APPARENT WATER LOSS
Data Driven

Conducted by:

Kelly Byrd

Ohio Sales Manager

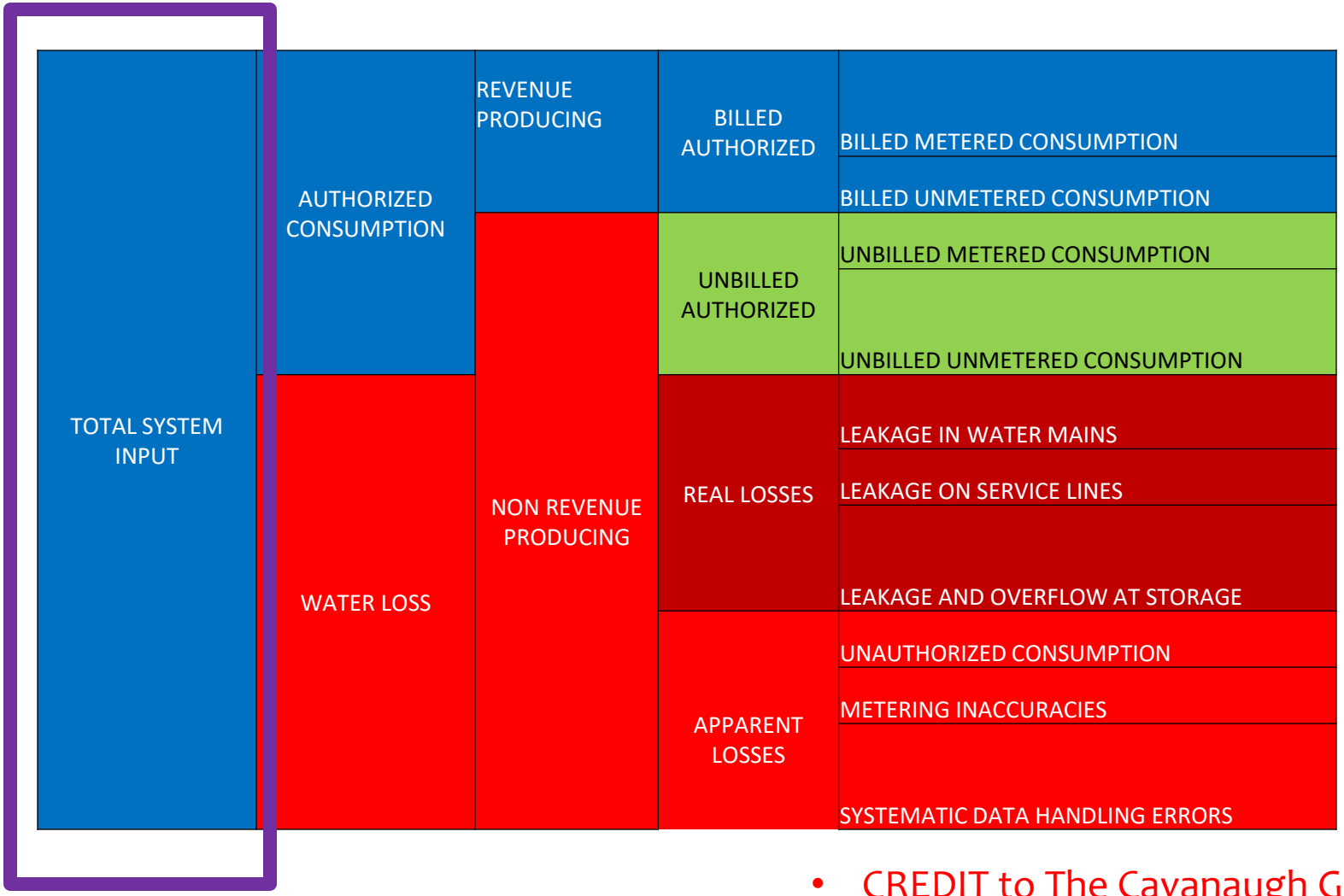
About NECO

- **Founded in 1934 as a family owned and operated business based out of Cincinnati, Ohio**
- **Providing Distribution Sales & Services featuring Neptune Technology Group Meters & Meter Reading Products**
- **Neptune Technology Group has manufactured meters and equipment for over 125 years**
- **Experience – 95% of our business is Meters & Reading Equipment**
  - **Remote Control Shut-Off Valves & Data Services**
- **All Field-Sales People are Factory Trained**
  - 2 Level-One trained representatives for AMR system training
- **Complete Services – Project Management, Meter Installation & Testing and Technical & Data Services**
- **Formerly known as Neptune Equipment Company**

Water Loss

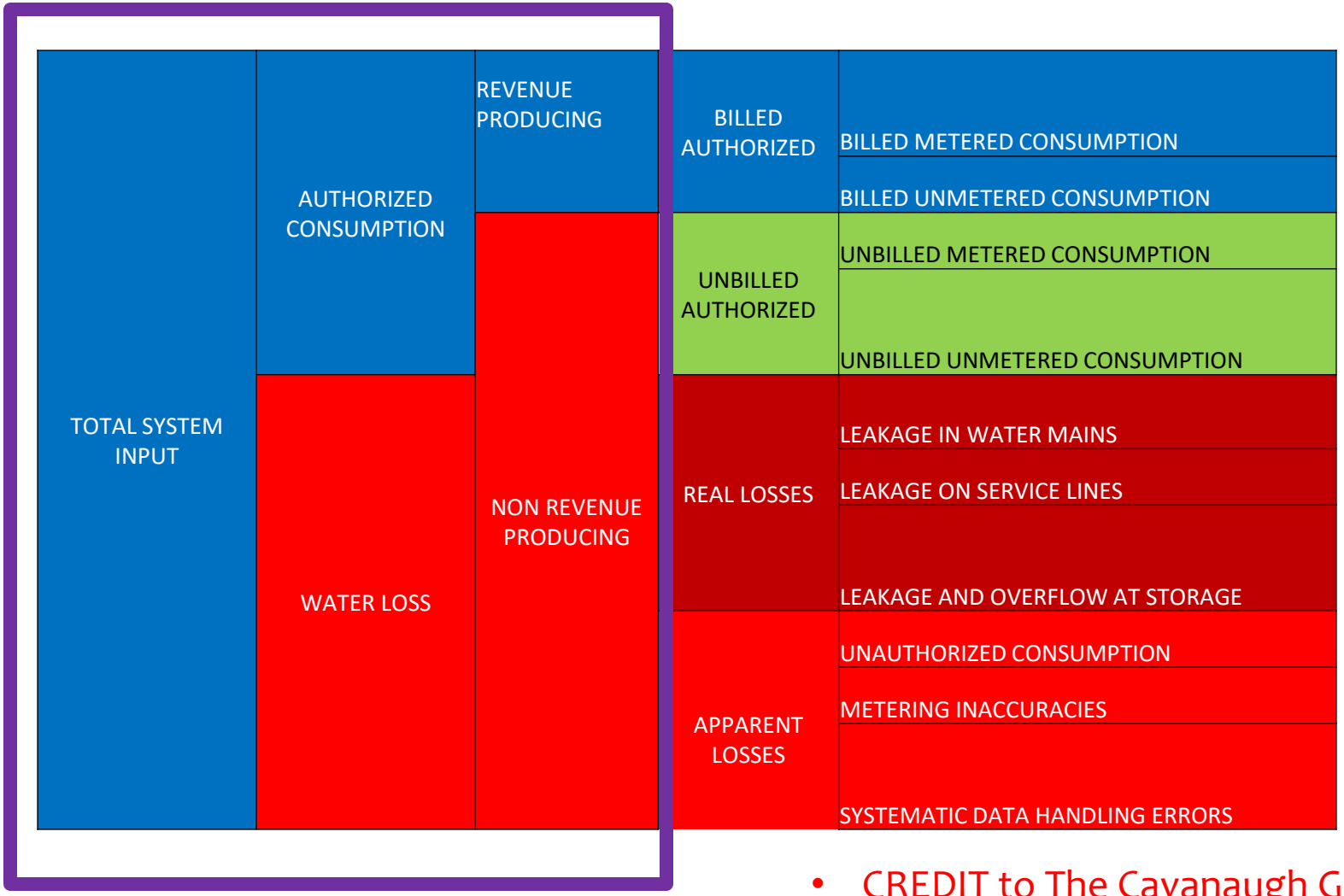
- EXPENSIVE
- ACCOUNTABILITY
- CONSERVATION
- EPA IS WATCHING
- CREDIT TO THE AWWA
- CREDIT TO The Cavanaugh Group
- How can a meter supplier help?

