

# ***Emerging Contaminants in the Upper Santa Cruz River: 2010-2011***

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# Accurate detection and quantification of EDC/PPCPs in complex aqueous matrices is needed:

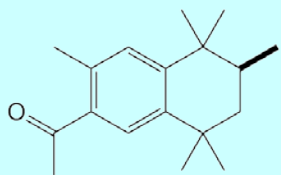
- to determine **contaminant concentrations** in the environment  
and
- to understand **fate and transport** behavior of EDC/PPCPs in watersheds

## State of the art approach

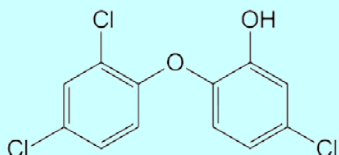
Solid phase extraction (**SPE**) prior to **LC-MSMS** detection to determine environmental contaminant levels.

# Some EDC/PPCPs analyzed by Arizona Laboratory for Emerging Contaminants

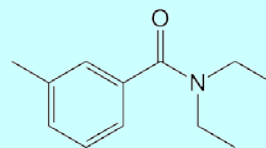
## Personal Care Products



AHTN  
Fragrance

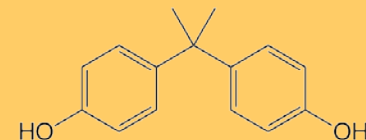


triclosan  
Antibacterial

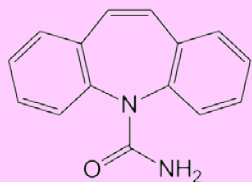


DEET  
Insecticide

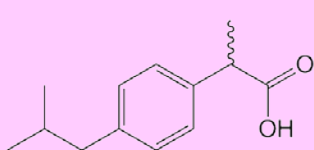
## Industrial products



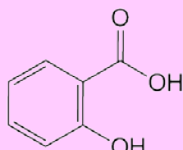
bisphenol A  
Plasticizer



carbamazepine  
Anti-epileptic

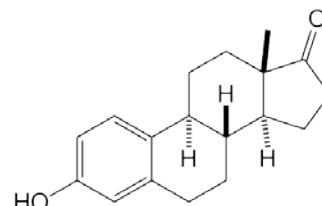


ibuprofen

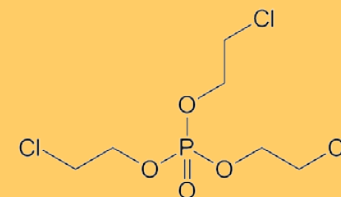


salicylic acid

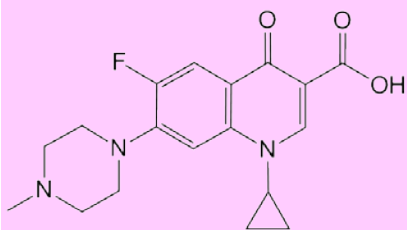
## Analgesics



estrone  
Estrogen

