Pipeline
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National Small Flows Clearinghouse
nesc
Small Community Wastewater Issues Explained to the Public

How To Keep Your Water 'Well'

Since the beginning of time, the search for water has guided the formation of kingdoms. History tells us its presence both sparked development and spurred devastation.

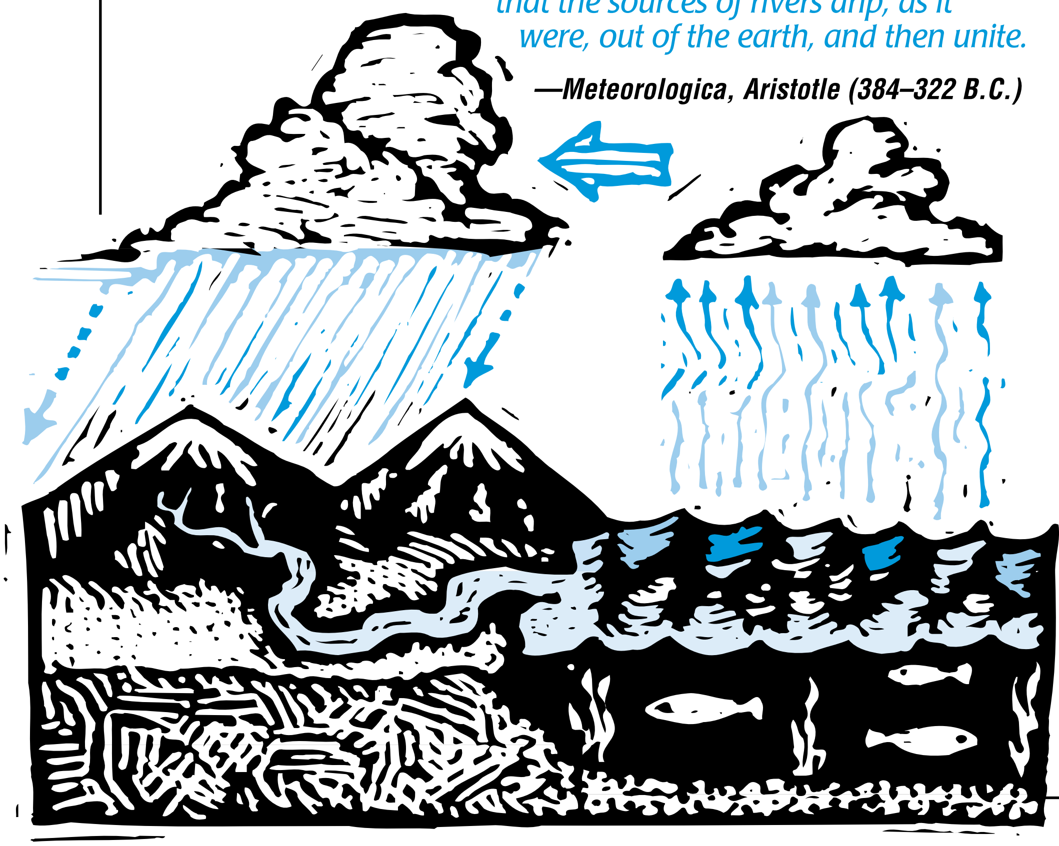
People searched for water, fought for water, and even died for it. It is nourishment—without it, life cannot exist. Yet today, most of us take it for granted—the clear, thirst-quenching liquid that flows effortlessly from our kitchen and bathroom fixtures.

We turn the faucet on, and there seems to be no end to this precious resource.

With such convenience, it is not surprising that the U.S. uses more water than any other country. The average individual uses 40 to 50 gallons of drinking water per day. Although it is labeled "drinking water," only a small portion is actually used for drinking. The majority is used for other purposes, such as toilet flushing, bathing, cooking, cleaning, and lawn watering.

Just as above the earth, small drops form and these join others, till finally water descends in a body as rain, so too we must suppose that in the earth the water at first trickles together little by little and that the sources of rivers drip, as it were, out of the earth, and then unite.

