Journal of Contemporary Water Research & Education

Issue No. 128 June 2004

Small Water Supply Systems: Meeting the Challenges of the Safe Drinking Water Act

Contents

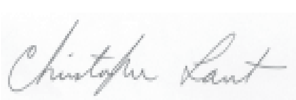
Dear Delegates and Other Subscribers:

Water Resources Update began as a newsletter of the Universities Council on Water Resources in September 1964. Through Issue 127, we retained the *Water Resources Update* name even though the publication itself has both graduated well beyond a newsletter and become a widely respected issue-focused journal publishing invited papers from authors who are prominent in their fields.

In recognition of this progress, the UCOWR Board has decided unanimously to change the name of *Water Resources Update* to the *Journal of Contemporary Water Research and Education*, thus reflecting UCOWR's mission to promote research and education in water resources. Over the past few issues, we have upgraded the journal's appearance to indicate this new status, including the new cover designed by our assistant editor Jim Stivers.

So we continue our tradition of concise, well-informed issue-oriented scholarship with Issue 128 on *Small Water Supply Systems: Meeting the Challenges of the Safe Drinking Water Act*. We welcome your feedback.

Best Regards,



Christopher Lant,

UNIVERSITIES COUNCIL ON WATER RESOURCES
JOURNAL OF CONTEMPORARY WATER RESEARCH & EDUCATION
ISSUE 128, PAGES 1-5, JUNE 2004

Economic and Financial Management of Small Water Supply Systems: Issue Introduction

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The Importance of Water System Management

The 1996 Safe Drinking Water Act amendments set aggressive targets for ensuring safe, secure, and reliable community water supplies. In raising the bar for system performance, Congress also recognized that small communities, as a group, would have greater difficulty in meeting the new requirements than larger communities.

According to the most recent available data (U.S. Environmental Protection Agency 2003) nearly 50,000 community water systems serve populations of 10,000 or less; almost 60% of these serve 500 or fewer people. Nearly 52 million people–20% of the U.S. population–depend on these systems. The 2001 Drinking Water Infrastructure Needs Survey found that the smallest of these systems–those serving 3,000 or fewer people–have maintenance and upgrade needs totaling $31 billion.

Many small communities are hard-pressed to evaluate needed improvements, raise the funds, and manage the more sophisticated systems required to meet the new drinking water standards. Their income and revenue bases are limited. Some aging communities are not retaining their younger citizens, leaving a declining pool of talent available to master the new requirements; others are bedroom communities with little cohesion; most have part-time officials and few if any staff members able to plan, oversee, and manage infrastructure improvements.

The challenges associated with small systems have been apparent for some time (e.g., National Research Council 1997). The 1996 Amendments stressed the need to build the technical, managerial, and financial (TMF) capacity of public water systems. The multifaceted nature of the concept of "capacity" is represented in Figure 1. In carrying out the TMF provisions, the U.S. Environmental Protection Agency (EPA) and its state counterparts support a variety of assistance programs. The National Drinking Water Advisory Council (NDWAC) advises the EPA on matters important to small community systems. The Rural Water Association is active in most states providing direct technical assistance to small communities. Six regional Environmental Finance Centers provide technical support for a variety of environmental infrastructure and management needs. Eight university-based Technology Assistance Centers develop new technologies and management tools appropriate to small systems. The National Drinking Water Clearinghouse (http://www.nesc.wvu.edu/ndwc/) serves as a nexus for technical information. There is also ongoing review of the regulatory environment for small systems. In 2003, the National Drinking Water Advisory Council's (2003) affordability report commented on variance policies and affordability criteria.

While these review and assistance efforts continue, it is not clear how they all fit together and whether gaps remain in the support system for economic and management needs. In an effort to assess progress and needs, the Midwest Technology

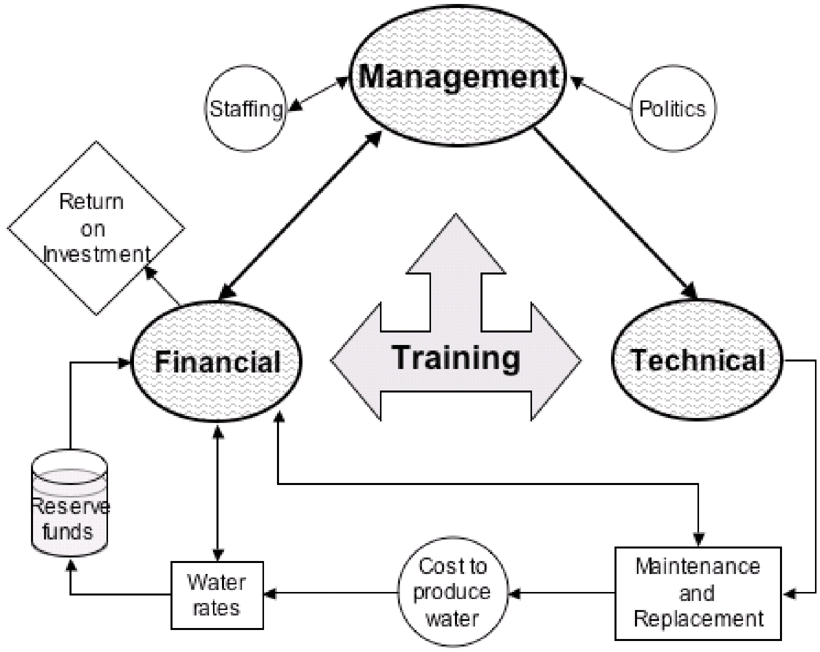

Figure 1. Simplified overview of a small water system.

Assistance Center (MTAC) for Small Drinking Water Systems assembled a panel of experts in November 2003 to assess progress and needs. (MTAC is administered by the Illinois Water Resources Center, the University of Illinois, and the Illinois State Water Survey with financial support from the U.S. Environmental Protection Agency.) The papers in this volume reflect the views of these experts.

The Contributions

The authors come from a variety of perspectives and experience. Professor Cornelia Butler Flora of Iowa State University studies the structure and function of rural communities. Her paper outlines the social context of rural community assistance efforts. Professor Flora connects the concept of community capitals to the case of small water systems. This concept incorporates six forms of capital that communities may already have or should develop for sustainable development: natural, cultural, human, social, political, and financial/built. Natural, cultural, and human types of capital can be transformed into social, political, and financial/built capital. Professor Flora's basic message is that the best technologies, tools, or advice will be successful only if the community is prepared organizationally and culturally to benefit from it.

Professor Ben Dziegelewski and Mr. Tom Bik of Southern Illinois University conduct research on the economic and technical performance of water systems and the factors that seem to correlate with success in system management. Their paper reflects the results of a recent study that developed performance benchmarks for small public water systems in the Midwest. Information from a survey allows them to profile the infrastructure, finances, and management of small systems. We learn that 40% of the systems surveyed had no water treatment and another 10% reported chlorination only. Ground water was the major source of drinking water. Eighty percent of systems have some sort of supplemental water storage to maintain pressure and meet peak demands. Most systems (59%) reported an increase in the population served. Yet, 17% of systems reported total revenues that were less than total costs, and more than 35% of systems with less than 500 customers had no reserve fund. Additionally, 51% of these systems had not increased their water rates during the past five years. Dziegielewski and Bik recommend the development of case studies to demonstrate successful techniques for achieving sustainability including successful engagement of consumers, restructuring, and regionalization alternatives.

Bill Jarocki, Director of the Environmental Finance Center at Boise State University, develops tools that communities can use to plan for system improvements, develop needed financing, and manage their systems. Mr. Jarocki's paper emphasizes the advances made in the 1996 SDWA Amendments in conceptualizing the viability of water systems. The new concept, "capacity," attempted to capture a number of the dimensions identified by Flora as well as Dziegielewski and Bik. Importantly, the concept was applied not in a binary fashion—pass/fail—but along a multidimensional continuum. This innovation changed the game for small systems. The new approach focuses on continuous improvement rather than just being satisfactory. Mr. Jarocki focuses especially on the maintenance of capital facilities and related capital budgeting as an important component of long-term success of small water systems. He notes that many systems fail to distinguish capital from operating budgets and to prepare financially for expenses of replacing equipment or meeting new requirements. New public accounting standards that went into force in 2003 may increase awareness and attention to capital budgeting, but it is not yet clear how small communities will respond.

Carl Brown serves as a consultant to small communities, advising on water rate analysis and setting water charges. Picking up on themes emphasized by Mr. Jarocki, Mr. Brown has found that many small communities are reluctant to engage in open discussion of the economic realities of water supply. His message is that realistic projection of the resources required to operate and maintain drinking water infrastructure are essential to assure reliable and safe water supplies. Furthermore, he emphasizes the need for continuous planning and improvement, because water systems and the needs they meet are never in static equilibrium. Mr. Brown argues that communities that recognize and respond to this reality will reap the rewards of a stronger financial future.

Dean Heneghan's consulting engineering firm provides contractual planning and management services for several small community water systems. In his paper, Mr. Heneghan describes various ways that communities and contract management services can work together to provide safe and reliable water. This flexibility allows individual systems to decide what to do in-house and what to obtain from outside sources. Contractors may be able to deploy personnel more efficiently, sustain better training, and spread the costs of management across more end-users than a small system, thereby improving services and reducing costs.

Jim Maras represents the Rural Utilities Service of the U.S. Department of Agriculture, a major provider of financing for rural infrastructure. Mr. Maras' paper stresses the need to treat smalls towns as small towns; that is, they should not be expected to achieve the level of sophistication or specialization on their own that larger communities can reach. A water system's ability to achieve and maintain compliance with federal and state drinking water standards is dependent on its technical, financial, and managerial capacity (TMF). One study has shown that communities with over 3,000 persons often have the capacity to self-finance more of their infrastructure needs than smaller communities. Besides the obvious challenges of funding, technology, and administering regulations in rural areas, staff turnover and difficulty of maintaining skills are important barriers for small systems. Mr. Maras emphasizes the need for flexibility in training and other aspects of compliance to tailor services to the needs of targeted groups.

Common Themes

A number of common themes are evident in this group of papers. One is that a great deal of progress has been made in expanding training programs, supplying tools and information for use by small communities, and encouraging innovation. Furthermore, the regulatory and funding agencies are paying close attention to the viability of these systems. The Safe Drinking Water Act Amendments of 1996 are credited with focusing on the financial and managerial viability of small systems, and there are encouraging signs. According to a community water system survey conducted in 2001 (U.S. Environmental Protection Agency 2002), approximately one-quarter of the publicly-owned small systems that were operating in the red in 1995 had eliminated their deficits by the year 2000.

Other successes include improved technical performance (violations of drinking water standards have decreased), acceptance of the need for developing technical, managerial, and financial (TMF) capacity, more collaboration between entities, and more regionalization due to capital investment. The "Sanitary Surveys," a form of self-assessment that has been promoted in some regions and states, is recognized as a useful foundation for decision-making. One way that some systems have become more viable is essentially to go out of business and contract with another, better-equipped system for water delivery and distribution management. Not coincidentally, the overall number of small systems decreased by 8% between 1993 and 2002. For those that remain, better data from the assessments, better training for officials and operators, and the use of a variety of planning tools have supported an increase in the availability of financial support. In addition, communication and collaboration between systems has been fostered by the increased involvement of water system directors and operators in voluntary professional associations.

In spite of the successes, the papers in this issue identify gaps in knowledge, training, staffing, and financial resources. When it comes to small drinking water systems, few problems are due to pollution. Most of the problems result from poor planning and management.

First among the noted weaknesses is the ability to measure managerial capacity, especially for use in the creation and deployment of training programs. There is a need for more information on the behavior of managers. The perceptions, attitudes, and opinions of managers affect their behavior. Their concern for how their rates compare to communities nearby may be irrelevant to consultants and agencies, but the fact remains that managers will still want to know and may be influenced by that information. It may take extra effort to convince managers that each system is different.

While consolidation of systems has been an important trend, it is a phenomenon that needs to be better understood and encouraged. There is a need for additional consolidation and collaboration among vulnerable legacy systems. Some systems are reaching an age where replacement will become imperative. These older water systems may benefit from consolidation (physical linkage) with nearby newer water systems. The additional load on the system can be offset by the revenue generated by the consolidated system, enabling add-on treatment capacity at a cost less than what total replacement would be. However, consolidation can be difficult for communities to accept culturally and politically. Skilled, impartial negotiators, organizers, or facilitators can help in this regard.

There is a need to use information more effectively in managing and operating small water systems. There is too much variation in interpretation of regulations and a lack of broad understanding of the distinctive responsibilities of directors, managers, and operators. A greater consistency in Sanitary Surveys (as could be accomplished, for example, through a common template and minimum standards) would be helpful in assessing the current state of small systems.

Finally, there is a large gap between perceptions of the availability of financial assistance and the actual support that is available from a variety of public and private sources. In particular, set-aside funds in state revolving trust accounts available at low interest to public systems are often underutilized. At the same time, a large number of small systems and the politicians that represent them seek financial grants to solve their problems. Because they do not require repayment, grants shield the recipients from the true cost of the resources they are using and, in the long run, may not do as much as loans to help communities understand the true nature of their local services and to make wise decisions about their provision.

Conclusions

The Safe Drinking Water Act Amendments of 1996 cast a bright light on the challenges faced by small public water systems. In a period when Congress has determined that all water systems should meet increasingly demanding standards for quality and reliability, it has been important to recognize that some systems would have difficulty keeping pace.

The 1996 Amendments created a web of programs designed to help small systems meet the challenge, either on their own or with assistance. The training programs and requirements set forth in the act, the focus on capacity-building, and the mandate for states to develop capacity-building programs, have done much to improve the flow of information and the ability to act on it. Partner agencies, including the Rural Utility Service and technical service providers, add important strands to this web. Nevertheless, this problem will not be solved once and for all. It is important to anticipate the need to sustain training and managerial assistance programs and to remind responsible officials that adjustments and investments will be required year after year as needs change, infrastructure grows old, and new officials and operators assume their responsibilities. The cycle of educating and training needs to be perpetual.

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UNIVERSITIES COUNCIL ON WATER RESOURCES
JOURNAL OF CONTEMPORARY WATER RESEARCH & EDUCATION
ISSUE 128, PAGES 6-12, JUNE 2004

Social Aspects of Small Water Systems

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The cost, safety, reliability, and flexibility of small water systems depend on the people who manage them and the socio-political-economic setting in which these individuals operate. Management is more than the technical operation of water systems. It is the governance of the community, and how water fits into the community's present and future. In small communities, the management system is ill-equipped to actively address change. Moreover, as systems built over 30 years ago begin to crumble, the old model of management is not effective.

There is a great deal of science to inform rural citizens about the state of their infrastructure, the quality of their water, and the threats to that quality. However, much to the distress of scientists, technical advisors, and federal and state public servants, data about these threats seem to be ignored. Consequently, the physical and financial viability of many small water systems continues to decline until the U.S. Environmental Protection Agency (EPA) informs citizens that their system is not in compliance. This situation produces an emergency response but not a rethinking of how to manage a water system to meet the future needs of the residents and businesses it serves.

How can multiple community capacities be built to move management from having to do something to wanting to act in the community's long-term interest? In considering this question, it is helpful to look at the pyramid of social control (Figure 1). The left-hand side of the pyramid shows the positive sanctions that encourage positive behavior, while the right side shows the negative sanctions that encourage negative behavior or which must be imposed to make sure that positive behavior takes place. In general, we all prefer positive sanctions. The left-hand base of the pyramid is where we want citizens and management to be: they want to do the right thing, and know how to do it. Much of our educational efforts are aimed at one part of those negative sanctions: those who want to do the right thing, but do not know how. This is the least intrusive form of helping management act in a way that is socially, fiscally, and environmentally responsible.

The next most effective action—in either helping or hindering good management—is social pressure. Many small towns have what Vidich and Bensman (1968) call a "low tax ideology" that is often translated into a low rates ideology. That ideology is generally reinforced by the notion, "If it ain't broke, don't fix it." The lack of capital accounting—an important part of a modern economy (Weber 1978)—by governments at all levels in the United States, means that managers and citizens have no idea of what their current infrastructure is worth or its replacement costs. Thus, depreciation of that critical community asset is not carried on the books, and there is no reserve to use for replacement or repair. And if there is a reserve, it is not invested in timely maintenance or used to help pay replacement costs for new equipment. Thus, peer pressure can lead to poor management. In communities where there is a sense of actively preparing for the future, however, the meaning of fiscal responsibility is quite different. The norms and values of these communities support asset maintenance and forward planning.

Economic sanctions are often used to encourage effective management. Grants or low-interest loans

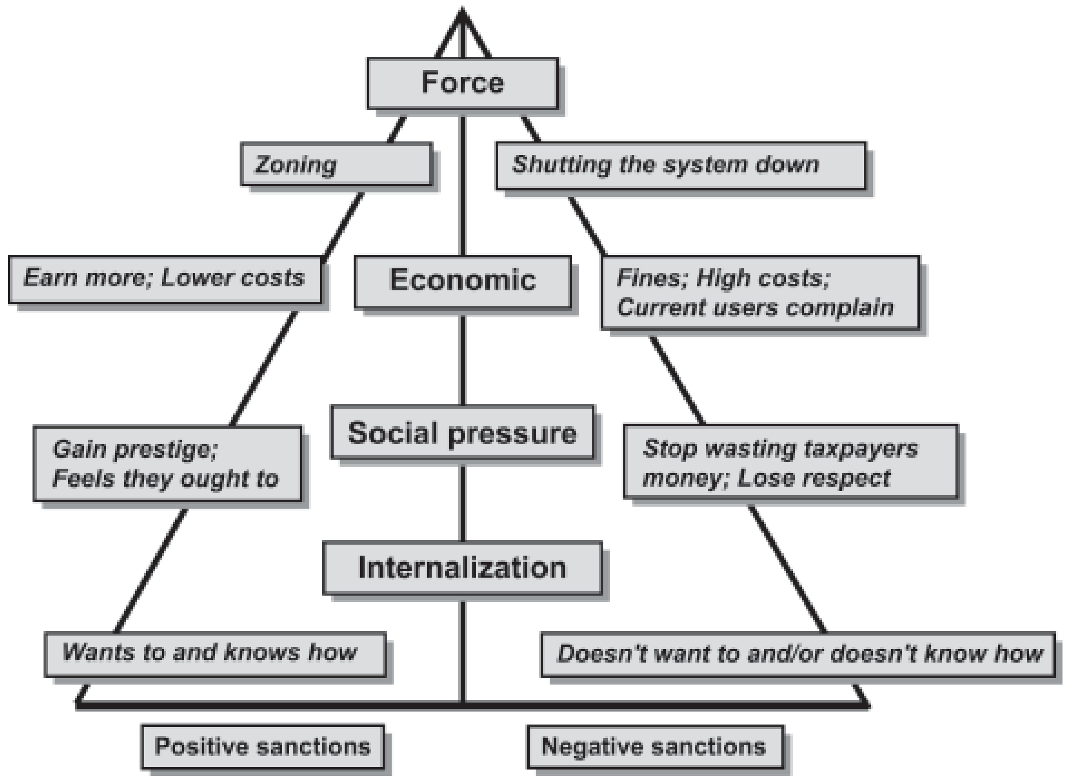

Figure 1. Pyramid of Social Control.

are given to water systems to replace old equipment, or the federal or state government can fine non-compliant systems.

Finally, if sanctions fail, force is applied. The system may be merged into a larger rural water system, or state or federal agencies can shut it down.

When local operators and officials feel overburdened with decisions they feel too busy to make, outside entities impose more obtrusive forms of social control. Thus, instead of being leaders marshalling the resources of the community in accordance with community goals and objects, operators and officials blame the outside for decisions they did not make, thus reinforcing the victimhood of the small community. Often, they feel that if they just wait long enough, a positive economic sanction in the form of a grant will appear, saving them once again from setting priorities and making decisions. This "cargo cult"[1] mentality is not unreasonable as they observe other rural water systems, but it leads neither to collaborative community governance nor an increased ability to manage the system and the community in a fiscally and environmentally responsible way.

