Characterization, potential toxicity, and fate of O&G wastewaters spread on roads in Pennsylvania

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USGS
science for a changing world

PENNSTATE

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Tasker, Travis, Burgos, W.D., Piotrowski, P., Castillo-Meza, L., Blewett, T.A., Ganow, K.B., Delompré, P.L.M., Goss, G.G., Fowler, L.B., Vanden Heuvel, J.P. , Dorman, F., Warner, N.R.

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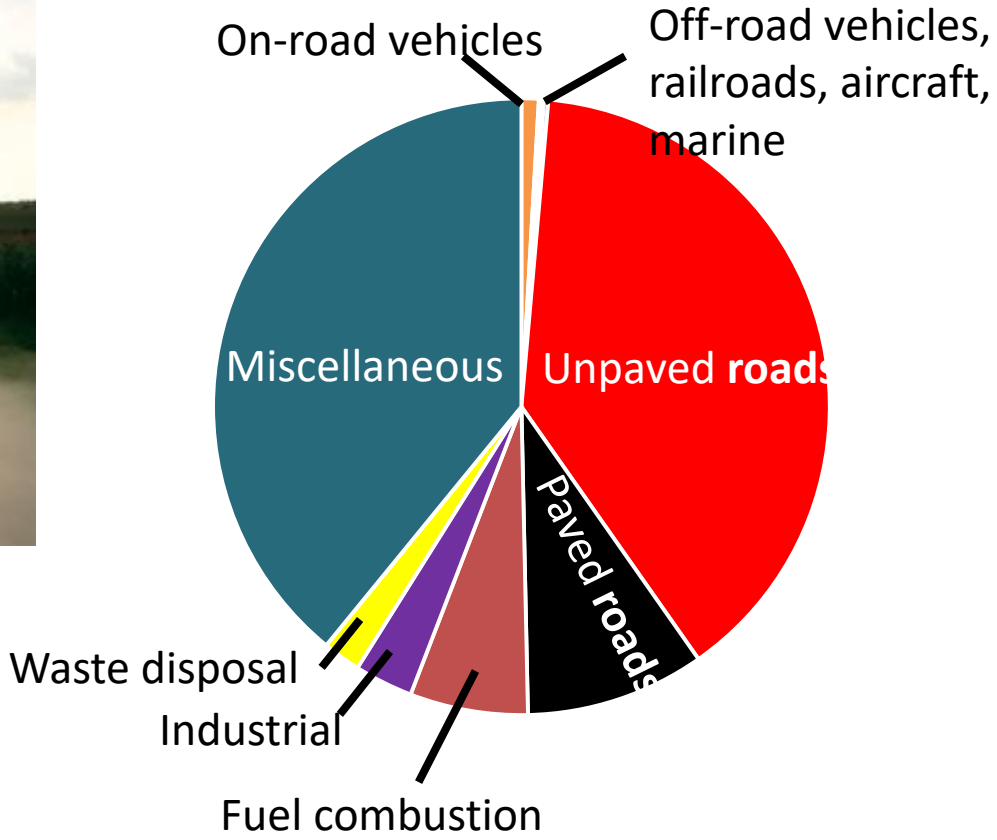
Unpaved roads increase airborne particulate matter

34% of U.S. roads are unpaved

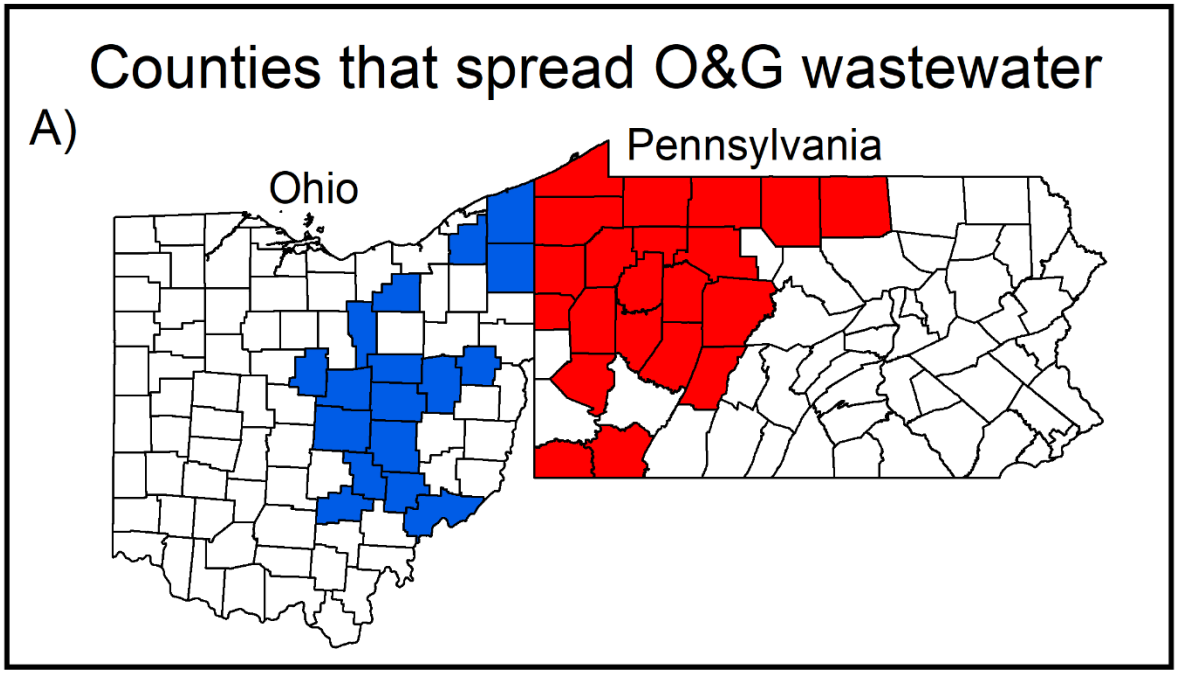
Release 40% of estimated PM_{10} in U.S.