—*Meteorologica*, Aristotle (384–322 B.C.)



The quality of our water reflects our general quality of life as a society. Whether we retrieve our water from a public treatment system or private well, all of the water we use comes from either surface water or groundwater.

Surface water sources include rivers, lakes, and reservoirs while most groundwater comes from rain and melting snow, which soaks through the ground getting trapped in spaces between rocks and soils. These underground water formations, called aquifers, may be only a few miles wide or may encompass the areas of many states.

The majority of private drinking water supplies draw groundwater from wells, but some households obtain water from streams and cisterns (rain water collected from rooftops). In addition to individual home wells, there are also community wells that serve entire towns.

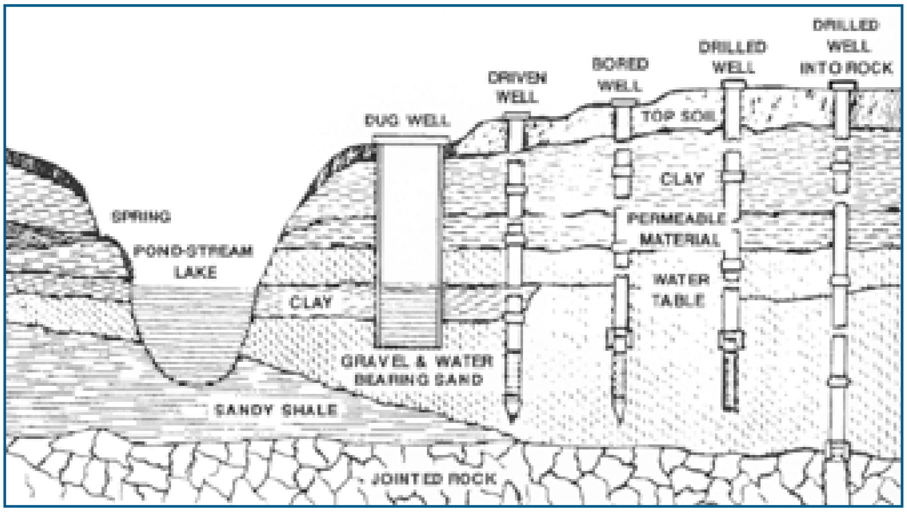
Large-scale water supply systems, found mostly in populated areas, are likely to rely on surface water sources, while small water systems, found in rural populations, tend to use groundwater as their source.

According to the U.S. Environmental Protection Agency (EPA), more than half of the U.S. population (53 percent or 151 million people) receives its drinking water from groundwater sources with approximately 8 percent or 23 million Americans retrieving their drinking water from private wells.

Continued on next page

Keeping wells free from contaminants requires careful planning, especially when an onsite system is in use nearby.

According to 1990 census data, nearly one out of every four homes in the U.S. relies on some form of onsite system to treat and dispose of their household wastewater.



Typical cross-section of underground strata, showing various types of well construction
Reprinted with permission from the Water Systems Handbook *described on page 7.*

Because septic tank effluent contains bacteria, viruses, and high levels of nitrates from human waste, contamination is a major concern in the incidences of waterborne pathogens in private wells in the U.S.

It is estimated that septic tanks may have contaminated 1 to 2 percent of the nation's usable aquifers. With 800 billion gallons of water per year being discharged to the subsurface in the U.S. via septic systems, contamination of wells is an important problem to address.

Groundwater Quality

By nature, all water contains some impurities. Contrary to what you may read on bottled water labels, there is no such thing as naturally pure water.

As water flows through rivers and streams and filters through soil and rock, it absorbs many of the substances it touches. The water quality in an aquifer depends on the nature of the rock, sand, or soil in the aquifer and what contaminants are in the area.

The dissolved minerals and gases and the amount of suspended matter determines water quality. Some contaminants are harmless, but some compounds may make the water unpalatable and even unsafe.

One basic measurement of water quality is the total dissolved solids (TDS), a reflection of the total amount of solids remaining when a water sample is evaporated.

