REUSING WATER

The worst drought in the last 50 years is focusing new attention on water reuse.

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The disaster wreaked by what experts are calling the worst drought to hit the U.S. in 50 years has underscored what forward thinkers have been saying: conservation, including water reuse, is critically important.

With almost all of the corn belt affected, along with much of the area where wheat and other small grains are grown, the current crisis lends new weight to a statement made back in 1958 by the United Nations affiliate UNESCO: "No higher quality water, unless there is a surplus of it, should be used for a purpose that can tolerate a lower grade."

Since that time, the situation has only become more complicated, with even the definition of "high quality water" subject for debate. Congressional passage of the 1983 amendments to the Safe Drinking Water Act with its demanding timetable for enactment of federal regulations and increasingly stringent drinking water standards has raised questions about the health and safety of all water supplies, including those that once were assumed pure.

After meeting federal and state requirements for secondary and advanced wastewater treatment, reclaimed water channeled through dual distribution systems can be made suitable for such nonpotable uses as toilet flushing, cooling in industrial and commercial settings and groundwater recharge. However, since there are no federal standards for reclaimed water yet, states have been left to decide many issues. Accidental exposure to reclaimed water is one of the public health concerns.

The nutritional value of reclaimed wastewater also makes it ideal for use as liquid fertilizer, as well as for agricultural and landscape irrigation, in both rural and metropolitan areas. With states such as California, Arizona and even humid Florida adopting legislation to encourage water reuse, many highway greenbelts, golf fairways, residential lawns and office shrubberies owe their greenery to reclaimed wastewater.

When wastewater is reclaimed, biological oxidation, followed by filtration and disinfection are needed. Devices to prevent backflow must be built into the distribution system and field inspections conducted to verify that cross connections between the primary system and the reclaimed wastewater system are not made. Microbiological standards for reclaimed water must also be checked.

In the home, reclaimed water is used primarily for toilet flushing and lawn watering. Researchers estimate that the average person uses 25 to 55 gal. of potable water a day for drinking, cooking and bathing. Each person may then use half again as much nonpotable water for other things.

The National Park Service has been frequently hailed for its first use of reclaimed wastewater for toilet flushing in 1926 at Arizona's Grand Canyon Village. Since then, wastewater reclaimed on-site has been used for toilet flushing at office buildings, schools, recreation sites and shopping malls in areas across the U.S. that are far from water supply or wastewater treatment facilities.

In California, the Irvine Water Ranch District (IRWD) has been supplying reclaimed wastewater for landscape and agricultural irrigation since the mid-1960s. In 1987, the district investigated the costs of using reclaimed water for toilet flushing in high-rise office buildings. At the Koll Center, an 11 story 249,000 sq ft building, an estimated 1,600 people would use 15 gal. per person per day. The IRWD concluded that substituting reclaimed water for 68% of the 24,000 gal. of water used at the building everyday for toilet flushing would be cheaper than buying and distributing potable water for the same purpose.

In another variation of the two supply system, the University of Arizona designed and retrofitted a residential water conservation home called Casa Del Agua in 1985, where rainwater was used as a reclaimed water source, in addition to grey water.

While the water from laundry, showers, and kitchen and bathroom sinks went to a grey water sump, rainwater was channeled to a separate cistern. The grey water was then piped to toilets or used for landscape irrigation. Toilet and garbage disposal waste was routed to the sewer.

After one year, the grey water fulfilled about 25% or 20,000 gal. of toilet water used. However, the grey water bacteria content, especially fecal coliform, exceeded the Arizona standard of 25 coliform per 100 ml.

In New Jersey, consideration is being given to the use of home potable water treatment units as an alternative to centralized treatment. This approach could be particularly effective in areas where private wells must be closed because of volatile organic contamination and may also be viable for urban or suburban areas served by a central water supply. However, unless the costs of home treatment can be lowered significantly, the centralized approach offers the ad-

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vantages of economy of scale in both treatment and monitoring.

Reused water may concentrate heavy metals and other contaminants in the soil or water table that could be harmful to humans, animals and vegetation. A 10 year study in Monterey, Calif. concluded in 1987 that food crops irrigated with chlorinated secondary municipal wastewater may be eaten safely without processing.

However, the degree of treatment and the biological standards to be maintained are the subject of some debate and in fact, allowable bacteria levels vary significantly from region to region.

For 25 years the city of Colorado Springs, Colo., operated a nonpotable irrigation system that used runoff and reclaimed wastewater. When the Colorado Department of Health (DOH) initiated regulation of the nonpotable system in 1977, it set a standard of 200 coliforms per 100 ml. In 1982, DOH used the California criteria and lowered that 200 level to 23 coliforms per 100 ml. Colorado Springs objected.

