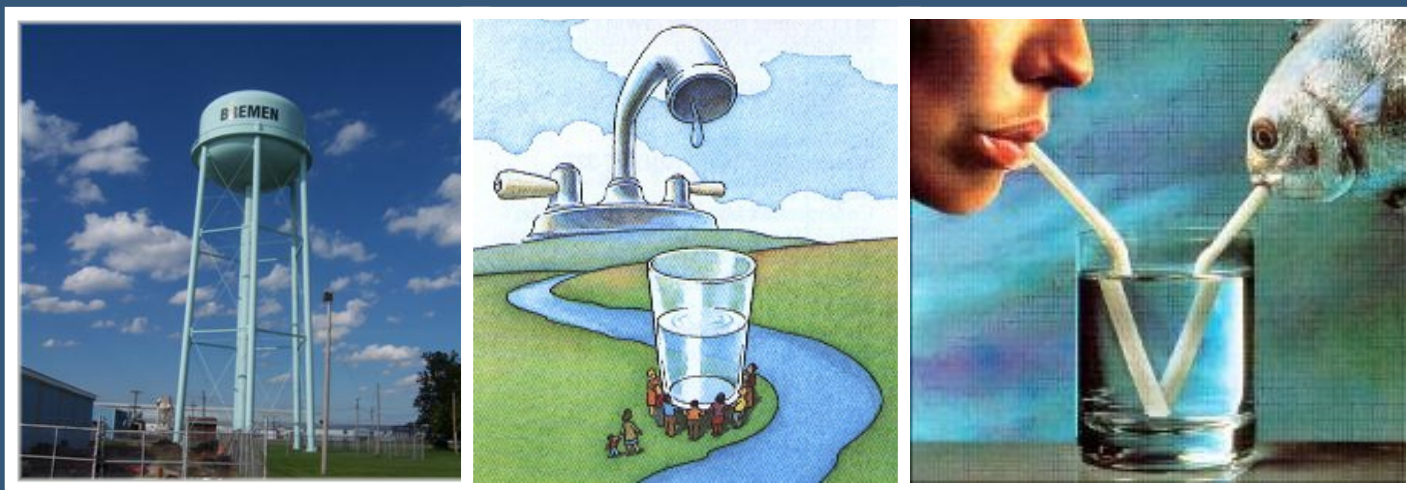
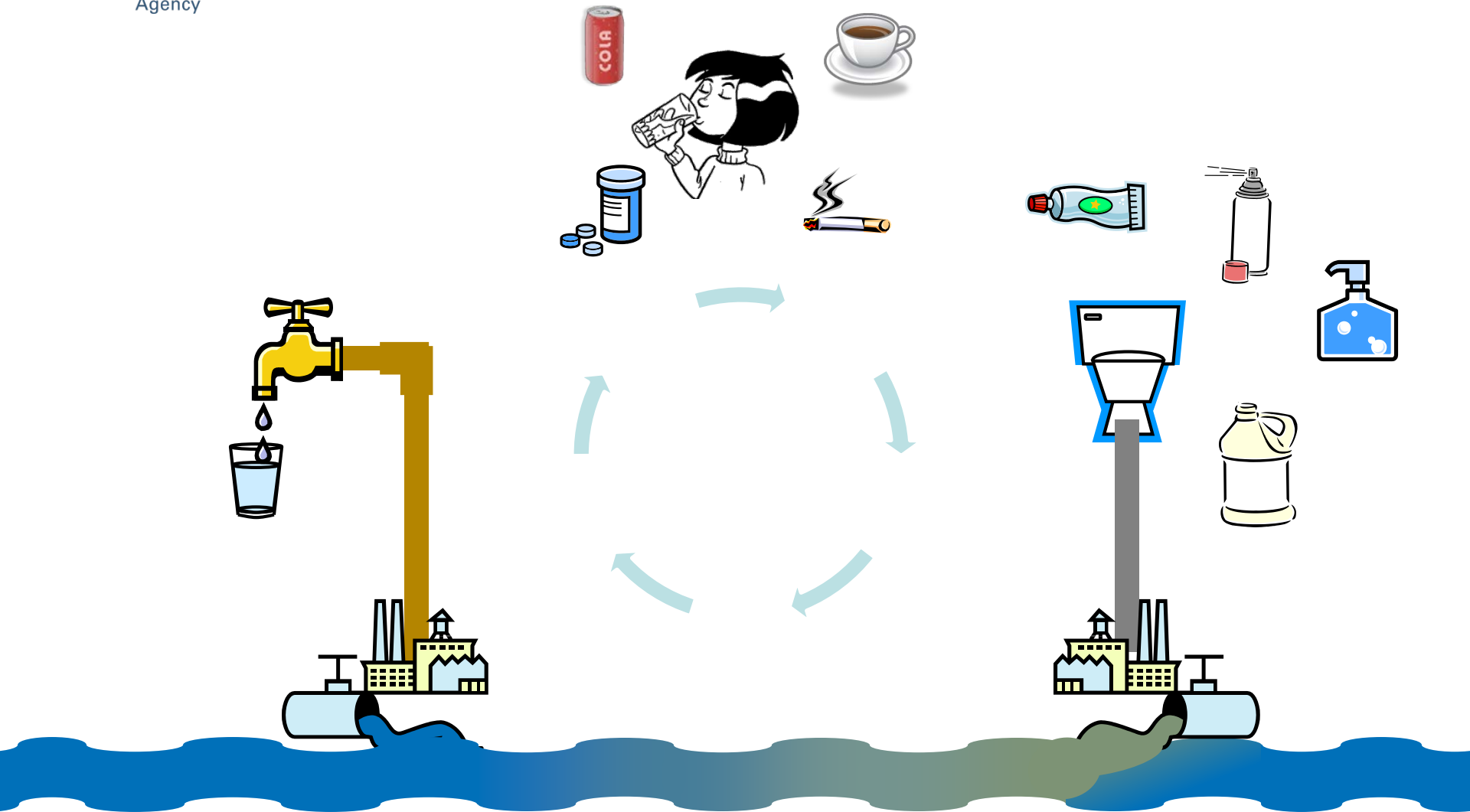


