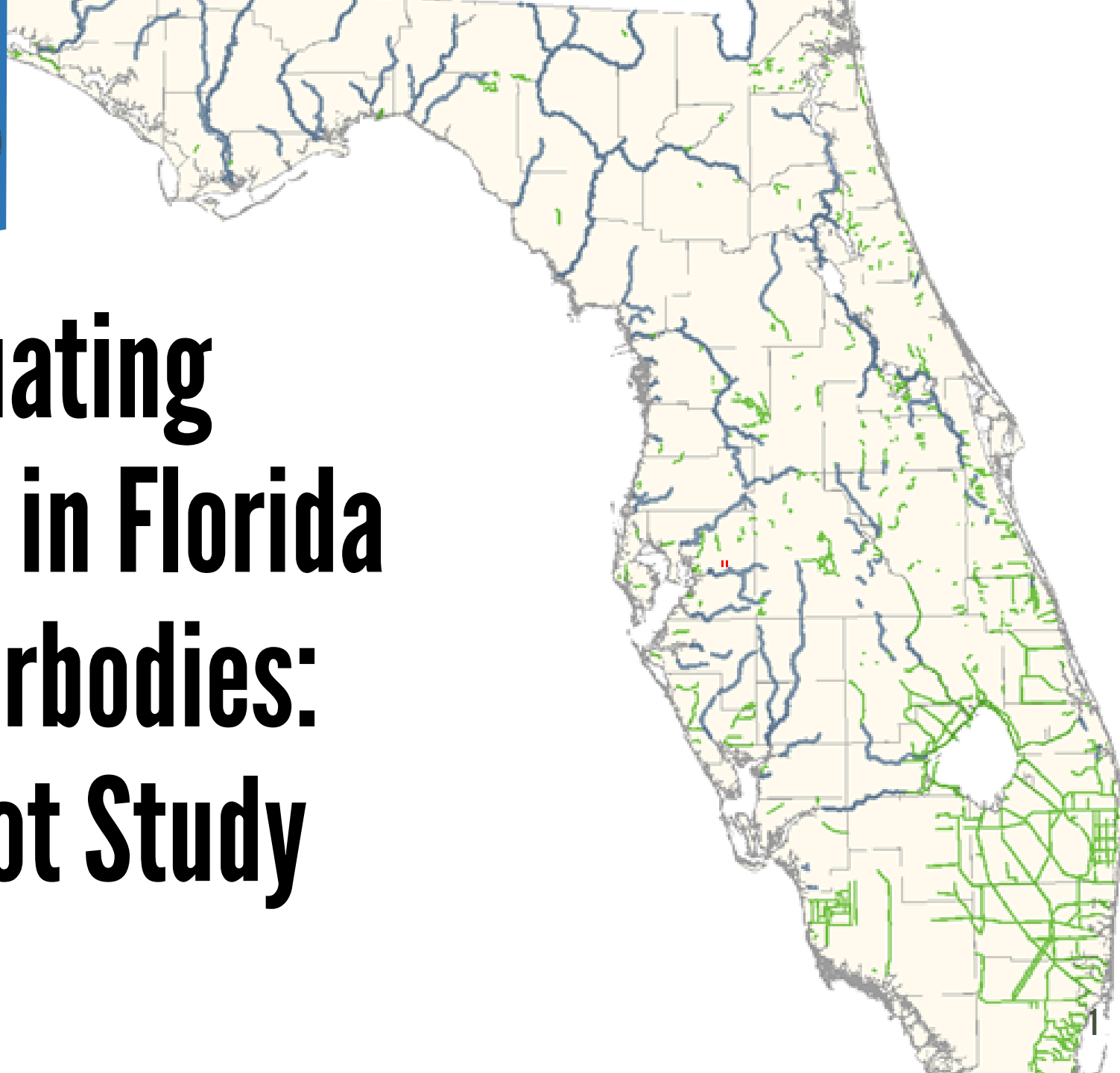




# Evaluating ESOC in Florida Waterbodies: A Pilot Study



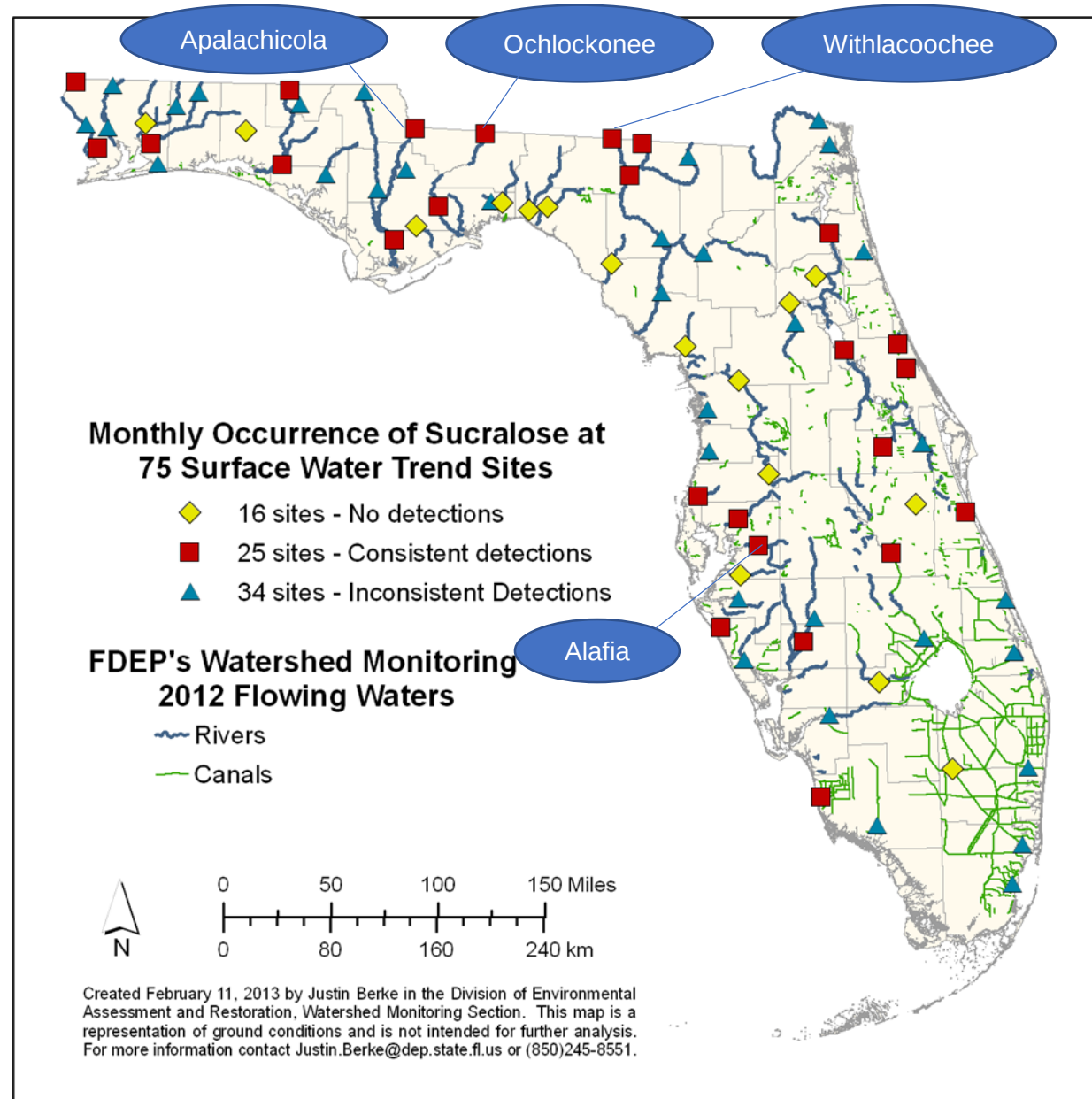


# Overview

- **4 river sites chosen:**
  - Ochlockonee, Withlacoochee, Apalachicola & Alafia
- **3 types of sample collection:**
  - Whole water samples (Grab)
  - Semi-Permeable Membrane Device (SPMD)
  - Polar Organic Compound Integrative Sampler (POCIS)
- **6 Categories of compounds:**
  - Pesticides, PPCPs, Hormones, PFCs, PBDEs, and Alkylphenols
- **QA is discussed in each category.**
- **SGS Analytical data is presented, then DEP, UF, and lastly USGS.**



# Surface Water Trend Stations' 2012 Sucralose Detection Frequency





# Ochlockonee River

- 190 miles long.
- The drainage basin is 1,002 square miles.
- River discharge averages 1,870 cubic feet/second.
- Drainage basin receives sediments from the Coastal Plain province.
- The river receives effluent from the Georgia cities of Cairo, Thomasville and Moultrie.
- Sucralose maximum value detected was 2.6  $\mu\text{g/L}$ .

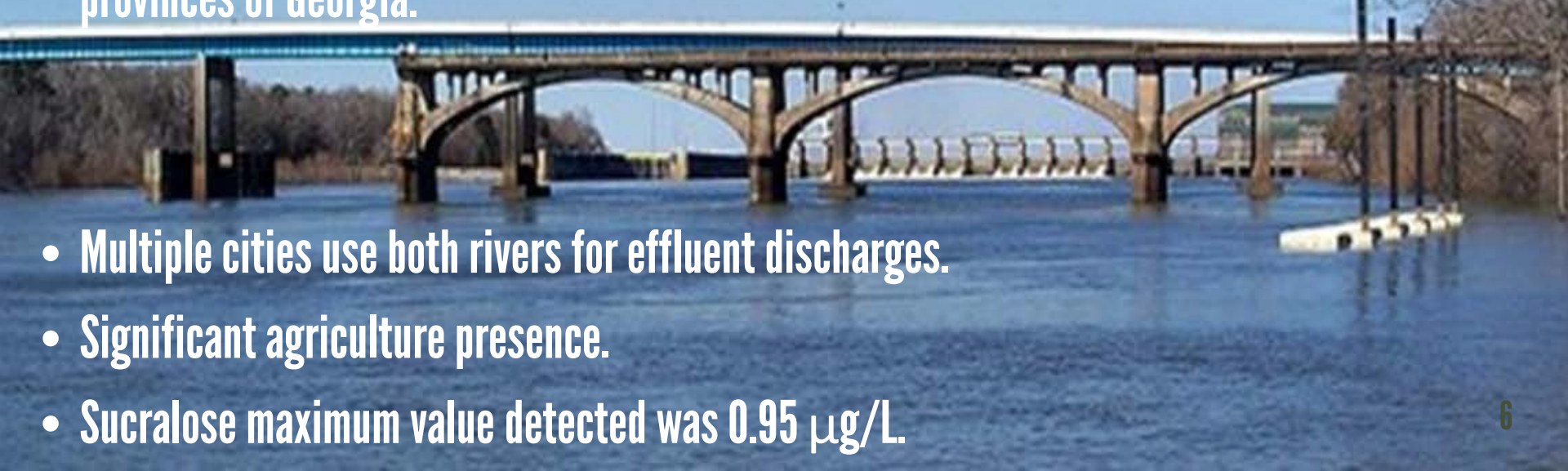


# Withlacoochee River

- 112 miles long.
- The drainage basin is 2,120 square miles.
- Discharge average 1,870 cubic feet/second.
- Drainage basin receives sediments from only the Coastal Plain province.
- The river receives effluent from the city of Valdosta about 20 miles upstream of site.
- The Withlacoochee River joins with the Suwannee River downstream from the site.
- Sucralose maximum value detected was 2.9  $\mu\text{g/L}$



# Apalachicola River

- Site located downstream from Woodruff Dam.
  - Largest river in Florida, based on discharge.
  - The ACF drainage basin is 17,230 square miles.
  - Discharge averages 16,500 cubic feet/second.
  - Drainage basin receives sediments from the Blue Ridge, Piedmont and Coastal Plain provinces of Georgia.
- 
- A large, multi-arched stone bridge spans a wide river. The bridge has several tall, dark stone piers supporting its arches. In the background, a dam with multiple spillways is visible. The river is calm, and the sky is clear and blue. Bare trees are visible on the right side of the frame.
- Multiple cities use both rivers for effluent discharges.
  - Significant agriculture presence.
  - Sucralose maximum value detected was 0.95  $\mu\text{g/L}$ .



