New Mexico's Water Conservation Planning Guide for Public Water Suppliers







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EXECUTIVE SUMMARY

Water conservation is an important and necessary part of managing any public water supply system. The *New Mexico Water Conservation Planning Guide for Public Water Suppliers* (Planning Guide) provides tools and step-by-step directions for developing a measureable and effective Water Conservation Plan for Public Water Suppliers (PWSs). Developing and implementing effective water conservation programs is a critical component of a Water Conservation Plan. Implementation of a water conservation program is a key action that can achieve the objectives and goals articulated by PWSs. Programs are at the heart of any successful conservation effort.

Water conservation programs are particularly critical in New Mexico, which is located in the high desert of the southwest where water has always been limited in quantity. The State Water Plan embraces the goal of ensuring a sustainable source of water for New Mexico through healthy watershed management. Water conservation is an essential piece of this goal, and the process of water conservation planning is a continuous effort. Data management is fundamental to ensure a measurable and effective process.

The first tool presented in the Planning Guide is the American Water Works Association (AWWA) Water Loss Control Committee Free Water Audit Software© ("Audit"). This software, which is offered by AWWA at no charge, provides a nationally recognized systematic method to organize water diversion data and track its path through the distribution system. A primary result of this analysis is "nonrevenue water," which is an estimation of water losses, theft, meter inaccuracies, and non-billed authorized consumption. The Audit requires financial data to help value nonrevenue water. The Audit also provides a measure of confidence in the output.

The second tool presented in the Planning Guide is the New Mexico Office of the State Engineer's (NMOSE) Gallons per Capita per Day (GPCD) Calculator ("GPCD Calculator"). This tool, also available at no charge, provides a standard method for organizing water diversions and end use. The GPCD Calculator has been extensively tested in New Mexico and is incorporated into many PWS NMOSE permit conditions. It breaks down end use into categories that can provide baseline data and identify trends. This enables PWSs to compare the effectiveness of end-use (demand-side) conservation programs to baseline use patterns.

PWSs should refer to this Planning Guide to learn how to use these tools and the additional steps outlined herein to make informed decisions about water management rather than randomly selecting programs from a list. In the long run, the process provided in this Planning Guide will save PWSs time and money and produce a more successful plan.

More broadly, the tools and measures described in the Planning Guide are aimed at helping PWSs improve their overall water supply management efforts. Improved water management often leads to better water conservation. The data gathered for the Water Conservation Plan also provides basic information needed for the asset management planning process. Asset management promotes intelligent decision making for the operation and maintenance of the infrastructure to ensure optimal and cost-effective operation over the long term, another goal of the State Water Plan.

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Acronyms and Abbreviations

Audit	American Water Works Association Water Loss Control Committee Free Water Audit Software©
AWE	Alliance for Water Efficiency
AWWA	American Water Works Association
BMPs	best management practices
CUWCC	California Urban Water Conservation Council
ECoBA	Evaluation and Cost Benefit Analysis of Municipal Water Conservation Programs
FTE	full-time employee
GPCD	Gallons per Capita per Day
GPCD Calculator	New Mexico Office of the State Engineer's Gallons per Capita per Day Calculator
ICI	Industrial, Commercial, Institutional
IWA	International Water Association
MFR	Multi-Family Residential
NMOSE	New Mexico Office of the State Engineer
NMRWA	New Mexico Rural Water Association
NMSU	New Mexico State University
Planning Guide	*New Mexico Water Conservation Planning Guide for Public Water Suppliers*
psi	pounds per square inch
PWS(s)	Public Water Supplier(s)
SFR	Single-Family Residential
USBR	United States Bureau of Reclamation
U.S. EPA	United States Environmental Protection Agency
WLCC	Water Loss Control Committee

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NEW MEXICO WATER CONSERVATION PLAN TEMPLATE BY SECTION

The template below demonstrates the New Mexico Office of the State Engineer's (NMOSE) recommended formatting and content for a Water Conservation Plan. Developing a Water Conservation Plan provides an opportunity for Public Water Suppliers (PWSs) to implement effective water conservation programs.

How to Use This Guide

The *New Mexico Water Conservation Planning Guide for Public Water Suppliers* ("Planning Guide") provides instructions for developing a Water Conservation Plan. To use this Planning Guide, first read through the template below, which outlines the basic structure of a Water Conservation Plan. For instructions on completing each section in the template, refer to subsequent sections of this Planning Guide.

It is necessary to complete a water audit using the American Water Works Association (AWWA) Water Loss Control Committee (WLCC) Free Water Audit Software© ("Audit") and the NMOSE's Gallons per Capita per Day Calculator ("GPCD Calculator") to develop a Water Conservation Plan. The Planning Guide provides instructions on how to use these tools to gather and identify data, examine the data, identify potential water conservation programs, and then select, evaluate, and implement the programs.

Developing a Water Conservation Plan begins by finding PWS data. Understanding the organizational structure of the PWS will simplify gathering information, data, and expert assistance. The PWS generally consists of a governing body, management and administration, and the operator(s). In small PWSs, one person may represent more than one area. Ideally, the PWS should organize a planning team with members representing each of the above-mentioned areas as well as a conservation specialist, an engineer, a financial specialist, and a manager (Section 1). If forming a planning team is not possible, identify contacts in each area that can provide the necessary information.

The following appendices are included in the Planning Guide to assist PWSs:

- Appendix A: Resources – This appendix includes information about organizations, manuals and other documents, websites, and funding sources.
- Appendix B: Instructions for AWWA Audit – This appendix provides guidance on collecting and entering data into the Audit.
- Appendix C: Examples – This appendix includes screen shots of the Audit and GPCD Calculator, as well as an example of a fictitious scenario based on Appendix B.

Finally, this Planning Guide does not provide a list of Best Management Practices (BMPs). There are many resources for PWSs to obtain ideas on BMPs appropriate for individual situations (see Section 3). Rather, this Planning Guide focuses on developing reproducible metrics to assist PWSs in scoping a Water Conservation Plan and provides a list of elements to consider when developing a water conservation program. It is these two elements that assist in communicating a PWS's water conservation program to both its internal management and staff as well as to its customers.

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SECTION 1: DATA COLLECTION

Section 1 will assist the Public Water Supplier (PWS) to identify the local conditions that could (1) affect water use, and (2) provide baseline water-use information. The type of data the PWS will need to collect and how to organize the data will be explained in this section.

This *New Mexico Water Conservation Planning Guide for Public Water Suppliers* ("Planning Guide") explains the use of two tools that will assist PWSs in development of a successful Water Conservation Plan:

- The American Water Works Association Water Loss Control Committee Free Water Audit Software© ("Audit").
- The NMOSE's Gallons per Capita per Day Calculator ("GPCD Calculator").

Section 1 includes the following subsections:

- Purpose
- Identify and Form a Planning Team
- Local Conditions
- Data Collection to Complete the Audit
- Data Collection to Complete NMOSE's GPCD Calculator

Both the Audit and the GPCD Calculator are tools that use standardized spreadsheets. This section will explain the type of data that needs to be entered into the spreadsheets. The spreadsheets will calculate baseline water use, which will be examined in Section 2.

Purpose

It is important to know "why" the plan is being prepared and "who" in the PWS has authorized this work. The "why" for the Water Conservation Plan may be water supply issues, water quantity permit conditions, requirements for state funding, or public relations. Knowing "why" the plan is being written is imperative since this will help determine the goals (Section 3).

It is important to understand "who" authorized the preparation of the plan. The entity that authorized the work (most often the governing body) can assist in allocating resources or facilitating collaboration among the various departments that will find and gather the data.

Identify and Form a Planning Team

Identify stakeholders and inform them of the water conservation planning process and invite them to participate. Form a team with the ability to provide information and monitor, assess, and implement a Water Conservation Plan. This team should include a conservation specialist, an engineer, and a financial specialist at a minimum, as well as representatives from the governing body, management and administration, and the operations department. It is also very important to consider public involvement as part of the water conservation planning process (see Section 4).

Local Conditions

In addition to understanding its supply and demand, each PWS should have a comprehensive understanding of the local conditions in the area. This category includes the various demographic and environmental conditions that influence water supply and use: geography, elevation, weather, and service area conditions (e.g., farmland, bedroom community, second homes, tourist area, historical area, industrial region). The following suggestions address the minimum number and type of conditions, but additional information that more appropriately explains local conditions can be included.

Map

Provide a map depicting the PWS's location in New Mexico and the boundaries of the service area. Water diversion locations should be included.

Water Supply Overview

It is important to have a thorough understanding of the reliability of the PWS's water supply (CWCB, 2012). Determine which basin the water is coming from and how susceptible the water supply is to drought or climate change. Provide information on the groundwater or surface water locations and the volume of supply from each point. Discuss any issues related to reliability of supply.

Demographics

To understand end use and to involve customers in end-use programs, the PWS must understand its customer base. For residential use, the primary considerations are age, income level, and primary language of the population. The U.S. Census Bureau is a good starting point for most of these statistics. The census's data 2010 table DP-1, Profile of General Population and Housing Characteristics, used in the GPCD Calculator, contains nearly all of this data. The University of New Mexico Bureau of Business and Economic Research and the website City-Data.com also provide local information.

In addition to these statistics, the PWS should have an understanding of the predominant characteristics of its service area. This could include elements such as landscaping or vegetable gardens, bedroom community or second homes, tourism, or cultural significance. The PWS should also look for any prominent Industrial, Commercial, and Institutional (ICI) uses, such as large single users such as a prison or school and any large group of users such as restaurants or car washes.

Housing

The characteristics of a house or a housing development also provide insight into water use. Landscape preferences and the age of indoor appliances and fixtures are the biggest contributors to water use. The U.S. Census provides information on the age of homes by area. Determine how many homes were built prior to 1994, which is when the Energy Policy Act began enforcement. The U.S. Census provides this information on its 2010 Table DP04, Selected Housing Characteristics.

Temperature and Precipitation

New Mexico is unique in the diversity of its weather conditions. Neighboring cities may be at sharply different elevations and receive completely different amounts of precipitation. Each PWS should determine the average weather conditions for its service territory. Start with temperature ranges and precipitation events and note when (months or seasons) these temperature fluctuations and precipitation events happen. City-Data.com publishes general information by city. The New Mexico State University (NMSU) Climate Center maintains weather data stations statewide that monitor the weather patterns. The NMSU website (html://weather.nmsu.edu/climate/) is interactive and allows for customization of graphs or data tables for each station.

Other Local Conditions

In the development of a Water Conservation Plan, the PWS may see the need to include local conditions that are not listed here. For example, a description of the PWS's water rights is a common topic that is often included. The PWS in preparing its Water Conservation Plan may require an expanded assessment of the local conditions that are not listed above.

Data Collection to Complete the Audit

A water audit provides a systematic method to organize water diversion data and track its path through the distribution system. A primary result of this analysis is "nonrevenue water," which is an estimation of water losses, theft, meter inaccuracies, and non-billed authorized consumption. The audit requires financial data to help value nonrevenue water. To review a completed example of the Audit, see Appendix C.

AWWA Free Water Audit Software

AWWA WLCC Free Water Audit Software©
The PWS can download the free AWWA spreadsheet from the AWWA WaterWiser website at http://www.awwa.org/resources-tools/water-knowledge/water-loss-control.aspx.

AWWA helped to develop a standard water audit methodology as part of a five-country task force formed by the International Water Association (IWA). This comprehensive water audit accounts for all water uses within a PWS system, focusing on supply-side uses. The Audit provides standardized metrics for system use. This section of the Planning Guide will introduce the water balance, explain how to establish the parameters of an audit, and explain how to grade the validity of the data. Additional information on how to collect, define, and organize the system's data, and how to input the data into the Audit spreadsheet can be found in Appendix A: Resources. The PWS can download the free Audit spreadsheet from the AWWA WaterWiser website at http://www.awwa.org/resources-tools/water-knowledge/water-loss-control.aspx. (Note: This link takes you to a webpage where you must register and create a login to access this free tool.)

Appendix B: Instructions for Audit includes the instructions for the type of data to be collected and how to input the data into the Audit spreadsheet. Table B-1 provides a complete list of all input values including definitions, tips for locating the value, and space for taking notes. The PWS can copy and use Table B-1 to collect and compile the Audit data.

Establish Parameters

The PWS needs to first establish limits for the Audit. Parameters need to be set for time period, system boundaries, and units of measure (AWWA, 2009a):

- Time period: A 12-month time period is recommended for a water audit. This provides enough data to produce realistic and useful results. The PWS should repeat the water audit every 12 months.
- System boundaries: The water audit should start at diversions and withdrawals and cover all end users served. The PWS can complete additional audits based on subsets, such as treated and untreated water to exclude wholesale water, or by pressure districts. These secondary scopes may provide additional details on potential problem areas.
- Units of measure: The Audit spreadsheet allows for water volume input in million gallons, megaliters, or acre-feet. The PWS must convert all data to one of these choices, whichever is a more usable metric for the supplier.

Once the PWS has established parameters, the next step is to collect input values for the Reporting Worksheet (this is a tab in the Audit spreadsheet). The Audit spreadsheet provides detailed instructions for filling out the necessary information to complete the water balance. Generally, to complete the audit, information will need to be collected from the PWS's billing

system and diversion data. Also, it may be necessary to conduct interviews with PWS plant operators, field technicians, and administrators to obtain (and perhaps estimate) the necessary input data.

Determine Data Validity

To determine the validity of the audit, AWWA requires a score or grade for specific input values in the Reporting Worksheet. The PWS must assign a grade to each input value that describes its confidence in the accuracy of that value. To receive the most applicable recommendations, it is important that the PWS be honest in the grading.

The Audit spreadsheet will make recommendations based on these grades. Section 2 will explain the spreadsheet's overall data validity score and the recommendations made by the Audit spreadsheet.

Table B-3 in Appendix B lists all of the input values that require a grade. Determine the grades for each input value based on the criteria provided for column E in the Reporting Worksheet. Record the grades in Table B-3.

Data Collection to Complete NMOSE's GPCD Calculator

Gallons per Capita per Day (GPCD) Calculator
The PWS can download the free GPCD Calculator from the NMOSE website at:
http://www.ose.state.nm.us/wucp_gcpd.html

Per capita water use, often referred to as gallons per capita per day (GPCD), is a common metric used in assessing PWSs. The most common approach for determining a system's GPCD is to use a very basic calculation: *(total diversion/ day) / total population.* The NMOSE has developed a method that is based on the end-use category (see the category definitions below) as well as the basic GPCD calculation. This categorization of end use provides an opportunity to assess individual sectors for conservation potential.

The GPCD Calculator provides a tool for organizing water diversions and end use by category. The GPCD Calculator helps to provide baseline data and identify recent and historical trends. A baseline can be defined as a measurement, calculation, or location used as a basis for comparison. The baseline then enables the PWS to have basic data to assess where opportunities exist for conservation programs and to track the effectiveness of a conservation program(s). The PWS can download the Microsoft Excel spreadsheet and the GPCD Instruction Module at no cost from the NMOSE website at http://www.ose.state.nm.us/wucp_gcpd.html (NMOSE, 2012). To review a completed example of the GPCD Calculator, see Appendix C.

Collecting census, billing, and metering data is necessary to complete the GPCD Calculator. For detailed information regarding this data, please refer to GPCD Instruction Module pages 3 and 4. The categories in the GPCD Calculator are as follows:

- *Single-Family Residential (SFR)* is for a stand-alone or independently metered housing unit.
- *Multi-Family Residential (MFR)* is for living units in an apartment complex, duplexes, triplexes, trailer parks, condominiums, or townhouses that have multiple units serviced by a single connection.
- *Industrial, Commercial, Institutional (ICI*) includes industrial properties such as manufacturing sites, commercial properties such as restaurants and shopping malls, and institutional customers such as schools, universities, and prisons.
- *Other Metered* includes all categories of billed use that are not classified in SFR, MFR, or ICI.
- *Reuse or recycled water* is for former waste water (sewage) that has been treated to remove solids and certain impurities and is reused by a water supplier.
- *Nonrevenue Water* is for all of the water the utility diverts and/or produces, but does not get paid for by customers.

Once the PWS completes the data entry, the GPCD Calculator will provide the system's total GPCD, as well as GPCDs for SFR and MFR. The GPCDs by category will not add up to the system's total GPCD. The system's total GPCD is based on the total population (including *Group Quarters*), compared to individual categories, which utilize population specific to each category.

SECTION 2: ASSESSING PWS PERFORMANCE

This section discusses the baseline data calculated using the Audit and the GPCD Calculator. This baseline data will provide the measurement by which the PWS will set goals, implement programs, and track use over time.

Section 2 includes the following subsections:

- Audit Reporting Worksheet
- GPCD Calculator Data Results

Audit Data Results

Introduction

The completed Audit provides baseline data for a number of different system metrics, including *Water Balance*, *Performance Indicators*, *Data Validity Score*, and *Priority Areas for Attention*. The baseline data can be used by the PWS to focus on supply-side objectives and goals (discussed in Section 3) and to identify specific water conservation programs. The following section provides a review of the primary Audit output and describes some of its limitations. To review an example of how the Audit can be applied, see the section titled "Example City" in Appendix C.

Advanced Functions of AWWA Audit Software

The Water Audit Software Compiler is a separate tool that can be downloaded from the AWWA website. The compiler displays all the input data in graphs for each audit. When used over time, it helps the PWS to visualize its data and results, and it provides graphs for reports or presentations.

Other updates to the AWWA software are scheduled. Check the AWWA's Water Loss Control website occasionally for updates (www.awwa.org).

Water Balance

The foundation of the Audit is the water balance (Table 1) (AWWA, 2012). The water balance is made up of components contributing to water supply and use. It provides accountability as all of the water placed into a distribution system should, in theory, equal all of the water taken out of the distribution system (AWWA, 2012). To complete the Audit, the PWS must gather data as prescribed in the Audit Reporting Worksheet.

Table 1. Audit Water Balance

<table>
<tr><td rowspan="8">System input volume</td><td rowspan="2">Authorized consumption</td><td>Billed authorized consumption</td><td>Billed metered consumption (including water exported)</td><td rowspan="2">Revenue water</td></tr>
<tr><td></td><td>Billed unmetered consumption</td></tr>
<tr><td rowspan="2">Unbilled authorized consumption</td><td>Unbilled metered consumption</td><td rowspan="6">Nonrevenue water</td></tr>
<tr><td>Unbilled unmetered consumption</td></tr>
<tr><td rowspan="4">Water losses</td><td rowspan="2">Apparent losses</td><td>Unauthorized consumption</td></tr>
<tr><td>Customer metering inaccuracies</td></tr>
<tr><td rowspan="3">Real losses</td><td>Systematic data-handling errors</td></tr>
<tr><td>Leakage on transmission and distribution mains</td></tr>
<tr><td>Leakage and overflows at utility's storage tanks</td></tr>
<tr><td></td><td></td><td></td><td>Leakage on service connections up to point of customer metering</td></tr>
</table>

An example of how the water balance can be used to monitor the system's performance is to complete the Audit monthly. Assessing the real losses and differences from previous months (specifically increases) alerts the PWS of changes to real losses. Once real loss increases have been identified, the system's operators can be notified and begin assessing potential leaks. This example is particularly useful for smaller systems. Water balance is not limited to only identifying real losses, but provides information in changes to the system's water distribution assessment.

Performance Indicators

There are two types of performance indicators: financial indicators and operational efficiency indicators. Both types of indicators provide information on the impacts of water loss through different metrics. The performance indicators highlight impacts of system water loss to revenue and operational considerations. While these indicators can be used to assist in setting conservation goals, AWWA cautions that financial indicators may be impacted by

AWWA has recommended against the use of the terms "unaccounted-for water" and "unaccounted-for water percentage." Instead, water utilities should employ the term "nonrevenue water" and should use the performance indicators in the Audit (AWWA, 2012).

varying levels of customer consumption, and that operational indicators for systems with less than 3,000 connections may not be effective. If these indicators are to be used in goal setting, the PWS should be aware of potential limitations and should research information provided by AWWA to develop indicators. Generally, the PWS should aim for the lowest level of water loss due to New Mexico's scarcity of water.

Data Validity Score

On a scale of 0 to 100, the data validity score measures the reliability of the data provided in the Audit. The Audit calculates this score from the grades the PWS assigned to the input values and entered into the spreadsheet. AWWA assigns a weight to each Audit category by importance. The PWS receives a higher score when the BMPs outlined in the Audit software and the AWWA manuals for metering (M6) and water loss (M36) are implemented. The Audit spreadsheet provides five levels of data validity in the Loss Control Planning tab: Level I (0-25), Level II (26-50), Level III (51-70), Level IV (71-90), and Level V (91-100). The Loss Control Planning tab provides basic functional focus areas to assist a PWS in prioritizing system improvements. The Audit recommends achieving a data validity score above 50 before using the performance indicators to set performance targets. If the data validity score is below 50, the PWS should assess using the Water Loss Control Planning Guide to help improve their score.

Priority Areas for Attention

The priority areas for attention are the three lowest-scoring areas on the PWS's audit. The spreadsheet assigns weights to these scores by area of importance (for more information, see the Grading Matrix worksheet). To improve the PWS's next audit, the PWS should address these priority areas. If the data validity score is lower than 50, the PWS should carefully assess priority areas for attention in program decision making and review the Water Loss Control Planning Guide.

The above-mentioned results are further evaluated using the Loss Control Planning worksheet and the Grading Matrix worksheet.

Loss Control Planning

When the PWS has completed the Audit Reporting Worksheet, the data validity grade level will automatically be highlighted in yellow on the Loss Control Planning worksheet. The Loss Control Planning worksheet prioritizes potential change based on the grade or level of data validity. If the PWS is Level I, the focus is data collection and short-term loss control. At Level II, the PWS can add in long-term loss control. At Level III or higher, the PWS can start looking at target setting and benchmarking, which are categories in the Loss Control Planning worksheet.

Grading Matrix

The Grading Matrix shows the three priority areas (shown in red font) that require attention and the corresponding recommended improvements. The Grading Matrix automatically highlights in yellow the grade assigned to the input value on the completed Audit Reporting Worksheet. In addition, it highlights the AWWA's suggestions for improving this grade (see Appendix C).

GPCD Calculator Data Results

The completed GPCD Calculator provides water-use information about metered end uses. The baseline data from the GPCD Calculator focuses on demand-side data to assist in identifying water conservation program(s).

The results of the GPCD Calculator are shown in various worksheets in green highlight. This information can be analyzed to develop potential conservation programs. At a minimum, the following results need to be analyzed in the Water Conservation Plan.

- Annual SFR GPCD (table or chart, minimum of five years)
- Monthly SFR GPCD (chart, minimum of five years)
- Annual MFR GPCD (table or chart, minimum of five years)
- Monthly MFR GPCD (chart, minimum of five years)
- Annual System Total GPCD (table or chart, minimum of five years)
- Monthly System Total GPCD (chart, minimum of five years)

Indoor and Outdoor Use

Water conservation programming to reduce SFR indoor water use is one of the most common water conservation strategies. Calculating SFR indoor water use can be accomplished in many ways. A simple technique to estimate SFR indoor GPCD is to average the three winter months with the lowest water use. This technique can also be used to estimate MFR indoor GPCD. These metrics must be included in the Water Conservation Plan.

Reducing SFR outdoor water use is another common water conservation strategy. This is generally calculated by subtracting the averaged SFR monthly indoor GPCD from the total monthly GPCD. This technique can also be used to estimate MFR outdoor GPCD. Often this area of water use is a major portion of the total SFR GPCD. These metrics must be included in the Water Conservation Plan.

ICI and Other Metered Uses

The GPCD Calculator provides ICI and Other Metered monthly and annual totals. A narrative of ICI accounts and other metered uses that are part of this category can be included if this category has a significant percentage of the overall water use. Additionally, the PWS should identify

consumers who use greater than 50,000 gallons per day. The PWS may want to consider analyzing its commercial sector, including hotels, golf courses, and car washes, for conservation opportunities.

