Environmental Justice

The right to a clean place to live, work, learn, and play

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On Tap

Drinking Water News and Information for America’s Small Communities

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Sponsored by USDA Rural Development
Dallas Tonsager, Under Secretary Rural Development
Jonathan S. Adelstein, Administrator
Joyce Taylor, RUS Loan Specialist

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The right to a clean place to live, work, and play
by Sandra Fallon

Steps to Sustainability
Water and Energy Efficiency
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Emerging Issues – Phosphorus
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Emerging Issues – Source Water Monitoring and Hydraulic Fracturing
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Oil and Gas Extraction and Source Water Protection

Although the U.S. petroleum industry has been around since the mid-19th century, increased demand for oil and natural gas, coupled with new extraction technologies has led to booms in several parts of the country. One area where the gas and oil industries have looked for new resources is the Marcellus Shale, which lies under several states in the Northeast. This Tech Brief discusses the possible effects on source water from these extraction processes, and what water systems can do to protect themselves.
Interest rates for Rural Development Utilities Service (RDUS) water and wastewater loans—issued quarterly at three different levels: the poverty line rate, the intermediate rate, and the market rate—have been announced. The rate applied to a particular project depends on community income and the type of project being funded.

To qualify for the poverty line rate, two criteria must be met. First, the loan must primarily be used for facilities required to meet health and sanitary standards. Second, the median household income of the area being served must be below 80 percent of the state’s non-metropolitan median income or fall below the federal poverty level. For 2012, the federal poverty level was $23,050 for a family of four.

To qualify for the intermediate rate, the service area’s median household income cannot exceed 100 percent of the state’s non-metropolitan median income.

The market rate is applied to projects that don’t qualify for either the poverty or intermediate rates. The market rate is based on the average of the Bond Buyer index. The rates, which apply to all loans approved on or after May 23, 2011, are:

- poverty line: 2.125 percent;
- intermediate: 2.75 percent; and
- market: 3.5 percent.

RDUS loans are administered through state Rural Development offices, which can provide specific information concerning RDUS loan requirements and applications procedures.

For the phone number of your state Rural Development office, contact the National Environmental Services Center at (800) 624-8301 or (304) 293-4191. The list is also available on the Rural Development Web site at [www.rurdev.usda.gov/eed_map.html](http://www.rurdev.usda.gov/eed_map.html).

India plans to become the first nation to certify “blue ratings” for commercial and industrial water use, says Elizabeth Cutright, Water Efficiency editor, in a May 2012 blog post. According to Cutright, this blue rating is intended as a partner to the green labels and carbon-footprint ratings that commercial and industrial agencies use to illustrate the importance of natural resource and environmental management.

Acting on a request by the Union Ministry of Water Resources, the Confederation of Indian Industries (CII) has agreed to “frame guidelines for increasing water efficiency in Indian industries.” The hope is that these guidelines will be set by March 2013.

For more information about the blue ratings, go to [www.indolink.com/displayArticleS.php?id=052012103414](http://www.indolink.com/displayArticleS.php?id=052012103414).
EPA and VA to Connect Veterans with Water Sector Jobs

The U.S. Environmental Protection Agency (EPA) and the U.S. Department of Veterans Affairs (VA) Vocational Rehabilitation and Employment Program plan to connect veterans with disabilities to career opportunities in the water and wastewater sectors—such as at wastewater plants and drinking water facilities—as part of EPA’s Water Sector Workforce Initiative.

EPA and the VA will work with water utilities, states and local VA counselors to promote water sector careers and resources for finding water jobs for veterans as well as educational programs to help veterans transition into careers in water industries.

More than one-third of all current water operators are eligible to retire within seven years and, according to the U.S. Department of Labor, employment for water and wastewater operators is expected to grow by 20 percent between 2008 and 2018, faster than the national average for all other occupations. EPA sees the need to invest now in creating a pipeline of future water sector professionals to fill these essential water sector careers.

Veterans are an important target group for water and wastewater utility jobs because many veterans already possess training and technical skills that are directly transferable to careers in the water sector.

Learn more about EPA’s Water Sector Workforce Initiative, go to water.epa.gov/infrastructure/sustain/ws_workforce.cfm. For more about VA connecting qualified veterans with employer needs, go to www.vetsuccess.gov/.

New WERF Project Enables Better Communication Among Utilities

The Water Environment Research Foundation (WERF) has recently launched WATERiD, an online knowledge base, that permits utilities to easily share their experiences, information, and lessons learned in managing the nation’s water infrastructure.

Developed by Dr. Sunil Sinha, associate professor of civil and environmental engineering at Virginia Tech, WATERiD will help the nation address the challenges associated with the aging and deteriorating wastewater and water infrastructure. WATERiD is unique in that it allows utilities to share their “lessons learned” and thus avoid repeating mistakes, explains Dr. Daniel Woltering, WERF director of research.

This sharing is accomplished through a “wiki”-like capability for utilities to submit their information on cost, performance, and capability of various technologies. Then, utilities can easily access all of the information necessary to assess whether a practice or technology is right for their application.

WATERiD can be accessed from the WERF website at www.werf.org or at www.waterid.org.
**USDA Develops Federal Resource Guide for Rural Communities**

U.S. Department of Agriculture (USDA) Under Secretary for Rural Development Dallas Tonsager announced the publication of a guide that outlines federal programs that support economic development and quality of life enhancement for rural communities.

“Rural communities across the country are working hard to build their economies and provide services to their residents,” says Tonsager during a speech at the national Rural Economic Developers Association. “Creating great places to live, raise families, provide recreational opportunities, and infrastructure for high paying jobs in rural America is very important to the Obama Administration and our efforts at USDA. This publication will provide easy, one-stop access to federal programs.”

The publication Federal Resources for Sustainable Rural Communities is a collaborative effort among USDA, the Department of Housing and Urban Development, the Department of Transportation, and the U.S. Environmental Protection Agency. It ensures rural communities have access to all of the federal resources that can support their efforts to promote economic competitiveness, protect healthy environments, modernize infrastructure, and provide services to residents. The guide has key information on funding and technical assistance opportunities available from four agencies.


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**Tool Estimates Water Pollution Control Affordability**

The U.S. Environmental Protection Agency has released a web-based tool to help stakeholders evaluate the economic and social impacts of pollution controls needed to meet water quality standards set for specific uses, such as swimming or fishing.

The tool will help states, territories, tribes, local governments, industry, municipalities and stormwater management districts identify and organize the necessary information, and perform the calculations to evaluate the costs of pollution control requirements necessary to meet specific water quality standards. The tool prompts users to submit treatment technology information, alternative pollution reduction techniques and their costs and efficiencies, and financing information, as well as explain where that information can be found.

For more information, visit [http://water.epa.gov/scitech/swguidance/standards/economics/](http://water.epa.gov/scitech/swguidance/standards/economics/).
EPA Wastewater Report Provides Onsite Resource

In June 2012, the U.S. Environmental Protection Agency’s Office of Wastewater management released Case Studies of Individual and Clustered (Decentralized) Wastewater Management Programs: State and Community Management Approaches.

EPA intends this report to serve as a resource for decision makers in rural, exurban, and suburban communities across the country who want to provide effective, efficient wastewater treatment. Local decision makers know the wastewater management challenges they face in existing developed areas with old, undersized, or malfunctioning septic systems; and in newer developments that need high-performance treatment facilities to protect groundwater and nearby lakes, rivers, streams, wetlands, and coastal waters.

This compendium of case studies illustrates how a few communities met—and bested—those challenges. Although the approaches varied considerably, the communities featured in this document assessed existing system performance, created new development requirements, and instituted management measures to ensure that all systems were operated and maintained appropriately. The communities considered a wide variety of treatment technologies, from simple septic systems to advanced treatment clustered units, as noted in the examples in the following sections.

The communities used a mix of public and private sector resources to identify which existing systems needed attention, what type of repair or replacement service was required, and how new development would be served. Local leaders also used new treatment technologies, such as high-performance, clustered treatment facilities for areas with small lots and challenging site conditions (e.g., poor soils, steep slopes, high groundwater table). An added benefit for many communities was the opportunity to create green jobs while improving treatment system management and performance.

