over 2000gal (the differentiation point between the high and low tier structure) per customer meter per month. Likely very accurate since the District requires reviews every 5 years to be eligible for grant funding.
Variable production cost (applied to Real Losses):	Unknown, conservative assumption. Specific operational costs do not seem to be well recorded.



AWWA Free Water Audit Software: Water Balance

WAS v5.0

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Water Audit Report for:	Twain Harte Community Services District (CA5510005)	
Reporting Year:	2019	1/2019 - 12/2019
Data Validity Score:	52	

	Water Exported	Billed Water Exported				
	<i>0.000</i>		Billed Authorized Consumption	Billed Metered Consumption (water exported is removed)	Revenue Water	
Own Sources (Adjusted for known errors) 78.115	Water Supplied 78.237	Authorized Consumption 56.071	55.515	55.515	55.515	
			Unbilled Authorized Consumption 0.556	0.000		
		Water Losses 22.167	Apparent Losses 0.334	0.007	Non-Revenue Water (NRW) 22.722	
				0.549		
0.196						
Water Imported 0.123	Real Losses 21.832	0.000	0.139			
		0.139				
		0.139				



AWWA Free Water Audit Software: Dashboard

WAS v5.0

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The graphic below is a visual representation of the Water Balance with bar heights proportional to the volume of the audit components

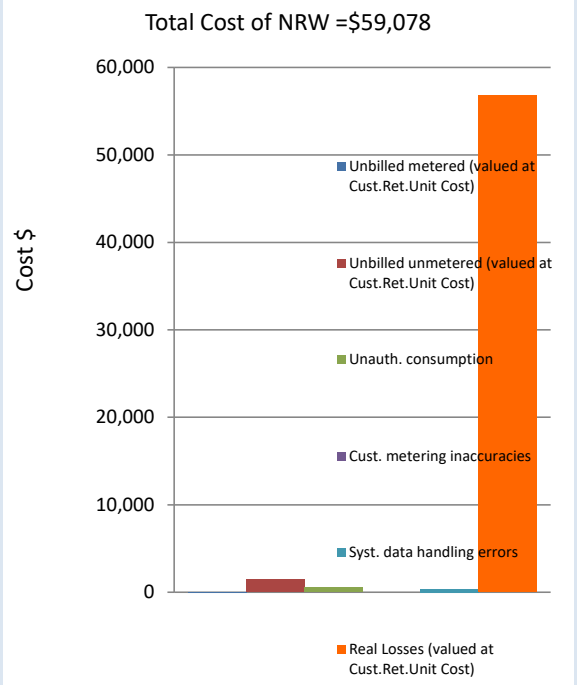
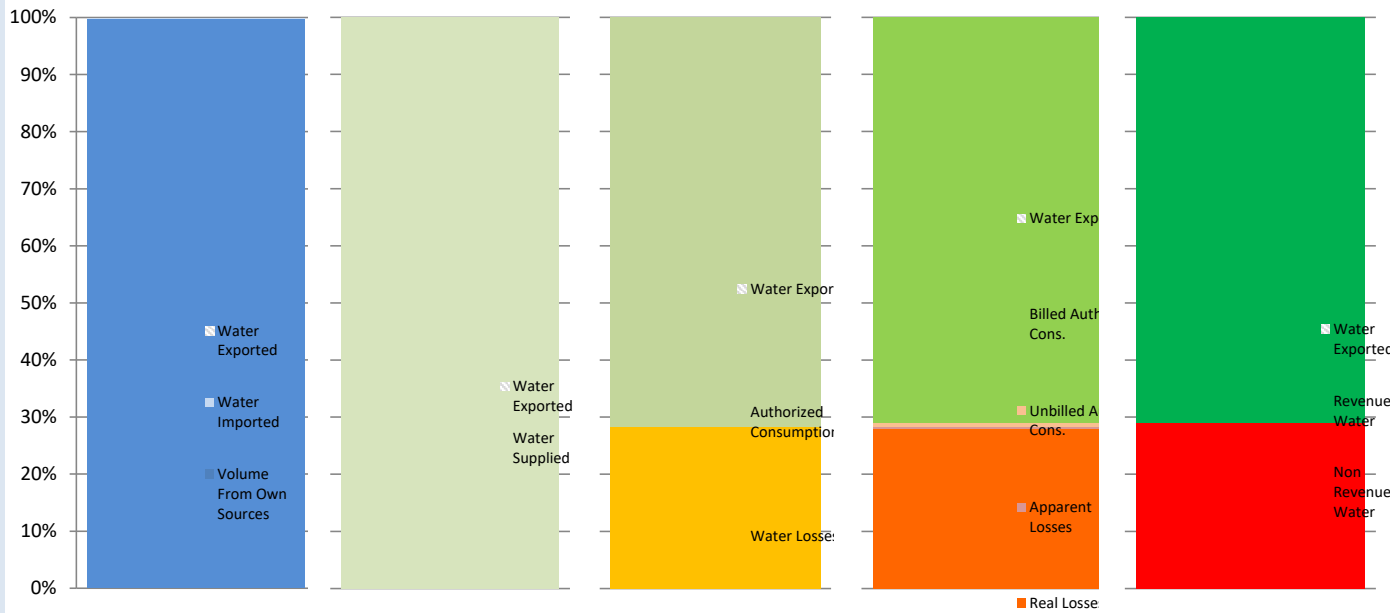
Water Audit Report for: **Twain Harte Community Services District (CA5510005)**

Reporting Year: **2019** **1/2019 - 12/2019**

Data Validity Score: **52**

Show me the VOLUME of Non-Revenue Water

Show me the COST of Non-Revenue Water



AWWA Free Water Audit Software: Grading Matrix

WAS 5.0

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The grading assigned to each audit component and the corresponding recommended improvements and actions are highlighted in yellow. Audit accuracy is likely to be improved by prioritizing those items shown in red

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
WATER SUPPLIED											
Volume from own sources:	Select this grading only if the water utility purchases/imports all of its water resources (i.e. has no sources of its own)	Less than 25% of water production sources are metered, remaining sources are estimated. No regular meter accuracy testing or electronic calibration conducted.	25% - 50% of treated water production sources are metered; other sources estimated. No regular meter accuracy testing or electronic calibration conducted.	Conditions between 2 and 4	50% - 75% of treated water production sources are metered, other sources estimated. Occasional meter accuracy testing or electronic calibration conducted.	Conditions between 4 and 6	At least 75% of treated water production sources are metered, <u>or</u> at least 90% of the source flow is derived from metered sources. Meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually. Less than 25% of tested meters are found outside of +/- 6% accuracy.	Conditions between 6 and 8	100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy	Conditions between 8 and 10	100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually, with less than 10% found outside of +/- 3% accuracy. Procedures are reviewed by a third party knowledgeable in the M36 methodology.
Improvements to attain higher data grading for "Volume from own Sources" component:		<u>to qualify for 2:</u> Organize and launch efforts to collect data for determining volume from own sources	<u>to qualify for 4:</u> Locate all water production sources on maps and in the field, launch meter accuracy testing for existing meters, begin to install meters on unmetered water production sources and replace any obsolete/defective meters.		<u>to qualify for 6:</u> Formalize annual meter accuracy testing for all source meters; specify the frequency of testing. Complete installation of meters on unmetered water production sources and complete replacement of all obsolete/defective meters.		<u>to qualify for 8:</u> Conduct annual meter accuracy testing and calibration of related instrumentation on all meter installations on a regular basis. Complete project to install new, or replace defective existing, meters so that entire production meter population is metered. Repair or replace meters outside of +/- 6% accuracy.		<u>to qualify for 10:</u> Maintain annual meter accuracy testing and calibration of related instrumentation for all meter installations. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to further improve meter accuracy.		<u>to maintain 10:</u> Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology.
Volume from own sources master meter and supply error adjustment:	Select n/a only if the water utility fails to have meters on its sources of supply	Inventory information on meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined	No automatic datalogging of production volumes; daily readings are scribed on paper records without any accountability controls. Flows are not balanced across the water distribution system; tank/storage elevation changes are not employed in calculating the "Volume from own sources" component and archived flow data is adjusted only when grossly evident data error occurs.	Conditions between 2 and 4	Production meter data is logged automatically in electronic format and reviewed at least on a monthly basis with necessary corrections implemented. "Volume from own sources" tabulations include estimate of daily changes in tanks/storage facilities. Meter data is adjusted when gross data errors occur, or occasional meter testing deems this necessary.	Conditions between 4 and 6	Hourly production meter data logged automatically & reviewed on at least a weekly basis. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and/or error is confirmed by meter accuracy testing. Tank/storage facility elevation changes are automatically used in calculating a balanced "Volume from own sources" component, and data gaps in the archived data are corrected on at least a weekly basis.	Conditions between 6 and 8	Continuous production meter data is logged automatically & reviewed each business day. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and/or results of meter accuracy testing. Tank/storage facility elevation changes are automatically used in "Volume from own sources" tabulations and data gaps in the archived data are corrected on a daily basis.	Conditions between 8 and 10	Computerized system (SCADA or similar) automatically balances flows from all sources and storages; results are reviewed each business day. Tight accountability controls ensure that all data gaps that occur in the archived flow data are quickly detected and corrected. Regular calibrations between SCADA and sources meters ensures minimal data transfer error.
Improvements to attain higher data grading for "Master meter and supply error adjustment" component:		<u>to qualify for 2:</u> Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature.	<u>to qualify for 4:</u> Install automatic datalogging equipment on production meters. Complete installation of level instrumentation at all tanks/storage facilities and include tank level data in automatic calculation routine in a computerized system. Construct a computerized listing or spreadsheet to archive input volumes, tank/storage volume changes and import/export flows in order to determine the composite "Water Supplied" volume for the distribution system. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps.		<u>to qualify for 6:</u> Refine computerized data collection and archive to include hourly production meter data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Use daily net storage change to balance flows in calculating "Water Supplied" volume. Necessary corrections to data errors are implemented on a weekly basis.		<u>to qualify for 8:</u> Ensure that all flow data is collected and archived on at least an hourly basis. All data is reviewed and detected errors corrected each business day. Tank/storage levels variations are employed in calculating balanced "Water Supplied" component. Adjust production meter data for gross error and inaccuracy confirmed by testing.		<u>to qualify for 10:</u> Link all production and tank/storage facility elevation change data to a Supervisory Control & Data Acquisition (SCADA) System, or similar computerized monitoring/control system, and establish automatic flow balancing algorithm and regularly calibrate between SCADA and source meters. Data is reviewed and corrected each business day.		<u>to maintain 10:</u> Monitor meter innovations for development of more accurate and less expensive flowmeters. Continue to replace or repair meters as they perform outside of desired accuracy limits. Stay abreast of new and more accurate water level instruments to better record tank/storage levels and archive the variations in storage volume. Keep current with SCADA and data management systems to ensure that archived data is well-managed and error free.
Water Imported:	Select n/a if the water utility's supply is exclusively from its own water resources (no bulk purchased/ imported water)	Less than 25% of imported water sources are metered, remaining sources are estimated. No regular meter accuracy testing.	25% - 50% of imported water sources are metered; other sources estimated. No regular meter accuracy testing.	Conditions between 2 and 4	50% - 75% of imported water sources are metered, other sources estimated. Occasional meter accuracy testing conducted.	Conditions between 4 and 6	At least 75% of imported water sources are metered, meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually for all meter installations. Less than 25% of tested meters are found outside of +/- 6% accuracy.	Conditions between 6 and 8	100% of imported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy	Conditions between 8 and 10	100% of imported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually for all meter installations, with less than 10% of accuracy tests found outside of +/- 3% accuracy.
Improvements to attain higher data grading for "Water Imported Volume" component: <i>(Note: usually the water supplier selling the water - "the Exporter" - to the utility being audited is responsible to maintain the metering installation measuring the imported volume. The utility should coordinate carefully with the Exporter to ensure that adequate meter upkeep takes place and an accurate measure of the Water Imported volume is quantified.)</i>		<u>to qualify for 2:</u> Review bulk water purchase agreements with partner suppliers; confirm requirements for use and maintenance of accurate metering. Identify needs for new or replacement meters with goal to meter all imported water sources.	<u>To qualify for 4:</u> Locate all imported water sources on maps and in the field, launch meter accuracy testing for existing meters, begin to install meters on unmetered imported water interconnections and replace obsolete/defective meters.		<u>to qualify for 6:</u> Formalize annual meter accuracy testing for all imported water meters, planning for both regular meter accuracy testing and calibration of the related instrumentation. Continue installation of meters on unmetered imported water interconnections and replacement of obsolete/defective meters.		<u>to qualify for 8:</u> Complete project to install new, or replace defective, meters on all imported water interconnections. Maintain annual meter accuracy testing for all imported water meters and conduct calibration of related instrumentation at least annually. Repair or replace meters outside of +/- 6% accuracy.		<u>to qualify for 10:</u> Conduct meter accuracy testing for all meters on a semi-annual basis, along with calibration of all related instrumentation. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to improve meter accuracy.		<u>to maintain 10:</u> Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Continue to conduct calibration of related instrumentation on a semi-annual basis. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology.

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Water imported master meter and supply error adjustment:	Select n/a if the Imported water supply is unmetered, with Imported water quantities estimated on the billing invoices sent by the Exporter to the purchasing Utility.	Inventory information on imported meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined. Written agreement(s) with water Exporter(s) are missing or written in vague language concerning meter management and testing.	No automatic datalogging of imported supply volumes; daily readings are scribed on paper records without any accountability controls to confirm data accuracy and the absence of errors and data gaps in recorded volumes. Written agreement requires meter accuracy testing but is vague on the details of how and who conducts the testing.	Conditions between 2 and 4	Imported supply metered flow data is logged automatically in electronic format and reviewed at least on a monthly basis by the Exporter with necessary corrections implemented. Meter data is adjusted by the Exporter when gross data errors are detected. A coherent data trail exists for this process to protect both the selling and the purchasing Utility. Written agreement exists and clearly states requirements and roles for meter accuracy testing and data management.	Conditions between 4 and 6	Hourly Imported supply metered data is logged automatically & reviewed on at least a weekly basis by the Exporter. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and to correct for error confirmed by meter accuracy testing. Any data gaps in the archived data are detected and corrected during the weekly review. A coherent data trail exists for this process to protect both the selling and the purchasing Utility.	Conditions between 6 and 8	Continuous Imported supply metered flow data is logged automatically & reviewed each business day by the Importer. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and/or results of meter accuracy testing. Any data errors/gaps are detected and corrected on a daily basis. A data trail exists for the process to protect both the selling and the purchasing Utility.	Conditions between 8 and 10	Computerized system (SCADA or similar) automatically records data which is reviewed each business day by the Exporter. Tight accountability controls ensure that all error/data gaps that occur in the archived flow data are quickly detected and corrected. A reliable data trail exists and contract provisions for meter testing and data management are reviewed by the selling and purchasing Utility at least once every five years.
Improvements to attain higher data grading for "Water imported master meter and supply error adjustment" component:		<u>to qualify for 2:</u> Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature. Review the written agreement between the selling and purchasing Utility.	<u>to qualify for 4:</u> Install automatic datalogging equipment on Imported supply meters. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps. Launch discussions with the Exporters to jointly review terms of the written agreements regarding meter accuracy testing and data management; revise the terms as necessary.		<u>to qualify for 6:</u> Refine computerized data collection and archive to include hourly Imported supply metered flow data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Make necessary corrections to errors/data errors on a weekly basis.		<u>to qualify for 8:</u> Ensure that all Imported supply metered flow data is collected and archived on at least an hourly basis. All data is reviewed and errors/data gaps are corrected each business day.		<u>to qualify for 10:</u> Conduct accountability checks to confirm that all Imported supply metered data is reviewed and corrected each business day by the Exporter. Results of all meter accuracy tests and data corrections should be available for sharing between the Exporter and the purchasing Utility. Establish a schedule for a regular review and updating of the contractual language in the written agreement between the selling and the purchasing Utility, at least every five years.		<u>to maintain 10:</u> Monitor meter innovations for development of more accurate and less expensive flowmeters; work with the Exporter to help identify meter replacement needs. Keep communication lines with Exporters open and maintain productive relations. Keep the written agreement current with clear and explicit language that meets the ongoing needs of all parties.
Water Exported:	Select n/a if the water utility sells no bulk water to neighboring water utilities (no exported water sales)	Less than 25% of exported water sources are metered, remaining sources are estimated. No regular meter accuracy testing.	25% - 50% of exported water sources are metered; other sources estimated. No regular meter accuracy testing.	Conditions between 2 and 4	50% - 75% of exported water sources are metered, other sources estimated. Occasional meter accuracy testing conducted.	Conditions between 4 and 6	At least 75% of exported water sources are metered, meter accuracy testing and/or electronic calibration conducted annually. Less than 25% of tested meters are found outside of +/- 6% accuracy.	Conditions between 6 and 8	100% of exported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy	Conditions between 8 and 10	100% of exported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually for all meter installations, with less than 10% of accuracy tests found outside of +/- 3% accuracy.
Improvements to attain higher data grading for "Water Exported Volume" component: (Note: usually, if the water utility being audited sells (Exports) water to a neighboring purchasing Utility, it is the responsibility of the utility exporting the water to maintain the metering installation measuring the Exported volume. The utility exporting the water should ensure that adequate meter upkeep takes place and an accurate measure of the Water Exported volume is quantified.)		<u>to qualify for 2:</u> Review bulk water sales agreements with purchasing utilities; confirm requirements for use & upkeep of accurate metering. Identify needs to install new, or replace defective meters as needed.	<u>to qualify for 4:</u> Locate all exported water sources on maps and in field, launch meter accuracy testing for existing meters, begin to install meters on unmetered exported water interconnections and replace obsolete/defective meters		<u>to qualify for 6:</u> Formalize annual meter accuracy testing for all exported water meters. Continue installation of meters on unmetered exported water interconnections and replacement of obsolete/defective meters.		<u>to qualify for 8:</u> Complete project to install new, or replace defective, meters on all exported water interconnections. Maintain annual meter accuracy testing for all exported water meters. Repair or replace meters outside of +/- 6% accuracy.		<u>to qualify for 10:</u> Maintain annual meter accuracy testing for all meters. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to improve meter accuracy.		<u>to maintain 10:</u> Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology.
Water exported master meter and supply error adjustment:	Select n/a only if the water utility fails to have meters on its exported supply interconnections.	Inventory information on exported meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined. Written agreement(s) with the utility purchasing the water are missing or written in vague language concerning meter management and testing.	No automatic datalogging of exported supply volumes; daily readings are scribed on paper records without any accountability controls to confirm data accuracy and the absence of errors and data gaps in recorded volumes. Written agreement requires meter accuracy testing but is vague on the details of how and who conducts the testing.	Conditions between 2 and 4	Exported metered flow data is logged automatically in electronic format and reviewed at least on a monthly basis, with necessary corrections implemented. Meter data is adjusted by the utility selling (exporting) the water when gross data errors are detected. A coherent data trail exists for this process to protect both the utility exporting the water and the purchasing Utility. Written agreement exists and clearly states requirements and roles for meter accuracy testing and data management.	Conditions between 4 and 6	Hourly exported supply metered data is logged automatically & reviewed on at least a weekly basis by the utility selling the water. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and to correct for error found by meter accuracy testing. Any data gaps in the archived data are detected and corrected during the weekly review. A coherent data trail exists for this process to protect both the selling (exporting) utility and the purchasing Utility.	Conditions between 6 and 8	Continuous exported supply metered flow data is logged automatically & reviewed each business day by the utility selling (exporting) the water. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and any error confirmed by meter accuracy testing. Any data errors/gaps are detected and corrected on a daily basis. A data trail exists for the process to protect both the selling (exporting) Utility and the purchasing Utility.	Conditions between 8 and 10	Computerized system (SCADA or similar) automatically records data which is reviewed each business day by the utility selling (exporting) the water. Tight accountability controls ensure that all error/data gaps that occur in the archived flow data are quickly detected and corrected. A reliable data trail exists and contract provisions for meter testing and data management are reviewed by the selling Utility and purchasing Utility at least once every five years.

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Improvements to attain higher data grading for "Water exported master meter and supply error adjustment" component.		<p><u>to qualify for 2:</u> Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature. Review the written agreement between the utility selling (exporting) the water and the purchasing Utility.</p>	<p><u>to qualify for 4:</u> Install automatic datalogging equipment on exported supply meters. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps. Launch discussions with the purchasing utilities to jointly review terms of the written agreements regarding meter accuracy testing and data management; revise the terms as necessary.</p>		<p><u>to qualify for 6:</u> Refine computerized data collection and archive to include hourly exported supply metered flow data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Make necessary corrections to errors/data errors on a weekly basis.</p>		<p><u>to qualify for 8:</u> Ensure that all exported metered flow data is collected and archived on at least an hourly basis. All data is reviewed and errors/data gaps are corrected each business day.</p>		<p><u>to qualify for 10:</u> Conduct accountability checks to confirm that all exported metered flow data is reviewed and corrected each business day by the utility selling the water. Results of all meter accuracy tests and data corrections should be available for sharing between the utility and the purchasing Utility. Establish a schedule for a regular review and updating of the contractual language in the written agreements with the purchasing utilities, at least every five years.</p>		<p><u>to maintain 10:</u> Monitor meter innovations for development of more accurate and less expensive flowmeters; work with the purchasing utilities to help identify meter replacement needs. Keep communication lines with the purchasing utilities open and maintain productive relations. Keep the written agreement current with clear and explicit language that meets the ongoing needs of all parties.</p>
AUTHORIZED CONSUMPTION											
Billed metered:	n/a (not applicable). Select n/a only if the entire customer population is not metered and is billed for water service on a flat or fixed rate basis. In such a case the volume entered must be zero.	Less than 50% of customers with volume-based billings from meter readings; flat or fixed rate billing exists for the majority of the customer population	At least 50% of customers with volume-based billing from meter reads; flat rate billing for others. Manual meter reading is conducted with less than 50% meter read success rate, remaining accounts' consumption is estimated. Limited meter records, no regular meter testing or replacement. Billing data maintained on paper records, with no auditing.	Conditions between 2 and 4	At least 75% of customers with volume-based, billing from meter reads; flat or fixed rate billing for remaining accounts. Manual meter reading is conducted with at least 50% meter read success rate; consumption for accounts with failed reads is estimated. Purchase records verify age of customer meters; only very limited meter accuracy testing is conducted. Customer meters are replaced only upon complete failure. Computerized billing records exist, but only sporadic internal auditing conducted.	Conditions between 4 and 6	At least 90% of customers with volume-based billing from meter reads; consumption for remaining accounts is estimated. Manual customer meter reading gives at least 80% customer meter reading success rate; consumption for accounts with failed reads is estimated. Good customer meter records exist, but only limited meter accuracy testing is conducted. Regular replacement is conducted for the oldest meters. Computerized billing records exist with annual auditing of summary statistics conducted by utility personnel.	Conditions between 6 and 8	At least 97% of customers exist with volume-based billing from meter reads. At least 90% customer meter reading success rate; at least 80% read success rate with planning and budgeting for trials of Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) in one or more pilot areas. Good customer meter records. Regular meter accuracy testing guides replacement of statistically significant number of meters each year. Routine auditing of computerized billing records for global and detailed statistics occurs annually by utility personnel, and is verified by third party at least once every five years.	Conditions between 8 and 10	At least 99% of customers exist with volume-based billing from meter reads. At least 95% customer meter reading success rate; minimum 80% meter reading success rate, with Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) trials underway. Statistically significant customer meter testing and replacement program in place on a continuous basis. Computerized billing with routine, detailed auditing, including field investigation of representative sample of accounts undertaken annually by utility personnel. Audit is conducted by third party auditors at least once every three years.
Improvements to attain higher data grading for "Billed Metered Consumption" component.	If n/a is selected because the customer meter population is unmetered, consider establishing a new policy to meter the customer population and employ water rates based upon metered volumes.	<p><u>to qualify for 2:</u> Conduct investigations or trials of customer meters to select appropriate meter models. Budget funding for meter installations. Investigate volume based water rate structures.</p>	<p><u>to qualify for 4:</u> Purchase and install meters on unmetered accounts. Implement policies to improve meter reading success. Catalog meter information during meter read visits to identify age/model of existing meters. Test a minimal number of meters for accuracy. Install computerized billing system.</p>		<p><u>to qualify for 6:</u> Purchase and install meters on unmetered accounts. Eliminate flat fee billing and establish appropriate water rate structure based upon measured consumption. Continue to achieve verified success in removing manual meter reading barriers. Expand meter accuracy testing. Launch regular meter replacement program. Launch a program of annual auditing of global billing statistics by utility personnel.</p>		<p><u>to qualify for 8:</u> Purchase and install meters on unmetered accounts. If customer meter reading success rate is less than 97%, assess cost-effectiveness of Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) system for portion or entire system; or otherwise achieve ongoing improvements in manual meter reading success rate to 97% or higher. Refine meter accuracy testing program. Set meter replacement goals based upon accuracy test results. Implement annual auditing of detailed billing records by utility personnel and implement third party auditing at least once every five years.</p>		<p><u>to qualify for 10:</u> Purchase and install meters on unmetered accounts. Launch Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) system trials if manual meter reading success rate of at least 99% is not achieved within a five-year program. Continue meter accuracy testing program. Conduct planning and budgeting for large scale meter replacement based upon meter life cycle analysis using cumulative flow target. Continue annual detailed billing data auditing by utility personnel and conduct third party auditing at least once every three years.</p>		<p><u>to maintain 10:</u> Continue annual internal billing data auditing, and third party auditing at least every three years. Continue customer meter accuracy testing to ensure that accurate customer meter readings are obtained and entered as the basis for volume based billing. Stay abreast of improvements in Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) and information management. Plan and budget for justified upgrades in metering, meter reading and billing data management to maintain very high accuracy in customer metering and billing.</p>
Billed unmetered:	Select n/a if it is the policy of the water utility to meter all customer connections and it has been confirmed by detailed auditing that all customers do indeed have a water meter; i.e. no intentionally unmetered accounts exist	Water utility policy does not require customer metering; flat or fixed fee billing is employed. No data is collected on customer consumption. The only estimates of customer population consumption available are derived from data estimation methods using average fixture count multiplied by number of connections, or similar approach.	Water utility policy does not require customer metering; flat or fixed fee billing is employed. Some metered accounts exist in parts of the system (pilot areas or District Metered Areas) with consumption read periodically or recorded on portable dataloggers over one, three, or seven day periods. Data from these sample meters are used to infer consumption for the total customer population. Site specific estimation methods are used for unusual buildings/water uses.	Conditions between 2 and 4	Water utility policy does require metering and volume based billing in general. However, a liberal amount of exemptions and a lack of clearly written and communicated procedures result in up to 20% of billed accounts believed to be unmetered by exemption; or the water utility is in transition to becoming fully metered, and a large number of customers remain unmetered. A rough estimate of the annual consumption for all unmetered accounts is included in the annual water audit, with no inspection of individual unmetered accounts.	Conditions between 4 and 6	Water utility policy does require metering and volume based billing but established exemptions exist for a portion of accounts such as municipal buildings. As many as 15% of billed accounts are unmetered due to this exemption or meter installation difficulties. Only a group estimate of annual consumption for all unmetered accounts is included in the annual water audit, with no inspection of individual unmetered accounts.	Conditions between 6 and 8	Water utility policy does require metering and volume based billing for all customer accounts. However, less than 5% of billed accounts remain unmetered because meter installation is hindered by unusual circumstances. The goal is to minimize the number of unmetered accounts. Reliable estimates of consumption are obtained for these unmetered accounts via site specific estimation methods.	Conditions between 8 and 10	Water utility policy does require metering and volume based billing for all customer accounts. Less than 2% of billed accounts are unmetered and exist because meter installation is hindered by unusual circumstances. The goal exists to minimize the number of unmetered accounts to the extent that is economical. Reliable estimates of consumption are obtained at these accounts via site specific estimation methods.