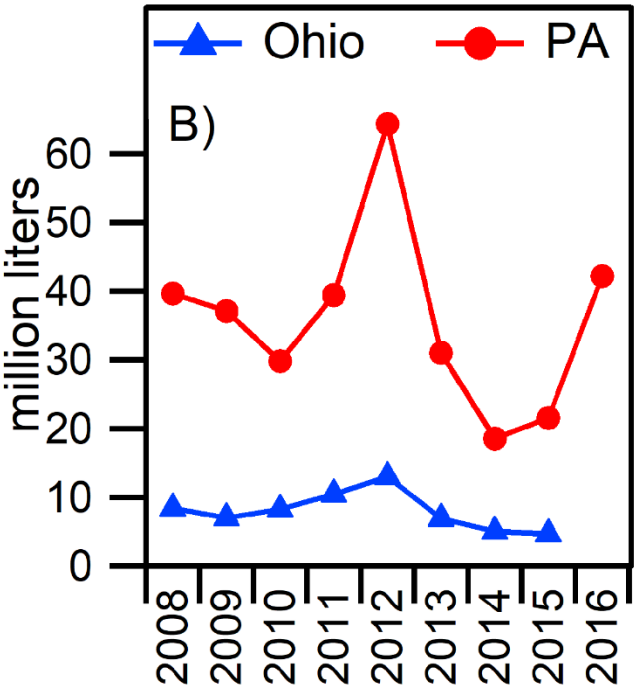
PM_{10} emissions from various sources

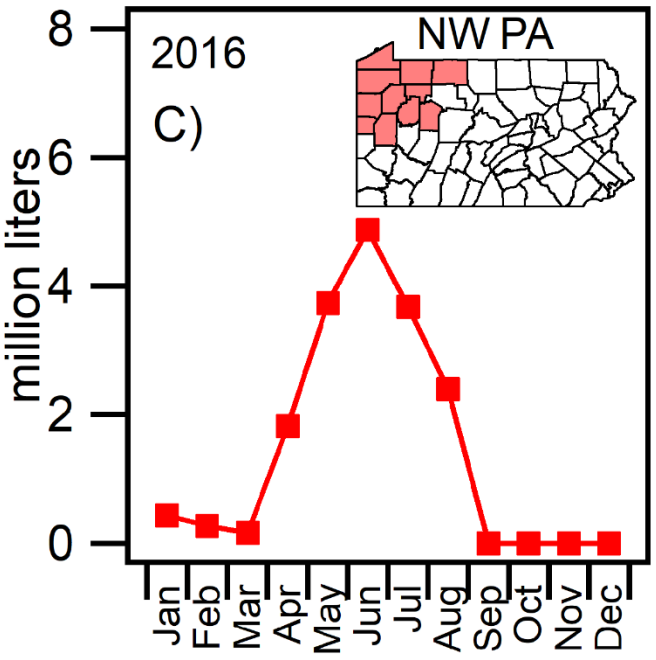


United States Department of Transportation. Bureau of Transportation Statistics. Retrieved from https://www.bts.gov/archive/publications/national_transportation_statistics/2001/table_04_43 (accessed 2018)

