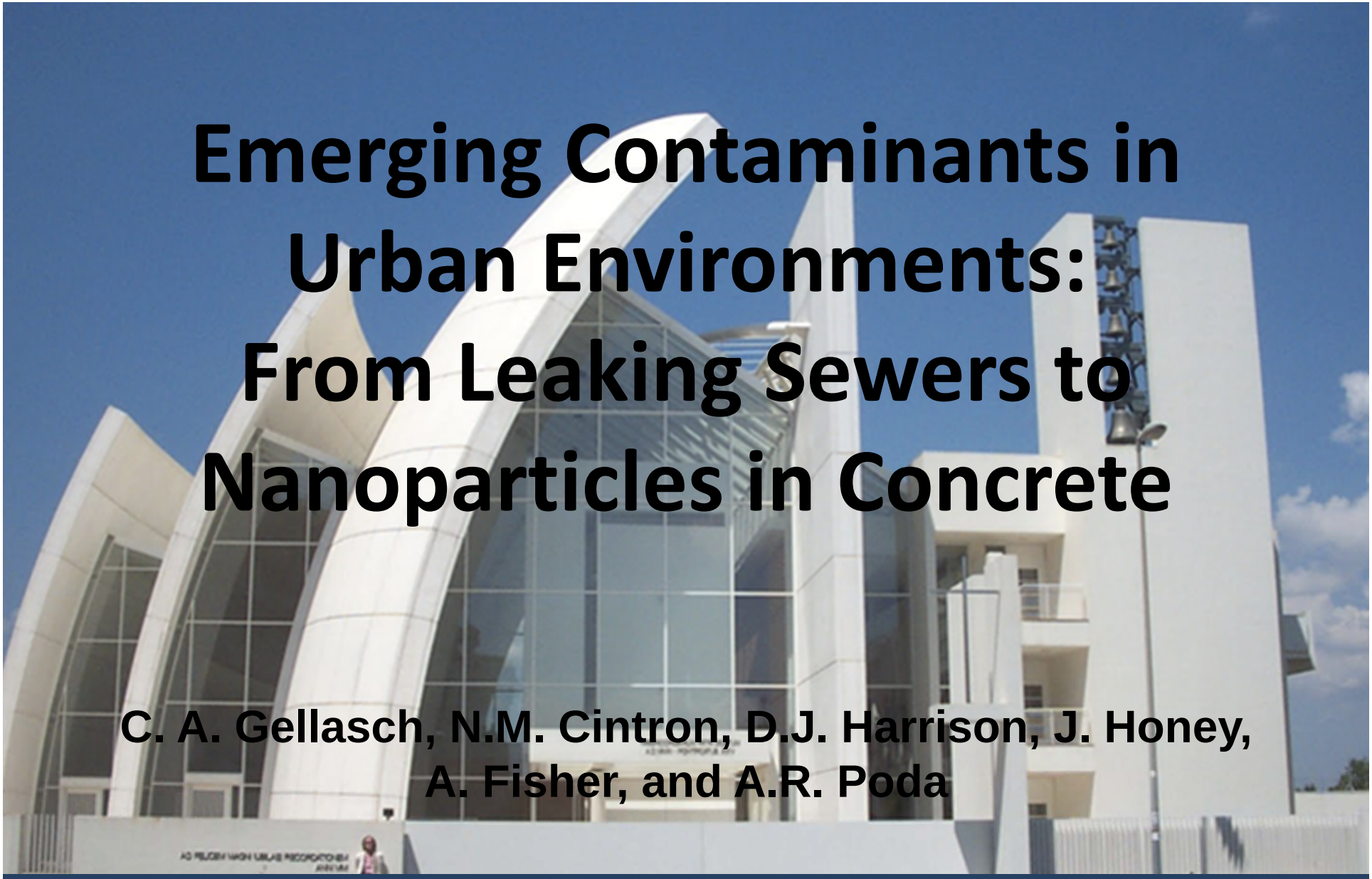

Emerging Contaminants in Urban Environments: From Leaking Sewers to Nanoparticles in Concrete

