DERP Forum

Strengthening Relationships with our Regulatory Partners

St. Louis, Missouri

May 8-9, 2019

PFAS in Minnesota: Lessons Learned From 15 Years of PFAS Investigations and Response

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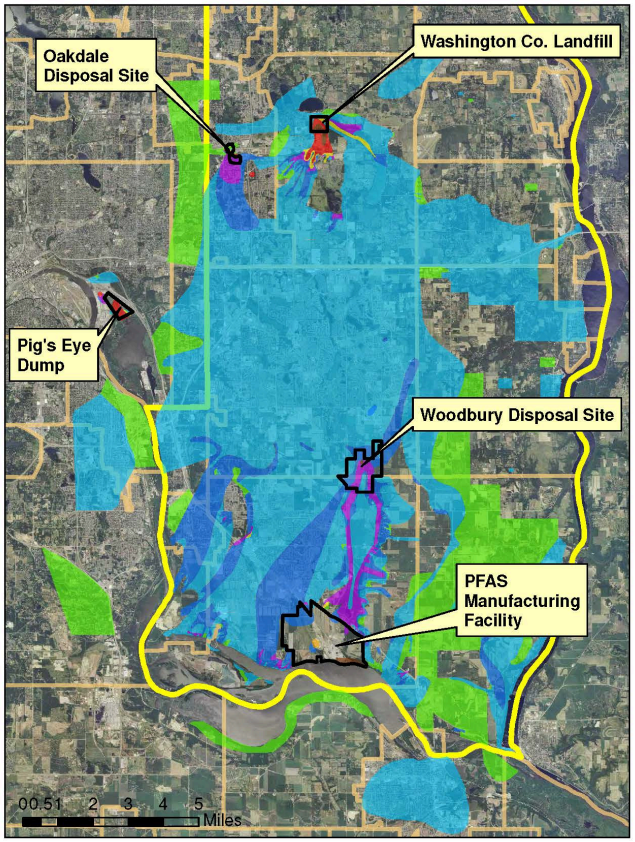
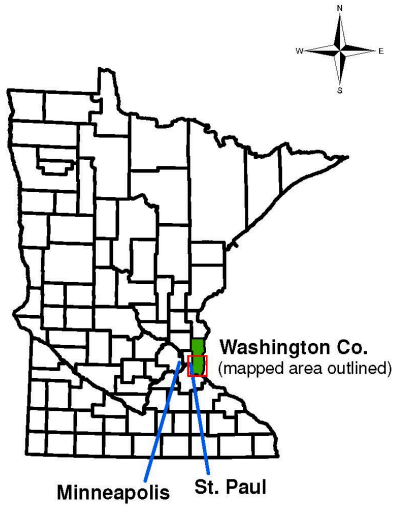
DERP Forum – May 8, 2019

Minnesota's early admission to the PFAS party

- **PFAS manufactured since 1940s**
- **Waste disposal: on-site and landfills**
- **2004 – PFOS & PFOA detected in Oakdale city wells**
- **Subsequent investigations:**
  - >150 mi^2 contaminated GW & SW
  - 4 major aquifers
  - 13 communities
  - 8 muni. systems (140,000+ pop.)
  - >2,700 private wells (1,100+ advisories)
  - 1 (or more?) illicit dumpsites & AFFF
  - Municipal WWTP sludge in a landfill



