

Rooting Out Nitrates

Can One County's Approach to Soil & Water Health be a Model of Disruption?

By Brian DeVore

Mark Thein's family has been tapping into Minnesota's aquifers since 1893, and in the southeastern Minnesota region where his well drilling company operates, the cracks, basins, and underground streams that make up its karst geology have long been an excellent source of drinking water. But Thein has noticed a troubling trend the past two decades: wells are increasingly contaminated with nitrates, and the pollution is diving deeper into the earth. This puts him in an awkward position when it comes to balancing the economic and the ecological.

"It's not in my best interest to save the aquifer because there are other aquifers deeper that I can make more money drilling wells to," he says. "But it's not in society's best interest to look the other way. I don't think it's fair to the next generation."

Drilling deeper is a fruitless race against gravity as water, and any pollutants along for the ride, steadily percolate through the fractured rock. Eventually, well drillers like Thein will run out of depths to plumb. As a result, a little over a year ago, he and fellow Olmsted County Commissioner Gregg Wright approached the local Soil and Water Conservation District (SWCD) office and asked a question: how can we prevent nitrates from entering that downward geological escalator in the first place? That conversation has resulted in an innovative program that takes a holistic approach to helping farmers implement a system that not only hangs on to nitrogen better, but is not as reliant on commercial applications of the fertilizer in the first place. A little over a year into its implementation, the Olmsted County Groundwater Protection and Soil Health Program (olmsted-soil-health-program-gis-olmsted.hub.arcgis.com) has resulted

in thousands of acres of cover crops being planted, as well as land diversified into water- and soil-friendly alternatives such as oats. Farmers have even used the program to convert row cropped land to deep-rooted perennial hay and pasture. The SWCD estimates that as a result of acres enrolled in the program, along with fields utilizing similar practices that aren't officially part of the ini-



"Protecting water quality is a perk, but the main reason I'm doing it is to try to be more profitable," says farmer Alan Bedtka of his use of practices supported by the Olmsted County Groundwater Protection and Soil Health Program. (LSP Photo)

tiative, over half-a-million pounds of nitrates have been kept out of the area's water.

The program is still too new to be considered a game changer that reverses the water quality trends in the region, but it's shown potential for taking a fresh approach to hitting that sweet spot of balancing farmers' profitability with a public good. Could it be a model for similar initiatives in other counties — even statewide or nationally?

"We've paid and we've paid and we've subsidized for the way that farming has gone," says Shona Langseth, a soil conservation technician for the Olmsted County Soil and Water Conservation District. "We're going to have to help transition farmers into the next way of thinking, and we're going to have to be creative about it."

Plugging the Leaks

In a sense, the idea for the Olmsted County Groundwater Protection and Soil Health Program has its seed in 2013 — that's when extreme rainstorms flooded area fields, leaving large swaths of corn and soybean fields unplanted. Desperate to keep washed out "prevent plant" fields covered during the growing season, the USDA's Natural Resources Conservation Service (NRCS) provided farmers cost-share funds to pay for planting cover crops such as cereal rye. For many of the farmers who took part in this cover crop program, this was the first time they'd had experience growing a non-cash crop on their land as a way to protect soil.

"Before that, nobody believed you could get a cover crop to work in a corn and soybean rotation this far north," recalls Martin Larsen, a conservation technician for the Olmsted SWCD. Larsen used cost-share funds to plant cover crops on his own farm that year, and, like many other farmers, found that it was not only possible to grow cover crops in Minnesota, but that they added numerous benefits to the soil: less erosion, better water management, and a lower reliance on chemical inputs as a result of added fertility and the breaking up of weed cycles. At about that time, news was coming out of North Dakota about how farmers like Gabe Brown were building soil health profitably using a system based on cover crops, no-till, managed rotational grazing, and diverse rotations. In 2015, the Land Stewardship Project's Bridge to Soil Health program was launched out of its

southeastern Minnesota office in Lewiston. Through that initiative, the Soil Builders' Network was developed — it now brings together hundreds of farmers in the region to share information on regenerative farming techniques.