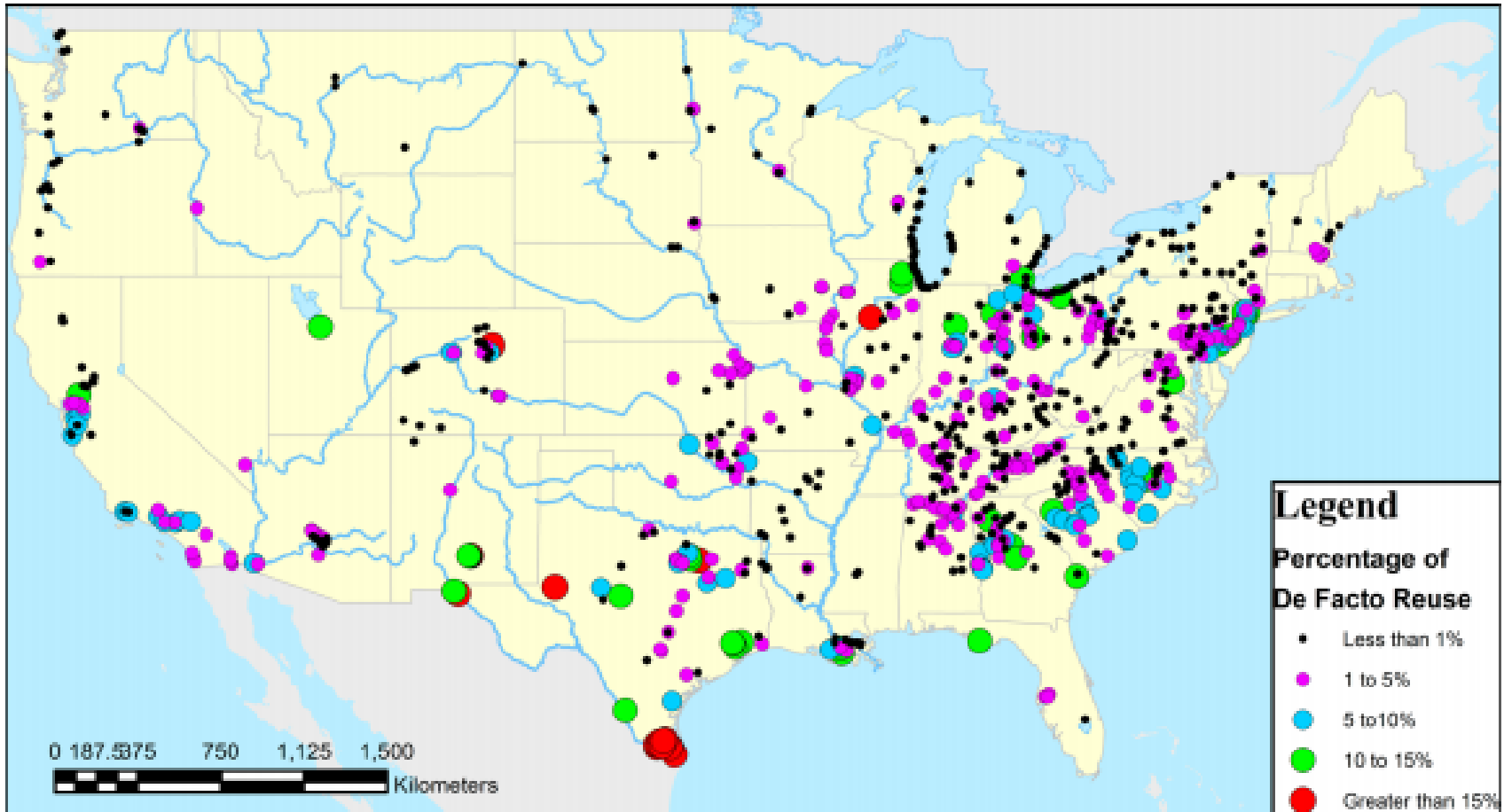
# Transport of Contaminants of Emerging Concern During De Facto Reuse