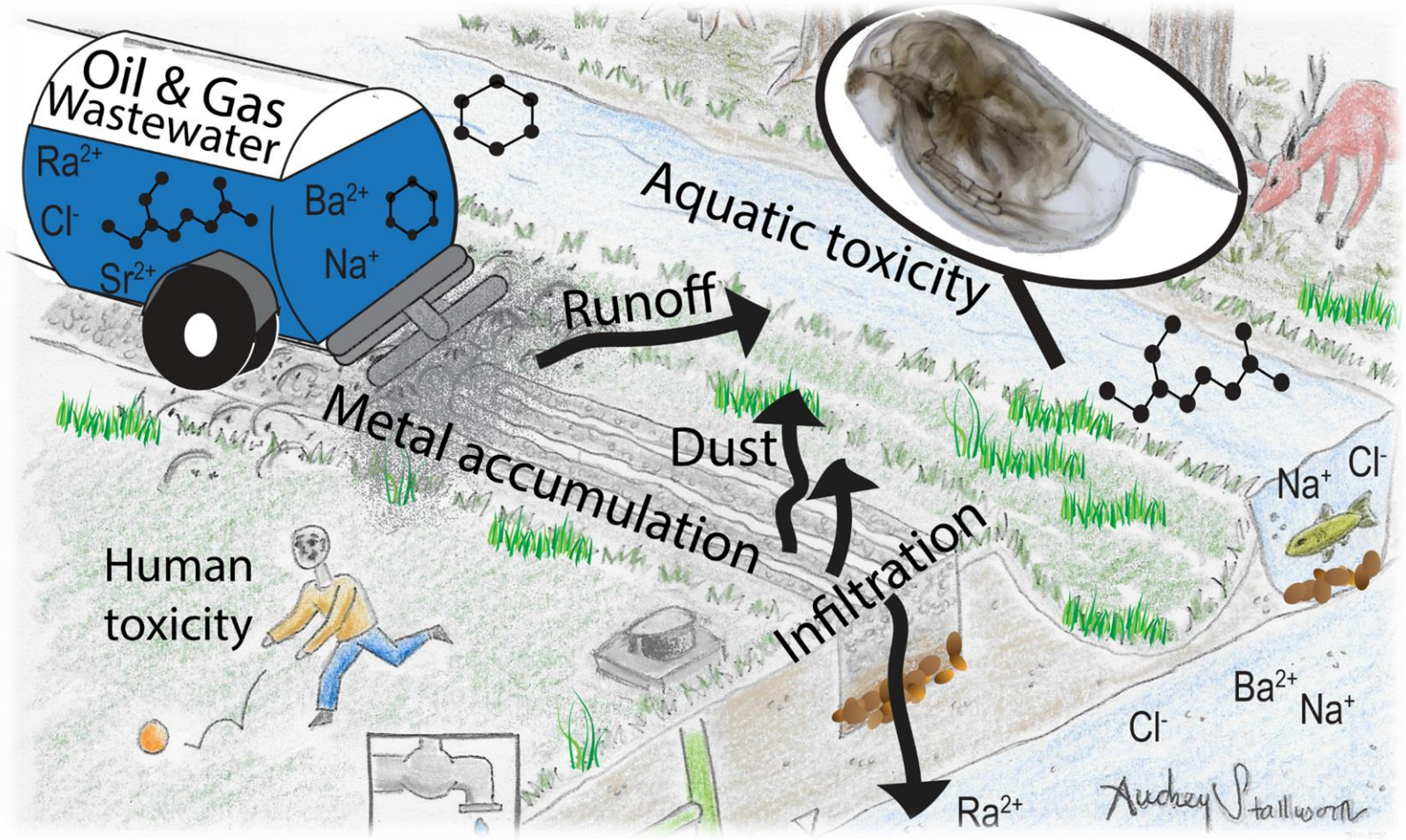
In Pennsylvania, spreading O&G wastewater occurs in the NW portion of the state and is used mainly for dust suppression





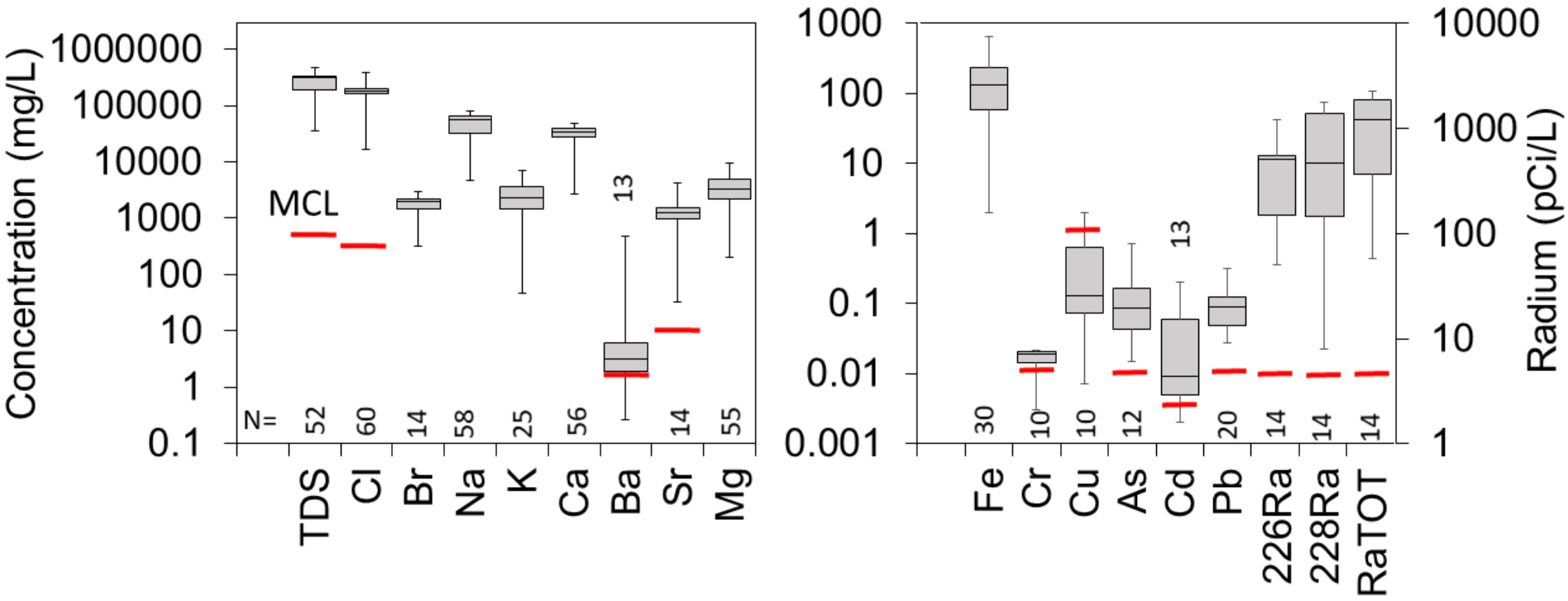


Research objective: Evaluate the human and environmental impacts of spreading O&G wastewaters on roads



We collected and characterized conventional O&G wastewaters spread on roads in Pennsylvania