This was all occurring as public health experts and other local government officials in Olmsted County became increasingly alarmed by the amount of nitrates that were showing up in water tests. Karst geology is made up of porous limestone that allows surface contaminants to easily make their way into underground aquifers. Nitrates are a particularly troublesome pollutant, given their ability to escape the surface and seep deeper into the earth. High nitrate levels can

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cause a sometimes-fatal condition called “blue baby syndrome,” as well as colorectal cancer, thyroid disease, and neural tube defects. The Environmental Protection Agency has set the drinking water standard for nitrate at 10 milligrams per liter, or 10 parts per million. In recent years, research has hinted at serious health problems associated with nitrate levels as low as three parts per million. Recent Minnesota Department of Agriculture testing has shown that over 12% of the private wells tested in southeastern Minnesota exceeded the EPA’s drinking water standard. More than 9,000 residents in the state’s eight-county karst region were or still are at risk of consuming water at or above the EPA standard, according to a letter the agency released in November 2023. Nitrate pollution has prompted LSP and 10 other groups to demand that government agencies recognize this as an “emergency” situation and take action under the Clean Water Act (*see sidebar on page 25*).

According to the Minnesota Pollution Control Agency, 89% of nitrate pollution in southeastern Minnesota comes from commercial fertilizer and manure. Corn requires lots of nitrogen and it’s by far the most used fertilizer in the Midwest — Minnesota farmers apply it on 98% of corn acres at a rate of 146 pounds per acre, according to recent USDA data. Nitrogen is leached from soils primarily in the form of nitrate.

Larsen likes to show a graphic comparing the diversity of agriculture between the 1940s and today — plantings that included row crops, small grains, hay, and pasture have been replaced by a duoculture of corn and soybeans. (As a legume, soybeans fix their own nitrogen, but fields planted to the oilseed can still be the source of “legacy” commercial fertilizer that was applied to corn in previous years.)

Analyses from around the world have shown that annual crops take up only about half of the nitrogen applied to the field, “leaving most of the remainder available for loss to the larger environment, including leaching loss to groundwater,” according to the journal *Agriculture, Ecosystems and Environment*.

In addition, large concentrated animal feeding operations, which have become more prevalent in southern Minnesota in recent years, rely on storing and disposing millions of gallons of liquid manure. That

manure is full of nitrates and nutrients such as phosphorous, which can make their way into groundwater, as well as surface waters, resulting in fish kills, among other problems.

In 2019-2020, Olmsted County began identifying areas where it may no longer be feasible to construct new wells that are free of nitrate. The county eventually passed rules around how much nitrate could be present in newly drilled wells. It’s considered the toughest well ordinance in the state, but it still acknowledges that water in certain areas of the county will continue to see

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— Mark Thein

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increasing nitrate levels as the contaminant moves deeper into aquifers due to historic land use practices, including applications of commercial fertilizers and manure. This is particularly troubling considering that when nitrates are present, it’s inevitable that other contaminants, such as pesticides, are also polluting the water.

“We’re allowing this to happen, but what can we do to prevent this in the first place?” Caitlin Meyer, the water resources coordinator for the Olmsted SWCD says, describing



Cover crops such as cereal rye that are planted in the fall and terminated in the spring build soil health, reduce erosion, and disrupt weed cycles. They also help keep nitrates out of water. (LSP Photo)

the question that people like Mark Thein were asking.

The answer Larsen and other soil health pioneers from the area gave was: build healthier soil by disrupting the conventional corn-bean-feedlot machine that dominates the current landscape. If we create the kind of year-round root structure that soaks up nitrates, plus become less reliant on continuous plantings of fertilizer-intensive crops like corn, nitrates could be nipped at the

surface before they made it underground.

