Cape Flattery in Clallam County by WHWise

SESSION 5

Puget Sound Challenges
Water Quantity

"We forget that the water cycle and
the life cycle are one."
Jacques Cousteau

SESSION GOALS

- To become more aware of clean water quantity as an essential resource at national, regional and local levels.
- To better understand the use of water regionally and the increasing demands on this vital resource.
- To become acquainted with water and water management in Puget Sound watershed.
- To learn about various water policies aimed at managing the region's finite water supplies.

REFLECTION QUESTION

Are there competing demands for water in your community? Who manages or resolves these demands?

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Reminders to Facilitator: The Reflection Question moves quickly.
Each participant gives a brief answer without questions or comments from others.
Also, there is a homework assignment for Session 5 at the end of this session.

SESSION INTRODUCTION

Throughout our existence the availability of fresh, clean water has determined the success or failure of the human experiment. History shows that civilizations have evolved only with access to adequate water resources. When water supplies have been interrupted, populations have secured new sources, migrated to areas of greater abundance, or simply collapsed.

Nationally and within our region, the realities of expanding population and economy, impact of changing climate, and heightening competition for water are shifting the public viewpoint from an assumption of abundance toward a realization that we must manage water supply and demand. How we plan for and take action on this imperative will strongly influence the odds for continuing prosperity in the Puget Sound region and in the State of Washington.

In the opening article, Sandra Postel covers the impact of our water management practices on our ecological environment, then moves to examples of the current shift to practices that harmonize with the environment. Postel ends with the challenge that "the water crisis requires us to pay attention to how we value and use water."

Next, *Water Footprint*, overviews water consumption by agriculture and industry in different parts of the world. The next laptop or roll of aluminum foil will likely enter the U.S. from abroad. An estimated 19 percent of the average American's water footprint falls outside the United States.

Focusing on the four regional states of the Pacific Northwest, *Overview of Groundwater Use in the Pacific Northwest* outlines the relative size of agricultural, industrial, and municipal groundwater use. Agriculture consumes the lion's share of groundwater in Idaho, Oregon and Washington, making water use for food production critical to overall water supply. Alaska, being relatively undeveloped, is the lone exception.

The next two articles focus directly on Puget Sound with *Protecting Our Stream Flows--Growing Needs for Water: Sharing a Limited Supply* and *2009 State of the Sound – Water Quantity.* These articles lay out the foundation and terminology as well as some of the challenges for Puget Sound water management.

The final articles, *A Water Shortage In The Rainy Pacific Northwest?* about Jefferson County and *Water* about Island County*,* depict some of the local complexities of water.

The question of how we as a society cope with the challenges of maintaining our water resources in the face of expanding demand is open, evolving, and worthy of our thoughtful consideration.

Water: Will There Be Enough?

By Sandra Postel, YES Magazine, Summer 2010

This article is an adaptation of a longer essay from The Post Carbon Reader: Managing the 21st Century's Sustainability Crises*, Fall 2010 from Watershed Media.*

For at least three decades, Americans have had some inkling that we face an uncertain energy future, but we've ignored a much more worrisome crisis—water. Cheap and seemingly abundant, water is so common that it's hard to believe we could ever run out. Ever since the Apollo astronauts photographed Earth from space, we've had the image of our home as a strikingly blue planet, a place of great water wealth. But of all the water on Earth, only about 2.5 percent is freshwater—and two-thirds of that is locked up in glaciers and ice caps. Less than one hundredth of one percent of Earth's water is fresh and renewed each year by the solar-powered hydrologic cycle.

Across the United States and around the world, we're already reaching or overshooting the limits of that cycle. The Colorado and Rio Grande Rivers are now so overtapped that they discharge little or no water to the sea for months at a time. In the West, we're growing food and supplying water to our communities by overpumping groundwater. This creates a bubble in the food economy far more serious than the recent housing, credit, or dot-com bubbles: We are meeting some of today's food needs with tomorrow's water.

The massive Ogallala Aquifer, which spans parts of eight states from southern South Dakota to northwest Texas, and provides 30 percent of the groundwater used for irrigation in the country, is steadily being depleted. As of 2005, a volume equivalent to two-thirds of the water in Lake Erie had been pumped out of this water reserve. Most farmers will stop irrigating when the wells run dry or the water drops so far down that it's too expensive to pump.

At the same time, climate change is rewriting the rules about how much water we'll have available and when. Climate scientists warn of more extreme droughts and floods, and of changing precipitation patterns that will make weather, storms, and natural disasters more severe and less predictable. The historical data and statistical tools used to plan billions of dollars worth of annual global investments in dams, flood control structures, diversion projects, and other big pieces of water infrastructure are no longer reliable.

While farmers in the Midwest were recovering from the spring flood of 2008 (in some areas the second "100-year flood" in 15 years), farmers in California and Texas fallowed cropland and sent cattle prematurely to slaughter to cope with the drought of 2009. In the Southeast, after 20 months of dryness, Georgia Governor Sonny Perdue stood outside the State Capitol in November 2007 and led a prayer for rain, beseeching the heavens to turn a spigot on for his parched state. Two years later, Perdue was pleading instead for federal aid after intense rain storms near Atlanta caused massive flooding that claimed eight lives.

Although none of these disasters can be pinned directly on global warming, they are the kinds of events climate scientists warn will occur more often as the planet heats up. It's through water that we'll feel the strains of climate change—when we can no longer count on familiar patterns of rain, snow, and river flow to irrigate our farms, power our dams, and fill our city reservoirs.

In answer to the climate crisis, the economy will need to move away from fossil fuels toward solar, wind, and other non-carbon energy sources. But there is no transitioning away from water. Water has no substitutes. And unlike oil and coal, water is much more than a commodity: It is the basis of life. A human being can only live for five to seven days without water. Deprive any plant or animal of water, and it dies. Our decisions about water—how to use, allocate, and manage it—are deeply ethical ones; they determine the survival of most of the planet's species, including our own.

Shifting Course

For most of modern history, water management has focused on bringing water under human control and transferring it to expanding cities, industries, and farms. Since 1950, the number of large dams worldwide has climbed from 5,000 to more than 45,000—an average construction rate of two large dams per day for half a century. Globally, 364 large water-transfer projects move 105 trillion gallons of water annually from one river basin to another—equivalent to transferring the annual flow of 22 Colorado Rivers. Millions of wells punched into the Earth tap underground aquifers, using diesel or electric pumps to lift vast quantities of groundwater to the surface.

Big water schemes have allowed oasis cities like Phoenix and Las Vegas to thrive in the desert, world food production to expand along with population, and living standards for hundreds of millions to rise. But globally they have also worsened social inequities, as poor people are dislocated from their homes to make way for dams and canals, and as downstream communities lose the flows that sustained their livelihoods.