As a compromise, Colorado Springs agreed to conduct a study of the health effects of irrigating with reclaimed water in a public park. In 1987, Roger Durand, University of Houston, reported, "No evidence was found that exposure to nonpotable irrigation water of wastewater origin is a source of gastrointestinal illness.... On the other hand, irrespective of irrigation, some connection was drawn between wet grass conditions in a park during activity and symptoms of gastrointestinal attack. (However other) findings suggest strongly that nonpotable water of wastewater origin can be used for park irrigation without hazard to the public's health provided ... fecal coliforms are kept below the density of 500 per 100 ml."

INSTALLATIONS

Retrofitting a dual system in an existing community can be done; however, construction costs will be higher. On the other hand, capital recovery may occur sooner since the users are already present.

Dual distribution systems have been operating in such places as the Las Virgenes Metropolitan Water District in western Los Angeles County since the early 1970s. The system was installed as part of the district's plan to use more reclaimed water for landscape irrigation, highway greenbelts, landfills, cemeteries, schools and private residences. All this hardware would ultimately convert 200 individual irrigation systems from potable water to reclaimed water.

Slated to supply about 2,700 acre-ft annually, the system was expected to decrease the peak summer demand for potable water and meet about 20% of the annual water needs. This reuse of almost 50% of the wastewater produced would also drastically extend the existing potable water supply.

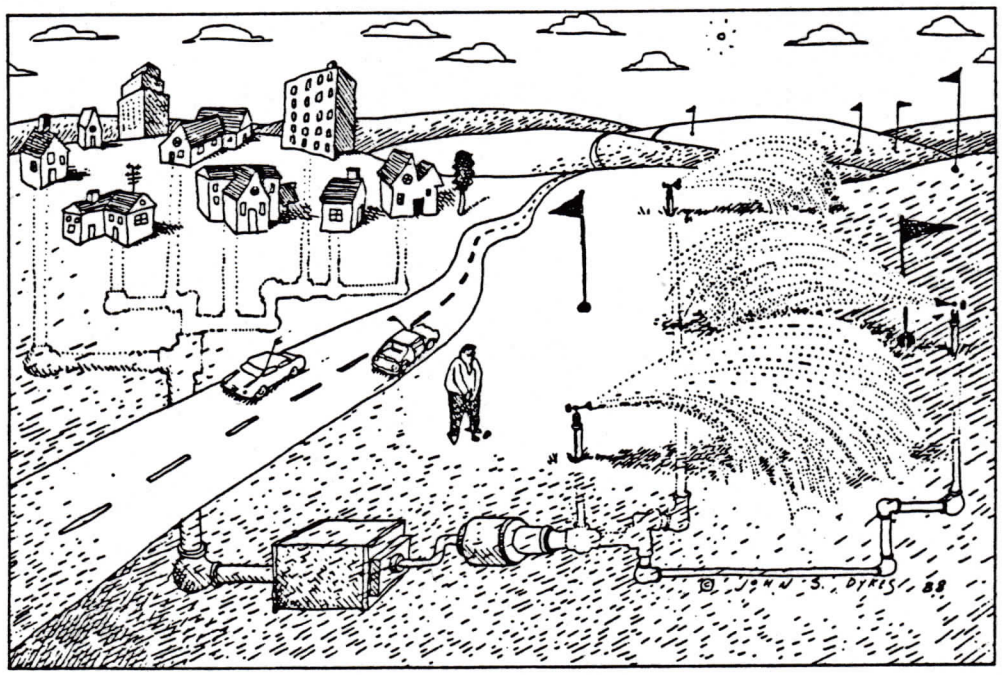
The project included a 23 mi pipeline, a 2.3 million gal. welded steel tank and a 900 hp pumping station. According to Glenn McPherson, Boyle Engineering Corp., Newport Beach, Calif., some 19 mi of pipeline were installed under the paved roads of Las Virgenes.

The project has taken eight years from inception to implementation. Will Stokes, district chief engineer, says, "... Water reuse systems are not only viable in newly developing communities but they are also highly beneficial in developed communities. The reclaimed water distribution system is a source of pride for the entire community."

In St. Petersburg, Fla. a dual distribution system that conveys potable water and filtered secondary effluent for fire protection, landscape and turf irrigation is closing the gap between a rising demand and static supply. According to William D. Johnson, director of public utilities for St. Petersburg, "the dual distribution system has proven to be an unusually successful undertaking ... total water utilization continues to rise ..."

Favorable federal environmental review and financing helped speed the system's construction valued at a total cost of about $104 million. This included: $60 million to upgrade treatment, $37 million for distribution and $7 million for the alternative discharge to deep wells.

With the system in place since 1977, approximately 25% of the 51 mgd of water consumed is re-



claimed. Residential customers for the reclaimed water have grown too, from 1981 levels of less than 20% of total customers to 1987's figure of 96%. Further, reclaimed water is now used for over 33% of the 4,500 acres irrigated. "Finally of great significance to Florida's Central Gulf Coast, zero discharge of treated wastewater to Tampa Bay has contributed to improvements in its overall water quality."

