Ohio's Professional Soil Scientists

2019 AUTUMN NEWSLETTER
VOLUME 46, ISSUE 3

On the Cover

Two soils with contrasting drainage: L - a well drained Miamian (fine, mixed, active, mesic Oxyaquic Hapludalfs) profile from Franklin Co., OH; R – a poorly drained Ragsdale (fine-silty, mixed, superactive, Typic Argiaquolls) profile from Clinton Co., OH. Photo credits J. Bigham

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Calendar of Events

- Onsite Wastewater Mega Conference - Oct. 14-16, Loveland, CO
- ASA, CSSA, SSSA Annual Meeting - Nov. 10-13, San Antonio, TX
- SSSA Fall Certification Exam - Nov. 15 - various locations

If you know of an upcoming local, regional, national or international event that might be of interest to our members, please submit the name, date, location, and any available link to our Editor.

President's Message

I hope you were able to attend the two day workshop this summer in southeastern Ohio. It was very interesting for me to view and learn about native and strip mine soils so different from the glaciated soils where I live. A great big THANK YOU! to Jeff Glanville and Rick Griffin for all their hard work and time invested to plan and deliver the workshop. Be sure to check out the workshop summary in the newsletter.

This year's local Wayne County land judging contest was blessed with great weather and a nice location north of the Wayne County airport. (Although the planes were a little distracting at times.) Kelly Riley, Education Specialist from the Wayne SWCD and I set up the pits and filled out score cards the day before, also with great weather. I had a captive audience at the practice pit prior to reviewing the results. I used that opportunity to talk about potential opportunities in soil science and briefly describe our organization.

I also had the opportunity to be the "soil guy" at one of two 5th grade farm tours in Holmes County sponsored by the Holmes SWCD. Approximately 160 students rotated through many natural resource and ag. related stations, including soil. At the soil station Michelle Wood, District Program Administrator, (she happens to be my wife) and I spoke about basic things such as texture, weathering, layers, soil organisms, parent material, glaciers, etc. Students also viewed soil horizons and colors from within the pit. Again, with a captive audience I was able to briefly talk about soil scientist jobs and describe the AOP. The student's favorite thing was augering holes. (I may have to look into legalities of hiring child labor, some of these kids could really dig!)

Soil, in my opinion, is underappreciated, and unless we are willing to step forward to show enthusiasm for soil and being soil scientists that will continue. If we are to attract young people to the field of soil science (and eventually AOP members) or to at least foster appreciation of soil, then I feel we all need to take an active role. I encourage you to help with events like the two mentioned above, donate a little time, and promote our science. Speaking of donating a little time, Jerry Bigham is seeking officer nominations for 2020. As past President, Jerry is tasked with finding a slate of candidates for our election held at the winter meeting. Many times, this job can be quite frustrating with repeated no's when people are asked to serve. Please consider saying yes when Jerry calls, or I know it's probably unimaginable, but you can also consider volunteering without being asked. If travel is the issue, fear not, all of our meetings but one have been through Zoom, a video link, thanks to Dr. Scott Demyan. We share documents by email. You can attend the meeting from the comfort of your own home. The down side is you have to provide your own coffee and donuts. Please consider serving AOP as an officer.

Thank you,

Duane

Summary of 2019 AOP Autumn Workshop

The AOP Autumn Workshop was held September 11 and 12, 2019, in Noble and Guernsey Counties. The workshop was organized by AOP President - elect, Jeff Glanville, and local Resource Soil Scientist, Rick Griffin, with a focus on soils of Region 12.

Registrants assembled on the morning of September 11 at the Ohio State University Extension Office in Caldwell, OH. There were 44 participants for the Day 1 program, which was dedicated to an overview of the genesis, properties, and mapping of soils in the region.

AOP President, Duane Wood, opened the meeting with a brief welcome and Jeff Glanville then summarized the workshop objectives. Andy Nash, Geologist with the ODNR Division of Geological Survey, began the technical program with an overview of OH geology that included an emphasis on Southeast Ohio (see photo below).

Tim Gerber, retired soil scientist with the former ODNR Div. of Soil and Water Conservation, then described the factors and processes that guided creation of the current Soil Regions Map of Ohio. He also shared a series of landscape photos from Region 12 that were taken while hiking the Buckeye Trail. Prior to his presentation, Tim received a plaque from AOP President, Duane Wood, commemorating his election as an Honorary Member of AOP at the previous winter meeting (see photo below).

Jeff Glanville, USDA-NRCS Soil Scientist, provided an overview of soil survey activities relevant to Soil Region 12 and noted some of the important historical documents that are available in the state office archives.

Jon Gerken, retired USDA-NRCS soil scientist, and Tim Gerber followed with their views on how the soil correlation process had evolved over time during the period of active soil inventory in Ohio and provided insights as to how that evolution had impacted soil series and mapping unit concepts in Region 12 and elsewhere.

Jerry Bigham, Ohio State University Professor Em., concluded the morning program with an overview of historical soil research projects that had been conducted in the region.

The morning session adjourned to a hearty meal and plenty of social interaction between the registrants. Following lunch, the group moved to nearby facilities of the OSU Eastern Ohio Agricultural Research Station (EARS) for examination of three soil pits dug by experiment station staff (see photo below). To facilitate discussion and participation, the

registrants were divided into three groups, and individuals familiar with local soils facilitated descriptions of the three pedons.

Andy Nash provides an overview of Ohio geology.

Honorary Member, Tim Gerber, receives a commemorative plaque from AOP President, Duane Wood.

One of the workshop soil pits on grounds of the EARS in Noble Co.

Day 2 of the workshop was focused on mine soils, land use activities in Region 12, and soil interpretations for sewage treatment and dispersal. A total of 47 registrants were initially treated to donuts and coffee in honor of a landmark birthday for co-organizer Rick Griffin. Social time was followed by a series of lectures in the excellent conference facility of Zane State College in Cambridge, OH.

Jeff Glanville kicked off the technical program with a review of Day 1 activities and an outline of plans for Day 2 of the workshop (see photo below). Jay McElroy, local District Conservationist for the USDA-NRCS, then provided an interesting overview of land use history, farming practices, and land resource concerns in Region 12.

