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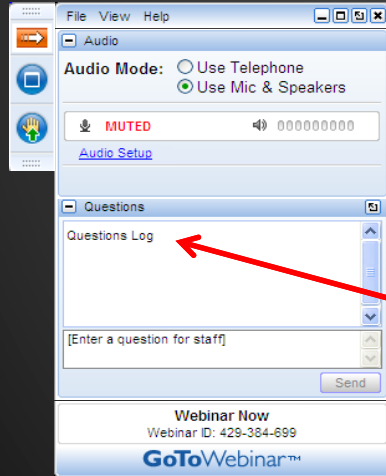
**Biosolids Today: Understanding –
and Communicating –
the State of the Science**

Thursday April 11, 2019
1:00 – 2:30 PM ET

The Water Environment Federation logo is located in the bottom right corner of the slide. It features the same white stylized 'W' icon and text as seen in the first slide.

2

How to Participate Today



- Audio Modes
 - Listen using Mic & Speakers
 - Or, select "Use Telephone" and dial the conference (please remember long distance phone charges apply).
- Submit your questions using the Questions pane.
- A recording will be available for replay shortly after this webcast.



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Today's Moderator



Jody Barksdale
Senior Vice President
Gresham, Smith & Partners



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Today's Speakers

- Ned Beecher
 - Current Challenges of Recycling Biosolids to Soils
- Sally Brown
 - New Vocabulary
- Dominic Brose & Allison Fore
 - Promoting MWRD Chicago's Biosolids and Compost for Use in an Urban Environment



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Current Challenges of Recycling Biosolids to Soils

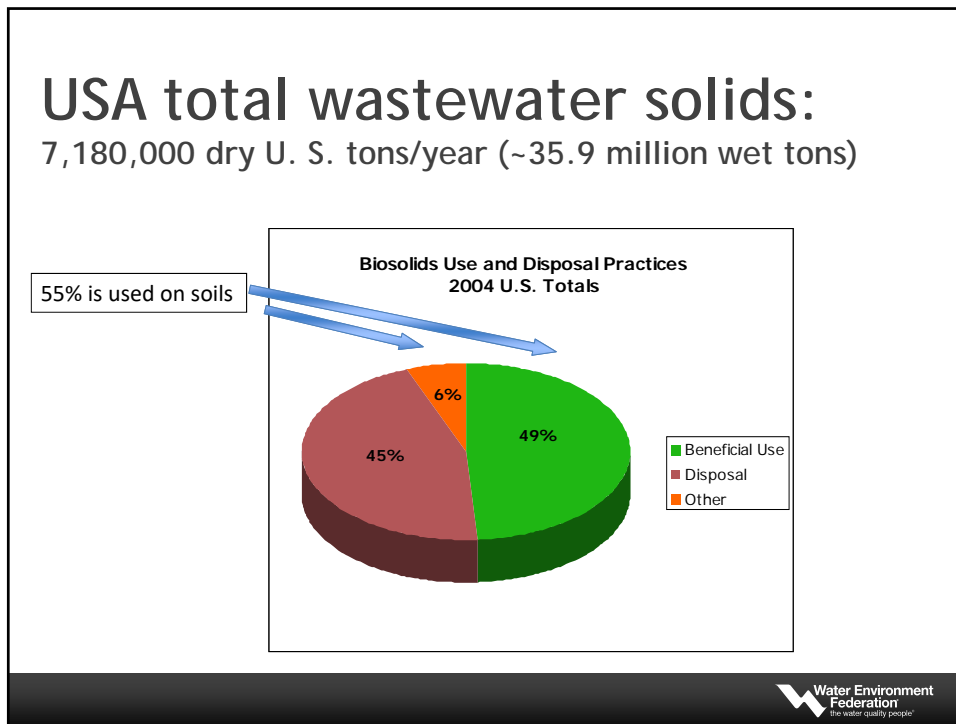
Ned Beecher • NEBRA

April 11, 2019

Webinar • Water Environment Federation

The logo for the Water Environment Federation, featuring a stylized 'W' and the text 'Water Environment Federation' with the tagline 'the water quality people' below it.

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“We don’t grow when things are easy;
we grow when we face challenges.”

- Anonymous

Right?

But it’s hard. Not always fun.

Water Environment Federation
the water quality people

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Challenges, April 2019

emerging contaminants
nutrient management
odors
public scrutiny & upset

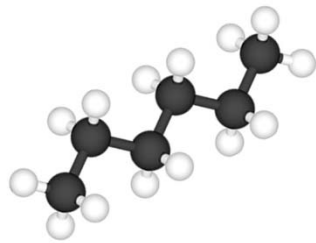
nitrogen

microplastics
EPA OIG report
phosphorus
AD & codigestion
incineration
landfill disposal

persistent opposition
issues *du jour*

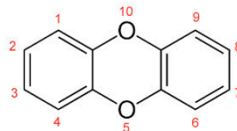


9



Emerging contaminants

raises fears of the unknown, uncertain



10

Concentrations of CECs in biosolids

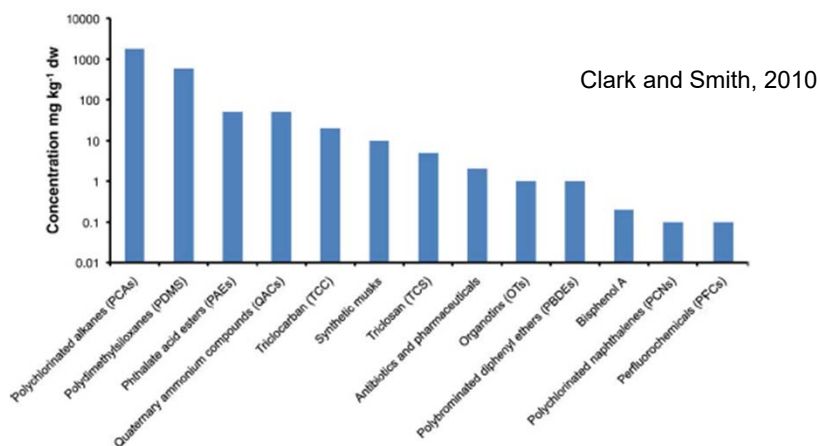


Fig. 1. Typical concentrations of selected 'emerging' organic contaminants in sewage sludge (mg kg⁻¹ dw).

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CECs / Microconstituents - Not Our First Rodeo

- Dioxins/Furans
- PPCPs
 - Medicine - hormones, drugs for disease & pain management, homeopathic drugs, vitamins & other health supplements, etc.
 - Hygiene - soaps, detergents, hand sanitizers, etc.
- Microbeads
- And now PFAS
 - With over 85,000 known chemical compounds in commerce, unlikely to be our last

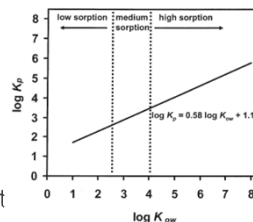
12

What does it mean?

Chemicals of greatest concern in biosolids have...

- High log K_{ow} - octanol-water partition coefficient
- High toxicity (to some species)
- Long half-lives (persistent)
- Bioaccumulative
- Dioxins/furans are excellent example: thoroughly studied to require regulation (EPA, 2003)

Xia et al.
2005



Far greater concerns and impacts are in the WRRF effluent and receiving aquatic environment.

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What does it mean?

Remember
:


1 ppm = 1
second in
11.6 days

1 ppb = 1
second in
31.7 years

1 ppt = 1
second in
31,700
years

- Healthy, microbially-active soils are the best medium for treatment of traces of organic chemicals.
- Significant impacts to biota have been measured in aquatic environments, but not in biosolids-amended soils.
- Risk to human health through biosolids-application-to-soil pathways appear to be negligible. Far greater human exposure to most are through daily use of products.
- Source reduction should focus on persistent compounds with known or potential toxicity.


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**NORTHWEST
BIOSOLIDS**

Biosolids: Understanding the risk

Putting it into perspective - how does using biosolids or compost made with biosolids compare to chemical exposures in everyday life?



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**Q: Where do we want to put CECs?
(We can't remove every bit from wastewater.)**

A: Get them into the solids...and into soils...
...because healthy soils (e.g. enriched with biosolids and/or other organic amendments) are the best media for degrading most CECs.

“These terrestrial systems have orders of magnitude greater microbial capability and residence time to achieve decomposition and assimilation compared with aquatic systems.”

– Overcash, Sims, Sims, and Neiman, 2005





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What biosolids managers can do...

Use Best Management Practices.

- Apply at agronomic rate, which limits total mass of CECs while providing optimum level of benefits.
- Maintain setbacks from surface & groundwater*, which keeps CECs out of the more sensitive aquatic environment.
- Apply to aerated soils and incorporate when possible, which aids decomposition of CECs and avoids direct ingestion.
- Use the same BMPs for manures/other residuals.
- Follow research & update BMPs.

Microplastics

- <https://www2.mst.dk/Udgiv/publicationer/2017/03/978-87-93529-44-1.pdf>

Microplastic in Danish
wastewater
Sources, occurrences
and fate

A session at WEFTEC 2018 addressed the issue. Recent news has reported finding microplastics in rivers, shellfish, and human excrement. But a Danish study of biosolids' role found more microplastics from ordinary agricultural practices than from biosolids.

EPA Office of Inspector General Biosolids Program Review, Nov. 2018

NEBRA Review of OIG Biosolids Review November 16, 2018

**U.S. Environmental Protection Agency
Office of Inspector General**

At a Glance

EPA Unable to Assess the Impacts of Unregulated Pollutants in Land-Applied Biosolids on Human Health and the Environment

What We Found

The EPA's controls over the land application of sewage sludge (biosolids) were incomplete or had weaknesses and may not fully protect.

There is an abundance of peer-reviewed science that evaluates the potential risk of many...

- <https://www.epa.gov/office-inspector-general/report-epa-unable-assess-impact-hundreds-unregulated-pollutants-land>
- <https://www.nebiosolids.org/news>



November 29, 2018

Charles E. Sheehan
Acting Inspector General

Subject: Office of Inspector General Evaluation of Federal Biosolids Program



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PFAS

<https://www.nebiosolids.org/pfas-biosolids>

FLUOROTECHNOLOGY MAKES IMPORTANT PRODUCTS FOR VITAL INDUSTRIES POSSIBLE

FluoroCouncil member companies voluntarily committed to a global phase-out of long-chain fluorochemistries by the end of 2015, resulting in the transition to alternatives, such as short-chain fluorochemistries that offer the same high-performance benefits, but with improved environmental and health profiles.

FLUORINE CARBON

Fluoro Technology is the use of fluorine chemistry to create any fluorinated product. When fluorine and carbon atoms join together, they create a powerful chemical bond. The use and manipulation of this bond gives Fluoro Technology its distinct properties of strength, durability, heat-resistance and stability. These properties are critical to the reliable and safe function of myriad products that industry and consumer rely on every day.

www.FluoroCouncil.org

<https://fluorocouncil.com/>



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Why are PFAS a hot topic for biosolids?

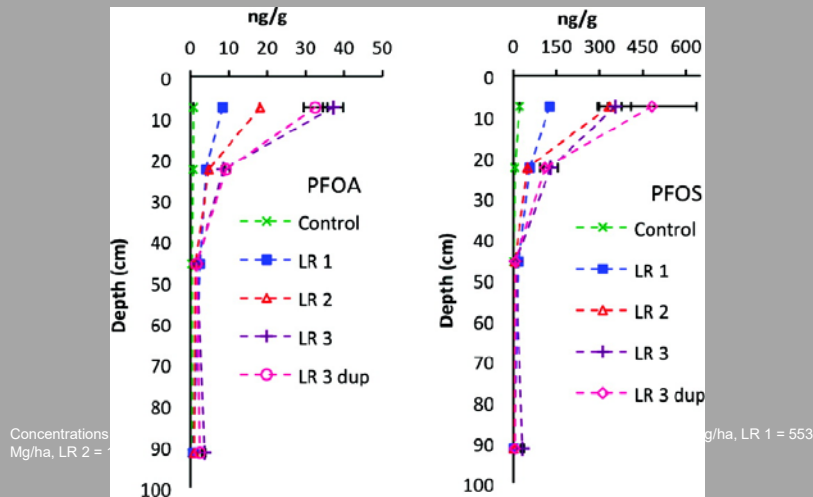
- 2000s → present: Increasing focus on PFOA & PFOS in the environment worldwide. PFOA & PFOS voluntary phase-out by 2015. Industrially-impacted biosolids contamination at Decatur, AL.
- May 2016 → EPA drinking water public health advisory (PHA) - - 70 ng/L (ppt) for PFOA & PFOS combined. Rare ppt PHA.
- State agencies look for sources → literature points to wastewater & residuals as some. (They convey PFAS.)
- Because they reflect modern life, wastewater, biosolids, & other residuals (e.g. from recycle paper mills) contain low microgram/L (ppb) concentrations of PFAS.
- PFOA & PFOS chemistry and persistence → Scant literature shows some leaching to groundwater possible at levels approaching the EPA PHA concentration → Regulators concerned. States' cursory screening sampling & analysis supports some concern. State reactions follow.
- 2107 - 2019: Public & legislative pressure drives efforts to lower the benchmark below EPA's PHA of 70 ppt, which could impact biosolids & residuals management. Pressure mounts to set biosolids screening level.