Total Water Balance



- CREDIT to The Cavanaugh Group

Total Water Balance

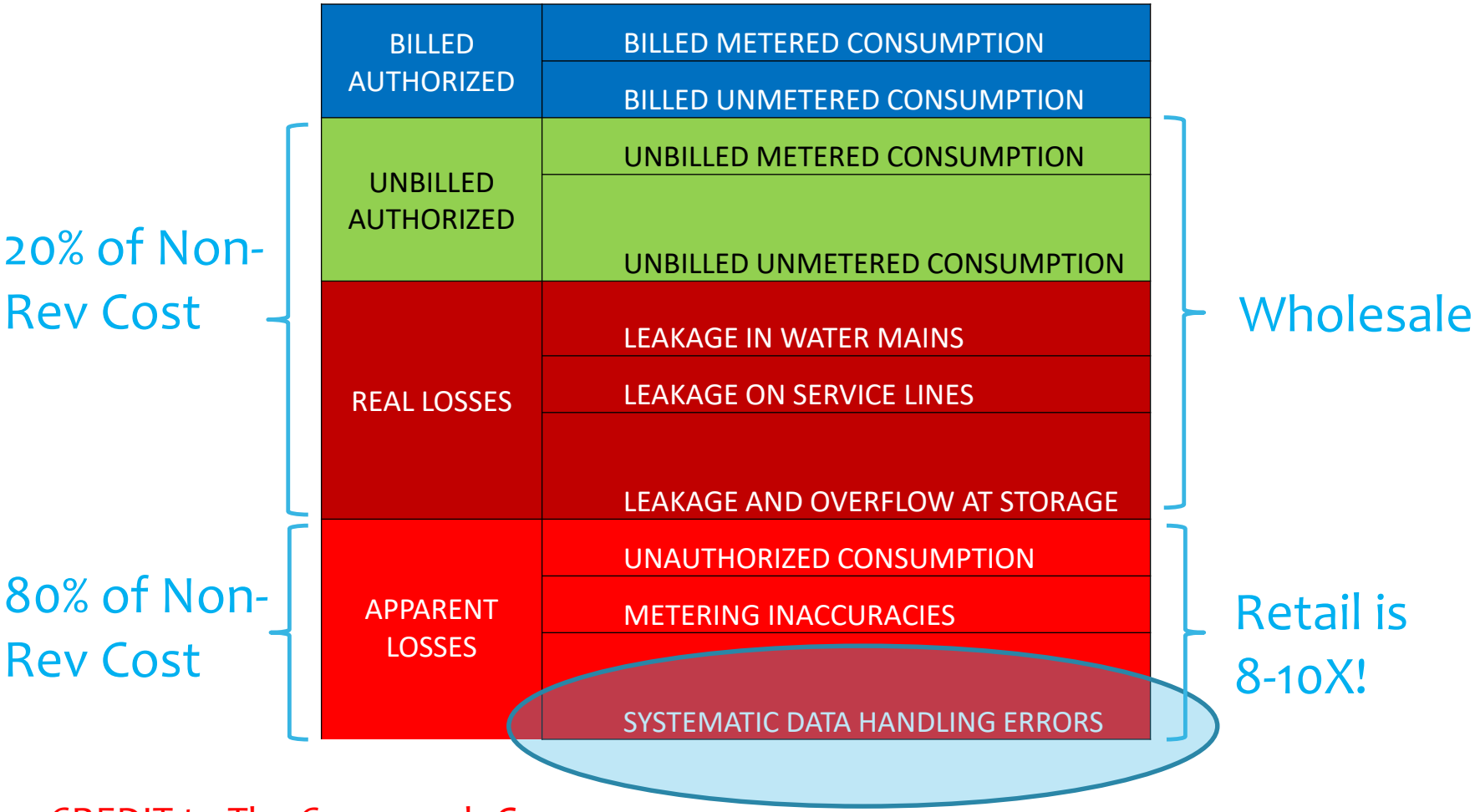


- CREDIT to The Cavanaugh Group

Total Water Balance

BILLED AUTHORIZED	BILLED METERED CONSUMPTION
	BILLED UNMETERED CONSUMPTION
UNBILLED AUTHORIZED	UNBILLED METERED CONSUMPTION
	UNBILLED UNMETERED CONSUMPTION
REAL LOSSES	LEAKAGE IN WATER MAINS
	LEAKAGE ON SERVICE LINES
	LEAKAGE AND OVERFLOW AT STORAGE
APPARENT LOSSES	UNAUTHORIZED CONSUMPTION
	METERING INACCURACIES
	SYSTEMATIC DATA HANDLING ERRORS

Water Loss



- CREDIT to The Cavanaugh Group

Meter Reading Data Integrity

Input Readings

Billing

File Transfers Must be Accurate!

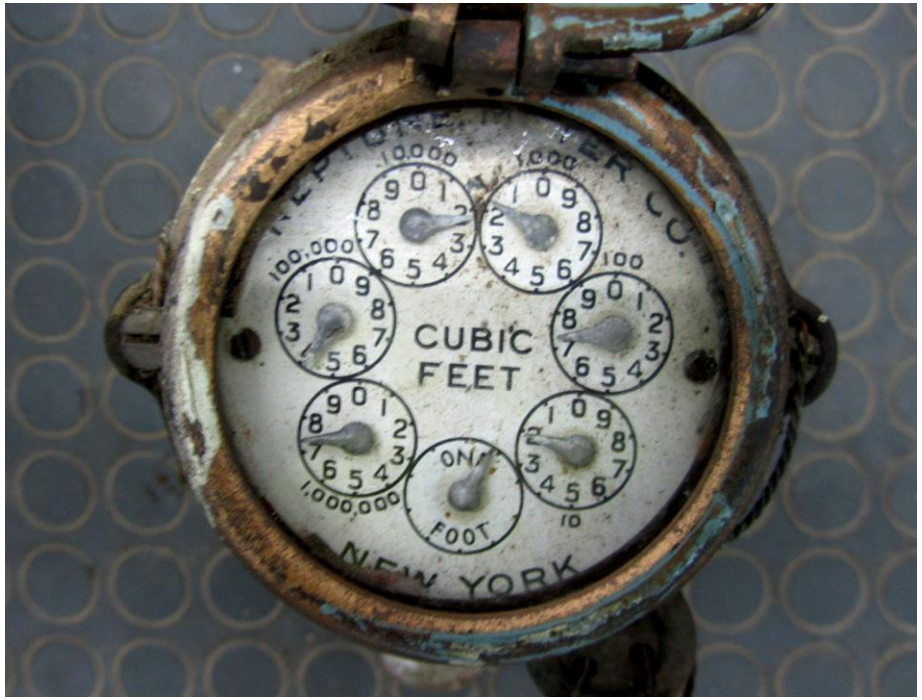
Data Input Methods

- Account Info
- Address
- Reading Method
- Meter Size
- Manual Multiplier?

Dial Function & Resolution

Gallons

Cubic Feet



Dial Function & Resolution

Gallons

Cubic Meters

Dial Function & Resolution

Gallons

U.S. Suppliers long ago settled on a standard

Cubic Feet

Dial Reading

Gallons

1000's of Gallons
100's of Cubic Feet

OLD METHOD:
Read Only the Moving White Wheels

CURRENT METHOD:
Read Using Standard Rules

Cubic Feet

Dial Reading

Gallons

Larger meters have more fixed zeros

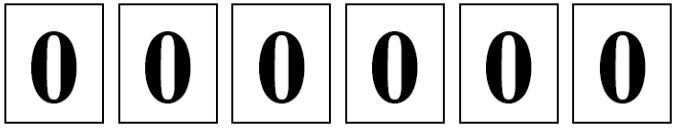
Compound meters may require reading two registers with different rules!

Cubic Feet

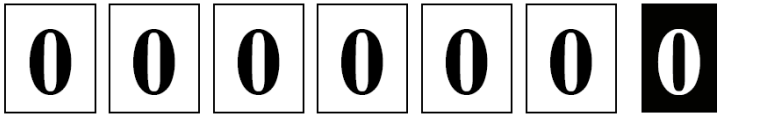
Direct Read Dials – 6 Wheels

Not Gallons???