Rick Griffin followed Jay's summary with a more detailed description of land use impacts on soils of the region, especially those related to mining. Dr. Scott Demyan, Asst. Prof. of Soil Science at Ohio State, then provided a summary of results from his M.S. thesis work at Ohio State, which involved a comparison of mine soil properties and classification in a small sub-watershed of Wills Creek immediately following reclamation and after 25 years of subsequent soil development (see photo below).

Following a short break, Joe Steiger, retired USDA-NRCS soil scientist, gave an overview of his experiences as a consulting soil scientist in the region. He emphasized the many opportunities available to persons that are well trained in soil morphology and classification but also noted some of the special challenges presented by individual property owners and developers with little or no knowledge of soil properties.

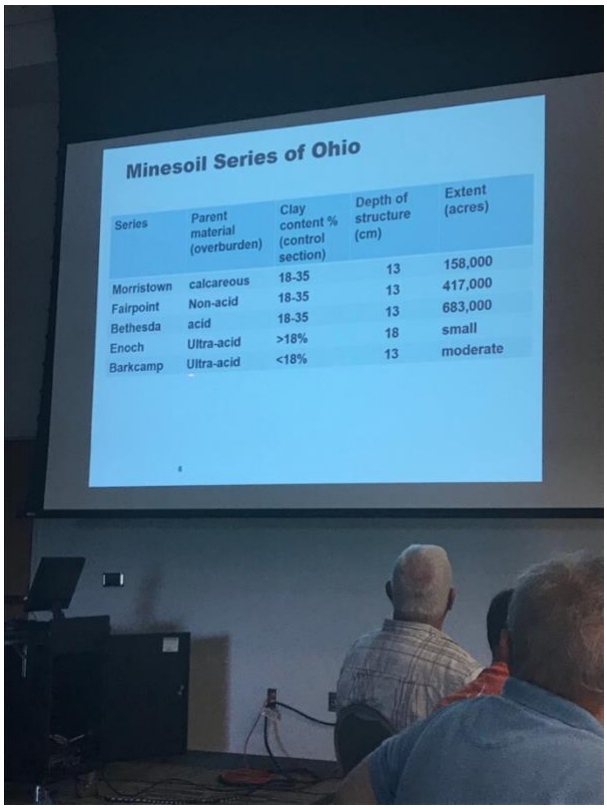
Following the lecture portion of the program, registrants returned by car to the EARS facility in Noble Co. and gathered in the headquarters meeting room where Larry Tornes, retired USDA-NRCS soil scientist, and Joe Steiger provided copies of the form *Site and Soil Evaluations for Sewage Treatment and Dispersal* and outlined their views on best practices in utilizing the form. In particular, they noted some of the major pitfalls and difficulties they had experienced in recognizing and interpreting redoximorphic features and limiting layers during soil and site evaluations. They also fielded questions and comments from the other registrants.

Following a box lunch in the EARS Arena, the group adjourned to the nearby pits examined and described on Day 1 of the workshop where Larry, Joe and others provided their views on how best to approach using the standard evaluation form for developing an acceptable soil and site evaluation for sewage treatment and dispersal (see photo below).

To conclude the workshop program, the group then caravanned to a local farm where part of the land had been surface mined in the 1960's for extraction of a shallow coal seam. The land owner, Mr. Jim Mizik, graciously dug pits to expose a mine soil representative of the Morristown series. Mr. Mizik also shared his knowledge of the site and local mining practices and fielded questions about his management of the Morristown soil for corn and forage production. Following an examination of the mine soil profiles (see photo below) and a period of general discussion, the workshop was concluded.

Both Jeff Glanville and Rick Griffin are to be congratulated on developing an interesting and diverse 2-day workshop. Special thanks also go to Mr. Wayne Shriver, manager of EARS, and Mr. Jim Mizik for their assistance with the field portion of the workshop.

Jeff Glanville providing an overview of Day 1 activities in the Zane State Conference Center.



Data on Ohio mine soils provided by Scott Demyan in his presentation.

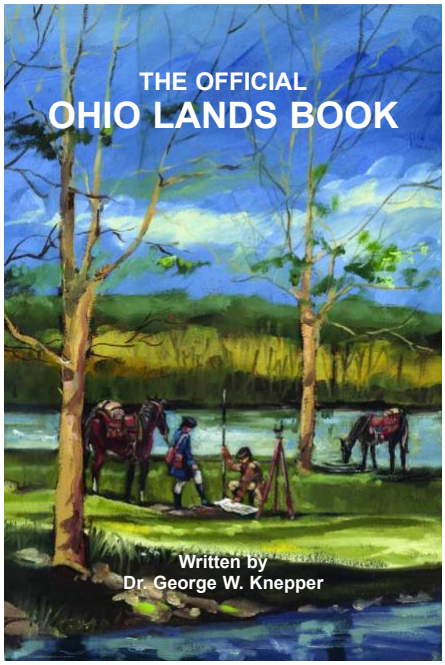
Joe Steiger giving his presentation on private consulting.

Larry Tornes and Joe Steiger leading discussion at one of the EARS soil pits.

Jim Mizik providing background information on mining and the agronomic productivity of the Morristown soil on his farm in Noble Co.

From the Library

THE OFFICIAL OHIO LANDS BOOK



Ohio occupies a unique place in the development of the public lands of the United States. No other state experienced so many different systems of original land survey. Names like the Seven Ranges, Northwest Ordinance, Virginia Military District, Connecticut Western Reserve, Ohio Company, and Symmes Purchase ring out from the pages of both Ohio and American history. This book provides a comprehensive description of both the public and private land surveys that shaped Ohio and offers explanations for many other land related topics. For example, it details why the Firelands were also called the Sufferers' Land. And it explains why the first fight between Ohio and "that state up north" almost involved a shooting war over the "Toledo Strip" - a conflict that wasn't fully resolved until 1973.

As the first state formed out of the public domain, Ohio was the social laboratory in which Congress worked out not only the basic federal rectangular survey system, but also first applied the process for moving a portion of the public domain from wilderness to statehood. The Ohio experience also set important precedents for federal land grants to the states for various purposes, including higher education.

