DISPOSAL & DISCHARGE

2018 Duke University study - radioactivity in waste that EPA still allows to be sent to municipal facilities is contaminating waterways. SB 753 would ban.

The EPA still allows waste to be treated and discharged from municipal facilities into waterways if it comes from vertically drilled or conventional wells.

Radioactivity from oil and gas wastewater persists in Pennsylvania stream sediments

Study finds that high levels of radioactivity persist in stream sediments at three disposal sites.

The contamination is coming from the disposal of conventional, or non-fracked, oil and gas wastewater, which, under current state (of PA) regulations (and EPA guidelines), can still be treated and discharged to local streams.

The level of radiation found in stream sediments at the disposal sites was about **650 times higher** than radiation in upstream sediments. In some cases, **it even exceeded the radioactivity level that requires disposal only at federally designated radioactive waste disposal sites**.

"**It's not only fracking fluids that pose a risk; produced water from conventional, or non-fracked, oil and gas wells also contains high levels of radium, which is a radioactive element. Disposal of this wastewater causes an accumulation of radium on the stream sediments that decays over time and converts into other radioactive elements**," said Avner Vengosh, professor of geochemistry and water quality at Duke's Nicholas School of the Environment.

"Despite the fact that conventional oil and gas wastewater is treated to reduce its radium content, we still found high levels of radioactive build-up in the stream sediments we sampled," Vengosh said. "Radium is attached to these sediments, and over time even a small amount of radium being discharged into a stream accumulates to generate high radioactivity in the stream sediments."

"While restricting the disposal of fracking fluids to the environment was important, it's not enough," he said. "Conventional oil and gas wastewaters also contain radioactivity, and their disposal to the environment must be stopped, too."

https://nicholas.duke.edu/about/news/radioactivity-oil-and-gas-wastewater-persists-pennsylvania-stream-sediments

CITATION: "Sources of Radium Accumulation in Stream Sediments Near Disposal Sites in Pennsylvania: Implications for Disposal of Conventional Oil and Gas Wastewater," Nancy Lauer, Nathaniel Warner, Avner Vengosh, *Environmental Science and Technology*, DATE Jan, 4, 2018, DOI: 10.1021/acs.est.7b04952

Abstract

In Pennsylvania, Appalachian oil and gas wastewaters (OGW) are permitted for release to surface waters after some treatment by centralized waste treatment (CWT) facilities. While this practice was largely discontinued in 2011 for unconventional Marcellus OGW at facilities permitted to release high salinity effluents, it continues for conventional OGW. This study aimed to evaluate the environmental implications of the policy allowing the disposal of conventional OGW. We collected stream sediments from three disposal sites receiving treated OGW between 2014 and 2017 and measured ^{228}Ra, ^{226}Ra, and their decay products, ^{228}Th and ^{210}Pb, respectively. We consistently found elevated activities of ^{228}Ra and ^{226}Ra in stream sediments in the vicinity of the outfall (total Ra = 90-25,000 Bq/kg) compared to upstream sediments (20-80 Bq/kg). In 2015 and 2017, ^{228}Th/^{228}Ra activity ratios in sediments from two disposal sites were relatively low (0.2-0.7), indicating that a portion of the Ra has accumulated in the sediments in recent (<3) years, when no unconventional Marcellus OGW was reportedly discharged. ^{228}Ra/^{226}Ra activity ratios were also higher than what would be expected solely from disposal of low ^{228}Ra/^{226}Ra Marcellus OGW. Based on these variations, we concluded that recent disposal of treated conventional OGW is the source of high Ra in stream sediments at CWT facility disposal sites. Consequently, policies pertaining to the disposal of only unconventional fluids are not adequate in preventing radioactive contamination in sediments at disposal sites, and the permission to release treated Ra-rich conventional OGW through CWT facilities should be reconsidered.

DISPOSAL & DISCHARGE
Fracking waste from horizontally-drilled wells was prohibited by EPA ONLY at publicly owned waste water tx facilities. EPA still allows it sent to private & centralized facilities.

