New England
Water Works Association

A Section of the
American Water Works Association

"Basic Training"
for Drinking Water Board Members
On-Line Course
Reference Guide
2012

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Top Ten Pieces of Advice for Board Members

1. Bring snacks to meetings. Food always makes a meeting more bearable (and gets people to come!).

2. Befriend regulators. They are not the enemy but are there to assist you in providing for and protecting the public's health.

3. Understand how to compromise effectively.

4. Know the rules under which your board operates and follow them.

5. Understand the basics of your treatment system from start to finish.

6. Show up to every meeting and contribute regularly.

7. Treat all customers, co-workers, contractors and employees with respect and dignity.

8. Laboratory analyses, budget line items, the size of your system and what it does are all described in numbers, and all of the numbers have meaning. Know what the numbers mean.

9. Don't be afraid to ask questions.

10. "Be the change you want to see in the world." (quote by Mahatma Gandi)

Pat Kline – author of *The Big Guide For Small Systems: A Resource for Board Members*

Table of Contents

To access the on-line training modules that accompany this reference guide, go to www.newwa.org. Each of the three self-paced modules is approximately 20 minutes and corresponds with the reference guide sections as indicated below.

Acknowledgements

NEWWA extends special thanks to the following organizations for permission to use information from the publications listed below. NEWWA also greatly appreciates feedback received from the New England states and specific comments from regional reviewers Bob Morency, Barry Woods, Terry Trott, Sara Flanagan, Ashley Lucht, Steven Boudreau, Cindy Klevens, Adam Torrey, and Yvette DePeiza. This guide is based on the work of many and would not be possible without the funding and direction provided by EPA Region I and Denise Springborg. Also, special thanks to Ali Armstrong of NEWWA for her diligent work on this project. Anyone interested in learning more about their water system is strongly encouraged to contact their state drinking water programs and examine the resources listed in the Appendices.

Rural Community Assistance Partnership Solutions, Inc.
New Hampshire Department of Environmental Services
A Handbook for Owners of Small Water Systems in New Hampshire

Vermont Department of Environmental Conservation
Vermont Small Water System Officials Handbook (Draft)

Rural Community Assistance Partnership (National)
National Environmental Services Center
A Drop of Knowledge: The Non-operator's Guide to Drinking Water Systems

Rural Community Assistance Partnership (National)
The Big Guide for Small Systems: A Resource for Board Members

National Drinking Water Clearinghouse of West Virginia University
The Water Board Bible

Association of State Drinking Water Administrators Workgroup
Water Basics for Decision Makers (Draft)

Foreword

Most of us take our drinking water for granted. We turn on the tap, and with very few exceptions, we have clean, safe water. Water is an ordinary and everyday part of our lives, yet it requires so much to get it to us – compliance with strict health regulations, treatment and distribution, and budgets and planning, to name only a few of the numerous tasks! And, while safe water is available nearly everywhere we go, what goes on behind the scenes to provide it is very complex and requires the input of many parts and people.

Among the many people supporting a community's water system are members of a governing board. These board members or in some communities, water commissioners, are often citizen volunteers with little or no prior knowledge of running a water system. State and federal agencies along with water associations recognize that these volunteers play a vital role in ensuring the continued safety of our drinking water supplies. To support the work of governing boards, they have developed numerous training tools and guides to understanding water treatment and regulations. This guide along with the accompanying on-line training course represents only a fraction of those tools. It was prepared to give board members a basic understanding of everything from running a board meeting, to setting water rates and working closely with the water operator. For those who want more training and information, many other detailed references are available and are listed in the Appendices.

While primarily developed for governing boards, much of the information contained in this guide can be used by owners and managers of water systems not governed by boards.

We hope that you find it useful and congratulate all of you for taking an interest in serving your community and helping to supply them with safe drinking water now and into the future!

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Section 1 – Roles & Responsibilities

Introduction

As a board member it is your responsibility to be as informed as possible about operating a financially sound and safe water system. With more information, you can make better decisions about current and future operations of your community's system. By using this guide, you are becoming engaged in the process of learning more about your responsibilities and becoming an essential resource in your community.

The number one concern for you as the governing body of your water utility is to protect the public's health while maintaining compliance with state and federal regulations. To ensure that decisions are made in the best interest of the public, anyone sitting on a water board must remember that they are keepers of the public's trust. Your certified operator is on the front lines of these protection and compliance efforts, making sure that your treatment facility operates in accordance with regulations and that all required tests, public notification and record keeping procedures are followed. As a board member, it is your duty to support the operator as he or she carries out these functions and to be knowledgeable of the consequences for failing to do so.

A well run board will be able to distinguish the role of the board from that of the operator and learn to strike the right balance between working with the operator and planning for the financial security of the water system. As in any relationship, mutual trust, fostered by good communication between the board and the operator is the key to a happy, successful, and rewarding experience.

Whether you were appointed, elected or have volunteered to be a board member, you will find that much of the work is common sense yet demanding. Here are a few examples:

- Customers want to trust that you can provide clean, good-tasting drinking water on demand for the lowest cost possible.
- Regulators want monitoring and testing performed according to their rules.
- Operators want the tools, equipment and training to perform their jobs efficiently.

- Board members want to be confident that your decisions have been made rationally and ethically within budgetary constraints.

The governing board is legally and morally responsible for all aspects of the water system, including employee oversight, finances, operation and maintenance, planning, and complying with regulations.

The first step to meeting these responsibilities is to ensure the board is following the rules. If your system is structured as a private entity, the rules may be different from those followed by one that is structured as a public or nonprofit entity. Laws that grant the authority for you to provide water services typically spell out procedures from procuring goods and services to labor relations and accounting. Know what rules and laws pertain to your water system and follow them!

Legal, Fiduciary, & Financial Responsibilities

As a board member, you are entrusted with managing the water system and have the power to act on behalf of and for the benefit of your constituents. Your basic legal responsibilities are to:

1. Carry out your rules and regulations (as laid out in your by-laws and/or water ordinances).

2. Ensure that your system is being operated in compliance with all of the applicable federal, state and local laws and ordinances.

3. Conduct business only as a board. Individual board members cannot enter into contracts, or other legal agreements unless authorized by the board to do so.

4. See all records, minutes and notices are created, maintained and made available according to federal, state and local laws.

Fiduciary responsibilities are related to the trust that the public is placing in the water board, as their representative, to handle the affairs of the water utility. Unless the board's actions are negligent, or it fails to take steps that keep the system in compliance with regulations, the board is probably meeting the minimum requirements of its fiduciary role.

Fiduciary responsibilities include:

- Exercising rights and powers for and on behalf of others with diligence and care.

- Developing reliable cost and revenue projections that demonstrate revenues sufficiently cover operation of the system, service on debt and reserve funds, plus future improvements and repairs.

- Providing proof of implementation of sound fiscal management and control policies and procedures.

If you have not worked with financial documents before or don't regularly work with a financial mindset, one of your most difficult duties as a board member might be understanding your financial responsibilities. Budgeting, audits, finding funding, raising rates, and keeping financial records are all a part of being a board member for a water system.

You might already know how important financial resources are to the operation of any business that provides a product or service. Your water system can sink or swim based on its financial standing. You also know how essential drinking water treatment is not only to a city or a community, but to even a single household. So in addition to the responsibilities you were elected to take on in overseeing the financial management of your utility, you probably understand that you have a deeper obligation to ensure that your utility's finances are managed properly because they are the main resources that support the delivery of safe drinking water.

Every board member should understand how to budget, how to read financial statements, what funding sources are available, and how to adjust rates. The more members who know what is going on financially in the utility, the better able they are to check each other and to plan for the future. Remember: whether your system is a not-for-profit, municipality, district, manufactured home park, etc., it is supposed to run like a business. This means that the full costs of providing service should be shared by the customers.

As a board member, your goal is to make the water system sustainable. Sustainability is your system's ability to provide safe, high-quality drinking water to your customers while meeting your regulatory responsibilities. If your system is financially sustainable, it will be able to provide water treatment services at a rate that consistently generates enough revenue (income) to meet all of your expenses, both in the short- and long-term. The challenge is being financially sustainable while providing services at an affordable and fair cost.

Complying with the Safe Drinking Water Act

As a board member, you should have a general awareness of drinking water regulations, but it is up to the operator to know specifically how to treat the water, what to test for and how often to test. The number of regulations that apply to your system depends on the water supply (well, lake, or river – also referred to as ground or surface water), the number of customers, and the type of contaminants present in the water. Understanding and remembering the details of each regulation is beyond the responsibility of the board. However, it is very important to talk with your operator to develop a basic understanding of the regulations. Ensuring that your water system is in compliance and your customers are receiving safe drinking water is your responsibility.

The Safe Drinking Water Act (SDWA) is the federal law that regulates the quality of drinking water served to the public by a municipality, district, business or organization. In general terms, the SDWA establishes regulations regarding treatment and monitoring for contaminants, keeping the public informed, and recording information. The SDWA allows individual states to administer provisions of the Act, provided the state's regulations are at least as stringent as the federal regulations. Each state has its own set of drinking water regulations to protect the public health and welfare. The Appendix contains links to federal and state regulations and how to reach staff that can help answer your questions. Don't hesitate to reach out to regulators; they want to help you succeed in providing safe water to the community.

Water Treatment and Contaminant Monitoring Regulations - The SDWA requires water systems to treat the water according to specifics rules and to prove that they are meeting water quality standards by sampling and testing drinking water for:

- Inorganic chemicals
- Microbiological contaminants (e.g. total coliform and *E. coli*)
- Organic chemicals (e.g. components of gasoline, pesticides, and herbicides)
- Radiological contaminants (e.g. uranium, radium)
- Turbidity
- Unregulated contaminants and chemicals
- Disinfection by-products (formed when chlorine combines with natural organics in water)

While this summary list may seem short, it is no reflection of the complexity of the regulations and treatment requirements. Do not underestimate the numerous regulatory checks and balances that are in place to ensure water systems comply with the law and provide safe water.

There are almost 100 primary and secondary drinking water standards. Primary standards are legally-enforceable and limit the level of specific contaminants allowed in drinking water. These contaminants have been studied and are known to have adverse human health effects. Primary standards include requirements for testing frequency. For each contaminant regulated by a primary standard, the EPA has set a maximum contaminant level (MCL) which is the maximum permissible level of the contaminant allowed in drinking water. Secondary drinking water standards are also set by EPA. These standards regulate contaminants that may cause cosmetic effects such as tooth discoloration, or aesthetic effects such as taste, color, and odor. Secondary standards are recommended but not enforced by most states.

The SDWA requires water systems to be operated and maintained by certified operators and testing to be performed by a laboratory certified to conduct drinking water analyses. The state environmental program responsible for oversight of the SDWA grants all certifications and lists these laboratories on the state website. Make sure your water system is using a certified laboratory and operator.

Record Keeping – Per SDWA requirements, the following records must be kept at the water treatment facility offices. Work with your operator to ensure an appropriate filling system is in place.

- Copies of laboratory results, including the name of the person who collected the sample
- Dates and locations of where samples were collected
- Records of violations and specific steps taken to correct the violations
- Reports from state inspections (known as sanitary survey reports)
- All other water quality information and/or operator's logs

Mission Statement

Why are you sitting around a table with a few other concerned people making decisions about your community's drinking water? Because you all have an interest in *providing high-quality, affordable, plentiful and dependable drinking*

water, that meets or exceeds state and federal standards for quality and quantity to all customers. This is an example of a mission statement, which simply states the organization's purpose and mission.

If a mission statement does not already exist, the governing board should create one. The mission statement will serve as a guidepost for future decisions. For example, what if there is a choice between installing a new state-of-the-art SCADA (remote control) system and a project designed to improve water pressure in a part of the system where it is inadequate. A clear mission statement can be a guide toward making the right choice by having made an earlier commitment to provide good quantity and quality water to all customers. Even though a SCADA might be a boon to the operator and an aid to monitoring the system, if the mission has not been fulfilled by serving all customers with the same level of basic services, then the choice may become clearer.

A good mission statement will guide your work, and that of future boards, by setting policy and direction to the endeavor of running the water system.

Section 2 – Communications

Image

Good communication is necessary for the public to understand that their funds are being used properly with regard to operation of the public water system. Communication also helps the board understand the public's concerns and perspective. Always relay the status and condition of the system through public meetings, public announcements, tours, open houses, word of mouth, bill stuffers, customer surveys, and newsletters. Do not make the mistake of assuring the public that all is well for years and then present a significant bond article and raising rates for financing a much needed major project.

One way to promote your system's good work is to use the media. Educate the local media about the system by submitting public information articles for publication on issues such as proper household waste disposal and water conservation, as well as problems with the system. Openness is essential.