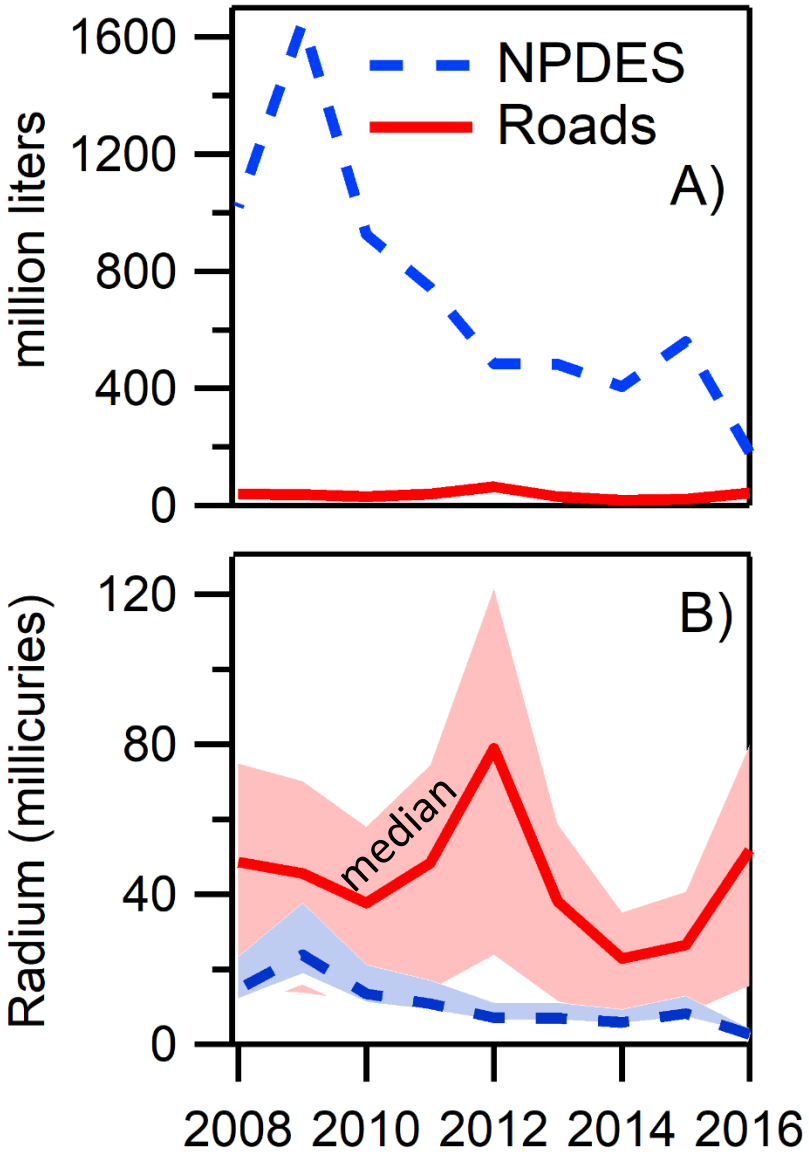
Oil and gas wastewaters spread on roads are salty and radioactive

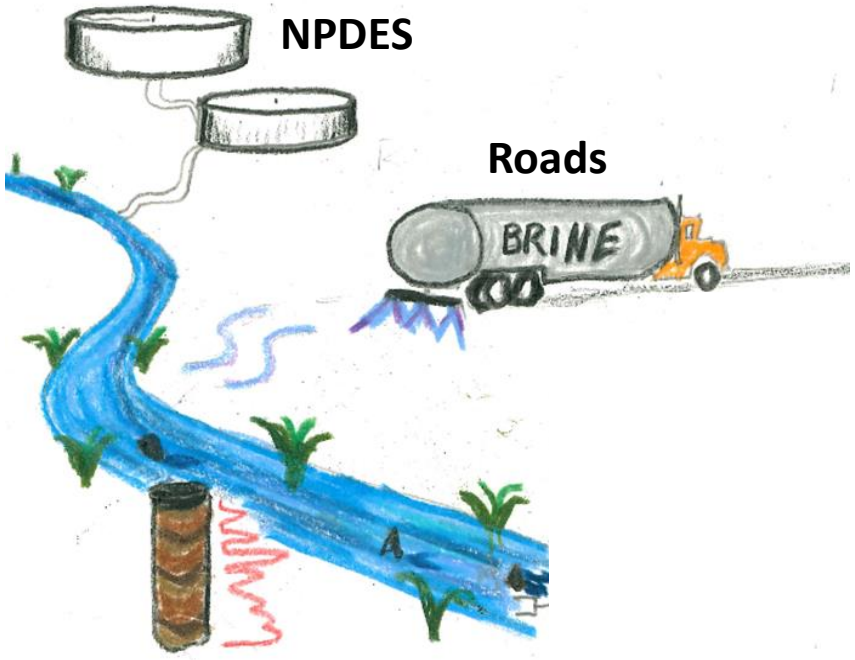


14 samples collected from Townships in PA for current study

53 Certificates of Analysis obtained from FOIA request to PA + NY agencies

In Pennsylvania, spreading O&G wastewaters on roads releases more radium than any disposal option