# CECs and the Water Cycle

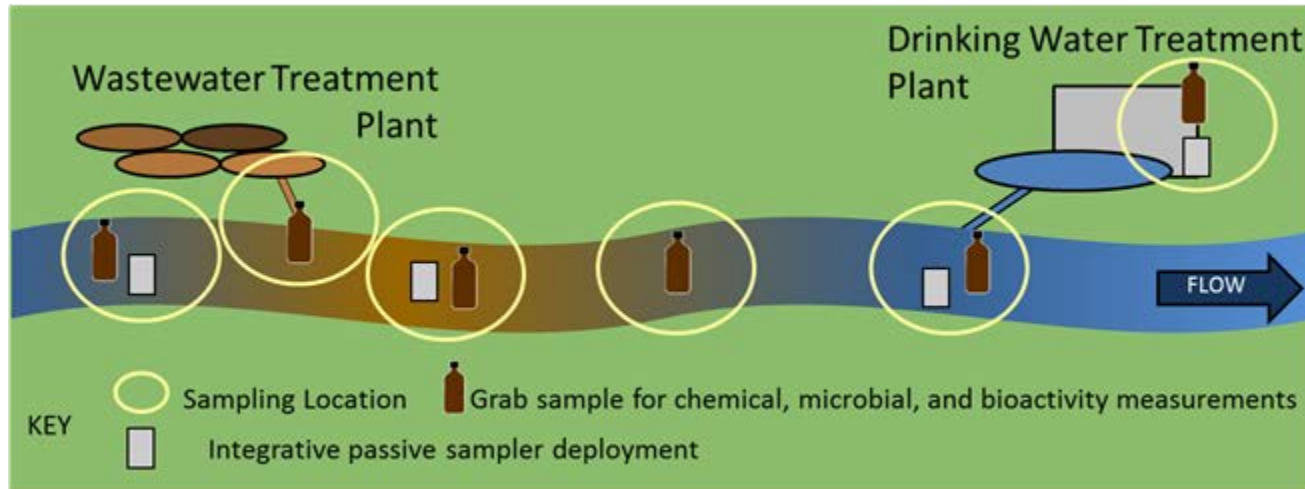


# De Facto Water Reuse



Rice et al ES&T 2015

# Transport of Wastewater Contaminants



- **Goal:** examine the occurrence, fate, and transport of CECs as they travel from WWTP into DWTP.
- **Sampling plan:** collect residence time weighted samples to analyze for chemicals, microorganisms, and bioactivity.
  - One location
  - Three sampling events (Oct 2014, April 2015 and Aug 2015)
  - Six sampling points

# Flow Conditions

October 2014

April 2015

August 2015



- Polar Organic Chemical Integrative Samplers (POCIS) and Semi-Permeable Membrane Devices (SPMDs).
- Deployed in upstream, effluent mixing zone, drinking water intake and treated drinking water for ~30 days.
- Provide more data on intermittent and/or low level contaminants.