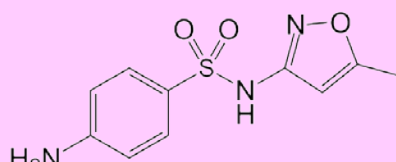


TCEP  
Flame retardant



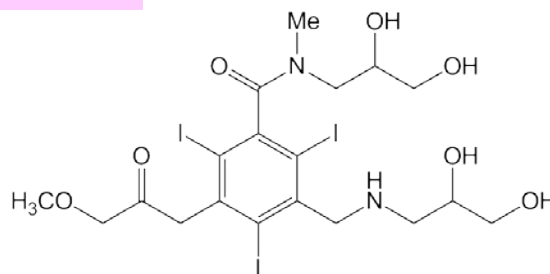
ciprofloxacin

## Antibiotics

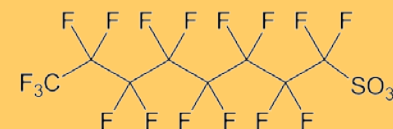


sulfamethoxazole

## Pharmaceuticals

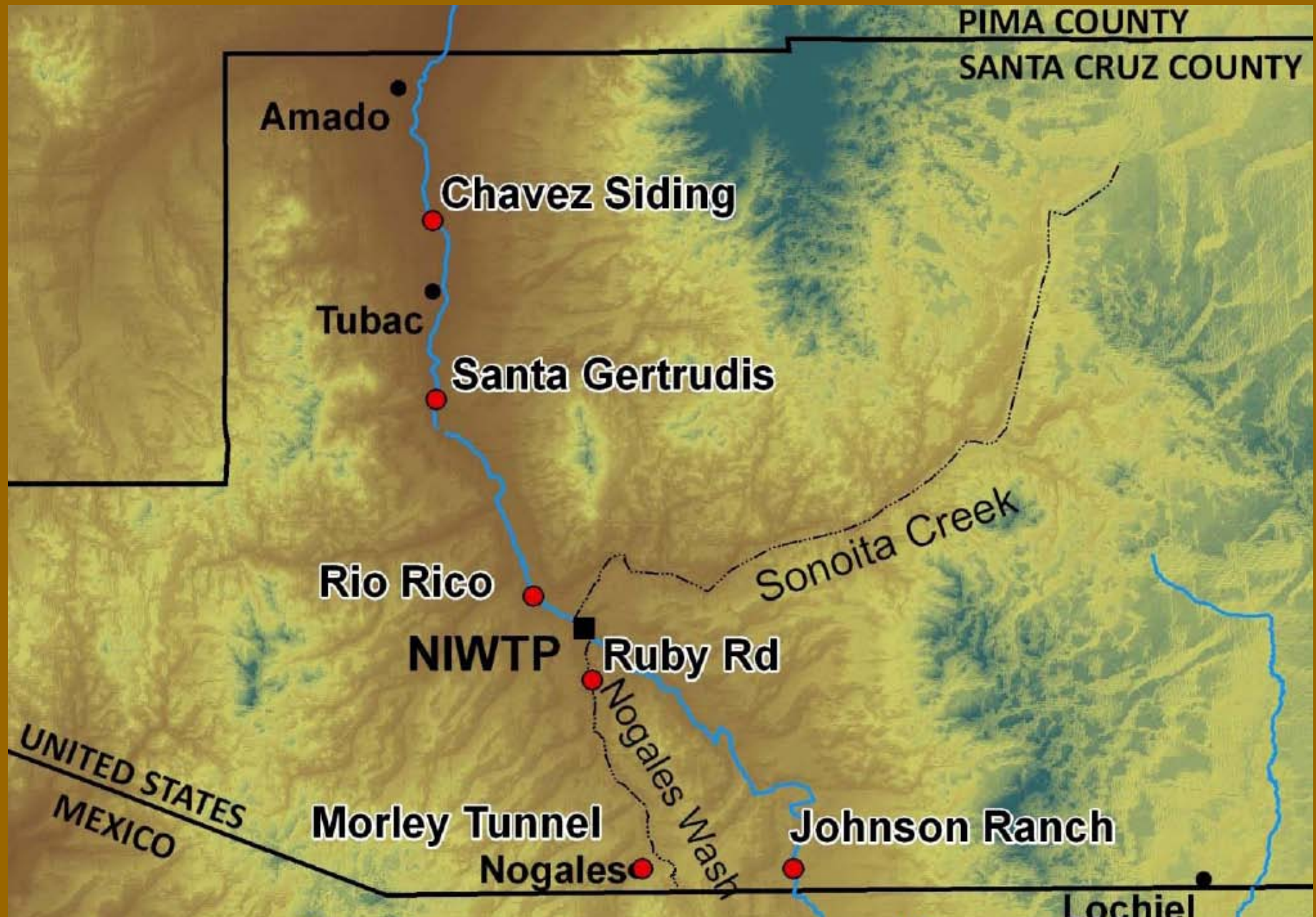


Iopromide  
Contrast agent

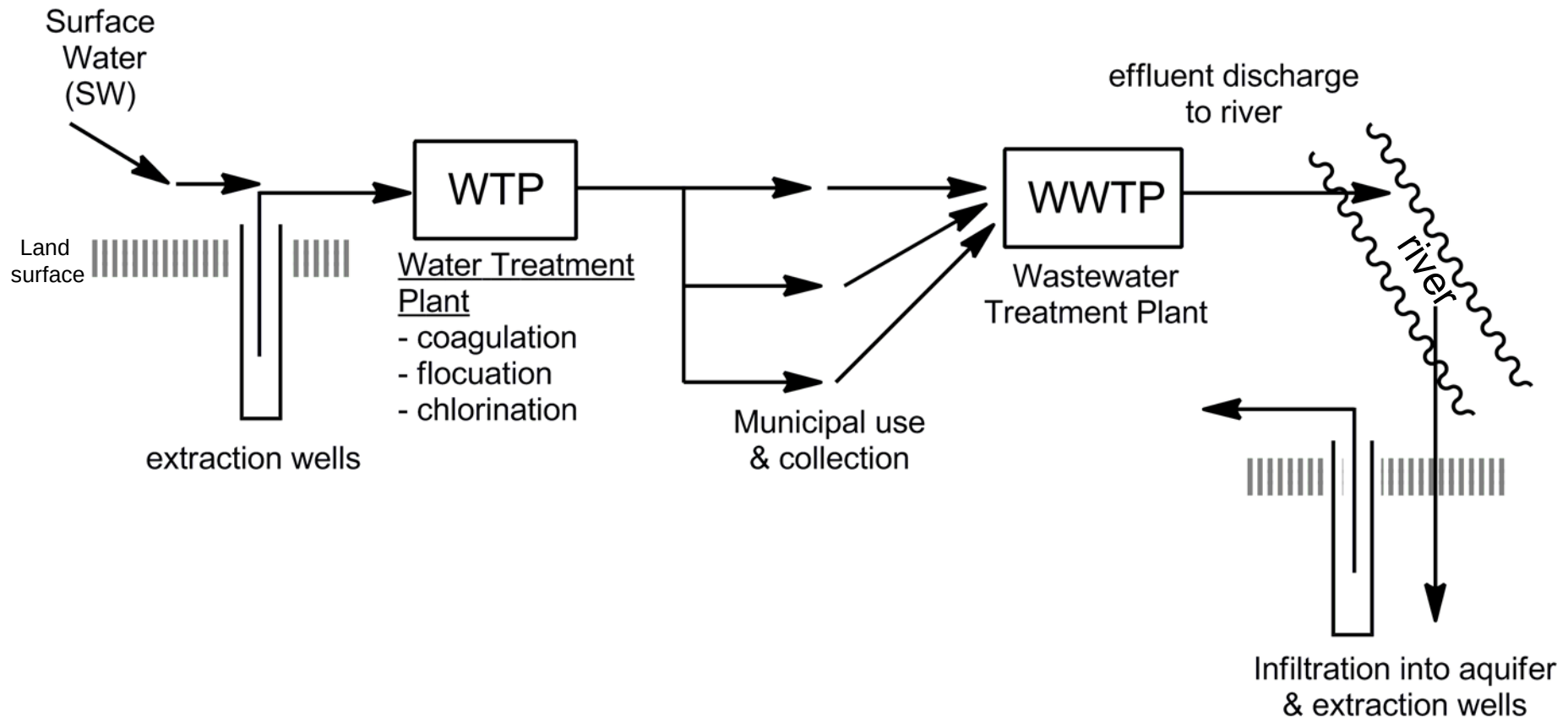


PFOS  
Perfluorinated  
surfactant

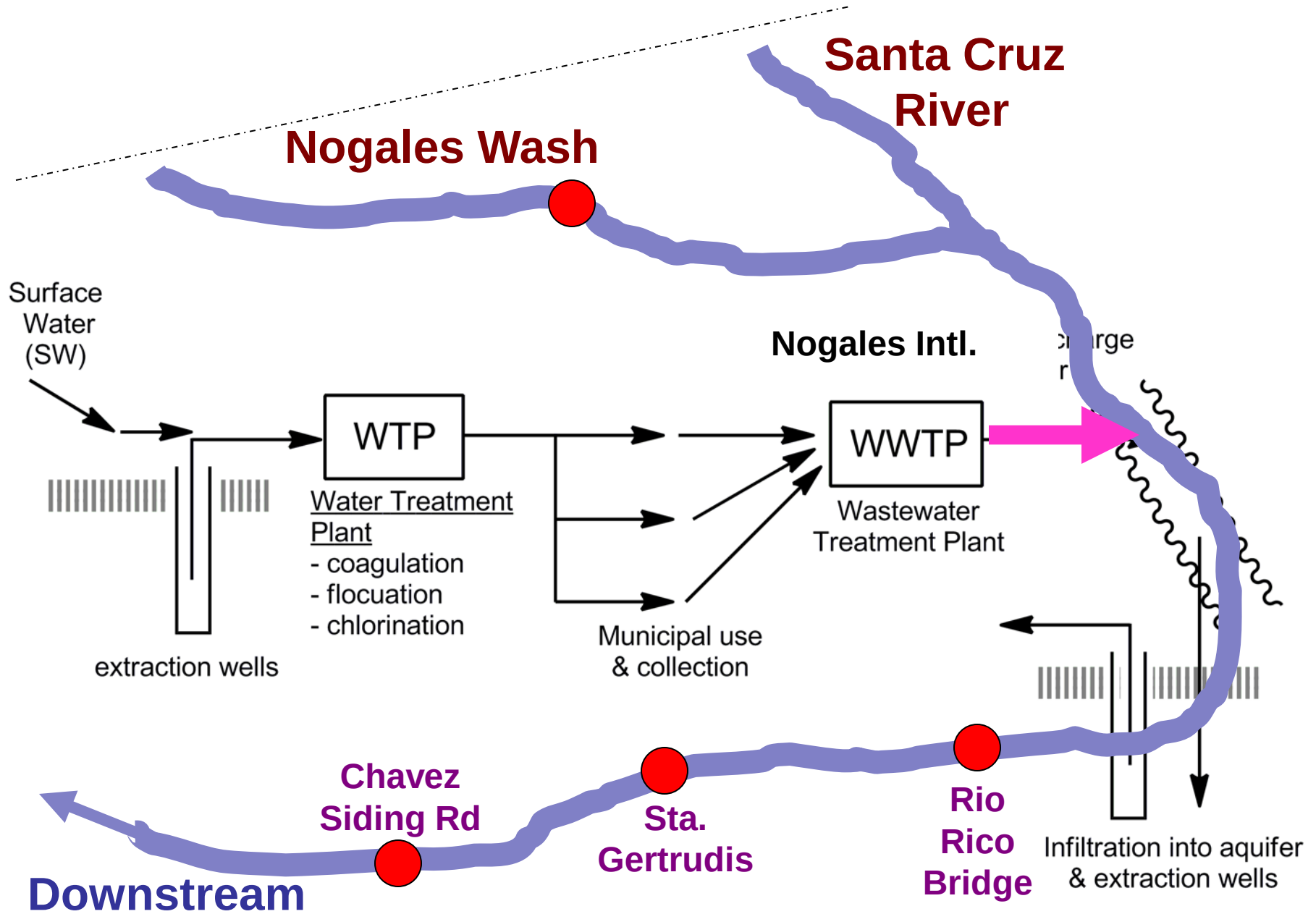
## (Four) water sample collection locations



# Generalized scheme of a Southwestern U.S. city hydrologic path



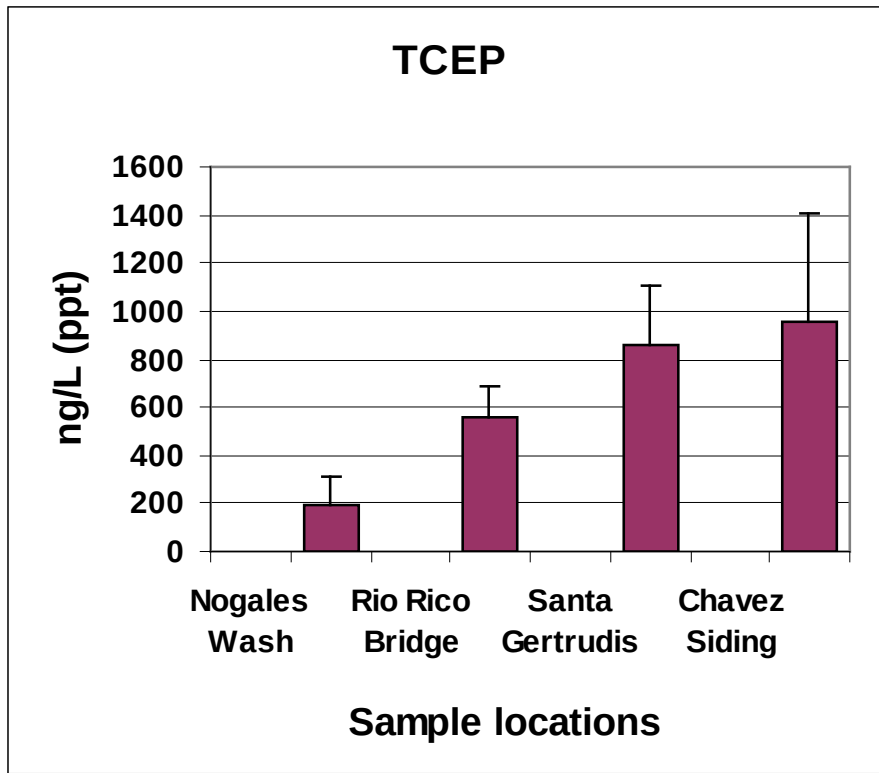
# Generalized scheme of Southern Santa Cruz River Valley hydrologic path