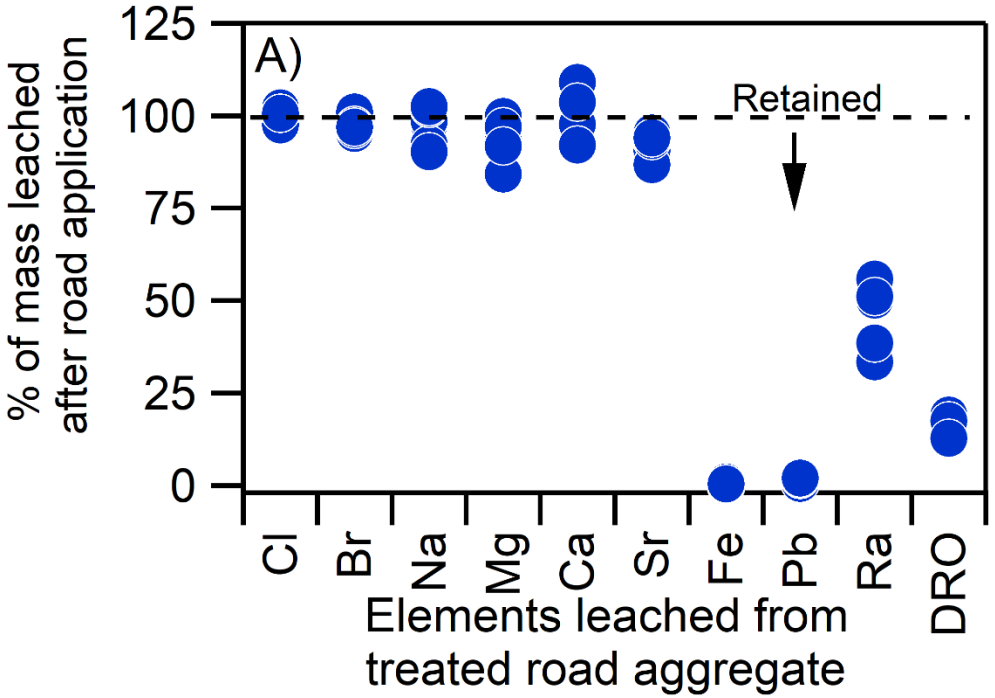
2008-2014 estimated total radium release