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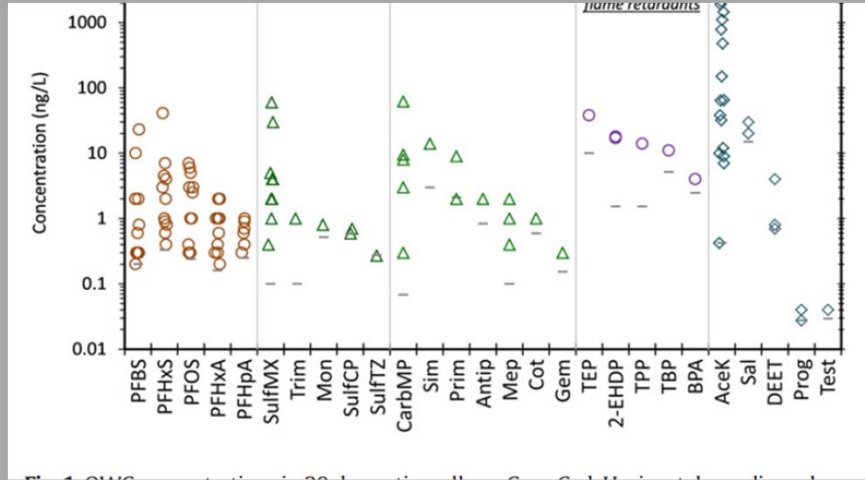
Some PFAS leach in soil

Sepulvado et al; *Environ. Sci. Technol.* 2011, 45, 8106-8112



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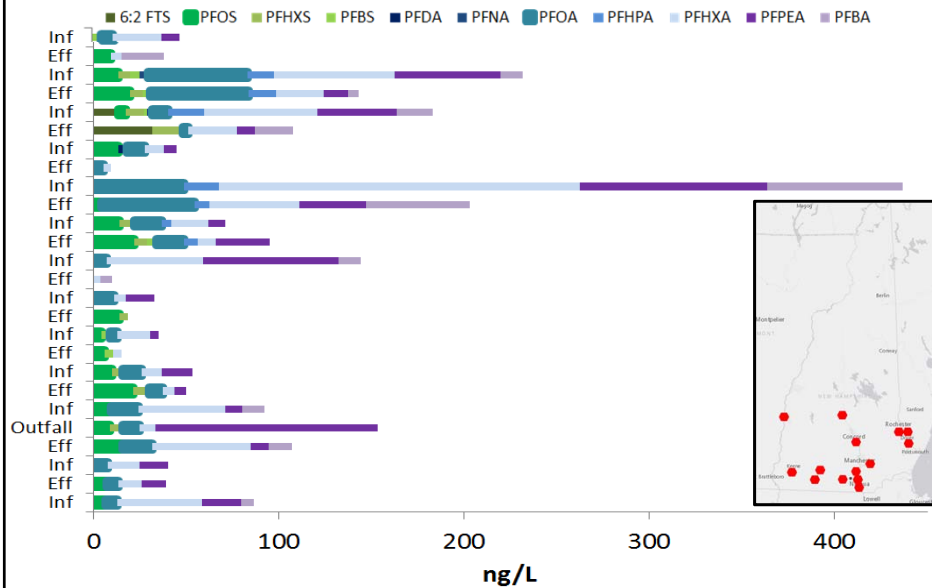
Cape Cod Groundwater impacted by septic systems



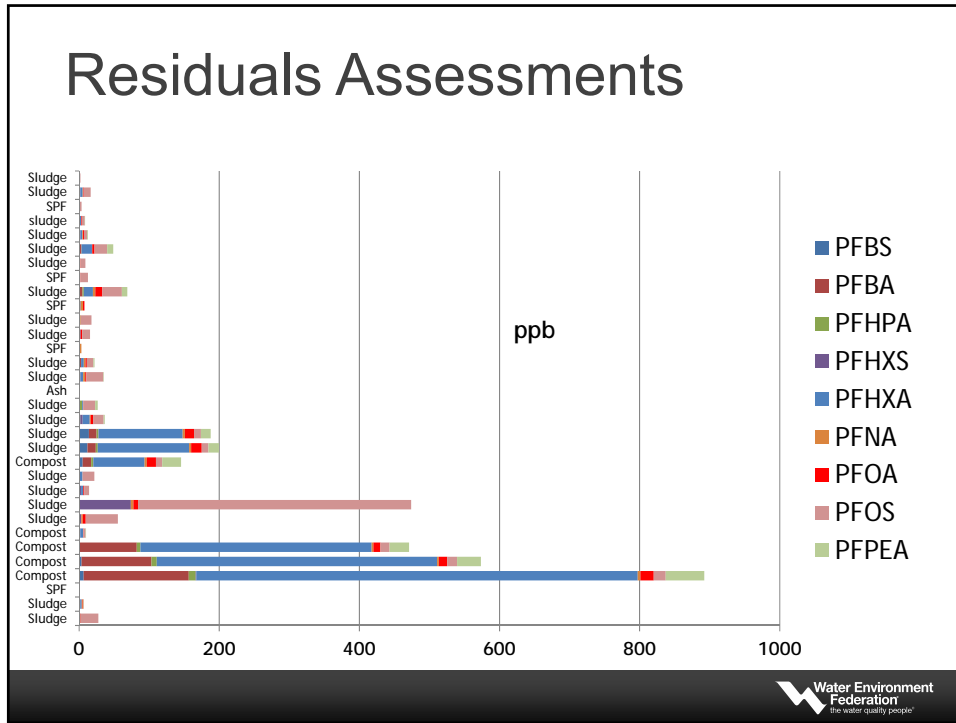
* Schaider et al., 2016. Septic systems as sources of organic wastewater compounds in domestic drinking water wells in a shallow sand and gravel aquifer. *Sci.*

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Wastewater Assessments



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Wastewater & biosolids convey PFAS, but...

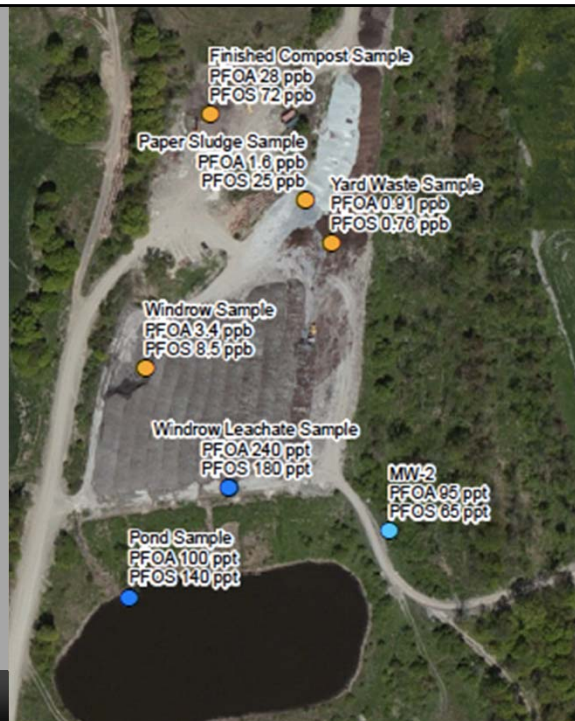
- PFAS are ubiquitous.** Even wastewater & biosolids with no industrial inputs can have 1's to 10's parts per billion (ppb*). Wastewater & biosolids are not sources, but transfer routes for PFAS. Source control & phase-outs are the best option for reductions. But we will not get to zero PFAS in wastewater and biosolids and the environment anytime soon.
- Presence does not necessarily mean risk.** For wastewater & biosolids, there is no dermal, inhalation, or ingestion risk. The indirect pathway of leaching to waters is the only possible human health concern, and that will depend on the endpoint screening levels set for ground- and surface waters.
- NH DES data for biosolids sites** show groundwater impacts directly under several worst-case-scenario legacy biosolids sites, but no significant impacts on neighboring drinking water wells (except 1 surface well with marginally elevated PFOA + PFOS, the sources of which are uncertain). Biosolids & soils bind longer-chain PFAS.
- PFOA & PFOS are at lower levels in modern wastewater & biosolids than in the past**, due to phase-outs. Wastewater & biosolids returning to the environment today are conveying significantly less PFOA & PFOS (~1/10th).
- Data are inadequate for robust modeling of leaching potential from biosolids applied to soils.** Most states recognize this. There are no approved EPA analytical methods. Efforts are underway for regional &/or national studies to address data gaps.
- Environmental impacts:** Wastewater & biosolids have contained PFAS for 50+ years – including PFOA & PFOS at higher levels than today. Bioassays of uses of effluent & biosolids have not found significant negative impacts, only benefits.
- How much will society – your municipality & state – spend chasing trace PFAS in waste streams & the environment?** And what is the public health benefit compared to use of those resources elsewhere? Prioritize – as DES has done – the obvious, highly-impacted industrial & military sites. Careful thinking is needed as screening levels & standards are set.
- Best practical option:** Phase out any PFAS that are particularly toxic, persistent, &/or bioaccumulative.

*1 ppb = 1 sec. in 31.7 years / 1 ppt = 1 sec. in 31,700 years

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A residuals compost facility...

Regulatory response in March 2017 drives recycle paper mill residuals to landfill and composting business to laying off workers.



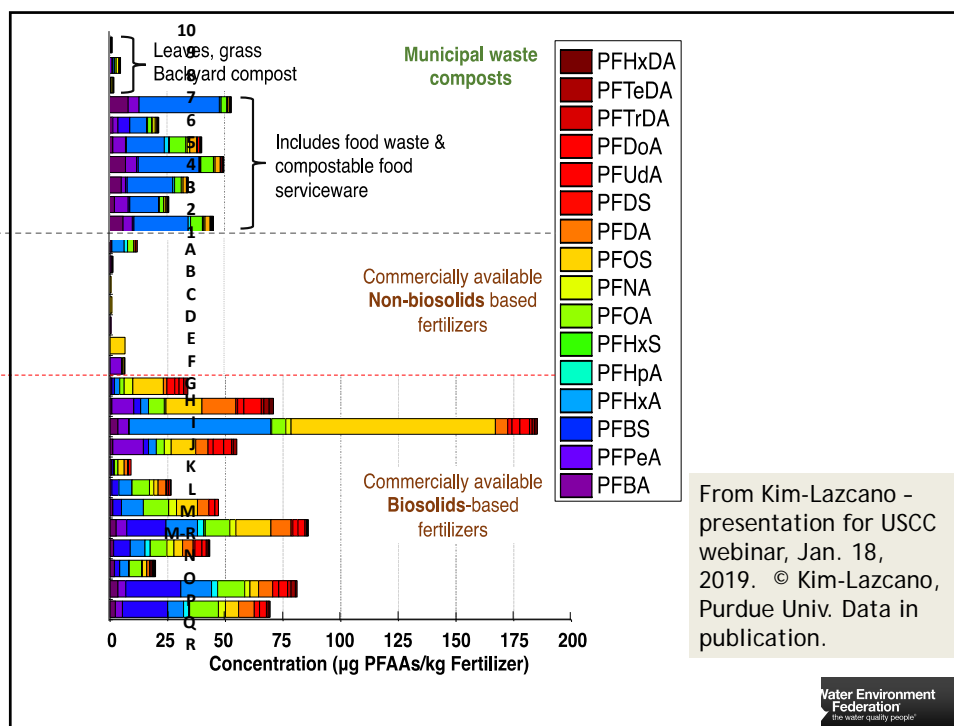
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A few biosolids around the U.S. are impacted at levels raising regulatory concern when an industry discharges large amounts of PFAS to a sewer. Apply pretreatment and source control.

- Decatur, AL (2000s)
- Lapeer, MI (2017)
- Maine farm (2019) - issue is not municipal biosolids

Large majority of biosolids average ~2 - 30 ng/g or ppb for each PFAS.