Unlike the Audit, the GPCD Calculator does not provide performance indicators or validity scores. Therefore, the PWS will need to research on its own BMPs that impact the metrics described above. Subsequent sections of this Planning Guide describe the process of selecting BMPs for implementation.

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SECTION 3: SETTING WATER CONSERVATION GOALS

This section discusses defining the objective and goals of a Water Conservation Plan.

Section 3 includes the following subsections:

- Objective and Reasons for Developing a Water Conservation Plan
- Water Conservation Goals
- Prioritizing Goals
- Evaluating Goals
- Best Management Practices

Objective and Reasons for Developing a Water Conservation Plan

The most important step in setting a goal is stating an objective and the reasons why a PWS is developing a Water Conservation Plan. Often times this is related to conserving water for future generations, protecting against drought or climate change, reducing withdrawals and the cost of operation, reducing nonrevenue water, extending existing resources to an increasing population, increasing accountability of water use, and meeting regulatory requirements.

Water Conservation Goals

Keep goals clear and measurable, and avoid any vague or undefined language. A measurable goal includes both a target and a timeline.

The following are examples of clear and measurable goals:

- Improve system management within five years as reflected in a data validity score of 70 or better on the Audit.
- Reduce nonrevenue water by 20 percent from five year average (2005-2009) by 2020.
- Achieve a single-family indoor GPCD below 70 within 15 years.

Prioritizing Goals

Short-term goals are usually meant to be achieved within five years or less. They should be very specific. Longer-term goals, greater than five years, require an understanding of the dynamics of various factors that can impact water use. The use of short-term goals may be steps that feed into the long-term goals. Prioritize goals by considering funding, resources, and timelines. The highest-priority goal will address the PWS's objective.

Evaluating Goals

Evaluate goals regularly and whenever conditions of the PWS change. Replace any goal that becomes obsolete or no longer reflects the values of the PWS. Once the PWS implements programming to achieve a goal, it may need to modify the goal or the programming to meet the stated objective.

To achieve stated goals, the PWS needs to develop water conservation programs that will quantitatively establish how that goal, and subsequently the objective, will be met. A simple metric often is the system's annual GPCD. However, other metrics from the Audit or the GPCD Calculator may be more appropriate to quantify progress. Determining a metric often relates to the objective and reason for developing a Water Conservation Plan.

Best Management Practices

Many existing publications outline programs or BMPs in water conservation and water efficiency. These publications provide the details of the BMPs and describe options for implementation and anticipated outcomes. This Planning Guide will not attempt to recreate these documents. A list of resources is provided in Appendix A, and the NMOSE will keep an updated list of references on its website at http://www.ose.state.nm.us/conservation_index.html.

The PWS should determine the best approaches and incentives for its specific circumstances and choose the BMPs that are most likely to be successful. Often multiple approaches can be used for the same program (e.g., a behavioral change [using less landscape water], can combine a regulatory incentive [time of day watering ordinance] and an educational incentive [distribution of brochures on new ordinance]).

Published BMPs include examples of what to anticipate. The publication "Evaluation and Cost Benefit Analysis of Municipal Water Conservation Programs (ECoBA)" from the Water Conservation Alliance of Southern Arizona (2006) is a good place to start for basic end-use programs. The NMOSE will provide links to updated research at http://www.ose.state.nm.us/wucp_links.html#public

SECTION 4: PUBLIC INVOLVEMENT, EDUCATION, AND OUTREACH

This section reviews two aspects of public interaction: (1) public involvement at the time of plan creation, and (2) outreach and education once the plan is completed. Public participation is an important part of developing a successful plan. The public can contribute ideas and information that will help direct the plan's programming, and the PWS can communicate its objective, reasons, and goals for the Water Conservation Plan.

Section 4 includes the following subsections:

- Public Involvement During the Planning Process
- Education and Outreach After a Plan is Adopted

Public Involvement During the Planning Process

Credibility in the PWS and the Water Conservation Plan is built by establishing an open and accessible planning and decision-making process. Identifying and understanding the diverse concerns and values of the parties potentially affected by decisions is a very important component of the process. The public includes stakeholders and customers. The PWS should solicit input from different groups and provide a public comment period.

A stakeholder, generally, is a person, agency, or organization with a direct or indirect stake in the PWS because it can affect or be affected by the PWS's actions. Key stakeholders in a PWS include employees, surrounding governments, developers, business and economic groups, non-governmental organizations, and the community at large. It is recommended to provide stakeholders with details on the data results and goals. With this information, stakeholders can assist with developing strategies for actions.

Soliciting Public Input

Methods to facilitate stakeholder and customer involvement opportunities include mailing questionnaires and information sheets, facilitating public meetings and workshops, and using focus groups, advisory committees, and local media. With the advancement of social media, the PWS can significantly cut costs by using online surveys and webinars.

Education and Outreach After a Plan is Adopted

After the plan is adopted, there are several public outreach and education components that need to be implemented. Three examples are explained below.

Develop a Public Information Program

Refer to *A Water Conservation Guide for Public Utilities, Section 3,* by NMOSE (2001), for more information on how to develop a well-planned public information program. A successful program will increase the public's awareness about the need to conserve water and inform customers about how to conserve water while also providing a positive public relations benefit for the PWS.

Determine Outreach Program Activities

Refer to *A Water Conservation Guide for Public Utilities, Section 3,* by NMOSE (2001), for more information on how to select activities to inform, encourage, and reinforce the importance of water conservation. In addition, social media is also a very effective method for presenting information to the public. More information on this topic can be found online.

Develop In-School Educational Programs

Refer to *A Water Conservation Guide for Public Utilities, Section 4,* by NMOSE (2001), for more information on how to develop in-school educational programs. To encourage long-term water conservation, it is important to educate students about water conservation and help them to develop water-saving habits. Many excellent water conservation educational materials, complete classroom programs, and websites are available. Contact the NMOSE for more information as they may be available to assist with educational water conservation programming, or visit their website at http://www.ose.state.nm.us./wucp_educators.html.

SECTION 5: DEVELOPING A WATER CONSERVATION PROGRAM

After collecting and examining the data, setting goals identifying and evaluating options, and determining the BMPs for implementation, the PWS now has the necessary information to develop a water conservation program(s). The water conservation program(s) clearly explains the actions the PWS will take to meet water conservation goals. This section addresses all of the components of a water conservation program.

Section 5 includes the following subsections:

- Challenges
- Program Components
- Prioritizing Programs
- Current and Past Water Conservation Programs
- Proposed Water Conservation Programs

Challenges

The limits of the PWS's available resources and any other challenges in implementing a water conservation program must be taken into account. Determine what types of resource constraints (e.g., equipment, labor, financial) might influence the programs chosen. Establish if additional resources are available through grants or partnerships. In addition, the PWS must determine how much time is needed to accomplish the program, which options will be best received by the intended user, and if there are any political obstacles.

Also, consider the local conditions first discussed in Section 1. Determine if water supply issues, demographics, housing characteristics, or temperature and precipitation will factor into the choice of programs.

Program Components

The following list identifies the information that needs to be provided to document the BMPs/ water conservation programs that have been selected. Additional information can be provided, if applicable.

- Program title
- Summary of program
- Why the program was chosen
- How the program will be implemented
- Implementation dates (start and finish)

- Targeted user (e.g., supply-side, landscape industry, homeowner)
- Anticipated cost (by year and total project)
- Funding source
- Anticipated staffing (list partnerships, if used)
- Anticipated results and how they align with goals
- Explanation of tracking and evaluation
- Estimated lifetime impact of the program
- Annual reporting and updates

Prioritizing Programs

After water conservation program options have been developed, the PWS must determine the highest priority for the system and develop a timeline for implementing all water conservation techniques. This will allow the PWS to allocate resources without getting overwhelmed. After the PWS has selected viable water conservation program options, it can develop the details of each program.

Current and Past Water Conservation Programs

PWSs in New Mexico have implemented water conservation programs for many years. Depending on the programs that have been implemented, there may be embedded savings in current and recent data. These current and past programs may have been developed through different conservation planning methods than those presented in this Planning Guide. In order to assess trends, it is necessary to compare past, current, and proposed conservation programs. Provide a summary, timeframes, and results of the current and past conservation programs.

Proposed Water Conservation Programs

- Narrative describing how selected water conservation programs meet stated goals and objective
- Overall timeline of programs as related to objectives
- Anticipated results for the entire Water Conservation Plan
    - *System total GPCD over time*
    - *Single-family residential GPCD over time*
    - *Nonrevenue water over time*

CONCLUSION

The above sections provide the direction necessary to complete a Water Conservation Plan. The template provides an outline of the necessary information to complete the Water Conservation Plan. Sections 1 through 5 contain basic instructions for addressing the items identified in the template. This includes completing the Audit and GPCD Calculator, data analysis, goal setting, public involvement, and detailing specific water conservation programs. The data collected through these steps can identify specific metrics to track water conservation programming progress. This process provides a standard approach that the PWS can repeat to obtain information on its system and customers' use.

Water conservation is an important and necessary part of managing any PWS system. Water conservation programs are even more critical in New Mexico since it is located in the high desert of the southwest, where water has always been limited in quantity. The process of water conservation planning is a continuous effort and should be approached as such. Further, the New Mexico State Water Plan embraces the goal of ensuring sustainable water sources for PWSs. Finally, many of the data collection and analysis processes provide the basic information needed to develop an effective asset management planning process. Water conservation and asset management are two principal goals of the State Water Plan to move New Mexico PWSs towards sustainability.

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APPENDIX A: RESOURCES

The New Mexico Office of the State Engineer (NMOSE) recommends the following resources. These include organizations, manuals, websites and funding sources. All the information on this page is subject to change. Check the NMOSE website for updates, http://www.ose.state.nm.us.

New Mexico Resources

New Mexico Office of the State Engineer

The NMOSE website, http://www.ose.state.nm.us./conservation_index.html, offers free educational materials and technical assistance for Public Water Suppliers (PWS):

- *Water conservation publications* for indoor and outdoor water conservation are available free of charge. Materials are can be downloaded or ordered in bulk. See the website for titles and ordering information.
- *K-12 classroom materials* are available free of charge. Materials are can be downloaded or ordered in bulk. See the website for titles and ordering information.
- Water use and conservation technical assistance to PWSs includes:
  - *The GPCD Calculator,* which is designed to help quantify and track water uses associated with water distribution systems, available for download at http://www.ose.state.nm.us/wucp_gcpd.html.
  - *Audit,* which is an Excel spreadsheet-based tool designed to help quantify and track water losses associated with water distribution systems and to identify areas for improved efficiency and cost recovery, available for download at *http://www.ose.state.nm.us/wucp_accounting.html*.
  - *A Water Conservation Guide for Public Utilities,* which is a guide developed to help municipalities and community water systems conserve water, available for download at http://www.ose.state.nm.us/water-info/conservation/pdf-manuals/nm-water-manual.pdf.
  - *The food service water audit program,* which is designed for restaurants and cafeterias within the PWS's water supply systems. It provides instructions, questionnaires, evaluations, reporting information, and supplemental resources on how to conduct a food service industry water audit program within a utility, and is available for download at http://www.ose.state.nm.us/wucp_food_service_audit.html.
  - *Other related reports,* available at http://www.ose.state.nm.us/wucp_pws.html.

New Mexico Environment Department

Planning and construction process: Documents to help communities through the planning and construction of infrastructure can be found at http://www.nmenv.state.nm.us/cpb/cpbtop.html.

New Mexico General Services Department

Water meters and installation components: Statewide price agreements for water meters and installation components can be found at http://www.generalservices.state.nm.us/statepurchasing/Statewide_Price_Agreements.aspx. Look for Water Services/Products. These contracts allow public entities to avoid the public bidding process. Various types of meters are available with features such as leak detection, remote read, and radio read.

On-site secondary treatment units: These systems are available for treating wastewater to be reused for irrigation, toilet flushing, and fire suppression. See the Liquid Waste Disposal and Treatment Regulations, 20.7.3 NMAC, Section 805, at http://www.nmcpr.state.nm.us/nmac/parts/title20/20.007.0003.htm.

Septic systems: Management structures can be set up to manage on-site infrastructure operations and maintenance. The United States Environmental Protection Agency (U.S. EPA) has several manuals and guidance documents that the New Mexico General Services Department recommends, available at http://water.epa.gov/type/drink/protection/upload/2006_08_28_sourcewater_pubs_septic.pdf.

New Mexico Rural Water Association (NMRWA)

NMRWA is a nonprofit membership organization committed to helping communities provide safe drinking water and wastewater services through on-site technical assistance, specialized training, and legislative support. NMRWA partners with community utilities across the state to create sustainable systems and build local expertise. It provides leadership, technical assistance, and training for utility professionals who serve rural New Mexico families. Their website is http://www.nmrwa.org/index.php.

The NMRWA has published several management and sustainability guides including "Water Use Auditing: A Guide to Accurately Measure Water Use and Water Loss" (http://www.nmrwa.org/wateraudit.php). It provides a list of funding sources at http://www.nmrwa.org/funding.php.

Federal Agencies and National Resources

U.S. Bureau of Reclamation

Achieving Efficient Water Management, A Guidebook for Preparing Municipal Water Conservation Plans, July 1997, http://www.usbr.gov/waterconservation/docs/MI.pdf. This guidebook was developed to help urban water districts of all sizes and complexities prepare Water Conservation Plans to achieve more efficient water use.

Much of the text in this section came directly from the referenced website. Be aware that websites change frequently and the listed addresses may not be current.

U.S. Environmental Protection Agency

WaterSense

WaterSense is a division of the U.S. EPA. The main goal of the program is to decrease indoor and outdoor nonagricultural water use through more efficient products, equipment, and programs. By providing a recognizable label on WaterSense-approved products, WaterSense helps consumers easily identify water-efficient products in the marketplace while ensuring product performance and encouraging innovation in manufacturing. The website, http://www.epa.gov/WaterSense/index.html, includes a product search and partnership information. Partnerships are free.

Alliance for Water Efficiency (AWE)

AWE is a nonprofit, membership-based organization that strives for efficient and sustainable use of water. A free online library provides access to existing and emerging research. Membership is based on number of connections, which provides reasonable rates for small public water suppliers. Membership also provides access to a water conservation tracking tool that evaluates the costs and benefits of conservation programs. AWE's website is http://www.allianceforwaterefficiency.org.

American Water Works Association (AWWA)

AWWA is an international nonprofit educational association dedicated to safe water. Founded in 1881 as a forum for water professionals to share information and learn from each other for the common good, AWWA, a paid membership organization, is the authoritative resource for knowledge, information, and advocacy for improving the quality and supply of water in North America and beyond.

AWWA has many resources that will be valuable to any public water supplier. Its website, http://www.awwa.org, provides information about news and upcoming events, including conferences. Look for the specialty conference on water conservation held every two years and for regional conferences through the Rocky Mountain Section. AWWA also provides industry information through manuals and journals.

Audit Software

The AWWA Water Loss Control Committee Version 4.2 (June 2010 release) Free Water Audit Software may be downloaded free of charge by members and nonmembers from http://www.awwa.org/resources-tools/water-knowledge/water-loss-control.aspx. (Note: This link takes you to a page where you must register to obtain a login to download this free tool.) The Free Water Audit Software is in Excel and includes 10 worksheets in a spreadsheet file. The software is not intended to provide a full and detailed water audit. (For guidance on comprehensive auditing procedures, see AWWA's M36 manual, *Water Audits and Loss Control*

Programs.) However, it allows water utilities to quickly compile a preliminary audit in the standardized and transparent manner that AWWA advocates.

AWWA Conservation Community
This is an online network where water professionals gather to share conservation knowledge. A free AWWA login is required. To create your login, go to http://www.awwa.org/Resources/index.cfm?navItemNumber=1416.

AWWA Manuals

- *Water Conservation Programs – A Planning Manual* (AWWA Manual 52) (AWWA, 2006). This detailed manual was written to assist in guiding agencies with a Water Conservation Plan. It discusses water conservation, the need for creating a plan, how to do so, and analyzing and evaluating data. Case studies in the document show examples of effective planning.
- *Water Audits and Loss Control Programs* (AWWA Manual 36) (AWWA, 2009a). This manual discusses how to conduct a water audit. It also discusses creating a program after conducting an audit in order to stop water loss. Manual M36 includes a chapter that advises small systems on obtaining financial and technical resources.
- *Water Conservation for Small and Medium-Sized Utilities* (by Deborah Green and William Maddaus). Written for utilities serving fewer than 100,000 customers, this book provides practical advice and guidance for implementing a water conservation program. With a menu of possible conservation techniques and approaches to choose from, the book lets you customize a program for your utility's particular needs, issues, and customers, regardless of your geographic location.
  Water Meters – Selection, Installation, Testing and Maintenance (AWWA Manual 6) (AWWA, 2009b). This is a complete practice manual about water meters for water service. It covers meter types, specifications, installation, testing, maintenance, and repair. The manual provides sample record-keeping forms and reviews the history of water-use measurement and development of modern meters. It is heavily illustrated with photos, diagrams, and performance specs.
- *Drought Preparedness and Response* (AWWA Manual 60). Preparing for drought and water shortages before they occur is the best defense. This manual will help water managers who are facing water shortages by illustrating how to employ tried-and-true strategies and tactics of drought mitigation, as well as new tools and methods.

Independent Publishers

Asset Management: A Guide for Water and Wastewater Systems, and
Financial Planning: A Guide for Water and Wastewater Systems

In 2005, the New Mexico Legislature passed House Joint Memorial 86, which required the NMOSE and partner agencies to "develop criteria for water system planning, performance and conservation as a condition of funding." This resulted in the recommendation that all systems complete a financial management plan, a water audit, and an asset management plan. In 2006, the Environmental Finance Center at New Mexico Tech published *Asset Management: A Guide for Water and Wastewater Systems,* and Rural Community Assistance Corporation published *Financial Planning: A Guide for Water and Wastewater Systems.* The purpose of both guides is to help water and wastewater systems better manage their water resources and plan for their future. The guides can be found on the NMOSE website at http://www.ose.state.nm.us/wucp_pws.html.

Handbook of Water Use and Conservation

This book by Amy Vickers, published in 2001 by WaterPlow Press (Amherst, Mass.), outlines 10 key steps for a successful conservation program. The author describes water-use characteristics of major customer sectors and provides water audit steps for homes, landscapes, businesses, factories, and farms. Detailed information is supplied about more than 100 water efficiency measures for long-term demand reductions and drought response. Estimated water savings, benefits, and costs for efficiency measures are presented, and energy conservation benefits from water efficiency measures are included. The book has appendices, a full index, a glossary, and conversion factors. The book is available from http://www.waterplowpress.com/.

Integrated Water Meter Management

Published by IWA Publishing and written by Francisco Arregui, Enrique Cabrera Jr., and Ricardo Cobacho, Integrated Water Meter Management is a comprehensive reference for engineers and managers alike, providing:

- In-depth technical information allowing the true nature and behavior of meters to be understood.
- A comprehensive review and comparison of relevant global water meter technologies – a useful tool to help decide which water meter is best for your utility.
- Discussion of key decisions concerning the use of water meters (when to replace them, which one to use, how to control their quality) from a managerial perspective.

Operator's Companion: Handy Tables, Formulas, and Other Stuff, 9th edition

Published by USA BlueBook (2010), this handbook provides basic information on performing a water audit, including how to determine meter accuracy.

Resources in Other States

Colorado

Guidebook of Best Practices for Municipal Water Conservation in Colorado

The *Best Practices Guidebook* was developed with funds from the Colorado Water Conservation Board's Water Efficiency Grant Program through a grant awarded to Colorado WaterWise. The guidebook includes a set of water conservation best practices to assist urban water providers with the selection and implementation of effective water conservation programs and measures. The guidebook is available from http://cwcb.state.co.us/technical-resources/best-management-practices/Pages/main.aspx.

Municipal Water Efficiency Plan Guidance Document

This document, written as a reference for the state of Colorado, provides an overview of water conservation and is meant to help other programs create an effective water efficiency plan. Further tools and information are provided at the Colorado Water Conservation Board website, http://cwcb.state.co.us/technical-resources/water-conservation-plan-development-guide/Pages/main.aspx. A link to the Guidance Document is provided in the list on the right side of the webpage.

Texas

Water Conservation Best Management Practices Guide

This guide was created by the Water Conservation Task Force to further water conservation efforts throughout Texas. The guide identifies the practices, techniques, programs, and technologies that help protect water resources, reduce consumption and waste, improve water use efficiency, and increase recycling and reuse of water to allow for the availability of future supplies. The guide is structured to deliver useful, proven, and cost-effective conservation measures. The guide is available from https://www.twdb.texas.gov/conservation/BMPs/index.asp.

Quantifying the Effectiveness of Various Water Conservation Techniques in Texas

This study evaluates the potential effectiveness of six residential and commercial water conservation techniques for regional water planning areas in Texas. The study calculated and determined estimated costs and potential water savings. It identified expected customer participation rates and projected lifetime for each measure. The study is available from http://www.twdb.state.tx.us/conservation/resources/conservation-research.asp.

California

Climate Change Handbook for Regional Water Planning

Developed cooperatively by the California Department of Water Resources, the U.S. Environmental Protection Agency, Resources Legacy Fund, and the U.S. Army Corps of Engineers, the *Climate Change Handbook for Regional Water Planning* provides a framework

for considering climate change in water management planning. Key decision considerations, resources, tools, and decision options are presented that will guide resource managers and planners as they develop means of adapting their programs to a changing climate. The handbook is available from http://www.water.ca.gov/climatechange/CCHandbook.cfm.

California Urban Water Conservation Council (CUWCC)
CUWCC's online resource center provides professional technical resources, water-efficient product information, best management practices, and publications. Their website is http://www.cuwcc.org/resource-center/resource-center.aspx.

Arizona
Evaluation and Cost Benefit Analysis of Municipal Water Conservation Programs (ECoBA)
An investigation of the actual water savings for actual water conservation programs and the comparable direct costs related to achievement of those savings would greatly inform our future efforts in water use efficiency. Published by Water CASA and available from http://www.watercasa.org/water-casa-research/

Funding Sources

United States Bureau of Reclamation (USBR)
The USBR recognizes that no single entity acting independently can meet the challenge of improving the efficiency of water use and management throughout the western states. Consequently, a key to meeting this challenge is the partnerships formed between the USBR and water users, other federal and state agencies, educational and research institutions, and other interested parties.

Water Conservation Field Services Program (15.530)
Grants require a 50 percent match and range from $25,000 to $100,000. Funding categories currently include water management planning, conservation education, demonstration of innovative technologies, and implementation of conservation measures. Look for funding opportunity announcements on www.Grants.gov.

WaterSMART
Focused on improving water conservation and helping water and resource managers make wise decisions about water use, the USBR's portion of the WaterSMART program is achieved through administration of grants, scientific studies, technical assistance, and scientific expertise. These grants usually require a 50 percent match. The range and funding categories vary. Look for funding opportunity announcements on www.Grants.gov.

New Mexico Environment Department (NMED)
Community Service Group of the Drinking Water Bureau of NMED
Assistance is available for communities to secure funding for water and wastewater infrastructure projects. Contact information and a funding interest form can be found at http://swim.nmenv.state.nm.us/APPLICATION_open.php.

APPENDIX B: INSTRUCTIONS FOR AUDIT

The American Water Works Association (AWWA) helped to develop a standard water audit methodology as part of a five-country task force formed by the International Water Association (IWA). This comprehensive water audit accounts for all water uses within a Public Water Supplier's (PWS) system, focusing on supply-side uses, and is completed using the AWWA Water Loss Control Committee Free Water Audit Software© ("Audit"). Audit provides standardized metrics for system use, including nonrevenue water and real losses.

