

Ohio's Professional Soil Scientists

2023 Spring-Summer Newsletter Volume 50, Issues 2-3 Part 2

Much to share in this educational edition. Grab a cup of coffee or tea, sit back and enjoy.

Matt Sullivan starts us off with this great picture from down memory lane. They are once again updating the Gwynn Nature Center at Farm Science Review. This photo shows Frank Gibbs (left) and Rick Griffin (right) explaining about soils to students. Matt thinks the photo is from about 2011.



Maumee River TMDL Comments

I am pleased to report that Bennett & Williams got our technical comments on the Maumee River TMDL report in to Ohio EPA by the deadline. Kerry Hughes Zwierschke and I collected all the relevant information compiled by Ohio soil scientists over the last three generations, pulled out all the important parts about secondary permeability, searched the internet for relevant USGS and state Cooperative Extension bulletins and added the information on composting that we heard at the Winter meeting. Special thanks goes to Frank Gibbs who reached out to Martin Shipatilo, now retired and back in Ohio. Martin searched through his publications, presentations and posters and found two more papers that

ASSOCIATION OF OHIO PEDOLOGISTS NEWSLETTER VOLUME 49 ISSUES 2-3
Part 2

we had not found. Our submission was 71 pages long so I'm not going to post it here. If anyone wants to read it, let me know and I'll send it to you. In all probably, the decisions made by Ohio will not count because the Maumee River Watershed is in three states so any decision will end up in the Federal Court System and with US EPA. Still, it is a start.

Because it became so clear that Ohio Dept. of Ag. was determining loading rates by primary porosity only, I then followed up with a letter to the department explaining that their OAC requirements were terribly out of date and needed to be recalibrated to take in the process of secondary permeability. My letter to Director Baldrige is below:

Julie Weatherington-Rice, PhD, CPG, CPSS
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Worthington, Ohio 43085
614-436-5248
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March 24, 2023

Director Brian Baldrige
Ohio Dept. of Agriculture
Via e-mail

RE: The OAC for Manure application rates

Dear Director Baldrige,

In preparing technical comments regarding Ohio EPA's draft TMDLs for the Maumee River Basin, I had the opportunity to review the section of the OAC that directly addresses the loading rates of how liquid manures should be legally applied to agricultural fields in Ohio. I was particularly taken with the assigned loading rates per acre listed on Appendix B. Where did these loading rates come from? They are clearly 25-50 years out of date and rely only on primary porosity for the infiltration and up take of these (mostly water) liquid wastes. If farmers are to follow this set of regulations, they most certainly will find the liquid manures short circuiting the system and coming out of agricultural tile drains, as base flow to streams and/or moving down into the groundwater aquifers under the fields.

There is no recognition of secondary porosity macropore flows down through fractures and biopores. Yet Ohio's soil scientists, geologists and agricultural engineers have spent the last 50+ years studying this critically important recharging system of water and contaminants that move with water from the surface of the earth to underlying aquifers. Ohio may very well lead the world in this research. We have discovered that their formation and dominance of transport is a function of soil grain size and clay mineralogy. We literally can go into the field, pick up a handful of soil, determine its texture and predict if secondary porosity will dominate the movement of water and liquids like liquid manure. These decades of research have been summarized in Kim, 2007, our Figure 5 in our technical report. In this

USDA textural triangle, she captures all the found soil textures where fractures have dominated here in Ohio, western Michigan, Wisconsin and eastern Iowa. She has also run laboratory experiments to determine just how much sand can be added to the found fractured soils before they no longer crack and primary porosity dominates.

In fact, the finer grained the soils are, the less important the matrix flow becomes. Our “impermeable blue clays” of northwest Ohio actually are impermeable. Matrix water has been age dated and has been found to be almost 14,000 years old, left over from when those clays were first deposited. Every year, the entire surface to ground water recharge is traveling right past those matrix materials, following the biopores and fractures that have formed and persist. So if you are basing loading rates in those soils based on primary porosity, the primary porosity doesn’t even factor into the transport system. The story becomes even older. Jerry Bigham and I published a paper in 2006 discussing deeply buried pre-Illinoian lake clays that we found in Clermont County that had not had water moving through its matrix in more than 700,000 years. All the annual recharge was passing by the matrix along fractures.

