Los Angeles Times
latimes.com

Traces of Prescription Drugs Found in Southland Aquifers

Various medications are detected in drinking water that has been derived from treated sewage. The health risk, if any, is unknown.

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January 30, 2006

Behind a tangle of willows, every second of every day for almost half a century, recycled sewage has gushed into an El Monte creek and nourished one of Los Angeles County's most precious resources: the drinking water stored beneath the San Gabriel Valley.

Cleansed so thoroughly that it is considered pure enough to drink, this flow from the Whittier Narrows reclamation plant meets all government standards. Yet county officials now report that they have found some potent — and until recent months undetected — ingredients in the treated waste: prescription drugs.

As new technology enables detection of infinitesimally smaller doses of chemicals in the environment, Southern California water-quality officials have learned that an array of hardy pharmaceuticals are defying even the most sophisticated sewage treatments in use.

Around the world, waterways and groundwater basins are virtual drugstores, awash in low doses of hundreds of prescription drugs excreted by people and flushed down drains.

Wherever there is sewage, there are traces of whatever pills people have popped: antibiotics and antipsychotics, birth-control hormones and beta blockers, Viagra and Valium.

"There is no place on Earth exempted from having pharmaceuticals and steroids in its wastewater," said Shane Snyder, head toxicologist at Las Vegas' water provider, the Southern Nevada Water Authority, and one of the nation's leading experts on

pharmaceuticals in water. "This is clearly an issue that is global, and we're going to see more and more of these chemicals in the environment; no doubt about it."

Locally, small amounts of medicines for depression, seizures, high cholesterol, anxiety, infections, inflammation and pain — among other ailments — have been detected in the wastewater that flows into California streams and seeps into drinking-water aquifers. The contamination raises questions about the safety of reclaimed water consumed by the public and the health of wild creatures that inhabit waterways.

The concentrations are so minuscule — in parts per trillion, or a few drops in an Olympic-sized swimming pool — that scientists suspect there is little or no human danger. They acknowledge, however, that no one knows the effects of ingesting tiny doses of multiple drugs continuously over a lifetime.

So far, concerns have focused mostly on the ecological threat. Biologists studying frogs on Prozac, insects dosed with anti-seizure drugs, algae killed by antibiotics and fish feminized by birth-control pills have discovered that some streams contain pharmaceuticals and synthetic estrogen at levels harmful to aquatic life.

"All the data we have compiled indicates these concentrations are trivial to public health. Even putting massive safety factors on this, it still wouldn't have a [human] impact," Snyder said. "Now for wastewater — that's a different story. When you have a fish or endangered species that is exposed 24 hours a day, we do need to look at this."

With thousands of varieties of prescription and over-the-counter drugs being sold, there are no government standards restricting any of them in drinking water or in effluent released into streams or lakes.

Water and sewage agencies aren't even required to look for them — and most don't. Testing of drinking water for drugs has been so infrequent that no one knows how much people are ingesting. A national association of wastewater agencies warned in November that pharmaceuticals are a "potential sleeping giant."

Los Angeles and Orange counties are among the world's leaders in recycling sewage to replenish water supplies, and officials there worry that the public's perception of the water supply will be tainted.

The Whittier Narrows plant, which has operated in El Monte since 1962, was the

nation's first reclamation plant. Since then, nearly half a trillion gallons of treated sewage from Whittier Narrows and two other county plants have replenished the Central Basin aquifer beneath the San Gabriel Valley, which supplies water to 4 million people.

Sewage in Southern California undergoes some of the world's most rigorous cleansing — tertiary treatment — to protect rivers and streams from bacteria and nitrogen. Much of the wastewater then is routed into aquifers, where it remains for at least six months so soil can filter out more contaminants before potable water is pumped.

In November, the Los Angeles County Sanitation Districts reported at a scientific conference that they found high levels of ibuprofen, naproxen and acetaminophen in raw sewage coming into its Whittier Narrows plant, and very small concentrations going out.

In waste that had undergone treatment, the antibiotic sulfamethoxazole and anti-cholesterol medication gemfibrozil were found at fairly high levels of around one part per billion. The antidepressant fluoxetine, the arthritis drug diclofenac, anti-anxiety and anti-seizure drugs, three more antibiotics and others were detected at lower levels, in parts per trillion. Estrogens also were measured in low levels.

Similar findings from two Los Angeles County reclamation plants will be published later this year by Jorg Drewes, an assistant professor of environmental science and engineering at the Colorado School of Mines.

Robert Horvath, the districts' technical services director, said tiny doses of over-the-counter drugs aren't that worrisome, but other less common medications can amount to an involuntary though "extremely low" public exposure. The agency, which operates 10 reclamation plants, is one of a few with the ability to test for pharmaceuticals.

"It's such a large list of compounds that even the testing is a lot of work — just teasing out which ones are important. So far, we have no [federal or state] goals to shoot for," Horvath said.