Water is made up of major constituents, such as chloride, sulfate, carbonate, and bicarbonate, and minor constituents, like iron, manganese, fluoride, nitrate, strontium, and boron. In addition, trace elements, such as arsenic, lead, cadmium, and chromium may be present. The trace elements are extremely important in determining water quality.

Prior to 1974 each state had its own drinking water program, setting the standards that had to be met. Standards were minimal at best. Since 1974, when Congress passed the original Safe Drinking Water Act, EPA has set uniform nationwide minimum standards for drinking water.

A process called risk assessment is used to set quality standards. EPA has issued more than 80 maximum contaminant levels (MCLs) for safe drinking water standards.

A Deep Subject

Private wells are not a new technology. People have been digging wells for centuries—long before modern technology was there to help. Primitive people would simply hand dig a hole deep enough to reach the water table. When the water filled the bottom of the hole, they would lower a bucket on a rope down to haul the water out.

Dug wells, which rarely exist today, are prohibited by many states because they are very susceptible to contamination from surface runoff.

Today most well drilling companies use large, truck-mounted rotary drills or auger bits. Wells may range up to 1,000 feet deep. There are three common types of wells—bored, driven, and drilled.

Bored wells are constructed with an auger. After the water table is reached, the hole typically is lined with steel pipe. The lower part of the well is provided with a screen to keep sand and other material from entering the water. Like dug wells, bored wells are subject to contamination unless the casing is sealed with grout and the well is at least 15 feet below ground surface.

Driven wells are made with a series of pipes fitted with a well point on the end. The well point is forced through the ground by a series of blows on the pipe or by using water pressure, especially in sandy soils. When the point reaches the water table, water flows into the pipe through screened openings on the well point. Driven wells are useful when the water table is no deeper than 50 to 60 feet.

Drilled wells, the most common today, are used when the water table is at a greater depth, volume, or diameter or when the ground is too hard to use a well point. Drilled holes are lined with steel or plastic well casing.

Many experts recommend that the well casing extend to a depth greater than 25 feet or 10 feet below the static water level in sand and gravel formations.

Location, Location…

Placement of wells in relation to septic tank systems is an imperative factor in preventing contamination. Setback standards for wells and septic tank systems vary widely from state to state, most ranging from 50 to 100 feet. (Contact your local health department for your particular setback regulations.)

Those setback distances may increase should limiting factors exist, such as the presence of limestone, karst, or fractured bedrock in the soil formation.

Table 1 on Page 5 presents the minimum horizontal separations required by the state of Washington from their onsite regulations.

Design and operating standards are meant to ensure that a septic system does not malfunction. Most wastewater treatment experts recommend that a septic tank be pumped out every three to five years, depending on the size of the tank. Onsite owners also should inspect their system annually to make sure it is operating properly.

The minimum lot size per typical household septic system varies from 0.5 to 5 acres, depending on the state or municipality.

Still, contamination may occur when inadequately treated effluent rapidly infiltrates the unsaturated or vadose zone and reaches the water table.

The likelihood of septic tank contamination seems to be higher in areas where there is a high density of homes with septic tanks, the soil layer over permeable bedrock is thin or extremely permeable, and the water table is within a few feet of the land surface.

Having a well that is more than 10 years old or less than 50 feet deep increases the chance for contamination. In order for a septic system to function properly, it must be properly sited, designed, installed, and maintained.

But even if the septic system is functioning properly and within proper setback limits, another factor to be considered is the placement of septic leachfields.

Since leachfields are generally located in areas where wastewater percolates through soil as part of the treatment process, placing leachfields close to a drinking water source can cause problems.

If your well tests positive for indicator organisms (e.g total coliforms or fecal coliforms), or chemical contaminants, but there are no septic systems nearby, public sewage treatment lines may be to blame. Leakage from sewer lines, which carry untreated raw sewage and may contain industrial waste, can introduce chlorides, microorganisms, organics, trace metals, and other chemicals.

Identification of Contaminants

In addition to failing or improperly sited septic tanks, a variety of human activities impact water quality. Pollution sources can range from industry, landfills, pesticides, fertilizers, livestock wastes, storm water runoff from agricultural and urban sources, and household wastes.