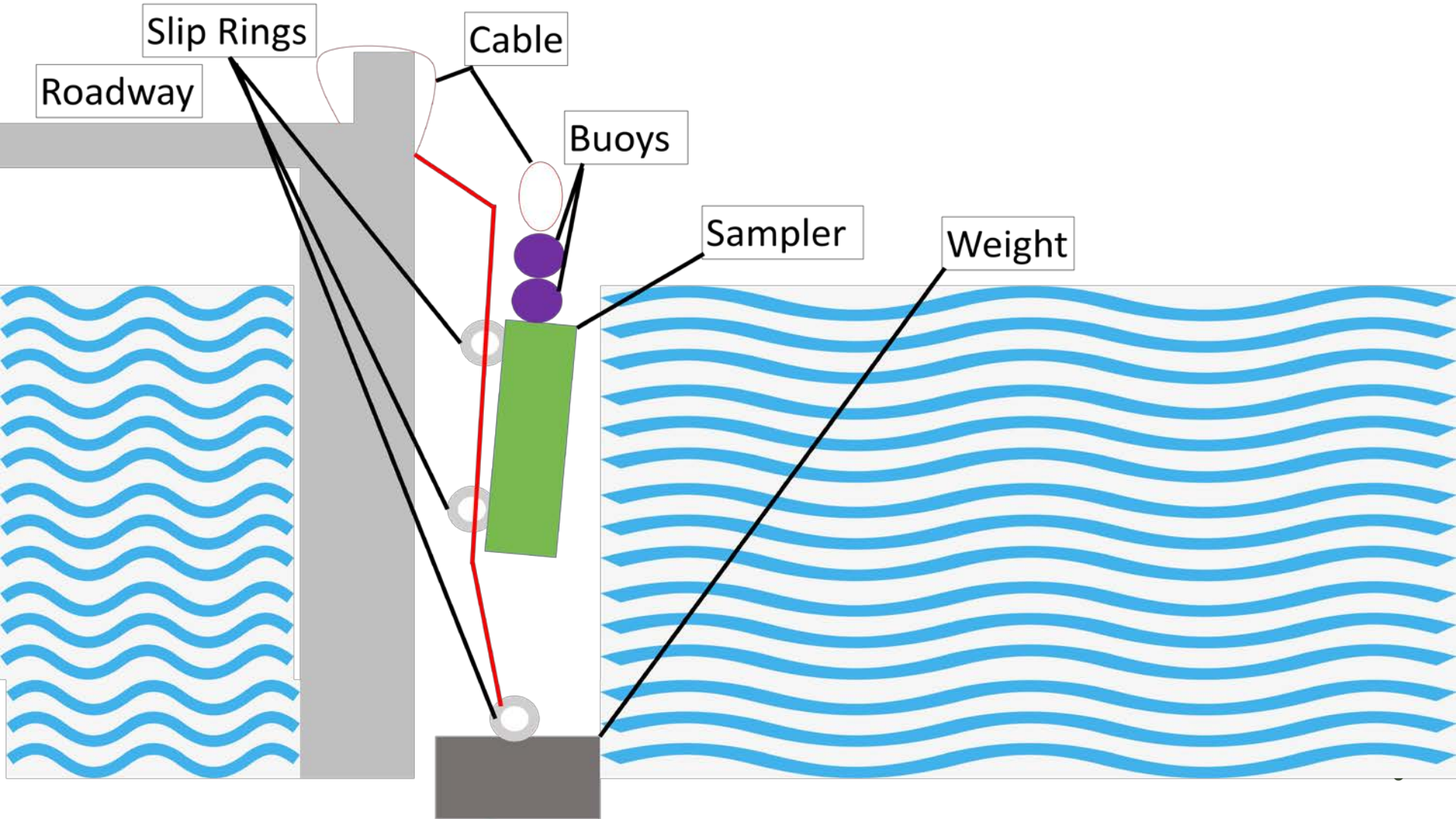
# Alafia River

- Site is downstream of the confluence of the North & South Prongs of the river at Tampa Bay Water Authority (TBWA) withdrawal point.
- 25 miles long.
- Watershed is 335 square miles.
- Discharges an average of 200 cubic feet/second.
- Numerous land uses influence quality of the river, including the City of Lakeland WWTP, phosphate mine sites and phosphate ore processing sites, and agriculture.
- Salt water tidal influence occurs upstream from Tampa Bay.
- Sucralose maximum value detected was 7.3  $\mu\text{g/L}$ .