Collect Data

The following section provides assistance on gathering and inputting PWS data into the Audit. Table B-1 organizes the collection of data. It corresponds to all of the input values and terms as they appear in the Audit spreadsheet and presents their connection to the water balance shown in Table 1 of the main Planning Guide.

Water Balance Calculation Term, the first column of Table B-1, includes the five main water audit input categories from the Audit: water supplied, authorized consumption, water losses, system data, and cost data. The second column, Water Audit Balance Term, shows how the terms in the water balance calculation (Table 1) relate to the terms in the Audit.

The third and fourth columns are the Input Value and the Input Definition. The Input Value column includes the terms as they appear in the Audit, and the Input Definition column provides an explanation of their meaning. The definition will assist the PWS in determining how to establish the actual value. (In some cases, there is an option to use an estimated value by percentage if a metered or calculated value is not available.)

The purpose of the last column, PWS Input Value, is to organize the PWS's data for input into the spreadsheet. Keep in mind the parameters set for time period and units of measure when entering the data.

Spreadsheet versus Worksheet

For the purposes of this Planning Guide, "spreadsheet" refers to the entire AWWA Free Water Audit Software© or the entire NMOSE GPCD Calculator. A "worksheet" refers to an individual tab within the spreadsheet.

Table B-1. Water Audit Input Values

Water Balance Calculation Term	Water Audit Balance Term	Input Value	Input Definition[1]	Public Water Supplier Input Value (million gallons or acre-feet)
				Use this column to gather data for input into the Audit spreadsheet. ⇩
Water supplied	System input value	Volume from own sources	All water diverted from groundwater or surface water, prior to treatment.	
		Master meter error adjustment	An estimate, or measure, of the degree of any inaccuracies that exist in the master meter measuring the volume from own sources. Be sure to note if this is an over-reading or an under-reading.	
		Water imported	Any water imported into the system from diversions not owned by the PWS completing the audit.	
		Water exported	Any water exported from the system to end-users not serviced by the PWS completing the audit.	
Authorized consumption	Billed authorized consumption/ revenue water	Billed metered	All metered consumption that is also billed. This includes all categories such as single-family residential, commercial, irrigation, standpipes, construction meters at fire hydrants, etc.	
		Billed unmetered	All billed consumption that is calculated based on estimates or norms but is not metered.	
	Unbilled authorized consumption/ nonrevenue water	Unbilled metered	Metered consumption that for any reason is not billed. This might include metered consumption by the utility itself or water provided to institutions free of charge.	

Water Balance Calculation Term	Water Audit Balance Term	Input Value	Input Definition[1]	Public Water Supplier Input Value (million gallons or acre-feet)
		Unbilled unmetered	Any kind of authorized consumption that is neither billed nor metered. This includes items such as firefighting, flushing of mains and sewers, street cleaning, etc. If any if these uses are metered, place them in unbilled metered. There are two options for calculating this figure: (1) Use a percentage of water supplied. The default percentage is 1.25%. (2) Use an estimated volume. If records have been kept for known problems, the PWS may have an estimated volume prepared.	
Water losses	Apparent losses/ nonrevenue water	Unauthorized consumption	Any unauthorized use of water. This may include illegal water withdrawal from hydrants, illegal connections, bypasses to consumption meters, or meter tampering. There are two options for calculating this figure: (1) Use a percentage of water supplied. The default percentage is 0.25%. (2) Use an estimated volume from records kept.	

Water Balance Calculation Term	Water Audit Balance Term	Input Value	Input Definition[1]	Public Water Supplier Input Value (million gallons or acre-feet)
		Customer meter inaccuracies	Apparent losses caused by customer meter inaccuracies and data-handling errors in the meter reading and billing system. There are two options for calculating this figure: (1) Use a percentage of metered authorized consumption. The recommendation is for less than 10%. (2) Use an estimated volume from records kept.	
		Systematic data-handling errors	Includes errors in meter reading, billing, and data handling of the water utility. There is no AWWA-recommended default. The PWS must rely on data records to enter a volume. Base estimates on known adjustments to billing data such as billing errors, credits, rebates, or adjustments not based on volume used (leaks).	
	Real losses		Real losses = water losses - apparent losses The software calculates this value. It includes leakage on transmission and distribution mains, leakage and overflows at utility's storage tanks, and leakage on service connections up to point of customer metering.	Automatically calculated in audit software
System data	n/a	Length of mains	Length of all pipelines (except for service connections) starting from point system input metering (i.e., treatment plant) to customer's meter.	

Water Balance Calculation Term	Water Audit Balance Term	Input Value	Input Definition[1]	Public Water Supplier Input Value (million gallons or acre-feet)
		Number of active and inactive service connections	This includes all service categories (commercial, residential, etc.), whether or not they are currently in use.	
		Average length of customer service line	This is entered where meters are installed inside the home or building, mostly in extreme cold-weather areas. If the customer meter is at or by the curb, 0 is entered. For more details, click on the Service Connection Diagram tab in the Audit spreadsheet (worksheet 5).	
		Average operating pressure	Use either an average or a weighted average by miles of lines.	
Cost data	n/a	Total annual cost of operating system	Includes operations, maintenance, and any annually incurred costs for long-term upkeep of the system (capital bonds, infrastructure improvement, etc.) on an annual basis.	
		Customer retail unit cost	This cost is the amount customers pay for water service per 1,000 gallons; a weighted average by customer class is recommended.	
		Variable production cost	This is the cost to produce and supply the next unit of water per million gallons (treatment, power, bulk purchases of water).	

[1] The definitions rely on the NMOSE's experience in using the Audit and on definitions provided in AWWA M36 and the Audit software.
Notes: n/a = not applicable.

Grade Data

To establish the validity of the Audit, AWWA requires a score or grade for specific input values. Determine the grade using the Grading Matrix worksheet supplied by the Audit, which is accessible via the Grading Matrix tab (Figure B-1). The grades, from 1 to 10, are based on best management practices (BMPs) outlined in AWWA's manuals for metering (M6) and the data management section in Water Audit and Loss Control Programs (M36).

Figure B-1. Grading Matrix Tab

Table B-2 provides an example from the Grading Matrix worksheet for the input value "volume from own sources." This example only shows grades 4-8 of the 10 grades. The PWS must meet all conditions listed for a particular grade level to qualify for that grade level. If it does not meet all conditions, it drops down to a lower grade.

Table B-2. Grading Matrix Example*

	4	5	6	7	8
Volume from own sources	50%-75% of treated-water production sources are metered; other sources are estimated. Occasional meter accuracy testing.	Conditions between 4 and 6	At least 75% of treated-water production sources are metered, or at least 90% of the source flow is derived from metered sources. Meter accuracy testing and/or electronic calibration are 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 are conducted annually. Less than 10% of meters are found outside of ±6% accuracy.

* This example shows grades 4-8 of 10 possible grades.

Table B-3 identifies all input values that require a grade and provides a space for the PWS to use to take notes or collect data.

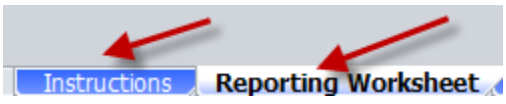
Table B-3. Water Audit Input Values Requiring Grades

Water Audit Input Category	Input Values Requiring Grade	Grade (from Grading Matrix)
Water supplied	Volume from own sources	
	Master meter error adjustment	
	Water imported	
	Water exported	
Authorized consumption	Billed metered	
	Billed unmetered	
	Unbilled metered	
	Unbilled unmetered (if using default value, grade is 5)	
Water losses	Unauthorized consumption (if using default value, grade is 5)	
	Customer metering inaccuracies	
	Systematic data-handling errors	
System data	Length of mains	
	Number of active and inactive service connections	
	Average length of customer service line	
	Average operating pressure	
Cost data	Total annual cost of operating system	
	Customer retail unit cost	
	Variable production cost	

Input Data

The Audit spreadsheet has two input worksheets: the first tab, Instructions, and the second tab, Reporting Worksheet (Figure B-2). In the first worksheet, the PWS provides its contact information, time period, and preferred units of measure. In the second worksheet, it records input values and grades. This section outlines where to insert the input values and grades on the Reporting Worksheet.

Figure B-2. Reporting Worksheet Tab



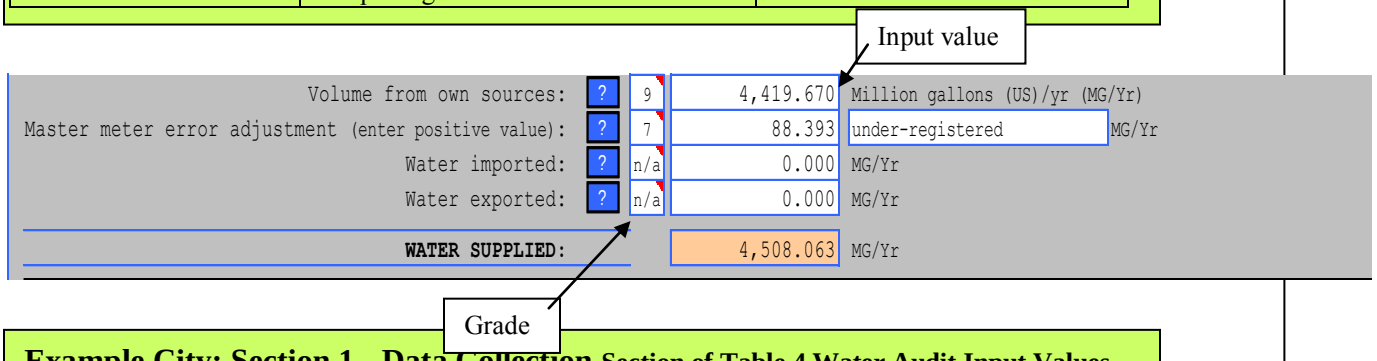
In Table B-1, the audit categories and input values directly correlate, both in terminology and in order, to the Audit software. In the Instructions worksheet, verify that the correct unit of measure is given to the right of each input value. In the Reporting Worksheet, find the correlating term and insert the value in the white cell under column G. (All input values will be

entered in white cells. All results calculated by the spreadsheet appear in orange cells.) The assigned grade goes in column E, to the left of the input values. Figure B-3 shows examples of data entered for water supplied (first category of Table B-1 and first category of Table B-3).

Figure B-3. Data Entry for Water Supplied

Example City: Section 1 - Data Collection
(Section of Table 2 Water Audit Input Values)

Input Values	Input Definitions	Public Water Supplier Input Value (million gallons)
Volume from own sources	All water diverted from groundwater or surface water, prior to treatment.	4,419.670
Master meter error adjustment (enter positive value)	An estimate, or measure, of the degree of any inaccuracies that exist in the master meter, measuring the volume from own sources. Be sure to note if this is an over-registered or an under-registered reading.	-88.393
Water imported	Any water imported into the system from diversions not owned by the PWS completing the audit.	0
Water exported	Any water exported from the system to end-users not serviced by the PWS completing the audit.	0



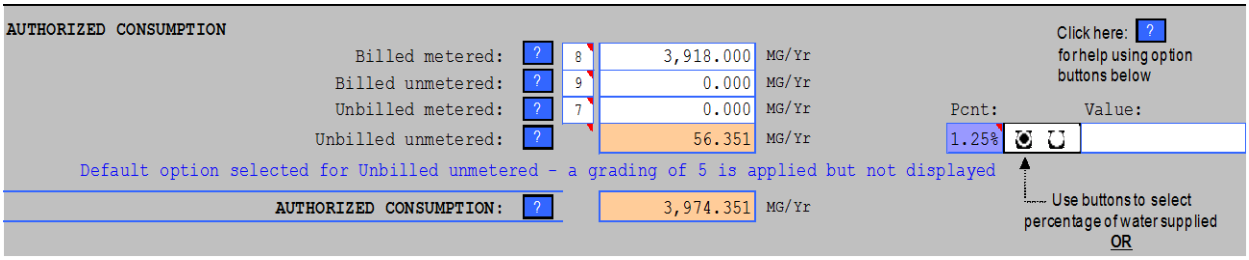
Example City: Section 1 - Data Collection Section of Table 4 Water Audit Input Values Requiring Grades

Water Audit Input Category	Input Values	Grade (from Grading Matrix)
Water supplied	Volume from own sources	9
	Master meter error adjustment	7
	Water imported	--
	Water exported	--

To the right of some of the input values are options for clarifying data or allowing for estimates when actual data are not available. In the water-supplied category, the master meter error adjustment allows the PWS to select whether the meter is over-registering or under-registering. The PWS must enter a positive input value and then choose either over-registered or under-registered (Figure B-3) in the space to the right.

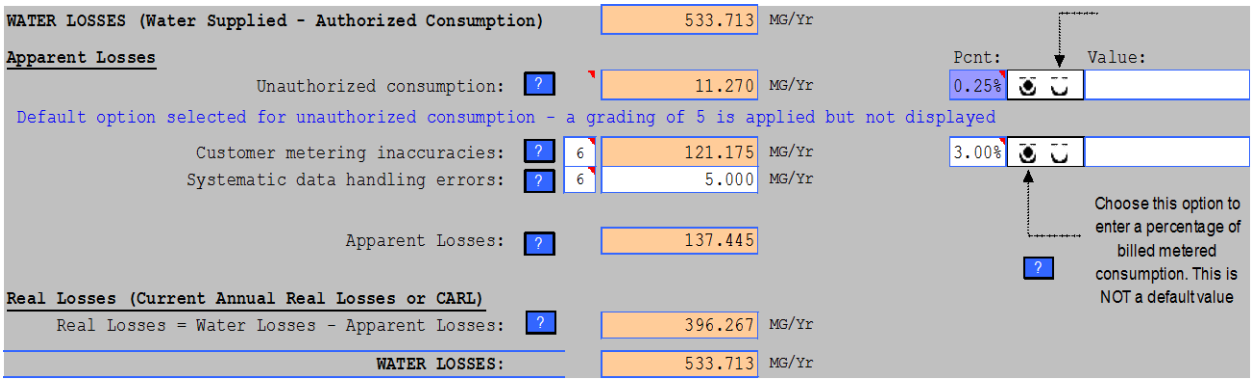
Figure B-4 is an example of data entry for authorized consumption. In this section, the PWS can enter unbilled unmetered as a volume of water or as a percentage of water supplied. On the Audit spreadsheet, make this selection all the way to the right of unbilled unmetered in a table that has three cells. The center cell is for selecting either percentage or value. The button on the left selects percentage. If the PWS selects this button, the percentage defaults to 1.25 percent and is automatically calculated based on water supplied. The spreadsheet also automatically selects a grade of 5. If the PWS has records that estimate unbilled unmetered, select the button to the right in the center cell. Then enter the actual value in the cell to the far right and a grade in the cell to the left of the input value.

Figure B-4. Data Entry for Authorized Consumption



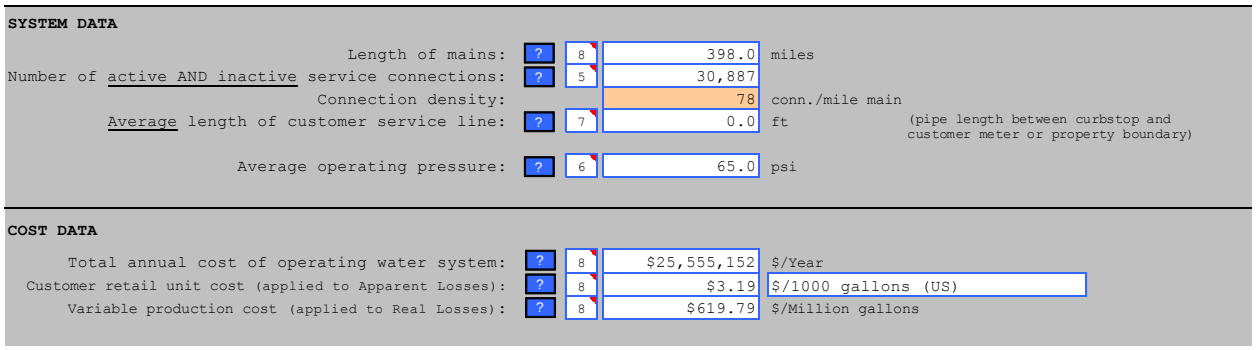
The water losses section of the Reporting Worksheet has two input values that require a choice between percentage and value – unauthorized consumption and customer metering inaccuracies (Figure B-5). These cells work the same as unbilled unmetered. Unauthorized consumption has a default value of 0.25 percent of water supplied. If the default value is used, the spreadsheet automatically enters a grade of 5. AWWA does not provide a default value for customer metering inaccuracies. If an actual value is not available, AWWA recommends entering less than 10 percent, which is based on metered authorized consumption (billed metered plus unbilled metered).

Figure B-5. Data Entry for Water Losses



Be careful with the units of measure in the data entry for system data and cost data (Figure B-6). The units of measure vary from the rest of the worksheet. The customer retail unit cost is the only one that provides a choice. The PWS can enter the cost per gallon, litre (liter), or cubic foot. Review the diagram in the Service Connection Diagram worksheet (tab 5) before estimating average length of customer service line. This input value is the distance of service line from the curb stop to the water meter. In most New Mexico PWSs, the meter is at the curb stop. If this is the case, the distance is "0.0" ft.

Figure B-6. Data Entry for System Data and Cost Data



Data Results

Table B-4 shows which input values or calculated values the Audit Reporting Worksheet uses to calculate the performance indicators. If the PWS chooses to focus on a performance indicator in its goals, Table B-4 will assist the PWS in determining which areas within its system should be the focus of water efficiency programs. All of the performance indicators contribute to the nonrevenue water category in the Audit water balance calculation (Table B-4).

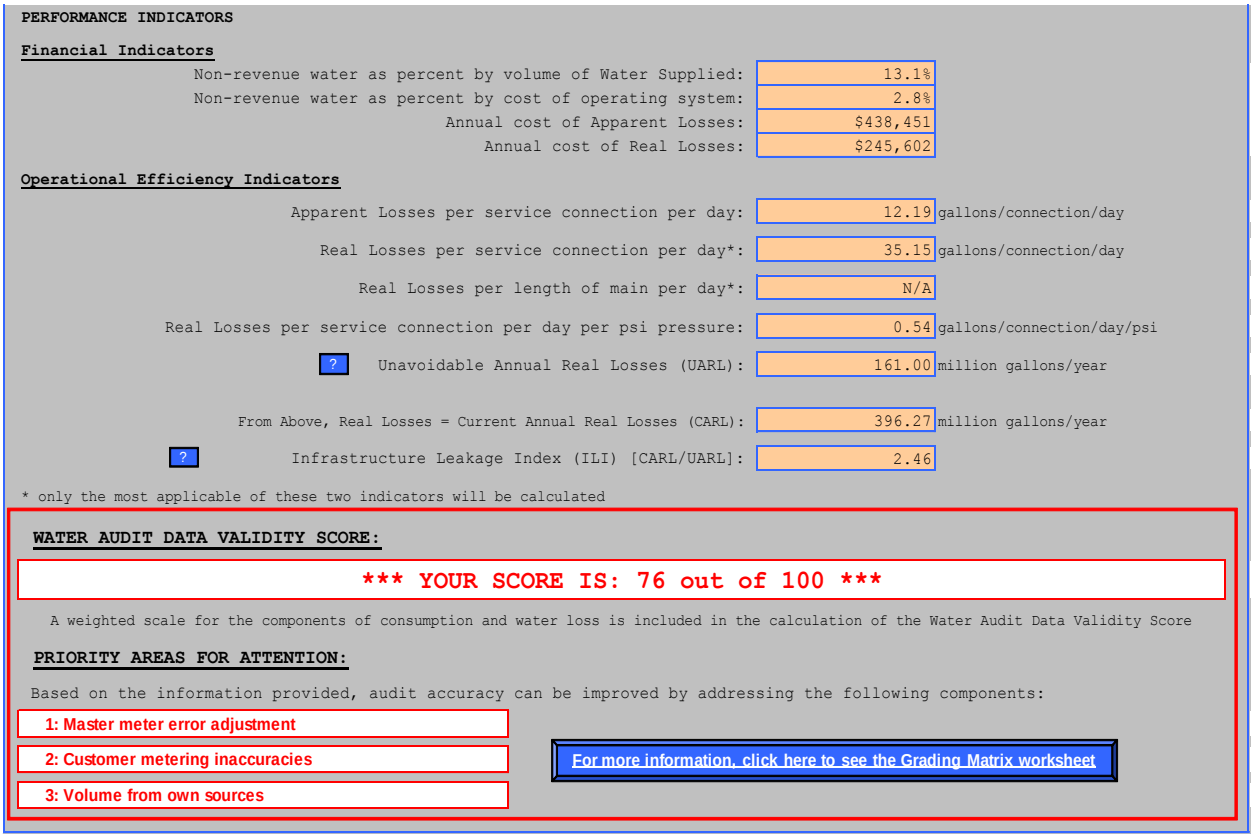
Table B-4. Values in Performance Indicators

Performance Indicator Category	Performance indicator	Related Calculated Values or Input Values
Financial	Nonrevenue water as percentage by volume of water supplied	Water supplied Unbilled metered and unmetered Apparent losses Real losses
	Nonrevenue water as percentage by cost of operating system	Unbilled metered and unmetered Apparent losses Real losses Customer retail unit cost Variable production cost
	Annual cost of apparent losses	Apparent losses Customer retail unit cost
	Annual cost of real losses	Real losses Variable production cost
Operational	Apparent losses per service connection per day	Apparent losses Number of active and inactive service connections
	Real losses per service connection per day	Real losses Number of active and inactive service connections
	Real losses per length of main per day*	Real losses Length of mains
	Real losses per service connection per day per pounds per square inch (psi)	Real losses per service connection per day Average operating pressure

*Only calculated if number of connections is not available.

Figure B-7 presents the results as shown on the Audit Reporting Worksheet (second tab).