Studies have shown that planting cover crops between the corn/soybean growing seasons provides the kind of soil environment that can cut nitrate leaching by 40% to over 50%. And Olmsted County has local research to back this up. Trials conducted at the SWCD’s own Soil Health Research Farm has shown that water beneath soybean plots grown without cover crops had nitrate concentrations that were as much as double the drinking water standard. Cover crops that were allowed to grow at least 12 inches high consistently reduced those levels below the safe drinking water standard.

Thein says that having that kind of practical, firsthand information available convinced him and other commissioners that the nitrate problem could be dealt with at the source, given the right approach. SWCD staff — Larsen, along with Meyer and soil conservation technician Angela White, as well as Skip Langer, the SWCD’s conservation manager — provided the commissioners information on what farming practices could reduce nitrate contamination and the practical ways they could be implemented and supported. It didn’t hurt that farmers who had worked with the SWCD and LSP on building soil health contacted the commissioners to encourage them to support cover cropping and other practices.

“I think that kind of local information was crucial,” says Thein. “I’m a well driller, not a farmer.”

Covering the 5 Principles

The overall message provided by SWCD staff and local farmers was that practices that build soil health can make a difference, but that making that transition can be tricky for farmers who have long been incentivized by federal agriculture policy to raise corn and soybeans in a system that’s input intensive and that leaves the soil exposed for the majority of the year.

Providing farmers financial assistance to put in a soil building practice is nothing new. The NRCS still provides cost-share funds for seeding cover crops, and EQIP (Environmental Quality Incentives Program) helps farmers establish rotational grazing systems, among other soil-friendly practices. Cover cropping assistance is also available through SWCDs, the Minnesota Board of Water and Soil Resources, and groups like Practical Farmers of Iowa and the Minnesota Soil Health Coalition. According to the latest National Cover Crop Survey, such incentives

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play a key role in getting farmers started on this practice; 49% of the cover crop users who participated in the survey reported receiving some sort of incentive payments for cover crops in 2022, and almost 78% of cover crop non-users said that incentive payments would be helpful.

For a time, the Olmsted County SWCD administered a traditional cover crop assistance program. The SWCD's White says the program was valuable in getting cover cropping established in the region and showing it could work, but it had limitations as far as producing positive environmental benefits. Farmers would often plow the cover crop under early in the spring before it could provide optimal soil health benefits, and they were frustrated with restrictions that controlled seeding rates, for example.

"They did what the program required of them," says White.

The Olmsted County Groundwater Protection and Soil Health Program takes a more comprehensive, yet flexible, approach to building healthy soil. For example, the program pays a farmer \$55 an acre to grow a cover crop to a minimum height of 12 inches. Farmers can also receive payments for growing so-called alternative crops like oats and other small grains, and for converting row-cropped acres to hay and pasture ground. The three main portions of the program — cover crops, alternative crops, and haying/grazing — have as sub-categories "enhancements" that can qualify a farmer for more money. For example, if a farmer allows a cover crop to get to 24 inches, they receive an additional \$20 per acre. If they plant their cash crop into a living cover crop, a practice called "planting green," that garners an additional \$10 an acre. All told, an individual farm can qualify for a maximum of a little over \$15,000 in payments per year.

The payment limit is key — when Olmsted County SWCD staffers originally brainstormed with area farmers about setting up the soil health initiative, a per-farm payment cap of \$20,000 to \$25,000 was being considered. However, the farmers insisted on a lower cap; that way more money could be spread around on more farms.

Meyer, Larsen, and White say the core question that drove the design of this program was: what farming practices will

reduce nitrate pollution in a way that works financially for the farmer? Research shows that allowing cover crops to grow at least 12 inches, for example, helps develop the kind of extensive root system that soaks up wayward nutrients. Converting row-cropped acres to perennial hay and pasture systems and rotating in alternative crops like oats also builds the kind of soil that slashes runoff while reducing the need for a heavy reliance on commercial fertilizer. And rotationally grazing pastures and cover cropped fields spreads animal manure and urine in a manner that it doesn't concentrate in one place and become a hazard to the environment — instead it becomes an input that builds biology.