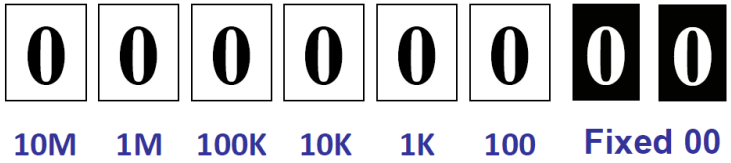
5/8”, 3/4”, 1” Cu. Ft



1 ½”- 4” Cu. Ft.



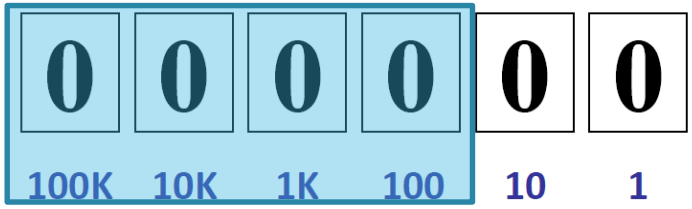
6”-12” Cu. Ft.



Direct Read Rules – Simple!

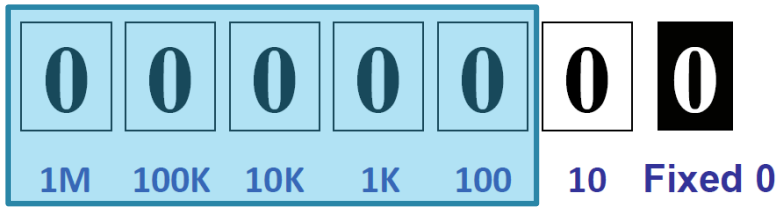
5/8”, 3/4”, 1” Cu. Ft

4 Dials



1 ½”- 4” Cu. Ft.

5 Dials



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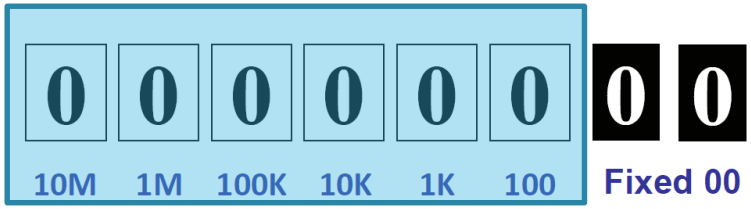
6 Dials



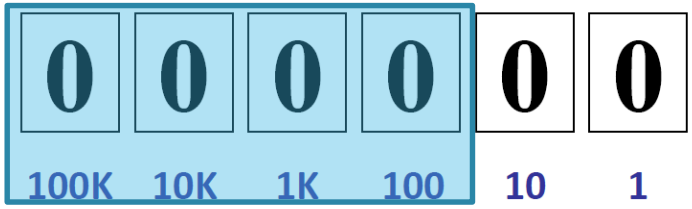
Direct Read Rules – Simple??

Not Using Gallons???

Correctly Sized Register???

5/8”, 3/4”, 1” Cu. Ft

4 Dials



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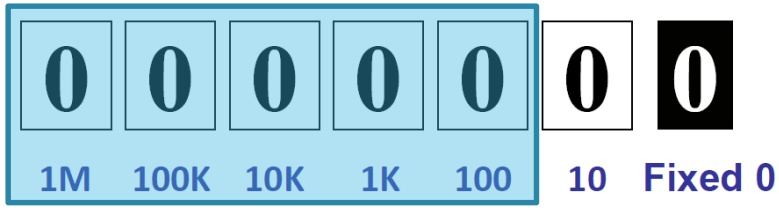

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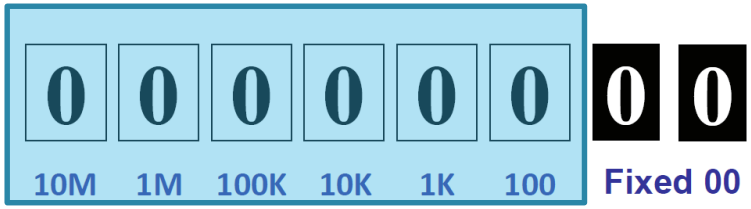
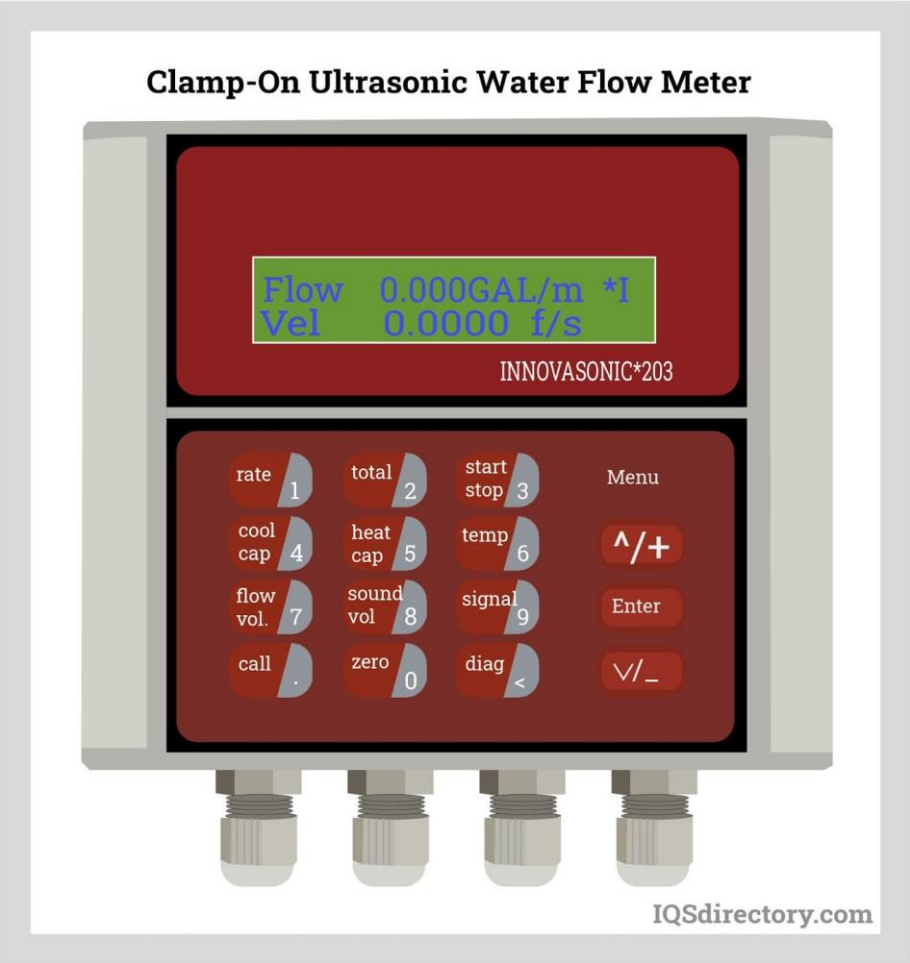
6 Dials