Figure B-7. Example City - Water Audit Results - Performance Indicators



PERFORMANCE INDICATORS

Financial Indicators

Non-revenue water as percent by volume of Water Supplied:	13.1%	
Non-revenue water as percent by cost of operating system:	2.8%	
Annual cost of Apparent Losses:	$438,451	
Annual cost of Real Losses:	$245,602	

Operational Efficiency Indicators

Apparent Losses per service connection per day:	12.19	gallons/connection/day
Real Losses per service connection per day*:	35.15	gallons/connection/day
Real Losses per length of main per day*:	N/A	
Real Losses per service connection per day per psi pressure:	0.54	gallons/connection/day/psi
? Unavoidable Annual Real Losses (UARL):	161.00	million gallons/year
From Above, Real Losses = Current Annual Real Losses (CARL):	396.27	million gallons/year
? Infrastructure Leakage Index (ILI) [CARL/UARL]:	2.46	

* only the most applicable of these two indicators will be calculated

WATER AUDIT DATA VALIDITY SCORE:

*** YOUR SCORE IS: 76 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: Master meter error adjustment

2: Customer metering inaccuracies

3: Volume from own sources

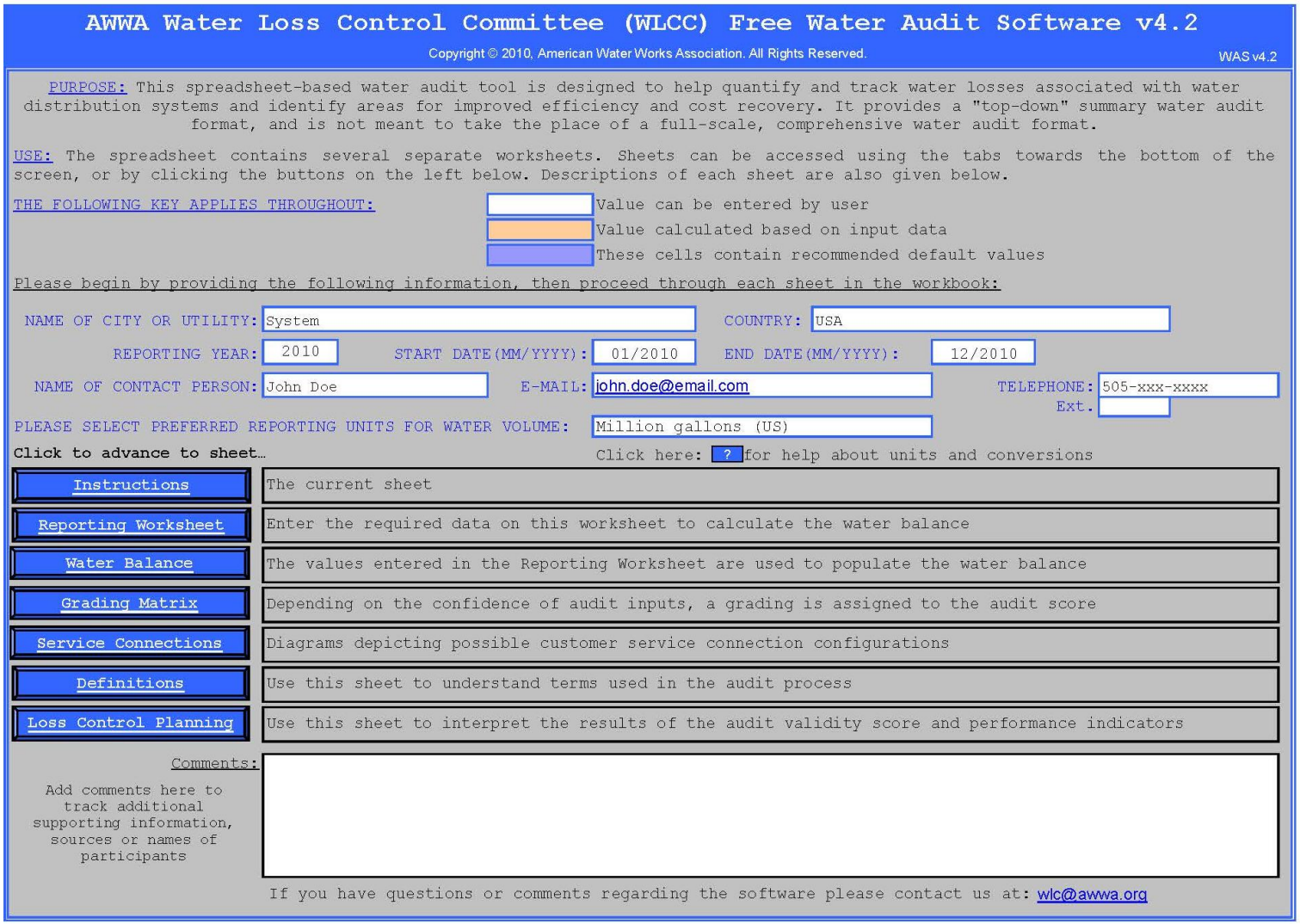
For more information, click here to see the Grading Matrix worksheet

APPENDIX C: EXAMPLES

Appendix C includes the following examples, which are unrelated:

- Audit
- GPCD Calculator
- Example City

Audit



AWWA Water Loss Control Committee (WLCC) Free Water Audit Software v4.2

WAS v4.2

PURPOSE: 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.

USE: The spreadsheet contains several separate worksheets. Sheets can be accessed using the tabs towards the bottom of the screen, or by clicking the buttons on the left below. Descriptions of each sheet are also given below.

THE FOLLOWING KEY APPLIES THROUGHOUT:

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

Please begin by providing the following information, then proceed through each sheet in the workbook:

NAME OF CITY OR UTILITY: System
COUNTRY: USA
REPORTING YEAR: 2010
START DATE(MM/YYYY): 01/2010
END DATE(MM/YYYY): 12/2010
NAME OF CONTACT PERSON: John Doe
E-MAIL: john.doe@email.com
TELEPHONE: 505-xxx-xxxx
Ext.
PLEASE SELECT PREFERRED REPORTING UNITS FOR WATER VOLUME: Million gallons (US)

Click to advance to sheet…

Click here: ? for help about units and conversions

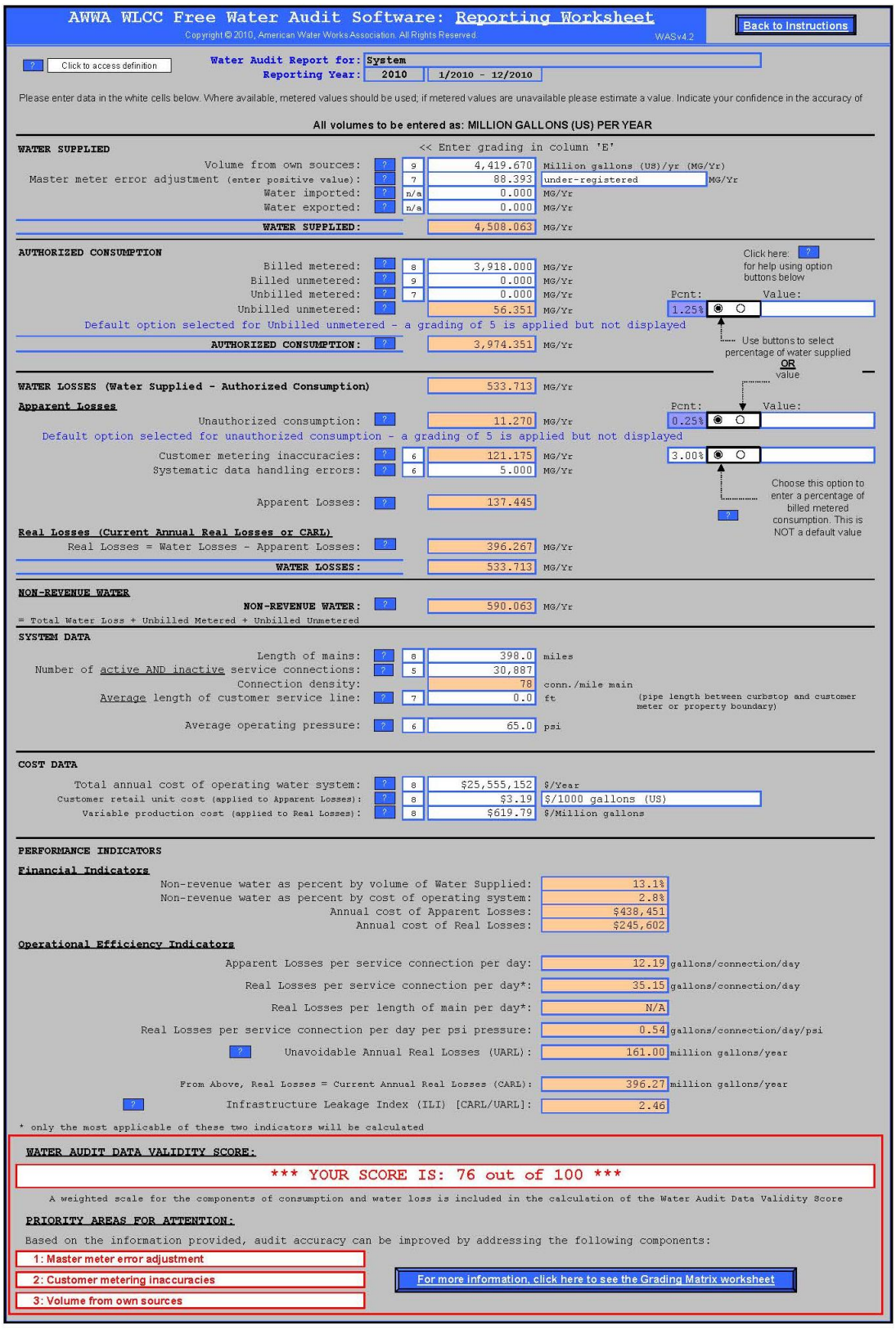
Instructions	The current sheet
Reporting Worksheet	Enter the required data on this worksheet to calculate the water balance
Water Balance	The values entered in the Reporting Worksheet are used to populate the water balance
Grading Matrix	Depending on the confidence of audit inputs, a grading is assigned to the audit score
Service Connections	Diagrams depicting possible customer service connection configurations
Definitions	Use this sheet to understand terms used in the audit process
Loss Control Planning	Use this sheet to interpret the results of the audit validity score and performance indicators

Comments:

Add comments here to track additional supporting information, sources or names of participants

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

AWWA Water Loss Control Committee Instructions 1



AWWA WLCC Free Water Audit Software: Reporting Worksheet

WASv4.2

Back to Instructions

Click to access definition

Water Audit Report for: System
Reporting Year: 2010 (1/2010 - 12/2010)

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

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

WATER SUPPLIED << Enter grading in column 'E'

Volume from own sources:	9	4,419.670	Million gallons (US)/yr (MG/Yr)	
Master meter error adjustment (enter positive value):	7	88.393	under-registered	MG/Yr
Water imported:	n/a	0.000	MG/Yr	
Water exported:	n/a	0.000	MG/Yr	
WATER SUPPLIED:		4,508.063	MG/Yr	

AUTHORIZED CONSUMPTION

Click here: for help using option buttons below

				Pcnt:	Value:
Billed metered:	8	3,918.000	MG/Yr		
Billed unmetered:	9	0.000	MG/Yr		
Unbilled metered:	7	0.000	MG/Yr		
Unbilled unmetered:		56.351	MG/Yr	1.25%	

Default option selected for Unbilled unmetered - a grading of 5 is applied but not displayed

Use buttons to select percentage of water supplied OR value

AUTHORIZED CONSUMPTION: 3,974.351 MG/Yr

WATER LOSSES (Water Supplied - Authorized Consumption) 533.713 MG/Yr

Apparent Losses

				Pcnt:	Value:
Unauthorized consumption:		11.270	MG/Yr	0.25%	

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

Customer metering inaccuracies:	6	121.175	MG/Yr	3.00%	
Systematic data handling errors:	6	5.000	MG/Yr		
Apparent Losses:		137.445			

Choose this option to enter a percentage of billed metered consumption. This is NOT a default value

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: 396.267 MG/Yr

WATER LOSSES: 533.713 MG/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 590.063 MG/Yr

= Total Water Loss + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	8	398.0	miles	
Number of active AND inactive service connections:	5	30,887		
Connection density:		78	conn./mile main	
Average length of customer service line:	7	0.0	ft	(pipe length between curbstop and customer meter or property boundary)
Average operating pressure:	6	65.0	psi	

COST DATA

Total annual cost of operating water system:	8	$25,555,152	$/Year
Customer retail unit cost (applied to Apparent Losses):	8	$3.19	$/1000 gallons (US)
Variable production cost (applied to Real Losses):	8	$619.79	$/Million gallons

PERFORMANCE INDICATORS

Financial Indicators

Non-revenue water as percent by volume of Water Supplied:	13.1%
Non-revenue water as percent by cost of operating system:	2.8%
Annual cost of Apparent Losses:	$438,451
Annual cost of Real Losses:	$245,602

Operational Efficiency Indicators

Apparent Losses per service connection per day:	12.19	gallons/connection/day
Real Losses per service connection per day*:	35.15	gallons/connection/day
Real Losses per length of main per day*:	N/A	
Real Losses per service connection per day per psi pressure:	0.54	gallons/connection/day/psi
Unavoidable Annual Real Losses (UARL):	161.00	million gallons/year
From Above, Real Losses = Current Annual Real Losses (CARL):	396.27	million gallons/year
Infrastructure Leakage Index (ILI) [CARL/UARL]:	2.46	

* only the most applicable of these two indicators will be calculated

WATER AUDIT DATA VALIDITY SCORE:

*** YOUR SCORE IS: 76 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: Master meter error adjustment
2: Customer metering inaccuracies
3: Volume from own sources

For more information, click here to see the Grading Matrix worksheet

AWWA Water Loss Control Committee Reporting Worksheet

AWWA WLCC Free Water Audit Software: Water Balance

WAS v4.2

Water Audit Report For:	Report Yr:
System	2010

Own Sources (Adjusted for known errors) 4,508.063	Water Exported 0.000		Billed Water Exported		
	Water Supplied 4,508.063	Authorized Consumption 3,974.351	Billed Authorized Consumption 3,918.000	Billed Metered Consumption (inc. water exported) 3,918.000	Revenue Water 3,918.000
				Billed Unmetered Consumption 0.000	
			Unbilled Authorized Consumption 56.351	Unbilled Metered Consumption 0.000	Non-Revenue Water (NRW) 590.063
				Unbilled Unmetered Consumption 56.351	
		Water Losses 533.713	Apparent Losses 137.445	Unauthorized Consumption 11.270	
				Customer Metering Inaccuracies 121.175	
				Systematic Data Handling Errors 5.000	
Water Imported 0.000			Real Losses 396.267	Leakage on Transmission and/or Distribution Mains Not broken down	
				Leakage and Overflows at Utility's Storage Tanks Not broken down	
				Leakage on Service Connections Not broken down	

AWWA WLCC Free Water Audit Software: Grading Matrix

WASv 4.2

Back to Instructions

In the Reporting Worksheet, grades were assigned to each component of the audit to describe the confidence and accuracy of the input data. 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
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.	25% - 50% of treated water production sources are metered; other sources estimated. No regular meter accuracy testing.	Conditions between 2 and 4	50% - 75% of treated water production sources are metered, other sources estimated. Occasional meter accuracy testing	Conditions between 4 and 6	At least 75% of treated water production sources are metered, or at least 90% of the source flow is derived from metered sources. 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 treated water production sources are metered, meter accuracy testing and electronic calibration 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 conducted semi-annually, with less than 10% found outside of +/- 3% accuracy.
Improvements to attain higher data grading for "Volume from own Sources" component:		to qualify for 2: Organize efforts to begin to collect data for determining volume from own sources	to qualify for 4: Locate all water production sources on maps and in field, launch meter accuracy testing for existing meters, begin to install meters on unmetered water production sources and replace any obsolete/defective meters		to qualify for 6: Formalize annual meter accuracy testing for all source meters. Complete installation of meters on unmetered water production sources and complete replacement of all obsolete/defective meters.		to qualify for 8: Conduct annual meter accuracy testing on all meters. 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.		to qualify for 10: Maintain annual meter accuracy testing for all meters. Repair or replace meters outside of +/- 6% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to improve meter accuracy.		to maintain 10: 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.
Master meter error adjustment:	Select n/a only if the water utility fails to have meters on its sources of supply, either its own source, and/or imported (purchased) water sources	Inventory information on meters and paper records of measured volumes in crude condition; data error cannot be determined	No automatic datalogging of production volumes; daily readings are scribed on paper records. Tank/storage elevation changes are not employed in calculating "Volume from own sources" component. 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. "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 adjusted to correct gross error from equipment malfunction and error confirmed by meter accuracy testing. Tank/storage facility elevation changes are automatically used in calculating a balanced "Volume from own sources" component.	Conditions between 6 and 8	Continuous production meter data logged automatically & reviewed daily. Data adjusted to correct gross error from equipment malfunction & results of meter accuracy testing. Tank/storage facility elevation changes are automatically used in "Volume from own sources" tabulations.	Conditions between 8 and 10	Computerized system (SCADA or similar) automatically balances flows from all sources and storages; results reviewed daily. Mass balance technique compares production meter data to raw (untreated) water and treatment volumes to detect anomalies. Regular calibrations between SCADA and sources meters ensures minimal data transfer error.
Improvements to attain higher data grading for "Master meter error adjustment" component:		to qualify for 2: Develop plan to restructure recordkeeping system to capture all flow data; set procedure to review data daily to detect input errors	to qualify for 4: Install automatic datalogging equipment on production meters. Identify tanks/storage facilities and include estimated daily volume of water added to, or subtracted from, "Water Supplied" volume based upon changes in storage		to qualify for 6: Review hourly production meter data for gross error on, at least, a weekly basis. Begin to install instrumentation on tanks/storage facilities to record elevation changes. Use daily net storage change to balance flows in calculating "Water Supplied" volume.		to qualify for 8: Complete installation of elevation instrumentation on all tanks/storage facilities. Continue to use daily net storage change in calculating balanced "Volume from own sources" component. Adjust production meter data for gross error and inaccuracy confirmed by testing.		to qualify for 10: 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.		to maintain 10: 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.
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	Conditions between 4 and 6	At least 75% of imported 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 imported water sources are metered, meter accuracy testing and/or electronic calibration 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/or electronic calibration conducted semi-annually, with less than 10% found outside of +/- 3% accuracy.
Improvements to attain higher data grading for "Water Imported Volume" component:		to qualify for 2: 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.	To qualify for 4: Locate all imported water sources on maps and in field, launch meter accuracy testing for existing meters, begin to install meters on unmetered imported water interconnections and replace obsolete/defective meters		to qualify for 6: Formalize annual meter accuracy testing for all imported water meters. Continue installation of meters on unmetered exported water interconnections and replacement of obsolete/defective meters.		to qualify for 8: Complete project to install new, or replace defective, meters on all imported water interconnections. Maintain annual meter accuracy testing for all imported water meters. Repair or replace meters outside of +/- 6% accuracy.		to qualify for 10: Maintain annual meter accuracy testing for all meters. Repair or replace meters outside of +/- 6% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to improve meter accuracy.		to maintain 10: 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:	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	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/or electronic calibration 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/or electronic calibration conducted semi-annually, with less than 10% found outside of +/- 3% accuracy.

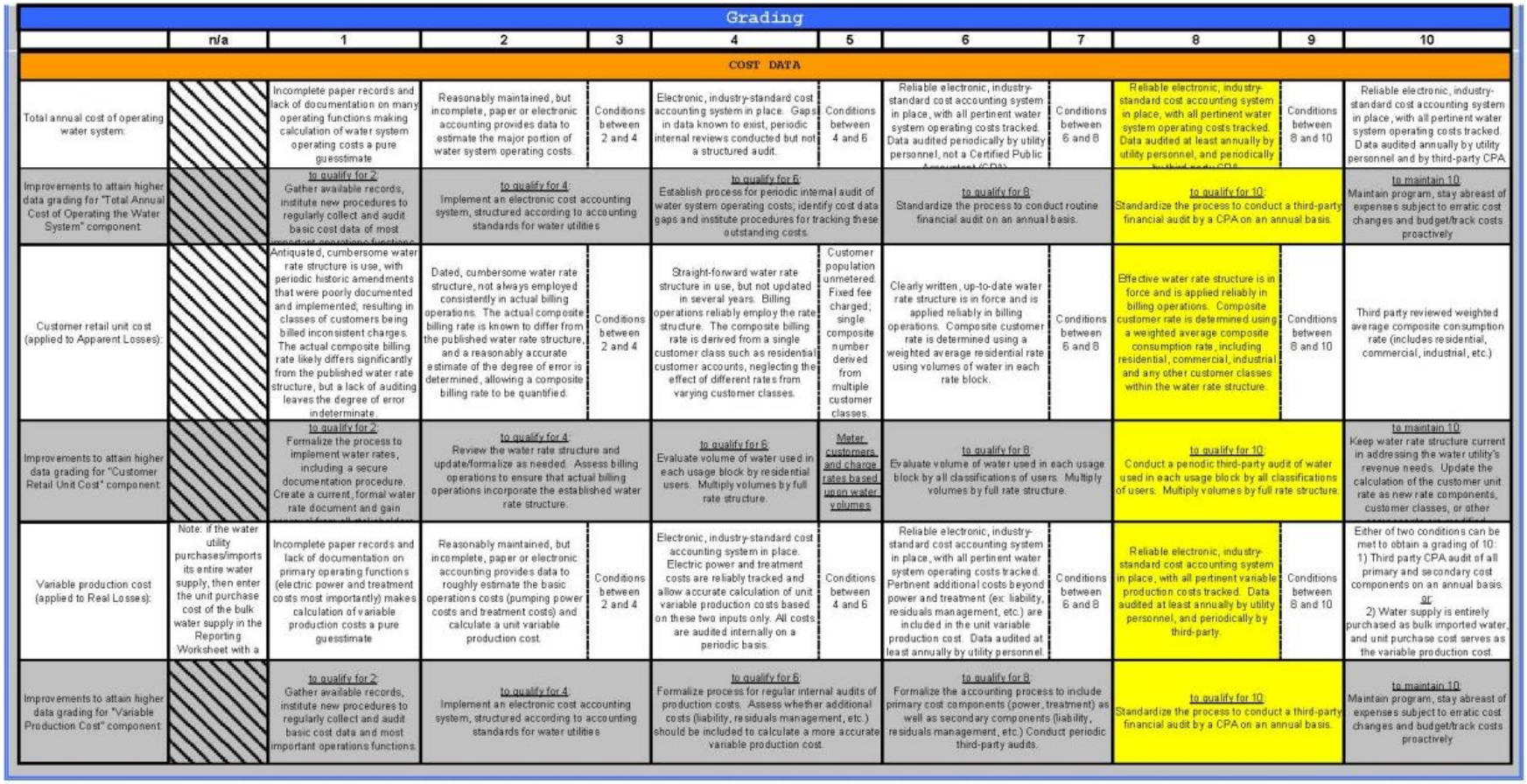
Grading										
	n/a	1	2	3	4	5	6	7	8	9	10
Improvements to attain higher data grading for "Water Exported Volume" component:		to qualify for 2: Review bulk water sales agreements with partner suppliers; confirm requirements for use & upkeep of accurate metering. Identify needs to install new, or replace defective meters as needed.	To qualify for 4: 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		to qualify for 6: 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.		to qualify for 8: Complete project to install new, or replace defective, meters on all exported water interconnections. Maintain annual meter accuracy testing for all imported water meters. Repair or replace meters outside of +/- 6% accuracy.		to qualify for 10: Maintain annual meter accuracy testing for all meters. Repair or replace meters outside of +/- 6% accuracy. Investigate new meter technology, pilot one or more replacements with innovative meters in attempt to improve meter accuracy.		to maintain 10: 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.
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 billed for the majority of the customer population	At least 50% of customers with volume-based billing from meter reads; flat rate billed for others. Manual meter reading, under 50% read success rate, remainder 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 billed for remainder. Manual meter reading used, at least 50% meter read success rate, failed reads are estimated. Purchase records verify age of customer meters; only very limited meter accuracy testing is conducted. Customer meters replaced only upon complete failure. Computerized billing records, but only periodic internal auditing conducted.	Conditions between 4 and 6	At least 90% of customers with volume-based billing from meter reads; remaining accounts are estimated. Manual customer meter reading gives at least 80% customer meter reading success rate, failed reads are estimated. Good customer meter records, limited meter accuracy testing, regular replacement of oldest meters. Computerized billing records with routine auditing of global statistics.	Conditions between 6 and 8	At least 97% of customers with volume-based billing from meter reads. At least 90% customer meter read success rate; or minimum 80% read success rate with planning and budgeting for trials of Automatic Metering Reading (AMR) 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; verified periodically by third party.	Conditions between 8 and 10	At least 99% of customers with volume-based billing from meter reads. At least 95% customer meter reading success rate; or minimum 80% meter reading success rate, with Automatic Meter Reading (AMR) trials underway. Statistically significant customer meter testing and replacement program in place. Computerized billing with routine, detailed auditing, including field investigation of representative sample of accounts. Annual audit verification by third party.
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.	to qualify for 2: Conduct investigations or trials of customer meters to select appropriate meter models. Budget funding for meter installations. Investigate volume based water rate structures.	to qualify for 4: 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.		to qualify for 6: Purchase and install meters on unmetered accounts. Eliminate flat fee billing and establish appropriate water rate structure based upon measured consumption. Continue to achieve verifiable success in removing manual meter reading barriers. Expand meter accuracy testing. Launch regular meter replacement program. Conduct routine audit of global statistics.		to qualify for 8: Purchase and install meters on unmetered accounts. Assess cost-effectiveness of Automatic Meter Reading (AMR) system for portion or entire system; or achieve ongoing improvements in manual meter reading success rate. Refine meter accuracy testing program. Set meter replacement goals based upon accuracy test results. Refine routine auditing procedures based upon third party guidance.		to qualify for 10: Purchase and install meters on unmetered accounts. Launch Automatic Meter Reading (AMR) system trials if manual meter reading success rate of at least 95% 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 routine auditing and require annual third party review.		to maintain 10: Regular internal and third party auditing, and meter accuracy testing ensures that accurate customer meter readings are obtained and entered as the basis for volume based billing. Stay abreast of improvements in Advanced Metering Infrastructure (AMI) and information management. Plan and budget for justified upgrades in metering, meter reading and billing data management.
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 unmetered accounts exist	Water utility policy does not require customer metering; flat or fixed fee billed. No data collected on customer consumption. Only estimates 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 billed. Some metered accounts exist in parts of the system (pilot areas or District Metered Areas) with consumption recorded on portable dataloggers. 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 but lacks written procedures and employs casual oversight, resulting in up to 20% of billed accounts believed to be 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 exemption 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 requires metering and volume based billing for all customer accounts. However, less than 5% of billed accounts remain unmetered because because installation is hindered by unusual circumstances. The goal is to minimize the number of unmetered accounts. Reliable estimates of consumption are obtained for unmetered accounts via site specific estimation methods.	Conditions between 8 and 10	Water utility policy requires 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.
Improvements to attain higher data grading for "Billed Unmetered Consumption" component:		to qualify for 2: Investigate a new water utility policy to require metering of the customer population, and a reduction of unmetered accounts. Conduct pilot metering project by installing water meters in small sample of customer accounts and datalogging the water consumption.	to qualify for 4: Implement a new water utility policy requiring customer metering. 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.		to qualify for 6: Budget for staff resources to review billing records to identify unmetered properties. Specify metering needs and funding requirements to install sufficient meters to significant reduce the number of unmetered accounts		to qualify for 8: 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. Implement procedures to obtain reliable consumption estimate for 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 to 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 unmetered accounts as is economically feasible.