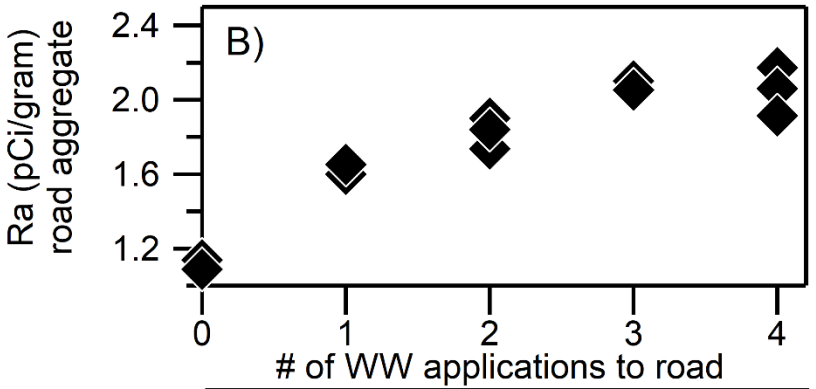
Spill events ~0.9 millicuries radium

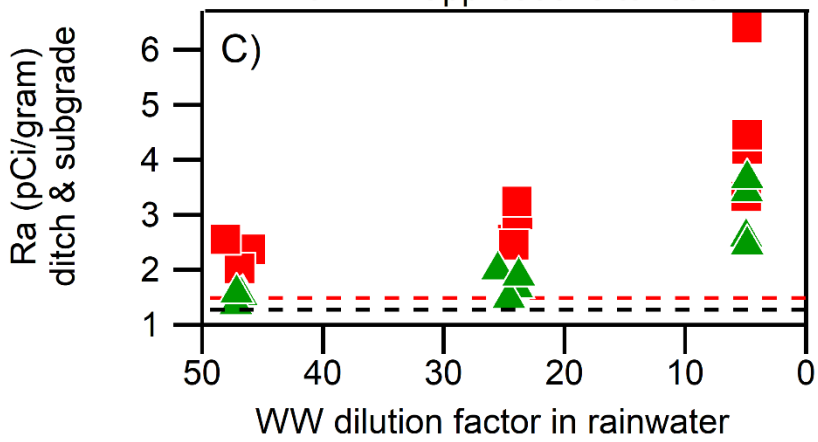
NPDES ~ 83 millicuries radium

Roads ~ 320 millicuries radium

Most contaminants in O&G wastewaters leach from roads

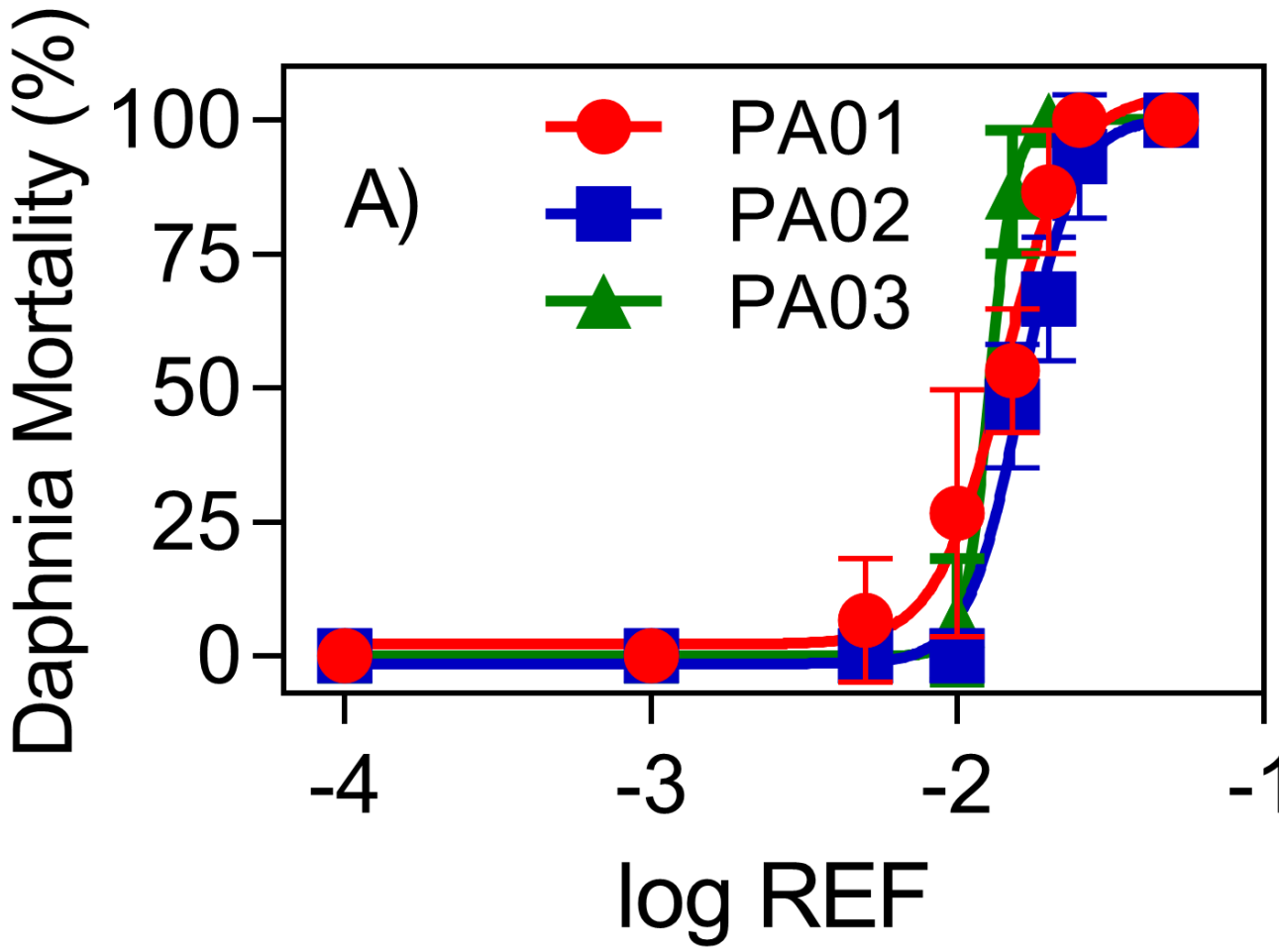






Fe, Pb, Ra and diesel range organics (DRO) are partially retained in roads

High salt concentrations in oil & gas wastewater are toxic to the freshwater indicator organism *Daphnia magna*



LC_{50} at **60-70** times dilution for wastewater and salinity-matched controls

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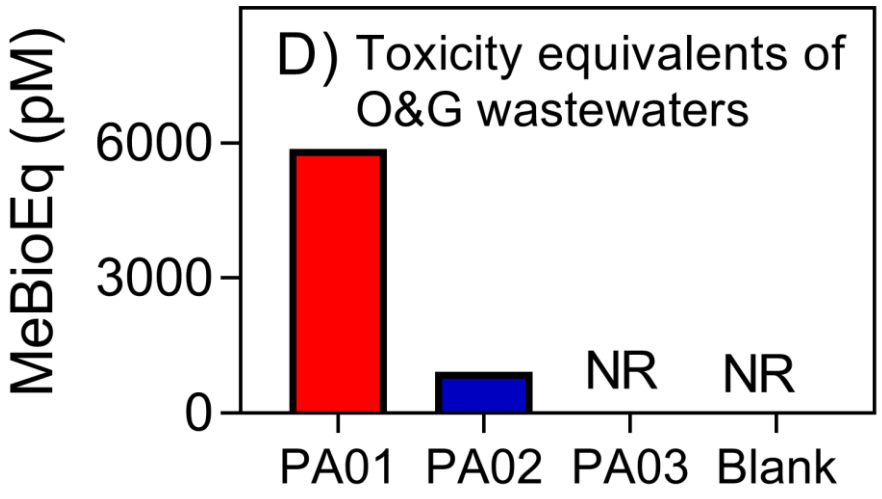
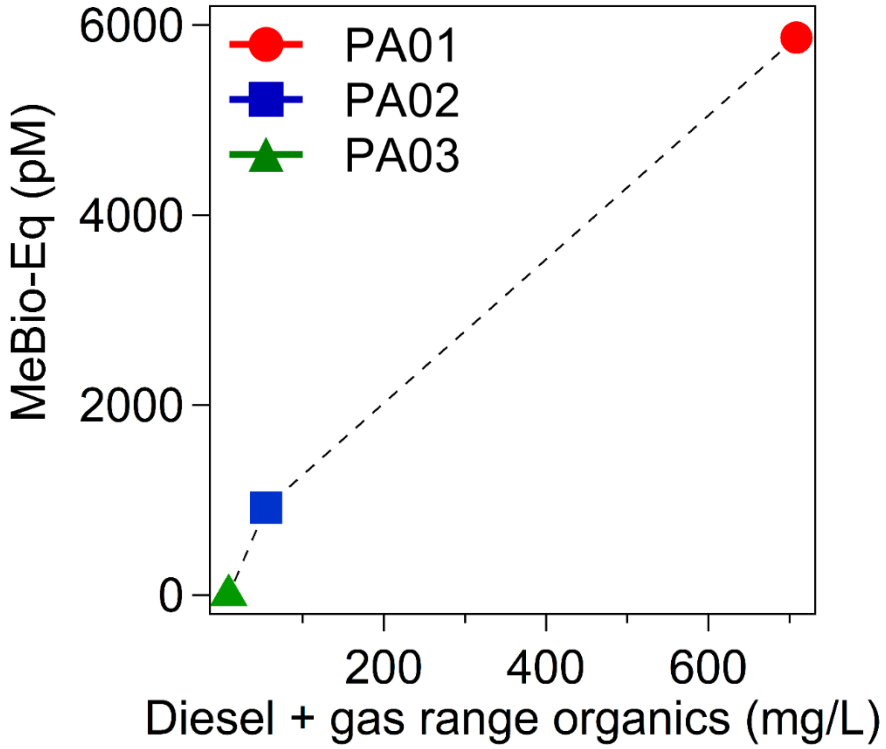
Organic micropollutants in oil & gas wastewater may be toxic to humans