The EPA recommends that private water wells be tested annually for indicator organisms and nitrate to detect contamination problems. Indicator organisms are not harmful in themselves, but their presence indicates that other pathogenic organisms, such as *E coli, Giardia, Cryptosporidium,* or hepatitis, could have survived

The water also should be tested for other potentially dangerous contaminants, such as pesticides and radon.

In addition to the above annual tests, many water experts recommend a broad range of water tests should be done every 5 to 10 years.

Homeowners can access a list of certified laboratories from their state or local health department. Some health departments will conduct the tests for free. The average cost of a private laboratory test for nitrate and bacteria samples will typically range between $10 to $20.

Contamination Happens

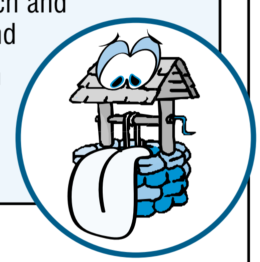
According to the EPA, in 1993 and 1994 there were 30 reported disease outbreaks associated with drinking water, 23 associated with public drinking water supplies, and seven with private wells.

Continued on next page

Well Water Wisdom

The risk of contamination depends on several factors, including:

- the well pumping rate,
- the aquifer slope,
- the distance between the soil absorption trench and well location, and
- the composition of the soil.



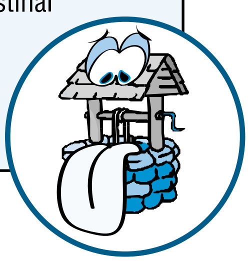
Although no definite statistics are available to document the potential contamination threat onsite systems may pose to drinking water, several cases of infectious disease outbreaks have been documented.

In Polk County, Arkansas, a 1971 outbreak of viral hepatitis was traced to a well that was contaminated by seepage from a septic tank located 95 feet away. In 1972, Yakima, Washington, experienced a typhoid outbreak that was attributed to well water from driven well points. Septic tank wastewater from the home of a typhoid carrier was discharged into the ground 21 feet away from the contaminated well. Similarly, a septic tank located 50 feet above the spring supplying drinking water to a resort camp in Colorado was found to be the cause of 400 cases of gastroenteritis.

Well Water Wisdom

Signs that suggest you should test your well include:

- water with an undesirable taste or smell,
- water that leaves a residue or stains plumbing fixtures or laundry,
- cloudy or colored water,
- corroded pipes or equipment that wears out fast, and
- any gastrointestinal distress from family members.



Possible signs of contamination may include:

- water that tests positive for coliform,
- unexplained illnesses, such as gastrointestinal problems, hepatitis A, or typhoid, and
- neighbors finding septic system contaminants in their water.

Septic system effluent containing nitrates can pose a health hazard to infants, in particular. Nitrates have been shown to cause methemoglobinemia, known as "Blue Baby Syndrome." Many health officials recommend testing well water in the vicinity of septic systems more frequently when children or pregnant women are present.

Education a Key Component

Homeowner education is a key component in coordinating the management of private water supplies and wastewater treatment systems.

A study that was published in the1998 *Journal of Soil and Water Conservation* illustrates the need for increased education programs. The study evaluated the water quality habits and beliefs of the approximately three million residents living in upstate New York who rely on groundwater to supply their drinking water and the 1.5 million households there with onsite wastewater treatment systems.

The study surveyed 244 homeowners in three counties. Drinking water was tested, and water supplies and onsite systems were inspected. An average of 32 percent of the drinking water tested positive for coliform. Nitrate levels varied with only two samples having concentrations greater than the current drinking water standard of 10 mg/L.

Despite these statistics, 82 percent of those questioned were satisfied with their water supply although 31 percent of those satisfied had coliform in their drinking water.