C. A. Gellasch, N.M. Cintron, D.J. Harrison, J. Honey, A. Fisher, and A.R. Poda

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Uniformed Services University of the Health Sciences

ERDC INNOVATIVE SOLUTIONS for a safer, better world

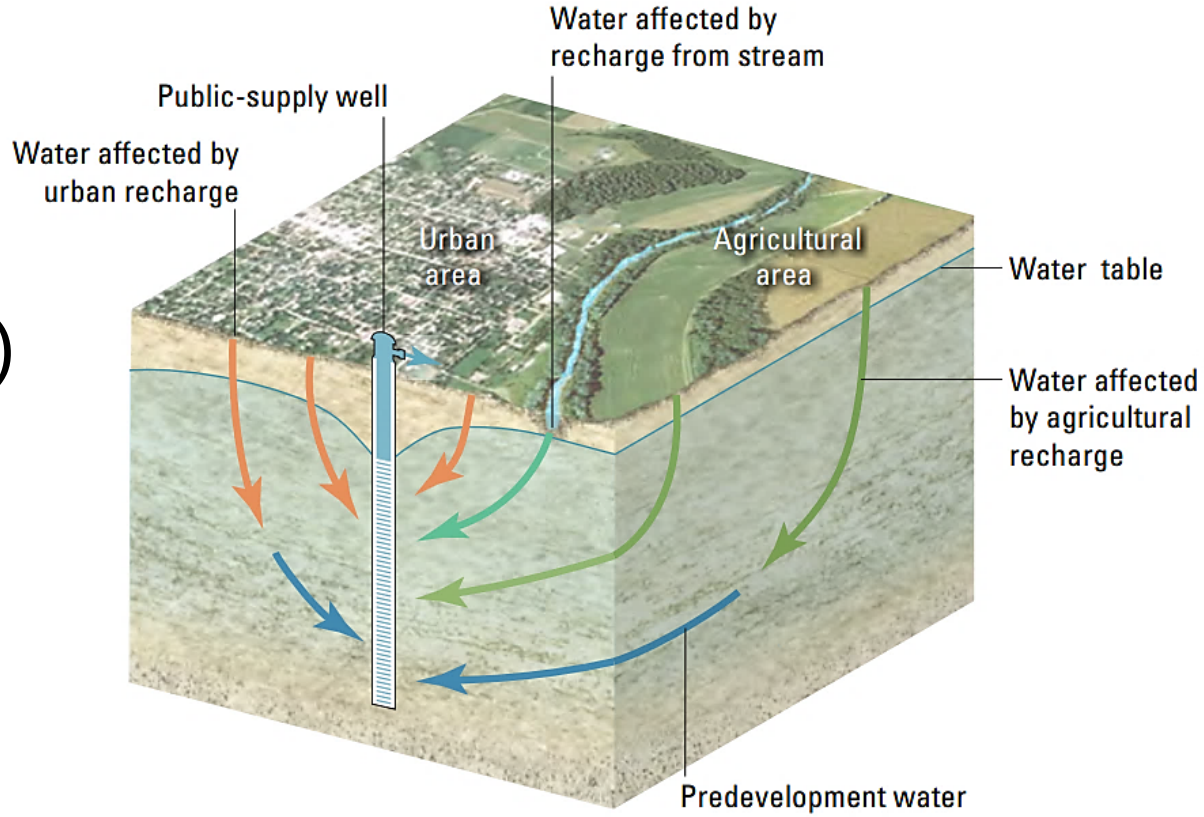
DISCLAIMER

The views expressed are those of the author and do not necessarily reflect the official views of the Uniformed Services University of the Health Sciences, the U.S. Army, or the Department of Defense.