We have searched all over Ohio and we cannot find a tile drain that does not smoke through its secondary porosity, no matter what form of tillage practices have been used. Soils leak and liquid manure leaks. That’s the nature of the materials and no amount of wishful thinking or carefully constructed laws and codes can change that situation. The only reasonable solution is to change how we handle all that liquid manure. We can put the animals out on pasture like they do in Canada. A 640 acre farm should be able to pasture about 500 cows. Or we can treat the manure through a packaged wastewater treatment plant, converting the phosphorus into a much less soluble form or we can construct large composting operations. That’s what the City of Columbus does with the bioslids from the Jackson Pike and Southerly waste water treatment plants. That material is sold as Com-Till for landscaping, the heavy metal content making it undesirable for growing foods. Composting of animal manures is well recognized. There is extensive research on the topic being conducted at the Ohio Agricultural Research and Development Center at Wooster. Approximately 9% of Ohio’s dairies are composting their wastes.

The bottom line is that your OAC requirements do not work and they cannot work because you are asking natural materials to behave in ways they cannot. Since it is clear that the persons working in your department who are responsible for these policies and rules are unfamiliar with current research, I would be pleased to work with them to educate them in the fields that they do not understand so the department can develop rules for liquid manure management that would actually work. I am attaching a copy of our technical comments as a place to start.

Why am I writing you? Because I have an ethical and legal responsibility to bring this matter to your attention. As a Certified Professional Soil Scientist, certified by the Soil Science Society of America, I have an ethical requirement to let you know that your system is not working and cannot work. I am also certified under OSHA and that carried a legal requirement to notify. If I see something that will cause contamination and harm, which I did when I read your OAC on manure management and I do not bring it to your attention, then I am also legally responsible for any damages that occur. I simply am not going

ASSOCIATION OF OHIO PEDOLOGISTS NEWSLETTER VOLUME 49 ISSUES 2-3
Part 2

to be responsible for the contamination of Ohio's waters, both surface and ground, from contaminants carried by liquid manures.

I hope this opens up a useful dialogue between ODA and the soil scientist and geologists in Ohio who work with water. Please feel free to contact me to open this dialogue.

Respectfully submitted,



Julie Weatherington-Rice, PhD, CPG, CPSS
(for identification purposes only)
Sr. Scientist, Bennett & Williams Environmental Cons. Inc.
Former Adjunct Professor, Dept. of Food, Ag. And Bio Engineering
The Ohio State University
Associate Supervisor,
Franklin Soil & Water Conservation District
Education Committee
Association of Ohio Pedologists

JWR/jr
Enclosure
Copies to team members
file

Director Baldrige's response:

From: Brian.Baldrige@agri.ohio.gov
Date: March 30, 2023 at 8:40:33 AM EDT
To: Julie Weatherington-Rice <jweatherington.rice@gmail.com>
Subject: RE: please pass on this letter and report to Director Baldrige

March 30, 2023
Julie Weatherington-Rice
298 W. New England Ave.
Worthington, Ohio 43085

Re: The OAC for Manure application rates

Dear Ms. Weatherington-Rice:

I am in receipt of your letter dated March 24, 2023, regarding Ohio EPA's draft TMDLs for the Maumee River Basin. I appreciate hearing from you on this matter and have shared your letter with our Soil and Water and Division of Livestock Environmental Permitting staff.

Sincerely,

Brian Baldrige, Director

Ohio Department of Agriculture

There has been no further communications to date. Please also note that my Dr. became a Ms. in his reply. I am not certain if that was an oversight or if it was a deliberating discretization of our credentials.

Kathy sends along this news item



Enriching Soil, Enhancing Life

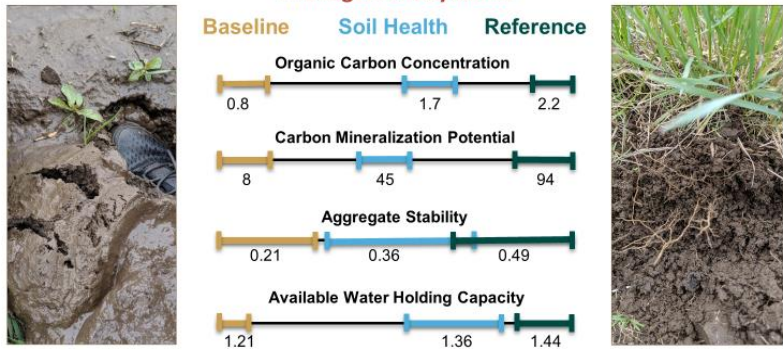
FOR IMMEDIATE RELEASE

Soil Health Institute Receives Grant From Wells Fargo To Establish Soil Health Targets in Iowa