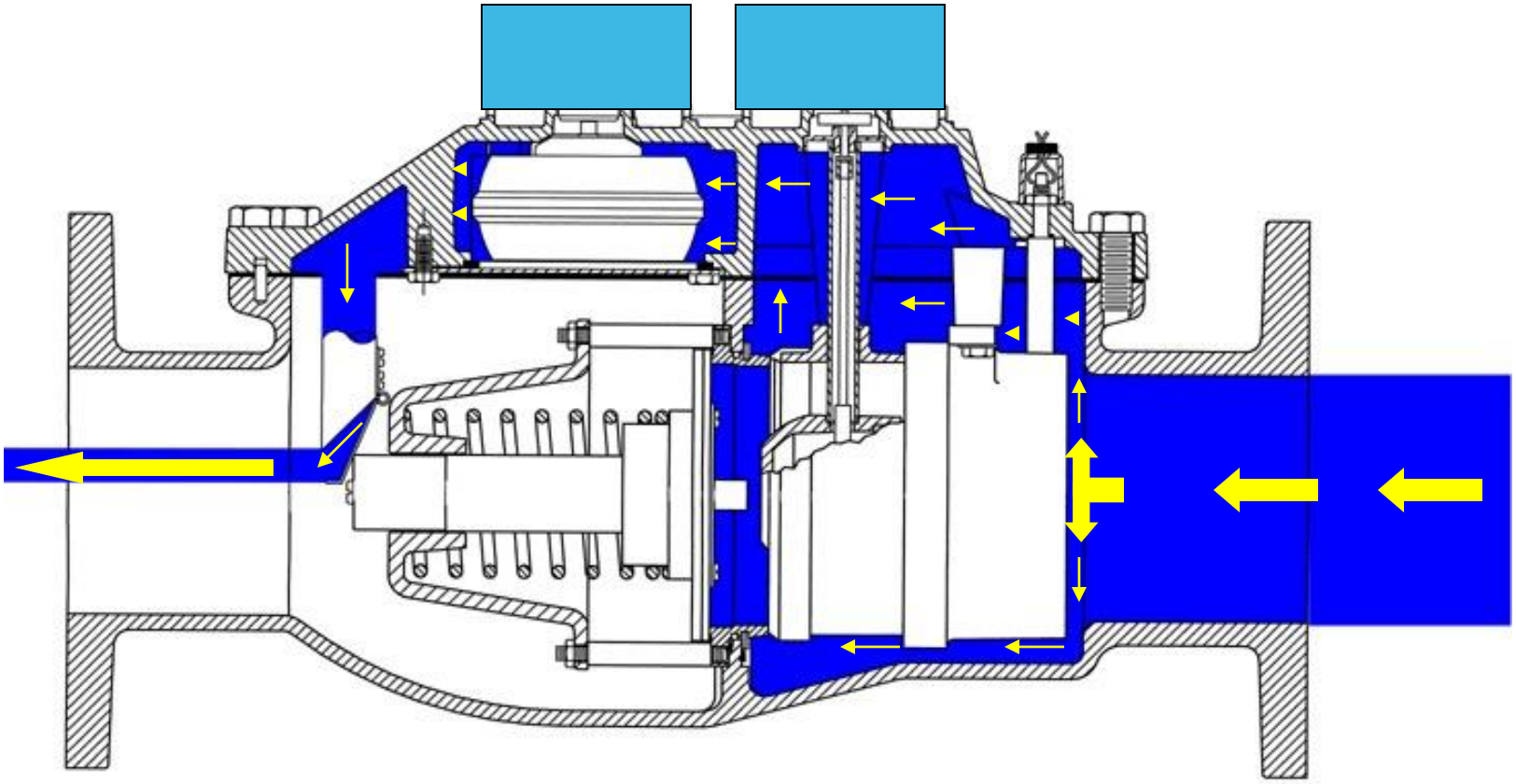


Unusual Registers



Compound Meter

Compound Meter

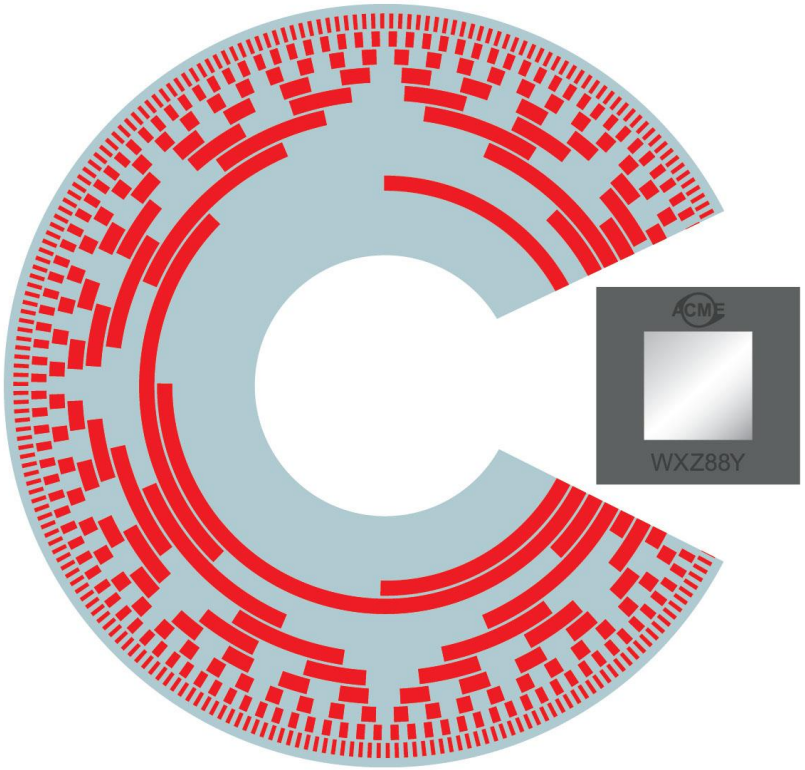


Dial Reading

Then we needed to automate meter reading

Encoder Output Technology

Absolute Encoders



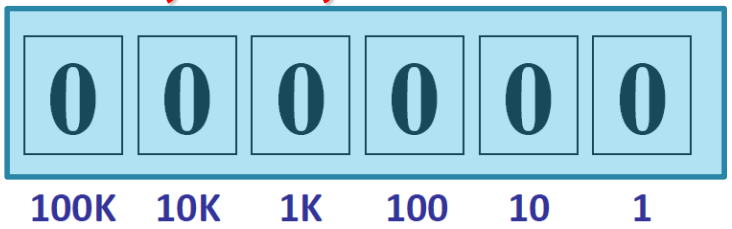
Pulse Output

Encoder Dial Resolution – Variable!

First Generation Encoders 4, 5 or 6 Wheels?

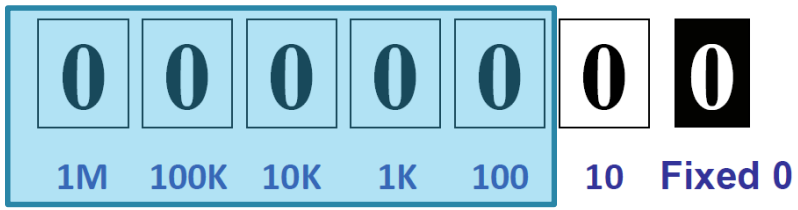
5/8", 3/4", 1" Cu. Ft

?



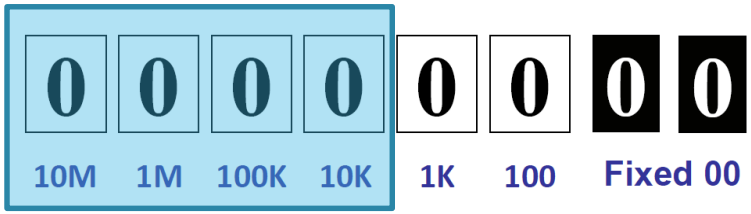
x 0.01
x 0.1
x 10
x 100
X 1000

1 ½" - 4" Cu. Ft.



6" -12-" Cu. Ft.

?



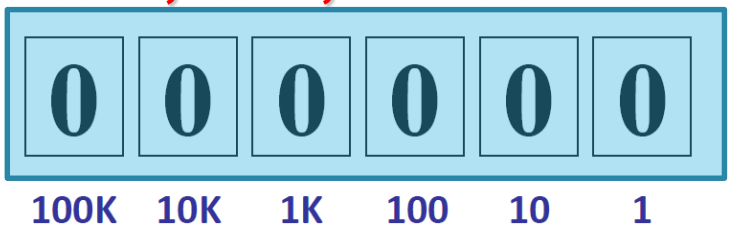
Encoder Dial Resolution – Programable!

First Generation Encoders 4, 5 or 6 Wheels?

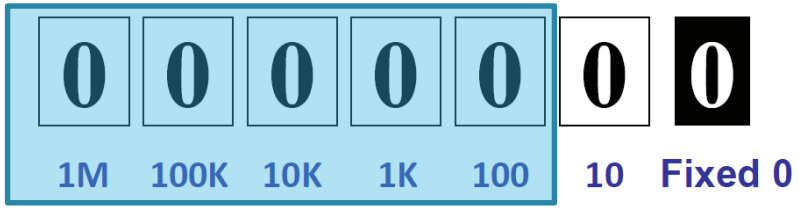
?

X 0.01
X 0.1
X 10
X 100
X 1000

5/8", 3/4", 1" Cu. Ft

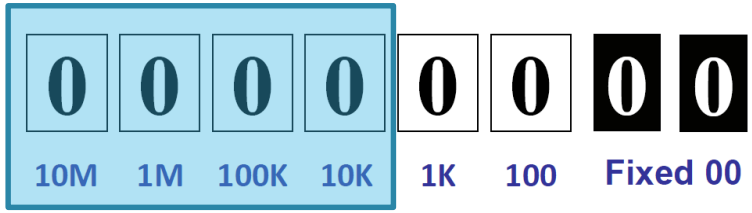


1 ½" - 4" Cu. Ft.