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Improvements to attain higher data grading for "Billed Unmetered Consumption" component:		to qualify for 2: Conduct research and evaluate cost/benefit of a new water utility policy to require metering of the customer population; thereby greatly reducing or eliminating unmetered accounts. Conduct pilot metering project by installing water meters in small sample of customer accounts and periodically reading the meters or datalogging the water consumption over one, three, or seven day periods.	to qualify for 4: Implement a new water utility policy requiring customer metering. Launch or expand pilot metering study to include several different meter types, which will provide data for economic assessment of full scale metering options. Assess sites with access difficulties to devise means to obtain water consumption volumes. Begin customer meter installation.		to qualify for 6: Refine policy and procedures to improve customer metering participation for all but solidly exempt accounts. Assign staff resources to review billing records to identify errant unmetered properties. Specify metering needs and funding requirements to install sufficient meters to significant reduce the number of unmetered accounts		to qualify for 8: Push to install customer meters on a full scale basis. Refine metering policy and procedures to ensure that all accounts, including municipal properties, are designated for meters. Plan special efforts to address "hard-to-access" accounts. Implement procedures to obtain a reliable consumption estimate for the remaining few unmetered accounts awaiting meter installation.		to qualify for 10: Continue customer meter installation throughout the service area, with a goal to minimize unmetered accounts. Sustain the effort to investigate accounts with access difficulties, and devise means to install water meters or otherwise measure water consumption.		to maintain 10: Continue to refine estimation methods for unmetered consumption and explore means to establish metering, for as many billed remaining unmetered accounts as is economically feasible.
Unbilled metered:	select n/a if all billing-exempt consumption is unmetered.	Billing practices exempt certain accounts, such as municipal buildings, but written policies do not exist; and a reliable count of unbilled metered accounts is unavailable. Meter upkeep and meter reading on these accounts is rare and not considered a priority. Due to poor recordkeeping and lack of auditing, water consumption for all such accounts is purely guesstimated.	Billing practices exempt certain accounts, such as municipal buildings, but only scattered, dated written directives exist to justify this practice. A reliable count of unbilled metered accounts is unavailable. Sporadic meter replacement and meter reading occurs on an as-needed basis. The total annual water consumption for all unbilled, metered accounts is estimated based upon approximating the number of accounts and assigning consumption from actively billed accounts of same meter size.	Conditions between 2 and 4	Dated written procedures permit billing exemption for specific accounts, such as municipal properties, but are unclear regarding certain other types of accounts. Meter reading is given low priority and is sporadic. Consumption is quantified from meter readings where available. The total number of unbilled, unmetered accounts must be estimated along with consumption volumes.	Conditions between 4 and 6	Written policies regarding billing exemptions exist but adherence in practice is questionable. Metering and meter reading for municipal buildings is reliable but sporadic for other unbilled metered accounts. Periodic auditing of such accounts is conducted. Water consumption is quantified directly from meter readings where available, but the majority of the consumption is estimated.	Conditions between 6 and 8	Written policy identifies the types of accounts granted a billing exemption. Customer meter management and meter reading are considered secondary priorities, but meter reading is conducted at least annually to obtain consumption volumes for the annual water audit. High level auditing of billing records ensures that a reliable census of such accounts exists.	Conditions between 8 and 10	Clearly written policy identifies the types of accounts given a billing exemption, with emphasis on keeping such accounts to a minimum. Customer meter management and meter reading for these accounts is given proper priority and is reliably conducted. Regular auditing confirms this. Total water consumption for these accounts is taken from reliable readings from accurate meters.
Improvements to attain higher data grading for "Unbilled Metered Consumption" component:		to qualify for 2: Reassess the water utility's policy allowing certain accounts to be granted a billing exemption. Draft an outline of a new written policy for billing exemptions, with clear justification as to why any accounts should be exempt from billing, and with the intention to keep the number of such accounts to a minimum.	to qualify for 4: Review historic written directives and policy documents allowing certain accounts to be billing-exempt. Draft an outline of a written policy for billing exemptions, identify criteria that grants an exemption, with a goal of keeping this number of accounts to a minimum. Consider increasing the priority of reading meters on unbilled accounts at least annually.		to qualify for 6: Draft a new written policy regarding billing exemptions based upon consensus criteria allowing this occurrence. Assign resources to audit meter records and billing records to obtain census of unbilled metered accounts. Gradually include a greater number of these metered accounts to the routes for regular meter reading.		to qualify for 8: Communicate billing exemption policy throughout the organization and implement procedures that ensure proper account management. Conduct inspections of accounts confirmed in unbilled metered status and verify that accurate meters exist and are scheduled for routine meter readings. Gradually increase the number of unbilled metered accounts that are included in regular meter reading routes.		to qualify for 10: Ensure that meter management (meter accuracy testing, meter replacement) and meter reading activities for unbilled accounts are accorded the same priority as billed accounts. Establish ongoing annual auditing process to ensure that water consumption is reliably collected and provided to the annual water audit process.		to maintain 10: Reassess the utility's philosophy in allowing any water uses to go "unbilled". It is possible to meter and bill all accounts, even if the fee charged for water consumption is discounted or waived. Metering and billing all accounts ensures that water consumption is tracked and water waste from plumbing leaks is detected and minimized.
Unbilled unmetered:		Extent of unbilled, unmetered consumption is unknown due to unclear policies and poor recordkeeping. Total consumption is quantified based upon a purely subjective estimate.	Clear extent of unbilled, unmetered consumption is unknown, but a number of events are randomly documented each year, confirming existence of such consumption, but without sufficient documentation to quantify an accurate estimate of the annual volume consumed.	Conditions between 2 and 4	Extent of unbilled, unmetered consumption is partially known, and procedures exist to document certain events such as miscellaneous fire hydrant uses. Formulae is used to quantify the consumption from such events (time running multiplied by typical flowrate, multiplied by number of events).	Default value of 1.25% of system input volume is employed	Coherent policies exist for some forms of unbilled, unmetered consumption but others await closer evaluation. Reasonable recordkeeping for the managed uses exists and allows for annual volumes to be quantified by inference, but unsupervised uses are guesstimated.	Conditions between 6 and 8	Clear policies and good recordkeeping exist for some uses (ex. water used in periodic testing of unmetered fire connections), but other uses (ex. miscellaneous uses of fire hydrants) have limited oversight. Total consumption is a mix of well quantified use such as from formulae (time running multiplied by typical flow, multiplied by number of events) or temporary meters, and relatively subjective estimates of less regulated use.	Conditions between 8 and 10	Clear policies exist to identify permitted use of water in unbilled, unmetered fashion, with the intention of minimizing this type of consumption. Good records document each occurrence and consumption is quantified via formulae (time running multiplied by typical flow, multiplied by number of events) or use of temporary meters.
Improvements to attain higher data grading for "Unbilled Unmetered Consumption" component:		to qualify for 5: Utilize the accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of this use. to qualify for 2: Establish a policy regarding what water uses should be allowed to remain as unbilled and unmetered. Consider tracking a small sample of one such use (ex: fire hydrant flushing).	to qualify for 5: Utilize accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of this use. to qualify for 4: Evaluate the documentation of events that have been observed. Meet with user groups (ex: for fire hydrants - fire departments, contractors to ascertain their need and/or volume requirements for water from fire hydrants).		to qualify for 5: Utilize accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of all such use. This is particularly appropriate for water utilities who are in the early stages of the water auditing process, and should focus on other components since the volume of unbilled, unmetered consumption is usually a relatively small quantity component, and other larger-quantity components should take priority.	to qualify for 6 or greater: Finalize policy and begin to conduct field checks to better establish and quantify such usage. Proceed if top-down audit exists and/or a great volume of such use is suspected.	to qualify for 8: Assess water utility policy and procedures for various unmetered usages. For example, ensure that a policy exists and permits are issued for use of fire hydrants by persons outside of the utility. Create written procedures for use and documentation of fire hydrants by water utility personnel. Use same approach for other types of unbilled, unmetered water usage.		to qualify for 10: Refine written procedures to ensure that all uses of unbilled, unmetered water are overseen by a structured permitting process managed by water utility personnel. Reassess policy to determine if some of these uses have value in being converted to billed and/or metered status.		to maintain 10: Continue to refine policy and procedures with intention of reducing the number of allowable uses of water in unbilled and unmetered fashion. Any uses that can feasibly become billed and metered should be converted eventually.

APPARENT LOSSES

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Unauthorized consumption:		Extent of unauthorized consumption is unknown due to unclear policies and poor recordkeeping. Total unauthorized consumption is guesstimated.	Unauthorized consumption is a known occurrence, but its extent is a mystery. There are no requirements to document observed events, but periodic field reports capture some of these occurrences. Total unauthorized consumption is approximated from this limited data.	conditions between 2 and 4	Procedures exist to document some unauthorized consumption such as observed unauthorized fire hydrant openings. Use formulae to quantify this consumption (time running multiplied typical flowrate, multiplied by number of events).	Default value of 0.25% of volume of water supplied is employed	Coherent policies exist for some forms of unauthorized consumption (more than simply fire hydrant misuse) but others await closer evaluation. Reasonable surveillance and recordkeeping exist for occurrences that fall under the policy. Volumes quantified by inference from these records.	Conditions between 6 and 8	Clear policies and good auditable recordkeeping exist for certain events (ex: tampering with water meters, illegal bypasses of customer meters); but other occurrences have limited oversight. Total consumption is a combination of volumes from formulae (time x typical flow) and subjective estimates of unconfirmed consumption.	Conditions between 8 and 10	Clear policies exist to identify all known unauthorized uses of water. Staff and procedures exist to provide enforcement of policies and detect violations. Each occurrence is recorded and quantified via formulae (estimated time running multiplied by typical flow) or similar methods. All records and calculations should exist in a form that can be audited by a third party.
Improvements to attain higher data grading for "Unauthorized Consumption" component:		to qualify for 5: Use accepted default of 0.25% of volume of water supplied. to qualify for 2: Review utility policy regarding what water uses are considered unauthorized, and consider tracking a small sample of one such occurrence (ex: unauthorized fire hydrant openings)	to qualify for 5: Use accepted default of 0.25% of system input volume to qualify for 4: Review utility policy regarding what water uses are considered unauthorized, and consider tracking a small sample of one such occurrence (ex: unauthorized fire hydrant openings)		to qualify for 5: Utilize accepted default value of 0.25% of volume of water supplied as an expedient means to gain a reasonable quantification of all such use. This is particularly appropriate for water utilities who are in the early stages of the water auditing process.	to qualify for 6 or greater: Finalize policy updates to clearly identify the types of water consumption that are authorized from those usages that fall outside of this policy and are, therefore, unauthorized. Begin to conduct regular field checks. Proceed if the top-down audit already exists and/or a great volume of such use is suspected.	to qualify for 8: Assess water utility policies to ensure that all known occurrences of unauthorized consumption are outlawed, and that appropriate penalties are prescribed. Create written procedures for detection and documentation of various occurrences of unauthorized consumption as they are uncovered.		to qualify for 10: Refine written procedures and assign staff to seek out likely occurrences of unauthorized consumption. Explore new locking devices, monitors and other technologies designed to detect and thwart unauthorized consumption.		to maintain 10: Continue to refine policy and procedures to eliminate any loopholes that allow or tacitly encourage unauthorized consumption. Continue to be vigilant in detection, documentation and enforcement efforts.
Customer metering inaccuracies:	select n/a only if the entire customer population is unmetered. In such a case the volume entered must be zero.	Customer meters exist, but with unorganized paper records on meters; no meter accuracy testing or meter replacement program for any size of retail meter. Metering workflow is driven chaotically with no proactive management. Loss volume due to aggregate meter inaccuracy is guesstimated.	Poor recordkeeping and meter oversight is recognized by water utility management who has allotted staff and funding resources to organize improved recordkeeping and start meter accuracy testing. Existing paper records gathered and organized to provide cursory disposition of meter population. Customer meters are tested for accuracy only upon customer request.	Conditions between 2 and 4	Reliable recordkeeping exists; meter information is improving as meters are replaced. Meter accuracy testing is conducted annually for a small number of meters (more than just customer requests, but less than 1% of inventory). A limited number of the oldest meters are replaced each year. Inaccuracy volume is largely an estimate, but refined based upon limited testing data.	Conditions between 4 and 6	A reliable electronic recordkeeping system for meters exists. The meter population includes a mix of new high performing meters and dated meters with suspect accuracy. Routine, but limited, meter accuracy testing and meter replacement occur. Inaccuracy volume is quantified using a mix of reliable and less certain data.	Conditions between 6 and 8	Ongoing meter replacement and accuracy testing result in highly accurate customer meter population. Testing is conducted on samples of meters of varying age and accumulated volume of throughput to determine optimum replacement time for various types of meters.	Ongoing meter replacement and accuracy testing result in highly accurate customer meter population. Statistically significant number of meters are tested in audit year. This testing is conducted on samples of meters of varying age and accumulated volume of throughput to determine optimum replacement time for these meters.	Good records of all active customer meters exist and include as a minimum: meter number, account number/location, type, size and manufacturer. Ongoing meter replacement occurs according to a targeted and justified basis. Regular meter accuracy testing gives a reliable measure of composite inaccuracy volume for the customer meter population. New metering technology is embraced to keep overall accuracy improving. Procedures are reviewed by a third party knowledgeable in the M36 methodology.
Improvements to attain higher data grading for "Customer meter inaccuracy volume" component:	If n/a is selected because the customer meter population is unmetered, consider establishing a new policy to meter the customer population and employ water rates based upon metered volumes.	to qualify for 2: Gather available meter purchase records. Conduct testing on a small number of meters believed to be the most inaccurate. Review staffing needs of the metering group and budget for necessary resources to better organize meter management.	to qualify for 4: Implement a reliable record keeping system for customer meter histories, preferably using electronic methods typically linked to, or part of, the Customer Billing System or Customer Information System. Expand meter accuracy testing to a larger group of meters.		to qualify for 6: Standardize the procedures for meter recordkeeping within an electronic information system. Accelerate meter accuracy testing and meter replacements guided by testing results.		to qualify for 8: Expand annual meter accuracy testing to evaluate a statistically significant number of meter makes/models. Expand meter replacement program to replace statistically significant number of poor performing meters each year.		to qualify for 9: Continue efforts to manage meter population with reliable recordkeeping. Test a statistically significant number of meters each year and analyze test results in an ongoing manner to serve as a basis for a target meter replacement strategy based upon accumulated volume throughput.	to qualify for 10: Continue efforts to manage meter population with reliable recordkeeping, meter testing and replacement. Evaluate new meter types and install one or more types in 5-10 customer accounts each year in order to pilot improving metering technology.	to maintain 10: Increase the number of meters tested and replaced as justified by meter accuracy test data. Continually monitor development of new metering technology and Advanced Metering Infrastructure (AMI) to grasp opportunities for greater accuracy in metering of water flow and management of customer consumption data.

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Systematic Data Handling Errors:	Note: all water utilities incur some amount of this error. Even in water utilities with unmetered customer populations and fixed rate billing, errors occur in annual billing tabulations. Enter a positive value for the volume and select a grading.	Policies and procedures for activation of new customer water billing accounts are vague and lack accountability. Billing data is maintained on paper records which are not well organized. No auditing is conducted to confirm billing data handling efficiency. An unknown number of customers escape routine billing due to lack of billing process oversight.	Policy and procedures for activation of new customer accounts and oversight of billing records exist but need refinement. Billing data is maintained on paper records or insufficiently capable electronic database. Only periodic unstructured auditing work is conducted to confirm billing data handling efficiency. The volume of unbilled water due to billing lapses is a guess.	Conditions between 2 and 4	Policy and procedures for new account activation and oversight of billing operations exist but needs refinement. Computerized billing system exists, but is dated or lacks needed functionality. Periodic, limited internal audits conducted and confirm with approximate accuracy the consumption volumes lost to billing lapses.	Conditions between 4 and 6	Policy and procedures for new account activation and oversight of billing operations is adequate and reviewed periodically. Computerized billing system is in use with basic reporting available. Any effect of billing adjustments on measured consumption volumes is well understood. Internal checks of billing data error conducted annually. Reasonably accurate quantification of consumption volume lost to billing lapses is obtained.	Conditions between 6 and 8	New account activation and billing operations policy and procedures are reviewed at least biannually. Computerized billing system includes an array of reports to confirm billing data and system functionality. Checks are conducted routinely to flag and explain zero consumption accounts. Annual internal checks conducted with third party audit conducted at least once every five years. Accountability checks flag billing lapses. Consumption lost to billing lapses is well quantified and reducing year-by-year.	Conditions between 8 and 10	Sound written policy and procedures exist for new account activation and oversight of customer billing operations. Robust computerized billing system gives high functionality and reporting capabilities which are utilized, analyzed and the results reported each billing cycle. Assessment of policy and data handling errors are conducted internally and audited by third party at least once every three years, ensuring consumption lost to billing lapses is minimized and detected as it occurs.
Improvements to attain higher data grading for "Systematic Data Handling Error volume" component:		to qualify for 2: Draft written policy and procedures for activating new water billing accounts and oversight of billing operations. Investigate and budget for computerized customer billing system. Conduct initial audit of billing records by flow-charting the basic business processes of the customer account/billing function.	to qualify for 4: Finalize written policy and procedures for activation of new billing accounts and overall billing operations management. Implement a computerized customer billing system. Conduct initial audit of billing records as part of this process.		to qualify for 6: Refine new account activation and billing operations procedures and ensure consistency with the utility policy regarding billing, and minimize opportunity for missed billings. Upgrade or replace customer billing system for needed functionality - ensure that billing adjustments don't corrupt the value of consumption volumes. Procedurize internal annual audit process.		to qualify for 8: Formalize regular review of new account activation process and general billing practices. Enhance reporting capability of computerized billing system. Formalize regular auditing process to reveal scope of data handling error. Plan for periodic third party audit to occur at least once every five years.		to qualify for 10: Close policy/procedure loopholes that allow some customer accounts to go unbilled, or data handling errors to exist. Ensure that billing system reports are utilized, analyzed and reported every billing cycle. Ensure that internal and third party audits are conducted at least once every three years.		to maintain 10: Stay abreast of customer information management developments and innovations. Monitor developments of Advanced Metering Infrastructure (AMI) and integrate technology to ensure that customer endpoint information is well-monitored and errors/lapses are at an economic minimum.
SYSTEM DATA											
Length of mains:		Poorly assembled and maintained paper as-built records of existing water main installations makes accurate determination of system pipe length impossible. Length of mains is guesstimated.	Paper records in poor or uncertain condition (no annual tracking of installations & abandonments). Poor procedures to ensure that new water mains installed by developers are accurately documented.	Conditions between 2 and 4	Sound written policy and procedures exist for documenting new water main installations, but gaps in management result in an uncertain degree of error in tabulation of mains length.	Conditions between 4 and 6	Sound written policy and procedures exist for permitting and commissioning new water mains. Highly accurate paper records with regular field validation; or electronic records and asset management system in good condition. Includes system backup.	Conditions between 6 and 8	Sound written policy and procedures exist for permitting and commissioning new water mains. Electronic recordkeeping such as a Geographical Information System (GIS) and asset management system are used to store and manage data.	Conditions between 8 and 10	Sound written policy exists for managing water mains extensions and replacements. Geographic Information System (GIS) data and asset management database agree and random field validation proves truth of databases. Records of annual field validation should be available for review.
Improvements to attain higher data grading for "Length of Water Mains" component:		to qualify for 2: Assign personnel to inventory current as-built records and compare with customer billing system records and highway plans in order to verify poorly documented pipelines. Assemble policy documents regarding permitting and documentation of water main installations by the utility and building developers; identify gaps in procedures that result in poor documentation of new water main installations.	to qualify for 4: Complete inventory of paper records of water main installations for several years prior to audit year. Review policy and procedures for commissioning and documenting new water main installation.		to qualify for 6: Finalize updates/improvements to written policy and procedures for permitting/commissioning new main installations. Confirm inventory of records for five years prior to audit year, correct any errors or omissions.		to qualify for 8: Launch random field checks of limited number of locations. Convert to electronic database such as a Geographic Information System (GIS) with backup as justified. Develop written policy and procedures.		to qualify for 10: Link Geographic Information System (GIS) and asset management databases, conduct field verification of data. Record field verification information at least annually.		to maintain 10: Continue with standardization and random field validation to improve the completeness and accuracy of the system.
Number of active AND inactive service connections:		Vague permitting (of new service connections) policy and poor paper recordkeeping of customer connections/billings result in suspect determination of the number of service connections, which may be 10-15% in error from actual count.	General permitting policy exists but paper records, procedural gaps, and weak oversight result in questionable total for number of connections, which may vary 5-10% of actual count.	Conditions between 2 and 4	Written account activation policy and procedures exist, but with some gaps in performance and oversight. Computerized information management system is being brought online to replace dated paper recordkeeping system. Reasonably accurate tracking of service connection installations & abandonments; but count can be up to 5% in error from actual total.	Conditions between 4 and 6	Written new account activation and overall billing policies and procedures are adequate and reviewed periodically. Computerized information management system is in use with annual installations & abandonments totaled. Very limited field verifications and audits. Error in count of number of service connections is believed to be no more than 3%.	Conditions between 6 and 8	Policies and procedures for new account activation and overall billing operations are written, well-structured and reviewed at least biannually. Well-managed computerized information management system exists and routine, periodic field checks and internal system audits are conducted. Counts of connections are no more than 2% in error.	Conditions between 8 and 10	Sound written policy and well managed and audited procedures ensure reliable management of service connection population. Computerized information management system, Customer Billing System, and Geographic Information System (GIS) information agree; field validation proves truth of databases. Count of connections recorded as being in error is less than 1% of the entire population.
Improvements to attain higher data grading for "Number of Active and Inactive Service Connections" component:	Note: The number of Service Connections does not include fire hydrant leads/lines connecting the hydrant to the water main	to qualify for 2: Draft new policy and procedures for new account activation and overall billing operations. Research and collect paper records of installations & abandonments for several years prior to audit year.	to qualify for 4: Refine policy and procedures for new account activation and overall billing operations. Research computerized recordkeeping system (Customer Information System or Customer Billing System) to improve documentation format for service connections.		to qualify for 6: Refine procedures to ensure consistency with new account activation and overall billing policy to establish new service connections or decommission existing connections. Improve process to include all totals for at least five years prior to audit year.		to qualify for 8: Formalize regular review of new account activation and overall billing operations policies and procedures. Launch random field checks of limited number of locations. Develop reports and auditing mechanisms for computerized information management system.		to qualify for 10: Close any procedural loopholes that allow installations to go undocumented. Link computerized information management system with Geographic Information System (GIS) and formalize field inspection and information system auditing processes. Documentation of new or decommissioned service connections encounters several levels of checks and balances.		to maintain 10: Continue with standardization and random field validation to improve knowledge of system.
	Note: if customer water	Gratings 1-9 apply if customer properties are unmetered, if customer meters exist and are located inside the customer building premises, or if the water utility owns and is responsible for the entire service connection piping from the water main to the customer building. In any of these cases the average distance between the curb stop or boundary separating utility/customer responsibility for service connection piping, and the typical first point of use (ex: faucet) or the customer meter must be quantified. Gratings of 1-9 are used to grade the validity of the means to quantify this value. (See the "Service Connection Diagram" worksheet)									Either of two conditions can be met for a grading of 10:

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Average length of customer service line:	meters are located outside of the customer building next to the curb stop or boundary separating utility/customer responsibility, then the auditor should answer "Yes" to the question on the Reporting Worksheet asking about this. If the answer is Yes, the grading description listed under the Grading of 10(a) will be followed, with a value of zero automatically entered at a Grading of 10. See the Service Connection Diagram worksheet for a visual presentation of this distance.	Vague policy exists to define the delineation of water utility ownership and customer ownership of the service connection piping. Curb stops are perceived as the breakpoint but these have not been well-maintained or documented. Most are buried or obscured. Their location varies widely from site-to-site, and estimating this distance is arbitrary due to the unknown location of many curb stops.	Policy requires that the curb stop serves as the delineation point between water utility ownership and customer ownership of the service connection piping. The piping from the water main to the curb stop is the property of the water utility; and the piping from the curb stop to the customer building is owned by the customer. Curb stop locations are not well documented and the average distance is based upon a limited number of locations measured in the field.	Conditions between 2 and 4	Good policy requires that the curb stop serves as the delineation point between water utility ownership and customer ownership of the service connection piping. Curb stops are generally installed as needed and are reasonably documented. Their location varies widely from site-to-site, and an estimate of this distance is hindered by the availability of paper records of limited accuracy.	Conditions between 4 and 6	Clear written policy exists to define utility/customer responsibility for service connection piping. Accurate, well-maintained paper or basic electronic recordkeeping system exists. Periodic field checks confirm piping lengths for a sample of customer properties.	Conditions between 6 and 8	Clearly worded policy standardizes the location of curb stops and meters, which are inspected upon installation. Accurate and well maintained electronic records exist with periodic field checks to confirm locations of service lines, curb stops and customer meter pits. An accurate number of customer properties from the customer billing system allows for reliable averaging of this length.	Conditions between 8 and 10	a) Customer water meters exist outside of customer buildings next to the curb stop or boundary separating utility/customer responsibility for service connection piping. If so, answer "Yes" to the question on the Reporting Working asking about this condition. A value of zero and a Grading of 10 are automatically entered in the Reporting Worksheet. b) Meters exist inside customer buildings, or properties are unmetered. In either case, answer "No" to the Reporting Worksheet question on meter location, and enter a distance determined by the auditor. For a Grading of 10 this value must be a very reliable number from a Geographic Information System (GIS) and confirmed by a statistically valid number of field checks.
Improvements to attain higher data grading for "Average Length of Customer Service Line" component:		<u>to qualify for 2:</u> Research and collect paper records of service line installations. Inspect several sites in the field using pipe locators to locate curb stops. Obtain the length of this small sample of connections in this manner.	<u>to qualify for 4:</u> Formalize and communicate policy delineating utility/customer responsibilities for service connection piping. Assess accuracy of paper records by field inspection of a small sample of service connections using pipe locators as needed. Research the potential migration to a computerized information management system to store service connection data.		<u>to qualify for 6:</u> Establish coherent procedures to ensure that policy for curb stop, meter installation and documentation is followed. Gain consensus within the water utility for the establishment of a computerized information management system.		<u>to qualify for 8:</u> Implement an electronic means of recordkeeping, typically via a customer information system, customer billing system, or Geographic Information System (GIS). Standardize the process to conduct field checks of a limited number of locations.		<u>to qualify for 10:</u> Link customer information management system and Geographic Information System (GIS), standardize process for field verification of data.		<u>to maintain 10:</u> Continue with standardization and random field validation to improve knowledge of service connection configurations and customer meter locations.
Average operating pressure:		Available records are poorly assembled and maintained paper records of supply pump characteristics and water distribution system operating conditions. Average pressure is guesstimated based upon this information and ground elevations from crude topographical maps. Widely varying distribution system pressures due to undulating terrain, high system head loss and weak/erratic pressure controls further compromise the validity of the average pressure calculation.	Limited telemetry monitoring of scattered pumping station and water storage tank sites provides some static pressure data, which is recorded in handwritten logbooks. Pressure data is gathered at individual sites only when low pressure complaints arise. Average pressure is determined by averaging relatively crude data, and is affected by significant variation in ground elevations, system head loss and gaps in pressure controls in the distribution system.	Conditions between 2 and 4	Effective pressure controls separate different pressure zones; moderate pressure variation across the system, occasional open boundary valves are discovered that breach pressure zones. Basic telemetry monitoring of the distribution system logs pressure data electronically. Pressure data gathered by gauges or dataloggers at fire hydrants or buildings when low pressure complaints arise, and during fire flow tests and system flushing. Reliable topographical data exists. Average pressure is calculated using this mix of data.	Conditions between 4 and 6	Reliable pressure controls separate distinct pressure zones; only very occasional open boundary valves are encountered that breach pressure zones. Well-covered telemetry monitoring of the distribution system (not just pumping at source treatment plants or wells) logs extensive pressure data electronically. Pressure gathered by gauges/dataloggers at fire hydrants and buildings when low pressure complaints arise, and during fire flow tests and system flushing. Average pressure is determined by using this mix of reliable data.	Conditions between 6 and 8	Well-managed, discrete pressure zones exist with generally predictable pressure fluctuations. A current full-scale SCADA System or similar realtime monitoring system exists to monitor the water distribution system and collect data, including real time pressure readings at representative sites across the system. The average system pressure is determined from reliable monitoring system data.	Conditions between 8 and 10	Well-managed pressure districts/zones, SCADA System and hydraulic model exist to give very precise pressure data across the water distribution system. Average system pressure is reliably calculated from extensive, reliable, and cross-checked data. Calculations are reported on an annual basis as a minimum.
Improvements to attain higher data grading for "Average Operating Pressure" component:		<u>to qualify for 2:</u> Employ pressure gauging and/or datalogging equipment to obtain pressure measurements from fire hydrants. Locate accurate topographical maps of service area in order to confirm ground elevations. Research pump data sheets to find pump pressure/flow characteristics	<u>to qualify for 4:</u> Formalize a procedure to use pressure gauging/datalogging equipment to gather pressure data during various system events such as low pressure complaints, or operational testing. Gather pump pressure and flow data at different flow regimes. Identify faulty pressure controls (pressure reducing valves, altitude valves, partially open boundary valves) and plan to properly configure pressure zones. Make all pressure data from these efforts available to generate system-wide average pressure.		<u>to qualify for 6:</u> Expand the use of pressure gauging/datalogging equipment to gather scattered pressure data at a representative set of sites, based upon pressure zones or areas. Utilize pump pressure and flow data to determine supply head entering each pressure zone or district. Correct any faulty pressure controls (pressure reducing valves, altitude valves, partially open boundary valves) to ensure properly configured pressure zones. Use expanded pressure dataset from these activities to generate system-wide average pressure.		<u>to qualify for 8:</u> Install a Supervisory Control and Data Acquisition (SCADA) System, or similar realtime monitoring system, to monitor system parameters and control operations. Set regular calibration schedule for instrumentation to insure data accuracy. Obtain accurate topographical data and utilize pressure data gathered from field surveys to provide extensive, reliable data for pressure averaging.		<u>to qualify for 10:</u> Annually, obtain a system-wide average pressure value from the hydraulic model of the distribution system that has been calibrated via field measurements in the water distribution system and confirmed in comparisons with SCADA System data.		<u>to maintain 10:</u> Continue to refine the hydraulic model of the distribution system and consider linking it with SCADA System for realtime pressure data calibration, and averaging.