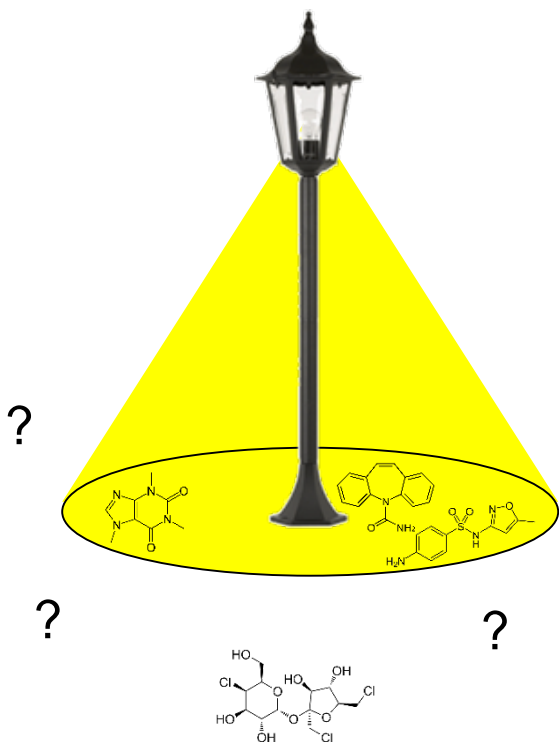
# Chemicals



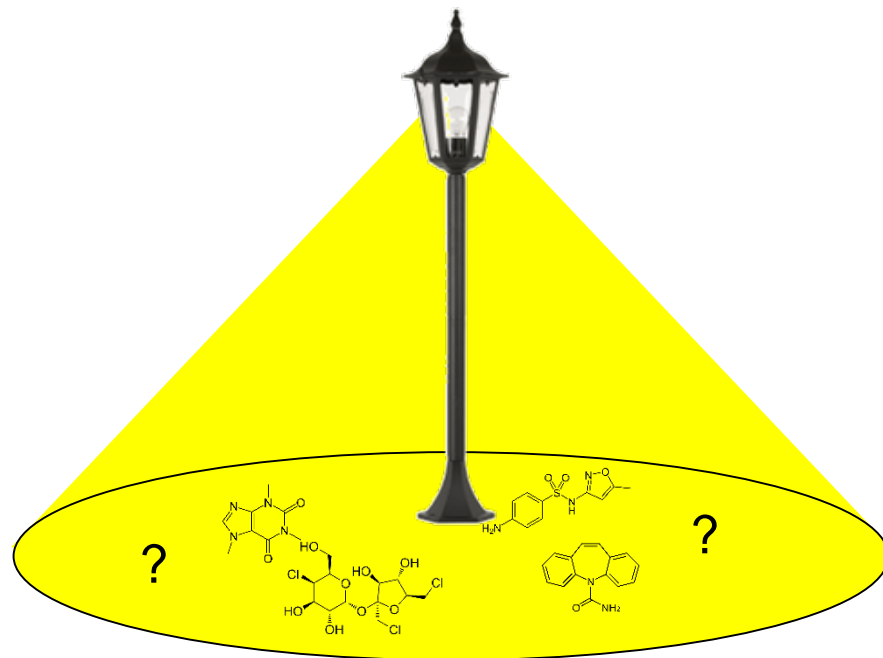
PI	Assay	Number of Analytes
USGS: Ed Furlong	Direct Aqueous Injection Pharmaceuticals	109
USGS: Mike Meyer	Antibiotics	33
USEPA: Tammy Jones-Lepp	Antibiotics and aromatase inhibitors	16
College of Wooster: Paul Edmiston	Antidepressants	8
USEPA: Kathy Schenck	Hormones and other EDCs	11
USEPA: Marc Mills	Hormones	16
USGS: Michelle Hladik	Disinfection Byproducts	29
USEPA: Marc Mills	Contaminants of emerging concern	9
FIU: Piero Gardinali	Sucralose	1
NCSU: Detlef Knappe	1,4-Dioxane	1
USGS: Dave Alvarez	Wastewater contaminants	47
USEPA: Marc Mills	Perfluorinated Compounds	16
USEPA: Andy Lindstrom	Perfluorinated Compounds	10
USEPA: Heath Mash	Inorganics	40
USEPA: Heath Mash	Algal Toxins	4

