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Water and Wastewater Research Agenda

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Introduction

This document outlines research needs for water and wastewater issues. This is a dynamic document, continually subject to modification and addition of new projects and proposals. Provide comments and suggestions to the Water Section Chief, David Denig-Chakroff at: ddenig-chakroff@nrri.org or (608) 630-4426.

Infrastructure Replacement and Asset Management: What Can Regulatory Commissions Do?

Background

Surveys conducted by the U.S. Environmental Protection Agency (U.S. EPA) suggest that the need for water and wastewater infrastructure improvement and replacement (both privately and publicly owned) over the next 20 years is between $500 billion and $1 trillion. This dollar level reflects a growing need across the Nation to replace water and sewer pipes and other water and wastewater facilities as they approach the end of their useful lives.

The reason for this surge in infrastructure needs stems from the population boom and economic growth at the end of World War II. During those post-war years, there was unprecedented industrial, business, commercial and residential development, along with the water and wastewater infrastructure to support it. That infrastructure is now reaching the age when it is beginning to wear out and needs to be upgraded or replaced. Water and wastewater utilities need to manage those assets actively or risk adverse economic consequences, such as unplanned system failures, increased maintenance costs, and unbudgeted repair and replacement costs. Depending on the length of useful life of various components, the need to replace this infrastructure will continue over the next several decades.

Existing reports and guidance manuals detail how utilities can assess the remaining useful life of their facilities and how they can develop effective asset management plans.[1] These plans generally consist of a complete assessment of utility facilities and assets, including a determination of the condition and remaining useful life of each component of the system, right down to each segment of buried pipe. Components of the system are also rated in terms of criticality for operation of the system. A model is often developed based on asset condition, criticality and other relevant factors to prioritize the infrastructure replacement and improvement needs over time. Costs are then applied to determine reinvestment needs over time.

The goal of these plans is to determine a reinvestment timeline that will allow continued operation of critical infrastructure throughout its useful life, but will ensure replacement before it fails and before maintenance costs increase dramatically. Planners then can prepare infrastructure replacement schedules and budgets that will spread out the costs of improvements over a pre-established planning horizon. This scheduling and budgeting will avoid unplanned maintenance and capital costs to the utility while maintaining efficient operation of the system.

This situation poses several challenges for utilities and regulatory commissions. One challenge is how to finance the necessary infrastructure replacements such that (a) rates increase gradually (as opposed to sudden spikes in rates), while (b) maintaining the utilities' financial stability. A second challenge is ensuring that the large expenditures are made prudently, so as to win and sustain customer trust and political credibility. Adding to the challenge is the absence, for most utilities, of a designated fund available to replace aging infrastructure—an absence attributable to ratemaking practices which have kept depreciation rates low and have disallowed or discouraged rate recovery of contributions in aid of construction.

Research Needs

The current research need is to determine optional and optimal roles for state regulatory commissions with regard to water and wastewater infrastructure replacement and asset management. Such research should answer the following questions:

1. How should commissions establish clear expectations for utilities' prudent conduct and implementation of infrastructure replacement and asset management plans? What should those expectations be?

2. Recognizing the need for both investor-owned and publicly-owned utilities to raise the funds necessary for the increased investment in infrastructure, what financial resources are available to utilities? It does not appear that utilities can

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[1] Examples include: (1) U.S. EPA, *Environmental Management Systems and Asset Management: Tools to Reduce Costs, Manage Risk, Improve Performance,* undated publication; (2) U.S. EPA, *Asset Management: A Handbook for Small Water Systems*, Sept. 2003; (3) Matichich, Mike, et al., *Asset Management Planning and Reporting Options for Water Utilities*, AwwaRF project 2848, Winter 2005-2006; (4) Cromwell, John, et. al., *Financial and Economic Optimization of Water Main Replacement Programs,* AwwaRF project 462, Spring 2001.

rely on federal grants. Some government supported low-interest loan programs (such as the Drinking Water State Revolving Loan Fund program) are an option for some (but not all) utilities. Traditional bond financing is one viable option. Another alternative is revenue-backed financing (RBF).