INTRODUCTION

Emerging Contaminants

- Urban areas
- Sewers (old)
- Concrete (new)
  - Roads
  - Buildings

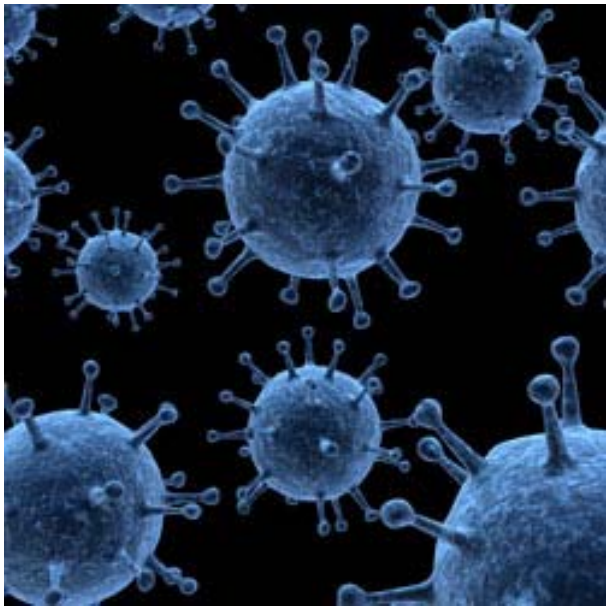


Eberts, et al., USGS Circular 1385, 2013

INTRODUCTION

LEAKING SEWERS

- Leakage rate
  - 0.01 to 0.1 L/sec/km
  - 10% to 50% of total flow
- Pharmaceuticals
- Human enteric viruses in water
  - Only source is human waste

