Apparent Water Loss

- EXPENSIVE
- ACCOUNTABILITY
- CONSERVATION
- EPA IS WATCHING
- CREDIT TO THE AWWA
# Water Balance

## Total System Input
- **Authorized Consumption**
- **Water Loss**

## Revenue Producing
- **Billed Authorized**
- **Billed Metered Consumption**
- **Billed Unmetered Consumption**
- **Unbilled Authorized**
- **Unbilled Metered Consumption**
- **Unbilled Unmetered Consumption**

## Non Revenue Producing
- **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

<table>
<thead>
<tr>
<th>Water Losses</th>
<th>Billed Authorized</th>
<th>Billed Unmetered Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Billed Authorized</td>
<td><strong>Billed Metered Consumption</strong></td>
<td><strong>Billed Unmetered Consumption</strong></td>
</tr>
<tr>
<td>Unbilled Authorized</td>
<td><strong>Unbilled Metered Consumption</strong></td>
<td><strong>Unbilled Unmetered Consumption</strong></td>
</tr>
<tr>
<td>Real Losses</td>
<td>Leakage in Water Mains</td>
<td>Leakage on Service Lines</td>
</tr>
<tr>
<td>Apparent Losses</td>
<td>Unauthorized Consumption</td>
<td>Metering Inaccuracies</td>
</tr>
</tbody>
</table>
Meter Reading Data Integrity

Reading

Billing
Water Loss
Original Dial Resolution

Gallons

Cubic Feet
### Direct Read Dial Resolution

**5/8”, 3/4”, 1” Gallons**

<table>
<thead>
<tr>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1M</td>
<td>100K</td>
<td>10K</td>
<td>1K</td>
<td>100</td>
<td>10</td>
<td>Fixed 0</td>
<td></td>
<td></td>
<td></td>
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</table>

**1 ½”- 4” Gallons**

<table>
<thead>
<tr>
<th>0</th>
<th>0</th>
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<th>0</th>
<th>0</th>
<th>0</th>
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<td>100K</td>
<td>10K</td>
<td>1K</td>
<td>100</td>
<td>Fixed 00</td>
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</table>

**6”-12” Gallons**

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<th>0</th>
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<tr>
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<td>100K</td>
<td>10K</td>
<td>1K</td>
<td>Fixed 000</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**5/8”, 3/4”, 1” Cu. Ft**

<table>
<thead>
<tr>
<th>0</th>
<th>0</th>
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<td>10K</td>
<td>1K</td>
<td>100</td>
<td>10</td>
<td>1</td>
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</table>

**1 ½”- 4” Cu. Ft.**

<table>
<thead>
<tr>
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<td>10K</td>
<td>1K</td>
<td>100</td>
<td>10</td>
<td>Fixed 0</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**6”-12” Cu. Ft.**

<table>
<thead>
<tr>
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<td>10K</td>
<td>1K</td>
<td>100</td>
<td>Fixed 00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Apparent Water Loss
Encoder Dial Resolution

First Generation Encoders  4 or 6 Wheel?

5/8”, 3/4”, 1” GALLONS

0 0 0 0 0 0 0 0 0

1M 100K 10K 1K 100 10 Fixed 0

1 ½” - 4” GALLONS

0 0 0 0 0 0 0 0

1M 1M 100K 10K 1K 100 Fixed 00

6” -12-” GALLONS

0 0 0 0 0 0 0 0

100M 10M 1M 100K 10K 1K Fixed 000

5/8”, 3/4”, 1” Cu. Ft

0 0 0 0 0 0 0 0

100K 10K 1K 100 10 1

1 ½” - 4” Cu. Ft.

0 0 0 0 0 0 0 0

1M 100K 10K 1K 100 10 Fixed 0

6” -12-” Cu. Ft.

0 0 0 0 0 0 0 0

10M 1M 100K 10K 1K 100 Fixed 00
High Resolution

Second Generation Encoders  8 wheel capability

5/8”, 3/4”, 1” GALLONS

Neptune

Sensus

Gallons Registers

Sensus 5/8”, 3/4” and 1” SR®, SR II® meters.

RF Transmitters & Leak Detection Capability

Apparent Water Loss
Water Loss

Period of Transition – Registers/Transmitters/Units
DATA AUDITING

- Auditing Firm
- Internal
- Meter Supplier
- Software Supplier
## DATA AUDITING

### DIALS MISMATCH

<table>
<thead>
<tr>
<th>Account</th>
<th>Address</th>
<th>MIU</th>
<th>Read Type</th>
<th>Dials</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>112403</td>
<td>225 PARK</td>
<td>472853</td>
<td>Actual Read 5</td>
<td>03-1</td>
<td>Inch</td>
</tr>
<tr>
<td>150649</td>
<td>2726 NORTH ROAD</td>
<td>102048</td>
<td>Actual Read 5</td>
<td>03-1</td>
<td>Inch</td>
</tr>
<tr>
<td>172349</td>
<td>312 EMMA</td>
<td>111309098</td>
<td>Actual Read 4</td>
<td>04-1.5</td>
<td>Inch</td>
</tr>
<tr>
<td>176255</td>
<td>3686 HIGHTREE SE</td>
<td>111306354</td>
<td>Actual Read 4</td>
<td>04-1.5</td>
<td>Inch</td>
</tr>
</tbody>
</table>