Total 350

## Chemical Analysis



## Untargeted Analyses

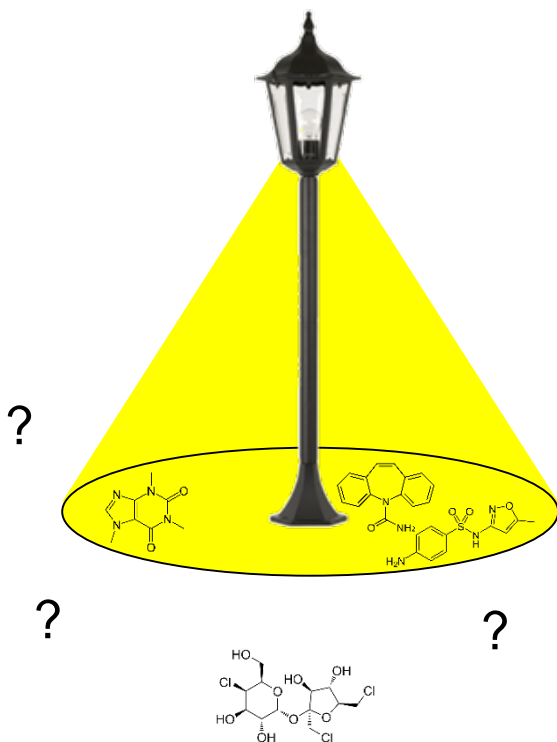




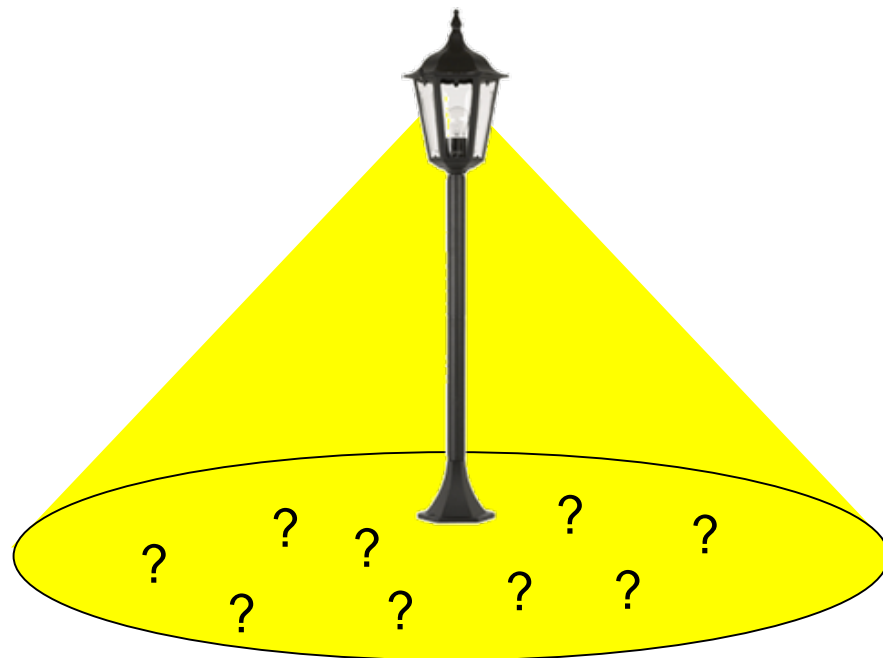
- One of the limitations of analytical chemistry techniques is that you can only see what you are screening for.
- These untargeted analyses will use a wide variety of instrumentation and tactics to identify other peaks that may be present in the grab samples and POCIS extracts.

PI	Instrumentation
SDSU: Eunha Hoh	GC x GC TOF-MS
USGS: Ed Furlong	QTOF with both GC and LC interfaces
USEPA: Angela Batt	LC-QTOF
USEPA: Mark Strynar	LC-TOF
FIU: Piero Gardinali	LC-HR-MS/MS Orbitrap
USEPA: Marc Mills	LC-IT-TOF
USEPA: Heath Mash	LC-IT-TOF