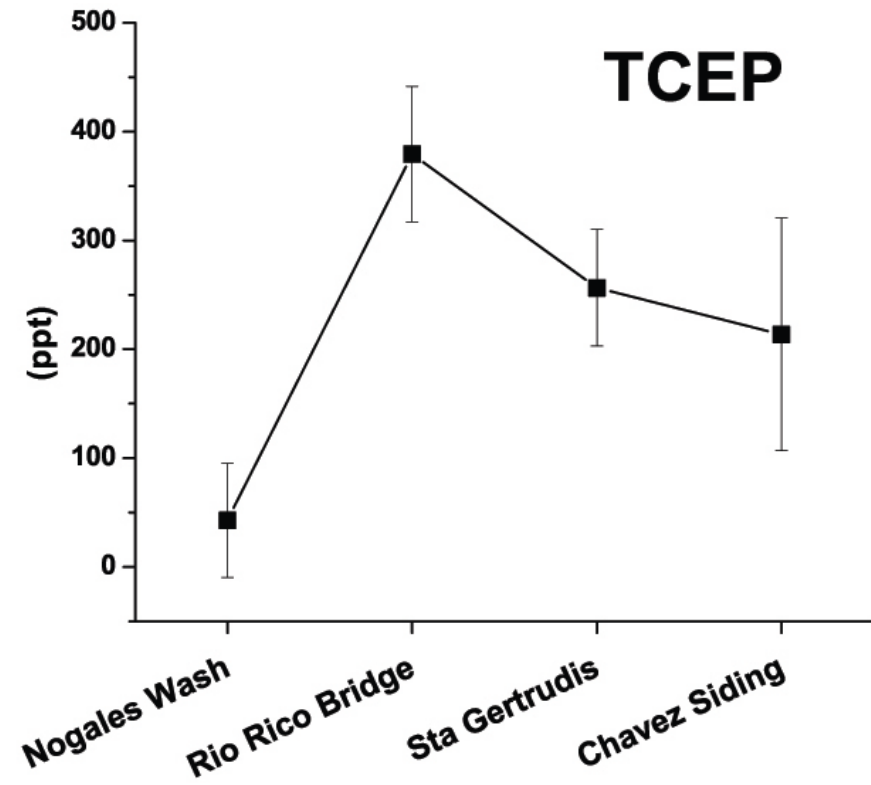


# Flame retardant

Dec 2009

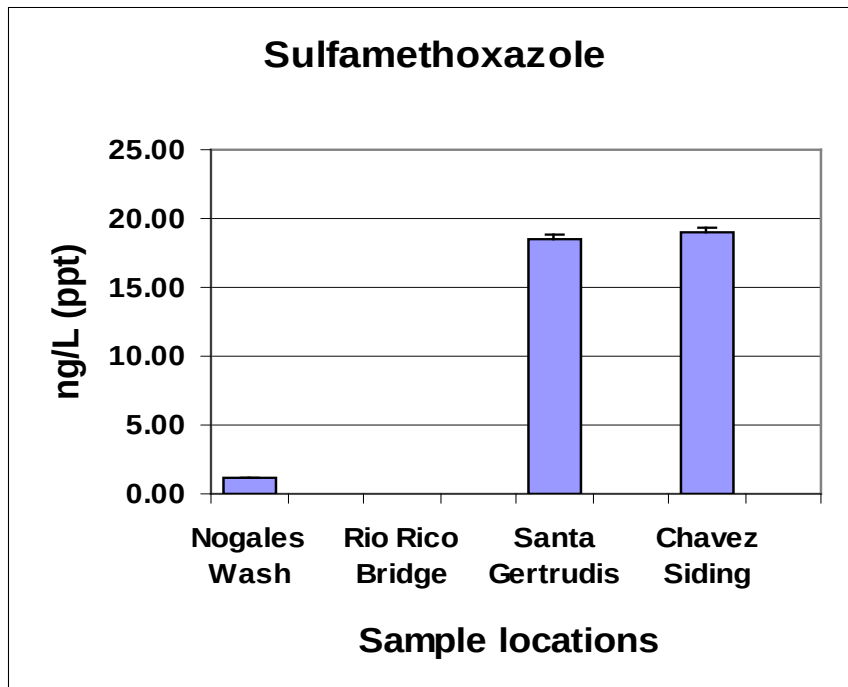


Jan 2011

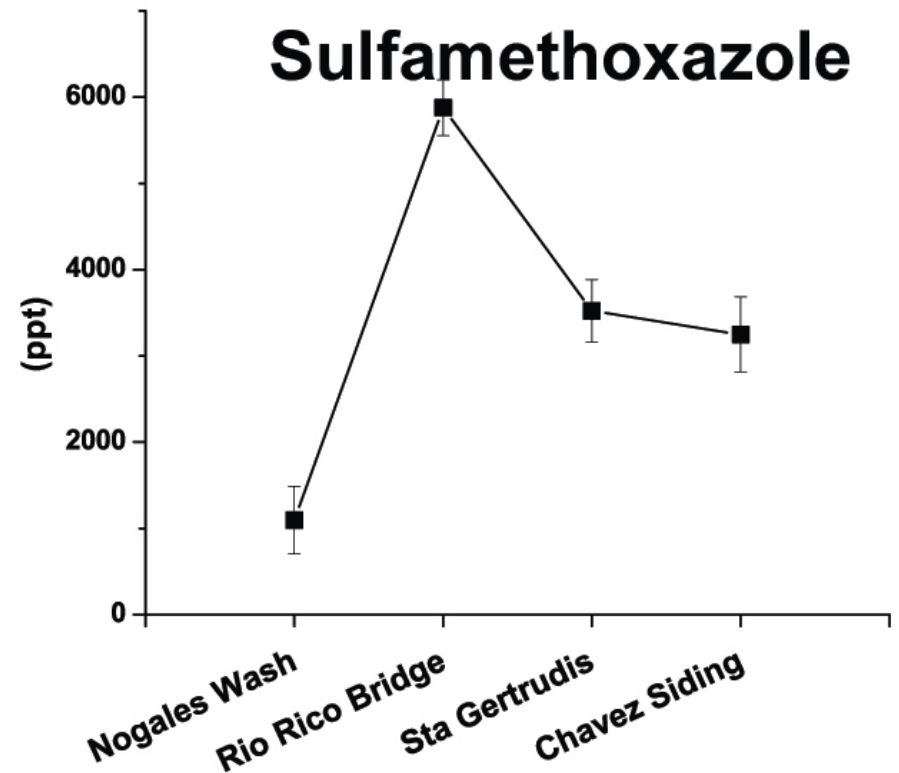


# Antibiotic

Dec 2009

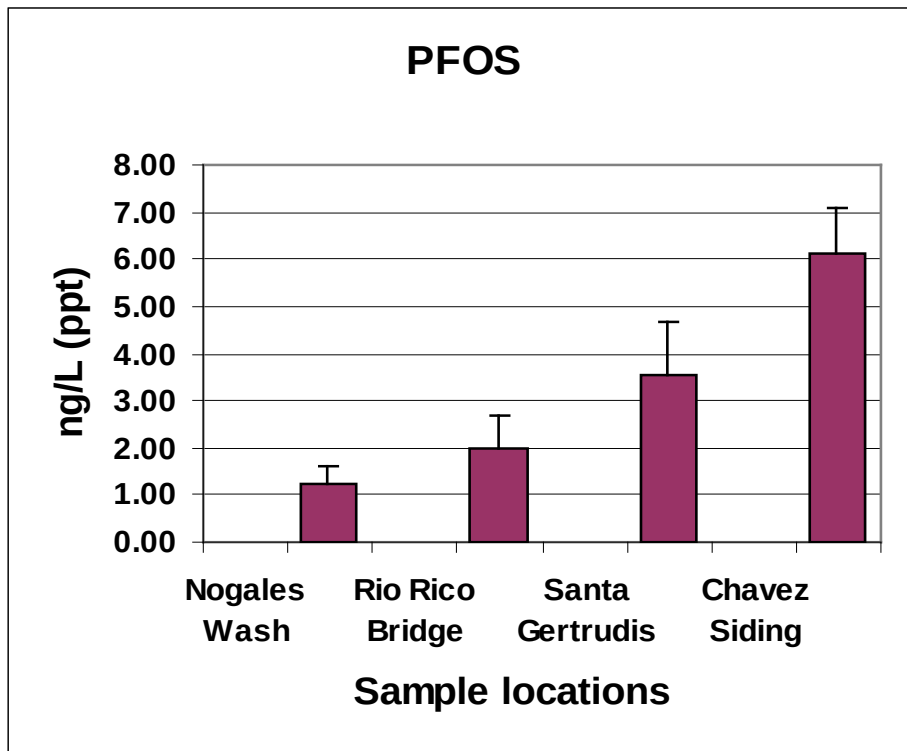


Jan 2011

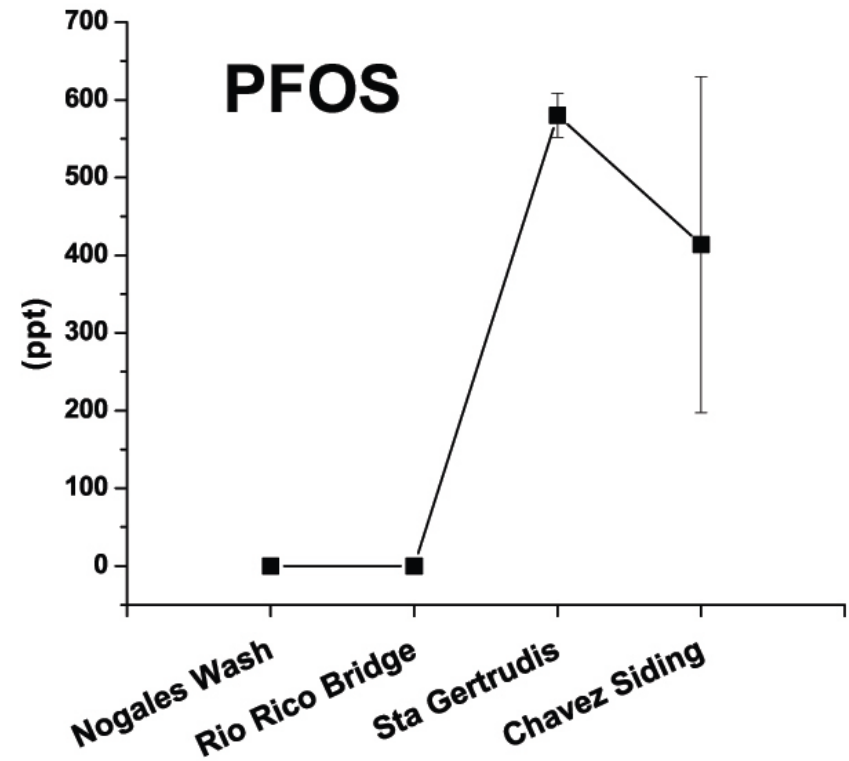


# Flame retardant

Dec 2009

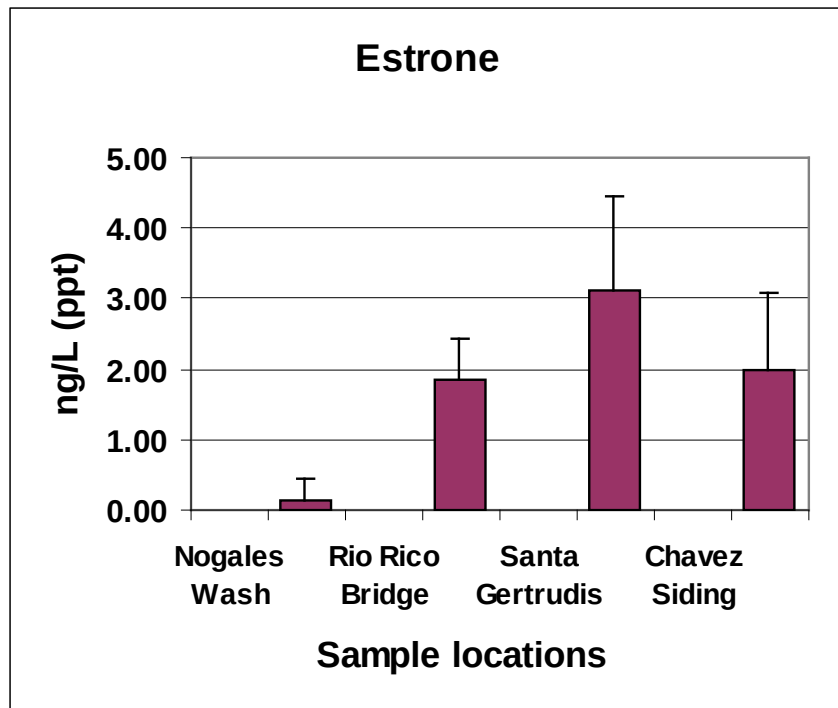


Jan 2011

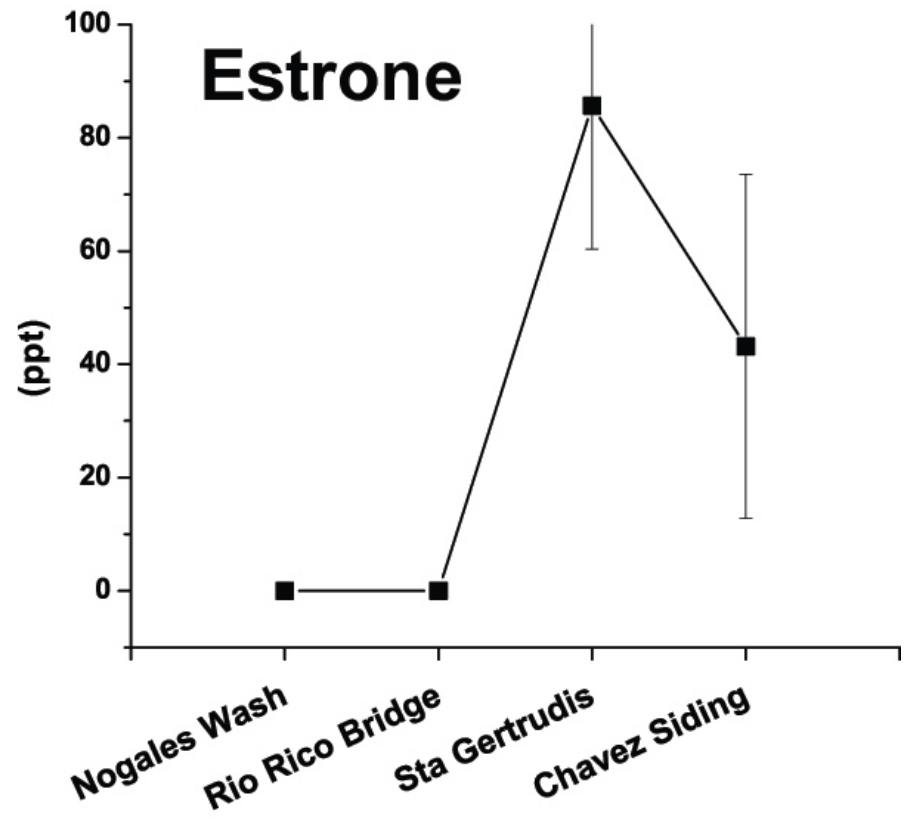


# Hormone / EDC

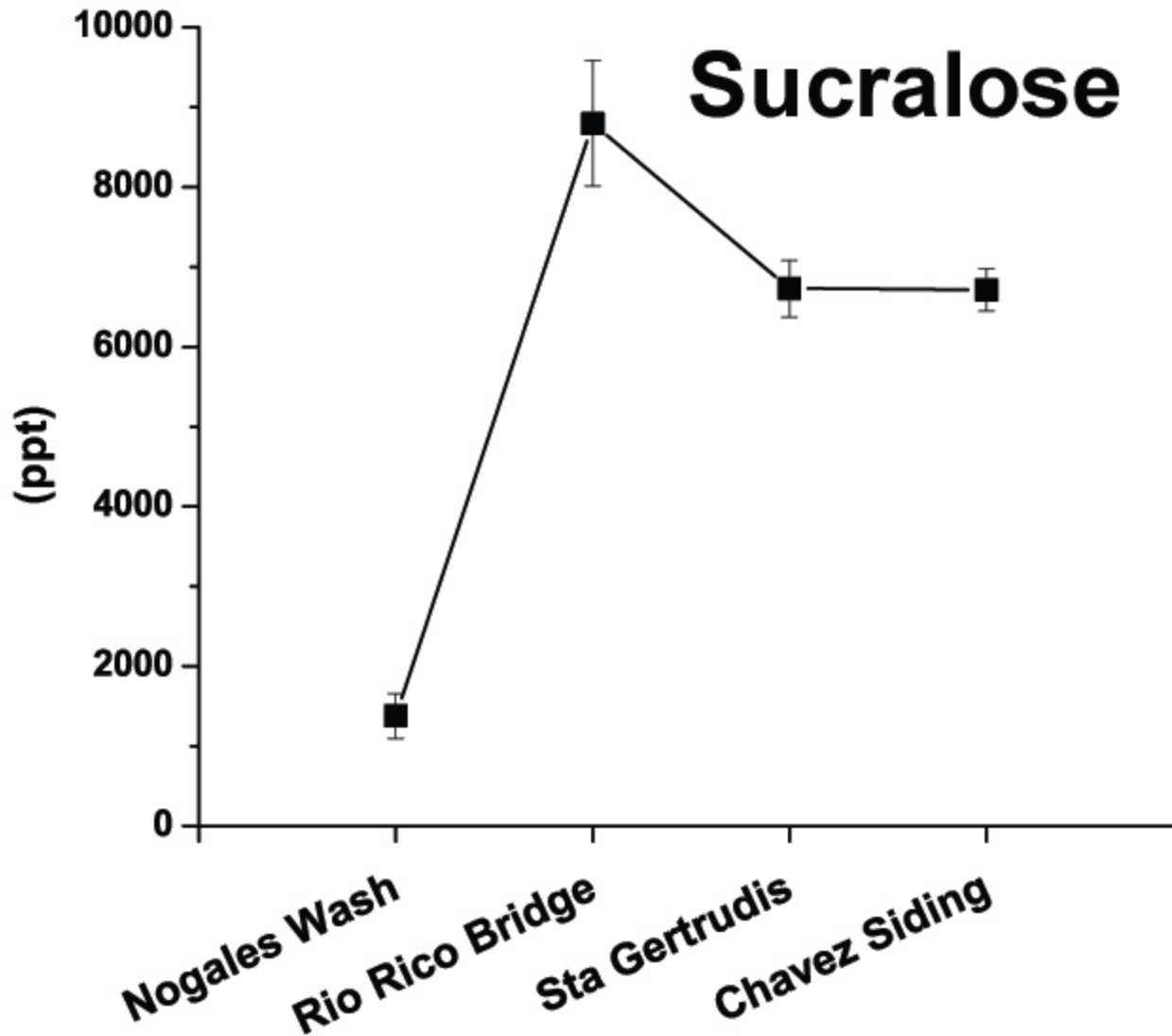
Dec 2009



Jan 2011



# Artificial sweetener



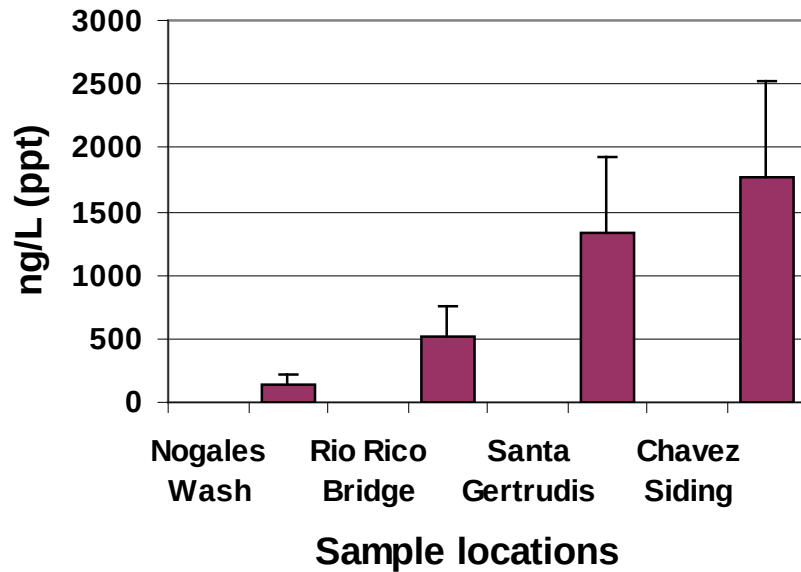
**Sucralose**

Jan 2011

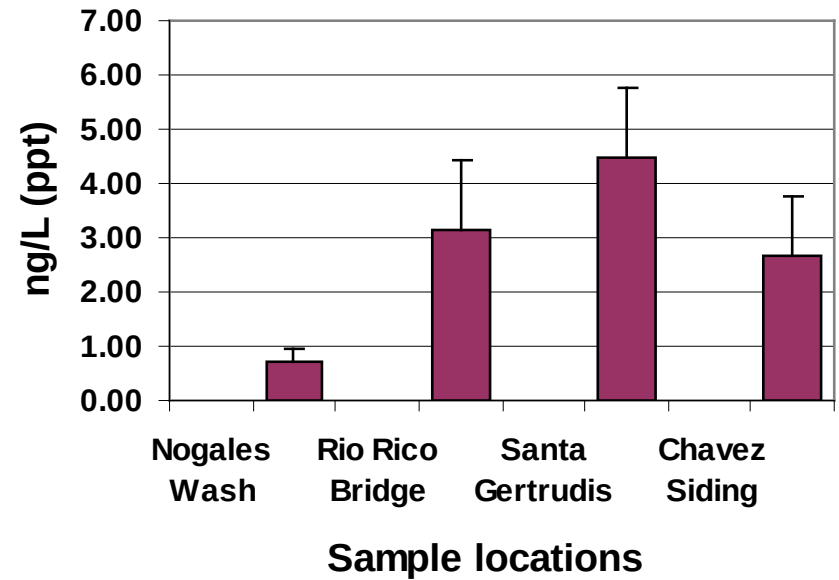
# PPCPs

Dec 2009