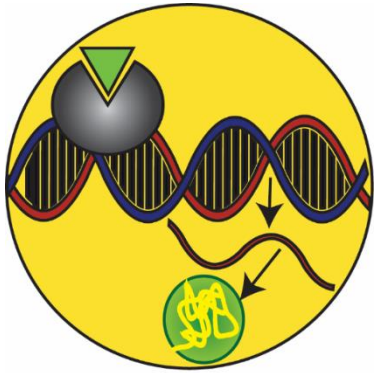
5-30 times dilution to reach EC_{10}



Reference compound known to interact with AhR
1-methyl-6-bromo-indirubin-3'oxime (MeBio)

Dilution is the solution to pollution?

5-30x dilution



Reduces human toxicity

60-70x dilution

Reduces Lethality

300-600x dilution

Reduces Immobility

Cl=730x dilution

Ra=250x dilution

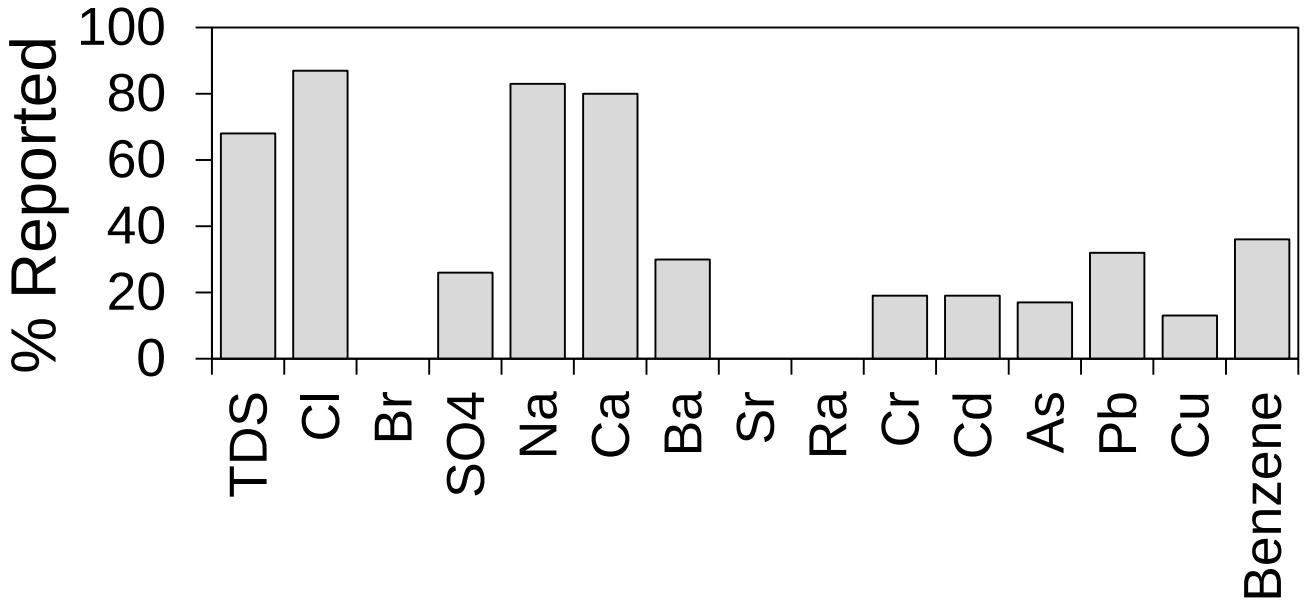
Meets National Primary Drinking Water Regulations

States require minimal O&G wastewater characterization prior to spreading on roads

CERTIFICATE OF ANALYSIS

TEST	METHOD	RESULT	UNITS
01 Brine Water (Chipmunk/Bradford 2nd)			
Sample Date: 06/09/2015		Sample Time: 08:00	
Chloride	EPA 300.0, Rv. 2.1	17000	mg/L
Total Dissolved Solids - TDS	SM2540 C-97,-11	44500	mg/L
Calcium	EPA 200.7, Rv. 4.4	2680	mg/L
Magnesium	EPA 200.7, Rv. 4.4	460	mg/L
Sodium	EPA 200.7, Rv. 4.4	8200	mg/L

