Indian Health Service

Water Loss Program:

AWWA M36 Workshop
Day 2

March 16, 2022

CAVANAUGH
Stewardship Through Innovation

Agenda – Day 2

Review from Day 1

AWWA Free Water Audit Software

Demonstration

Developing the Inputs

Breakout Exercise

Common Exercise – Developing the Inputs

Break

Review of Common Exercise

Data Validity

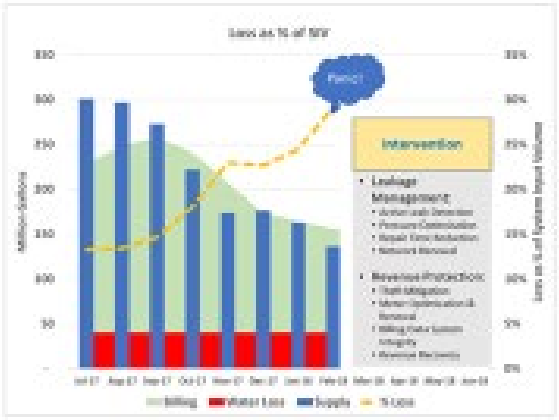
Data Validity Score

AWWA Free Water Audit Software – Interactive Data Grading

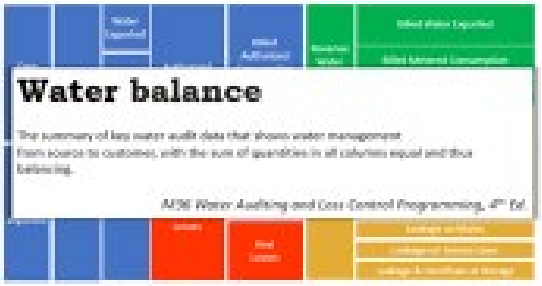
Importance of Level 1 Validation

Summary Review & Wrap-Up

Review from Day 1



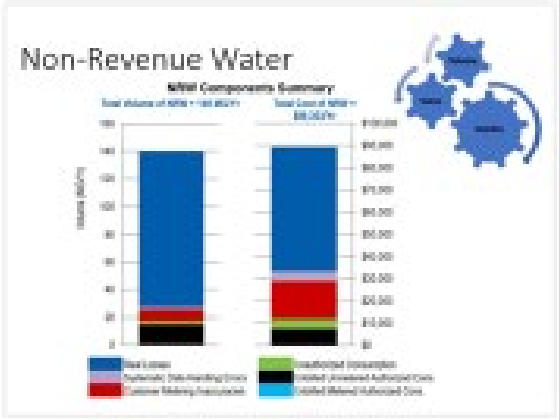
The Water Balance & Water Auditing



The Big Picture

The Water Balance & Water Auditing

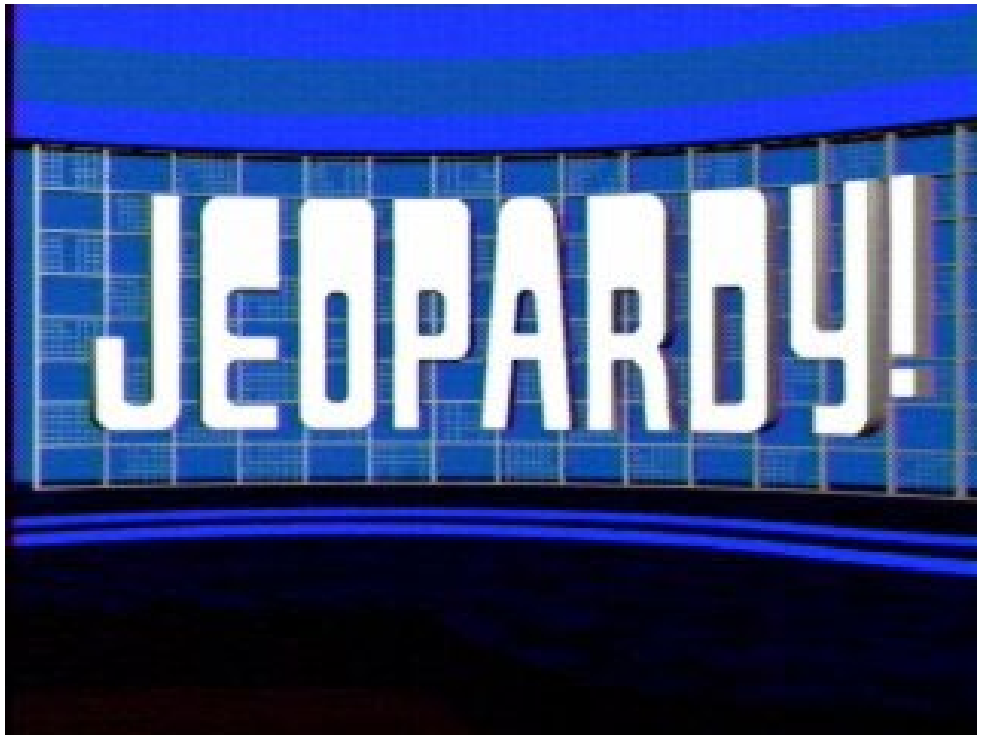
Non-Revenue Water



3-V

Dashboard

Water Audit Jeopardy!



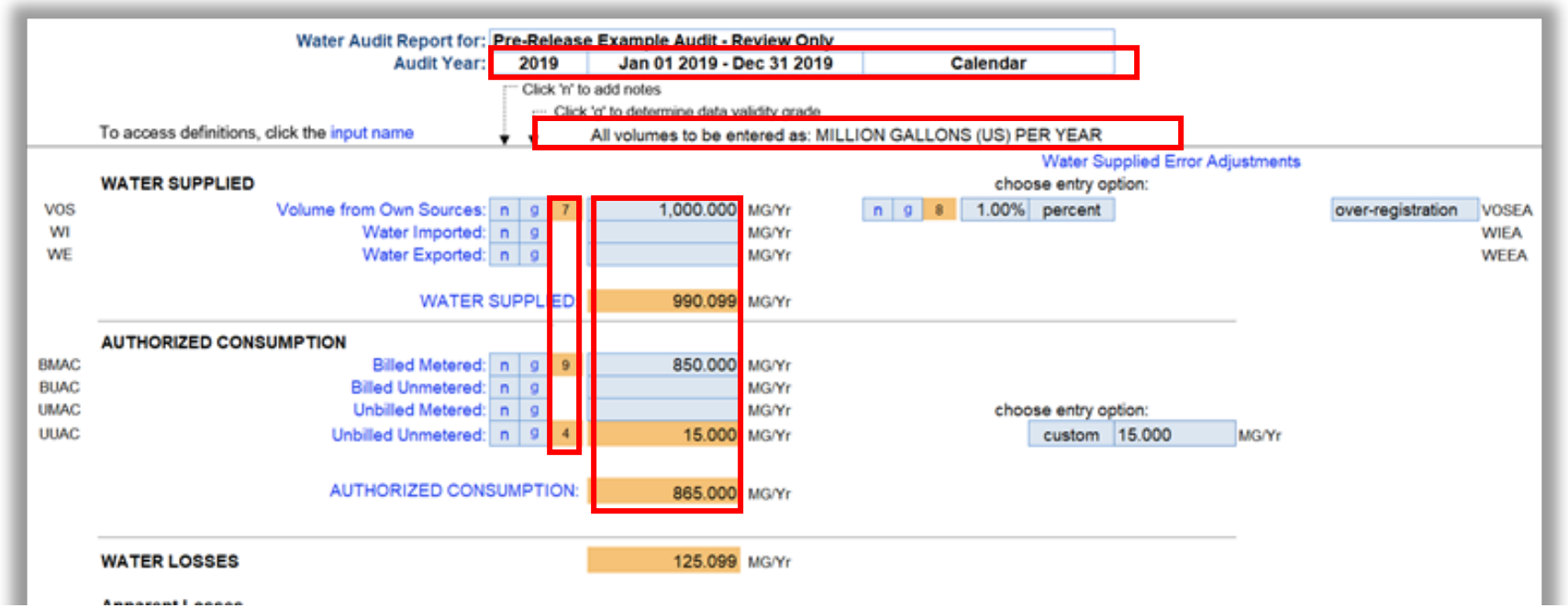
AWWA Free Water Audit Software

Demonstration

Developing the Inputs

AWWA Free Water Audit Software

Developing the Inputs



Developing the Inputs

1. Assemble supporting documents

2. Develop the data inputs

3. Check the metrics

Supporting Documentation

provides more detail on key values

When compiling supporting documents, remember!

- excel spreadsheets, text files preferred over PDFs for tabular data
- include notes on any exceptions, corrections, or data gymnastics included in your audit input calculation

Supporting Documentation

provides more detail on key values

REQUIRED	SUPPLEMENTAL
❑ Volume from Own Sources *broken down by month and meter* ❑ Water Imported *broken down by month and meter* ❑ Water Exported *broken down by month and meter* ❑ Supply Meter Test Records *for all supply meters, if conducted* ❑ Volume of Metered Consumption *broken down by month and use type/code*	❑ Customer Meter Inaccuracy derivation ❑ Average Operating Pressure derivation ❑ Customer Retail Unit Cost derivation ❑ Variable Production Cost derivation ❑ System Schematic *showing locations of Supply and Export Meters*

Step 1 – Assemble the Supporting Documents

Indian Health Service
Water Loss Program

CAVANAUGH
Stewardship Through Innovation

- Timeframe for the data requested unless noted otherwise: Calendar Year 2021.
- Format for the data requested: **Excel preferred**, scan or PDF if Excel format not available.