EPA has provided additional detail on how to develop management programs for individual and clustered systems in the Handbook for Managing Onsite and Clustered (Decentralized) Wastewater Treatment Systems, which may be found at http://water.epa.gov/infrastructure/septic/index.cfm. The website also provides other resources and tools.
**St. Louis Community College Gets Drinking Water Job Training Grant**

The U.S. Environmental Protection Agency (EPA) has awarded $181,638 to St. Louis Community College (STL-CC) for drinking water job training.

EPA Region 7 Administrator Karl Brooks notes, “From EPA’s standpoint, it is essential that we groom talented and committed young people into drinking water fields in order to meet the need and shortage of experts in this important industry. The certification training is essential to successful job placement in this field.”

The training meets requirements set by the Missouri Department of Natural Resources for drinking water treatment certification. The core curriculum focuses on the skills necessary for entry-level jobs at drinking water facilities. It includes sessions on water quality monitoring, green infrastructure, operations, maintenance, mathematics, and drinking water regulations.

EPA oversees the protection of water quality and public health. The responsibility for ensuring safe drinking water is shared by EPA, states, tribes, water systems, and the public.

For more information about drinking water-related activities in EPA Region 7, visit [www.epa.gov/drink/](http://www.epa.gov/drink/).

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**Washington Announces Rain Runoff Requirements**

Washington state will begin requiring municipalities to use rain gardens and pervious pavement in new urban developments to combat rainwater pollution to the state’s rivers and lakes and to the Puget Sound, according to a July 2012 Associated Press article.

The new low-impact development practices will be phased in over the next few years in an attempt to minimize the fiscal impact on local governments, the state Department of Ecology said.

“Storm water is the number one water pollution problem for populated areas,” says Ted Sturdevant, Washington’s director of ecology.

Rain gardens are planted depressions featuring soil and shrubs that allow rainwater runoff to soak into the ground. Pervious pavement also allows runoff to filter into the soil.

“It’s a whole lot easier and cheaper to prevent runoff and pollution as we plan our developments, than to try to manage storm water after the fact,” says Sturdevant.

Rain runoff that’s not absorbed tends to pick up pollutants as it makes its way into streams, then into rivers, lakes or the Puget Sound.

Under the new initiative, the state will monitor how the new practices work, and check to see whether pollutants in Washington’s waters are decreasing. The new rules primarily affect new developments.
U.S. and Canada Ink Great Lakes Agreement

U.S. Environmental Protection Agency Administrator Lisa P. Jackson and Canada’s Minister of the Environment Peter Kent signed the newly amended Great Lakes Water Quality Agreement at a formal ceremony in September 2012. First signed in 1972 and last amended in 1987, the Great Lakes Water Quality Agreement is a model of bi-national cooperation to protect the world’s largest surface freshwater system and the health of the surrounding communities.

“Protecting cherished water bodies like the Great Lakes is not only about environmental conservation. It’s also about protecting the health of the families—and the economies—of the local communities that depend on those water bodies for so much, every day,” Jackson said. “The amended Great Lakes Water Quality Agreement we signed today outlines the strong commitment the U.S. and Canada share to safeguard the largest freshwater system in the world. Our collaborative efforts stand to benefit millions of families on both sides of the border.”

The revised agreement will facilitate action on threats to Great Lakes water quality and includes strengthened measures to anticipate and prevent ecological harm. New provisions address aquatic invasive species, habitat degradation and the effects of climate change, and support continued work on existing threats to people’s health and the environment in the Great Lakes Basin such as harmful algae, toxic chemicals, and discharges from vessels.

The overall purpose of the agreement is “to restore and maintain the chemical, physical and biological integrity of the waters” of the Great Lakes and the portion of the St. Lawrence River that includes the Canada-United States border. Both governments sought extensive input from stakeholders before and throughout the negotiations to amend the Agreement. Additionally, the amended Agreement expands opportunities for public participation on Great Lakes issues.

The amended agreement sets out a shared vision for a healthy and prosperous Great Lakes region, in which the waters of the Great Lakes enhance the livelihoods of present and future generations of Americans and Canadians.

To view the text of the agreement, go to: http://www.bina-tional.net/home_e.html

NOAA Tracks Toxic Great Lakes Algae from Space

Algae forming in lakes and rivers not only harms the water, it can kill indigenous marine life and the aquatic vegetation needed to sustain a healthy ecosystem. A new pilot program is taking a close-up look at the problem from afar.

The program, involving the National Oceanic and Atmospheric Administration (NOAA), the University of Toledo, and Blue Water Satellite Inc., is using satellite imagery of Lake Erie’s western basin to monitor the harmful algal blooms that have been increasing-ly threatening the Great Lake for the past several years.

The harmful algal blooms in Lake Erie commonly contain cyanobacteria, also known as blue-green algae. Many cyanobacteria release toxins that are known to cause liver and nerve damage in humans, and kill pets and other animals.

If proven successful, the monitoring project could become an ongoing service during outbreak season, roughly April through October each year.

Researchers will combine the data from the NASA MODIS satellite, the U.S. Geological Survey’s Landsat 7 satellite and the DigitalGlobe WorldView 2 satellite.

The data produced could give governmental agencies the ability to see early bloom-formation conditions of the toxic algae across the entire western Lake Erie region within 24 hours of each satellite overpass.

For more information about NOAA’s research, go to www.glerl.noaa.gov.
Environmental Justice

The right to a clean place to live, work, learn, and play

By Sandra Fallon
NESC Training Specialist
Who can expect to breathe clean air, drink clean water, and live on unpolluted land? As it turns out, not everyone. It can depend on your race, your income level, and your neighborhood. Consider these three examples:

1. In Ocala, Florida, retired elementary school teacher Ruth Reed organized her neighbors to fight pollution from the nearby Royal Oak charcoal factory when she got sick and tired of putting a wet washcloth over her face when the neighborhood would become enveloped in a cloud of smoke and lighter fluid fumes. She couldn’t breathe in her own house.

2. On January 22, 2005, more than 100 people gathered at Fontana City Hall in California to kick off a local campaign to make sure that the state’s recently proposed standards for the chemical perchlorate would truly protect the public’s health. Perchlorate contamination was widespread in the area, and had been found in drinking water, milk, breast milk, and vegetables. The disposal of perchlorate, which is a salt used primarily in solid rocket fuel and mostly produced by defense companies, can contaminate soil and water. It affects the thyroid gland, which produces hormones crucial to the body’s growth, development, and metabolism, and has been linked to cancer. Perchlorate is especially harmful for pregnant women and infants. One resident commented “My children and grandchildren are at constant risk of exposure…Where can we turn for clean water and food?”

3. Potentially dangerous levels of lead were found in soil samples of 21 neighborhoods in 13 states, according to an April 20, 2012, USA Today report. The lead particles in the soil are fallout from lead factories that operated from about the 1930s to the 1960s. Some areas are so contaminated that children should not be playing in the yard. Parents reported they were unaware of the soil contamination and were shocked to find out that their kids faced such risks. Lead poisoning of children can result in lower intelligence, delayed puberty, and other problems. Some yards had lead levels five to 10 times higher than what the EPA considers hazardous to children.

Studies over the past 25 years examining situations like these have shown that industrial and chemical pollution, sanitary landfill siting, and toxic waste disposal occur primarily in low-income communities and communities of color—those populated primarily by African Americans, Latinos, and Native American. In Sacrifice Zones: The Front Lines of Toxic Chemical Exposure in the United States, Steve Lerner, research director at Commonweal, a nonprofit health and environmental research institute, writes that residents living “along the fenceline with heavy industry often experience elevated rates of respiratory disease, cancer, reproductive disorders, birth defects, learning disabilities, psychiatric disorders, eye problems, headaches, nosebleeds, skin rashes, and early death. In effect, the health of these Americans is sacrificed, or, more precisely, their health is not protected to the same degree as citizens who can afford to live in exclusively residential neighborhoods.”

A sacrifice zone is a hot spot of nuclear, chemical, or other pollution that occurs where people live and where they are expected or forced to make disproportionate health and economic sacrifices to benefit a larger goal or region. Recognition of these realities helped give rise to the environmental justice movement.