SB 753 would prevent disposal & downstream flow into the Poquabuck, Farmington, Connecticut and Quinnipiac Rivers from private facilities in Bristol and Meriden, and into the Long Island Sound from a private facility in Bridgeport.

2017 Penn State researchers find treated wastes still contaminate water ways

Treated hydraulic fracturing wastewater may pollute area water sources for years

The results determined that the discharge of oil and gas wastewater did impact water quality and sediment quality on a larger scale than previously thought. Large quantities of oil and gas wastewater with high loads of chloride, barium, strontium, radium and organic compounds left high concentrations in the sediments and pore water.

Specifically, **two important types of organic contaminants were found: endocrine disrupting chemicals** (nonylphenol ethoxylates) **and carcinogens** (polycyclic aromatic hydrocarbons). The highest concentrations coincided with sediment layers deposited five to 10 years ago, during the peak of Marcellus Shale activity. "The isotopes confirm these are unconventional oil and gas wastes," said Burgos.

This current study demonstrates that elevated levels were found as far away as 12 miles downstream from the treatment plants.

"These are contaminants that passed through these centralized waste treatment plants, and they can be transported great distances," Burgos said.

Though **the findings show long-term contamination of Pennsylvania watersheds**, the researchers say the effects on the environment and human health are still unknown and difficult to assess.

Abstract
Combining horizontal drilling with high volume hydraulic fracturing has increased extraction of hydrocarbons from low-permeability oil and gas (O&G) formations across the United States; accompanied by increased wastewater production. Surface water discharges of O&G wastewater by centralized waste treatment (CWT) plants pose risks to aquatic and human health. We evaluated the impact of surface water disposal of O&G wastewater from CWT plants upstream of the Conemaugh River Lake (dam controlled reservoir) in western Pennsylvania. Regulatory compliance data were collected to calculate annual contaminant loads (Ba, Cl, total dissolved solids (TDS)) to document historical industrial activity. In this study, two CWT plants 10 and 19 km upstream of a reservoir left geochemical signatures in sediments and porewaters corresponding to peak industrial activity that occurred 5 to 10 years earlier. Sediment cores were sectioned for the collection of paired samples of sediment and porewater, and analyzed for analytes to identify unconventional O&G wastewater disposal. Sediment layers corresponding to the years of maximum O&G wastewater disposal contained higher concentrations of salts, alkaline earth metals, and organic chemicals. Isotopic ratios of $^{226}Ra/^{228}Ra$ and $^{87}Sr/^{86}Sr$ identified that peak concentrations of Ra and Sr were likely sourced from wastewaters that originated from the Marcellus Shale formation.

CITATION: "Watershed-Scale Impacts from Surface Water Disposal of Oil and Gas Wastewater in Western Pennsylvania," Burgos, et al, *Environmental Science and Technology*, DATE Jul 12, 2017, DOI: 10.1021/acs.est.7b01696

https://www.cee.psu.edu/news/2017-fracking-story.aspx

ROADSPREADING OF DEICER & DUST TAMPER

2018 Study Penn State University radioactive brine road spreading

Researchers test oil & gas well brine spread on roads, used for de-icing in winter and dust control in summer on unpaved roads

Results showed brines used in 14 townships were contaminated with:

- High levels of radioactive radium.
  The median levels of radium were 1,200-1,500 picocuries per liter for brines used on roads.
  Safe drinking Water Act is 5 picocuries per liter for municipal drinking water.
  Industrial waste discharges regulated by NRC must be less than 60 picocuries per liter.
- Lead
- Excessive chlorides
- Run off occurring and residual left on roads.

Study conclusion: Nearly all of the metals from these wastewaters leach from roads after rain events, likely reaching ground and surface water.

"Some of the radium and some of the lead sticks to the road. But a lot of it just sort of leaches out with any rain event." – Nathaniel Warner, an assistant professor of civil and environmental engineering at Penn State.