How do technical assistance providers help community leaders move away from the emergency response mode, where they either feel like victims of uncontrollable outside forces or that resources will arrive through political connections to solve their problems for them?

Motivation for Sustainable Management

Our research suggests that to move from reaction to action, communities need a collective vision of their future existence. Often an outside facilitator, such as a cooperative extension educator, may help them arrive at a collective vision. For the technician working with water programs, collaborating with organizations that have the expertise to help form a vision that can be the basis for considerations of infrastructure can be critical. Such collaboration does several things. First, it models inter-institutional relationships where resources, knowledge and credit are shared for a common end. Second, it builds a rationale for deciding on alternative paths to infrastructure development. Third, it helps build accountability for the results of decisions and a mechanism for adapting management in light of the degree to which the community seems to be moving toward their goals.

Once there is some agreement on a community's desired future, which is tacitly acknowledged by local elected and appointed officials, leaders of local organizations, local business managers, and state and federal entities with which the community works, the community can assess the resources it has to move toward those desired future conditions. At the present time, federal and state income shortfalls mean that pleading great need will be less convincing than showing that a good basis for investment exists. Further, the current fiscal crisis means that collaboration to leverage resources will be required for success and sustainability.

Community Capitals

Capital includes resources used to create new resources. Small rural communities must turn resources into different forms of capitals, first by identifying them and then by investing in them. Flora et al. (2004) have identified six forms of capital that communities must identify and transform for sustainable development: natural, cultural, human, social, political, and financial/built. Figure 2 shows these capitals and how they overlap. Natural, cultural, and human forms of capital are the basic resources that can be transformed into social, political and financial/built capital.

Natural capital

Natural capital includes the environment—altitude, longitude, climate, slope and other geographic configurations that cannot be changed, although humans build structures and move earth in attempts to overcome them. Natural resources—water (ground or surface) and its quantity and quality, soils, and biodiversity (plants and animals)—are also part of natural capital. These resources can be altered by human action, generally negatively. Together, the environment and natural resources make up the base around which humans act.

Cultural capital

Cultural capital is a human construction that often arises from responses to natural capital. Generally, it is created over generations and includes ways of knowing (what is accepted as evidence), language, ways of acting, and defining what is problematic. Cultural capital determines how we see the world, what we take for granted (as urban migrants take functioning water and sewer systems), what we value (cheap services), and what things we think possible to change (the Commissions or Town Council would never agree to a rate hike). Hegemony allows one group to impose its cultural values and reward system on others.

In a society as mobile as that of the United States, people bring cultural expectations about natural capital that cause it to further deteriorate. For example, migrants to Phoenix, who often moved to avoid the allergies that were a part of the natural capital of the humid eastern United States, immediately planted lawns and flowerbeds requiring huge amounts of water. Through evapotransporation, the humidity of the area then increased, allowing allergenic species to thrive and causing the migrants to have the same allergies they had moved to escape.

Human capital

Human capital is the native intelligence, skills, abilities, education, and health of individuals within a community. Many assume that small communities lack human capital. But this perception is more a result of the community's size than its native intelligence or lack of specific skills. Because of the small community's size, there is not the diversity of skills, education, and training that exists in larger places. Public officials and citizens must take on as volunteers (or volunteered) multiple responsibilities that are carried out by complete departments in cities. When they struggle to fulfill these responsibilities, outsiders often attribute those struggles to lack of native intelligence, rather than task overload.

These three forms of capitals make up the base of any community. When working with local people to resolve the issues surrounding water, wastewater, and other environmental issues, a technical service provider needs to be aware of these bases.

Social capital

Social capital is a community characteristic based on the interactions among individuals and groups. It includes mutual trust, reciprocity, collective identity, cooperation and a sense of a shared future. Bonding social capital consists of interactions within specific interactions among social groups.

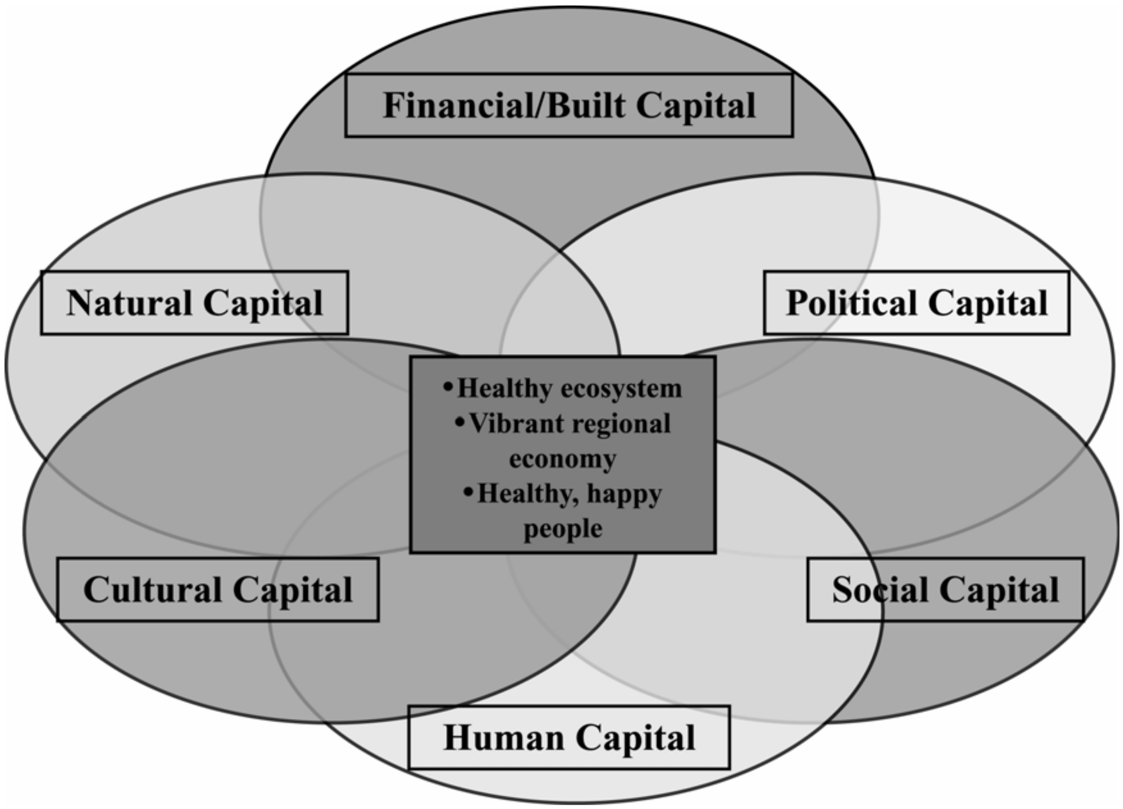

Figure 2. Intersections of forms of community capitals for successful water system management.

Often small communities have very strong bonding social capital that makes them suspicious of outsiders there to "help" them. However, strong bonding social capital does not mean that everyone in town gets along. When there is strong bonding social capital, there are often strong divisions and cliques that keep the community from effectively organizing in its own behalf. Research by Hernandez (2003) and others suggests that bridging social capital must be present to overcome local "boss politics," where one individual controls access to the outside and hands out favors to those who serve his (or very occasionally, her) interests. When only bridging social capital exists, the community does not work together. While there are many connections to the outside, the efforts of community residents and groups go toward outside interests and causes. Outside programs or agencies determine what is done locally, so there are often diverse projects that are not integrated and sometimes contradict each other. For example, the county economic development director attempts to bring in a manufacturer that uses a huge amount of water at the same time construction begins on a water plant that cannot accommodate the waste products or the water demands of the new industry. There are different ways that the two types of social capital can be balanced—or brought out of balance—in small rural communities. Conditions are best when both bonding and bridging social capital are moderately high. Citizens have a collective vision of the future of the community and can mobilize resources both internally and externally to move toward that future. When both are low, communities are highly disorganized and mechanisms of social control are practically non-existent. These rural places often have high crime rates. There is no collective decision making that is cumulative, and governing bodies change often and undo the work of the previous administration. When bonding social capital is high and bridging social capital is low, the community rejects actions and ideas from "outsiders"—which includes anyone whose grandfather is not buried there. There is often factionalism within the community. When bridging social capital is high and bonding social capital is low, the community changes in response to outside initiatives without the local ownership necessary for maintenance or effective utilization.

Political capital

Political capital is the ability of a community to influence the distribution of resources and to determine which resources are made available. Political capital includes voice, organization, connections and power. In small communities, there is a tendency to rely on political connections—the representative, senator, or legislator—to mobilize resources, rather than building the ability of the community to plan and to follow the rules and regulations that determine rational governmental resource distribution. There is evidence that such "pork" is increasing, ultimately defeating the democratic processes that can determine universal decisions about the distribution of public resources.

Financial/Built capital

Those that use only political connections see financial capital as the major goal; they give little thought to how to utilize and maintain the built capital that it is designed to construct. Financial capital includes debt capital (e.g., bond issue or a low-interest loan from a governmental entity), investment capital (e.g., when an industry pays for a portion of sewer system expansion to make possible that expansion), savings (e.g., when water rates setting allows for repair and replacement), tax revenue (e.g., to support water and sewer systems or repay a bond), tax abatements (e.g., to support new industries), and grants, which are not only the favorite source of funding, but also a primary contributor to the cargo cult mentality and to victimization (e.g., when a grant is not awarded).

Community Participation

While infrastructure can be built without participation, it is necessary to achieve development of all the capitals (Gasteyer et al., 2002). By carrying out a meta-analysis of participatory practice, we identified nine elements of participation. We then sampled from U.S. water systems, stratified by size, region, and ground/surface water source. We gathered secondary data and conducted interviews with key informants in each water system to determine the state of the six capitals before and after the implementation of the latest change in the water system and to learn which elements of participation were used in its implementation. We found that the more elements of participation employed, the higher the impact on a greater number of capitals.

Elements of Participation

Context Specificity (Uniqueness of place)

Each community's unique array of capitals determines the possibilities and limits of infrastructure installation and maintenance. While the tendency is to focus primarily on natural capital, better system design and implementation often result from working with the community to identify and acknowledge the presence and impact of the other capitals. Often a community development professional can partner with a technician who feels uncomfortable with issues surrounding cultural, human, social, and political capital.

Collective Vision (Sense of place is made explicit)

Once a community's capitals are acknowledged, it has a sense of the current conditions and thus a way to begin making decisions about desired future conditions. This step is critical because it moves the community from passive emergency response to strategic readiness.

Diverse Perspectives

The old model of getting things done was to get to the decision maker, tell that person what to do, and help them do it. But if diverse perspectives are not present in decision making, all the technical expertise in the world will not create a sustainable water system. Thus, decisions around the specifics of a water system should include people drawn from business, education, health care, real estate, youth, and civic organizations. Often those diverse perspectives can help link a system to place and the people who will use it and pay for it.

Facilitating Impartial Agents

While making decisions about water systems—rates, expansion, repairs, etc.—may seem purely technical, these questions are often quite contested. Someone, either from within the community or outside, who is trusted by various factions within the community, can greatly help in reaching sound decisions that will actually be implemented or supported.

Group Inquiry (Negotiate evidence)

One of the real issues in rural water systems relates to what constitutes an adequate, safe water system. Generally, the standards come from outside the community, most often the federal government. For many small communities, especially those with a strong sense of victimhood, federal regulations make no sense. They are viewed as something that a bureaucrat thought up at her or his desk with little or no understanding of local context. Thus, it is critical that federal agency representatives are part of the process in determining the indicators of system success. The regulator's tendency to say, "That part per million is the regulation; thus you are not in compliance" is strong. Yet it is important to link the standards derived on the basis of scientific generalization to the local sense of what is good water. As monitoring and reporting are critical parts of system compliance, the more widespread the responsibility of monitoring and more regularly it is reported (not only to the government but also to local citizens) the better. And the more it is reported in a way that is meaningful, the greater the legitimacy such regulation and the regulator will have. Surface water monitoring efforts involving youth have proven successful. Involving high school science classes in monitoring and reporting could be one way to increase community understanding about the importance of system maintenance and human health.

Participatory Contract (Who is accountable for what to whom, including funders)

In participatory management of any complex system, it is critical to be clear about who is responsible for what and when. It is also important to spell out the contingencies of performance. For example, USDA/RD will initiate a new program in which you can participate WHEN Congress passes the appropriations bill and IF the administration's funding request is met. Likewise, local water systems may be able to act only if local citizens agree to pass a revenue bond to fund improvements or expansions. Just because there are contingencies does not mean that no one is responsible. It also suggests that more time should be spent on dealing with contingencies and less on blaming the other parties as projects stall.

Monitoring, with attention to outputs & outcomes

Once the evidence has been negotiated, monitoring is relatively easy. Water systems impact all community capitals, and good monitoring systems look at all capitals, linking them to the aspects of development over which the community and its collaborators have some degree of control. Monitoring allows all parties to see if the multiple benefits of a water system are being achieved and at what cost.

Sustained Systematic Learning (Measure, reflect, act, measure, reflect . . .)

Monitoring can be ritualized into reporting numbers, with no reflection on what those numbers mean in terms of future action. That is the danger of having only one person doing the monitoring and reporting to outside agencies. Unless there is reflection on the meaning of the change in indicators over time (by both the community actors and government agencies), there is little chance that future actions will improve performance. Often, when local, state, or federal agencies fail to give feedback on the monitoring, it becomes lax. As a result, there is no learning occuring at any of the levels of responsibility and supposed accountability.

Evaluation in the context of the whole community

It is not enough to report back to the city council that the system is now in compliance. While that information can yield a sigh of relief—"The Feds are off our backs" or "We'll get the next grant"—it does not tell us whether the community is moving toward or away from its desired future conditions as a result of infrastructure investment. This type of evaluation can only be carried out if the community has a collective vision of its future with respect to all six kinds of capital. Otherwise, the focus will be linear, of interest to only a few citizens, and unlikely to maintain the type of participation necessary for small communities to thrive.

Conclusions

Although sustainable water systems often seem entirely dependent on technical expertise and funding, community participation has an impact not only on the system's sustainability but on community sustainability as well. We have found that the larger the numbers of elements of participation that are in place, the more likely water systems are associated with multiple community benefits. While the technician may not be skilled in putting these elements in practice, the extra collaborative effort necessary to involve those with skills in the planning and implementation process has long-term positive pay-offs. While the transaction costs might appear high at first to an individual who is most interested in getting the engineering right and who must share credit for a successful project, the long-term community sustainability of such actions are worth the investment.

However, it is not just a matter of the individual technician. The supporting agency—whether for profit, not-for-profit, or governmental—must support and encourage such action through its reward structure. Otherwise, those on the ground who do collaborate get burned out, not only in building effective coalitions, but in defending the time invested in them to their employers.

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Notes

[1] Cargo cults were observed by anthropologists on Melanesian Islands accompanying colonists, missionaries and military. Huge objects came out of the sky or from the water, disgorging all sorts of wonderful things that were used by the military or the colonists–and sometimes shared with the local people. The appearance of the cargo was unexplainable. Nothing in their past experience could explain it. Thus the "silver birds"–and their contents–became objects of hopes and rituals, often keeping people from their ordinary productive work as they sought to somehow appease the gods so that they would receive more cargo (Wilson 1973).

Universities Council on Water Resources
Journal of Contemporary Water Research & Education
Issue 128, Pages 13-20, June 2004

Technical Assistance Needs and Research Priorities for Small Community Water Systems

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Drinking water supplies in the United States are among the safest in the world. This is primarily due to the system of national drinking water regulation and monitoring that began with the passage of the Safe Drinking Water Act in 1974. Currently, approximately 94% of the U.S. population is served by community water systems that meet all existing health-based standards (U.S. Environmental Protection Agency 2002b). However, the burden of meeting these regulatory demands falls most heavily on the nation's smallest systems. These systems face numerous community, economic, and environmental challenges in operating and maintaining their systems and meeting regulatory guidelines (Cromwell et al. 1992; National Research Council 1996; Shanaghan 1994).

Numerous initiatives have been employed to improve small systems' viability. Technical assistance programs from non-governmental organizations, funding assistance from state and federal agencies, promotion of regional approaches to water delivery systems, and operator training programs are some of the efforts that have targeted different facets of the small system problem. The most recent amendments to the Safe Drinking Water Act (1996) included many provisions that address the needs of small systems. One of these provisions authorized nine Technical Assistance Centers to serve small systems, including the Midwest Technology Assistance Center (Midwest Technology Assistance Center 2003). MTAC's mission is to "provide small system administrators and operators with the information necessary to make informed decisions on planning, financing, and the selection and implementation of technological solutions to address their needs" (MTAC 2003).

As part of its mission, MTAC sponsored a study to establish benchmarks of economic and managerial capacity for small systems (Dziegielewski et al. 2000). This paper reports on that benchmark study; specifically, it reviews (1) the status of drinking water systems in the Midwest and (2) the expressed need of system managers for assistance.

Small Water Systems in the Midwest

Many of the problems of small drinking water systems are directly related to their institutional, economic, financial, and physical characteristics. The following review of water system characteristics was prepared to support the workshop discussion, provide insight into the challenges of small system management, and suggest potentially beneficial research and intervention activities. Much of the information presented came from the Environmental Protection Agency (EPA) Safe Drinking Water Information System (SDWIS) data and annual "Factoids" reports, which are available on the EPA website (U.S. Environmental Protection Agency 2003a; 2003b). A second source of data was information collected during the MTAC benchmark study. This study was designed to solicit participation from the many different constituencies that make up the small drinking water community using a variety of interactive approaches. Details on the data collection components of this project can be found in the final project report, which is available on the MTAC website (http://mtac.sws.uiuc.edu/finalrep.asp).

Review of USEPA Data for Midwestern Water Systems

The most obvious challenge in improving the management of small systems is the sheer number of systems. There are nearly 55,000 public water systems in the 10 states in EPA Regions 5 and 7, the area generally considered to be the Midwest. Nearly 80% of these systems are non-community systems that serve very small transient and non-transient populations. These non-community systems serve only about 10% of the nearly 58 million people in the Midwest who use public water systems. The other 90% of public water system consumers are served by community water systems (CWS), broadly defined as those that serve more than 25 persons, or 15 connections, year round (Table 1).

Economies of size are significant in water system operation and have a profound effect on system management. EPA defines small systems as those serving 3,300 people or less. Although small systems serve only about 10% of the community systems population, they constitute more than 80% of the total number of systems. Nearly 6,000 very small systems serve populations of less than 500. These smallest systems are at a distinct economic disadvantage.

The type of source water available determines the kinds of challenges a system will face in providing safe, affordable, and sustainable water services to its customers. Although groundwater systems must respond to fewer regulatory requirements, they may also be at risk from inappropriate wastewater disposal and agri-chemical pollutants. The great majority of water systems in the Midwest are groundwater systems (Table 2). Smaller systems are most likely to use groundwater sources.

System ownership also influences the economics and performance of water systems (Table 3). Systems controlled by local governments generally operate outside of the scope of state regulatory bodies that oversee rates, revenues, and record keeping. Local government systems have also had better access traditionally to subsidized loans and grants. Control of expenditures by these systems is also under the direct control of local officials, who are in-turn responsible to voters.

Nearly 60% of all community water systems are operated by local governments, and these systems serve more than 80% of CWS customers. As systems get smaller, the percentage of private ownership increases. Nearly 60% of very small systems are privately owned, however, more than half of the population of very small systems is served by local government systems (Table 4).

SDWA standards stipulate the maximum level of contaminants (MCL), required treatment techniques (TT), and monitoring and reporting requirements (M/R). Ultimately, SDWA compliance is the measure of water system performance of greatest importance to consumers and regulators. EPA is required to issue an annual report of national compliance, which includes a review of violations by systems size. Table 5 compares the number of SWDA violations by system size.