6" -12-" Cu. Ft.

?



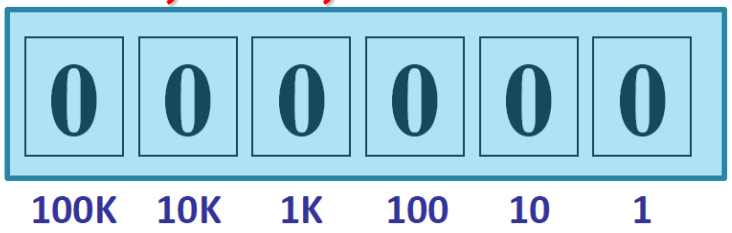
Encoder Dial Resolution – Multipliers!

First Generation Encoders 4, 5 or 6 Wheels?

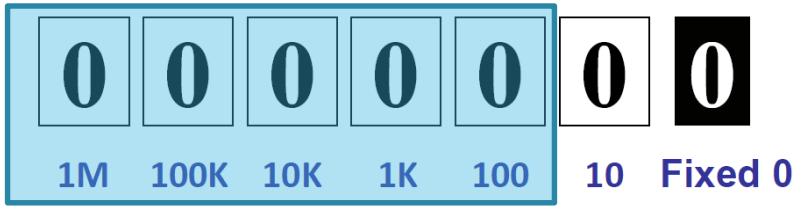
?

X 0.01
X 0.1
X 10
X 100
X 1000

5/8", 3/4", 1" Cu. Ft



1 ½" - 4" Cu. Ft.



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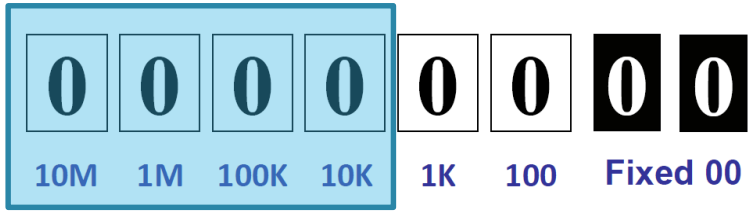
?



Encoder Output Technology

First Generation Encoders

4 or 6 Wheel?

First Generation Radios: 6 Digits

Encoder Output Technology

Now we can:

- Program Registers
- Program Radios
- Program Software to read various reading methods and dial numbers

But we also deal with:

- Programming Errors
- Meter readers can't obviously tell what the read should be
- We look at the actual meters less often