Notices Required by Law

The Consumer Confidence Report, a federally required annual report that every community water system must prepare, is also an excellent way to inform the public.

Per the Safe Drinking Water Act, results from water quality tests and other information about the water system must be reported to customers by July 1st. The report must include the concentrations of detected contaminants, describe health concerns associated with the contaminants and outline problems encountered by the system. All definitions and explanations must be in plain, easy to understand language. Providing a well written CCR can assist your system in keeping customers informed and confident that their system is providing them with quality water and service. Ask your operator for a copy of last year's CCR and familiarize yourself with it. The CCR is also an excellent vehicle for the system to educate users about what is being done to correct any problems at the system.

Templates for preparing these reports can be obtained from states and water associations. EPA provides *Preparing Your Drinking Water Consumer Confidence Report* which can be downloaded from the EPA website, www.epa.gov/safewater/ccr/pdfs/guide_ccr_forwatersuppliers.pdf. Check with your state regulatory agency because many provide assistance for preparing the reports through local water associations. For more information, *Consumer Confidence Report Rule: A*

Quick Reference Guide can be downloaded from the EPA website, www.epa.gov/safewater/. Click on "Quick Links-Publications."

Be aware that the Safe Drinking Water Act Public Notification Rule requires water systems to notify consumers when specific regulations are violated and the following situations occur:

- Test results indicate that a contaminant is present at levels exceeding the maximum allowable level for that contaminant.
- The water system fails to provide required daily treatment or upgrade the water system to improve treatment as scheduled.
- The water system operator does not collect and analyze water samples or monitor water quality as required.
- The water system fails to use the appropriate methods and protocols for testing water samples.

Some notifications must be made within 24 hours. The rule was established to help ensure that consumers are always informed of a problem with the drinking water. Specific information must be included in each notice. How and when the notice must be delivered is based on the type and seriousness of the violation. Whenever the public must be notified, the best course of action is to contact your state agency. They have the experience and tools to help you effectively communicate with your consumers while meeting the rule requirements.

The rule designates three levels of public notification/violations. Tier 1 is the most serious and may result in fines, civil suits, or plant and distribution system improvements that could cost your water system thousands and in some cases millions of dollars. A Tier 1 violation occurs when there is or likely is an immediate threat to public health. Examples of Tier 1 conditions include boiling water to protect against bacteria and viruses in the water and the presence of nitrates/nitrites which pose a serious health threat to infants. The public must be notified within 24 hours by mail, newspaper, or broadcast. Tier 2 violations must be issued within 30 days by mail and are generally for failure to sample and test the water. Tier 3 is for lesser violations; notification is usually made annually by mail.

For more information, *The Public Notification Rule: A Quick Reference Guide* can be downloaded from the EPA website, www.epa.gov/safewater/pws/pn/guide.pdf. As mentioned earlier, state agencies prefer to work with you and many require that they approve the final public notice. State agencies can also provide you with template notifications. This is important because federal regulations require that specific health effects language be included. See the appendix for your state's contact information.

Responding to Customer Complaints

Be attentive to consumer complaints as they may indicate an underlying problem with the system. Communicating with customers and investigating complaints will improve the water utility's image and credibility. Without proper communication, the public may quickly begin to question whether or not there is good service and will correctly equate this to poor management. It is very important that all aspects of water utility service, including management, provide the highest quality service to the public.

The best way to address customer complaints is to prepare now, before you get one! Most, but not all complaints, are associated with a change in the water system and can be anticipated. Ask the operator to give the board and system staff advance notice of activities such as water main repairs, flushing, increasing chlorine dose, or when there is a significant change in water quality. These activities may result in taste, odor, or color problems. Main breaks and heavy rainfalls are other causes for immediate concern. Loss of pressure may occur during breaks or work on the distribution. A standard table outlining causes and solutions to common customer complaints should be shared with the staff responsible for answering complaints. In addition, consider using an auto dial phone system or bill stuffers to inform customers in advance of any changes. Be sure to let customers know when the event is expected, how long it might last, and what the customer should do in the meantime.

Emergencies

Consumers often fear the worst during a crisis. Public officials should remain calm and accurately relay the facts of the situation, whether it is loss of water or public notification to boil the water due to bacteria. Avoid rumors or speculation and try to convey that public safety is of utmost importance to the utility. Emergency communication policies and procedures should be stated in an Emergency Response Plan (ERP). To avoid conflicting information and confusion, the ERP should indicate the single person designated to release information to the public. The best rule of thumb is to be quick and honest. Advise users of the problem, what is being done to address it and what precautions to take.

Section 3 - Board Operations

Regular meetings of a governing board are necessary to ensure that problems are addressed in a timely manner and that communications between the board and the operator are maintained. Having regular meetings also helps to keep communications open with your customers.

Agendas, Minutes & Records

A written agenda should be distributed to all members several days in advance of a regularly scheduled meeting. Having an agenda allows each member to come prepared to discuss all topics. This is vital to running an effective meeting.

Minutes must be taken at each meeting and include all topics and motions that arise during the meeting. Minutes should include at least the following minimal information. State and local regulations may require additional items.

- all members present
- all other active participants at the meeting (those who spoke during the meeting)
- all motions, proposals and resolutions made, offered and considered
- the results of any votes, with a record of the individual vote of each member if a roll call is taken

Remember that meeting minutes are the official record of board decisions. In case of litigation or personnel grievances, these are the records of the board's actions. The few minutes it takes to review, compare, and confirm the minutes with your notes and/or memory is a necessary part of the job.

Most water system records are considered public information. Personnel files and information that is confidential due to security concerns are not public information. Customers have the right to inspect public water system records and copies of the records must be provided on demand. Each state has unique "Public Information" laws that dictate what records are deemed public information so it is advisable to be aware of your state's requirements.

Notification & Open Meeting Laws

Notification of meetings is required for all publicly owned water systems. Boards of privately-owned water systems (including larger systems and small home owners associations) should check the by-laws of the organization to determine if meetings must be notified, and how. Even if notification is not required, the board should let customers know about meetings and include an agenda. Check your state and federal regulations along with municipal or private by-laws to determine requirements for annual, monthly, or special meetings.

All states have an "open meeting law" also known as a "Sunshine Law." The law generally states that if a quorum of a membership of a public body convenes to discuss or act upon a matter over which the body has authority, it is considered a public meeting, and must conform to the law. Although it can be frustrating and may seem inefficient, conducting public business in the open is the most effective way of encouraging public interest, awareness, and support. The law makes exceptions for chance meetings and social gatherings. The rule of thumb is that public business should only be conducted in public, not in a closed setting. However, some exceptions are made and non-public meetings may be held to discuss issues such as:

- Personnel issues (hiring-firing, promotion, discipline, compensation)
- Any matter relating to someone's reputation
- Real estate negotiations
- Security related issue
- Pending litigation
- Emergency planning

Almost all Sunshine Laws require advance notice to the public for specific meeting types. The minimum notice time is usually 72 hours. Some laws also describe how the announcement should be delivered (newspaper, etc.). Violating a Sunshine Law is a serious offence and may result in criminal or civil penalties.

Participation & Solving Problems

Without high quality participation by members of the board, the board won't be able to make sound decisions. Members should be ready to participate in meetings, keeping the following ground rules in mind:

DO

- Read agendas and prepare prior to the meeting
- Participate in discussions
- Help with time management
- Stay focused
- Take by-laws seriously
- Vote thoughtfully
- Keep board business confidential
- Review draft meeting minutes and comment

DON'T

- Come to a meeting unprepared
- Arrive late and/or leave early
- Distract others
- Ignore by-laws
- Put down other board members or staff
- Gossip about board business

It's not easy to bring a bothersome behavior to someone's attention, especially if you've developed a bond, by virtue of being on the board together. However, the board functions best when all members behave in a civilized and polite manner. The job of the board is to see that the mission statement is carried out. To do this everyone has to work together. Below are several common problems and suggested solutions.

- Inconsistent Meeting Attendance – Adopt a bylaw stating that more than three unexcused absences in a year constitute a resignation.

- Being Unprepared – Board members inform the offender that lack of preparation creates a burden on the process by wasting valuable time.

- Put-downs, Wisecracks & Distractions – Chair person stops the behavior as it happens and refocuses attention on the agenda.

- Dominating Personality – Chair thanks the dominator for their opinion, and then solicits opinions from others. Later when alone, the Chair alerts the person that everyone must have the opportunity to speak.

- Unethical Behavior – Address as soon as the slightest hint of this behavior occurs. Review the by-laws annually and discuss conflicts of interest; encourage abstaining from votes where there is a potential conflict of interest.

- Conflicting Opinions – Disagree diplomatically (Examples: I hear and respect your opinion. I don't agree, but value your opinion.) Reach or create a compromise. Seek more information and ask additional questions. Communicate and seek a win-win solution.

- Confidentiality – Confidentiality is difficult, because it takes self-discipline. The line between natural pride in the work of the system, and talking about plans and achievements, and giving up information that should not be discussed is easily crossed during normal conversation. Breaking confidentiality is often viewed as a break in trust. Since trust is basic to building a team, it follows that breaking confidentiality can quickly lead to breaking up the team and must be addressed immediately. Do not wait.

Board Organization

Many boards consist of members and officers (president/chairperson, vice president/chairperson, secretary, and treasurer). All members are vital to the board. Each provides support to the others and employees of the water system. In addition, officers serve the following functions.

President or Chairperson:

- Ensures that the board is carrying out duties that are mandated by law or board policy

- Facilitates meetings to keep them on schedule and on task

- Ensures that the board's business gets done between meetings

- Appoints board members to committees to accomplish the work of the board

- Acts as the liaison between the board and the facility manager or operator

- Fosters a spirit of teamwork among the board's members

Vice President or Vice Chairperson: Serves in the absence of the president and must be knowledgeable of the president's duties.

Secretary or Clerk: Takes minutes and is responsible for maintaining historical documents for the board including paperwork and other records.

Treasurer: Oversees the financial aspects of the board's work, ensures accurate financial recordkeeping, sees that an annual audit is performed, assists in the preparation of the budget, and interprets financial reports.

Committees can be formed to explore issues such as project planning. Often, a committee meeting on a special issue can get more work done than the full board that meets to discuss many issues. If a committee is formed, make sure to define goals, deadlines, and responsibilities up front. Using constituents in addition to board members on committees can have very positive results, especially in terms of gaining public support for infrastructure improvement projects. And, committees can serve as training grounds for good potential members who otherwise might view board membership as beyond their abilities and commitment level.

Section 4 - Working With Your Operator

Roles

The board guides and sets the direction for the utility, while the operator conducts the day-to-day operations. Working together, the board should be able to strike a balance between taking little or no interest in running the water system (hire an operator, and that's that!), and becoming too involved in the operator's day-to-day activities.

Your operator is the board's greatest asset since he or she is key to maintaining a safe and reliable drinking water supply. The operator is licensed by the state and trained to understand all aspects of water system operation. The health and safety of your community as well as the operator's license are at risk if the water system is not in compliance with regulations.

Financial and managerial oversight, planning, and policy setting are traditionally functions of the board. However, the board should seek the operator's advice regarding user rate adjustments and building capital improvement funds in order to maintain financial stability. Remember, approval of an annual budget is the board's responsibility; spending within the approved budget is the operator's responsibility. It may be helpful to create a written document clearly outlining the responsibilities of the board and operator.

Expectations

The board relies on the operator to run the system properly and to keep the board informed of issues present and projected. The board should expect regular written reports from the operator on the condition of the system. He or she should keep the board informed of equipment replacement, preventative maintenance, system expansion, and/or facility upgrade needs. The operator should also provide the board with copies of monthly water quality reports and lab results. The board should be immediately informed of regulatory violations or emergency situations. Any unusual occurrences, such as a power spike, a drift in power usage, or a repair, should be reported and reviewed with the board. This information is useful to the board for one of its prime duties: planning for future needs.

To ensure continuous communication, the board should hold regular meetings with the operator to discuss new regulations, compliance monitoring results, system performance, and customer complaints. Input from the public about such matters as water quality, water pressure, taste and color, as well as any problems that might be due to treatment processes should be available in writing

to board members for their attention. The operator should notify the board and staff well in advance of any maintenance or treatment changes that could result in customer complaints.

Supporting and encouraging the operator to communicate may be one of the most important roles of the board. If an operator is discouraged from bringing "bad news" to the board, it may lead to a cover-up of non-compliance and customer complaints. This can lead to loss of consumer confidence and regulatory action that can be more costly than if the issue were corrected earlier.