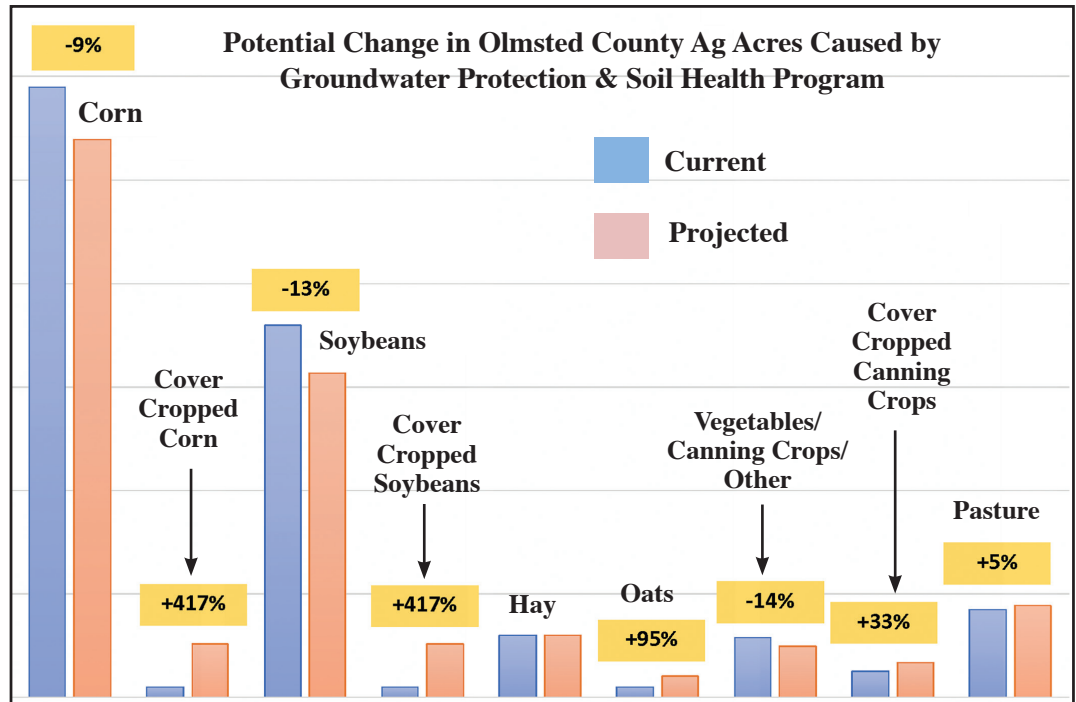
The program also acknowledges that

In other words, instead of relying on promoting one or two isolated farming practices, the program attempts to provide farmers an incentive to implement the five principles of soil health that were popularized by soil health pioneers in North Dakota: armor the soil, minimize disturbance, increase plant diversity, keep roots in the soil as long as possible, and integrate livestock.

Creeks, Cash, Connections

Not all participants in the program are going to check all five soil health principle boxes, of course, but the flexibility built into the Olmsted County initiative makes it at least a possibility.

One early morning in late September,



The Olmsted County SWCD has calculated how, if it lives up to its potential, the Groundwater Protection and Soil Health Program could impact the make-up of ag acres in the county. (Source: Olmsted County SWCD)

growing conditions can change in a flash on a farm. If a farmer signs up to grow cover crops to 12 inches and droughty conditions make that seem like not a good idea because they'll compete with cash crops for moisture — as was the case for many farmers this year — they can still get payments if they signed up to grow an alternative crop or to convert a field to haying and grazing.

"We have a total of nine different ways to sign up," says Larsen. "I'm going to do a little bit of grazing — oh, maybe not, I don't have any cattle so I'd like to try small grains. And then I'm going to have these corn and soybean acres that I slip cover crops into. So there's more than one option."