1. Calendar Year 2021 water audit, in AWWA Free Water Audit Software format (v6.0) – this version to be delivered to participants with adequate time before the December workshops.
   a. Just do your best to complete the worksheet including inputs and interactive data grades.
   b. If you also are tracking water loss in your own format, please provide that as well.
2. Water Supplied
   - Basic schematic showing where supply meters are located relative to distribution system, including any export or import meters, and pressure zones if applicable
   - Inventory or your finished water meters, import water meters and export water meters – size, type & age.
   - Provide your current policy for flow testing and/or signal calibration of these meters, if you have one.
   - Provide all available records/reports/data from testing and/or calibration activities for each finished water and/or purchase meter

Example of Supporting Documentation for all Water Supplied Volumes

Volume from Own Sources, Water Imported, Water Exported
UNITS = MG

Month	Import M-1	Well 1	Well 2	Well 3	Export E-1	Monthly Distribution Totals
May 2017	*125.48*	*15.33*	*11.19*	*45.61*	-	*197.60*
June 2017	*170.61*	-	*55.48*	*30.59*	-	*256.68*
July 2017	202.11	5.75	60.58	36.22	-	304.67
August 2017	185.45	2.03	37.67	32.58	-	257.74
September 2017	178.74	1.49	34.31	32.04	-	246.59
October 2017	171.39	-	25.15	-	5.18	191.36
November 2017	123.00	2.31	39.35	32.85	45.79	151.72
December 2017	49.11	5.43	58.60	35.91	22.46	126.58
January 2018	31.56	34.60	23.82	64.49	-	154.46
February 2018	7.29	31.94	22.20	61.89	-	123.32
March 2018	6.06	31.22	21.70	61.18	-	120.17
April 2018	58.44	35.56	24.43	65.44	-	183.87

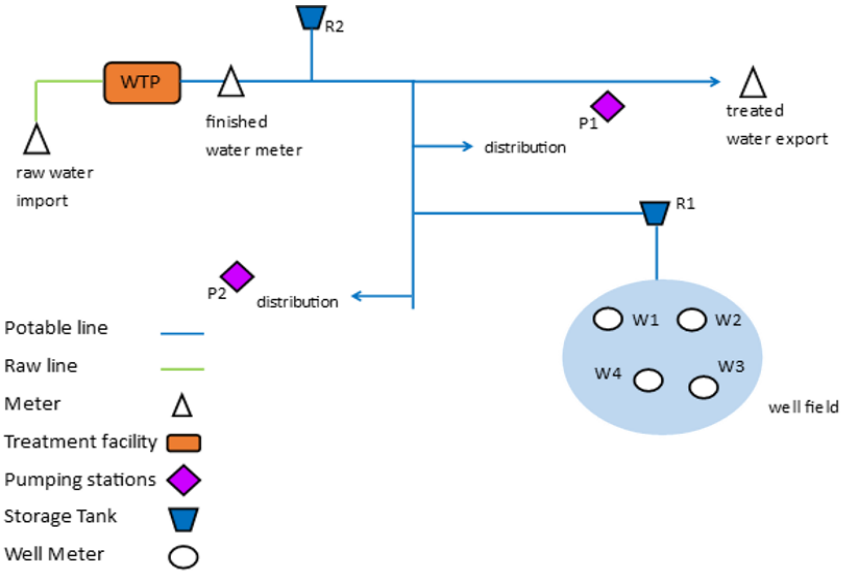
Example of Supporting Documentation for Billed Metered Authorized Consumption

Water Sold, UNITS = MG

Month	*May 2017*	*June 2017*	July 2017	August 2017	September 2017	October 2017	November 2017	December 2
Single Family Residential	*31.15*	*32.81*	38.42	28.18	42.15	47.77	48.99	5
Multi Family Residential	*16.07*	*15.55*	18.54	17.84	18.49	17.65	19.29	2
Commericial/Institutional	*12.67*	*14.23*	8.78	8.96	10.84	13.01	12.91	1
Industrial	*1.20*	*1.40*	1.40	1.50	1.20	1.10	1.60	
Landscape Irrigation	*10.02*	*7.56*	2.54	4.82	8.42	10.48	11.94	1
Municipal	*3.45*	*2.88*	2.22	2.25	2.56	2.93	2.91	
Water Department	*1.42*	*1.10*	1.50	1.55	1.05	1.66	1.20	
Recycled	*8.53*	*9.11*	10.08	8.04	10.83	11.95	12.20	1

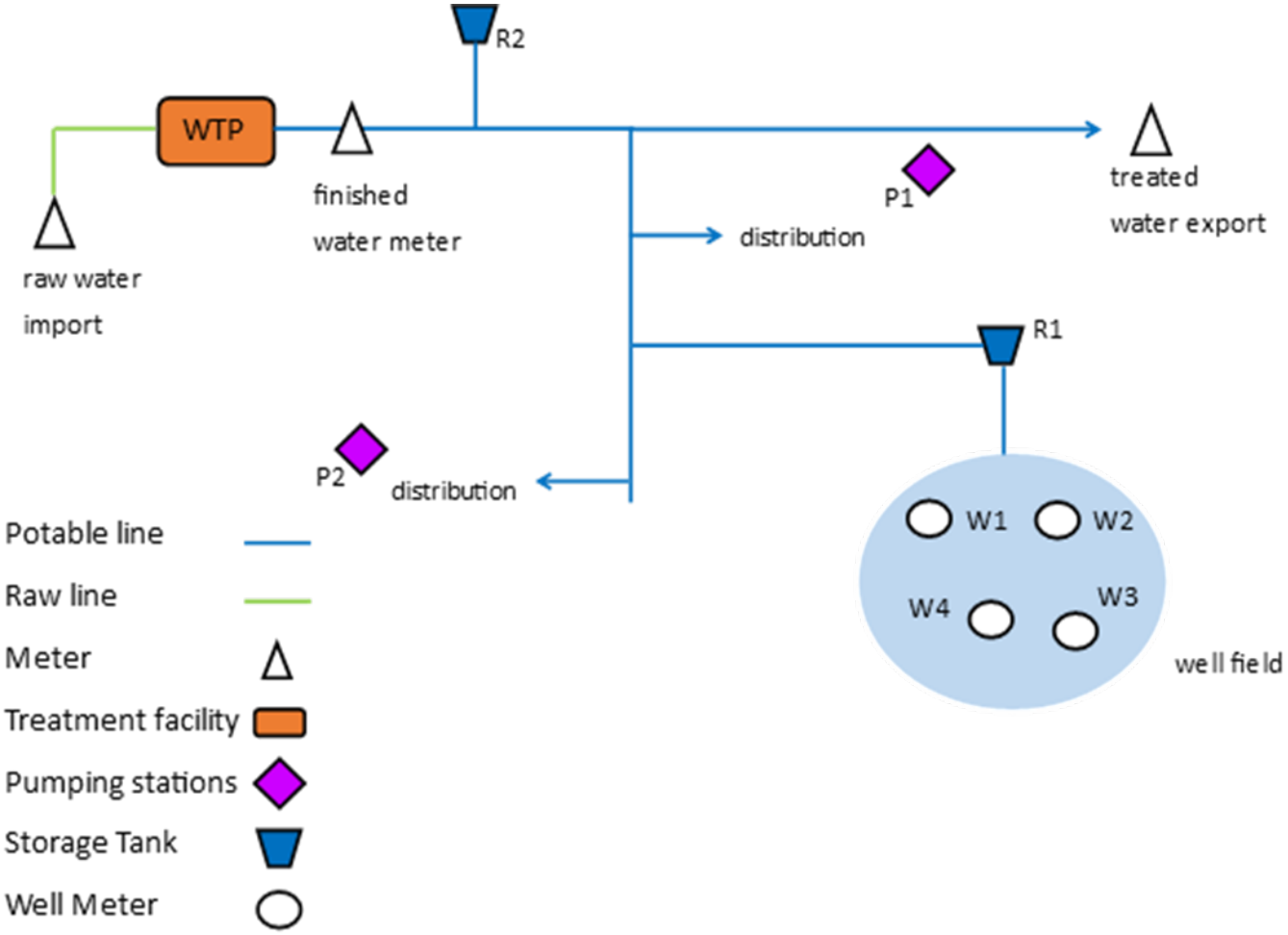
WATER AUDIT TOTALS
excludes recycled water accounts

Billed Metered Authorized Consumption:	1,051.33	MG	*includes SF Residential, MF Re*
Billed Unmetered Authorized Consumption:	N/A		*all billed customers have a me*
Unbilled Metered Authorized Consumption:	17.27	MG	*this includes our own facility u*
Unbilled Unmetered Authorized Consumption:			*this includes minimal flushing,*



Walk-Through of Supporting Documentation

System Schematic



Water Supplied

Volume from Own Sources

UNITS = MG				
Month	**Meter 1**	**Meter 2**	**Meter 3**	**Monthly Distribution Totals**
November 2020	*254.86*	*132.65*	*45.61*	*433.12*
December 2020	*355.89*	*111.78*	*30.59*	*498.26*
January 2021	339.87	111.06	27.764	478.69
February 2021	279.90	91.46	22.864	394.22
March 2021	379.86	124.10	31.024	534.98
April 2021	439.84	143.72	35.93	619.49
May 2021	579.78	189.45	47.362	816.59
June 2021	599.78	195.98	48.996	844.76
July 2021	679.75	222.11	55.528	957.39
August 2021	719.73	235.18	58.794	1,013.70
September 2021	599.78	195.98	48.996	844.76
October 2021	479.82	156.78	39.19	
November 2021	399.85	130.66	32.66	
December 2021	359.87	117.59	29.39	
January 2022	*345.77*	*106.33*	*34.0*	
February 2022	*340.02*	*101.22*	*34.6*	
VOS Total	5857.83	1914.06	478.5	

Reminders for Water Supplied (VOS, WI, WE) Supporting Documentation

* volume produced per meter by month
* measuring raw or treated water?
* any backwash or flow to waste setups to account for?
* any water-wheeling or special arrangments to account for?

Authorized Consumption

Water Sold, UNITS = Gallons

Month	J-21	F-21	M-21	A-21	M-21	J-21	J-21	A-21	S-21	O-21	N-21	D-21	2021 TOTAL
Single Family Residential	122,393,949	100,795,017	136,793,237	158,392,169	208,789,677	215,989,321	244,787,897	259,187,185	215,989,321	172,791,457	143,992,881	129,593,593	2,109,495,704.67
Multi Family Residential	61,196,974	50,397,508	68,396,618	79,196,085	104,394,839	107,994,661	122,393,949	129,593,593	107,994,661	86,395,729	71,996,440	64,796,796	1,054,747,852.33
Commericial	85,053,422	70,043,995	95,059,707	110,069,135	145,091,132	150,094,274	170,106,844	180,113,129	150,094,274	120,075,419	100,062,849	90,056,565	1,465,920,744.67
Municipal	42,526,711	35,021,997	47,529,853	55,034,567	72,545,566	75,047,137	85,053,422	90,056,565	75,047,137	60,037,710	50,031,425	45,028,282	732,960,372.33

Unmetered Use	Estimated Volume for 2021 in MG:
WQ flushing	2.35
Complaint flushing	0.059
Repair flushing	0.85
Fire Department	1.758
New construction flushing	2.22
Street cleaning	0.98
Sewer jetting	4.15

Reminders for Billed Metered Authorized Consumption (BMAC) Supporting Documentation:

* volume billed per customer class (or rate code, or account type) by month
* highlight and exclude any non-potable customer classes
* highlight any customer classes (like water utility or facility use) that does not generate revenue (unbilled!)