Grading											
	n/a	1	2	3	4	5	6	7	8	9	10
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.		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.		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.		to qualify for 10: Ensure that meter management (meter accuracy testing, meter replacement) and meter reading activities 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 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 x typical flowrate x 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: unmetered fire connections registering consumption), 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 x typical flow) 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 x typical flow) or use of temporary meters.
Improvements to attain higher data grading for "Unbilled Unmetered Consumption" component:		to qualify for 5: Utilize accepted default value of 1.25% of system input volume 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 as unbilled and unmetered. Consider tracking a small sample of one such use (ex: fire hydrant flushings).	to qualify for 5: Utilize accepted default value of 1.25% of system input volume 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 for water from fire hydrants).		to qualify for 5: Utilize accepted default value of 1.25% of system input volume 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 5 or greater: Finalize policy and do field checks. 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 to ensure that fire hydrant permits are issued for use by persons outside of the utility. Create written procedures for use and documentation of fire hydrants by water utility personnel.		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											
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 x typical flowrate x number of events).	Default value of 0.25% of system input volume is employed	Coherent policies exist for some forms of unauthorized consumption but others await closer evaluation. Reasonable surveillance and recordkeeping exist for occurrences that fall under the policy. Volumes quantified by inference from these records. Unsupervised uses are guesstimated.	Conditions between 6 and 8	Clear policies and good recordkeeping exist for certain events (ex: tampering with water meters); 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 quantified via formulae (time x typical flow) or similar methods.

Grading											
	n/a	1	2	3	4	5	6	7	8	9	10
Improvements to attain higher data grading for "Unauthorized Consumption" component:		to qualify for 5: Use accepted default of 0.25% of system input volume. 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 system input volume as 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 and do field checks. Proceed if top-down audit exists and/or a great volume of such use is suspected.	to qualify for 6: 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 use 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 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. Workflow is driven chaotically by customer complaints 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.	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. Limited number of oldest meters 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. 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 at varying lifespans to determine optimum replacement time for various types of meters.	Conditions between 8 and 10	Good records of number, type and size of customer meters; ongoing meter replacement occurs. Regular meter accuracy testing gives reliable measure of composite inaccuracy volume for the system. New metering technology is embraced to keep overall accuracy improving.
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	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 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 procedures for meter recordkeeping with the 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 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 technology in Advanced Metering Infrastructure (AMI) to grasp opportunities for greater accuracy in metering and customer consumption data.
Systematic Data Handling Error:	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.	Vague policy for permitting (creating new customer accounts) and billing. Billing data maintained on paper records which are in disarray. No audits conducted to confirm billing data handling efficiency. Unknown number of customers escape routine billing due to lack of billing process oversight.	Policy for permitting and billing exists but needs refinement. Billing data maintained on paper records or insufficiently capable electronic database. Only periodic unstructured auditing work conducted to confirm billing data handling efficiency. Volume of unbilled water due to billing lapses is a guess.	Conditions between 2 and 4	Policy and procedures for permitting and billing 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 for permitting and billing is adequate and reviewed periodically. Computerized billing system 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	Permitting and billing policy reviewed at least biannually. Computerized billing system includes an array of reports to confirm billing data and system functionality. Annual internal checks conducted with periodic third party audit. Accountability checks flag billing lapses. Consumption lost to billing lapses is well quantified and reducing year-by-year.	Conditions between 8 and 10	Sound policy exists for permitting of all customer billing accounts. Robust computerized billing system gives high functionality and reporting capabilities. Assessment of policy and data handling errors conducted internally and audited by third party annually, 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 for permitting and billing. 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 for permitting and billing. Implement a computerized customer billing system. Conduct initial audit of billing records as part of this process.		to qualify for 6: Refine permitting and billing 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 permitting and billing practices. Enhance reporting capability of computerized billing system. Formalize regular auditing process to reveal scope of data handling error.		to qualify for 10: Close policy/procedure loopholes that allow some customer accounts to go unbilled, or data handling errors to exist. Ensure that internal and third party audits are conducted annually.		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 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 policy and procedures for permitting and documenting new water main installations, but gaps in management result in a uncertain degree of error in tabulation of mains length.	Conditions between 4 and 6	Sound 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 policy and procedures exist for permitting and commissioning new water mains. Electronic recordkeeping and asset management system are used to store and manage data.	Conditions between 8 and 10	Sound 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.

Grading											
	n/a	1	2	3	4	5	6	7	8	9	10
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. Assemble policy documents regarding permitting and documentation of water main installations by the utility and building developers; identify gaps in procedure that result in poor documentation.	to qualify for 4: Complete inventory of paper records of water main installations & abandonments for a number of years prior to audit year. Review policy and procedures for commissioning and documenting new water main installation and abandonments.		to qualify for 6: Finalize updates/improvements to 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 databases with backup as justified.		to qualify for 10: Link Geographic Information System (GIS) and asset management databases, conduct field verification of data.		to maintain 10: Continue with standardization and random field validation to improve knowledge of 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	Permitting 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	Permitting policy 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 that 3%.	Conditions between 6 and 8	Permitting policy and procedures reviewed at least biannually. Well-managed computerized information management system and routine, periodic field checks and internal system audits allows counts of connections that is no more than 2% in error.	Conditions between 8 and 10	Sound permitting policy and well managed and audited procedures ensure reliable management of service connection population. Computerized information management system and Geographic Information System (GIS) information agree; field validation proves truth of databases. Count of connections believed to be in error by less than
Improvements to attain higher data grading for "Number of Active and Inactive customer service connections" component:		to qualify for 2: Draft new policy and procedures for permitting and billing. Research and collect paper records of installations & abandonments for several years prior to audit year.	to qualify for 4: Refine policy and procedures for permitting and billing. 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 permitting 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 permitting policy 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.
Average length of customer service line:	Note: if customer water meters are located outside of the customer building next to the curbstop or boundary separating utility/customer responsibility, follow the grading description for 10(a). Also see the Service Connection Diagram worksheet.	Gradings 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 curbstop 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. Gradings 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 to obtain a grading of 10: a) The customer water meter is located outside of the customer building adjacent to the curbstop or boundary separating utility/customer responsibility for the service connection piping. In this case enter a value of zero in the Reporting Worksheet with a grading of 10. b). Customer water meters are located inside customer buildings, or the properties are unmetered. In either case the distance is highly reliable since data is drawn from a Geographic Information System (GIS) and confirmed by routine field checks.
		Vague policy exists to define the delineation of water utility ownership and customer ownership of the service connection piping. Curbstops 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 curbstops.	Policy requires that the curbstop 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 curbstop is the property of the water utility; and the piping from the curbstop to the customer building is owned by the customer. Curbstop 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 curbstop serves as the delineation point between water utility ownership and customer ownership of the service connection piping. Curbstops 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.	Conditions between 4 and 6	Clear 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 curbstops and meters, which are inspected upon installation. Accurate and well maintained electronic records exist with periodic field checks to confirm locations of service lines, curbstops 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	
Improvements to attain higher data grading for "Average Length of Customer Service Line" component:		to qualify for 2: Research and collect paper records of service line installations. Inspect several sites in the field using pipe locators to locate curbstops. Obtain the length of this small sample of connections in this manner.	to qualify for 4: 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.		to qualify for 6: Establish coherent procedures to ensure that policy for curbstop, meter installation and documentation is followed. Gain consensus within the water utility for the establishment of a computerized information management system.		to qualify for 8: Implement an electronic means of recordkeeping, typically via a customer information system or customer billing system. Standardize the process to conduct field checks of limited number of locations.		to qualify for 10: Link customer information management system and Geographic Information System (GIS), standardize process for field verification of data.		to maintain 10: Continue with standardization and random field validation to improve knowledge of system.

Grading											
	n/a	1	2	3	4	5	6	7	8	9	10
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 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 breech 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 breech pressure zones. Well-covered telemetry monitoring of the distribution system 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 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 SCADA 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.
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 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> Obtain average pressure data from 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 real-time 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 documentation on many operating functions making 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. Gaps in data known to exist, periodic internal reviews conducted but not a structured 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, not a Certified Public	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 periodically	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 by third-party CPA
Improvements to attain higher data grading for "Total Annual Cost of Operating the Water System" component:		to qualify for 2: Gather available records, institute new procedures to regularly collect and audit basic cost data of most	to qualify for 4: Implement an electronic cost accounting system, structured according to accounting standards for water utilities		to qualify for 6: Establish process for periodic internal audit of water system operating costs; identify cost data gaps and institute procedures for tracking these outstanding costs.		to qualify for 8: Standardize the process to conduct routine financial audit on an annual basis.		to qualify for 10: Standardize the process to conduct a third-party financial audit by a CPA on an annual basis.		to maintain 10: Maintain program, stay abreast of expenses subject to erratic cost changes and budget/track costs proactively
Customer retail unit cost (applied to Apparent Losses):		Antiquated, cumbersome water rate structure is use, 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.	Customer population unmetered. Fixed fee charged; single composite number derived from multiple customer classes.	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, including residential, commercial, industrial and any other customer classes within the water rate structure.	Conditions between 8 and 10	Third party reviewed weighted average composite consumption rate (includes residential, commercial, industrial, etc.)
Improvements to attain higher data grading for "Customer Retail Unit Cost" component:		to qualify for 2: Formalize the process to implement water rates, including a secure documentation procedure. Create a current, formal water rate document and gain	to qualify for 4: 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.		to qualify for 6: Evaluate volume of water used in each usage block by residential users. Multiply volumes by full rate structure.	Meter customers and charge rates based upon water volumes	to qualify for 8: Evaluate volume of water used in each usage block by all classifications of users. Multiply volumes by full rate structure.		to qualify for 10: Conduct a periodic third-party audit of water used in each usage block by all classifications of users. Multiply volumes by full rate structure.		to maintain 10: 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
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	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 calculation of unit variable production costs based on these two inputs only. 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 and treatment (ex: liability, residuals management, etc.) are included in the unit variable production cost. Data audited at least annually by utility personnel.	Conditions between 6 and 8	Reliable electronic, industry-standard cost accounting system in place, with all pertinent variable production costs tracked. Data audited at least annually by utility personnel, and periodically by third-party.	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 primary and secondary cost components 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:		to qualify for 2: Gather available records, institute new procedures to regularly collect and audit basic cost data and most important operations functions.	to qualify for 4: Implement an electronic cost accounting system, structured according to accounting standards for water utilities		to qualify for 6: Formalize process for regular internal audits of production costs. Assess whether additional costs (liability, residuals management, etc.) should be included to calculate a more accurate variable production cost.		to qualify for 8: Formalize the accounting process to include primary cost components (power, treatment) as well as secondary components (liability, residuals management, etc.) Conduct periodic third-party audits.		to qualify for 10: Standardize the process to conduct a third-party financial audit by a CPA on an annual basis.		to maintain 10: Maintain program, stay abreast of expenses subject to erratic cost changes and budget/track costs proactively

AWWA WLCC Free Water Audit Software: Customer Service Line Diagrams

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Average Length of Customer Service Line

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

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

Figure 2 shows the configuration of the customer water meter located inside the customer building, where Lp is the distance from the curbstop to the water meter.

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

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

Click for more information

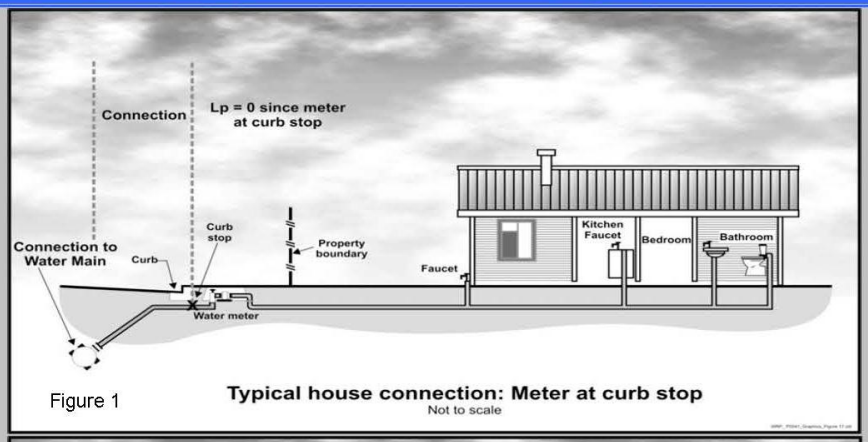

Figure 1 **Typical house connection: Meter at curb stop**
Not to scale

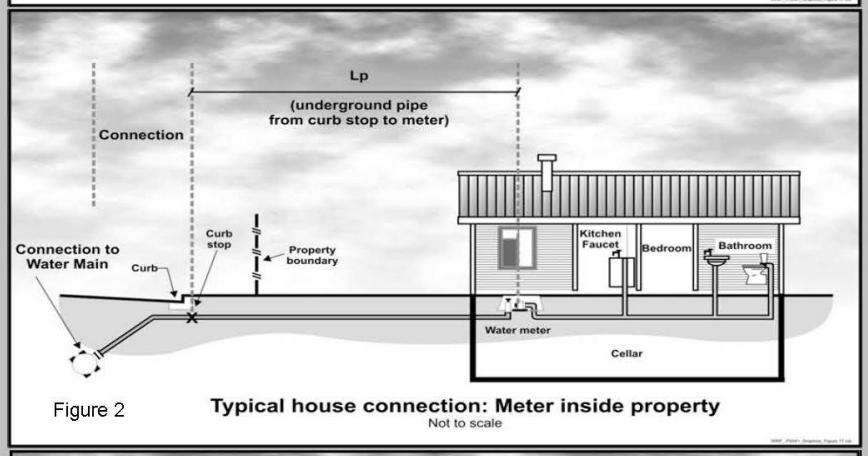

Figure 2 **Typical house connection: Meter inside property**
Not to scale

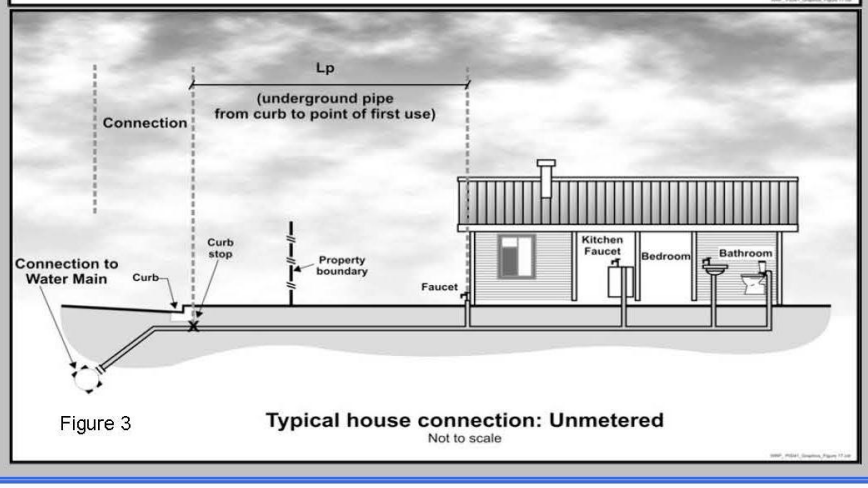

Figure 3 **Typical house connection: Unmetered**
Not to scale

AWWA WLCC Free Water Audit Software: Definitions

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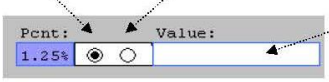
Item Name		Description
Apparent Losses	Find	= unauthorized consumption + meter under-registration + data handling errors Includes all types of inaccuracies associated with customer metering as well as data handling errors (meter reading and billing), plus unauthorized consumption (theft or illegal use). NOTE: Over-registration of customer meters, leads to under-estimation of Real Losses. Under-registration of customer meters, leads to over-estimation of Real Losses.
AUTHORIZED CONSUMPTION	Find	= billed metered + billed unmetered + unbilled metered + unbilled unmetered The volume of metered and/or unmetered water taken by registered customers, the water supplier and others who are implicitly or explicitly authorized to do so by the water supplier, for residential, commercial and industrial purposes. This does NOT include water sold to neighboring utilities (water exported). Authorized consumption may include items such as fire fighting and training, flushing of mains and sewers, street cleaning, watering of municipal gardens, public fountains, frost protection, building water, etc. These may be billed or unbilled, metered or unmetered.
Average length of customer service line	Find	This is entered for unmetered services and in cold or other areas where meters are installed inside homes and buildings. It is the length of customer service line either between the utility's service connection (often at the curbstop) and the meter, or to the building line (first point of customer consumption) if customers are unmetered. Note that the length of service connection between the main and customer service line is owned by the utility and its length and potential leakage is accounted for in the UARL formula by the number of service connections. **What role does the "Average Length of Customer Service Line" parameter serve in the Water Audit?** In many water distribution systems the water utility has maintenance responsibility for a portion of the customer service piping from its connection point at the water main to the curbstop valve located midway to the customer building. The customer is responsible to maintain the customer service piping from the curbstop to the building premises. When leaks arise on customer service piping, water utilities respond faster to repair leaks than customers when the leak is on piping under their responsibility. Leak durations are longer on the customer-maintained piping than the utility-maintained piping. The total length of pipe maintained by customers is one of the components of the Unavoidable Annual Real Loss (UARL) equation and is determined by multiplying the average length of customer maintained pipe, Lp by the number of customer service connections. Therefore this parameter is important to the calculation of the UARL and the Infrastructure leakage Index (ILI). Click to see Service Connection Diagram
Average operating pressure	Find	The average pressure may be approximated when compiling the preliminary water audit. Once routine water auditing has been established, a more accurate assessment of average pressure should be pursued. If the water utility infrastructure is recorded in a Geographical Information System (GIS) the average pressure at many locations in the distribution system can be readily obtained. If a GIS does not exist, a weighted average of pressure data can be calculated from water pressure measured at various fire hydrants scattered across the water distribution system.
Billed Authorized Consumption		All consumption that is billed and authorized by the utility. This may include both metered and unmetered consumption. See "Authorized Consumption" for more information.
Billed metered consumption	Find	All metered consumption which is billed. This includes all groups of customers such as domestic, commercial, industrial or institutional. It does NOT include water sold to neighboring utilities (water exported) which is metered and billed. 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 lagtime, however additional analysis is necessary to determine the adjustment value, which may or may not be significant.
Billed unmetered consumption	Find	All billed consumption which is calculated based on estimates or norms but is not metered. This might be a very small component in fully metered systems (for example billing based on estimates for the period a customer meter is out of order) but can be the key consumption component in systems without universal metering. It does NOT include water sold to neighboring utilities (water exported) which is unmetered but billed.
Connection density		=number of connections / length of mains

Item Name		Description
Customer metering inaccuracies	Find	Apparent water losses caused by the collective under-registration of customer water meters. Many customer water meters will wear as large cumulative volumes of water are passed through them over time. This causes the meters to under-register. 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. Alternatively, if the auditor has substantial data from meter testing to arrive at their own volumes of such losses, this volume may be entered directly. 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, then 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.
Customer retail unit cost	Find	The Customer Retail Unit Cost represents the charge that customers pay for water service. This unit cost is applied to the components of apparent loss, since these losses represent water reaching customers but not (fully) paid for. It is important to compile these costs per the same unit cost basis as the volume measure included in the water audit. For example, if all water volumes are measured in million gallons, then the unit cost should be dollars per million gallon ($/mil gal). The 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. 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, stormwater or biosolids processing, if these charges are based upon the volume of potable water consumed.
Infrastructure Leakage Index (ILI)	Find	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.
Length of mains	Find	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: 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]
Master meter error adjustment	Find	An estimate or measure of the degree of any inaccuracy that exists in the master meters measuring the Volume from own sources. Please also indicate if this adjustment is because the master meters under-registered (did not capture all the flow) or over-registered (overstated the actual flow). All systems encounter some degree of error in their Master Meter data. Please enter a positive value.
NON-REVENUE WATER	Find	= Apparent Losses + Real Losses + Unbilled Metered + Unbilled Unmetered Water which does not provide any revenue to the utility
Number of active AND inactive service connections	Find	Number of service connections, main to curb stop. 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)
Real Losses	Find	Physical water losses from the pressurized system 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.
Revenue Water		Water which is charged to customers to provide revenue to the utility.
Systematic data handling errors	Find	Apparent water losses caused by systematic data handling errors in the meter reading and billing system.
Total annual cost of operating the water system	Find	These costs include those for operations, maintenance and any annually incurred costs for long-term upkeep of the system, 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. These costs should not include any costs to operate wastewater, biosolids or other systems outside of drinking water.