Alan Bedtka checks out a stand of sorghum-sudangrass he had planted on his family's farm east of Rochester in June, in the midst of a major drought in the region. Sorghum-sudangrass thrives in dry, hot weather, and this 20-acre field was no exception. Part of the field had been grazed a week or so before, and the sudangrass, along with the cowpeas, millet, sunflower, and buckwheat that had been seeded with it, was green and thriving. Bedtka hadn't added fertilizer to this field in two years, and the ground was sprouting earthworm middens and toad stools, signs of healthy soil activity.

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But what the farmer was most happy about was how integrating cover crops into his cash crop system is helping him make money with his cow-calf herd. His family raises field corn, soybeans, and sweet corn, and during the past four years, Bedtka has been growing a diverse mix of cover crops on the row cropped land, which has allowed him to expand how much access to grazing his herd has. In fact, thanks to portable fencing, he is pretty much at his goal of grazing every acre annually.

That's money in the bank — especially in a drought year, hay is expensive, and the farmer feels he's building his soil's natural ability to generate its own biological health, which saves on the fertilizer bill.

Bedtka concedes that 2023 was a tough year to build soil health profitably, given that his area was at one point the epicenter of the worst of the drought that struck Minnesota. But what helped get him through the season was his enrollment in the Olmsted SWCD initiative. In 2023, he participated in the portion of the program that paid him for growing his cover crop to 12 inches before he terminated it. "It was close on one field — it was *exactly* 12 inches on the day we sprayed it," he recalls.

Bedtka also signed up to raise cover crops for seed production, which qualified him for the alternative crop portion of the initiative. Finally, his use of rotational grazing and the growing of forages on formerly row cropped land qualified him for the haying and grazing payment.

The program comes at a time when cover cropping and grazing are creating a kind of synergy between economic viability and environmental health — the farmer is saving money on feed and fertilizer costs while seeing fewer washouts on the local creek.

"Protecting water quality is a perk, but the main reason I'm doing it is to try to be more profitable," says Bedtka. "You're soaking water in better, you're not seeing it

pile up and go down the streams. So that means you're growing more grass and more cows per acre. All the benefits are kind of tied up into one."

One of the main goals of the Olmsted County program is to alleviate the risks that farmers face when they adopt a regenerative ag practice.

Logan Clark is in the process of converting row cropped ground to rotationally grazed pastures for his cow-calf herd. His land drains into Lynch Creek, a trout stream that flows near the town of Chatfield in the southeastern part of Olmsted County.

"The reason I'm doing all this is because the land is highly erodible," says Clark, adding that the previous owners of his farm had row cropped continuously for several years, leaving the soil in poor shape. "They'd been running it no-till before this, but I don't think it should have been in row crops, regardless."

Clark, who is a graduate of LSP's Farm Beginnings course (*see page 27*) and who teaches high school fulltime, admits he's a "newbie" when it comes to government programs. He enrolled in EQIP to help set up a rotational grazing system, and in 2023 signed up for the Olmsted County nitrate reduction initiative to help cover some of the expense of turning cropland into pasture. However, getting the seeding in late during an unusually dry growing season, coupled with the fact that he grazed the new pasture when it was under stress and he used rye in the mix, which crowded out the grasses, resulted in a poor stand of perennial pasture.

"Lots of hindsight right now," says the farmer. But Clark is still committed to pushing forward with his perennialization plan, and he's learned a few lessons. During such a dry year, he says he would have been better off enrolling some land planted to sorghum-sudangrass. Regardless, the SWCD

Give it a Listen

LSP's *Ear to the Ground* podcast episode 326 features Shona Langseth talking about how the Olmsted County Groundwater Protection and Soil Health Program could serve as a holistic model for supporting practices that are good for the farmer, the land, and water quality: landstewardshipproject.org/podcast/ear-to-the-ground-326-rooting-out-nitrates.

In episode 320, farmer Alan Bedtka discusses his use of the program: landstewardshipproject.org/podcast/ear-to-the-ground-320-season-stretcher.

program payment helped take some of the economic sting out of experimenting.