System Data

Length of Mains

1756458	Length of all Water Lines (ft)
1580	Number of Fire Hydrants (ea)
15	Average Fire Hydrant Lead Length (ft)
23700	Length of Fire Hydrant Leads
1780158	Total Length of Mains (ft)
337.1511364	**Total Length of Mains (mi)**

Active Service Connections

11081	Total Number of Services
	Adjustments
	Less Number of Fire Service Meters on Lateral Tees
	Less Number of Fire Service Meters on Manifolds
	Less Number of M&I Meters on Manifolds
	Plus Number of Manifolds
1347	Subtotal Adjustments
9734	**Total Active and Inactive Service Connections**

Water System Zones and Pressures

	HIGH psi	LOW psi	AVERAGE psi
ZONE 1	133	110	121.5
ZONE 2	69	51	60
ZONE 3	93	40	66.5
ZONE 4	129	48	88.5
ZONE 5	111	39	75
ZONE 6	115	93	104
ZONE 7	129	40	84.5
ZONE 8	70	68	69
ZONE 9	74	64	69

Cost Data

Customer Retail Unit Cost

Method 1 (revenue / billed metered)

Consumptive revenue ($) divided by Billed Metered (volume)

Customer Retail Unit Cost - Method 2 (weighted rate)

Customer classes	Volume sold (gal)	% Volume Sold	Rate	Weighted Rate
Residential - Single Family	2,109,495,705	39%	$ 4.65	$ 1.83
Residential - Mulit Family	1,054,747,852	20%	$ 4.65	$ 0.91
Commercial	1,465,920,745	27%	$ 5.65	$ 1.54
Municipal	732,960,372	14%	$ 5.65	$ 0.77
Total	5,363,124,674			$ 5.06 water - weighted avg

Sewer revenues	Volume sold (MG)	% Sewer sold	Sewer - single rate	Sewer - prorated
water sold	5363.12	64%	$ 5.81	$ 3.74
sewer sold	3448.98			
				$ 8.80 per 1000 gallons

Variable Production Cost (Primary costs only)

Primary cost	Amount ($)
chemical	$1,093,145.38
power	$2,263,889.57
	$3,357,034.95
VPC	$406.89 per MG

Developing the Inputs

1. Assemble supporting documents

Must-have docs

2. Develop the data inputs

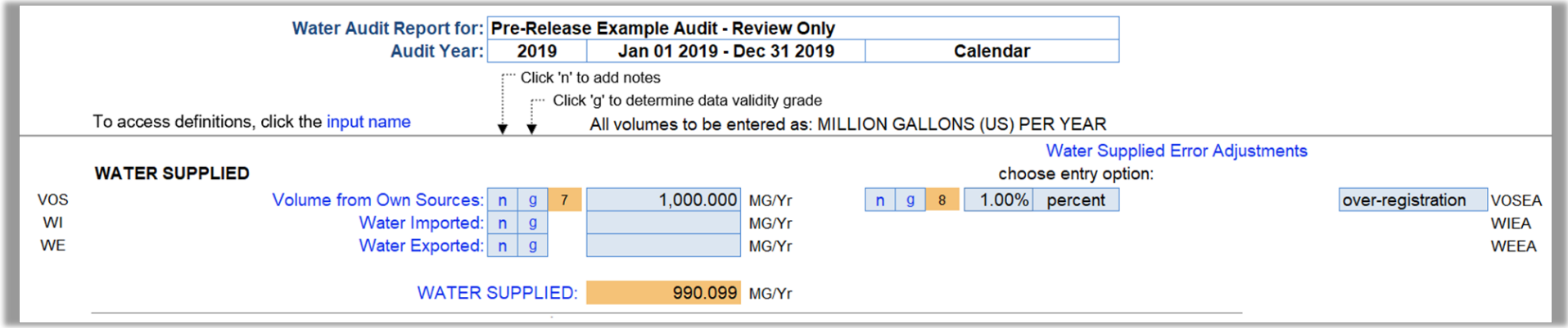
Good-to-have docs

3. Check the metrics

Developing the Inputs

1. Assemble supporting documents
   - → Must-have docs
   - → Good-to-have docs
2. Develop the data inputs
   - → Build it from supporting docs
   - → Look for errors. Does the data make sense?
3. Check the metrics

Step 2 – Develop the Inputs



Water Audit Report for: Pre-Release Example Audit - Review Only
Audit Year: 2019 | Jan 01 2019 - Dec 31 2019 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To access definitions, click the input name

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

WATER SUPPLIED

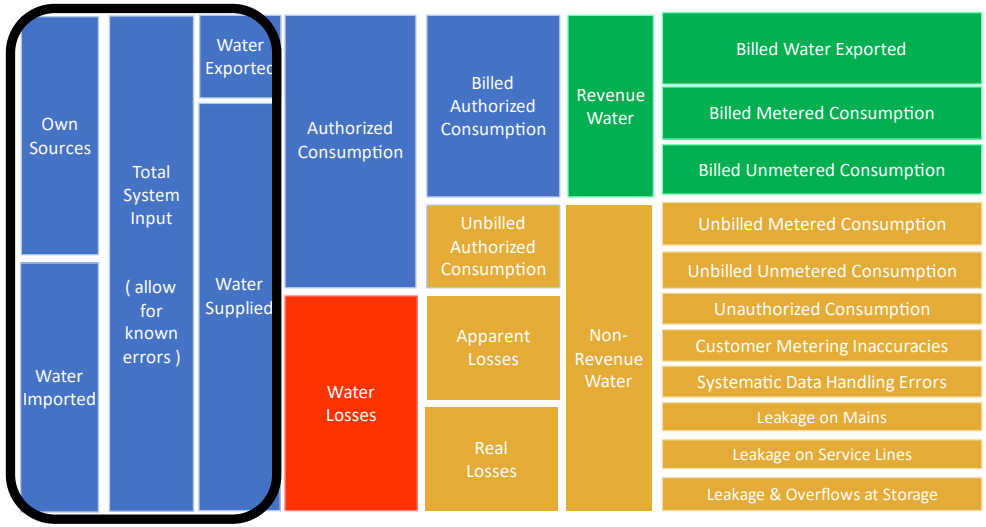
VOS	Volume from Own Sources:	n	g	7	1,000.000	MG/Yr	n	g	8	1.00% percent	over-registration	VOSEA
WI	Water Imported:	n	g			MG/Yr						WIEA
WE	Water Exported:	n	g			MG/Yr						WEEA
	WATER SUPPLIED:				990.099	MG/Yr						

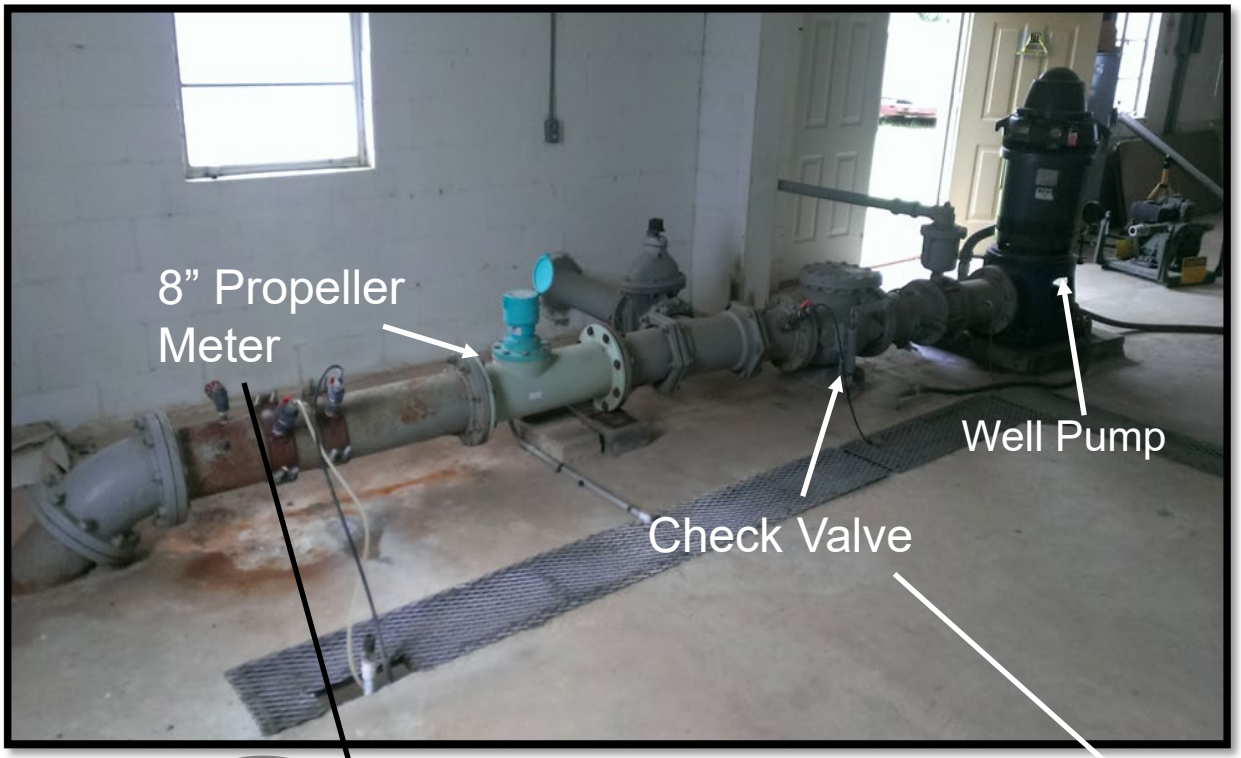
Water Supplied Error Adjustments
choose entry option:

- **Develop the Input**
  - Trace from production reports
  - Trace from testing reports
- **Look for Potential Errors**
  - Missing or extra volumes
  - Mismatched timeframe
  - Error adjustment should be a weighted average of test results (if available)
  - Wrong + or – on error adjustment

Potential Errors in Water Supplied

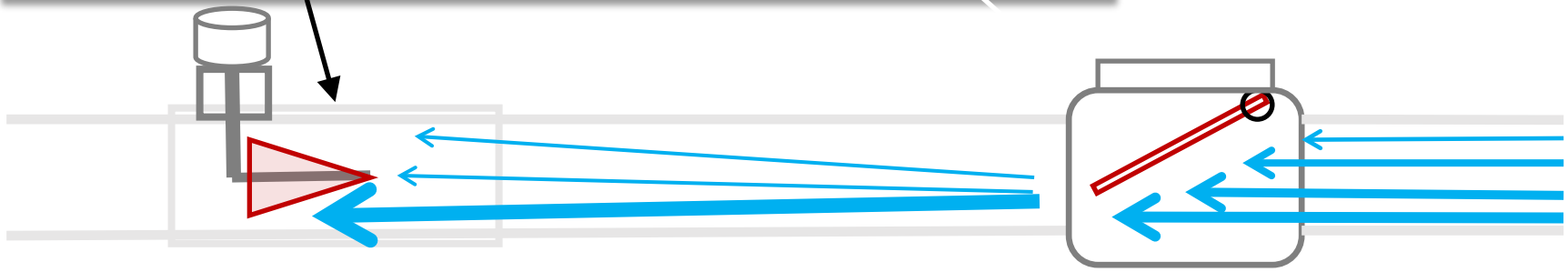
- Meter wear
- Meter location
- Meter selection
- Meter programming
- Flow data archiving





