



Indicators of organic contamination in the Lower Santa Cruz River

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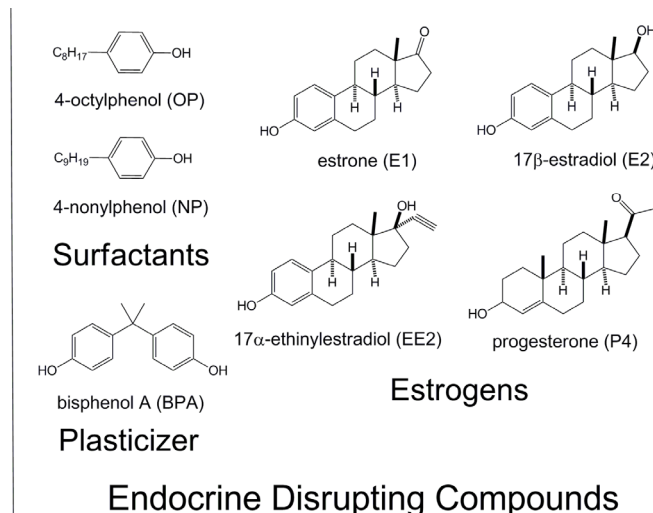


Introduction and Background

- In Arizona treated wastewater effluent discharge constitutes a significant fraction of surface water flux (e.g. the Lower Santa Cruz River in **Figure 1** is primarily effluent dependent).
- PPCPs** (Pharmaceuticals and Personal Care Products) and **EDCs** (Endocrine Disrupting Compounds) are measured in surface water is widely attributed to broad, domestic use of these compounds, followed by **wastewater treatment** that is only partially effective in their removal, prior to discharge into receiving waters.
- PPCPs and EDCs were **detected** in measurable amounts (between 10 ppt and 10 ppb) in the Upper and Lower reaches of the Santa Cruz River by Kolpin *et al.* more than ten years ago.¹ This legacy of contamination includes DEET (1.1 ppb), triclosan (0.73), bisphenol A (12.0 ppb), erythromycin (0.7 ppb), estriol (0.019 ppb), and sulfamethoxazole (1.9 ppb).¹
- Estrogenic activity** in the Lower Santa Cruz River has also been measured as high 2 ppb (6 nM equivalents of 17 β -estradiol) by Quanrud, *et al.*²
- Potential sources of surface and ground water contamination may include atmospheric deposition and storm water run off, in addition to treated wastewater effluent. Accurate measurement of each chemical species is costly and technically challenging, therefore a calibrated appreciation of **indicator chemical species** and a strategically implemented sampling plan may inform us about the relevancy of new measurements and help us interpret analytical results.

