

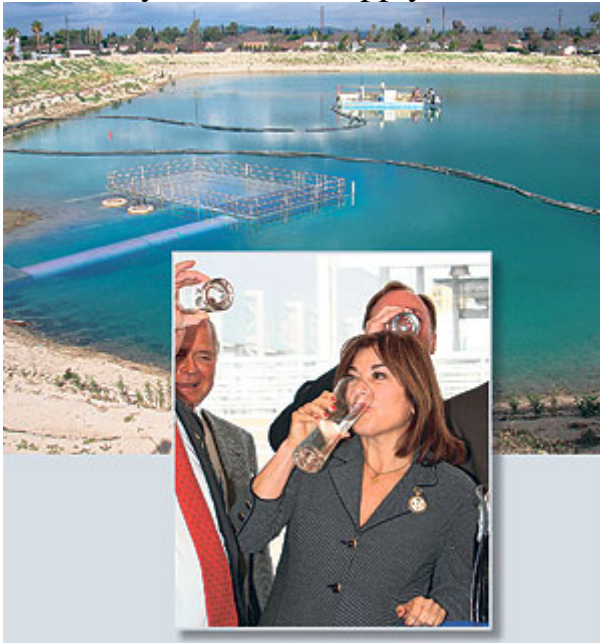
## Sewer to Spigot: Recycled Water

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A growing number of cities and counties grappling with water shortages are turning to a solution that may be tough for some homeowners to stomach: purifying wastewater so that residents can drink it.

In an effort to replenish its groundwater supply, Los Angeles is slated to announce Thursday a plan that will recycle 4.9 billion gallons of treated wastewater to drinking standards by 2019. In San Diego, the city council voted in favor of a pilot project that would pump recycled sewage water into a drinking-water reservoir, despite a veto from the mayor over the system's cost. Miami-Dade County, Fla., is planning a system that would pump 23 million gallons a day of purified wastewater into the ground; the water will eventually travel to a supply well and be reclaimed for drinking use.



Orange County Water District

Orange County, Calif., pumps a portion of its treated wastewater to the Miller Basin, where it percolates into deep aquifers and eventually mixes with the drinking water supply (main photo); local officials taste water that's been treated (inset).

Water recycling is just one of a number of tactics parched cities -- many of which have faced water shortages for years -- are using. "Demand is growing, and supply is pretty much staying static," says Wade Miller, executive director of the WateReuse Association, a nonprofit in Alexandria, Va., that promotes water recycling.

Cities ranging from San Diego to Denver already recycle wastewater for irrigation and industrial use. Some communities, such as the Tampa Bay area of Florida, desalinate seawater, which is generally more expensive than recycling. Many

cities are also pushing water-conservation initiatives such as implementing restrictions on when residents can water lawns or offering rebates for high-efficiency washers and toilets.

But cities considering large-scale systems that recycle wastewater to drinking standards may face an uphill battle. Such initiatives -- dubbed "toilet to tap" proposals by critics -- have encountered resistance in the past as a result of cost and the overall yuck factor. In 2001, Los Angeles scrapped a \$55 million wastewater-recycling project that would have provided the equivalent of the annual water needs of 200,000 city residents. A similar proposal in San Diego was derailed in the late 1990s amid an outcry that poor neighborhoods would be forced to use the wastewater from rich neighborhoods.

The cost of such projects may also be tough for residents to swallow. In Miami-Dade County, the estimated price tag on a new wastewater-recycling system is \$350 million. It is unclear how this will affect the water bills of residents, though local officials expect rates to rise.

The concept of recycling wastewater to meet drinking-water standards isn't new. A handful of cities in the U.S. and abroad have done it on smaller scales and sometimes with older technology. In most cases, the water is disinfected and pumped into an aquifer or reservoir where it remains for a period of time before being distributed to the public through drinking-water wells -- a concept known as indirect potable reuse.



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Wastewater in Orange County is treated with reverse osmosis to remove viruses, salts and pharmaceuticals.

Recurring droughts and growing populations are increasing the allure of recycling. In Los Angeles, groundwater contamination in the San Fernando Valley, where the majority of the city's groundwater supply is produced, has limited water available for pumping. "If we don't commit ourselves to conserving and recycling water, we will tap ourselves out," says Los Angeles Mayor Antonio Villaraigosa in a statement.

A new system in Orange County, Calif., where water demand is expected to increase 16% between 2010 and 2030, is the largest and most high-tech in the world. The system, which was launched in January, produces 70 million gallons a day, enough water for 500,000 people a year. It cost \$481 million to construct and costs \$29 million a year to operate. (The county says it offset part of the cost with \$90 million in federal and state grants). Other cities that are planning their own projects say they are using the Orange County system as a standard.

It is a three-step process: Sewer water that has already been treated by the county's sanitation district goes through a microfilter to remove solids and bacteria. It then undergoes a reverse-osmosis treatment, which passes the water through a membrane filter that removes viruses, salts, pharmaceuticals and other materials. Finally, it is treated with ultraviolet light and hydrogen peroxide to get rid of contaminants that are left.

The water is then pumped into a groundwater basin where it mixes with other water and filters through materials like sand, gravel, and clay. It takes about a year for the water to travel to a drinking-water well -- so county residents aren't yet drinking water that has been treated with the new system. The Orange County Water District, which manages the county's groundwater basin, compares its quality to that of distilled water.

