THE AMERICAN WELL OWNER

★ INFORMATION AND ADVICE ABOUT GROUND WATER, WELLS AND WATER SYSTEMS ★

A Quarterly Publication for Well Owners - 2003 Number 3

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Acid Rain and Ground Water pH

MESSAGE FROM THE PUBLISHER

Ground Water Education

Ground water education is the foundation of fair, sustainable and resilient water use decisions. Education provides an understanding of water resources so that citizens recognize cause and effect impacts. The American Well Owner can be an effective tool for educators to incorporate into their lessons as a source of science information or as a touchstone for class discussions involving ground water policies.

By 2050, there will be over 200 million people in the United States drinking ground water. There will be even more consuming products that require ground water in a manufacturing process. It is important that we promote and emphasize ground water science in our schools today. Future generations of water users will have to understand the scientific information that will (must) form the basis for developing sound water resource policy and management procedures. Without this understanding citizens will not be able to choose the path that leads to an effective lasting long-term mix of water allocations among the competing needs of environmental, business and domestic consumers.

You can help the Trust increase ground water education opportunities in our schools by supporting the Trust's Ground Water Institute for Teachers program. Call the Trust to inquire about how you can make a difference today that protects our ground water resources for the future.

Andrew W. Stone
American Ground Water Trust

An important measure of water quality is its pH. The letters "pH" describe the acidic or basic nature of a substance. Scientifically a liquid's pH is a measure of the concentration of hydrogen ions (H^+) it contains. The Danish biochemist S.P.L. Sorenson originally proposed the concept and the pH scale in 1909 as a method to describe the "acidity" of beer.

The pH scale ranges from 0 to 14 with a value of 7 indicating a neutral pH (neither acidic nor basic). Distilled water has a pH of 7. Basic (or alkaline) solutions (i.e. bleach and ammonia) have values greater than 7. Acidic solutions (i.e. battery acid, lemon juice, and vinegar) have values less than 7. Each unit change in pH is equal to a 10-fold (10 times) change in the pH. The table shows the approximate pH value for some common substances.

Rain and snow (the principal sources of ground water) have pH values near 5.6, if they are relatively free of pollution. However, in many areas of the United States "acid rain" is now the norm because of pollution emissions from sources such as coal-fired power plants and car exhaust. Acid rain can have pH values near 4. There are concerns that acid rain is having effects on vegetation and aquatic fauna. Once on the ground, some of the acidic precipitation infiltrates downward to mix with ground water and can affect the ground water pH.

The pH of ground water will vary depending on the composition of the rocks and sediments that surround the travel pathway of the recharge water infiltrating to the ground water. Ground water chemistry will also vary depending on how long the existing ground water is in contact with a particular rock. The chemical composition of

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Acid Rain and Ground Water pH . . . *continued from page 1*

the bedrock tends to stabilize (buffer) the pH of the ground water. The longer the contact time, the larger the effect of the rock chemistry on the composition and pH of the ground water. Ground water passing through carbonate-rich rocks (e.g., limestones and marbles) will usually have pH values greater than 7 as the acidic water is "neutralized." If the geology of the aquifer containing the ground water has few carbonate rocks (e.g., sandstones, metamorphic granitic schists and gneisses; volcanic rocks, etc.) the ground water will tend to remain acidic.

Acidity in water is not in itself harmful to health. Many popular beverages have considerable acidity or alkalinity. The concern for acidity in drinking water is that even mildly acid water can dissolve lead or copper that may in plumbing pipes and fixtures. In theory, there should be no lead content in home plumbing systems built since 1987. However for millions of homes there is the potential for a problem. For this reason, the United States Environmental Protection Agency has determined that drinking water should have a pH between 6.5 and 8.5 in order to limit the concentration of dissolved contaminants from acidic waters or the build up of scale deposits from alkaline water. (Learn more about this situation at the Trust website page http://www.agwt.org/info/pdfs/leadandplumbing.pdf).

It is a good idea to test the pH when a new well is drilled (check again after six months of use), when you move to a new home, or if your well has never been tested. If the pH is not within the EPA recommended range then it may be necessary to increase the pH of the water with limestone, marble chips or sodium hydroxide, or to reduce the pH with acetic acid (white vinegar) or citric acid treatments. These treatments are not expensive, not difficult to maintain, and can be easily installed by a professional. Test your water to make sure you actually need the pH adjusted before you install any equipment.