Location of Legacy PFAS Sites in Washington Co., Minnesota



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July 11, 2018

Factors Controlling PFAA Distribution in Groundwater

PFAAs highly soluble, mobile, persistent = very large plumes

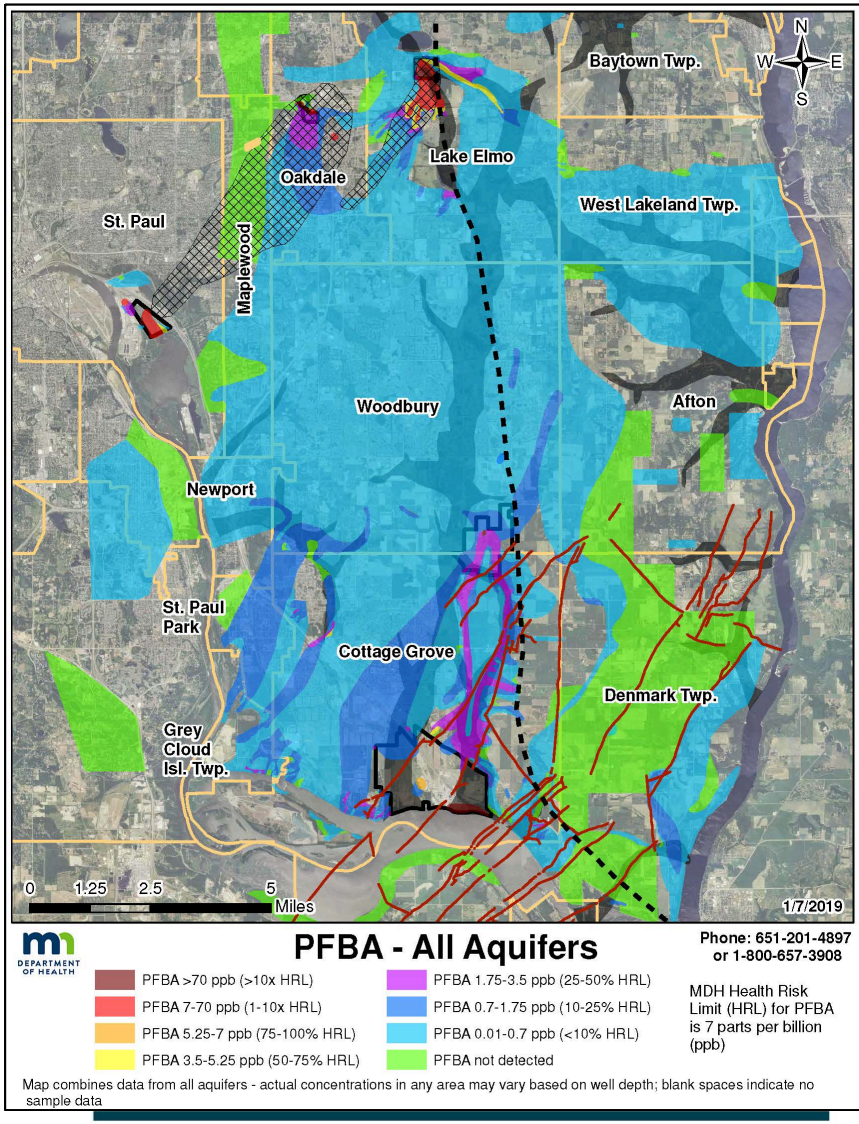
- Much larger than predicted by models
- Co-mingled plumes