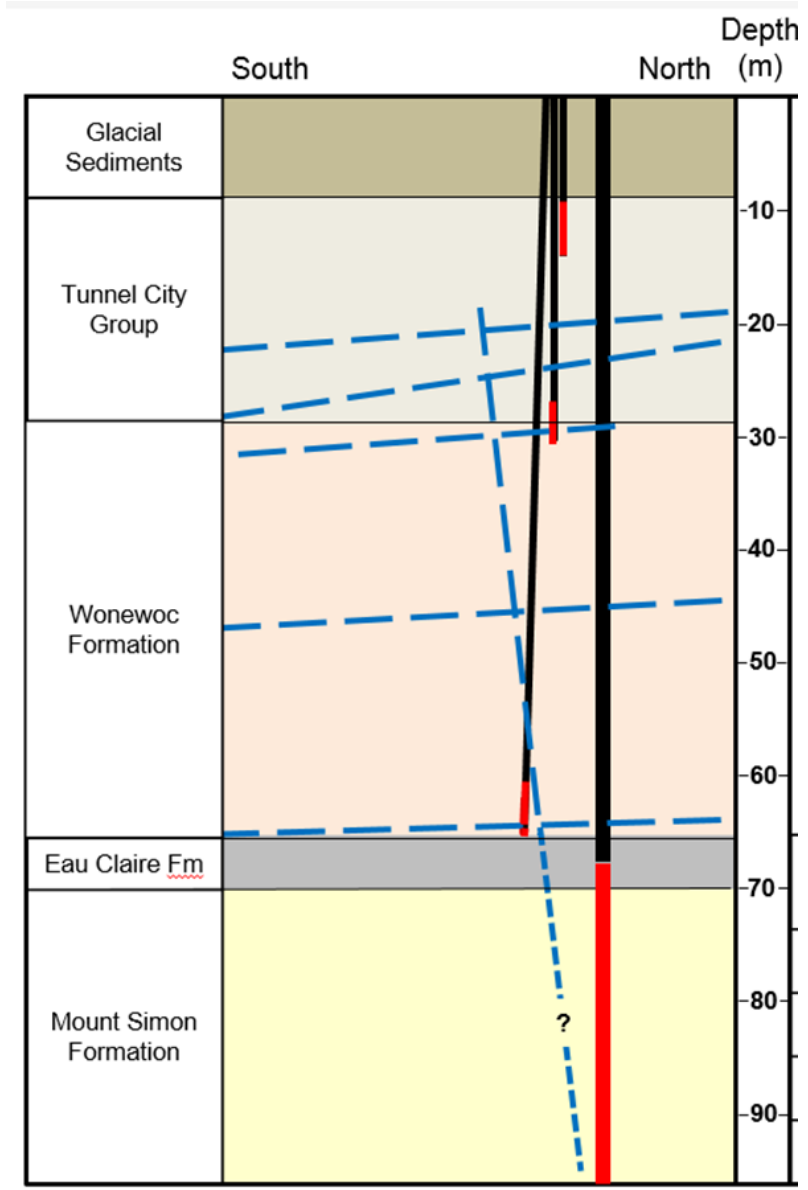


Norovirus

Image: http://www.epa.gov/microbes/research/waterbourneviruses.html

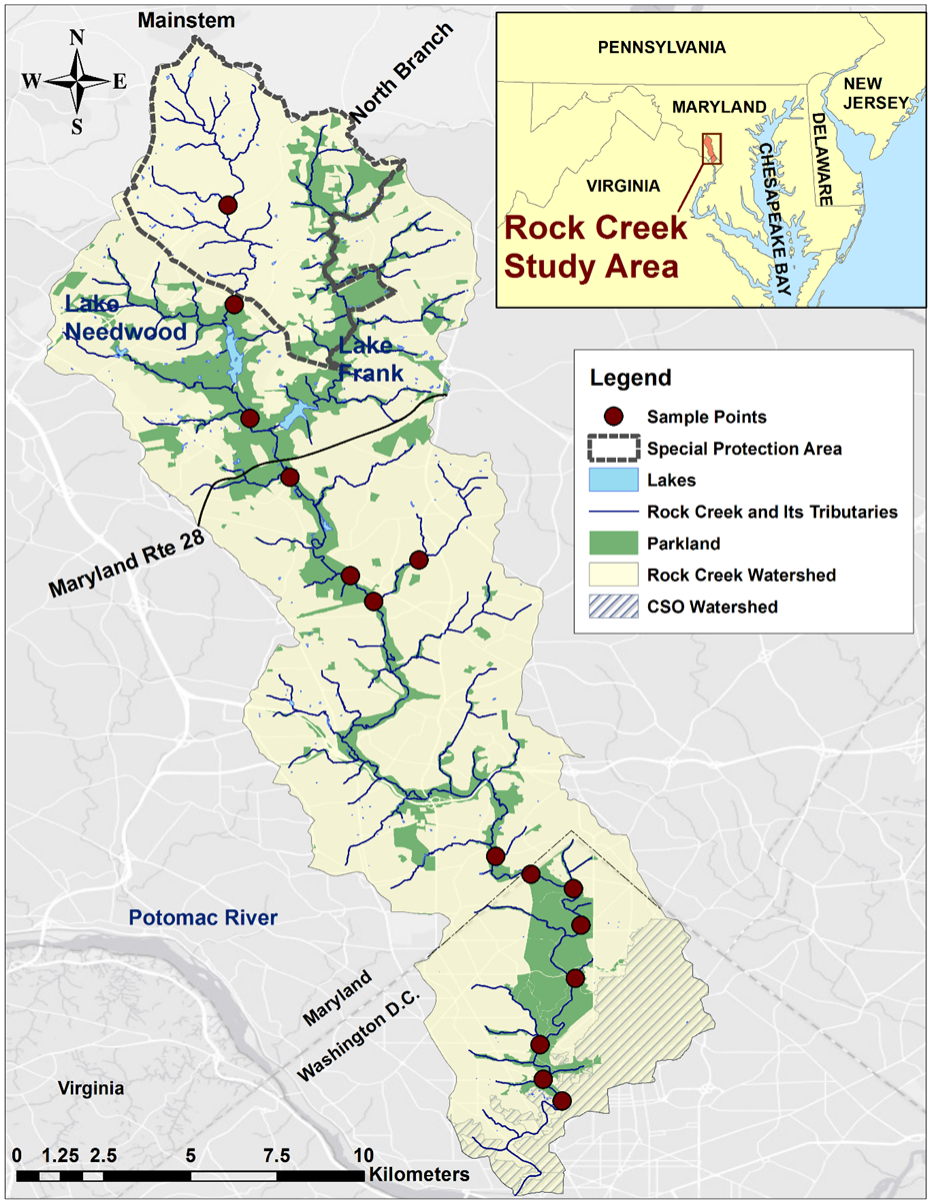
MADISON, WI STUDY

- Virus detection
  - All monitoring wells
  - Public supply well
- Sewers likely source
- Rapid transport to lower aquifer