**What is Environmental Justice?**

The U.S. Environmental Protection Agency (EPA) defines environmental justice as “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.” Fair treatment, according to EPA, means, “no group of people should bear a disproportionate burden from the negative environmental consequences of industrial, municipal, and commercial operations or policies.”

“All too often,” says EPA Administrator Lisa Jackson, “low-income, minority and tribal Americans live in the shadows of the worst pollution, facing disproportionate health impacts and greater obstacles to economic growth in communities that cannot attract businesses and new jobs.”

“Simply put,” according to Robert D. Bullard, a sociologist and environmental justice scholar, “environmental justice demands that everyone (not just the people who can ‘vote with their feet’ and move away from threats or individuals who can afford lawyers, experts and lobbyists to fight on their behalf) is entitled to equal protection and equal enforcement of our environmental, health, housing, land use, transportation, energy and civil rights laws and regulations.”

Conditions in Environmental Justice Communities

In minority and poor communities, few residents can afford to hire lawyers, doctors, geologists, water or other experts to challenge polluting practices. Local people may lack access to information about public hearings regarding the permitting of new industries. A major barrier is a lack of time, according to Bill Price, Environmental Justice Program Organizer for the West Virginia Sierra Club. “Many people are working their lives away just to put food on the table,” he says.

Other environmental justice advocates point out that residents fear they’ll lose jobs and income if they complain about local companies poisoning the neighborhood. They say poor and minority communities lack political power, and have little or no say in land use planning, zoning laws, or industrial development. Some claim that zoning decisions are used to keep undesired land uses, such as industrial or waste facilities, in low-income and communities of color.

In 1991, the First Nation People of Color Environmental Leadership Summit, held in Washington, D.C., drew more than 1,000 participants and broadened the movement’s early anti-toxics focus to include public health, worker safety, land use, transportation, housing, resource allocation, and the empowerment of communities. Participants also develop the 17 Principles of Environmental Justice, which guide the movement to this day.

The EPA and Environmental Justice

The EPA began investigating environmental justice issues in the early 1990s as a result of pressure from environmental justice activists. In 1994, due to this pressure and to EPA’s own research findings that “racial minorities may have a greater potential for exposure to some pollutants because they tend to live in urban areas, are more likely to live near a waste site, or exhibit a greater tendency to rely on subsistence fishing for dietary protein,” President Bill
Clinton signed Executive Order 12898, Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations. The order directed federal agencies to make environmental justice part of their mission by "identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations."

Despite this executive order, the federal government has not adequately addressed environmental justice. In fact, a 2004 EPA Office of Inspector General report found that the agency had not identified minority and low-income communities, had not defined the term "disproportionately impacted," and had failed to provide definitions and guidance to its regional offices, which made it difficult for any EPA program to implement environmental justice. A second Office of Inspector General Report in 2006 found that the EPA program and regional offices had not performed environmental justice reviews as required by the 1994 executive order.

In 2011, EPA and 16 other federal agencies agreed to develop environmental justice strategies for protecting the health of citizens who live in communities overburdened by pollution. The EPA’s strategy, Plan EJ2014, calls for:
- a unified agency approach toward policy and guidance development that addresses rulemaking, permitting, compliance, and enforcement;
- community engagement and empowerment; development of tools for environmental justice analysis; and
- timelines for implementation.

**Questioning Traditional Environmental Protection Approaches**

Environmental justice advocates contend, however, that the fundamental principles guiding the U.S. regulatory approach will continue to prevent it from providing the necessary environmental protections. The Toxic Waste and Race at Twenty report notes that, “Significant racial and socioeconomic disparities exist today despite the considerable social attention to the problems noted…. These findings raise serious questions about the ability of current policies and institutions to adequately protect people of color and the poor from toxic threats.”

The report explains that the foremost goal of current environmental-protection regulations is to manage, regulate, and distribute risks. Bullard, referring to a 1992 National Law Journal analysis of environmental lawsuits in the U.S., writes that, “the current system has institutionalized unequal enforcement, traded human health for profit, placed the burden of proof on the ‘victims’ and not the polluting industry, legitimated human exposure to harmful chemicals, pesticides, and hazardous substances, promoted ‘risky’ technologies such as incinerators, exploited the vulnerability of economically and politically disenfranchised communities, subsidized ecological destruction, created an industry around risk assessment, delayed cleanup actions and failed to develop pollution prevention as the overarching and dominant strategy.”

The environmental justice framework does not advocate tinkering with current risk management approaches. Rather, it advocates preventing environmental threats before they occur. According to Bullard, this approach asks, “‘How little harm is possible’ rather than ‘How much harm is allowable.’” The Precautionary Principle, upon which this approach is based, “demands that decision makers set goals for safe environments, examine all available alternatives for achieving the goals, and places the burden of proof of safety onto those who are proposing to use inherently dangerous and ‘risky’ technologies.”

Of the approximately 85,000 chemicals currently in use in commerce in the U.S., for example, less than two percent (1,432) have been found to pose a potential unreasonable risk to the public health and environment. However, EPA, who regulates these chemicals, relies primarily on available data from chemical manufacturers or importers in making this determination. When incomplete information or limited analyses exist, EPA reports that a new chemical has no risk, according to a 2010 Office of Inspector General report. Under the current regulatory and legal system, people who are harmed by exposure to a chemical and are seeking help or redress must prove the chemical caused the harm. The environmental justice perspective would shift the focus, requiring the chemical manufacturer to prove the chemical was safe before being allowed to manufacture and release it into the environment.

**Environmental Justice for All?**

From its early days fighting environmental racism, to today’s focus on a wide range of injustices that affect a variety of minority and low-income people, the environmental justice movement continues its efforts to
ensure that all U.S. citizens have the right to live, work, learn, and play in a clean and healthy environment. Toxic Wastes and Race at Twenty reminds us that many environmental injustices could be eliminated through vigorous and nondiscriminatory enforcement of current environmental, health, housing, land use, and civil rights laws. Addressing others will require new legislation, or a precautionary approach and institutional change at many levels of society. Perhaps it’s also incumbent upon each of us to ask what level of pollution and health risk we’re willing to accept for ourselves, our children and families, and our fellow citizens.

About the Author
Sandra Fallon is a training specialist with the National Environmental Services Center.

For More Information

The Environmental Justice Resource Center  
http://www.ejrc.cau.edu/
An environmental justice research, policy, and information clearinghouse located at Clark Atlanta University.

The Principles of Environmental Justice  
http://www.ejnet.org/ej/principles.html
The seventeen principles adopted at the 1991 First National People of Color Leadership Summit that served as a defining document of the environmental justice movement.

U.S. EPA Environmental Justice Website  
http://www.epa.gov/environmentaljustice/index.html
Provides information and links to EPA’s environmental justice programs and activities.

U.S. EPA Environmental Justice Small Grants Program  
http://www.epa.gov/environmentaljustice/grants/ej-smgrants.html
Competitive grant program that provides financial assistance to community organizations and local and tribal governments to address local environmental or public health issues.

Environmental Justice for All: A Fifty State Survey of Legislation, Policies, and Initiatives  
http://www.uchastings.edu/public-law/docs/ejreport-fourthedition.pdf
A comprehensive and up to date survey of environmental justice laws, policies, and cases in all 50 states and the District of Columbia.

During summer 2012, the Environmental News Network ran a 10-part series investigating environmental justice. Read these articles at:  

Environmental and Public Health Statistics

According to Toxic Wastes and Race at Twenty, 1987-2007:

- Most of the nation’s brownfields (between 130,000 and 450,000 abandoned waste sites) are located in or near neighborhoods with low-income, working class and people of color.
- More than 5.1 million people of color reside in neighborhoods with one or more commercial hazardous waste facilities (2.5 million Hispanics or Latinos, 1.8 million African Americans, 616,000 Asians/Pacific Islanders, 62,000 Native Americans).
- “Neighborhoods with commercial hazardous waste facilities (host neighborhoods) are 56 percent people of color;” neighborhoods without are 30 percent people of color.
- “Poverty rates in host neighborhoods are 1.5 times greater than non-host areas (18 percent vs. 12 percent).”