Accuracy results from MFR test bench: 99.5%

Accuracy results from in-situ test: 142.2%



Courtesy MESCO

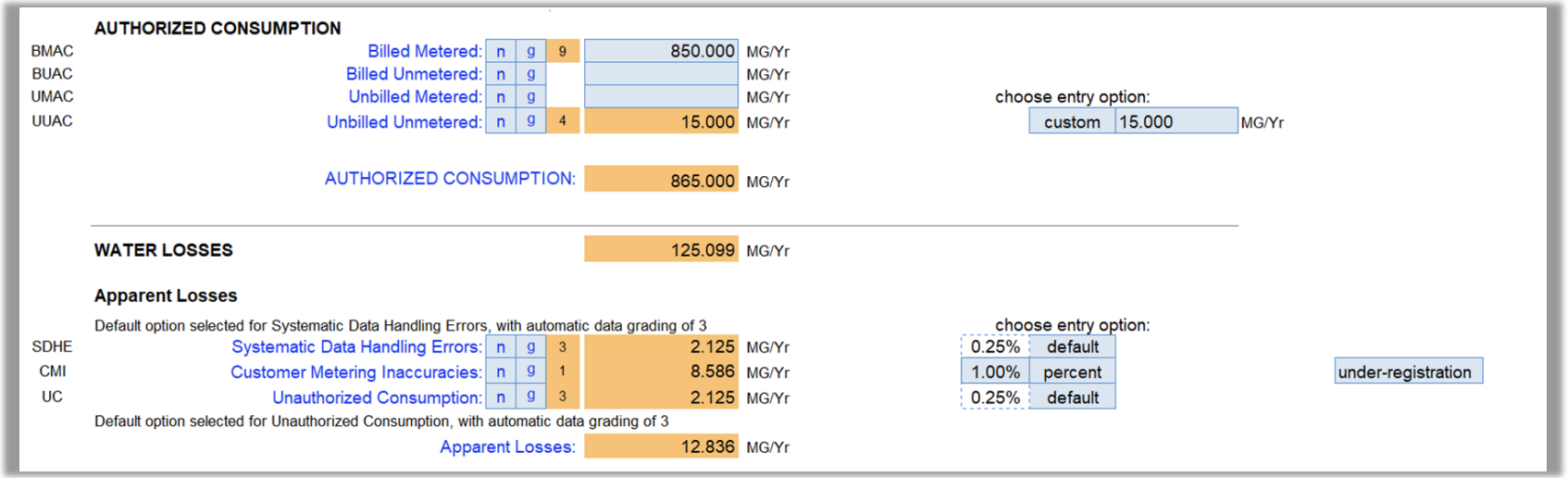
Flow Data Archiving

- Production flow data should be reviewed every business day for data gaps
- Gaps occur due to:
  - Unplanned interruption: lightning strike, power failure
  - Planned interruption: instrumentation calibration
- Gaps in water flow data should be quantified and added back to the daily total

Example of Water Pumping Data Gaps an		
8/15/2012, hrs	High Service Pumping Rate, mgd actual flow	High Service Pumping Rate, mgd raw recorded data
0:00	8.69	8.69
1:00	8.65	8.65
2:00	8.32	8.32
3:00	8.11	8.11
4:00	7.94	0
5:00	8.02	0
6:00	8.44	0
7:00	8.98	0
8:00	9.34	0
9:00	9.25	0
10:00	9.17	0
11:00	9.12	9.12
12:00	9.27	9.27
13:00	9.22	9.22
14:00	9.08	9.08
15:00	8.99	8.99
16:00	9.14	9.14
17:00	9.18	9.18
18:00	9.25	9.25
19:00	9.22	9.22
20:00	8.82	8.82
21:00	8.78	8.78
22:00	8.75	8.75
23:00	8.71	8.71
0:00	8.68	8.68
Total	**212.43**	**151.29**
Average	**8.85**	**6.30**
Difference		**2.55**

(Source: AWWA M36 Publication, 4th Ed.)

Step 2 – Develop the Inputs

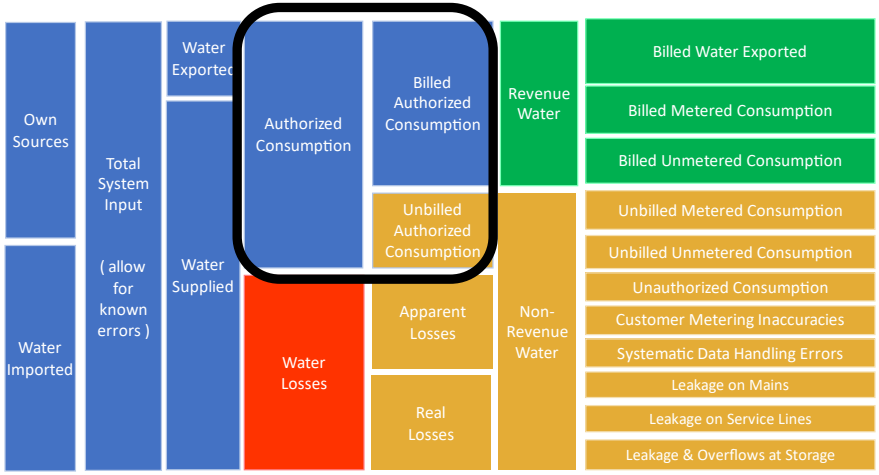


	AUTHORIZED CONSUMPTION							
BMAC	Billed Metered:	n	g	9	850.000	MG/Yr		
BUAC	Billed Unmetered:	n	g			MG/Yr		
UMAC	Unbilled Metered:	n	g			MG/Yr	choose entry option:	
UUAC	Unbilled Unmetered:	n	g	4	15.000	MG/Yr	custom 15.000	MG/Yr
	AUTHORIZED CONSUMPTION:				865.000	MG/Yr		
	WATER LOSSES				125.099	MG/Yr		
	Apparent Losses							
	Default option selected for Systematic Data Handling Errors, with automatic data grading of 3						choose entry option:	
SDHE	Systematic Data Handling Errors:	n	g	3	2.125	MG/Yr	0.25% default	
CMI	Customer Metering Inaccuracies:	n	g	1	8.586	MG/Yr	1.00% percent	under-registration
UC	Unauthorized Consumption:	n	g	3	2.125	MG/Yr	0.25% default	
	Default option selected for Unauthorized Consumption, with automatic data grading of 3							
	Apparent Losses:				12.836	MG/Yr		

- **Develop the Input**
  - Trace from billing reports
  - Trace from flushing (etc) tracker
- **Look for potential errors**
  - Billing report
  - Double counting Water Exported in Billed Metered
  - Double counting Unbilled Metered in Billed Metered
  - Including leaks / breaks in Unbilled Unmetered

Potential Errors in Authorized Consumption

- Duplicate volumes
- Non-potable volumes
- Missing volumes
- Mismatched timeframes



System Data

Infrastructure information

- Length of Mains (includes hydrants laterals)
- Count of service connections (active and inactive)

Operating Pressure

used to calculate a technical minimum volume of leakage

Cost Data

Total Annual Operating Cost

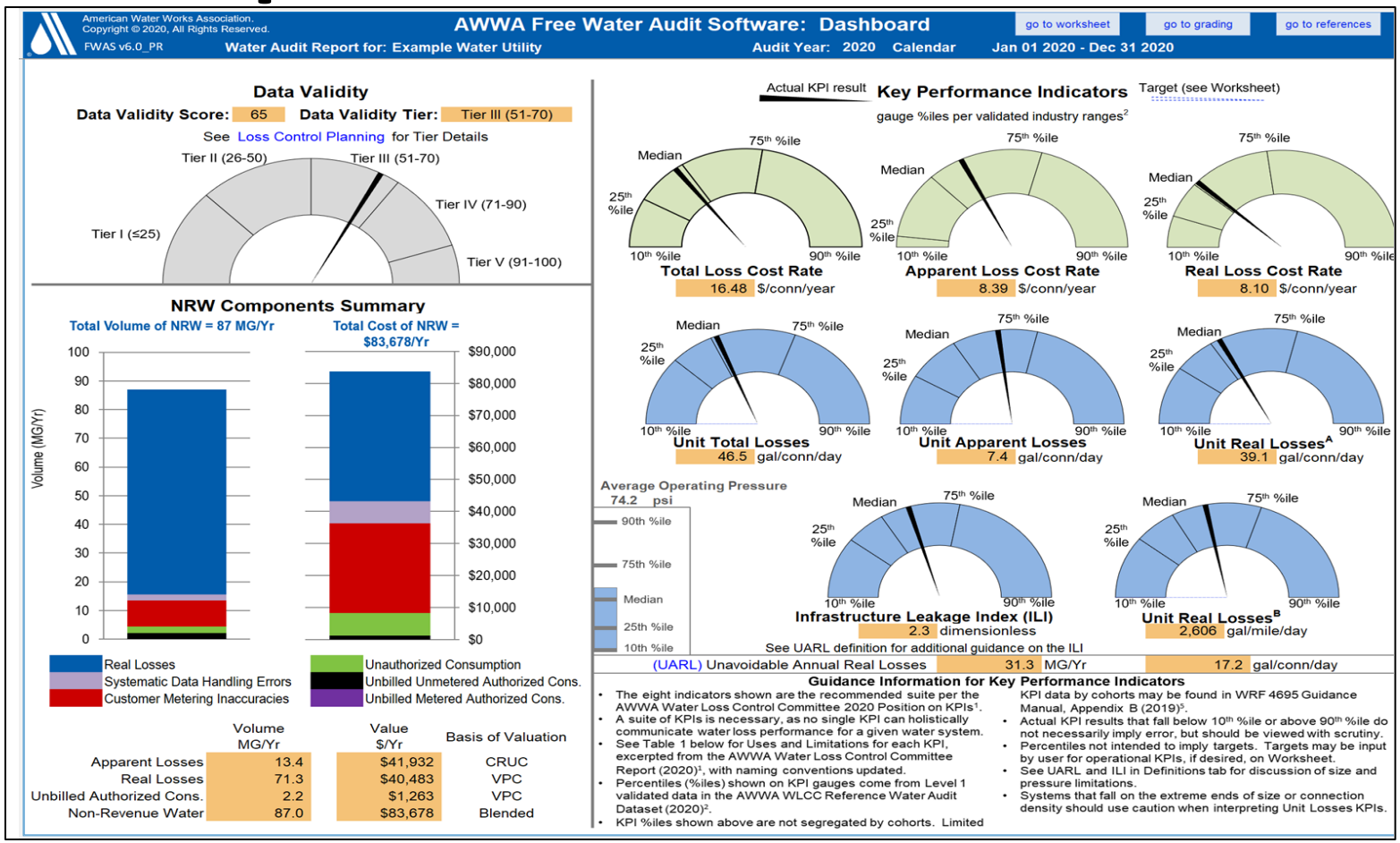
Customer Retail Unit Cost

Variable Production Cost

Developing the Inputs

1. Assemble supporting documents
   - → Must-have docs
   - → Good-to-get docs
2. Develop the data inputs
   - → Build it from supporting docs
3. Check the metrics
   - → Look for gremlins
   - → Sanity check
   - → Inside typical ranges
   - → Metrics versus practices

Step 3 – Check the Metrics



- **Metrics versus Practices**
  - Inside the range – are they high, mid, or low?
  - How does that compare to the water loss management practices?