### INACTIVE WITH USAGE

<table>
<thead>
<tr>
<th>Service Address</th>
<th>Status</th>
<th>MIU</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>317 N. IDA ST.</td>
<td>T</td>
<td>14606938</td>
<td>12</td>
</tr>
<tr>
<td>14380 CR 140</td>
<td>T</td>
<td>14800526</td>
<td>20</td>
</tr>
<tr>
<td>1010 S. MAIN ST.</td>
<td>T</td>
<td>14803889</td>
<td>84</td>
</tr>
<tr>
<td>116 W. COLUMBUS ST.</td>
<td>T</td>
<td>15469770</td>
<td>42</td>
</tr>
<tr>
<td>213 N. HIGH ST.</td>
<td>T</td>
<td>14845154</td>
<td>60</td>
</tr>
<tr>
<td>104 MADISON AVE.</td>
<td>T</td>
<td>14609093</td>
<td>38</td>
</tr>
</tbody>
</table>

### READING MISMATCH

<table>
<thead>
<tr>
<th>Service Address</th>
<th>Account</th>
<th>Status</th>
<th>Size</th>
<th>MIU</th>
<th>Dials</th>
<th>N_Sight Reading</th>
<th>CIS Reading</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>117 JACOB PARROT BLVD</td>
<td>5</td>
<td></td>
<td>5</td>
<td>14611129</td>
<td>76</td>
<td>0474570</td>
<td>4745700</td>
<td>Multiplier Added</td>
</tr>
<tr>
<td>1211 W. LIMA ST.</td>
<td>5</td>
<td></td>
<td>5</td>
<td>14609736</td>
<td>70</td>
<td>0404140</td>
<td>4041400</td>
<td>Multiplier Added</td>
</tr>
<tr>
<td>631 SILVER DR</td>
<td>1</td>
<td></td>
<td>6</td>
<td>14873303</td>
<td>86</td>
<td>032640</td>
<td>2806950</td>
<td>Multiplier Added</td>
</tr>
<tr>
<td>631 SILVER DR</td>
<td>6</td>
<td></td>
<td>7</td>
<td>14871481</td>
<td>76</td>
<td>0280695</td>
<td>2806950</td>
<td>Multiplier Added</td>
</tr>
</tbody>
</table>
Data Audit Requirements

Minimum Info Required:
1. The 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)
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

<table>
<thead>
<tr>
<th>TEST PERFORMED</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Dials Check</td>
<td>Meter size, Numbers of Dials and Multipliers were examined for any discrepancies</td>
</tr>
<tr>
<td>Meter Read Mismatch Check</td>
<td>Large meter readings from the N_Sight meter reading software were checked against the readings in the Billing Software Reading Report</td>
</tr>
<tr>
<td>Inactive accounts with consumption</td>
<td>Accounts with an inactive status were checked for consumption.</td>
</tr>
<tr>
<td>Duplicate MIU Check</td>
<td>The list of MIU’s was scanned for duplicates.</td>
</tr>
</tbody>
</table>
## Dials Mismatch

<table>
<thead>
<tr>
<th>Account</th>
<th>Address</th>
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<td>111306354</td>
<td>Actual Read</td>
<td>04- 1.5 Inch</td>
</tr>
</tbody>
</table>

## Inactive with Consumption

<table>
<thead>
<tr>
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<th>Status</th>
<th>MIU</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>317 N. IDA ST.</td>
<td>T</td>
<td>1460693812</td>
<td>15580</td>
</tr>
<tr>
<td>14380 CR 140</td>
<td>T</td>
<td>1480052620</td>
<td>4240</td>
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<tr>
<td>1010 S. MAIN ST.</td>
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<td>1480388984</td>
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<td>116 W. COLUMBUS ST.</td>
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</tr>
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<td>213 N. HIGH ST.</td>
<td>T</td>
<td>1484515460</td>
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<tr>
<td>104 MADISON AVE.</td>
<td>T</td>
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</tbody>
</table>
### Reading Mismatch

<table>
<thead>
<tr>
<th>Service Address</th>
<th>Account Status</th>
<th>Size</th>
<th>MIU</th>
<th>Dials</th>
<th>N_Sight Reading</th>
<th>CIS Reading</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>117 JACOB PARROT BLVD</td>
<td>A</td>
<td>5</td>
<td>1461112976</td>
<td>7</td>
<td>0474570</td>
<td>4745700</td>
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<td>7</td>
<td>0280695</td>
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   Enables a crosscheck with the list of all unmetered properties

List of any services that have meters but are unbilled

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

SPREADSHEET PLEASE
# Water Loss

## 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

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.

WATER SUPPLIED

Volume from own sources: + ?
Water imported: + ?
Water exported: + ?

WATER SUPPLIED:

AUTHORIZED CONSUMPTION

Billed metered: + ?
Billed unmetered: + ?
Unbilled metered: + ?
Unbilled unmetered: + ?

Default option selected for Unbilled unmetered - a grade

AUTHORIZED CONSUMPTION: ?

WATER LOSSES (Water Supplied - Authorized Consumption)

Master Meter and Supply Error Adjustments

<-------- Enter grading in column 'E' and 'J'-------->
Pcnt: ____________________________ Value: ____________________________

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

WATER LOSSES (Water Supplied - Authorized Consumption)

Apparent Losses

Unauthorized consumption: + ?

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 questioned.
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.
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.