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Interim guidance - wastewater & biosolids

- *Evaluate potential sources of PFAS in wastewater. Look upstream for industries that use any of these chemicals. Look at landfill leachate. Apply industrial pretreatment & source control strategies to reduce PFAS in influent.*
- *Consider testing for PFOA and PFOS and other PFAS. Be careful, because these chemicals are everywhere and the analytical levels (ppt) are challenging. There is still no EPA-approved analytical method for PFAS in non-potable waters; one is expected in late 2019.*
- *Honestly communicate with your regulators, ratepayers, employees, and customers (farmers, landowners) about traces of chemicals - including PFAS - in various media, including wastewater, biosolids, other residuals, composts, digestates, animal manures, and soils. Honor their questions and address them as you can. Offer to provide further information.*

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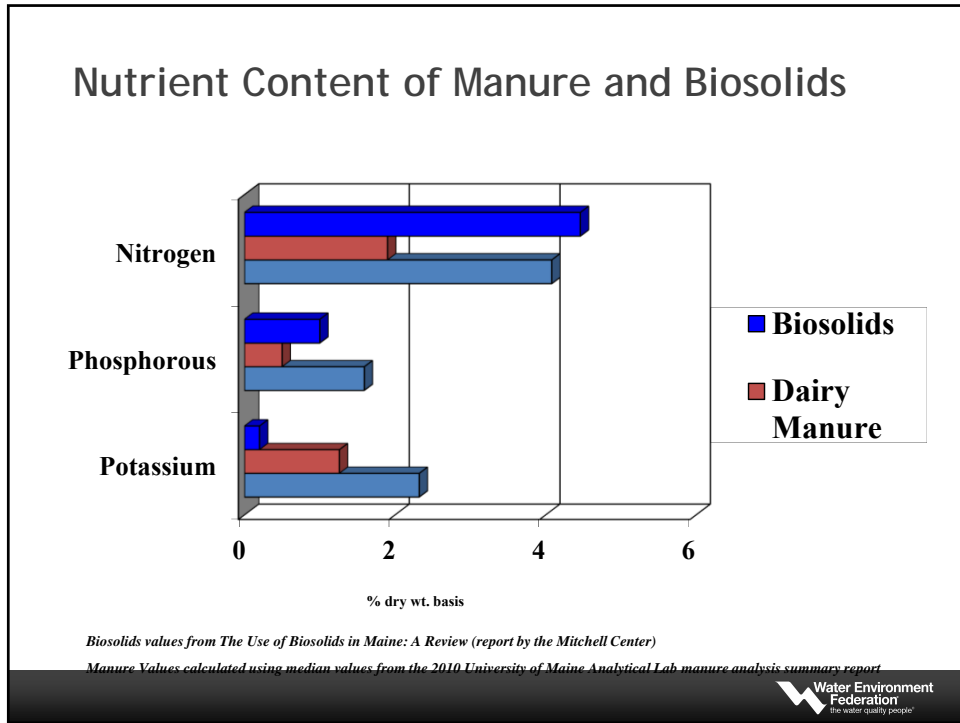
The latest...

Maine imposes moratorium... testing for PFAS required for all biosolids to be land applied

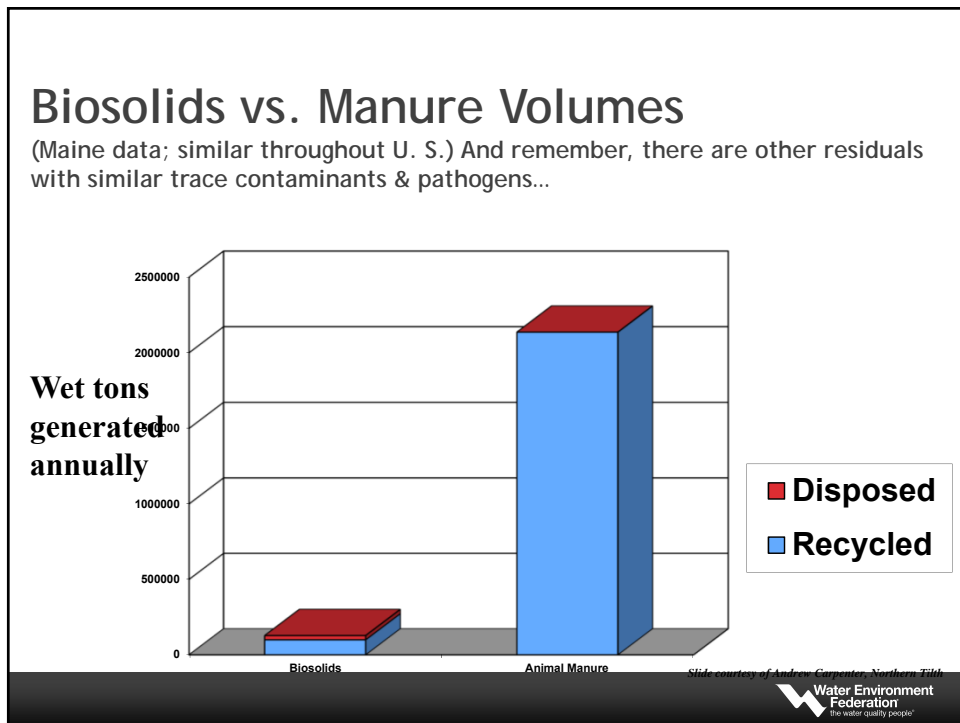
- <https://www.nebiosolids.org/maine-dep-disrupts-biosolids-recycling>

Nutrient management

a known concern
ongoing vigilance & best practices needed



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Federal guidance: USDA NRCS Code 590

Nutrient Management (January 2012)

- Applies to all nutrients - fertilizers, manures, biosolids, etc.
- Driving farm nutrient management planning
- Not regulatory, but required for many farm support programs & grants (EQIP, etc.)
- Adopted & tailored by most states

NATURAL RESOURCES CONSERVATION SERVICE
 CONSERVATION PRACTICE STANDARD
NUTRIENT MANAGEMENT
 (Ac.)
 CODE 590

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Federal regulation: Food Safety Modernization Act

- Applies to manures, biosolids - concerns with pathogens
- Reclaimed water & biosolids must be applied in accordance with EPA Part 503 and similar standards.
- Manures must be managed with similar safeguards as biosolids.
- Reasonable.
- Protective.
- Challenging for farms.

FDA Food Safety Modernization Act (FSMA)

SHARE TWEET LINKEDIN PINTEREST EMAIL PRINT

Sign-Up for FSMA Email Updates

About 48 million people in the U.S. (1 in 6) get sick, 128,000 are hospitalized, and 3,000 die each year from foodborne diseases, according to recent data from the Centers for Disease Control and Prevention. This is a significant public health burden that is largely preventable.

The FDA Food Safety Modernization Act (FSMA) is transforming the nation's food safety system by shifting the focus from responding to foodborne illness to preventing it. Congress enacted FSMA in response to dramatic changes in the global food system and in our understanding of foodborne illness and its consequences, including the realization that



Spotlight

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Don't "P" on Your Lawn!

and other lawn care tips for green lawns, not green lakes



MD's Lawn Fertilizer Law



Be Wise

don't over-fertilize





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Decades of efforts on nutrient management

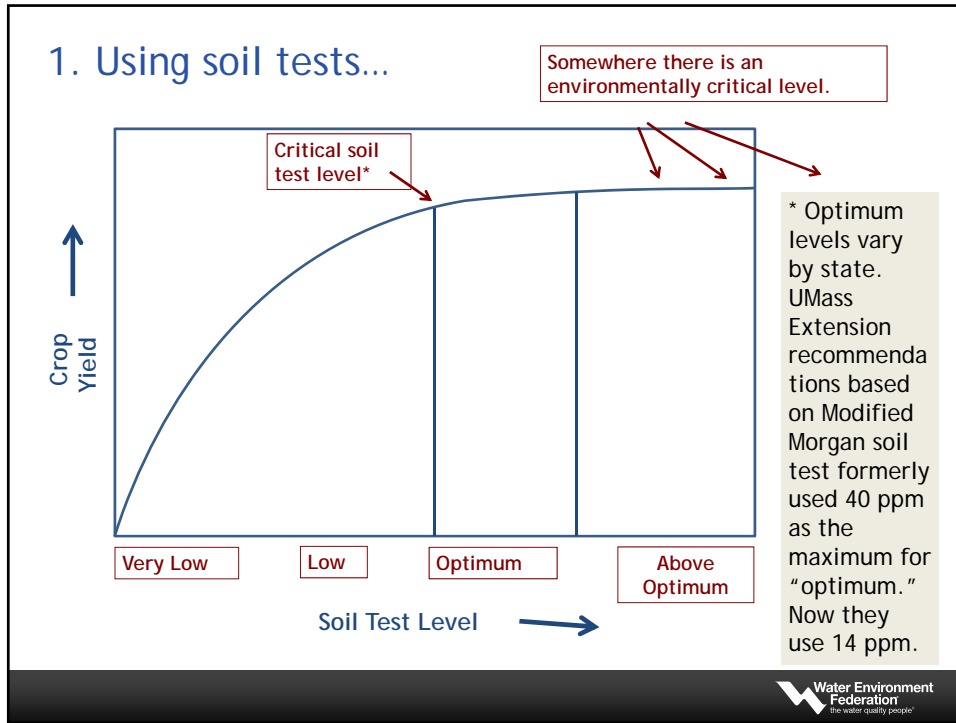
→ mostly guidance until recently

- Agricultural nutrient management planning
 - Early focus on N (leaching / groundwater), then focus on P (runoff / surface water)
 - NRCS Code 590 - last updated in January 2012, incorporated biosolids in 2011
 - Recent state examples: MD & VT efforts to reduce P to Chesapeake & Lake Champlain
- State turf & lawn fertilizer regulations - past ~10 years
 - Focused mostly on P
 - Key provision: soil test must show need before P is applied
 - ~16 states in Mid-west & Northeast, also WA
 - Some exempt biosolids, some exempt agriculture
 - New England Interstate Water Pollution Control Commission (NEIWPC) → model state regulation

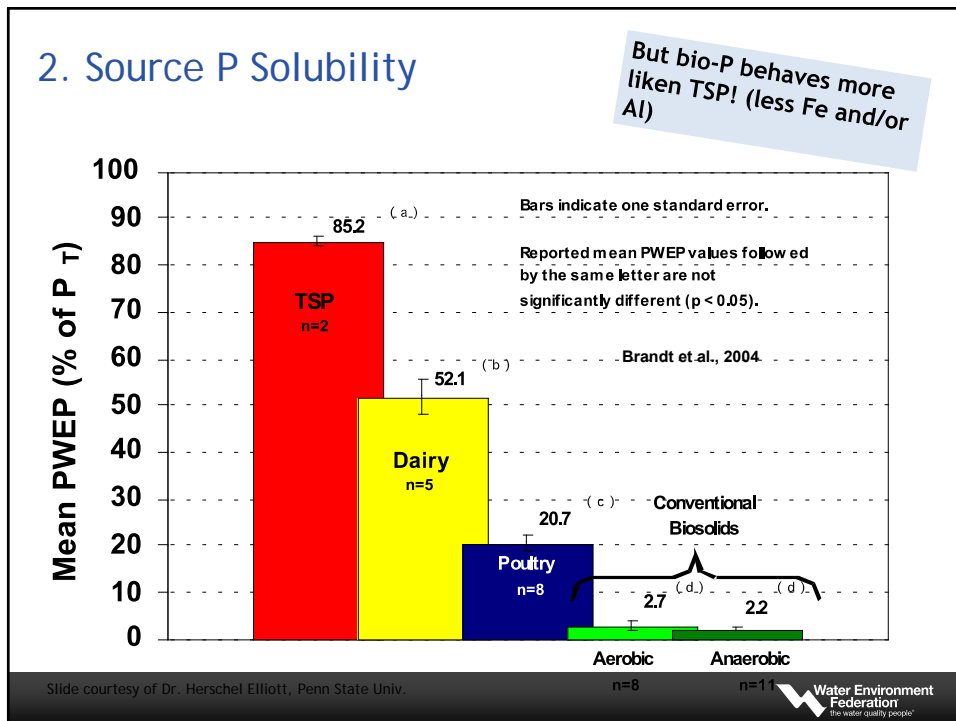




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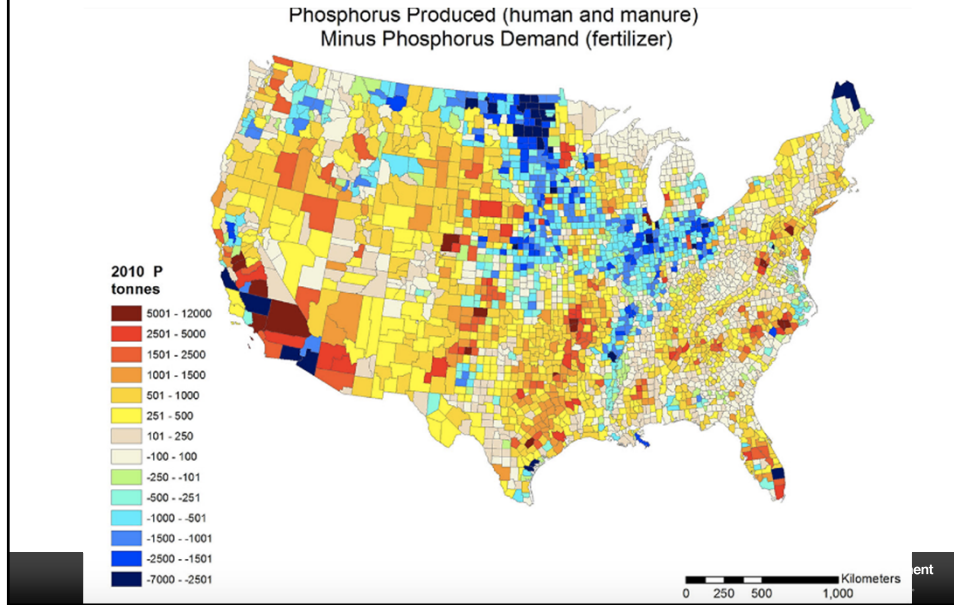