The proportion of total violations for the very small size category (73%) is much larger than the proportion of systems in this category (57%). Monitoring and Reporting (M/R) violations dominate all size categories (nearly 60% of all violations), and more than 80% of M/R violations are accounted for by very small systems. EPA considers MCL and TT violations to be the most serious and classifies these as health-based violations. These violations appear to occur in proportion to the number of systems in each size category. It should also be noted that violations by the few very large systems have the potential to affect a much larger number of people.

Survey Responses of Midwestern Water Systems

Additional details of the characteristics of small public water systems in the Midwest can be found by reviewing the 350 responses to the MTAC benchmarking study mail survey. Some of the characteristics of responding systems are:

Population served:
50% serve 500 customers or less
Water source:
57% groundwater; 23% purchased water
Ownership structure:
55% municipal
Age of systems:
44% built between 1951 and 1975; 20% pre-1951

Information from the survey responses was used to prepare the infrastructure, financial, and

Table 1. Number of Public and Community Water Systems and Population Served in the Midwest

System type	Number of systems	Population served by systems	Percent of CWS	Percent of population served
Public Water Systems	54,472	57,596,201	--	--
Community Water Systems	11,683	52,008,475	100	100.0
Small (≤3300)	9,750	6,278,475	83	12.1
Very Small (≤500)	5,899	1,090,037	50	2.1
Very Small (≤100)	2,359	141,086	20	0.3

Source: U.S. Environmental Protection Agency, 2003b

Table 2. Dependence of Midwest Community Systems on Groundwater. Number of Surface and Groundwater Systems in the Midwest with Percent of Populations Served

System	Ground-water systems[a]	Surface water systems[a]	Percent groundwater systems	Population served by groundwater systems
Community system	9,532	2,001	82.6	56.8
Small systems	8,513	1,237	87.3	80.0
Very small systems	5,648	469	92.3	89.8

Source: U.S. Environmental Protection Agency, 2003b
[a]Number of groundwater and surface water systems do not sum to totals above because some systems did not report water source.

Table 3. Ownership Structure of Community Water Systems in the Midwest

Ownership type	Number of systems	Population served	Percent of systems	Percent of population served
Local government	6,947	41,660,580	59.5	80.1
Private	4,443	9,748,141	38.0	18.7
Public/Private	146	242,148	1.3	0.5
State government	96	220,650	0.8	0.4
Federal government	31	130,808	0.3	0.3
Unknown	15	3,280	0.1	0.01
Native American	5	2,868	0.04	0.01
Total	11,683	52,008,475	100.0	100.0

Source: U.S. Environmental Protection Agency, 2003b

Table 4. Ownership of Very Small Community Water Systems

Ownership type	Number of systems	Population served	Percent of systems	Percent of population served
Private	3,472	460,466	58.86	42.24
Local government	2,259	595,312	38.29	54.61
Public/Private	101	20,295	1.71	1.86
Sate government	39	9,581	0.66	0.88
Unknown	13	1,049	0.22	0.10
Federal government	12	3,017	0.20	0.28
Native American	3	317	0.05	0.03
Total	5,899	1,090,037	100.0	100.0

Source: U.S. Environmental Protection Agency, 2003b

management "profiles" of small systems in the Midwest. In terms of infrastructure characteristics 40% of systems had no water treatment; another 10% reported chlorination only, and 80% operate storage reservoirs. Also, 24% of systems had no water meters; these were mostly mobile home parks or homeowner associations serving less than 100 people. The miles of transmission and distribution line per 100 connections were significantly greater for smaller systems. In terms of system growth, 59% reported increased population served over the past 5 years; 8% reported decreases.

With respect to the financial profile: 17% of systems reported total revenues that were less than total costs, 47% had no debt; 61% of systems were serving less than 500 customers, and more than 35% of the systems with less than 500 customers had no reserve fund. Also, 30% of systems received technical assistance in financial analysis, and 36% have used capital financing/grants/loans. In terms of water rates, the mean monthly charge was $25.80/6,000 gallons/month. Also, rates charged by municipal systems and groundwater systems were lower than average rates while systems serving 101-500 customers charged the highest rates. An interesting finding was that 51% of responding systems had no rate increase in the past 5 years.

Finally, with respect to the management profile, 50% had one or less full-time employee including 10% of systems that had no paid employees. Other noteworthy management characteristics indicate that: 30% had at least one M/R or MCL violation between 1996 and 1999, only 17% of systems reported "unaccounted for" water, 80% reported preparing some type of financial report or statement. However, 56% did not report enough information to calculate net revenues; most systems reported only revenues, and many systems did not report cost data. Only one-third of systems used financial indicators, while 30% received assistance in financial analysis, and 86% of systems serving over 1,000 people used contract services.

Implications for Operational and Financial Characteristics

Several summarizing statements can be made regarding the existing circumstances of small water supply systems in the Midwest:

-The very large number of small systems greatly increases the difficulty of regulatory monitoring and the provision of technical assistance.

-The dominance of private systems in smaller size range may make it more difficult to organize efforts to provide assistance.

-Greater reliance on groundwater makes small systems less likely to require expensive treatment but more difficult to assist if groundwater sources are affected by pollution or lowered water tables—two common problems in rural agricultural areas of the Midwest.

-The greater occurrence of safe drinking water violations in smaller systems requires investigation and remediation.

-Many aspects of the small-system profile point to the difficulties of effective operations and management: aging systems, one or less employees, low population densities, inadequate

Table 5. Number of Violations by System Size in United States for 2002

Description	System size					
	Very small	Small	Medium	Large	Very large	All
MCL violations	2,959	1,066	341	322	5	4,693
TT violations	1,279	662	226	222	19	2,408
M/R violations	59,415	12,787	4,488	3,363	582	80,635
Other violations	8,805	2,127	492	311	24	11,759
Total violoations	72,458	16,642	5,547	4,218	630	99,495
Percent total violations	72.8	16.7	5.6	4.2	0.6	100
Percent health-based viol.	59.7	24.3	8.0	7.7	0.3	100
Percent systems	57	27	9	6	1	100
Percent population served	2	8	10	36	45	100

Source: U.S. Environmental Protection Agency, 2003a[a]

[a]The Factoids report does not contain a size breakdown for violations by individual state. However, the percent of Midwestern systems with violations (26%) compares well the percent nationally (22%) as does the percent of the population served in the Midwest (23% in the Midwest versus 20% nationally).

record keeping, infrequent rate increases, expanding service populations, and lack of access to technical assistance.

These conditions point to the limited capacity of small water supply systems to deal with the mandates of the SDWA and maintain an adequate level of water supply services. System managers, technical assistance providers, and regulatory officials are all aware of these circumstances, and they presented numerous suggestions for how they might be addressed during the benchmark study. Some of these are discussed in the following section.

Expressed Needs of Small Water Systems

In each component of the benchmarking project, water system managers, technical assistance providers, regulatory officials, consultants, and researchers presented their experiences with managing and improving small systems. These comments were reviewed to identify problems and needs that could define the technical assistance, training, and research response from MTAC and other technical and financial assistance organizations.

Financial Issues

Financial issues, especially water rates, dominated the discussion in all research contacts. For example, the first question of the mail survey asked respondents to list and rank anticipated management decisions. The highest ranked decision was to increase water rates, followed by the need to expand water service to new areas, to locate funding assistance and the need to adjust rate structures. Other concerns cited by survey participants centered on infrastructure issues and restructuring actions.

The discussion and comments about water rates also focused on the chronic under-pricing of water services, often driven by local decision makers' desire to keep rates as low as possible. Financial performance was also hampered by poor record keeping, co-mingled community accounting systems, and the use of water system revenues to address other community needs. Finally, study participants reported that small systems almost inevitably lacked reserve funds to help them through difficult periods.

Infrastructure and Operational Issues

Numerous comments from participants pointed to the need for most small systems to replace antiquated and inadequate infrastructure. Aging transmission and distribution lines were cited as the system component most in need of replacement. It was also reported that small systems find it difficult to find and retain trained, certified water systems operators and knowledgeable municipal or water board decision makers who understand the consequences of poorly financed water systems. Finally, managers are uncertain as to how and when to consider restructuring alternatives such as purchasing treated water from a nearby system, selling their system to a larger entity, or pursuing some form of contract or remote management.

Financial Assistance Issues

Contradictory viewpoints were expressed on the topic of financial assistance. One perspective was that grants or low interest loans used to rescue failing systems actually provide a perverse incentive for poor management. The other viewpoint was that the highly structured loan repayment programs set up by lenders such as the USDA Water and Wastewater Program were instrumental in promoting fiscal responsibility and good record keeping. Study participants also found it difficult to locate and access funding assistance. Technical assistance organizations that provide financial information and training did receive high marks whenever they were mentioned by study participants. However, they were mentioned very infrequently in the study components, and private consultants (accountants, engineering firms, bankers, etc.) were cited most frequently as the providers of assistance on financial matters.

Communication Issues

A failure to communicate effectively appears to be at the core of many small system problems. Failure to communicate a water system's financial position to consumers makes it difficult to earn their support for new fees or rate increases to support needed system expenditures. A similar failure in communication with elected officials and water boards prevents these decision makers from responding to urgent systems needs in a timely fashion. Poor communication between water systems prevents the exploration of cost-saving cooperative efforts, such as sharing of personnel or expensive equipment, development of emergency interconnections, and money-saving bulk purchasing of supplies. Finally, a surprising number of comments expressing distrust of government agencies and other water systems were recorded during the study.

Community Issues

Many respondents linked water system performance to community capacity or the resources and abilities within the community itself. Poor water system management was often a reflection of poor community management. Communities with a high percentage of low-income residents or senior citizens on fixed incomes are often the most vulnerable. Community commitment is critical to the operation of effective community water systems, and virtually all best-performing water systems are run by an individual or group of individuals who are willing and able to demonstrate leadership and commitment.

Implications for Training and Research

Technical Assistance and Training

The shortcomings and difficulties in managing small water systems point to a continuing need for technical assistance and training. Our research indicates four areas where technical assistance and training are most needed.

Development and implementation of water rates

The topic of water rates dominated participant feedback. System managers, technical assistance staff, and regulatory officials all commented on the difficulties of establishing full-cost pricing and the inability of many systems to raise adequate revenues. Standardized methods of rate calculation would provide water managers and governing boards with an externally validated way of translating costs and revenue requirements into customer charges.

Financial management training

Accurate records are required to prepare effective water rates and calculate financial performance measures. Only four out of 10 participating systems prepared monthly financial reports, and only half reported using an annual budget. Training and assistance to develop standardized record keeping procedures would benefit small systems. This financial training would be most effective if it included village/system clerks as well as appointed or elected "decision makers." Improved systems to access information on funding sources for small water systems would also be beneficial.

Improved communications

The management and financial needs of small water systems are rarely well understood by members of the communities they serve or even their own rate-setting bodies. The actions taken to provide safe and reliable water are largely invisible, particularly when efficiently done. Consequently, consumers will only learn to value these services when system costs and needs are clearly communicated. Water system operators could benefit from training in techniques that help them to communicate system needs to the community decision makers and to the public. Even very small communities would benefit from careful preparation of periodic public awareness events and press releases to the local media.

Improved delivery of technical assistance services

Only 30% of survey respondents had used the services of technical assistance providers. There appears to be a need to explore avenues for enhanced opportunities for technical assistance to small water systems. Two possible improvements were suggested by study participants: (1) development of a system for coordinating technical assistance from different sources and (2) development and implementation of "peer-to-peer" technical assistance within states or small regions that cross state boundaries.

Research Needs

While the existing knowledge base on the physical, financial, and management aspects of small water systems is substantial, several areas of additional research may be beneficial.

Case studies of best-performing systems

The development of a peer-to-peer assistance programs would require a method to identify a set of best small water systems. One repeated observation from the MTAC benchmarking study was that most small systems already provide safe, affordable water services. Case studies could demonstrate the paths and techniques that these best performing systems used to achieve sustainability. Troubled systems can learn from their example.

Consumer perception of water prices and costs

Consumer opposition to periodic water rate increases is a serious obstacle to the improved financial management of small water systems. Research on the consumer perceptions of the costs of water supply in their community as well as the acceptability and affordability of water rates would be beneficial to system managers and governing bodies. Misconceptions and unreasonable expectations about the real costs of water system operations are likely to underlie much of the opposition to increased water rates. It is important to emphasize that any study of consumer perception should be supported by an analysis of system water rates to ensure that system managers and decision makers in study communities are indeed following a path of least-cost for the provision of water supply services.

Criteria for sustainability and restructuring alternatives

Caught between aging systems, a history of inadequate rates, and myriad other problems described by participants in the MTAC benchmarking report, a substantial number of small community systems are currently facing the possibility of restructuring. System managers need a set of criteria that would help them to determine whether to make the substantial financial investment required to maintain independent services or to turn over some or all of their operations to external service providers. System managers would also benefit from knowledge of their restructuring options and avenues for entering into negotiations with other providers.

Purchased water contracts and regionalized alternatives

Increased regulatory stringency, depletion and pollution of local water sources, and economies of scale in water treatment all suggest that purchased water arrangements will become an increasingly attractive option for improving water services to small communities. Participants in the benchmarking study reported both successful and problematic institutional arrangements for purchased water services and other regionalized arrangements. Documentation of these arrangements and the lessons learned during their development would be beneficial for system managers who are considering such actions.

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Universities Council on Water Resources
Journal of Contemporary Water Research & Education
Issue 128, Pages 21-26, June 2004

Funding the Future: Meeting the Costs of Capital Replacement

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In 1996, significant amendments to the Safe Drinking Water Act (SDWA) were adopted that reflected the concerns of many in the drinking water industry to define the performance of water utilities in broader terms. Prior to this time, water systems that were providing safe drinking water on a consistent basis were considered "viable," and failing systems were termed "non-viable." The SDWA amendments discarded this binary measurement system and formalized the idea of "capacity," which now encompasses the technical, management, and financial aspects of delivering safe drinking water to the public. Instead of a pass-fail basis of measuring performance, capacity could be measured along a continuum. This article focuses on the measures of financial capacity that reflect the commitment of managers and boards of directors regarding the long-term funding requirements of drinking water systems.

This new concept of capacity required the regulated community of water systems—as well as the regulators and other stakeholders—to develop measures of capacity to determine the point upon the capacity continuum where systems would be more likely than not to be sustainable. State drinking water programs were required to develop measures of technical, financial, and managerial capacity for proposed water systems as well as for those seeking to borrow money from the new Drinking Water State Revolving Fund (DWSRF) for system improvements. Many states have used those capacity measures to examine existing water systems and to search for those needing capacity building assistance.

Regarding financial capacity, the Idaho Drinking Water Program uses eleven indicators that describe the fiscal capacity and financial management of water systems seeking state revolving loan funds. Among these are indicators that can be used either to compare the capabilities of water systems that are similar in size or to track financial performance of an individual system over time. From such comparisons, we can draw inferences about the financial indicators that correlate with the reliability, safety, and cost of providing safe drinking water.

Experts believe that the long-term success of water systems is related to keeping their capital facilities in good shape. This means not only investing in the water system when it is built, but also anticipating the costs of replacing it when it wears out. Regulatory agencies have devoted program resources toward improving the sustainability of public water systems. In 2003, the U. S. Environmental Protection Agency (EPA), for example, released two handbooks for water system managers addressing the topics of strategic planning and capital asset management (U.S. Environmental Protection Agency, 2003a; 2003b).

Acting to Reduce Risk in Delivering Essential Services

As required by law and regulation, water system board members and officers are obligated to deliver safe drinking water to their customers. Running a water system like a business is not only what customers want (and assume), it is an appropriate approach given the complexity of the task of producing and delivering safe drinking water. Without good management, a system will not be able to meet future challenges. Poor planning puts the water system finances and its customers' health at risk. As financial capacity measures have been instituted by the state drinking water programs, we are beginning to learn about the relatedness of poor planning and troubled water systems.

Capital Budgeting and Capital Improvements Planning

Within general purpose governments, or as special units of government, utility operations (such as water systems) are considered business enterprises: the full cost of a water system should be supported by the customers who purchase service. Given this expectation, how do water systems perform? Are these water "businesses" in danger of going out of business?

Looking beyond water testing results to discover the viability or capacity of water systems reveals that small water systems can be dangerously close to being unsustainable even while they continue to supply water. Over the past five years, the Environmental Finance Center at Boise State University (EFC) has reviewed the financial capacity of water systems seeking capital improvement resources from the DWSRF—the Idaho Drinking Water State Revolving Fund (20 reviews)—and the Alaska Drinking Water State Revolving Fund (8 reviews). A review of the descriptive statistics generated from the Idaho reviews indicates that smaller systems do a poor job of capital budgeting and capital improvements planning (Environmental Finance Center, 2004). The effects of the lack of long-range financial planning for these water systems are also reflected in their financial records and reports.

In Idaho, 78 % of the systems seeking taxpayer-subsidized low-interest financing from the DWSRF did not meet minimum standards for capital budgets and capital improvement plans. These water systems presented no evidence that future infrastructure needs had been identified, either for replacing worn-out assets or for acquiring the new structures or materials necessary for supplying safe water. Not surprisingly, these DWSRF applicants presented neither a funding strategy nor a capital budget for existing or proposed infrastructure improvements.

Given the lack of evidence of formal long-term planning, is it possible that some measure of the long-term responsibility for maintaining capital assets is occurring informally, as part of the operating budget? Infrastructure upkeep and repair should be occurring as part of the operating budget as an operating expense. For systems without formal capital budgeting and capital improvement plans, the annual operating expenses could conceivably include some of the longer-term replacement and expansion funding needs of the system because, at the operations level, field staff might not distinguish short-term maintenance and repair from long-term asset or component replacement. A couple of financial indicators may be used to detect if monies are available for the water system to use for capital replacement: the operating ratio and the sales-to-net fixed assets ratio.

A common financial indicator—the operating ratio—explains that these small Idaho water systems do not have the excess operating financial resources necessary for sustaining long-term service quality. The median operating ratio (operating revenues compared to operating expenses) for the Idaho DWSRF applicants was 1.33. After operating expenses are paid, the balance of revenues is available for reserves, debt service, and depreciation or system replacement costs. While the median value for the Idaho applicants seems reasonable, one water system demonstrated an operating ratio of 0.90 (the maximum ratio was 2.42). In this case, operating expenses exceeded operating revenues, a situation requiring the commitment of prior-year retained earnings, deficit financing, or some other means to meet operating costs. This is an unsustainable recipe for system operations.

It is not unusual for water system managers to believe that a "balanced budget"—where an operating ratio would be equal or close to 1.0—is acceptable. This view ignores the capital expenses that are essential for system longevity.

Another common financial indicator that underscores the responsibility to fund capital replacement is the ratio of sales to net fixed assets. Assuming that water sales provide the revenues for both operations and capital asset replacement and acquisition, the components of this ratio provide a wealth of information for consideration.

Small water systems require tremendous investments in capital assets before a drop of water can be supplied to their customers. For example, it is not unusual for small towns of one or two hundred people to face the challenge of installing $500,000 of treatment equipment to meet new regulatory standards. Revenues from water sales must support the operation, maintenance, and replacement of facilities needed to deliver safe water. The sales-to-net fixed assets ratio demonstrates the ability of the utility assets to generate sales. If the population served is small, the user fees collected from water sales may be insufficient to support that investment.

The Idaho DWSRF applicants' sales-to-net fixed asset ratio median value was 0.26 and can be interpreted as a return on capital investment of 26%. For most businesses this would be an attractive return on investment. Note, however, that the ratio of sales to net fixed assets for capital intensive businesses must be higher than for capital-lean enterprises. In other words, sales must be generated at a level to support the operational and other non-operating expenses of the capital-intensive business.