Parts of Orange County, though, have been drinking treated wastewater since the 1970s through a system called Water Factory 21, which used reverse osmosis on a smaller scale. That system, when it existed, recycled just five million gallons a day.

Doctors and engineers say recycled water is safe to drink. Indeed, reverse osmosis coupled with ultraviolet light and hydrogen peroxide treats wastewater beyond what federal and state drinking standards require, they say.

That wasn't always the case. A National Research Council committee concluded in a 1998 report that reclaimed or purified wastewater can be used to supplement drinking-water sources only as a "last resort" and "after a thorough health and safety evaluation." But Jim Crook, the chair of the committee, says that since that report was issued, there have been a great deal of advances in treatment of wastewater, such as the use of ultraviolet light after reverse osmosis.

"We know a lot more than we did back then, and we can treat it to higher levels," says Mr. Crook, who is a member of an independent advisory panel created to review the Orange County system and a similar independent panel that looked at wastewater recycling in San Diego a few years ago. In Orange County, the purified wastewater is cleaner than the county's groundwater supply, he says.

Recent reports of trace amounts of pharmaceuticals found in drinking water are spurring increased scrutiny of public drinking water supply -- a factor that could affect public opinion of new wastewater-recycling plans. "Many of the pharmaceutical compounds taken nowadays by adults are excreted unchanged in urine, says Jack Skinner, an internal-medicine specialist in Newport Beach, Calif., who serves on a state committee that is evaluating drinking-water standards. "They show up in the wastewater just because of the sheer volume of people taking pharmaceutical compounds now." He adds that endocrine disrupters -- a series of compounds found in birth-control pills and plastics -- have caused birth defects in wildlife and are of particular concern to the public.

But reverse osmosis followed by treatment with ultraviolet light and hydrogen peroxide effectively removes pharmaceutical compounds and endocrine disrupters, as well as any viruses, such as hepatitis, that are spread through oral contact with fecal particles, Dr. Skinner says.

The high price tag of the new recycling systems can also be a hurdle. In San Diego, Mayor Jerry Sanders vetoed a plan to launch a pilot program to recycle wastewater back into the public-drinking-water supply last year. "The mayor determined it was not the best use of financial resources at this time," says Bill Harris, the mayor's spokesman, adding that the city has infrastructure problems that require more immediate attention.

Preliminary estimates of San Diego's pilot project are between \$6 million and \$8 million. If the pilot project is successful, the cost estimate of a larger-scale project is \$237.6 million, according a San Diego study on water reuse released in 2006.

Another issue affecting public perception in San Diego? The proposed project would pump purified wastewater into a reservoir instead of an aquifer. That prevents it from undergoing the same natural filtration process as treated wastewater in Orange County's system.

But the City Council voted to override the mayor's veto in December and forge ahead with the pilot project. "We're just not in a position to turn our nose up at any option to increase water supply," says City Council President Scott Peters.

Skeptics may feel squeamish about drinking what used to be toilet water, Mr. Peters says, but San Diego already receives at least some wastewater from other cities that discharge treated sewage water into the Colorado River. "The Colorado River is not filled with Dasani," Mr. Peters says. "That's where we get our water from."

In Orange County, officials say there was no organized opposition to its groundwater-replenishment system. The county's water district says it minimized outcry with an aggressive public-outreach program that educated local officials, environmental groups, regulatory agencies and the public about the benefits of wastewater recycling.

People who learned about the system early on and were involved in county politics say they have no health concerns. "The public gets a little nervous about it," says Ralph Bauer, 77, a retired research chemist and former Huntington Beach mayor who was on the City Council from 1992 to 2002. But "you can actually make the water purer than what you would get out of rivers and lakes."

Still, some residents find it unsettling. "I would never touch it, nor would I give it to my dog to drink," says Carina Sampson, a 29-year-old hairstylist in Anaheim, Calif., who found out about Orange County's groundwater-replenishment system through a friend a few months ago. Anaheim is one of the areas that will eventually receive water that has passed through the new wastewater-treatment process.

Ms. Sampson and her Chihuahua both drink bottled water exclusively. She says of the recycled waste: "I just find it repulsive regardless of what it goes through."

Public opinion of wastewater reuse can shift when people are presented with more details. In a September 2007 survey conducted by the San Diego Institute for Policy Research, 50% of the 1,000 adults in San Diego County who were polled said they opposed turning wastewater into drinking water. Forty-four percent said they supported it, and 6% said they were unsure.

Respondents who weren't strongly committed one way or the other were then presented with an additional piece of information: San Diego gets more of its water supply from the Colorado River than anywhere else. The river gets 400 million gallons of treated wastewater discharged into it each day. That means residents are already drinking treated wastewater.

The survey shows that 64% of these "swing" respondents said they were "more inclined to support" turning wastewater into drinking water. "We found that if just a little bit more education goes on, people's opinion is malleable," says Erik Bruvold, president and chief executive of the San Diego research firm.

Indeed, in Orange County, some opponents changed their minds. California State Assemblyman Michael Duvall, from the Orange County community of Yorba Linda, originally was against groundwater replenishment because of the cost of the system. But after learning just how much water could be recycled, he says, he became a supporter.

"It tastes like distilled water," says Mr. Duvall, who has sampled the water on more than one occasion and has brought family and fellow lawmakers to the plant. "It's about as pure as it can possibly be."