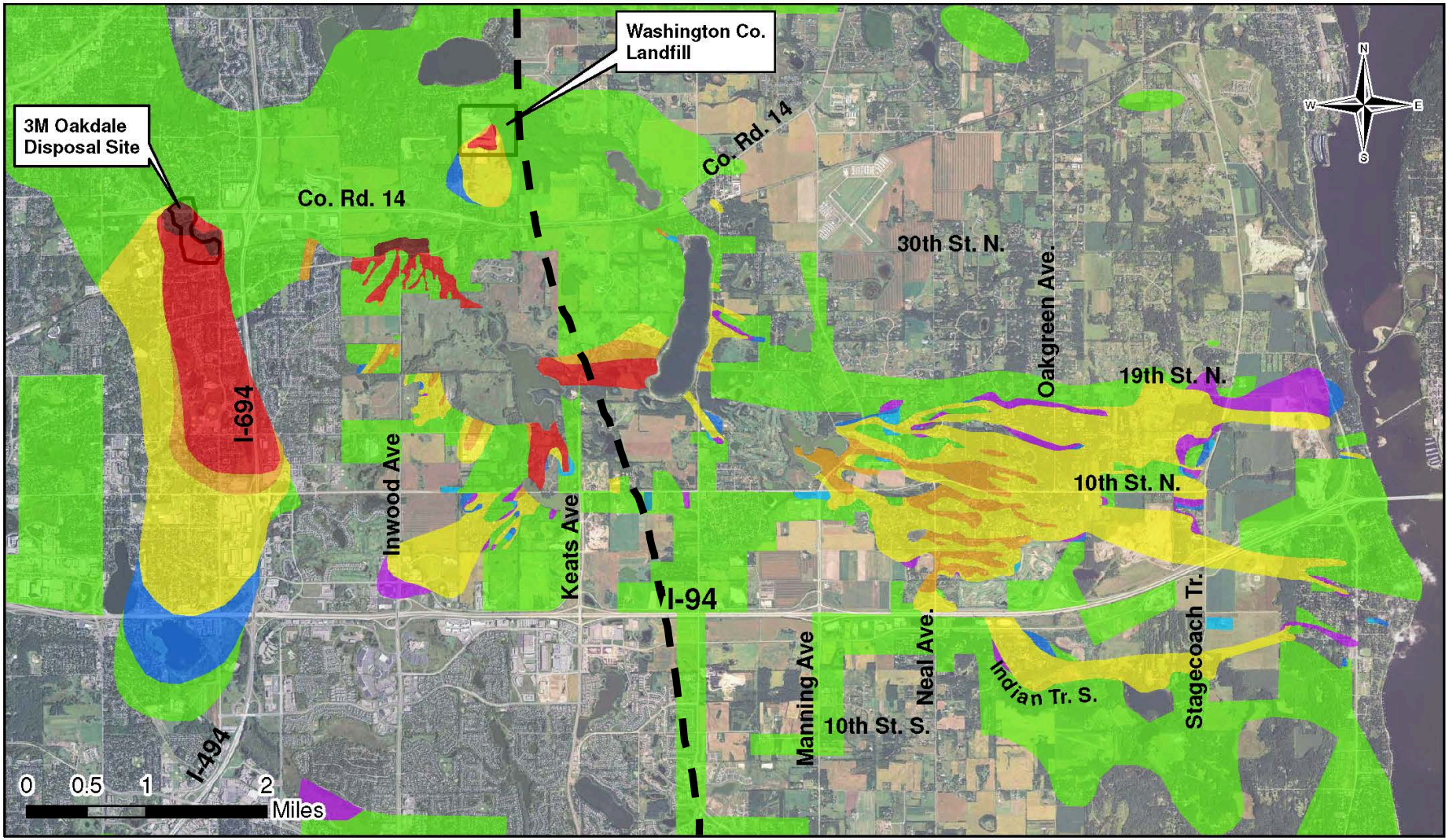
PFBA most widespread

- Extremely soluble and mobile = GW tracer
- Distal plume difficult to distinguish from urban "background" levels

Distribution controlled by:

- GW divide: Mississippi and St. Croix Rivers
- Bedrock features: buried valleys and faults
- Groundwater - surface water interactions
- PFAS partitioning
- Source area PFAS "signature"
- Groundwater pumping