Such approaches also ignore water's limits and the value of healthy ecosystems. Today, many rivers flow like plumbing works, turned on and off like water from a faucet. Fish, mussels, river birds, and other aquatic life no longer get the flows and habitats they need to survive: 40 percent of all fish species in North America are at risk of extinction.

As we face the pressures of climate change and growing water demands, many leaders and localities are calling for even bigger versions of the strategies of the past. By some estimates the volume of water moved through river transfer schemes could more than double globally by 2020. But mega-projects are risky in a warming world where rainfall and river flow patterns are changing in uncertain ways.

> *"We call upon the waters that rim the earth horizon to horizon*
> *that flow in our rivers and streams, that fall upon our gardens and fields,*
> *and we ask that they teach us and show us the way."*
> Chinook Indian Blessing

Such big projects also require giant quantities of increasingly expensive energy. Pumping, moving, treating, and distributing water takes energy at every stage. Transferring Colorado River water into southern California, for example, requires about 1.6 kilowatt-hours (kWh) of electricity per cubic meter (about 264 gallons) of water; the same quantity of water sent hundreds of kilometers from north to south through California's State Water Project takes about 2.4 kWh. As a result, the energy required to provide drinking water to a typical southern California home can rank third behind that required to run the air conditioner and refrigerator.

Planners and policy-makers are eyeing desalination as a silver-bullet solution to water shortages. But they miss—or dismiss—the perverse irony: By burning more fossil fuels and by making local water supplies more and more dependent on increasingly expensive energy, desalination creates more problems than it solves. Producing one cubic meter of drinkable water from salt water requires about 2 kWh of electricity.

Water for People and Nature

As the limitations of big-infrastructure strategies have become more apparent, a vanguard of citizens, communities, farmers, and corporations are thinking about water in a new way. They're asking, what do we really need the water for, and can we meet that need with less? The upshot of this shift in thinking is a new movement in water management that is much more about ideas, ingenuity, and ecological intelligence than it is about big pumps, pipelines, dams, and canals. These solutions tend to work with nature, rather than against it. In this way, they make effective use of "ecosystem services"—the benefits provided by healthy watersheds and wetlands. And through better technologies and more informed choices, they seek to raise water productivity—to make every drop count.

Communities are finding, for example, that protecting watersheds is the best way to make sure water supplies are clean and reliable. A healthy watershed can do the work of a water treatment plant—filtering out pollutants, and at a lower cost to boot. New York City, for instance, is investing some $1.5 billion to restore and protect the Catskill-Delaware Watershed (which supplies 90 percent of its drinking water) in lieu of constructing a $6 billion filtration plant that would cost an additional $300 million a year to operate. A number of other cities across the United States—from tiny Auburn, Maine, to Seattle—have saved hundreds of millions of dollars in avoided capital and operating costs by opting for watershed protection over filtration plants.

Communities facing increased flood damage are achieving cost-effective flood protection by restoring rivers. After enduring 19 flood episodes between 1961 and 1997, Napa, Calif., opted for this approach over the conventional route of channelizing and building levees. In partnership with the U.S. Army Corps of Engineers, the $366 million project is reconnecting the Napa River with its historic floodplain, moving homes and businesses out of harm's way, revitalizing wetlands and marshlands, and constructing levees and bypass channels in strategic locations. In addition to increased flood protection and reduced flood insurance rates, Napa residents will benefit from parks and trails for recreation, higher tourism revenues, and improved habitat for fish and wildlife.

Similarly, communities facing increased damage from heavy stormwater runoff can turn roofs, streets, and parking lots into water catchments. Portland, Ore., is investing in "green roofs" and "green streets" to prevent sewer overflows into the Willamette River. Chicago now boasts more than 200 green roofs—including atop City Hall—that collectively cover 2.5 million square feet, more than any other U.S. city. The vegetated roofs are providing space for urban gardens and helping to catch stormwater and cool the urban environment.

Many communities are revitalizing their rivers by tearing down dams that are no longer safe or serving a justifiable purpose. Over the last decade more than 500 dams have been removed from U.S. rivers, opening up habitat for fisheries, restoring healthier water flows, improving water quality, and returning aquatic life to rivers. In the 10 years since the Edwards Dam was removed from the Kennebec River near Augusta, Maine, populations of alewives and striped bass have returned in astounding numbers, reviving a recreational fishery that adds $65 million annually to the local economy.

Conservation remains the least expensive and most environmentally sound way of balancing water budgets. Many cities and towns have reduced their water use through relatively simple measures like repairing leaks in distribution systems, retrofitting homes and businesses with water-efficient fixtures and appliances, and promoting more sensible and efficient outdoor water use. Motivated by a cap on groundwater pumping from the Edwards Aquifer in south-central Texas, San Antonio has cut its per capita water use by more than 40 percent, to one of the lowest levels of any Western U.S. city. Even more impressive, a highly successful conservation program started in 1987 in Boston cut total water demand 43 percent by 2009, bringing water use to a 50-year low and eliminating the need for a costly diversion project from the Connecticut River.

But the potential for conservation has barely been tapped. It is especially crucial in agriculture. Irrigation accounts for 70 percent of water use worldwide and even more in the western U.S., so getting more crop per drop is central to meeting future food needs sustainably. In California, more famers are turning to drip irrigation, which delivers water at low volumes directly to the roots of crops. Between 2003 and 2008, California's drip and micro-sprinkler area expanded by 630,000 acres, bringing its total to more than 2.3 million acres—62 percent of the nation's total area under drip irrigation.

As individuals, we'll also need to make more conscious choices about what and how much we consume. Some products and foods—especially meat—have a high water cost. It can take five times more water to supply 10 grams of protein from beef than from rice. So eating less meat can lighten our dietary water footprint (while also improving our health). If all U.S. residents reduced their consumption of animal products by half, the nation's total dietary water requirement in 2025 would drop by 261 billion cubic meters per year, a savings equal to the annual flow of 14 Colorado Rivers.

We'll need to change how we use water in and around our homes and neighborhoods. Turf grass covers some 40.5 million acres in the United States—an area three times larger than any irrigated farm crop in the country. Particularly in the western United States, where outdoor watering typically accounts for 50 percent or more of household water use, converting thirsty green lawns into native drought-tolerant landscaping can save a great deal of water. Las Vegas now pays residents up to $1.50 for each square foot of grass they rip out, which has helped shrink the city's turf area by 125 million square feet and lower its annual water use by 7 billion gallons.

Albuquerque, New Mexico, has reduced its total water use by 21 percent since 1995, largely through education and rebates to encourage water-thrifty landscapes.