Item Name		Description
Unauthorized consumption	Find	Includes water illegally withdrawn from hydrants, illegal connections, bypasses to consumption meter or meter reading equipment tampering. While this component has a direct impact on revenue, in most water utilities the volume is low and it is recommended that the auditor apply a default value of 0.25% of the volume from own sources. If the auditor has well validated data that indicates the volume from unauthorized consumption is substantially higher or lower than that generated by the default value then this value can be entered. However, for most water utilities it is recommended to apply the default value. Note that a value of zero will not be accepted since all water utilities have some volume of unauthorized consumption occurring in their system.
Unavoidable Annual Real Losses (UARL)	Find	UARL (gallons/day)=(5.41Lm + 0.15Nc + 7.5Lc) xP, or UARL (litres/day)=(18.0Lm + 0.8Nc + 25.0Lc) xP where: Lm = length of mains (miles or kilometres) Nc = number of service connections Lc = total length of customer service lines (miles or km) = Nc multiplied by the average distance of customer service line, Lp (miles or km) P = Pressure (psi or metres) Click to see Service Connection Diagram 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). It is not necessary that water utilities set this level as the target level of leakage, unless water is unusually expensive, scarce or both. NOTE: The UARL calculation has not yet been fully proven as effective for very small, or low pressure water distribution systems. If, in gallons per day: (Lm x 32) + Nc < 3000 or P <35psi in litres per day: (Lm x 20) + Nc < 3000 or P < 25m 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.
Unbilled Authorized Consumption		All consumption that is unbilled, but still authorized by the utility. See "Authorized Consumption" for more information.
Unbilled metered consumption	Find	Metered Consumption which is for any reason unbilled. This might for example include metered consumption of the utility itself or water provided to institutions free of charge. It does NOT include water sold to neighboring utilities (water exported) which is metered but unbilled.
Unbilled unmetered consumption	Find	Any kind of Authorized Consumption which is neither billed nor metered. This component typically includes items such as fire fighting, flushing of mains and sewers, street cleaning, frost protection, etc. In most water utilities it is a small component which is very often substantially overestimated. It does NOT include water sold 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 of 1.25% of the volume from own sources. Select the default percentage to enter this value. If the water utility already 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. 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.
Units and Conversions	Find	The user may develop an audit based on one of three unit selections: 1) Million Gallons (US) 2) Megalitres (Thousand Cubic Metres) 3) Acre-feet 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): Enter Units: Convert From... Converts to..... 1 Million Gallons (US) = 3.06888 Acre-feet (conversion factor = 3.06888328973723)

Item Name		Description
Use of Option Buttons	Find	To use the percent value choose this button To enter a value choose this button and enter the value in the cell to the right  **NOTE:** For unbilled unmetered consumption and unauthorized consumption, a recommended default value can be applied by selecting the Percent option. The default values are based on fixed percentages of water supplied 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. If a default value is selected, the user does not need to grade the item; a grading value of 3 is automatically applied (however, this grade will not be displayed).
Variable production cost (applied to Real Losses)	Find	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 should also include the unit cost of bulk water purchased as an import if applicable.
Volume from own sources	Find	The volume of treated water input to system from own production facilities
Water exported	Find	Bulk water sold and conveyed out of the water distribution system. Typically this is water sold to a neighboring water utility. Be sure to account for any export meter inaccuracy in reporting this volume
Water imported	Find	Bulk water purchased to become part of the water supplied. Typically this is water purchased from a neighboring water utility or regional water authority. Be sure to account for any import meter inaccuracy in reporting this volume
WATER LOSSES	Find	= apparent losses + real losses The difference between System Input and Authorized Consumption. Water losses can be considered as a total volume for the whole system, or for partial systems such as transmission or distribution systems, or individual zones. Water Losses consist of Real Losses and Apparent Losses.

AWWA WLCC Free Water Audit Software: Determining Water Loss Standing

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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

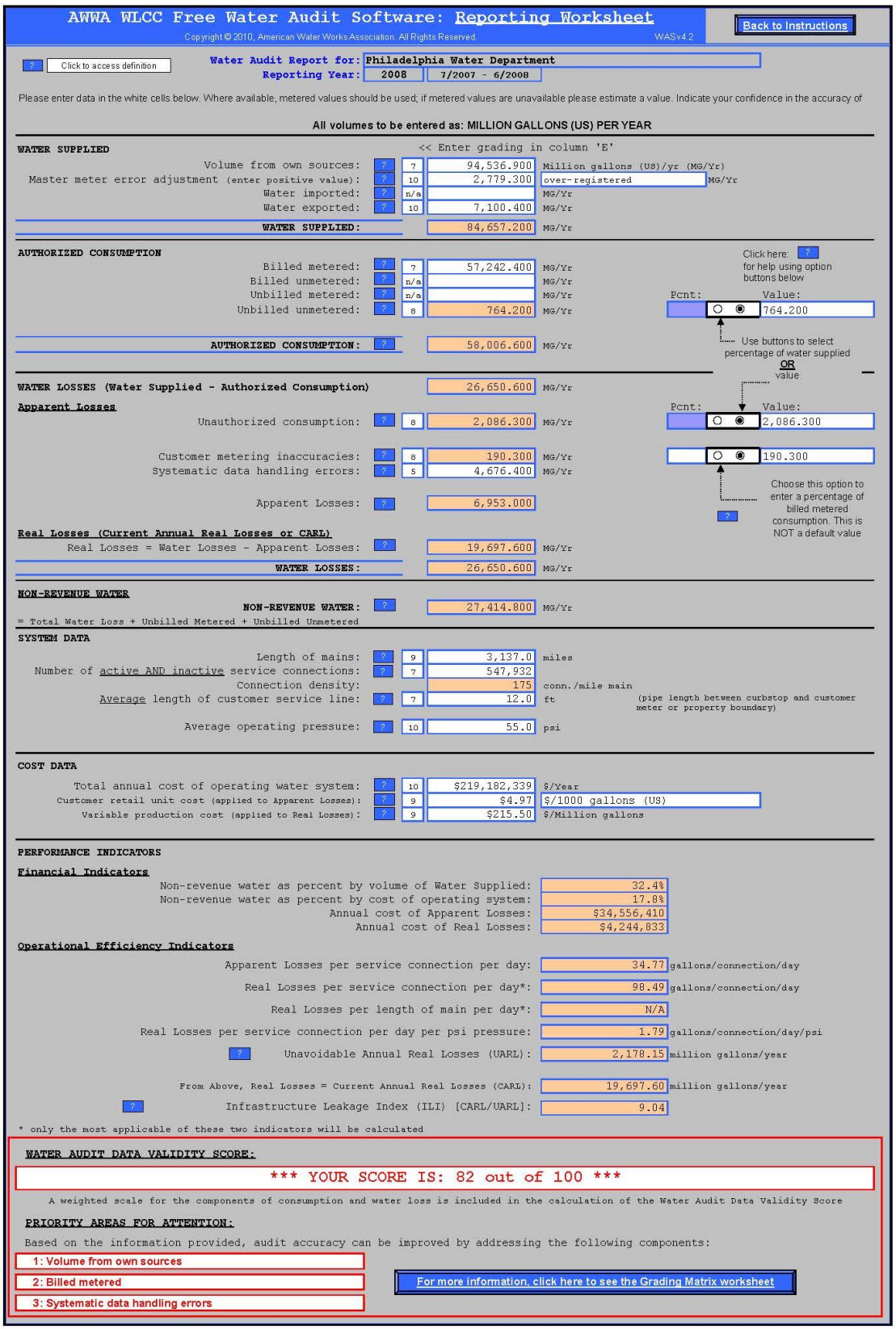
For validity scores of 50 or below, the shaded blocks should not be focus areas until better data validity is achieved.

Once data has 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 is 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 planning.
>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 WLCC Free Water Audit Software: Reporting Worksheet

Back to Instructions

 WASv4.2

Click to access definition

Water Audit Report for: Philadelphia Water Department
Reporting Year: 2008 (7/2007 - 6/2008)

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

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

WATER SUPPLIED << Enter grading in column 'E'

Volume from own sources:	7	94,536.900	Million gallons (US)/yr (MG/Yr)	
Master meter error adjustment (enter positive value):	10	2,779.300	over-registered	MG/Yr
Water imported:	n/a			MG/Yr
Water exported:	10	7,100.400		MG/Yr
WATER SUPPLIED:		84,657.200		MG/Yr

AUTHORIZED CONSUMPTION

Click here: for help using option buttons below

				Pcnt:	Value:
Billed metered:	7	57,242.400	MG/Yr		
Billed unmetered:	n/a		MG/Yr		
Unbilled metered:	n/a		MG/Yr		
Unbilled unmetered:	8	764.200	MG/Yr		764.200
AUTHORIZED CONSUMPTION:		58,006.600	MG/Yr		

Use buttons to select percentage of water supplied OR value

WATER LOSSES (Water Supplied - Authorized Consumption) 26,650.600 MG/Yr

Apparent Losses

				Pcnt:	Value:
Unauthorized consumption:	8	2,086.300	MG/Yr		2,086.300
Customer metering inaccuracies:	8	190.300	MG/Yr		190.300
Systematic data handling errors:	5	4,676.400	MG/Yr		
Apparent Losses:		6,953.000			

Choose this option to enter a percentage of billed metered consumption. This is NOT a default value

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: 19,697.600 MG/Yr

WATER LOSSES: 26,650.600 MG/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 27,414.800 MG/Yr

= Total Water Loss + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	9	3,137.0	miles	
Number of active AND inactive service connections:	7	547,932		
Connection density:		175	conn./mile main	
Average length of customer service line:	7	12.0	ft	(pipe length between curbstop and customer meter or property boundary)
Average operating pressure:	10	55.0	psi	

COST DATA

Total annual cost of operating water system:	10	$219,182,339	$/Year
Customer retail unit cost (applied to Apparent Losses):	9	$4.97	$/1000 gallons (US)
Variable production cost (applied to Real Losses):	9	$215.50	$/Million gallons

PERFORMANCE INDICATORS

Financial Indicators

Non-revenue water as percent by volume of Water Supplied:	32.4%
Non-revenue water as percent by cost of operating system:	17.8%
Annual cost of Apparent Losses:	$34,556,410
Annual cost of Real Losses:	$4,244,833

Operational Efficiency Indicators

Apparent Losses per service connection per day:	34.77	gallons/connection/day
Real Losses per service connection per day*:	98.49	gallons/connection/day
Real Losses per length of main per day*:	N/A	
Real Losses per service connection per day per psi pressure:	1.79	gallons/connection/day/psi
Unavoidable Annual Real Losses (UARL):	2,178.15	million gallons/year
From Above, Real Losses = Current Annual Real Losses (CARL):	19,697.60	million gallons/year
Infrastructure Leakage Index (ILI) [CARL/UARL]:	9.04	

* only the most applicable of these two indicators will be calculated

WATER AUDIT DATA VALIDITY SCORE:

*** YOUR SCORE IS: 82 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

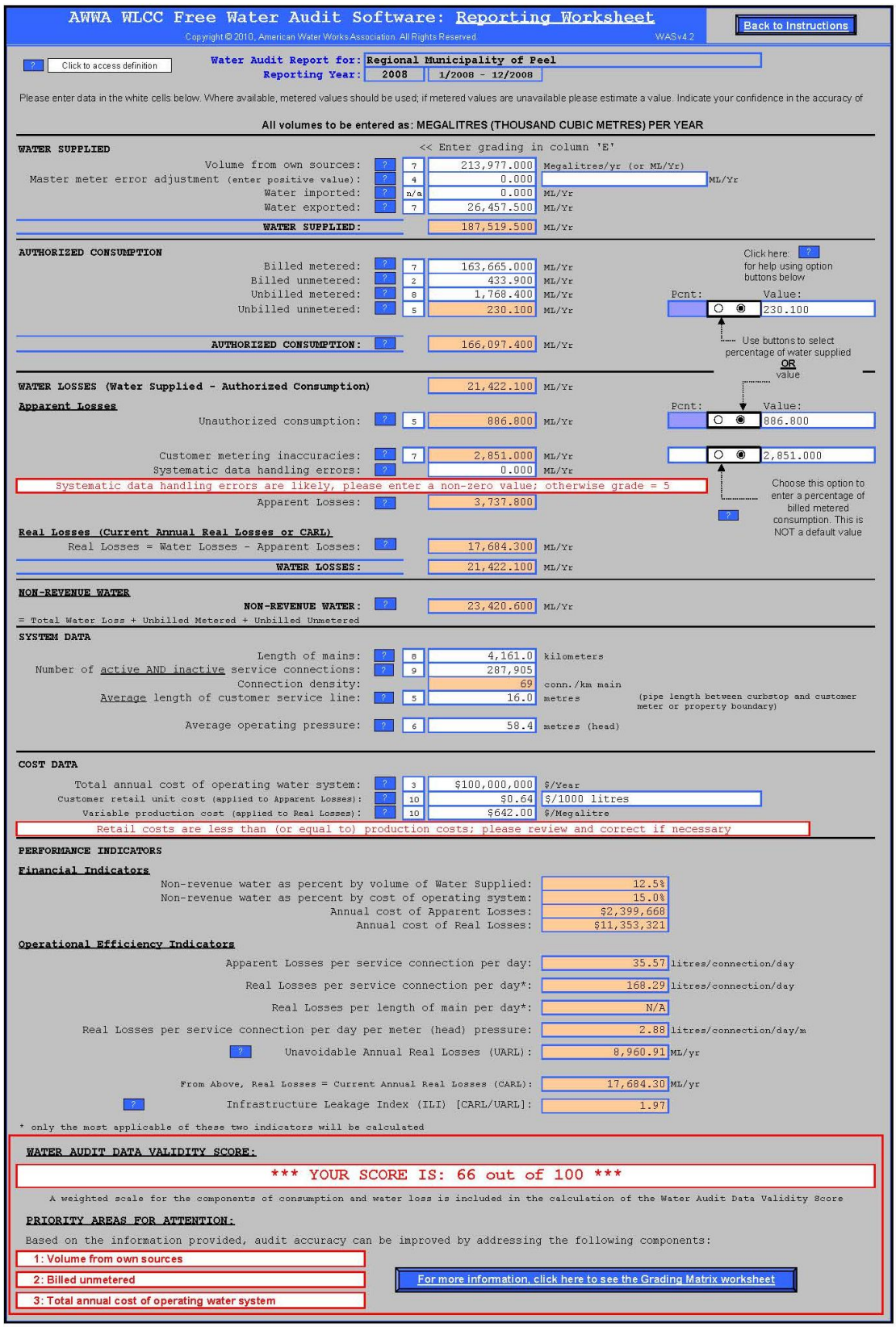
PRIORITY AREAS FOR ATTENTION:

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

1: Volume from own sources
2: Billed metered
3: Systematic data handling errors

For more information, click here to see the Grading Matrix worksheet

AWWA Water Loss Control Committee Ex. Audit 1 (Million Gallons)



AWWA WLCC Free Water Audit Software: Reporting Worksheet

WASv4.2

Back to Instructions

Click to access definition

Water Audit Report for: Regional Municipality of Peel

Reporting Year: 2008 (1/2008 - 12/2008)

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

All volumes to be entered as: MEGALITRES (THOUSAND CUBIC METRES) PER YEAR

WATER SUPPLIED (<< Enter grading in column 'E')

Volume from own sources:	7	213,977.000	Megalitres/yr (or ML/Yr)
Master meter error adjustment (enter positive value):	4	0.000	ML/Yr
Water imported:	n/a	0.000	ML/Yr
Water exported:	7	26,457.500	ML/Yr
WATER SUPPLIED:		187,519.500	ML/Yr

AUTHORIZED CONSUMPTION

Click here: for help using option buttons below

				Pcnt:	Value:
Billed metered:	7	163,665.000	ML/Yr		
Billed unmetered:	2	433.900	ML/Yr		
Unbilled metered:	8	1,768.400	ML/Yr		
Unbilled unmetered:	5	230.100	ML/Yr		230.100
AUTHORIZED CONSUMPTION:		166,097.400	ML/Yr		

Use buttons to select percentage of water supplied OR value

WATER LOSSES (Water Supplied - Authorized Consumption) 21,422.100 ML/Yr

Apparent Losses

				Pcnt:	Value:
Unauthorized consumption:	5	886.800	ML/Yr		886.800
Customer metering inaccuracies:	7	2,851.000	ML/Yr		2,851.000
Systematic data handling errors:		0.000	ML/Yr		

Systematic data handling errors are likely, please enter a non-zero value; otherwise grade = 5

Apparent Losses: 3,737.800

Choose this option to enter a percentage of billed metered consumption. This is NOT a default value

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: 17,684.300 ML/Yr

WATER LOSSES: 21,422.100 ML/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 23,420.600 ML/Yr

= Total Water Loss + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	8	4,161.0	kilometers
Number of active AND inactive service connections:	9	287,905	
Connection density:		69	conn./km main
Average length of customer service line:	5	16.0	metres (pipe length between curbstop and customer meter or property boundary)
Average operating pressure:	6	58.4	metres (head)

COST DATA

Total annual cost of operating water system:	3	$100,000,000	$/Year
Customer retail unit cost (applied to Apparent Losses):	10	$0.64	$/1000 litres
Variable production cost (applied to Real Losses):	10	$642.00	$/Megalitre

Retail costs are less than (or equal to) production costs; please review and correct if necessary

PERFORMANCE INDICATORS

Financial Indicators

Non-revenue water as percent by volume of Water Supplied:	12.5%
Non-revenue water as percent by cost of operating system:	15.0%
Annual cost of Apparent Losses:	$2,399,668
Annual cost of Real Losses:	$11,353,321

Operational Efficiency Indicators

Apparent Losses per service connection per day:	35.57	litres/connection/day
Real Losses per service connection per day*:	168.29	litres/connection/day
Real Losses per length of main per day*:	N/A	
Real Losses per service connection per day per meter (head) pressure:	2.88	litres/connection/day/m
Unavoidable Annual Real Losses (UARL):	8,960.91	ML/yr
From Above, Real Losses = Current Annual Real Losses (CARL):	17,684.30	ML/yr
Infrastructure Leakage Index (ILI) [CARL/UARL]:	1.97	

* only the most applicable of these two indicators will be calculated

WATER AUDIT DATA VALIDITY SCORE:

*** YOUR SCORE IS: 66 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

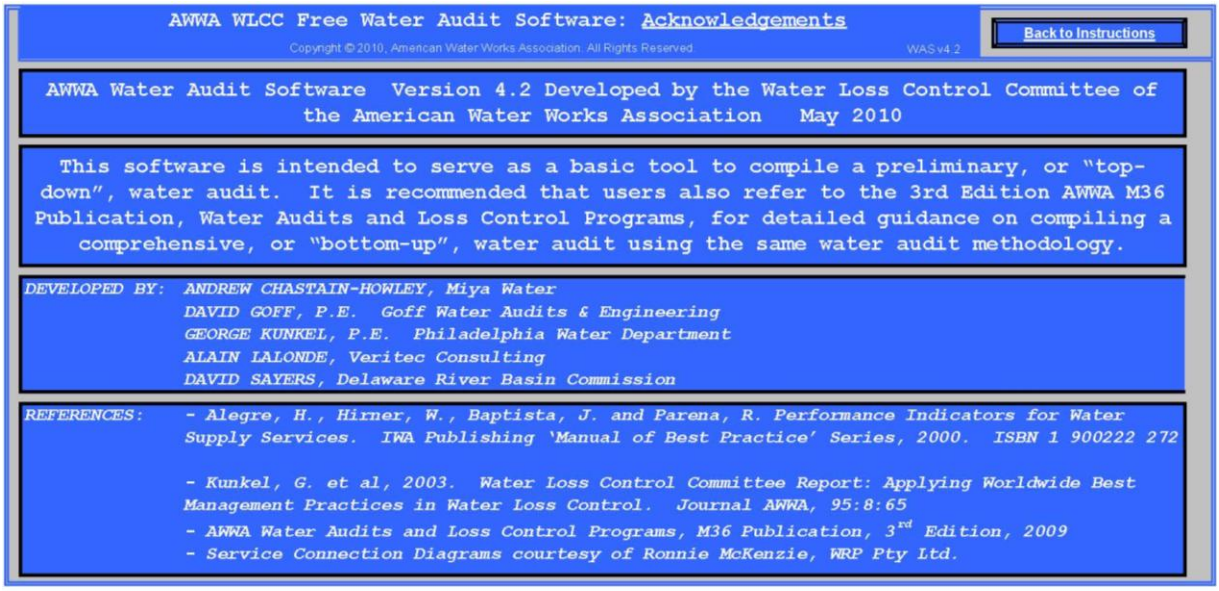
2: Billed unmetered

3: Total annual cost of operating water system

For more information, click here to see the Grading Matrix worksheet

AWWA Water Loss Control Committee

Ex. Audit 2 (Megalitres)


AWWA WLCC Free Water Audit Software: Acknowledgements
Copyright © 2010, American Water Works Association. All Rights Reserved.
WAS v4.2
Back to Instructions
AWWA Water Audit Software Version 4.2 Developed by the Water Loss Control Committee of the American Water Works Association May 2010
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 3rd Edition 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.
DEVELOPED BY: ANDREW CHASTAIN-HOWLEY, Miya Water
DAVID GOFF, P.E. Goff Water Audits & Engineering
GEORGE KUNKEL, P.E. Philadelphia Water Department
ALAIN LALONDE, Veritec Consulting
DAVID SAYERS, Delaware River Basin Commission
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.