Steps to Reduce Contaminants

The EPA recommends the following steps to protect groundwater supplies:

- periodically inspect exposed parts of the wells to determine any cracking or corrosion or damage to the well casing or cap, and look for settling or cracking of surface seals;
- slope the area around the well to drain surface runoff away from the well;
- install a well cap or sanitary seal to prevent unauthorized entry to the well;
- disinfect drinking water wells once a year with bleach or hypochlorite granules;
- keep records of any maintenance, such as disinfection or sediment removal, that may require the use of chemicals;
- hire certified well drillers for any new construction, modification, or abandonment of wells;
- avoid mixing or using pesticides, fertilizers, herbicides, degreasers, fuels, and other pollutants near wells;
- do not dispose of wastes in abandoned wells;
- do not cut the well casing below the land surface;
- pump and inspect septic systems routinely; and
- never dispose of hazardous materials in septic systems.

Routine maintenance was also listed in the study as a problem since nearly half of the residents had not tested their drinking water and more than one third had never pumped their septic system.

The study concluded that "a general lack of homeowner knowledge suggests the need for increased educational programs targeted to the rural audience, as well as additional research to better understand what

Continued on page 6

Table 1

Minimum Horizontal Separations

Items Requiring Setback	From edge of disposal component and reserve area	From septic tank, holding tank, containment vessel, pump chamber, and distribution box	From building sewer, collection, and non-perforated distribution line[1]
Non-public well or suction line	100 ft.	50 ft.	50 ft.
Public drinking water well	100 ft.	100 ft.	100 ft.
Public drinking water spring,[3]	200 ft.	200 ft.	100 ft.
Spring or surface water used as drinking water source[2,3]	100 ft.	50 ft.	50 ft.
Pressurized water supply line[4]	10 ft.	10 ft.	10 ft.
Properly decommissioned well[5]	10 ft.	N/A	N/A
Surface water[3]			
Marine water	100 ft.	50 ft.	10 ft.
Fresh water	100 ft.	50 ft.	10 ft.
Building foundation	10 ft. [6]	5 ft. [6]	2 ft.
Property or easement line[6]	5 ft.	5 ft.	N/A
Interceptor/curtain drains/drainage ditches			
Down-gradient[7]	30 ft.	5 ft.	N/A
Up-gradient[7]	10 ft.	N/A	N/A
Down-gradient cuts or banks with at least 5 ft. of original, undisturbed soil above a restrictive layer due to a structural or textural change	25 ft.	N/A	N/A
Down-gradient cuts or banks with less than 5 ft. of original, undisturbed, soil above a restrictive layer due to a structural or textural change	50 ft.	N/A	N/A

1. "Building sewer" as defined by the most current edition of the Uniform Plumbing Code. "Non-perforated distribution" includes pressure sewer transport lines.
2. If surface water is used as a public drinking water supply, the designer shall locate the OSS outside of the required sanitary control area.
3. Measured from the ordinary high-water mark.
4. The local health officer may approve a sewer transport line within 10 feet of a water supply line if the sewer line is constructed in accordance with section 2.4 of the Department of Ecology's "Criteria For Sewage Works Design," revised October 1985, or equivalent.
5. Before any component can be placed within 100 feet of a well, the designer shall submit a decommissioned water well report provided by a licensed well driller, which verifies that appropriate decommissioning procedures noted in chapter 173-160 WAC were followed. Once the well is properly decommissioned, it no longer provides a potential conduit to groundwater, but septic tanks, pump chambers, containment vessels or distribution boxes should not be placed directly over the site.
6. The local health officer may allow a reduced horizontal separation to not less than two feet where the property line, easement line, or building foundation is up-gradient.
7. The item is down-gradient when liquid will flow toward it upon encountering a water table or a restrictive layer. The item is up-gradient when liquid will flow away from it upon encountering a water table or restrictive layer.

Source: Washington Administrative Code, Chapter 246-272/On-Site Sewage Systems influences homeowner perceptions and management practices."

The Final Word

Septic systems and drinking water wells can, and do, coexist harmoniously if the proper precautions are taken. Ultimately, the responsibility is left up to the homeowner.

David Pask, engineering scientist with the National Small Flows Clearinghouse (NSFC), has some additional advice for homeowners who may find that their well supply is contaminated by an existing or new septic system despite compliance with codes.

