

## THE CHIPS ARE DOWN

**A CENTRAL CALIFORNIA BIOREACTOR PROJECT COULD HAVE WIDESPREAD IMPLICATIONS FOR IMPROVING WATER QUALITY.**

BY KIM O'CONNELL



Like most wetlands, the marshes and mudflats of central California's Salinas Valley act like a biological sponge, filtering pollutants from water that drains from the region's highly productive agricultural landscape. Creating wetlands from scratch to harness those benefits, however, can be difficult and costly for farmers. A new bioreactor research project may have answers.

Bioreactors are vessels or apparatuses that use biological organisms, such as plants or bacteria, to cause a certain chemical reaction. Located on agricultural land owned by PG&E (Pacific Gas & Electric) near Castrolville, California, a test bed of several bioreactors is being used to evaluate methods of nitrogen removal from agricultural discharge, primarily using wood chips as a substrate.

Created by the Central Coast Wetlands Group (CCWG), itself part of California State University's Moss Landing Marine Labs consortium, the bed features 12 identical channels, each 100 meters long by one meter wide and one meter deep. Methods being studied include filtering the water either through nonheated or heated wood chips, which are acted upon by bacteria that convert nitrates into an inert gaseous form, or through penny-

wort (*Hydrocotyle ranunculoides*), a floating, intertwining aquatic plant that is known for its denitrifying qualities. If successful, these bioreactors could mimic the functionality of natural wetlands and thus help the state to meet environmental clean water goals.

Excessive nitrogen in runoff is a major water quality concern nationwide. It often leads to eutrophication, or an excess amount of nutrients, which depletes oxygen and creates aquatic "dead zones." According to the Environmental Protection Agency, more than 10 trillion gallons of untreated runoff enters U.S. waterways each year. The potential for the bioreactor idea is therefore great, says Ross Clark, the director of the CCWG. "California has been a leader in clean water...regulating large dischargers since the 1970s and 1980s," he says. "But with nonpoint source pollution, the responsibilities of dealing with it are diffused within the landscape." The bioreactor is a possible smaller-scale solution that farmers and other landowners could implement on site, especially if they don't have the money, space, or inclination to create a natural wetland.

Russell Huddleston, the president of the Western Chapter of the Society of Wetland Scientists, says this method

should work. "Using wood chips as a substrate for bacteria in these wetlands provides for both a high surface-to-volume ratio as well as a source of carbon for the bacteria," he says. "Depending on the nitrogen load, the rate of water movement through the system, and temperature, such a treatment system should be an effective method of removing nitrogen from the effluent."

Although CCWG has not yet completed its research, the nonheated wood chips are so far proving most effective, Clark says, removing about 45 percent of nitrates. He says that both the heated wood chips and the pennywort have potential as well, but the channels are more stratified and therefore have uneven nitrate removal, though he suspects that design modifications could improve outcomes in both scenarios. The forthcoming challenge is to persuade California's policy makers to provide some regulatory incentive for farmers who implement this kind of on-site water treatment. "There's only so much that individual farmers can do to minimize pollution before they see an impact on their yields and the certainty of their crops," Clark says. "That's where our research comes in. Someday, we'd like to see lots of small bioreactor systems distributed throughout the watershed." ●

**TOP**  
Identical channels use wood chips and pennywort plants to test methods of removing pollutants from agricultural runoff.