3. What rate-design options are available? Rate-design options include, without limitation, distribution system investment charges, surcharges for non-revenue producing investment, and single tariff pricing. Research is necessary to assess alternatives in terms of economic efficiency, business practicality, consumer acceptability and other factors.

4. What ratemaking procedures should be employed to help mitigate the expenses of infrastructure replacement? Some examples that should be considered include:
   a. Increased allowable returns on equity.
   b. Prospective-looking rate cases.
   c. Construction work in progress (CWIP)[2] in rate base.
   d. Single-cost rate case for passthrough of a single category of costs.
   e. Adjustment clauses to recover a single category of cost specifically stated on the customer's bill.
   f. Streamlined rate cases.

5. What advance commitments, if any, should regulators or legislators make concerning cost recovery so that investors and bond holders can reduce their risks (thus lowering finance costs), without weakening the accountability necessary to ensure that expenditures are prudent.

Deliverables

1. A guide for regulators on the facts and principles underlying effective asset management, including both utility practices and regulatory policy, with specific descriptions of successful programs. The guide will also include a recommended reading list for regulators, including an annotated bibliography of relevant reports, studies and research on the subject.

2. A compilation, analysis and evaluation of effective financial alternatives for utilities to address infrastructure replacement. Analysis of alternatives will include their effect on rates and bond ratings.

3. A compilation, analysis and evaluation of rate-design options for commissions to address infrastructure replacement and asset management.

[2] CWIP allows certain construction costs for plant not yet in service to be included in rate base. Allowance for Funds Used During Construction (AFUDC) does not provide cash flow to fund a project.

4. A compilation, analysis and evaluation of ratemaking procedures available to state commissions to address infrastructure replacement and asset management.

Meeting Drinking Water Quality Standards: What is the Appropriate Role for Regulatory Commissions?

Background

EPA establishes rules for drinking water quality under the authority of the Safe Drinking Water Act (SDWA). Enforcement of federal water quality standards, however, is generally the responsibility of state environmental and natural resources agencies. The state agencies are referred to as "primacy" agencies, because they have primary responsibility for enforcing the federal rules.

The SDWA provides that EPA may grant a state primary enforcement responsibility if the state adopts drinking water regulations that are no less stringent than federal rules. If a state does not adopt such regulations, EPA will enforce the federal rules in that state. A state with primacy status may adopt regulations that are more stringent than federal rules.

Some local (i.e., substate) jurisdictions establish water quality standards that are more stringent than both federal and state standards. A common example is a utility that establishes a standard exceeding a Federal secondary drinking water quality standard.[3] The secondary standards EPA establishes serve as guidelines for utilities and are nonbinding. Utilities and local officials can choose to enforce the federal guidelines or their own standard. They might enforce a stricter standard to increase public confidence in the drinking water system.

State utility commissions are responsible for utility rate setting and quality of service issues. When they issue certificates of public convenience for water treatment systems and when they rule on rate hikes for capital investment and operating expenses related to water quality, they are affecting water quality decisions by determining what cost levels are appropriate for the community.

Federal agencies, state environmental and resource agencies, state regulatory commissions, local governments and utilities all have some say in making and enforcing drinking water quality standards in a community. Lines of authority, however, are not always clear and decisions by these various agencies are not always coordinated, consistent or fully informed.

Research Needs

[3] Federal primary drinking water quality standards apply to constituents in water that pose a health risk. Secondary standards apply to constituents that can cause aesthetic annoyance like unpleasant appearance, taste and odor, such as iron and manganese.