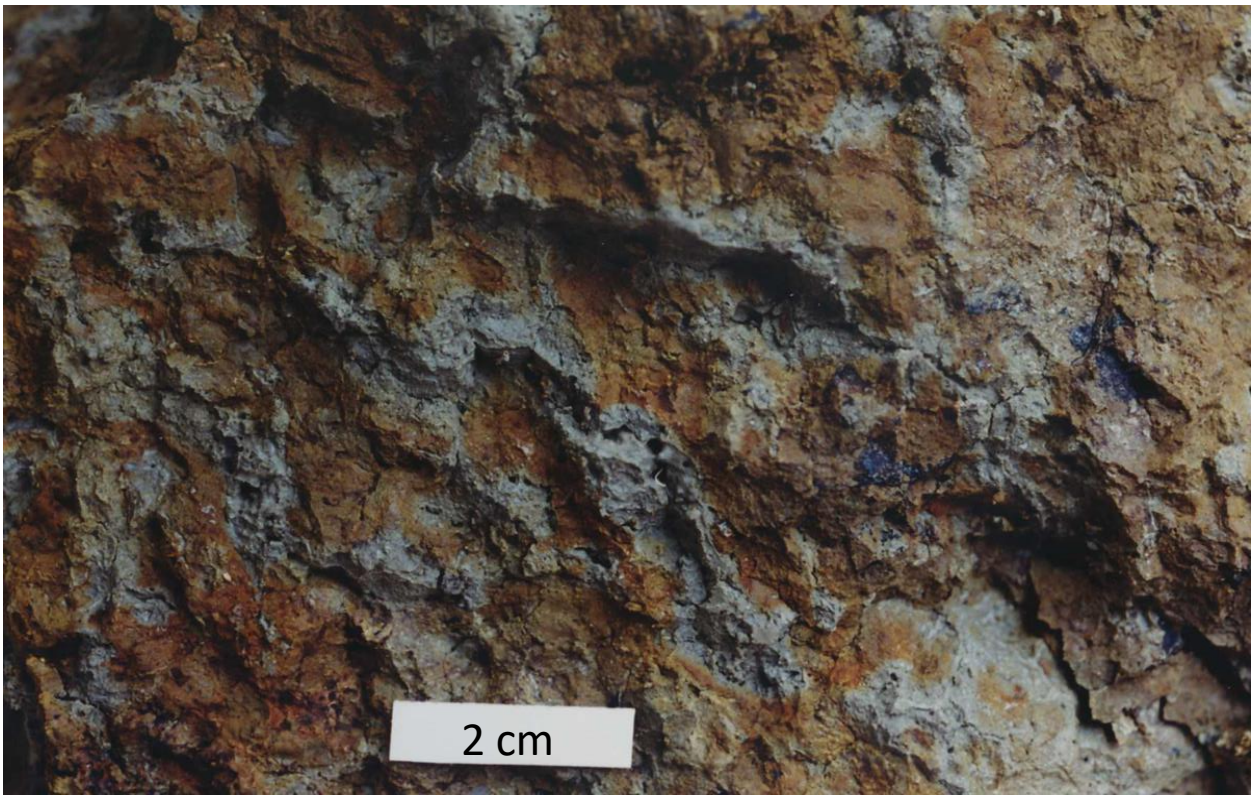
This 82-page book was commissioned by the Ohio Auditor of State and written by George W. Knepper (1926 - 2018), former Distinguished Professor of History and University Historian at The University of Akron. It is well illustrated and includes a short but useful list of additional references. The first paperback edition was released in 2002. Although the book is currently out of print, copies can be purchased from used book sellers or downloaded at: https://www.ohioauditor.gov/publications/OhioLandsBook.pdf

The Scoop on Redoximorphic Features: Part 2

This article is reproduced verbatim from *Onsite Installer* and includes links to related articles in the same magazine. *Onsite Installer* serves those who design, manufacture, engineer and install septic systems serving both residential and commercial onsite wastewater treatment applications.

We continue to explore the nitty-gritty soil science behind identification based on colors and conditions you encounter during excavation

- By Jim Anderson and Dave Gustafson
- June 2019



Last month we discussed in detail the conditions needed to form the features in soil referred to as redoximorphic. This month we will provide more information on the appearance and formation of redoximorphic features in soils, how we determine their presence and some interpretations of their presence or absence.

We use the presence or absence of these features to determine depth to a limiting soil condition due to water saturation. Since saturated soil zones are limiting conditions, the presence of these features will set the elevation of the bottom of our soil treatment trenches or beds to provide adequate separation distance to provide treatment.

Remember, we highlighted there are several kinds of features: redox concentrations, redox depletions and reduced matrices.

Areas of concentration are where iron and manganese have accumulated after being reduced when the soil is saturated and then re-oxidized when the soil dries out and oxygen reenters the soil pores. Three kinds of concentrations are recognized: nodules and concretions, masses, and pore linings. Nodules and concretions are firm to extremely firm, so difficult to break. Masses are soft bodies within the soil matrix. Pore linings are just that, accumulations within larger-diameter pores in the soil, such as root channels or wormholes.

Understanding depletions

Areas of depletion include iron depletions and clay depletions. These are areas within the soil where iron, manganese or clay has been stripped out or removed. When using the Munsell color notation, these are areas of low chroma, less than or equal to two and values higher than four across numerous hues. We used to call these “gray mottles,” but as mentioned last month, there are similarly colored soils not indicative of periodic soil saturation; depletions are more accurate depictions related to soil saturation. Clay depletions are areas along ped surfaces or channels where the clay has been removed, leaving a layer of silt. The clay removed is often found coating soil peds at a lower horizon.

Reduced matrices are the interiors of peds that have a low chroma color because the iron in the peds is reduced. When the soil is exposed to air, the color will change, usually within 30 minutes. This indicates areas in the soil that are saturated for long periods of time without much water movement. So if as an installer you are digging a trench and gray soil is being excavated and the clods change color to brighter reds or browns, it indicates you are excavating in an area that should not be used for soil treatment trenches.

