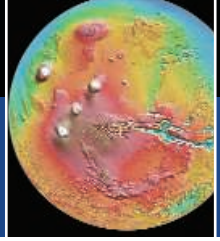

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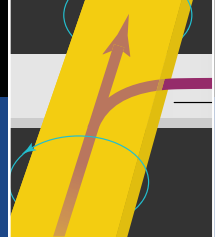

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Up to snuff? Wetland mitigation projects will be required to meet standards drawn from research such as this at a restoration project in Indiana.

ENVIRONMENTAL REGULATION

New Rules on Saving Wetlands Push the Limits of the Science

In one of the most significant wetlands regulations in 2 decades, the U.S. Army Corps of Engineers has spelled out what developers must do to mitigate damage from their construction projects. The new regulations are meant to make mitigation efforts more accountable, successful, and scientific. But some researchers and environmentalists believe that the rule isn't strict enough, and that too little is known about how to restore some of these fragile ecosystems, for the rule to work as intended.

In 1989, President George H. W. Bush announced a policy of no net loss of wetlands. Mitigation was a major tool to achieve the goal. It works like this: Any construction project that will harm a wetland or stream, say a shopping mall or highway, requires a permit from the corps. The agency issues some 80,000 permits a year, and each one requires developers to minimize the impact on wetlands and mitigate any unavoidable damage. Developers and public agencies spend nearly $3 billion a year on mitigation, much of it in or around wetlands they built on. In the past decade, more developers have started buying credits from "mitigation banks" set up to restore and create wetlands.

But the process didn't work well. Many projects have been flops, and the corps has failed to exert sufficient oversight, according to reports by the U.S. National Academy of Sciences' National Research Council (*Science*, 6 July 2001, p. 25) and other groups. Congress asked the agency to issue a new rule. The corps itself wasn't satisfied, says Mark Sudol, its chief regulator: "We knew we had to fix something."

The rule, to be published 10 April in the *Federal Register*, is designed to improve the track record of mitigation by recommending the use of a watershed approach and by requiring enforceable, ecologically-based performance standards. It extends mitigation policies to streams, a controversial idea given the nascent state of stream restoration science. The rule also standardizes requirements for all types of mitigation and strengthens long-term protection of sites. "They have moved forward significantly on some of the administrative issues that have dogged mitigation," says Julie Sibbing of the National Wildlife Federation in Reston, Virginia.

With a watershed approach, the corps would consult a detailed inventory of streams and wetlands, threats, and priorities for restoration before deciding whether a proposed mitigation project is adequate. But such watershed plans are costly, and only a few states have created them. In many places, scientists just don't know enough about the exact functions of particular wetlands and how to prioritize their restoration. Sudol says that his agency is weighing how regulators can make progress using the data at hand, for example, by trying to get mitigation projects located near parks or wildlife corridors.

To improve the success rate of mitigation projects, the rule—issued jointly with the Environmental Protection Agency (EPA)—requires developers and mitigation bankers to meet ecological performance standards. For example, a riparian wetland might need to encounter enough floods per year to remain healthy. Although wetland ecology varies enormously around the country, the standards must be based on the "best available science that can be measured or assessed in a practicable manner." In addition, the corps will now require backup plans in case a mitigation project fails. A developer or mitigation banker "can't just walk away," Sudol says.

But many researchers are alarmed that the rule enters uncharted territory with provisions on stream mitigation. The government was concerned that damage to streams was not being adequately addressed, says Palmer Hough, EPA's lead scientist on the rule. The mitigation for stream damage tended to be "in-lieu fees" that went to state or nonprofit programs designed to help wetlands elsewhere, some of which have been mismanaged in the past. "We won't trade streams for wetlands," says Sudol, who notes that the new rule requires stream impacts to be offset by stream mitigation.

Margaret Palmer, a stream ecologist at the University of Maryland, College Park, is troubled that the creation of new streams is part of the definition of restoration. Palmer emphasizes that there is no evidence that an engineered stream can ▶

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replace the functions of a natural one. In addition, she cautions that the science of stream restoration is relatively immature. Sudol acknowledges that but says prudent experimentation will be valuable: "If we don't allow someone to try something to see if it works, how will we move ahead?" He notes that developers must carry out at least 5 years of monitoring and submit backup plans.