ROCK CREEK STUDY

- Mixed-use watershed
  - Maryland and DC
  - Rural to urban
- Sewer density and age (GIS)
- Creek sampling
  - *E. coli*
  - Nutrients (N and P)



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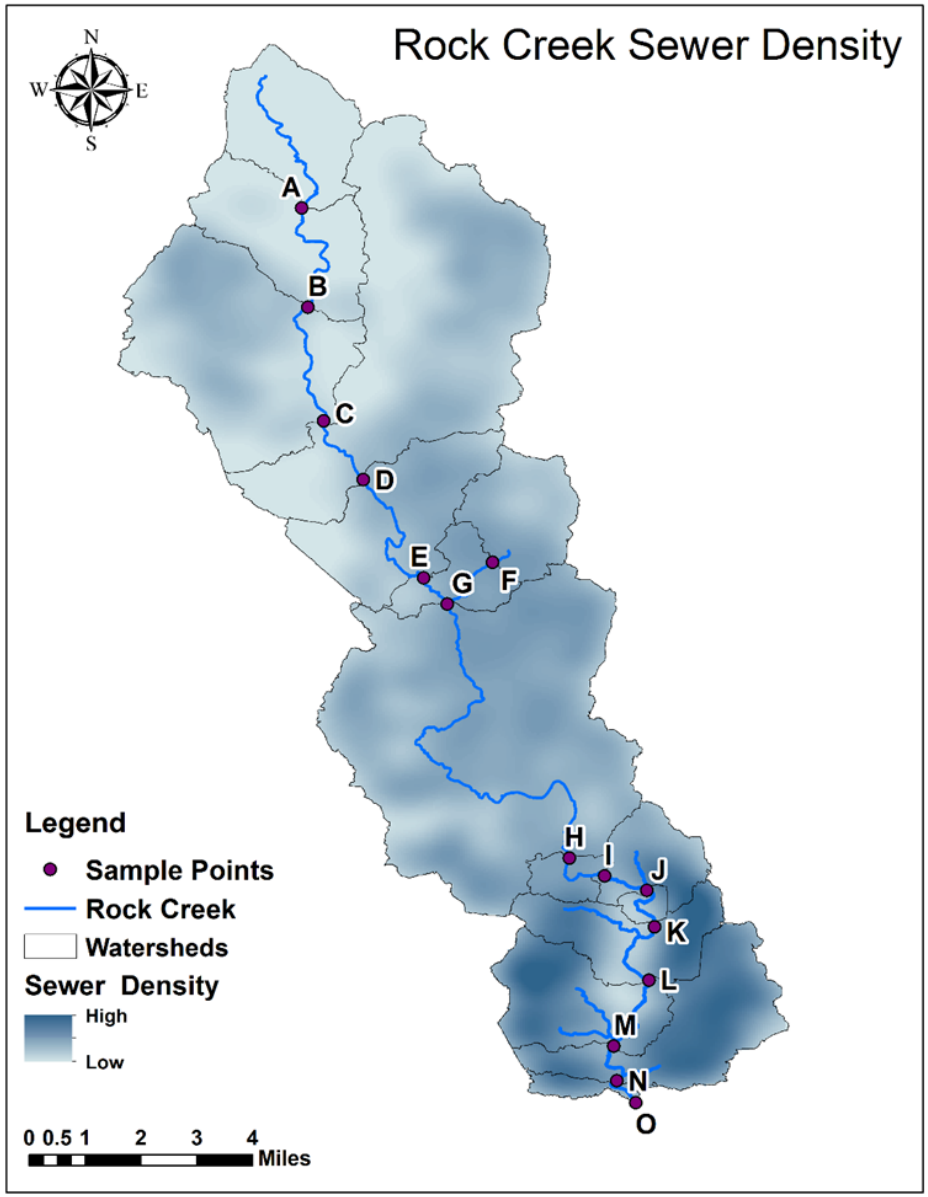