This all seems to be very straightforward; but there are a number of exceptions and complications to correctly identifying and interpreting soil colors related to reduced and saturated conditions. There are soils that have matrix “low chroma” colors associated with accumulations of organic matter or calcium carbonate. These are not redoximorphic features. In some cases, soil parent material is gray or low chroma in color. Then it is

natural for the soil to exhibit a low chroma color. This condition occurs more often in sandy soils because the individual sand grains are often predominantly quartz, which is gray or white in color.

On the opposite end of the spectrum are soils with parent materials naturally high in iron content. These are very red colored soils due to the high amount of iron. Even though the soils are reduced, the appearance of the gray areas is very hard to identify unless you are used to working in areas where these soils occur. Where we live in northern Minnesota, Wisconsin and the Upper Peninsula of Michigan, there are large areas where these soils occur. Since they are mostly clay in texture, they are slowly permeable and often wet. It is an example of when knowing the soils where you work helps identify potential problems.

At the edges

Areas of accumulation we discussed above are very resistant once they form. While it may only take less than a year to 100 years to form, they can persist for a few hundred years or more. The way to identify this in the field is to look at the accumulations with a magnifying glass, paying close attention to the edges of the concretion or nodule. Edges that are blurry and not sharp indicate the feature is still forming and reflects current-day conditions. Sharp edges mean the conditions under which they were formed no longer exist or they were transported from another location to where they are today.

Even with these problems, identifying and investigating the cause of these soil features is one of the best ways to avoid excavating too close or into soil horizons that are seasonally or periodically saturated, which can cause premature failure of soil treatment trenches and beds.

Related: How to Pick a Soil Loading Rate

We always highlight for installers, site evaluators and inspectors that if you see these types of features and are unsure, it should raise a red flag about the area and work should not proceed until questions about system separation from these features is resolved. This is where it is helpful to consult the soil survey for the area.

Look at the interpretations and the soil profile descriptions for evidence of saturated conditions. This is easier these days than ever because soil surveys are available on the web from the Natural Resource Conservation Service. A visit with a soil scientist from your area conservation district can also help you determine whether features you see should be a concern.

FLASHBACK

The 2003/2004 Ohio State Soil Judging Teams, coached by Dr. Neil Smeck, qualified for national competition by placing second in a regional contest hosted by the University of Rhode Island.

(L-R) Joe Ringler, Eric Dapra, Jesse Dotterer, and Scott Demyan in Rhode Island

The following spring, a re-organized group also placed second in the national contest in Illinois.

(L-R) Libby Yocum, Bryan Ford, Joe Ringler, Neil Smeck, and Scott Demyan

Re-Birth of the SoilWeb App for Smartphones

The following article was taken verbatim from the July 11, 2019, issue of the SWCS Conservation News Briefs, and the original article, dated July 8, 2019, can be accessed at the NextGov website.

How an Agriculture App that Spills the Dirt on Soil Got a Second Life

By Brandi Vincent,

The department's (NRCS and UC Davis) barebones SoilWeb app grew a following until app stores changed their rules in 2017. Now it's back.

Soil holds powerful insights about what America is made of and many people leverage historical data about it to make better use of their land.

SoilWeb 2.0, a revamped smartphone app from the Agriculture Department's Natural Resources Conservation Service and the University of California at Davis' Soil Resource Laboratory, translates the world's largest database of soil information into a smart and simple interface that teaches people about their present-day surroundings. But the road to SoilWeb 2.0 was a rocky one.

The app is part of a broader suite of SoilWeb Tools that all started in 2005. It was originally launched on the app store in 2010 and was widely used for years. But in 2017, SoilWeb became unexpectedly non-compliant with app store policies, rendering it non-functional. The evolution to its re-release in late June speaks to the outcomes of agency-academic partnerships—and it also presents unique lessons for federal insiders working to pioneer new technologies.

SoilWeb is the brainchild of NRCS Soil Scientist Dylan Beaudette and UC Davis Professor and Cooperative Extension specialist Anthony O'Geen. Beaudette was a student at the school in 2005, and quickly learned that he and O'Geen shared an interest in the digital representation of soil survey and making dense scientific information seem more applicable to all people. Further, part of O'Geen's role was to help people understand how to best use soil survey data.

The two frequently used Agriculture's SSURGO database, which has more than 120 years of data about soil collected in the NCSS. It represents the most detailed accounting of soil resources in America.

"With any given ten-acre chunk on the ground, there are at least a thousand different soil properties and characteristics and interpretations that are stored in this database," Beaudette said. "And we got to talking, and for both of us it was a tremendous resource, but it was just so large and so complicated and we were looking for ways to create a simplified interface to it."

Together they built the first version of SoilWeb, a simplified web interface that links to the SSURGO database in graphical format. The platform, which is still in use today, ultimately provides users with information about the soil types associated with specific geographic locations.

By 2010, Beaudette was a Ph.D student at the school, and smartphones with built-in GPS were among the hottest new technologies. At a science conference that year, Beaudette and a colleague were inspired with a new idea: making soil survey information accessible through GPS-enabled smartphones, so people could use it right where they are standing.

"It seemed like a great idea," Beaudette said. "But I didn't have a smartphone, O'Geen didn't have a smartphone. I only knew two people who had them."

Still, over a 2-week holiday break, Beaudette downloaded a software development kit and got to work building the app. He tested it on his brother's iPhone, and when it worked he paid $95 to post it on the app store.

"The first version was embarrassingly simple," he said.

But O'Geen and Beaudette agree that the first app had a notable influence."When SoilWeb came out, you didn't hear about these things—science apps," O'Geen said. "I think [Beaudette] sort of pioneered those apps, to be honest."

The new app was a hit and received "far more downloads" than either could imagine. All of a sudden, people from across the country were reaching out with comments and recommendations on how to make the platform better. In terms of engagement, Beaudette said the original app received an average of 600 to 700 unique queries a day.

"It was exciting because I knew every time someone used this thing, they were gaining access to soil survey in a way where before they would have ignored it or not even been aware of it," he said.

The soil scientist went on to develop an Android app and made it available on Google Play. For the next seven years the "primitive apps" were compatible with both iOS and Android. Beaudette went on to work at NRCS and continued to collaborate with

O'Geen. But in 2017, SoilWeb was all of a sudden no longer in compliance with the requirements set by Apple and Google.