Drinking water quality concerns have become more pronounced. Customers and community leaders have become better informed and more vocal about water quality standards. These factors have increased the need for regulatory commission involvement in water quality issues. Utilities are increasingly seeking rate recovery and construction approvals for water quality activities and facilities. Commissions and their staff need to be well informed about water quality problems and concerns and the most effective utility responses so they can make optimal decisions. Some examples of effective practices being employed by progressive utilities are:

1. Community-wide education programs

    a. Annual water quality reports to customers.

    b. Website information.

    b. Water quality newsletters and listserves.

    c. Bill inserts.

    d. School curricula.

    e. Speaking bureaus.

2. Water quality complaint tracking systems to pinpoint—geographically and technically—problems in the distribution system and expedite resolution.

3. Distribution system models that help predict and prevent systemic conditions that will diminish water quality.

4. Advanced distribution system cleaning programs, such as unidirectional flushing and pigging.[4]

5. Source water protection programs.

What then is the role of state commissions? One purpose of regulation is to establish performance standards and to evaluate utilities' effectiveness in meeting those standards. For drinking water quality, standards have been established by federal and other state agencies. Can state commissions establish more stringent standards? Should they? In their ratemaking activities, should state commissions automatically support the political decisions made by local and state water quality regulators, or should they give independent scrutiny? For example, suppose a utility should request rate recovery to achieve a water quality standard far in excess of

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[4] Unidirectional flushing is a system of manipulating valves and opening hydrants in a manner that maximizes water velocity in isolated segments of pipe. While this operation optimizes distribution system cleaning, it is much more labor intensive and expensive than traditional flushing systems. Pigging forces foam and plastic bullet-shaped plugs through the distribution system to scour and clean the insides of pipes.

federal and state standards. Does a state commission have the authority to deny such a request if it finds in the customers best interest to do so? Can the state commission declare that water quality should be higher than the levels established by federal, state and local agencies? (In the electric industry, for example, a state commission can insist on reliability levels higher than those established by regional or federal entities, provided the state commission sets rates sufficient to recover the cost associated with the higher reliability level.)

What are the respective roles of EPA, state primacy agencies, state commissions and local governments on drinking water quality regulation? How can these entities best work together to ensure that there is one clear standard? Options deserving consideration include:

1. Legislation to consolidate authority in one regulatory agency.

2. Joint issuance of regulations by multiple agencies.

3. A review board with representatives of multiple entities.

4. Regular meetings of entities with regulatory authority.

Deliverables

1. Describe the most significant water quality problems and the most effective utility responses.

2. Describe optional roles for state commissions in establishing and enforcing expectations concerning water quality.

3. Provide effective options for multiple regulatory agencies with water quality responsibilities to agree on and communicate clear performance standards.

Water Conservation, Efficiency and Sustainability: Balancing Resource Management and Revenue

Background

Water conservation programs have become commonplace across the country, even in areas with relatively abundant water supply. In arid western states, water conservation has become a necessary fact of life. Other areas of the country frequently experience periodic short-term drought that trigger water conservation measures, especially during hot summer months. Regions that have not experienced long-term drought are not exempt, as experienced by Atlanta, Georgia in 2007. Some of the fastest growing areas in the country, such as Las Vegas, Nevada, are in areas with very limited water supply.

In addition to helping sustain water supplies, water conservation programs defer construction of new facilities. Growing communities can delay construction of wells, storage reservoirs and treatment systems if they reduce their per capita water demand.

The great majority of water utility costs are fixed costs, such as payroll, benefits, and debt service associated with capital assets. Water conservation programs do little to reduce existing fixed costs of a utility (although they can defer, as just explained, "future fixed costs"). Traditional rate structures recover fixed costs through variable charges (i.e., dollars per gallons of water sold). Under traditional rate structures, therefore, water conservation reduces a utility's ability to recover its fixed costs. This problem afflicts gas and electric utilities as well.[5]

Research Needs

How then can water utilities promote and gain the benefits of water conservation and efficiency while maintaining financial stability? What expectations and obligations should state commissions establish?