High Resolution

Second Generation Encoders

8+ wheel capability

8 Dials

9 Dials

10 Dials

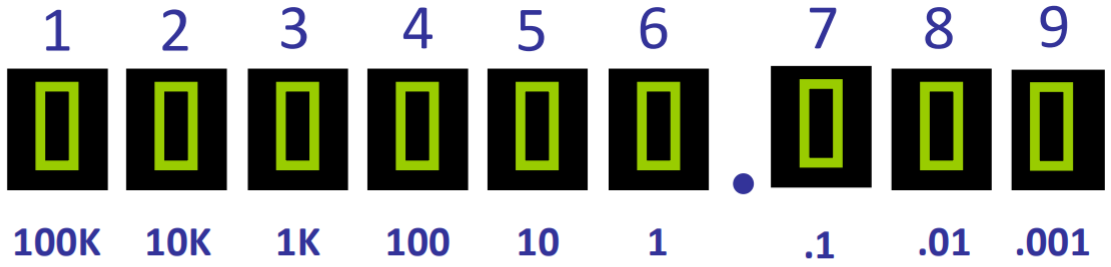
8 Digit Radios

Leak Detection Capability

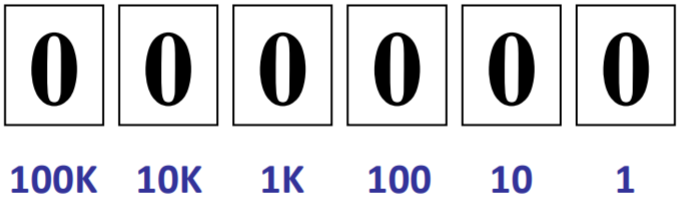
High Resolution

Second Generation Encoders 8+ wheel capability

E-Coder 9-digit



ProRead 6-wheel



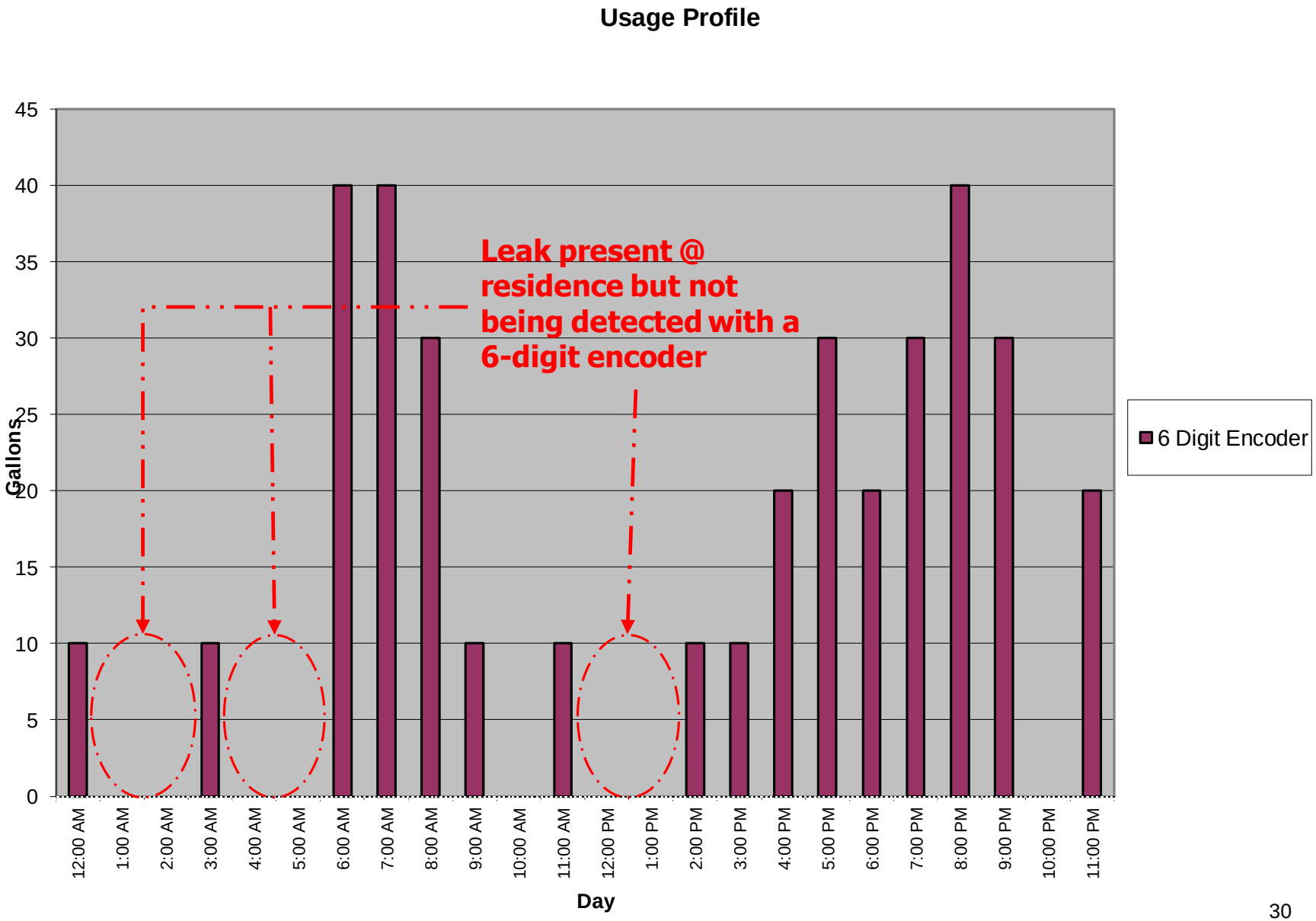
5/8", 3/4", 1" T-10, CUBIC FEET

Includes Disc Side of Tru Flo

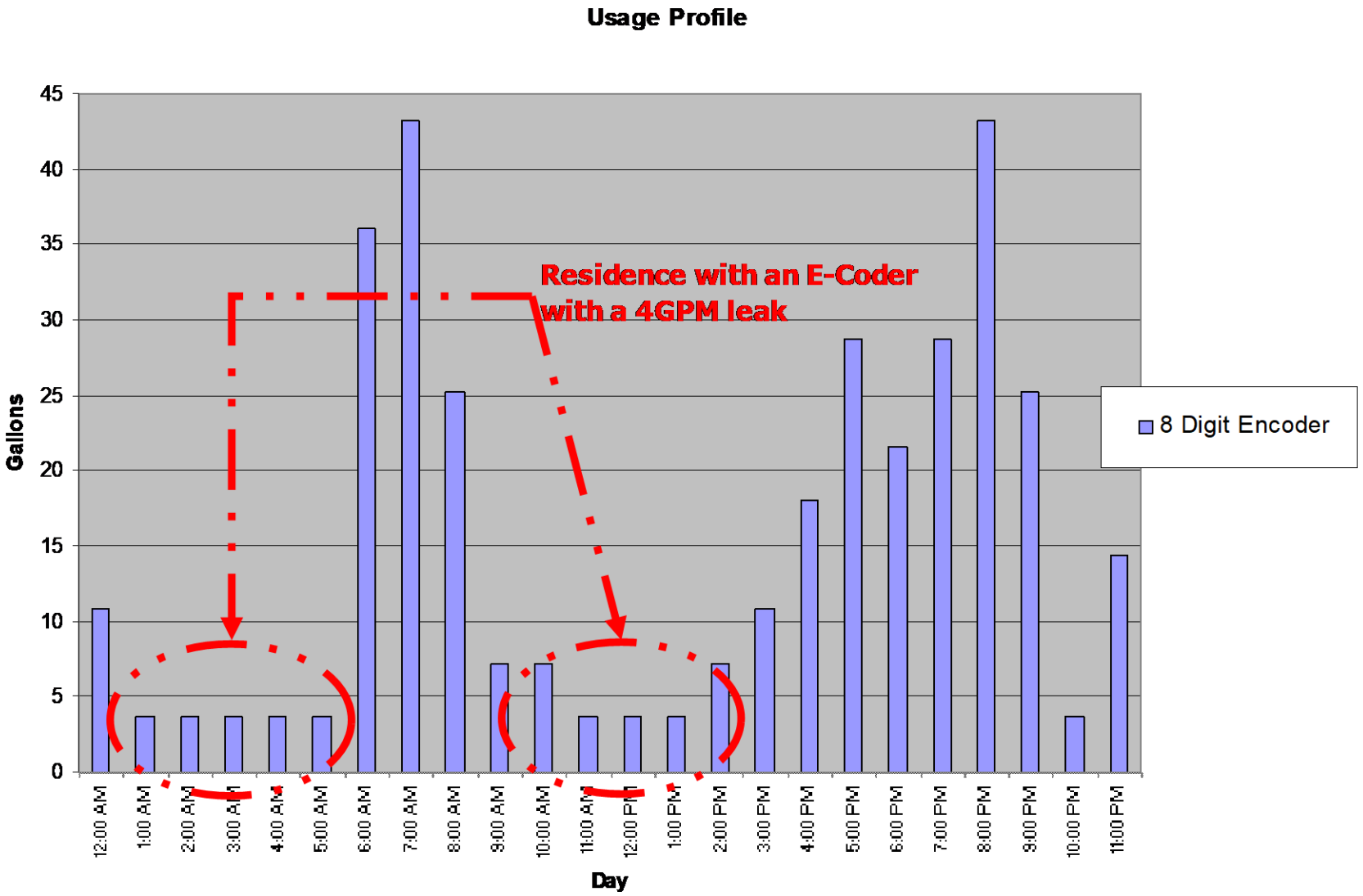
8 Digit Radios

Leak Detection Capability

High Resolution

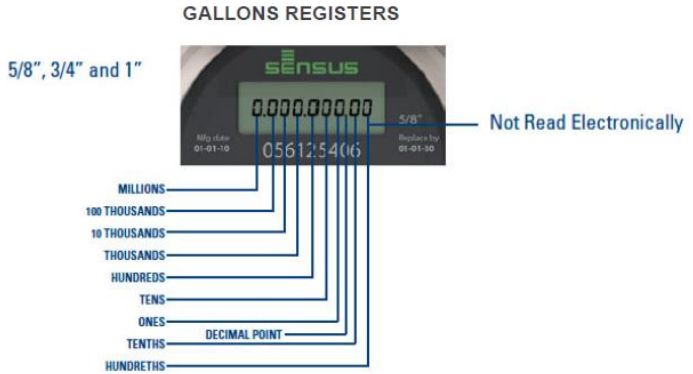


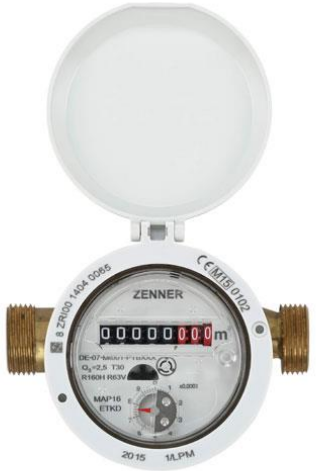
High Resolution



Period of Transition

Register Resolution Automation Transmitters Units!



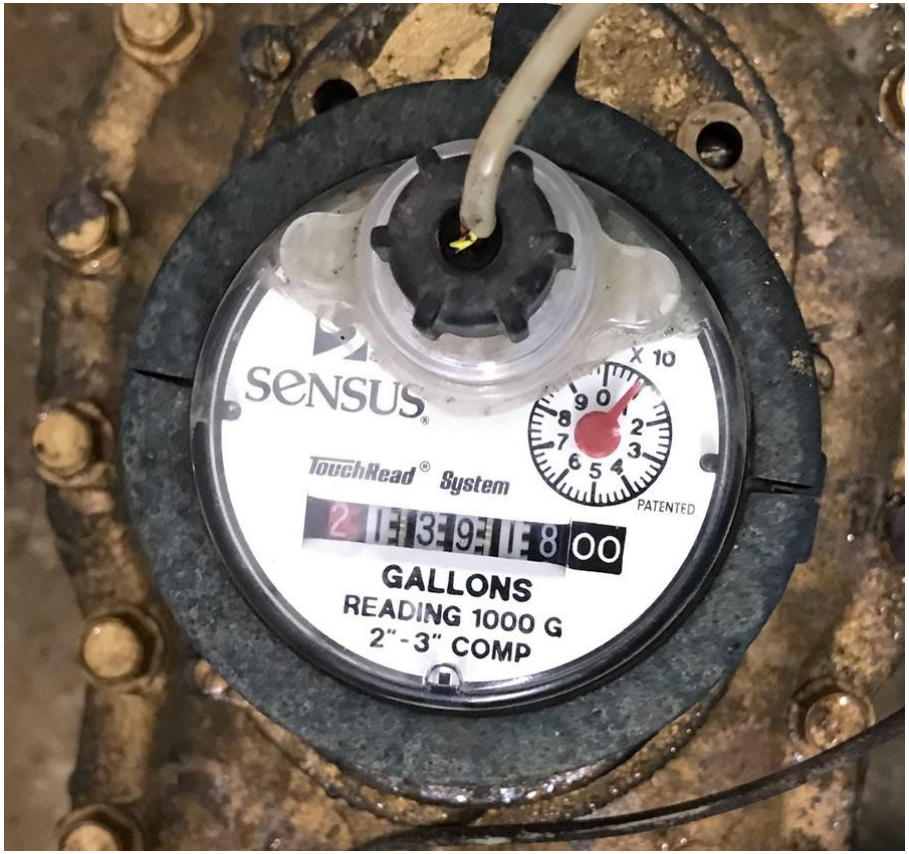


Period of Transition

Potential Combination Situations

- Registers
  - Direct Read
  - First Generation Encoder
  - Second Generation Encoder
- Radios
  - 6 Digit reads on any meter
  - 8 Digit reads on any meter
- Reading Methods – May Cause Confusion
  - Direct Read
  - Touch
  - Radio
    - Handheld, Laptop, Fixed Base, Cellular, LoRa, Other

Transition Example



Radio Read Only
Giving 5 Dials and
Missing the First Digit!

Meter Reading Challenges

Different Reading Methods Look Different!