He said it might be possible to eliminate the problem by installing additional well casing to extend the depth of pumping to below any shallow septic effluent.

If the well casing was sufficiently below the static water level, it would be advisable to reduce the flow of the well pump by a throttling valve or to install a pump of low capacity. However, a water storage tank may be necessary to allow for sporadic high water demand under a constant low pumping rate.

If all of the compliance regulations have been met and the homeowners' water still persistently tests positive for coliform and other contaminants, they may need to install filtration and disinfection device in the well system for proper treatment.

For more answers to your drinking water questions, feel free to contact the National Drinking Water Clearinghouse (NDWC), our sister program.

The NDWC offers *On Tap*, a quarterly magazine; more than 250 free products; a bibliographic database; and RESULTS [Registry of Equipment Suppliers of Treatment Technologies for Small Systems] data base. For more information, call (800) 624-8301 or visit their Web site at *www.ndwc.wvu.edu.*

EPA Private Water Education System

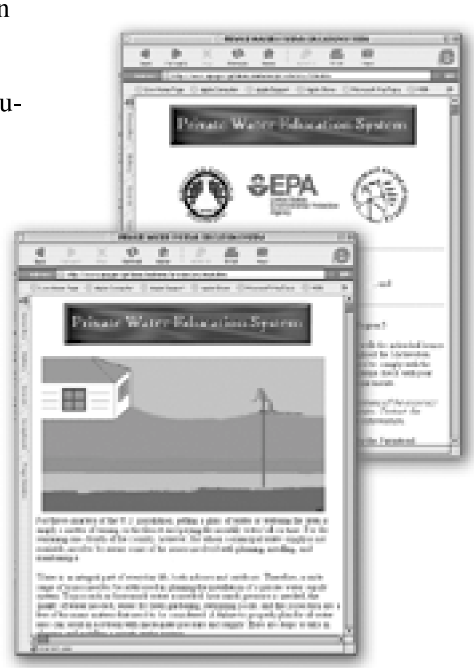
Interactive hypertext format and dozens of color screens provide a complete minicourse in design and construction of private drinking water systems (wells and piping). Menu items include water quantities required, water pumps, systems controls, Equivalent to a 200-page book that takes you by the hand and teaches you! Also available in Spanish.

This is a basic illustrated guide to the planning and design of water wells for individual homes and farms. It illustrates general prudent practice as observed throughout the Midwestern U.S. at the end of the 20th century. It was not designed to comply with the design regulations of any particular state, county or municipality. Always check with your local public and environmental health authorities for any specific requirements.

The user is also referred to "Fertilizer and Pesticide Containment Facilities Handbook" by the Midwest Plan Service for further information on the construction of environmentally sound fertilizer and pesticide storage facilities. Material and figures from that manuscript are also included in this risk assessment and improvement package.

Purdue University expressly disclaims any warranties or guarantees of the accuracy of fitness for a particular purpose of the material presented herein. Contact the Agricultural and Biological Engineering Department for more information.

The material within this package is based on information released by the Farmstead Assessment Program, a cooperative project of the University of Wisconsin-Extension, Minnesota Extension Service, and the U.S. Environmental Protection Agency Region 5.



www.epa.gov/grtlakes/seahome/private/src/title.htm

WSC Supports Private Well Owners

If you're a private well owner and you want information about how to care for your investment, the Water Systems Council (WSC) is a very good place to begin. WSC is a non-profit organization, founded in 1932 and dedicated to promoting the wider use of wells and to protecting groundwater resources.

WSC's mission is to educate consumers, community leaders, government agencies, and the general public about the cost-effectiveness and efficiency of modern wells as safe drinking water systems.

WSC actively educates well owners about their wells. They assist those who rely on individual wells to identify and access testing, operation and monitoring services, such as those provided to customers of other drinking water systems to ensure safe drinking water.

The council:

- promotes wells and groundwater protection through education, advocacy, and communication;
- identifies and creates financing options for public and private wells;
- opposes government restrictions on the use of private water wells; and
- establishes standards for well industry products and lists products in compliance with these standards.