The following example demonstrates the challenges a system would face where sales are low in relation to capital investment needs. Imagine a water system that has a net fixed asset value of $1 million, with a sales-to-net fixed assets ratio of 26% (generating water sales of $260,000) and operating expenses of $195,000 (using the Idaho median operating ratio of 1.33). After subtracting operating expenses from sales, only $65,000 remains for debt service, reserves, anad system replacement. Assume further $15,000 of that $65,000 is necessary for annual debt service. The remainder of $50,000 could be available for reserves, system replacement, and capital acquisition expenses. A prudent approach would sequester additional sums for emergencies and professional engineering services—say a total of $20,000 annually. After all of those expenses are counted against sales, only $30,000, or the equivalent of 3% of the asset value, remains for replacement. This is a very small sum for a capital-intensive enterprise.

Business enterprises fund the wear and tear on capital assets used in the production process through sales receipts to replenish their production capability. If a water system's production assets are not expensed to the customers that use up those assets, someone other than those customers will need to replace the system when it wears out. In our example above, the remainder of $30,000—after operating and other expenses are paid—would not come close to the annual expense of capital replacement funding regardless of whether a depreciation or asset replacement methodology is being used to replenish the capital investment in the system.

Although the data set is smaller for Alaska utilities, the EFC's financial reviews show that the median of the sales-to-net fixed asset ratio was only 0.11, which shows that the return on investment for these Alaska water systems was 11% *before* expenses are counted against sales. An examination of net sales to net fixed assets would present an even more discouraging picture of financial sustainability for these same Alaska systems.

With their internal funding for replacement of assets falling far short of the amounts required to replace or improve capital equipment, many water systems are unprepared for the future. In our review of Idaho applicants for revolving loans, 75% of the systems fell into this category. More troubling is that the systems studied are a tiny subset of the 2,100 public water systems regulated by the State of Idaho. Our sample suggests that capital improvement planning and capital budgets are non-existent for the majority of systems and that existing user charges are not sufficient to the fund the full costs of providing service. The costs of replenishing the productive assets needed to provide water service are either ignored or under-funded. If small water systems have similar financial liabilities from state to state, it seems likely that the majority of small systems across the country are underfunded.

What other factors contribute to the problem of sustaining financial capacity? Customer perception of the cost of service, which is conditioned by the price they are accustomed to paying for water, is one factor. Related to that perception are the problems of calculating the full costs of service for a water system to be financially sustainable and of persuading customers that full-cost pricing is necessary.

Customer Perception of Cost of Service

In presenting numerous long-term budgeting, rate setting, and capital asset financing workshops to small water systems in the northwest states of Alaska, Idaho, Oregon, and Washington, some common themes emerge. First, those who attend those workshops are usually motivated by a need for capital financing and a desire to understand the impact of that financing on existing budgets. Second, upon realizing that most capital resources that may be received require repayment with interest, the attendees are anxious to minimize the increase in user charges that may be necessary to support additional debt service. Third, many attendees are not happy to discover that acquisition of capital resources may require that user charges be adjusted to include other costs that have not been incorporated into those charges previously.

It is in these workshops that "reality" meets the customer perception of cost of service. This customer perception is conditioned by the price paid over time for water service. Even if water has been "under-priced"—as compared to the full cost of providing it (the "reality" mentioned above)—customers seem to react to any increases in charges or costs imposed by governments regardless of their legitimacy. More troubling is the "sticker shock" reaction of customers to rapid and significant price increases necessary to compensate for delays in system improvements or failures to properly reserve resources for future capital improvements.

Figure 1 represents the underfunded water system that has not planned for the future and experiences a major unanticipated event that requires additional resources. That event—usually unanticipated because of a lack of proper planning—requires new capital facility funding (debt financing because of a lack of capital reserve funds) and new facility operating funds above the current increasing operating expenses (line ab). The trigger for capital replacement can be a breakdown of system components or a change in regulatory standards that requires new technology. The *new* full-cost funding level (line ef) is above the prior full-cost level (line cd), which was above the level of funding previously supported by user charges. The double arrow represents this change in funding that the customers must now bear. In this scenario, the greater the distance between the current and new full-cost funding levels, the greater the sticker shock and customer resistance to user charge increases.

Returning to the EFC's analysis of applicants to the State Revolving Fund, the customer perception of current cost and future cost relative to capital acquisition should not be a limiting factor to user charge increases. The EFC examined the affordability of the applicant water systems' *current* user charges and *future* user charges relative to incurring DWSRF debt financing. Affordability of user charges has been defined by the State of Idaho as less than 1.5% of median household income. The median values for current and future user charge affordability were significantly below the state threshold of 1.5%. Current charges amounted to 0.76% of median monthly household income while the charges required to cover operations plus needed capital improvements amounted to 1.0% of median household income. This situation leads one to conclude that the real problem is not the affordability of the needed charges but the illusion that is created when rates are held substantially below true costs.

GASB 34: An Additional Driver for Full-Cost Pricing of Service

New accounting standards for government-owned public water systems will have some effect upon managers and board members of water systems regarding full-cost pricing. The Governmental Accounting Standards Board's (1999) Statement 34 requires that governments adequately express the extent to which the public has invested in public infrastructure as well as its financial plan to protect that investment. These requirements became effective for governments with sales of less than $10 million beginning June 15, 2003. Water systems have two options for reporting capital investments and reinvestment to the public. The first approach is the traditional depreciation of assets method, and the other is an asset replacement methodology (modified approach). Finance managers and accountants seem to prefer the depreciation method because it is easier to calculate. The modified approach seems to be preferred by utility managers because it generates an inventory of capital assets which respects the real differences of useful life and condition for specific assets.[1] Professional organizations such as the American Society of Civil Engineers have presented strong arguments for the latter (Koechling, 2004). Water systems seeking to establish full-cost pricing benefit from using the modified approach because its asset management methodology provides detailed information for persuading customers of the need to reinvest in the water system through increased user charges. It is

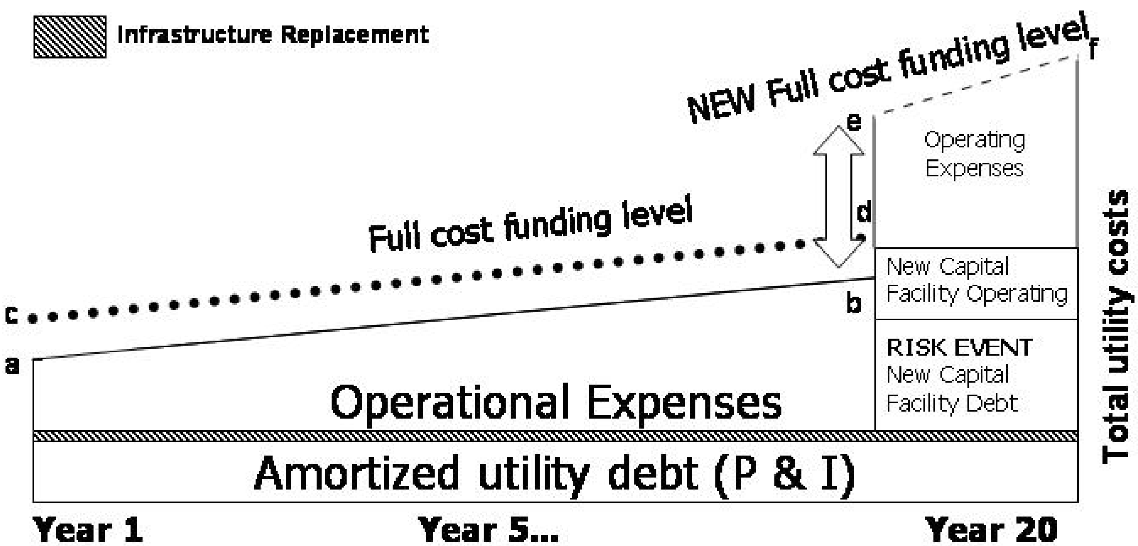

Figure 1. Anticipating the Need for Revenue Over Time: Risk Event Scenario

too soon to tell which approach will be preferred by smaller entities.

Conclusions

The Safe Drinking Water Act Amendments of 1996 transformed how drinking water systems are to be evaluated. The traditional measures of performance relative to the quality of drinking water delivered from the tap have now been expanded to include fiscal and financial management.

As a microcosm of America's small community water systems, applicants to the Idaho Drinking Water State Revolving Fund have a poor record of preparing their water systems to be financially sustainable and resilient in an operating environment that is constantly changing. While further empirical study is necessary, it is reasonable to expect that America's smallest public water systems, as a general rule, are not fully funded through user charges. While operational costs are probably being met in most cases, capital replacement and reinvestment costs are not. This situation poses financial and other risks to the current and future customers and owners of water systems.

A major obstacle to achieving sustainability is customer resistance to rate increases. Failure to adjust rates regularly as the real costs increase lulls consumers into a false sense of the true costs and increases the difficulty of making significant catch-up adjustments. New governmental accounting standards are transforming how information about public infrastructure investment is presented to the customers of governmental water systems. Hopefully, this will help systems to justify more consistent rate adjustments. Sustainable water systems are those that fund the full costs of service and that aggressively plan to acquire and restore the capital assets necessary to consistently provide safe drinking water.

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Notes

[1] The modified method is incorporated in CAPFinance, a software tool developed by the Region 10 Environmental Finance Center to help water utilities develop long-term capital budgets and to incorporate capital costs in user charge systems. See http://sspa.boisestate.edu/efc.

UNIVERSITIES COUNCIL ON WATER RESOURCES
JOURNAL OF CONTEMPORARY WATER RESEARCH & EDUCATION
ISSUE 128, PAGES 27-30, JUNE 2004

Making Small Water Systems Strong

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There are approximately 52,000 "community" water systems (Rourke and Selby 2002) and 16,000 "publicly owned treatment works" or wastewater systems (U.S. Environmental Protection Agency 2002b) in the United States. While the vast majority of water and sewer customers are served by large metropolitan systems, most systems are small and located in rural areas. Due to their small size, these rural systems are generally more expensive to build and operate on a per-user basis, and they tend to have more problems complying with environmental and public health requirements. Many of these systems need special help to serve their customers reliably over the long term.

Within the last few years, the U.S. Environmental Protection Agency (EPA) commissioned two studies of community water systems. One was the Community Water System Survey 2000 (Rourke and Selby 2002); the other was the Clean Water and Drinking Water Infrastructure Gap Analysis (U.S. Environmental Protection Agency 2002a), commonly referred to as the Gap Analysis. These studies revealed that between the years 2000 and 2020 water and sewer systems in the U.S. will experience a cumulative funding shortfall for operating and capital improvement costs of between 500 and 750 billion dollars. We are now several years into that time frame, and there is little evidence of progress toward erasing the looming shortfall. Without measures to increase revenues and reduce costs, in the next several decades, our water and sewer systems will experience serious financial upsets that may shut some systems down and seriously imperil the operations of many others. The effects will hit small rural systems disproportionately hard.

Large systems enjoy economies of scale that allow them to hire financial and other management and planning expertise. They tend to be well funded and managed on a current operations basis. However, they will experience a staggering capital improvements funding shortfall over the next few decades as they replace aging distribution and treatment systems.

Small systems, lacking economies of scale, are frequently poorly funded. They will experience the same kinds of funding shortfalls as the large systems. They also commonly operate at a loss on an operating cost basis. Small system managers attempt to manage well, but they are at a distinct disadvantage without proper training, experience, tools, and funding.

This paper examines successes in helping small systems, and it highlights opportunities to strengthen the capacity of these systems.

Successes

The U.S. water and wastewater industry generally designs and builds exceptional infrastructure and operates it well. The industry and its associated agencies and organizations also develop and deliver training, tools, and assistance to enable operators and decision makers to manage this infrastructure.

Operator Training

Operators get training, mostly technical, largely because it is required for certificate renewal. That training, delivered by state agencies, associations, assistance agencies, and private contractors, focuses mainly on operational and technical issues that enable operators to satisfy permit requirements. While this situation is not ideal, it works.

Decision Maker Training

Some states, environmental finance centers, rural water associations, and others have conducted "water board training" and similar training opportunities for water system decision makers. Most of this training is very effective for those who participate. As their budgets allow, these organizations continue to offer more training opportunities.

Tools

The State of Missouri has developed the Show-me Ratemaker software, a do-it-yourself spreadsheet program that small water and sewer systems use to analyze and reset their user rates. It is used throughout the country by thousands of systems and consultants. The environmental finance center at Boise State University has developed several software programs for rate setting and asset management. Many states have developed technical, managerial, and financial capacity assessment checklists. Several companies market commercial accounting, finance, billing, and rate-setting software programs. The National Drinking Water Clearinghouse distributes hundreds of titles of technical guides, books, and other resources. These are a few representative examples of tools that are readily available and often free.

Assistance

Many states, rural water associations, environmental finance centers, rural community assistance programs, and others offer technical assistance to small systems. For a fee, consulting engineers, accountants, and bond attorneys help the more financially fit systems or those getting grants and loans to put together capital improvement construction projects.

From the design and construction of facilities, to operations, to the development and delivery of training, tools, and assistance, the water and wastewater industry does an exceptional job in some respects. It does an admirable job in most others. Unfortunately, gaps still remain.

Gaps

Serious gaps accompany our successes. Most gaps in the water and wastewater industry center on issues related to the future. Infrastructure does not last forever. Growth and regulatory changes eventually render infrastructure inadequate, and the service requirements we place on that infrastructure change over time.

Training, Tools, and Assistance

Decision makers and assistance providers under-utilize the training, tools, assistance, and other opportunities already afforded to them. For example, in the State of Missouri alone there are approximately 10,000 community decision makers who would benefit by attending the state's award-winning Environmental Management Institute. Yet, only 813 have attended in the six years the program has been offered. At that rate, it would take 73 years to reach them all, disregarding the fact that all of these decision maker positions will turn over many times during such a long period. Personnel turnover is continuous so, even if the training effort was great enough to reach them all in a reasonable time, the effort would need to be on-going to continue training their replacements. Other programs such as those offered by the rural water associations are better attended but do not offer all the topics about which decision makers need training.

Rate Analysis

Small water systems need to analyze and adjust their rates on an ongoing basis—every year or every other year at the least. Many systems have never analyzed their rates and almost none do it as an annual exercise. Elected boards tend to believe that their role is to keep rates low. In the extreme, which is common, this tactic results in a compromised level of service and financial capacity to handle future capital improvement needs. The predictions of the Gap Analysis (U.S. Environmental Protection Agency 2002a) reflect this problem. There is rarely ill intent by such boards. The failure to analyze rates regularly deprives them of the information needed to be able to appreciate the short- and long-term effects of their decisions.

One of the major roots of this problem is the simple tendency of people to be reticent about sharing their financial information. Just as individual citizens hesitate to discuss their income with neighbors, water and sewer system decision makers hesitate to share information about the financial well-being of their systems. Such reticence prevents many systems from achieving financial health.

The power of rate analysis can be illustrated with a seemingly unlikely example. I analyzed the water rates of an Illinois city with a population of approximately 12,000 in 2003. This system's rate revenues were $2.7 million, and its operating costs were $3.6 million during the test year through June, 2003. This system was losing approximately $900,000 per year in net operating revenues, not counting significant capital replacement needs that were going unmet. This city had been so hesitant to get a proper rate analysis that it is now facing financial ruin if it does not make drastic rate increases. This kind of performance occasionally happens in relatively large and prosperous communities. It is much more common as community size and prosperity decreases.

In spite of the impact on the financial prospects of the water system, amazingly, the city was hesitant to move forward with a similar analysis of sewer system finances, even though that system is in even worse financial condition. Calculations, information, and forecasts do not cure the fundamental problem of shyness about finances.

Even though there is a great need for water and sewer rate analysis around the country, the lack of demand leads to a lack of affordable, talented service providers for small systems. State agencies, associations, and similar organizations could provide this assistance, but they tend to avoid sensitive rate and finance issues.

Asset Management

All systems need to start managing their infrastructure assets in a more comprehensive way so they can make them function as well as possible while minimizing their life-cycle costs (U.S. Environmental Protection Agency 2002b). This strategy is often called advanced asset management (AAM). One potential benefit of AAM is closing the mounting funding gap. Even small systems can do simplified AAM and reap valuable benefits.

At its most basic, AAM is accomplished by answering these five sets of questions.

1. What do I own? Where is it? What is its condition?
2. What is my required level of service?
3. Which assets are critical? How do they fail? How can we prevent their failure or compensate for their failure?
4. What are the possible combinations of infrastructure and management regimes that will yield the required level of service?
5. What is the required funding level for the most economical combination of infrastructure and management regime?

While these gaps are very serious, they are long-term and do not require an immediate change of direction. If systems will use this time to plan well, they will be able to cover the gaps over time with relatively modest short-term rate increases. Over the long-term, rates will actually be lower on a purchasing power basis due to the return from good planning and execution. Assistance providers can likewise develop well conceived programs to help systems make these future-oriented changes.

Direction Changes and Opportunities

Advanced asset management, several related planning techniques, sound business principles, and generally accepted accounting standards should be adopted by infrastructure systems if those systems are to serve their users well at the most economical cost.

Community leaders, voters, and utility service users need to change some of their attitudes about infrastructure systems. All need to require that these systems be built and managed using sound business principles, not just politics and anecdotal information. Public investments should be made like private investments, seeking a strong return on investment.

The Governmental Accounting Standards Board (GASB), organized to set accounting standards for government operations, recently issued guidance for reporting financial activity, including the value of assets. This guidance, GASB Statement 34, should be adopted by all municipal infrastructure systems because it gives an accurate portrayal of the net value and financial management of those systems. This information is a good basis for infrastructure managers and citizens alike to make sound judgments about the management of those assets.

Systems should strive to continuously improve their technical, managerial, and financial capacity (TMF) to operate their systems. Originated by the federal government and now adopted by the state agencies that regulate water systems, TMF embodies good business principles as they are applied to the water industry.

The federal and state governments need to continue improving their use of good business principles and encourage the use of those principles in small water systems. In that regard, TMF, advanced asset management, and similar strategies promoted by the federal and state governments should be taught to the systems whenever possible. This strategy would enable government agencies to lead systems toward good performance and force them less.

Funding agencies need to continue their emphasis on protection of public health and the environment while seeking the greatest return on investment of the funds they devote to water systems. To do so, agencies should consider requiring applicants to submit a rate analysis that will show critical financial and investment information, thus enabling agencies to fund the neediest, most deserving and/or most productive applicants.

While the need for financial assistance will never go away, agencies should increase their emphasis on technical assistance and the development and provision of tools to help systems solve problems. Appropriate technical assistance will always yield a good return on investment. Agencies need to give technical assistance a higher profile and more funding so it will be more easily seen, trusted, and used.

Importantly, federal and state agencies need to continue to improve their ability to accurately measure and document the results of their assistance so they can prove its effectiveness to legislative and executive funding decision makers. These decision makers also need to know that they are receiving the best possible returns on investment.

Agency assistance providers do fine work, but the need is simply too great for them to service it all. There is so much need for assistance that consultants and other service providers should be used to their greatest advantage. Concurrently, agencies need to teach system decision makers how to be smart consumers of agency, consultant, and other service providers' services. Agencies need to always keep the systems' best interests in mind and train them in how to protect and serve themselves through the use of assistance providers.

Conclusion

Small water and sewer systems currently do a good job of providing services at a reasonable cost. Future prospects; however, are not as good. There is a looming gap between the level of funding these systems are now receiving and the level they will need to operate on a sustainable basis. To bridge that gap and maintain the level of service that customers desire, the systems should adopt advanced asset management, TMF, rate analysis, improved accounting standards, and related strategies. These actions will assure that systems build the right infrastructure and maintain and operate it so as to incur the lowest possible costs over the life of the facilities. Federal and state government agencies can foster adoption of such strategies by developing, promoting, and teaching these strategies and methodologies.