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
COST DATA											
Total annual cost of operating water system:		Incomplete paper records and lack of financial accounting documentation on many operating functions makes calculation of water system operating costs a pure guesstimate	Reasonably maintained, but incomplete, paper or electronic accounting provides data to estimate the major portion of water system operating costs.	Conditions between 2 and 4	Electronic, industry-standard cost accounting system in place. However, gaps in data are known to exist, periodic internal reviews are conducted but not a structured financial audit.	Conditions between 4 and 6	Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Data audited periodically by utility personnel, but not a Certified Public Accountant (CPA).	Conditions between 6 and 8	Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Data audited at least annually by utility personnel, and at least once every three years by third-party CPA.	Conditions between 8 and 10	Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Data audited annually by utility personnel and annually also by third-party CPA.
Improvements to attain higher data grading for "Total Annual Cost of Operating the Water System" component:		<u>to qualify for 2:</u> Gather available records, institute new financial accounting procedures to regularly collect and audit basic cost data of most important operations functions.	<u>to qualify for 4:</u> Implement an electronic cost accounting system, structured according to accounting standards for water utilities		<u>to qualify for 6:</u> Establish process for periodic internal audit of water system operating costs; identify cost data gaps and institute procedures for tracking these outstanding costs.		<u>to qualify for 8:</u> Standardize the process to conduct routine financial audit on an annual basis. Arrange for CPA audit of financial records at least once every three years.		<u>to qualify for 10:</u> Standardize the process to conduct a third-party financial audit by a CPA on an annual basis.		<u>to maintain 10:</u> Maintain program, stay abreast of expenses subject to erratic cost changes and long-term cost trend, and budget/track costs proactively
Customer retail unit cost (applied to Apparent Losses):	Customer population unmetered, and/or only a fixed fee is charged for consumption.	Antiquated, cumbersome water rate structure is used, with periodic historic amendments that were poorly documented and implemented, resulting in classes of customers being billed inconsistent charges. The actual composite billing rate likely differs significantly from the published water rate structure, but a lack of auditing leaves the degree of error indeterminate.	Dated, cumbersome water rate structure, not always employed consistently in actual billing operations. The actual composite billing rate is known to differ from the published water rate structure, and a reasonably accurate estimate of the degree of error is determined, allowing a composite billing rate to be quantified.	Conditions between 2 and 4	Straight-forward water rate structure in use, but not updated in several years. Billing operations reliably employ the rate structure. The composite billing rate is derived from a single customer class such as residential customer accounts, neglecting the effect of different rates from varying customer classes.	Conditions between 4 and 6	Clearly written, up-to-date water rate structure is in force and is applied reliably in billing operations. Composite customer rate is determined using a weighted average residential rate using volumes of water in each rate block.	Conditions between 6 and 8	Effective water rate structure is in force and is applied reliably in billing operations. Composite customer rate is determined using a weighted average composite consumption rate, which includes residential, commercial, industrial, institutional (CII), and any other distinct customer classes within the water rate structure.	Conditions between 8 and 10	Current, effective water rate structure is in force and applied reliably in billing operations. The rate structure and calculations of composite rate - which includes residential, commercial, industrial, institutional (CII), and other distinct customer classes - are reviewed by a third party knowledgeable in the M36 methodology at least once every five years.
Improvements to attain higher data grading for "Customer Retail Unit Cost" component:		<u>to qualify for 2:</u> Formalize the process to implement water rates, including a secure documentation procedure. Create a current, formal water rate document and gain approval from all stakeholders.	<u>to qualify for 4:</u> Review the water rate structure and update/formalize as needed. Assess billing operations to ensure that actual billing operations incorporate the established water rate structure.		<u>to qualify for 6:</u> Evaluate volume of water used in each usage block by residential users. Multiply volumes by full rate structure.	<u>Launch effort to fully meter the customer population and charge rates based upon water volumes</u>	<u>to qualify for 8:</u> Evaluate volume of water used in each usage block by all classifications of users. Multiply volumes by full rate structure.		<u>to qualify for 10:</u> Conduct a periodic third-party audit of water used in each usage block by all classifications of users. Multiply volumes by full rate structure.		<u>to maintain 10:</u> Keep water rate structure current in addressing the water utility's revenue needs. Update the calculation of the customer unit rate as new rate components, customer classes, or other components are modified.
Variable production cost (applied to Real Losses):	Note: if the water utility purchases/imports its entire water supply, then enter the unit purchase cost of the bulk water supply in the Reporting Worksheet with a grading of 10	Incomplete paper records and lack of documentation on primary operating functions (electric power and treatment costs most importantly) makes calculation of variable production costs a pure guesstimate	Reasonably maintained, but incomplete, paper or electronic accounting provides data to roughly estimate the basic operations costs (pumping power costs and treatment costs) and calculate a unit variable production cost.	Conditions between 2 and 4	Electronic, industry-standard cost accounting system in place. Electric power and treatment costs are reliably tracked and allow accurate weighted calculation of unit variable production costs based on these two inputs and water imported purchase costs (if applicable). All costs are audited internally on a periodic basis.	Conditions between 4 and 6	Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Pertinent additional costs beyond power, treatment and water imported purchase costs (if applicable) such as liability, residuals management, wear and tear on equipment, impending expansion of supply, are included in the unit variable production cost, as applicable. The data is audited at least annually by utility personnel.	Conditions between 6 and 8	Reliable electronic, industry-standard cost accounting system in place, with all pertinent primary and secondary variable production and water imported purchase (if applicable) costs tracked. The data is audited at least annually by utility personnel, and at least once every three years by a third-party knowledgeable in the M36 methodology.	Conditions between 8 and 10	Either of two conditions can be met to obtain a grading of 10: 1) Third party CPA audit of all pertinent primary and secondary production and water imported purchase (if applicable) costs on an annual basis, or; 2) Water supply is entirely purchased as bulk imported water, and unit purchase cost serves as the variable production cost.
Improvements to attain higher data grading for "Variable Production Cost" component:		<u>to qualify for 2:</u> Gather available records, institute new procedures to regularly collect and audit basic cost data and most important operations functions.	<u>to qualify for 4:</u> Implement an electronic cost accounting system, structured according to accounting standards for water utilities		<u>to qualify for 6:</u> Formalize process for regular internal audits of production costs. Assess whether additional costs (liability, residuals management, equipment wear, impending infrastructure expansion) should be included to calculate a more representative variable production cost.		<u>to qualify for 8:</u> Formalize the accounting process to include direct cost components (power, treatment) as well as indirect cost components (liability, residuals management, etc.) Arrange to conduct audits by a knowledgeable third-party at least once every three years.		<u>to qualify for 10:</u> Standardize the process to conduct a third-party financial audit by a CPA on an annual basis.		<u>to maintain 10:</u> Maintain program, stay abreast of expenses subject to erratic cost changes and budget/track costs proactively



Average Length of Customer Service Line

The three figures shown on this worksheet display the assignment of the Average Length of Customer Service Line, L_p , for the three most common piping configurations.

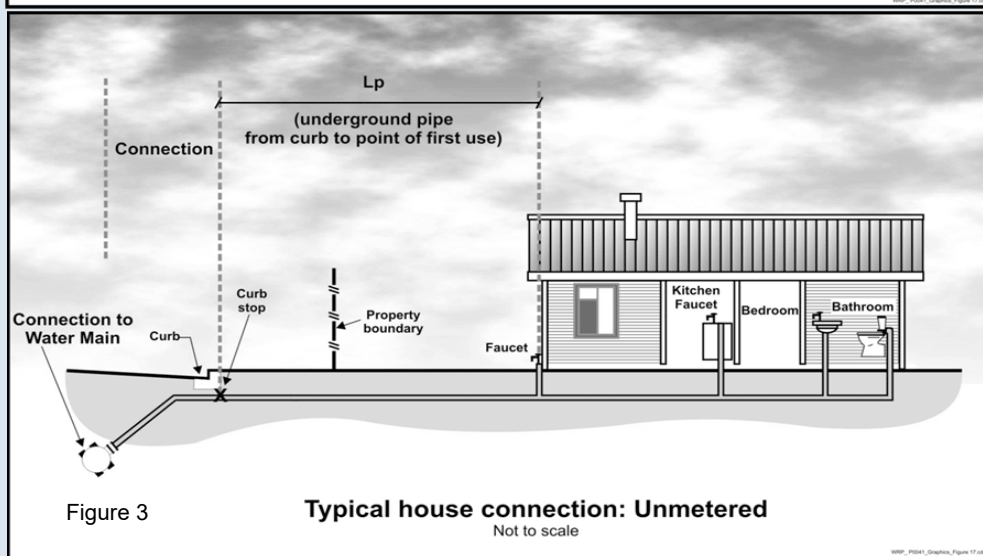
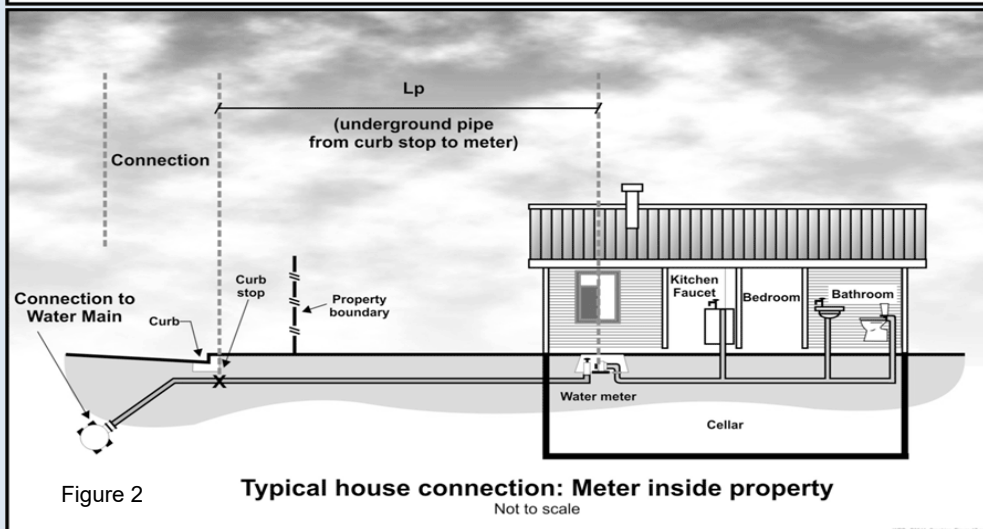
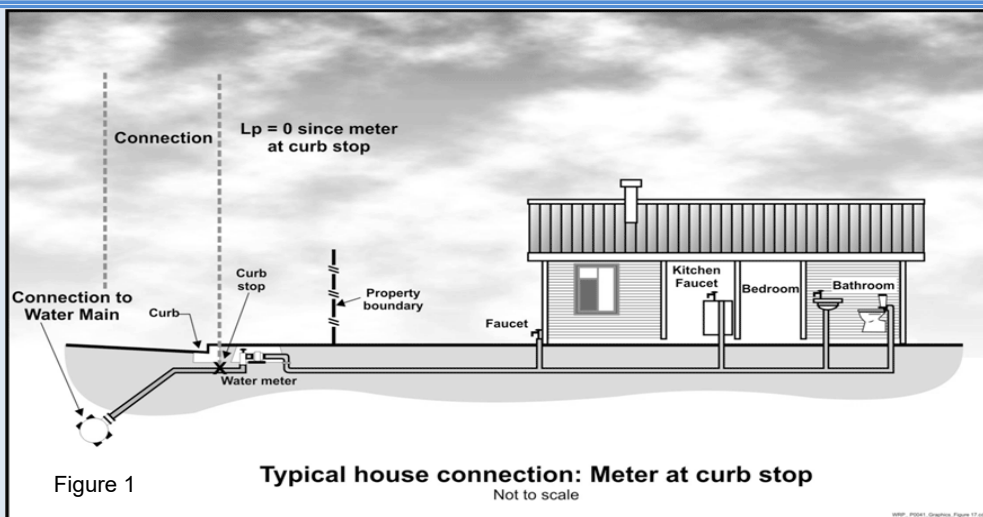
Figure 1 shows the configuration of the water meter outside of the customer building next to the curb stop valve. In this configuration $L_p = 0$ since the distance between the curb stop and the customer metering point is essentially zero.

Figure 2 shows the configuration of the customer water meter located inside the customer building, where L_p is the distance from the curb stop to the water meter.

Figure 3 shows the configuration of an unmetred customer building, where L_p is the distance from the curb stop to the first point of customer water consumption, or, more simply, the building line.

In any water system the L_p will vary notably in a community of different structures, therefore the average L_p value is used and this should be approximated or calculated if a sample of service line measurements has been gathered.

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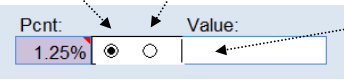
AWWA Free Water Audit Software: Definitions

WAS v5.0
American Water Works Association.
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Item Name	Description
<p>Apparent Losses</p> <p style="text-align: center;">Find</p>	<p>= unauthorized consumption + customer metering inaccuracies + systematic data handling errors</p> <p>Apparent Losses include all types of inaccuracies associated with customer metering (worn meters as well as improperly sized meters or wrong type of meter for the water usage profile) as well as systematic data handling errors (meter reading, billing, archiving and reporting), plus unauthorized consumption (theft or illegal use).</p> <p>NOTE: Over-estimation of Apparent Losses results in under-estimation of Real Losses. Under-estimation of Apparent Losses results in over-estimation of Real Losses.</p>
<p>AUTHORIZED CONSUMPTION</p> <p style="text-align: center;">Find</p>	<p>= billed water exported + billed metered + billed unmetered + unbilled metered + unbilled unmetered consumption</p> <p>The volume of metered and/or unmetered water taken by registered customers, the water utility's own uses, and uses of others who are implicitly or explicitly authorized to do so by the water utility; for residential, commercial, industrial and public-minded purposes.</p> <p>Typical retail customers' consumption is tabulated usually from established customer accounts as billed metered consumption, or - for unmetered customers - billed unmetered consumption. These types of consumption, along with billed water exported, provide revenue potential for the water utility. Be certain to tabulate the water exported volume as a separate component and do not "double-count" it by including in the billed metered consumption component as well as the water exported component.</p> <p>Unbilled authorized consumption occurs typically in non-account uses, including water for fire fighting and training, flushing of water mains and sewers, street cleaning, watering of municipal gardens, public fountains, or similar public-minded uses. Occasionally these uses may be metered and billed (or charged a flat fee), but usually they are unmetered and unbilled. In the latter case, the water auditor may use a default value to estimate this quantity, or implement procedures for the reliable quantification of these uses. This starts with documenting usage events as they occur and estimating the amount of water used in each event. (See Unbilled unmetered consumption)</p>
<p style="text-align: center;">View Service Connection Diagram</p> <p>Average length of customer service line</p> <p style="text-align: center;">Find</p>	<p>This is the average length of customer service line, Lp, that is owned and maintained by the customer; from the point of ownership transfer to the customer water meter, or building line (if unmetered). The quantity is one of the data inputs for the calculation of Unavoidable Annual Real Losses (UARL), which serves as the denominator of the performance indicator: Infrastructure Leakage Index (ILI). The value of Lp is multiplied by the number of customer service connections to obtain a total length of customer owned piping in the system. The purpose of this parameter is to account for the unmetered service line infrastructure that is the responsibility of the customer for arranging repairs of leaks that occur on their lines. In many cases leak repairs arranged by customers take longer to be executed than leak repairs arranged by the water utility on utility-maintained piping. Leaks run longer - and lose more water - on customer-owned service piping, than utility owned piping.</p> <p>If the customer water meter exists near the ownership transfer point (usually the curb stop located between the water main and the customer premises) this distance is zero because the meter and transfer point are the same. This is the often encountered configuration of customer water meters located in an underground meter box or "pit" outside of the customer's building. The Free Water Audit Software asks a "Yes/No" question about the meter at this location. If the auditor selects "Yes" then this distance is set to zero and the data grading score for this component is set to 10.</p> <p>If water meters are typically located inside the customer premise/building, or properties are unmetered, it is up to the water auditor to estimate a system-wide average Lp length based upon the various customer land parcel sizes and building locations in the service area. Lp will be a shorter length in areas of high density housing, and a longer length in areas of low density housing and varied commercial and industrial buildings. General parcel demographics should be employed to obtain a composite average Lp length for the entire system.</p> <p>Refer to the "Service Connection Diagram" worksheet for a depiction of the service line/metering configurations that typically exist in water utilities. This worksheet gives guidance on the determination of the Average Length, Lp, for each configuration.</p>
<p>Average operating pressure</p> <p style="text-align: center;">Find</p>	<p>This is the average pressure in the distribution system that is the subject of the water audit. Many water utilities have a calibrated hydraulic model of their water distribution system. For these utilities, the hydraulic model can be utilized to obtain a very accurate quantity of average pressure. In the absence of a hydraulic model, the average pressure may be approximated by obtaining readings of static water pressure from a representative sample of fire hydrants or other system access points evenly located across the system. A weighted average of the pressure can be assembled; but be sure to take into account the elevation of the fire hydrants, which typically exist several feet higher than the level of buried water pipelines. If the water utility is compiling the water audit for the first time, the average pressure can be approximated, but with a low data grading. In subsequent years of auditing, effort should be made to improve the accuracy of the average pressure quantity. This will then qualify the value for a higher data grading.</p>
<p>Billed Authorized Consumption</p>	<p>All consumption that is billed and authorized by the utility. This may include both metered and unmetered consumption. See "Authorized Consumption" for more information.</p>
<p>Billed metered consumption</p> <p style="text-align: center;">Find</p>	<p>All metered consumption which is billed to retail customers, including all groups of customers such as domestic, commercial, industrial or institutional. It does NOT include water supplied to neighboring utilities (water exported) which is metered and billed. Be sure to subtract any consumption for exported water sales that may be included in these billing roles. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component. The metered consumption data can be taken directly from billing records for the water audit period. The accuracy of yearly metered consumption data can be refined by including an adjustment to account for customer meter reading lag time since not all customer meters are read on the same day of the meter reading period. However additional analysis is necessary to determine the lag time adjustment value, which may or may not be significant.</p>
<p>Billed unmetered consumption</p> <p style="text-align: center;">Find</p>	<p>All billed consumption which is calculated based on estimates or norms from water usage sites that have been determined <u>by utility policy</u> to be left unmetered. This is typically a very small component in systems that maintain a policy to meter their customer population. However, this quantity can be the key consumption component in utilities that have not adopted a universal metering policy. This component should NOT include any water that is supplied to neighboring utilities (water exported) which is unmetered but billed. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.</p>

Item Name	Description
<p>Customer metering inaccuracies</p> <p>Find</p>	<p>Apparent water losses caused by the collective under-registration of customer water meters. Many customer water meters gradually wear as large cumulative volumes of water are passed through them over time. This causes the meters to under-register the flow of water. This occurrence is common with smaller residential meters of sizes 5/8-inch and 3/4 inch after they have registered very large cumulative volumes of water, which generally occurs only after periods of years. For meters sized 1-inch and larger - typical of multi-unit residential, commercial and industrial accounts - meter under-registration can occur from wear or from the improper application of the meter; i.e. installing the wrong type of meter or the wrong size of meter, for the flow pattern (profile) of the consumer. For instance, many larger meters have reduced accuracy at low flows. If an oversized meter is installed, most of the time the routine flow will occur in the low flow range of the meter, and a significant portion of it may not be registered. It is important to properly select and install all meters, but particularly large customer meters, size 1-inch and larger.</p> <p>The auditor has two options for entering data for this component of the audit. The auditor can enter a percentage under-registration (typically an estimated value), this will apply the selected percentage to the two categories of metered consumption to determine the volume of water not recorded due to customer meter inaccuracy. Note that this percentage is a composite average inaccuracy for <u>all</u> customer meters in the entire meter population. The percentage will be multiplied by the sum of the volumes in the Billed Metered and Unbilled Metered components. Alternatively, if the auditor has substantial data from meter testing activities, he or she can calculate their own loss volumes, and this volume may be entered directly.</p> <p>Note that a value of zero will be accepted but an alert will appear asking if the customer population is unmetered. Since all metered systems have some degree of inaccuracy, a positive value should be entered. A value of zero in this component is valid only if the water utility does not meter its customer population.</p>
<p>Customer retail unit cost</p> <p>Find</p>	<p>The Customer Retail Unit Cost represents the charge that customers pay for water service. This unit cost is applied routinely to the components of Apparent Loss, since these losses represent water reaching customers but not (fully) paid for. Since most water utilities have a rate structure that includes a variety of different costs based upon class of customer, a weighted average of individual costs and number of customer accounts in each class can be calculated to determine a single composite cost that should be entered into this cell. Finally, the weighted average cost should also include additional charges for sewer, storm water or biosolids processing, <u>but only if</u> these charges are based upon the volume of potable water consumed.</p> <p>For water utilities in regions with limited water resources and a questionable ability to meet the drinking water demands in the future, the Customer Retail Unit Cost might also be applied to value the Real Losses; instead of applying the Variable Production Cost to Real Losses. In this way, it is assumed that every unit volume of leakage reduced by leakage management activities will be sold to a customer.</p> <p>Note: the Free Water Audit Software allows the user to select the units that are charged to customers (either \$/1,000 gallons, \$/hundred cubic feet, or \$/1,000 litres) and automatically converts these units to the units that appear in the "WATER SUPPLIED" box. The monetary units are United States dollars, \$.</p>
<p>Infrastructure Leakage Index (ILI)</p> <p>Find</p>	<p>The ratio of the Current Annual Real Losses (Real Losses) to the Unavoidable Annual Real Losses (UARL). The ILI is a highly effective performance indicator for comparing (benchmarking) the performance of utilities in operational management of real losses.</p>
<p>Length of mains</p> <p>Find</p>	<p>Length of all pipelines (except service connections) in the system starting from the point of system input metering (for example at the outlet of the treatment plant). It is also recommended to include in this measure the total length of fire hydrant lead pipe. Hydrant lead pipe is the pipe branching from the water main to the fire hydrant. Fire hydrant leads are typically of a sufficiently large size that is more representative of a pipeline than a service connection. The average length of hydrant leads across the entire system can be assumed if not known, and multiplied by the number of fire hydrants in the system, which can also be assumed if not known. This value can then be added to the total pipeline length. Total length of mains can therefore be calculated as:</p> <p>Length of Mains, miles = (total pipeline length, miles) + [{(average fire hydrant lead length, ft) x (number of fire hydrants)} / 5,280 ft/mile] or Length of Mains, kilometres = (total pipeline length, kilometres) + [{(average fire hydrant lead length, metres) x (number of fire hydrants)} / 1,000 metres/kilometre]</p>
<p>NON-REVENUE WATER</p> <p>Find</p>	<p>= Apparent Losses + Real Losses + Unbilled Metered Consumption + Unbilled Unmetered Consumption. This is water which does not provide revenue potential to the utility.</p>
<p>Number of active AND inactive service connections</p> <p>Find</p>	<p>Number of customer service connections, extending from the water main to supply water to a customer. Please note that this includes the actual number of distinct piping connections, including fire connections, whether active or inactive. This may differ substantially from the number of customers (or number of accounts). Note: this number does not include the pipeline leads to fire hydrants - the total length of piping supplying fire hydrants should be included in the "Length of mains" parameter.</p>
<p>Real Losses</p> <p>Find</p>	<p>Physical water losses from the pressurized system (water mains and customer service connections) and the utility's storage tanks, up to the point of customer consumption. In metered systems this is the customer meter, in unmetered situations this is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks and overflows.</p>
<p>Revenue Water</p>	<p>Those components of System Input Volume that are billed and have the potential to produce revenue.</p>
<p>Service Connection Density</p> <p>Find</p>	<p>=number of customer service connections / length of mains</p>