MORRISVILLE, N.C., Feb. 9, 2023 /PRNewswire/ -- The Soil Health Institute (SHI), a global non-profit with a mission to safeguard and enhance the vitality and productivity of soils, announced a \$300,000 grant today from Wells Fargo to establish achievable levels of soil health and soil carbon ("Soil Health Targets") for the Des Moines Lobe Region in Iowa. The agriculturally important region spans 7.75 million acres, including approximately 3.4 million acres in corn and 2.6 million acres in soybean production.

"Supporting soil health is critically important for our customers and communities as we continue to work toward a resilient, equitable, and sustainable future," said Robyn Luhnig, Chief Sustainability Officer at Wells Fargo. "Wells Fargo is pleased to support the Soil Health Institute's work to deliver locally-relevant, actionable, and practical soil health information for growers and landowners in Iowa."

"Soil health benefits growers, the environment, and society in many ways," said Dr. Minerva Dorantes, Project Soil Scientist at SHI. "These include improved nutrient use efficiency, drought resilience, downstream water quality, greenhouse gas mitigation, carbon sequestration, and ultimately, profitability. At SHI, we are advancing the science and application of soil health. Determining achievable levels of soil organic carbon concentration, carbon mineralization potential, aggregate stability, and available water holding capacity for different soil types is foundational to our efforts and those of growers and landowners who manage this precious resource."



Example application of Soil Health Targets by the Soil Health Institute. Pictures are of the same soil on the same day but under different management systems separated by a fence.

"Because soils vary across a landscape in terms of their functional capacity to cycle water, nutrients, and carbon, SHI is grouping soils across the United States based on their inherent soil properties. Then, within those groups, SHI is sampling baseline production systems, soil health systems, and perennial reference systems to determine the effect of management on soil health status. By comparing their current soil health status to reference values, growers and their advisors can set achievable Soil Health Targets," said Dr. Dorantes. "Our goal is to provide a standardized, science-based framework to measure and monitor soil health: the foundation of regenerative agriculture."