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3. Imbalanced P flows



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Jarvie et al, 2015

The Pivotal Role of Phosphorus in a Resilient Water–Energy–Food Security Nexus

Helen P. Jarvie,* Andrew N. Sharpley, Don Flaten, Peter J. A. Kleinman, Alan Jenkins, and Tarra Simmons

Abstract

We make the case that phosphorus (P) is inextricably linked to an increasingly fragile, interconnected, and interdependent nexus of water, energy, and food security and should be managed accordingly. Although there are many other drivers that influence water, energy, and food security, P plays a unique and under-recognized role within the nexus. The P paradox derives from fundamental challenges in meeting water, energy, and food security for a growing global population. We face simultaneous dilemmas of overcoming scarcity of P to sustain terrestrial food and biofuel production and addressing overabundance of P entering aquatic systems, which impairs water quality and aquatic ecosystems and threatens water security. Historical success in redistributing rock phosphate as fertilizer to enable modern feed and food production systems is a grand societal achievement in

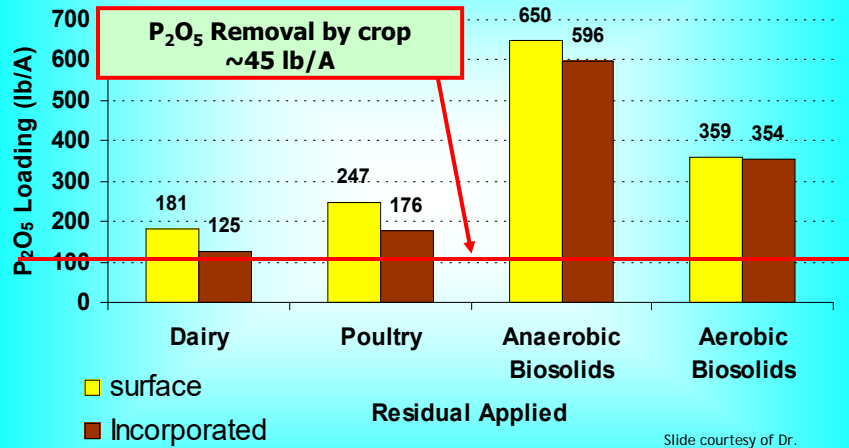
The Phosphorus Paradox at the Heart of a Converging Water, Energy, and Food Securities Challenge

The water–energy–food security nexus—the complex interrelationships and interdependencies between three critical resources that underpin human life and civilization—has been identified as one of the greatest challenges for the global economy and sustainable development (World Economic Forum, 2011; Engel and Schaefer, 2013; Olsson, 2013; Perrone and Hornberger, 2014). To date, the role of phosphorus (P) within this nexus has been overlooked. In this “Environmental Issues” contribution, we make the case that P is inextricably linked to an increasingly fragile nexus of water, energy, and food

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4. Imbalanced nutrients in biosolids & residuals:

P_2O_5 Loadings When Materials Are Used to Satisfy Crop Nitrogen Needs



Crop = 125 bu/A corn for grain with net PAN need of 84 lbs./acre

Slide courtesy of Dr. Herschel Elliott, Penn State Univ.

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Talking about nutrients: P Recovery Technologies



- some examples
- there are more now



NuReSys®
Nutrient Recovery Systems

Pearl®
Ostara Nutrient Recovery Technologies Inc.

AirPrex™
CNP Technologies

PHOSPAQ™
Paques

Multiform™
Multiform Harvest Inc.

the water quality people

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Odors

still the single factor most responsible for disruptions to biosolids recycling programs



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Stench of sewer sludge raises concerns in Loudoun Co.

By Neal Augenstein | @AugensteinWTOP
October 3, 2018 9:40 am

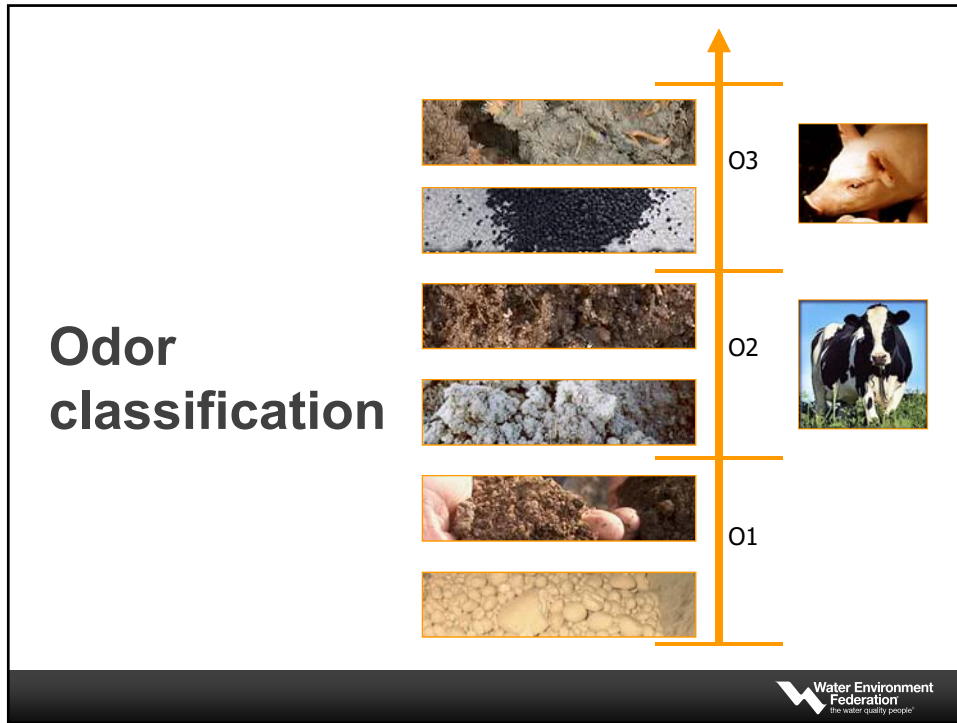
f t e p +

The stench of human waste in farm fertilizer has raised complaints from neighbors in Loudoun County and has prompted the board of supervisors to seek how it can have more control over the use of biosolids.

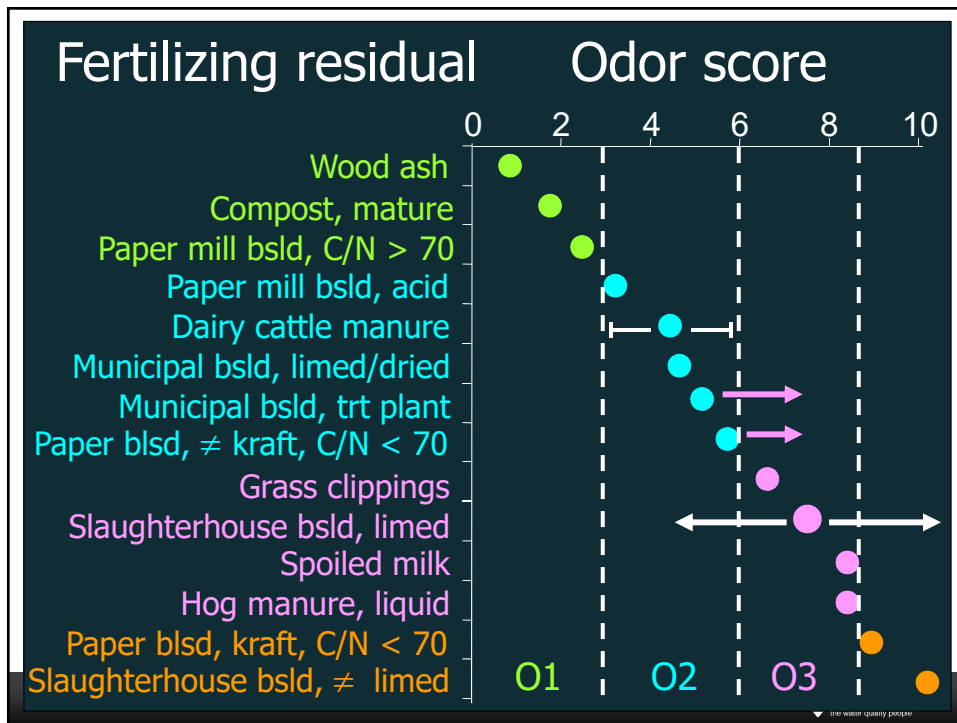
- Go above & beyond regulations.
- Stay vigilant.
- Communicate.



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And even odor control is challenging and presents surprises.

- Nitrogen (N) leaching from a biofilter at a compost facility in Maine resulted in ongoing groundwater impacts that the regulators found unacceptable. It was the *odor control system*, not odors, that led to this compost facility's current suspension of operations. <https://www.nebiosolids.org/awpca-compost-facility-closing>

Other challenges

Challenges in operations, of course... but we're not even getting into those day-to-day challenges here...

Challenges for co-digestion, as an example:

- Digester upsets / foaming
- Spikes in biogas production
- Pipe blockages (issue with FOG especially)
- Contaminants (grit, utensils, rags, trash, etc.)
- Consider ammonia toxicity (e.g. poultry DAF skimmings = 1226 mg N/L in one study; FOG is typically <100 mg N/L)
- Impacts on dewatering & biosolids quality?

- Regulations are a challenge.

Driven by public input.
Vary from state to state.
Etc.

Global GAP



- Outreach led by Greg Kester, CASA
- Trying to reverse G GAP ban on biosolids use in their voluntary growing practices standards
- https://www.globalgap.org/uk_en/



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Public scrutiny & upset

an opportunity to share the water
resource recovery story



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P & algae issues → biosolids targeted → public upset



- <https://www.tcpalm.com/story/news/local/indian-river-lagoon/health/2019/01/23/biosolids/2642871002/>



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Even the best programs are questioned.

(This is an AD codigestion energy project in MA.)

LOCAL



Cambridge's Composting Program Isn't Actually Composting. Is What They're Doing As Good?



LATEST STORIES

Greater Boston Full Show: 04



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(Not a new phenomenon...)
1991 2002

Dairy ruined by sludge: Zanders
Farmers, public warned of sludge danger
Tulalips refuse to take trash, sludge
Whatcom residents preparing a lawsuit over sludge incident
Contamination fears halt sludge fertilizer program
Could sludged trees' deaths happen here?

Pathogen Risks From Applying Sewage Sludge to Land
Human fertilizer poses cancer risk: study
University of Georgia Researchers Link Illness to Sewage Sludge Used as Fertilizer
Making a Stink

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Public & media concerns → regulatory & legal battles

- The staying power of critics & t

A Backlash After San Francisco Labels Sewage Sludge "Organic"
 —By Josh Harkinson | The Star, 4/20/17 7:43 PM EDT

Activists wearing face masks and hazmat suits dumped a pile of sewage sludge on the steps of San Francisco's city hall today to protest the city's practice of marketing the material to home gardeners as "organic compost." The US Department of Agriculture's organic standards explicitly prohibit organic produce from being grown on sludge-treated land. "The City of San

TOXIC SLUDGE IS GOOD FOR YOU!
 LIES, DAMN LIES AND THE PUBLIC RELATIONS INDUSTRY
 JOHN STAUBER AND SHELDON RAMPTON
 INTERVIEWED BY MARK

SCIENCE FOR SALE
 HOW THE US GOVERNMENT USES POWERFUL CORPORATIONS AND LEADING UNIVERSITIES TO SUPPORT GOVERNMENT POLICIES, SILENCE TOP SCIENTISTS, JEOPARDISE OUR HEALTH, AND PROTECT CORPORATE PROFITS

SEWAGE SLUDGE VICTIMS
 under construction

Real people are sick and dying across this Country from exposure to sewage sludge pollutants in biosolids.