Test Your Knowledge

Developing the Inputs

Breakout Exercise

Common Exercise – Developing the Inputs

Break

Review of Common Exercise

Data Validity

Data Validity Score

AWWA Free Water Audit Software – Interactive Data Grading

Importance of Level 1 Validation

The Big Picture

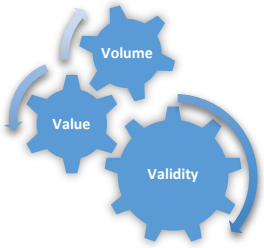
Annual Water Balance

Annual M36 water audit

Apparent & Real Loss volumes

Level 1 validation

baseline



Stage 1

Loss Profiling & Uncertainty

Advanced Validation
- Level 2 Analytics
- Level 3 Field Study
- Margins of Error

Apparent Loss Profile
- Theft
- Meter Inaccuracy
- Data Handling

Real Loss Profile
- Reported Leakage
- Unreported Leakage
- Background Leakage

technical analysis

Stage 2

Cost-Benefit & Targets

Costs of losses
- by subcomponent
- in aggregate
- wholesale & retail

Costs of intervention strategies

Program design

System-specific

economic analysis

Stage 3

Intervention

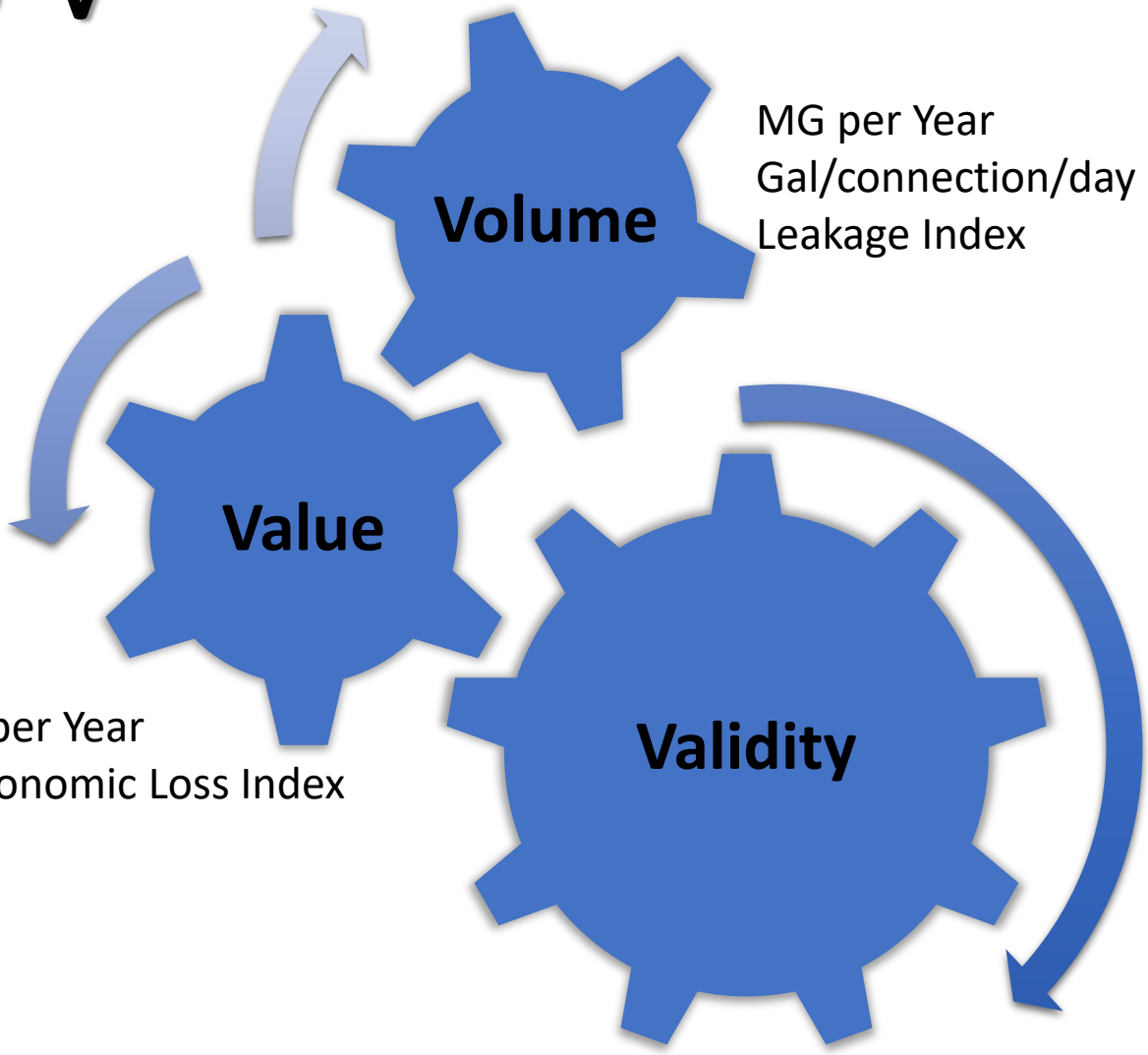
Leakage Management:
- Active Leak Detection
- Pressure Optimization
- Repair Time Reduction
- Network Renewal

Revenue Protection:
- Theft Mitigation
- Meter Optimization & Renewal
- Billing Data System Integrity
- Revenue Recovery

cost-effectiveness

Stage 4

3-V



MG per Year
Gal/connection/day
Leakage Index

$ per Year
Economic Loss Index

Water Audit Data Validity Score
95% Confidence Limits
Key Data Input Grades

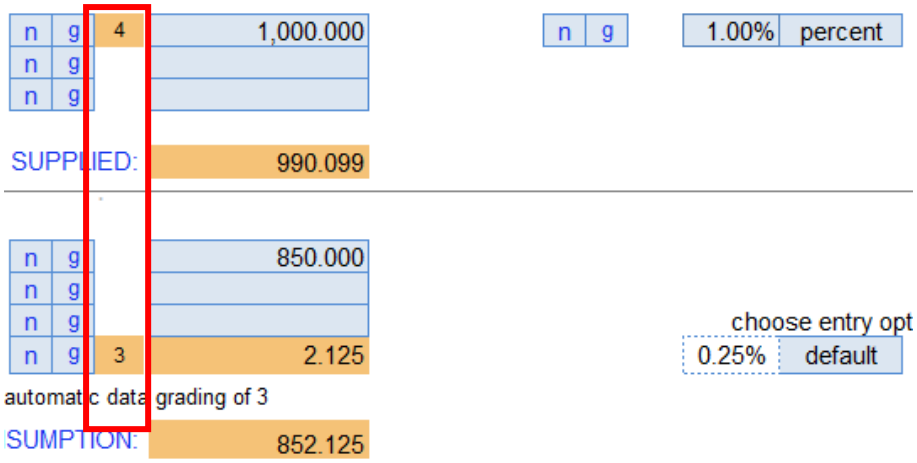
Data Validity Grades

Data validity grades (DVGs) document utility practices of:

- Data collection
- Data review
- Instrument maintenance

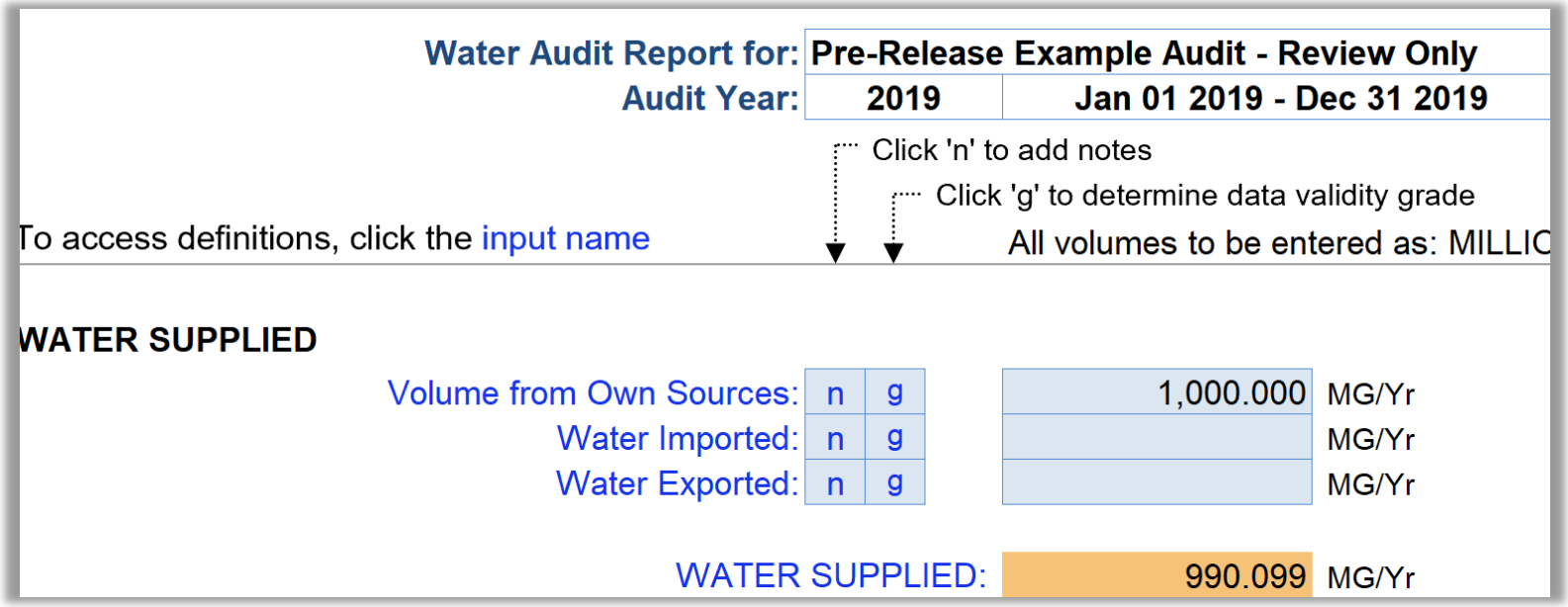
Each audit input is automatically assigned a DVG between 1 and 10 based on answers to IDG criteria questions