Reading in 100's of CF via:

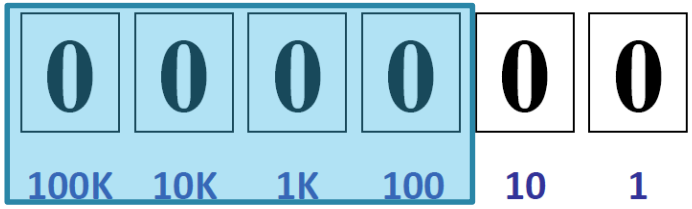
- Direct Read: 5278
- Touch Pad, 4 Dials: 5278
- Touch Pad, 5 Dials: 52780
- Touch Pad, 6 Dials: 527801
- Radio, 6 Digit: 527801
- Radio, 8 Digit: 52780100
- With Tablet & App: 527801.00

- **Beware of Manual Manipulation!**

Dial Read Rules

5/8”, 3/4”, 1” Cu. Ft

4 Dials



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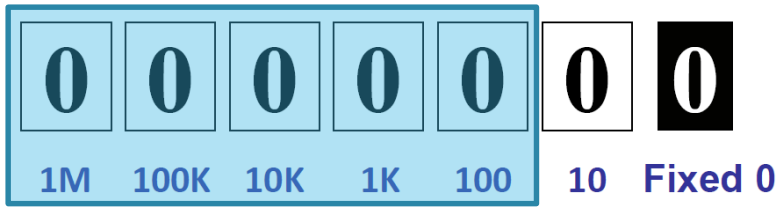
5 Dials



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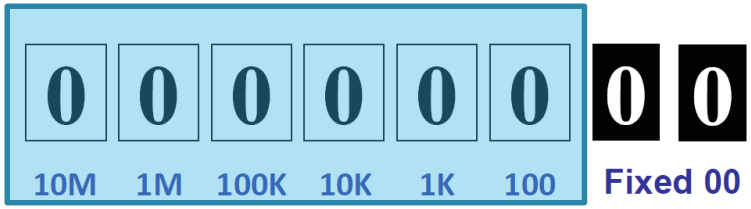
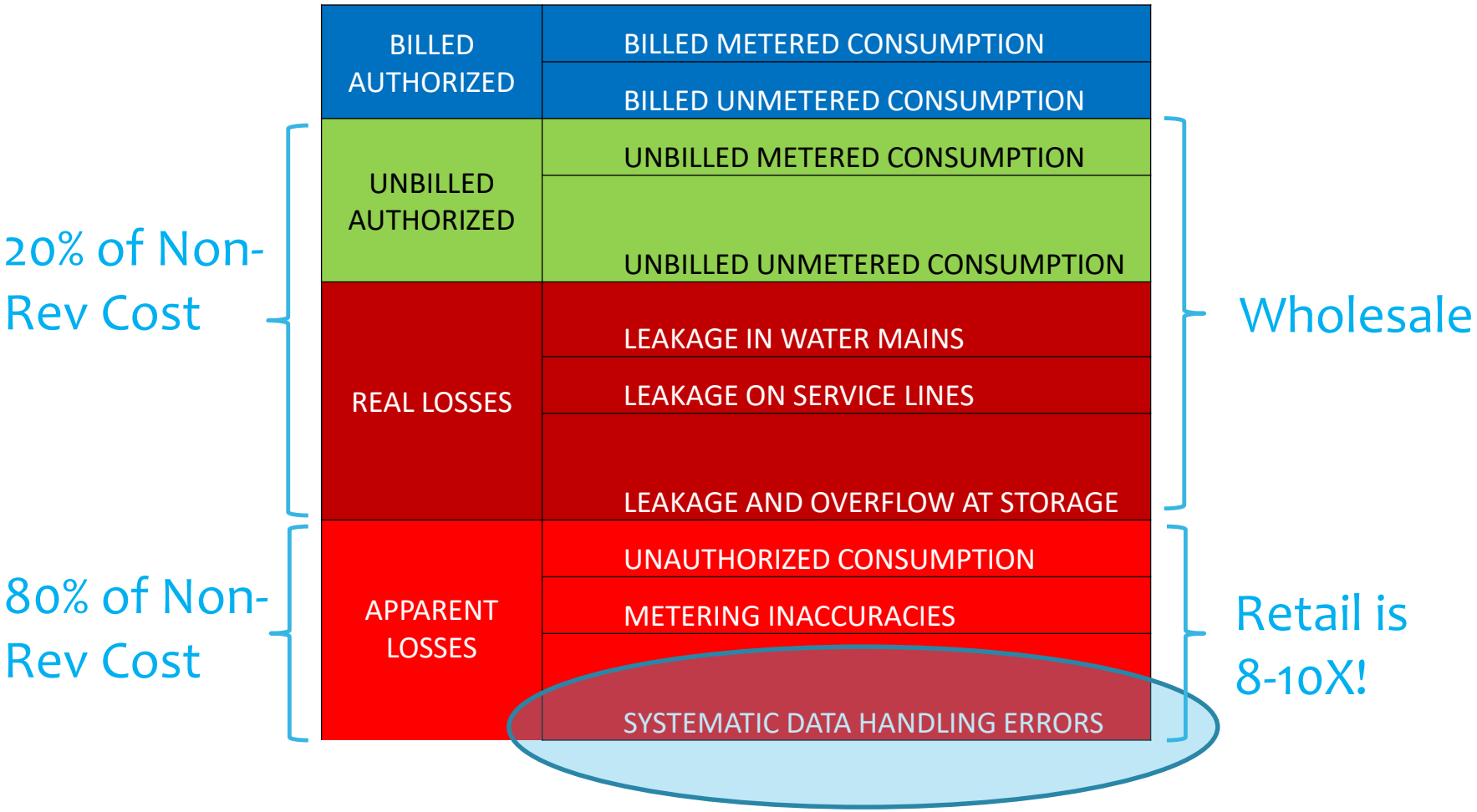
6 Dials



Fortunately, and by Design, the Reading Rules Stay the Same!

Apparent Water Loss



DATA AUDITING RECOMMENDED!

- Auditing Firm
- Internal Resources
- Meter Supplier
- Software Supplier

NECO
Smart Solutions, Water Powered

WATER METER BILLING AUDIT

June 6, 2018

Thank you for allowing us to perform a check of your meter reading and billing system. The purpose of this audit is to search for what the AWWA refers to as “apparent water loss.” This loss involves those areas of the system where revenue is lost due to water being provided without generating revenue. In many instances, this is acceptable to the utility such as for the utility’s buildings. In other cases, discrepancies in the number of digits being read, inactive accounts with consumption and other data issues can cause a significant amount of lost revenue. We have received information that has allowed us to examine some of those areas and look forward to continued study.

Information Received:

- May, 2018 Reading Report
- Backup of May Neptune N_Sight database
- SSI Meter Information Report 4/30/18

Helpful Information we would like to request:

- List of all properties within the Village Limits
  - Enables a check for unmetered locations
- List of known unmetered locations
  - Enables a crosscheck with the list of all unmetered properties
- List of any services that have meters but are unbilled
- List of any services that are unbilled and unmetered
- List of accounts and their billing codes, if available
  - May spot accounts erroneously coded as non-billed status
- Leak forgiveness policy and tracking method
  - Enables the inclusion of this information in the audit

DATA AUDITING REQUIREMENTS

Minimum Info Required:

1. **Billing Software Report** including:
    - Endpoint Serial Number
    - Address/Account Number
    - Meter Size
    - Meter Reading
    - Meter Consumption
    - Meter status (active or inactive)

2. **Meter Reading Software Report** including:
    - Endpoint Serial Number
    - Dials to be read
    - Meter reading
    - Meter consumption (or calculated)

DATA AUDITING

- Correct Units?
- Correct Size?
- Number of Dials
- Multiplier Confirmation
- Read versus Billing Match
- Inactive Accounts with Consumption
- Duplicate MIU
- Service Without MIU
- Known Un-Metered Service (Estimated?)
- Known Metered Un-Billed Service
- Correct Billing Code for Billed and Un-Billed
- Leak Forgiveness
  - Policy In Place?
  - Tracking In Place?