An Associated Press analysis of EPA data found that:

- “African Americans are 79 percent more likely than whites to live in neighborhoods where industrial pollution is suspected of posing the greatest health danger.”
- “In 19 states, blacks were more than twice as likely as whites to live in neighborhoods where air pollution seems to pose the greatest health danger.”
- “Residents of the at-risk neighborhoods were generally poorer and less educated, and unemployment rates…were nearly 20 percent higher than the national average.”

The 2009 report Race, Income, and Environmental Inequality in the United States found that:

- “Black, white, and Hispanic households with similar incomes live in neighborhoods of dissimilar environmental quality.
- “Blacks are more highly represented in census tracts with high toxic concentration levels than any other major racial/ethnic group in the country.”
- “Low-income black neighborhoods and households experience a much higher pollution burden than do any other neighborhood or household type (included in the study).”
References


Price, B. 2012. Environmental Justice Program Organizer, Sierra Club of West Virginia. (February 24). Personal interview.


Taking Steps to Sustainability

Water and Energy Efficiency Are Attainable Goals

By Kathy Jesperson
NESC Editor
From improving small drinking water and wastewater treatment system compliance to creating thriving communities, sustainability—defined by The U.S. Environmental Protection Agency (EPA) as creating and maintaining “the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations”—makes sense on many levels. But creating such a program takes foresight and planning.

EPA notes that effective planning is essential for water and wastewater systems so they can manage their operations and infrastructure as well as ensuring the sustainability of the communities they serve. The agency further suggests that sustainability plans should include effective utility management practices, because it is critical to building and sustaining the technical, managerial, and financial capacity of the drinking water, wastewater, and stormwater systems that make up the water sector.

Becoming sustainable can seem like an overwhelming goal, but focusing on water and energy efficiency are important first steps water utilities can take to start the journey to sustainability.

Creating the Plan

First things first: be sure to hammer out the goals, objectives, and targets of the plan and then decide how you will meet them. For example, if your goal is to become sustainable over the next five years, what would it take to satisfy that goal? These will be your objectives. Then you will set targets for how much and when these procedures will be accomplished. A target might be that your system will implement energy efficient practices by the second quarter of the fiscal year and achieve a 10 percent savings in energy expenditures.

Include a financial strategy that ensures adequate revenues for new infrastructure and operational investments—as well as the overall system—so they are sufficiently funded, operated, maintained, and replaced over time on a full lifecycle cost basis, with appropriate considerations for disadvantaged households.

Make sure the goals you set are attainable and measureable. Setting lofty goals could end up as a disappointment for the system and the community it serves. One way to help you achieve some of sustainability goals to develop partnerships.

Partnerships Evolve

Creating a sustainability plan can provide small drinking water and wastewater systems with the opportunity to form unique partnerships with individuals, community environmental groups, industry and businesses, academia, and local, state, and federal governments. Through these partnerships, small systems can build sustainable practices that not only benefit them but their communities as well. For example, collaboration with neighboring systems can lead to more efficient and cost-effective methods of supplying participating communities with drinking water and wastewater services.

In addition, actively engaging employees in improvement efforts—helping to identify improvement opportunities, participating in cross-functional improvement teams, etc.—builds camaraderie.

Water Efficient Practices

Water conservation is critical to balance current and future water needs. As public awareness grows, so does the attention paid to water conservation. Water conservation practices can result in lower wastewater discharges that can mean an improvement in overall water quality. It also diminishes our need to find or build new water sources, leaving them in reserve for our possible later use.

“More water will be available for current and future uses people or the environment and communities will be more prepared to deal with water shortages,” says Ruth Greenhouse, conservation coordinator, Arizona Department of Water Resources. “This is particularly important in communities that rely on groundwater that is being depleted from overdraft, or communities where surface water supply is decreasing or at risk. “

Not only do water conservation and efficiency programs save small systems money, they can also provide the opportunity to develop educational and awareness programs for the customers, Greenhouse adds.

On the supply side, there are two key activities that will make a world of difference for the system’s water supplies, notes EPA. The first is accounting for water. The agency says that this strategy is probably the single most important step toward ensuring that a water utility is sustainable. This is best accomplished when water systems meter their customers’ water usage.
Metering helps to identify losses due to leakage and also provides the foundation on which to build an equitable rate structure to ensure adequate revenue to operate the system.

The second activity is water loss control. According to EPA, on average, water systems lose 14 percent of the water they treat to leaks. Some water systems have reported water losses exceeding 60 percent. Accounting for water and minimizing water loss are critical functions for any water utility that wants to be sustainable.

On the demand side, water conservation practices reduce the amount of money you spend each month for household water use. Your community saves the money spent pumping and treating water before and after use, plus conservation can delay expenditures for additional water sources and treatment facilities.

Water conservation can positively affect the reliability of your water supplies during periods of high demands (such as the summer months) and during droughts. Communities should implement a water conservation program that discourages wasteful water use at all times and restricts non-essential water uses during droughts, says EPA. During droughts, such a program can enable a community to respond to water shortages early and thus avoid the need for more extreme measures later.

One of the most effective ways to reduce demand for water is to establish rates that escalate as more water is used. “Issues like examining their user rates, which many communities haven’t done in far too long to ensure that they are not only covering their costs, but also being able to set aside something for the emergency repairs and maintenance, as well as something for future capital improvements. This is a tough sell, but with the right education of local officials and customers it can be done,” Deb Martin, director Great Lakes Rural Community Assistance Partnership (RCAP).

Getting consumers to reduce water use by installing water-efficient products or employing efficiency practices, such as turning the water off while brushing teeth or running washing machines only when they are full. Water systems can promote these actions through consumer rebates for plumbing fixtures and education programs to change public behavior.

Energy Efficient Practices

“One of the things that we’ve been trying to get utilities to focus on these days is looking at their energy usage and how they might reduce their usage and costs, usually through simple fixes like operational modifications and other low-cost options,” Martin says. “Energy costs represent the single highest cost after personnel for utilities, and substantial cost reductions often can be achieved through an audit. These audits can often be funded by utility companies (in whole or in part), and the savings achieved can then be put toward other aspects of the operations. This is just one example, and there are many more.”

By determining baseline energy use, water and wastewater utility managers and operators can better understand their electricity provider’s rate structure and how their current operations impact energy costs within that structure, says EPA. Further, energy-intensive processes such as pumping and aeration can be identified and prioritized for improvement. Baseline energy use can be determined through third-party energy audits or self-assessments.

Improving energy efficiency is an ongoing challenge for water sector utilities.
While energy costs often represent 25 to 30 percent of a utility’s total operation and maintenance (O&M) costs, they also represent the largest controllable cost of providing water and wastewater services, says EPA.

**Best Energy Practices**

Once you know your baseline energy use and where you are consuming the most energy, you can identify and prioritize energy conservation opportunities. These opportunities are often easily achievable and involve implementation of best industry practices for energy management.

Increasingly, wastewater utilities are realizing that in addition to being a consumer of energy, they can be a generator of energy using combined heat and power also known as cogeneration. For example, Portland, Oregon’s Columbia Boulevard Wastewater Treatment plant produces over 12 million kilowatt hours of electricity through a 1.7 megawatt cogeneration system. The heat from the system is used to warm the digesters while the electricity provides about 40 percent of the plant’s daily power needs. Excess biogas is sold to a nearby metal roof manufacturing company, generating an additional $60,000 for the wastewater treatment plant.

But you don’t have to generate your own energy to be efficient. In lieu of generating renewable energy onsite, utilities may have the option of purchasing renewable energy directly from the power grid or through the purchase of renewable energy certificates (RECs).

RECs are credits sold separately from electricity. They represent the environmental, social and other positive attributes of power generated by renewable resources that enable organizations to choose renewable power even if their local utility or power marketer does not offer a green power product. The availability of these options varies according to your facility’s location and your electricity provider’s offerings.

While water and energy efficiency provide a good foundation for many small drinking water and wastewater systems, before you can do anything, you need to know where your assets lie.