They also found that the contaminants in the brine could be drying up and getting into the air, presenting a hazard for people who live nearby. *"The road dries out and the cars drive across it and make the dust," said William Burgos. "The dust is then carrying some of those contaminants."*

Environmental and Human Health Impacts of Spreading Oil and Gas Wastewater on Roads

Citation: *Environmental Science and Technology.*201852127081-7091
Publication Date: May 30, 2018 https://doi.org/10.1021/acs.est.8b00716

Abstract

Thirteen states in the United States allow the spreading of O&G wastewaters on roads for deicing or dust suppression. In this study, the potential environmental and human health impacts of this practice are evaluated. Analyses of O&G wastewaters spread on roads in the northeastern, U.S. show that these wastewaters have salt, radioactivity, and organic contaminant concentrations often many times above drinking water standards. Bioassays also indicated that these wastewaters contain organic micropollutants that affected signaling pathways consistent with xenobiotic metabolism and caused toxicity to aquatic organisms like *Daphnia magna*. The potential toxicity of these wastewaters is a concern as lab experiments demonstrated that nearly all of the metals from these wastewaters leach from roads after rain events, likely reaching ground and surface water. Release of a known carcinogen (e.g., radium) from roads treated with O&G wastewaters has been largely ignored. In Pennsylvania from 2008 to 2014, spreading O&G wastewater on roads released over 4 times more radium to the environment (320 millicuries) than O&G wastewater treatment facilities and 200 times more radium than spill events. Currently, state-by-state regulations do not require radium analyses prior to treating roads with O&G wastewaters. Methods for reducing the potential impacts of spreading O&G wastewaters on roads are discussed.

ROADSPREADING OF DEICER

2017 & 2018 Ohio Department of Natural Resources & Ohio Department of Health

Byproduct testing shows high levels of radioactivity in deicer sold under brand name AquaSalina.

- Sold at hardware stores
- On-line through Lowes Hardware
- Same product is also sold in bulk to Ohio DOT and PA townships

The owner of Nature's Own Source, producer of AquaSalina, owns vertically drilled gas wells. This byproduct is created by treating and processing wastewaters from these wells.

Source material and links below available at Buckeye Environmental Network:
http://www.benohio.org/tools-research

Toxicologist report here:

I have reviewed the Ohio Department of Natural Resources Division of Oil and Gas Resources Management (DOGRM), Radiation Safety Section Interoffice Memorandum, prepared by Chuck McCracken, Manager of the Radiation Safety Section on July the 26th, 2017 at the request of Richard Simmers, Chief, Division of Oil & Gas. **This memo clearly and irrefutably shows that AquaSalina deicing brine is not fit to be sold to the public as it contains levels of radioactivity that pose significant risks to public health and the environment.** This report evaluated the results of radiological testing of samples collected from a consumer product, AquaSalina, produced by Nature's Own Source. The product is sold as a deicing liquid that is produced from radioactive oil and gas industry waste. **This report makes clear the public health risks that this product poses for consumers and for the environment.**
It is important, to note, however, the ease with which AquaSalina can contaminate watersheds, recreational areas, and drinking water supplies if its continued use and application is allowed. The inherent purpose of the product is to lower the freezing point of water, either preventing liquid water from freezing or making it easier for solid water to melt. The intended use of this product brings **huge volumes of water into direct contact with highly radioactive waste material before it flows off and joins the greater watershed. Streams, rivers and lakes used for recreation, fishing, and ultimately for drinking water, can be adversely impacted by this product that contains high levels of radioactivity,** increasingly so as more consumers apply this product**.** It is also problematic that **AquaSalina is not only used for deicing roadways, but it can also be used by consumers on sidewalks, driveways, and steps increasing the risk of tracking the radioactive waste into residential homes.**

https://static1.squarespace.com/static/57e9616a197aea97db1e5202/t/5c0db0052b6a28f9e791d20c/1544400903768/Toxicologist+report+on+AquaSalina.pdf

Lab results here:

https://static1.squarespace.com/static/57e9616a197aea97db1e5202/t/5c0dadcb89858343873be667/1544400342450/ODNR+lab+tests.pdf

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BIOACCUMULATION WHERE WATERWAYS RECEIVED DISCHARGE

2018 Penn State Study Freshwater Mussels Contaminated with Strontium

Researchers at Pennsylvania State University found elevated concentrations of Strontium in the shells of freshwater mussels downstream from a former fracking wastewater disposal site.