About the Soil Health Institute

About the Soil Health Institute

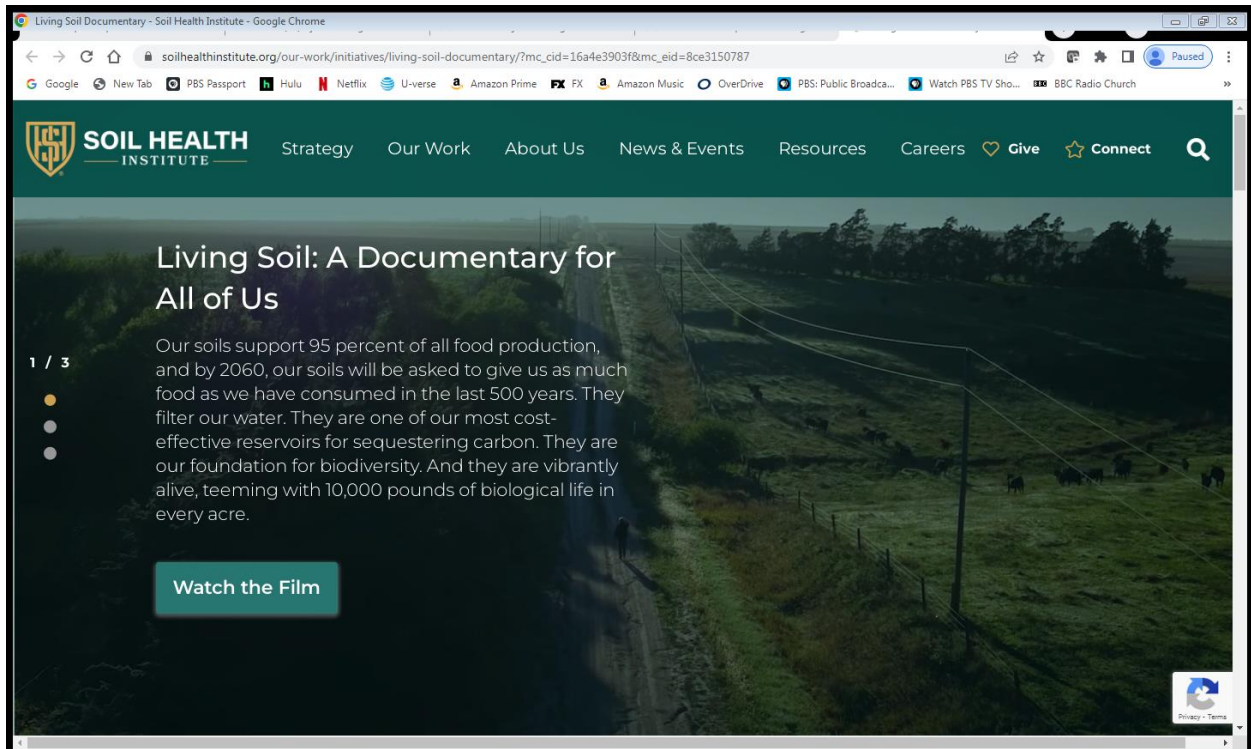
The Soil Health Institute is a global 501(c)(3) non-profit with a mission to safeguard and enhance the vitality and productivity of soil through scientific research and advancement. We bring together leaders in soil health science and the industry to help farmers, ranchers, and landowners adopt soil health systems that build drought resilience, stabilize yield, and benefit their bottom line. The Institute's team of scientists, holding doctorates in various soil science and related disciplines, has developed highly effective soil health targets and standardized measurements to quantify progress at achieving regenerative and sustainable agricultural systems, and leads the cutting-edge fields of carbon sequestration and decoding the soil microbiome. Healthy soils are the foundation for rejuvenating our land. Together, we can create a secure future for all, mitigate the effects of climate change, and help agriculture and organizations meet production and environmental goals at scale.

Visit www.soilhealthinstitute.org to learn more and follow us on [LinkedIn](#), [YouTube](#), and [Facebook](#).

PLEASE SHARE WITH YOUR NETWORKS



Another learning experience from Kathy



Vinayak Shedekar's DrainMod for Septic Systems Working Group has been meeting

Both Dan Michael and I are attending, we will update as we learn more.

Book Review from Tim Gerber

A brief, informal review of *Soil Science Americana: Chronicles and Progressions 1860-1960*, by Alfred E. Hartemink.

I really enjoyed reading this book, partly because it gave me a much better appreciation for the state of the discipline when members of the generation ahead of me began their careers. Hartemink has drawn from many of the sources cited in *Profiles in the History of the U.S. Soil Survey* (2002), but this book offers a better presentation of pedology's history in both its international and soil science contexts. As a faculty member at the U. of Wisconsin, the author benefitted from access to records tracing Emil Truog's connections with soil survey leaders, particularly Charles Kellogg, during his 42 years in the Dept. of Soils there (1912-1954).

Kellogg is the central figure in the book, based on his tenure as head of USDA's soil survey (1935-1971), but the career of AOP honorary member Roy Simonson, a post-career resident of Oberlin, is also prominent. Others with Ohio or OSU connections frequently mentioned in the book include Firman Bear, Richard Bradfield, George Coffey, Arthur McCall, Merritt Miller and Robert Salter.

The last half of the book covers, in detail, two International Congresses of Soil Science hosted by the U.S., the 1st in 1927 and the 7th in 1960, at Madison, WI with Truog as the finance chair and congress manager. And, it follows an iterative process, begun in 1950, to develop a new classification system before it was presented at the 7th Congress as the *Seventh Approximation*. The last two chapters of the book offer fewer details and more really interesting observations about the evolution of pedology in the U.S.

Tim Gerber

Joh Gerken is honored (submitted by Tim Gerber)

AOP member Jon Gerken was recognized in June by OSU's School of Environment and Natural Resources (SENR) and the Environment and Natural Resources Alumni Society (ENRAS) by being inducted into the Environment and Natural Resources Honorary 100. The Honorary 100 was initiated by the first School's first Director, Dr. Robert Teater, in 1969. The list now includes 134 members, including AOP member Dr. Jerry Bigham.