DATA AUDITING FEEDBACK

DIALS MISMATCH					
Account	**Address**	**MIU**	**Read Type**	**Dials**	**Size**
112403	225 PARK	472853	Actual Read	5	03- 1 Inch
150649	2726 NORTH ROAD	102048	Actual Read	5	03- 1 Inch
172349	312 EMMA	111309098	Actual Read	4	04- 1.5 Inch
176255	3686 HIGHTREE SE	111306354	Actual Read	4	04- 1.5 Inch

DATA AUDITING FEEDBACK

INACTIVE WITH USAGE				
	Service Address	Status	MIU	Usage
317	N. IDA ST.	T	1460693812	15580
14380	CR 140	T	1480052620	4240
1010	S. MAIN ST.	T	1480388984	2665
116	W. COLUMBUS ST.	T	1546977042	828
213	N. HIGH ST.	T	1484515460	815
104	MADISON AVE.	T	1460909338	775

DATA AUDITING FEEDBACK

READING MISMATCH								
Service Address		Account Status	Size	MIU	Dials	Reading	CIS Reading	Notes
117	JACOB PARROT BLVD		5	1461112976	7	0474570	4745700	Multiplier Added
1211	W. LIMA ST.		5	1460973670	7	0404140	4041400	Multiplier Added
631	SILVER DR		1	1487330386	6	032640	2806950	Multiplier Added
631	SILVER DR		6	1487148176	7	0280695	2806950	Multiplier Added

Water Loss Audit Software

AWWA Free Water Audit Software v5.0

Email Address:	bbecker@necowater.com
Telephone | Ext.:	513 623-9990
Name of City / Utility:	
City/Town/Municipality:	
State / Province:	Select a state / province from the list
Country:	
Year:	Select Type...
Start Date:	Enter MM/YYYY numeric format
End Date:	Enter MM/YYYY numeric format
Audit Preparation Date:	
Volume Reporting Units:	
PWSID / Other ID:	

Value can be entered by user

Value calculated based on input data

These cells contain recommended default values

Use of Option (Radio) Buttons: Pcnt: 0.25% 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

Instructions

The current sheet. Enter contact information and basic audit details (year, units etc)

Reporting Worksheet

Enter the required data on this worksheet to calculate the water balance and data grading

Comments

Enter comments to explain how values were calculated or to document data sources

Performance Indicators

Review the performance indicators to evaluate the results of the audit

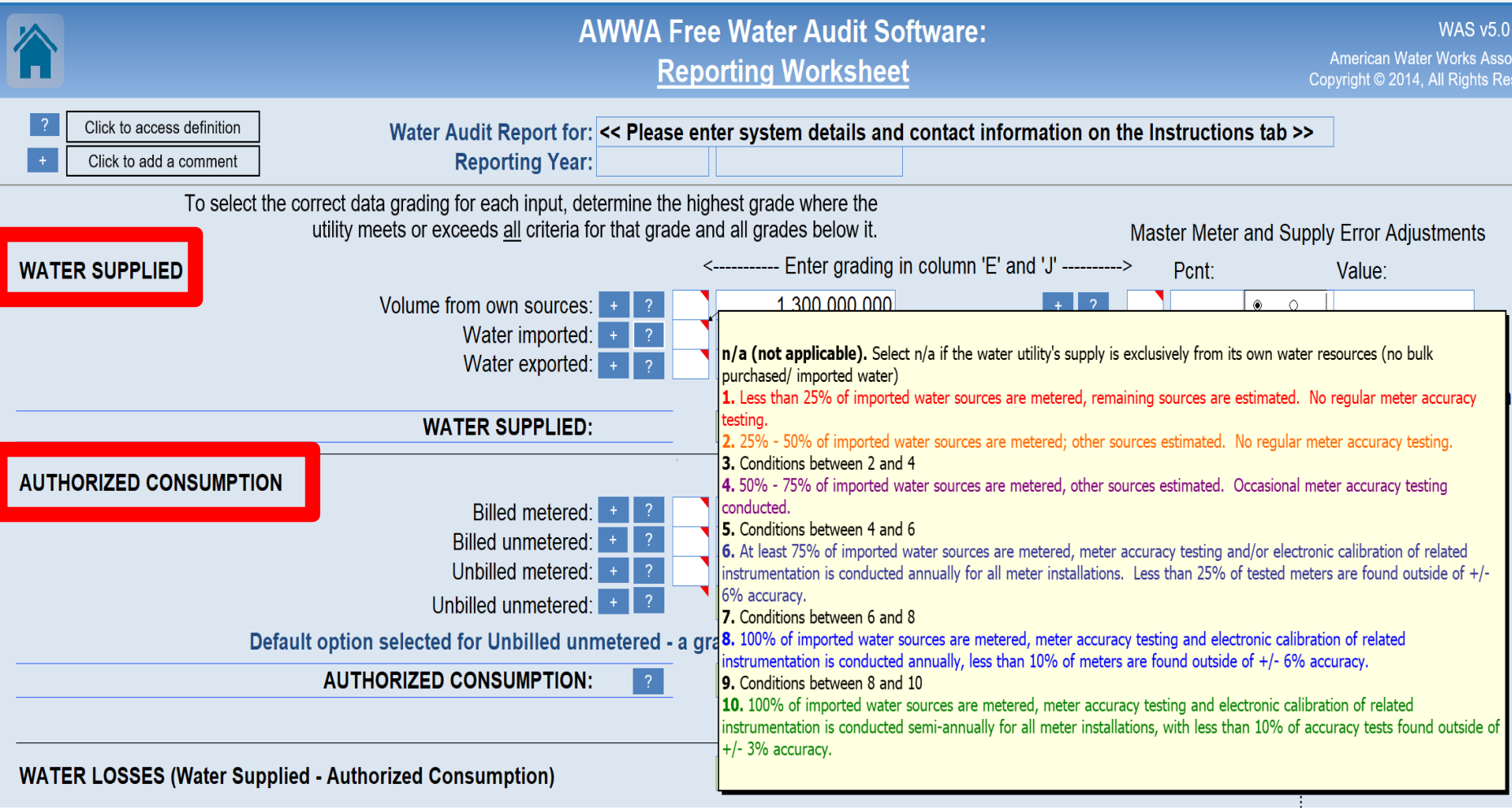
Water Balance

The values entered in the Reporting Worksheet are used to populate the Water Balance

Dashboard

A graphical summary of the water balance and Non-Revenue Water components

Water Loss


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: << Please enter system details and contact information on the Instructions tab >>
Reporting 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.
Master Meter and Supply Error Adjustments
WATER SUPPLIED
<---------- Enter grading in column 'E' and 'J' ---------->
Pcnt:
Value:
Volume from own sources:
Water imported:
Water exported:
1,300,000,000
WATER SUPPLIED:
AUTHORIZED CONSUMPTION
Billed metered:
Billed unmetered:
Unbilled metered:
Unbilled unmetered:
Default option selected for Unbilled unmetered - a gra
AUTHORIZED CONSUMPTION:
WATER LOSSES (Water Supplied - Authorized Consumption)
n/a (not applicable). Select n/a if the water utility's supply is exclusively from its own water resources (no bulk purchased/ imported water)
1. Less than 25% of imported water sources are metered, remaining sources are estimated. No regular meter accuracy testing.
2. 25% - 50% of imported water sources are metered; other sources estimated. No regular meter accuracy testing.
3. Conditions between 2 and 4
4. 50% - 75% of imported water sources are metered, other sources estimated. Occasional meter accuracy testing conducted.
5. Conditions between 4 and 6
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.
7. Conditions between 6 and 8
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.
9. Conditions between 8 and 10
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.

Water Loss

? Click to access definition
+ Click to add a comment

Water Audit Report for: << Please nter system details and contact information on the Instructions tab >>
Reporting Year:

WATER LOSSES (Water Supplied - Authorized Consumption) 0.000

Apparent Losses

Unauthorized consumption: + ? 0.000 Pcnt: 0.25% Value:

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

Customer metering inaccuracies: + ?
Systematic data handling errors: + ?

Apparent Losses: ?

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: ?

WATER LOSSES:

NON-REVENUE WATER

NON-REVENUE WATER: ?

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains: + ?
Number of active AND inactive service connections: + ?
Service connection density: ?

n/a (not applicable). select n/a only if the entire customer population is unmetered. In such a case the volume entered must be zero.

1. 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.

2. 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.

3. Conditions between 2 and 4

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.

5. Conditions between 4 and 6

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.

7. Conditions between 6 and 8

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.

9. 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.

Water Loss

GRADING MATRIX

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.

Apparent Water Loss

With all the changes over the years in register resolution, reading methods, transmitters and software, it is critical to audit your data to ensure accurate meter reading.

You must work with both your meter and billing software suppliers to confirm accuracy.

QUESTIONS?