Item Name	Description
<p>Systematic data handling errors</p> <p>Find</p>	<p>Apparent losses caused by accounting omissions, errant computer programming, gaps in policy, procedure, and permitting/activation of new accounts; and any type of data lapse that results in under-stated customer water consumption in summary billing reports.</p> <p>Systematic Data Handling Errors result in a direct loss of revenue potential. Water utilities can find "lost" revenue by keying on this component.</p> <p>Utilities typically measure water consumption registered by water meters at customer premises. The meter should be read routinely (ex: monthly) and the data transferred to the Customer Billing System, which generates and sends a bill to the customer. Data Transfer Errors result in the consumption value being less than the actual consumption, creating an apparent loss. Such error might occur from illegible and mis-recorded hand-written readings compiled by meter readers, inputting an incorrect meter register unit conversion factor in the automatic meter reading equipment, or a variety of similar errors.</p> <p>Apparent losses also occur from Data Analysis Errors in the archival and data reporting processes of the Customer Billing System. Inaccurate estimates used for accounts that fail to produce a meter reading are a common source of error. Billing adjustments may award customers a rightful monetary credit, but do so by creating a negative value of consumption, thus under-stating the actual consumption. Account activation lapses may allow new buildings to use water for months without meter readings and billing. Poor permitting and construction inspection practices can result in a new building lacking a billing account, a water meter and meter reading; i.e., the customer is unknown to the utility's billing system.</p> <p>Close auditing of the permitting, metering, meter reading, billing and reporting processes of the water consumption data trail can uncover data management gaps that create volumes of systematic data handling error. Utilities should routinely analyze customer billing records to detect data anomalies and quantify these losses. For example, a billing account that registers zero consumption for two or more billing cycles should be checked to explain why usage has seemingly halted. Given the revenue loss impacts of these losses, water utilities are well-justified in providing continuous oversight and timely correction of data transfer errors & data handling errors.</p> <p>If the water auditor has not yet gathered detailed data or assessment of systematic data handling error, it is recommended that the auditor apply the default value of 0.25% of the Billed Authorized Consumption volume. However, if the auditor has investigated the billing system and its controls, and has well validated data that indicates the volume from systematic data handling error is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations and select an appropriate grading. Note: negative values are not allowed for this audit component. If the auditor enters zero for this component then a grading of 1 will be automatically assigned.</p>
<p>Total annual cost of operating the water system</p> <p>Find</p>	<p>These costs include those for operations, maintenance and any annually incurred costs for long-term upkeep of the drinking water supply and distribution system. It should include the costs of day-to-day upkeep and long-term financing such as repayment of capital bonds for infrastructure expansion or improvement. Typical costs include employee salaries and benefits, materials, equipment, insurance, fees, administrative costs and all other costs that exist to sustain the drinking water supply. Depending upon water utility accounting procedures or regulatory agency requirements, it may be appropriate to include depreciation in the total of this cost. This cost should not include any costs to operate wastewater, biosolids or other systems outside of drinking water.</p>
<p>Unauthorized consumption</p> <p>Find</p>	<p>Includes water illegally withdrawn from fire hydrants, illegal connections, bypasses to customer consumption meters, or tampering with metering or meter reading equipment; as well as any other ways to receive water while thwarting the water utility's ability to collect revenue for the water. Unauthorized consumption results in uncaptured revenue and creates an error that understates customer consumption. In most water utilities this volume is low and, if the water auditor has not yet gathered detailed data for these loss occurrences, it is recommended that the auditor apply a default value of 0.25% of the volume of water supplied. However, if the auditor has investigated unauthorized occurrences, and has well validated data that indicates the volume from unauthorized consumption is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations. Note that a value of zero will not be accepted since all water utilities have some volume of unauthorized consumption occurring in their system.</p> <p>Note: if the auditor selects the default value for unauthorized consumption, a data grading of 5 is automatically assigned, but not displayed on the Reporting Worksheet.</p>
<p>Unavoidable Annual Real Losses (UARL)</p> <p>Find</p>	<p>UARL (gallons/day)=(5.41Lm + 0.15Nc + 7.5Lc) xP, or UARL (litres/day)=(18.0Lm + 0.8Nc + 25.0Lc) xP</p> <p>where: Lm = length of mains (miles or kilometres) Nc = number of customer service connections Lp = the average distance of customer service connection piping (feet or metres) (see the Worksheet "Service Connection Diagram" for guidance on deterring the value of Lp) Lc = total length of customer service connection piping (miles or km) Lc = Nc X Lp (miles or kilometres) P = Pressure (psi or metres)</p> <p>The UARL is a theoretical reference value representing the technical low limit of leakage that could be achieved if all of today's best technology could be successfully applied. It is a key variable in the calculation of the Infrastructure Leakage Index (ILI). Striving to reduce system leakage to a level close to the UARL is usually not needed unless the water supply is unusually expensive, scarce or both.</p> <p>NOTE: The UARL calculation has not yet been proven as fully valid for very small, or low pressure water distribution systems. If,</p> <p><u>in gallons per day:</u> (Lm x 32) + Nc < 3000 or P < 35psi</p> <p><u>in litres per day:</u> (Lm x 20) + Nc < 3000 or P < 25m</p> <p>then the calculated UARL value may not be valid. The software does not display a value of UARL or ILI if either of these conditions is true.</p>

Item Name	Description								
Unbilled Authorized Consumption	<p>All consumption that is unbilled, but still authorized by the utility. This includes Unbilled Metered Consumption + Unbilled Unmetered Consumption. See "Authorized Consumption" for more information. For Unbilled Unmetered Consumption, the Free Water Audit Software provides the auditor the option to select a default value if they have not audited unmetered activities in detail. The default calculates a volume that is 1.25% of the Water Supplied volume. If the auditor has carefully audited the various unbilled, unmetered, authorized uses of water, and has established reliable estimates of this collective volume, then he or she may enter the volume directly for this component, and not use the default value.</p>								
Unbilled metered consumption <input type="button" value="Find"/>	<p>Metered consumption which is authorized by the water utility, but, for any reason, is <u>deemed by utility policy</u> to be unbilled. This might for example include metered water consumed by the utility itself in treatment or distribution operations, or metered water provided to civic institutions free of charge. It does not include water supplied to neighboring utilities (water exported) which may be metered but not billed.</p>								
Unbilled unmetered consumption <input type="button" value="Find"/>	<p>Any kind of Authorized Consumption which is neither billed or metered. This component typically includes water used in activities such as fire fighting, flushing of water mains and sewers, street cleaning, fire flow tests conducted by the water utility, etc. In most water utilities it is a small component which is very often substantially overestimated. It does NOT include water supplied to neighboring utilities (water exported) which is unmetered and unbilled – an unlikely case. This component has many sub-components of water use which are often tedious to identify and quantify. Because of this, and the fact that it is usually a small portion of the water supplied, it is recommended that the auditor apply the default value, which is 1.25% of the Water Supplied volume. Select the default percentage to enter this value.</p> <p>If the water utility <u>has</u> carefully audited the unbilled, unmetered activities occurring in the system, and has well validated data that gives a value substantially higher or lower than the default volume, then the auditor should enter their own volume. However the default approach is recommended for most water utilities.</p> <p>Note that a value of zero is not permitted, since all water utilities have some volume of water in this component occurring in their system.</p>								
Units and Conversions	<p>The user may develop an audit based on one of three unit selections:</p> <ol style="list-style-type: none"> 1) Million Gallons (US) 2) Megalitres (Thousand Cubic Metres) 3) Acre-feet <p>Once this selection has been made in the instructions sheet, all calculations are made on the basis of the chosen units. Should the user wish to make additional conversions, a unit converter is provided below (use drop down menus to select units from the yellow unit boxes):</p> <div style="text-align: center;"> <table border="1" style="margin: auto;"> <tr> <td style="padding: 5px;">Enter Units:</td> <td style="padding: 5px;">Convert From...</td> <td style="padding: 5px;">=</td> <td style="padding: 5px;">Converts to.....</td> </tr> <tr> <td style="padding: 5px; text-align: center;">1</td> <td style="padding: 5px; text-align: center;">Million Gallons (US)</td> <td style="padding: 5px;"></td> <td style="padding: 5px; text-align: center;">3.06888329 Acre-feet</td> </tr> </table> <p>(conversion factor = 3.0688832897323)</p> </div>	Enter Units:	Convert From...	=	Converts to.....	1	Million Gallons (US)		3.06888329 Acre-feet
Enter Units:	Convert From...	=	Converts to.....						
1	Million Gallons (US)		3.06888329 Acre-feet						
Use of Option Buttons	<p>To use the default percent value choose this button</p> <p>To enter a value choose this button and enter the value in the cell to the right</p> <div style="text-align: center;">  </div> <p>NOTE: For Unbilled Unmetered Consumption, Unauthorized Consumption and Systematic Data Handling Errors, a recommended default value can be applied by selecting the Percent option. The default values are based on fixed percentages of Water Supplied or Billed Authorized Consumption and are recommended for use in this audit unless the auditor has well validated data for their system. Default values are shown by purple cells, as shown in the example above.</p> <p>If a default value is selected, the user does not need to grade the item; a grading value of 5 is automatically applied (however, this grade will not be displayed).</p>								
Variable production cost (applied to Real Losses) <input type="button" value="Find"/>	<p>The cost to produce and supply the next unit of water (e.g., \$/million gallons). This cost is determined by calculating the summed unit costs for ground and surface water treatment and all power used for pumping from the source to the customer. It may also include other miscellaneous unit costs that apply to the production of drinking water. It should also include the unit cost of bulk water purchased as an import if applicable.</p> <p>It is common to apply this unit cost to the volume of Real Losses. However, if water resources are strained and the ability to meet future drinking water demands is in question, then the water auditor can be justified in applying the Customer Retail Rate to the Real Loss volume, rather than applying the Variable Production Cost.</p> <p>The Free Water Audit Software applies the Variable Production costs to Real Losses by default. However, the auditor has the option on the Reporting Worksheet to select the Customer Retail Cost as the basis for the Real Loss cost evaluation if the auditor determines that this is warranted.</p>								
Volume from own sources <input type="button" value="Find"/>	<p>The volume of water withdrawn (abstracted) from water resources (rivers, lakes, streams, wells, etc) controlled by the water utility, and then treated for potable water distribution. Most water audits are compiled for utility retail water distribution systems, so this volume should reflect the amount of <u>treated</u> drinking water that entered the distribution system. Often the volume of water measured at the effluent of the treatment works is slightly less than the volume measured at the raw water source, since some of the water is used in the treatment process. Thus, it is useful if flows are metered at the effluent of the treatment works. If metering exists only at the raw water source, an adjustment for water used in the treatment process should be included to account for water consumed in treatment operations such as filter backwashing, basin flushing and cleaning, etc. If the audit is conducted for a wholesale water agency that sells untreated water, then this quantity reflects the measure of the raw water, typically metered at the source.</p>								

Item Name	Description
Volume from own sources: Master meter and supply error adjustment <input type="button" value="Find"/>	<p>An estimate or measure of the degree of inaccuracy that exists in the master (production) meters measuring the annual Volume from own Sources, and any error in the data trail that exists to collect, store and report the summary production data. This adjustment is a weighted average number that represents the collective error for all master meters for all days of the audit year and any errors identified in the data trail. Meter error can occur in different ways. A meter or meters may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Data error can occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of inaccuracy in master meters and data errors in archival systems are common; thus a value of zero should <u>not</u> be entered. Enter a negative percentage or value for metered data under-registration; or, enter a positive percentage or value for metered data over-registration.</p>
Water exported <input type="button" value="Find"/>	<p>The Water Exported volume is the bulk water conveyed and sold by the water utility to neighboring water systems that exists outside of their service area. Typically this water is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water utility that is selling the water: i.e. the exporter. If the water utility who is compiling the annual water audit sells bulk water in this manner, they are an exporter of water.</p> <p>Note: The Water Exported volume is sold to wholesale customers who are typically charged a wholesale rate that is different than retail rates charged to the retail customers existing within the service area. Many state regulatory agencies require that the Water Exported volume be reported to them as a quantity separate and distinct from the retail customer billed consumption. For these reasons - and others - the Water Exported volume is always quantified separately from Billed Authorized Consumption in the standard water audit. Be certain not to "double-count" this quantity by including it in both the Water Exported box and the Billed Metered Consumption box of the water audit Reporting Worksheet. This volume should be included only in the Water Exported box.</p>
Water exported: Master meter and supply error adjustment <input type="button" value="Find"/>	<p>An estimate or measure of the volume in which the Water Exported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived exported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of error in their metered data, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived data. Thus, a value of zero should <u>not</u> be entered. Enter a negative percentage or value for metered data under-registration; or enter a positive percentage or value for metered data over-registration. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. Corrections to data gaps or other errors found in the archived data should also be included as a portion of this meter error adjustment.</p>
Water imported <input type="button" value="Find"/>	<p>The Water Imported volume is the bulk water purchased to become part of the Water Supplied volume. Typically this is water purchased from a neighboring water utility or regional water authority, and is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water supplier selling the water to the utility conducting the water audit. The water supplier selling the bulk water usually charges the receiving utility based upon a wholesale water rate.</p>
Water imported: Master meter and supply error adjustment <input type="button" value="Find"/>	<p>An estimate or measure of the volume in which the Water Imported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived imported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some level of meter inaccuracy, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived metered data. Thus, a value of zero should <u>not</u> be entered. Enter a negative percentage or value for metered data under-registration; or, enter a positive percentage or value for metered data over-registration. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment.</p>
WATER LOSSES <input type="button" value="Find"/>	<p>= apparent losses + real losses</p> <p>Water Losses are the difference between Water Supplied and Authorized Consumption. Water losses can be considered as a total volume for the whole system, or for partial systems such as transmission systems, pressure zones or district metered areas (DMA); if one of these configurations are the basis of the water audit.</p>



AWWA Free Water Audit Software: Determining Water Loss Standing

WAS v5.0

American Water Works Association,
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Water Audit Report for: **Twain Harte Community Services District (CA5510005)**

Reporting Year: **2019** **1/2019 - 12/2019**

Data Validity Score: **52**

Water Loss Control Planning Guide

Functional Focus Area	Water Audit Data Validity Level / Score				
	Level I (0-25)	Level II (26-50)	Level III (51-70)	Level IV (71-90)	Level V (91-100)
Audit Data Collection	Launch auditing and loss control team; address production metering deficiencies	Analyze business process for customer metering and billing functions and water supply operations. Identify data gaps.	Establish/revise policies and procedures for data collection	Refine data collection practices and establish as routine business process	Annual water audit is a reliable gauge of year-to-year water efficiency standing
Short-term loss control	Research information on leak detection programs. Begin flowcharting analysis of customer billing system	Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc.	Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring	Refine, enhance or expand ongoing programs based upon economic justification	Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation
Long-term loss control		Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or Automatic Meter Reading (AMR) system.	Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process.	Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management	Continue incremental improvements in short-term and long-term loss control interventions
Target-setting			Establish long-term apparent and real loss reduction goals (+10 year horizon)	Establish mid-range (5 year horizon) apparent and real loss reduction goals	Evaluate and refine loss control goals on a yearly basis
Benchmarking			Preliminary Comparisons - can begin to rely upon the Infrastructure Leakage Index (ILI) for performance comparisons for real losses (see below table)	Performance Benchmarking - ILI is meaningful in comparing real loss standing	Identify Best Practices/ Best in class - the ILI is very reliable as a real loss performance indicator for best in class service

For validity scores of 50 or below, the shaded blocks should not be focus areas until better data validity is achieved.

Once data have been entered into the Reporting Worksheet, the performance indicators are automatically calculated. How does a water utility operator know how well his or her system is performing? The AWWA Water Loss Control Committee provided the following table to assist water utilities in gauging an approximate Infrastructure Leakage Index (ILI) that is appropriate for their water system and local conditions. The lower the amount of leakage and real losses that exist in the system, then the lower the ILI value will be.

Note: this table offers an approximate guideline for leakage reduction target-setting. The best means of setting such targets include performing an economic assessment of various loss control methods. However, this table is useful if such an assessment is not possible.

**General Guidelines for Setting a Target ILI
(without doing a full economic analysis of leakage control options)**

Target ILI Range	Financial Considerations	Operational Considerations	Water Resources Considerations
1.0 - 3.0	Water resources are costly to develop or purchase; ability to increase revenues via water rates is greatly limited because of regulation or low ratepayer affordability.	Operating with system leakage above this level would require expansion of existing infrastructure and/or additional water resources to meet the demand.	Available resources are greatly limited and are very difficult and/or environmentally unsound to develop.
>3.0 -5.0	Water resources can be developed or purchased at reasonable expense; periodic water rate increases can be feasibly imposed and are tolerated by the customer population.	Existing water supply infrastructure capability is sufficient to meet long-term demand as long as reasonable leakage management controls are in place.	Water resources are believed to be sufficient to meet long-term needs, but demand management interventions (leakage management, water conservation) are included in the long-term
>5.0 - 8.0	Cost to purchase or obtain/treat water is low, as are rates charged to customers.	Superior reliability, capacity and integrity of the water supply infrastructure make it relatively immune to supply shortages.	Water resources are plentiful, reliable, and easily extracted.
Greater than 8.0	Although operational and financial considerations may allow a long-term ILI greater than 8.0, such a level of leakage is not an effective utilization of water as a resource. Setting a target level greater than 8.0 - other than as an incremental goal to a smaller long-term target - is discouraged.		
Less than 1.0	If the calculated Infrastructure Leakage Index (ILI) value for your system is 1.0 or less, two possibilities exist. a) you are maintaining your leakage at low levels in a class with the top worldwide performers in leakage control. b) A portion of your data may be flawed, causing your losses to be greatly understated. This is likely if you calculate a low ILI value but do not employ extensive leakage control practices in your operations. In such cases it is beneficial to validate the data by performing field measurements to confirm the accuracy of production and customer meters, or to identify any other potential sources of error in the data.		



AWWA Water Audit Software Version 5.0 Developed by the Water Loss Control Committee of the American Water Works Association August, 2014

This software is intended to serve as a basic tool to compile a preliminary, or “top-down”, water audit. It is recommended that users also refer to the current edition of the AWWA M36 Publication, Water Audits and Loss Control Programs, for detailed guidance on compiling a comprehensive, or “bottom-up”, water audit using the same water audit methodology.

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REFERENCES: - Alegre, H., Hirner, W., Baptista, J. and Parena, R. Performance Indicators for Water Supply Services. IWA Publishing 'Manual of Best Practice' Series, 2000. ISBN 1 900222 272
- Kunkel, G. et al, 2003. Water Loss Control Committee Report: Applying Worldwide Best Management Practices in Water Loss Control. Journal AWWA, 95:8:65
- AWWA Water Audits and Loss Control Programs, M36 Publication, 3rd Edition, 2009
- Service Connection Diagrams courtesy of Ronnie McKenzie, WRP Pty Ltd.

VERSION HISTORY:

Version:	Release Date:	Number of Worksheets:	Key Features and Developments
v1	2005/ 2006	5	The AWWA Water Audit Software was piloted in 2005 (v1.0 beta). The early versions (1.x) of the software restricted data entry to units of Million Gallons per year. For each entry into the audit, users identified whether the input was measured or estimated.
v2	2006	5	The most significant enhancement in v2 of the software was to allow the user to choose the volumetric units to be used in the audit, Million Gallons or Thousand Cubic Metres (megalitres) per year. Two financial performance indicators were added to provide feedback to the user on the cost of Real and Apparent losses.
v3	2007	7	In v3, the option to report volumetric units in acre-feet was added. Another new feature in v3 was the inclusion of default values for two water audit components (unbilled unmetered and unauthorized consumption). v3 also included two examples of completed audits in units of million gallons and Megalitres. Several checks were added into v3 to provide instant feedback to the user on common data entry problems, in order to help the user complete an accurate water audit.
v4 - v4.2	2010	10	v4 (and versions 4.x) of the software included a new approach to data grading. The simple "estimated" or "measured" approach was replaced with a more granular scale (typically 1-10) that reflected descriptions of utility practices and served to describe the confidence and accuracy of the input data. Each input value had a corresponding scale fully described in the Grading Matrix tab. The Grading Matrix also showed the actions required to move to a higher grading score. Grading descriptions were available on the Reporting Worksheet via a pop-up box next to each water audit input. A water audit data validity score is generated (max = 100) and priority areas for attention (to improve audit accuracy) are identified, once a user completes the required data grading. A service connection diagram was also added to help users understand the impact of customer service line configurations on water losses and how this information should be entered into the water audit software. An acknowledgements section was also added. Minor bug fixes resulted in the release of versions 4.1 and 4.2. A French language version was also made available for v4.2.
v5	2014	12	In v5, changes were made to the way Water Supplied information is entered into software, with each major component having a corresponding Master Meter Error Adjustment entry (and data grading requirement). This required changes to the data validity score calculation; v5 of the software uses a weighting system that is, in part, proportional to the volume of input components. The Grading Matrix was updated to reflect the new audit inputs and also to include clarifications and additions to the scale descriptions. The appearance of the software was updated in v5 to make the software more user-friendly and several new features were added to provide more feedback to the user. Notably, a dashboard tab has been added to provide more visual feedback on the water audit results and associated costs of Non-Revenue Water. A comments sheet was added to allow the user to track notes, comments and to cite sources used.

Attachment B

AWWA Water Loss Audit 2020

AWWA Free Water Audit Software v5.0

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This spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water distribution systems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format, and is not meant to take the place of a full-scale, comprehensive water audit format.

Auditors are strongly encouraged to refer to the most current edition of AWWA M36 Manual for Water Audits for detailed guidance on the water auditing process and targetting loss reduction levels

The spreadsheet contains several separate worksheets. Sheets can be accessed using the tabs towards the bottom of the screen, or by clicking the buttons below.

Please begin by providing the following information

Name of Contact Person:

Email Address:

Telephone (incl Ext.):

Name of City / Utility:

City/Town/Municipality:

State / Province:

Country:

Year:

Start Date: Enter MM/YYYY numeric format

End Date: Enter MM/YYYY numeric format

Audit Preparation Date:

Volume Reporting Units:

PWSID / Other ID:

The following guidance will help you complete the Audit

All audit data are entered on the [Reporting Worksheet](#)

- -
 -
- Value can be entered by user
 Value calculated based on input data
 These cells contain recommended default values

Use of Option (Radio) Buttons: Pcnt: Value:

Select the default percentage by choosing the option button

To enter a value, choose this button and enter a value in the cell to the right

The following worksheets are available by clicking the buttons below or selecting the tabs along the bottom of the page

<p><u>Instructions</u></p> <p>The current sheet. Enter contact information and basic audit details (year, units etc)</p>	<p><u>Reporting Worksheet</u></p> <p>Enter the required data on this worksheet to calculate the water balance and data grading</p>	<p><u>Comments</u></p> <p>Enter comments to explain how values were calculated or to document data sources</p>	<p><u>Performance Indicators</u></p> <p>Review the performance indicators to evaluate the results of the audit</p>	<p><u>Water Balance</u></p> <p>The values entered in the Reporting Worksheet are used to populate the Water Balance</p>	<p><u>Dashboard</u></p> <p>A graphical summary of the water balance and Non-Revenue Water components</p>
<p><u>Grading Matrix</u></p> <p>Presents the possible grading options for each input component of the audit</p>	<p><u>Service Connection Diagram</u></p> <p>Diagrams depicting possible customer service connection line configurations</p>	<p><u>Definitions</u></p> <p>Use this sheet to understand the terms used in the audit process</p>	<p><u>Loss Control Planning</u></p> <p>Use this sheet to interpret the results of the audit validity score and performance indicators</p>	<p><u>Example Audits</u></p> <p>Reporting Worksheet and Performance Indicators examples are shown for two validated audits</p>	<p><u>Acknowledgements</u></p> <p>Acknowledgements for the AWWA Free Water Audit Software v5.0</p>

If you have questions or comments regarding the software please contact us via email at: wlc@awwa.org



AWWA Free Water Audit Software: Reporting Worksheet

WAS v5.0
American Water Works Association

? [Click to access definition](#)
+ [Click to add a comment](#)

Water Audit Report for: Twain Harte Community Services District (CA5510005)
Reporting Year: 2020 1/2020 - 12/2020

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input

All volumes to be entered as: MILLION GALLONS (US) PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

WATER SUPPLIED

----- Enter grading in column 'E' and 'J' ----->

Volume from own sources:	+ ?	5	82.033	MG/Yr	+ ?
Water imported:	+ ?	n/a	0.000	MG/Yr	+ ?
Water exported:	+ ?	5	2.315	MG/Yr	+ ?

Master Meter and Supply Error Adjustments

Pcnt:	Value:
<input type="radio"/> () <input checked="" type="radio"/> () <input type="radio"/> ()	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>
Enter negative % or value for under-registration Enter positive % or value for over-registration	

WATER SUPPLIED: 79.718 MG/Yr

AUTHORIZED CONSUMPTION

Billed metered:	+ ?	5	61.479	MG/Yr
Billed unmetered:	+ ?	n/a	0.000	MG/Yr
Unbilled metered:	+ ?	8	0.004	MG/Yr
Unbilled unmetered:	+ ?	4	0.549	MG/Yr

Click here: ?
for help using option

Pcnt:	Value:
<input type="radio"/> () <input checked="" type="radio"/> () <input type="radio"/> ()	<input type="text" value="0.549"/> <input type="text" value=""/>

Use buttons to select percentage of water supplied
OR
value

AUTHORIZED CONSUMPTION: 62.032 MG/Yr

WATER LOSSES (Water Supplied - Authorized Consumption)

17.687 MG/Yr

Apparent Losses

Unauthorized consumption: 0.199 MG/Yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

Customer metering inaccuracies:	+ ?	1	0.000	MG/Yr
Systematic data handling errors:	+ ?	7	0.154	MG/Yr

Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed

Apparent Losses: 0.353 MG/Yr

Pcnt:	Value:
<input type="radio"/> () <input checked="" type="radio"/> () <input type="radio"/> ()	<input type="text" value="0.25%"/> <input type="text" value=""/>

0.00%	<input checked="" type="radio"/> () <input type="radio"/> ()
0.25%	<input checked="" type="radio"/> () <input type="radio"/> ()

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: 17.334 MG/Yr

WATER LOSSES: 17.687 MG/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 18.239 MG/Yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	+ ?	4	30.0	miles
Number of <u>active</u> AND <u>inactive</u> service connections:	+ ?	8	1,582	
Service connection density:	?		53	conn./mile main

Are customer meters typically located at the curbside or property line? No (length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line: 2 28.0 ft

Average operating pressure: + ? 3 80.0 psi

COST DATA

Total annual cost of operating water system:	+ ?	10	\$1,282,744	\$/Year
Customer retail unit cost (applied to Apparent Losses):	+ ?	8	\$2.80	\$/1000 gallons (US)
Variable production cost (applied to Real Losses):	+ ?	1	\$2.80	\$/Million gallons <input checked="" type="checkbox"/> Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 52 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources

2: Customer metering inaccuracies

3: Variable production cost (applied to Real Losses)



AWWA Free Water Audit Software: System Attributes and Performance Indicators

WAS v5.0
American Water Works Association.

Water Audit Report for: **Twain Harte Community Services District (CA5510005)**

Reporting Year: **2020** **1/2020 - 12/2020**

***** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 52 out of 100 *****

System Attributes:

	Apparent Losses:	0.353	MG/Yr
	+ Real Losses:	17.334	MG/Yr
	= Water Losses:	17.687	MG/Yr

? Unavoidable Annual Real Losses (UARL): **See limits in definition** MG/Yr

Annual cost of Apparent Losses: **\$988**

Annual cost of Real Losses: **\$48,534** Valued at **Customer Retail Unit Cost**
Return to Reporting Worksheet to change this assumption

Performance Indicators:

Financial: {

Non-revenue water as percent by volume of Water Supplied:	22.9%	
Non-revenue water as percent by cost of operating system:	4.0%	Real Losses valued at Customer Retail Unit Cost

Operational {

Apparent Losses per service connection per day:	0.61	gallons/connection/day
Real Losses per service connection per day:	30.02	gallons/connection/day
Real Losses per length of main per day*:	N/A	
Real Losses per service connection per day per psi pressure:	0.38	gallons/connection/day/psi

From Above, Real Losses = Current Annual Real Losses (CARL): **17.33** million gallons/year

? Infrastructure Leakage Index (ILI) [CARL/UARL]:

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline



AWWA Free Water Audit Software: User Comments

WAS
American Water Works Association.

Use this worksheet to add comments or notes to explain how an input value was calculated, or to document the sources of the information used.