Energy and water are tightly entwined, and all too often public policies to “solve” one problem simply make the other one worse. For example, the 2007 congressional mandate to produce 15 billion gallons of corn ethanol a year by 2015 would require an estimated 1.6 trillion gallons of additional irrigation water annually (and even more direct rainfall)—a volume exceeding the annual water withdrawals of the entire state of Iowa. Even solar power creates a demand for water, especially some of the big solar-thermal power plants slated for the sunny Southwest. It’s still possible to have a future in which all basic food and water needs are met, healthy ecosystems are sustained, and communities remain secure and resilient, even in the face of climate disruptions. Just as the economic crash is forcing Americans to reassess what they value financially, the water crisis requires us to pay attention to how we value and use water. Across the country, communities will need to learn to take care of the ecosystems that supply and cleanse water, to live within their water means, and to share water equitably.

Sandra Postel adapted this article for **Water Solutions,** the Summer 2010 issue of YES! Magazine. Sandra is director of the Global Water Policy Project, a fellow of the Post Carbon Institute and the first freshwater fellow of the National Geographic Society. She is the author of numerous books and articles, including the award-winning *Last Oasis: Facing Water Scarcity*, which became the basis of a PBS documentary.

Water Footprint?

The Indirect Use Of Water In Agriculture And Industry

by Petitjean Olivier

This article appeared on partagedeseaux.info in October 2009. First publication: December 2008.

Consumer goods and other industrial products, food and other agricultural products, energy etc.: there are few economic sectors that do not involve massive water consumption. All too often, industrial processes and economic models were developed without taking the need to conserve water into consideration.

Some sectors are well known for using a lot of water. This is particularly the case of irrigation in agriculture, household and leisure use such as car-washing, golf courses, swimming pools... We are less aware of the amounts of water used in agricultural or industrial production. In the countries of the South, agriculture often uses 80% of the available water resources. In Europe, on the other hand, industry consumes 54% of water resources, far ahead of agriculture, which uses 33%. The energy sector also uses enormous amounts of water (read Climate Change and the "Water-Energy Nexus").

With the impacts of climate change, consumers are starting to worry about their carbon footprint, that is to say the amount of greenhouse gas emissions involved in transport and products that they buy. In like manner, advertising the “water footprint” of all products sold can prove to be particularly edifying. Dutch researchers launched a Water Footprint network, dedicated to calculating the water footprint of various products, sectors and countries and promoting water saving. This information is available on their Internet site at http://www.waterfootprint.org.

Some agribusiness multinationals, especially Coca-Cola, whose impact on water resources has been seriously challenged in recent years, have recently launched marketing campaigns designed to "greenwash" their image in this area. Unilever announced that their tomato sauce for pasta now uses tomatoes from farmers who only use drip irrigation. This gesture is all the more significant as the company buys at least 7% of the global tomato production. In April 2009, the Finnish agribusiness, Raiso, became the first company in the sector to include the water footprint on the packaging of their products. The American chain, Wal-Mart, which is the biggest in the world, stated that they intend to develop a universal system of labelling for their products that states both the carbon and the water footprint. Coca-Cola now declares itself to be a "water-neutral" company (based on the expression "carbon-neutral"), in spite of their well-documented waste, on the pretext that they are involved in programmes restoring rivers or promoting rainwater harvesting. Although the concept of water footprint is relevant, that of "water neutral" appears more like a marketing gimmick, even more than that of "carbon-neutral", which is already being seriously abused. Nevertheless most sectors are based on economic and industrial models that treat water as though it were a limitless resource – and the introduction of these new concepts does mark a limited form of progress.

The use of water in agriculture

Apart from the many other pitfalls, industrial agriculture uses a particularly high amount of water. It takes 180 litres to produce a single battery-farmed egg. Making one kilo of bread requires 1000 litres. One kilo of wheat needs 625 litres of water (555 million litres per hectare grown), one kilo of rice uses 3,000 litres and one kilo of meat requires even more (some sources talk of 25,000 litres, others 100,000 litres). The question of saving water are thus linked to our dietary regimes: according to the experts from the Worldwatch Institute, every 10 grammes of meat protein needs 5 times the amount of water required for 10 grammes of rice protein. If we compare the calories, the difference is even more remarkable, because it takes 20 times more water to produce 500 calories of meat than 500 calories of rice. It also takes 8 times more water to produce a given quantity of sugar compared with the same quantity of wheat.
Of course the amount of water involved in making a product depends on the conditions where it is grown: making a litre of orange juice involves 22 litres of water in Brazil, and 1000 in the United States, where orange groves have to be irrigated. But on the other hand transporting Brazilian orange juice to the markets of the North, with the operations involved (concentrating and deep-freezing it) also consumes a huge amount of water.

Fish farming also consumes a lot of water. Shrimp farming in India requires 50 times more water than growing rice. It involves intensive pumping of water that can lead to real quakes due to land caving in. This farming has become less profitable than rice farming, which has been abandoned in many regions.

The use of water in industry

Industry involves steam as well as using water to clean things, for air conditioning, cooling and freezing systems, and transport. Oil refineries, agribusiness, metallurgy, chemical industries as well as those manufacturing paper pulp and many others use vast quantities of water. The same holds true for mining activities, particularly gold mining.

It takes:
18 liters of water to make 1 litre of petrol
13 000 liters of water to make one 6 inch wafer of silicone, an element used in making many electronic devices
400,000 liters of water to make a car
750,000 liters of water to make 1 ton of newspaper
8 tons of water per ton of final product are required for treating sand and bitumen in Morocco or Canada

This massive use of water by industry also leads to very severe pollution by heavy metals, solvents and polychloride biphenols, oils, over and above any possible recuperation that can be carried out.

In terms of saving water and developing a more rational use of the resource, industry is where the greatest efforts need to be made. The processes used are obviously the key. Between 1950 and 1990, industry in the United States reduced its water consumption by a third, although the volume of goods produced increased four-fold. Considerable progress has also been made in Sweden and Germany. The Worldwatch Institute quotes the instance of several companies that have launched ambitious water-saving plans. IBM is reputed to have saved 375 000 cubic meters of water in one year by more efficient use of water, and a further 315 000 by recycling. Columbia Steel economized 63 million cubic meters by rainwater harvesting and redesigning their cooling towers to recirculate water. As a final example, Unilever reduced their water consumption between 1998 and 2002 from 6.5 to 4.3 cubic liters per tons of products manufactured.

Nevertheless, specialists foresee that industrial use of water will double by 2025. The countries of the South that are in the process of industrialization, need to make greater progress in saving water. In China, it takes between 23 and 56 cubic meters of water to make one ton of steel, whereas the average in Germany, in the United States or in Japan is only 6 cubic meters.

To conclude, the quantitative aspects are of course decisive in evaluating the water footprint of a product or a process, but are not in themselves enough. It is also necessary to take at least the qualitative aspects into account (at least the degree of pollution of the waste water) and the geographical dimension (in which region of the world the water is being extracted and used). Water footprinting is an instrument that speaks for itself, but it is limited in what it can accomplish.