Jon was elected in 1975 as Secretary of the steering committee charged with creating the Constitution and By-Laws for what became AOP and has been a member since AOP's inception in 1976. He led NRCS' soil survey program in Ohio from 1995 to 2007 and served in NRCS' National Headquarters as the Assistant Soil Survey Manager from 2007 until his retirement in 2012. He received the Distinguished Alumni Award from OSU's College of Food, Agriculture and Environmental Sciences in 2013 and has served as a member of ENRAS' Executive Council.

Congratulations, Jon!

Jerry Bigham sent the link to the web page that discusses the program and highlights the accomplishments of everyone honored that day. The list includes Dorothy Teater who is known and loved by many of us. Here is the web link: <https://epn.osu.edu/events/honoring-ohios-environment-and-celebrating-its-champions>

Duane Wood sends this story out of the Ohio's Country Journal (Mid May 2023)

Ohio No-Till News

Randall Reeder, OSU Extension Agricultural Engineer (retired), writes this page, with input from the Ohio No-till Council members.



Soil Erosion Costs Money (for Farmers and Society)

It's estimated that soil erosion costs the United States around \$44 billion each year in lost agricultural land.

Clay Pope of Oklahoma wrote this recently in an article published online in "Southern Plains Perspective."

As Clay stated, poor management can negatively affect a farmer's profit margin while also impacting the rest of society (sediment and nutrients in rivers and lakes). According to a report from North Dakota State University, agriculture producers lose nearly \$700 worth of nutrients per acre when they lose one inch of topsoil. University of Colorado researchers say unhealthy soil costs

producers as much as \$500,000,000 each year. One-third of the fertilizer applied to grow corn in the U.S. each year is simply compensating for the loss of soil fertility. Rick Cruse, Iowa State University agronomy professor, points out that farmers can lose between 50% and 70% of their yield potential because of the loss of topsoil. These drastic yield losses occur in dry years.

Tom Kaspar, USDA-ARS, measured corn yields for several years on fields in West Central Iowa with different depths of topsoil ranging from 3 inches to 50 inches. In dry years, corn yields with about 6 inches of topsoil (A Horizon) ranged from

110 to 150 bu/ac while fields with 24 inches yielded 140 to 175 bu/ac. Healthy topsoil stores moisture to maintain a crop through weeks without rain.

In Ohio, 40 years of USDA-ARS research at Coshocton proved that soil erosion can be reduced to near zero. On a steep slope, continuous corn, no-tilled, had erosion of a few pounds per acre, not tons. So why do we accept 5 tons/acre loss per year as "normal?"

Continuous no-till, especially with cover crops, reduces input costs like fuel and fertilizer while maintaining or increasing yields. And increases wealth.

Upcoming No-Till events

Aug. 17: Ohio No-Till (Summer) Field Day, Jeff Duling Farm, Putnam Co.

Aug. 22: Ohio No-Till (Afternoon) Field Day, VanTilburg Farm, Mercer Co.

Aug. 31: Ohio No-Till (Morning) Field Day, Seneca Co.

Aug. 31: Ohio No-Till Evening Special, OSU South Centers, Piketon

Dec. 6: Ohio No-Till Conference, Plain City

Frank Gibbs offers this download from Apple News (Inside Climate News)

<https://insideclimatenews.org/news/14052023/ohio-pennsylvania-fracking-wastewater/>

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Fossil Fuels

Ohio Environmentalists, Oil Companies Battle State Over Dumping of Fracking Wastewater

Advocates for both sides say public drinking water may be tainted by underground leaks of "produced water."

By Jon Hurdle
May 14, 2023



Two 18-wheel tractor trailers carry fresh water to natural gas wells being drilled by hydrofracking in the Marcellus Shale Sept. 10, 2012 in Williamsport, Pennsylvania. Credit: Robert Nickelsberg/Getty Images
Related

- **Shell Sued Over Air Emissions at Pennsylvania's New Petrochemical Plant**



- **Awash in Toxic Wastewater From Fracking for Natural Gas, Pennsylvania Faces a Disposal Reckoning**



• In Pennsylvania, Home to the Nation's First Oil Well, Environmental Activists Stage a 'People's Filibuster' at the Bustling State Capitol



Share this article

Ten years ago, Tim Kettler asked local officials to stop spreading liquid waste from fracking on the road near his home in Warsaw, Ohio, because he was worried that the fluid would contaminate a pond where he gets his drinking water.