"Apple made a big shift from allowing a mixture of 64-bit and 32-bit applications to only allowing 64-bit applications, which meant you had to run your source code through a new compiler," Beaudette said. "And then they started adding on a bunch of policies—for every app there had to be a privacy policy and a user license agreement, all these additional hoops to jump through. So, it stayed up but it was non-functional."

By that point, O'Geen and Beaudette said the app had really started to take on a life of its own and had been widely and consistently used, even though it was built on such a shoestring budget. Soon, users' complaints and frustrations began to rapidly flow in. The two would receive phone calls from frustrated users who wanted the app every week and felt the highs and lows of being excited that people wanted to use it but disappointed that there wasn't a quick fix to make it work.

"People were very upset," O'Geen said. "Since it had been taken off, I would probably get one to two emails a day from people saying the system changed and it didn't work on their phones—and that probably lasted for two years, so it was a lot of people."

The team, together with developer Mike Walkinshaw, recoded the technology to make the web-based system accessible by phone, even though it wasn't through an app. O'Geen said he genuinely thought people would be comfortable with using the substitute instead of the app, but that turned out not to be the case. Even though they had replacements, users continued to ask to retrieve the soil information directly via their smartphones.

"That's a problem for academia and the federal government, which is that we have our ways in which we think we can get this information out to people, but they have their own ways. And so even though you have these things out there and they are seeing it, it's not really adding much value," O'Geen said. "So, you've got to go where the demand is."

Beaudette also noticed that of all the responses they were receiving, many came from soil conservationists, who were using SoilWeb for a great deal of their work. "That was eye-opening and also kind of a justification of asking for money," Beaudette said. "So, for about a year and a half, I petitioned the head of our NRCS division and anyone who would listen. I said 'we have this great thing and it doesn't work anymore but here's a budget to get it back on.'" Finally, through a $100,000 grant from Agriculture, Beaudette, O'Geen and Walkinshaw were able to revamp the app into SoilWeb 2.0 and get it back up and running on the app store.

"Walkinshaw had never made apps for Apple or Google, but he sat down and taught himself to do it and did it in a way that we could write the app once and recode it to each operating system," Beaudette said. "It's now fully in line with modern programming practices and it jumps through all the new hoops."

This simplified and scaled the processes dramatically. The updated app is also equipped with many new features and can help users answer questions around the production capabilities of their properties or the best places to build or dig ponds. It also provides detailed information about different soil profiles, taxonomy, land classification, and erosion and soil sustainability ratings.

"We feel that this tool has changed how survey soil information is used, because now so many different people are using it," O'Geen said. "It could be master gardeners and people using it in their backyards, it could be real estate appraisers, and we also see growers, consultants, and a lot of federal agency staff people using it in a variety of ways."

And the new app has also boosted user engagement. Beaudette said since its launch, SoilWeb 2.0 gets on average up to 1000 unique queries a day. As of July, the SoilWeb web-based platform for desktops and mobile devices receives about 3,000 unique queries a day. For the team that runs it, it feels as though it makes the most of an underutilized database. And Beaudette also said it's important to note that SoilWeb is built on servers in UC Davis' Land, Air and Water Resources Department.

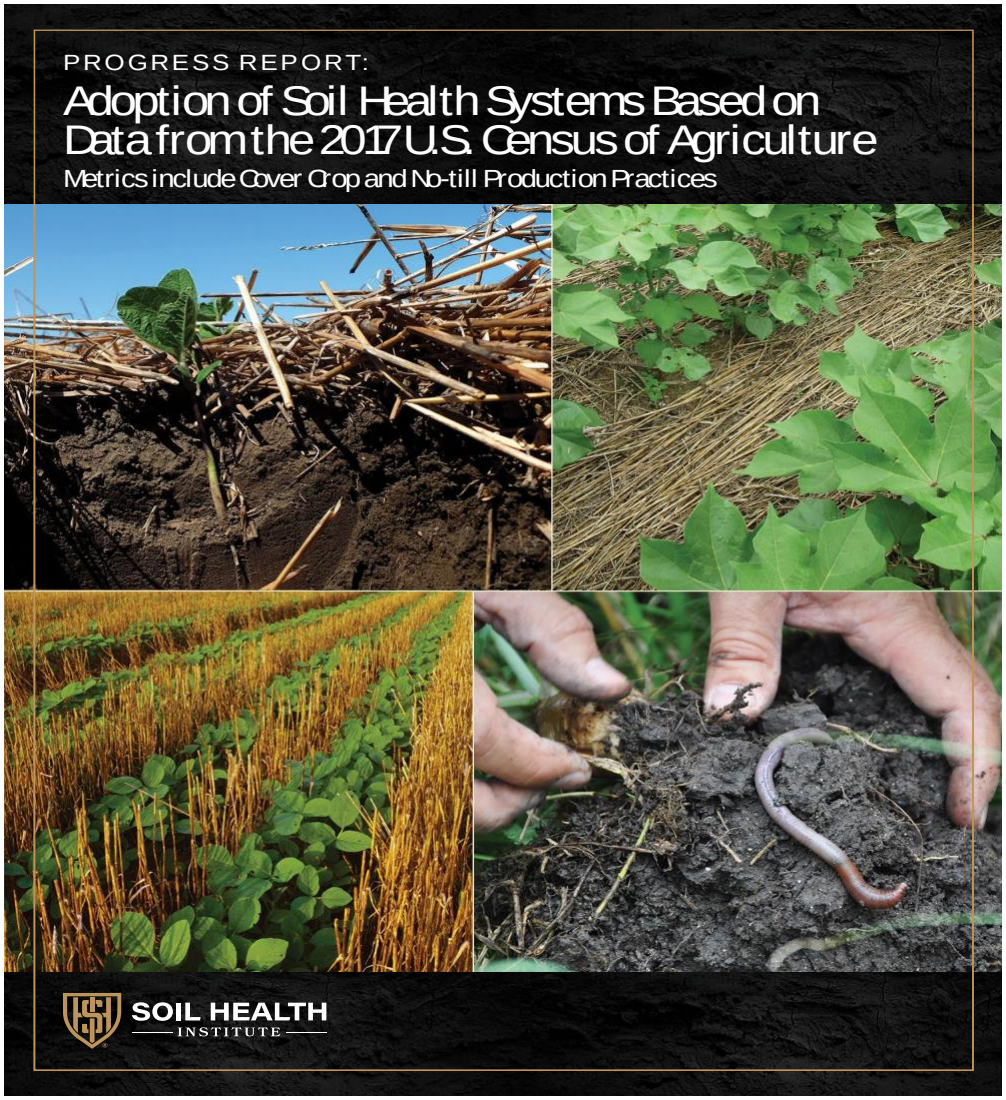
"Again, I think this is an excellent model for how NRCS and other government agencies can cooperate with universities. You find a cooperator like O'Geen, who is interested in long-term work and you can really take advantage of a small IT department," he said. "And you don't necessarily have to satisfy all the requirements that USDA has to."