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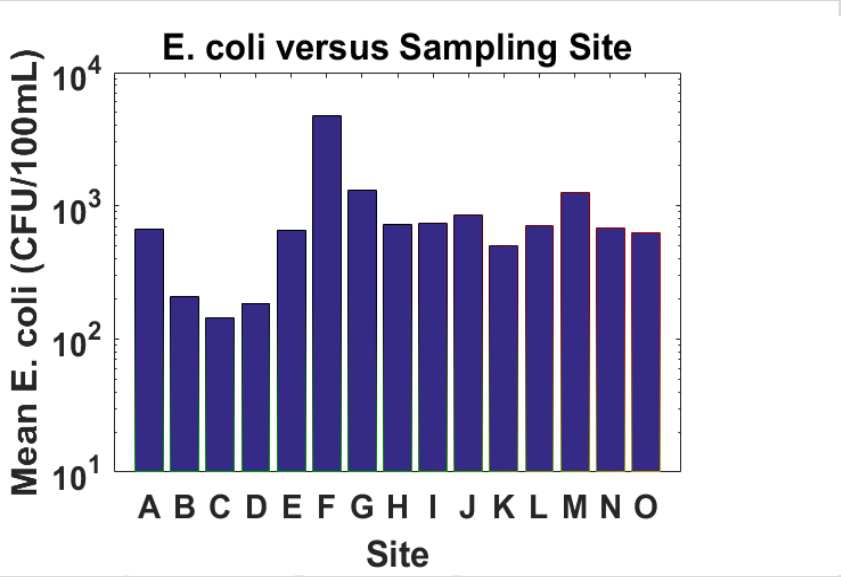
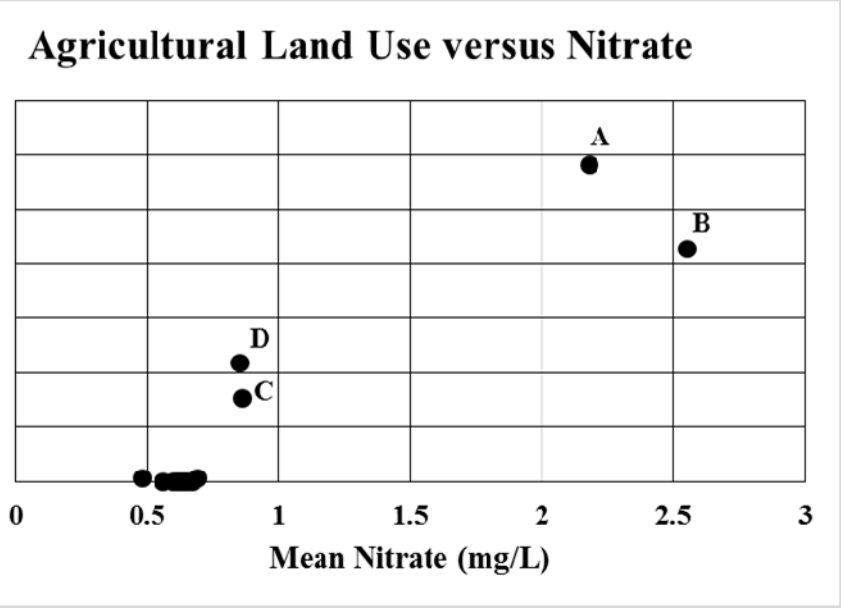
ROCK CREEK RESULTS

- High levels of E. coli
  - Not correlated with sewers
  - Correlation to rain events
  - Multiple sources (humans, pets, wildlife)
- Nitrate correlated to land use