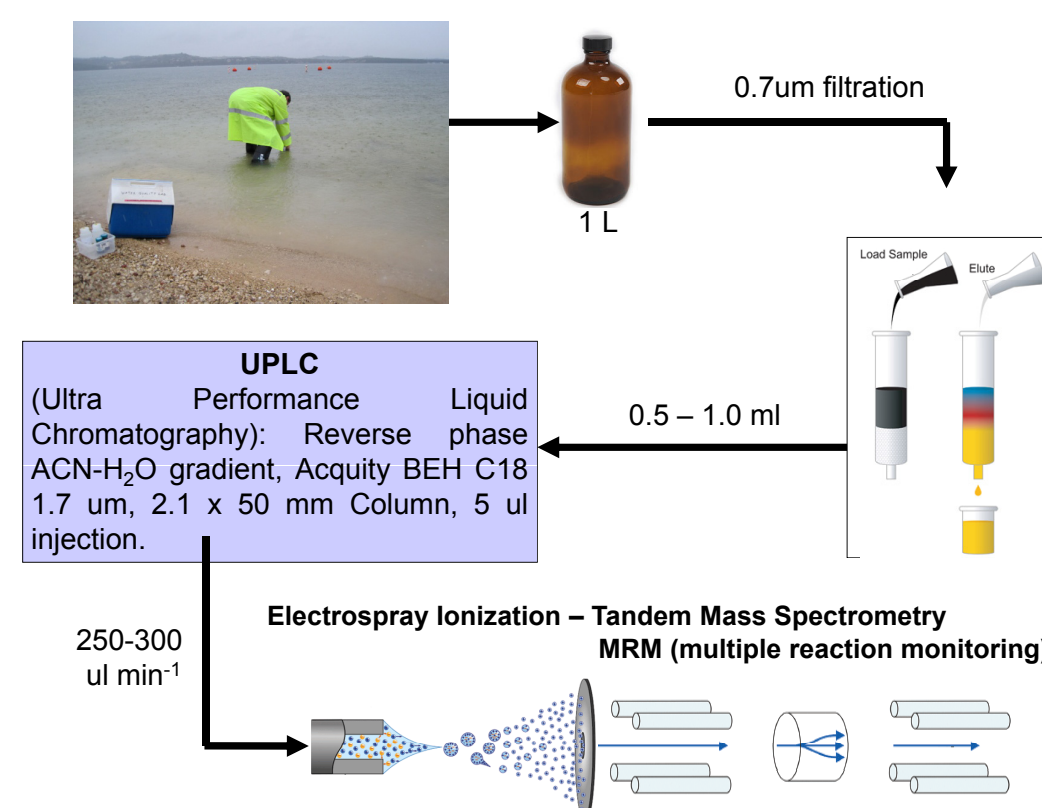


← **Figure 1.** Effluent dependent river in City of Tucson, AZ.



Methods

Samples collection, extraction, and analysis