Overview Of Groundwater Use In The Pacific Northwest

These charts appeared on US EPA REGION 10: The Pacific Northwest in 2009.

The following charts depict fresh groundwater withdrawals within each of Pacific Northwest States. The size of the circles shows the relative groundwater withdrawals between the states. Within each circle, the major uses: public supply, domestic and commercial, agriculture, industrial, thermoelectric power and mining. Alaska, with its smaller population, is enlarged to enable the withdrawal segments to be more easily read.

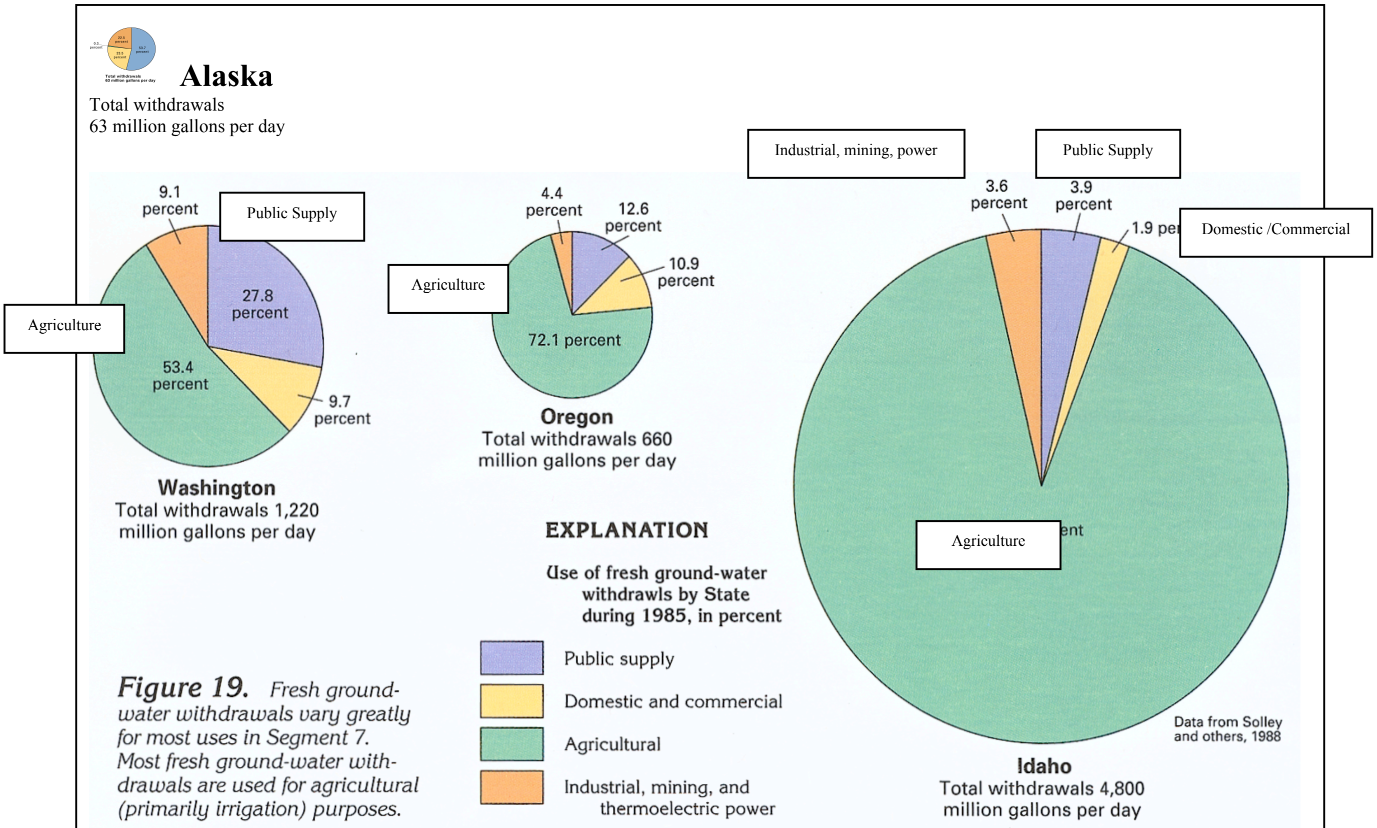


Figure 19. *Fresh ground-water withdrawals vary greatly for most uses in Segment 7. Most fresh ground-water withdrawals are used for agricultural (primarily irrigation) purposes.*

ALASKA enlarged version:

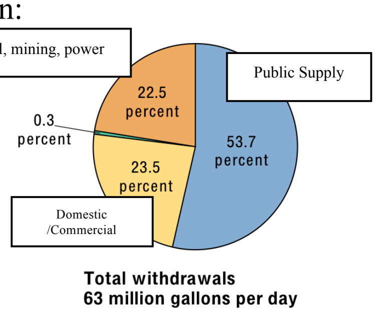


Figure 12. More than one-half of the fresh ground water withdrawn in Alaska during 1990 was used for public supply. Domestic and commercial withdrawals were the second largest category of water use.

Protecting Our Stream Flows –
Growing Needs for Water: Sharing a Limited Supply
Department of Ecology State of Washington
This article appeared on ecy.wa.gov/programs/wr/instream-flows/isfpct.html

"The water flowing through our streams and rivers has many uses – and many demands on it. But how much water do we need for a particular use? And if we take that water, what happens to the stream itself and the life in it?"

John Bartholow, U.S. Geological Survey

Historically, Washington residents have enjoyed an abundance of clean, accessible water in a water-rich state. However, residents find they can no longer take water availability for granted. Washington increasingly lacks water when and where it is needed for communities and the environment. Many factors affect water availability. Global warming is resulting in reduced snowpack and higher temperatures. Rapid population growth means more water is being used. Ongoing development increases the land covered with buildings and pavement. This causes less water to be absorbed through the ground to feed wells and summer stream flows.

Why should we worry about low stream flows?

Sufficient water in streams is necessary to sustain both the natural environment and our community water supplies. Washington State is known for its natural beauty and quality of life, both of which are affected by limited water. Fish and wildlife depend on adequate water, as do many recreational activities. Flows affect water levels in wetlands, lakes and ponds, and are an important aspect of water quality. "Out-of-stream" water uses, including farming, irrigation, domestic water supplies, and hydroelectric power can also be affected by low stream flows. How can we protect stream flows?

One way to protect stream flows is to adopt a rule. A rule adopted in the Washington Administrative Code (WAC) is a legal instrument used by the Department of Ecology to implement existing state laws, including those requiring the agency to protect stream flows. Stream flows protected in a rule are generally described as "instream flows." These rules specify the amount of water needed in a particular place for a defined time, and typically follow seasonal variations.