**GIS Solutions**

“Ohio RCAP is working on developing a shared GIS service for small utilities. These utilities generally cannot afford to have a GIS specialist on staff, so we were searching for a way of making this available to small communities,” says Martin.

“We’re in the process of developing an entity that will host all of the GIS data in the cloud for these systems that can then access maps of their systems and update them as needed. This has a number of sustainability implications,” she continues. “First, it helps because many small systems don’t even know where their lines, valves, and other system components are. Not only does this waste precious staff time, but it also puts them in a position that if they lose their operator then all of the knowledge of the system goes with him/her. In addition, they can’t even begin to look at things like asset management, that help achieve sustainability, until they know what assets they have, what condition they’re in, and where they are.”

**Finding Your Way**

Getting a handle on your system’s assets, becoming more water and energy wise, along with proper planning have many benefits, and sustainable practices can be implemented. Sustainability practices can save money and time for systems with low budgets and manpower.

**More Information**


For more information about Portland’s cogeneration project, go to: [http://www.portlandoregon.gov/bes/article/344953](http://www.portlandoregon.gov/bes/article/344953).

The National Environmental Services Center has dozens of articles and products related to the topics discussed in this article. Visit the NESC website at [www.nesc.wvu.edu](http://www.nesc.wvu.edu). A good way to find what you’re looking for is to enter a key word or short description in the search feature found on the home page.
PART 2
THE RATE SETTING STORY:
How to Adopt New User Rates

By Carl Brown, President
GettingGreatRates.com
Getting your proposed user rates accepted by your ratepayers is critical but not always easy. Adopting new user rates is akin to flying a plane: Hours of workmanlike activity, many landings without a hitch, and then the rare but terrifying event happens. In the old days—before disinfection by-products, Cryptosporidium, facilities wearing out, and multi-million dollar upgrades—workmanlike rate setting was enough. Rates were dirt cheap, so fairness was not an issue either. Now, every rate adjustment can become a disaster. Because you want your story to have a happy ending, you must make plans every time to avoid disaster or to deal with it if it happens.

The best way to avoid disaster is to be completely upfront with your ratepayers. They will not come to you to inquire about their rates. That is, not until you propose big changes. At that point they’re just mad and you’ve lost them. You must go to them. But, what does that mean?

First it means that you must put together a good rate calculation or analysis. Importantly, it must include some visuals that will show ratepayers—using color, lines and such—what the proposed rates really mean to them. Start with what they care about most: their money. They really don’t want to mess with this rate adjustment stuff so you must show them quickly and clearly that the new rates won’t hurt and prove that those adjustments are needed.

One of your visuals needs to be a simple table of the bills that different types of users will pay at different volumes of use. From this table users can find their current average bill and what will happen to that bill because of the new rates. Chart 14 is part of a full-page table pulled from a rate analysis. Notice, for example, that the low-volume residential customers’ rates will actually go down, and the high-volume ones won’t go up much. If you leave it to the rumor mill to spread the word, the rate reduction part of the story won’t get told.

Another useful visual shows the affordability index of the current rates compared to the proposed rates. You need something like Chart 9 to show ratepayers that, even with the proposed increase, the average residential customer’s water bill will only cost them 0.05 percent of their household income more than the current rates, going from an affordability index of 0.23 percent in 2010 to 0.28 percent. That amounts to one cheeseburger out of their monthly budget! And besides that, the average affordability index in the U.S. is about one percent so these rates are dirt cheap now, and they will still be dirt cheap after the increase.

To prove to ratepayers that the adjustments are really needed, you must show what will happen if rates are not increased. Do that with something like Chart 11. This chart shows that if the current rates are continued, the system will go broke in a few years. If it’s financially broke, it won’t operate. Ratepayers don’t want that. With the increase, reserves will stay in the black so the water service can keep coming. The best choice is clear.

Of course, it will not be enough to simply flash some nice charts up on the screen to convince ratepayers that a rate increase is in their best interest. You also need to apply a bit of salesmanship to accomplish that. Fortunately, salesmen are not born. They learn how to sell their wares just as you can learn how to sell rate adjustments. To do that you can read about rate setting or you can ask your association for some rate-setting training provided by a rate-setting specialist. Then you can avoid becoming a bad newspaper headline. Do this well and your rate-setting story will have a happy ending—you will adopt fair and adequate rates. Then, like all successful Hollywood movies…

Foley, MN, Water Rates Scenario 3
Chart 14 - Old Rates, New Rates and Changes

<table>
<thead>
<tr>
<th>Median or Actual Average use in 1,000 Gallons</th>
<th>Current Average Bill</th>
<th>Proposed Average Bill Starting on 12/31/10</th>
<th>Bill Increase or (Decrease) After Rate Adjustment</th>
<th>Percent Increase or Decrease (-) After Rate Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.123</td>
<td>$29.40</td>
<td>$22.38</td>
<td>-$7.02</td>
<td>-24%</td>
</tr>
<tr>
<td>1.547</td>
<td>$29.40</td>
<td>$26.42</td>
<td>-$2.98</td>
<td>-10%</td>
</tr>
<tr>
<td>2.505</td>
<td>$29.40</td>
<td>$29.13</td>
<td>-$0.27</td>
<td>-1%</td>
</tr>
<tr>
<td>3.460</td>
<td>$29.40</td>
<td>$31.84</td>
<td>$2.44</td>
<td>8%</td>
</tr>
<tr>
<td>11.991</td>
<td>$50.35</td>
<td>$57.88</td>
<td>$7.53</td>
<td>15%</td>
</tr>
<tr>
<td>Apartments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.000</td>
<td>$29.40</td>
<td>$36.21</td>
<td>$6.81</td>
<td>23%</td>
</tr>
<tr>
<td>15.000</td>
<td>$62.99</td>
<td>$64.56</td>
<td>$1.56</td>
<td>2%</td>
</tr>
<tr>
<td>25.000</td>
<td>$104.99</td>
<td>$92.90</td>
<td>-$12.09</td>
<td>-12%</td>
</tr>
<tr>
<td>35.000</td>
<td>$146.99</td>
<td>$121.25</td>
<td>-$25.74</td>
<td>-18%</td>
</tr>
<tr>
<td>46.878</td>
<td>$196.87</td>
<td>$154.92</td>
<td>-$41.95</td>
<td>-21%</td>
</tr>
</tbody>
</table>
Your Fans will be Clamoring for a Sequel

Actually, no, your ratepayers don’t want a sequel, but there is no way around it; this must be done again. But as in Hollywood, you will be under pressure to make the sequel better than the original. Use some of the following storylines to make that happen.

The first time around you probably will fight an uphill battle to arrive at fair rates. After all, “fair” is in the eye of the beholder, and no beholder thinks their rates should go up. You can get a leg up on that battle by adopting a resolution that is something like the following goal statement concerning fair and adequate rates.

“The (council/board) of ___________ resolves to set and maintain utility rates and fees that are fairly structured for the ratepayers and high enough to adequately fund the system on a sustainable basis.

– From the “Ratepayer’s Survival Guide©”

The initial rate adjustment should have fixed your rate structure and increased overall rates. This was the hard adjustment. Adjustments that you will do for the next several years only need to raise revenues incrementally, on the order of three to five percent across the board each year. These increases are no big deal. Don’t make them into one. All they do is match your projected income with your projected budget needs.

Let this phrase be your mantra: “Raise rates every year, at least a little bit.” For all practical purposes, inflation is a law. When inflation happens, you need more revenue to cover it. Ratepayers understand inflation; it happens to them, too. But if you go five or 10 years without a rate increase, they get used to that. When you finally ask for an increase, and it will be a big one, they get mad. And there you go. You’ve lost them again.

Of course, you should always look for ways to cut costs so rates won’t need to go up so much:

• Form a purchasing co-op with neighbors so you can make bulk purchases of chemicals, supplies, etc. at cheaper prices.

• Form cooperative agreements so your system and neighboring systems can share rarely used equipment like backhoes, dump trucks, jetter trucks and the like. Why should a small system pay for a backhoe that sits around in a storage lot 300 days out of the year?