General Comment:	
-------------------------	--

Audit Item	Comment
Volume from own sources:	100% of production water is metered (from both the SWTP and the wells). Production meters are calibrated every 5 years instead of annually (marked as occasionally). To get a score above a 5, production meters must be calibrated annually.
Vol. from own sources: Master meter error adjustment:	This volume (82.033MG) was taken from the 2020 EIR pp. 5/16. Using the District supplied water production meter data, the total volume was found to be 81.820MG and losses from flushing, sampling, etc was found to be 0.549MG.
Water imported:	Assumed 0% for this. The effluent Cadillac meter calibration data (dated 2/28/2019) received ranged from -2.44% to 1.01% error.
Water imported: master meter error adjustment:	No water imported this year per 2020 EIR
Water exported:	NA
Water exported: master meter error adjustment:	NA
Billed metered:	Obtained from 2020 EIR pp. 5/16. Score assumed to be the same as Volume from own sources - 100% metered and meters calibrated every 5 years.
Billed unmetered:	Same as above
Unbilled metered:	Data obtained from Customer Consumption spreadsheet. Values match the 2020 monthly customer data except for the month of April which is off by 15,349 gal. All meters are upgraded types which allow wireless communication. They have 99.7 to 99.9% read rate success. There is no meter challenge testing conducted and the meters are 10+ years old. Scoring above a 5 requires meter challenge testing
Unbilled unmetered:	No billed unmetered
Unbilled metered:	Use by the Fire suppression force is metered. The accounts total to under 10,000 gallons across the year and are insignificant.
Unbilled unmetered:	Estimated sampling volumes, flushing, and other losses in the treatment facility. Not metered, logged as estimates

Audit Item	Comment
Unauthorized consumption:	Default percentage used. Unauthorized consumption amounts are unknown (and likely small or zero from communications with the district).
Customer metering inaccuracies:	Challenge testing is not conducted on the customer meters. 0% was assumed for the inaccuracies because of this. District installs new ones as the old ones cease to function. Current meters are approx 11-12 years old.
Systematic data handling errors:	Per communications with the District.
Length of mains:	Used GIS data which is not accurate. Data is based off of as-builts from the original construction of the system and was not kept up-to-date as new assets were put in. Many of the assets are not field validated and there is error in pipe lengths and distances between valves throughout the system.
Number of active AND inactive service connections:	Obtained from EAR report 2020. District has good accounting for the metering in the area. Unlikely that they are off by many connections (if any). However, the monthly customer data that was used had 1674 billing codes, nearly 100 more than the number of service connections. This is something for the District to look at.
Average length of customer service line:	Used GIS data for all customer service lines in the District. Again, primarily based off as-builts. GIS data has discrepancies when out in the field
Average operating pressure:	Estimated based on TM from previous Twain Harte system modeling project. Pressures vary between 20 and 165psi. 80 is an estimate
Total annual cost of operating water system:	Costs audited yearly by CPA. Data was pulled from FY 2020 report pp 19. Line item "Total Operating Expenses" under the water column.
Customer retail unit cost (applied to Apparent Losses):	Per Resolution #16-04, the rate for FY19-20 is \$2.38, however the fiscal year ends in mid July. Two tier rate structure, the low tier is \$2.38 and the high tier is \$3.74. For this analysis the weighted average cost was calculated based on excess water usage over 2000gal (the differentiation point between the high and low tier structure) per customer meter per month. Likely very accurate since the District requires reviews every 5 years to be eligible for grant funding.
Variable production cost (applied to Real Losses):	Unknown, conservative assumption. Specific operational costs do not seem to be well recorded.



AWWA Free Water Audit Software: Water Balance

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Water Audit Report for:	Twain Harte Community Services District (CA5510005)	
Reporting Year:	2020	1/2020 - 12/2020
Data Validity Score:	52	

Own Sources (Adjusted for known errors) 82.033	Water Exported 2.315	Billed Water Exported				
	Authorized Consumption 62.032	Billed Authorized Consumption 61.479	Billed Metered Consumption (water exported is removed) 61.479		Revenue Water 61.479	
Unbilled Authorized Consumption 0.553		Billed Unmetered Consumption 0.000				
Water Supplied 79.718	Water Losses 17.687	Apparent Losses 0.353		Non-Revenue Water (NRW) 18.239		
		Unauthorized Consumption 0.199				
		Customer Metering Inaccuracies 0.000				
		Systematic Data Handling Errors 0.154				
Water Imported 0.000		Real Losses 17.334		Leakage on Transmission and/or Distribution Mains <i>Not broken down</i>		
				Leakage and Overflows at Utility's Storage Tanks <i>Not broken down</i>		
				Leakage on Service Connections <i>Not broken down</i>		



AWWA Free Water Audit Software: Dashboard

WAS v5.0
American Water Works Association.

The graphic below is a visual representation of the Water Balance with bar heights proportional to the volume of the audit components

Water Audit Report for: **Twain Harte Community Services District (CA5510005)**

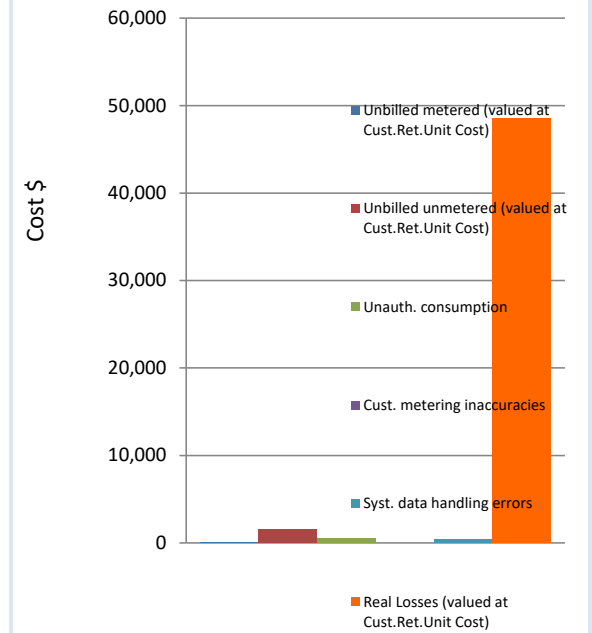
Reporting Year: **2020** **1/2020 - 12/2020**

Data Validity Score: **52**

- Show me the VOLUME of Non-Revenue Water
- Show me the COST of Non-Revenue Water



Total Cost of NRW = \$51,070





AWWA Free Water Audit Software: Grading Matrix

WAS
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The grading assigned to each audit component and the corresponding recommended improvements and actions are highlighted in yellow. Audit accuracy is likely to be improved by prioritizing those items shown in red

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
WATER SUPPLIED											
Volume from own sources:	Select this grading only if the water utility purchases/imports all of its water resources (i.e. has no sources of its own)	Less than 25% of water production sources are metered, remaining sources are estimated. No regular meter accuracy testing or electronic calibration conducted.	25% - 50% of treated water production sources are metered; other sources estimated. No regular meter accuracy testing or electronic calibration conducted.	Conditions between 2 and 4	50% - 75% of treated water production sources are metered, other sources estimated. Occasional meter accuracy testing or electronic calibration conducted.	Conditions between 4 and 6	At least 75% of treated water production sources are metered, <u>or</u> at least 90% of the source flow is derived from metered sources. Meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually. Less than 25% of tested meters are found outside of +/- 6% accuracy.	Conditions between 6 and 8	100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy	Conditions between 8 and 10	100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually, with less than 10% found outside of +/- 3% accuracy. Procedures are reviewed by a third party knowledgeable in the M36 methodology.
Improvements to attain higher data grading for "Volume from own Sources" component:		<u>to qualify for 2:</u> Organize and launch efforts to collect data for determining volume from own sources	<u>to qualify for 4:</u> Locate all water production sources on maps and in the field, launch meter accuracy testing for existing meters, begin to install meters on unmetered water production sources and replace any obsolete/defective meters.		<u>to qualify for 6:</u> Formalize annual meter accuracy testing for all source meters; specify the frequency of testing. Complete installation of meters on unmetered water production sources and complete replacement of all obsolete/defective meters.		<u>to qualify for 8:</u> Conduct annual meter accuracy testing and calibration of related instrumentation on all meter installations on a regular basis. Complete project to install new, or replace defective existing, meters so that entire production meter population is metered. Repair or replace meters outside of +/- 6% accuracy.		<u>to qualify for 10:</u> Maintain annual meter accuracy testing and calibration of related instrumentation for all meter installations. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to further improve meter accuracy.		<u>to maintain 10:</u> Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology.
Volume from own sources master meter and supply error adjustment:	Select n/a only if the water utility fails to have meters on its sources of supply	Inventory information on meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined	No automatic datalogging of production volumes; daily readings are scribed on paper records without any accountability controls. Flows are not balanced across the water distribution system; tank/storage elevation changes are not employed in calculating the "Volume from own sources" component and archived flow data is adjusted only when grossly evident data error occurs.	Conditions between 2 and 4	Production meter data is logged automatically in electronic format and reviewed at least on a monthly basis with necessary corrections implemented. "Volume from own sources" tabulations include estimate of daily changes in tanks/storage facilities. Meter data is adjusted when gross data errors occur, or occasional meter testing deems this necessary.	Conditions between 4 and 6	Hourly production meter data logged automatically & reviewed on at least a weekly basis. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and/or error is confirmed by meter accuracy testing. Tank/storage facility elevation changes are automatically used in calculating a balanced "Volume from own sources" component, and data gaps in the archived data are corrected on at least a weekly basis.	Conditions between 6 and 8	Continuous production meter data is logged automatically & reviewed each business day. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and/or results of meter accuracy testing. Tank/storage facility elevation changes are automatically used in "Volume from own sources" tabulations and data gaps in the archived data are corrected on a daily basis.	Conditions between 8 and 10	Computerized system (SCADA or similar) automatically balances flows from all sources and storages; results are reviewed each business day. Tight accountability controls ensure that all data gaps that occur in the archived flow data are quickly detected and corrected. Regular calibrations between SCADA and sources meters ensures minimal data transfer error.
Improvements to attain higher data grading for "Master meter and supply error adjustment" component:		<u>to qualify for 2:</u> Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature.	<u>to qualify for 4:</u> Install automatic datalogging equipment on production meters. Complete installation of level instrumentation at all tanks/storage facilities and include tank level data in automatic calculation routine in a computerized system. Construct a computerized listing or spreadsheet to archive input volumes, tank/storage volume changes and import/export flows in order to determine the composite "Water Supplied" volume for the distribution system. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps.		<u>to qualify for 6:</u> Refine computerized data collection and archive to include hourly production meter data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Use daily net storage change to balance flows in calculating "Water Supplied" volume. Necessary corrections to data errors are implemented on a weekly basis.		<u>to qualify for 8:</u> Ensure that all flow data is collected and archived on at least an hourly basis. All data is reviewed and detected errors corrected each business day. Tank/storage levels variations are employed in calculating balanced "Water Supplied" component. Adjust production meter data for gross error and inaccuracy confirmed by testing.		<u>to qualify for 10:</u> Link all production and tank/storage facility elevation change data to a Supervisory Control & Data Acquisition (SCADA) System, or similar computerized monitoring/control system, and establish automatic flow balancing algorithm and regularly calibrate between SCADA and source meters. Data is reviewed and corrected each business day.		<u>to maintain 10:</u> Monitor meter innovations for development of more accurate and less expensive flowmeters. Continue to replace or repair meters as they perform outside of desired accuracy limits. Stay abreast of new and more accurate water level instruments to better record tank/storage levels and archive the variations in storage volume. Keep current with SCADA and data management systems to ensure that archived data is well-managed and error free.
Water Imported:	Select n/a if the water utility's supply is exclusively from its own water resources (no bulk purchased/ imported water)	Less than 25% of imported water sources are metered, remaining sources are estimated. No regular meter accuracy testing.	25% - 50% of imported water sources are metered; other sources estimated. No regular meter accuracy testing.	Conditions between 2 and 4	50% - 75% of imported water sources are metered, other sources estimated. Occasional meter accuracy testing conducted.	Conditions between 4 and 6	At least 75% of imported water sources are metered, meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually for all meter installations. Less than 25% of tested meters are found outside of +/- 6% accuracy.	Conditions between 6 and 8	100% of imported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy	Conditions between 8 and 10	100% of imported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually for all meter installations, with less than 10% of accuracy tests found outside of +/- 3% accuracy.
Improvements to attain higher data grading for "Water Imported Volume" component: <i>(Note: usually the water supplier selling the water - "the Exporter" - to the utility being audited is responsible to maintain the metering installation measuring the imported volume. The utility should coordinate carefully with the Exporter to ensure that adequate meter upkeep takes place and an accurate measure of the Water Imported volume is quantified.)</i>		<u>to qualify for 2:</u> Review bulk water purchase agreements with partner suppliers; confirm requirements for use and maintenance of accurate metering. Identify needs for new or replacement meters with goal to meter all imported water sources.	<u>To qualify for 4:</u> Locate all imported water sources on maps and in the field, launch meter accuracy testing for existing meters, begin to install meters on unmetered imported water interconnections and replace obsolete/defective meters.		<u>to qualify for 6:</u> Formalize annual meter accuracy testing for all imported water meters, planning for both regular meter accuracy testing and calibration of the related instrumentation. Continue installation of meters on unmetered imported water interconnections and replacement of obsolete/defective meters.		<u>to qualify for 8:</u> Complete project to install new, or replace defective, meters on all imported water interconnections. Maintain annual meter accuracy testing for all imported water meters and conduct calibration of related instrumentation at least annually. Repair or replace meters outside of +/- 6% accuracy.		<u>to qualify for 10:</u> Conduct meter accuracy testing for all meters on a semi-annual basis, along with calibration of all related instrumentation. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to improve meter accuracy.		<u>to maintain 10:</u> Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Continue to conduct calibration of related instrumentation on a semi-annual basis. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology.

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Water imported master meter and supply error adjustment:	Select n/a if the Imported water supply is unmetered, with Imported water quantities estimated on the billing invoices sent by the Exporter to the purchasing Utility.	Inventory information on imported meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined. Written agreement(s) with water Exporter(s) are missing or written in vague language concerning meter management and testing.	No automatic datalogging of imported supply volumes; daily records without any accountability controls to confirm data accuracy and the absence of errors and data gaps in recorded volumes. Written agreement requires meter accuracy testing but is vague on the details of how and who conducts the testing.	Conditions between 2 and 4	Imported supply metered flow data is logged automatically in electronic format and reviewed at least on a monthly basis by the Exporter with necessary corrections implemented. Meter data is adjusted by the Exporter when gross data errors are detected. A coherent data trail exists for this process to protect both the selling and the purchasing Utility. Written agreement exists and clearly states requirements and roles for meter accuracy testing and data management.	Conditions between 4 and 6	Hourly Imported supply metered data is logged automatically & reviewed on at least a weekly basis by the Exporter. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and to correct for error confirmed by meter accuracy testing. Any data gaps in the archived data are detected and corrected during the weekly review. A coherent data trail exists for this process to protect both the selling and the purchasing Utility.	Conditions between 6 and 8	Continuous Imported supply metered flow data is logged automatically & reviewed each business day by the Importer. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and/or results of meter accuracy testing. Any data errors/gaps are detected and corrected on a daily basis. A data trail exists for the process to protect both the selling and the purchasing Utility.	Conditions between 8 and 10	Computerized system (SCADA or similar) automatically records data which is reviewed each business day by the Exporter. Tight accountability controls ensure that all error/data gaps that occur in the archived flow data are quickly detected and corrected. A reliable data trail exists and contract provisions for meter testing and data management are reviewed by the selling and purchasing Utility at least once every five years.
Improvements to attain higher data grading for "Water imported master meter and supply error adjustment" component:		<u>to qualify for 2:</u> Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature. Review the written agreement between the selling and purchasing Utility.	<u>to qualify for 4:</u> Install automatic datalogging equipment on Imported supply meters. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps. Launch discussions with the Exporters to jointly review terms of the written agreements regarding meter accuracy testing and data management; revise the terms as necessary.		<u>to qualify for 6:</u> Refine computerized data collection and archive to include hourly Imported supply metered flow data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Make necessary corrections to errors/data errors on a weekly basis.		<u>to qualify for 8:</u> Ensure that all Imported supply metered flow data is collected and archived on at least an hourly basis. All data is reviewed and errors/data gaps are corrected each business day.		<u>to qualify for 10:</u> Conduct accountability checks to confirm that all Imported supply metered data is reviewed and corrected each business day by the Exporter. Results of all meter accuracy tests and data corrections should be available for sharing between the Exporter and the purchasing Utility. Establish a schedule for a regular review and updating of the contractual language in the written agreement between the selling and the purchasing Utility, at least every five years.		<u>to maintain 10:</u> Monitor meter innovations for development of more accurate and less expensive flowmeters; work with the Exporter to help identify meter replacement needs. Keep communication lines with Exporters open and maintain productive relations. Keep the written agreement current with clear and explicit language that meets the ongoing needs of all parties.
Water Exported:	Select n/a if the water utility sells no bulk water to neighboring water utilities (no exported water sales)	Less than 25% of exported water sources are metered, remaining sources are estimated. No regular meter accuracy testing.	25% - 50% of exported water sources are metered; other sources estimated. No regular meter accuracy testing.	Conditions between 2 and 4	50% - 75% of exported water sources are metered, other sources estimated. Occasional meter accuracy testing conducted.	Conditions between 4 and 6	At least 75% of exported water sources are metered, meter accuracy testing and/or electronic calibration conducted annually. Less than 25% of tested meters are found outside of +/- 6% accuracy.	Conditions between 6 and 8	100% of exported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy	Conditions between 8 and 10	100% of exported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually for all meter installations, with less than 10% of accuracy tests found outside of +/- 3% accuracy.
Improvements to attain higher data grading for "Water Exported Volume" component: (Note: usually, if the water utility being audited sells (Exports) water to a neighboring purchasing Utility, it is the responsibility of the utility exporting the water to maintain the metering installation measuring the Exported volume. The utility exporting the water should ensure that adequate meter upkeep takes place and an accurate measure of the Water Exported volume is quantified.)		<u>to qualify for 2:</u> Review bulk water sales agreements with purchasing utilities; confirm requirements for use & upkeep of accurate metering. Identify needs to install new, or replace defective meters as needed.	<u>To qualify for 4:</u> Locate all exported water sources on maps and in field, launch meter accuracy testing for existing meters, begin to install meters on unmetered exported water interconnections and replace obsolete/defective meters		<u>to qualify for 6:</u> Formalize annual meter accuracy testing for all exported water meters. Continue installation of meters on unmetered exported water interconnections and replacement of obsolete/defective meters.		<u>to qualify for 8:</u> Complete project to install new, or replace defective, meters on all exported water interconnections. Maintain annual meter accuracy testing for all exported water meters. Repair or replace meters outside of +/- 6% accuracy.		<u>to qualify for 10:</u> Maintain annual meter accuracy testing for all meters. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to improve meter accuracy.		<u>to maintain 10:</u> Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology.
Water exported master meter and supply error adjustment:	Select n/a only if the water utility fails to have meters on its exported supply interconnections.	Inventory information on exported meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined. Written agreement(s) with the utility purchasing the water are missing or written in vague language concerning meter management and testing.	No automatic datalogging of exported supply volumes; daily readings are scribed on paper records without any accountability controls to confirm data accuracy and the absence of errors and data gaps in recorded volumes. Written agreement requires meter accuracy testing but is vague on the details of how and who conducts the testing.	Conditions between 2 and 4	Exported metered flow data is logged automatically in electronic format and reviewed at least on a monthly basis, with necessary corrections implemented. Meter data is adjusted by the utility selling (exporting) the water when gross data errors are detected. A coherent data trail exists for this process to protect both the utility exporting the water and the purchasing Utility. Written agreement exists and clearly states requirements and roles for meter accuracy testing and data management.	Conditions between 4 and 6	Hourly exported supply metered data is logged automatically & reviewed on at least a weekly basis by the utility selling the water. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and to correct for error found by meter accuracy testing. Any data gaps in the archived data are detected and corrected during the weekly review. A coherent data trail exists for this process to protect both the selling (exporting) utility and the purchasing Utility.	Conditions between 6 and 8	Continuous exported supply metered flow data is logged automatically & reviewed each business day by the utility selling (exporting) the water. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and any error confirmed by meter accuracy testing. Any data errors/gaps are detected and corrected on a daily basis. A data trail exists for the process to protect both the selling (exporting) Utility and the purchasing Utility.	Conditions between 8 and 10	Computerized system (SCADA or similar) automatically records data which is reviewed each business day by the utility selling (exporting) the water. Tight accountability controls ensure that all error/data gaps that occur in the archived flow data are quickly detected and corrected. A reliable data trail exists and contract provisions for meter testing and data management are reviewed by the selling Utility and purchasing Utility at least once every five years.

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Improvements to attain higher data grading for "Water exported master meter and supply error adjustment" component.		<p><u>to qualify for 2:</u> Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature. Review the written agreement between the utility selling (exporting) the water and the purchasing Utility.</p>	<p><u>to qualify for 4:</u> Install automatic datalogging equipment on exported supply meters. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps. Launch discussions with the purchasing utilities to jointly review terms of the written agreements regarding meter accuracy testing and data management; revise the terms as necessary.</p>		<p><u>to qualify for 6:</u> Refine computerized data collection and archive to include hourly exported supply metered flow data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Make necessary corrections to errors/data errors on a weekly basis.</p>		<p><u>to qualify for 8:</u> Ensure that all exported metered flow data is collected and archived on at least an hourly basis. All data is reviewed and errors/data gaps are corrected each business day.</p>		<p><u>to qualify for 10:</u> Conduct accountability checks to confirm that all exported metered flow data is reviewed and corrected each business day by the utility selling the water. Results of all meter accuracy tests and data corrections should be available for sharing between the utility and the purchasing Utility. Establish a schedule for a regular review and updating of the contractual language in the written agreements with the purchasing utilities, at least every five years.</p>		<p><u>to maintain 10:</u> Monitor meter innovations for development of more accurate and less expensive flowmeters; work with the purchasing utilities to help identify meter replacement needs. Keep communication lines with the purchasing utilities open and maintain productive relations. Keep the written agreement current with clear and explicit language that meets the ongoing needs of all parties.</p>
AUTHORIZED CONSUMPTION											
Billed metered:	n/a (not applicable). Select n/a only if the entire customer population is not metered and is billed for water service on a flat or fixed rate basis. In such a case the volume entered must be zero.	Less than 50% of customers with volume-based billings from meter readings; flat or fixed rate billing exists for the majority of the customer population	At least 50% of customers with volume-based billing from meter reads; flat rate billing for others. Manual meter reading is conducted with less than 50% meter read success rate, remaining accounts' consumption is estimated. Limited meter records; no regular meter testing or replacement. Billing data maintained on paper records, with no auditing.	Conditions between 2 and 4	At least 75% of customers with volume-based, billing from meter reads; flat or fixed rate billing for remaining accounts. Manual meter reading is conducted with at least 50% meter read success rate; consumption for accounts with failed reads is estimated. Purchase records verify age of customer meters; only very limited meter accuracy testing is conducted. Customer meters are replaced only upon complete failure. Computerized billing records exist, but only sporadic internal auditing conducted.	Conditions between 4 and 6	At least 90% of customers with volume-based billing from meter reads; consumption for remaining accounts is estimated. Manual customer meter reading gives at least 80% customer meter reading success rate; consumption for accounts with failed reads is estimated. Good customer meter records exist, but only limited meter accuracy testing is conducted. Regular replacement is conducted for the oldest meters. Computerized billing records exist with annual auditing of summary statistics conducted by utility personnel.	Conditions between 6 and 8	At least 97% of customers exist with volume-based billing from meter reads. At least 90% customer meter reading success rate; at least 80% read success rate with planning and budgeting for trials of Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) in one or more pilot areas. Good customer meter records. Regular meter accuracy testing guides replacement of statistically significant number of meters each year. Routine auditing of computerized billing records for global and detailed statistics occurs annually by utility personnel, and is verified by third party at least once every five years.	Conditions between 8 and 10	At least 99% of customers exist with volume-based billing from meter reads. At least 95% customer meter reading success rate; with Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) trials underway. Statistically significant customer meter testing and replacement program in place on a continuous basis. Computerized billing with routine, detailed auditing, including field investigation of representative sample of accounts undertaken annually by utility personnel. Audit is conducted by third party auditors at least once every three years.
Improvements to attain higher data grading for "Billed Metered Consumption" component.	If n/a is selected because the customer meter population is unmetered, consider establishing a new policy to meter the customer population and employ water rates based upon metered volumes.	<p><u>to qualify for 2:</u> Conduct investigations or trials of customer meters to select appropriate meter models. Budget funding for meter installations. Investigate volume based water rate structures.</p>	<p><u>to qualify for 4:</u> Purchase and install meters on unmetered accounts. Implement policies to improve meter reading success. Catalog meter information during meter read visits to identify age/model of existing meters. Test a minimal number of meters for accuracy. Install computerized billing system.</p>		<p><u>to qualify for 6:</u> Purchase and install meters on unmetered accounts. Eliminate flat fee billing and establish appropriate water rate structure based upon measured consumption. Continue to achieve verified success in removing manual meter reading barriers. Expand meter accuracy testing. Launch regular meter replacement program. Launch a program of annual auditing of global billing statistics by utility personnel.</p>		<p><u>to qualify for 8:</u> Purchase and install meters on unmetered accounts. If customer meter reading success rate is less than 97%, assess cost-effectiveness of Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) system for portion or entire system; or otherwise achieve ongoing improvements in manual meter reading success rate to 97% or higher. Refine meter accuracy testing program. Set meter replacement goals based upon accuracy test results. Implement annual auditing of detailed billing records by utility personnel and implement third party auditing at least once every five years.</p>		<p><u>to qualify for 10:</u> Purchase and install meters on unmetered accounts. Launch Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) system trials if manual meter reading success rate of at least 99% is not achieved within a five-year program. Continue meter accuracy testing program. Conduct planning and budgeting for large scale meter replacement based upon meter life cycle analysis using cumulative flow target. Continue annual detailed billing data auditing by utility personnel and conduct third party auditing at least once every three years.</p>		<p><u>to maintain 10:</u> Continue annual internal billing data auditing, and third party auditing at least every three years. Continue customer meter accuracy testing to ensure that accurate customer meter readings are obtained and entered as the basis for volume based billing. Stay abreast of improvements in Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) and information management. Plan and budget for justified upgrades in metering, meter reading and billing data management to maintain very high accuracy in customer metering and billing.</p>
Billed unmetered:	Select n/a if it is the policy of the water utility to meter all customer connections and it has been confirmed by detailed auditing that all customers do indeed have a water meter; i.e. no intentionally unmetered accounts exist	Water utility policy does not require customer metering; flat or fixed fee billing is employed. No data is collected on customer consumption. The only estimates of customer population consumption available are derived from data estimation methods using average fixture count multiplied by number of connections, or similar approach.	Water utility policy does not require customer metering; flat or fixed fee billing is employed. Some metered accounts exist in parts of the system (pilot areas or District Metered Areas) with consumption read periodically or recorded on portable dataloggers over one, three, or seven day periods. Data from these sample meters are used to infer consumption for the total customer population. Site specific estimation methods are used for unusual buildings/water uses.	Conditions between 2 and 4	Water utility policy does require metering and volume based billing in general. However, a liberal amount of exemptions and a lack of clearly written and communicated procedures result in up to 20% of billed accounts believed to be unmetered by exemption; or the water utility is in transition to becoming fully metered, and a large number of customers remain unmetered. A rough estimate of the annual consumption for all unmetered accounts is included in the annual water audit, with no inspection of individual unmetered accounts.	Conditions between 4 and 6	Water utility policy does require metering and volume based billing but established exemptions exist for a portion of accounts such as municipal buildings. As many as 15% of billed accounts are unmetered due to this exemption or meter installation difficulties. Only a group estimate of annual consumption for all unmetered accounts is included in the annual water audit, with no inspection of individual unmetered accounts.	Conditions between 6 and 8	Water utility policy does require metering and volume based billing for all customer accounts. However, less than 5% of billed accounts remain unmetered because meter installation is hindered by unusual circumstances. The goal is to minimize the number of unmetered accounts. Reliable estimates of consumption are obtained for these unmetered accounts via site specific estimation methods.	Conditions between 8 and 10	Water utility policy does require metering and volume based billing for all customer accounts. Less than 2% of billed accounts are unmetered and exist because meter installation is hindered by unusual circumstances. The goal exists to minimize the number of unmetered accounts to the extent that is economical. Reliable estimates of consumption are obtained at these accounts via site specific estimation methods.