Hiring an Operator

Before advertising for an operator, prepare a detailed job description. The description should include the responsibilities and expectations of the position, the work schedule, minimum qualifications, system size, and any physical requirements. The board should also be familiar with the municipalities established Personnel Policy and Procedures Manual which outlines policies and benefits affecting the operator.

To attract a good operator, compensation must be adequate. Experience shows that a well paid, competent employee is more affordable than a poorly paid incompetent employee. Fines, asset damage, and loss of consumer confidence in the water quality may more than offset the difference. Good compensation may also include training and advancement opportunities. Talk with other systems of similar size and complexity to determine a relative baseline compensation for your system's operator.

Boards should consider securing an additional/back-up certified operator for emergency purposes (e.g. if the primary operator gets sick, is on vacation or is otherwise unavailable).

Owners of small water systems might consider the benefits and simplicity of hiring a firm that offers the part-time services of a professional certified operator on a contractual basis. As part of this consideration, it is suggested that as many firms as possible be contacted to discuss different levels of service and cost. Some states maintain lists of state certified contract operators. Check the state specific contact information pages in the Appendices for more information.

Operator Duties

Whether hiring a permanent or contract operator, these are the duties he or she should be expected to perform.

1. Conduct routine inspections of the water system in accordance with regulations and standard operating procedures.

2. Oversee operation and maintenance to maintain the safety and reliability of water service by ensuring that repairs and improvements are performed properly and in a timely manner, or, in the alternative, notifying the board of the need for such repairs and improvements.

3. Be knowledgeable in all operational aspects of the water system.

4. Have supervisory authority, including supervision of operating personnel, where applicable.

5. Oversee all chemical monitoring, bacterial monitoring, and other monitoring required in accordance with regulations.

6. Attend any site visits and inspections conducted by state personnel.

7. Oversee wellhead protection, watershed protection, and other activities associated with chemical monitoring waivers or otherwise required by regulations.

8. Conduct all reporting necessary in order for the water system to comply with regulations.

9. Keep complete and accurate water system records as indicated in regulations.

10. Communicate any regulatory or non-compliance issues to the board and owner.

Budgeting

Planning and budgeting are essential functions of any board. Budgets are plans using dollar values. Budgets should be based on meeting the needs of the water system (both long and short-term), not on keeping water rates low. The board should prepare an annual budget. In fact, many lenders require the submission of an annual budget and cash-flow projections for each fiscal year. Projected planning budgets, or budgets that predict future revenues and expenses can be developed for any time period: three years, five years, ten years, or whatever span of time makes the most sense to your board. Once the budget has been set, the rate structure should be reviewed annually and adjusted to meet the budget.

Prior to generating a new budget, the budget for the previous year should be reviewed and analyzed. To budget effectively, you should understand the amounts and the reasons for each expenditure from the previous year, the future needs of your system and what they will cost (e.g. new treatment equipment, distribution mains), and how to prioritize projected needs given available revenues. Using this annual review, the board can plan for the future by adjusting expenditures or revenues.

In summary, five main financial areas should be examined when generating a new budget:

- loan payments and debt-service reserve required by your lenders
- financial reserves required by your system
- the full cost of operating your system
- system revenue from water sales
- adjusting your revenue to cover your anticipated expenses

Think about how an increase or decrease in your service area would affect your system's financial stability. Make sure to consider economic trends and employment levels in your service area. Examine trends related to the cost of materials and services. Consider whether your system should focus on paying off debt or on expansion and upgrading treatment or both. Take into account

costs that cannot be controlled, and minimize expenses as much as possible. For instance, petroleum costs might be fluctuating. That's a cost you can't control. But using plastic pipe, which is manufactured using petroleum, for replacement or repair might be purchased when the cost of petroleum is down. That's a cost you can control.

Table 1 contains examples of typical line items that might be included in a water utility budget. The example annual budget in Table 2 illustrates typical small water system expenses. In order to break even and remain solvent, the system must collect enough revenue through water billing, etc. to cover the annual expenses outlined in the budget. Note that the capital improvement fund is included as an expense. This is in recognition that components are in the process of wearing down during any given year, incurring an expense.

Budgeting should be a team activity in which the board maintains an ongoing dialogue with the person who is responsible for keeping the books. Regularly scheduled board meetings should include a review of expenditures and revenues, and how the actual numbers compare to the budget. This includes monitoring the cash flow and considering adjusting the billing period if it is a problem (more frequent billing smoothes out case flow). Monthly review of the water system's finances is recommended.

It is also a good idea to set up a system of checks and balances, such as requiring internal controls on how money is collected and spent. An external audit may also be wise for some larger systems.

Several staff should be involved with internal financial controls.

- One staff person (or board member) might be charged with receiving and recording payments, and another with verifying that all items received are recorded.
- A second staff person could prepare deposit slips.
- A third staff person could record the amount in the accounting system, and verify that the deposit was made.
- A fourth staff person could be charged with reconciling the bank statement by verifying that the bank statement matches the deposits that were made.

Likewise, expenditures can be handled so that one person writes checks, while another signs them, and yet another does the bank statement reconciliation. This system may sound like over-kill, but with a clerk/secretary, and a well-managed staff and board, it is possible to implement some control.

Table 1 - Major Parts of a Water Utility Budget

Revenues	
Residential	Charities
Commercial	Fire Protection
Agricultural	Hydrant maintenance
Industrial	Refill Fire Truck Pumper
Wholesale	Connections and other fees
Public Authorities	
Reserves	
Depreciation	Capital Improvement
Interest Income	Contingency
Debt Service Payments	
Long Term Debt Escrow	
Taxes	
Payroll Tax	Sales Tax
State Tax	
Expenses	
Payroll	
Operator (primary)	Trustee Fees
Operator (backup)	Outside Contractors
Administration	
General Expenses	
Legal	Memberships
Accounting (audit fees)	Training
Office Lease/Rent	Transportation
Newspaper Notices	Licenses
Postage (PO Box & Stamps)	Operating Permits
Water Testing – Lab Fees	
Utilities	
Electrical	Cell
Heating	Pager
Phone	
Insurance	
Workman's Comp	Bond
Liability	Property
Director/Officer Policy	
Operation and Maintenance	
Water Treatment Chemicals	Repair Work
Hardware	Instrument Calibration
Repair Parts	Special Services
Material Supplies – charts/pens	Leak Detection
Plowing & Grading	Well Screen Cleaning
Equipment Rental	Engineering Services

Table 2 - Small Water System Annual Budget (using a volunteer operator)

Expense Items	
Administration (F) – salaries, auditor fee, etc.	$1,700
Postage (F) – billing, annual report, public notices	$400
Insurance (F) – structure/equipment, workers compensation	$500
Permit to Operate (F)	$200
Licenses (F)	$100
Memberships (F)	$100
Operator Certification Training (F)	$800
Source Operation (V) – electricity, fuel for generator	$3,600
Compliance Testing (V) – bacteria, lead/copper, nitrate/nitrite, other	$900
Water Treatment (V) – chlorine, miscellaneous supplies, maintenance	$2,000
Distribution System (F) – valve exercising, hydrant flushing, tank cleaning	$1,000
Meter Reading (F)	$1,500
Services (F) – leak detection, snow plowing, lawn cutting	$1,248
Supplies (V)- cleaning, paint, fuel for vehicles	$300
Subtotal Operating Expenses	$14,348
Debt Repayment (F)	$44,000
Capital Improvement Fund (F) (reserves)	$8,500
Grand Total Expenses	**$66,648**
F= Fixed cost = $60,048 (total)	
V = Variable cost = $6,800 (total)	

As part of the annual budget process, board members should conduct a brief "financial health" check. This simple calculation can provide you with a basic idea of whether your revenue adequately covers the cost of your operations and debt.

Ratios to Access Financial Health

Operating Ratio

= Revenue divided by Expenses
= $70,060/$66,848
= 1.04

If greater than one, the system is in adequate to good financial health.
If less than one, the system needs more revenue to cover operations.

Debt Service Coverage Ratio

= (Annual Gross Revenue minus operation and maintenance) divided by Annual Loan Principle and Interest Charges)
= ($70,060-$14,348)/$44,000
= 1.26

1.5 or greater is very good.
1.0 to 1.5 is acceptable.
Less than 1.0 means there is inadequate revenue to cover debt service.

Reserves

Equipment wears out or breaks, treatment systems require upgrading, and emergencies happen. For these reasons, your system should have financial reserves. Reserves are cash that is set aside in a separate account and used for emergencies (rainy day fund), capital improvements, or used as buffers against rate increases in times of community stress. There are several steps you can take to determine just how much you need to keep in reserves. Work with your operator to determine the lifespan of the equipment in your facilities and the costs of repairing it. Review what emergencies took place during the past two years and the costs associated with resolving the emergencies. Estimate the cost of future upgrades and expansion that the board has committed to, and decide how much of that cost will be paid for out of the reserves and how much will be financed with loans or bonds. This kind of forward-thinking planning and budgeting is crucial to the long-term sustainability of the water utility operation.

In addition to the principal and interest you must pay on loans, lenders often require that you open a separate cash account referred to as a debt-service reserve. Maintaining a debt-service reserve is sometimes mandated by state statute. It ensures that you can make your loan payments on time even if an emergency occurs. Frequently, the amount of this reserve will be set at one year of principal and interest payments. Most lenders forbid withdrawals or transfers from a debt-service reserve account without prior approval by the lenders. So debt-service reserve is known as a "restricted" cash asset.

Setting Water Rates

Part of planning for a sustainable future is ensuring that your water rates support all functions of the water system operation, including establishment of a reserve fund. System expenditures change based on a variety of expenses such as utility costs, emergency repairs, etc.; and therefore, can be difficult to predict. Often, the only way to balance the budget is to raise rates. The rate setting process can be painful for boards who may take great pride in having the lowest rates around. This mind set often creates runaway spending problems that result in a significant rate increase at a future date. Though you might not want to ask customers for small increases each year or every couple of years, it is better than being faced with a huge rate increase due to mandated improvements or an emergency situation. In the long run, your customers will appreciate gradual increases and proper planning for their future needs.

Setting water rates requires an understanding of two equally important types of budgeted expenses, fixed and variable costs. Examples of fixed and variable costs are indicated in Table 2. Depending on the size of your water system and user types (mostly residential or mix of residential and commercial), the board will determine an appropriate rate structure for your community. Typical rate structures are described below.

Fixed Costs and Base Rate - Fixed costs are based on expenses incurred by the system regardless of the amount of water produced. Typical fixed costs include debt service (paying back loans), insurance, taxes, salaries, training, administrative costs, capital improvement (i.e. new distribution mains), and system maintenance. Users can be charged for fixed costs based upon the taxing authority of a community or as established in a water district's charter. A base rate is often charged to customers to cover fixed costs. Several examples of how to set a base rate are described in the following paragraphs.

Normally, fixed costs are allocated on a flat rate, based upon the size of the connection. Many small drinking water systems choose to treat every connection equally, resulting in a single flat rate for each connection to cover fixed costs. The larger-sized connections are typically commercial, requiring more water and a higher flow, and therefore, pay a higher flat rate.

If there are a wide variety of commercial users, it may be desirable to use a formula based upon the number of gallons used by each type of user. The following table lists typical anticipated demands for different users. Consider using this table, or contact your state agency for guidance on estimating water use by any given customer.

Another approach to developing a base rate is to perform a fixture-unit analysis on each connection. A fixture-unit calculation is usually based upon knowledge of numbers and types of fixtures in a facility. For example, the number of washing machines in a laundromat may indicate how much water is likely to be used.

Anticipated Demand

Type of Use	Design Flow gpd=gallons per day	Type of Use	Design Flow gpd=gallons per day
Single family home *(typically 3 bedrooms)* 150 gallons per day per bedroom	450 gpd	**Motel** *(typically 4 persons/per room)*	50 gpd *per person*
Recreational vacation home *(typically 3 bedrooms)* 150 gallons per day per bedroom	450 gpd	**School with gym and cafeteria**	25 gpd *per student*
Mobile homes *(typically 2 bedrooms)* 150 gallons per day per bedroom	300 gpd	**Factory** *(sanitary use only)*	20 gpd *per worker*
Apartment/Condominium	150 gpd *per bedroom*	**Restaurant**	40 gpd *per seat*
Efficiency apartment	225 gpd *per unit*	**Lounge**	20 gpd *per seat*
Campground (sewered)	90 gpd *per site*	**Office space**	15 gpd or 15 gpd/100 sq. ft.
Campground w/central comfort station	75 gpd *per site*		

It is also possible to cover fixed costs by calculating a rate based upon actual or historical water consumption, using water meter readings. Using this approach, customer's fixed base rates are directly proportional to water system demand, assuring that heavy water users pay their fair share of the fixed expenses needed to supply the water.