↑ **Figure 2.** Sample filtration, solid phase extraction, UPLC-ESI-MSMS

Target Analytes / Indicator Compounds

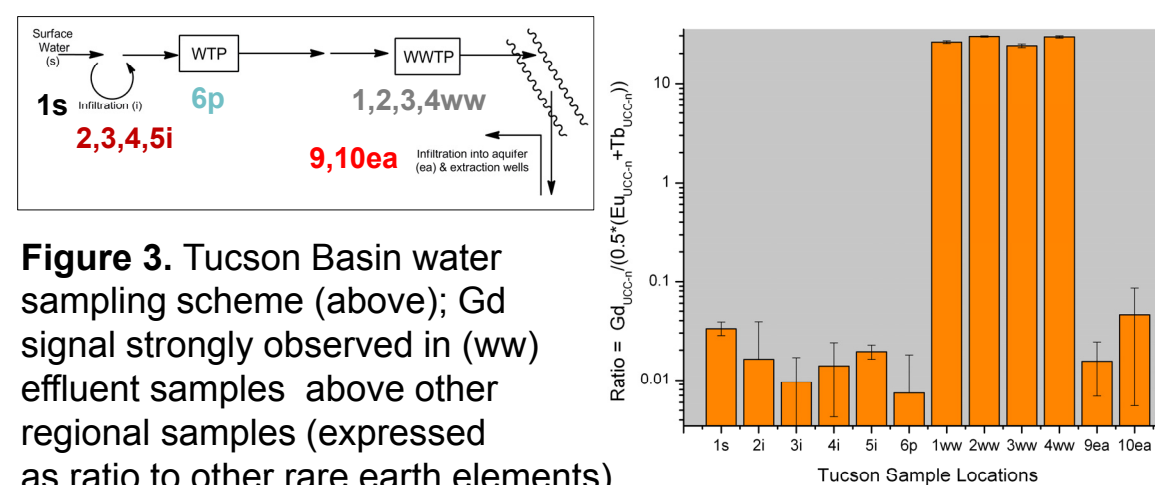
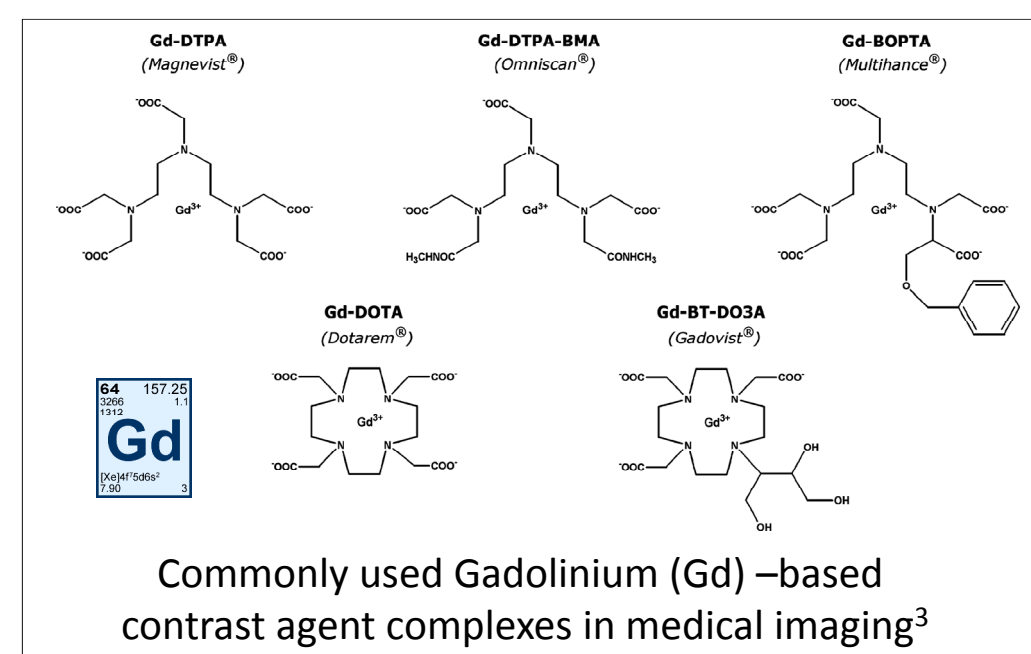