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Improvements to attain higher data grading for "Billed Unmetered Consumption" component:		to qualify for 2: Conduct research and evaluate cost/benefit of a new water utility policy to require metering of the customer population; thereby greatly reducing or eliminating unmetered accounts. Conduct pilot metering project by installing water meters in small sample of customer accounts and periodically reading the meters or datalogging the water consumption over one, three, or seven day periods.	to qualify for 4: Implement a new water utility policy requiring customer metering. Launch or expand pilot metering study to include several different meter types, which will provide data for economic assessment of full scale metering options. Assess sites with access difficulties to devise means to obtain water consumption volumes. Begin customer meter installation.		to qualify for 6: Refine policy and procedures to improve customer metering participation for all but solidly exempt accounts. Assign staff resources to review billing records to identify errant unmetered properties. Specify metering needs and funding requirements to install sufficient meters to significant reduce the number of unmetered accounts		to qualify for 8: Push to install customer meters on a full scale basis. Refine metering policy and procedures to ensure that all accounts, including municipal properties, are designated for meters. Plan special efforts to address "hard-to-access" accounts. Implement procedures to obtain a reliable consumption estimate for the remaining few unmetered accounts awaiting meter installation.		to qualify for 10: Continue customer meter installation throughout the service area, with a goal to minimize unmetered accounts. Sustain the effort to investigate accounts with access difficulties, and devise means to install water meters or otherwise measure water consumption.		to maintain 10: Continue to refine estimation methods for unmetered consumption and explore means to establish metering, for as many billed remaining unmetered accounts as is economically feasible.
Unbilled metered:	select n/a if all billing-exempt consumption is unmetered.	Billing practices exempt certain accounts, such as municipal buildings, but written policies do not exist; and a reliable count of unbilled metered accounts is unavailable. Meter upkeep and meter reading on these accounts is rare and not considered a priority. Due to poor recordkeeping and lack of auditing, water consumption for all such accounts is purely guesstimated.	Billing practices exempt certain accounts, such as municipal buildings, but only scattered, dated written directives exist to justify this practice. A reliable count of unbilled metered accounts is unavailable. Sporadic meter replacement and meter reading occurs on an as-needed basis. The total annual water consumption for all unbilled, metered accounts is estimated based upon approximating the number of accounts and assigning consumption from actively billed accounts of same meter size.	Conditions between 2 and 4	Dated written procedures permit billing exemption for specific accounts, such as municipal properties, but are unclear regarding certain other types of accounts. Meter reading is given low priority and is sporadic. Consumption is quantified from meter readings where available. The total number of unbilled, unmetered accounts must be estimated along with consumption volumes.	Conditions between 4 and 6	Written policies regarding billing exemptions exist but adherence in practice is questionable. Metering and meter reading for municipal buildings is reliable but sporadic for other unbilled metered accounts. Periodic auditing of such accounts is conducted. Water consumption is quantified directly from meter readings where available, but the majority of the consumption is estimated.	Conditions between 6 and 8	Written policy identifies the types of accounts granted a billing exemption. Customer meter management and meter reading are considered secondary priorities, but meter reading is conducted at least annually to obtain consumption volumes for the annual water audit. High level auditing of billing records ensures that a reliable census of such accounts exists.	Conditions between 8 and 10	Clearly written policy identifies the types of accounts given a billing exemption, with emphasis on keeping such accounts to a minimum. Customer meter management and meter reading for these accounts is given proper priority and is reliably conducted. Regular auditing confirms this. Total water consumption for these accounts is taken from reliable readings from accurate meters.
Improvements to attain higher data grading for "Unbilled Metered Consumption" component:		to qualify for 2: Reassess the water utility's policy allowing certain accounts to be granted a billing exemption. Draft an outline of a new written policy for billing exemptions, with clear justification as to why any accounts should be exempt from billing, and with the intention to keep the number of such accounts to a minimum.	to qualify for 4: Review historic written directives and policy documents allowing certain accounts to be billing-exempt. Draft an outline of a written policy for billing exemptions, identify criteria that grants an exemption, with a goal of keeping this number of accounts to a minimum. Consider increasing the priority of reading meters on unbilled accounts at least annually.		to qualify for 6: Draft a new written policy regarding billing exemptions based upon consensus criteria allowing this occurrence. Assign resources to audit meter records and billing records to obtain census of unbilled metered accounts. Gradually include a greater number of these metered accounts to the routes for regular meter reading.		to qualify for 8: Communicate billing exemption policy throughout the organization and implement procedures that ensure proper account management. Conduct inspections of accounts confirmed in unbilled metered status and verify that accurate meters exist and are scheduled for routine meter readings. Gradually increase the number of unbilled metered accounts that are included in regular meter reading routes.		to qualify for 10: Ensure that meter management (meter accuracy testing, meter replacement) and meter reading activities for unbilled accounts are accorded the same priority as billed accounts. Establish ongoing annual auditing process to ensure that water consumption is reliably collected and provided to the annual water audit process.		to maintain 10: Reassess the utility's philosophy in allowing any water uses to go "unbilled". It is possible to meter and bill all accounts, even if the fee charged for water consumption is discounted or waived. Metering and billing all accounts ensures that water consumption is tracked and water waste from plumbing leaks is detected and minimized.
Unbilled unmetered:		Extent of unbilled, unmetered consumption is unknown due to unclear policies and poor recordkeeping. Total consumption is quantified based upon a purely subjective estimate.	Clear extent of unbilled, unmetered consumption is unknown, but a number of events are randomly documented each year, confirming existence of such consumption, but without sufficient documentation to quantify an accurate estimate of the annual volume consumed.	Conditions between 2 and 4	Extent of unbilled, unmetered consumption is partially known, and procedures exist to document certain events such as miscellaneous fire hydrant uses. Formulae is used to quantify the consumption from such events (time running multiplied by typical flowrate, multiplied by number of events).	Default value of 1.25% of system input volume is employed	Coherent policies exist for some forms of unbilled, unmetered consumption but others await closer evaluation. Reasonable recordkeeping for the managed uses exists and allows for annual volumes to be quantified by inference, but unsupervised uses are guesstimated.	Conditions between 6 and 8	Clear policies and good recordkeeping exist for some uses (ex. water used in periodic testing of unmetered fire connections), but other uses (ex. miscellaneous uses of fire hydrants) have limited oversight. Total consumption is a mix of well quantified use such as from formulae (time running multiplied by typical flow, multiplied by number of events) or temporary meters, and relatively subjective estimates of less regulated use.	Conditions between 8 and 10	Clear policies exist to identify permitted use of water in unbilled, unmetered fashion, with the intention of minimizing this type of consumption. Good records document each occurrence and consumption is quantified via formulae (time running multiplied by typical flow, multiplied by number of events) or use of temporary meters.
Improvements to attain higher data grading for "Unbilled Unmetered Consumption" component:		to qualify for 5: Utilize the accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of this use. to qualify for 2: Establish a policy regarding what water uses should be allowed to remain as unbilled and unmetered. Consider tracking a small sample of one such use (ex: fire hydrant flushing).	to qualify for 5: Utilize accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of this use. to qualify for 4: Evaluate the documentation of events that have been observed. Meet with user groups (ex: for fire hydrants - fire departments, contractors to ascertain their need and/or volume requirements for water from fire hydrants).		to qualify for 5: Utilize accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of all such use. This is particularly appropriate for water utilities who are in the early stages of the water auditing process, and should focus on other components since the volume of unbilled, unmetered consumption is usually a relatively small quantity component, and other larger-quantity components should take priority.	to qualify for 6 or greater: Finalize policy and begin to conduct field checks to better establish and quantify such usage. Proceed if top-down audit exists and/or a great volume of such use is suspected.	to qualify for 8: Assess water utility policy and procedures for various unmetered usages. For example, ensure that a policy exists and permits are issued for use of fire hydrants by persons outside of the utility. Create written procedures for use and documentation of fire hydrants by water utility personnel. Use same approach for other types of unbilled, unmetered water usage.		to qualify for 10: Refine written procedures to ensure that all uses of unbilled, unmetered water are overseen by a structured permitting process managed by water utility personnel. Reassess policy to determine if some of these uses have value in being converted to billed and/or metered status.		to maintain 10: Continue to refine policy and procedures with intention of reducing the number of allowable uses of water in unbilled and unmetered fashion. Any uses that can feasibly become billed and metered should be converted eventually.

APPARENT LOSSES

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Unauthorized consumption:		Extent of unauthorized consumption is unknown due to unclear policies and poor recordkeeping. Total unauthorized consumption is guesstimated.	Unauthorized consumption is a known occurrence, but its extent is a mystery. There are no requirements to document observed events, but periodic field reports capture some of these occurrences. Total unauthorized consumption is approximated from this limited data.	conditions between 2 and 4	Procedures exist to document some unauthorized consumption such as observed unauthorized fire hydrant openings. Use formulae to quantify this consumption (time running multiplied typical flowrate, multiplied by number of events).	Default value of 0.25% of volume of water supplied is employed	Coherent policies exist for some forms of unauthorized consumption (more than simply fire hydrant misuse) but others await closer evaluation. Reasonable surveillance and recordkeeping exist for occurrences that fall under the policy. Volumes quantified by inference from these records.	Conditions between 6 and 8	Clear policies and good auditable recordkeeping exist for certain events (ex: tampering with water meters, illegal bypasses of customer meters); but other occurrences have limited oversight. Total consumption is a combination of volumes from formulae (time x typical flow) and subjective estimates of unconfirmed consumption.	Conditions between 8 and 10	Clear policies exist to identify all known unauthorized uses of water. Staff and procedures exist to provide enforcement of policies and detect violations. Each occurrence is recorded and quantified via formulae (estimated time running multiplied by typical flow) or similar methods. All records and calculations should exist in a form that can be audited by a third party.
Improvements to attain higher data grading for "Unauthorized Consumption" component:		to qualify for 5: Use accepted default of 0.25% of volume of water supplied. to qualify for 2: Review utility policy regarding what water uses are considered unauthorized, and consider tracking a small sample of one such occurrence (ex: unauthorized fire hydrant openings)	to qualify for 5: Use accepted default of 0.25% of system input volume to qualify for 4: Review utility policy regarding what water uses are considered unauthorized, and consider tracking a small sample of one such occurrence (ex: unauthorized fire hydrant openings)		to qualify for 5: Utilize accepted default value of 0.25% of volume of water supplied as an expedient means to gain a reasonable quantification of all such use. This is particularly appropriate for water utilities who are in the early stages of the water auditing process.	to qualify for 6 or greater: Finalize policy updates to clearly identify the types of water consumption that are authorized from those usages that fall outside of this policy and are, therefore, unauthorized. Begin to conduct regular field checks. Proceed if the top-down audit already exists and/or a great volume of such use is suspected.	to qualify for 8: Assess water utility policies to ensure that all known occurrences of unauthorized consumption are outlawed, and that appropriate penalties are prescribed. Create written procedures for detection and documentation of various occurrences of unauthorized consumption as they are uncovered.		to qualify for 10: Refine written procedures and assign staff to seek out likely occurrences of unauthorized consumption. Explore new locking devices, monitors and other technologies designed to detect and thwart unauthorized consumption.		to maintain 10: Continue to refine policy and procedures to eliminate any loopholes that allow or tacitly encourage unauthorized consumption. Continue to be vigilant in detection, documentation and enforcement efforts.
Customer metering inaccuracies:	select n/a only if the entire customer population is unmetered. In such a case the volume entered must be zero.	Customer meters exist, but with unorganized paper records on meters; no meter accuracy testing or meter replacement program for any size of retail meter. Metering workflow is driven chaotically with no proactive management. Loss volume due to aggregate meter inaccuracy is guesstimated.	Poor recordkeeping and meter oversight is recognized by water utility management who has allotted staff and funding resources to organize improved recordkeeping and start meter accuracy testing. Existing paper records gathered and organized to provide cursory disposition of meter population. Customer meters are tested for accuracy only upon customer request.	Conditions between 2 and 4	Reliable recordkeeping exists; meter information is improving as meters are replaced. Meter accuracy testing is conducted annually for a small number of meters (more than just customer requests, but less than 1% of inventory). A limited number of the oldest meters are replaced each year. Inaccuracy volume is largely an estimate, but refined based upon limited testing data.	Conditions between 4 and 6	A reliable electronic recordkeeping system for meters exists. The meter population includes a mix of new high performing meters and dated meters with suspect accuracy. Routine, but limited, meter accuracy testing and meter replacement occur. Inaccuracy volume is quantified using a mix of reliable and less certain data.	Conditions between 6 and 8	Ongoing meter replacement and accuracy testing result in highly accurate customer meter population. Testing is conducted on samples of meters of varying age and accumulated volume of throughput to determine optimum replacement time for various types of meters.	Ongoing meter replacement and accuracy testing result in highly accurate customer meter population. Statistically significant number of meters are tested in audit year. This testing is conducted on samples of meters of varying age and accumulated volume of throughput to determine optimum replacement time for these meters.	Good records of all active customer meters exist and include as a minimum: meter number, account number/location, type, size and manufacturer. Ongoing meter replacement occurs according to a targeted and justified basis. Regular meter accuracy testing gives a reliable measure of composite inaccuracy volume for the customer meter population. New metering technology is embraced to keep overall accuracy improving. Procedures are reviewed by a third party knowledgeable in the M36 methodology.
Improvements to attain higher data grading for "Customer meter inaccuracy volume" component:	If n/a is selected because the customer meter population is unmetered, consider establishing a new policy to meter the customer population and employ water rates based upon metered volumes.	to qualify for 2: Gather available meter purchase records. Conduct testing on a small number of meters believed to be the most inaccurate. Review staffing needs of the metering group and budget for necessary resources to better organize meter management.	to qualify for 4: Implement a reliable record keeping system for customer meter histories, preferably using electronic methods typically linked to, or part of, the Customer Billing System or Customer Information System. Expand meter accuracy testing to a larger group of meters.		to qualify for 6: Standardize the procedures for meter recordkeeping within an electronic information system. Accelerate meter accuracy testing and meter replacements guided by testing results.		to qualify for 8: Expand annual meter accuracy testing to evaluate a statistically significant number of meter makes/models. Expand meter replacement program to replace statistically significant number of poor performing meters each year.		to qualify for 9: Continue efforts to manage meter population with reliable recordkeeping. Test a statistically significant number of meters each year and analyze test results in an ongoing manner to serve as a basis for a target meter replacement strategy based upon accumulated volume throughput.	to qualify for 10: Continue efforts to manage meter population with reliable recordkeeping, meter testing and replacement. Evaluate new meter types and install one or more types in 5-10 customer accounts each year in order to pilot improving metering technology.	to maintain 10: Increase the number of meters tested and replaced as justified by meter accuracy test data. Continually monitor development of new metering technology and Advanced Metering Infrastructure (AMI) to grasp opportunities for greater accuracy in metering of water flow and management of customer consumption data.

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Systematic Data Handling Errors:	Note: all water utilities incur some amount of this error. Even in water utilities with unmetered customer populations and fixed rate billing, errors occur in annual billing tabulations. Enter a positive value for the volume and select a grading.	Policies and procedures for activation of new customer water billing accounts are vague and lack accountability. Billing data is maintained on paper records which are not well organized. No auditing is conducted to confirm billing data handling efficiency. An unknown number of customers escape routine billing due to lack of billing process oversight.	Policy and procedures for activation of new customer accounts and oversight of billing records exist but need refinement. Billing data is maintained on paper records or insufficiently capable electronic database. Only periodic unstructured auditing work is conducted to confirm billing data handling efficiency. The volume of unbilled water due to billing lapses is a guess.	Conditions between 2 and 4	Policy and procedures for new account activation and oversight of billing operations exist but needs refinement. Computerized billing system exists, but is dated or lacks needed functionality. Periodic, limited internal audits conducted and confirm with approximate accuracy the consumption volumes lost to billing lapses.	Conditions between 4 and 6	Policy and procedures for new account activation and oversight of billing operations is adequate and reviewed periodically. Computerized billing system is in use with basic reporting available. Any effect of billing adjustments on measured consumption volumes is well understood. Internal checks of billing data error conducted annually. Reasonably accurate quantification of consumption volume lost to billing lapses is obtained.	Conditions between 6 and 8	New account activation and billing operations policy and procedures are reviewed at least biannually. Computerized billing system includes an array of reports to confirm billing data and system functionality. Checks are conducted routinely to flag and explain zero consumption accounts. Annual internal checks conducted with third party audit conducted at least once every five years. Accountability checks flag billing lapses. Consumption lost to billing lapses is well quantified and reducing year-by-year.	Conditions between 8 and 10	Sound written policy and procedures exist for new account activation and oversight of customer billing operations. Robust computerized billing system gives high functionality and reporting capabilities which are utilized, analyzed and the results reported each billing cycle. Assessment of policy and data handling errors are conducted internally and audited by third party at least once every three years, ensuring consumption lost to billing lapses is minimized and detected as it occurs.
Improvements to attain higher data grading for "Systematic Data Handling Error volume" component:		to qualify for 2: Draft written policy and procedures for activating new water billing accounts and oversight of billing operations. Investigate and budget for computerized customer billing system. Conduct initial audit of billing records by flow-charting the basic business processes of the customer account/billing function.	to qualify for 4: Finalize written policy and procedures for activation of new billing accounts and overall billing operations management. Implement a computerized customer billing system. Conduct initial audit of billing records as part of this process.		to qualify for 6: Refine new account activation and billing operations procedures and ensure consistency with the utility policy regarding billing, and minimize opportunity for missed billings. Upgrade or replace customer billing system for needed functionality - ensure that billing adjustments don't corrupt the value of consumption volumes. Procedurize internal annual audit process.		to qualify for 8: Formalize regular review of new account activation process and general billing practices. Enhance reporting capability of computerized billing system. Formalize regular auditing process to reveal scope of data handling error. Plan for periodic third party audit to occur at least once every five years.		to qualify for 10: Close policy/procedure loopholes that allow some customer accounts to go unbilled, or data handling errors to exist. Ensure that billing system reports are utilized, analyzed and reported every billing cycle. Ensure that internal and third party audits are conducted at least once every three years.		to maintain 10: Stay abreast of customer information management developments and innovations. Monitor developments of Advanced Metering Infrastructure (AMI) and integrate technology to ensure that customer endpoint information is well-monitored and errors/lapses are at an economic minimum.
SYSTEM DATA											
Length of mains:		Poorly assembled and maintained paper as-built records of existing water main installations makes accurate determination of system pipe length impossible. Length of mains is guesstimated.	Paper records in poor or uncertain condition (no annual tracking of installations & abandonments). Poor procedures to ensure that new water mains installed by developers are accurately documented.	Conditions between 2 and 4	Sound written policy and procedures exist for documenting new water main installations, but gaps in management result in an uncertain degree of error in tabulation of mains length.	Conditions between 4 and 6	Sound written policy and procedures exist for permitting and commissioning new water mains. Highly accurate paper records with regular field validation; or electronic records and asset management system in good condition. Includes system backup.	Conditions between 6 and 8	Sound written policy and procedures exist for permitting and commissioning new water mains. Electronic recordkeeping such as a Geographical Information System (GIS) and asset management system are used to store and manage data.	Conditions between 8 and 10	Sound written policy exists for managing water mains extensions and replacements. Geographic Information System (GIS) data and asset management database agree and random field validation proves truth of databases. Records of annual field validation should be available for review.
Improvements to attain higher data grading for "Length of Water Mains" component:		to qualify for 2: Assign personnel to inventory current as-built records and compare with customer billing system records and highway plans in order to verify poorly documented pipelines. Assemble policy documents regarding permitting and documentation of water main installations by the utility and building developers; identify gaps in procedures that result in poor documentation of new water main installations.	to qualify for 4: Complete inventory of paper records of water main installations for several years prior to audit year. Review policy and procedures for commissioning and documenting new water main installation.		to qualify for 6: Finalize updates/improvements to written policy and procedures for permitting/commissioning new main installations. Confirm inventory of records for five years prior to audit year, correct any errors or omissions.		to qualify for 8: Launch random field checks of limited number of locations. Convert to electronic database such as a Geographic Information System (GIS) with backup as justified. Develop written policy and procedures.		to qualify for 10: Link Geographic Information System (GIS) and asset management databases, conduct field verification of data. Record field verification information at least annually.		to maintain 10: Continue with standardization and random field validation to improve the completeness and accuracy of the system.
Number of active AND inactive service connections:		Vague permitting (of new service connections) policy and poor paper recordkeeping of customer connections/billings result in suspect determination of the number of service connections, which may be 10-15% in error from actual count.	General permitting policy exists but paper records, procedural gaps, and weak oversight result in questionable total for number of connections, which may vary 5-10% of actual count.	Conditions between 2 and 4	Written account activation policy and procedures exist, but with some gaps in performance and oversight. Computerized information management system is being brought online to replace dated paper recordkeeping system. Reasonably accurate tracking of service connection installations & abandonments; but count can be up to 5% in error from actual total.	Conditions between 4 and 6	Written new account activation and overall billing policies and procedures are adequate and reviewed periodically. Computerized information management system is in use with annual installations & abandonments totaled. Very limited field verifications and audits. Error in count of number of service connections is believed to be no more than 3%.	Conditions between 6 and 8	Policies and procedures for new account activation and overall billing operations are written, well-structured and reviewed at least biannually. Well-managed computerized information management system exists and routine, periodic field checks and internal system audits are conducted. Counts of connections are no more than 2% in error.	Conditions between 8 and 10	Sound written policy and well managed and audited procedures ensure reliable management of service connection population. Computerized information management system, Customer Billing System, and Geographic Information System (GIS) information agree; field validation proves truth of databases. Count of connections recorded as being in error is less than 1% of the entire population.
Improvements to attain higher data grading for "Number of Active and Inactive Service Connections" component:	Note: The number of Service Connections does not include fire hydrant leads/lines connecting the hydrant to the water main	to qualify for 2: Draft new policy and procedures for new account activation and overall billing operations. Research and collect paper records of installations & abandonments for several years prior to audit year.	to qualify for 4: Refine policy and procedures for new account activation and overall billing operations. Research computerized recordkeeping system (Customer Information System or Customer Billing System) to improve documentation format for service connections.		to qualify for 6: Refine procedures to ensure consistency with new account activation and overall billing policy to establish new service connections or decommission existing connections. Improve process to include all totals for at least five years prior to audit year.		to qualify for 8: Formalize regular review of new account activation and overall billing operations policies and procedures. Launch random field checks of limited number of locations. Develop reports and auditing mechanisms for computerized information management system.		to qualify for 10: Close any procedural loopholes that allow installations to go undocumented. Link computerized information management system with Geographic Information System (GIS) and formalize field inspection and information system auditing processes. Documentation of new or decommissioned service connections encounters several levels of checks and balances.		to maintain 10: Continue with standardization and random field validation to improve knowledge of system.
	Note: if customer water	Gratings 1-9 apply if customer properties are unmetered, if customer meters exist and are located inside the customer building premises, or if the water utility owns and is responsible for the entire service connection piping from the water main to the customer building. In any of these cases the average distance between the curb stop or boundary separating utility/customer responsibility for service connection piping, and the typical first point of use (ex: faucet) or the customer meter must be quantified. Gratings of 1-9 are used to grade the validity of the means to quantify this value. (See the "Service Connection Diagram" worksheet)									Either of two conditions can be met for a grading of 10:

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Average length of customer service line:	meters are located outside of the customer building next to the curb stop or boundary separating utility/customer responsibility, then the auditor should answer "Yes" to the question on the Reporting Worksheet asking about this. If the answer is Yes, the grading description listed under the Grading of 10(a) will be followed, with a value of zero automatically entered at a Grading of 10. See the Service Connection Diagram worksheet for a visual presentation of this distance.	Vague policy exists to define the delineation of water utility ownership and customer ownership of the service connection piping. Curb stops are perceived as the breakpoint but these have not been well-maintained or documented. Most are buried or obscured. Their location varies widely from site-to-site, and estimating this distance is arbitrary due to the unknown location of many curb stops.	Policy requires that the curb stop serves as the delineation point between water utility ownership and customer ownership of the service connection piping. The piping from the water main to the curb stop is the property of the water utility; and the piping from the curb stop to the customer building is owned by the customer. Curb stop locations are not well documented and the average distance is based upon a limited number of locations measured in the field.	Conditions between 2 and 4	Good policy requires that the curb stop serves as the delineation point between water utility ownership and customer ownership of the service connection piping. Curb stops are generally installed as needed and are reasonably documented. Their location varies widely from site-to-site, and an estimate of this distance is hindered by the availability of paper records of limited accuracy.	Conditions between 4 and 6	Clear written policy exists to define utility/customer responsibility for service connection piping. Accurate, well-maintained paper or basic electronic recordkeeping system exists. Periodic field checks confirm piping lengths for a sample of customer properties.	Conditions between 6 and 8	Clearly worded policy standardizes the location of curb stops and meters, which are inspected upon installation. Accurate and well maintained electronic records exist with periodic field checks to confirm locations of service lines, curb stops and customer meter pits. An accurate number of customer properties from the customer billing system allows for reliable averaging of this length.	Conditions between 8 and 10	a) Customer water meters exist outside of customer buildings next to the curb stop or boundary separating utility/customer responsibility for service connection piping. If so, answer "Yes" to the question on the Reporting Working asking about this condition. A value of zero and a Grading of 10 are automatically entered in the Reporting Worksheet. b) Meters exist inside customer buildings, or properties are unmetered. In either case, answer "No" to the Reporting Worksheet question on meter location, and enter a distance determined by the auditor. For a Grading of 10 this value must be a very reliable number from a Geographic Information System (GIS) and confirmed by a statistically valid number of field checks.
Improvements to attain higher data grading for "Average Length of Customer Service Line" component:		<u>to qualify for 2:</u> Research and collect paper records of service line installations. Inspect several sites in the field using pipe locators to locate curb stops. Obtain the length of this small sample of connections in this manner.	<u>to qualify for 4:</u> Formalize and communicate policy delineating utility/customer responsibilities for service connection piping. Assess accuracy of paper records by field inspection of a small sample of service connections using pipe locators as needed. Research the potential migration to a computerized information management system to store service connection data.		<u>to qualify for 6:</u> Establish coherent procedures to ensure that policy for curb stop, meter installation and documentation is followed. Gain consensus within the water utility for the establishment of a computerized information management system.		<u>to qualify for 8:</u> Implement an electronic means of recordkeeping, typically via a customer information system, customer billing system, or Geographic Information System (GIS). Standardize the process to conduct field checks of a limited number of locations.		<u>to qualify for 10:</u> Link customer information management system and Geographic Information System (GIS), standardize process for field verification of data.		<u>to maintain 10:</u> Continue with standardization and random field validation to improve knowledge of service connection configurations and customer meter locations.
Average operating pressure:		Available records are poorly assembled and maintained paper records of supply pump characteristics and water distribution system operating conditions. Average pressure is guesstimated based upon this information and ground elevations from crude topographical maps. Widely varying distribution system pressures due to undulating terrain, high system head loss and weak/erratic pressure controls further compromise the validity of the average pressure calculation.	Limited telemetry monitoring of scattered pumping station and water storage tank sites provides some static pressure data, which is recorded in handwritten logbooks. Pressure data is gathered at individual sites only when low pressure complaints arise. Average pressure is determined by averaging relatively crude data, and is affected by significant variation in ground elevations, system head loss and gaps in pressure controls in the distribution system.	Conditions between 2 and 4	Effective pressure controls separate different pressure zones; moderate pressure variation across the system, occasional open boundary valves are discovered that breach pressure zones. Basic telemetry monitoring of the distribution system logs pressure data electronically. Pressure data gathered by gauges or dataloggers at fire hydrants or buildings when low pressure complaints arise, and during fire flow tests and system flushing. Reliable topographical data exists. Average pressure is calculated using this mix of data.	Conditions between 4 and 6	Reliable pressure controls separate distinct pressure zones; only very occasional open boundary valves are encountered that breach pressure zones. Well-covered telemetry monitoring of the distribution system (not just pumping at source treatment plants or wells) logs extensive pressure data electronically. Pressure gathered by gauges/dataloggers at fire hydrants and buildings when low pressure complaints arise, and during fire flow tests and system flushing. Average pressure is determined by using this mix of reliable data.	Conditions between 6 and 8	Well-managed, discrete pressure zones exist with generally predictable pressure fluctuations. A current full-scale SCADA System or similar realtime monitoring system exists to monitor the water distribution system and collect data, including real time pressure readings at representative sites across the system. The average system pressure is determined from reliable monitoring system data.	Conditions between 8 and 10	Well-managed pressure districts/zones, SCADA System and hydraulic model exist to give very precise pressure data across the water distribution system. Average system pressure is reliably calculated from extensive, reliable, and cross-checked data. Calculations are reported on an annual basis as a minimum.
Improvements to attain higher data grading for "Average Operating Pressure" component:		<u>to qualify for 2:</u> Employ pressure gauging and/or datalogging equipment to obtain pressure measurements from fire hydrants. Locate accurate topographical maps of service area in order to confirm ground elevations. Research pump data sheets to find pump pressure/flow characteristics	<u>to qualify for 4:</u> Formalize a procedure to use pressure gauging/datalogging equipment to gather pressure data during various system events such as low pressure complaints, or operational testing. Gather pump pressure and flow data at different flow regimes. Identify faulty pressure controls (pressure reducing valves, altitude valves, partially open boundary valves) and plan to properly configure pressure zones. Make all pressure data from these efforts available to generate system-wide average pressure.		<u>to qualify for 6:</u> Expand the use of pressure gauging/datalogging equipment to gather scattered pressure data at a representative set of sites, based upon pressure zones or areas. Utilize pump pressure and flow data to determine supply head entering each pressure zone or district. Correct any faulty pressure controls (pressure reducing valves, altitude valves, partially open boundary valves) to ensure properly configured pressure zones. Use expanded pressure dataset from these activities to generate system-wide average pressure.		<u>to qualify for 8:</u> Install a Supervisory Control and Data Acquisition (SCADA) System, or similar realtime monitoring system, to monitor system parameters and control operations. Set regular calibration schedule for instrumentation to insure data accuracy. Obtain accurate topographical data and utilize pressure data gathered from field surveys to provide extensive, reliable data for pressure averaging.		<u>to qualify for 10:</u> Annually, obtain a system-wide average pressure value from the hydraulic model of the distribution system that has been calibrated via field measurements in the water distribution system and confirmed in comparisons with SCADA System data.		<u>to maintain 10:</u> Continue to refine the hydraulic model of the distribution system and consider linking it with SCADA System for realtime pressure data calibration, and averaging.