A final type of rate, often selected by small communities, is a "category type." For example, a single-family home could be a standard category. There could be any number of categories for users, including, commercial, industrial, municipal and residences of varying sizes. Often times, in this structure, a water system allows a reduced residential rate category for retired single persons or couples on a fixed income. Each category has an associated base rate to correspond with its projected use.

Clearly, it is important to have water rates that are fair and equitable. A base rate determined by actual or historical use, although most accurate, is complicated and difficult for the average residential user to understand. Usually small rural systems with mostly residential users prefer the flat rate to cover fixed costs, because it's easier to understand and relatively fair.

Variable Costs and Flow Rate - Variable costs are the actual expenses of providing water to the customers. Examples of variable costs include electricity, chemicals, and water testing. The amount charged to a customer to cover variable costs is optimally a function of a meter reading, although any of the previously described rate structures are often used. The most popular rate structure used to cover variable costs is referred to as the "flow rate" structure. This method is illustrated in the following example, where rate is based on the amount of water produced for customer use divided by the cost to produce that amount of water.

Example of Rate Structures & Fixed and Variable Costs to the Customer (for 200 customers)

A. Base Rate – Fixed Cost to Customers

Divide fixed expenses of $60,048 (from example budget table) by number of connections
= $60,048/200 connections
= $300.24 per year/per connection

B. Flow Rate – Variable Cost to Customers (based upon water use)

- System produces 45,000 gallons per day
- Multiply number of gallons used per day by the number of days water is used during the year

45,000 gallons of water produced per day x 365 days =
16,425,000 gallons per year minus 2,400,000 gallons (water allocated for hydrant flushing, etc. and not charged to customer)

= 14,025,000 gallons produced per year for customers

Then divide variable operating expenses (from example budget table) by gallons produced.
$6,800/14,025,000 (gallons produced per year)

= $0.00050 dollars per gallon or $0.50 per thousand gallons

Revenue from water production (amount charged to customers)
Multiply 14,025,000 (the gallons produced per year) by $0.50 per thousand gallons.

=$7,012.50

C.	**Other Revenue (income)**	
	Interest on Deposits	$700.00
	Hook-up Fees	$2,500.00
D.	**Total Revenue**	
	Fixed Charge	$60,048.00
	Variable Charge	$7,012.50
	Other Revenue	$3,200.00
Grand Total Water Revenue		**$70,260.50**
Grand Total Expenses		**$66,848.00**
Difference (to put in reserve fund, etc.)		**$3,412.50**

Total Cost per Connection

$300.24 per year
Plus $0.50 per 1,000 gallons consumed

Alternatively, a water system could charge each customer for a fixed amount of water on a quarterly or annual basis. Additional amounts of water beyond the fixed amount may be purchased based on meter readings and charged at an agreed upon rate (similar to the example). This can be a flat rate (price per each gallon), or a community may choose to adopt an increasing block rate. With an increasing block rate, customers are charged a higher price for increasing amounts of water; this rate structure is designed to discourage excess consumption. It is often used in communities where there is a limited amount of water at the source.

Some systems use other rate adjustments to adapt for individual needs. For example, a seasonal community might wish to adopt a different set of

rates for winter and summer. Systems may also sell water to other systems, towns, or customers, often referred to as "consecutive systems". Under these circumstances, an inter-municipal agreement may be a desirable legal solution to communities with regional issues. This sort of document, usually drawn up by an attorney, makes it possible for each water district's powers and rights to be protected, giving them a tool to design a legal management plan for their system.

Lost Water & Metering

Drinking water systems intend to sell the water they produce to their customers; water lost or otherwise unaccounted for drains system resources and revenues – and ultimately can threaten the sustainability of the operation. Some water systems sell water at a flat rate without metering. As water has become more valuable and metering technology has improved, more and more water systems in the U.S. meter their customers. Although all customers may be metered in a given utility, a fairly sizable portion of the water that most utilities produce does not pass through customer meters.

Unmetered water includes non-revenue uses, losses from accounting errors, malfunctioning distribution system controls, thefts, inaccurate meters or leaks. Some unauthorized uses may be identifiable. When they are not, these unauthorized uses constitute non-revenue water use. Some unmetered water is taken for authorized purposes, such as firefighting, flushing and blow-offs for improving water quality. These quantities are usually fairly small. The primary cause of unaccounted for water is often leaks.

Use the calculation below to determine how much water is lost in your system. Share this number with customers and other town officials to make a case for installing water meters and instituting leak detection programs.

Calculating Unaccounted for Water

Unaccounted for water is the difference between water produced (metered at the treatment plant) and metered use (i.e. sales plus non-revenue producing metered water). Unaccounted for water can be expressed in millions of gallons of water per day (MGD) but is usually discussed as a percentage of water production:

$$\text{Unaccounted for water} = \frac{(\text{production} - \text{metered use}) \times 100}{(\text{production})}$$

Importance of Meters - Any business must be able to determine how much of its product it is making and selling if that business is to be viable. Your water system is a business. The best way for a water utility to account for the water it produces and sells is to use meters.

Water meters are important to a utility for several reasons:

1. They make it possible to charge customers in proportion to the amount of water they use.

2. They allow the system to demonstrate accountability.

3. They are fair for all customers because they record specific usage.

4. They encourage customers to conserve water (especially compared to a flat-rate system).

5. They allow a utility to monitor the volume of finished water it puts out and compare that with the amount of water paid for by customers.

6. They aid in the detection of leaks and waterline breaks in the distribution system.

7. Modern water meters incorporate backflow prevention devices. These devices prevent dirty household water (i.e. sinks and toilets) from being pulled backwards into the water system during negative pressure events (i.e. fire fighting demand).

Section 6 – Planning for the Future

One of your most important duties as a board member is to plan for the water system's future needs. Operators are caught up in day to day operation of the water system, but don't have extra time for planning. They know what needs to be done right now, what should be done in the future, how much time it will take, and how much it could cost. It is up to you to work with the operator, and use his or her knowledge of the system to anticipate your system's needs. A safe and sustainable water source will help ensure the health and prosperity of your community. Planning for the future requires properly managing your assets, understanding how much water is being used, preparing for emergencies, protecting the water source from contamination, and ensuring active board participation.

Asset Management for Long-term Sustainability

Asset management is a planning process which helps to ensure that you get the most value from each of your assets and have the financial resources to rehabilitate and replace them when necessary. Asset management also includes developing a plan to reduce costs while increasing the efficiency and the reliability of your assets. Successful asset management depends on knowing all about your system's assets and regularly communicating with the operator about your system's future needs. Remember, asset management is a joint responsibility shared by both the board and the operator. The board needs it for planning rate increases and the operator needs it for scheduling and implementing system upgrades. Ultimately, increasing your knowledge of the water system, will allow you to make better financial decisions. You can use this knowledge to address future challenges such as meeting regulatory requirements or upgrading the water system. Some of the benefits of practicing asset management include:

- Reducing system "down-time" and the number of emergency repairs, since you will have planned for the replacement and rehabilitation of your assets.
- Prioritizing rehabilitation and replacement needs and providing time to research cost-effective alternatives.
- Showing investors and the public that you are using their money effectively and efficiently, which may make them more likely to increase investment or tolerate rate increases.

- Giving you greater access to financial assistance. Some funding sources give applicants extra credit (higher priority ratings) for having an asset management plan or a capital improvement plan.

Asset management consists of the following five steps:

1. **Taking an inventory.** Before you can manage your assets, you need to know what assets you have and what condition they are in (i.e. pumps, treatment equipment, distribution lines, storage tanks; include make, model, date of installation, and repair history). This information will help you schedule rehabilitations and replacements of your assets.

2. **Prioritizing your assets.** Your water system probably has a limited budget. Prioritizing your assets will ensure that you allocate funds for the rehabilitation or replacement of your most important assets when they have reached their expected life.

3. **Developing an asset management plan.** Planning for the rehabilitation and replacement of your assets includes estimating how much money you will need each year to maintain the operation of your system. This includes developing a budget and calculating your required reserves by obtaining replacement costs.

4. **Implementing your asset management plan.** Once you have determined how much money you need to set aside each year and how much additional funding (if any) you will need, work with your management, customers and regulators to carry out your plan. Gain support for the plan through education and outreach, begin setting aside funds, and implement the repair schedule.

5. **Reviewing and revising your asset management plan.** Once you have developed an asset management plan, do not stick it in a drawer and forget about it! Your asset management plan should be used to help you shape your operations. It is a flexible document that should evolve as you gain more information and as priorities shift. Costs will likely increase over time and some assets may exceed or fall short of the useful life expectancy; adjust the plan as necessary.

There are numerous resources available to assist you in getting started with asset management for the future sustainability of your water system, including resources such as EPA's Asset Management Handbook for Small Water Systems and EPA's Strategic Planning STEP Guide. These tools can give you a good idea of the challenges your system may face in the future and help you think about the most cost-effective and efficient way to address those challenges. Consulting

with your state regulatory agency and developing a plan of action with their assistance will ensure that you can continue to deliver safe and secure drinking water well into the future. For further information, please visit: www.epa.gov/safewater/smallsys/ssinfo.htm or visit EPA's Check-up Program for Small Systems website at http://www.epa.gov/cupss/.

Long Range Planning

It is important for boards to consider the long-term needs and growth potential for their community and water system. Long range planning requires a comprehensive look at the future sustainability of the water system. It combines asset management with an examination of whether a water system is financially capable of meeting projected needs. Long range plans should include:

- Description of existing conditions: How many connections are there; is the source ground or surface water; what type of treatment is required; how old is the system?
- Description of management structure: What are the roles and responsibilities of the board, management, and operators; what is the customer complaint policy?
- Cost of Operation and Maintenance: Include a 5 year budget and justification for expenditures; identify capital reserve fund; and describe need for user rates adjustments.
- Revenues: Where does the money come from and how much is coming in; how is the system funded?
- Growth and Modernization: Is the population growing or declining; is growth mainly residential or are there industrial and commercial needs too; are plant upgrades needed to meet regulations?
- Water Conservation Plan: Is the system efficient; is there a plan to determine leak detection and unaccounted for water; how is the community educated on conservation?

Leak Detection & Conservation

Leaking distribution systems can cost individual utilities thousands to hundreds of thousands of dollars in repairs and lost revenue annually. Not only are utilities losing money when treated water leaks out of the distribution lines before it reaches customers, constantly leaking distribution lines will inevitably increase costs for pumping, treatment and operating a system.

Old and poorly constructed pipelines, inadequate corrosion protection, poorly maintained valves, and mechanical damage are some of the factors that contribute to leakage. Leaks not only cause water loss, but they can also reduce pressure in the system.

Establishing a leak-detection program is an opportunity to improve drinking water services. Because it is a highly visible program, it can be the first part of a water-conservation program which encourages customers to think about water conservation before they are asked to reduce their own water use.

The economic benefits of leak detection and repair can be estimated easily. For an individual leak, the amount lost in a given period of time multiplied by the retail value of that water will provide a dollar amount. Remember to factor in the costs of developing new water supplies and other hidden costs. Some other potential benefits of leak detection and repair that are difficult to quantify include:

- increased knowledge about the distribution system, which can be used, for example, to respond more quickly to emergencies and to set priorities for replacement or rehabilitation programs
- more efficient use of existing supplies and delayed expansion of a system's capacity
- improved relations with both the public and a utility's employees
- improved environmental quality
- increased firefighting capabilities
- reduced property damage, reduced legal liability, and reduced insurance because of fewer water main breaks
- reduced risk of contamination

Undetected leaks, even small ones, can lead to the loss of large quantities of water because these leaks might exist for long periods of time.

Of course, detecting leaks is only the first step. Leak repair is the more costly step in the process. On average, the savings in water no longer lost to leakage outweigh the cost of leak detection and repair. In most systems, assuming detection is followed by repair, it is economical to completely survey the system every one to three years. Instead of repairing leaking mains, some argue it is preferable to replace more leak-prone (generally older) pipes. Selecting a strategy depends upon the frequency of leaks in a given pipe and the relative costs to replace and repair them.

Leak detection activities can be tied to other activities that can help optimize and manage the assets of the water system, including updating maps of the distribution system, hydrant inspections and pipe inspection/cleaning and other maintenance efforts.

Consumer conservation and leak detection are two examples of steps water systems can take to improve their overall water efficiency. By tracking water and using it wisely while still providing the same level of service to consumers, your water system can reduce overhead costs. Improving water effieciency reduces operation costs (e.g. pumping and treatment) and reduces the need to develop new supplies and expand water infrastructure. It also reduces withdrawls from limited resources, leaving more water for future use. More and more utilites are using water efficiency and consumer conservation programs to increase the sustainability of their supplies.