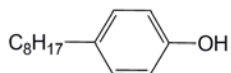
**Carbamazepine**



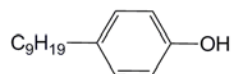
**DEET**



# Endocrine disrupting compounds (EDCs)

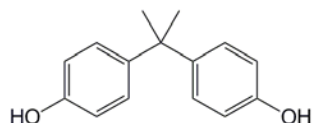


4-octylphenol (OP)



4-nonylphenol (NP)

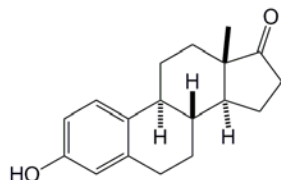
Surfactants



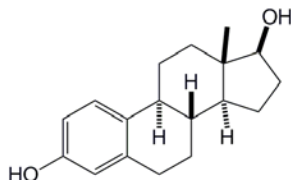
bisphenol A (BPA)

Plasticizer

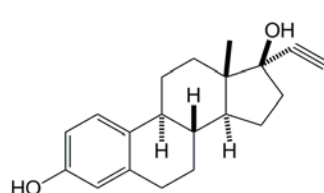
Endocrine Disrupting Compounds



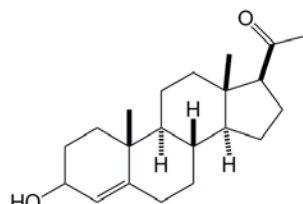
estrone (E1)



17 $\beta$ -estradiol (E2)

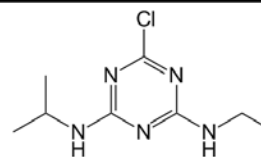


17 $\alpha$ -ethinylestradiol (EE2)



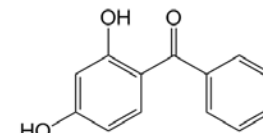