They complied with his request, but the practice continues in many other places across the state, and threatens to taint its groundwater with radioactivity and a cocktail of other contaminants in the residue from natural gas drilling.

Water from the pond, downhill from the road where the salty waste was once spread, remains clean and drinkable, but that hasn't stopped Kettler and other activists in Ohio from campaigning against a practice that has been used for years to de-ice roads in the winter and keep dust down in the summer.

They say that high levels of two kinds of radium in the waste, known as produced water, as well as its extreme salinity, is already damaging the environment where the brine is spread and will eventually find its way into underground sources where people get their drinking water.

In a related development, lawyers for two Ohio oil and gas companies filed suit in the spring of 2022 against the owners of wells where produced water from Ohio, Pennsylvania and West Virginia is being injected for long-term disposal claiming their business is being hurt by the leakage of waste into production wells. The suits were dismissed but are being appealed, adding to pressure on the fracking industry, and the State of Ohio, from an unlikely pairing of interest groups.

Millions of gallons of produced water from fracking in the region have been pumped into more than 200 underground injection wells—either purpose-built or reused oil and gas wells—as oil and gas production has surged in the Appalachian states, raising fears that the natural environment is being contaminated, and that public water sources are being poisoned.

“Putting our water at risk, especially in the area where there are known earthquake faults, just seems pretty wrong-headed,” said Kettler, who owns a wastewater business, and is a member of the Ohio Brine Task Force, an advocacy group that works to stop produced water from fracking from being spread on roads.

“The constituents of this wastewater are known to be toxic and radioactive. Putting that on the ground, especially where people use surface water for their domestic water supply, as I do—where runoff is inevitable—is a problem.”

Ohio’s Department of Natural Resources says about 22 million barrels of produced water from Ohio sources—924 million gallons—were pumped into injection wells in 2022, and another 12 million barrels—504 million gallons—came from out-of-state sources, including Pennsylvania.

Pennsylvania recycled or reused about 93 percent of produced water from fracking in 2021, when it produced a record-high 7.6 trillion cubic feet of natural gas, underlining its position as the second-biggest U.S. producer of natural gas after Texas, according to its Department of Environmental Protection.

Produced water contains dozens of highly toxic chemicals along with naturally occurring poisons like arsenic and radioactive material like radium 226 and 228. It is far saltier than ocean water, which makes it deadly to most plants and freshwater life.

The Marcellus Shale Coalition, a trade group representing the Pennsylvania natural gas industry, said its wastewater policy protects water sources.

“Our members are minimizing the need for freshwater withdrawals while reducing truck traffic for disposal,” said the coalition’s president, David Callahan, in a statement. “Managing water and waste are key parts of developing natural gas responsibly.”

Pennsylvania has only 12 active injection wells for fracking waste because it does not have “primacy” over the wells, and so must obtain approval from the U.S. Environmental Protection Agency before issuing permits. By contrast, Ohio has primacy, and so has permitted many more injection wells. There are 234 now operating in Ohio plus “a few” applications pending, the Department of Natural Resources said.

Andy Chow, a spokesman for the department, said the state legislature is prevented by the U.S. Constitution from blocking interstate commerce, and therefore cannot restrict brine entering from other states. He said that since the start of the current program to allow produced water to be pumped into injection wells, “no water supplies have been impacted.”

This is not actually true; the Village of Barnesville lost Reservoir No. 1 in March 2016 when a tanker truck hauling brine to an injection well overturned and spilled its load into the reservoir, effectively shutting it down for three months until the reservoir could be flushed. In the early 1980’s the ParkOil injection well in Ashtabula County suffered an injection well pipeline rupture, emptying their holding tank all over their property with production fluids and they flowed under the road and flooded Curtis Hill’s sheep pasture as well. Although the site was quickly cleaned up, Mr. Hill’s water well was contaminated, one of the earliest indications of secondary fracture flow that we recognized in Ohio. Mr. Hill sued ParkOil for damages in Ashtabula County Court of Common Pleas and won. The injection well has changed

hands. It is now out of commission and under orders to be closed but it currently sits abandoned. Mr. Chow is a new hire at ODNR and so would not be familiar with these historic incidents.