PH Scale

14		
—	13.9	Sodium Hydroxide
—	13.1	Household Lye
13		
—	12.6	Household Bleach
—	12.4	Calcium Hydroxide
12		
—		
—	11.2	Ammonia
11		
—		
—	10.3	Milk of Magnesia
10		
—		
—	9.3	Borax
9	9.0	Upper Limit for most fish
—	8.4	Baking Soda
—	8.2	Sea Water
8		
—		
—	7.4	Blood
7	7.0	Distilled Water (neutral)
—		
—	6.5	Milk
6	6.0	Corn
—	5.8	Rainwater
—	5.1	Boric Acid
5	5.0	Lower Limit for most fish
—	4.5	Tomatoes
—	4.3	Orange Juice
4		
—	3.9	Beer and Wine
—		
3		
—	2.8	Vinegar
—		
2		
—	1.9	Lemon Juice
—		
1	1.0	Car Battery Acid
—		
—		
0		

Conservation Math . . . *continued from page 4*

If you are on "city water" operated by a utility, the **7.88** gallons that runs down the drain in two minutes takes up about one cubic foot of space in a pipe (7.48 gallons in a cubic foot) coming into the home fresh or going out to the sewer as waste. Most of the families in your neighborhood want to brush their teeth at about the same time as you each morning and night. This is called the peak demand time (e.g., about 6 to 8 AM each morning). Several thousands of people may try to get their "cubic foot of teeth-brushing water" at the same time. There is only so much room in the piping system so new and expensive larger pipes at about **$400,000** per mile for a 30-inch ductile iron water main, may be needed to supply the "extra capacity" required by thousands of cubic feet of "unconserved" teeth brushing water. Making sure the sewer lines and water treatment plant is large enough for the extra flow would likely also add more expense. *Who pays for this? You do.*

The increased demand on resources to replenish this "lost water" will add further engineering costs. New well costs can be on the order of $1,000,000 for a new 500,000 gallons per day source. *Who pays for this? You do.* If local water sources are exhausted, then the transfer of water over a long distance, or purchase from an adjoining town may be necessary. *Who pays for this? You do.*

As you can see from the math, using a small glass of water in the bathroom can be a valuable habit! Now think about the other daily activities that require water. How much water and money can be saved if the **dishwasher** is run when full or if the **clothes washer** is set to use the proper amount of water, or if we don't **irrigate** our lawns or if teenagers can be persuaded to spend less time in the **shower**?

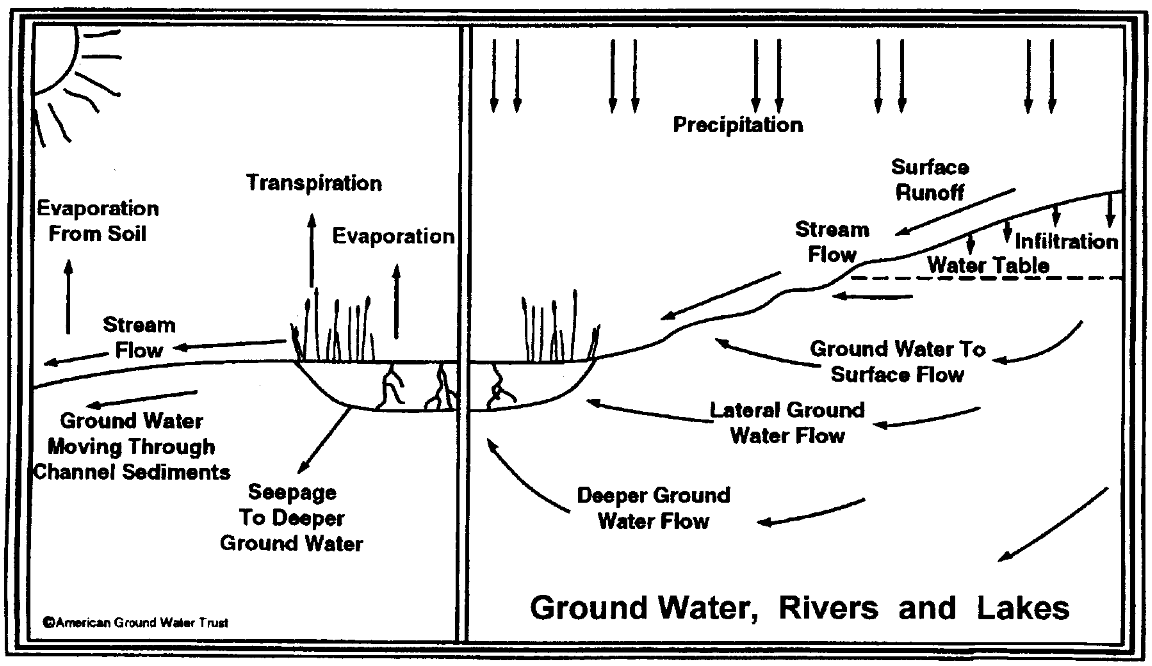
We all benefit when we conserve water. When more water is used than needed, the excess water used is not available for another economic activity or environmental purpose. Do your part to use only the water you need. Conserve water so we do not need to use our rainy day funds for replacing well equipment or for providing more water supply infrastructure. *Who will benefit from this? You will.*