In August 1999, WSC received a grant from the U.S. Department of Agriculture's Rural Utilities Service for a project known as Wellcare™. Grant-funded activities in the Wellcare project help communities that rely on wells for potable drinking water gain operation and management services that are traditionally associated with larger water systems.

Other WSC programs are:

WSC's Promote Our Private Wells (POP) Campaign educates the general public, regulators, and legislators about modern well systems. Today, wells are constructed to exacting standards that ensure safe water. Modern wells are reliable water sources and meet the increased demand in today's homes.

The Well Water—Naturally Better Initiative constitutes WSC's groundwater protection efforts, including educational and communications activities related to safe drinking water from wells and good health.

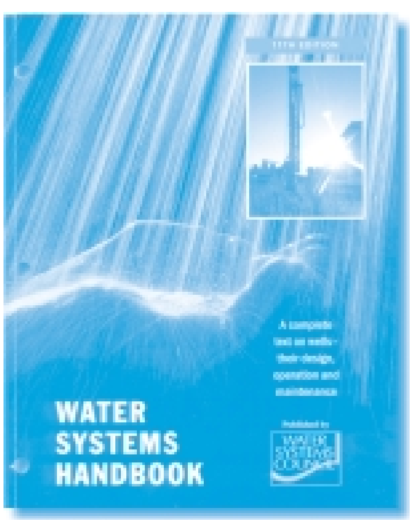
WSC's International Initiatives are a partnership of corresponding international organizations committed to expanding the role of advanced well water information and technology around the world.

For more information about the Water Systems Council, write to WSC, National Programs Office, 13 Bentley Drive, Sterling, VA 20165, or call (703) 430-6045. You may also fax them at (703) 430-6185, or visit their Web site at *www.watersystemscouncil.org*.

WATER SYSTEMS COUNCIL

www.watersystemscouncil.org

Handbook Available for Well Owners



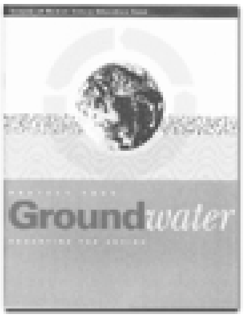
The 11th edition of the *Water Systems Handbook* is now available from the Water Systems Council. This handbook is a comprehensive technical manual on the proper siting, construction, and operation of wells. It is written for novices in the industry as well as experienced drillers, pump contractors, engineers, and end-users.

The handbook, which was revised and updated this year, includes information that well owners should know—such as details about water sources, well construction, pump operation, well caps, electricial supply, disinfection, and well design. The handbook costs $20, which includes shipping and handling.

To order the *Water Systems Handbook*, log onto the Water Systems Council's Web site at *www.watersystemscouncil.org*, or write to them at Water Systems Council, National Programs Office, 13 Bentley Drive., Sterling, VA 20165. You also may call (703) 430-6045 or fax (703) 430-6185.

NESC RESOURCES AVAILABLE

Be sure to request each item by number and title. A shipping and handling charge will apply.



Groundwater Awareness Book

Protect Your Ground Water: Educating for Action is a 64 page book describing how a community can implement a groundwater awareness program that can help safeguard groundwater supplies. Item #DWBKPE66.

Available at no cost from the National Drinking Water Clearinghouse at (800) 624-8301 or by email at ndwc_orders@ndwc.wvu.edu

Groundwater and Septic Systems

Third in a series of three brochures, *Groundwater Protection and Your Septic System* deals with groundwater and drinking water sources in relation to septic systems. Along with ways to prevent contaminants from reaching the groundwater, this National Small Flows Clearinghouse brochure discusses groundwater protection based upon proper septic system sizing and location. Various schematic diagrams are provided. Item #WWBRPE21.

Available from National Small Flows Clearinghouse at (800) 624-8301, email orders at nsfc_orders@mail.estd.wvu.edu.

First copy provided at no charge; additional copies available for 20¢ each.

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