But he said the state may investigate claims of water contamination from the oil and gas industry. "If any person believes their water well has been impacted by oil and gas activity, the [Division of Oil and Gas Resources'] environmental assessment team will conduct an investigation, which may include water well sampling," he said.

Permits are required to drill a well for production or disposal, and the department has denied some applications, Chow said.

As a result of the availability of disposal wells in Ohio, trucks carrying fracking waste from Pennsylvania and West Virginia are arriving in Ohio "24 hours a day, seven days a week," said Bob Lane, an oil and gas operator who in May 2022 sued the owners of 11 injection wells near his production sites in two Ohio counties. He claimed the fluid pumped into injection wells has leaked into some of his wells and damaged his production.

Lane, president of Bethel Oil & Gas Co., based in Marietta, Ohio, said four of his 65 wells have been shut down by injection-well leakage while production has "significantly" declined in eight to 10 more.

"The more water they pump into the ground, the more they drive the natural resources under the ground away from our leases," he said. "Even in some of my better wells, the production has gone bad because more and more of the formations down there are getting flooded. We have a smaller area to draw oil and gas from so your production starts tailing off."

Despite the alleged damage to his business, Lane said the real worry is whether contaminated water in the injection wells will get into aquifers supplying drinking water to the public. That might happen, he said, via some disused oil and gas wells, where the produced water is now coming to the surface, or through a fault along the Ohio River Valley, where some injection wells operate.

"If it can get to the surface, there's a lot of old wells drilled around here, and if it gets in the old wells, it is going to get out into the water," he said.

He predicted that produced water will eventually contaminate aquifers with high levels of radioactivity and other fracking constituents, at which point those sources would be permanently lost for drinking water. "We haven't had any subsurface water contaminated yet but it's going to be," he said.

Lane's suit was dismissed by a judge last year on the grounds that he had not done enough to show that his wells had been damaged by the injection wells, said Zachary Zatezalo, his lawyer. But Lane appealed the dismissal, and the case is now due to be reheard by a three-judge panel.

Another Ohio oil and gas operator, Bob Wilson, sued injection well owners with the same complaint at the same time and that suit, too, was dismissed but is now being appealed, Zatezalo said.

In January this year, the impact of injection wells on nearby oil and gas operations was highlighted by an order from the Ohio Department of Natural Resources suspending operations at two Noble County injection wells that leaked brine. Between 2010 and 2021, four oil and gas wells were impacted by brine coming to the surface, the order said. This year, brine was reported spraying from the production casing of another oil and gas well, according to the Jan. 9 order from Eric Vendel, chief of the department's Division of Oil and Gas Resources.

Vendel suspended operations by Deeprock Disposal Solutions of Marietta, Ohio, at its Warren Drilling and Travis injection wells, saying their continued operation "represents an imminent danger to the health and safety of the public, and is likely to result in immediate substantial damage to the natural resources of the state."

The Department has also recognized high levels of radioactivity in brine from oil and gas production wells around the state. In a 2018 report, the DNR found that combined radium 226 and 228 in brine from 107 samples in 10 geological formations all sharply exceeded the state health standard for those isotopes in drinking water. They included three samples in Ohio's part of the giant Marcellus formation, where the average radiological activity was 2,316 picocuries per liter, dramatically higher than the state and federal health limits of 5 picocuries per liter in drinking water. A picocurie is a commonly used measure of radiation in a liquid or gas. The EPA says the naturally occurring level of radium-266 in surface water is 0.1 to 0.5 picocuries per liter.

In October last year, the environmental law firm Earthjustice, representing local activist groups, asked the EPA to rule that Ohio's permitting program allowing the use of injection wells does not prevent the practice endangering public water supplies, and fails to comply with the federal Safe Drinking Water Act.

In Athens County, where both injection and production wells operate, local leaders passed a resolution that calls on the state to end the spreading of frack waste on roads but they remain powerless to stop it, said Lenny Eliason, a county commissioner.

"The issue we have is the permitting and the lack of local involvement in the decision," he said. "You can get a permit a lot faster in Ohio than you can in the states surrounding us, such as West Virginia and Pennsylvania. So we get a lot of out-of-state waste."

The DNR's findings on radiation levels and produced water leakage show the dedication of its staff but also the limitations of their power to curb the oil and gas industry, said Julie Weatherington-Rice, a geologist who volunteers for the nonprofit Ohio Brine Task Force.