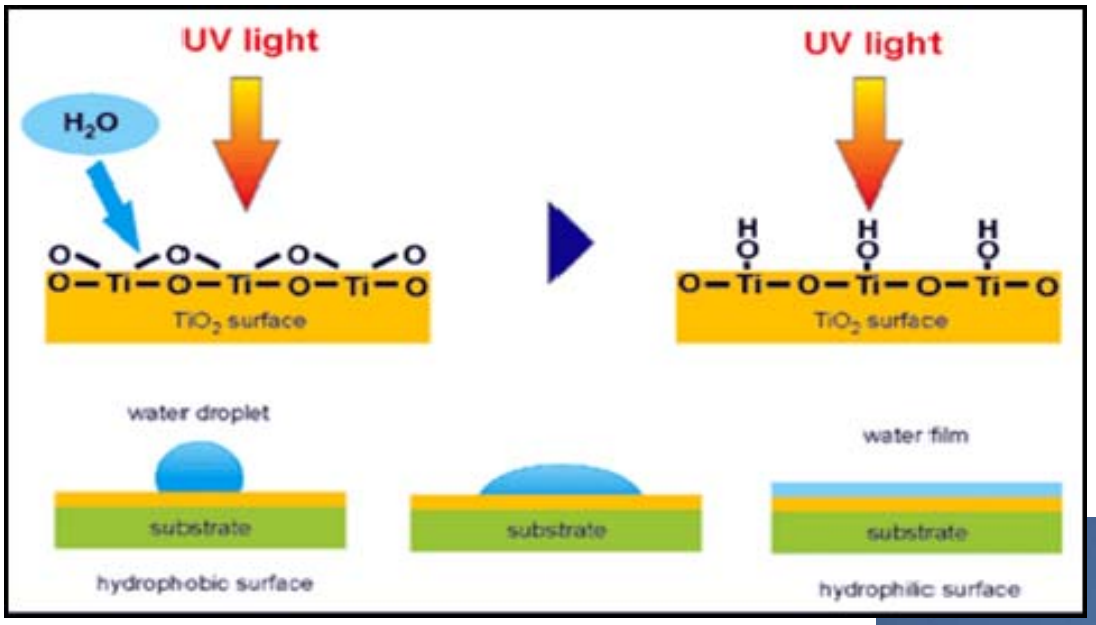


CURRENT STUDY

- Rock Creek Sampling
  - Old vs. new sewers
  - *E. coli*
  - Bacteroides species
- Microbial source tracking
  - Human vs. non-human
  - PCR analysis

$$\frac{\text{\# Human Bacteroides}}{\text{\# Total Bacteroides}}$$

NANO-TiO_2 IN CONCRETE



UV Activated

- Hydrophilic surface
- Self Cleaning
- Reduces NO_x

Impact of weathering?