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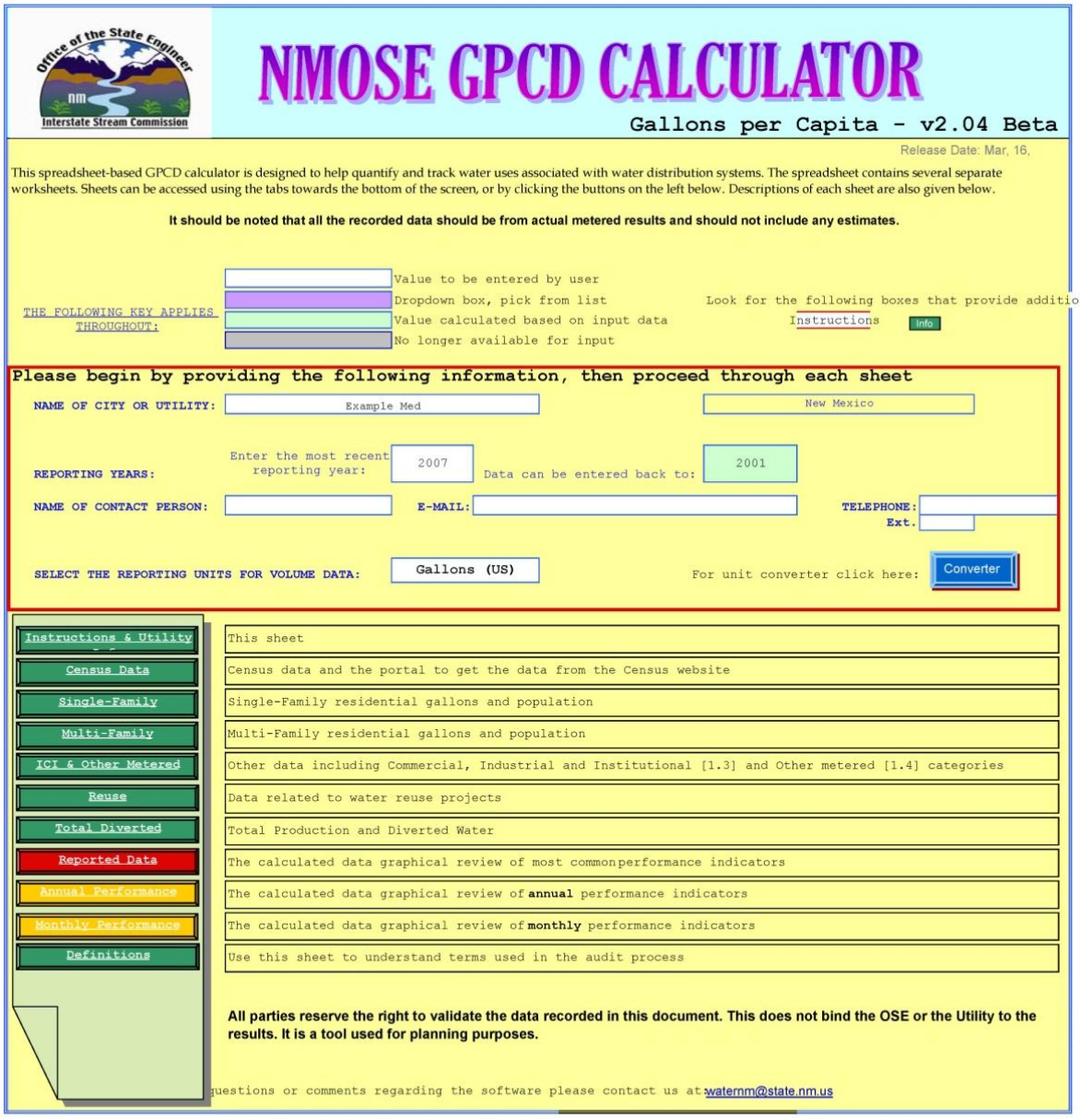
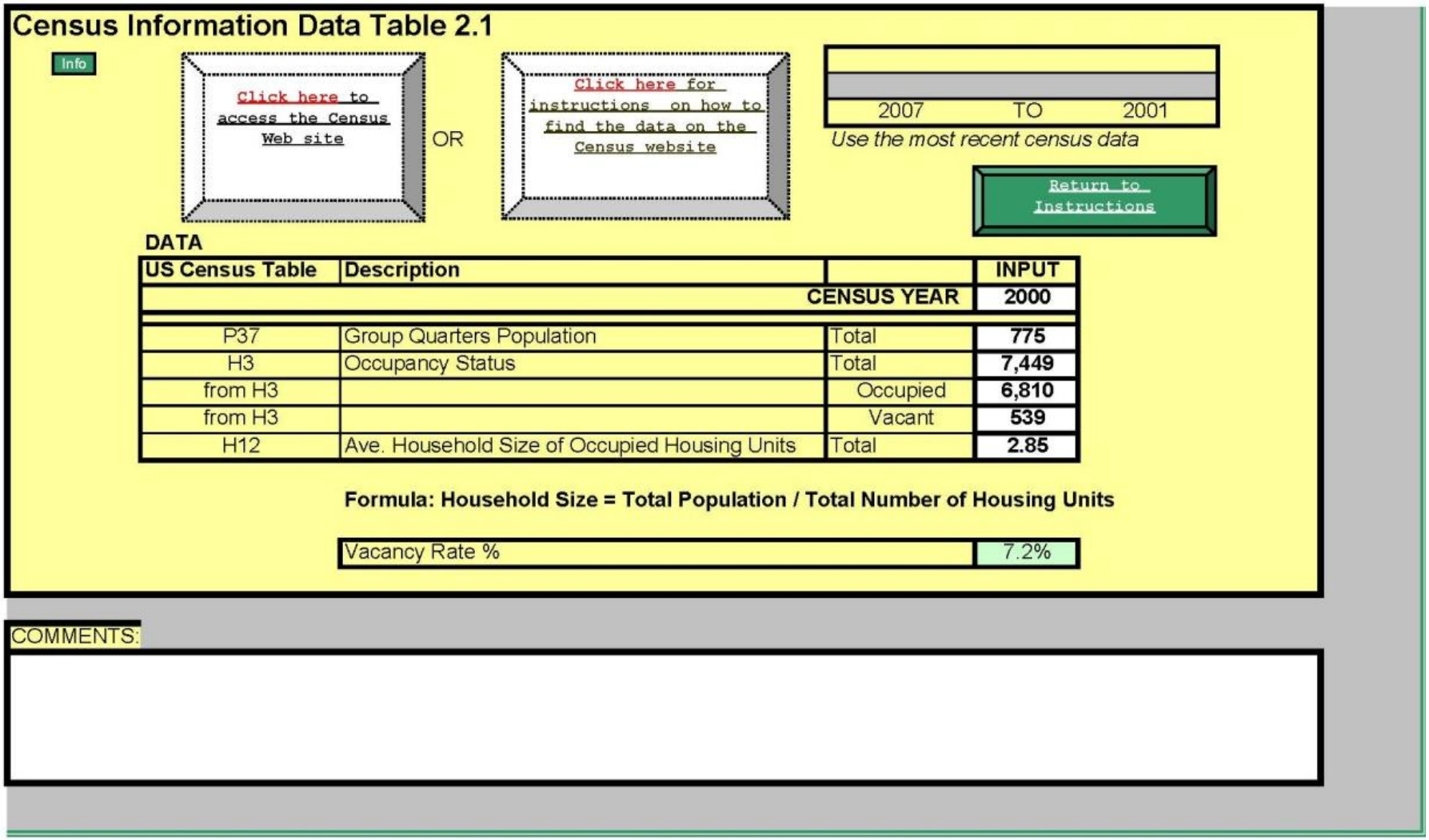
GPCD Calculator





NMOSE GPCD Calculator v2.02

DATA INPUT SHEET

Example Med

Instructions

3. SINGLE-FAMILY RESIDENTIAL (SFR)

Return to Instructions

MONTHLY DATA

TABLE 3.1 Info

2007 TO 2001

SFR BILLED WATER CONSUMPTION (Gallons (US))

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007	27,092,868	23,963,259	18,492,478	21,596,338	21,223,298	29,892,520	33,809,452	29,457,904	31,688,252	24,286,236	22,423,063	22,002,272
2006	20,415,979	43,331,236	21,490,160	18,924,976	35,748,581	25,793,778	25,664,217	21,079,657	35,493,318	22,301,620	20,149,542	16,710,829
2005	27,819,788	21,572,118	22,148,617	26,548,779	22,665,552	34,322,122	37,893,762	31,484,741	29,955,149	24,305,617	23,445,948	23,566,722
2004												
2003												
2002												
2001												

TABLE 3.2 Info

Active Connections Only

You have chosen to enter Active Connections Only, enter the monthly values below, or enter annual values in table 3.8 Check message above Table 3.3 to see if additional data is required.

NUMBER OF SFR CONNECTIONS (Monthly)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007	5,223	5,228	5,228	5,232	5,223	5,223	5,228	5,239	5,220	5,225	5,230	5,232
2006	5,198	5,196	5,223	5,228	5,228	5,232	5,223	5,223	5,228	5,239	5,220	5,225
2005	5,200	5,199	5,202	5,200	5,199	5,198	5,196	5,223	5,228	5,228	5,232	5,238
2004												
2003												
2002												
2001												

TABLE 3.3 Info

You have entered Active Connections Only in Table 3.2; leave the cells below blank

INACTIVE (ZERO USE) SFR CONNECTIONS (Monthly)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007												
2006												
2005												
2004												
2003												
2002												
2001												

TABLE 3.4

Formula = (No. of Connections - No. of Zero Use Accounts) * Ave. Household Size

SFR POPULATION (Monthly)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007	14,886	14,900	14,900	14,911	14,886	14,886	14,900	14,931	14,877	14,891	14,906	14,911
2006	14,814	14,809	14,886	14,900	14,900	14,911	14,886	14,886	14,900	14,931	14,877	14,891
2005	14,820	14,817	14,826	14,820	14,817	14,814	14,809	14,886	14,900	14,900	14,911	14,928
2004	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
2003	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
2002	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
2001	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data

TABLE 3.5

Formula = Billed Water Consumption (SFR only) / Calculated Population (SFR only)

SFR GPCD CALCULATION (Monthly)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007	58.71	57.44	40.04	48.28	45.99	66.94	73.20	63.64	71.00	52.61	50.14	47.60
2006	44.46	104.50	46.57	42.34	77.40	57.66	55.62	45.68	79.40	48.18	45.15	36.20
2005	60.55	52.00	48.19	59.71	49.34	77.23	82.55	68.23	67.01	52.62	52.41	50.92
2004	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
2003	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
2002	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
2001	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data

COMMENTS:

Decemeber 2006 partial monthly reading. Jan 2007 is 5 weeks.

ANNUAL DATA

TABLE 3.6 ANNUAL CONSUMPTION

333,857,521
351,298,236
354,852,236
360,458,754

TABLE 3.7 ANNUAL CALCULATION

305,927,940
307,103,893
325,728,915
333,857,521
351,298,236
354,852,236
360,458,754

TABLE 3.8 AVG. ANNUAL CONNECTIONS

5,206
5,199
5,196
5,190

TABLE 3.9 AVG CONN. CALCULATION

5,228
5,222
5,212
5,206
5,199
5,196
5,190

TABLE 3.10 Info CALCULATED GROWTH RATE

0.11%
0.19%
0.11%
0.13%
0.06%
0.12%

TABLE 3.11 No. VACANT SFR CONNECTIONS

TABLE 3.12 Info SIZE OF HOUSEHOLD

2.85
2.85
2.85
2.85
2.85
2.85
2.85

TABLE 3.13 Info SFR POPULATION

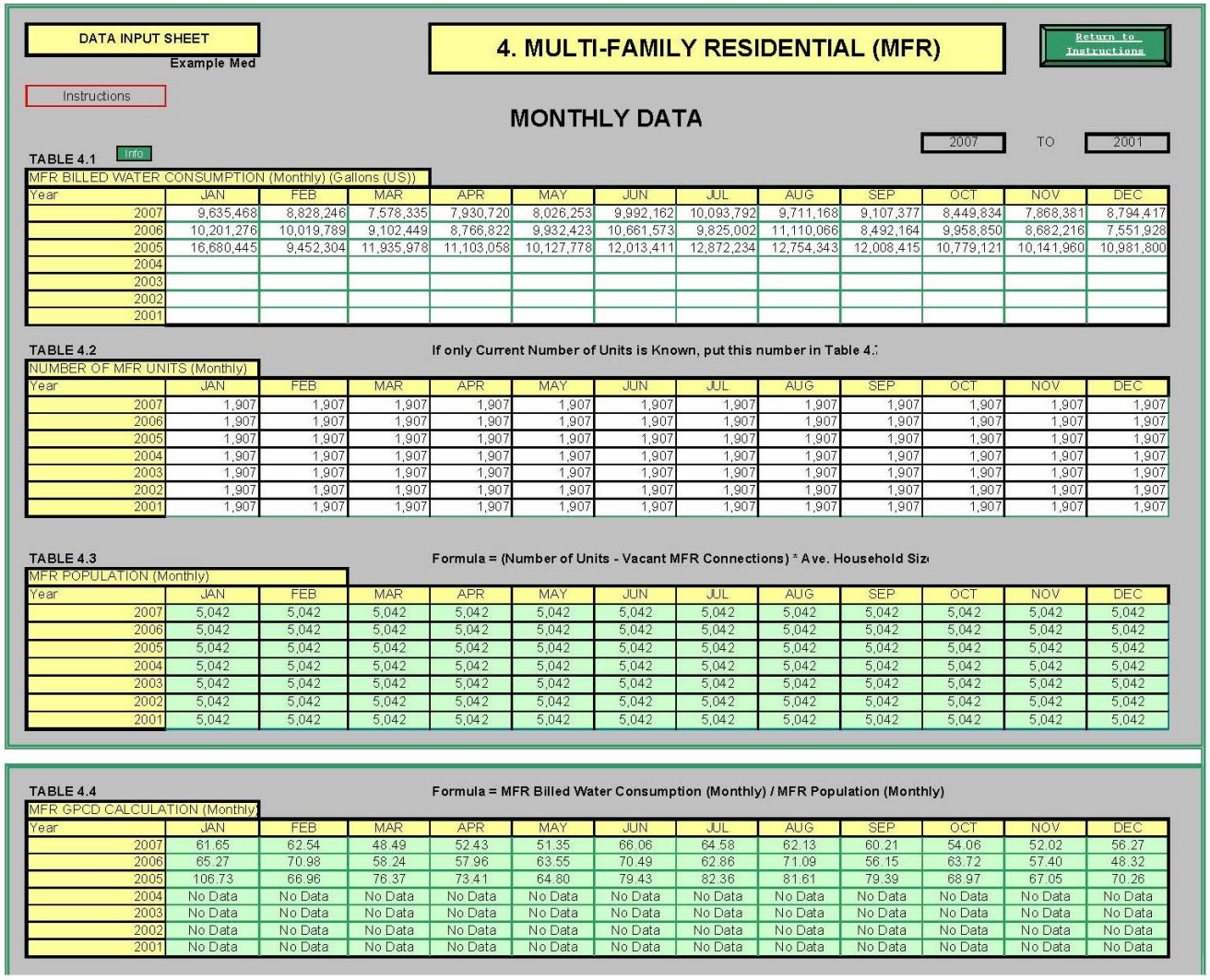
14,899
14,882
14,854
14,837
14,817
14,809
14,792

TABLE 3.14 Info

ANNUAL SFR GPCD

56.26
56.54
60.08
61.65
64.96
65.65
66.77

NMOSE GPCD Calculator v2.02



DATA INPUT SHEET

Example Med

4. MULTI-FAMILY RESIDENTIAL (MFR)

Return to Instructions

Instructions

MONTHLY DATA

2007 TO 2001

TABLE 4.1 Info

MFR BILLED WATER CONSUMPTION (Monthly) (Gallons (US))

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007	9,635,468	8,828,246	7,578,335	7,930,720	8,026,253	9,992,162	10,093,792	9,711,168	9,107,377	8,449,834	7,868,381	8,794,417
2006	10,201,276	10,019,789	9,102,449	8,766,822	9,932,423	10,661,573	9,825,002	11,110,066	8,492,164	9,958,850	8,682,216	7,551,928
2005	16,680,445	9,452,304	11,935,978	11,103,058	10,127,778	12,013,411	12,872,234	12,754,343	12,008,415	10,779,121	10,141,960	10,981,800
2004												
2003												
2002												
2001												

TABLE 4.2 If only Current Number of Units is Known, put this number in Table 4.

NUMBER OF MFR UNITS (Monthly)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907
2006	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907
2005	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907
2004	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907
2003	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907
2002	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907
2001	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907	1,907

TABLE 4.3 Formula = (Number of Units - Vacant MFR Connections) * Ave. Household Siz

MFR POPULATION (Monthly)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042
2006	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042
2005	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042
2004	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042
2003	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042
2002	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042
2001	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042	5,042

TABLE 4.4 Formula = MFR Billed Water Consumption (Monthly) / MFR Population (Monthly)

MFR GPCD CALCULATION (Monthly)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007	61.65	62.54	48.49	52.43	51.35	66.06	64.58	62.13	60.21	54.06	52.02	56.27
2006	65.27	70.98	58.24	57.96	63.55	70.49	62.86	71.09	56.15	63.72	57.40	48.32
2005	106.73	66.96	76.37	73.41	64.80	79.43	82.36	81.61	79.39	68.97	67.05	70.26
2004	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
2003	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
2002	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
2001	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data

ANNUAL DATA

TABLE 4.5 ANNUAL CONSUMPTION

146,895,214
162,854,000
166,854,789
170,598,741

TABLE 4.6 ANNUAL CALCULATION

106,016,153
114,304,558
140,850,847
146,895,214
162,854,000
166,854,789
170,598,741

TABLE 4.7 No. CURRENT UNITS

TABLE 4.8 ANNUAL UNIT CALCULATION

1,907
1,907
1,907
1,907
1,907
1,907
1,907

TABLE 4.9 Info MFR POPULATION

5,042
5,042
5,042
5,042
5,042
5,042
5,042

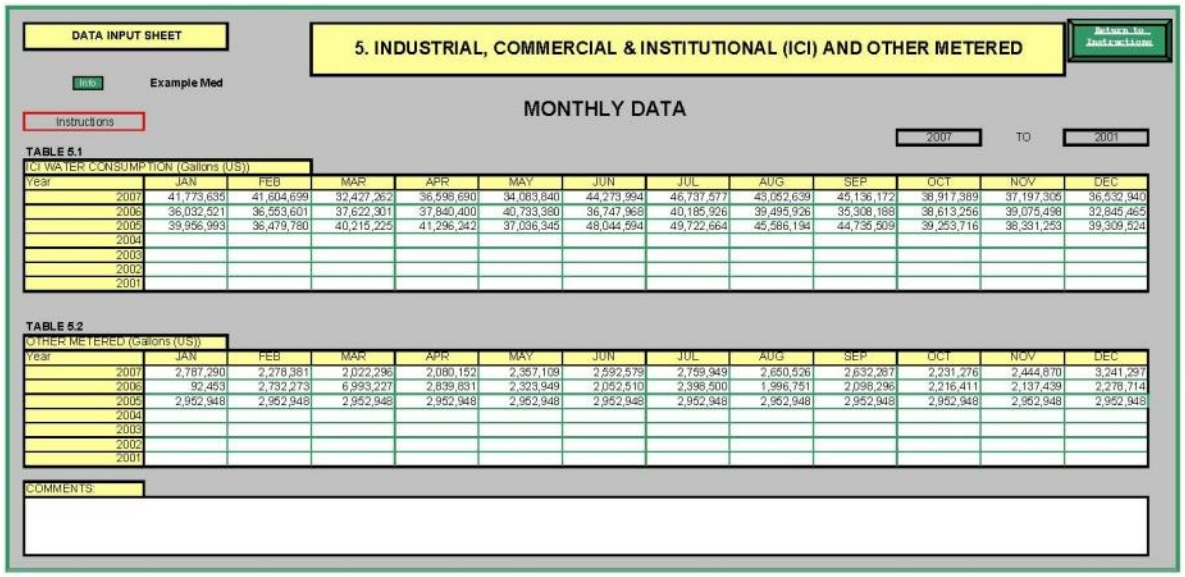
TABLE 4.10 VACANT MFR CONNECTIONS

138
138
138
138
138
138
138

TABLE 4.11 Info

ANNUAL MFR GPCD
57.61
62.11
76.54
79.83
88.50
90.67
92.71

NMOSE GPCD Calculator v2.02



DATA INPUT SHEET

Info

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5. INDUSTRIAL, COMMERCIAL & INSTITUTIONAL (ICI) AND OTHER METERED

Return to Instructions

MONTHLY DATA

2007 TO 2001

TABLE 5.1

ICI WATER CONSUMPTION (Gallons (US))

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007	41,773,635	41,604,699	32,427,262	36,596,690	34,083,840	44,273,994	46,737,577	43,052,639	45,136,172	38,917,389	37,197,305	36,532,940
2006	36,032,521	36,553,601	37,622,301	37,840,400	40,733,380	36,747,968	40,185,926	39,495,926	35,308,188	38,613,256	39,075,498	32,845,465
2005	39,956,993	36,479,780	40,215,225	41,296,242	37,036,345	48,044,594	49,722,664	45,586,194	44,735,509	39,253,716	38,331,253	39,309,524
2004												
2003												
2002												
2001												

TABLE 5.2

OTHER METERED (Gallons (US))

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007	2,787,290	2,278,381	2,022,296	2,080,152	2,357,109	2,592,579	2,759,949	2,650,526	2,632,287	2,231,276	2,444,870	3,241,297
2006	92,453	2,732,273	6,993,227	2,839,831	2,323,949	2,052,510	2,398,500	1,996,751	2,098,296	2,216,411	2,137,439	2,278,714
2005	2,952,948	2,952,948	2,952,948	2,952,948	2,952,948	2,952,948	2,952,948	2,952,948	2,952,948	2,952,948	2,952,948	2,952,948
2004												
2003												
2002												
2001												

COMMENTS:

ANNUAL DATA

TABLE 5.3 ICI ANNUAL CONSUMPTION	TABLE 5.4 ICI GPCD	TABLE 5.5 ICI ANNUAL CALCULATED
	63.26	478,336,142
	59.70	451,054,430
	66.27	499,968,039
500,989,325	66.46	500,989,325
510,895,987	67.84	510,895,987
512,986,553	68.14	512,986,553
525,212,552	69.82	525,212,552

TABLE 5.6 OTHER ANNUAL CONSUMPTION	TABLE 5.7 OTHER METERED GPCD	TABLE 5.8 OTHER ANNUAL CALCULATED
	3.98	30,078,012
	3.99	30,160,354
	4.70	35,436,376
28,154,800	3.73	28,154,800
30,654,892	4.07	30,654,892
32,654,128	4.34	32,654,128
30,854,621	4.10	30,854,621

NMOSE GPCD Calculator v2.02

DATA INPUT SHEET | Info

Example Med

6. REUSE

Return to Instructions

Instructions

MONTHLY DATA

2007 TO 2001

TABLE 6.1

REUSE DIVERSIONS (Monthly) (Gallons (US))

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007	893,680	809,010	865,780	864,320	940,990	1,009,810	1,147,250	1,018,100	965,130	855,260	812,710	849,080
2006	899,090	845,360	894,800	944,790	1,066,720	1,050,780	1,080,147	968,890	933,200	886,630	822,550	882,157
2005	921,740	892,230	859,960	944,130	1,026,890	1,144,449	1,265,188	1,052,456	973,460	991,196	883,689	906,436
2004											60,982	382,917
2003												
2002												
2001												

COMMENTS:

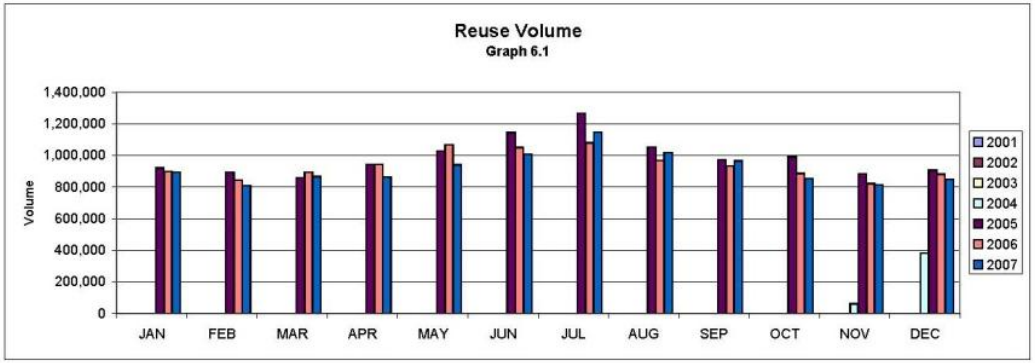
Reuse sales started in November 2004.