Orange County is spending $500 million to build the world's most advanced sewage-recycling plant. When operating in 2007, it is expected to bring pharmaceuticals and other contaminants to undetectable levels.

Christian Daughton, chief of environmental chemistry at the EPA's National Exposure Research Laboratory branch in Las Vegas, has said that drugs rival pesticides but unlike such conventional pollutants, they are unregulated and flow continuously into waterways from sewage treatment plants. The U.S. Geological Survey found one or more pharmaceuticals in 80% of 139 streams tested in 2002.

In a 1999 report, Daughton warned that medications "could lead to cumulative, insidious, adverse impacts" on aquatic ecosystems — such as declining reproduction and survival rates — that "can accumulate over time to ultimately yield truly profound changes," even in protected areas such as national parks.

Fish, frogs and other creatures live, feed and breed in waterways — exposed to the drugs from birth to death.

Collecting carp and other fish in a Dallas stream fed by treated sewage, Baylor University toxicologist Bryan Brooks found fluoxetine, an ingredient of Prozac and other antidepressants, in all fish sampled.

In laboratory frogs, Prozac slows growth and metamorphosis, leaving tadpoles more vulnerable to predation, according to research by University of Georgia ecotoxicologist Marsha Black. In fish, it causes lethargy and delays reproduction, and in crustaceans and shellfish, reproductive rates drop.

The most striking discovery is feminized fish. Male fish in British rivers, Nevada's Lake Mead, the Potomac River and elsewhere are growing female ovarian tissues from continuous exposure to birth-control estrogens and natural hormone excretions in treated sewage.

Many popular medications, such as acetaminophen and ibuprofen, are eliminated during sewage treatment. But some pass out of the plants unaltered and are released into streams, oceans and groundwater basins.

"Most pharmaceuticals are designed to be tough because they have to get through your body to have a therapeutic effect," said Margaret Nellor, an environmental consultant who specializes in reclaimed water.

Two widely used anti-epileptic medications — carbamazepine and primidone — survive not only Arizona's advanced, tertiary treatment but also filtration through aquifers' soil. Even after eight years underground, they still contaminate well water used to irrigate parks in Mesa and Tucson, Drewes said.

Yet experts suspect that the millions of Americans who drink reclaimed water — which includes virtually everyone in Los Angeles County — would experience no effects.

Drugs in wastewater are detected in nanograms though they usually are administered by doctors in milligrams, a unit 1 million times larger.

"People would have to drink the water for many hundreds of years to get a dose of a pharmaceutical equivalent to therapy," said Drewes.

Still, the public exposure is widespread, and some drugs share a common mode of action. When combined, they could lead to significant exposure.

Because some pills are intentionally flushed down toilets, Los Angeles and Orange counties will begin distributing cards to pharmacies in March advising customers to take unwanted drugs to hazardous waste roundups or wrap them and put them in the trash.

Water agencies predict that soon they will have to tackle this new generation of contaminants. The EPA is likely to add a few pharmaceuticals to a new candidates list, which could initiate monitoring of water in 2008.

In the meantime, the newest technology can detect chemicals in parts per quintillion — equivalent to one tablespoon in the Mississippi River.

"The analytical capability has really, really outstripped our ability to understand what it means," said Michael Wehner of the Orange County Water District, which taps a basin replenished by the Santa Ana River, composed almost entirely of treated sewage.

"There's a question of which pharmaceuticals may be persistent in the environment, which have the greatest potential for adverse effects," he said. "The information is still sketchy compared to the traditional contaminants. There's some good work going on to help us get a handle on it, but it's still early."

Drugs in the environment

Tests of raw and treated sewage at Los Angeles County's Whittier Narrows Reclamation Plant show that some pharmaceuticals are resistant even to advanced

treatment and are released into the San Gabriel Valley's groundwater basin in ultra-low levels.

Drugs in sewage and in treated water(Parts per trillion)

	Entering plant	Discharged into groundwater
Estrogens (female sex hormones)	69.6	4.6
Triclosan (antibiotic)	610-667	51-74
Acetaminophen (analgesic)	20,300-35,200	under 10
Naproxen (analgesic)	3,780-5,100	35-74
Ibuprofen (analgesic)	4,720-6,630	43-52
Hydrocodone (pain killer)	31-52	34-50
Sulfamethoxazole (antiobiotic)	320-882	742-919
Meprobamate (anti-anxiety)	194-241	219-294
Dilantin (anti-convulsant)	39-48	98-120
Carbamazepine (anti-seizure, analgesic)	58-95	93-133
Diclofenac (arthritis)	22-30	40-63
Trimethoprim (antibiotic)	178-591	231-337
Erythromycin (antibiotic)	205-299	419-517
Gemfibrozil (anti-cholesterol)	2,300-3,020	733-1,110
Fluoxetine (anti-depressant)	under 10	13-18

*The tests of the incoming sewage and the outgoing waste were made at different times, which explains why some effluent is more contaminated than the incoming waste.

Source: Los Angles County Sanitation Districts, Nov. 2005