progesterone (P4)

Estrogens

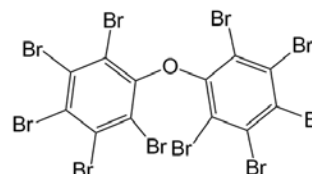


atrazine

Pesticide

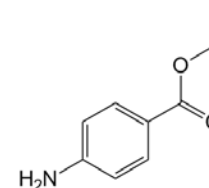


benzophenone-1



brominated diphenyl ether 209

Flame retardant



ethyl-4-aminobenzoate

UV filters

Other EDCs of interest

# Changes in reproductive biomarkers in an endangered fish species (bonytail chub, *Gila elegans*) exposed to low levels of organic wastewater compounds in a controlled experiment

David B. Walker<sup>a,\*</sup>, Nicholas V. Paretti<sup>b,2</sup>, Gail Cordy<sup>b,2</sup>, Timothy S. Gross<sup>c,3</sup>, Steven D. Zaugg<sup>d,4</sup>, Edward T. Furlong<sup>d,5</sup>, Dana W. Kolpin<sup>e,6</sup>, William J. Matter<sup>f,7</sup>, Jessica Gwinn<sup>a,1</sup>, Dennis McIntosh<sup>g,8</sup>

Aquatic Toxicology 95 (2009) 133–143

Aim:

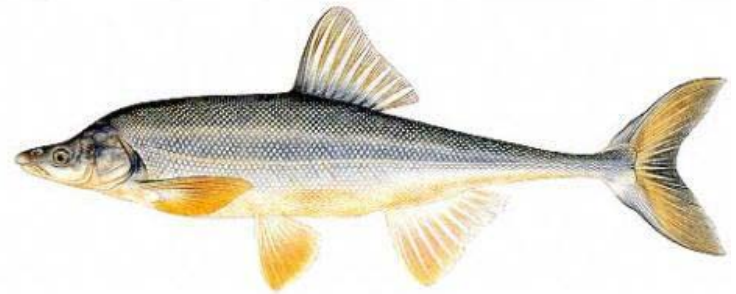
Study the ecological effect of low levels of environmentally persistent organic wastewater compounds

Normally inverse relationship between primary male and female sex hormones, expected in un-impaired fish, was greatly decreased in treatment vs control female fish

Inter-sex condition did not occur

No morphological alteration in fish observed

Fertility, fecundity, or behavior were not measured, so population-level effects are unknown