While instream flows are determined through scientific studies, factors such as legal and economic concerns also affect the levels at which flows are set. Determining instream flow levels requires considering both "instream values" (how water is used within the stream) and "out-of-stream" needs.

It is important to remember that just adopting an instream flow does not ensure that the specified amount will actually be there. Instream flows do not affect existing water rights; they are, in essence, a water right for fish that protects fish and instream values from future withdrawals. Strategies for addressing how to achieve instream flows are part of water management for a given area.

Why regulate stream flows?

It is important to maintain and effectively manage our water resources and habitats for both the natural environment and human uses:

For salmon and healthy habitats

Some streams and rivers have had so much water withdrawn that existing flows cannot support healthy fish and wildlife populations. Salmon and other fish are markers for the vitality of river ecosystems, and require adequate stream flows at key life stages as an important part of their habitat. Salmon and related fisheries also are important to our state's economic base and cultural identity, and they hold particular significance to local Native American tribes.

For water management

When making decisions about how to distribute water, it is necessary to know how much is needed and how much is available. Whether and under what conditions new water uses can occur depend on if there is sufficient water to meet the instream flow levels. As a result, instream flow rules help water managers plan for future water needs.

Who determines instream flows?

While the authority to adopt instream flows by rule rests with Ecology, local planning groups are evaluating water quantity and other water issues, and many may recommend instream flows. These groups are developing plans to protect and restore stream flows, while also making water available for use by people.

How can I find out what is happening in my watershed?

Watershed planning groups are active in most areas of the state. (A watershed is an area that drains to a common waterway.) These groups include local governments, many affected tribes, public water representatives, citizen groups, businesses, and individuals interested in local water issues.

Time Out for a Watershed Moment

Take a moment to view this YouTube video

http://www.youtube.com/user/FriendsOfCedar

2009 State of the Sound

A report on Puget Sound ecosystem status and a performance management system to track Action Agenda implementation

Puget Sound Partnership, January 2010
Excerpted from Section II – Ecosystem Status, pages 50 – 54, of 2009 State of the Sound *on psp.wa.gov/sos2009.php*

Water Quantity

Stream flows support aquatic life by moving sediments and organic matter to create and sustain a diversity of habitats in fresh, estuarine, and marine waters by moderating stream temperatures and modifying water quality by aeration and dilution. Stream flows also support withdrawals of surface waters from human uses.

The Partnership's interests in water quantity are expressed in the statutory goal for ecosystem recovery:

> *An ecosystem that is supported by ground water levels and river and stream flow levels sufficient to sustain people, fish, and wildlife, and the natural functions of the environment.*

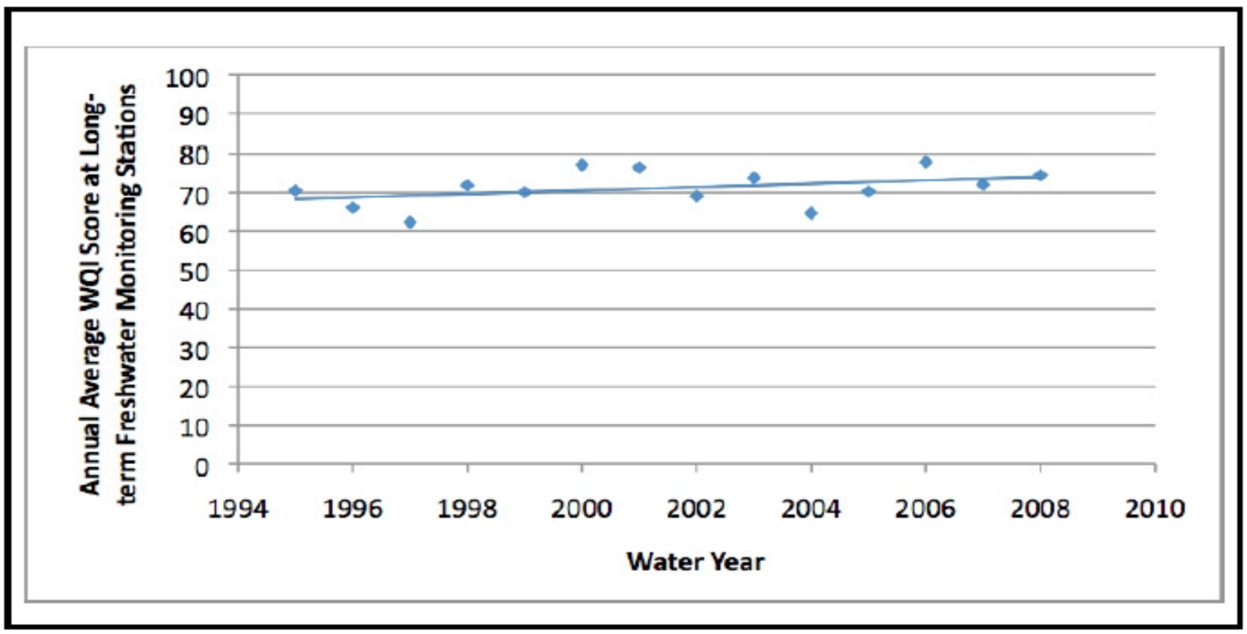


Figure 2-25 **Average freshwater Water Quality Index scores at Puget Sound region long-term monitoring stations**

One category of indicators of water quantity was identified for evaluating the status and trends of freshwater quantity: streamflows in major rivers. Stream flow in major rivers is most affected by climate change and variability, land use practices, and water withdrawals. A second category, hydrologic alteration, was also identified because it is considered to be a significant cause of declining biological richness as basins become urbanized. At present a specific indicator for this category has not been fully developed and tested, preliminary information is provided in the full Ecosystem Status and Trends report. The Partnership's focused reporting on water quantity for 2009 does not include characterization of ground water levels or ground water storage. This version of the Partnership's reporting also does not describe all aspects of surface water hydrology, surface water storage in natural or human-built reservoirs, or human use of fresh waters. It also does not describe water use or track trends in withdrawals and consumptive use in Puget Sound's major basins. These aspects of water quantity may be addressed in future reports by the Partnership.

What is the current status of water quantity in Puget Sound?
Stream flows in Puget Sound are affected by long-term climate influences (i.e., reduced summer flows and increased winter flows) and altered (i.e., more flashy) runoff in streams directly affected by urban development.

What affects the status of water quantity in Puget Sound?
The primary influences on Puget Sound stream flows are climate, development of watersheds, withdrawals of water, and regulation of flows for flood control or power generation.

How does water quantity affect other aspects of the Puget Sound ecosystem?
Water quantity affects human well-being by determining the amount of water available for human consumption and other uses. Stream flows affect species and food webs and the formation and maintenance of habitats. Water quantity can also affect water quality since it can drive circulation of marine waters and affect the distribution and concentration of pollutants in fresh and marine waters.