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
COST DATA											
Total annual cost of operating water system:		Incomplete paper records and lack of financial accounting documentation on many operating functions makes calculation of water system operating costs a pure guesstimate	Reasonably maintained, but incomplete, paper or electronic accounting provides data to estimate the major portion of water system operating costs.	Conditions between 2 and 4	Electronic, industry-standard cost accounting system in place. However, gaps in data are known to exist, periodic internal reviews are conducted but not a structured financial audit.	Conditions between 4 and 6	Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Data audited periodically by utility personnel, but not a Certified Public Accountant (CPA).	Conditions between 6 and 8	Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Data audited at least annually by utility personnel, and at least once every three years by third-party CPA.	Conditions between 8 and 10	Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Data audited annually by utility personnel and annually also by third-party CPA.
Improvements to attain higher data grading for "Total Annual Cost of Operating the Water System" component:		<u>to qualify for 2:</u> Gather available records, institute new financial accounting procedures to regularly collect and audit basic cost data of most important operations functions.	<u>to qualify for 4:</u> Implement an electronic cost accounting system, structured according to accounting standards for water utilities		<u>to qualify for 6:</u> Establish process for periodic internal audit of water system operating costs; identify cost data gaps and institute procedures for tracking these outstanding costs.		<u>to qualify for 8:</u> Standardize the process to conduct routine financial audit on an annual basis. Arrange for CPA audit of financial records at least once every three years.		<u>to qualify for 10:</u> Standardize the process to conduct a third-party financial audit by a CPA on an annual basis.		<u>to maintain 10:</u> Maintain program, stay abreast of expenses subject to erratic cost changes and long-term cost trend, and budget/track costs proactively
Customer retail unit cost (applied to Apparent Losses):	Customer population unmetered, and/or only a fixed fee is charged for consumption.	Antiquated, cumbersome water rate structure is used, with periodic historic amendments that were poorly documented and implemented, resulting in classes of customers being billed inconsistent charges. The actual composite billing rate likely differs significantly from the published water rate structure, but a lack of auditing leaves the degree of error indeterminate.	Dated, cumbersome water rate structure, not always employed consistently in actual billing operations. The actual composite billing rate is known to differ from the published water rate structure, and a reasonably accurate estimate of the degree of error is determined, allowing a composite billing rate to be quantified.	Conditions between 2 and 4	Straight-forward water rate structure in use, but not updated in several years. Billing operations reliably employ the rate structure. The composite billing rate is derived from a single customer class such as residential customer accounts, neglecting the effect of different rates from varying customer classes.	Conditions between 4 and 6	Clearly written, up-to-date water rate structure is in force and is applied reliably in billing operations. Composite customer rate is determined using a weighted average residential rate using volumes of water in each rate block.	Conditions between 6 and 8	Effective water rate structure is in force and is applied reliably in billing operations. Composite customer rate is determined using a weighted average composite consumption rate, which includes residential, commercial, industrial, institutional (CII), and any other distinct customer classes within the water rate structure.	Conditions between 8 and 10	Current, effective water rate structure is in force and applied reliably in billing operations. The rate structure and calculations of composite rate - which includes residential, commercial, industrial, institutional (CII), and other distinct customer classes - are reviewed by a third party knowledgeable in the M36 methodology at least once every five years.
Improvements to attain higher data grading for "Customer Retail Unit Cost" component:		<u>to qualify for 2:</u> Formalize the process to implement water rates, including a secure documentation procedure. Create a current, formal water rate document and gain approval from all stakeholders.	<u>to qualify for 4:</u> Review the water rate structure and update/formalize as needed. Assess billing operations to ensure that actual billing operations incorporate the established water rate structure.		<u>to qualify for 6:</u> Evaluate volume of water used in each usage block by residential users. Multiply volumes by full rate structure.	<u>Launch effort to fully meter the customer population and charge rates based upon water volumes</u>	<u>to qualify for 8:</u> Evaluate volume of water used in each usage block by all classifications of users. Multiply volumes by full rate structure.		<u>to qualify for 10:</u> Conduct a periodic third-party audit of water used in each usage block by all classifications of users. Multiply volumes by full rate structure.		<u>to maintain 10:</u> Keep water rate structure current in addressing the water utility's revenue needs. Update the calculation of the customer unit rate as new rate components, customer classes, or other components are modified.
Variable production cost (applied to Real Losses):	Note: if the water utility purchases/imports its entire water supply, then enter the unit purchase cost of the bulk water supply in the Reporting Worksheet with a grading of 10	Incomplete paper records and lack of documentation on primary operating functions (electric power and treatment costs most importantly) makes calculation of variable production costs a pure guesstimate	Reasonably maintained, but incomplete, paper or electronic accounting provides data to roughly estimate the basic operations costs (pumping power costs and treatment costs) and calculate a unit variable production cost.	Conditions between 2 and 4	Electronic, industry-standard cost accounting system in place. Electric power and treatment costs are reliably tracked and allow accurate weighted calculation of unit variable production costs based on these two inputs and water imported purchase costs (if applicable). All costs are audited internally on a periodic basis.	Conditions between 4 and 6	Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Pertinent additional costs beyond power, treatment and water imported purchase costs (if applicable) such as liability, residuals management, wear and tear on equipment, impending expansion of supply, are included in the unit variable production cost, as applicable. The data is audited at least annually by utility personnel.	Conditions between 6 and 8	Reliable electronic, industry-standard cost accounting system in place, with all pertinent primary and secondary variable production and water imported purchase (if applicable) costs tracked. The data is audited at least annually by utility personnel, and at least once every three years by a third-party knowledgeable in the M36 methodology.	Conditions between 8 and 10	Either of two conditions can be met to obtain a grading of 10: 1) Third party CPA audit of all pertinent primary and secondary production and water imported purchase (if applicable) costs on an annual basis, or; 2) Water supply is entirely purchased as bulk imported water, and unit purchase cost serves as the variable production cost.
Improvements to attain higher data grading for "Variable Production Cost" component:		<u>to qualify for 2:</u> Gather available records, institute new procedures to regularly collect and audit basic cost data and most important operations functions.	<u>to qualify for 4:</u> Implement an electronic cost accounting system, structured according to accounting standards for water utilities		<u>to qualify for 6:</u> Formalize process for regular internal audits of production costs. Assess whether additional costs (liability, residuals management, equipment wear, impending infrastructure expansion) should be included to calculate a more representative variable production cost.		<u>to qualify for 8:</u> Formalize the accounting process to include direct cost components (power, treatment) as well as indirect cost components (liability, residuals management, etc.) Arrange to conduct audits by a knowledgeable third-party at least once every three years.		<u>to qualify for 10:</u> Standardize the process to conduct a third-party financial audit by a CPA on an annual basis.		<u>to maintain 10:</u> Maintain program, stay abreast of expenses subject to erratic cost changes and budget/track costs proactively



Average Length of Customer Service Line

The three figures shown on this worksheet display the assignment of the Average Length of Customer Service Line, L_p , for the three most common piping configurations.

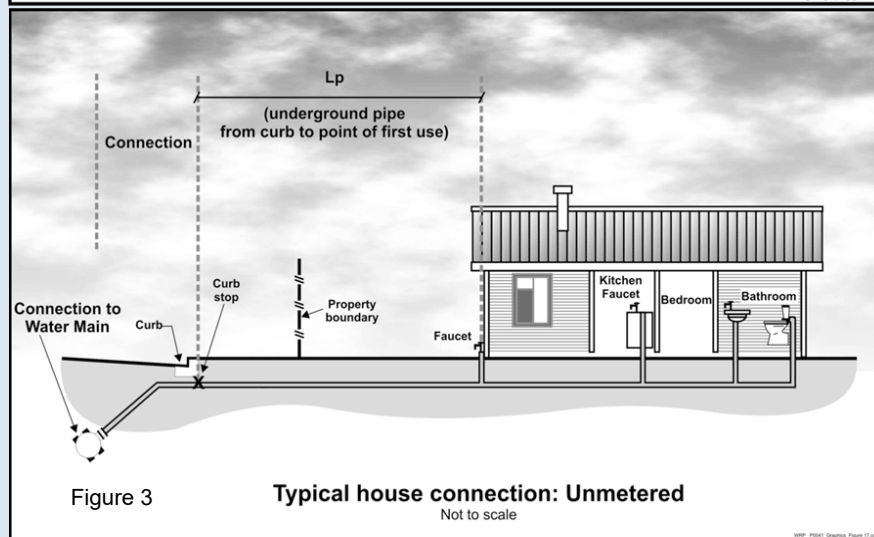
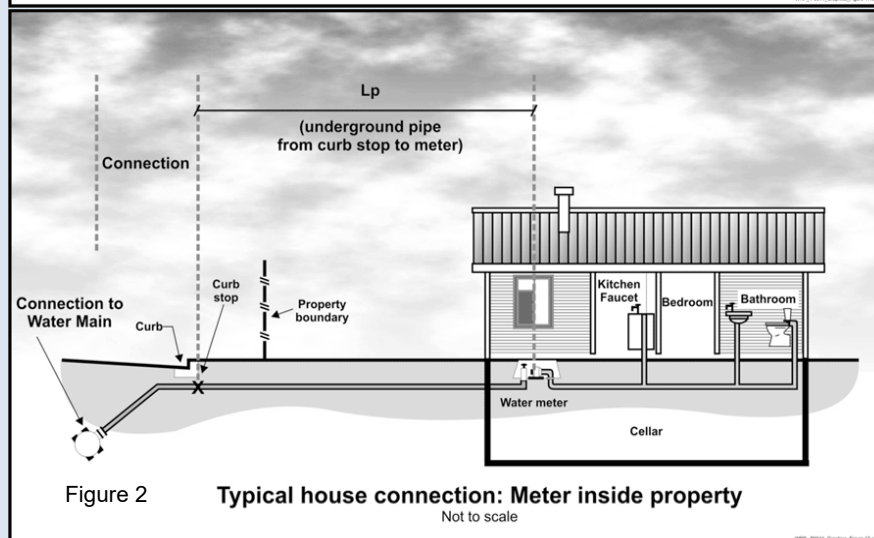
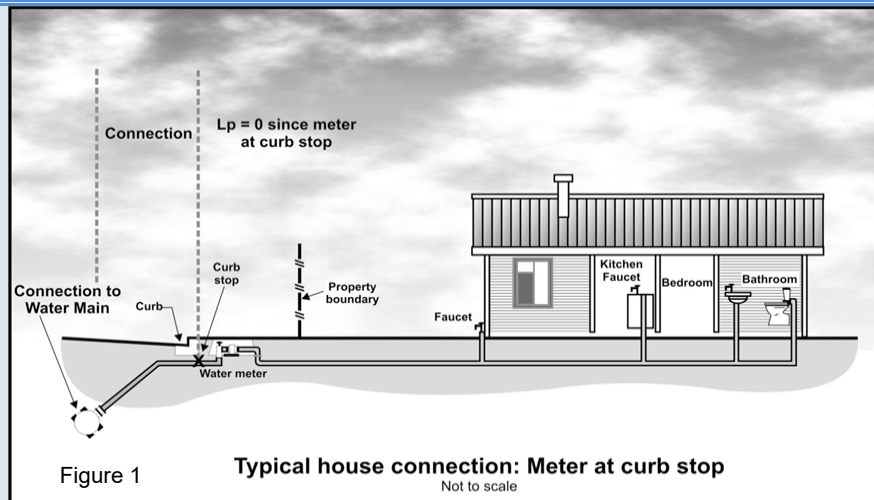
Figure 1 shows the configuration of the water meter outside of the customer building next to the curb stop valve. In this configuration $L_p = 0$ since the distance between the curb stop and the customer metering point is essentially zero.

Figure 2 shows the configuration of the customer water meter located inside the customer building, where L_p is the distance from the curb stop to the water meter.

Figure 3 shows the configuration of an unmetered customer building, where L_p is the distance from the curb stop to the first point of customer water consumption, or, more simply, the building line.

In any water system the L_p will vary notably in a community of different structures, therefore the average L_p value is used and this should be approximated or calculated if a sample of service line measurements has been gathered.

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AWWA Free Water Audit Software: Definitions

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Item Name	Description
<p>Apparent Find</p>	<p>= unauthorized consumption + customer metering inaccuracies + systematic data handling errors</p> <p>Apparent Losses include all types of inaccuracies associated with customer metering (worn meters as well as improperly sized meters or wrong type of meter for the water usage profile) as well as systematic data handling errors (meter reading, billing, archiving and reporting), plus unauthorized consumption (theft or illegal use). NOTE: Over-estimation of Apparent Losses results in under-estimation of Real Losses. Under-estimation of Apparent Losses results in over-estimation of Real Losses.</p>
<p>AUTHORIZED CONSUMPTION Find</p>	<p>= billed water exported + billed metered + billed unmetered + unbilled metered + unbilled unmetered consumption</p> <p>The volume of metered and/or unmetered water taken by registered customers, the water utility's own uses, and uses of others who are implicitly or explicitly authorized to do so by the water utility; for residential, commercial, industrial and public-minded purposes.</p> <p>Typical retail customers' consumption is tabulated usually from established customer accounts as billed metered consumption, or - for unmetered customers - billed unmetered consumption. These types of consumption, along with billed water exported, provide revenue potential for the water utility. Be certain to tabulate the water exported volume as a separate component and do not "double-count" it by including in the billed metered consumption component as well as the water exported component.</p> <p>Unbilled authorized consumption occurs typically in non-account uses, including water for fire fighting and training, flushing of water mains and sewers, street cleaning, watering of municipal gardens, public fountains, or similar public-minded uses. Occasionally these uses may be metered and billed (or charged a flat fee), but usually they are unmetered and unbilled. In the latter case, the water auditor may use a default value to estimate this quantity, or implement procedures for the reliable quantification of these uses. This starts with documenting usage events as they occur and estimating the amount of water used in each event. (See Unbilled unmetered consumption)</p>
<p>View Service Connection</p> <p>Average length of customer service line Find</p>	<p>This is the average length of customer service line, Lp, that is owned and maintained by the customer; from the point of ownership transfer to the customer water meter, or building line (if unmetered). The quantity is one of the data inputs for the calculation of Unavoidable Annual Real Losses (UARL), which serves as the denominator of the performance indicator: Infrastructure Leakage Index (ILI). The value of Lp is multiplied by the number of customer service connections to obtain a total length of customer owned piping in the system. The purpose of this parameter is to account for the unmetered service line infrastructure that is the responsibility of the customer for arranging repairs of leaks that occur on their lines. In many cases leak repairs arranged by customers take longer to be executed than leak repairs arranged by the water utility on utility-maintained piping. Leaks run longer - and lose more water - on customer-owned service piping, than utility owned piping.</p> <p>If the customer water meter exists near the ownership transfer point (usually the curb stop located between the water main and the customer premises) this distance is zero because the meter and transfer point are the same. This is the often encountered configuration of customer water meters located in an underground meter box or "pit" outside of the customer's building. The Free Water Audit Software asks a "Yes/No" question about the meter at this location. If the auditor selects "Yes" then this distance is set to zero and the data grading score for this component is set to 10.</p> <p>If water meters are typically located inside the customer premise/building, or properties are unmetered, it is up to the water auditor to estimate a system-wide average Lp length based upon the various customer land parcel sizes and building locations in the service area. Lp will be a shorter length in areas of high density housing, and a longer length in areas of low density housing and varied commercial and industrial buildings. General parcel demographics should be employed to obtain a composite average Lp length for the entire system.</p> <p>Refer to the "Service Connection Diagram" worksheet for a depiction of the service line/metering configurations that typically exist in water utilities. This worksheet gives guidance on the determination of the Average Length, Lp, for each configuration.</p>
<p>Average operating pressure Find</p>	<p>This is the average pressure in the distribution system that is the subject of the water audit. Many water utilities have a calibrated hydraulic model of their water distribution system. For these utilities, the hydraulic model can be utilized to obtain a very accurate quantity of average pressure. In the absence of a hydraulic model, the average pressure may be approximated by obtaining readings of static water pressure from a representative sample of fire hydrants or other system access points evenly located across the system. A weighted average of the pressure can be assembled; but be sure to take into account the elevation of the fire hydrants, which typically exist several feet higher than the level of buried water pipelines. If the water utility is compiling the water audit for the first time, the average pressure can be approximated, but with a low data grading. In subsequent years of auditing, effort should be made to improve the accuracy of the average pressure quantity. This will then qualify the value for a higher data grading.</p>
<p>Billed Authorized Consumption</p>	<p>All consumption that is billed and authorized by the utility. This may include both metered and unmetered consumption. See "Authorized Consumption" for more information.</p>
<p>Billed metered consumption Find</p>	<p>All metered consumption which is billed to retail customers, including all groups of customers such as domestic, commercial, industrial or institutional. It does NOT include water supplied to neighboring utilities (water exported) which is metered and billed. Be sure to subtract any consumption for exported water sales that may be included in these billing roles. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component. The metered consumption data can be taken directly from billing records for the water audit period. The accuracy of yearly metered consumption data can be refined by including an adjustment to account for customer meter reading lag time since not all customer meters are read on the same day of the meter reading period. However additional analysis is necessary to determine the lag time adjustment value, which may or may not be significant.</p>
<p>Billed unmetered consumption Find</p>	<p>All billed consumption which is calculated based on estimates or norms from water usage sites that have been determined <u>by utility policy</u> to be left unmetered. This is typically a very small component in systems that maintain a policy to meter their customer population. However, this quantity can be the key consumption component in utilities that have not adopted a universal metering policy. This component should NOT include any water that is supplied to neighboring utilities (water exported) which is unmetered but billed. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.</p>

Item Name	Description
<p>Customer metering</p> <p>Find ies</p>	<p>Apparent water losses caused by the collective under-registration of customer water meters. Many customer water meters gradually wear as large cumulative volumes of water are passed through them over time. This causes the meters to under-register the flow of water. This occurrence is common with smaller residential meters of sizes 5/8-inch and 3/4 inch after they have registered very large cumulative volumes of water, which generally occurs only after periods of years. For meters sized 1-inch and larger - typical of multi-unit residential, commercial and industrial accounts - meter under-registration can occur from wear or from the improper application of the meter; i.e. installing the wrong type of meter or the wrong size of meter, for the flow pattern (profile) of the consumer. For instance, many larger meters have reduced accuracy at low flows. If an oversized meter is installed, most of the time the routine flow will occur in the low flow range of the meter, and a significant portion of it may not be registered. It is important to properly select and install all meters, but particularly large customer meters, size 1-inch and larger.</p> <p>The auditor has two options for entering data for this component of the audit. The auditor can enter a percentage under-registration (typically an estimated value), this will apply the selected percentage to the two categories of metered consumption to determine the volume of water not recorded due to customer meter inaccuracy. Note that this percentage is a composite average inaccuracy for <u>all</u> customer meters in the entire meter population. The percentage will be multiplied by the sum of the volumes in the Billed Metered and Unbilled Metered components. Alternatively, if the auditor has substantial data from meter testing activities, he or she can calculate their own loss volumes, and this volume may be entered directly.</p> <p>Note that a value of zero will be accepted but an alert will appear asking if the customer population is unmetered. Since all metered systems have some degree of inaccuracy, a positive value should be entered. A value of zero in this component is valid only if the water utility does not meter its customer population.</p>
<p>Customer retail</p> <p>Find st</p>	<p>The Customer Retail Unit Cost represents the charge that customers pay for water service. This unit cost is applied routinely to the components of Apparent Loss, since these losses represent water reaching customers but not (fully) paid for. Since most water utilities have a rate structure that includes a variety of different costs based upon class of customer, a weighted average of individual costs and number of customer accounts in each class can be calculated to determine a single composite cost that should be entered into this cell. Finally, the weighted average cost should also include additional charges for sewer, storm water or biosolids processing, <u>but only if</u> these charges are based upon the volume of potable water consumed.</p> <p>For water utilities in regions with limited water resources and a questionable ability to meet the drinking water demands in the future, the Customer Retail Unit Cost might also be applied to value the Real Losses; instead of applying the Variable Production Cost to Real Losses. In this way, it is assumed that every unit volume of leakage reduced by leakage management activities will be sold to a customer.</p> <p>Note: the Free Water Audit Software allows the user to select the units that are charged to customers (either \$/1,000 gallons, \$/hundred cubic feet, or \$/1,000 litres) and automatically converts these units to the units that appear in the "WATER SUPPLIED" box. The monetary units are United States dollars, \$.</p>
<p>Infrastructure Leakage Index</p> <p>Find </p>	<p>The ratio of the Current Annual Real Losses (Real Losses) to the Unavoidable Annual Real Losses (UARL). The ILI is a highly effective performance indicator for comparing (benchmarking) the performance of utilities in operational management of real losses.</p>
<p>Length of mains</p> <p>Find </p>	<p>Length of all pipelines (except service connections) in the system starting from the point of system input metering (for example at the outlet of the treatment plant). It is also recommended to include in this measure the total length of fire hydrant lead pipe. Hydrant lead pipe is the pipe branching from the water main to the fire hydrant. Fire hydrant leads are typically of a sufficiently large size that is more representative of a pipeline than a service connection. The average length of hydrant leads across the entire system can be assumed if not known, and multiplied by the number of fire hydrants in the system, which can also be assumed if not known. This value can then be added to the total pipeline length. Total length of mains can therefore be calculated as:</p> <p>Length of Mains, miles = (total pipeline length, miles) + [{(average fire hydrant lead length, ft) x (number of fire hydrants)} / 5,280 ft/mile]</p> <p>or</p> <p>Length of Mains, kilometres = (total pipeline length, kilometres) + [{(average fire hydrant lead length, metres) x (number of fire hydrants)} / 1,000 metres/kilometre]</p>
<p>NON-REVENUE WATER</p> <p>Find </p>	<p>= Apparent Losses + Real Losses + Unbilled Metered Consumption + Unbilled Unmetered Consumption. This is water which does not provide revenue potential to the utility.</p>
<p>Number of active AND inactive service connections</p> <p>Find ons</p>	<p>Number of customer service connections, extending from the water main to supply water to a customer. Please note that this includes the actual number of distinct piping connections, including fire connections, whether active or inactive. This may differ substantially from the number of customers (or number of accounts). Note: this number does not include the pipeline leads to fire hydrants - the total length of piping supplying fire hydrants should be included in the "Length of mains" parameter.</p>
<p>Real Losses</p> <p>Find </p>	<p>Physical water losses from the pressurized system (water mains and customer service connections) and the utility's storage tanks, up to the point of customer consumption. In metered systems this is the customer meter, in unmetered situations this is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks and overflows.</p>
<p>Revenue Water</p>	<p>Those components of System Input Volume that are billed and have the potential to produce revenue.</p>
<p>Service Connection Density</p> <p>Find </p>	<p>=number of customer service connections / length of mains</p>

Item Name	Description
<p>Find; data handling errors</p>	<p>Apparent losses caused by accounting omissions, errant computer programming, gaps in policy, procedure, and permitting/activation of new accounts; and any type of data lapse that results in under-stated customer water consumption in summary billing reports.</p> <p>Systematic Data Handling Errors result in a direct loss of revenue potential. Water utilities can find "lost" revenue by keying on this component.</p> <p>Utilities typically measure water consumption registered by water meters at customer premises. The meter should be read routinely (ex: monthly) and the data transferred to the Customer Billing System, which generates and sends a bill to the customer. Data Transfer Errors result in the consumption value being less than the actual consumption, creating an apparent loss. Such error might occur from illegible and mis-recorded hand-written readings compiled by meter readers, inputting an incorrect meter register unit conversion factor in the automatic meter reading equipment, or a variety of similar errors.</p> <p>Apparent losses also occur from Data Analysis Errors in the archival and data reporting processes of the Customer Billing System. Inaccurate estimates used for accounts that fail to produce a meter reading are a common source of error. Billing adjustments may award customers a rightful monetary credit, but do so by creating a negative value of consumption, thus under-stating the actual consumption. Account activation lapses may allow new buildings to use water for months without meter readings and billing. Poor permitting and construction inspection practices can result in a new building lacking a billing account, a water meter and meter reading; i.e., the customer is unknown to the utility's billing system.</p> <p>Close auditing of the permitting, metering, meter reading, billing and reporting processes of the water consumption data trail can uncover data management gaps that create volumes of systematic data handling error. Utilities should routinely analyze customer billing records to detect data anomalies and quantify these losses. For example, a billing account that registers zero consumption for two or more billing cycles should be checked to explain why usage has seemingly halted. Given the revenue loss impacts of these losses, water utilities are well-justified in providing continuous oversight and timely correction of data transfer errors & data handling errors.</p> <p>If the water auditor has not yet gathered detailed data or assessment of systematic data handling error, it is recommended that the auditor apply the default value of 0.25% of the Billed Authorized Consumption volume. However, if the auditor has investigated the billing system and its controls, and has well validated data that indicates the volume from systematic data handling error is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations and select an appropriate grading. Note: negative values are not allowed for this audit component. If the auditor enters zero for this component then a grading of 1 will be automatically assigned.</p>
<p>Find</p>	<p>These costs include those for operations, maintenance and any annually incurred costs for long-term upkeep of the drinking water supply and distribution system. It should include the costs of day-to-day upkeep and long-term financing such as repayment of capital bonds for infrastructure expansion or improvement. Typical costs include employee salaries and benefits, materials, equipment, insurance, fees, administrative costs and all other costs that exist to sustain the drinking water supply. Depending upon water utility accounting procedures or regulatory agency requirements, it may be appropriate to include depreciation in the total of this cost. This cost should not include any costs to operate wastewater, biosolids or other systems outside of drinking water.</p>
<p>Find</p>	<p>Includes water illegally withdrawn from fire hydrants, illegal connections, bypasses to customer consumption meters, or tampering with metering or meter reading equipment; as well as any other ways to receive water while thwarting the water utility's ability to collect revenue for the water. Unauthorized consumption results in uncaptured revenue and creates an error that understates customer consumption. In most water utilities this volume is low and, if the water auditor has not yet gathered detailed data for these loss occurrences, it is recommended that the auditor apply a default value of 0.25% of the volume of water supplied. However, if the auditor has investigated unauthorized occurrences, and has well validated data that indicates the volume from unauthorized consumption is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations. Note that a value of zero will not be accepted since all water utilities have some volume of unauthorized consumption occurring in their system.</p> <p>Note: if the auditor selects the default value for unauthorized consumption, a data grading of 5 is automatically assigned, but not displayed on the Reporting Worksheet.</p>
<p>Find</p>	<p>UARL (gallons/day)=(5.41Lm + 0.15Nc + 7.5Lc) xP, or UARL (litres/day)=(18.0Lm + 0.8Nc + 25.0Lc) xP</p> <p>where: Lm = length of mains (miles or kilometres) Nc = number of customer service connections Lp = the average distance of customer service connection piping (feet or metres) (see the Worksheet "Service Connection Diagram" for guidance on deterring the value of Lp) Lc = total length of customer service connection piping (miles or km) Lc = Nc X Lp (miles or kilometres) P = Pressure (psi or metres)</p> <p>The UARL is a theoretical reference value representing the technical low limit of leakage that could be achieved if all of today's best technology could be successfully applied. It is a key variable in the calculation of the Infrastructure Leakage Index (ILI). Striving to reduce system leakage to a level close to the UARL is usually not needed unless the water supply is unusually expensive, scarce or both.</p> <p>NOTE: The UARL calculation has not yet been proven as fully valid for very small, or low pressure water distribution systems. If,</p> <p><u>in gallons per day:</u> (Lm x 32) + Nc < 3000 or P < 35psi</p> <p><u>in litres per day:</u> (Lm x 20) + Nc < 3000 or P < 25m</p> <p>then the calculated UARL value may not be valid. The software does not display a value of UARL or ILI if either of these conditions is true.</p>