Supply-side conservation: Many utilities have large volumes of water that are "unaccounted for"; i.e., the difference between water produced and water sold. These water losses may be due to physical loss from leaky pipes or from substandard metering or inaccurate recordkeeping. Commissions should ensure that utilities are taking corrective action if amounts of unaccounted for water are excessive. Such action could include:

1. Conducting water loss audits.

2. Implementing a leak detection program.

[5] For a discussion of the problems associated with rate structures which recover fixed costs through variable charges, see Costello, Ken, *Decision-Making Strategies for Assessing Ratemaking Methods: The Case of Natural Gas*, National Regulatory Research Institute, September 2007.

3. Ensuring that all customers are appropriately metered (some utilities do not meter all customers or may maintain a single meter for multiple customers).

4. Maintaining an effective meter testing and replacement program.

5. Maintaining accurate records of water produced and delivered.

Demand-side conservation: There are a large number of conservation program options, including educational and informational programs, low-flow fixture promotions, lawn sprinkling restrictions, and building code enhancement. Program effectiveness varies. If a community already has a low per capita water use ratio, the marginal cost of additional conservation may exceed the benefit.

Rate structure can encourage or discourage water conservation and efficiency. Regulatory commissions need to determine those rate structures that will optimize conservation and maintain the financial stability of a utility at the most reasonable cost to customers. Inclining block rates, seasonal rates, excess use rates or surcharges, lifeline rates and decoupling of rates from sales volumes are among the options.

Deliverables

1. Supply-side problems and solutions: Identify sources of and reasons for unaccounted water and water loss in utility systems. Discuss reasonable water loss expectations for utilities given existing technology. Identify options for reducing water loss and analyze their costs and benefits. Discuss new and innovative water efficiency programs, such as integrated water resource management, water reuse and recycling. Provide a recommended reading list for those wanting more detail.

2. Demand-side solutions, including the following without limitation:

    a. Educational programs for schools and civic groups.

    b. Neighborhood action groups and community meetings and events.

    c. Consumer informational campaigns (websites, mailings, bill inserts).

    d. Radio and television ads and public service announcements.

    e. Water fixture and hardware promotions, including low-flow toilets, showerheads and faucets; low-water-use washing machines and dishwasher; aerators; and lawn sprinkling restrictors (timers, rain sensors).

    f. Policies and regulations, such as sprinkling ordinances, building codes, watershed management, infiltration enhancement (porous pavement, rain gardens), and wetlands protection.

Describe and discuss the applicability and limitations of each program option. Evaluate the costs and relative effectiveness of each. Provide a recommended reading list for those wanting more detail.

3. Discuss and analyze rate-design options and issues and their effect on water conservation and efficiency.

The Water-Electric Nexus: Conserving Electricity through Water Efficiency and Conserving Water by Reducing Electric Demand

Background

Producing and delivering safe drinking water and disposing of wastewater are power-intensive operations. Generating electricity uses large quantities of water. Consequently, reducing water use reduces demand for electricity and reducing electric demand in turn reduces use of water.

Water systems are often one of the biggest power users in their communities. Power costs are typically a major budget item for water and wastewater utilities. Water and wastewater operations account for 19% of the total annual power use in California. Reduction of power use in the water sector would thus have a measurable effect on reducing electric demand and would simultaneously improve efficiency and reduce costs of water operations.

Pumps are large consumers of electric power. Groundwater systems rely on electric pumps to bring water to the surface from aquifers, which may be hundreds of feet to over 1,000 feet in depth. In all water systems, water must be pumped from its source to treatment plants, to storage reservoirs, into water towers, and through transmission and distribution lines to serve customers. Wastewater systems rely on pumps to transport sewage from its source to treatment plants. Increasing pump and pumping efficiency can both shave peak power demands and reduce overall power use. Other aspects of water operations, such as water treatment and facility lighting, provide additional opportunity for reducing power consumption.