The study, published Wednesday in the peer-reviewed journal *Environmental Science & Technology*, is among the first to show bioaccumulation—the buildup of chemicals in the bodies of living creatures—from oil and gas wastewater downstream of a surface water disposal facility.

"We don't know how much of an impact this has on human health, or if it has any impact at all," Warner said, "but **this means it's entering the food chain**."

The mussels collected downstream of the discharge facility contained significantly greater concentrations of Strontium than the mussels upstream, or the mussels collected from the Juniata and Delaware Rivers.

Warner also noted that despite having a similar, if less-concentrated chemical makeup, **wastewater from conventional oil and gas facilities is still regularly treated at municipal sewage plants and discharged into rivers.**

"We can see the specific signature that comes from Marcellus shale in the shells, but there's still **radioactivity and extremely high levels of salt in the wastewater that's coming from conventional oil and gas facilities**," Warner said.

"**Looking at what happens with disposal of wastewater from conventional oil and gas is just as important as fracking, at least when it comes to freshwater mussels**—they don't know the difference."

Accumulation of Marcellus Formation Oil and Gas Wastewater Metals in Freshwater Mussel Shells

- CITATION: *Environmental Science and Technology.*2018521810883-10892
Publication Date:September 4, 2018 https://doi.org/10.1021/acs.est.8b02727

Abstract

For several decades, high-salinity water brought to the surface during oil and gas (O&G) production has been treated and discharged to waterways under National Pollutant Discharge Elimination System (NPDES) permits. In Pennsylvania, USA, a portion of the treated O&G wastewater discharged to streams from 2008 to 2011 originated from unconventional (Marcellus) wells. We collected freshwater mussels, *Elliptio dilatata* and *Elliptio complanata*, both upstream and downstream of a NPDES-permitted facility, and for comparison, we also collected mussels from the Juniata and Delaware Rivers that have no reported O&G discharge. We observed changes in both the Sr/Ca_{shell} and $^{87}Sr/^{86}Sr_{shell}$ in shell samples collected downstream of the facility that corresponded to the time period of greatest Marcellus wastewater disposal (2009–2011). Importantly, the changes in Sr/Ca_{shell} and $^{87}Sr/^{86}Sr_{shell}$ shifted toward values characteristic of O&G wastewater produced from the Marcellus Formation. Conversely, shells collected upstream of the discharge and from waterways without treatment facilities showed lower variability and no trend in either Sr/Ca_{shell} or $^{87}Sr/^{86}Sr_{shell}$ with time (2008–2015). These findings suggest that (1) freshwater mussels may be used to monitor changes in water chemistry through time and help identify specific pollutant sources and (2) O&G contaminants likely bioaccumulated in areas of surface water disposal.

SURFACE SPILLS SEEP INTO AQUIFERS –

THE MORE TRUCKS BRINGING IT HERE, HIGHER RISK OF SPILLS

2015 Yale University Study (corrected 2019)

Presence of diesel-like chemicals and fracking additive bis(2-ethylhexyl) phthalate found in 64 drinking water wells in PA. Surface spills are likely cause.

Yale University Press Release:

New Haven, Conn. – In the largest study of its kind, a Yale-led investigation found no evidence that trace contamination of organic compounds in drinking water wells near the Marcellus Shale in northeastern Pennsylvania came from deep hydraulic fracturing shale horizons, underground storage tanks, well casing failures, or surface waste containment ponds.