# Review of Deployment

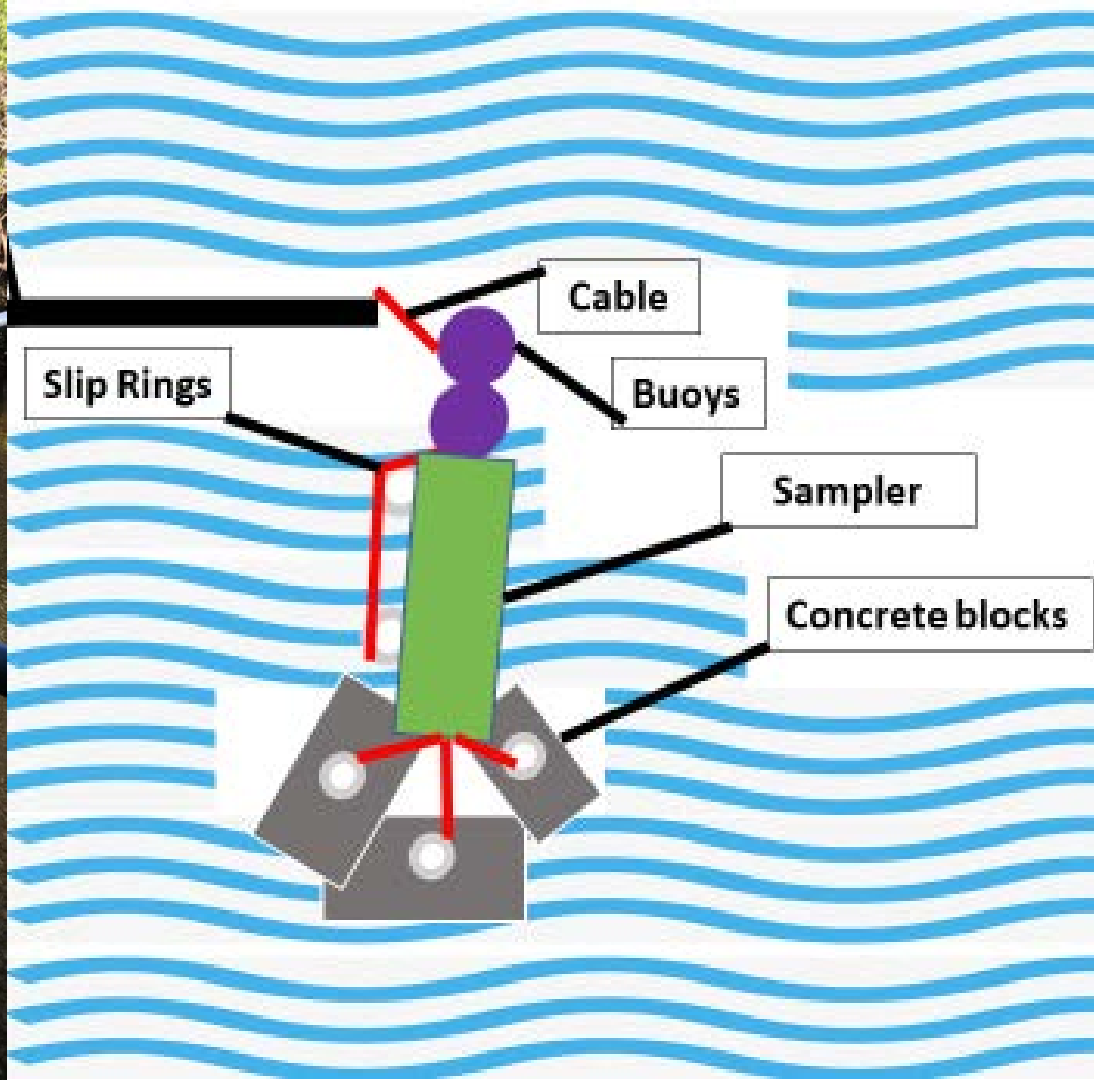
## Ochlockonee, Withlacoochee & Apalachicola





# Review of Deployment

## Alafia





# Semi-Permeable Membrane Device (SPMD)

- Mimics natural system to collect bioavailable pollutants in water.
- Passive transport similar to chemical transport through fish gills.
- Doesn't metabolize sequestered compounds; isn't affected by poor water quality conditions.
- Selective diffusion of **hydrophobic** organic chemicals through pores & stored in the lipid phase.



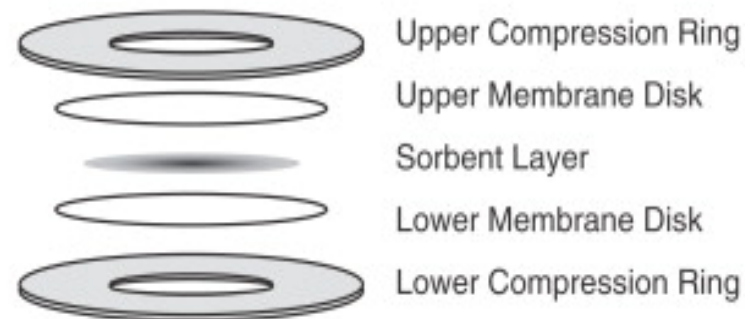
<http://www.est-lab.com/spmd.php>





# Polar Organic Compound Integrative Sampler (POCIS)

- Monitors **hydrophilic** contaminants that could be potential EDs, or acutely toxic.
- Provides reproducible method for determining concentration of POCs in the ppt range.



<https://www.sciencedirect.com/science/article/pii/S0166526X06480089>





# Blank Collection

## 2 field blanks were collected at Apalachicola

### 1. Passive sampling equipment

- The blank sample containers (cans) were opened twice; once when passive sampler was deployed, and again when recovered from site.
- Blank cans stayed open while passive sampling devices (POCIS & SPMD) were exposed to air.
- Sealed blank cans were stored at -20°C during deployment period.

### 2. Grab sample

- Blank collected using DI water supplied from SGS.





# Analytical Strategy

## **Targeted analyses based on:**

- **Occurrence in published literature.**
- **Information gleaned from an RFI from SGS.**
- **Potential for adverse environmental effects.**
- **Availability of sampling methods.**
- **Capability of laboratories responding to an RFI.**



# Compound Priority List

## Workgroup determined priority pollutant list

- 141 compounds selected

| Pesticides | PPCPs | Hormones | PCFs | PBDEs | Alkyl Phenols |
|------------|-------|----------|------|-------|---------------|
| 72         | 21    | 15       | 15   | 8     | 10            |



# SGS Data



# Pesticides

- Analyzed samples for 76 compounds (72 on DEP priority list).
- 42 compounds (39 on priority list) detected at one or more sites, in at least one sample type (POCIS, SPMD, or Grab).
- 38 / 39 priority compounds detected using combo. of Grab & SPMD.
- 30 compounds (28 on priority list) detected at all sites (N = 4), using a single sampling method.
- 17 priority & 1 non-priority compounds detected had data qualified due to lab/field blank detections (37% of all detects qualified).

| Compound<br>(* = DEP Priority) | SPMD # Sites<br>with Detects | POCIS # Sites<br>with Detects | Grab # Sites<br>with Detects |
|--------------------------------|------------------------------|-------------------------------|------------------------------|
| 2,4'-DDD*                      | 4                            |                               |                              |
| 4,4'-DDD*                      | 4                            |                               |                              |
| 2,4'-DDE*                      | 3                            |                               |                              |
| 4,4'-DDE*                      | 4                            |                               | 1                            |
| 4,4'-DDT*                      | 4                            |                               |                              |
| Alachlor*                      | 1                            | 1                             | 1 (100% VG)                  |
| Aldrin*                        | 4 (75% V)                    | 1                             | 2                            |
| Ametryn*                       |                              | 1                             |                              |
| Atrazine*                      | 2                            | 4                             | 4                            |
| Chlordane, alpha (cis)*        | 4                            | 2                             |                              |
| Chlordane, gamma (trans)*      | 4 (75% G)                    | 4 (100% G)                    | 3 (100% V)                   |
| Chlordane, oxy-*               | 4 (100% VG)                  |                               | 2 (100% V)                   |
| Chlorpyrifos*                  | 4                            |                               | 1                            |
| Desethylatrazine*              |                              | 4                             | 4                            |
| Diazinon*                      | 1                            | 1                             |                              |
| Dieldrin*                      | 4                            | 4                             | 4                            |
| Dimethenamid*                  | 1                            | 3                             | 3                            |
| Endosulphan, alpha*            | 4 (100% VG**)                | 4 (100% VG**)                 | 4 (100% VG)                  |
| Endosulphan, beta*             | 4 (100% VG)                  | 3 (100% VG**)                 | 4 (100% VG**)                |
| Endosulphan Sulphate*          | 4                            | 4                             | 3                            |
| Endrin*                        | 4 (75% V, 100% G)            |                               | 2 (100% V**)                 |