Stream Flow in Major Rivers
Indicator: Magnitude and Timing of Stream Flow in Major Rivers

This assessment of the magnitude and timing of stream flows in the major, unregulated rivers includes some portion of 5 of the 12 largest Puget Sound rivers. As seen in Figure 2-26, the major unregulated river flows for 1984 to 2003 shows a shift to higher and earlier fall flows, higher spring flows, and summer flows that are lower and peak earlier compared to flows from 1939 to 1967. The pattern of higher and earlier fall flows observed from 1984 to 2003 has also continued in the most recent 5 years of data. Peak summer flows have also continued to occur earlier than they did in the mid-20th century, but are not reduced as were flows from 1984 to 2003. In recent years' annual flow has been near the long-term mean values for the period.

What is the current status of stream flows in major rivers?
Stream flows have shifted over the past 70 years. Seasonal patterns of runoff have shifted towards higher winter stream flows and earlier and reduced summer flows supported by snowmelt.

What affects the status of stream flows in Puget Sound's major rivers?
Climate and flow regulation are the primary influences on stream flows of Puget Sound's major rivers.

The combined summer flows of Puget Sound's major, unregulated rivers show a decreasing trend (Figure 2-27), which has been hypothesized as a regional effect of global climate change.

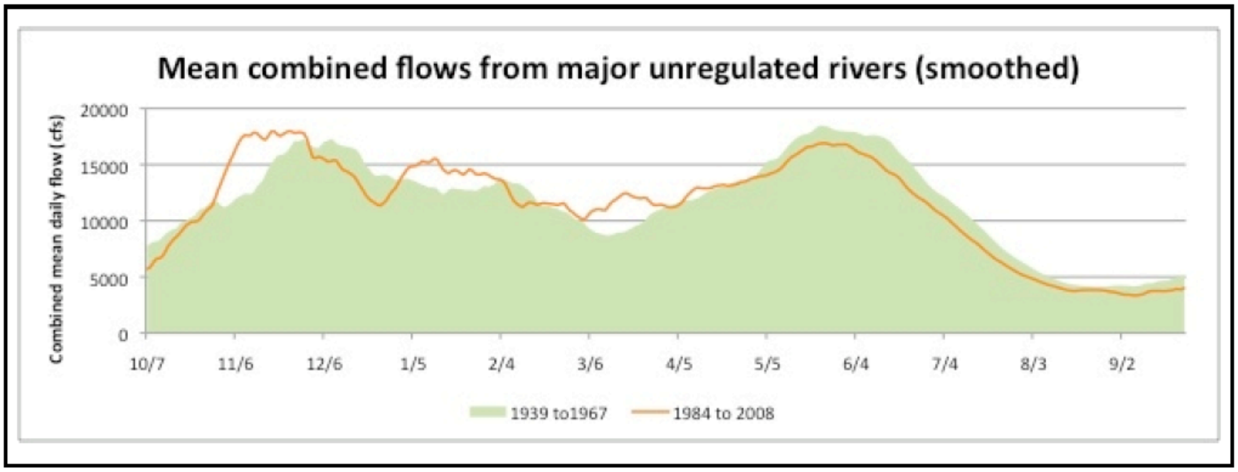


Figure 2-26 Seasonal pattern of runoff from Puget Sound's major rivers has shifted from conditions observed in the mid-20th century