Part 503.8(t) Pollutant is an organic substance, an inorganic substance, a combination of organic and inorganic substances, or a pathogenic organism that, after discharge and upon exposure, ingestion, inhalation, or assimilation into an organism either directly from the environment or indirectly by ingestion through the food chain, could, on the basis of information available to the Administrator of EPA, cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunction in reproduction), or physical deformations in either organisms (humans) or offspring (children) of the organisms.

EPA and the sewage industry have refused to investigate or release a list of the victims who have requested help under EPA's Charter Biosolids is the public relations term for sewage sludge that is contaminated with pollutants that EPA has admitted cause illness and death

Victims Listing
 THE UNKNOWABLE: THE X FACTOR
[HTTP://WWW.SLUDGEVICTIMS/THE_UNKNOWNABLES_THE_X_FACTORS.HTM](http://www.sludgevictims/The_Unknownables_The_X_Factors.htm)

Water Environment Federation
 the water quality people

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Outreach needed!

<http://www.waterburyobserver.org/node/2254>

RAW SEWAGE DUMPED INTO NAUGATUCK RIVER

Mon, 10/23/2017 - 01:00



Like · Reply · 5 · 17 hrs

Wallace Coles Jr. · John F. Kennedy High School, Waterbury, CT

That stupid plant should have never been built I always said and this is exactly why

Like · Reply · 1 · 18 hrs



60

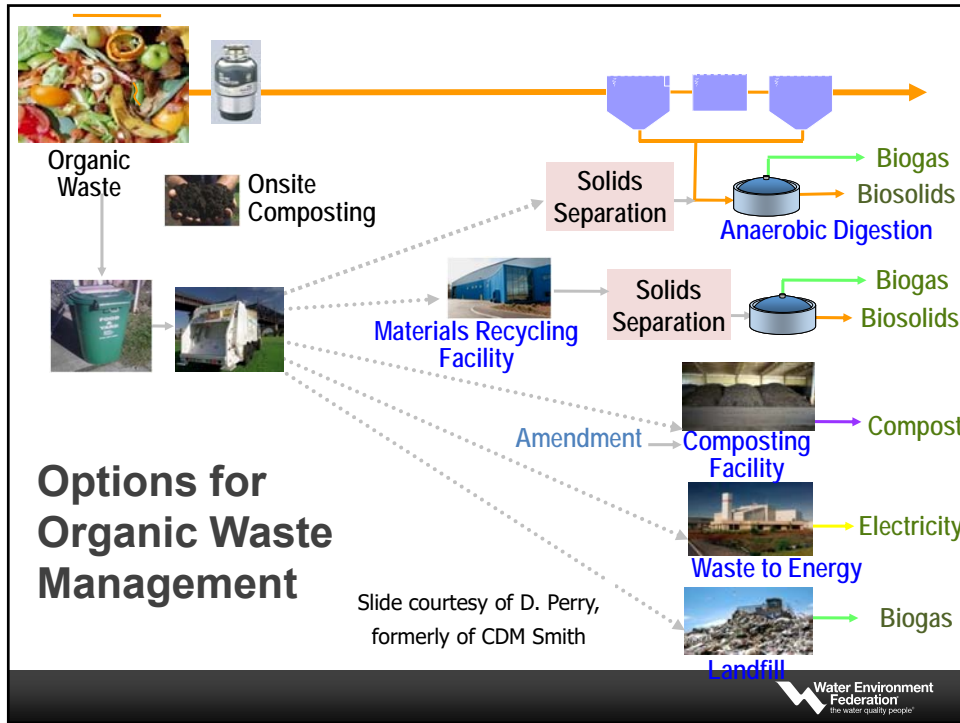
The ultimate challenge?

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THE Ultimate Challenge?

- **Wastewater solids must be managed.**
- Landfilling, incineration, use on soil... all have risks and benefits, but...
- ...in most cases, recycling to soils is the best overall environmental choice.
- And we can continue to further reduce risks by addressing the challenges head on, advancing research & best practices, & communicating proactively with all stakeholders.

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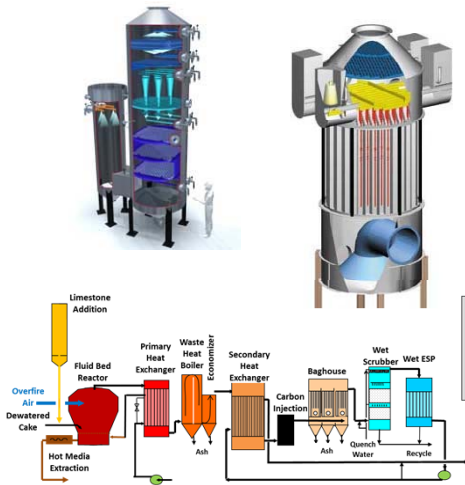
Germany chooses incineration

- <https://www.bmu.de/en/law/sewage-sludge-ordinance/>
- "The current practice of soil-related sewage sludge utilisation will only be permitted for sewage sludge from treatment plants with a capacity of less than 100,000 p.e. starting in 2029. From 2032, this will only be allowed for plants with a capacity of less than 50,000 p.e. This takes into account the special circumstances in rural regions. In addition, the ordinance opens the possibility for soil-related sewage sludge utilisation on the basis of voluntary quality control that supplements regulatory supervision."

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Incineration is challenged too.

- EPA MACT standards controlling air emissions.
- Several sewage sludge incinerators (SSIs) have closed in the past few years.
- Expensive upgrades for many.



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We have many answers...

- There are answers for these challenges, and you will hear some today.
- NEBRA's resources to address concerns:
<https://www.nebiosolids.org/resources>



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Managing biosolids & organic residuals:

What's ideal for sustainability?

MAXIMIZE BENEFICIAL USES OF RESOURCES

<u>Constituent</u>	<u>Benefits</u>	<u>Concerns</u>
Water	valuable in agriculture in dry times	cost of transport
Organic matter	vital to soils	putrescible, odor
Nutrients	plant & animal food	impacts to water
Energy	renewable, displaces oil/gas organic matter if	air emissions, no use of nutrients & incinerated

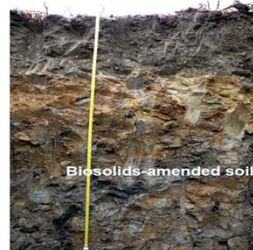
MANAGE TO MINIMIZE POTENTIAL RISKS

Reduce/control/mitigate trace elements (e.g. metals), pathogens, synthetic and natural organic chemical compounds, odors, nuisances



67

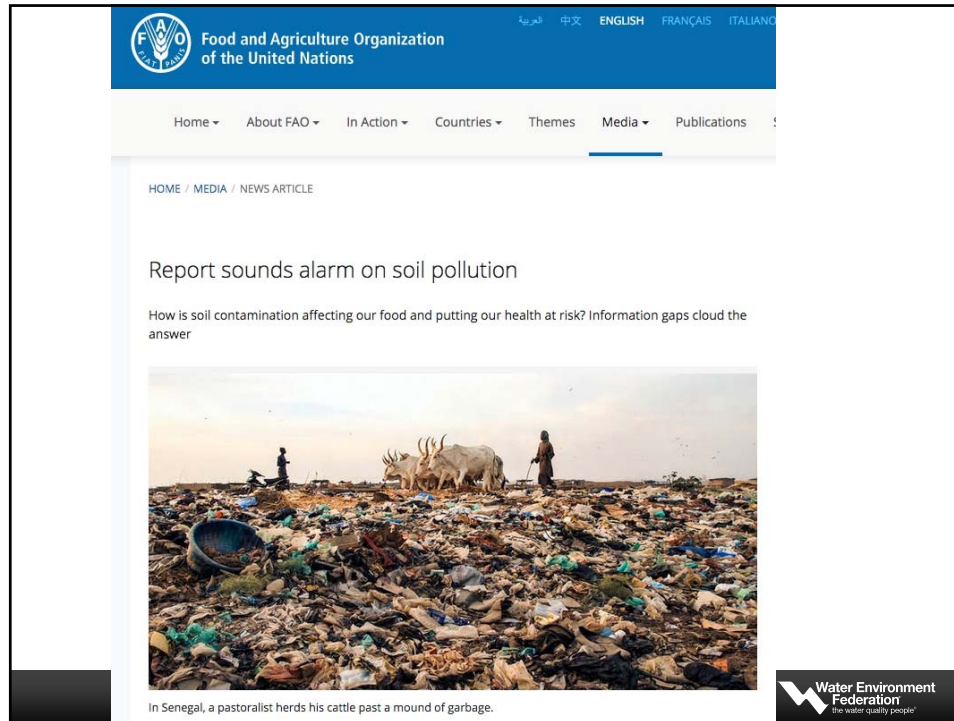
Soil Health



- Maintain high level of soil organic matter
- Optimize water stable aggregate level
- Have good level of nitrogen mineralization
- Maintain a biologically active soil
- Minimize physical or chemical soil disturbance
- Use appropriate inputs based on soil nutrient and soil health analyses.



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The screenshot shows the FAO website header with the logo and navigation menu. The article title is "Report sounds alarm on soil pollution". Below the title is a sub-headline: "How is soil contamination affecting our food and putting our health at risk? Information gaps cloud the answer". A photograph shows a pastoralist herding cattle through a large mound of garbage in Senegal. The caption below the photo reads: "In Senegal, a pastoralist herds his cattle past a mound of garbage." The Water Environment Federation logo is visible in the bottom right corner of the screenshot.


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Soil Health


In May, 2018, the U.N. FAO raised [concerns about soil pollution](#) with a [report](#) and symposium. Biosolids use is discussed: "Considering that the positive effects of sewage sludge amendment - such as waste reduction, nutrient cycling, increase of soil fertility, improvement of soil structure and water holding capacity - are significantly more important than the negative effects, efforts should focus on reducing the content of pollutants in sewage sludge and wastewaters used for irrigation."

- Rodríguez-Eugenio, N., McLaughlin, M. and Pennock, D. 2018. *Soil Pollution: A Hidden Reality*. Rome, FAO., p. 54


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Thank you.



Ned Beecher, Executive Director
NEBRA
Tamworth, NH
ned.beecher@nebiosolids.org
603-323-7654



Biosolids compost for my raspberries... still using it, even though I know it has PFAS in it. The benefits far outweigh the risks. :)



71

Sally Brown
Research Professor



**School of Environmental
and Forest Sciences**

UNIVERSITY of WASHINGTON

College of the Environment



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New Vocabulary

73

Easy to have tunnel vision

- Biosolids reflect the world we live in
- Contain traces of every thing including contaminants of concern
- While understanding fate and transport is important
- Focusing solely on these contaminants means missing the big picture
- Learn how to talk about them in language people understand

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Learn how to communicate when questions are asked
(Brown et al., 2019)

Two tablets or two truckloads



While biosolids often contain detectable concentrations of common pharmaceuticals like acetaminophen, these concentrations are typically orders of magnitude lower than a recommended daily dose. For example, you would need to eat almost 30 wet tons of biosolids to get the same amount of acetaminophen that you get in two tablets of extra strength Tylenol



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Big picture-people want to fix our soil and our planet

- They recognize bigger threats to our planet than pharmaceuticals
- Biosolids have a key role in this big picture
- Focus on how biosolids fit into this big picture

The Next Soil Advocate Training Begins April 2nd!

 A collage of five diverse people (three women and two men) smiling and engaged in conversation. One woman in the center is wearing a purple t-shirt with the text 'DEGENERATION SUSTAINABLE REGENERATION'.

Empower YOUR VOICE, be a catalyst for positive change and join a global community.



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Big picture = terms like

- Circular economy
- Soil health/ regeneration
- Nutrient density
- Food systems

And with these terms biosolids is understood as part of an answer

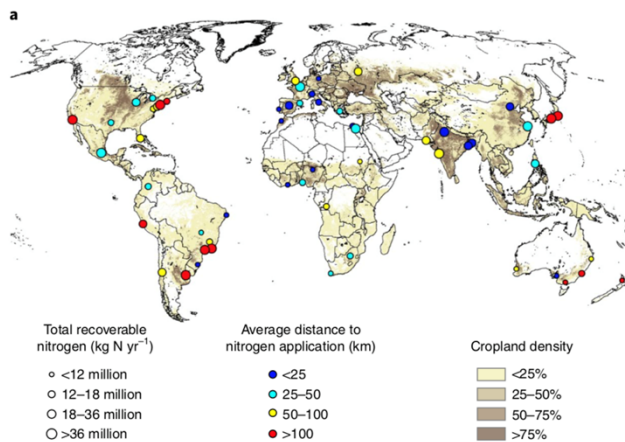
Poop is now 'cool'



77

Circular economy Recirculation of human-derived nutrients from cities to agriculture across six continents

John T. Trimmer and Jeremy S. Guest



78

Soil Quality/Soil Health Jim Ippolito CSU

(Karlen et al., 1997)



FIGURE 1.15. The effect of organic matter (OM) on the same soil type managed using conventional plow tillage (left) or zone tillage for 10 years (right). Soil with good tillth is crumbly well structured, dark with OM and has no large and hard clods.