Other examples of how to improve water efficiency include accurate meter reading as well as conservation based water rates and public education programs. Metering helps to identify losses due to leakage and also provides the foundation on which to build an equitable rate structure to ensure adequate revenue to operate the system. One of the most effective ways to reduce demand for water is to establish rates that escalate as more water is used. And, consumers can reduce water use by installing water-efficient products or simply turning the water off while brushing teeth or running washing machines only when they are full. Water systems can promote these actions through consumer rebate and education programs. For free public education materials and guideance on water efficiency, consider joining EPA's WaterSense Program at http://www.epa.gov/watersense/.

Preparing for an Emergency

Proper emergency response planning is essential for keeping your community's water supply safe and secure during an actual emergency. States require water systems to develop an emergency response plan. Once the plan is prepared, officials and water system staff should conduct "table top exercises" to simulate emergencies and test the plan. Talk with your state environmental agency for more information about free exercises.

To help identify emergency situations that might occur at your system, a vulnerability assessment should be performed. This assessment will help determine the water system's susceptibility to failure during an adverse event (intentional or unintentional). An adverse event might include a terrorist attack, natural disaster, or any emergency caused by reasons beyond the control of

the water system. Any of these events might result in power outages, loss of water, damage to distribution mains, or contamination and substantially disrupt the ability of the system to provide safe and reliable water. At a minimum, an emergency response plan should include:

- Chain-of-command names and phone numbers
- Notification List
- Critical system components
- Potential emergency scenarios
- Alternate water source(s)
- Boil water information and notices
- Water conservation information
- Procedure for returning to normal operation

Knowing who to contact during an emergency is key to a successful outcome. Critical contact names and numbers should be recorded, updated, and kept in a location accessible to all. The plan should be reviewed annually and updated as needed.

Take these steps to prepare for, protect against, and respond to an emergency.

1. Prepare (or update) an emergency response plan. Make sure all employees receive training on the plan. Contact information for vulnerable customers (hospitals, schools, nursing homes – those facilities with infants, elderly, and immuncompromised) should be included in the plan.

2. In case of an emergency, first call "911" then follow your emergency response plan. If there was a possible crime, the area should not be disrupted until police arrive.

3. Install good lighting around the water source, facility, and parking lot.

4. Fence and lock the well cap and any buildings or structures that provide access to the water supply.

5. Prevent pouring or siphoning contaminants through well vent pipes by enclosing them in a lockable structure. If that isn't possible, fence them to prevent access.

6. Get to know your police and ask them to include the water system in their local rounds. Practice emergency response procedures with local police, emergency response and public health officials.

7. Updated emergency 24-hour numbers should be posted at the facility in highly visible areas and given to key personnel and local response officials.

8. Keep track of the type and amount of chemicals and fuels that are delivered and stored on site. During a spill, the amount released into the water supply can be determined with this information.

9. Install back-up power and determine if a generator should be installed. Many states require community water systems to install back-up power for critical equipment. Generators should be exercised on a regular basis.

10. Make sure you have funds for security upgrades and emergency response planning.

Protecting Your Water Source

Many land use activities can pollute a drinking water supply, so protecting the land around the water supply is the first line of defense against contamination. Identifying what the potential sources of contamination are in your area and eliminating those that you can control are the best ways to protect the water supply. For most water systems, protecting the source can be accomplished with a modest investment of staff time, and little to no expenses. Remember, the cost to clean-up and treat a contaminated drinking water source will be far more than taking these simple steps.

1. If the water system has not already adopted by-laws to protect and limit land uses around the water supply, work with other town officials to establish these important measures.

2. Dispose of hazardous chemicals and wastes properly never dumping them down drains, or on the property.

3. If the source is a well, make sure the area around the wellhead slopes away from it to keep surface runoff draining away from the well.

A map locating your drinking water source and the area around it which should be protected is available from your state agency. States were required to create these maps along with a list of potential contaminant sources located in the area. Your water system should update this information by documenting and mapping activities such as:

- Septic systems
- Landfills
- Underground fuel storage tanks (gas stations, etc.)

- Industries (dry cleaners, etc.)
- Animal waste sources (both wild and domestic livestock/pastures)
- Mining operations
- Potentials for spills of fuels or toxic wastes from industry or roadside accidents

You should talk with these facility owners about reducing the potential for spills or contamination. Simple behavioral changes, such as proper maintenance of an on-lot septic system, proper application of fertilizers, or taking waste oil to a recycling center will remove some threats. Conduct additional testing for associated contaminants if a threat exists. Talk with your state for more information; most states have exceptional public education programs and training opportunities to help water systems plan and implement source water protection programs.

Replacing Board Members

Just like you need to think about the long-term sustainability of the water system, the future of the board must be considered as well. Planning efforts should include a periodic assessment of the board members' status including their willingness to serve into the future and member term limits that might be up soon. As a board, you should always be thinking about recruiting new members. What kind of qualities should new members have? It's tempting to bring people on board who look, think, and act as you do, but this might not always be wise. Instead, look for traits such as:

- Commitment
- Understanding
- Experience
- Availability
- Tolerance for other people's views

Skills that are transferable might include experience as a business manager, financial officer or previous experience as a board member. People with technical skills, such as plumbers, fire fighters, or scientists bring a valuable perspective when decisions need to be made concerning water system technical needs. Consider recruiting members from existing committees which often serve as training grounds for good people who otherwise might view board membership as beyond their abilities and commitment level. Keep in mind that the board is a governing, planning, and policy making body where teamwork is key.

Section 7 - Treatment & Distribution

While you are not involved directly in the day-to-day operations of the public water supply, it is important that you understand some fundamental concepts in order to make informed decisions about treatment needs for your system.

This overview is general and might not provide all the details needed to describe your particular system. These basics are a good starting point; you are encouraged to talk with your certified operators to gain additional insight on how the system works.

Definition of a Public Water System

Across the United States, there are approximately 155,000 public water systems. According to the Environmental Protection Agency's definition, a public water system transports water that is safe for human consumption through a system of pipes to at least 15 connections, or to a place where 25 people or more are served water at least 60 days out of the year.

Depending on how many people are served and whether or not customers are served year round, a public water supplier can be defined in one of three ways:

- A community water system, which supplies water to the same population year-round
- A non-transient, non-community water system, which supplies water to the same 25 people at least six months out of a year
- A transient, non-community water system, which supplies water to 25 different people for 60 days or more per year (examples of this kind of system are restaurants, gas stations and similar places where people do not stay for long periods of time)

Your water system is classified as a community water system. Community water systems get their water from one of two possible sources (sometimes a combination): surface water or ground water. The majority of small water systems use ground water sources, while large metropolitan areas tend to use surface water sources.

Each of these sources has unique characteristics that require different treatment processes to make them safe for human consumption. Let's take a look at both types of sources and the processes used to treat them.

Groundwater Treatment

Groundwater is just what it sounds like: water that comes from the ground. Groundwater comes from rain, snow, sleet, and hail that soaks into the ground. The water moves down into the ground because of gravity, passing between particles of soil, sand, gravel, or rock until it reaches a depth where the ground is filled, or saturated, with water. The area that is filled with water is called the saturated zone, and the top of this zone is called the water table. The water table may be very near the ground's surface, or it may be hundreds of feet below.

Groundwater is naturally filtered to some extent when it passes through the earth to underground reservoirs called aquifers. This water typically does not contain as much organic material or microorganisms as surface water, so it requires less treatment.

Wells can vary greatly in depth, volume and quality. Well water may contain more minerals in solution than surface water and may require treatment to soften the water by removing minerals such as calcium, iron and manganese.

Small communities often get their water from wells large enough to support their populations. Wells are typically bored or drilled into underground aquifers to access the available groundwater. Electric submersible pumps, vertical turbine pumps, or other mechanical pumps draw the water to the surface, where it is treated and then provided to the community's residents through the distribution system.

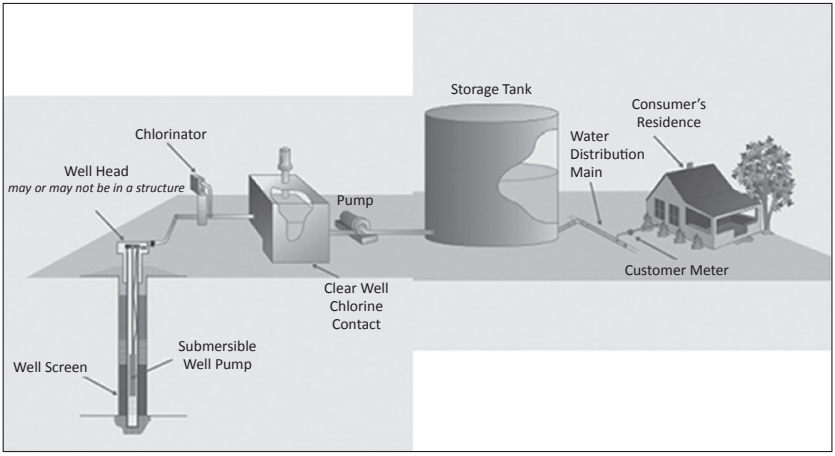
In small water systems, the role of pumping equipment is extremely critical. Because these systems are frequently constructed without back-up pumps, a single pump could fail and cause customers to be without water for an extended period of time. Additionally, small systems that use hydropneumatic tanks have very little stored water, and, therefore, a pump failure can result in customers being completely out of water within a matter of minutes.

Many groundwater systems require little treatment to make the water they produce safe for human consumption. These systems typically have few contaminants, low turbidity, and limited bacteria. Treatment usually consists of disinfection and pH adjustment. pH adjustment is important for preventing pipe corrosion if the water is too acidic. Adding a disinfectant ensures that almost all microorganisms that may be in the water or the distribution system are killed before the water reaches customers.

Turbidity, microorganisms, and contaminants can all affect groundwater systems. If a groundwater system has contaminants, such as arsenic, nitrates, nitrites, or chromium, its operators must take precautions to protect the health of people who drink the water. These contaminants might be naturally occurring, enter the water through contaminated runoff from surrounding agricultural sites or other

businesses or industries, or originate from sources that cannot be pinpointed. In any case, the best available drinking water treatment technologies must be employed to remove these contaminants and meet the Safe Drinking Water Act regulations.

Typical Groundwater Treatment System



Source: National Environmental Services Center

Surface Water Treatment

Because it is directly subject to contamination from storm run-off and fecal contamination from wildlife, surface water requires complex treatment to make it safe for drinking. The first challenge is getting it into the treatment plant.

Surface water enters the treatment facility through an intake. An intake draws raw water (untreated water) through a suction line that typically has a screen or other device attached to avoid drawing in fish, other wildlife, and garbage. Intakes can be fixed in place or be adjustable to draw raw water in at different levels from the river, stream, lake, or reservoir. This sometimes provides for a better quality or quantity of water at different times of the year. A raw water pump, located near the source water, may be used. In some cases, drinking water systems can use gravity to get the raw water into the treatment plant. This is true if the raw water source is higher than the treatment plant.

Pre-settlement is necessary if the raw water is very turbid or contains contaminants that need time to settle. Most drinking water systems use either earthen or concrete basins for pre-settlement. The raw water is pumped or gravity-fed to the basin. While in the basin, the water is allowed to sit so that

solids can sink to the bottom of the basin. Then water that is close to the surface, usually just a few inches below the top of the basin, is pumped, or gravity is used to get the water to the next step in the treatment system.

Adding chemicals to raw water at or before the start of the treatment process is called pre-treatment. Chlorine or potassium permanganate is sometimes added at the beginning of treatment to oxidize contaminants in the source water. Oxidation of certain inorganic contaminants (e.g., metals) will cause them to come out of solution and form solids that can settle or be removed by filtration.

If the water is acidic, the pH (a measure of acidity) can be adjusted using chemicals, such as soda ash, lime, and caustic soda, among others. Adjusting the pH helps prevent corrosion in the distribution lines and aids in the coagulation process.

When the pre-treatment chemicals are added, they should be thoroughly mixed with the raw water. Proper mixing of the chemicals can speed the process and even reduce the amount of chemicals used and, in the long run, save money. Static mixers or flash chambers are used for mixing pre-treatment chemicals.

Coagulation

Chemicals called "coagulants" are added to raw or pre-treated water to help clarify the water. When the water and chemicals are rapidly mixed, the coagulation process begins. Coagulation causes organics and other particulates in the water to combine. When particulates combine, they are more easily removed from the treated water because they become heavier and sink or settle to the bottom of the tank or basin. This action allows the cleaner water on the surface to move on to the next step in the treatment plant.