## Chemical Analysis

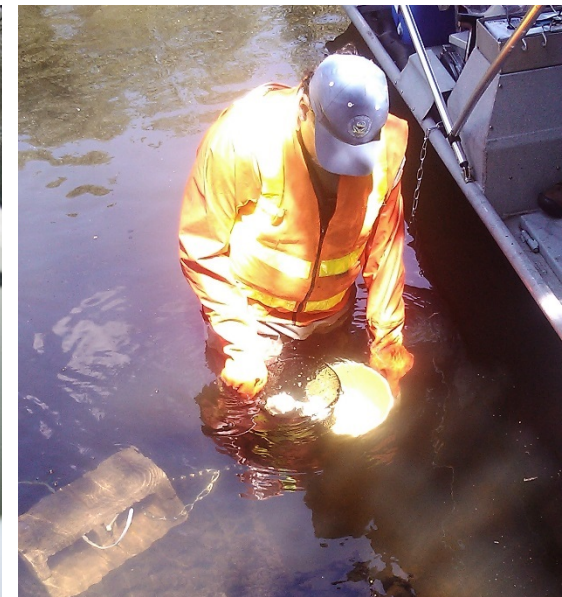
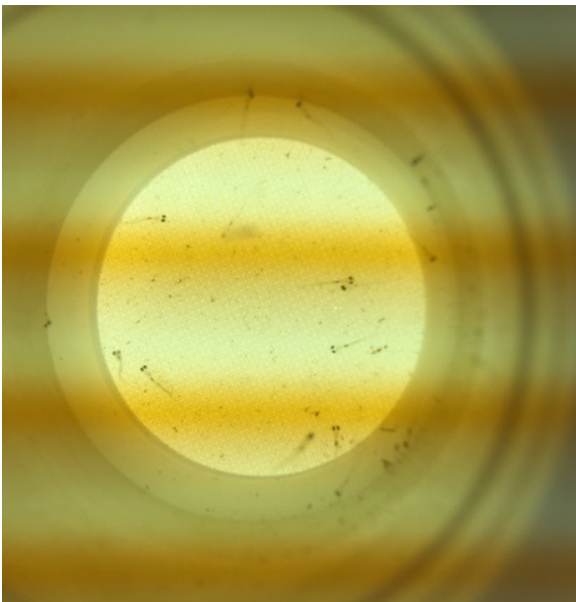


## Bioassay



PI	Assay
USEPA: Vickie Wilson	Estrogens T47D-KBluc
USEPA: Vickie Wilson	Androgens MDA-kb2
USEPA: Phill Hartig	Glucocorticoids CV-1 transient GR assay
USEPA: Dan Villeneuve/Gary Ankley	Steroidogenesis Pimephales promelas
USEPA: Dan Villeneuve/Gary Ankley	Gene expression Pimephales promelas
USEPA: Dan Villeneuve/Gary Ankley	Nuclear receptor and transcription factor activation
USEPA: Quincy Teng/Drew Ekman/Tim Collette	Metabolite profiling Danio rerio
USEPA: David Lattier/Jim Lazorchak/Adam Biales/ Mitch Kostich/ MJ See	'omics through RNA-sequencing
USEPA: David DeMarini / Jane Ellen Simmons	Mutagenicity Ames assay with and without metabolic activation
USEPA: Jane Ellen Simmons	Microtox Assay

- Deployed in upstream and effluent for 24 hours in August 2015 sampling event.
- Additional grab samples collected for lab exposures and pharmaceutical, hormone, and PFC analysis