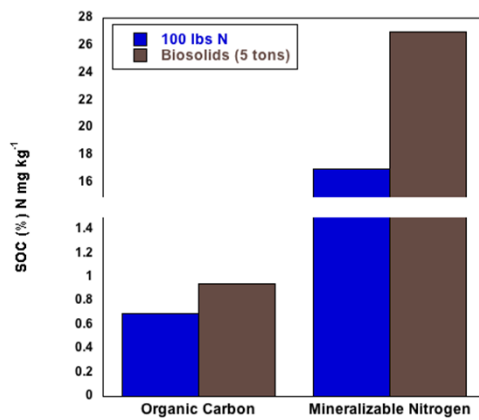
- The ability of soil to:
 - Function within natural or managed ecosystems
 - Sustain plant and animal productivity
 - Maintain or enhance water and air quality
 - Support human health and habitation

Organic matter is critical to soil quality/
health

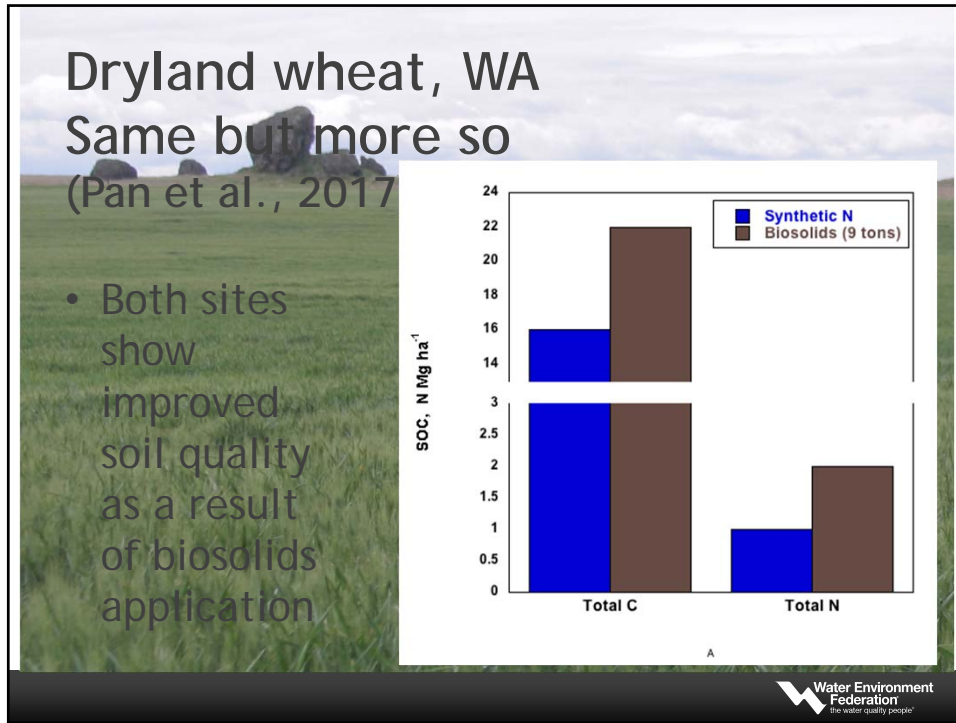


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Two biosolids studies in USDA study of soil health: Dryland wheat, CO



80



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Soil health: Erosion control

- WSU studied impact of biosolids +/- no till on soil erosion in dryland wheat
- General trend for reduced erosion with no-till
- Also indications of reduced erosion with biosolids as a result of increased soil C and associated higher moisture content in soil

<https://www.loopforyoursoil.com/what-is-loop/videos-media/>

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Nutrient density- 'biofortification'

Zinc = essential nutrient
Zinc ~~=~~ heavy metal

- Steve P. McGrath- long-time biosolids 'opponent' from UK
- Biofortification of zinc in wheat grain by the application of sewage sludge (2012)



83

My own research: Exploring the link between Soil health and plant yield and nutritional status

- Field study measuring both yield and nutritional quality
- Biosolids and vermi-compost versus fertilizer



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Two sites- control (NPK) versus amended

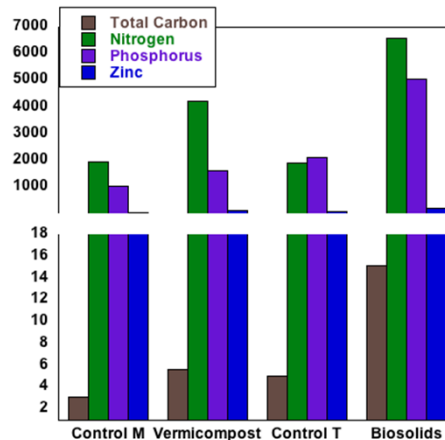
- Vermi-compost
- Biosolids soil product



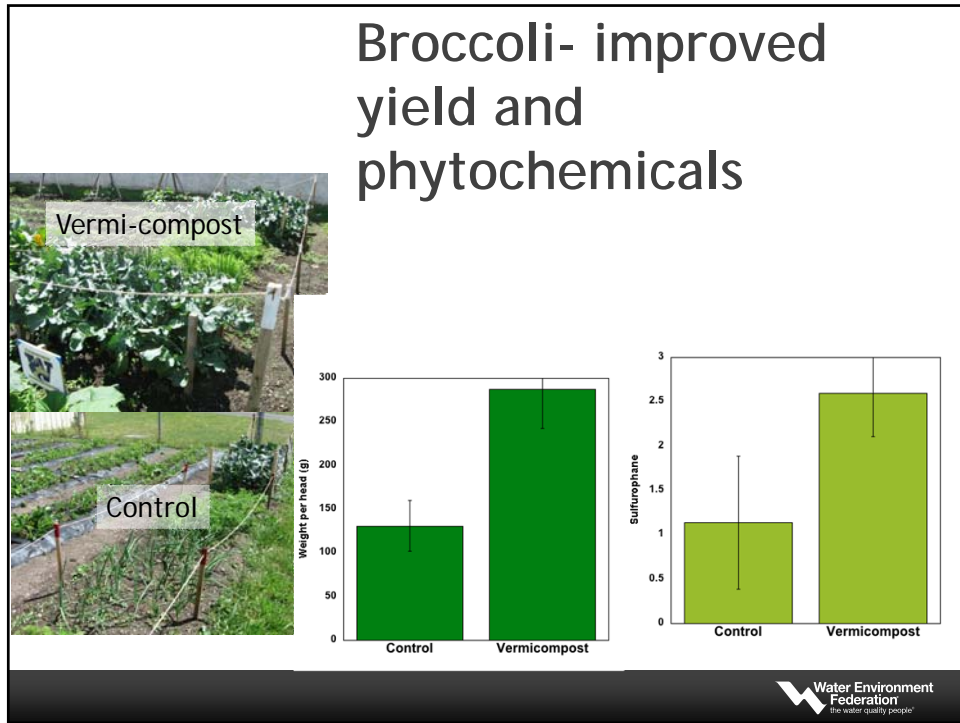
85

General improvement in soil health

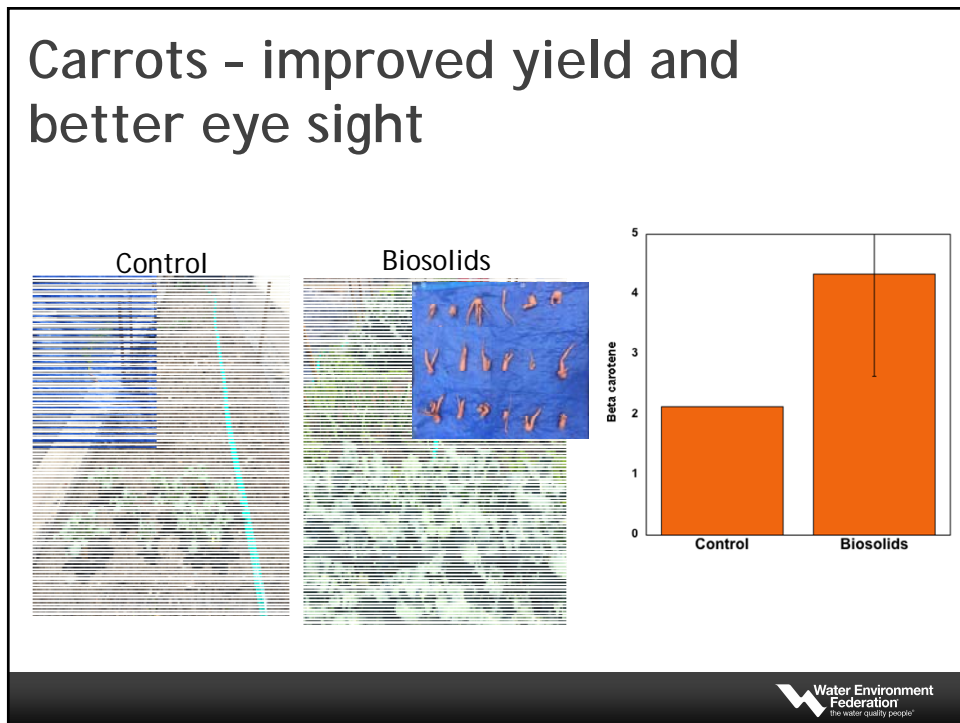
- Increased C, N, P, Zn
- Also reduced bulk density, improved water infiltration
- More to be tested



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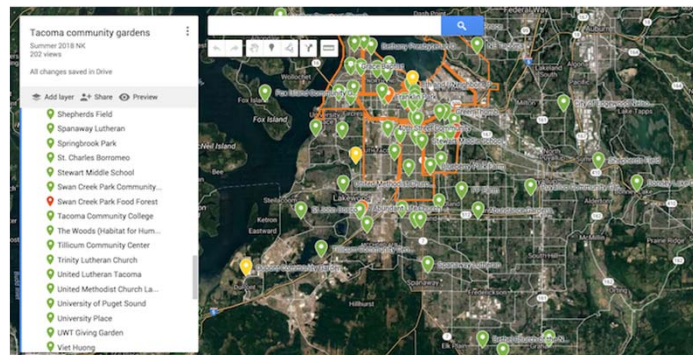
Leads to the question of how biosolids can be used in local food systems



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Harvest Pierce County

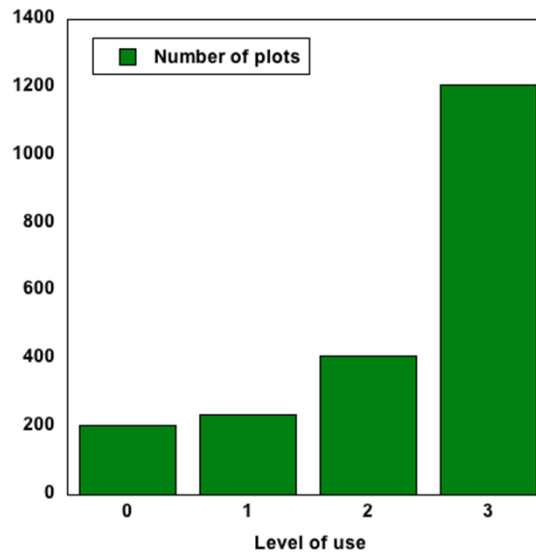
- Community garden program in Tacoma
- All gardens get free Tagro



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Harvest Pierce County

- The 67 gardens surveyed had a total of 2057 plots
- Assuming 3 people are impacted by each plot that means that over 6000 people benefit from the 67 gardens surveyed
- The total area farmed across the gardens surveyed was 10.55 hectares or 26 acres



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Can any city make its own version of Tagro?

- Ryan Batjiaka - MS student, now with San Francisco



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Goals for a blended biosolids soil amendment

Treatment	Specifications	Odor	Appearance	Plant growth
af	Fail	Fail	Pass	Fail
bc	Fail	Pass	Pass	Pass
gb	Fail	Pass	Fail	Fail
rs	Fail	Pass	Fail	Pass
rsd	Fail	Pass	Fail	Pass
SF cake	Fail	Fail	Fail	Fail
vlf	Fail	Pass	Fail	Pass
vlf 100	Pass	Pass	Pass	Fail
ws	Fail	Fail	Fail	Pass
wsc	Fail	Fail	Pass	Fail
yf	Fail	Pass	Pass	Pass
Yard waste fines + cake	Pass	Pass	Pass	Pass
zlf	Fail	Pass	Pass	Pass
zlf 100	Pass	Pass	Pass	Pass

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What have we learned?