DVG criteria are predominantly qualitative



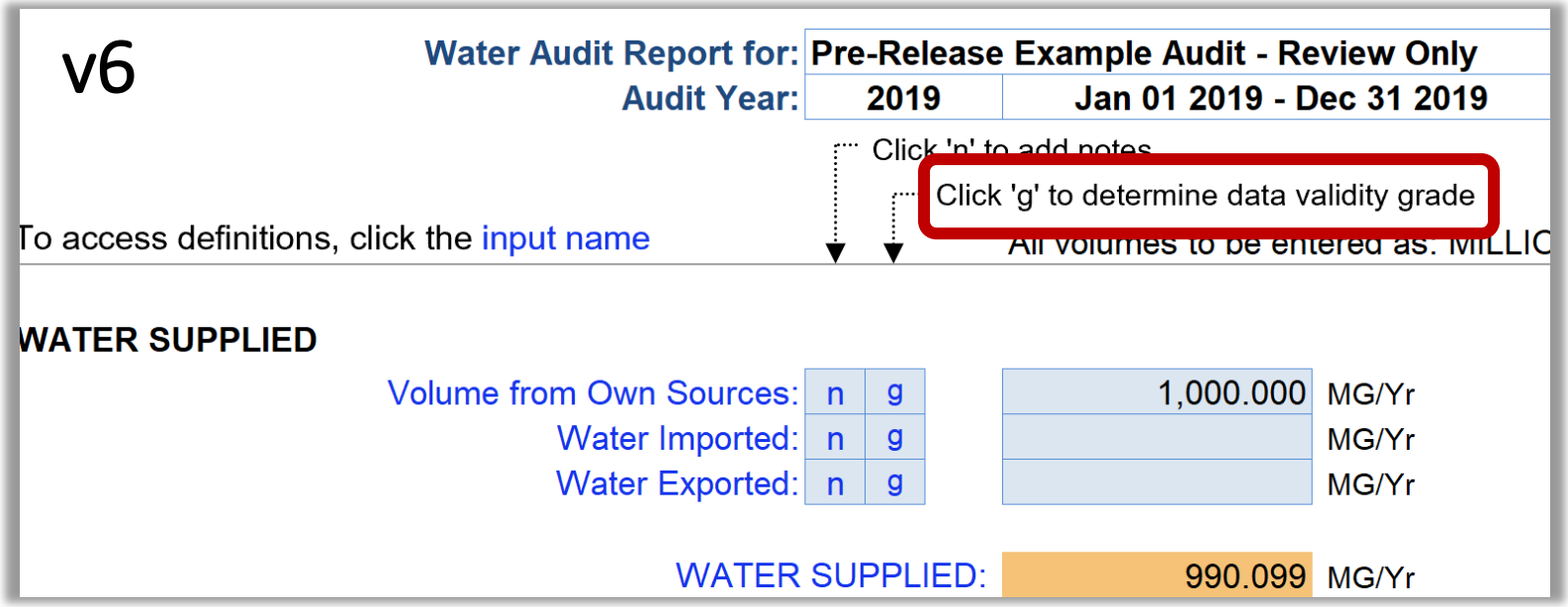
DVGs are NOT a measure of accuracy!

Data Validity Grading



Water Audit Report for:	**Pre-Release Example Audit - Review Only**			
Audit Year:	**2019**	**Jan 01 2019 - Dec 31 2019**		
	Click 'n' to add notes			
	Click 'g' to determine data validity grade			
To access definitions, click the input name		All volumes to be entered as: MILLIC		
WATER SUPPLIED				
Volume from Own Sources:	n	g	1,000.000	MG/Yr
Water Imported:	n	g		MG/Yr
Water Exported:	n	g		MG/Yr
WATER SUPPLIED:			990.099	MG/Yr

Data Validity Grading



Data Validity Grading

v6

Test Utility
2019

White = incomplete
Orange = complete
Use acronyms for navigation

AWWA Free Water Audit Software: Interactive Data Grading

VOS | VOSEA | WI | WIEA | WE | WEEA | BMAC | BUAC | UMAC | UUAC

SDHE | CMI | UC | Lm | Nc | Lp | AOP | CRUC | VPC

acronym key

Limiting criteria (see Start Page for details)

go to input

Volume from Own Sources (VOS) - Data Grading Criteria

go to notes

vos	Criteria Question	Select Best-Fit Answers to All Visible Questions
vos.0	Did the water utility supply any water from its own sources during the audit year?	Yes
vos.1	What percent of own supply volume is metered?	>99%

For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the finished water volume.
In-situ flow accuracy testing refers to a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location.
Electronic calibration refers to a process that checks for error in the metering secondary device(s) and/or the tertiary device(s).
Secondary device can include meter transmitter, DP cell, chart recorder or similar instrumentation.
Tertiary device can include SCADA, historian or other computerized archival system.

vos.2	What is the frequency of electronic calibration?	Annually
vos.3	What level of data transfer errors are checked as part of the electronic calibration process?	Data transfer errors are checked at secondary device(s) AND tertiary device(s)
vos.4	Is the most recent electronic calibration documentation available for review?	Yes
vos.5	What is the frequency of in-situ flow accuracy testing?	Less than annual but within last 5 years
vos.6	Is the most recent in-situ flow accuracy testing documentation available for review?	Yes
vos.7	What are the total volume-weighted average results of in-situ flow accuracy testing (during or closest to audit year)?	
vos.8	Have testing and calibration procedures been closely scrutinized for compliance with procedures described in the AWWA M36 and/or M33 Manual(s)?	
vos.9	Which best describes the frequency of finished water meter readings?	
vos.10	Which best describes the frequency of data review for anomalies/errors? These can include numbers that are outside of typical patterns, and zero or 'null' values that may reflect a gap in data recording.	

At ±6% or greater
Between ±3% to ±6%
At or within ±3%

FINAL DATA GRADE FOR THIS AUDIT INPUT:

Data Validity Grading

v6

Test Utility
2019

White = incomplete
Orange = complete
Use acronyms for navigation

AWWA Free Water Audit Software: Interactive Data Grading

VOS | VOSEA | WI | WIEA | WE | WEEA | BMAC | BUAC | UMAC | UUAC

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Limiting criteria (see Start Page for details)

go to input

Volume from Own Sources (VOS) - Data Grading Criteria

go to notes

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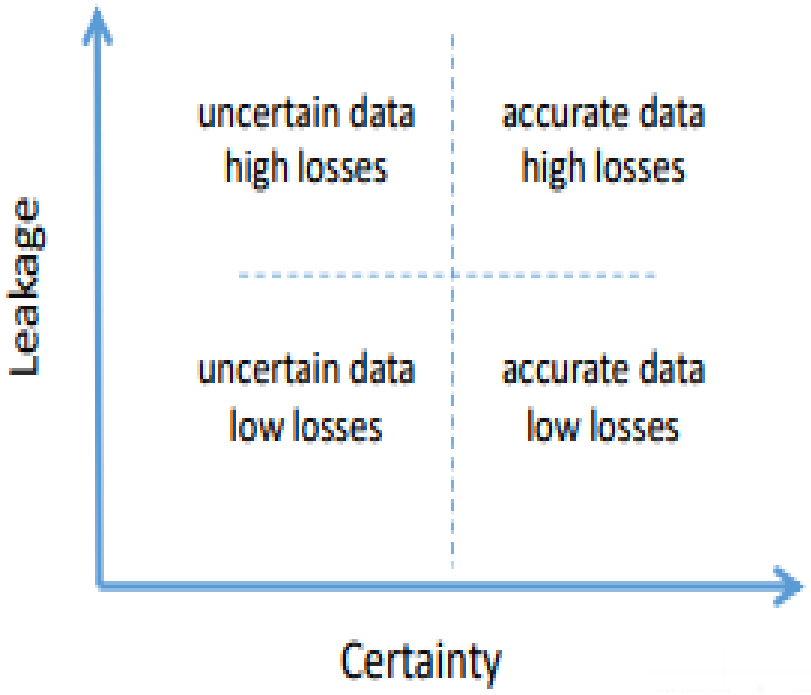
	For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the finished water volume. **In-situ flow accuracy testing** refers to a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location. **Electronic calibration** refers to a process that checks for error in the metering secondary device(s) and/or the tertiary device(s). **Secondary device** can include meter transmitter, DP cell, chart recorder or similar instrumentation. **Tertiary device** can include SCADA, historian or other computerized archival system.		
vos.2	What is the frequency of electronic calibration?	Annually	
vos.3	What level of data transfer errors are checked as part of the electronic calibration process?	Data transfer errors are checked at secondary device(s) AND tertiary device(s)	
vos.4	Is the most recent electronic calibration documentation available for review?	Yes	
vos.5	What is the frequency of in-situ flow accuracy testing?	Less than annual but within last 5 years	Limiting
vos.6	Is the most recent in-situ flow accuracy testing documentation available for review?	Yes	
vos.7	What are the total volume-weighted average results of in-situ flow accuracy testing (during or closest to audit year)?	At or within ±3%	
vos.8	Have testing and calibration procedures been closely scrutinized for compliance with procedures described in the AWWA M36 and/or M33 Manual(s)?	Yes	
vos.9	Which best describes the frequency of finished water meter readings?	Continuous	
vos.10	Which best describes the frequency of data review for anomalies/errors? These can include numbers that are outside of typical patterns, and zero or 'null' values that may reflect a gap in data recording.	Daily	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**7**	

The BEST(?) Number

100

The BEST(?) Number



VS.