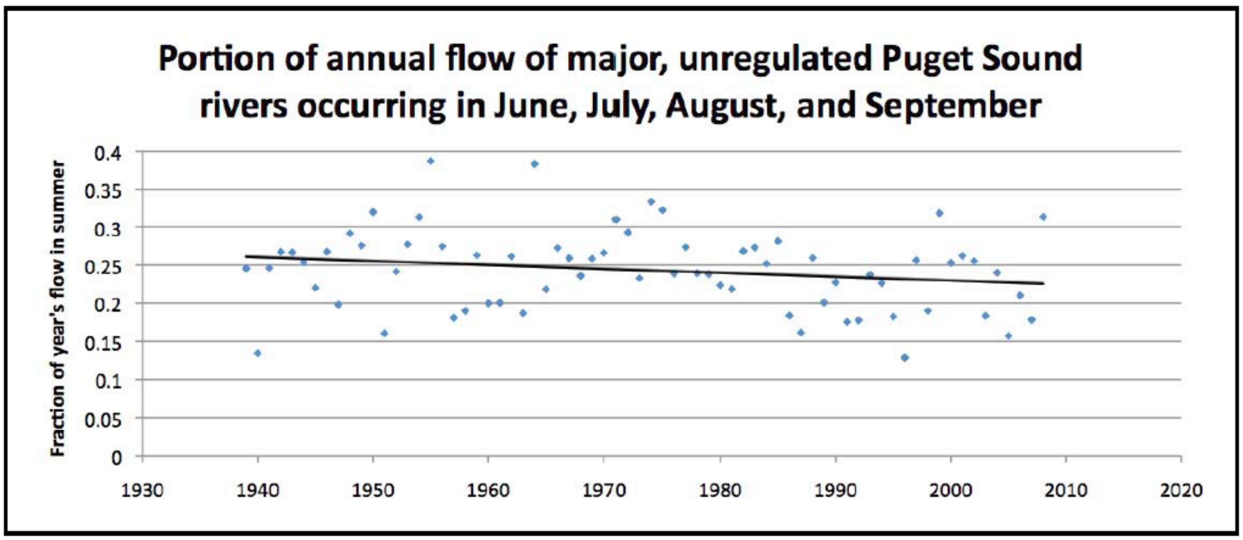


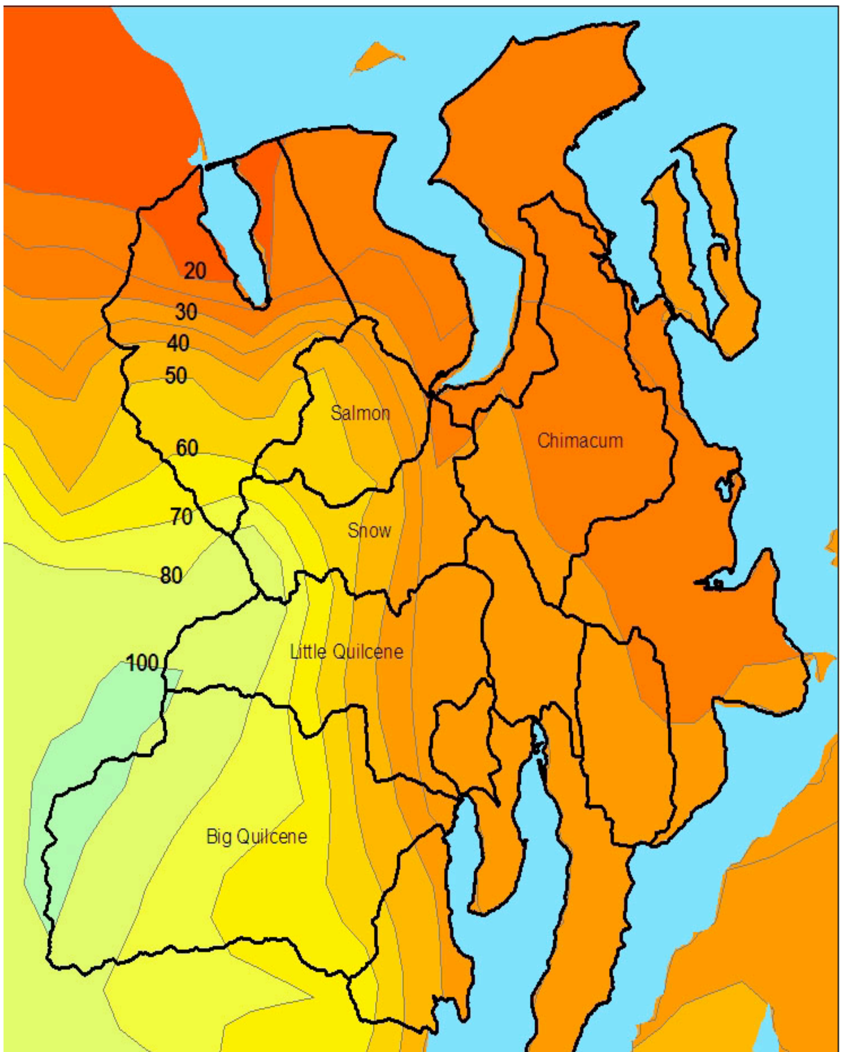
Figure 2-27 The combined summer flows of Puget Sound's major, unregulated rivers

A Water Shortage In The Rainy Pacific Northwest?

By Brie Van Cleve and Pat Pearson, At Home in the Quilcene-Snow Watershed, WSU Jefferson County Extension, October 26, 2007

The climate differs widely from one sub-basin to another

Much of WRIA 17 is located within the rain shadow of the Olympic Mountains and 70% of our annual precipitation falls during the wet winter months from November to April. The dry summer and early fall months are when people use the most water for crops and lawns and also when federally-protected salmon require sufficient water levels in rivers so they can return to spawn.



Due to the rain shadow affect, annual precipitation in WRIA 17 ranges from 19 – 100 inches.
Map by HydroLogic Services Co., 2006

So, do we in the rainy Pacific Northwest have a water shortage?

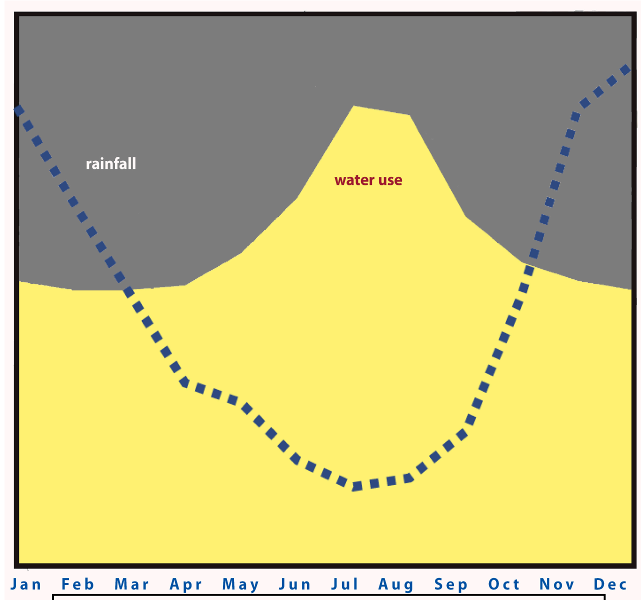
The answer is "no" if you consider only average annual precipitation for the entire region, but if you consider specific places and times during the year, there indeed may not always be enough water to meet current or future human demand.

Rainforest or banana belt?

The amount of annual precipitation varies dramatically throughout WRIA 17. For example, Quilcene receives 56 inches of precipitation annually while Port Townsend receives only 19 inches - just a few more inches than Los Angeles receives. Because most of the residents of WRIA 17 live in the drier parts, we've constructed a system of pipes to move water from wet places to dry places and we use natural and artificial lakes – Lords and City Lakes, respectively – to collect water in wet times and release it in dry times.

Possible solutions

There are many possible strategies for addressing water challenges in WRIA 17 including conservation, underground aquifer storage and recharge, operational improvements, desalination, recycling or water reuse, and above-ground storage. We also need to consider the contribution of natural systems to meeting our water needs. For example, forests collect and retain water and wetlands are especially effective at storing snowmelt, rainfall and excess runoff, purifying it, and then slowly releasing water downstream or recharging underlying aquifers. These natural systems also provide habitat for culturally and commercially important species such as salmon. Ultimately, a solution for WRIA 17 will likely involve a combination of options after careful consideration of their economic and environmental costs and benefits.



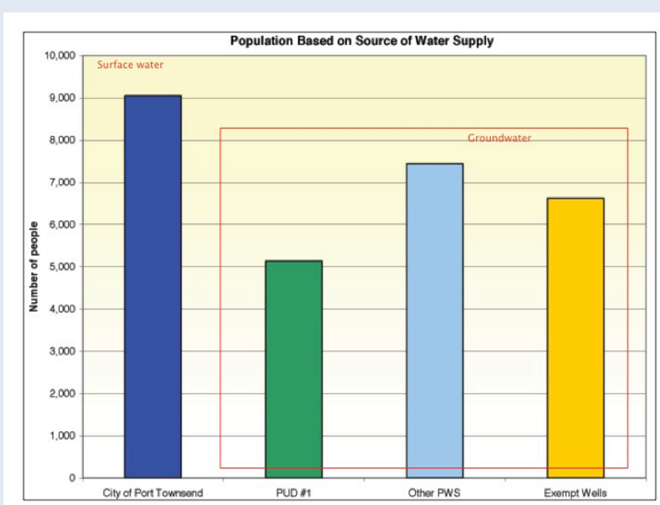
In Western Washington, the highest water demands occur during the driest summer months.

Is your water surface water or groundwater?

In Washington state about half of the population (approximately 3 million people) relies on surface water for drinking.

In the Quilcene-Snow Watershed (WRIA 17 in Jefferson County), about 70% of the population is supplied by groundwater (individual wells or public and private community wells), leaving about 30% of the population supplied by surface water (lakes or streams and the City of Port Townsend's water system).