PFOS - All Aquifers

Phone: 651-201-4897
or 1-800-657-3908

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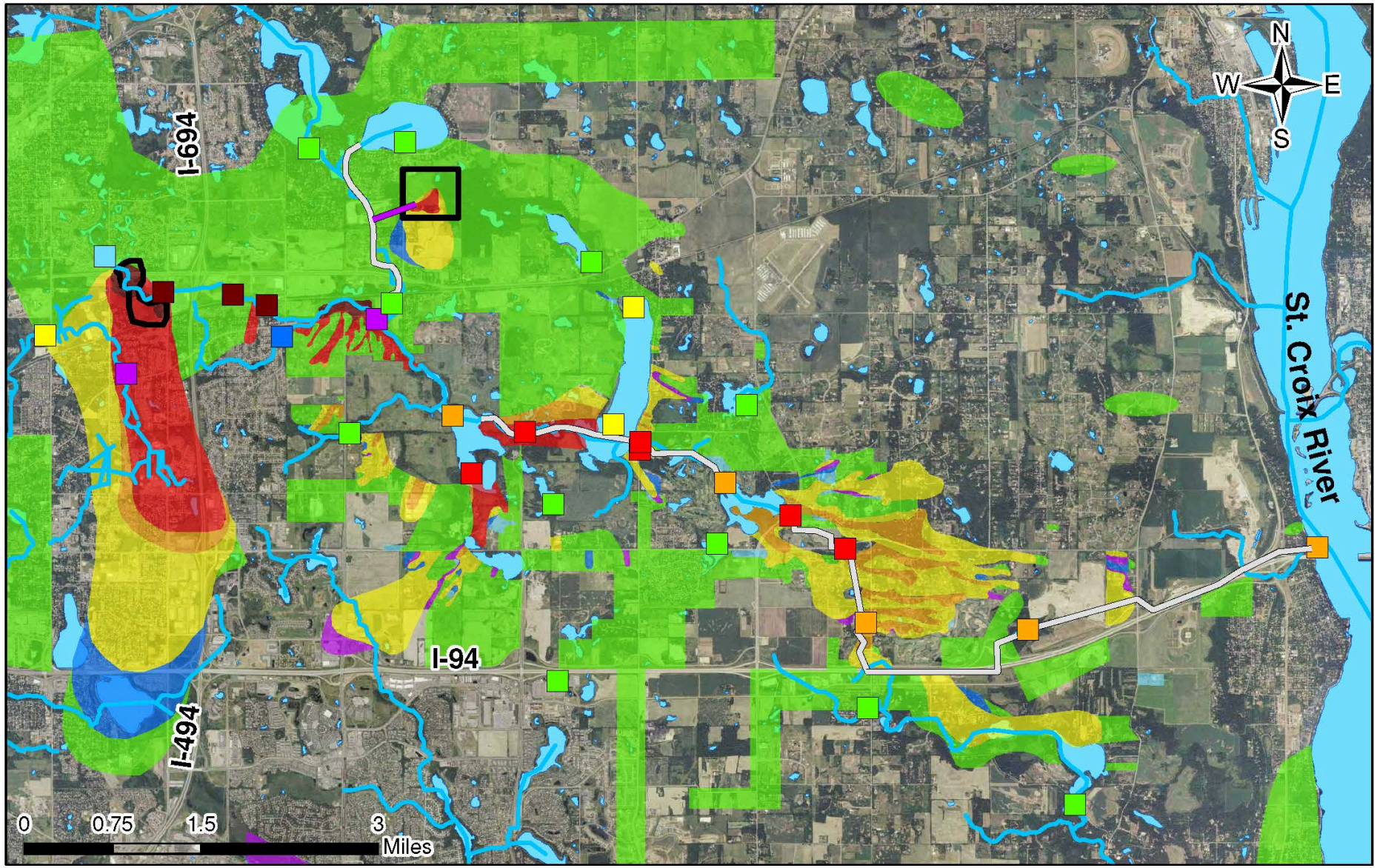
- PFOS > 1.35 ppb (>50x HBV)
- PFOS 0.271-1.35ppb (10-50x HBV)
- PFOS 0.136-0.27ppb (5-10x HBV)
- PFOS 0.028-0.135ppb (1-5x HBV)
- PFOS 0.021-0.027 ppb (75-100% HBV)
- PFOS 0.0136-0.02ppb (50-75% HBV)
- PFOS 0.004-0.0135ppb (<50% HBV)
- PFOS not detected