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UNIVERSITIES COUNCIL ON WATER RESOURCES
JOURNAL OF CONTEMPORARY WATER RESEARCH & EDUCATION
ISSUE 128, PAGES 31-34, JUNE 2004

Economic and Financial Management Capacity of Small Water Systems

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Small communities—those with a population less than 3,300—and the small water systems they operate are an important part of the quality of life enjoyed in rural America. In many cases, economic opportunities in rural areas are also connected to the availability of water from these small systems. Small water systems serve a low percentage (13.5%) of the total population, but they comprise the majority (95%) of the water systems operating in the United States. It is important to understand the need for "capacity" and the challenges the very small systems face in operating and maintaining compliance with increasing standards. Small systems face unique challenges in developing sustainability. Locating affordable funding, retaining certified operators, complying with regulatory standards, engaging local leadership, accessing training and technology, meeting unattainable mandates, and finding a community meeting place are just some of the challenges.

In this article, I present some inherent barriers built into small water systems and some goals for consideration in overcoming these challenges.

Technical, Financial, and Managerial Capacity (TFM)

Water system capacity is the ability to plan for, achieve, and maintain compliance with applicable drinking water standards. For a system to have capacity, adequate capability in three key areas–technical, financial, and managerial–is necessary (EPA 2000; EPA 2003) (Fig. 1). TFM capability has been the buzzword from water system regulators for several years, yet almost everyone agrees that it is a good policy and, in theory, benefits all water systems. However, many small water systems still lack TFM capacity and do not understand the basic concept, including short- and long-term planning. Small system needs for capacity may differ from those of larger systems, and policy makers must be cognizant of these differences.

Rural America: Where and Who is it?

When one thinks of small communities, a picturesque view of rural America usually comes to mind. The U.S. Census Bureau defines rural as all territory, population, and housing units in

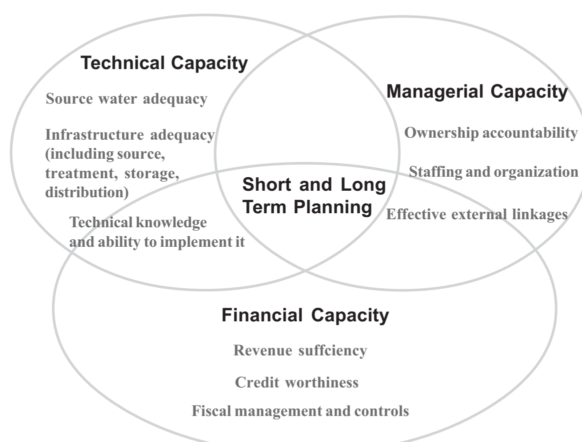

Figure 1 Concept of technical, financial, and managerial capacity (U.S. Environmental Protection Agency, 2003).

nonurbanized areas of less than 2,500 persons. Areas with a rural classification appear in both metropolitan and non-metropolitan designated counties. Fifty-nine million people (21% of the total population) live in areas classified as rural (U.S. Department of Agriculture, 2003). The definition for small systems varies among agencies and organizations, which creates part of the problem in addressing small system needs. For my purposes, I define "very small systems" as those serving under 2,500 persons. This figure would typically equate to fewer than 100 household connections within a system.

Capacity in Rural America

A distinction is made with very small systems since they are the systems most likely to be lacking TFM capacity. There is an economy of scale for the number of users that water systems must have to be sustainable, and very small systems typically fall below that magic number. As a rule, communities with populations of more than 3,000 people have the ability to self-finance a larger proportion of their infrastructure needs and the managerial capacity to address infrastructure operations, maintenance, and improvements (West Central Initiative, 2003).

Small systems can improve their sustainability through several methods such as cooperative management agreements, sale of excess capacity, or mergers to form larger systems.

Building Capacity in Very Small Systems

Technical assistance providers, like the National Rural Water Association (NRWA) and the Rural Community Assistance Partnership (RCAP), have been successful in building capacity in very small systems. The training and operational assistance provided to these system operators has improved system performance and reduced regulatory violations. Project development assistance has enabled the systems to access grant and loan programs that keep user rates at an affordable level. There are very few barriers in receiving technical assistance from the NRWA or the RCAP. The main problem is that demand for technical assistance far exceeds the available resources. Requests for the USDA Rural Utilities Service Technical Assistance and Training grant funds for fiscal year 2004 are 50% more than those available.

Because they provide on-demand technical expertise at an hourly rate, engineers, attorneys, accountants, and other consultants provide an important service to very small systems that cannot afford the overhead of having full-time staff. However, hiring a knowledgeable consultant and paying the associated fee can be a barrier for these systems. The USDA, Rural Utilities Service, Water and Waste Disposal Program initiated a pre-development and planning grant component in 2003, targeting very small systems that lack financial resources. The funding for the program is being doubled in fiscal year 2004 to $2 million to meet expected demands.

Assistance is available to help very small systems build and improve TFM capacity. Consideration needs to be given on how to be more effective and efficient with limited resources.

Dealing with Rural Areas

By delaying compliance dates for small systems, EPA's implementation of the new arsenic standard and vulnerability assessment requirements of the Bioterrorism Act showed regulatory flexibility. Although the health and safety of users in very small systems must not be compromised, there are additional regulatory issues (e.g. flexibility) that should be considered when small water systems are involved. Intervals for reporting, testing, and consumer confidence reports are examples of areas where current regulations create an unnecessary burden for very small systems.

Technical assistance programs successfully assist very small systems. Continuing current programs and promoting a peer technical assistance group could stretch limited funding and promote greater cooperation with nearby systems. Very small systems can provide each other additional resources that will improve their TFM capabilities. In many very small systems, the operator of the water system performs many duties and is on call twenty-four hours per day, seven days a week. Technical assistance providers report "burn-out" as one of the reasons for the high turn-over among very small system operators. Working together can provide benefits in equipment ownership, parts inventories, and human resources management while maintaining individual system identities.

Training needs to be done in an effective manner. Technical assistance providers have shown that hands-on, one-on-one training on operational content is very effective but also somewhat inefficient. Video conferencing has proven to be an effective means to deliver training for operational content as well. The University of Nevada, Nevada Health Division, RCAP, Nevada Rural Water Association, and the California-Nevada Section of the American Water Works Association have utilized videoconferencing to provide training on a variety of topics for operators. Attendees responded favorably, passing the Operator Certification Exam at a rate of 92% as compared to an 84% overall success rate (Montecinos et al. 2003).

Training in management concepts, leadership skills, planning and benchmarking needs to be developed in a media that allows user flexibility and interaction (e.g. web-based or multimedia content delivery). As the Nevada training example shows, a flexible location and an interactive capability creates a training experience that is acceptable and beneficial to the trainees. The management organizations for very small systems are comprised of people that serve essentially as unpaid volunteers, making them very hard to reach. This is a significant difference from the water system operators, who are usually paid to attend training. These management volunteers typically have full-time jobs, and the work of the water system is completed, after their regular job ends, usually in the evening. Utilizing web-conferencing or video-conferencing through local public television could prove successful in very small systems where a central meeting facility is not available. Flexibility in the delivery of training is essential to reach this group. In my own volunteer experience as a director for a credit union, I found training sessions held on weekends, where lodging and meals were provided, were very successful in attracting participants.

Setting mandates for TFM, asset management, and accounting principles for very small systems that are unattainable often create frustration. For example, Generally Accepted Accounting Principles (GAAP) include a standard that requires separation of duties for financial transactions. Very small systems with limited staff fail this standard every audit cycle. The resulting corrective action plan and correspondence to address the separation of duties standard only create additional burden on the limited staff and volunteers of very small systems. Mandates can be useful to accomplish certain objectives, but they must be written to be useful and meaningful.

Organizations and agencies working with very small systems need to place a priority on planning, not additional mandates. Short- and long-term planning is at the center of TFM, and additional emphasis on it will build capacity in rural areas. In the short-term, proper planning will consume additional resources, including both time and money. The long-term benefits will be better managed systems and less need for limited grant dollars that very small systems seemingly need.

Goals for Assisting Very Small Systems

Standards for financial, operational, and asset management need to be set at an appropriate level. Very small systems should be treated as "very small systems" and not held to standards developed for larger systems. The public health of very small system users can be protected with a prudent application of regulations.

Informed decision-makers, make better decisions. Proper planning will provide very small system decision-makers with the knowledge needed to manage and maintain sustainability. By their nature, very small systems have rapid turnover in their operational and leadership positions. The structure that exists for training operators on maintaining systems compliance is successful and has helped very small systems. The same emphasis is needed for the training of the management organization to ensure that very small systems stay viable. Ongoing technical assistance and effective training are the keys to continuing and improving TFM capacity.

Clean water is the cornerstone for rural areas wishing to keep and attract people and businesses. Very small systems must ascertain their role in the quality-of- life and economic opportunities within their service area. Increased and improved TFM capacity will assist the rural areas with more than just operation of their very small water systems.

Author Bio and Contact Information

Jim Maras is Director of Water Programs Division, USDA, Rural Utilities Service (RUS). Mr. Maras has served as the National Office Director since June 2003 and previously served as the RUS/CF Program Director in Minnesota. His USDA work experience covers over 20 years spent assisting families and communities in rural Minnesota. He has been involved in the Water Programs since 1989. Mr. Maras holds a B. S. degree in Agricultural Economics (1982) from North Dakota State University. Mr. Maras can be contacted at USDA, Rural Utilities Service, Mail Stop 1570, Room 2234-S, 1400 Independence Ave, SW, Washington, DC, 20250-1570, Phone: 202.720.9628, Email: jim.maras@usda.gov

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UNIVERSITIES COUNCIL ON WATER RESOURCES
JOURNAL OF CONTEMPORARY WATER RESEARCH & EDUCATION
ISSUE 128, PAGES 35-37, JUNE 2004

Contract Management Services

Dean P. Heneghan, P.E., P. L. S.

Heneghan and Associates, P. C.

Over the past several decades, many communities have contracted with private management companies to operate their public water supply systems. Such arrangements have become an important option for communities of all sizes. They take many different forms depending on the needs of the community. My purpose in this paper is to describe the different ways that communities and service providers work together toward the goal of providing safe and reliable water. While these arrangements are not confined to systems serving fewer than 10,000 customers, I will focus on that segment of the market.

Contract management services have now existed long enough to permit the strengths and limitations of these arrangements to be assessed. Unfortunately, most of the articles written to date have focused on large systems serving more than 25,000 people, including systems serving more than 1 million. Moreover, these articles tend toward the elliptical, offering glowing reports of the advantages or terrifying reports about failures.

The truth of the matter is that contract management services do not make sense for all public water supply systems, small or large. They require a good match of public needs and private capabilities. Each system's governing board must weigh the advantages and disadvantages of particular contractual arrangements and individual service providers to determine whether contract management services are the right solution for their system.

Functions that Can Be Contracted

Supplying water requires that a number of separable tasks be undertaken in a coordinated way. Some, but not all, of those services can be provided by providers that are not part of local government. The following sections consider some of the services that a small system might want to contract out and why contract services provide a viable way to provide these services for some small communities.

1. System Operation by a Licensed Operator

Of all the functions that must be performed by a viable water system, the involvement of a licensed operator is the one most often obtained through a private service provider. Years ago, becoming a licensed operator usually was accomplished on the job. A person could go to work for a village or rural water system as a meter reader or maintenance person and learn the basic skills. Within a short time, he or she was granted a license or could take and pass the basic tests then used to judge proficiency. There were few training requirements before or following licensure. Operators were easy to secure. The modest technical demands allowed operators to serve more than one system as long as day-to-day maintenance issues were addressed by someone else. But, times have changed. To become a licensed operator today requires some college training. To remain licensed, an operator must satisfy continuous education requirements to ensure their knowledge and skills are up to date. A greater awareness of liability issues has reduced operator willingness to moonlight in a community down the road where he or she does not have a role in system maintenance.

Yet another factor driving changes in the market for operators is the growth in the cost of benefits such as vacation and sick leave, health coverage, and retirement. Many small systems simply cannot afford a full-time operator or effectively manage the leave and liability issues. Contracting out for operator services to a company with more than one operator provides a big advantage in covering leave periods. It can also add to the knowledge base. Experience in other systems and places can be a big help when addressing an issue in a particular system. External service providers can provide this window to the larger world.

2. Computer Billing Services

Ten or fifteen years ago, computerized automation of management and operational functions was beyond the reach of most small communities. The machinery and software were expensive, and few small communities possessed the know-how to apply and maintain those systems. Even though the hardware costs have decreased, the software costs can still keep small systems from becoming automated. Many small systems still operate with manual billing procedures. Those procedures prevent effective aggregation and tracking of overall system trends. They do not easily support diagnosis of problems or planning for the future.

Management service providers are equipped with efficient management systems. These systems can speed up billing cycles, track customer status, and decrease the frequency of nonpayment. They can report on overall system performance and be used to detect problems such as leakage. Because the service providers typically serve multiple systems, they are able to spread the fixed costs of training, maintenance, and upgrading of these systems, thereby reducing the costs to individual systems.

3. Meter Reading

Reading water meters is a simple but essential task. It does not require any detailed training and is a very repetitive task. But, not only must it be done regularly and reliably, meter reading also provides a unique opportunity to gather first-hand information about operational problems. An astute meter reader can discover a water leak on their rounds before a large amount of water is lost. The meter reader also is an important interface with customers.

Many small community water systems do not have enough connections to keep a meter reader occupied full time. In addition, experience with other systems can help a reader develop data gathering skills that improve her or his effectiveness for each of the systems.

4. Treasurer

A treasurer provides essential support for the governing board of a water system. The monthly, quarterly, and annual treasurer's reports as well as yearly budget projections are indispensable for understanding whether a system is financially sound. Furthermore, the treasurer verifies and pays the accounts payable on time, manages the accounts receivable, and manages cash flow and investments. In a very real sense, the financial security of the system is largely in the treasurer's hands. A good treasurer can, at the very least, not cost the system money in bank charges and late payments. More likely, the treasurer can earn valuable non-operating income for the system by investing funds properly and paying bills early to receive discounts. Any savings or non-operating income that can be realized is money that customers will not have to pay in higher monthly user fees.

In many small communities, the treasurer's duties are given to someone with little accounting training. They are left to perform the duties just like the last treasurer. More times than not their main duty is to pay bills, collect money, and inform the board when funds are getting low. They may be poorly equipped to provide management reports needed by the governing board.

A contract service provider can supply the treasurer's functions. The service provider will typically be able to offer personnel with an accounting background able to provide the cash flow services while also being knowledgeable about the role of financial information in management decisions. Accounting firms that perform required annual audits are among the potential providers of these services. Another source is an engineering firm that provides technical services. Engineering firms typically have an accountant or business manager on staff. These two sources generally are already familiar and provide advice on other matters. The provision of business services is an extension of existing relationships.

In addition to these four core services, external providers can assume responsibility for hook-ups and mainline repairs. For a great number of water systems, the tap-on fee comes nowhere close to covering the costs of installation. Many systems seem to believe that they need to keep their tap-on fees low (e.g., under $500) irrespective of the real cost. For those systems, referring installation to a licensed contractor who can charge the true cost can make an immediate positive financial improvement for the system. The system can collect a modest tap-on fee and still control the material that goes in the ground, but the labor cost is fully picked up by the customer.

These are some of the tasks that can be easily contracted out and provide a benefit to a small system. The benefits can be both immediate improvements in financial status as well as improved planning, investment, and maintenance for the long term good of the system. One large advantage to contracting out some services is gaining knowledge from the provider as to how other comparable systems operate and perform. The board no longer needs to manage in a vacuum. Through service providers who work with other clients, they can learn good and bad points from how other systems handle particular problems.

Against these advantages, water systems must consider the costs of contractual services. Many times, systems considering partnerships with private service providers are chasing the carrot of large savings. But, for small systems, large savings are rarely available. The real advantage is in realizing more and better services for the same costs or for a small savings. Items such as an 800 number, 24 hour answering service, more than one licensed operator being available at all times, quicker, more comprehensive water usage reports, and more in-depth financial reports and budgets are the types of improvements that should be available with a contract management firm.

Conclusions

A water system needs to weigh its ability to provide each of the essential water supply functions. Where its abilities are limited, external service providers may be able to provide those functions more effectively, with greater discipline and problem-solving abilities, although probably not more cheaply. But in today's world, with more sophisticated customers than in the past, cost is not the only criteria to be considered. Adequacy of service is more important. Failure to provide customers with reliable, safe water will override cost considerations. An approach that provides more benefits can be justified to customers and be a win-win situation for all involved.

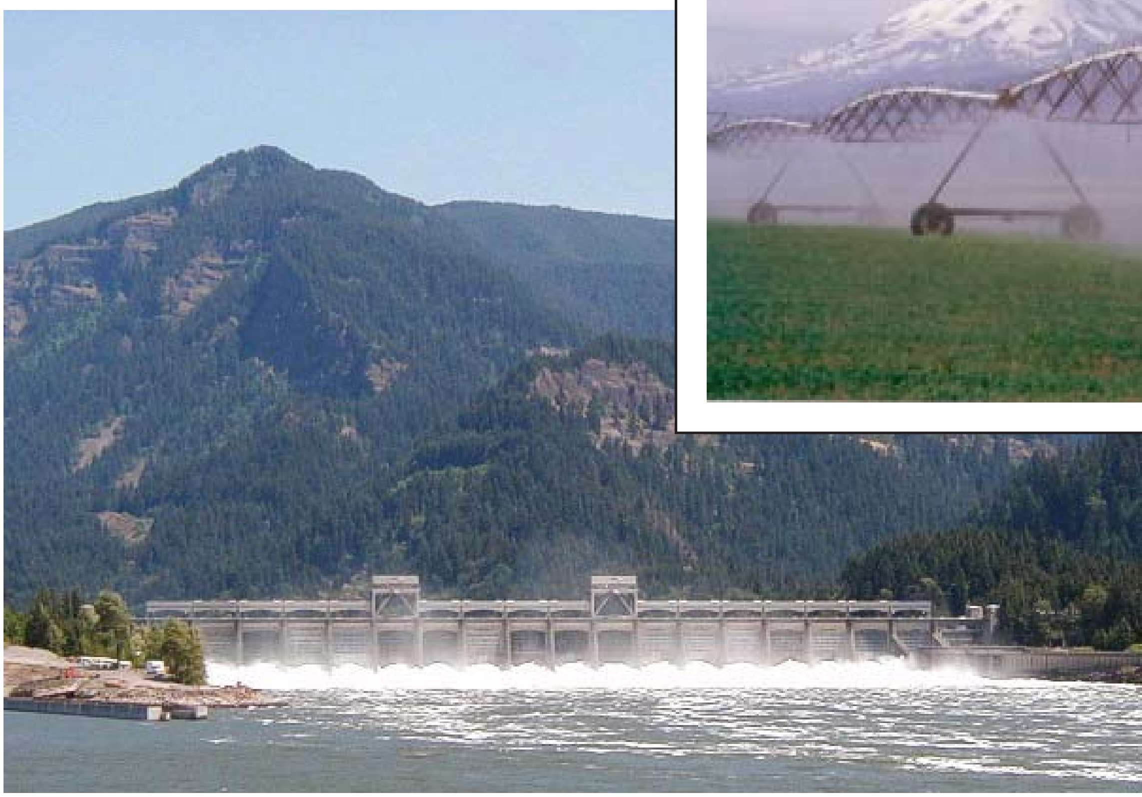
Author Bio and Contact Information

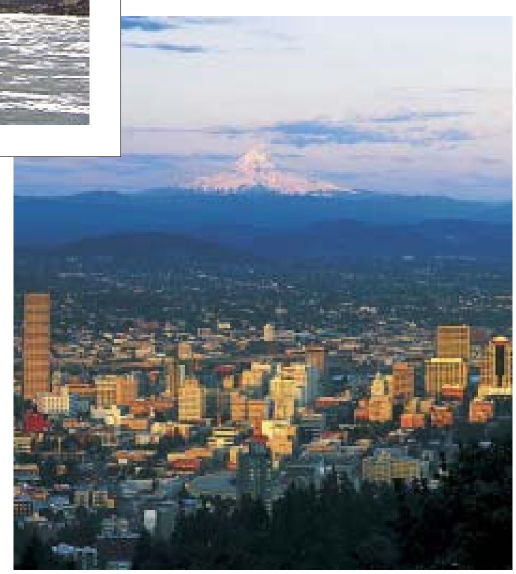
Dean P. Heneghan is President of Heneghan and Associates, an engineering and surveying firm that provides contract operations and management services for over 20 small water and wastewater systems owned by state government, municipalities, private companies, and rural water systems. He is a licensed professional engineer in the states of Illinois and Missouri and a licensed land surveyor in the state of Illinois. Mr. Heneghan holds a B.S. degree in Civil Engineering from the University of Missouri, Rolla. Mr. Heneghan may be contacted at 1004 State Highway 16 Jerseyville, IL 62052, Phone: 618.498.6418, E-mail: dpheneghan@heneghanassoc.com

Allocating Water: Economics and the Environment

(Preliminary Program & Registration)

July 20-22, 2004
Portland, OR





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Allocating Water: Economics and the

MONDAY (July 19)

Afternoon Activities

Field Trip
Tualatin
12:30-5:30 PM

Registration
3:00-6:00 PM
Lower Level, Main Lobby

UCOWR Board Meeting
2:00-6:00 PM
Eugene Room

UCOWR Committee Meetings
Tuesday July 20
12:00-1:30 p.m.
All UCOWR delegates welcome.