"I put \$6,500 total expenses into seeding — the program paid back \$3,500," says the farmer. "So I'd at least be \$3,500 more in the hole if I didn't have the program."

A few miles from Clark's operation, Mark Stokes is another farmer whose land abuts a trout stream — Trout Run Creek, in this case. The fact that it helps "keep the dirt out of there" is one reason he's been no-tilling for 26 years, says Stokes. But around five years ago, he noticed that even on his no-till acres he was seeing some erosion, so he started growing cover crops utilizing traditional cost-share programs. He isn't afraid to experiment even within the cover cropping system itself — he's grazed his beef cow herd on a nine-way mix of cover crops he seeded after oats, and a few years ago, after seeing it being done on YouTube, mounted a seeder box on his combine, making it possible to plant cover crops while he's harvesting corn.

Stokes enrolled in the Olmsted SWCD program in 2023 to help cover the risk of yet another practice he uses: planting green. He's glad he had the payment to fall back on. Through the contract, he agreed to plant his corn and soybeans into cereal rye green, and terminate the cover when it was at least 12 inches tall. But the droughty conditions made it a bad year to let a cover crop grow that tall. And then the nitrogen Stokes applied later was soaked up by the rye, setting back his crop further. On the other hand, the food grade oats he raised in 2023 thrived.

"Oats will probably pencil out better than the corn, considering how expensive fertilizer was this last year," says Stokes, who belongs to an oat marketing cooperative Larsen and other farmers formed recently.

So, says the farmer, when he signed up for the Olmsted program for 2024, he took advantage of the program's flexibility. "I signed up for more oats, so we don't have to worry about the cereal rye so much and if we have to, we can terminate it sooner."

EPA to State: SE MN Nitrates Need Addressed

In April 2023, the Land Stewardship Project joined 10 other groups in filing a petition calling on the Environmental Protection Agency to use its emergency authority under the Safe Drinking Water Act to address the fact that nitrate contamination is causing "an imminent and substantial endangerment to public health" in the karst region of southeastern Minnesota — Dodge, Fillmore, Goodhue, Houston, Mower, Olmsted, Wabasha, and Winona counties. In response, in early November the EPA requested that the Minnesota Department of Agriculture, the Minnesota Pollution Control Agency, and the Minnesota Department of Health develop a plan for dealing with the nitrate pollution issue and provide safe drinking water to residents with wells above the maximum contaminant level.

To read the petition and the EPA's letter, see <https://bit.ly/LSPnitrate>. Check out LSP's blog on this issue at landstewardshipproject.org.

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Truckloads of Disruption

The Olmsted County program was launched as a pilot in 2022, and it soon became clear there was a pent-up demand for such an initiative. For the 2023 growing season, 52 farmers signed up for the cover crop option — more than double what was expected. During the first sign-up, over 5,300 acres of cover cropped land was certified as being allowed to grow to the 12-inch height; 2,700 acres of land was certified at 24 inches. As of early fall 2023, over 70 farmers had signed up to raise cover crops under the program for the 2024 growing season, representing almost 13,000 acres. Farmers signed up to raise over 600 acres of alternative crops such as oats, rye, and sorghum-sudangrass in 2024. Over 200 acres of row cropped fields will be converted to hay ground and pastureland under the program as a result of the most recent sign-up. To be clear, there's over 240,000 acres of cropland in Olmsted County, so the vast majority of the area's farmers aren't participating in this program.

But the water quality benefits of building soil health are not exclusive to acres enrolled in the initiative. Farmers are also implementing practices like cover cropping and rotational grazing on acres that aren't officially signed up under the program, according to SWCD conservation technicians. The agency has estimated that based on how much land was enrolled in the initiative as of fall 2023, roughly 310,000 pounds of nitrogen is being kept out of the region's drinking water. When the SWCD includes its estimates of unenrolled acres farmed using soil building practices, that figure goes up to 560,000 pounds. That's equivalent to 23 semi-truckloads of urea fertilizer.