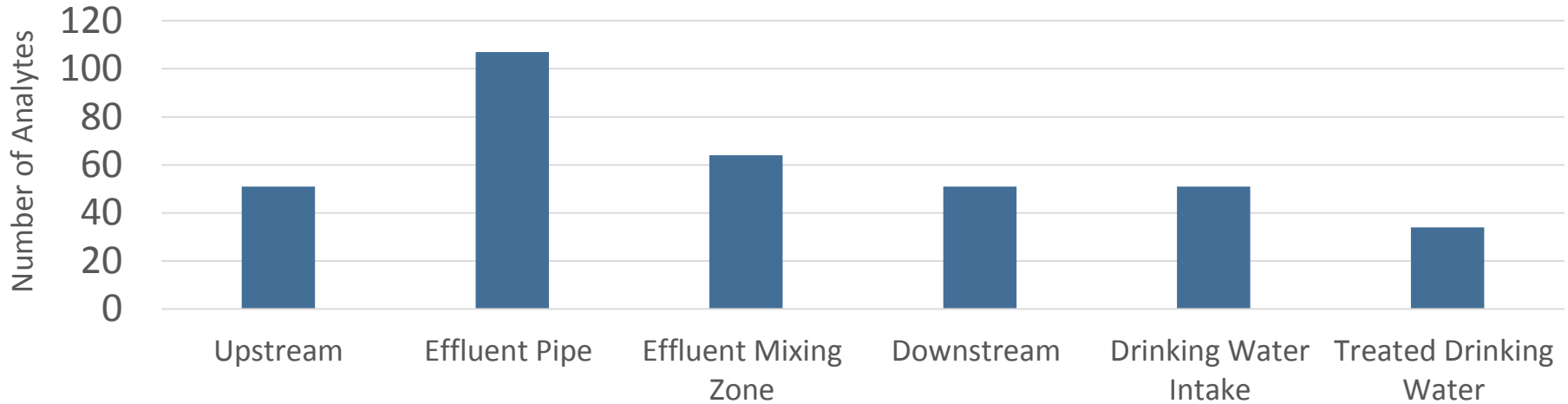
# Microorganisms

PI	Assay
USEPA: Stacy Pfaller	QPCR for Mycobacteria and Legionella Culture for Mycobacteria
USEPA: Stacy Pfaller	Unknown culture isolate analysis
USEPA: Jorge Santo-Domingo	16S rRNA bacteria sequencing

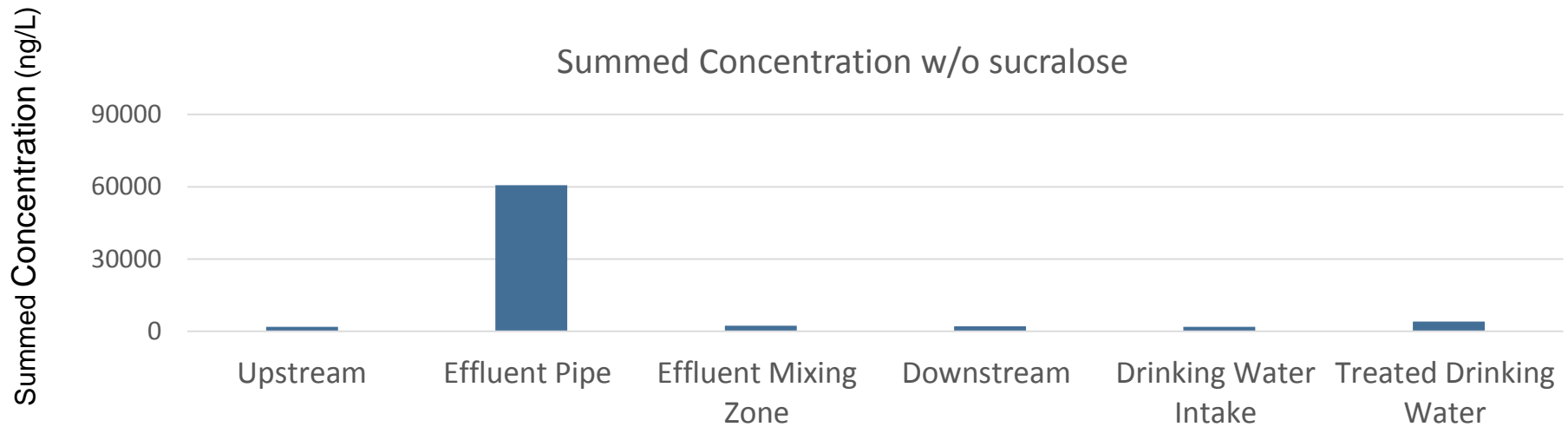
# Preliminary Data

## October 2014

Qualitative Detections (max n= 194)



Summed Concentration w/o sucralose



# Co-PIs

## USGS

**Ed Furlong**  
**Dana Kolpin**  
Dave Alvarez  
Michelle Hladik  
Mike Meyer  
Jason Sorenson  
Marc Zimmerman



## USEPA

**Susan Glassmeyer** Jorge Santo  
**Marc Mills** Domingo  
Angela Batt Kathy Schenck  
Adam Biales MJ See  
Drew Ekman Jane Ellen Simmons  
Phill Hartig Mark Strynar  
Tammy Jones-Lepp Quincy Teng  
Dave Lattier Dan Villeneuve  
Jim Lazorchak Vickie Wilson  
Andy Lindstrom  
Heath Mash  
Stacy Pfaller

## Academia

Paul Edmiston  
Piero Gardinali  
Eunha Hoh  
Detlef Knappe