• Consider what you own and what you need to own in light of the utility’s mission – to provide safe, dependable drinking water or provide sanitary wastewater collection and treatment service. If an activity or piece of equipment does not substantially contribute to accomplishing the mission, axe it. And then “brag” about axing it. Your ratepayers need to be told that you are continuously looking out for them.

Considering what you own, and what you need to own in the future, is a must if you want to adopt adequate rates. You must set rates that include the costs to repair, refurbish and replace equipment (commonly called “R&R” for short), and the costs of building new facilities in the next five to 10 years. R&R costs commonly run about 15 percent of the total costs to operate and maintain the system, excluding administration costs. Capital improvement costs (debt service) in a fairly new system can easily run total costs up by 50 percent. Disregarding these two items when setting rates will quickly get you into the same shape the federal government is in right now. R&R needs to be modeled using a present value calculation, something that few people know how to do.

For most residential ratepayers the incremental increase will amount to 50 cents to 75 cents per month, not worth attending a meeting for.
Finally, take stock of the effort it took to do basic rate calculations and to convince the ratepayers of the wisdom of making rate adjustments:

• Would your time have been better spent doing something else?
• Would you have enjoyed doing something else more than doing rate calculations?
• Did your simple calculations serve the ratepayers better than a comprehensive rate analysis would have?
• Did you end up netting more revenue than a rate setting specialist would have gotten you?
• Did you avoid lawsuits and disgruntlement from your ratepayers?

Not surprisingly, the last issue is a big one. Ratepayers are angry these days. Anger doesn’t help you. Sometimes that anger even leads to lawsuits. But after-the-fact and in court is the wrong time and place to be addressing these issues. It should always happen on the front end and on your home turf. None of this is to say that you must hire a rate-setting specialist. But, when you do need a specialist, no one else will do.

We’ve come to the conclusion of your rate-setting story. By restructuring and raising your rates as described here you will bring in the money your system needs and do it fairly.

**For More Information**

To learn more about user rates, visit:

The National Environmental Services Center website at [www.nesc.wvu.edu](http://www.nesc.wvu.edu). Search using the term “rate setting” to review several free articles.

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The American Water Works Association (AWWA) website at [www.awwa.org](http://www.awwa.org) and search for the manual called, *Principles of Water Rates, Fees and Charges*. AWWA has other related manuals you may find useful if you are serious about doing the calculations yourself.

The [GettingGreatRates.com](http://www.gettinggreatrates.com) website to download the free Ratepayer’s Survival Guide©. You also may purchase the book *How to Get Great Rates*. Some rural water associations also sell the book at a discount. You can also download the free EquipmentScheduler© spreadsheet. Plug in your equipment replacement needs and the spreadsheet will spit out the amount you need to set aside each year for these items. Then you simply plug this amount into your operating and ownership costs list. Also add in the annual costs of debt service and payments to your capital improvement reserves fund.

Carl Brown Consulting to take advantage of the free request for qualifications and proposals template (RFQ Model in Microsoft Word format) linked at the bottom of [carlbrownconsulting.com](http://carlbrownconsulting.com).

**Disclaimer:** The author is not an attorney and the information in this article should not be considered legal advice. State laws and local policies vary, so consult your attorney to avoid running afoul of these. In addition, the calculations in this article are the common denominators. There are whole volumes of manuals on rate calculations that teach you these methods. And there are software programs that do most of these calculations for you. But you need to know the basic calculations so you will understand what needs to be done and why.

Carl Brown is President of Carl Brown Consulting, LLC, specializing in water, sewer and storm water system rate analysis, asset management and training nationwide; and GettingGreatRates.com, home of many rate-setting tools. Contact: (573) 619-3411; E-mail carl@carlbrownconsulting.com or at [http://carlbrownconsulting.com](http://carlbrownconsulting.com).
Phosphorus is a naturally occurring element, found in water, food, and the human body, especially our teeth and bones. It is a vital nutrient for humans, plants, and animals.

Phosphates are natural compounds: salts containing phosphorus and other minerals, and are used in baking products, toothpaste, and carbonated beverages. Phosphates and phosphoric acid are used in fertilizers.

Phosphate is a common ionic form of phosphorus consisting of one phosphorus atom bonded to four oxygen atoms, and is represented chemically as \( \text{PO}_4^{-3} \). Because the phosphate ion has a negative charge, it readily combines with positively charged ions to form numerous compounds. For example, when combined with hydrogen it forms phosphoric acid, \( \text{H}_3\text{PO}_4 \).

Because phosphorus is commonly found in the form of phosphate, the terms “phosphorus” and “phosphate” tend to be used interchangeably.

As an essential plant nutrient, phosphorus is a key component of fertilizer for agriculture in the form of concentrated phosphoric acids. Global demand for fertilizers led to large increase in phosphate production in the second half of the 20th century, resulting in the agricultural industry being heavily reliant on fertilizers that contain phosphate, mostly in the form of superphosphate of lime.

**Why are phosphates and phosphorus an issue?**

Because it is a plant nutrient, phosphorous and phosphates trigger algal blooms that deplete the receiving waters of oxygen under certain conditions, killing the aquatic life. This process is called eutrophication and, although reversible and based on natural effects (plant nutrient, plant development), has become a significant environmental problem. In many
surface waters, algal blooms can have considerable detrimental impacts on leisure activities, tourism, and fish and other organisms. Algal blooms also impact the source water quality for drinking water utilities. Although fertilizer runoff is a big contributor to eutrophication, domestic sewage also contributes to the problem.

The biological removal of both nitrate and phosphate is often the best method. However, biological removal is not possible in most situations so wastewater treatment plants have to resort to chemical and more elaborate means to deal with phosphorus.

Treatment technologies currently available for phosphorus removal include those categorized as physical (e.g., filtration and membrane technologies), chemical (e.g., precipitation and physical-chemical adsorption), and biological (e.g., assimilation and enhanced biological phosphorus removal).

Physical treatment with sand filtration is similar to a sand filter in a drinking water plant. Membrane technology is also being employed and can include micro-, nano-, ultra-filtration or reverse osmosis. In these processes, the membranes physically filter some of the phosphorus.

Chemical treatment for phosphorus or chemical precipitation has been used for many years. The chemicals used include compounds of calcium, aluminum, and iron. The most commonly used chemical is ferric chloride or ferrous sulphate. Other chemical-physical processes can include enhanced coagulation where the chemical addition helps settle the phosphorus out.

Biological treatment is the most commonly used process. Traditionally, this involved treatment ponds containing planktonic or attached algae, rooted plants, or even floating plants (e.g., water hyacinths, duckweed). Enhanced biological phosphorus removal (EBPR) is becoming a popular treatment for phosphorus removal. EBPR has the potential to achieve low (<0.1 mg/L) effluent phosphorus levels at modest cost and with minimal additional sludge production.

EBPR features an anaerobic tank (nitrate and oxygen are absent) prior to the aeration tank. In the anaerobic tank, bacteria called polyphosphate-accumulating organisms are selectively

Reducing Phosphorus From Wastewater Discharges

The removal of phosphorus during sewage treatment process has become an area of interest as more and more regional regulations take effect. The Chesapeake Bay, where the U.S. Environmental Protection Agency has established the Chesapeake Bay Total Maximum Daily Load calling for a 25 percent reduction in nitrogen, 24 percent reduction in phosphorus, and 20 percent reduction in sediment, is one example of a regional regulation.
enriched in the bacterial community within the activated sludge. These bacteria accumulate large quantities of polyphosphate within their cells, enhancing the removal of phosphorus.

Removal of traditional carbonaceous contaminants (biological oxygen demand), nitrogen, and phosphorus can all be achieved in a single system, although it can be challenging to achieve very low concentrations of both total nitrogen and phosphorus in such systems. The phosphate in EBPR is removed in the waste activated sludge, which might have five percent or more phosphorus (dry weight) as opposed to only two to three percent in non-EBPR sludges.

Regardless of the method used, removing phosphorus is necessary to assure healthy aquatic and plant life, as well as protecting the water that becomes drinking water.