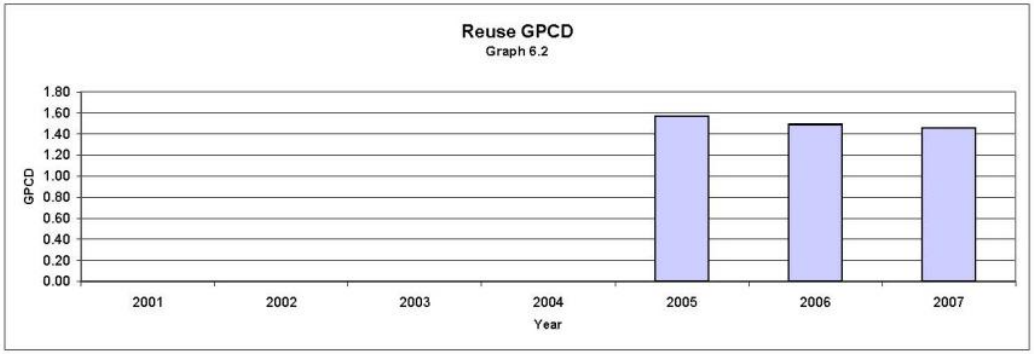
ANNUAL DATA

TABLE 6.2 REUSE ANNUAL DIVERSIONS

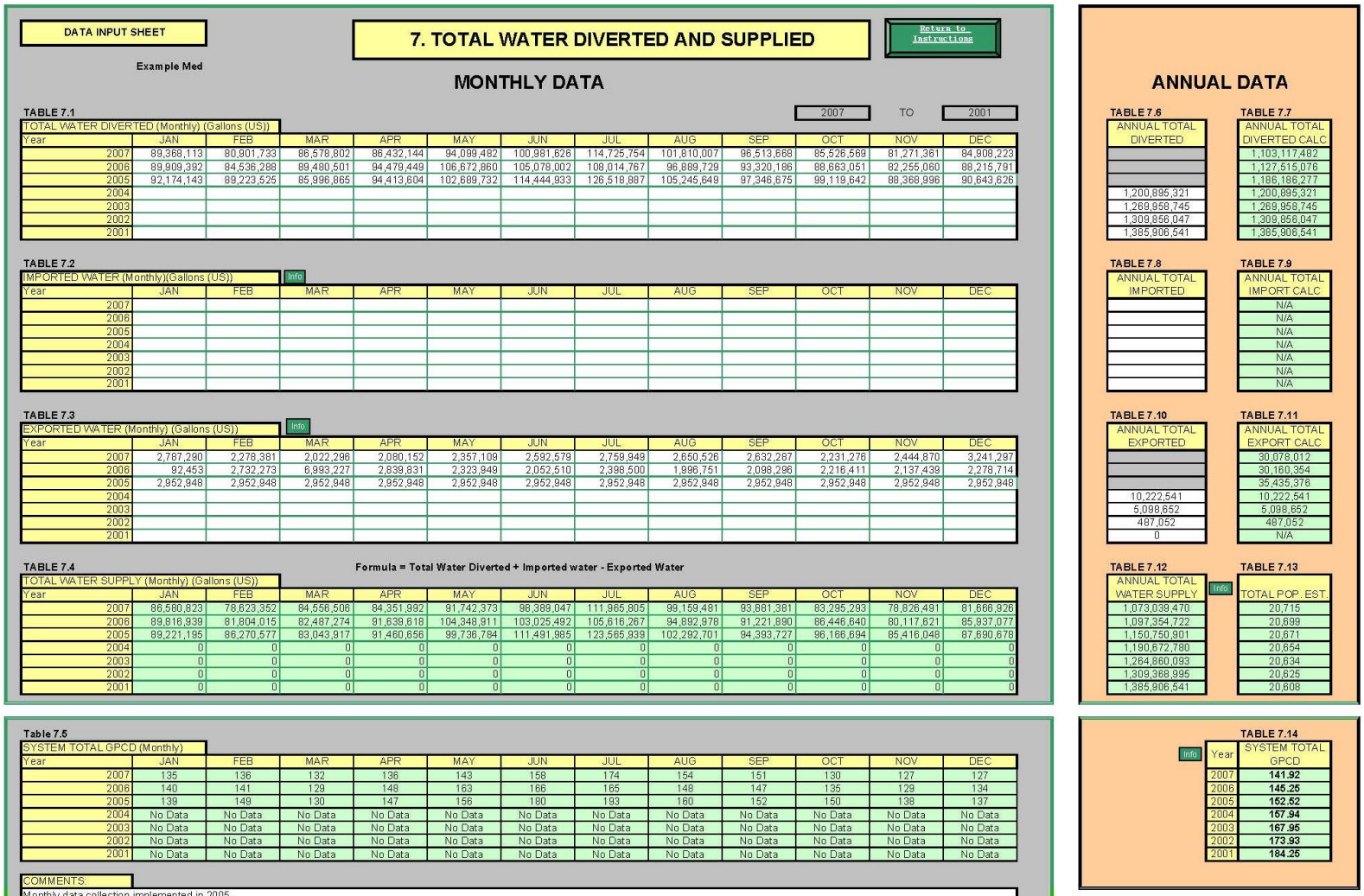
TABLE 6.3 REUSE GPCD

REUSE GPCD
1.46
1.49
1.57
N/A
N/A
N/A
N/A





NMOSE GPCD Calculator v2.02



DATA INPUT SHEET

Example Med

7. TOTAL WATER DIVERTED AND SUPPLIED

Return to Instructions

MONTHLY DATA

TABLE 7.1

TOTAL WATER DIVERTED (Monthly) (Gallons (US))

2007 TO 2001

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007	89,368,113	80,901,733	86,578,802	86,432,144	94,099,482	100,981,626	114,725,754	101,810,007	96,513,668	85,526,569	81,271,361	84,908,223
2006	89,909,392	84,536,288	89,480,501	94,479,449	106,672,860	105,078,002	108,014,767	96,889,729	93,320,186	88,663,051	82,255,060	88,215,791
2005	92,174,143	89,223,525	85,996,865	94,413,604	102,689,732	114,444,933	126,518,887	105,245,649	97,346,675	99,119,642	88,368,996	90,643,626
2004												
2003												
2002												
2001												

TABLE 7.2

IMPORTED WATER (Monthly)(Gallons (US)) Info

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007												
2006												
2005												
2004												
2003												
2002												
2001												

TABLE 7.3

EXPORTED WATER (Monthly) (Gallons (US)) Info

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007	2,787,290	2,278,381	2,022,296	2,080,152	2,357,109	2,592,579	2,759,949	2,650,526	2,632,287	2,231,276	2,444,870	3,241,297
2006	92,453	2,732,273	6,993,227	2,839,831	2,323,949	2,052,510	2,398,500	1,996,751	2,098,296	2,216,411	2,137,439	2,278,714
2005	2,952,948	2,952,948	2,952,948	2,952,948	2,952,948	2,952,948	2,952,948	2,952,948	2,952,948	2,952,948	2,952,948	2,952,948
2004												
2003												
2002												
2001												

TABLE 7.4

Formula = Total Water Diverted + Imported water - Exported Water

TOTAL WATER SUPPLY (Monthly) (Gallons (US))

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007	86,580,823	78,623,352	84,556,506	84,351,992	91,742,373	98,389,047	111,965,805	99,159,481	93,881,381	83,295,293	78,826,491	81,666,926
2006	89,816,939	81,804,015	82,487,274	91,639,618	104,348,911	103,025,492	105,616,267	94,892,978	91,221,890	86,446,640	80,117,621	85,937,077
2005	89,221,195	86,270,577	83,043,917	91,460,656	99,736,784	111,491,985	123,565,939	102,292,701	94,393,727	96,166,694	85,416,048	87,690,678
2004	0	0	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0	0	0	0

ANNUAL DATA

TABLE 7.6 ANNUAL TOTAL DIVERTED

1,200,895,321
1,269,958,745
1,309,856,047
1,385,906,541

TABLE 7.7 ANNUAL TOTAL DIVERTED CALC

1,103,117,482
1,127,515,076
1,186,186,277
1,200,895,321
1,269,958,745
1,309,856,047
1,385,906,541

TABLE 7.8 ANNUAL TOTAL IMPORTED

TABLE 7.9 ANNUAL TOTAL IMPORT CALC

N/A
N/A
N/A
N/A
N/A
N/A
N/A

TABLE 7.10 ANNUAL TOTAL EXPORTED

10,222,541
5,098,652
487,052
0

TABLE 7.11 ANNUAL TOTAL EXPORT CALC

30,078,012
30,160,354
35,435,376
10,222,541
5,098,652
487,052
N/A

TABLE 7.12 ANNUAL TOTAL WATER SUPPLY Info

1,073,039,470
1,097,354,722
1,150,750,901
1,190,672,780
1,264,860,093
1,309,368,995
1,385,906,541

TABLE 7.13 TOTAL POP. EST.

20,715
20,699
20,671
20,654
20,634
20,625
20,608

Table 7.5

SYSTEM TOTAL GPCD (Monthly)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007	135	136	132	136	143	158	174	154	151	130	127	127
2006	140	141	129	148	163	166	165	148	147	135	129	134
2005	139	149	130	147	156	180	193	160	152	150	138	137
2004	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
2003	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
2002	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
2001	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data

COMMENTS:

Monthly data collection implemented in 2005.

TABLE 7.14

Info

Year	SYSTEM TOTAL GPCD
2007	**141.92**
2006	**145.25**
2005	**152.52**
2004	**157.94**
2003	**167.95**
2002	**173.93**
2001	**184.25**

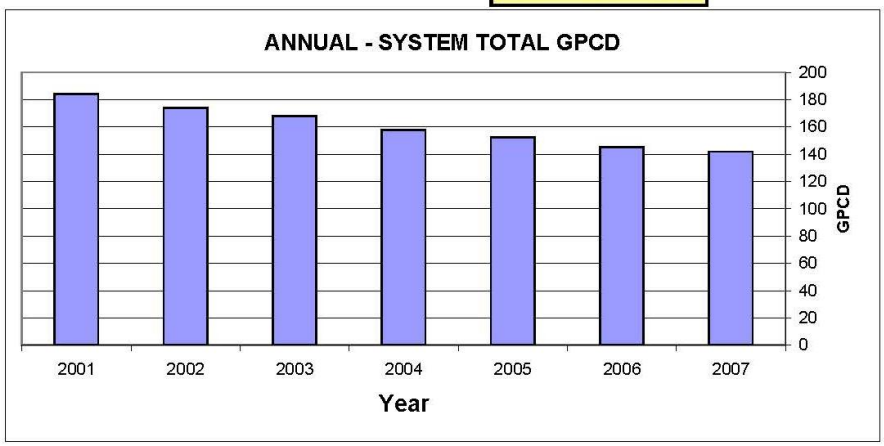
NMOSE GPCD Calculator v2.02

8. SUMMARY GPCD REPORTED DATA

Example Med		
2007	To:	2001

ANNUAL

Year	SYSTEM GPCD
2007	141.92
2006	145.25
2005	152.52
2004	157.94
2003	167.95
2002	173.93
2001	184.25

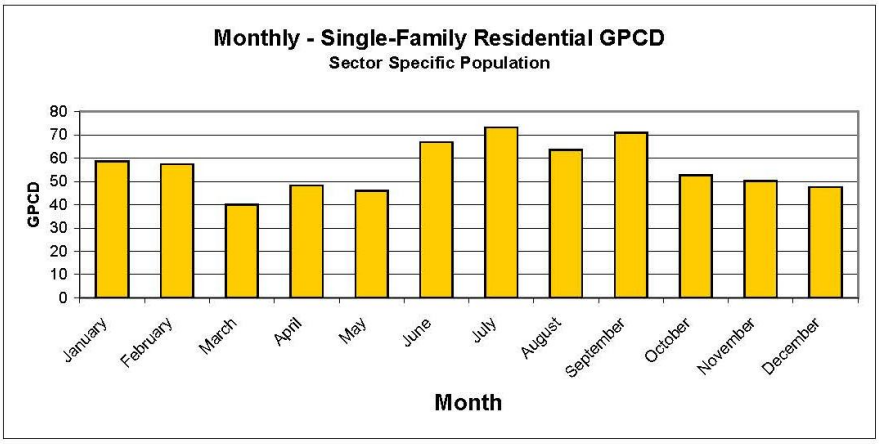


MONTHLY

Month	SFR GPCD
January	58.71
February	57.44
March	40.04
April	48.28
May	45.99
June	66.94
July	73.20
August	63.64
September	71.00
October	52.61
November	50.14
December	47.60

Year	2007

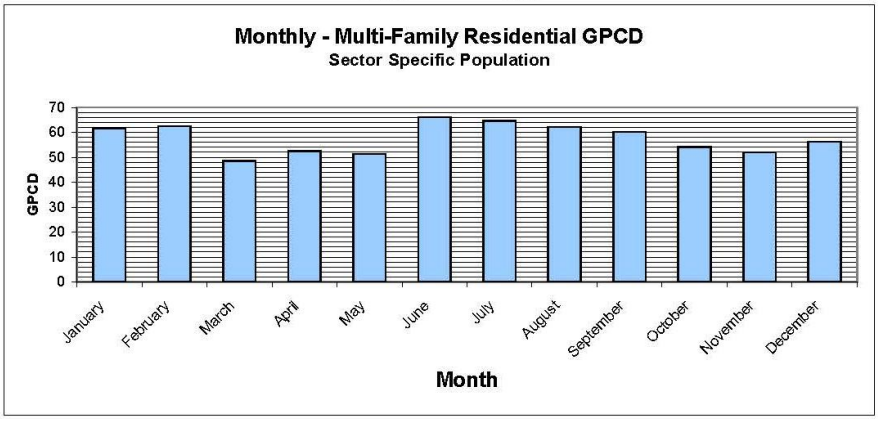
Peak/Ave	1.30



YEAR 2007

Month	MFR GPCD
January	61.65
February	62.54
March	48.49
April	52.43
May	51.35
June	66.06
July	64.58
August	62.13
September	60.21
October	54.06
November	52.02
December	56.27

Peak/Ave	1.15



YEAR 2007

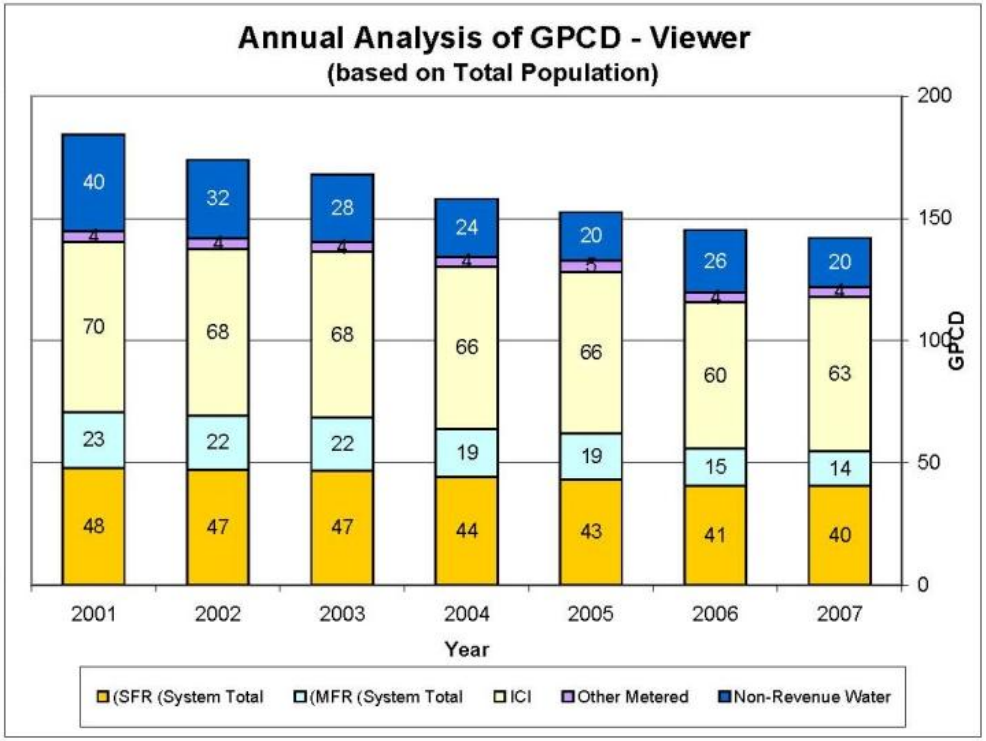
NMOSE GPCD Calculator v2.02

9. System Total Annual Reporting Performance

Overall Annual GPCD (based on Total Population)

	SFR (System Total)	MFR (System Total)	ICI	Other Metered	Non-Revenue Water (Info)	Total Supplied	Non-Revenue Volume Million Gallons (US)
Year							
On Graph?	Yes	Yes	Yes	Yes	Yes		
2007	40.46	14.02	63.26	3.98	20.19	143.38	152.68
2006	40.65	15.13	59.70	3.99	25.77	146.74	194.73
2005	43.17	18.67	66.27	4.70	19.72	154.09	148.77
2004	44.29	19.49	66.46	3.73	23.98	157.94	180.78
2003	46.64	21.62	67.84	4.07	27.77	167.95	209.16
2002	47.14	22.16	68.14	4.34	32.15	173.93	242.02
2001	47.92	22.68	69.82	4.10	39.72	184.25	298.78

Example Med		
2007	to	2001



NMOSE GPCD Calculator v2.02

10. Monthly Reporting Performance

Choose Year for Monthly Analysis 2007

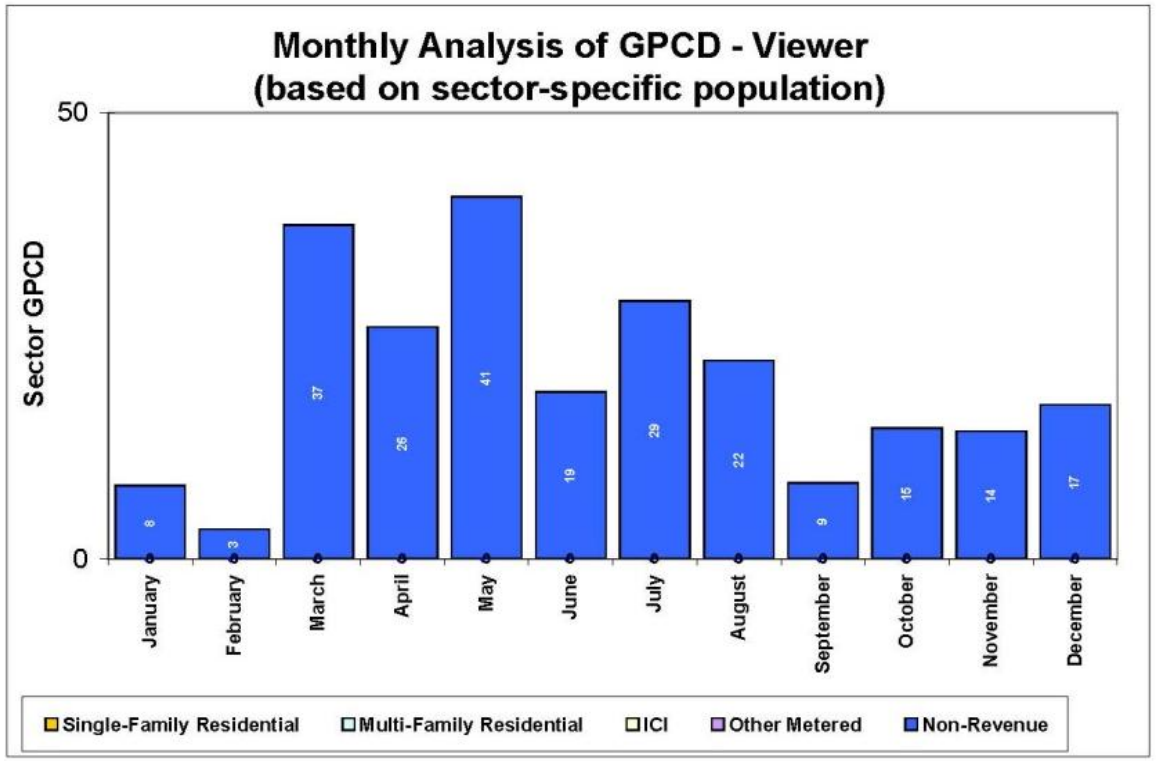
Choose Sector Non-Revenue

Monthly GPCD

Month	Single-Family Residential GPCD	Multi-Family Residential GPCD	ICI GPCD	Other Metered GPCD	Non-Revenue GPCD
JAN	58.71	61.65	65.05	4.34	8.24
FEB	57.44	62.54	71.73	3.93	3.36
MAR	40.04	48.49	50.50	3.15	37.43
APR	48.28	52.43	58.89	3.35	25.98
MAY	45.99	51.35	53.08	3.67	40.57
JUN	66.94	66.06	71.24	4.17	18.73
JUL	73.20	64.58	72.78	4.30	28.91
AUG	63.64	62.13	67.04	4.13	22.25
SEP	71.00	60.21	72.63	4.24	8.56
OCT	52.61	54.06	60.60	3.47	14.65
NOV	50.14	52.02	59.85	3.93	14.31
DEC	47.60	56.27	56.89	5.05	17.28

Example Med

2007 to 2001



NMOSE GPCD Calculator v2.02

Example City

This example provides a general summary of a fictitious scenario based on Appendix B for sections two through five from the Planning Guide.

Data Analysis and Results

Audit Data Results

The AWWA spreadsheet for Example City is located in Appendix B.
Priority area for attention: Customer metering inaccuracies
Annual cost of apparent losses: $438,451
Apparent losses per service connection per day: 12.19 gallons
Data validity score: 76
Looking back at the data, the PWS lost approximately 3 percent metered authorized consumption due to meter errors. The grade of 6 indicates that there may be outdated or inaccurate meters in the system and that meter accuracy testing does not occur on a regular basis. This contributed to $438,451 in lost revenue and 12.19 gallons per connection per day in apparent losses.

Example of Potential Audit (Supply Side Options)

Change to consider	Behavior/Management	Hardware/Technology
Meter testing	a. Calculate end-user meter error using industry equations b. Initiate policy on meter testing	a. Provide bench testing b. Purchase flow-meter testing equipment
Example City: Meter replacement	a. Initiate policy on meter replacement	a. Purchase AMR meters b. Replace all 2” meters

GPCD Calculator Data Results

*These values are assumed, not provided in the example GPCD Calculator.

Baseline

- System total GPCD: 180

Goal

- Reduce system total GPCD by 20 percent by 2020 from 5 year average (2005-2009)

Notes from GPCD Calculator data results

- Trends over time: system total slightly upward trending
- Peak uses: SFR summer, ICI September, winter holiday
- New SFR connections due to incorporation of area previously on domestic wells

Example of Potential GPCD (Demand-Side) Options

Change to Consider	Behavior/Management	Hardware/Technology
SFR peak summer use	a. Landscape watering ordinance b. Training classes	a. Smart irrigation controllers
New connections	a. Education of new users	a. Low-flow end-use fixtures b. Rainwater collection

Setting Goals

Objective: Conserve water and end the sustainability of the supply.
Goal: Within five years, the PWS will increase the accountability of existing water use to <10 gallons per day per connection and will improve data validity to >80.
Baselines selected:

- Apparent losses per service connection per day: 12.19 gallons
- Data validity score: 76

Loss Control Planning (worksheet 7): Data Validity Score for Example City is in Level IV (71–90). Level IV recommends setting five-year apparent and real loss reduction goals.
Grading Matrix (worksheet 4): Apparent Losses is a calculated value that includes customer meter inaccuracies. Our example has a grade of 6 for customer metering inaccuracies. In the Grading Matrix, AWWA recommends expanding annual metering accuracy testing and expanding the meter replacement program, both at statistically significant levels.

Evaluating Resources and Challenges

Potential programs have been selected based on data results. Below, one option each from supply and demand has been expanded for consideration.

Supply-side program: Meter testing
Behavior/Management
Initiate policy on meter testing.
Option 1: Education incentive
Training class for meter readers on how to recognize and report broken or questionable meters
Option 2: Regulation incentive
New policy on testing meters over a certain age, over a certain volume per year, and when problem is reported
Option 3: Financial incentive
n/a

Demand-side program: SFR peak summer use
Hardware/technology
SFR smart irrigation controllers
Option 1: Education incentive
Brochure distribution on benefits of smart controllers
Option 2: Regulation incentive
New ordinance requiring smart controllers for lawns
Option 3: Financial incentive
Rebates offered for installation of smart controllers

PWS Resources and Challenges
(Each PWS will have to determine its specific resources and challenges. The following are provided as examples.)

- 20 percent of one full-time employee (FTE) available for supply-side, 50 percent of FTE available for demand-side
- $1,000 annual budget
- Large lots with mostly lawns, several second homes, end-users unwilling to give up lawns

Programs under consideration
Meter testing: Option 2, new policy on testing, small budget for replacing or repairing problem meters on large accounts
SFR peak summer use: Option 1, distribute low-cost or free existing education materials to all (or high-use only) SFR connections

Prioritizing Programs
The estimates below are fabricated for this example. They are not transferable, as each system is unique.

Programs under Consideration
Meter testing – Option 2, new policy on testing, small budget for replacing or repairing problem meters on large accounts
Anticipated Results – 5 percent replacement of 2" meters over next 3 years, increase in revenue due to proper metering of large accounts, reduction in system total nonrevenue water by 2 percent
SFR Peak Summer Use – Option 1, distribute existing education materials (low cost or free) to all (or high-use only) SFR connections
Anticipated Results – 3 percent reduction in summer peak on SFR connections, one seasonal mailing to all SFR accounts, potential follow-up to high-volume users

Selected Program: Meter Testing

Year one

- Draft new meter testing policy and get governing body authorization to implement
- Research smart controllers and corresponding educational materials, obtain any needed materials, prepare mailing list

Year two

- Implement new meter testing policy and set up budget for replacing broken meters
- Mail out educational materials and set up contact for follow-up phone calls
- Look into data validity score improvements

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WATER USE AND CONSERVATION BUREAU

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