Environmentalists worry that the rule, which goes into effect in early June, gives too much discretion to the corps' 38 district offices. "It's couched in scientific terms, but almost all of that can be waived when the district engineer feels it's not practicable," says Joan Mulhern of Earthjustice, an advocacy group in Washington, D.C. Sudol prefers to describe it as a balancing act. "The corps wants to bring in science, but we still need to make timely permit decisions," he says.

Patrick Parenteau of Vermont Law School in South Royalton welcomes new provisions for public notification and comment. In addition, monitoring results will be available on the Web. At the very least, he says, the new rules will make it easier to tell whether mitigation is working and how to improve it. **–ERIK STOKSTAD**

MEDICINE

Drug Bestows Radiation Resistance on Mice and Monkeys

Radiation therapy is a mixed blessing for cancer patients: It destroys tumor cells but also inflicts harm on healthy tissues, particularly the spleen, bone marrow, and gastrointestinal tract. On page 226, researchers led by Lyudmila Burdelya of the Roswell Park Cancer Institute in Buffalo, New York, report a promising new way to protect those tissues, one they claim could help improve outcomes of radiation therapy—and perhaps even save lives in a nuclear catastrophe. The strategy may be tested in cancer patients as early as this year.

Richard Kolesnick of the Memorial Sloan-Kettering Cancer Center in New York City calls the work "a breakthrough in an issue that has challenged the scientific community." It's a fine example, he says, of "how understanding mechanisms of tissue damage can result in [the discovery of] valuable pharmacologic agents."

Radiation induces damage in healthy tissues not by directly killing cells but by prompting them to commit suicide through a process called apoptosis. Burdelya and her colleagues wondered if they could rescue radiation-blasted tissues by shutting down this cell death program, which the body normally turns on in cells with damaged DNA to keep them from multiplying.

Tumor cells persist in the body because they are able to block apoptosis, by activating a transcription factor known as nuclear factor–κB. "Many in the cancer field are trying to inhibit NF-κB in tumor cells in order to let them commit suicide," says Andrei Gudkov, a co-author and a molecular geneticist at Roswell. "We thought, 'Why not try to do the opposite in normal cells to help them survive radiation?' "

Burdelya and her colleagues knew that human gut and immune cells activate NF-κB when flagella, bacteria's whiplike tails, tickle a cell surface protein called Toll-like receptor 5. Drawing upon this insight, they developed an NF-κB-activating drug, dubbed CBLB502, by modifying a small fragment of a *Salmonella* flagella. The team found that mice and rhesus monkeys injected with CBLB502 45 minutes to 24 hours before exposure to lethal radiation were more likely to survive, or survive longer, than animals that did not receive the drug. The drug also helped prevent death in mice when administered an hour after the animals received a radiation dose. There were no obvious side effects to the drug, and in another experiment, the researchers showed that radiation was still effective in treating tumors in mice that had received CBLB502.

CREDIT: MICHAEL ANDERSON/NCI

Safeguarding cells. A drug based on a bacterial protein could help radiation therapy treat tumors more safely.

Cleveland BioLabs, a Buffalo, New York, company that owns the drug, views CBLB502 as an adjuvant to radiotherapy but also hopes to sell it to governments as a preventive medicine to be stockpiled for a nuclear war, dirty bomb, or nuclear accident. (Five of the paper's 12 authors are employees of the company, and three others, including Burdelya and Gudkov, are paid consultants.) Other research groups, some funded by the U.S. Department of Homeland Security, are pursuing different strategies for radiation-protection drugs.

Burdelya's approach may have broad application, says Preet Chaudhary, an oncologist at the University of Pittsburgh School of Medicine in Pennsylvania. "It will be interesting to test it in other conditions with excess apoptosis, such as degenerative disorders and ischemia reperfusion injury," he says. **–YUDHIJIT BHATTACHARJEE**

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