Item Name	Description								
Unbilled Authorized Consumption <input type="button" value="Find"/>	<p>All consumption that is unbilled, but still authorized by the utility. This includes Unbilled Metered Consumption + Unbilled Unmetered Consumption. See "Authorized Consumption" for more information. For Unbilled Unmetered Consumption, the Free Water Audit Software provides the auditor the option to select a default value if they have not audited unmetered activities in detail. The default calculates a volume that is 1.25% of the Water Supplied volume. If the auditor has carefully audited the various unbilled, unmetered, authorized uses of water, and has established reliable estimates of this collective volume, then he or she may enter the volume directly for this component, and not use the default value.</p>								
Unbilled metered consumption <input type="button" value="Find"/>	<p>Metered consumption which is authorized by the water utility, but, for any reason, is <u>deemed by utility policy</u> to be unbilled. This might for example include metered water consumed by the utility itself in treatment or distribution operations, or metered water provided to civic institutions free of charge. It does not include water supplied to neighboring utilities (water exported) which may be metered but not billed.</p>								
Unbilled unmetered consumption <input type="button" value="Find"/>	<p>Any kind of Authorized Consumption which is neither billed or metered. This component typically includes water used in activities such as fire fighting, flushing of water mains and sewers, street cleaning, fire flow tests conducted by the water utility, etc. In most water utilities it is a small component which is very often substantially overestimated. It does NOT include water supplied to neighboring utilities (water exported) which is unmetered and unbilled – an unlikely case. This component has many sub-components of water use which are often tedious to identify and quantify. Because of this, and the fact that it is usually a small portion of the water supplied, it is recommended that the auditor apply the default value, which is 1.25% of the Water Supplied volume. Select the default percentage to enter this value.</p> <p>If the water utility <u>has</u> carefully audited the unbilled, unmetered activities occurring in the system, and has well validated data that gives a value substantially higher or lower than the default volume, then the auditor should enter their own volume. However the default approach is recommended for most water utilities.</p> <p>Note that a value of zero is not permitted, since all water utilities have some volume of water in this component occurring in their system.</p>								
Units and Conversions	<p>The user may develop an audit based on one of three unit selections:</p> <ol style="list-style-type: none"> 1) Million Gallons (US) 2) Megalitres (Thousand Cubic Metres) 3) Acre-feet <p>Once this selection has been made in the instructions sheet, all calculations are made on the basis of the chosen units. Should the user wish to make additional conversions, a unit converter is provided below (use drop down menus to select units from the yellow unit boxes):</p> <div style="text-align: center;"> <table border="1" style="margin: auto;"> <tr> <td style="padding: 5px;">Enter Units:</td> <td style="padding: 5px;">Convert From...</td> <td style="padding: 5px;">=</td> <td style="padding: 5px;">Converts to.....</td> </tr> <tr> <td style="padding: 5px; text-align: center;">1</td> <td style="padding: 5px; text-align: center;">Million Gallons (US)</td> <td style="padding: 5px;"></td> <td style="padding: 5px; text-align: center;">3.06888329 Acre-feet</td> </tr> </table> <p>(conversion factor = 3.06888328973723)</p> </div>	Enter Units:	Convert From...	=	Converts to.....	1	Million Gallons (US)		3.06888329 Acre-feet
Enter Units:	Convert From...	=	Converts to.....						
1	Million Gallons (US)		3.06888329 Acre-feet						
Use of Option Buttons	<p>To use the default percent value choose this button To enter a value choose this button and enter the value in the cell to the right </p> <div style="text-align: center; border: 1px solid gray; padding: 5px; width: fit-content; margin: auto;"> <table style="border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">Pcnt:</td> <td style="padding: 2px 5px;"><input checked="" type="radio"/></td> <td style="padding: 2px 5px;">Value:</td> <td style="padding: 2px 5px;"><input type="text"/></td> </tr> <tr> <td style="padding: 2px 5px;"></td> <td style="padding: 2px 5px;"><input type="radio"/></td> <td style="padding: 2px 5px;"></td> <td style="padding: 2px 5px;"></td> </tr> </table> </div> <p>NOTE: For Unbilled Unmetered Consumption, Unauthorized Consumption and Systematic Data Handling Errors, a recommended default value can be applied by selecting the Percent option. The default values are based on fixed percentages of Water Supplied or Billed Authorized Consumption and are recommended for use in this audit unless the auditor has well validated data for their system. Default values are shown by purple cells, as shown in</p> <p>If a default value is selected, the user does not need to grade the item; a grading value of 5 is automatically applied (however, this grade will not be</p>	Pcnt:	<input checked="" type="radio"/>	Value:	<input type="text"/>		<input type="radio"/>		
Pcnt:	<input checked="" type="radio"/>	Value:	<input type="text"/>						
	<input type="radio"/>								
Variable production cost (applied to Real Losses) <input type="button" value="Find"/>	<p>The cost to produce and supply the next unit of water (e.g., \$/million gallons). This cost is determined by calculating the summed unit costs for ground and surface water treatment and all power used for pumping from the source to the customer. It may also include other miscellaneous unit costs that apply to the production of drinking water. It should also include the unit cost of bulk water purchased as an import if applicable.</p> <p>It is common to apply this unit cost to the volume of Real Losses. However, if water resources are strained and the ability to meet future drinking water demands is in question, then the water auditor can be justified in applying the Customer Retail Rate to the Real Loss volume, rather than applying the Variable Production Cost.</p> <p>The Free Water Audit Software applies the Variable Production costs to Real Losses by default. However, the auditor has the option on the Reporting Worksheet to select the Customer Retail Cost as the basis for the Real Loss cost evaluation if the auditor determines that this is warranted.</p>								
Volume from own sources <input type="button" value="Find"/>	<p>The volume of water withdrawn (abstracted) from water resources (rivers, lakes, streams, wells, etc) controlled by the water utility, and then treated for potable water distribution. Most water audits are compiled for utility retail water distribution systems, so this volume should reflect the amount of <u>treated</u> drinking water that entered the distribution system. Often the volume of water measured at the effluent of the treatment works is slightly less than the volume measured at the raw water source, since some of the water is used in the treatment process. Thus, it is useful if flows are metered at the effluent of the treatment works. If metering exists only at the raw water source, an adjustment for water used in the treatment process should be included to account for water consumed in treatment operations such as filter backwashing, basin flushing and cleaning, etc. If the audit is conducted for a wholesale water agency that sells untreated water, then this quantity reflects the measure of the raw water, typically metered at the source.</p>								

Item Name	Description
Volume from own sources: Master meter and supply error adjustment <input type="button" value="Find"/>	<p>An estimate or measure of the degree of inaccuracy that exists in the master (production) meters measuring the annual Volume from own Sources, and any error in the data trail that exists to collect, store and report the summary production data. This adjustment is a weighted average number that represents the collective error for all master meters for all days of the audit year and any errors identified in the data trail. Meter error can occur in different ways. A meter or meters may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Data error can occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of inaccuracy in master meters and data errors in archival systems are common; thus a value of zero should <u>not</u> be entered. Enter a negative percentage or value for metered data under-registration; or, enter a positive percentage or value for metered data over-registration.</p>
Water exported <input type="button" value="Find"/>	<p>The Water Exported volume is the bulk water conveyed and sold by the water utility to neighboring water systems that exists outside of their service area. Typically this water is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water utility that is selling the water: i.e. the exporter. If the water utility who is compiling the annual water audit sells bulk water in this manner, they are an exporter of water.</p> <p>Note: The Water Exported volume is sold to wholesale customers who are typically charged a wholesale rate that is different than retail rates charged to the retail customers existing within the service area. Many state regulatory agencies require that the Water Exported volume be reported to them as a quantity separate and distinct from the retail customer billed consumption. For these reasons - and others - the Water Exported volume is always quantified separately from Billed Authorized Consumption in the standard water audit. Be certain not to "double-count" this quantity by including it in both the Water Exported box and the Billed Metered Consumption box of the water audit Reporting Worksheet. This volume should be included only in the Water Exported box.</p>
Water exported: Master meter and supply error adjustment <input type="button" value="Find"/>	<p>An estimate or measure of the volume in which the Water Exported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived exported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of error in their metered data, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived data. Thus, a value of zero should <u>not</u> be entered. Enter a negative percentage or value for metered data under-registration; or enter a positive percentage or value for metered data over-registration. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. Corrections to data gaps or other errors found in the archived data should also be included as a portion of this meter error adjustment.</p>
Water imported <input type="button" value="Find"/>	<p>The Water Imported volume is the bulk water purchased to become part of the Water Supplied volume. Typically this is water purchased from a neighboring water utility or regional water authority, and is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water supplier selling the water to the utility conducting the water audit. The water supplier selling the bulk water usually charges the receiving utility based upon a wholesale water rate.</p>
Water imported: Master meter and supply error adjustment <input type="button" value="Find"/>	<p>An estimate or measure of the volume in which the Water Imported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived imported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some level of meter inaccuracy, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived metered data. Thus, a value of zero should <u>not</u> be entered. Enter a negative percentage or value for metered data under-registration; or, enter a positive percentage or value for metered data over-registration. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment.</p>
WATER LOSSES <input type="button" value="Find"/>	<p>= apparent losses + real losses</p> <p>Water Losses are the difference between Water Supplied and Authorized Consumption. Water losses can be considered as a total volume for the whole system, or for partial systems such as transmission systems, pressure zones or district metered areas (DMA); if one of these configurations are the basis of the water audit.</p>



AWWA Free Water Audit Software: Determining Water Loss Standing

WAS v5.0

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Water Audit Report for: **Twain Harte Community Services District (CA5510005)**

Reporting Year: **2020** **1/2020 - 12/2020**

Data Validity Score: **52**

Water Loss Control Planning Guide

Functional Focus Area	Water Audit Data Validity Level / Score				
	Level I (0-25)	Level II (26-50)	Level III (51-70)	Level IV (71-90)	Level V (91-100)
Audit Data Collection	Launch auditing and loss control team; address production metering deficiencies	Analyze business process for customer metering and billing functions and water supply operations. Identify data gaps.	Establish/revise policies and procedures for data collection	Refine data collection practices and establish as routine business process	Annual water audit is a reliable gauge of year-to-year water efficiency standing
Short-term loss control	Research information on leak detection programs. Begin flowcharting analysis of customer billing system	Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc.	Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring	Refine, enhance or expand ongoing programs based upon economic justification	Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation
Long-term loss control		Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or Automatic Meter Reading (AMR) system.	Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process.	Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management	Continue incremental improvements in short-term and long-term loss control interventions
Target-setting			Establish long-term apparent and real loss reduction goals (+10 year horizon)	Establish mid-range (5 year horizon) apparent and real loss reduction goals	Evaluate and refine loss control goals on a yearly basis
Benchmarking			Preliminary Comparisons - can begin to rely upon the Infrastructure Leakage Index (ILI) for performance comparisons for real losses (see below table)	Performance Benchmarking - ILI is meaningful in comparing real loss standing	Identify Best Practices/ Best in class - the ILI is very reliable as a real loss performance indicator for best in class service

For validity scores of 50 or below, the shaded blocks should not be focus areas until better data validity is achieved.

Once data have been entered into the Reporting Worksheet, the performance indicators are automatically calculated. How does a water utility operator know how well his or her system is performing? The AWWA Water Loss Control Committee provided the following table to assist water utilities in gauging an approximate Infrastructure Leakage Index (ILI) that is appropriate for their water system and local conditions. The lower the amount of leakage and real losses that exist in the system, then the lower the ILI value will be.

Note: this table offers an approximate guideline for leakage reduction target-setting. The best means of setting such targets include performing an economic assessment of various loss control methods. However, this table is useful if such an assessment is not possible.

**General Guidelines for Setting a Target ILI
(without doing a full economic analysis of leakage control options)**

Target ILI Range	Financial Considerations	Operational Considerations	Water Resources Considerations
1.0 - 3.0	Water resources are costly to develop or purchase; ability to increase revenues via water rates is greatly limited because of regulation or low ratepayer affordability.	Operating with system leakage above this level would require expansion of existing infrastructure and/or additional water resources to meet the demand.	Available resources are greatly limited and are very difficult and/or environmentally unsound to develop.
>3.0 -5.0	Water resources can be developed or purchased at reasonable expense; periodic water rate increases can be feasibly imposed and are tolerated by the customer population.	Existing water supply infrastructure capability is sufficient to meet long-term demand as long as reasonable leakage management controls are in place.	Water resources are believed to be sufficient to meet long-term needs, but demand management interventions (leakage management, water conservation) are included in the long-term
>5.0 - 8.0	Cost to purchase or obtain/treat water is low, as are rates charged to customers.	Superior reliability, capacity and integrity of the water supply infrastructure make it relatively immune to supply shortages.	Water resources are plentiful, reliable, and easily extracted.
Greater than 8.0	Although operational and financial considerations may allow a long-term ILI greater than 8.0, such a level of leakage is not an effective utilization of water as a resource. Setting a target level greater than 8.0 - other than as an incremental goal to a smaller long-term target - is discouraged.		
Less than 1.0	If the calculated Infrastructure Leakage Index (ILI) value for your system is 1.0 or less, two possibilities exist. a) you are maintaining your leakage at low levels in a class with the top worldwide performers in leakage control. b) A portion of your data may be flawed, causing your losses to be greatly understated. This is likely if you calculate a low ILI value but do not employ extensive leakage control practices in your operations. In such cases it is beneficial to validate the data by performing field measurements to confirm the accuracy of production and customer meters, or to identify any other potential sources of error in the data.		



AWWA Water Audit Software Version 5.0 Developed by the Water Loss Control Committee of the American Water Works Association August, 2014

This software is intended to serve as a basic tool to compile a preliminary, or “top-down”, water audit. It is recommended that users also refer to the current edition of the AWWA M36 Publication, Water Audits and Loss Control Programs, for detailed guidance on compiling a comprehensive, or “bottom-up”, water audit using the same water audit methodology.

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- AWWA Water Audits and Loss Control Programs, M36 Publication, 3rd Edition, 2009
- Service Connection Diagrams courtesy of Ronnie McKenzie, WRP Pty Ltd.

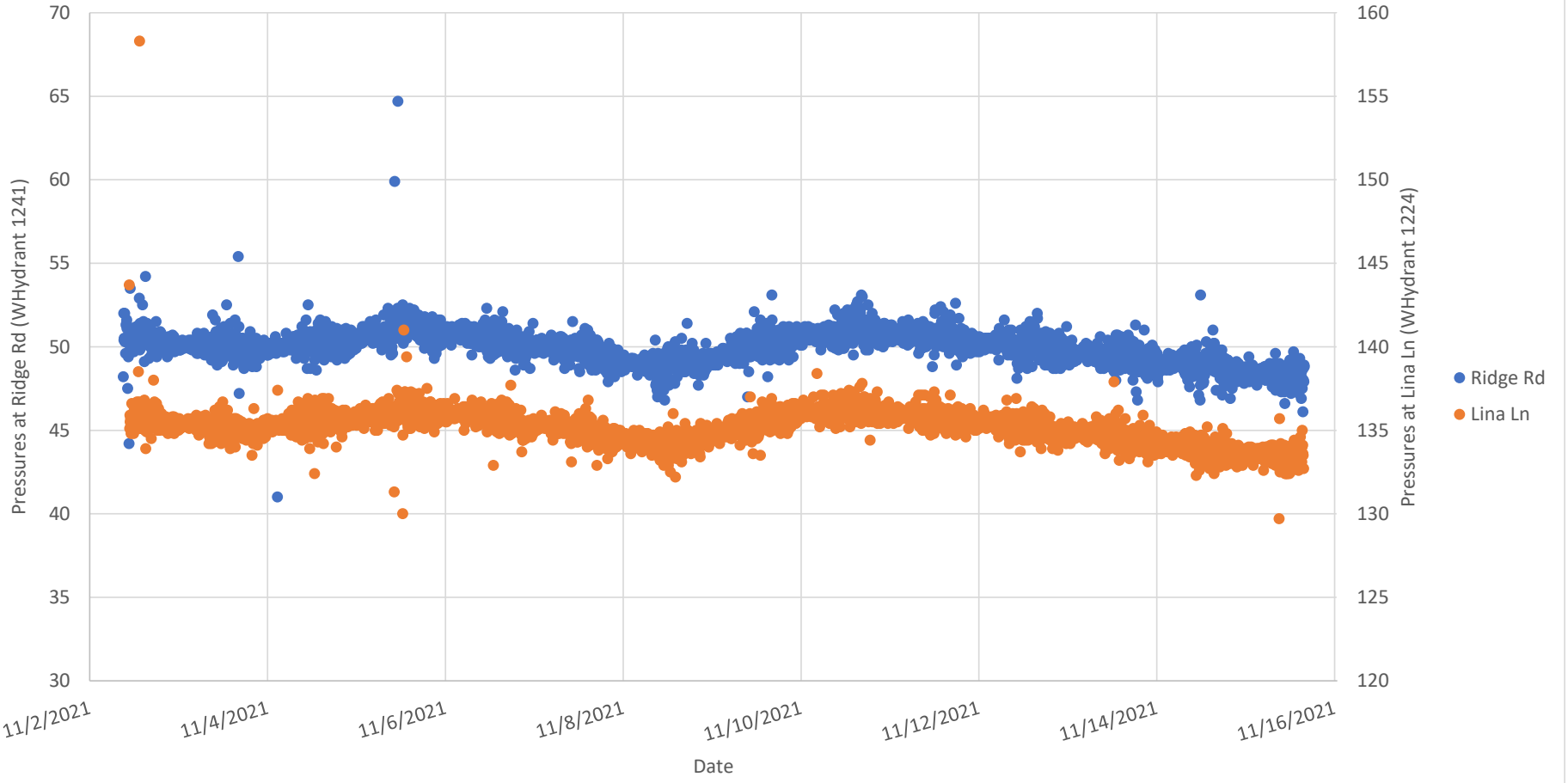
VERSION HISTORY:

Version:	Release Date:	Number of Worksheets:	Key Features and Developments
v1	2005/ 2006	5	The AWWA Water Audit Software was piloted in 2005 (v1.0 beta). The early versions (1.x) of the software restricted data entry to units of Million Gallons per year. For each entry into the audit, users identified whether the input was measured or estimated.
v2	2006	5	The most significant enhancement in v2 of the software was to allow the user to choose the volumetric units to be used in the audit, Million Gallons or Thousand Cubic Metres (megalitres) per year. Two financial performance indicators were added to provide feedback to the user on the cost of Real and Apparent losses.
v3	2007	7	In v3, the option to report volumetric units in acre-feet was added. Another new feature in v3 was the inclusion of default values for two water audit components (unbilled unmetered and unauthorized consumption). v3 also included two examples of completed audits in units of million gallons and Megalitres. Several checks were added into v3 to provide instant feedback to the user on common data entry problems, in order to help the user complete an accurate water audit.
v4 - v4.2	2010	10	v4 (and versions 4.x) of the software included a new approach to data grading. The simple "estimated" or "measured" approach was replaced with a more granular scale (typically 1-10) that reflected descriptions of utility practices and served to describe the confidence and accuracy of the input data. Each input value had a corresponding scale fully described in the Grading Matrix tab. The Grading Matrix also showed the actions required to move to a higher grading score. Grading descriptions were available on the Reporting Worksheet via a pop-up box next to each water audit input. A water audit data validity score is generated (max = 100) and priority areas for attention (to improve audit accuracy) are identified, once a user completes the required data grading. A service connection diagram was also added to help users understand the impact of customer service line configurations on water losses and how this information should be entered into the water audit software. An acknowledgements section was also added. Minor bug fixes resulted in the release of versions 4.1 and 4.2. A French language version was also made available for v4.2.
v5	2014	12	In v5, changes were made to the way Water Supplied information is entered into software, with each major component having a corresponding Master Meter Error Adjustment entry (and data grading requirement). This required changes to the data validity score calculation; v5 of the software uses a weighting system that is, in part, proportional to the volume of input components. The Grading Matrix was updated to reflect the new audit inputs and also to include clarifications and additions to the scale descriptions. The appearance of the software was updated in v5 to make the software more user-friendly and several new features were added to provide more feedback to the user. Notably, a dashboard tab has been added to provide more visual feedback on the water audit results and associated costs of Non-Revenue Water. A comments sheet was added to allow the user to track notes, comments and to cite sources used.

Attachment C

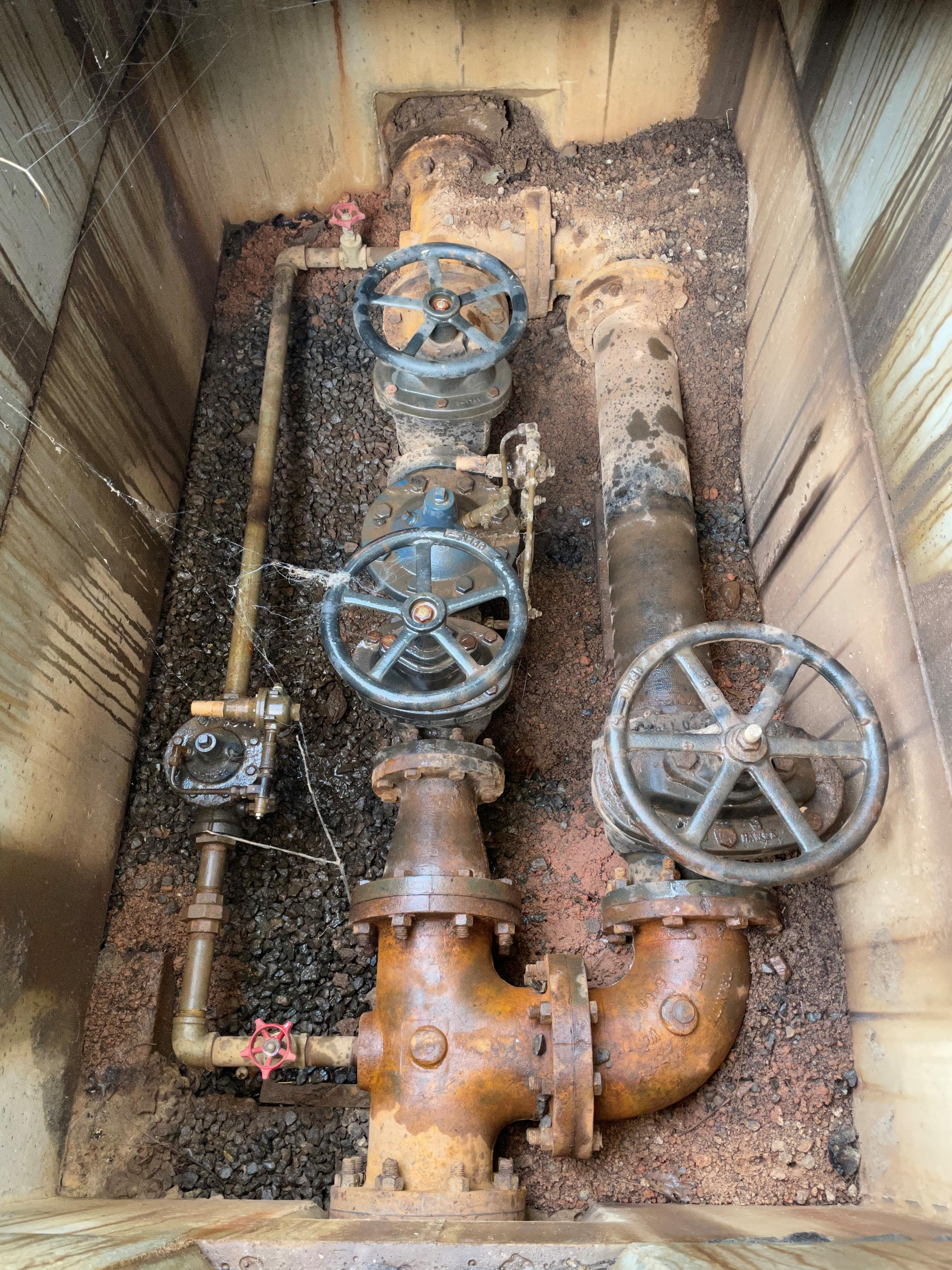
Pressure Logger Data from Lilac Terrace

Pressure Logger Data - Lilac Terrace Area



Attachment D

Pressure Reducing Station Photo



Corporate Risk Matrix

Twain Harte Community Services District | March 2022

Consequence of Failure						
<p>Safety 15%</p>	No injury, no lost time. No exposure	Minor Injury – contusions & lacerations w/out lost time, first aid applied. Low exposure	Moderate injury, medical claims \$1k-\$20K, lost time or restricted duty. Medium exposure (e.g. traffic control)	Major injury, serious health issues (acute & chronic) – disabling; medical claim of \$20K-\$250K, considerable lost time. High exposure (e.g. confined space)	Fatalities; Permanent Disability, Medical claims >\$250K. Extreme exposure (e.g. trenching)	Safety
<p>Environmental and Regulatory Impact 15%</p>	No negative impacts on environment, public health or regulatory compliance	No negative impacts on environment or public health; (i.e. incidental discharge of drinking water that is immediately contained)	Minor compliance issues (i.e. SDWA violation quickly resolved or small drinking water leak/discharge not dechlorinated)	Moderate negative impact to the environment and/or public health; Public complaint of illness resulting in financial or legal impact (i.e. results in formal enforcement response)	Significant negative impact to the environment and/or public health; major permit violation i.e. "Serious Violator" EPA status or results in multiple formal enforcement responses)	Environmental and Regulatory Impact
<p>Reliable Service Impact 25%</p>	No impacts on service delivery or customers. No complaints	Impact limited to individual customers. 0-3 complaints	Moderate localized impact to groups of customers; two hours or less of service disruption. 3-5 complaints	Individual zone impacts with potential service disruption of 12 hours or less. Local media coverage, 5-10 complaints. Social media coverage.	Service area-wide impacts; Long-term service outages surpassing 12 hours. 10+ complaints.	Reliable Service Impact
<p>Most Extreme Frequency 15%</p>	Annually	Quarterly	Monthly	Weekly	Daily	Most Extreme Frequency
<p>Fiscal Impact 20%</p>	< \$5K	\$5-25K	\$25-60K	\$60-200K	\$200K+	Fiscal Impact
<p>Damages 10%</p>	No damage to any adjacent facilities	Minor localized damage to private property. Couple hours of cleanup	One day of cleanup/repairs	Insurance claim - small to medium	Major insurance claim	Damages

Asset Risk Evaluation