For more information on conservation visit the American Ground Water Trust website: http://www.agwt.org/info/pdfs/conservation.pdf

River Flow and Ground Water

Where does the water in a stream come from during a drought or when it has not rained recently? Base flow is the technical name for the dry weather flow in a stream or river. River base flow results from ground water seeping into riverbanks or the riverbed. The flow may be significant enough to allow the stream to flow year round (i.e., perennial or permanent stream). Without base flow recharge from ground water to streams and rivers, many would not carry a flow of water except during storms. Streams that flow only periodically in response to rainstorms or seasonal snowmelt events are known as ephemeral or intermittent streams. On average, 40 percent of all flow in United States rivers and streams originates as ground water. Trout streams that flow year round with cool clear water virtually all result from constant input from ground water.

Water flowing into a stream from ground water is called a "gaining stream" and this is the most common occurrence. However, there are also "losing streams" that "leak" water from their channel into the ground beneath. Losing streams are common in dry environments where ground water may flow in a stream only during the "rainy season" of the year. In a gaining stream, the ground water level is higher than the water level in the channel. In a losing stream, the ground water is below stream level.



When river levels rise, for example in response to a storm, water can flow from the river into the channel banks as the water level in the channel rises above the pre-storm ground water level. If the stream over tops its banks to spread over a flood plain, flood water infiltrates to the ground water under the flood plain. This seepage and infiltration can help reduce the impacts of flooding in downstream areas, and after the storm, the slow release of water from the surrounding saturated area maintains the base flow in the channel. Infiltration through the flood plain to the underlying ground water table is one of the reasons why maintaining flood plains in an undeveloped (pervious) condition must be an important consideration for planning development. Tidal rivers may also induce a pattern of losing and gaining conditions as the elevation of the water in the channel rises and falls twice per day with the tide.

A stream may switch back and forth between losing or gaining on a seasonal basis during the year and/or during the course of its flow downstream from its headwaters. Conditions may change from gaining to losing at the upstream end of a meander or at the top of an abrupt change in the gradient of the channel. Pumping a well in the vicinity of a stream or lake may induce a "losing" condition when the zone of drawdown around the well intersects the surface water body.

Ground water and surface water are not separate resources. When our activities use one of these resources, it often affects the other in a relatively short time frame in terms of quantity and quality.

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TOPICS IN UPCOMING ISSUES
- **Well Casing - Steel or Plastic**
- **Drugs in Your Water**
- **Hydrologic Cycle Misconceptions**

CONSERVATION MATH - TOOTH BRUSH WATER

What does it mean to conserve ground water or surface water? Does it mean saving it for later use? Does it mean protecting it from pollution? Does it mean using only what you need for a specific purpose (growing lettuce, irrigating a sports field, washing clothes, etc.)? All of the above? What are the benefits of conserving water?

Many of us overlook water conservation during our daily routine, because when you have enough of something there is not the incentive to use it moderately. The water we use to brush our teeth can illustrate this point. Let's do some simple water math.

A typical bathroom faucet flows about **two** gallons per minute and dentists' recommended brushing time is **two** minutes. Leaving the water running for the entire brushing will run about **four** gallons of water down the sink drain. Filling an 8-oz glass (**1 cup**) with water to rinse would have taken less than two seconds and saved **98.4** percent of the water released from the aquifer for this activity. If you brush your teeth twice per day then 126 cups (**7.88** gallons) of water would have remained in the aquifer. A family of four would use about **32** gallons less per day or **11,500** gallons less per year. A 1,000-gallon capacity on-site septic tank will cycle almost 12 extra times a year just from the wasteful practice of brushing teeth while the tap is running!

"So what?" - that water goes back into the ground via the leach field. OK, but septic systems have a lifespan partly related to how much wastewater they receive. They work best when there is time for the solids that enter the tank to settle out so they do not enter the leach field and clog it. The more use you make of your septic system the greater the chance of needing a $5,000 to $20,000 replacement (depending on the geologic/ soil conditions). Alternatively, you might get away with pumping the septic tank more often than once every two years, but at $150 to $300 per pumping that adds up quickly too. *Who pays for this? You do.*

By filling a small glass with rinse water for your teeth, your well pump will likely not have to run because residential pressure tanks that control when the well pump cycles on, don't usually kick in until a gallon or more is used. Well pumps are like any appliance that turns on and off; the more you use it the sooner it will need to be replaced. *Who pays for this? You do.*

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