Factors that affect the coagulation process include temperature, pH, alkalinity (a measure of a solution's ability to neutralize acids), mixing of the chemicals, the type of chemical, and turbidity levels.

Flocculation

When the coagulant is added, the smaller particles stick together during rapid mixing and then form bigger particles called "floc." In the flocculation process, water flows into a tank or tanks with paddles that provide slow mixing of the coagulant chemicals. This brings small particles together to form larger particles or clumps. If the mixing is too fast, the flocs will break apart into small particles that are difficult to remove by settling or filtering.

Sedimentation

After the particles have "flocked" together, they need a place to "settle out" or sink to the bottom of the tank or basin. The key factors in good sedimentation

are surface area, time, calm water, and a way to remove the sedimentation once it has sunk to the bottom of the tank or basin.

The larger the area of the tank, the calmer the water, and the more time for the process, the better the sedimentation. The tank or basin must be deep enough for the sedimentation process. Water should enter the sedimentation basin as slowly as possible. Keeping the water calm ensures that the particles settle faster. Baffling or curtain walls can help keep the water calm. Time can be extended with baffling or curtain walls that make the flow zigzag from one end of the treatment basin to the other. If the line of flow is too straight and short, it could short-circuit the flow path. Consequently, the flocculation and sedimentation process will be disrupted.

Once the sediment sinks to the bottom of the tank, it has to be removed or it will build up and cause problems in the next step of the treatment process. Some sediment basins have cone-shaped bottoms where the sediment is collected. Others have bottoms that slope to one end or have squeegee baffles that very slowly scrape the bottom, collecting the sediment at one end.

The sediment is then pumped out into a sludge basin, or, if the water treatment plant is connected to a city sewer system, it's pumped into the sewer system. Some plants without automated sediment collection must periodically drain the sedimentation basin and manually clean it out. Even some automated plants should be drained and cleaned occasionally.

Direct filtration

After sedimentation, filtration is generally the next step. However, some systems use direct filtration, meaning that the raw water goes straight to the filters, bypassing coagulation, flocculation, and sedimentation. If the raw water, either groundwater or surface water, is good quality (it has low turbidity and few, if any, other contaminants, even during storm events or seasonal changes), then filtration may be the only treatment the water needs, aside from disinfection.

Filtration

Federal and state laws require surface water systems to filter their water to remove contaminants that didn't settle out during coagulation, flocculation, and sedimentation processes. Filtration simply means passing the water through a permeable fabric or a bed of porous material, such as sand, that collects, catches, or gathers suspended solids from an incoming flow. Filtration methods include slow and rapid sand filtration, pressure vessel filters, membrane filtration, cartridge filtration, bag filtration, and diatomaceous earth filtration.

When the filter's pores become clogged, they need to be cleaned. This typically involves a backwash, which is reversing the flow and increasing the speed at

which water passes back through the filter. This, in effect, blasts the clogged particles off and out of the filter. Although every filter is unique, the principles of backwashing are similar for all filters except slow sand filters, in which the top few inches are periodically skimmed off.

Sludge disposal

Most surface water systems and some groundwater systems have to deal with sludge disposal. The sludge comes from all of the particulates that settle in the sedimentation basins and are caught from the filters when backwashed.

The sludge that remains in the backwash or sludge basin after decanting will eventually have to be pumped out and either hauled to a landfill or to a sewage treatment plant for proper disposal. Most states do not allow land application of sludge from a drinking water plant because of possible heavy metals and other concentrated contaminants.

Disinfection & Chemical Treatment

Disinfection

Disinfection is the process of destroying a large portion of microorganisms in drinking water with the probability that pathogenic (disease-causing) organisms are killed in the process.

Chlorine is the most common chemical used for disinfection. It is typically used in either liquid (sodium hypochlorite solution or a solution made from calcium hypochlorite powder) or gaseous form. The liquid form is supplied to the water by a hypochlorination system. Hypochlorination is the most common means of disinfection for small water systems.

Other disinfectant products may be used, such as chloramines, ozone, or ultraviolet light.

Chloramines form when chlorine is added to water that contains ammonia or when ammonia is added to water that contains chlorine (hypochlorite or hypochlorous acid). Chloramines are sometimes used in low concentrations as a disinfectant in municipal water distribution systems because they are much more stable than chlorine. It is also believed that chloramines are less likely to produce regulated contaminants known as disinfection byproducts, (e.g. chloroform), although there are still small amounts produced. In addition, chloramines do not have a chlorine aftertaste.

Ozone is a powerful oxidizing and disinfecting agent. Many municipal drinking water systems use ozone to kill bacteria instead of the more common chlorine because it has a very high oxidation potential. Ozone does not form chlorinated disinfection byproducts, which are toxic, but ozone can form a toxic disinfection byproduct when the raw water contains bromine. Ozone does not remain in the water after treatment (i.e. leave a residual). Drinking water regulations mandate that all surface water systems must maintain a disinfectant residual in the distribution system; therefore, those systems apply chlorine or chloramines after filtration.

Ultraviolet light radiation can be used to disinfect. The ultraviolet light is generated by a special lamp. When it penetrates the cell wall of an organism, the cell's genetic material is disrupted, and the cell is unable to reproduce. As with ozone, a disinfectant residual is needed to maintain a safe barrier against any contaminants in the distribution system. Again, this residual is usually achieved with chlorine or chloramines.

Other Chemical Applications

Activated carbon, although technically not a chemical, might be used to control taste and odor problems. It is typically added in granular form to the sediment basin or on top of the filters. The contaminants are adsorbed onto the activated carbon.

Fluoride is often added at the end of the treatment process to reduce tooth decay in their customers. Fluoridation does not affect the appearance, taste or smell of drinking water. It is normally accomplished by adding one of three compounds to the water: sodium fluoride, fluorosilicic acid, or sodium fluorosilicate. Fluoride can occur naturally in some groundwater systems, and if higher than recommended levels, should be reduced.

Sodium hydroxide or other chemicals are often added before the finished or treated water enters the distribution system to restore the water to a safe pH range and to prevent it from being corrosive.

Phosphates or other chemicals might be added to groundwaters with iron or manganese as sequestering agents to prevent "red" (from iron) and "black" (from manganese) water. In simple terms, to sequester a mineral or molecule is to keep it in suspension. However, the ultimate result is that the sequestered compound or molecule is made unavailable to interact with the surrounding environment.

<u>Distribution & Maintaining Good Water Quality</u>

After the water has been through the treatment process, it is safe for human consumption. But until the treated water reaches the people who need it, the

job isn't done. A water distribution system transports water from the treatment facility to customers' homes. The distribution system, which includes pumps, storage tanks, and miles of buried pipe, should supply adequate quantities of water that's under sufficient pressure without impairing its quality.

Clear wells

After treatment, the water goes to a clear well, which is really just a storage tank. The clear well is usually at the plant, but at some systems, it could be the first or *only* storage tank in the distribution system. Drinking water systems use the clear well for disinfection (usually chlorine) contact time. Contact time gives the disinfectant time to kill any microorganisms that may have made it through the treatment process. Also, drinking water systems often use the clear well to store water that will be used to backwash the filters.

Pumps

Unless the water treatment plant is located entirely uphill from the community it serves—thus making it possible for the system to supply water via gravity— it will have to pump water to its customers. Pumps are an important part of any water distribution system because they discharge pressurized water to the pipe network or lift it to places it cannot go by gravity, especially to water towers.

Electricity used for running pumps is one of the most significant expenses that water systems incur. Proper sizing of pumps to conserve electricity is very important to good financial management.

Storage Tanks

After water leaves the treatment plant, it must be adequately and safely stored. The water distribution system should have enough storage capacity to meet all expected needs. Storage tanks:

- provide a reserve of treated water that will minimize interruptions in supply due to failures of mains, pumps, or other plant equipment
- help maintain uniform pressure
- provide a reserve of water for firefighting and other emergencies
- act as a relief valve on a system of mains supplied by pumping
- permit a reduction in the size of distribution mains below that which would be required in the absence of a reservoir
- allow pumping at the average rather than peak-flow rate

Daily use of stored water varies. Water use is greatest in the mid-morning and early-evening hours. Stored water is withdrawn during these peak demand hours of the day and is replenished during minimum-demand times in the late-night and early-morning hours.

Pipes

A drinking water system's distribution network can be made up of many different kinds of materials. The diameter of the distribution pipelines can range from as small as 3/4 inch for service lines to 6 feet or bigger for transmission or raw water lines. The materials that water lines are made of include:

- cast iron
- ductile iron
- steel (plain, galvanized and even stainless)
- polyvinyl chloride (PVC)
- high-density polyethylene (HDPE)
- reinforced concrete
- concrete truss pipe (a composite plastic and concrete)
- copper
- asbestos cement
- lead (no longer used for current water line installations but could be in use in the distribution system)
- wood—was used in very early times

Once water lines have been installed, it is important to keep track of them using an accurate set of as-built drawings. "As-built" drawings represent changes from the design stage to the construction stage due to unforeseen events, such as other underground utilities that weren't accounted for or right-of-way issues with surrounding landowners. The as-built drawings should reflect all of these changes.

Over the last 20 years, many systems have opted to put tracer wire or magnetic location tape on the pipes to make them easier to locate. When used in conjunction with an electronic pipe finder, these make the job of finding distribution lines much easier. In fact, some of these electronic locaters will work on metallic pipe without tracer wire or magnetic tape.

Maintenance & Flushing

Maintaining the distribution system is important to keep drinking water quality at its best. Flushing the distribution system at least twice a year and line scouring every few years are two of the best ways to keep the system clean. Flushing the system helps keep sediment and biofilms down and remove stagnant water, which can affect taste and bacteria levels. The flushing should start at the source (plant, master meter) and work out in a radial pattern.

Drinking water systems can use a variety of pipeline-cleaning techniques, including mechanical scraping, pigging, swabbing, chemical cleaning, and flow jetting.

Other maintenance activities that utilities can use to minimize water quality degradation include:

- Preventing and eliminating cross connections
- Covering and venting storage tanks
- Maintaining an adequate separation from sewers
- Enforcing applicable plumbing codes

Water Quality in the Distribution System

A drinking water system's water quality must be acceptable when the water leaves the treatment plant; however, a variety of transformations can happen after the water enters and travels through a distribution system. Water producers need to understand the causes of water quality degradation during the distribution process; in addition to taste and odor problems that can occur, research suggests that degraded water quality can increase the risk of gastrointestinal illnesses.

A distribution system's pipes and storage equipment constitute a complex network of uncontrolled physical, chemical and biological reactors that can produce significant variations in water quality. The principle factors that affect water degradation during distribution are the system's structure, its operation and a number of water quality factors.

Historically, water system designers tended to create oversized pipelines and storage equipment. While system designers may have been planning for future growth in a region when doing this, oversized equipment results in long detention times, loss of chlorine residual, taste and odor concerns and other water quality problems. Furthermore, some of the materials designers choose to install in distribution systems create favorable environments for growth of microorganisms. In addition, microorganisms settle on pipe surfaces and produce

a microenvironment known as biofilm. Biofilms form when organisms enter the distribution system and become trapped in slow-flow areas, line obstructions or dead-end sections. They usually appear as a patchy mass in pipe sections or as a uniform layer along the inner walls of a storage tank. While not all biofilm is unsafe, researchers are currently unsure of its exact effect. Coliform bacteria may colonize in it, and biofilm can interfere with coliform detection. Biofilms also increase the chlorine demand of the distribution system, which can reduce the chlorine residual and the ability to keep potentially harmful levels of bacteria at bay. Biofilms may also cause taste and odor problems.

Operational Factors

From an operations standpoint, a network's operating conditions, such as slow water velocities, supply sources going on and off line, and the amount of time that systems store water all greatly affect water quality. Any of these factors can cause chlorine residuals to be depleted and thus allow microbial growth in the system. Hydraulic conditions can also cause sediment to deposit, accumulate and serve as both habitat for microbes and protection from disinfection. What's more, many systems are kept so full so that the system can be better prepared for emergency conditions. However, the long storage times result in degraded water quality.

Some of the other factors that provide optimal conditions for microorganisms to multiply include long water detention times in tanks and pipes, adequate nutrient levels and warm temperatures. In addition, research has shown that the level of biodegradable organic matter in the distribution system strongly affects bacterial re-growth and harbors opportunistic pathogens.