| Compound<br>(* = DEP Priority) | SPMD # Sites<br>with Detects | POCIS # Sites<br>with Detects | Grab # Sites<br>with Detects |
|--------------------------------|------------------------------|-------------------------------|------------------------------|
| Endrin Ketone*                 | 2                            |                               | 1 (100% G**)                 |
| Ethalfuralin*                  | 3                            |                               |                              |
| Flufenacet                     | 1                            |                               |                              |
| Flutriafol*                    |                              | 1                             | 1 (100% G)                   |
| HCH, alpha*                    | 4                            | 2                             | 1                            |
| HCH, beta*                     | 4                            | 3                             | 3                            |
| HCH, delta*                    | 2                            | 1                             |                              |
| HCH, gamma                     | 4 (100% G)                   | 3                             | 1                            |
| Heptachlor*                    | 4 (100% G)                   | 4 (100% G)                    |                              |
| Heptachlor Epoxide*            | 4 (50% V)                    | 4 (100% G)                    | 3 (100% VG)                  |
| Hexachlorobenzene*             | 4 (100% G)                   | 4 (100% VG)                   | 4 (100% VG)                  |
| Hexazinone*                    |                              | 1                             | 2                            |
| Metolachlor*                   | 4 (100% G)                   | 4                             | 4 (25% V)                    |
| Mirex*                         | 4 (100% VG)                  | 1                             | 3                            |
| Nonachlor, cis-*               | 4 (25% G)                    |                               | 1 (100% G)                   |
| Nonachlor, trans-*             | 4                            | 4                             | 2                            |
| Pendimethalin*                 | 4                            |                               |                              |
| Quintozone*                    | 3 (100% G**)                 | 3 (100% G**)                  |                              |
| Simazine*                      |                              | 4                             | 4                            |
| Tebuconazol*                   | 3 (100% G)                   | 4                             | 4                            |
| Trifluralin                    | 4                            | 1                             |                              |

|   |                                         |    |                                                                 |
|---|-----------------------------------------|----|-----------------------------------------------------------------|
|   | Compound detected at all sites (N = 4). | V  | Data qualified due to lab blank detection.                      |
|   | Compound not detected at any sites.     | G  | Data qualified due to field blank detection.                    |
| * | DEP Priority Compound                   | ** | Presence uncertain due to high analyte concentration in blanks. |



# PPCPs

- **Analyzed samples for 127 compounds (21 on DEP priority list).**
- **Compounds divided into 5 analytical lists. ANEG had most priority compounds. APOS had most priority compounds detected.**
- **39 compounds (15 on priority list) were detected at one or more sites, in at least one sample type (POCIS or Grab).**
- **14 / 15 priority compounds detected in POCIS; 10 / 15 detected in Grab**
- **7 compounds (2 on priority list) detected at all sites (N = 4), using a single sampling method.**
- **3 non-priority compounds detected had data qualified due to lab/field blank detections (10% of all detects qualified).**

| Compound<br>(* = DEP Priority) | List  | POCIS # Sites<br>with Detects | Grab # Sites<br>with Detects |
|--------------------------------|-------|-------------------------------|------------------------------|
| Alprazolam                     | APOSX | 4                             |                              |
| Amitriptyline                  | APOSX | 2                             | 4                            |
| Amphetamine                    | BPOS  | 4 (100% VG**)                 | 4 (100% VG)                  |
| Atenolol*                      | BPOS  | 2                             | 3                            |
| Azithromycin                   | APOS  | 1                             |                              |
| Caffeine                       | APOS  |                               | 2                            |
| Carbamazepine*                 | APOS  | 4                             | 3                            |
| Clarithromycin                 | APOS  | 1                             |                              |
| Cocaine                        | APOSX | 3                             | 2                            |
| Colchicine                     | APOSY |                               | 2                            |
| Cotinine                       | BPOS  |                               | 2                            |
| DEET                           | APOSX | 4                             | 4 (50% VG)                   |
| Dehydronifedipine              | APOS  | 1                             | 1                            |
| Desmethyldiltiazem             | APOSX | 2                             |                              |
| Diatrizoic acid                | APOSY |                               | 2                            |
| Diazepam                       | APOSX | 1                             |                              |
| Diltiazem*                     | APOS  | 2                             | 1                            |
| Diphenhydramine*               | APOS  | 1                             | 1                            |
| Erythromycin-H2O               | APOS  | 4                             |                              |
| Furosemide*                    | ANEG  |                               | 1                            |

| Compound<br>(* = DEP Priority) | List  | POCIS # Sites<br>with Detects | Grab # Sites<br>with Detects |
|--------------------------------|-------|-------------------------------|------------------------------|
| Gemfibrozil*                   | ANEG  | 3                             |                              |
| Hydrochlorothiazide*           | ANEG  | 1                             |                              |
| Hydrocodone                    | BPOS  | 3                             |                              |
| Iopamidol                      | APOSY |                               | 3                            |
| Meprobamate                    | APOSX |                               | 2                            |
| Metformin                      | BPOS  |                               | 3 (100% G)                   |
| Metoprolol*                    | APOSX | 3                             |                              |
| Naproxen*                      | ANEG  | 3                             | 3                            |
| Oxolinic Acid                  | APOS  | 1                             | 1                            |
| Oxycodone*                     | BPOS  | 3                             |                              |
| Propoxyphene                   | APOSX | 1                             |                              |
| Sertraline*                    | APOSX | 1                             | 1                            |
| Sulfadimethoxine               | APOS  | 1                             |                              |
| Sulfamethazine                 | APOS  | 1                             |                              |
| Sulfamethoxazole*              | APOS  | 4                             | 4                            |
| Triamterene*                   | BPOS  | 3                             | 1                            |
| Trimethoprim*                  | APOS  | 3                             |                              |
| Valsartan*                     | APOSX | 2                             | 1                            |
| Venlafaxine                    | APOSY | 3                             | 2                            |

