160 species ON JUST 150 AC of MARSH

PART of the SOLUTION

Letting Nature Do the Dirty Work

SUMMARY: Wetlands were once dismissed as foul places awaiting development. Now, some communities are constructing their own. Among the attributes of wetlands is their ability to filter and purify water, which makes the areas valuable as an economical way of treating wastewater to meet stringent federal and state standards.

On the southern edge of Arcata, a small community on the north shore of Humboldt Bay in Northern California, sit 150 acres of wetlands teeming with more than 160 species of birds and other wildlife. The marshy area, dotted with trails, bird blinds and benches, also plays host to tens of thousands of joggers, bicyclists and other outdoor enthusiasts each year. What makes it different from similar areas across the nation is its history. Less than 10 years ago, the land was the site of an abandoned logging mill, marginal pasturelands and a closed sanitary landfill, a large barren mound of earth dubbed Mount Trashmore.

The area's transformation to today's maze of meandering streams, cattail-covered estuaries and freshwater ponds began in the early 1980s, when new water quality regulations required Arcata to stop discharging its treated wastewater into the bay. A state agency wanted the city of 15,000 to close its local treatment plant and join other towns in the construction of a large regional facility. Fearing exorbitant costs, Arcata looked for an alternative to meet the stringent water quality standards and opted to let nature take its course. Working with professors from Humboldt State University, the city's Department of Public Works developed a system of marshes and ponds to filter out pollutants remaining in the treated water.

Arcata's wetlands system begins like most other treatment methods with the sewage piped into a conventional treatment plant where solids are removed and wastewater is disinfected. The water is pumped into oxidation ponds, where suspended solids settle to the bottom while bacteria and algae break down the organic compounds. The level of other pollutants and pathogens also may be reduced during the month or so the water remains in the ponds.

No more Mount Trashmore in Arcata

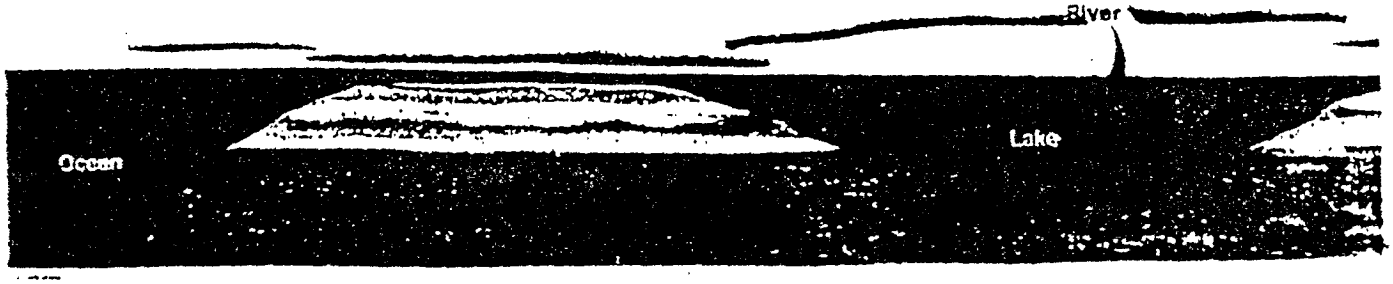
Before the federal Clean Water Act of 1972, most municipal sewage that passed through oxidation ponds, septic systems or other so-called secondary treatment procedures was considered adequately treated and allowed to be discharged into streams, lakes, oceans or other surface water. The Arcata wetlands system, completed in 1986, was designed to purify the effluent further to meet the act's more stringent water quality standards.

With the town's wetlands system, water from the oxidation ponds is regulated to flow into a series of three 2.5-acre marshes where cattails, bulrushes and other vegetation are fed by the nutrients still in the water. The plants, in turn, filter out certain pollutants. At the same time, chemical reactions and microbial activity break down harmful compounds of nitrogen and phosphorus. The wetlands are stocked with fish that feed on insect larvae to help control the mosquitoes and other pests that often proliferate in marshes. After having filtered through the marshes for two days, the water is pumped back to the treatment plant, where it is chlorinated to kill any remaining pathogens, dechlorinated and discharged into 30 acres of marshes for further purifying before emptying into Humboldt Bay.