References


For More Information

The National Environmental Services Center magazine Small Flows has a juried article titled “Cost and Affordability of Phosphorus Removal at Small Wastewater Plants” online at www.nesc.wvu.edu/pdf/ww/publications/smallflows/magazine/SFQ_FA04.pdf (beginning on page 36 in the publication).

To extract natural gas from geologic deposits, a process called hydraulic fracturing or “fracking” is used. This process uses a large volume of water and added chemicals that are injected into the gas well under high pressure to create cracks, seams, and fissures in the deep rock layers within which the gas is trapped. The newly created fissures allow the gas to be extracted more freely and efficiently.

When the frac fluid returns to the surface it is referred to as return or flowback fluid and should be considered industrial wastewater. The flowback wastewater typically has a very different chemical composition than the frac mixture that went down the well. This is because frac fluid often mixes with deep geologic groundwater, referred to as “formation water” or “natural brine,” that has a high concentration of dissolved substances. In many cases the flowback wastewater is considerably saltier than seawater. The composition of flowback wastewater is variable depending on the makeup of the frac fluid and the local geology. In the Marcellus Shale region of Pennsylvania and West Virginia, the flowback wastewater shows highly elevated concentrations of total dissolved solids (TDS), barium, iron, sodium, chloride, bromide, and dissolved organic carbon. Other potential contaminants include volatile organic compounds (VOCs), dissolved methane, oil and grease, and radionuclides.

Testing Is a Must

When private well owners or public water systems have source water—either groundwater or surface water—close to a drilling operation they worry about what could happen and want to stay vigilant to protect themselves and their communities. One way to stay on top of the situation is to have the source water tested before drilling starts thereby establishing a baseline. After the
drilling and hydraulic fracturing starts, conduct water tests at regular intervals (at least every six months) for several years after the drilling stops.

One common contaminant of flowback wastewater that is of particular concern to drinking water plant operators is bromide. While bromide is not considered to be a direct health risk, when it is present in chlorinated water it reacts to form bromine. Bromine, the elemental form of bromide, belongs to the same group of elements (the halogens) as chlorine, and has similar properties, including some disinfection capability. However, just as chlorine can react to form disinfection by-products (DBPs) in the presence of organic matter, so can bromine. The presence of bromide in the source water can lead to the formation of a wide array of DBPs that are a mixture of chlorinated and brominated compounds.

This can create a problem for drinking water operators because one resulting bromine compound, hypobromous acid, has been found to react much more readily with organic matter than its chlorinated counterpart, hypochlorous acid. This means that the resulting DBPs may be more highly brominated than might be expected given the initial concentration of bromide in the source water. Further, because bromine/bromide is heavier than chlorine/chloride, the more heavily brominated the DBPs become, the more likely the water system is to find itself in violation of DBP drinking water standards.

Because of the extremely high concentration of dissolved solids in flowback wastewater, frequent monitoring for TDS is important. Fortunately, TDS can be monitored easily with a meter. The dissolved solids are primarily in ionic form and carry a slight electrical charge. Electrical conductivity meter readings are a good approximation of TDS. Water systems with well drilling occurring within their source water area may want to consider the installation of continuous reading conductivity meters in their source water as an early warning system for possible wastewater spills.

Drinking water systems and private well and spring owners should know and have an established baseline or history of the characteristic chemical concentrations of their drinking water source. Any significant changes to their baseline indicators should be viewed as a potential sign that their systems are being influenced by external factors and should trigger additional investigations.

References


For More Information

The National Environmental Services Center has two articles related to water and shale gas extraction. The first, “Communities, Water Sources and Potential Impacts of Shale Gas Development,” is available at www.nesc.wvu.edu/waterwedrink while the second, Tech Brief: Oil and Gas Extraction and Source Water Protection may be downloaded from www.nesc.wvu.edu/pdf/DW/publications/ontap/tech_brief/TB54_OIlGasExtraction.pdf.
Operating a water or wastewater utility has never been easy. And with new technologies and increasing regulations, the job just keeps getting more difficult. If you have questions about a particular technology or about other aspects of running your system, the National Environmental Services Center’s (NESC) technical staff may have the answers you need. Our engineers, certified operators, and support staff have decades of experience working with small drinking water and wastewater systems.

Call us at (800) 624-8301 and select option 3 to speak with one of NESC’s technical assistance specialists. Even though many of our customers find our experience and information invaluable, we don’t charge for the call or the advice. It’s free!
Oil and Natural Gas in the U.S. With imported oil and gas prices continually rising at the pumps and home heating bills also on the rise, the demand for lower prices and the lure of big money has spurred gas and oil industries to search domestically for new resources. An area that has seen a flurry of activity and is believed to have one of the largest shale gas deposits in the world is the region associated with the Marcellus Shale.

Extending south from New York’s Finger Lakes region, this deposit is found in New York, Pennsylvania, West Virginia, Virginia, Ohio, Maryland, and Kentucky. Other significant areas of gas and oil deposits in the U.S. include Texas, Louisiana, Arkansas, Oklahoma, Wyoming, and Utah. (See the map of showing U.S. shale formations on page three.)

The Marcellus Shale is a brittle layer of rock more than a mile underground; it is the geological remnant of an ancient sea and is laced with pockets of trapped gas, which is mostly methane. Terry Engelder, a Penn State University geologist reports, in the article “The New Gas Boom,” that the deposit could contain as much as 516 trillion cubic feet of natural gas. That would make it the second largest gas field in the world, containing 20 times our current annual national consumption of natural gas.

However, compared to previous gas and oil fields, these new deposits are increasingly deeper and locked in shale. To extract the gas and oils from these deep deposits, a procedure called hydraulic fracturing is used.

Hydraulic Fracturing (Hydrofracking or Fracking) Hydraulic fracturing, also known as “hydrofracking” or “fracking,” is the use of high-pressure fluids to force open fissures or seams in rock to allow the gas or oil to be extracted more easily and efficiently. Although it's not a new technique, hydrofracking has increased in the last few years as a way to get the deeper, harder to reach deposits of gas and oil, and is now is used in about 90 percent of the nation’s oil and natural gas wells. As a result of hydraulic fracturing and advances in horizontal drilling technology, natural gas production in 2010 reached its highest level in decades.

The amount of water needed for the hydraulic fracturing process varies from well to well and from one shale formation to another, but it is typically about five to six million gallons per well. The water used is either purchased from nearby systems (and often trucked to the site) or a well is drilled near the gas well to provide the raw water needed.

But water isn’t the only thing used in the hydraulic fracturing process. Each company has a mix of water, chemicals, and other ingredients that they use for this purpose, and have historically kept this recipe secret. The frack solution varies from well site to well site and from drilling company to drilling company. Some drilling companies buy the frack water solution already mixed and ready to be used, while others mix the solution at the well site. Many gas and oil companies recycle the frack fluids, but for this to be cost-effective
there must be more than one well nearby to make the recycling worth the trouble.

As the use of hydraulic fracturing has grown, so have concerns about its environmental and public health impacts. One concern is that hydraulic fracturing fluids used to fracture rock formations contain numerous chemicals that could harm human health and the environment, especially if they enter drinking water supplies. The resistance of many oil and gas companies to publicly disclose the chemicals they use heightens this concern.

In 2010, the U.S. House of Representatives Committee on Energy and Commerce began investigating the chemicals and components used in hydraulic fracturing. The committee compiled information from the leading 14 gas and oil service companies, who agreed to supply their proprietary information on condition of anonymity, and published their findings in Chemicals Used In Hydraulic Fracturing.

The committee found that the most widely used chemical in hydraulic fracturing was methanol, a hazardous air pollutant and a candidate for regulation under the Safe Drinking Water Act (SDWA). Other chemical components used in hydraulic fracturing between 2005 and 2009 as reported to the committee included:

- Isopropanol (Isopropyl alcohol, propan-2-ol);
- Crystalline silica–quartz (SiO2);
- Ethylene glycol monobutyl ether (2-butoxyethanol);
- Ethylene glycol (1,2-ethanediol);
- Hydrotreated light petroleum distillates;
- Sodium hydroxide (Caustic soda).