|   |                                         |
|---|-----------------------------------------|
|   | Compound detected at all sites (N = 4). |
|   | Compound not detected at any sites.     |
| * | DEP Priority Compound                   |

|    |                                                                 |
|----|-----------------------------------------------------------------|
| V  | Data qualified due to lab blank detection.                      |
| G  | Data qualified due to field blank detection.                    |
| ** | Presence uncertain due to high analyte concentration in blanks. |



# Hormones

- Analyzed samples for 17 compounds (15 on DEP priority list).
- 5 compounds (3 on priority list) detected at one or more sites, in at least one sample type (POCIS or Grab).
- 3 / 3 priority compounds detected using POCIS.  
2 / 3 priority compounds detected using Grab.
- 100% of Grab detects and 0% of POCIS detects qualified due to lab/field blank detections
- 1 priority compound detected at all sites ( $N = 4$ ), using a single sampling method.



| Compound<br>(* = DEP Priority) | POCIS # Sites<br>with Detects | Grab # Sites<br>with Detects |
|--------------------------------|-------------------------------|------------------------------|
| Allyl Trenbolone               | 2                             |                              |
| Androstenedione*               | 3                             |                              |
| Androsterone*                  | 2                             | 2 (100% G)                   |
| Mestranol*                     | 2                             | 4 (100% VG)                  |
| Testosterone                   | 1                             |                              |

|   |                                         |    |                                                                 |
|---|-----------------------------------------|----|-----------------------------------------------------------------|
|   | Compound detected at all sites (N = 4). | V  | Data qualified due to lab blank detection.                      |
|   | Compound not detected at any sites.     | G  | Data qualified due to field blank detection.                    |
| * | DEP Priority Compound                   | ** | Presence uncertain due to high analyte concentration in blanks. |



# **Perfluorinated Compounds**

## **PFCs**

- Analyzed samples for 13 compounds (10 on DEP priority list).**
- 10 compounds (8 on priority list) detected at one or more sites, in at least one sample type (POCIS or Grab).**
- 8 / 8 priority compounds detected using POCIS.**
- 5 / 8 priority compounds detected using Grab.**
- No data qualified due to lab/field blank detections.**
- 3 priority compounds detected at all sites (N = 4), using a single sampling method.**

| Compound<br>(* = DEP Priority) | Acronym | POCIS # Sites<br>with Detects | Grab # Sites<br>with Detects |
|--------------------------------|---------|-------------------------------|------------------------------|
| Perfluorobutanoate             | PFBA    |                               | 2                            |
| Perfluorobutanesulfonic acid*  | PFBS*   | 1                             | 1                            |
| Perfluorodecanoic acid*        | PFDA*   | 2                             |                              |
| Perfluoroheptanoic acid*       | PFHpA*  | 4                             | 2                            |
| Perfluorohexanoic acid*        | PFHxA*  | 1                             | 2                            |
| Perfluorohexanesulfonic acid*  | PFHxS*  | 3                             |                              |
| Perfluorononanoic acid*        | PFNA*   | 2                             |                              |
| Perfluorooctanoic acid*        | PFOA*   | 4                             | 2                            |
| Perfluorooctanesulfonic acid*  | PFOS*   | 4                             | 1                            |
| Perfluoropentanoate            | PFPeA   |                               | 2                            |

|   |                                         |    |                                                                 |
|---|-----------------------------------------|----|-----------------------------------------------------------------|
|   | Compound detected at all sites (N = 4). | V  | Data qualified due to lab blank detection.                      |
|   | Compound not detected at any sites.     | G  | Data qualified due to field blank detection.                    |
| * | DEP Priority Compound                   | ** | Presence uncertain due to high analyte concentration in blanks. |



# **Polybrominated Diphenyl Ethers PBDEs**

- **Analyzed samples for 8 compounds (all on DEP priority list).**
- **All compounds detected at one or more sites, in both sample types (SPMD and Grab).**
- **All SPMD detects and 92% of Grab detects qualified due to lab/field blank detections.**
- **All priority compounds detected at all sites ( $N = 4$ ), using a single sampling method.**



| Compound                       | SPMD # Sites with Detects | Grab # Sites with Detects |
|--------------------------------|---------------------------|---------------------------|
| 2,2',3,3',4,4',5,5',6,6'-DeBDE | 4 (100% VG**)             | 4 (100% G)                |
| 2,2',3,4,4',5',6-HpBDE         | 4 (100% G)                | 3 (100% G)                |
| 2,2',4,4',5,5'-HxBDE           | 4 (100% G)                | 2                         |
| 2,2',4,4',5,6'-HxBDE           | 4 (100% G)                | 3 (100% G)                |
| 2,2',4,4',5-PeBDE              | 4 (100% G)                | 4 (100% VG)               |
| 2,2',4,4',6-PeBDE              | 4 (100% G)                | 4 (100% VG)               |
| 2,2',4,4'-TeBDE                | 4 (100% G)                | 4 (100% VG)               |
| 2,4,4'-TriBDE                  | 4 (100% G)                | 2 (100% G**)              |

|   |                                         |    |                                                                 |
|---|-----------------------------------------|----|-----------------------------------------------------------------|
|   | Compound detected at all sites (N = 4). | V  | Data qualified due to lab blank detection.                      |
|   | Compound not detected at any sites.     | G  | Data qualified due to field blank detection.                    |
| * | DEP Priority Compound                   | ** | Presence uncertain due to high analyte concentration in blanks. |