The presence of organic compounds in groundwater aquifers overlying the Marcellus Shale is likely the result of surface releases from hydraulic fracturing operations and not migration from gas wells or deep shale layers, according to researchers in the lab of Desiree L. Plata, assistant professor of chemical and environmental engineering at Yale. The results of the study were published in the journal Proceedings of the National Academy of Sciences. Brian Drollette, a Ph.D. student in Plata's lab, is the lead author.

Due to its vast reserves of natural gas, the Marcellus Shale has become an active site for hydraulic fracturing. During a period of rapid natural gas well expansion, the researchers regularly visited the northeastern region of Pennsylvania, covering about 7,400 square kilometers, over three years and obtained 64 samples from the drinking water wells of residential properties.

Using a suite of chemical analyses, the researchers found that a subset of the groundwater samples contained low levels of organic compounds in areas close to natural gas wells. The analyses also indicated that these compounds most likely entered the groundwater supply from gas extraction operations above the ground surface — and not subsurface migration.

Correction for Drollette et al., Elevated levels of diesel range organic compounds in groundwater near Marcellus gas operations are derived from surface activities

PNAS April 30, 2019 116 (18) 9135; first published April 22, 2019 https://doi.org/10.1073/pnas.1905353116

See original article:
Elevated levels of diesel range organic compounds in groundwater near Marcellus gas operations are derived from surface activities

Article | Info & Metrics | PDF

ENVIRONMENTAL SCIENCES Correction for "Elevated levels of diesel range organic compounds in groundwater near Marcellus gas operations are derived from surface activities," by Brian D. Drollette, Kathrin Hoelzer, Nathaniel R. Warner, Thomas H. Darrah, Osman Karatum, Megan P. O'Connor, Robert K. Nelson, Loretta A. Fernandez, Christopher M. Reddy, Avner Vengosh, Robert B. Jackson, Martin Elsner, and Desiree L. Plata, which was first published October 12, 2015; 10.1073/pnas.1511474112 (*Proc Natl Acad Sci USA* 112:13184–13189).

The authors wish to note the following: "In the original calculation of sorption-retarded transport through porous media, log K_{oc} (4.998 to 5.078) values were used instead of K_{oc} values ($10^{4.998}$ to $10^{5.078}$ L kg^{-1}). This propagates to transport times of 0.001 to 4 m·y^{-1} (over 200 y to migrate a 1-km distance) for the detected phthalates. Critically, we note that this does not change the primary conclusions or principle arguments; the presence of bis(2-ethylhexyl) phthalate would have to occur via some enhanced transport or solubilization process, as discussed in the original contribution.

Pipes and Tanks Radioactive Scale

The oil and gas industry has known for decades that pipe and tank scale ("scale") can accumulate high levels of radioactivity, mainly due to radium (Wilson and Scott, 1992).

Scale has been found to exhibit activities as high as 410,000 pCi/g (White and Rood, 2001, and references therein).

High radioactivity in scale results from radium associating with other alkaline earth metals (e.g., calcium, barium, strontium) in sulfate- and carbonate-based mineral deposits that precipitate from production fluids onto pipe and tank walls (White and Rood, 2001).

Soils impacted by scale cleaning operations may also exhibit elevated radioactivity. For example, one study found that such soils had radium-226 + radium-228 activities ranging from 6.75-1,681 pCi/g (Wilson and Scott, 1992).

Thus, there is a high likelihood that pipe and tank scale, as well as soil impacted by scale cleaning operations, would exceed Colorado Dept. of Public Health and Environment administrative levels for radioactivity."

Source: Gradient Corporation analysis, an Environmental and Risk Sciences Firm, for Pawnee Waste, LLC

Radioactivity and BETX in Shale-oil and Shale-gas Exploration and Production Wastes, Gradient Corporation, Memorandum to Pawnee Waste, LLC, Oct. 3, 2017.

http://www.pawneewaste.com/wp-content/uploads/2017/10/Gradient_Memo_2017_10_03.pdf