Further north in Sea Pines Island, 60 mi east of Charleston, S.C., a similar set of factors has evolved. In 1978, the state closed the area's shellfish beds and later in 1982, imposed a moratorium on wastewater treatment plant expansions. Simultaneously, environmental reviews conducted by federal and state agencies were yielding recommendations that reclaimed wastewater be used for irrigation. Consequently, says Richard Hirsekorn of CH2M Hill, an existing reclamation distribution system for golf courses was expanded to service public, commercial and residential areas, as well as an alternate discharge to some wetlands.

INDUSTRIAL USE

In northeast New Jersey, stringent wastewater treatment requirements to protect estuaries and rivers have generated 100 million gal. of highly treated wastewater and close to 400 mgd of secondary wastewater that nearby powerplants, industries, and recreational areas might use. Wastewater treatment operators are expected to benefit since chemical costs may drop as effluent discharge decreases. Even treatment capacity needs might decrease if reuse demand coincides with such critical discharge times as low stream flows.

In Sparrows Point, Md., Bethlehem Steel is spending $4,000 to $5,000 every month to buy practically all of Baltimore's wastewater. Up to 100 mgd of secondary effluent is piped nine miles to the steel plant for cooling and processing. The effluent meets the low chloride concerns of steel manufacturing and the city benefits because Bethlehem Steel assumes responsibility for chlorination. The deal also keeps the effluent and its harmful nutrient loads out of the nearby Back River.

Capital cost recovery is an important consideration for industrial and commercial establishments that convert to reuse systems. Generally, a three to ten year recovery range is considered acceptable.

In planning a dual distribution system, the Walnut Valley water district utility in California submitted rate estimates to potential consumers who were then asked how those rates would affect their consumption. The results of this exercise provided valuable information on the service area, base load and peak demands and helped the utility conclude that it could recover its costs within a reasonable amount of time if it priced reclaimed water within 70 to 85% of the potable water rate.

RECHARGING

Reclaimed water can be used for recharging depleted groundwater when the water table drops or saltwater intrudes. However it hasn't been widely adopted since there is still no consensus on its safety. This may be due, in part, to regional water tables, geologic conditions and health concerns.

Florida rules governing recharge projects highlight the reluctance of some states to introduce reclaimed water into potable water aquifers. In Orange County, plans to irrigate citrus groves received less than favorable reviews because purveyors feared the introduction of unknown contaminants into the potable water aquifer. The Florida Department of Environmental Resources prohibits recharge within a 10 year zone of protection around any existing or proposed well.

Orange County, Calif., like many other U.S. coastal areas, has experienced problems with saltwater intruding into groundwater. In response, the Orange County Water Factory #21 began using reclaimed water for recharging in early 1980. Five mgd of secondary wastewater is reclaimed using high pH lime flocculation, air stripping, recarbonation, multimedia filtration, granular activated carbon, reverse osmosis and chlorination. Next, the water is injected into the underground aquifer to form a mound in front of the saltwater. The treatment helps prevent the injection well from clogging and protects the water supply aquifer from contaminants.

To combat steep declines in Arizona groundwater levels—as much as 400 ft in some regions—the Arizona legislature passed the Groundwater Management Act in 1980, which mandated aquifer recharge to stop water mining and return the aquifers to their safe yield by the year 2025. Reclaimed wastewater is expected to provide about 500,000 acre-ft annually. This should constitute about 17% of total consumption by the year 2025.

In 1986 in El Paso, Tex. the Fred Hervy water reclamation plant recharged 1.6 billion gal. of drinking quality water to a groundwater reservoir. The plant treats 10 mgd of domestic wastewater with powdered activated carbon, activated sludge, lime, recarbonation, sand filtration, ozone disinfection, granular activated carbon and a trace of chlorine. In 1986, reports Daniel Knorr, project manager for the Texas firm Parkhill, Smith & Cooper, the treatment cost was $1.55 per 1,000 gal. Eventually, it is expected that reused water will make up about 25% of the total water supply in this area.

CONCLUSIONS

Dual supply and dual distribution systems are operating successfully. They can be adapted to local conditions and fulfill the objectives of using only the highest quality water for drinking and lower grades of water for groundwater recharge, irrigation, toilet flushing, powerplant cooling and industrial applications.

We've now amassed considerable data on the health effects, cost and treatability of reclaimed water. The quality of wastewater has improved, as well as our ability to analyze and detect contaminants and determine their possible effects on health. Although more information is needed on water reuse in both humid and arid climates, experts have predicted, based upon available data, it may be reasonable to reuse 10 to 25% of total water consumption in regions of 5 to 10 million people.

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