MDH Health Based Value (HBV) for PFOS is 0.027 parts per billion (ppb; or 27 parts per trillion)

NOTES: Map combines data from all aquifers, actual concentrations in any area may vary; blank spaces indicate no sample data

1/7/2019



PFOS in Surface Water and Groundwater

4/2/2018

- PFOS greater than 1.35ppb (>50x HBV)
- PFOS 0.271-1.35ppb (10-50x HBV)
- PFOS 0.136-0.27ppb (5-10x HBV)
- PFOS 0.028-0.135ppb (1-5x HBV)
- PFOS 0.021-0.027ppb (75-100% HBV)
- PFOS 0.0136-0.02ppb (50-75% HBV)
- PFOS 0.004-0.0135ppb (<50% HBV)
- PFOS not detected
- Project1007

Note: map combines groundwater data from all aquifers, actual concentrations in a given well may vary; blank spaces indicate no sample data

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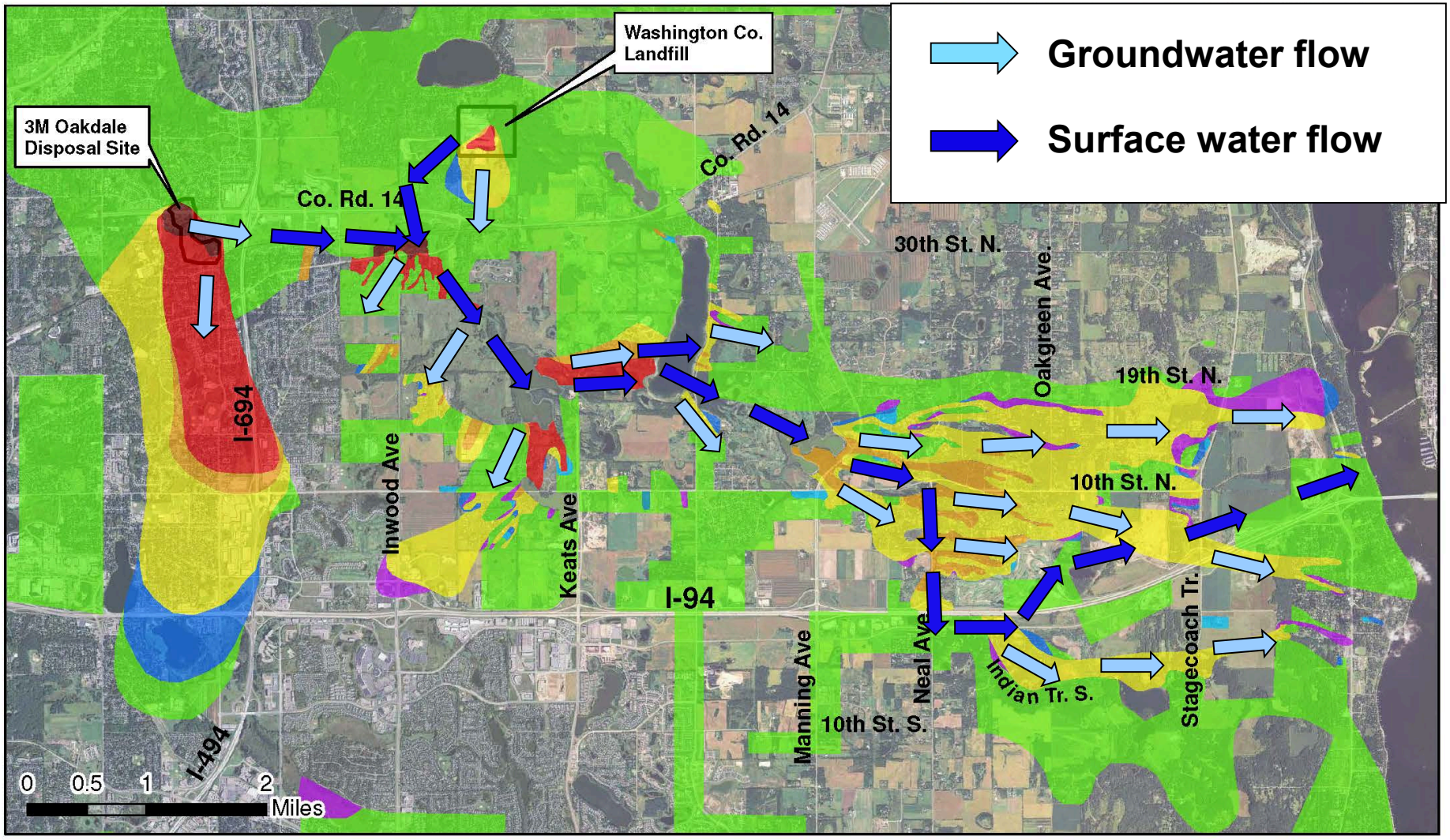