Beaudette added that the team can't seem to stop coming up with future plans. He hopes to add more contextual information in the future to not just tell users what soil surrounds them, but also why it's there. Like many government endeavors, the journey has been long. But for the team who made it happen, it's been worth it.

"I feel like we have developed something that has had a huge impact on society," O'Geen said. "It's not just the people developing SoilWeb, but it's also the NCSS—they've done all the work of inventorying this land but people didn't realize how to use the data and they couldn't get to it in an easy way. So, I feel like we've done a massive social good by making people realize that this information is at their fingertips now."

Progress Report on Adoption of Soil Health Systems

The Soil Health Institute has released *PROGRESS REPORT: Adoption of Soil Health Systems* Based *on Data from the 2017 U.S. Census of Agriculture.* The analysis includes a state-by-state breakdown of changes in adoption from 2012 to 2017 for cover crops and no-till production.



The report was developed by Rob Myers, Ph.D., a University of Missouri agronomist and Co-chair of the Soil Health Institute Policy Action Team, and Joe LaRose, a University of Missouri extension associate. The full report may be viewed at: https://soilhealthinstitute.org/wp-content/uploads/2019/07/Soil-Health-Census-Report.pdf

AOP Consultant List

The Association of Ohio Pedologists maintains a list of Certified Soil Scientists who are currently available for soil consulting. The list may be viewed on the AOP website at: https://www.ohiopedologist.com/consultant-list.html Certification *must* be through the Soil Science Society of America, and inclusion on the AOP list is voluntary. If you are SSSA-certified and would like to be added (or removed) from the list or if modifications are required to your current listing, please respond to the following:

Name:_____

Action Requested:

1. Please remove my name and contact information from the list _____

2. Please add my name and contact information to the list _____

   Provide the following information, as appropriate:
   Name: _____
   Business Name: _____
   Address: _____
   _____
   _____
   Email: _____
   Telephone No: _____
   Facsimile No: _____
   Website URL: _____
   Degrees and Certifications: _____
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   Usual Service Area: _____

3. Please modify my existing personal/business information as shown above ___

Return this page to:

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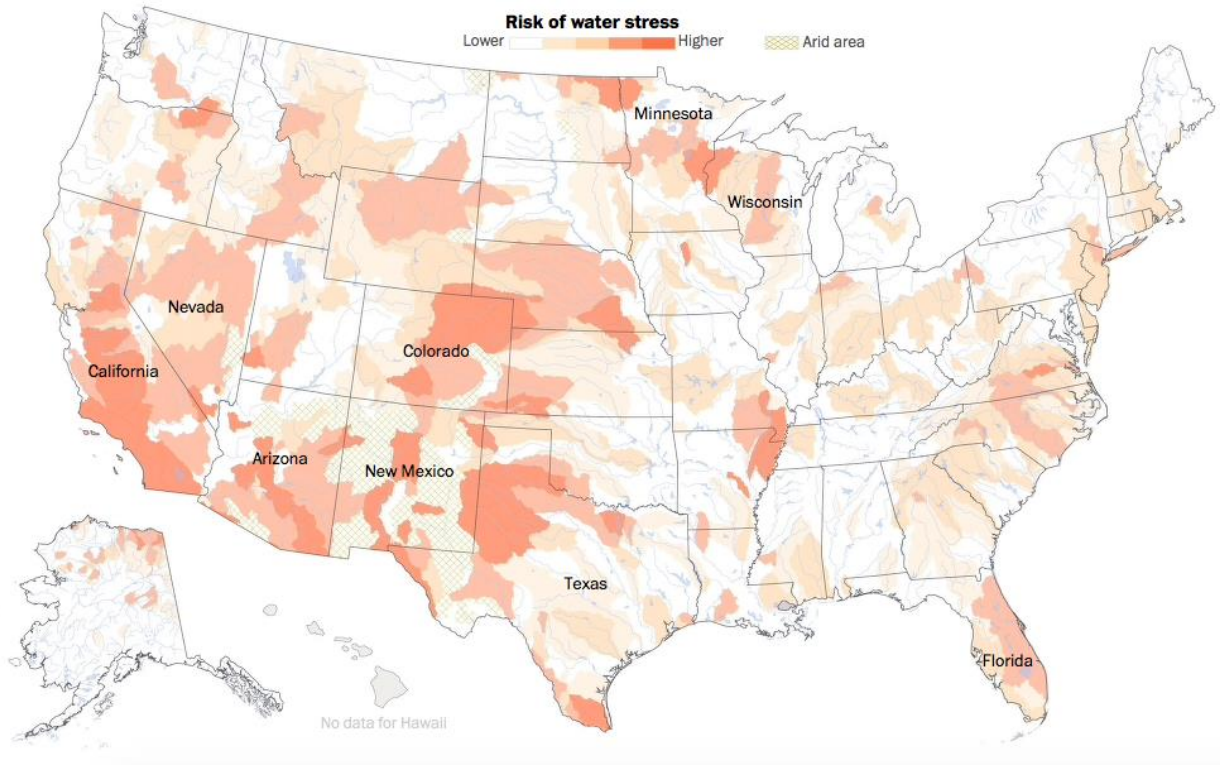
Mapping the Strain on Our Water

The following article is taken verbatim from a SWCS Conservation News Briefs dated August 8, 2019 and is, in turn, based on a report from the August 6, 2019 issue of the *Washington Post*.