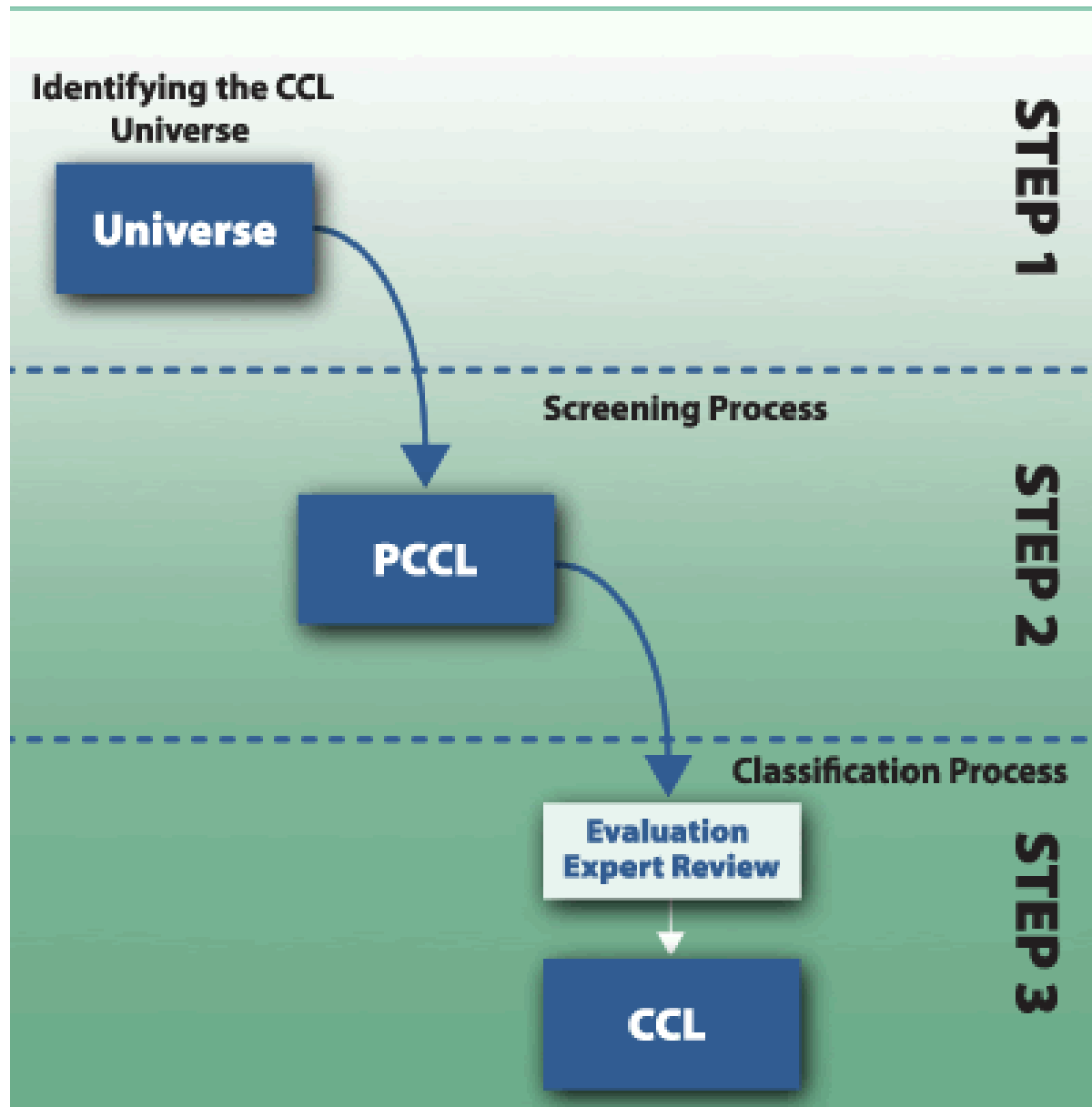


# EPA Contaminant Candidate List (CCL)

- EPA has drinking water regulations for more than 90 contaminants.
- Process to identify and list unregulated contaminants which may require a regulation in the future.
- EPA must periodically publish this list of contaminants (called the Contaminant Candidate List or CCL) and decide whether to regulate at least five or more contaminants on the list
- EPA uses this list of unregulated contaminants to prioritize research and data collection

<http://water.epa.gov/scitech/drinkingwater/dws/ccl/>

# CCL 3 Process Flow Diagram



# EDC/PPCPS on CCL3

## Estrogenic hormones

|                                                |          |                                                                 |
|------------------------------------------------|----------|-----------------------------------------------------------------|
| Estrone                                        | 53-16-7  | estrogenic hormone used in veterinary and human pharmaceuticals |
| 17alpha-estradiol                              | 57-91-0  | estrogenic hormone used in pharmaceuticals                      |
| Equilin                                        | 474-86-2 | estrogenic hormone used in pharmaceuticals                      |
| Estradiol (17-beta estradiol)                  | 50-28-2  | hormone and is used in pharmaceuticals                          |
| Estriol                                        | 50-27-1  | estrogenic hormone used in veterinary pharmaceuticals           |
| Ethinyl Estradiol (17-alpha ethynyl estradiol) | 57-63-6  | estrogenic hormone used in veterinary and human pharmaceuticals |

## Perfluorinated compounds

|                                      |           |                                                                                                                                                              |
|--------------------------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Perfluorooctane sulfonic acid (PFOS) | 1763-23-1 | used in fire fighting foams and various surfactants; few of which are still ongoing because no alternatives are available                                    |
| Perfluorooctanoic acid (PFOA)        | 335-67-1  | PFOA is used in the manufacture of fluoropolymers, substances which provide non-stick surfaces on cookware and waterproof, breathable membranes for clothing |

## Antibiotic(s)

|              |          |                                                 |
|--------------|----------|-------------------------------------------------|
| Erythromycin | 114-07-8 | in pharmaceutical formulations as an antibiotic |
|--------------|----------|-------------------------------------------------|



ALEC

Arizona Laboratory for Emerging Contaminants

# What do we know?

analytical  
**chemical**  
**methods**

**fate** of  
compounds  
**during**  
conventional  
and advanced  
**w/w treatment**

persistence and  
transport **in the**  
**environment**

**health effects**  
and risk  
management

Some Information



Essentially  
Nothing Known

# Acknowledgements

ALEC – Jon Chorover, Mary Kay Amistadi,  
student assistants

Friends of the Santa Cruz River (FOSCR)