Blending makes products which can better meet specifications

Blends had less offensive odors than biosolids

Blends promote plant growth better than biosolids alone

Curing generally improves odor

Several blends meet all of our criteria

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For fun and profit:

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Conclusions

- Shift the focus to broader issues
- This will shift the discussion
- People are ready



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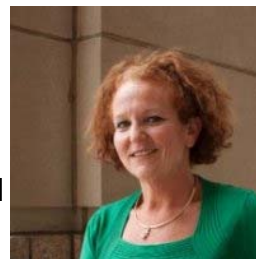


Metropolitan Water Reclamation District of Greater Chicago



Dominic Brose, PhD
Senior Environmental Research
Scientist

Allison Fore
Public & Intergovernmental
Affairs Officer




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Overview of the MWRD Chicago

- **Founded in 1889 to protect Lake Michigan**
- **Services Cook County including City of Chicago and 125 suburban communities (875 sq. miles)**
- **Population equivalent of 10 million people (5.75 residential)**
- **Seven water reclamation plants treating nearly 1.4 billion gallons of water each day (total treatment > 2 billion)**
- **Tunnel and Reservoir Plan (TARP) > 14 billion gallon capacity for stormwater management**



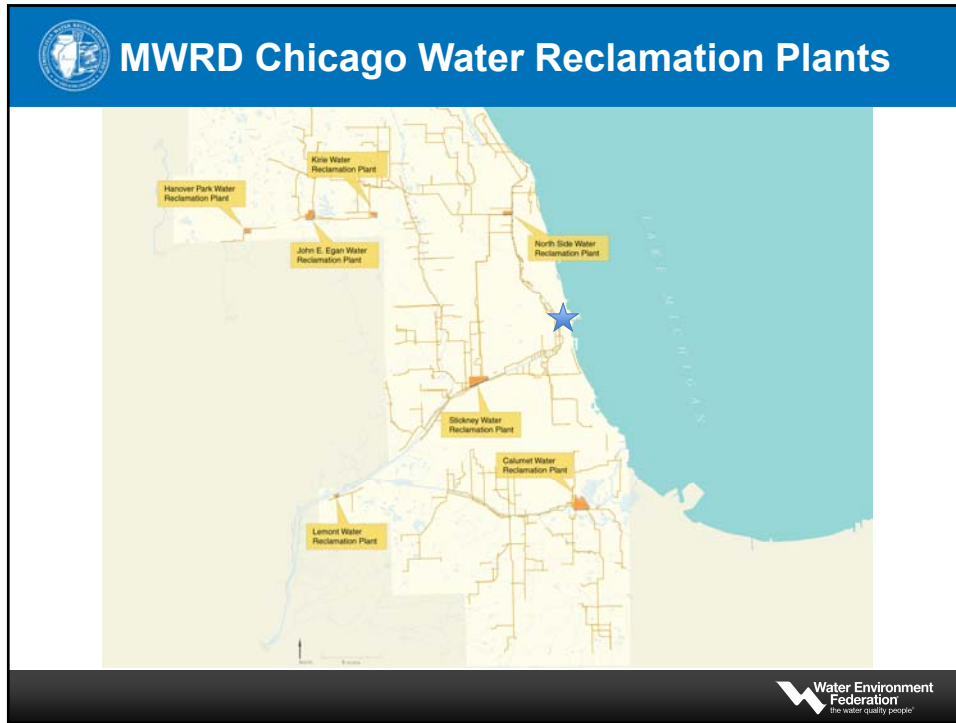
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MWRD Chicago Board of Commissioners




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MWRD Chicago's Biosolids Programs

- **The MWRD Chicago produces ~ 120,000 dry tons of biosolids annually**
- **Different biosolids products target different uses:**
 - ✓ Class A EQ air-dried biosolids: topdressing at parks/golf courses
 - ✓ Class A EQ composted biosolids: landscaping applications
 - ✓ Class A EQ heat-dried pellets: produced/distributed by Veolia N.A.
 - ✓ Class B lagoon- or mechanically-dewatered biosolids: farm-field application

The Water Environment Federation logo is in the bottom right corner.

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EQ Compost: For An Urban Market

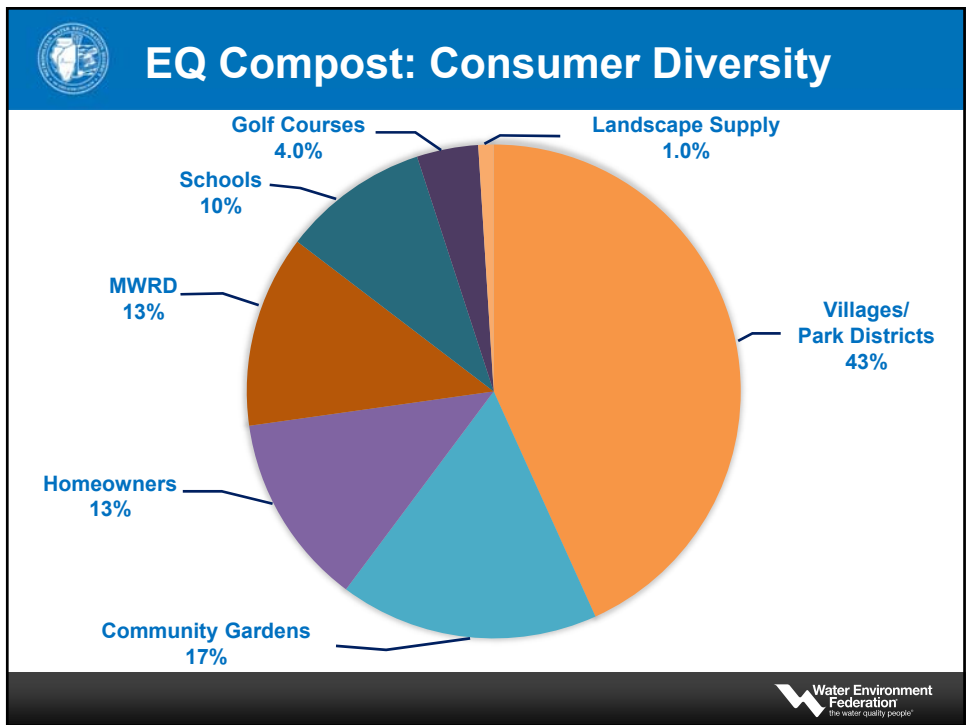
➤ Composting was piloted in 2015 and began full-scale in 2016 to broaden distribution in Chicago

3 Woodchips + 1 Biosolids + Oxygen



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EQ Compost: Program Outreach

<p>Outreach</p> <ul style="list-style-type: none"> ✓ Residents ✓ Landscapers ✓ Parks ✓ Community Gardeners ✓ Schools 	<p>SAFETY</p>	<p>Use</p> <ul style="list-style-type: none"> ✓ Flowers / Shrubs ✓ Topsoil Blends ✓ Vegetables ✓ Lawn Care ✓ Restoration
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Program Outreach: Tailoring a Message

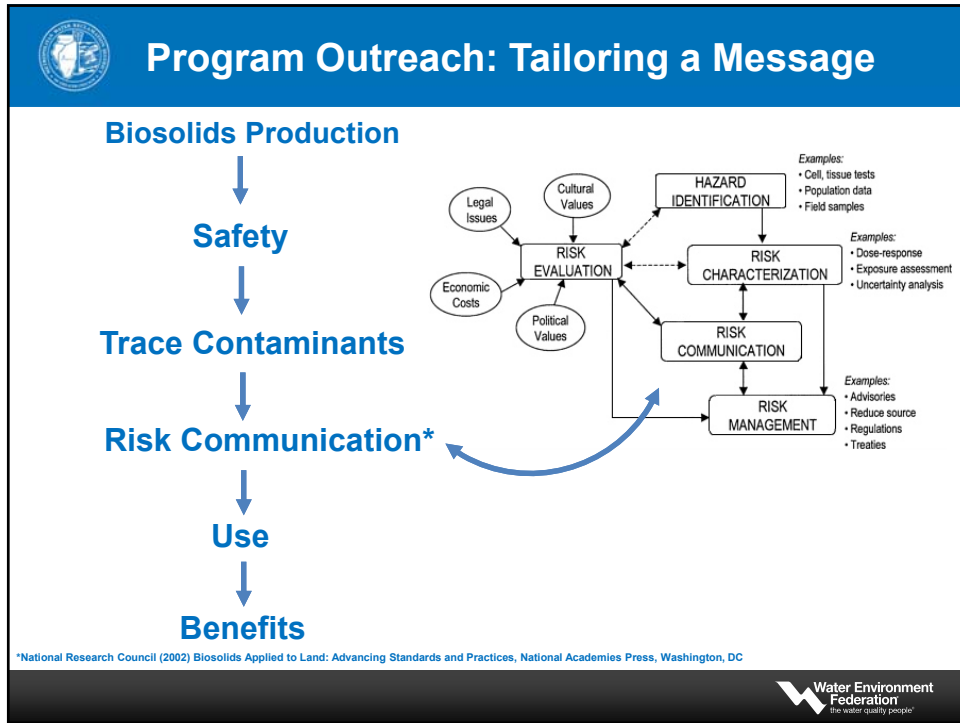
<u>Approach</u>	<u>Messages</u>
<ul style="list-style-type: none"> ➤ Speaking at Organizational and Community Meetings ➤ Direct Public Interaction and Engagement ➤ Site Visits ➤ Providing References / Resources 	<ul style="list-style-type: none"> ➤ Hazard ≠ Risk ➤ Relative Risk ➤ Product Familiarity ➤ Benefits



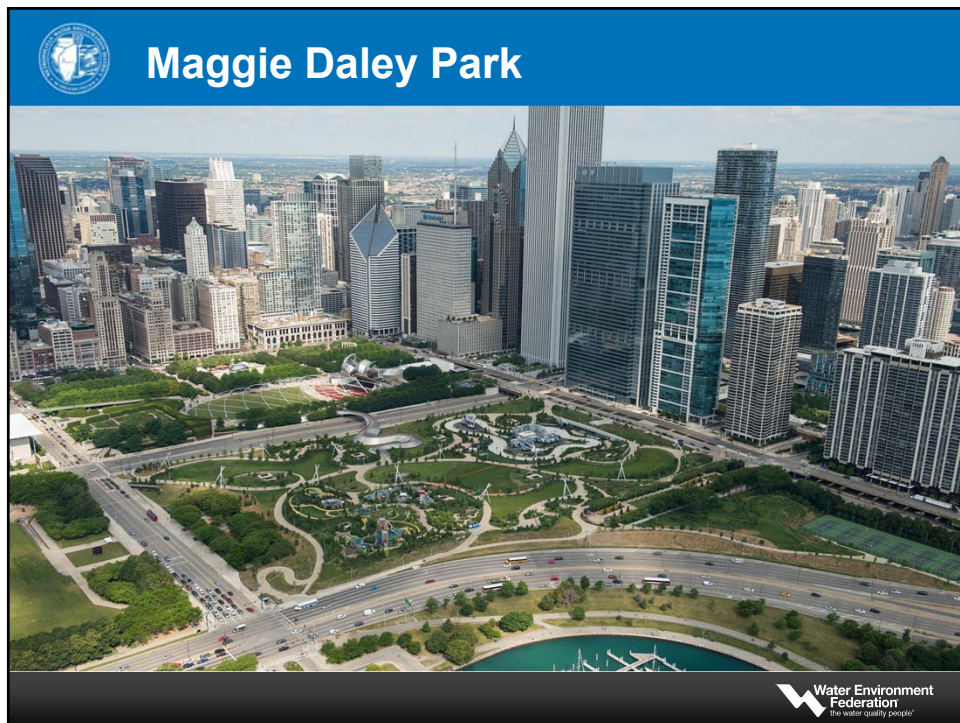


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Maggie Daley Park: A biosolids delivery

Metropolitan Water Reclamation District of Greater Chicago
Press Release
 For immediate release July 9, 2014

First truckloads of MWRD biosolids delivered to Maggie Daley Park



Metropolitan Water Reclamation District of Greater Chicago (MWRD) Commissioners were on hand as the first truckloads of MWRD biosolids were delivered to the future Maggie Daley Park in downtown Chicago recently.

Biosolids are the nutrient-rich, organic material developed through the extensive wastewater treatment process. They are a superior, yet less expensive alternative to chemical fertilizers. They are used in landscaping and for fertilizing turf grass at parks and athletic fields and row crops in farmers' fields.

Chicagoand soil can be too compacted for good root development, and it can lack the vital nutrients and organic matter that plants need to thrive. Heavy summer rains can wash fertilizers away, and long dry spells can leave grass parched. Using biosolids can help create a beautiful landscape.