Digitized 53 certificate of analyses for wastewaters to be spread on roads

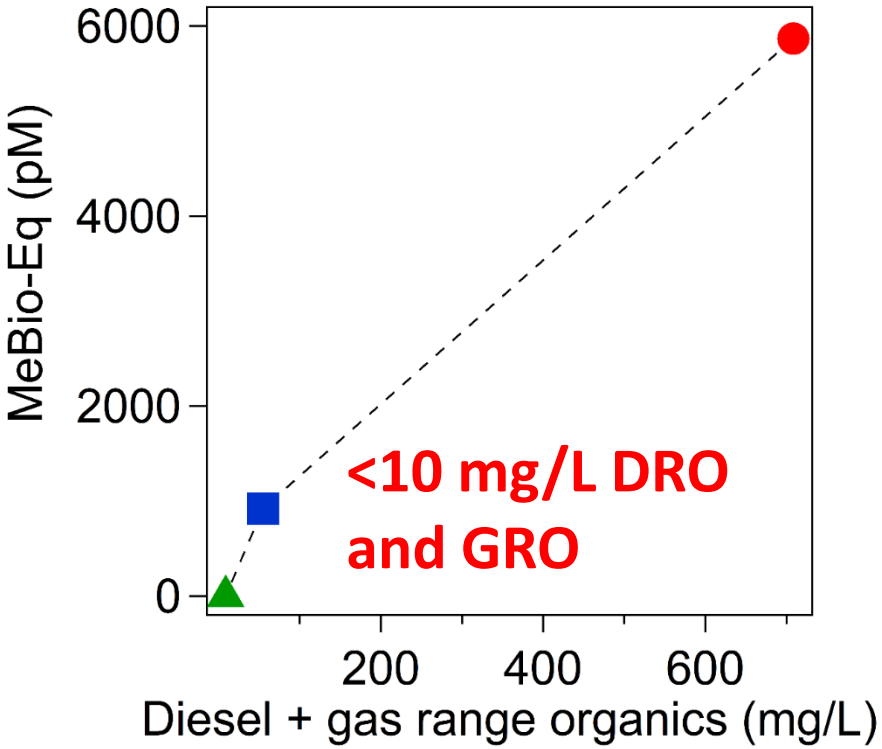


>80% of the analyses reported Cl, Na, and Ca

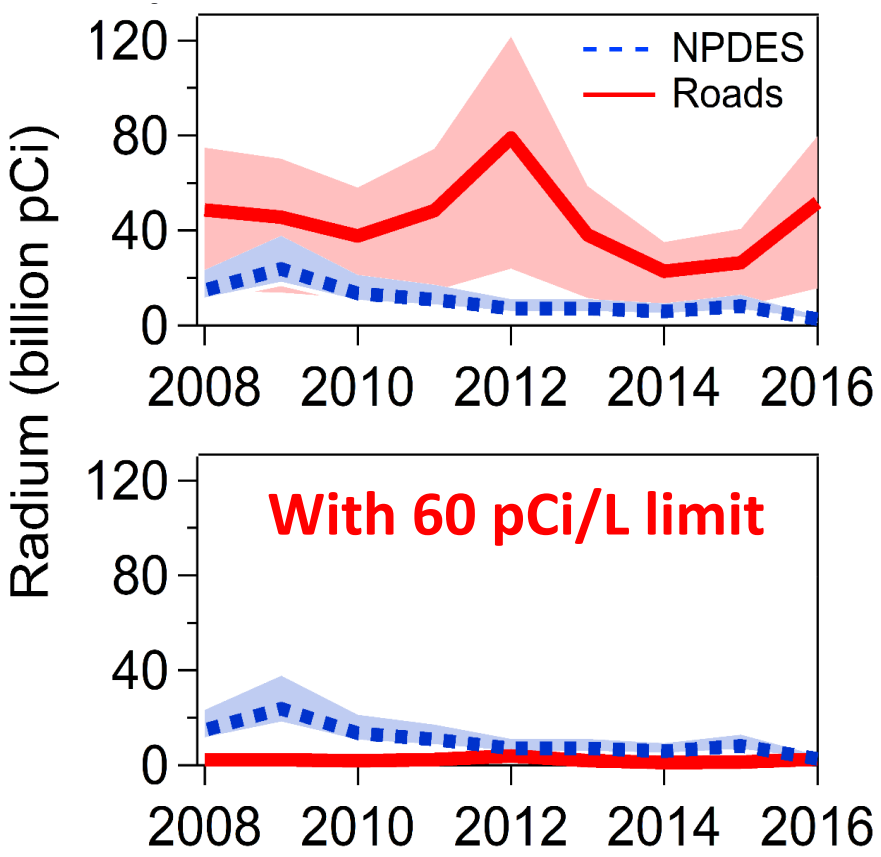
<20% reporting for Cr, Cd, As, and Cu

0% reporting for Br, Sr, and Ra

Standards to reduce the concerns of spreading O&G wastewaters on roads



With no Ra (pCi/L) limit



Impacts from disposal of conventional oil & gas wastewater onto roads

- Wastewater from conventional oil & gas wells are allowed to be spread on roads in at least 13 states
- O&G wastewaters collected in Pennsylvania (and spread on roads in 2017) contained elevated concentrations of salts, radium, and organic micropollutants
- In Pennsylvania, spreading O&G wastewaters on roads releases more radium to the environment than any other disposal option

Acknowledgements

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