Main Breaks

Occasionally, water systems encounter situations in which they must repair distribution system pipes. Distribution lines can break for a variety of reasons, including excessive weight, such as increased traffic continuously running over a buried pipe. Extremely cold temperatures can also cause breaks because when water freezes, it expands. But environmental conditions are not the only reason a line may break. The pipes may split or crack because they may not have been properly installed in the trench, creating a situation where it's only a matter of time before a line bursts. Corrosion and scaling are two more reasons that pipes can rupture. Corrosion may lead to breaks or leaks in pipes because acidic conditions can cause pitting or holes. In addition, scaling (build-up) can cause restrictions leading to high-pressure pockets in some areas of pipe.

Certain leaks may require the system to notify the state primacy agency (regulatory office), and the system may need to issue a "boil water advisory" to customers.

Cross-Connections & Contamination

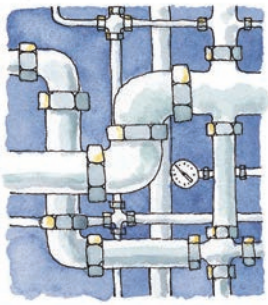
Cross connections are points in a distribution system where chemical, biological, or other contaminants can accidentally come in contact with potable water. When contaminants are drawn or pushed into the water system at a cross-connection, it is referred to as a backflow event. The public water distribution system and the plumbing within a facility are continuously jeopardized unless appropriate backflow prevention devices are installed and maintained at all connections to the potable water system.

Contaminants can enter the distribution system through two mechanisms:

- Backsiphonage: Contaminated water is drawn when negative or reduced pressure in the supply piping sucks non-potable fluids into the distribution system.

- Backpressure: Contaminated water is pushed into a potable water system when it is connected to a non-potable system of higher pressure.

A common example within a water treatment plant is the connection where chemicals are added to the water for treatment. If backflow prevention is not installed, too much chemical could be drawn directly into the water system. Surveying water users for unprotected cross connections is the most challenging and difficult part of any cross connection control program. It is, however, of prime importance in the protection of both water supply distribution mains in the street and internal potable water supply systems within a facility. Make sure your water system actively searches for cross-connections both in and outside the treatment plant.



Appendix A – State Resources

Connecticut

CT Department of Public Health information:

- **CTDPH Drinking Water Section Homepage**
  www.ct.gov/dph/publicdrinkingwater

- **Drinking Water Section Contact Information**
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387300&dphNav=|&dphNav_GID=1824

- **Drinking Water State Revolving Fund**
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387340

- **Public Water System Information**

  Public Water System Lists
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387346

  Statutes, Regulations and Federal Drinking Water Rules
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387306

  Technical Guidance for Public Water Systems
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387294

  Certificate of Public Convenience and Necessity
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387326

- **Certified Operator Information**

  Operator Certification Program Information
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387328

  Certificate Renewal and Training
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387344

  Examination Information
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387314

Certified Operator Assignments
http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387350

Backflow Prevention and Cross Connection Control
http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387288

- **Source Protection/Planning Information**

  Source Water Protection
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387338

  Source Water Assessment Program/Reports
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387342

  Water Utility Coordinating Committee
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387352

- **Water Quality Monitoring and Reporting Information**

  Water Quality Monitoring Schedules
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387350

  Certified Testing Laboratories
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387286

  Electronic Data Interchange (EDI)
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387308

- **Security and Emergency Response - Report a Drinking Water Emergency**

  Report A Public Water Supply Emergency
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387312

  Drinking Water Security and Emergency Response
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387336

  The Connecticut Water/Wastewater Agency Response Network (CtWARN)
  http://www.ct.gov/dph/cwp/view.asp?a=3139&Q=387298&dphNav_GID=1824

  Natural Disaster (Flood, Hurricane) Emergency Response
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387310

- **Educational Opportunities**
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=474076

- **Public Water Supply Consumer Information**

  Drinking Water Fact Sheets
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=393238

  Current Public Drinking Water Reservoir Status
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387302

  Water Conservation
  http://www.ct.gov/dph/cwp/view.asp?a=3139&q=387296

Maine

- **Maine Department of Health and Human Services**

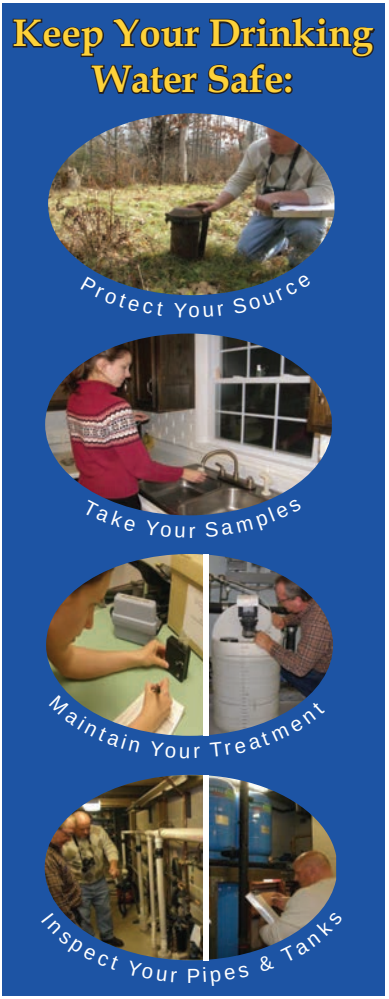
- **Maine Drinking Water Program**

  Water system board members (trustees) are responsible for overseeing the water system, making major decisions, and promoting long term sustainability. Understanding all aspects of a water system can be challenging. There are many resources available to assist board members in understanding water system operations and federal and state regulations. Training sessions are available for water system owners, operators, employees, and trustees. There are also grant and loan opportunities for water system infrastructure improvements. **Please visit the websites below or call the Maine Drinking Water Program at (207) 287-2070 for assistance.**

  Maine Drinking Water Program
  www.medwp.com

  Maine Public Utilities Commission
  www.maine.gov/mpuc/water

  Maine Municipal Association
  www.memun.org



- **Partnerships**

  Maine Rural Water Association
  www.mainerwa.org

  Maine Water Utilities Association (MWUA)
  www.mwua.org

  Rural Community Assistance Partnership (RCAP)
  www.rcapsolutions.org

Massachusetts

- **MassDEP information on:**

  Capacity Building (Technical, Financial, and Managerial)
  http://www.mass.gov/eea/agencies/massdep/water/drinking/water-systems-ops.html#3

  Certified Operators
  http://www.mass.gov/eea/agencies/massdep/water/drinking/water-systems-ops.html#5

  Certified Laboratories
  http://www.mass.gov/eea/agencies/massdep/water/drinking/certified-laboratories.html

  Drinking Water System Management Handbook (A Tool for Public Officials)
  http://www.mass.gov/eea/docs/dep/water/drinking/alpha/i-thru-z/sysmngt.pdf

  Emergency Response Guidance Materials
  http://www.mass.gov/eea/agencies/massdep/water/drinking/water-systems-ops.html#10

  State Revolving Loan Fund
  http://www.mass.gov/eea/agencies/massdep/water/grants/state-revolving-fund.html

  Public Notification Information
  http://www.mass.gov/eea/agencies/massdep/water/drinking/water-systems-ops.html#20

  Training
  http://www.mass.gov/eea/agencies/massdep/water/drinking/water-systems-ops.html#28

  Water Systems Operations
  http://www.mass.gov/eea/agencies/massdep/water/drinking/water-systems-ops.html

- **MassDEP Contacts**

Boston	Michael Maynard Margaret Finn	(508) 767-2735 (617) 292-5746
Central Region	Liz Kotowski Robert Bostwick	(508) 767-2779 (508) 849-4036
Northeast Region	Sean Griffin Zachary Peters	(978) 694-3404 (978) 694-3247
Southeast Region	Dan DiSalvio Terry Dayian	(508) 946-2793 (508) 946-2765
Western Region	Mike McGrath	(413) 755-2202

Training and Outreach

Boston	Ken Pelletier	(617) 348-4014
Central Region	Liz Kotowski	(508) 767-2779
Northeast Region	Hilary Jean	(978) 694-3229
Southeast Region	Terry Dayian	(508) 946-2765
Western Region	Dan Laprade	(413) 755-2289

- **Other Information from Massachusetts State Offices**

Massachusetts Open Meeting Law, Attorney General's website
www.mass.gov/ago/government-resources/open-meeting-law/

Massachusetts manual on "Designing and Constructing Public Facilities, Legal Requirements, Recommended Practices, Sources of Assistance," Office of the Inspector General
www.mass.gov/ig/publications/manuals/dcmanual.pdf

The Massachusetts Board of Certification of Operators of Drinking Water Facilities
www.mass.gov/ocabr/licensee/dpl-boards/dw/

- **Partnerships**

  Rural Community Assistance Partnership (RCAP)
  www.rcap.org/

  Massachusetts Rural Water Association
  www.massrwa.org/

  New England Water Works Association (NEWWA)
  www.newwa.org/

- **Municipal Water and Sewer Rate Surveys**
  www.newwa.org/Resources/UtilityResources/WaterRateSurveys.aspx

New Hampshire

- **State Information & Assistance**

  NHDES Drinking Water & Groundwater Bureau – (603) 271-2513
  http://des.nh.gov/organization/divisions/water/dwgb/index.htm

  NHDES Small Public Water System Help Center
  http://des.nh.gov/organization/divisions/water/dwgb/capacity/index.htm

  NHDES OneStop Data
  (for specific water system data, Master Sampling Schedule, & forms)
  http://www2.des.state.nh.us/DESOnestop/BasicSearch.aspx

  NHDES Drinking Water Fact Sheets
  http://des.nh.gov/organization/commissioner/pip/factsheets/dwgb/index.htm

  NH Public Health Laboratory
  http://des.nh.gov/organization/commissioner/lsu/index.htm

  NH Public Utilities Commission
  http://www.puc.nh.gov/Water-Sewer/water-sewer.htm

  NH Open Meeting Law
  http://www.gencourt.state.nh.us/rsa/html/vi/91-A/91-A-mrg.htm

- **Partnerships**

  New Hampshire Water Works Association (NHWWA)
  http://nhwwa.org/

  New England Water Works Association (NEWWA)
  http://www.newwa.org/

  Granite State Rural Water Association (GSRWA)
  http://www.gsrwa.com/

  RCAP Solutions (RCAP)
  http://www.rcapsolutions.org/

- **Loan & Funding Sources**

  NHDES Drinking Water State Revolving Loan Fund
  http://des.nh.gov/organization/divisions/water/dwgb/capacity/dwsrf.htm

  Community Development Finance Authority
  http://www.nhcdfa.org/block-grants/

  NH Municipal Bond Bank
  http://www.nhmbb.org/bonding_program.htm

  USDA Rural Development
  http://www.rurdev.usda.gov/NH-VTHome.html

  Rural Community Assistance Partnership Financial Resources
  http://www.rcapsolutions.org/financial-resources/

  NH Community Loan Fund
  http://www.communityloanfund.org/

Rhode Island

- **RI Department of Health**
  http://health.ri.gov/

- **Office of Drinking Water Quality**
  http://health.ri.gov/drinkingwaterquality/
  Three Capitol Hill, Providence, RI 02908
  P: 401-222-6867
  F: 401-222-6953

  Information for Public Water Suppliers
  http://health.ri.gov/drinkingwaterquality/for/watersuppliers/index.php

  Information for Drinking Water Operators
  http://health.ri.gov/drinkingwaterquality/for/drinkingwateroperators/index.php

  Information about the Drinking Water State Revolving Loan Fund
  http://health.ri.gov/programs/drinkingwaterstaterevolvingloanfund/index.php

  Information for Private Well Owners
  http://health.ri.gov/drinkingwaterquality/for/privatewellowners/

  Information about the Bottled Water Program
  http://health.ri.gov/programs/bottledwater/index.php

  Information about the Public Pools and Spas Program
  http://health.ri.gov/programs/publicswimmingpools/index.php