* Education and Public Service
* International Programs
* Policy, Legislation and Administration
* Research

TUESDAY (July 20)

Registration
8:00AM-5:00PM
Lower Level, Main Lobby

Time	TUESDAY (July 20)
8:30-10:00 AM	Plenary Session I: Welcome -Mac McKee -James Moncur -Gary Johnson Keynote -John Keys
10:00-10:30 AM	BREAK
10:30AM-12:00 PM	Concurrent Technical Sessions Session 2 Session 3 Session 4 Session 5 Session 6
12:00PM-1:30 PM	UCOWR COMMITTEE MEETINGS
1:30PM-3:00 PM	Concurrent Technical Sessions Session 7 Session 8 Session 9 Session 10 Session 11
3:00PM-3:30 PM	BREAK
3:30PM-5:00 PM	Concurrent Technical Sessions Session 12 Session 13 Session 14 Session 15 Session 16
Evening Activities	Combined Event -Welcome Reception -Technical Poster Session -Student Poster Competition (5:30-7:30 PM)

Environment Conference at a Glance

WEDNESDAY (July 21)

Registration
8:00AM-4:00PM
Lower Level, Main Lobby

Plenary Session II:
Northwestern Approaches to Changing Water Allocation
- Paul Cleary
- Joe Stohr
- Karl Dreher

BREAK

Concurrent Technical Sessions
Session 19
Session 20
Session 21
Session 22
Session 23

LUNCH ON YOUR OWN

Plenary Session III:
Evolving Economic Approaches
- Robert Young
- Charles Howe

BREAK

Concurrent Technical Sessions
Session 25
Session 26
Session 27
Session 28
Session 29

UCOWR Banquet and Awards Ceremony (7-9 PM)
Warren A. Hall Medal
Dissertation Awards
Friends of UCOWR Award
Ed. & Pub. Service Award

THURSDAY (July 22)

Registration
8:00AM-2:00PM
Lower Level, Main Lobby

Concurrent Technical Sessions
Session 30
Session 31
Session 32
Session 33
Session 34

BREAK

Plenary Session IV:
NGO Approaches to Balancing Economics and the Environment
- Gail Achterman
- Ruth Mathews
- Norman Whittlesey

Closing Remarks
- Karl Wood
- Jim Moncur

UCOWR Board Meeting
12:00-2:00 PM
Committee Chairs Invited
Lunch Provided

CONFERENCE NOTES

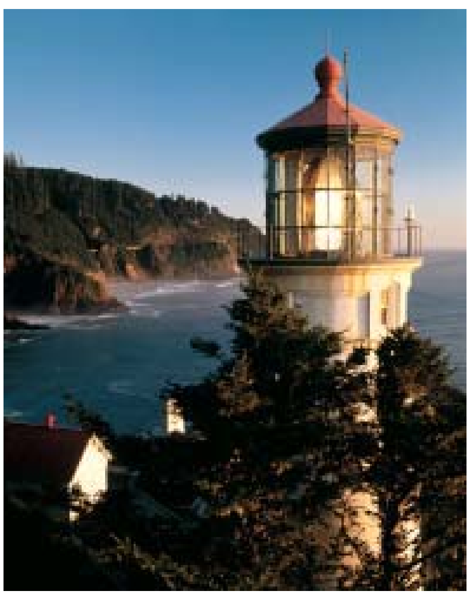
Welcome

Welcome to the 2004 UCOWR Annual Conference on "Allocating Water: Economics and the Environment." In all parts of the United States—and, indeed, around the world—it is becoming more and more difficult to manage scarce water resources to achieve an ever growing list of competing objectives and satisfy increasingly diverse sets of stakeholder groups.

This conference will bring together academics, representatives of federal and state agencies, water managers, and other professionals to discuss approaches and policies for allocating water. Interesting and innovative case studies, analyses of current water allocation problems in several U.S. river basins, and proposed new techniques will be presented. These discussions will yield valuable materials for consideration in water resources research, education, legislation and policy.

Please join us for this interesting and significant meeting in Portland, Oregon.

Mac McKee
President, Universities Council on Water Resources
Professor, Civil and Environmental Engineering
Director, Utah Water Research Laboratory, Utah State University



CONFERENCE COMMITTEE

Gary Johnson, University of Idaho, Chair
Ari Michelsen, Texas A&M University, Co-Chair
Mac McKee, Utah State University, UCOWR President
Mike Barber, Washington State University
Lisa Bourget, EWRI / International Joint Commission
Susan Durden, U.S. Army Corps of Engineers
Bob Hamilton, U.S. Bureau of Reclamation
Joel Hamilton, University of Idaho
Peggy Hammel, Idaho Water Institute
Denise Lach, Oregon State University
Lynne Lewis, Bates College
Garth Taylor, University of Idaho
Christopher Lant, SIU Carbondale, UCOWR Executive Director
Rosie Gard, SIU Carbondale, Program Administrative Assistant
Jim Stivers, SIU Carbondale, Conference Program Design

The **Universities Council on Water Resources (UCOWR)** is an organization of U.S. universities and international affiliates actively engaged in water resources education, research, and public service. UCOWR institutional members and delegates are leaders in water resources related research and education and represent virtually all fields of science. In addition to our annual national conference, UCOWR publishes the journal ***The Journal of Contemporary Water Research and Education***. If you would like to join UCOWR, please visit our website at: www.ucowr.siu.edu or call 618-536-7571.

NIWR
The National Institutes for Water Resources

The **National Institutes for Water Resources (NIWR)** is a network of research institutes in each state that, in collaboration with the USGS, is responsible for implementing the Federal Water Resources Research Act. They conduct basic and applied research to solve water problems unique to their area. The bulk of Institute funding comes from non-federal sources. They have established themselves as a primary link between water-related personnel in the academic community; local, state, and federal government; and the private sector.

Keynote Speakers

PLENARY SESSION I

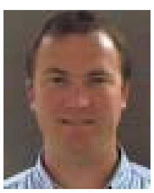
John Keys

Mr. Keys, P.E., heads the U.S. Bureau of Reclamation and is responsible for its water storage, distribution, and power generation facilities. The Bureau is the nation's largest wholesaler of water, providing one-fifth of western farmers with irrigation water for 10 million acres of farmland that produces 60% of the nation's vegetables and 25% of its fruit and nuts. He is committed to developing creative solutions to meet current and future water resources challenges facing the West and was awarded the Department of Interior's highest honor for maintaining open lines of communication and keeping interest groups focused on solutions.

PLENARY SESSION II

Paul R. Cleary

Paul R. Cleary is the Director of the Oregon Water Resources Department. He is responsible for the statewide administration of surface and ground water rights and for promoting wise long-term water management while addressing Oregon's water supply and streamflow restoration needs. He has over 25 years of experience in state natural resource management, policy development, and program administration. Mr. Cleary has previously served as: Director of the Oregon Division of State Lands; Deputy Director of the Wyoming State Land and Farm Loan Office; and as a natural resource advisor in the Wyoming Governor's Office. He began his professional career at the University of Wyoming's Water Resources Research Institute. He is a member of the Western States Water Council. He earned his M.S. in Water Resources in 1978 from the University of Wyoming where he was Phi Kappa Phi, and B.S. in Biology in 1975 from Trinity College in Hartford, Connecticut.



Joe Stohr

Joe Stohr has been with the Washington Department of Ecology for over 18 years. Since March 2001, he has served as program manager for the Water Resources Program. He received the Governor's Distinguished Manager Award in 2003 for improvements to water rights processing. Mr. Stohr's first five years with Ecology were spent in the Nuclear Waste Program as a program specialist and section supervisor where he received an Outstanding Achievement, Program Service, and two Special Recognition Awards. In 1997, Mr. Stohr accepted the section supervisor position to the Water Resource's Operations Support Section where he led a working team associated with reorganization of the Water Resource and Shorelands Programs. Prior to coming to Water Resources, Mr. Stohr spent the previous three and one-half years as the Program Manager for the Spill Prevention, Preparedness, and Response Program. Prior to working for the Department of Ecology, Mr. Stohr worked for the Washington Department of Social and Health Services for 4 years as a Unit Manager Health Physicist.

Karl J. Dreher

Mr. Dreher has 30 years of experience in developing and managing water resources covering a broad spectrum of disciplines including interstate negotiations, developing legislation, water rights administration, water law, water policy, water treatment, environmental issues, planning, program/project management, construction management, personnel management, contract negotiations, hydraulic analysis and design, structural analysis and design, and permitting for projects. Mr. Dreher has been involved with water resource projects in various countries throughout the world and has served as a consultant to a number of public as well as private organizations involved in the development and management of water resources. Mr. Dreher is a licensed professional engineer and is completing his second term as the Director of the Idaho Department of Water Resources. Mr. Dreher is also the current chairman of the Western States Water Council, which is an adjunct of the Western Governor's Association established to work on water policy and legislative issues.

Keynote Speakers

PLENARY SESSION III

2004
WARREN A. HALL
AWARD WINNER

ROBERT YOUNG

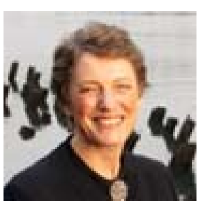
Robert A. Young is a resource and agricultural policy economist with over 40 years of applied research, teaching and consulting experience. He received degrees in Agriculture (1954) and Agricultural Economics (1958) from the University of California (Davis) and an Agricultural Economics doctorate from Michigan State University (1963). Young was on the faculty at the University of Arizona and then for two years was a visiting staff member at the nonprofit research organization Resources for the Future, Inc. in Washington, DC. Since his retirement in 1992 after 22 years as a full-time Colorado State University Agricultural Economics faculty member, Young has carried on his university research and outside consulting activities. He continues to focus on: methods for economic evaluation of proposed public policies for investments in, and allocation of, water supplies and water quality improvements; concepts and methods for valuation of nonmarketed water-related goods and services; and developing interdisciplinary approaches to modeling of water policy issues. He is the author or co-author of numerous articles, monographs, reports and conference papers.

2003
WARREN A. HALL
AWARD WINNER

CHARLES (CHUCK) HOWE

Chuck Howe is Professor Emeritus of Economics and a member of the professional staff of the Environment and Behavior Program, Institute of Behavioral Science, University of Colorado-Boulder –a program he directed for 12 years. He has served as consultant to international agencies and numerous countries. He is a Fellow of the American Geophysical Union and recipient of the American Water Resources Association Icko Iben Award and the Warren A. Hall Medal from the Universities Council on Water Resources. His most recent article is "Water Transfers and Their Impacts: Lessons from Three Colorado Water Markets,"*Journal of the American Water Resources Association* (forthcoming).

PLENARY SESSION IV



GAIL ACHTERMAN

Gail Achterman is the Director of the Institute for Natural Resources at Oregon State University. The Institute is a center for research, information access and policy analysis created by the Oregon Legislature in 2001. She received her J.D. and an M.S. in resource policy from the University of Michigan. Her natural resource experience in private law practice, state and federal government, well suits her for work across political, economic, social, and environmental interests.

RUTH MATHEWS

Ruth Mathews is the manager of Freshwater Conservation Programs for the Washington Chapter of The Nature Conservancy. During her seven years with The Nature Conservancy she has been working collaboratively with water managers, scientists, water users and other conservationists to protect and restore river flows. She co-authored a paper published in the journal *Ecological Applications* titled "Ecologically Sustainable Water Management: Managing River Flows for Ecological Integrity." Ms. Mathews has lived in the Pacific Northwest since 2001.

NORMAN K. WHITTLESEY

Norman K. Whittlesey is Professor (Emeritus) of Agricultural Economics at Washington State University, where he has been since 1964. While at WSU he was involved in research and teaching related to production agriculture, irrigation development, water policy and environmental economics. In 1987, he won the prestigious Award For Professional Excellence from the American Agricultural Economics Association for work in water policy. In 1998, he was honored as a Fellow of the American Agricultural Economics Association.

Conference Location & Hotel

RESERVATIONS

To make reservations, call 1-800-546-9513 and ask for the Universities Council on Water Resources 2004 Annual Conference rate. If you prefer to make reservations through www.marriott.com, use the rate code **ucwucwa**.The rate for attendees is $115 plus tax per room per night for single, double, triple, or quad accommodations. Please make your arrangements as early as possible to guarantee conference rates. Regular rates will go into effect when UCOWR's block of rooms is filled or on **June 25, 2004**, whichever happens first.

ACCOMMODATIONS

- All guest rooms feature individual climate control, two telephones with voice mail, data ports, high-speed Internet access and unlimited long-distance for $9.95/day, complimentary cable television with in-room pay movies, coffeemaker, hair dryer, iron, and ironing board.

GUEST SERVICES

- Concierge, valet service, concierge lounge, safe-deposit boxes, business center, gift shop, shoeshine

RECREATION

- Heated indoor swimming pool, health club with exercise room, whirlpool, and sauna
- Jogging trail, golf, tennis, hiking, snowskiing, fishing, boating, and waterskiing nearby

The Mariott icon to the left marks the location of the conference hotel on the maps on the next page.

Portland Marriott Downtown
1401 SW Naito Parkway
Portland, Oregon 97201
Phone: (503) 226-7600
Fax: (503) 221-1789
www.portlandmarriott.com

Driving Directions

From the North (Seattle): Stay on I-5 South. Take the OMSI/Oregon City exit; remain in the right lane. Exit onto the Morrison Bridge; remain in the right lane. Take the ramp to Naito Parkway, which makes a sharp loop to the right, going back under the bridge. Head south on Naito Parkway, the hotel is located 8 blocks on the right.

From the South (Salem): Take I-5 North and as you approach closer to Portland remain in the extreme left lane. Take the Naito Parkway exit, which approaches rapidly. When you get to the stoplight, cross Naito Parkway onto Clay Street. Remain on Clay and make a right on 2nd Avenue. Make a right on Columbia Street and follow it down to NaitoParkway. The driveway of the hotel is the second entrance on your right.

From the East (Portland International Airport): Follow the signs to I-205 South/Salem. Take the exit I-84 West to Portland. Remain in the left lane and follow signs to OMSI/City Center. On the overpass, switch to the right lane and take the City Center exit that goes onto the Morrison Bridge. On the bridge, remain in the right lane and take the Naito Parkway exit, which makes a sharp loop to the right, going back under the bridge. Head south on Naito Parkway, the hotel is located 8 blocks on the right.

From the West (Oregon Coast): From Highway 26/Sunset Highway, take the Market Street exit (just through the tunnel). This will take you to 4th Avenue. Follow 4th Avenue to Columbia Street. Make a right on Columbia and follow it to NaitoParkway. Make a right on Naito Parkway and the driveway of the hotel is the second entrance on the right.

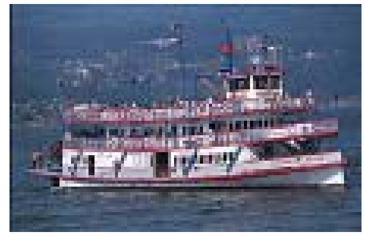
Shuttle Service

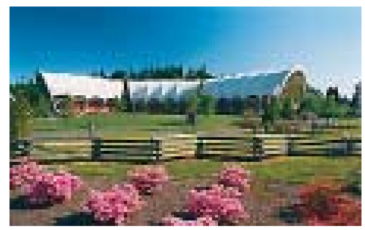
Shuttles are easily accessible at the Portland International Airport. From the baggage claim area, go out the glass doors. Look forward (across traffic lanes) and to the left for a small hut outside of which will be a menu of transportation modes and charges. The attendee can arrange for a "shuttle" to take you directly to the hotel for $12 cash (per person), or the attendee can arrange other choices from the menu. As there are two Marriotts in downtown Portland, make sure the driver knows to go to the one located at 1401 SW Naito Parkway.

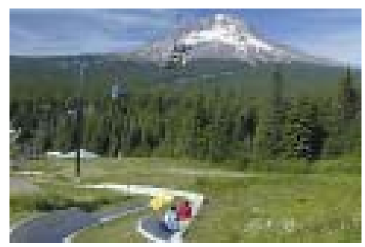
Commercial shuttles from the Marriott to the Airport can be arranged through the front desk. The charge is $15 cash. If you have an early flight, this is best done the previous day.

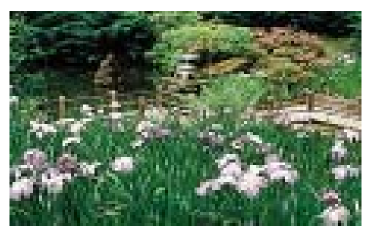
For more information on ground transportation around Portland, you can visit the following website: http://www.portlandairportpdx.com/web_pop/grndtran.HTM.