With improved soil quality, turf grass at the park will be healthier, more durable and will require less maintenance. Biosolids provide nutrients but also improve soil structure, help retain moisture and prevent erosion. MWRD biosolids will be mixed with soil to improve the quality of the fields at Maggie Daley Park.

"Maggie Daley was a passionate advocate for the children of Chicago," said Commissioner Patrick D. Thompson. "The park will be a wonderful place for children and families to enjoy. It is an honor to play a part in the creation of this very special tribute to an amazing person."

Maggie Daley Park's total acreage is 25.2 acres, of which 18.9 acres will serve as a green roof parking facility. This will be the second largest green roof in the country, with the 24.5 acres of Millennium Park the largest. The park will provide 85,580 cubic feet of detention volume storage across the green roof site and another 19,863 cubic feet of detention volume storage in the area known as Peanut Park.

Additional information about Maggie Daley Park can be found at <http://maggiedaleyconstruction.org/>. Additional information about MWRD biosolids can be found at www.mwrdd.org or by calling (312) 751-4633.




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Sun Times, WTTW 2014

20 FRIDAY, JULY 18, 2014 CHICAGO SUN-TIMES CHICAGO SUN-TIMES.COM

VIEWPOINT

Getting over the ick factor



MARLEEN GARCIA

Some will snicker and others will be unimpressed after reading this column. Those with a truly open mind about recycling will appreciate the innovation.

It's about turning human waste into organic fertilizer, a process being undertaken across the country by municipalities that dispose of tons of waste daily after we flush toilets.

Some towns still use landfills to deposit sludge while others incinerate it. Recycling human waste is an alternative backed by Environmental Protection Agency.

Under strict EPA guidelines, the Metropolitan Water Reclamation District of Greater Chicago is turning human waste into organic fertilizers, in the pellet form or a fine dirt-like substance that resembles topsoil.

The recycling process is complex (don't try it at home) and involves the use of heat and microorganisms to greatly reduce odors and eliminate harmful pathogens such as E.coli. I saw the operation up close at the MWRD's Slickney plant; it doesn't smell nearly as bad as the mushroom compost that made me gag when I hauled it from the garden store.

In its finished form, recycled waste is termed a biosolid, though some still call it sludge.

Most of us probably have been to parks or eaten food from crops fertilized with it.

"Farmers are getting amazing results," said Herb Ogg, an extension educator for the University of Nebraska who works with a biosolid program that has been in place for 22 years.

Ogg explained that biosolids contain slow-release nitrogen that isn't prone to run off from rains. Chemical fertilizers have the run-of problem, increasing contaminants in groundwater and sapling plants of nitrogen.

In Chicago, Maggie Daley Park is incorporating 4,000 cubic yards of biosolids to enhance that soil, according to the MWRD Area schools and golf courses also have used biosolids.

Under EPA standards, the MWRD must closely monitor the distribution of biosolids and their effects after applications. This is important, especially in farming, where research has shown that biosolids, richer in nutrients than other fertilizers, can provide too much phosphorous with repeated use.

A leading soil scientist for the MWRD, Lakhwinder Hundal, said his department has conducted more than a million analyses on biosolids, screening for metals and pathogens and studying nutrients. Cow manure, a popular steady fertilizer full of pathogens, isn't analyzed with such scrutiny.

The MWRD had trouble removing metals from biosolids in the past but has made substantial progress in recent decades, thanks to enhanced oversight of industrial companies.

Still, environmental groups have not embraced biosolids.

The Illinois Environmental Council is encouraged because of the elimination of metals but remains concerned about pharmaceutical drugs contaminating the recycling process, according to Executive Director Jennifer Walling.

"Traces of medicines "are present but at such low levels that there is no impact," said Jeff Hutton of the Illinois EPA.

There's also a general ick factor for the public.


"Society has to change the way it thinks," said David St. Pierre, MWRD executive director. "We have to learn how to use everything."

In September, the Illinois EPA will begin revising its guidelines to allow the public to buy biosolid fertilizers produced here. Other states already do it.

We can buy Milorganite fertilizer, derived from Milwaukee sludge, at garden centers around here.


I'm betting our shade is as good as theirs.

Email: marlegarcia777@gmail.com



NEWS MAIN VIDEO ARCHIVE SPONSORS ABOUT
 Politics Education Business Culture Science/Technology Health


SCIENCE/TECHNOLOGY
Transforming Waste into Organic Material
 Chicago Tonight | August 15, 2014 5:30 pm




LAKHWINDER HUNDAL
 METROPOLITAN WATER RECLAMATION DISTRICT

They're called Class A and Class B biosolids and take weeks to years to make. They're great for the ground, and the Metropolitan Water Reclamation District of Greater Chicago grows over tons of the material for free on a regular basis. The process is done on the property of the Hickory Plant, which is the world's largest water treatment facility, handling billions of gallons of water daily.

The MWRD's dream is that new EPA guidelines will make biosolids available for the general home gardener. But there still need to figure out exactly how to market it. It is a time when contaminated water supplies and communicable diseases are terrifying the larger population, the scientists at the MWRD have the research and experience to prove they have a safe product. But it's enough convincing the public because nobody believes their neighbor's boss doesn't stink.




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 **Sun Times 2018**

CHICAGO SUN+TIMES
The Hardest-Working Paper in America
Our Pledge To You

NEWS
05/30/2018, 03:17pm


A recycling effort that shouldn't go to waste



Exceptional quality bioresidue compost produced at the Metropolitan Water Reclamation District of Greater Chicago's Joliet plant. | Ashlee Kain/Sun-Times

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By Marlen Garcia [email](#)

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 **Tours: The public and elected officials**





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Tours: Illinois Congressman

Metropolitan Water Reclamation District of Greater Chicago

Press Release

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For immediate release January 31, 2018

Congressman Mike Quigley works as undercover Treatment Plant Operator

Congressman Mike Quigley served as an undercover treatment plant operator at the Metropolitan Water Reclamation District of Greater Chicago's (MWRD's) Stickney Water Reclamation Plant in Cicero on Jan. 24. "Congressman Quigley is a great champion of the environment and Illinois," said MWRD President Kathleen Means. "He continues to support TARP and other environmental and life quality efforts in Cook County. We appreciate his interest in our day-to-day activities that protect the health and welfare of our region. *The tasks we perform are not always glamorous but they*"

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Community partnerships

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Community partnerships




Metropolitan Water Reclamation District of Greater Chicago
Press Release

Alison Foss
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For immediate release
September 1, 2017

Mega plants sprout from MWRD biosolids at Franklin Park garden

The sunflowers in Franklin Park this summer are nearly 12 feet tall and the corn stalks reach 18 inches thanks in part to a valuable resource: Metropolitan Water Reclamation District of Greater Chicago (MWRD) biosolids that is sprouting plant growth across Cook County to the south.

Last week, Franklin Park Mayor Ramon Pacheco and Franklin Park Deputy Commissioner of Utilities Andrew Tomlin presented a narrow strip of green space to the northwestern corner of the Tin House Taverned into a beautiful garden. They contacted the MWRD, and the MWRD donated and delivered 127 tons of Class A exceptional quality (EQ) biosolids last October.

It was not the 127 tons of EQ biosolids from the MWRD that was a challenge, it was the Mayor Pacheco and Deputy Commissioner Tomlin's request that MWRD officials to come check out what they had created. MWRD Commissioner Kurt Sheck, MWRD District Manager Michael Lohm and Environmental Soil Scientist Douglas Brown visited the Franklin Park garden recently and were impressed with what they saw.

"I greatly commend Mayor Pacheco and Commissioner Tomlin for their efforts in transforming an unused piece of property into a lush green oasis," said Commissioner Sheck. "I think this is a meaningful example of getting municipal resources to work."

Biosolids are an environmentally friendly product of the water treatment process that recycle organic matter and improve soil structure and capacity to allow plants to more effectively utilize nutrients. Under the Clean Environmental Protection Act, signed into law in 2003, biosolids were formally recognized as a safe, beneficial and renewable resource that should be used locally. Rather than being hauled out of state to distant farms and landfills as in years past, the biosolids are now beneficially recycled in Cook County to the local food bank and feed the fish, the ornamental trees, and are used on refuge as well as forests, athletic fields and other recreational areas, and for restoration of landslides and other degraded land.

"The Franklin Park community has continued to be a tremendous partner," said MWRD President Matthew Spagnuolo. "Whether it's providing valuable property, helping us get an excellent site management and working toward sustainable solutions like rain barrels, we have seen our great collaboration, we have others on this success story and participate in helping to protect our environment one community garden at a time."

Recovering Resources. Transforming Water

Established in 1889, the MWRD (successor) is an award-winning, special purpose government agency responsible for water treatment and wastewater management in Cook County, Illinois.



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Community partnerships

Metropolitan Water Reclamation District of Greater Chicago
Press Release

Alison Foss
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100 East Erie Street, Chicago, Illinois 60601

For immediate release
August 15, 2017

MWRD biosolids compost help energize Ford Heights field of dreams




The MWRD provided 130 tons of Class A exceptional quality (EQ) biosolids compost, a product of the water treatment process that recycle organic matter and improve soil structure and capacity to allow plants to more effectively utilize nutrients. The compost can be used as a soil amendment or conditioner for establishing and growing or as a nitrogen fixer to improve soil health. These biosolids were recycled in 2015 recognizing the environmental benefits of recycling MWRD biosolids locally to provide green to the community. It was successfully used as golf courses and athletic fields at both public parks and schools in the Chicago area, including Maggie Daley Park and the 95th Trail.

"We are happy to support this beautiful project that gives Ford Heights' biosolids plants an attractive place to play and the entire community a central meeting place," said MWRD President




Matthew Spagnuolo. "Thank you to Cook County Sheriff Tom Dart for coordinating this amazing project and for offering us the opportunity to come to the aid of Ford Heights by restoring these reclaimed resources that benefit the environment of the Cook County community as a whole."

The field became an initiative of Sheriff Dart after hearing the story of Ford Heights Park District President and baseball coach George "Katy" Green and local baseball player. Residents of the neighborhood south which first formed a youth team in 2014, but the team had to travel to neighboring, wealthier suburbs to play, which hampered local involvement and increased the cost for participation. The Cook County Sheriff's Office, which serves as the village's local police department, has sought to support recreation and participation in the area.

"Prior to this field, these kids had to travel miles away to play baseball. Thanks to everyone who came together and put in more than a year and a half of work, the children of Ford Heights now have a field of their own and this community, that has seen so much hardship, has created a place that is theirs," said Sheriff Dart. The Cook County Sheriff's Office reached out to the MWRD and other partners. Cook County District project provided 147,000 and the Baseball Tournament Fund, a joint initiative, committed



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Annual Event: Sustainability Summit

Office of Environmental Sustainability
210 East Lake Street
Chicago, IL 60601

Metropolitan Water Reclamation District of Greater Chicago

Marysue T. Strykowski President	Sam Durkin Marsh J. Durkin
Barbara J. McDonnell Vice President	Julina Morris Debra Shore
Frans Aulla Chief of Finance	Karl K. Steele David J. Walsh

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SIXTH ANNUAL SUSTAINABILITY SUMMIT 2018
Tuesday, October 16 | 10 a.m. - 1 p.m.

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Annual Event: Chicago Flower & Garden Show, Navy Pier

CHICAGO FLOWER & GARDEN SHOW

For the first time, the District participated in the Chicago Flower and Garden Show held at Navy Pier March 14 - 18. The booth depicted the backyard of a house and highlighted the use of rain barrels, permeable pavement and our compost products. The project was a joint effort of multiple departments: Law, M&C, M&I and Public Affairs. Public Affairs Specialist Justin Brown drew the needling for the booth, and the structure was brought to life and constructed by carpenter foreman Jim Foley and carpenters Pat Richardson and Dave Robertson. An estimated 40,000 people from throughout the area attended the show, and many took home sample buckets of compost and entered the District's drawing to win a free rain barrel by completing the District's Water Environment Pledge. Residents Justin, staff working at the show included Dominic Brose, Environmental Soil Scientist; Dan Dreger, Environmental Research Technician; Allison Fore, Public & Intergovernmental Affairs Officer; Jan Kolar, Graphic Artist; Rudip Kumar, Senior Environmental Soil Scientist; Olawale Oladajo, Environmental Soil Scientist; Shelia Porter, Senior Public Affairs Specialist; Maricela Sotelo, Environmental Research Technician; Robert Swanson and Cindy Qin, Environmental Research Scientists; and Pat Thomas and Dan Wendt, Public Affairs Specialists. In addition, Commissioner Karl K. Steele helped welcome visitors throughout the event, and Lisa Luhrs Draper, Head Assistant Attorney, stopped by the Yellow Brick Road.

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P&M concept Green Back Yard

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 **Giveaways: Compost & Saplings**



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 **For additional information**



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Questions?



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