By all accounts, the Arcata system is considered a fiscal and ecological success. The operators hardly have had to contend with mosquitoes or odors, two fairly common by-products of the process. The city estimates the constructed wetlands system has saved at least $2 million in capital costs over the regional facility and continues to offer significant savings in annual operating and maintenance costs. It also opened up a whole part of town that had been an eyesore, says David Hull, aquatic resource specialist at Arcata's public works department. Tests show the wetlands system easily handles the roughly 2.5 million gallons of wastewater the city generates each day, says Bob Gearheart, professor of environmental engineering at Humboldt State and one of the designers of the system, which has a capacity of 6 million gallons a day. "After two years of operation, it has proven to be an effective and efficient process, producing water that exceeds the standards and is even cleaner than the seawater it is going into," he says.

Only recently have the nation's wetlands come to be widely appreciated. Historically, they often have been considered little more than breeders of disease and pests, good for nothing unless they could be drained, filled and put into productive use. As a result, the Environmental Protection Agency estimates, by the mid-1970s more than half the wetlands in the 48 contiguous states, an area roughly the size of California totaling more than 100 million acres, had been lost, primarily to agriculture and urban development.

Now, scientists have come to realize the vital role wetlands play in the ecological



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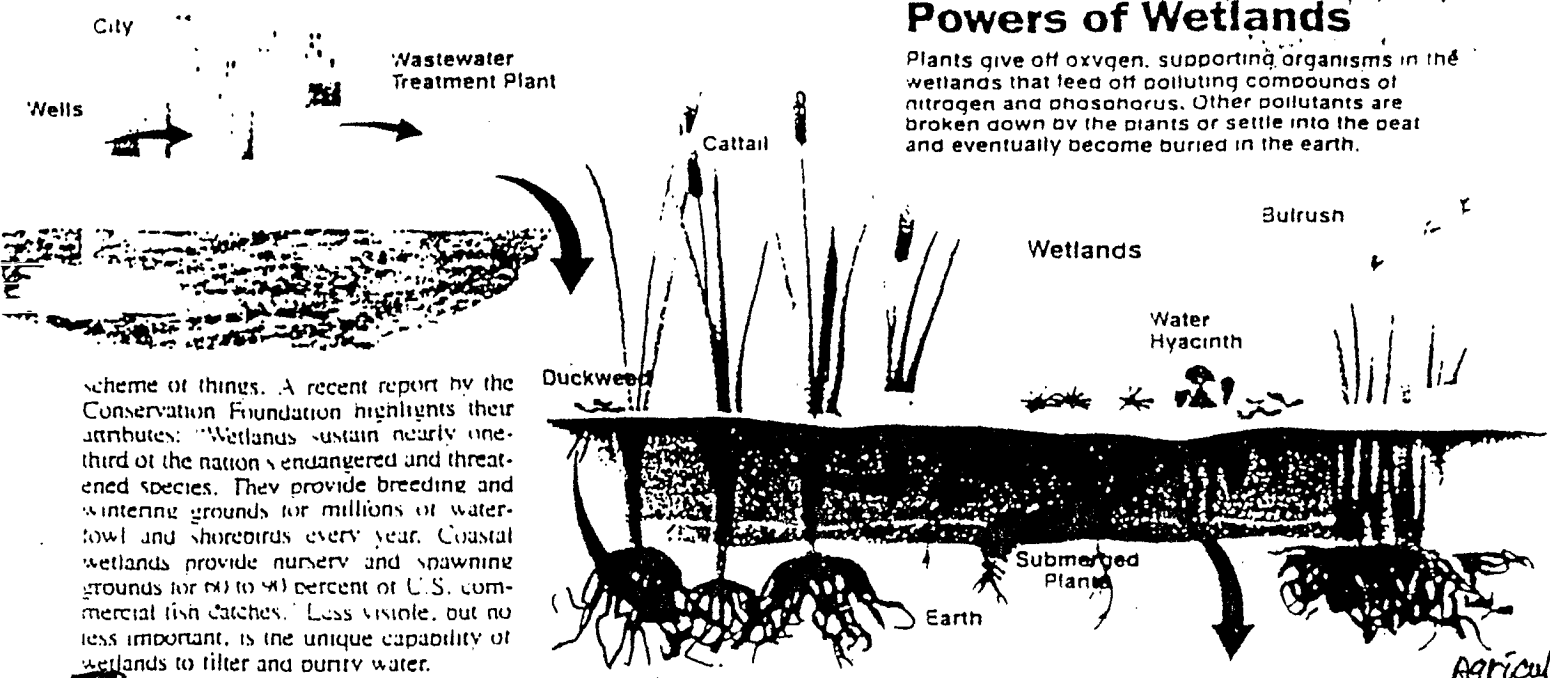
The Natural Cleansing Powers of Wetlands