Pockets in several U.S. states — and across the globe — are draining their limited water supplies

By **Bonnie Berkowitz** and
Adrian Blanco
August 6

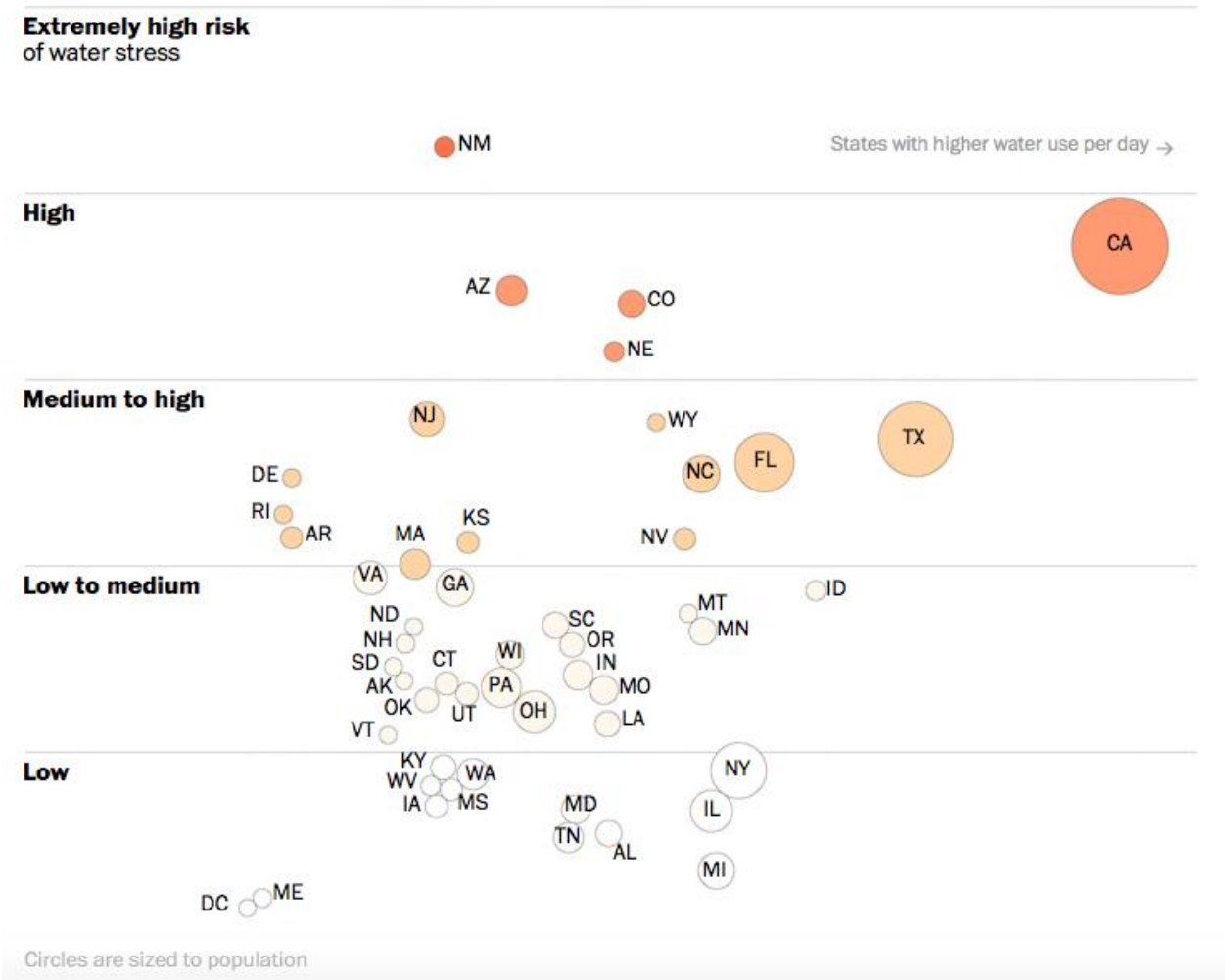


The United States has enough water to satisfy the demand, but newly released data from the World Resources Institute shows some areas are out of balance. The WRI's Aqueduct Water Risk Atlas researchers used hydrological models and more than 50 years of data to estimate the typical water supply of 189 countries compared to their

demand. The result was a scale of “water stress” — how close a country comes to draining its annual water stores in a typical year.

Of course, many years are not typical, and unpredictable weather patterns of a changing climate can have drastic consequences. In areas of high or extremely high water stress, said Betsy Otto, director of WRI’s Global Water Program, "if you then hit a drought ... you’re really in trouble, because you’re already using most of what you have.”

The United States ranked 71st of 189 countries, and low-medium on the stress scale, meaning we are pulling out just under 20 percent of our available water.



But within the country, the push-and-pull for water varies greatly. Paul Reig, an environmental scientist who leads Aqueduct, helped explain why.

The southwest is most stressed

Because much of the territory is naturally arid, southwestern states are in the most precarious positions when it comes to water, Reig said. New Mexico, for instance, was the only state in the "extremely high" category, earning the same alarming score (4.26 on a five-point scale) as the United Arab Emirates, which was the 10th most-stressed in the world.

New Mexico's demand sucks up more than 80 percent of the largely arid state's annual supply. That leaves 20 percent, but such a narrow margin means that it may have trouble withstanding an extended drought or an increase in demand from population or industry growth. Neighboring Arizona was among four states in the somewhat-less-perilous "high stress" category.

California uses more water than any state

Ample water resources in northern areas of California are balanced by huge demands from Central Valley agriculture and the large populations in hotter, drier southern areas such as Los Angeles and San Diego. California uses the most water of any state, according to the U.S. Geological Survey, up to 9 percent of all withdrawals from the national supply.

Central Florida is straining its aquifer

On the other coast, Florida demonstrates that a state surrounded by seas and perforated by lakes and rivers can still have a water problem. Desalinization of saltwater is expensive and often not practical. The enormous Floridan aquifer provides most of the area's freshwater, but demand is high. Florida uses the fourth-most water of any state. Reig said it also supplies up to 7 percent of the water used for the country's thermoelectric power.