- UV exposure
- pH of rain

METHODS

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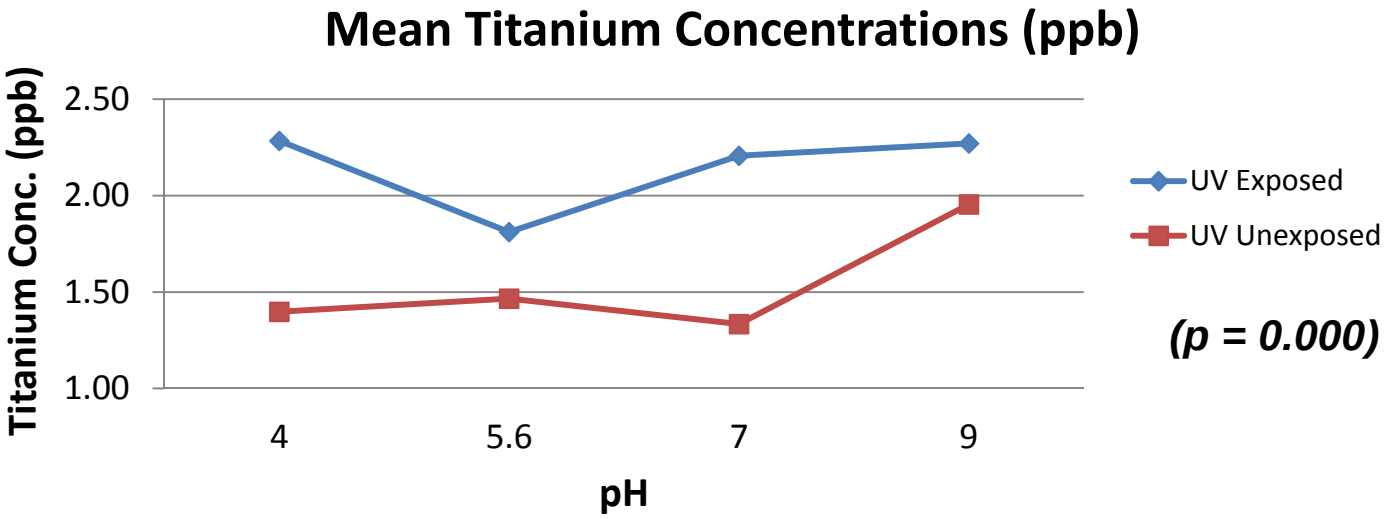
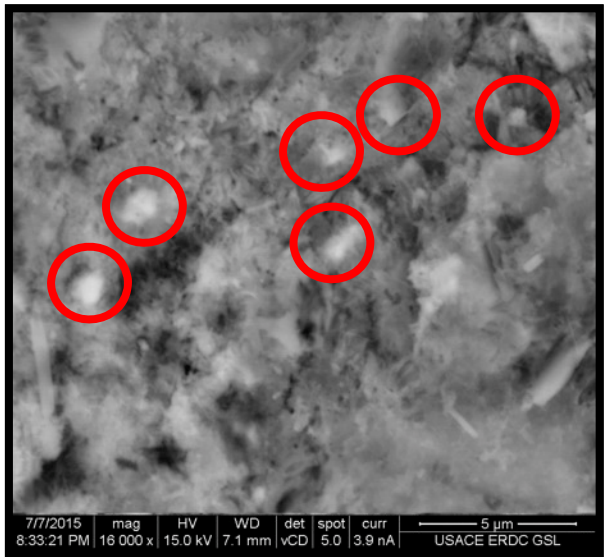
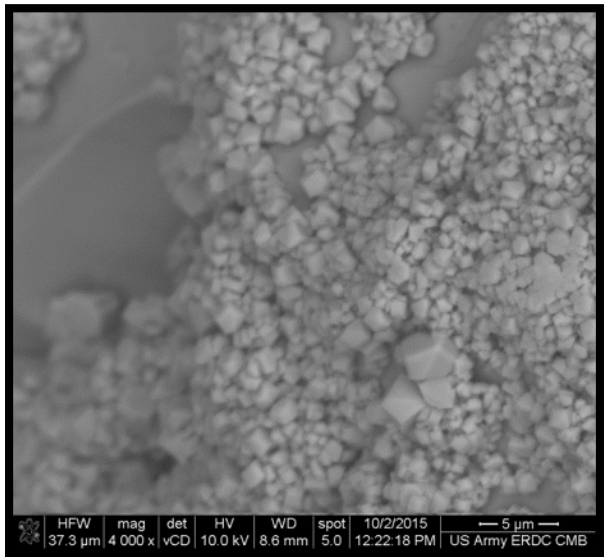
RESULTS



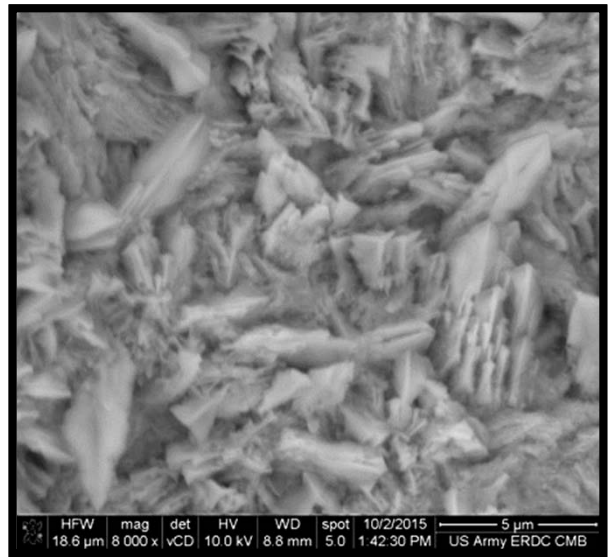
No Exposure



pH 4 and non-UV Exposure



pH4 and UV Exposure



CONCLUSIONS

- New and old sources of emerging contaminants in urban environments
- Direct analysis of viruses may be optimal to detect sewer leakage
- More work required to better understand how nano-TiO_2 may impact environment and human health

QUESTIONS?