"It doesn't mean their heart isn't in the right place; it just means they don't have any power," she said.

But she said the state is “insane” to allow highly radioactive fracking waste to be spread on roads and injected into the ground. “What idiot in their right mind would take something that hot and spread it around on the countryside?” she asked.

Chow of the DNR said in response that the department enforces laws passed by the state legislature. The Division of Oil and Gas Resources “continues to regulate Ohio’s oil and gas operations,” he said. “Through this regulation, the division works tirelessly to protect public health, safety, and the environment.”

While regulators have established the radioactivity of the produced water being dumped in the state, it is not yet clear what happens to the waste once it’s released underground or on public roads. The answer to that is being left up to citizen scientists like the Ohio Brine Task Force, and its affiliate, the Buckeye Environmental Network, said Weatherington-Rice, who works for an environmental consulting company and has a Ph.D. in soil science.

“We are very worried about the interconnection, subsurface especially, in areas where there are pathways nobody knows are down there,” she said. “It isn’t like it just goes down in a hole and disappears. It goes somewhere, and the ‘somewhere’ is the \$64,000 question.”

Volunteers like Weatherington-Rice are doing their own investigation into the contents and pathways of the fracking wastewater, in the absence of work that they say should have been done by state officials.

“We are clearly spreading things that are hotter than the federal and state law permits, so then the question is: how much dilution occurs when it is spread, and where does it go?” she said. “Does it go into surface water? Does it go into the dust, into the soil, into the groundwater? Tracking down where it goes is the next big study that people are looking at here. We know it’s there, we just have to find it.”

In the state legislature, a bill that would ban the spreading of frack waste on roads was introduced last year by state Rep. Mary Lightbody, a Democrat. The bill failed to get a vote before the end of the legislative session but is expected to be reintroduced in the current session, advocates said. Lightbody did not respond to a request for comment.

Asked whether a new bill would have any chance of becoming law, Weatherington-Rice said that the state is “owned by oil and gas” and that its chances will depend on whether citizen scientists can find a smoking gun. “If we can prove that this stuff is getting loose into the environment, maybe,” she said.

The difficulty of finding evidence of water contamination from frack waste is compounded by the expense of private water testing, deterring many people from hiring a testing company, said Roxanne Groff, a member of Athens County’s Future Network, a nonprofit that fights the negative effects of fracking.

“If somebody was told they needed to shell out \$1,500 to hire a private tester, they’re not going to do it,” she said. “They are going to carry water or buy a water buffalo. That’s just the way people are here. I

think the reason we are not hearing any peeps is that nobody can afford to go out and test their own stuff. We all know the harm is happening but without proper measuring there's no way to know the degree of harm."

And even if grassroots groups pooled their resources to pay for water testing to look for contamination from injection wells and road spreading, any such report is likely to be ignored by a legislature that traditionally accommodates the oil and gas industry, Groff said.

"It would call attention for a short period of time that there's a problem, but you still have to convince the lawmakers that laws are needed," she said. "You're not going to convince the right-wing Republican party to do that; it's just never, ever going to happen."

Grassroots groups are also faced with the oil and gas industry's exemptions from several federal statutes including the Safe Drinking Water Act, as a result of the so-called [Halliburton loophole](#), which means the EPA does not regulate the industry under those laws. The loophole is named after the oil and gas company that was headed by former U.S. Vice President Dick Cheney before he came to office.

Despite the long odds stacked against them, activists like Kettler say they will continue to seek evidence that fracking waste is contaminating public water and the environment.

"It's all self-taught citizen science," he said. "It's in the beginning stages because nobody has done this before, and we are having to teach it to ourselves. It's up to us to get the evidence about fracking waste."

I have been working with this citizens group for a number of years now. I have been calling for the end of oil and gas "brine" spreading on roads ever since I worked on Curtis Hill's case in the mid-1980s. I was part of the minority report for the Governor's Oil and Gas Regulatory Review Commission in 1986-87 that called for the ban. However, it wasn't until Mel Palmer, beloved friend of many of us, determined that the cancer he and his neighbor later died from came from the road dust laden with "brine" that they were exposed to when they mowed their yards. That research has focused my determination to do all that I could to prevent others from suffering the same fate.

This ends Part 2 of the Spring-Summer AOP Newsletter