- SW transport may move PFAS many miles away from source areas
- Infiltration along a SW pathway may create discrete GW plumes isolated from the source.
- GW discharge to SW may contaminant water bodies long distances from source areas.
- Persistence and mobility of some PFAS allows them to migrate multiple times between GW and SW

Minnesota Water Guidance

MDH health-based guidance values evolve over time as additional research becomes available

- Protective of breast-fed infants of mothers with long (>10 yr) exposure
- Promulgated (HRL) and non-promulgated values (HBVs)
- Surrogate values used when widespread detection of chemical, but insufficient tox. data

	PFOA	PFOS	PFBA	PFBS	PFHxS
2002	7	1			
2006	1	0.6	1		
2007	0.5	0.3	7		
2009	0.3	0.3	7	7	
2013	0.3	0.3	7	7	0.3
2016	0.07	0.07	7	7	0.07
2017	0.035	0.027	7	3/2	0.027
2019	0.035	0.015	7	3/2	0.047

Blue = HRL; Red = HBV; Green = Surrogate

Health Risk Index (HI): allows MDH to evaluate mixtures of similar chemicals

- Similar to TEQ approach
- HI > 1 considered an exceedance

$$HI = \frac{PFOA_{[conc]}}{0.035} + \frac{PFOS_{[conc]}}{0.015} + \frac{PFBA_{[conc]}}{7} + \frac{PFBS_{[conc]}}{3} + \frac{PFHxS_{[conc]}}{0.047}$$

Remediation – “Back To The Future”