(For a complete list of the 750 chemicals reported to the committee, see: http://democrats.energy-commerce.house.gov/sites/default/files/documents/Hydraulic%20Fracturing%20Report%204.18.11.pdf.)

Chemicals weren’t the only components used in fracking; though. One company used instant coffee as one of the components in fluid designed to inhibit acid corrosion, while two companies reported using walnut hulls as part of a breaker, which is a product used to degrade the fracturing fluid viscosity. Another used tallow soap to reduce loss of fracturing fluid in the exposed rock.

**Fracking and Water**

Most problems with hydraulic fracturing happen when casing and cement, which reinforce the well at the point where it is drilled through the groundwater, are not installed properly or fail for other reasons. Multiple seals at the wellhead and in the first few hundred feet of the drill hole are supposed to direct the pressure and frack fluid to the bottom of the well. (See the cross section of a hydraulic fracturing well on page five.)

Other groundwater contamination problems, however, can happen above ground. Most wells have a holding pond for the frack water that returns to the surface (typically 10 to 20 percent of the total water used). This return frack water is rife with chemicals and sometimes carries traces of radiation from underground rock. Most municipal wastewater plants cannot adequately treat or remove this waste. Therefore, much of it remains stored in ponds near the wellheads for long periods of time where it can possibly leak into the groundwater, even if the ponds are lined with plastic.

Surface water contamination from the fracking process can happen when frack fluid spills at the wellhead site or as the trucks carrying this fluid travel to and from the wellhead leak. These spills may be from unused frack fluid or return frack fluid, which comes back up the well during the fracturing process. Again, a holding pond may leak, which could drain its contents into nearby streams or the holding ponds may overflow from large rain events. One of the biggest issues with surface water contamination is from the treatment of the spent or processed frack water at municipal wastewater plants.

The return frack water is very high in chlorides, sodium, and calcium. These chemicals create high total dissolved solids (TDS) levels. In addition, investigators have found sodium concentrations higher than what are normally found in seawater. Other contaminants include bromide, radiation, radon, methane, and others. A typical wastewater treatment plant cannot remove enough of these contaminants from the treated wastewater it releases into receiving streams. Because of the high contaminant levels, the spent frack water requires specialized treatment and some states, such as Pennsylvania, have limited the number and type of wastewater treatment plants that can receive this wastewater.

Other concerns from oil and gas extraction are air, noise, and light pollution. Drilling is a 24-hour operation with many high-powered lights for safe operation. The equipment at the well site is usually powered by gas and diesel engines that run almost nonstop and the exhaust contributes to air pollution. Other concerns are heavy traffic loads on rural roads and the possibility of damaging the roads and creating leaks in the drinking water distribution systems that are under the roads. When trucks bring in water for fracking, hundreds of
round trips are needed to bring in enough water. If the well uses potable water for the frack fluid, it could create high demand on already short-staffed water systems, although the added revenue is often attractive. Seismic activity may also be associated with the hydraulic fracturing process in areas that have rarely, if ever, seen it, affecting structures that were not built with seismic specifications.

**Protecting Source Water**

One of the best ways a community’s water system can protect its source water is to have total ownership of the land, minerals, and gas and oil rights in the watershed area, or strict land-use ordinances or regulations. Most communities do not have this kind of control to protect their source water. But, there are other steps that can be taken. For instance, the drinking water system could update its source water protection plan or wellhead protection plan to show where any gas or oil wells past and present are located. In addition to mapping the wells, the system could note any possible transport routes to active wells and plan ways to be prepared for possible spills.

System operators should learn about drilling that is being permitted in their watershed area before it starts. Contact the state permitting agency to inquire about new and pending permits, and attend public hearings or meetings that may involve the source water. Be familiar with the regulations for drilling for gas and oil in your state. Get the community involved; having more eyes on what is happening promotes awareness, much like a neighborhood watch program.

Lab test results that drinking water systems normally obtain to meet SDWA requirements and that wastewater systems get for the National Pollutant Discharge Elimination Systems (NPDES) requirements, as well as information available from the state primacy agency, are valuable and establish a baseline for any future anomalies. Establishing a good history with certified lab results will be important to show changes in water quality if changes occur.

Drinking water systems should keep an eye on their raw water quality and wastewater systems should watch their influent wastewater for any significant changes. Changes to look for include high levels of total dissolved solids (TDS), conductivity, total suspended solids (TSS), chloride, methane, bromide, pH, and radon. Be especially cautious about chloride and bromide. Bromide creates high levels of disinfection byproducts when a drinking water system uses chlorine for disinfection. For systems using ozone as a disinfectant, bromine and ozone react to form bromate, a primary contaminant regulated under the SDWA. Bromide and chloride in the influent entering wastewater treatment plants is hard to remove and can be passed through relatively untreated into receiving waters.

Monitoring the source water for drinking water systems and influent for the wastewater water systems should include volatile organic compounds, TDS, conductivity, TSS, chloride, bromide, dissolved methane, pH, and radon. Systems on a limited budget should concentrate on chloride, bromide, conductivity, TDS, and pH.

Once the baselines for these contaminants are secured, any significant changes should be viewed as potential signs that external factors such as frack fluid may have influenced the system. Armed with this information, the system can then investigate the cause more thoroughly.

**Solid Waste and Wastewater Concerns**

Frack water disposal is one of the key concerns related to gas and oil industry activity. Typically, these operations use lined holding ponds to capture and hold the spent frack water. This helps some suspended solids settle out. When all hydraulic fracturing is finished, the used frack fluid is usually trucked from these holding ponds to a municipal wastewater plant, if the state allows it. Municipal wastewater plants that do or can accept the spent frack fluid must have the ability to treat the fluid. These systems are usually more modern and include filtration, such as membrane treatment.

If trucking to a municipal treatment system, companies must take spill precautions and have an emergency plan if a spill does occur. Some states, such as Ohio, allow deep well injection to dispose of the spent frack fluid.

If the company does not have access to any of the options discussed, they may be able to contract with companies that specialize in treating spent frack fluid. Some of these companies offer mobile treatment. Keep in mind any discharge to the surface still needs a NPDES permit. Any treatment of this fluid produces residual waste, such as solids and even filter backwash slurry. These solids or thick slurries are usually taken to a landfill that is permitted to take them.

The drilling process also generates solid waste from the cuttings (earth, rock, and other materials) removed from the borehole. A borehole’s size can range from 20 inches at the top, to make room for the double and triple casings, to four inches at the bottom. When companies drill 5,000 feet down and then another 2,000 or 3,000 feet horizontally, they produce a lot of cuttings. In the past the method for disposing the drill cuttings was to dig a pit onsite and bury them. Until recently, the pit did
Natural gas is piped to market.

Storage Tanks

Natural gas flows out of well.

Recovered water is stored in open pits then taken to a treatment plant.

A pumper truck injects a mix of sand, water and chemicals into the well.

Tanker trucks deliver water for the fracturing process.

Water table

Sand keeps fissures open

Mixture of water, sand and chemical agents

Natural gas from fissures into well

Fissure

Marcellus Shale

Well turns horizontal

Source: Adapted from an illustration by Al Granberg, www.propublica.org.
not have to be lined. These cuttings contain heavy metals, minerals, salts, and volatile organic compounds. They also may contain naturally occurring radioactive material. Federal law and some states specifically exclude drilling fluids, produced waters, and other wastes associated with gas and oil extraction as hazardous waste. Therefore, any landfill that may have a special waste permit can accept the drill cuttings.

**Closing**

The treatment, handling, disposal, reuse, and regulation of the gas and oil extraction waste are dynamic issues. Future developments to watch for include return frac water radioactivity and out-of-basin and out-of-state flows. Opportunities exist for researchers to develop improved systems for tracking water and wastewater flows, including reuse, transportation, treatment, and disposal, as well as striving for new energy resources and energy independence. Considerable care must be taken to protect the valuable fresh water we have.

**References:**


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Tech Briefs have been a regular feature in NESC’s publication *On Tap* for many years. Each fact sheet provides concise technical information about drinking water treatment technology or issues relevant to small systems. *Tech Briefs* are written for drinking water professionals, particularly small systems operators. Tables and descriptive illustrations are provided as well as sources for more information.

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