  Information on RI Open Meetings
  http://sos.ri.gov/publicinfo/openmeetings/

  RI State Rules and Regulations
  http://sos.ri.gov/documents/archives/regdocs/

Rhode Island Department of Public Health
Drinking Water Program Contacts

Aschman, Doris Surface Water Treatment Disinfection Byproducts Engineering Plan Review 401-222-7786 Doris.Aschman@health.ri.gov	**Kurdziel, Fred** Bacteria/Total Coliform Rule Sampling Requirements Inorganics/ Synthetic Organics 401-222-7787 Frederick.Kurdziel@health.ri.gov
Boudreau, Steven Operator Certification Training, Education, Consumer Reports Capacity Development 401-222-7781 Steven.Boudreau@health.ri.gov	**Poucher, Sherry** Compliance 401-222-7783 Sherry.Poucher@health.ri.gov
Chobanian, Gary Revolving Loan Fund Engineering Plan Review 401-222-7768 Gary.Chobanian@health.ri.gov	**Rabideau, Susan** Surface Water Treatment Disinfection Byproducts Emergency Response Engineering Plan Review 401-222-7775 Susan.Rabideau@health.ri.gov
Commons, Clayton Lead & Copper Rule Licensing 401-222-7740 Clayton.Commons@health.ri.gov	**Schultz, Robert** Emergency Planning Security 401-222-7824 Robert.Schultz@health.ri.gov
Craft, Patrick Private Wells 401-222-3436 Patrick.Craft@health.ri.gov	**Smith, Garry** System Inspections 401-222-7779 Garry.Smith@health.ri.gov
Kwolek, Alfred Enforcement 401-222-8033 Alfred.Kwolek@health.ri.gov	**Swallow, June** Chief, ODWQ 401-222-7790 June.Swallow@health.ri.gov

Vermont

- **State Environmental Protection Rules**
  http://www.anr.state.vt.us/dec/rulessum.htm

- **Drinking Water & Groundwater Protection Division**

  Drinking Water Program
  www.vermontdrinkingwater.org

  Vermont Water Supply Rule
  http://drinkingwater.vt.gov/pcwsrules.htm

- **Vermont Open Meeting Law**
  http://www.sec.state.vt.us/municipal/pubs/openmeeting/

  http://www.vlct.org/vermont-local-government/vermont-open-meeting-law/

  http://www.sec.state.vt.us/municipal/pubs/a%C2%AD%C2%AD_guide_to_open_meetings_2006.pdf

- **Vermont Statutes**
  http://www.leg.state.vt.us/statutesmain.cfm

- **ANR GIS Well Locator & Environmental Interest Locator**
  http://www.anr.state.vt.us/site/html/maps.htm

- **Department of Public Service – Water Division**
  http://publicservicedept.vermont.gov/

- **Public Service Board**
  http://psb.vermont.gov/

- **Vermont Water Supply Division Operators**
  http://www.vermontdrinkingwater.org/opcert.htm

- **Vermont's Certified Labs**
  http://healthvermont.gov/enviro/ph_lab/documents/certified_labs.pdf

- **Vermont Municipal Water and Sewer Rate Information**
  http://www.vlct.org/assets/Resource/Surveys/2008_Municipal_Water_and_Sewer_Rate_Information.pdf#search="water and sewer rate"

- **Water Supply Division Public Notification Information**
  http://drinkingwater.vt.gov/opcert/pdf/publicnoticecert.pdf#zoom=100

- **Water Supply Division Emergency Response Planning and Vulnerability Assessment**
  http://drinkingwater.vt.gov/pcwsemergencyplan.htm

- **Water Supply Division Source Water Protection**
  http://drinkingwater.vt.gov/pcwssourcewaterprotection.htm

- **Vermont Rural Water Association**
  http://www.vtruralwater.org

- **Vermont League of Cities and Towns**
  http://www.vlct.org/

- **Green Mountain Water Environment Association**
  http://www.gmwea.org

- **Vermont Community Development Block Grant Program**
  http://accd.vermont.gov/strong_communities/opportunities/funding/vcdp

Appendix B – Additional Resources

Great Overall Resources

- ***The Water Board Bible: The Handbook of Modern Water Utility Management***
  National Environmental Services Center, West Virginia University
  http://www.nesc.wvu.edu/drinkingwater.cfm

- ***The Big Guide for Small Systems: A Resource for Board Members* (2011)**
  Rural Community Assistance Partnership
  http://www.rcap.org/sites/default/files/rcap-files/publications/RCAP%20Big%20Guide%20for%20Small%20Systems%20(for%20boards).pdf

- **Small Utility Board Training – CD Training for Any Utility Nationwide; developed with EPA funding**
  Montana Water Center
  http://watercenter.montana.edu/training/board_training/default.htm

- **A Handbook for Owners of Small Water Systems in New Hampshire**
  RCAP Solutions, Inc & New Hampshire Department of Environmental Services
  http://des.nh.gov/organization/divisions/water/dwgb/capacity/documents/handbook_for_pws_owners.pdf

- **Plain Talk About Drinking Water – Questions and Answers About the Water You Drink**
  American Water Works Association Publication
  http://www.awwa.org/index.cfm

- **Safe Drinking Water Act (SDWA) Regulations**
  http://www.epa.gov/safewater/sdwa/index.html

- **Safe Drinking Water Hotline – Free Help Provided by EPA**
  (800) 426-4791
  http://water.epa.gov/drink/hotline/index.cfm

Helpful Organizations

- **Environmental Protection Agency Region 1 (EPA New England)**
  Resources for Small Drinking Water Systems
  http://www.epa.gov/region1/eco/drinkwater/small_dw_initiative.html

- **EPA Region 1 (New England)**
  Resources & Links to Help Drinking Water Systems
  http://www.epa.gov/region1/eco/drinkwater/index.html

- **EPA Office of Groundwater and Drinking Water**
  Wide Range of Resources & Regulatory Information
  http://www.epa.gov/safewater/

- **New England Water Works Association (NEWWA)**
  Regional organization educating all types of water professionals and promoting water resource stewardship.
  http://www.newwa.org/

Resources for Communities and People

- **RCAP Solutions**
  Work with communities to improve quality of life for all through numerous assistance programs.
  http://www.rcapsolutions.org/

- **Rural Community Assistance Partnership (RCAP)**
  National organization working with small communities to improve their drinking water and wastewater systems.
  http://www.rcap.org

- **Find Contact Information for Your State Primacy Agency Through the Association of State Drinking Water Administrators (ASDWA)**
  http://www.asdwa.org/index.cfm?fuseaction=Page.viewPage&pageId=487

- **Find Contact Information for Your State & Local Health Departments**
  www.healthguideusa.org/local_health_departments.htm

- **Find Contact Information for Your State USDA-Rural Development Office**
  Dedicated to improving the quality of life in rural communities through supporting essential utility services.
  www.rurdev.usda.gov/recd_map.html

- **National Environmental Services Center (NESC)**
  Assists small and rural communities with environmental training, management issues, and general drinking water and wastewater needs.
  http://www.nesc.wvu.edu/index.cfm

- **American Water Works Association (AWWA)**
  National association assisting and educating communities and their utility staff on how to properly manage and operate drinking water systems from treatment through rate setting and public education.
  http://www.awwa.org/index.cfm

- **National Rural Water Association (NRWA)**
  National association supporting the needs of small water systems; provide classroom and on-site technical assistance to utilities and state agencies.
  http://www.nrwa.org

- **The Groundwater Foundation**
  Nonprofit dedicated to educating people and inspiring action to protect the nation's groundwater.
  http://www.groundwater.org/

Resources by Topic

- **Consumer Confidence Report & Public Notification Requirements**

  Consumer Confidence Report Page - EPA
  http://www.epa.gov/safewater/ccr/index.html

  Preparing Your Drinking Water Consumer Confidence Report - EPA
  http://www.epa.gov/safewater/ccr/pdfs/guide_ccr_forwatersuppliers.pdf

  EPA's Revised Public Notification Guide
  http://water.epa.gov/lawsregs/rulesregs/sdwa/publicnotification/upload/PNrevisedPNHandbookMarch2010.pdf

- **Working with Your Operator**

  EPA's Operator Page
  http://www.epa.gov/safewater/operatorcertification/index.html

  Sample Contract for Contract Operations
  https://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/OperatorCertification/Pages/index.aspx

- **Rate Setting**

  Setting Small Drinking Water System Rates for a Sustainable Future - EPA
  http://www.epa.gov/waterinfrastructure/pdfs/final_ratesetting_guide.pdf

Full Cost Pricing Report – EPA
http://water.epa.gov/infrastructure/sustain/pricingresources.cfm

General Information Regarding Water Pricing – EPA
http://water.epa.gov/infrastructure/sustain/financing_priceofwater.cfm

- **Financial Management**

The Basics of Financial Management for Small Community Utilities – RCAP Publications
http://www.rcap.org/commpubs

Running Your System Like a (Good) Business Special Issue of On Tap: Summer, 2004, Volume 4, Issue 2, The National Environmental Services Center
http://www.nesc.wvu.edu/ndwc/articles/OT/SU04/GoodBusiness.pdf

Environmental Finance Center, Boise State University –EPA funded
http://efc.boisestate.edu/

Environmental Finance Center, New Mexico Tech – EPA funded
http://nmefc.nmt.edu/home.php

Capacity Development Program – EPA
http://www.epa.gov/safewater/smallsystems/

- **Planning & Managing Assets**

Managing a Small Drinking Water System
National Environmental Training Center for Small Communities - West Virginia University
http://www.nesc.wvu.edu/subpages/capacity_manage.cfm

Strategic Planning: A Handbook for Small Water Systems – EPA
http://www.epa.gov/ogwdw/smallsystems/pdfs/guide_smallsystems_stratplan.pdf

Liquid Assets – The Story of Our Water Infrastructure
http://www.liquidassets.psu.edu/

Check Up Program for Small Systems (CUPSS) – Asset Management
http://www.epa.gov/cupss/

Asset Management for Local Officials – EPA
http://www.epa.gov/safewater/smallsystems/pdfs/guide_smallsystems_assetmanagement_localofficials.pdf

Asset Management: A Handbook for Small Water Systems – EPA
http://water.epa.gov/type/drink/pws/smallsystems/upload/guide_smallsystems_asset_mgmnt.pdf

Asset Management: A Best Practice Guide – EPA
http://www.epa.gov/safewater/smallsystems/pdfs/guide_smallsystems_assetmanagement_bestpractices.pdf

Effective Utility Management
http://www.watereum.org/

- **Security**

  Water Security – EPA
  http://water.epa.gov/infrastructure/watersecurity/index.cfm

- **Source Protection**

  Protecting Drinking Water Sources in Your Community: A New Source Water Protection Tool for Municipal Officials
  New England Interstate Water Pollution Control Commission (NEIWPCC)
  http://www.neiwpcc.org/sourcewateroutreach/

  Source Water Protection - EPA
  http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/index.cfm

- **Conservation**

  Conservation - Water Sense - EPA
  http://www.epa.gov/WaterSense/

  Water Efficiency Strategies – EPA
  http://water.epa.gov/infrastructure/sustain/wec_wp.cfm

  Saving Water & Energy in Small Systems – Montana Water Center
  http://watercenter.montana.edu/training/savingwater/

- **Treatment & Distribution**

  A Drop of Knowledge – The Non-Operator's Guide to Drinking Water Systems
  Rural Community Assistance Partnership
  http://www.rcap.org/DWguide

Advice for New (and Old) Board Members
(from H.B. Calvert)

- Meet with your system's operator, other board members, or community members to get a general idea about the system. Ask and learn about such things as water sources, treatment, storage capacity, problems in the distribution lines (leaks), etc. As a board member you should have a general idea of what it takes to operate the system and what expenses are to be expected. I found in my work that a town's board spends more time hiring someone to mow a park than they do to hire someone to operate and maintain probably the biggest investment the town has ever made. The reason: They know what it takes to mow a park, but probably don't have the slightest clue what it takes to operate the water system.

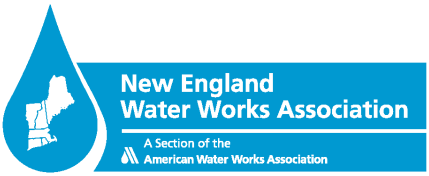
- At a minimum, every system should have a written operation plan for the system. It doesn't have to be elaborate but should state what needs to be done, how often it needs to be done, and who is responsible for doing it. The information in the operations plan can then be used to develop an operator's job description, which eliminates the "I didn't know that was my job or responsibility" excuse.

- There are two types of board members: the ones who won't leave the system alone and makes "adjustments" for the operator and the ones who don't want to hear anything about the system unless it completely fails. A good board member is somewhere between those two.

- Review and understand the system's budget to make sure all expenses and revenues are included, the system can support itself financially, and all utility finances are separate from each other and from the town's general fund. A system must show a positive cash flow. Even though you may have a certificate of deposit tucked away, if you do not have a positive cash flow, that CD will be gone in a short while if it is used to supplement day-to-day operations.

- No one likes rate increases, but when the need arises to raise rates, be informed and willing to explain the need for a rate increase to your customers.

H.B. Calvert retired as a Technical Assistance Provider in 2011 after serving for nearly 20 years on the staff of the Midwest Assistance Program, the Midwest RCAP. From *The Big Guide for Small Systems: A Resource for Board Members* published by RCAP.



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