Soil & Sediment

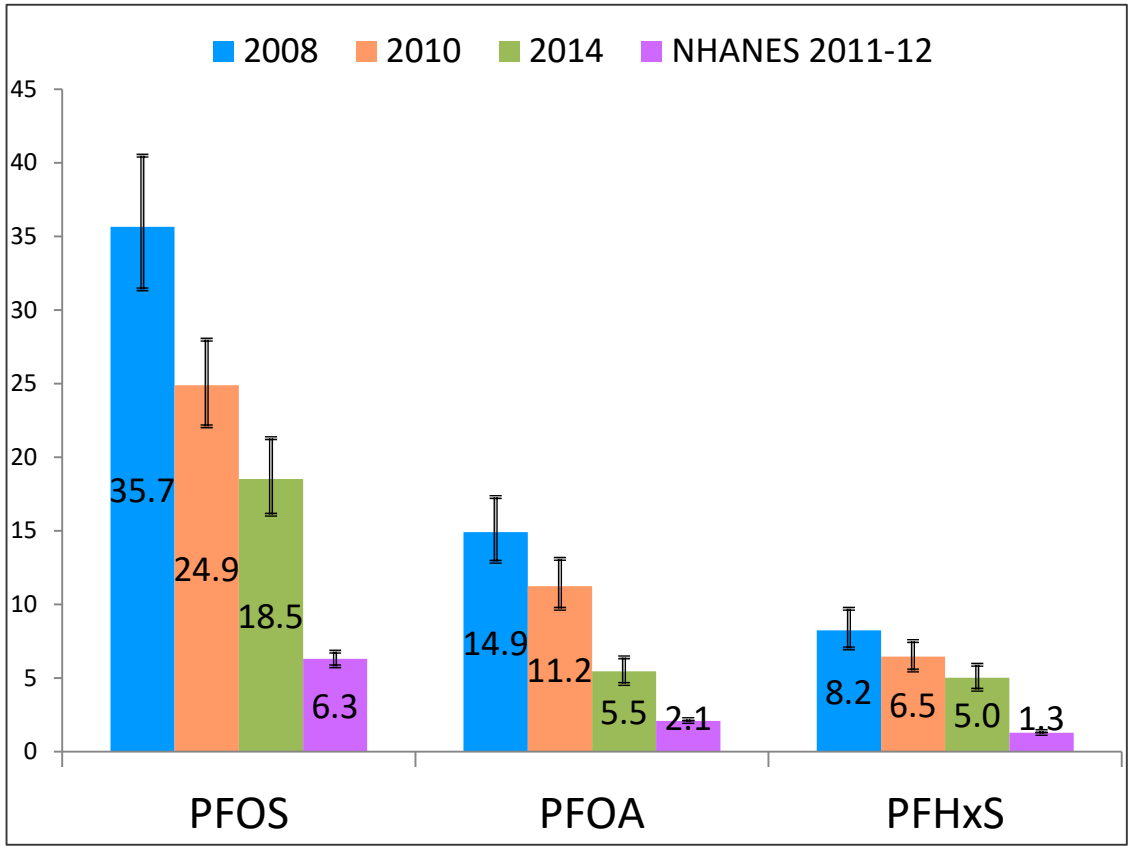
- Excavation / dredging
- Containment vaults / capping

Groundwater

- Pump & treat: GAC

Biomonitoring

- **Exposed adults in affected communities:**
  - 3 rounds: 2008, 2010, 2014
  - 196 initial participants (164 completed all 3 rounds)
- **PFOS, PFOA, and PFHxS detected in 100%**
- **PFAS serum levels decreased for residents drinking treated water, but…**
- **Mean concentrations > national means**
- **Conclusion: removing drinking water pathway key to reducing exposure**



Plant Uptake of PFAS

- Identified uptake of PFAS in produce grown in gardens irrigated with PFAS contaminated water
- Primarily PFBA
- Below levels of health concern

(Scher et al., 2018, Chemosphere, v. 196)

Statewide Investigations

- **AFFF**
  - 74 sites evaluated, ~30 investigated, 2 with DW impacts
- **Fish**
  - Consumption advisories
  - Led to identification of 3 plating facilities releasing PFOS
- **WWTP**
- **Landfills**
- **Ambient groundwater monitoring**
  - PFBA widely detected

BUT much of this work completed in 2008-2010 before lower detection limits achievable.

Looking Forward: MN PFAS Inventory Pilot Project

4 County Pilot Study

- Using North American Industry Classification System (NAICS) to identify potential PFAS sources
- Evaluate human & ecological receptors to rank sites
  - Distance to drinking water wells and wellhead protection areas
  - Aquifer sensitivity
  - Distance to surface water
- Ground truth method with site sampling
- Also evaluating compost sites
  - Have detected ppb concentrations of PFAS in runoff

Thank You

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The opinions expressed are those of the author and do not necessarily reflect the official views of ATSDR, the CDC, the Department of Health and Human Services, or the Minnesota Department of Health.

FOR MORE INFORMATION:

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www.health.state.mn.us/communities/environment/hazardous/topics/pfcs.html

www.pca.state.mn.us/waste/perfluorochemicals-pfcs