At the Olmsted County SWCD office in Rochester, Meyer, the water resources coordinator, flashes a color-coded map onto a wall-mounted screen. It shows spots around the county where farmers have signed-up for the program so far: blue for cover crops, green for alternative crops, and orange for haying and grazing. Blue is by far the most prominent color, and with the exception of a few blank spots, cover crops are present in

most areas of the county.

"If we could get 30% in our subwatersheds put into cover crops, we'd be making real progress, at least moving the dial on nitrogen," she says. Between the number of acres signed up through the program and the anecdotal evidence of other, non-program fields being managed using soil-friendly practices, one estimate is that some watersheds are approaching the 20% mark of being consistently planted to cover crops. That's a good start, Meyer says.

Larsen then displays a chart showing what kind of acreage changes could occur if the program lives up to its potential: 9% less corn, 13% less soybeans, 417% more cover cropped corn, 95% more oats, 5% more pasture. In short, the corn-soybean system will have been disrupted.

"With those changes in acreage amounts, it could lower the nitrates across all of the county, and not just on ag acres," he says.



"We're allowing this to happen, but what can we do to prevent this in the first place?" is a key question that is asked about nitrate contamination in Olmsted County, says Caitlin Meyer, shown here (left to right) with fellow SWCD staffers Angela White, Martin Larsen, and Shona Langseth. (LSP Photo)

The program also requires that participants take part in at least one soil health educational program — workshop, field day, etc. — during the life of the contract. That's important — a literature review conducted by the University of Minnesota Water Resources Center found that participation in farmer networks increased the likelihood of adoption of soil-friendly practices.

Larry Cowing raises crops using no-till and cover cropping in southwestern Minnesota's Martin County. He also serves on the local SWCD board, which administers cover crop cost-share funds to farmers. He's heard about the Olmsted program, and likes that it takes a holistic, systems-based approach to promoting soil health while requiring participants to take part in farmer-to-farmer educational events.

"When you go with cover crops there's going to be a little more mental management

you have to deal with," he says. "It's kind of a long-term management thing."

Downstream Thinking

Ironically, the Olmsted County Groundwater Protection and Soil Health Program would not exist in its current form if it wasn't for COVID-19. As a result of the pandemic, money was made available to communities throughout the country via the American Rescue Plan Act (ARPA). The Olmsted County Commissioners agreed to set aside \$5 million in ARPA funds for the nitrate reduction program. Mark Thein, the commissioner and well driller, realizes that without the ARPA funding, it would have been an extremely tough pitch to his colleagues on the county board when they were asked to vote on budgeting for this program. SWCD staffers estimate that if they spend roughly \$1 million a year on the initiative, it will have a five-year lifespan.

"This \$5 million is eventually going to be gone," says Thein. "What are we going to do then?"

He hopes a cost-benefit analysis can show that such a proactive program saves the taxpayer money in the end by reducing the need for new drinking water infrastructure to deal with pollutants. It would be ideal, he adds, if the program was successful enough that it prompted the state of Minnesota to create a large-scale version, taking pressure off local governments to fund something like this.

Perhaps the most powerful legacy a program like this can leave is that it creates an atmosphere of success associated with building soil health. Such a positive image can inspire the farming community at large to adopt regenerative practices, whether government payments are available or not. There also needs to be an acknowledgement that pollution does not respect property boundaries, and that change must occur on a landscape-wide level. After all, despite the steps that Alan Bedtka has taken to reduce runoff, a nitrate sample taken from his well recently clocked in at 12 parts per million.

"I don't know if water quality is going to change much just from my management, when you consider all the farmland that feeds into this creek," he says while walking near a small, winding stream that cuts through one of his pastures. At one point, he passes an exposed face of limestone, a reminder of the vulnerable karst geology in the area. "Would all the neighbors upstream have to start doing cover crops and stuff like that to get my well a little better too?" □