Data quality matters!

inaccuracy & uncertainty in inputs → inaccuracy & uncertainty in results

Sources of error:

- Instruments
- Databases
- People
- Missing information

Levels of Validation

Water audit validation aims to:

- Identify and correct errors
- Evaluate and communicate uncertainty

Level 1 – interview & summary records

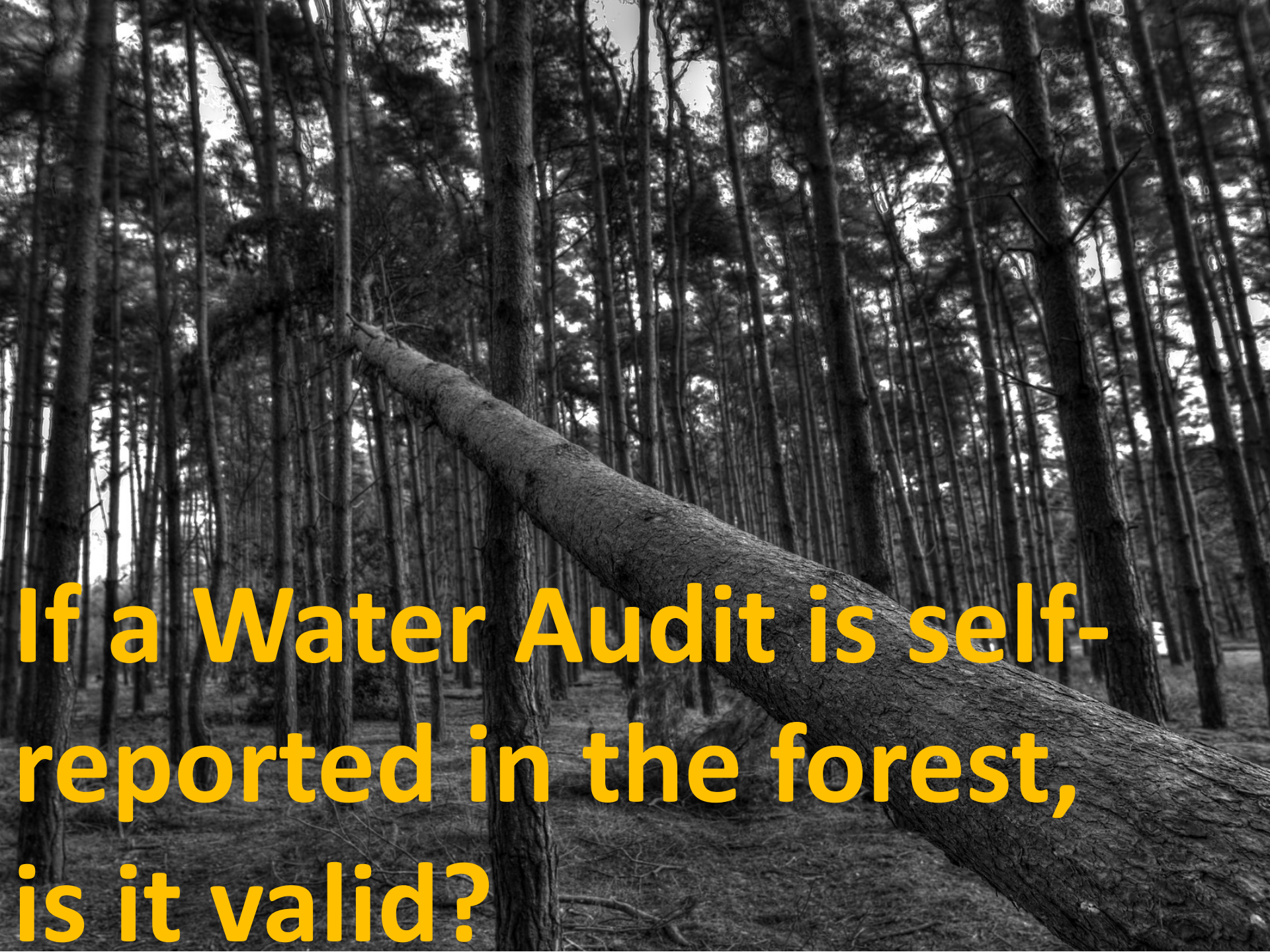
Level 2 – deep data review

Level 3 – new data from the field

WRF #4372B:

Water Audits in the United States: A Review of Data Validity and Results

Data quality – the validity, or trustworthiness, of the data


If a Water Audit is self-reported in the forest, is it valid?

Water Audit Results Across the Country

- *Water Research Foundation 4372B*

- many audits are **unrealistic**
  - *more training (ie GA, TN) produces fewer unrealistic audits*
  - *even level 1 validation doesn't fully eliminate unrealistic audits*

	CA	DRBC	GA	TN	TX
total audits	300	517	452	629	2,646
# of unrealistic audits	100	130	74	122	1,065
% of unrealistic audits	*33%*	*25%*	*16%*	*19%*	*40%*

sources of uncertainty:

- data source quality (primary measurement or secondary data management)
- methodology (use of the software, selection of data)

2016 UWMP Submitted Data - Unfiltered

		2016 n = 292	2016 n = 292	2016 n = 292	
	STATISTIC	*min*	*median*	*max*	**UNIT**
financial	Customer Retail Unit Cost	$0.00	$3.93	$180,097.61	$ / 1,000 gal
	Variable Production Cost	$0.00	$1,315.45	$25,007,000.00	$ / million gal
	NRW as % of Operating Cost	0.00%	3.54%	242305%	% of operating cost
volumetric	Apparent Losses	-4.34	6.36	122.3	gal/ serv conn / day
	Real Losses (serv conns)	-35	19.46	334.54	gal/ serv conn / day
	Real Losses (pressure)	-0.66	0.371	5.31	gal/ serv conn / day / psi
	ILI	-3.03	1.18	17.84	CARL / UARL
	Data Validity Score	2.35	75.33	98.27	points out of 100

WRF #4639:

Establishing Water Utility Guidance and Methodology for Water Audit Validation

Data validation – a quality control process conducted to verify, and improve as needed, the data inputs and gradings of the water audits submitted by water utilities.

Water Loss Audit validation – does not make data inputs or gradings "right" or "wrong", but merely aligns them with the actual conditions that occurred in the operation of the utility for the audit year

Level 1 -- Top down Data Review

Level 2 -- Top down Data Mining Review

Level 3 -- Bottom up Field Investigation

Purpose of Level 1 Validation

1) review of audit methodology and volume derivation
2) review of Interactive Data Grading answers

goals: quality and consistency

Purpose of Level 1 Validation

1) review of audit methodology and volume determination
2) review of Data Validity Grade selection

Level 1 Validation Tools:

- Discussion with Validator
- Supporting Documentation

What does Level 1 water audit validation do?

The Level 1 water audit validation aims to:

- Confirm the accurate application of AWWA M36 water audit methodology and terminology to the utility-specific situation
- Identify/adjust any evident inaccuracies
- Validation of best-fit IDG answers, and understanding the answers in full context of the utility operations

In meeting these goals, the Level 1 validation process results in:

- Data validity grades that reflect utility practices
- Identification of macro-level inaccuracies
- Recommendations for advanced validation activities

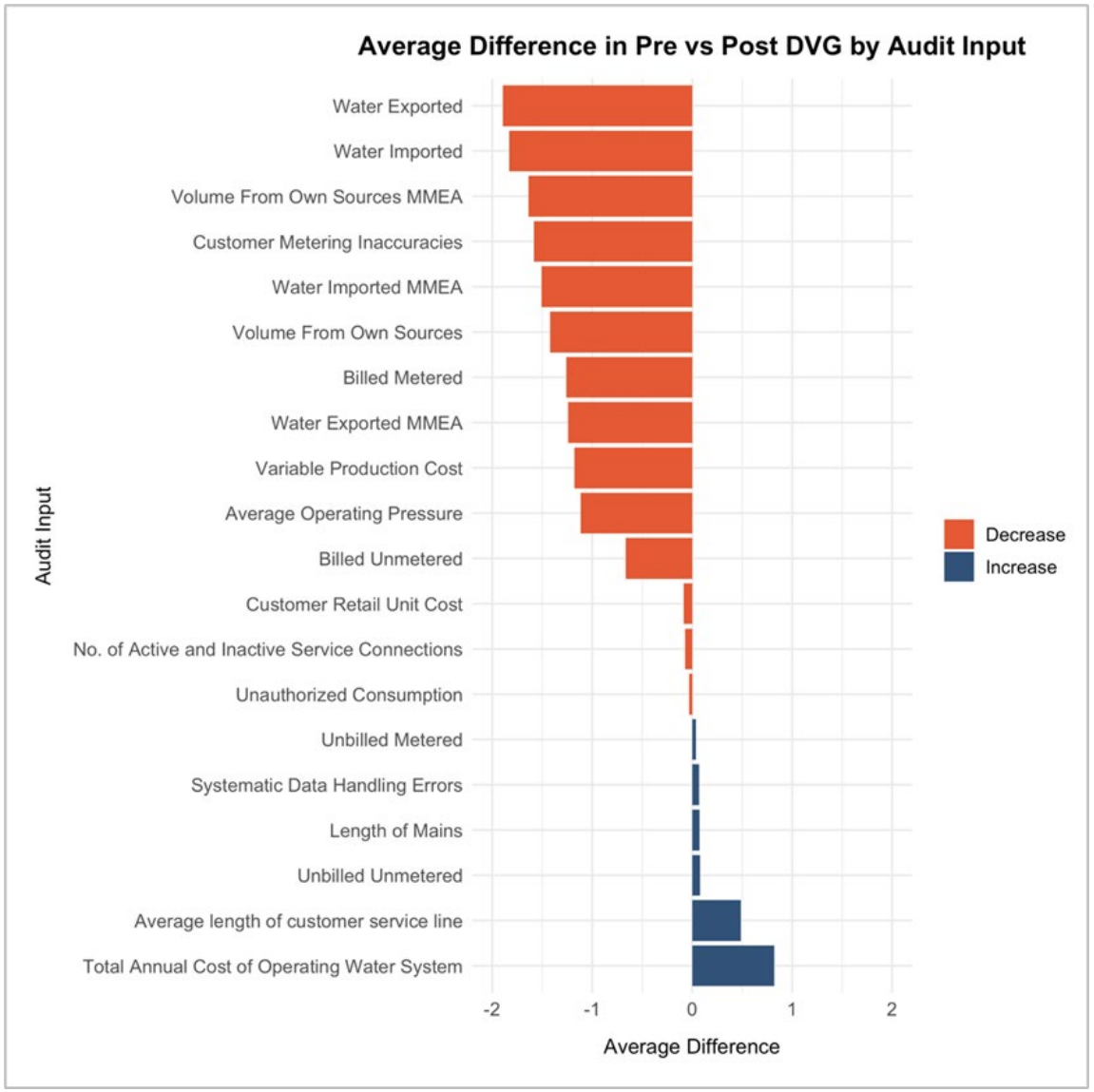
What does Level 1 water audit validation *NOT* do?