Portland Area Attractions









- Visit North America’s most fascinating and diverse gardens
- Try out China Town
- Explore Oregon’s fantastic beaches and seaside communities
- Cruise down the Columbia and Willamette Rivers on a sternwheeler or jet boat
- Experience wind surfing and kite boarding on the Columbia River
- Sample the nation’s largest variety of microbrews
- Tour downtown by riding free of charge on streetcars, buses, and light rail
- Try the year-round skiing at Mt. Hood
- Go crabbing on the Lower Columbia
- Land the most powerful fish you will ever catch--a lunker sturgeon on the Columbia
- Visit the downtown art gallery and museum
- Check out the many nearby wineries
- Visit the Columbia Maritime Museum in Astoria
- Don’t forget Mt. St. Helens is unforgettable
- Investigate the Oregon Museum of Science and Industry

Need more information? The Portland Oregon Visitors Association can help: http://www.pova.com/visitors/

On the facing page, there are maps of Portland and surrounding area. The numbers on those maps correspond to the following attractions:

	Upper Map	Lower Map
1.	Port. Rose Gardens	Vancouver Nat. Hist. Res.
2.	Japanese Garden	Columbia Gorge Interp. Ctr.
3.	Forest Discovery Ctr.	Columbia Gorge Outlets
4.	Oregon Zoo	Mt. Hood Railroad
5.	Children’s Museum	Columbia Gorge Disc. Ctr.
6.	Pittock Mansion	Mt. Hood Ski Bowl
7.	Port. Art Museum	Evergreen Aviation Museum
8.	Class. Chinese Gard.	End of OR Trail
9.	Oaks Amuse. Park	Woodburn Co. Stores
10.	Willamette Jet Boats	The OR Garden
11.	OMSI	Wilsonville Family Fun Ctr.
12.	Clackamas Town Ctr.	The Enchanted Forest
13.	The Portland Spirit	Pumpkin Ridge Golf Club
14.	Sternwheeler	Reserve Vineyard & Golf Club
15.	The Grotto	Willamette Shore Trolley
16.	Pioneer Place	Wildlife Safari
17.	Port. Saturday Mkt.	Colum. River Maritime Mus.
18.	Lloyd Ctr.	Tillamook Cheese Visitor Ctr.
19.	Jantzen Beach Ctr.	Blue Heron Cheese Co.
20.		Factory Stores @ Lincoln City
21.		OR Coast Aquarium
22.		OR’s Mt. Hood Territory

Portland Maps

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Technical Program

Tuesday, July 20, 2004

PLENARY SESSION I **8:30am – 10:00 am**

Welcome, Introductions, and Conference Keynote
Mac McKee, UCOWR President, Utah State University
James E.T. Moncur, NIWR President, University of Hawaii
Gary Johnson, Host, University of Idaho

Water Resources Management in the 21st Century
John Keys**,** Commissioner, U.S. Bureau of Reclamation

CONCURRENT SESSIONS **10:30am – 12:00 pm**

Session 2: Impacts, Risks, Prices and Irrigation

Implications of Incorporating Risk into the Analysis of an Irrigation District's Capital Renovation; Texas Lower Rio Grande Valley. ***Michael E. Popp*****,** Allen W. Sturdivant, M. Edward Rister, Ronald D. Lacewell, and John R. C. Robinson, Texas A&M University, College Station, TX
Estimating a Price for Water Rights in the Umpqua Basin, Oregon. ***Van Butsic*** and Noelwah R. Netusil, Reed College, Portland, OR
Aspects of the Economic Impact on Irrigated Agriculture in the Juarez Valley Due to Salinity and as a Result of the Water Distribution between Mexico and United States in 1906. ***Jorge A. Salas*** Plata M, Universidad Autonoma de Ciudad Juarez
Substitutions Between Water and Other Agricultural Inputs - A Modeling Analysis. ***Ximing Cai*****,** University of Illinois, Urbana-Champaign, IL

Session 3: Sustainability of semi-Arid Hydrology and Riparian Areas (SAHRA)

Multi-Resolution Integrated Modeling for Basin-Scale Water Resources Management and Policy Analysis. ***Hoshin V. Gupta*** and Thorsten Wagener, The University of Arizona, Tucson AZ; David S. Brookshire, University of New Mexico, Albuquerque, NM; Everett Springer, Los Alamos National Laboratories, NM
Options and Consequences: Water Banking/Leasing Explored for the Rio Grande in Southern New Mexico. ***Vincent Tidwell*****,** James Krumhansl, Len Malczynski, Orman Paananen and Howard Passell, Sandia National Laboratories, Albuquerque, NM; David Brookshire, Janie Chermak, Kristan Cockerill, Kristine Grimsrud and Paul Matthews, University of New Mexico, Albuquerque, NM; Enrique Vivoni, New Mexico Institute of Mining and Technology, Socorro, NM
Induced Infiltration of Water from the Rio Grande Alluvium to the Hueco Bolson Aquifer: An Isotopic and Numerical Analysis. ***Barry Hibbs***, California State University, Los Angeles, CA; Chris Eastoe, University of Arizona; Bill Hutchison and Scott Reinert, El Paso Water Utilities; Alfredo Granados, University of Ciudad Juarez, Mexico
A Decision Support System for Demand Management of the Rio Conchos Basin, Mexico. ***Steve Stewart*****,** Juan Valdes and Jesus Gastelum, University of Arizona, Tucson, AZ; David Brookshire, University of New Mexico, Albuquerque, NM; Javier Aparicio, Jorge Hidalgo and Israel Velazco, Instituto Mexicano de Tecnologia del Agua, Morelos, Mexico
SAHRA Integraded Modeling Approach to Address Water Resources Management in Semi-Arid River Basins. Everett P. Springer, Los Alamos National Laboratory, Los Alamos, NM; Hoshin V. Gupta and Yuqiong Liu, The University of Arizona, Tucson, AZ; ***David S. Brookshire***, University of New Mexico, Albuquerque, NM

Session 4: Balancing the Economic and Environmental Demands on Oregon's Water Resources: Real Life Success Stories

The Recylcing of Oregon's Water. ***Kent Madison***, Madison Ranches, Oregon
The Walla Walla Way. ***Ron Brown***, Walla Walla River Irrigation District and Earl Brown and Sons Orchardists, Milton-Freewater, Oregon
Learning Together: Developing a Cooperative Water Policy Framework for the Deschutes Basin. ***Patrick Griffiths***, Water Program Specialist, City of Bend, Oregon
Food Processing Water Re-Use. ***Mark Steele***, Corporate Engineer, Norpac Foods, Inc., Stayton, Oregon

Session 5: Assessing Climate Change Vulnerability, Impacts and Adaptation

Climate Change and Adaptation in Irrigated Agriculture—A Case Study of the Yakima River. ***Michael J. Scott*** and Lance W. Vail, Battelle Pacific Northwest Division, Richland, WA; Claudio Stockle and Armen Kemanian, Washington State University, Pullman, WA

Vulnerability of Borderland Water Resources: Developing Indicators for Selected Watersheds on the U.S. Mexico Border—The Paso del Norte Region. ***Christopher Brown***, Janet Greenlee, Marguerite Hendrie and Brian Hurd, New Mexico State University, Las Cruces, NM; Alfredo Granados, La Universidad Autonoma de Ciudad, Juarez, Mexico

Potential Impacts of Global Warming on Water Resources: Lessons from the Upper Rio Grande Basin. ***Ed Hamlyn*** and Charles D. Turner, University of Texas, El Paso, TX

Session 6: Solving Water Conflicts through Cooperation

40 Years of Change: The Western States Water Council. ***Anthony Willardson***, Western States Water Council, Midvale, UT

Packaging Policies as a Vehicle for Reforming the Water Sector: The Case of the Californian Drought and the Central Valley Project Improvement Act. ***Itay Fischhendler*** and David Zilberman, University of California, Berkeley, CA

Creeks and Communities: Accelerating Cooperative Riparian Restoration and Management. ***Laura Van Riper*****,** National Riparian Service Team, Pineville, OR

Environmental Clearinghouse as an Institutional Incentive for Data and Information Sharing and Conflict Reduction in the Mekong River Basin. ***Godwin Uche Aliagha*** and Goh Kim Chuan, Nanyang Technlogical University, Singapore

CONCURRENT SESSIONS 1:30 pm – 3:00 pm

Session 7: Water Rights Markets, Prices and Limitations

Water Rights Trading—Water Allocation Solution or Exploitation? ***Jeff Barry*****,** Groundwater Solutions, Inc., Portland, OR

Market Prices for Water in the Semi-Arid West. ***David S. Brookshire***, Mary Ewers and Philip Ganderton, University of New Mexico, Albuquerque, NM; Bonnie Colby University of Arizona, Tucson, AZ

Water Market Futures for Rio Grande Water in El Paso County Texas. ***Charles D. Turner*** and Abhijeet Jahagirdar, University of Texas, El Paso, TX

The Anatomy of Hydrologic Externalities: Limitations to Water Markets. ***Zena Cook***, Idaho Department of Water Resources, Boise, ID; R.D. Schmidt, US Department of Interior, Bureau of Reclamation, Boise, ID; Joel Hamilton and R.G. Taylor, University of Idaho, Moscow, ID

Session 8: Legal Issues of Water Allocation

Restricting the Place of Use in Water Marketing – Sound Policy or Unjustified Economic Protectionism. ***Olen Paul Matthews***, University of New Mexico, Albuquerque, NM

Quid Pro Quo: To What Extent Can States Implement Efficiency Standards on Individual Water Rights Under the Prior Appropriation Doctrine? ***Michael Pease***, Southern Illinois University, Carbondale, IL

Water Wars, Eastern Style: Divvying Up the Apalachicola-Chattahoochee-Flint River Basin. ***J.B. Ruhl***, Florida State University, Tallahassee, FL

Session 9: Balancing Water Allocation Among Listed Species

The Role of Science in Balancing the Needs of Protected Species: A History Lesson. ***Michael Thabault***, US Fish and Wildlife Service, Washington, DC

Policy Implications: A Delicate Balance. ***Judi Danielson***, Chair and Idaho Council Member, Northwest Power and Conservation Council, Boise, ID

Grand Coulee Dam: A Microcosm of Decision-Making. ***Craig Sprankle***, Bureau of Reclamation, Grand Coulee, WA

Western Water Law and the ESA. ***Martha O. Pagel***, Schwabe Williamson & Wyatt, P.C., Former Director, Oregon Water Resources Department, Salem, OR

Tribal Perspectives of the Upper Columbia United Tribes. ***Mary Verner*****,** Upper Columbia United Tribes, Spokene, WA

Session 10: University, Agency and NGO Partnerships

Predicting the Ecological Outputs of Increased Base Flows in Ephemeral Texas Streams: Policy Implications for Agencies. ***Rebecca S. Griffith***, US Army Corps of Engineers, Forth Worth, TX

Predicting the Ecological Response to Increased Base Flows in Ephemeral Texas Streams: Results from Field Investigations. ***Neal R. Wilkins***, Kirk O. Winemiller and Ronald D. Lacewell, Texas A&M University, College Station, TX; Rebecca S. Griffith, US Army Corps of Engineers, Forth Worth, TX

Finding Solutions with Competing Uses in Agriculture and Natural Resources: Report from the Texas Water Summit. ***A. Gene Nelson***, Ric Jensen and Allan Jones, Texas A&M University, College Station, TX

Creating Partnerships and "New" Water in the Walla Walla Watershed. ***Chris Hyland***, Corps of Engineers, Walla Walla, WA; Gary James, Confederated Tribes of the Umatilla Indian Reservation

Session 11: Methods for Valuing and Balancing Ecosystems and Water Use

The Value of Ecosystem Services in Portland, Oregon. ***Dan Heagerty***, Kevin O'Hara and Gillian Ockner, David Evans and Associates, Portland, OR; Ed Whitelaw, University of Oregon and ECONorthwest, Eugene, OR; Ed MacMullan, ECONorthwest, Portland, OR; Jim Middaugh, City of Portland, Portland, OR

Pecos River DSS System: Application for Adjudication Settlement and River Operations EIS. ***Jim McCord*** and John C. Carron, Hydrosphere Resource Consultants, Inc., Socorro, NM; Beiling Liu and Sharon Rhoton, Socorro, NM Interstate Stream Commission, Santa Fe, NM; Miguel Rocha, US Bureau of Reclamation, Albuqquerque, NM; Tomas Stockton, Tetra Tech, Albuquerque, NM

Balancing Water Use, Water Rights, Endangered Species and Economics: A Multi-Objective, System Operations Optimization Approach. ***Leon Basdekas*** **,** Luis Bastidas, Arthur Caplan, Thomas Hardy, Mac McKee and David Stevens, Utah State University, Logan, UT

Allocation of Water Resources for the Large Scale Irrigation Project of Chi-Mun River Basin, Thailand. ***Tawatchai Tinsanchali***, Asian Institute of Technology, Pathumthani, Thailand

CONCURRENT SESSIONS 3:30 pm – 5:00 pm

Session 12: Prices and Policy: Management of Groundwater Resources (Extended Session)

Ground Water Banking and Conjunctive Management of Ground Water and Surface Water. ***Bryce A. Contor***, University of Idaho, Idaho Falls, ID

Valuation of Groundwater Resources Using the Hotelling Valuation Principle. ***Mary Ewers***, University of New Mexico, Albuquerque, NM

Efficient Groundwater Pricing, Intergenerational Welfare, and Inter-District Exchange. ***Basharat A. Pitafi*** and James A. Roumasset, University of Hawaii, Manoa, HI

Watershed Conservation or Efficient Groundwater Pricing? Optimal Policy Sequencing in Pearl Harbor. ***Basharat A. Pitafi*** and James A. Roumasset, University of Hawaii, Manoa, HI

The Economics of Water Regulation in Arizona. ***Sharon B. Megdal***, Director, Water Resources Research Center, University of Arizona, Tucson, AZ

Session 13: PANEL – Columbia River Treaty: Past, Present and Future

Richard Kyle Paisley, University of British Columbia, Vancouver, Canada
Kate Stoeckel, University of British Columbia, Vancouver, Canada
Glen Hearns, University of British Columbia, Vancouver, Canada
Bo Bricklemyer, ARC Group, Port Townsend, WA
Lynne Lewis, Bates College, Lewiston, ME

Session 14: New Programs in Water Resource Education

Masters Degree Program in Water Resources Planning and Management: An Update. ***Paul G. Bourget***, US Army Corps of Engineers, Alexandria, VA

Designing an Interdisciplinary Graduate Water Degree. ***Ronald A. Kaiser*** and Valeen Silvy, Texas A&M University, College Station, TX

Over the River and Through the Woods: Teaching Environmental and Natural Resource Economics in the Field. ***Mark Griffin Smith***, Colorado College, Colorado Springs, CO

Eye-to-Eye with a Lunker Brown Trout: Oden State Fish Hatchery & Watershed Walk. ***Douglas Denison*****,** JJR Incorporated, Ann Arbor, MI

Session 15: Approaches to Water Conservation

Demand-Side Management of Urban Water Resources in Salt Lake City, Utah. ***Eric A. Coleman*** and Terry Glover, Utah State University, Logan, UT

Can Irrigation Technology Subsidies Effect *Real* Water Conservation? ***Susan M. Scheierling***, Robert A. Young and Grant E. Cardon, Colorado State University, Fort Collins, CO

Issues in the Experimental Determination of Urban Water Demand. ***David S. Brookshire***, Janie M. Chermak and Kate Krause, University of New Mexico, Albuquerque, NM; Steven Stewart, University of Arizona, Tucson, AZ

Evaluation of Water Policy Alternatives for Intertemporal Allocation of Groundwater in the Southern High Plains of Texas. ***Jeffrey W. Johnson***, Phillip N. Johnson, Kenneth A Rainwater, Eduardo Segarra and David Willis, Texas Tech University, Lubbock, TX

Session 16: Integrated Surface and Ground Water Management (Extended Session)

Economic and Environmental Aspects of Site Evaluation for Stream Augmentation Recharge Ponds in Colorado. ***Catherine J. Shrier*** and Darrell G. Fontane, Colorado State University, Fort Collins, CO

Investigating the Groundwater Quality Effects on Ecosystems and Human Activities for Informed Groundwater Policy. ***Leroy P. Kettren***, Steve Miller, Pamela K.B. Hunt, Andreanne Simard and John Bartholic, Michigan State University, East Lansing, MI

Aquifer Storage and Recovery – An Innovative Water Resources Management Tool. ***Jeff Barry***, Groundwater Solutions, Inc., Portland, OR

Procedures for Conjunctive Management Analyses in the Upper Snake River Basin. ***Roger K. Larson***, US Bureau of Reclamation, Boise, ID

The Water Rights Transfer Tool: A Tool for Evaluating the Impacts to River Reaches due to Water Rights Transfers. ***D.M. Cosgrove*** and G.S. Johnson, University of Idaho, Idaho Falls, ID

RECEPTION AND POSTER SESSION 5:30 pm – 7:30 pm

Technical Posters

USDA – CSREES National Water Quality Program: Applying Knowledge to Improve Water Quality. ***Lloyd Walker***, Colorado State University, Fort Collins, CO

Water for Endangered Species, Communities, and Cultural and Economic Uses – A Southwestern Collaborative Solution. ***Grace Haggerty***, New Mexico Interstate Stream Commission, Santa Fe, NM; Christina Radu, Tetra Tech EMI, Albuquerque, NM

Spokane Watershed Planning. ***Douglas R. Allen***, Department of Ecology, Spokane, WA

Student Poster Competition

A student poster competition with cash awards is being sponsored by UCOWR and the U.S. Bureau of Reclamation. Please contact Rosie Gard (gardr@siu.edu) or Gary Johnson (johnson@if.uidaho.edu) for information on abstract submission.

Wednesday, July 21, 2004

PLENARY SESSION II 8:30am – 10:00 am

Northwestern Approaches to Changing Water Allocation

Paul Cleary, Director, Oregon Water Resources Department

Karl Dreher, Director, Idaho Department of Water Resources

Joe Stohr, Water Resources Manager, Washington Department of Ecology

CONCURRENT SESSIONS 10:30am – 12:00pm

Session 19: Alternative Policies, Risk and Tradeoffs in River Management

Economic Impacts of Alternative Policy Responses to Prolonged and Severe Drought in the Upper Rio Grande Basin. ***Ari M. Michelsen***, Texas A&M University, El Paso, TX; Frank A. Ward, New Mexico State University, Las Cruces, NM; J.F. Booker, Siena College, Loudonville, NY

Water Demand, Risk, and Optimal Reservoir Storage. ***James F. Booker***, Siena College, Loudonville, NY

The Economics of Fish and Water: Balancing Instream Flow Needs of Listed Fish Species with Traditional State Water Allocation. ***Krista I. Born***, Stoel Rives LLP, Portland, OR

Session 20: PANEL - Water Resources Development: Recent Trends in the Decision-Making Process

Warren (Bud) Viessman, Department of Environmental and Engineering Sciences, University of Florida
John Boland, Department of Geography and Environmental Planning, Johns Hopkins University
David Moreau, Department of Environmental Science and Engineering, University of North Carolina
Cliff Russell, Environmental Studies, Bates College
Peter Rogers, Department of Environmental Engineering, Harvard University
Gerry Galloway, Enterprise Engineering Group, Titan Corp., Fairfax, VA

Session 21: Water Utility Supply and Demand Planning

The Implementation of a Plan to Provide Water and Wastewater Service to El Paso County Residents. ***Hector Gonzalez*** and Mariana Chew, University of Texas, El Paso, TX
"A Common Share" – Water Supply Choices in Urban Turkey. ***Anya Butt*****,** Central College, Pella, IA; Aysel Acar, Derya Eroglu and Ali Demirci, Fatih University, Istanbul, Turkey
Demand Responsive Pricing: A New Paradigm for Water Utilities. ***Edna T. Loehman*****,** University of Colorado, Boulder, CO; John Whitcomb, Stratus Consulting, Boulder, CO

Session 22: Interpreting Perceptions of Stakeholders

Assessing Stakeholder Perceptions About a Proposed Method to Prioritize Watersheds for Environmental Restoration. ***Ric Jensen*** and C. Allan Jones, Texas A&M University, College Station, TX
Use of a Preference-Feasibility System for Addressing Choice Conflicts in Water Planning and Instream Flow Decision Making. ***Valeen Silvy*** and Ronald A. Kaiser, Texas A&M University, College Station, TX
Integrating Science with Society: Environmental Systems Analysis in a Participatory Context. ***Olufemi Osidele*****,** University of Georgia, Athens, GA
Water Resources Gateway: An Internet-based Approach for Promoting Water Management and Planning Dialogues, ***Paul G. Bourget*****,** US Army Corps of Engineers, Alexandria, VA

Session 23: Valuation of Natural Resources and Hydrologic Information

Economic Analysis of Fishery Enhancement: Case Study of Yakima River. ***Earl Ekstrand*****,** US Bureau of Reclamation, Denver, CO
Can an Economic Value of Water to Sustain the Ecosystem Be Derived from the Analysis of Ecotourism Production? ***Mitchell Mathis*****,** Houston Advanced Research Center, Houston, TX
Property Rights and the Value of Commercial Rafting Permits. ***Joshua Mack*** and Mark Griffin Smith, Colorado College, Colorado Springs, CO
Willingness to Pay for Hydrologic Information Appropriation in Consensus Based Decision-Making on Water Allocation: A Hypothetical Analysis. ***Saket Pande*** and Mac McKee, Utah State University, Logan, UT

PLENARY SESSION III 1:30 pm – 3:00pm

Evolving Economic Approaches

Non-Market Valuation for Public Water Allocation Choices: Progress and Problems
Robert Young**,** Emeritus Professor, Colorado State University, Estes Park, CO

The Return to the River Basin: The Increasing Costs of "Jurisdictional Externalities."
Charles (Chuck) Howe, Department of Economics, University of Colorado, Boulder, CO