Plants give off oxygen, supporting organisms in the wetlands that feed off polluting compounds of nitrogen and phosphorus. Other pollutants are broken down by the plants or settle into the peat and eventually become buried in the earth.



scheme of things. A recent report by the Conservation Foundation highlights their attributes: "Wetlands sustain nearly one-third of the nation's endangered and threatened species. They provide breeding and wintering grounds for millions of waterfowl and shorebirds every year. Coastal wetlands provide nursery and spawning grounds for 60 to 90 percent of U.S. commercial fish catches." Less visible, but no less important, is the unique capability of wetlands to filter and purify water.

Located at the edge of land and water, the plant and animal life found in the saturated soil conditions of all wetlands creates an environment that naturally breaks pollutants down into harmless substances. "The chemical and biological processes taking place have the potential to remove virtually every kind of contaminant," says James T. Watson, senior environmental engineer in the water quality department of the Tennessee Valley Authority.

The federal agency first constructed a wetlands area for the treatment of municipal waste in 1986 to test their viability for use in small Appalachian communities that had systems not complying with government water standards. "Small towns were finding even scaled-down versions of the sophisticated mechanical sewage treatment plants used in large cities still too complicated to operate," says Watson. "Even with training, the operators had trouble understanding how to run the plants. They needed simpler technology. Finding the money to build treatment plants also posed a problem for many communities."

In December 1986, the TVA and Benton, Ky., a town of 5,000 under EPA orders to upgrade its treatment facilities, completed a $260,000, 10-acre wetlands waste system that more than doubled the sewage capacity to 1 million gallons a day. The conventional treatment facility Benton had been considering carried a $2 million price tag. In the past two years, the TVA has assisted the southwest Kentucky towns of Hardin, population 600, and Pembroke, population 650, in the construction of wetlands treatment systems. "We think the technology is most suitable for smaller towns with populations of 10,000 or less whose wastewater flows are 1 million gallons per day or less," says Watson, who estimates that towns opting for such a system instead of a mechanical plant can expect to save 50 percent or more in capital costs and an even greater percentage in ongoing expenses.

The major drawback is that the process is land-intensive. A city with a population of 100,000 needs up to 300 acres of land, although the acreage would not have to be contiguous, says Gearheart. Others estimate systems of roughly 20 acres for every 10,000 people. Just how much wetlands are needed is contingent on how dirty the water is and what kinds of contaminants need to be removed, but even the land requirement has not deterred some larger cities from adopting the technology.

Constructed wetlands look particularly attractive to municipalities in Florida, where state laws designed to curb the traditional practice of discharging treated wastewater directly into surface water recently have gone into effect. In 1986, Orlando, with 1 million people in its metropolitan area generating roughly 50 million gallons of sewage daily, began constructing 1,200 acres of wetlands. The $21 million project, designed to handle a daily flow of 20 million gallons of highly treated wastewater, began operation in June 1987. In addition to surpassing all permit limits, the wetlands have become a haven for more than 100 species of birds, including many on the endangered species list that previously had not been sighted in the area, says Jo Ann Jackson, an engineer at Post, Buckley, Schuh & Jernigan Inc., the design firm that handled the project. The company also has completed a 1,400-acre system for nearby Lakeland.

Altogether, the Environmental Protection Agency estimates that 50 municipalities nationwide have developed wetlands systems to treat sewage. In a handful of experiments, constructed wetlands also are being used to treat agricultural runoff and industrial wastes and for storm water management. Hundreds more have been constructed by the coal mining industry, which spends more than $1 million a day on the chemical treatment of the highly acidic water that flows from mine sites.

Agricult, STORM DRAIN INDUST. WASTE,

Experts agree that the expanded use of wetlands for wastewater treatment will depend largely on a greater understanding of the various chemical and biological processes taking place within the wetlands environment. The mix of vegetation, the water level, the quality of the water entering the system and the number of days the water is retained in the wetlands are just some of the variables affecting the efficiency of a wetlands waste system, says Watson. The technology is promising, he notes, "but we need to get better performance data and develop specific design criteria before we are going to get widespread appeal."

Birds flock to Orlando's wetlands.

— *Susan Dillingham*

ORLANDO, FLORIDA 1 Mill people 50 mill gal/day 1200 AC of LAND

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