Stress appears in seemingly unlikely areas

Only part of Colorado is snowy peaks and mountain streams. Much of the eastern half of the state is largely flat, fairly dry agricultural land that uses an enormous amount of water for irrigation. Same for Colorado's northeast neighbor, Nebraska.

Even the “Land of 10,000 Lakes” can have water issues. Parts of Minnesota and Wisconsin border Great Lakes, and in those places water is plentiful, Reig said. But other heavily agricultural parts of the states rely on limited resources that tend to fluctuate.

Much of the world is worse

The U.S. water picture is far less grim than that of other places. Seventeen countries ranked in the “extremely high stress” category, and they are home to about a quarter of the world’s population. The most dire numbers are in Qatar (4.97 on a water-stress scale of 1 to 5), which pulls out nearly all its available water in any given year, followed by Israel and Lebanon.

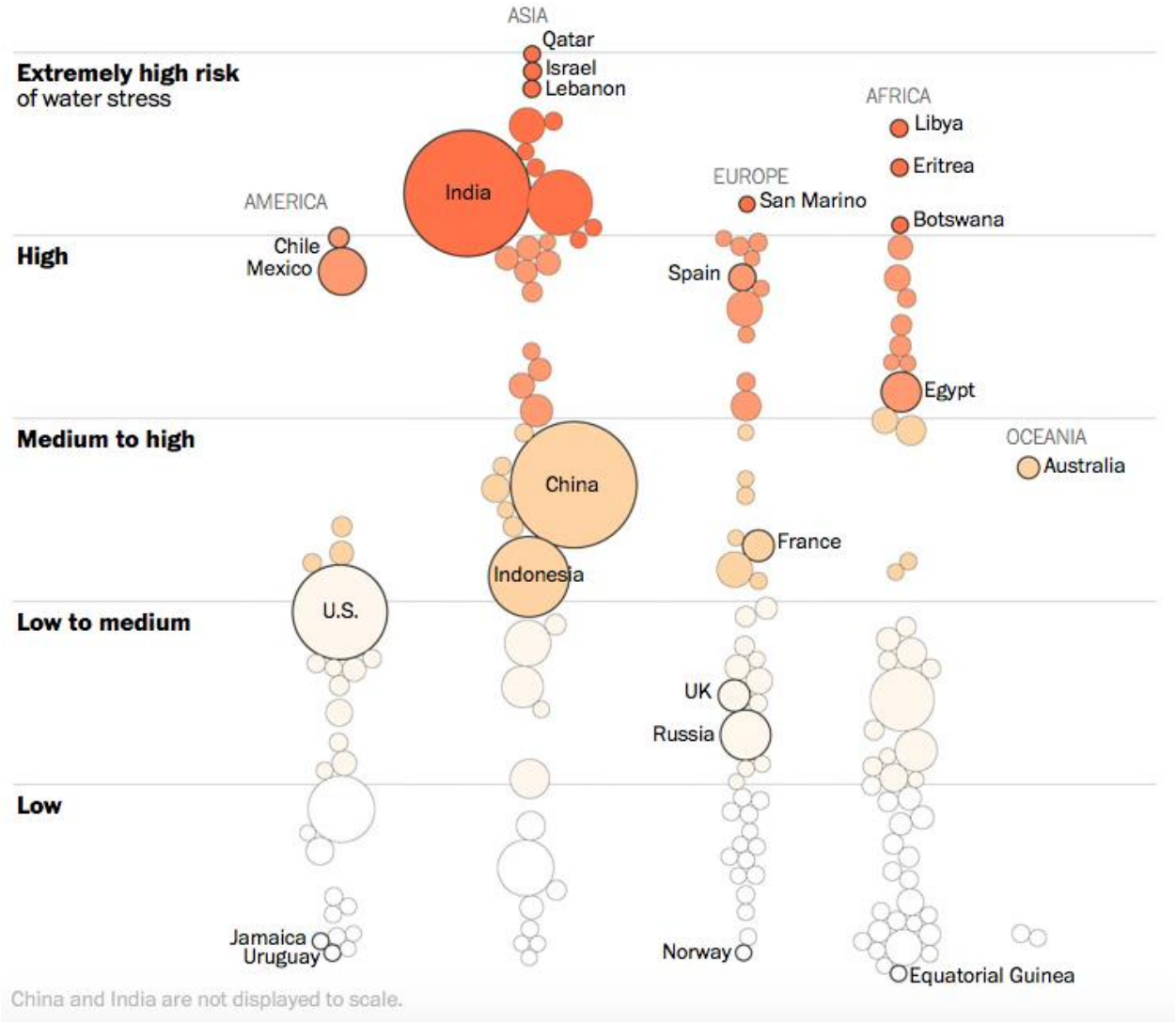
But by far the most populous high-stress country is India, where more than 600 million people live in areas of high or extreme water stress, said Shashi Shekhar, the country’s former secretary of India’s Ministry of Water Resources. After two straight unusually weak monsoon seasons, taps in the city of Chennai ran dry in June.
In South Africa, Cape Town only narrowly avoided Chennai’s fate in 2018 after drastically curbing water use. Mexico City, meanwhile, is sinking because so much groundwater is being pulled out, Otto said.

Not all the news is bad

Fourteen countries had a score of 0.0, meaning either supply is very high, demand is very low or both. Those include countries such as Uruguay, Norway, Jamaica and Equatorial Guinea.

And in the United States? Many places are in good shape, but this may be the only metric ever in which D.C.'s stress level ranks lowest in the country.

Note: Reig said that small islands are very difficult to model because they’re not part of a watershed. So Hawaii and some island nations are not included in the data.


ASIA
Qatar
Israel
Lebanon
Extremely high risk
of water stress
AFRICA
Libya
Eritrea
Botswana
India
EUROPE
San Marino
AMERICA
Chile
Mexico
High
Spain
Egypt
Medium to high
OCEANIA
Australia
China
France
Indonesia
U.S.
Low to medium
UK
Russia
Low
Jamaica
Uruguay
Norway
Equatorial Guinea
China and India are not displayed to scale.