# Alkylphenols

- **Analyzed samples for 4 compounds (all on DEP priority list).**
- **2 compounds detected at one or more sites, in at least one sample type (SPMD or Grab).**
- **2 / 2 priority compounds detected using SPMD.**  
**1 / 2 priority compounds detected using Grab.**
- **All data qualified due to lab/field blank detections.**
- **Both compounds detected at all sites (N = 4), using a single sampling method.**



| Compound<br>(* = DEP Priority) | SPMD # Sites<br>with Detects | Grab # Sites<br>with Detects |
|--------------------------------|------------------------------|------------------------------|
| 4-Nonylphenol diethoxylates*   | 4 (100% G)                   |                              |
| 4-Nonylphenols*                | 4 (100% G, 25% V)            | 4 (100% VG)                  |

|   |                                         |    |                                                                 |
|---|-----------------------------------------|----|-----------------------------------------------------------------|
|   | Compound detected at all sites (N = 4). | V  | Data qualified due to lab blank detection.                      |
|   | Compound not detected at any sites.     | G  | Data qualified due to field blank detection.                    |
| * | DEP Priority Compound                   | ** | Presence uncertain due to high analyte concentration in blanks. |



# DEP Data



# DEP Data

- **Analyzed samples for 92 compounds (4 PPCPs, 88 pesticides). 44 (1 PPCP, 43 pesticides) on priority list**
- **32 compounds (3 PPCPs, 29 pesticides) detected at one or more sites, in at least one sampling method (SPMD, POCIS, or Grab). 13 (1 PPCP, 12 pesticides) on priority list.**
- **No data qualified due to lab / field blank detections.**
- **6 priority compounds detected at all sites ( $N = 4$ ), using a single sampling method.**

| Compound<br>(* = DEP Priority) | SPMD # Sites<br>with Detects | POCIS # Sites<br>with Detects | Grab # Sites<br>with Detects |
|--------------------------------|------------------------------|-------------------------------|------------------------------|
| 2,4-D                          |                              | 2                             | 3                            |
| Acetaminophen                  |                              |                               | 2                            |
| Acetochlor                     |                              | 3                             | 3                            |
| Ametryn*                       |                              |                               | 1                            |
| Atrazine*                      |                              | 4                             | 4                            |
| Atrazine Desethyl*             |                              |                               | 4                            |
| Bentazon                       |                              | 1                             | 4                            |
| Bromacil                       |                              | 4                             | 4                            |
| Carbamazepine*                 |                              | 4                             | 4                            |
| Chlordane                      | 3                            | N/A                           |                              |
| Chlordane (alpha)*             | 3                            | N/A                           |                              |
| Chlordane (gamma)*             | 2                            | N/A                           |                              |
| Chlorpyrifos Ethyl*            | 4                            |                               | 1                            |
| DDD-p,p' *                     | 2                            | N/A                           |                              |
| DDE-p,p'*                      | 3                            | N/A                           |                              |
| Dieldrin*                      | 2                            | N/A                           |                              |

| Compound<br>(* = DEP Priority) | SPMD # Sites<br>with Detects | POCIS # Sites<br>with Detects | Grab # Sites<br>with Detects |
|--------------------------------|------------------------------|-------------------------------|------------------------------|
| Fipronil                       |                              | 1                             | 3                            |
| Fipronil Sulfide               |                              |                               | 1                            |
| Fipronil Sulfone               |                              |                               | 4                            |
| Fluridone                      |                              | 3                             | 3                            |
| Diuron                         |                              | 4                             | 4                            |
| Hexazinone*                    |                              |                               | 4                            |
| Imidacloprid                   |                              | 4                             | 4                            |
| Metolachlor                    | 2                            | 4                             | 4                            |
| Norflurazon                    |                              | 1                             | 2                            |
| Pendimethalin*                 | 2                            |                               |                              |
| Prometon                       |                              | 2                             | 2                            |
| Simazine*                      |                              | 4                             | 4                            |
| Sucralose                      | 1                            | 4                             | 4                            |
| Toxaphene                      | 2                            | N/A                           |                              |
| Trifluralin                    | 2                            | N/A                           |                              |

|   |                                         |    |                                                                 |
|---|-----------------------------------------|----|-----------------------------------------------------------------|
|   | Compound detected at all sites (N = 4). | V  | Data qualified due to lab blank detection.                      |
|   | Compound not detected at any sites.     | G  | Data qualified due to field blank detection.                    |
| * | DEP Priority Compound                   | ** | Presence uncertain due to high analyte concentration in blanks. |



# University of Florida



# ER and AR Transactivation Assay

Tests for the ability of the activated receptor to turn on gene transcription

## Estrogen Receptor Results

- **Grab**

- Estrogenic activity found only at Ochlockonee.
- Interference at Apalachicola.

- **POCIS & SPMD**

- Variable results indicated interference with the assay.
- POCIS sample from Apalachicola was only one that conclusively showed no estrogenic activity.

## Androgen Receptor Results

- **Grab**

- Low level of androgenic activity found in the field blank.
  - May be due to androsterone contamination in the sample (analyzed by SGS).
- Low level of androgenic activity found in the grab sample for Ochlockonee.
- Interferences were found in the Apalachicola sample.

- **POCIS & SPMD**

- No activity.



# ER and AR Binding Assay

*Tests the ability of estrogen or an estrogen mimic to bind directly to the estrogen receptor, or an androgen mimic to bind directly to the androgen receptor*

- **Grab**

- All sites had presence of estrogenic/androgenic activity
- Highest concentration at Withlacoochee
- Background fluorescence detected
  - High color water an issue

- **SPMD**

- All sites had presence of estrogenic/androgenic activity

- **POCIS**

- Results variable due to background fluorescence
- No androgenic activity at Apalachicola