Level 1 water audit validation is the least rigorous level of validation. The effort and time required to complete Level 1 validation are relatively small. Level 1 water audit validation does not:

- Correct inaccuracies in raw data that may affect summary data and audit inputs
- Investigate data processing and handling to identify and correct inaccuracies
- Study instrument accuracy through field tests to improve the certainty of the water audit
- Corroborate the volume of Real Losses with bottom-up or field investigations of leakage

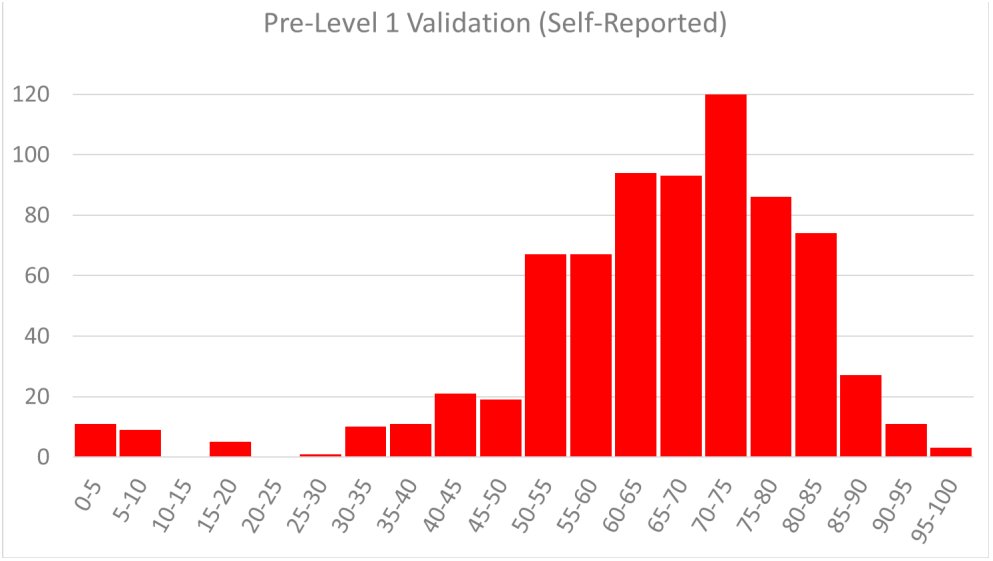
WRF #5057:
Update to Level 1 Validation Guidance Manual

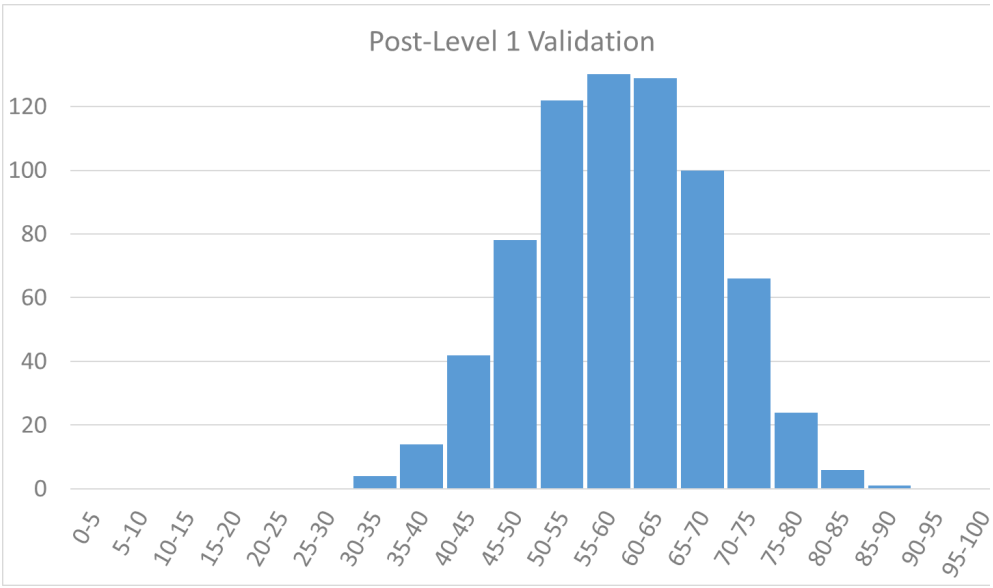
- **New chapter on AWWA Software v6** that describes the major changes from v5 and how they affect the validation process. This manual assumes that the user is validating a water audit completed using the AWWA Software v6.
- **New content related to audit input validation** that emphasizes key points of consideration when reviewing the methodology used to determine specific input values.
- **Real world examples of supporting documentation** for each audit input, as well as idealized versions to make best practices clear.
- **Updated language** throughout the manual to match AWWA Software v6 and to clarify confusing or ambiguous terminology.
- **Summary of research** related to certification programs and the effect of validation in North America.
- **Revisions based on industry feedback** that was collected from a dedicated advisory group of water loss professionals familiar with the first edition of the manual.



Pre-Validated vs. Post-Validated Audits

Changes to Data Validity Grades

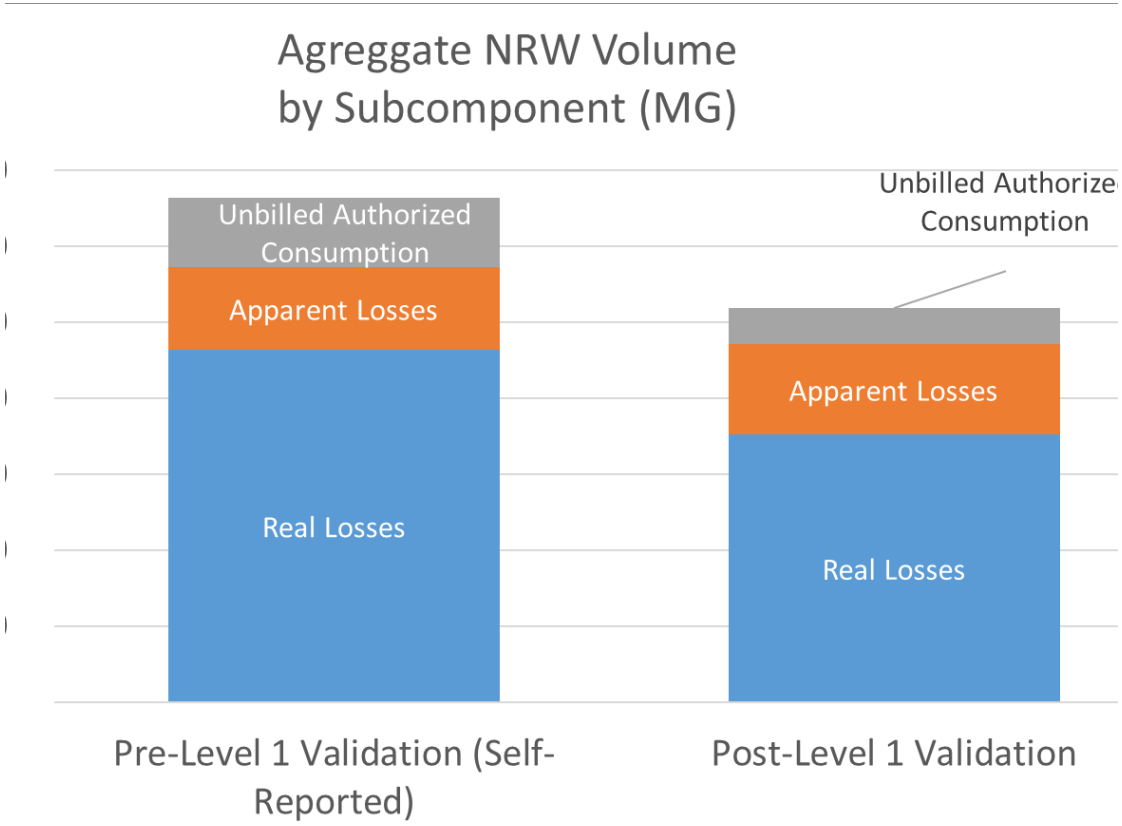




Pre-Validated vs. Post-Validated Audits

Data Validity Distribution

- **Unit errors**. Unit errors typically occur when the auditor enters the volumetric inputs as the wrong unit (i.e. ‘gallons’ instead of ‘million gallons’).
- **Method errors**. NRW is the sum of water losses (Apparent and Real Losses) and Unbilled Authorized Consumption.



Pre-Validated vs. Post-Validated Audits

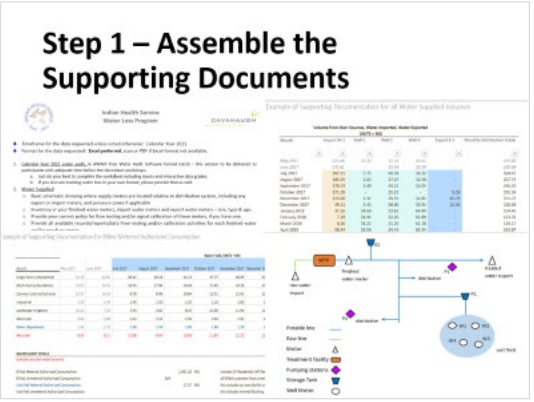
Identification of macro-level inaccuracies

Test Your Knowledge

Data Validity

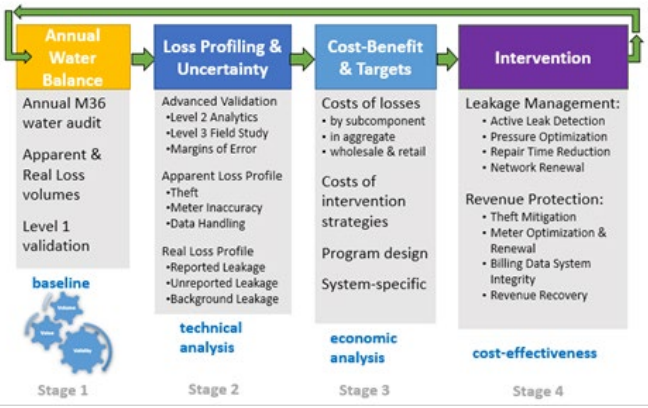
Summary Review & Wrap-Up

Step 1 – Assemble the Supporting Documents



The BEST(?) Number

The Big Picture



Supporting Documentation

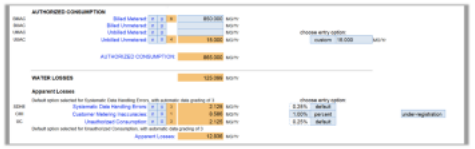
provides more detail on key values

REQUIRED	SUPPLEMENTAL
❑ Volume from Own Sources *Broken down by month and meter*	❑ Customer Meter Inaccuracy derivation
❑ Water Imported *Broken down by month and meter*	❑ Average Operating Pressure derivation
❑ Water Exported *Broken down by month and meter*	❑ Customer Retail Unit Cost derivation
❑ Supply Meter Test Records *for all supply meters, if conducted*	❑ Variable Production Cost derivation
❑ Volume of Metered Consumption *Broken down by month and use type/code*	❑ System Schematic *showing locations of Supply and Export Meters*

The BEST(?) Number

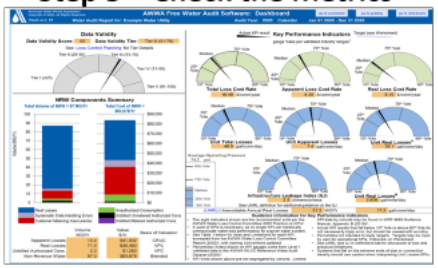
100

Step 2 – Develop the Inputs



- **Develop the Input**
  - Trace from billing reports
  - Trace from flushing (etc) tracker
- **Look for potential errors**
  - Billing report
  - Double counting Water Exported in Billed Metered
  - Double counting Unbilled Metered in Billed Metered
  - Including leaks / breaks in Unbilled Unmetered

Step 3 – Check the Metrics



- **Metrics versus Practices**
  - Inside the range – are they high, mid, or low?
  - How does that compare to the water loss management practices?

Workshop Evaluation