Power plants use large quantities of water in cooling towers. In many cases, the sources of cooling water are also sources of drinking water. A large proportion of cooling water is lost to the atmosphere and cannot be returned to the source from which it is drawn.

Research Needs

1. Regulatory commissions need a better understanding of how water and wastewater utilities can optimize the efficiency of their pumping and other operations. With this understanding, they can make informed regulatory

judgments regarding both water and electric utility operations. Areas this research should address include:

a. Optimizing pump efficiency, including proper sizing of pumps and use of variable speed drive pumps where applicable.

b. Optimizing pumping efficiency through proper sizing and use of storage reservoirs and proper configuration of treatment and distribution systems.

c. Reducing flow resistance in distribution systems.

d. Using Supervisory Control and Data Acquisition (SCADA) systems to operate water and wastewater systems with optimal energy efficiency.

e. Identifying reasonable expectations for energy conservation in water and wastewater utilities, which regulators can use to establish standards.

2. Commissions also need better understanding of the use of water for generating electricity and how conservation of electricity affects water use.

Deliverables

1. Provide an overview of power use in water and wastewater operations and methods used by progressive utilities to improve efficiency and reduce power demand.

2. Provide an overview of water use in power generation and methods used by progressive utilities to reduce water use.

3. Discuss energy-saving options for water and wastewater utilities with comparative analysis of electric reduction potential and cost savings to the utility.

4. Discuss water-saving options for electric utilities with a comparative analysis of water reduction potential and its potential effect on sources of water supply.

5. Identify reasonable energy-saving expectations for water and wastewater utilities given existing technology.

6. Identify reasonable water-savings expectations for electric utilities given existing technology.

Small Water System Issues

Background

NRRI published a report in February 2008 entitled *Small Water Systems: Challenges and Recommendations.*[6] The report identified the challenges, attributes and practices associated with successful small water systems. It also examined state commission policies, practices, regulations and standards that could improve the management and operation of small utilities. Commission commenters indicated a desire for additional research and more detail regarding some of the issues addressed.

NRRI sponsored a web-based meeting on the report on April 29, 2008. About 60 people attended the meeting. Participants consisted primarily of regulatory commission staff. Thirteen state regulatory commissions were represented at the meeting. Participants prioritized issues for additional research needed by state commissions.

Research Needs

The three issues identified as priority issues for additional research are: (1) establishing standards, expectations and certification requirements for small water systems, (2) designing policies to encourage efficient acquisitions, consolidations and regionalization of small substandard systems, and (3) tailoring regulatory requirements to small systems.

Deliverables

1. **Establishing standards, expectations and certification requirements.** This project would investigate and evaluate specific performance standards for small utilities that commissions could establish and enforce through certification requirements. Specific certification requirements would include those that could accompany an acquisition and those that could be used to de-certify a failing system. Certification requirements based on technical and operational standards as well as financial and business standards will be investigated.

2. **Designing policies to encourage efficient acquisitions, consolidations and regionalization of substandard systems.** This project would investigate possible inducements for mergers and acquisition of failing and substandard systems. It would investigate whether commissions should approve the acquisition of a failing system at a purchase price exceeding book value and allow the acquirer to recover the acquisition premium from ratepayers. The project would evaluate takeover regulations and other commission policies that promote acquisition of substandard systems and report on their success and lessons learned.

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[6] Stanford, Melissa, J., *Small Water Systems: Challenges and Recommendations*, National Regulatory Research Institute, Pub. 08-02, February 7, 2008.

3. **Tailoring regulatory requirements to small systems**. This project would investigate various regulatory policies and requirements to evaluate how they have been or could be tailored to the special needs of small systems. Issues to be investigated would include staff-assisted rate cases, alternative methods for calculating rates of return (e.g., operating ratio method), distribution system improvement charges (DSIC), and commodity cost rate adjustments.