Brie Van Cleve and Pat Pearson
Water Quality, Quantity, and Habitat in Your Watershed



Water

Friends of the San Juans, a public interest not-for-profit organization
Appeared online at www.sanjuans.org/FreshWaterPolicy.htm in January 2011

San Juan County's unprecedented growth in the past few decades has resulted in significant threats to the islands rural landscape and fresh water resources. As the county's population grows, its demands on water quality and availability become more pressing, particularly because that water is limited to recharge from rainfall. Key issues include low water recharge to aquifers, seawater intrusion, well failure during summer months, and lack of capacity to serve areas designated for growth by the county's Comprehensive Plan.
FRIENDS participates on San Juan County's Water Resource Management Committee to guide water development that is sensitive to the County's limited water resources. FRIENDS also advocates against proposals that fail to adequately address water quantity or quality concerns.

Water Resource Planning

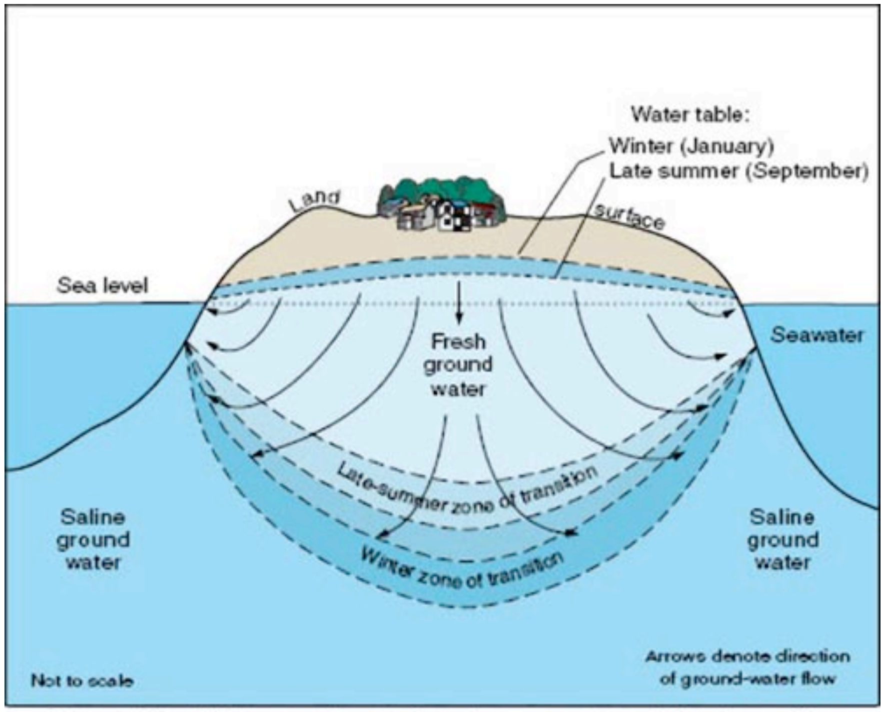
The people of Washington state own all fresh water in common, including rain. Water, like air, is a benefit for all. Consequently, the state Department of Ecology regulates the use of both surface water and groundwater through a water rights system known as first-in-time, first-in-right. Typically, the first person to prove to Ecology that they have put a specific amount of water to use will obtain a right for the use of that amount of water. Later applicants must show that their use of a certain amount of water will not impact those who obtained the right to use water before them.

In San Juan County, however, many water users take advantage of an exemption from the permitting requirement (though not the requirement to avoid impacting prior rights holders) for the use of less than 5,000 gallons per day of groundwater. Because those wells are not required to report their water use, it is difficult to ascertain the quantity of water needed for planning purposes. Efforts are being made to estimate both the amount of water available for use and the amount likely to be used as the County continues to grow.

Critical Aquifer Recharge

Aquifers are water-bearing layers of rock and soil that store water underground. In San Juan County, more than half the population taps these aquifers for drinking water (the other half draw from surface water sources, like Friday Harbors Trout Lake reservoir). Through the Critical Area Ordinance update, the County has designated all its land as a critical aquifer recharge area because the County draws its water solely from underground aquifers and because those aquifers are highly susceptible to contamination by surface pollutants. Typical pollutants include petroleum products from automobiles and other machinery, fertilizers, and inadequately treated animal and human wastes

Seawater Intrusion
Seawater intrusion, contamination of the aquifer by salt water, is already occurring in several coastal areas, particularly on Lopez. Seawater can enter an aquifer by two routes, lateral intrusion and upconing. Lateral intrusion occurs when too much water is pumped from the aquifer, causing the lens of fresh water in the aquifer to thin. When the lens thins, the pressure keeping saltwater offshore diminishes, and the mixed salt and fresh water moves inland.



Generalized flow pattern of an homogenous island aquifer. Movement of the zone of transition and water table shown for winter and late summer. Figure from USGS

Upconing occurs when a well, drilled near the shoreline in the thin edges of the aquifer, pumps salty water from the zone of transition directly into the well. Sometimes adequate fresh water resources exist in the aquifer, but because a well is poorly sited, it pumps seawater into the well. Recharge to the aquifer creates a healthy outward flow. Some of the recharge can be diverted for human use with no harm to the system. But if we mine the aquifer, taking more than a sustainable percentage of the recharge, we destroy the health of the whole system

Wetland Protection

If a wetland is not already degraded, the most effective protection strategy can be as simple as providing a buffer between it and any activities that might be harmful. Depending on the size and condition of a wetland, it may be protected by an array of local, state and federal regulations.

POSSIBLE DISCUSSION QUESTIONS

1. Sandra Postel in *Water: Will There Be Enough* makes a case that we need to "shift course" in how we use water at the national, community and personal levels. She ends the article stating, "It's still possible to have a future in which all basic food and water needs are met, healthy ecosystems are sustained, and communities remain secure and resilient…" Do you agree? Why or why not?
2. *Water Footprint*? takes the concept of water footprint from the personal arena to industry and agriculture. What are the hidden components of our collective water footprint from the products and food we consume? How much water does it take to support our lifestyle?
3. Agriculture, manufacturing, hydroelectric power, environmental and domestic needs all use fresh water. Looking at water use in the Pacific Northwest, what do you think of the current balance of water use by these competing needs?
4. Who are the large water users in your community? Based on what you have learned, do you believe there is an ample supply of water in your community to support these needs, now, and for your grandchildren?
5. View the "Friends of Cedar Creek Watershed" YouTube video from the "Timeout for a Watershed Moment", page 12. Take a moment with the group to share your perceptions.
6. Going local, the articles focused on Jefferson County *A Water Shortage In The Rainy Pacific Northwest?* and San Juan County *Water,* provide a view into the complexity of water management. How would you rate watershed management in your community, how is it done, and what are the hot buttons?

FURTHER READING & RESOURCES

- EPA Region 10: the Pacific Northwest: Water and Watersheds
  Website: yosemite.epa.gov/R10/
- Bonneville Power Administration
  Website: bpa.gov/corporate

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