Figure 3. Tucson Basin water sampling scheme (above); Gd signal strongly observed in (ww) effluent samples above other regional samples (expressed as ratio to other rare earth elements)

Results

Target Analytes / Indicator Compounds

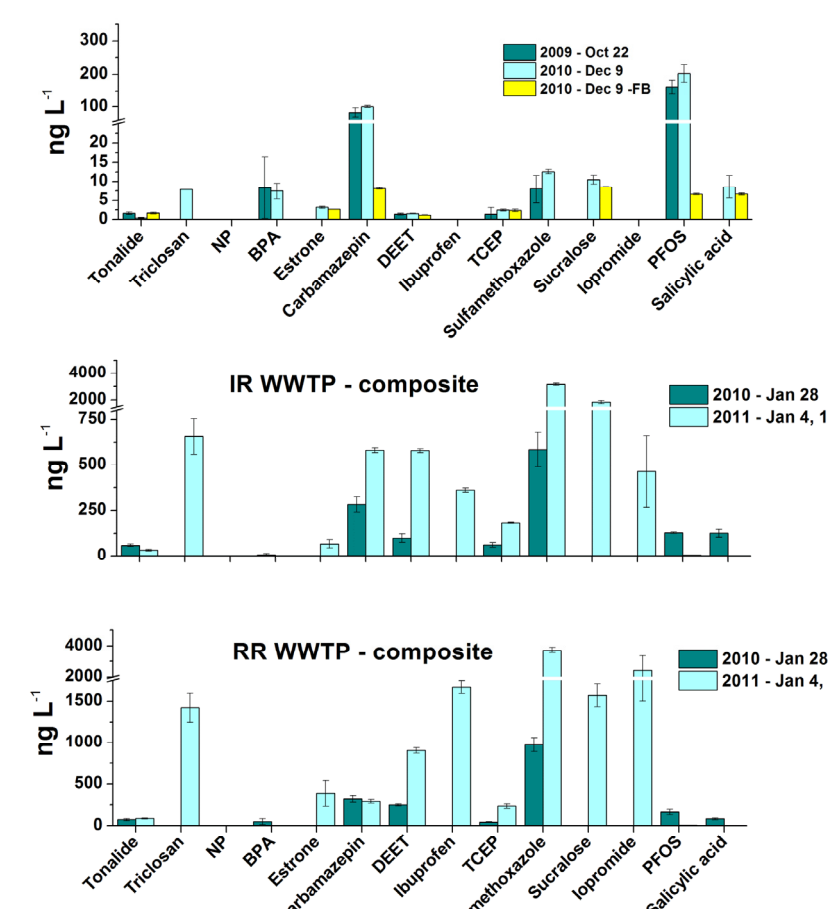
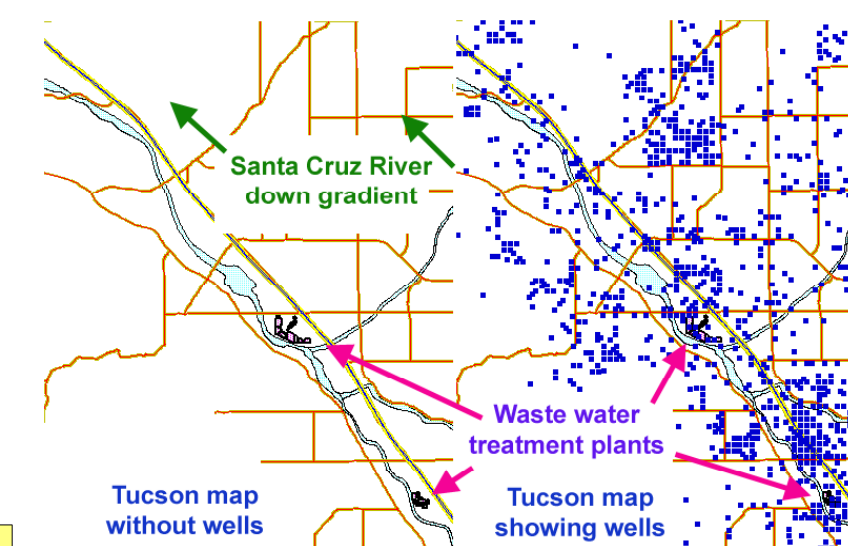
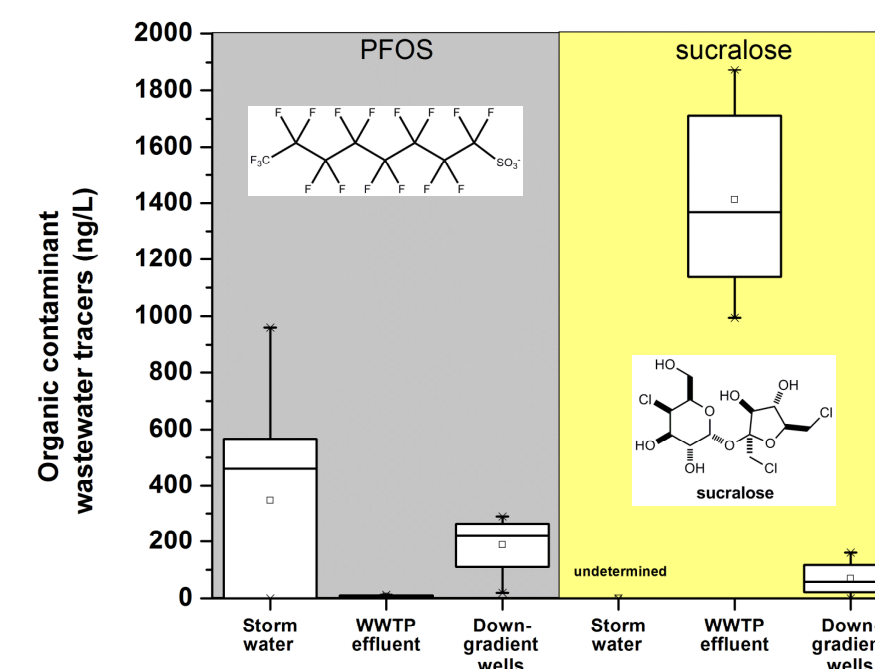


Figure 4. Stacked plots (left) showing measured PPCP/EDC (target analyte) concentrations in ground water well (top) located down gradient (along the Lower Santa Cruz River) of Ina Rd (IR) and Roger Rd (RR) waste water treatment plants (WWTPs; bottom, left plots). Pharmaceuticals carbamazepine and sulfamethoxazole were detected. Parallel maps (below) showing multiple well locations down gradient from the two major wastewater treatment plants in Tucson, AZ.



← **Figure 5.** Box plot showing measured PFOS (industrial surfactant and flame retardant) and sucralose (artificial sweetener; Splenda™) concentrations in different water sample types from the Lower Santa Cruz River watershed including wastewater treatment plants that discharge therein and groundwater wells potentially affected by WW effluent infiltration. Notice (i) PFOS concentration in effluent is lower than in wells, and (ii) sucralose concentration in effluent is 10 X more than in wells.



References

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