CONCURRENT SESSIONS 3:30pm – 5:00pm

Session 25: Ecologic Requirements and Water Rights Tradeoffs

An Integrated Assessment of Impacts of Altered Flow Regimes on Hydrologic, Ecologic and Economic Conditions within the Walker River Basin. ***John C. Tracy*****,** Desert Research Institute, Reno, NV; Tom Harris, University of Nevada, Reno, NV
Priority Water Rights and Environmental Protection. ***Tom McGuckin*****,** New Mexico State University, Las Cruces, NM
Water Leasing to Accommodate ESA: Impacts on the Regional Economies in the Platte River Basin. ***Dawn Munger*****,** Bureau of Reclamation, Denver, CO
Water Resource Valuation and Millennium Ecosystem Assessment Framework. ***Suren Kulshreshtha*****,** Richard Kellow and Joel Brunneau, University of Saskatchewan, Saskatoon, SK, Canada

Session 26: Using and Improving Water Transaction Strategies to Enhance Ecological Conditions

Oregon Water Trust Perspective on Allocating and Managing Water for a Sustainable Future. ***Fritz Paulus*****,** Oregon Water Trust, Portland, OR

Montana Water Trust Perspective on Allocating and Managing Water for a Sustainable Future. ***John Ferguson*****,** Montana Water Trust, Missoula, MT

Finding Water to Restore Stream Flows. ***Hedia Adelsman*****,** Washington Department of Ecology, Olympia, WA

Idaho Water Transaction Program. ***Bill Graham*****,** Idaho Department of Water Resources, Boise, ID

Session 27: Water Market Myths and Public Interest Values

The Importance of Getting Names Right: The Myth of Markets for Water. ***Joseph W. Dellapenna*****,** Villanova University, Villanova, PA

What if Markets Won't Work? An Alternative Market-Based Instrument for Water Allocation in the Presence of Irrigation Subsidies and Social Value for Instream Flows. ***Mitchell Mathis*****,** Houston Advanced Research Center, Houston, TX

Economic Efficiency, Ecosystem Management, and Policy Making in the Watershed. ***William Blomquist*****,** Indiana University Purdue University Indianapolis, Indianapolis, IN

Estimation of the Use and Non-Use Value of the Agmon: A TCM and CVM Approach. ***Nir Becker*****,** Haifa University, Haifa, Israel

Session 28: Weighing Tradeoffs in Water Quality, Quantity, Compliance and Costs

TMDL Allocations and Water Allocations – Reconciling Quality and Quantity. ***Paul J. Pickett*****,** Washington State Department of Ecology, Olympia, WA

The Mid Columbia Total Dissolved Gas TMDL: Balancing Compliance with Other Demands. ***Paul J. Pickett*****,** Washington State Department of Ecology, Olympia, WA

The Societal Costs and Benefits of Misallocating Water and Gasoline Additives in California. ***Ed Whitelaw*****,** University of Oregon and ECONorthwest, Eugene, OR; John Tapogna, ECONorthwest, Portland, OR; Thomas Guardino ECONorthwest, Eugene, OR

Was MtBE A Costly Mistake? The Evidence from Maine. ***Cecilia Clavet*****,** John M. Peckenham and Jonathan Rubin, University of Maine, Orono, ME

Session 29: Emerging Challenges and Technologies (Extended Session)

Feasibility of Using Desalination Technologies to Supplement Water Supplies in Eastern Virginia. Kimberly A. Edmonds, Yan Liang, Dixie W. Reaves and ***Tamim Younos***, Virginia Polytechnic Institute and State University, Blacksburg, VA

Enhancing Watershed Fresh Water Supplies Through Innovative Water Treatment Systems. ***D.B. Burnett*****,** C. Allen Jones, William E. Fox and Gene Theodori, Texas A&M University, College Station, TX

Riparian Response to Hydrologic Flux in the Downstream Reach of an Impounded 2nd Order Stream. ***Jacqueline R. Duke*****,** Joseph D. White and Peter M. Allen, Baylor University, Waco, TX; Ranjan S. Muttiah, Blackland Research Center, Temple, TX

Raster-Based Streamflow Analysis Applied to the Middle and Upper Snake River. ***Richard B. Koehler*****,** GeoSystems Analysis, Inc., Tucson, AZ

Water Availability for the Western United States: The Scientific Challenges. ***Mark T. Anderson*****,** US Geological Survey, Tucson, AZ; Lloyd Woosley, US Geological Survey, Austin, TX

Thursday, July 22, 2004

CONCURRENT SESSIONS 8:30am – 10:00am

Session 30: Water Resources Institutions and Federal Intervention

The October 2003 Quantification Settlement Agreement Implications for Water Management. ***Jonathan W. Bulkley***,Peter M. WegeChair in Sustainable Systems at the School of Natural Resources and Environment, The University of Michigan, Ann Arbor, MI

Characteristics of the Brownsville Irrigation District's Operations: Texas Lower Rio Grande Valley. ***Megan Stubbs*****,** Ed Rister, Ron Lacewell, Allen Sturdivant and John Robinson, Texas A&M University, College Station, TX

Evaluating Change in Water Institutions: Methodological Issues and Country Examples. ***Marie Leigh Livingston*****,** University of Northern Colorado, Greeley, CO

Session 31: PANEL - Upper Rio Grande Operations Model: A Reference Point for Problem Solving

Gail Stockton, US Army Corps of Engineers, Albuquerque, NM
Mark Yuska, US Army Corps of Engineers, Albuquerque, NM
Zhuping Sheng, Texas A&M University, El Paso Research Center, El Paso, TX
Tim J. Ward, University of New Mexico, Albuquerque, NM
Vincent Tidwell, Sandia National Laboratory, Albuquerque, NM

Session 32: Water Allocation: Differing Geographic Perspectives

Public Support for Species Conservation Policies: The Case of Pacific Salmon in Oregon. ***Valentina Fomenko***, Oregon State University, Corvallis, OR
The Downstream Economic Benefits from Storm Water Management: A Comparison of Conservation and Conventional Development. ***Douglas M. Johnston*** and John B. Braden, University of Illinois, Urbana, IL; Thomas H. Price, Conservation Design Forum, Elmhurst, IL
Evolving Eastern Water Allocation Policies: The Conflict Between Public Interest and Market Mechanisms Relating to Water Allocation in Georgia. ***James E. Kundell*** and Don R. Christy, University of Georgia, Athens, GA
Water Allocation Alternatives for the South Saskatchewan River Basin: Optimization Modelling for Improved Policy Choices. ***Marius I. Cutlac*** and Theodore M. Horbulyk, University of Calgary, Calgary, Alberta, Canada

Session 33: Water Resources Sustainability

Sustainable Water Allocation Resembles the Starship Enterprise. ***Jason C. Lynch***, US Military Acdemy, West Point, NY
Understanding Sustainability at the State Level. ***John R. Wells***, Minnesota Environmental Quality Board, St. Paul, MN
Challenges to Water Resources Sustainability in Florida. ***Joseph J. Delfino***, University of Florida, Gainesville, FL
Perspectives on Conservation and Sustainability: A New Paradigm or Two. ***Peter E. Black***, SUNY College of Environmental Science and Forestry, Syracuse, NY

Session 34: The Klamath: "Good Science", Water Markets and Fish

Allocating Water in the Klamath Basin: The Endangered Species Act and "Good Science". ***Greg D. Corbin***, Stoel Rives LLP, Portland, OR
Resolving Water Conflicts in the Klamath Basin: A Role for Markets and Institutions. ***William K. Jaeger***, Oregon State University, Corvallis, OR
Field Validation of Habitat Modeling of Chinook Spawning and Fry Life Stages in the Lower Klamath River. ***Thomas B. Hardy***, Utah State University, Logan, UT

PLENARY SESSION IV 10:30am-12pm

NGO Approaches to Balancing Economics and the Environment

Gail Achterman, Director of the Institute for Natural Resources, Oregon State University
Ruth Mathews, Manager of Freshwater Conservation Programs, WA Chapter of The Nature Conservancy
Norm Whittlesey, Professor Emeritus, Washington State University

Closing Remarks

Karl Wood, UCOWR President 2004-2005, Director New Mexico Water Resources Research Institute
Jim Moncur, NIWR President, Director, Hawaii Water Resources Research Center

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Who Should Register

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Allocating Water: Economics and the Environment
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	By June 20	After June 20
Member	$200 ☐	$250 ☐
Speaker	$200 ☐	$250 ☐
Non-Member	$250 ☐	$300 ☐

Please check the box(es) below for each day of registration; includes session attendance and food functions for day(s) of registration only.

☐ Tuesday ☐ Wednesday ☐ Thursday

Tualatin Project Tour $15 ☐

PAYMENT

☐ Check # ______________________
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(I agree to pay the above amount according to the card-issuer agreement.)
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Make checks payable to the Universities Council on Water Resources. Checks must be issued in U.S. dollars, drawn on U.S. banks. On-site registrants must be accompanied by payment or copy of purchase order. For pre-registration discount, form must be postmarked by June 20, 2004. Mail to Universities Council on Water Resources, Southern Illinois University, 1000 Faner Drive, Room 4543, Carbondale, IL 62901-4526. Telephone (618) 536-7571, Fax: (618) 453-2671. Cancellations must be submitted in writing by June 30, 2004. A $50 processing fee will be deducted from the registration fee.

REGISTRATION INCLUDES

	Sessions	Tue. Reception	Weds. Banquet	Daily Breakfast	Proceedings
Full Registration	●	●	●	●	●
Daily Registration					
Tuesday	●	●		●	●
Wednesday	●		●	●	●
Thursday	●			●	●
Student Registration	●	●		●	●
Spouse / Guest Reg.	●	●	●	●	

If you require special assistance while attending the conference, please contact UCOWR directly. All requests should be submitted in writing before June 20, 2004.

Special Events

Tualatin Project Technical Tour - Monday, July 19, 12:30-5:30 PM

Welcome Reception & Poster Session - Tuesday, July 20, 5:30-7:30 PM

Includes Student Poster Competition

UCOWR Banquet & Awards Ceremony - Wednesday, July 21, 7:00-9:00 PM

Warren Hall Medal Award-UCOWR presents the Warren A. Hall Medal to recognize distinguished achievements of an individual in the field of water resources. The friends and family of Warren A. Hall have established this memorial.

Friends of UCOWR-UCOWR recognizes individuals who have made outstanding contributions to the organization and names them "Friends of UCOWR."

Dissertation Awards-UCOWR recognizes two outstanding Ph.D. dissertations on water issues, one in each of the following categories: (1) water policy and socio-economics and (2) natural science and engineering.

Education and Public Service Award-This award is given to recognize individuals, groups, or agencies that have made significant contributions to increased public awareness of water resources development, use, or management.

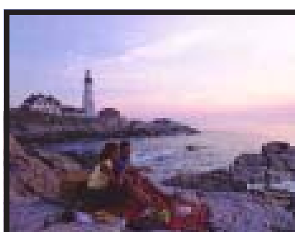
Tualatin Project Tour

A technical tour of the Tualatin Project, west of Portland will precede the conference on the afternoon of Monday July 19. For a modest fee of $15 you can climb aboard a comfortable tour bus and spend the afternoon enjoying the scenery of the Portland area while learning something about water concerns and management in the area.

The Tualatin Project, west of Portland in the coast range is a Bureau of Reclamation facility, operated by Washington County Parks and Recreation Department. It includes Scoggins Dam, Henry Hagg Lake which is 1,132 surface acres, two pumping plants, approximately 100 miles of buried pipeline, and recreation, fish and wildlife facilities. It is one of the few recreational lakes near the Portland, Oregon metropolitan area. The lake provides flat water recreation, such as boating and fishing, and abundant wildlife such as deer, elk, cougar and bobcat in the forests surrounding the lake. The natural flow of Scoggins Creek is stored in Henry Hagg Lake for irrigation, municipal and industrial uses, recreation, fish and wildlife and water quality. The project also reduces flooding on Scoggins Creek and the Tualatin River. The area west of Portland, Oregon has one of the fastest population growth rates in the state. The local residents are looking toward the future needs of the area for water resources and are working with the Oregon Congressional Delegation to obtain funding and authorization for a feasibility study. Increasing the storage capacity of Henry Hagg Lake is one of the options being explored in the feasibility study, doing a water exchange from the Willamette River is another option. The tour will include the Tualatin NWR, Clean Water Services–Joint Water Commission, Springhill Pumping Plant, Scoggins Dam and the recreational facilities at Henry Hagg Lake.

The Tour Departs Conference Hotel at 12:30 PM, Monday, July 19 and returns about 5:30. Tour participants must include payment with their registration by June 20 (see registration form). If we do not receive the minimum necessary advance registrations, those who sign up will be notified of tour cancellation.

2005 UCOWR Conference, Portland, Maine



2005 UCOWR Annual Conference

"River and Lake Restoration"

July 12-14, 2005

Holiday Inn By the Bay

Allocating Water: Economics and the Environment July 20-22, 2004

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Benefits of UCOWR Membership

The Universities Council on Water Resources (UCOWR) is an organization of almost 90 member universities united in common goals of research, education and service related to the wise use, protection and conservation of our nation's water resources. Benefits from UCOWR membership include:

Advocacy

UCOWR is dedicated, through its membership, to the objectives of developing new science and preparing leaders and technologies for the use, management and protection of our water resources. Through policies and recommendations developed through its committee structure, UCOWR delegates act as advocates for incorporation of contemporary issues and methodologies in the classroom and research laboratories. Evolving academic programs in water resources represent excellent examples of model curricula for other interdisciplinary programs.

Leadership

UCOWR's officers and member delegates represent the nation's leading academic professionals who are dedicated to providing the expanding knowledge base and training water resource professionals. Graduates of UCOWR institutions constitute the majority of new professionals entering water resources careers each year. UCOWR encourages delegates to assume leadership roles within their institutions and supports this role through electronic and personal networking services. In addition, the organizational structure of UCOWR provides opportunities for leadership development through participation in offices, committees and the Board of Directors.

Awareness

UCOWR is the only professional organization serving academic institutions and their faculties to embrace the entire range of disciplines involved in water resources. This diversity sets UCOWR apart from discipline affiliated organizations and provides a holistic view necessary to solve today's complex water problems and to train the nation's future water resource leaders. As a forward looking organization, UCOWR promotes incorporation of cutting edge science and methodology into the classroom through active programs of discussion, demonstration and publications. UCOWR, through UWIN, its Internet Home Page, also enhances public awareness of the need for inclusion of a broad range of viewpoints in providing sustainable solutions to water problems. UWIN provides a database of several thousand water resource experts and registered more that 1 million queries in 1996.

Professional Growth

UCOWR promotes the professional growth of member delegates in order to enhance their impact and effectiveness within the community of water resources professionals. *Water Resources Update*, our quarterly publication, provides opportunities for publication of research information and establishment of dialog on contemporary water issues to a degree not afforded by other water related journals. The annual meetings provide a forum for exchanges of information in an atmosphere conducive to open discussion and personal and institutional network building with professional organizations through cosponsorship of meetings and development of UWIN as a clearinghouse for information. Achievements of outstanding water resource professionals are recognized through the UCOWR awards program that focuses attention on water research, education and service. Student awards recognize outstanding dissertations chosen in a national competition and encourage life long dedication to careers in water resource fields.

Service

The variety of benefits described above promote and support opportunities for member delegates to provide services to their institutions and their various clienteles. As a member of UCOWR, delegates actively participate in national debates that will determine future directions of water resources research, education, and public service. As active participants, they will have access to and be responsible for the incorporation of new tools and ideas into the education and training programs of their institutions to produce better prepared and more effective graduates. These same tools and ideas are incorporated into life long learning activities for practicing professionals through UCOWR and university sponsored programs, thus directly serving the public. Finally, active participation in UCOWR provides the stimulation necessary for the advancement of science from which solutions to our nation's complex water problems arise.

FRIENDS OF UCOWR

In appreciation of their vision and leadership in the advancement of Water Resources Research and Education, the following individuals have been named "Friends of UCOWR."

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Robert Young– 2004

Dam Removal: Lessons Learned – Coming to a Region Near You!

EWRI is hosting Dam Removal: Lessons Learned, a series of two-day regional workshops focusing on past and recent dam removal projects and what can be learned from them. These workshops will focus on what has been learned from actual dam removal processes and will not debate individual views on overall pros and cons. This series of workshops continues the successful format of the first workshop held at Johns Hopkins University and is the result of recommendations made by both the Aspen Institute and the H. John Heinz III Center for Science, Economics and the Environment in their respective studies, "Dam Removal – New Option for a New Century," and "DAM REMOVAL – Science and Decision Making." Both reports noted that holding a workshop would improve communication across disciplinary boundaries.

The workshops will feature six sessions including: Permitting; Economic Impacts; Biological Impacts; Social/Cultural Impacts; Aesthetics/Recreation; and Geomorphologic/Hydrologic Impacts. However, a large amount of functional overlap between the sessions is expected and will be encouraged. Each session will include a presentation by two dam removal professionals chosen to reflect diversity in experience and perspective, mixing both intra and extra regional experience to enhance dialogue and understanding. The workshops will close with an open discussion of means to improve cross disciplinary communication of lessons learned and improved decision making processes about dam removal. Ten Professional Development Hours (PDHs) can be earned through participation in one of these workshops.

Please visit http://www.ewrinstitute.org/damremoval04/ for more information and to register! EWRI staff members Gail Sor (gsor@asce.org) and Katie Gorscak (kgorscak@asce.org) may be contacted for additional workshop information.

Plan to register for a workshop in your area!

- July 12-13, 2004 - University of Michigan, Ann Arbor, Michigan
- August 16-17, 2004 - University of CA, Berkeley, California
- August 30-31, 2004 - Ft. Collins Marriott, Fort Collins, Colorado
- November 8-9, 2004 - Heathman Lodge, Vancouver, Washington
- February 10-11, 2005 - University of Tennessee, Knoxville, Tennessee

Dam Removal - Westward Bound!

University of Michigan
July 12-13, 2004

The first stop for Dam Removal 2004 is Ann Arbor, Michigan-home of the University of Michigan Wolverines! The workshops will be held in the Dana Building, home of the School of Natural Resources and Environment. The Dana Building recently underwent a major renovation where its hundred-year-old infrastructure was updated and newer facilities were adapted. All aspects of this transformation were performed on an environmentally responsible level with all aspects of the building now demonstrating "Green" building practices. Featured speakers for this workshop include Joan Harn of the National Park Service on the topic of Permitting in addition to John Boland of Johns Hopkins University discussing the Economic Impacts of Dam Removal.

University of California, Berkeley
August 16-17, 2004

Sunny skies and the San Francisco Bay Area will be the beautiful backdrop for our second Dam Removal Workshop at the University of California, Berkeley. Founded in the 1860s, the University of California at Berkeley is renowned worldwide for the distinction of its faculty and students, the scope of its research and publications, and the quality of its libraries. The campus acts as an oasis of nature for this part of California where the wooded 178-acre central campus area is known for its architectural and historical landmarks. The workshops will be held in Evans Hall and will feature such speakers as Brian Rheinhart of the U.S. Army Corps of Engineers on Aesthetics and Recreation as well as Mark Capelli of National Marine Fisheries Service discussing the Geomorphologic/Hydrologic Impacts of Dam Removal.

Ft. Collins, Colorado
August 30-31, 2004

Third in our workshop series, Ft. Collins, Colorado is often considered to be the pathway to the Rocky Mountains. Located sixty miles north of Denver, this bustling town boasts three hundred days of sunshine a year to complement its large array of outdoor activities. With forty parks within the city and a number of shopping districts and local attractions, Fort Collins is a great place for an extended visit. The workshop will be held in the recently renovated Fort Collins Marriott located just two miles from Colorado State University. Speakers from all over the country will be on hand at this workshop along with individuals from local universities including the University of Colorado are invited to present.

Small Water Supply Systems

Meeting the Challenges of the Safe Drinking Water Act

Issue Editor: John C. Braden

Contents

2004 UCOWR Annual Conference
Allocating Water:
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