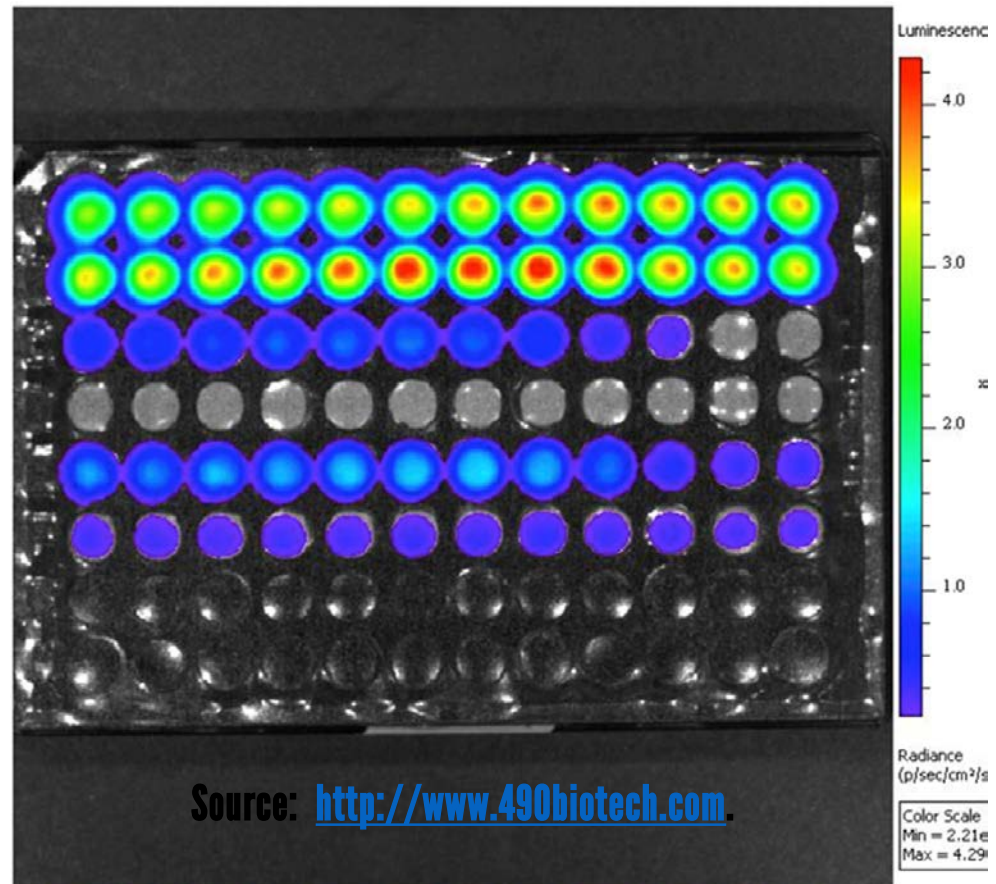
# USGS

*science for a changing world*



# Bioluminescent Yeast Estrogen & Androgen Screen

Used to detect water's estrogenic and androgenic activity by promoting a light-generating or bioluminescent response in the yeast strain





# **Bioluminescent Yeast Estrogen & Androgen Screen Results**

## **BLYES Results**

- **Grab**
  - **Alafia, Apalachicola, Withlacoochee Rivers had estrogenic samples**
- **POCIS**
  - **All sites had estrogenic samples**

## **BLYAS results**

- **No androgenic activity**

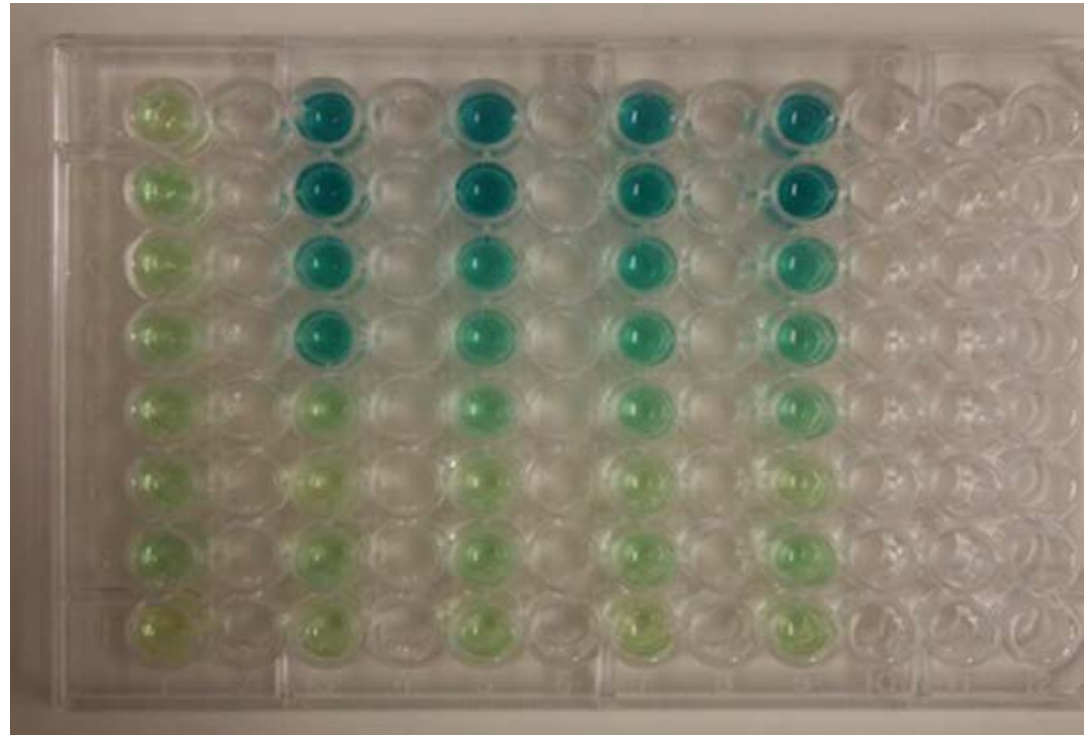


# SOS Chromotest

*The SOS Chromotest is a colorimetric test that measures the reaction of *E. coli* bacteria to DNA damaging compounds in water samples.*

## Results

- POCIS & SPMD
  - Presence of DNA damaging compounds at the Alafia River site.





# Take Home Messages

## Water Chemistry

- Advantages of using passive sampling devices is that they pick up periodic discharges of the compounds whereas grab samples may miss them.
- Odds are if you're seeing the compounds in grab samples they are likely to be continually present in the water column .
- Some pesticides, the PBDEs, and the alkylphenols are hydrophobic. Therefore we need to use SPMDs and/or collect sediment samples to determine their presence.
- The vast majority of the remaining compounds may be collected by grab samples, reducing the need for POCIS sampling to the first bullet above.



# Take Home Messages

## Ecotoxicology

- **The BLYES and SOS Chromotest provided information which may corroborate our water chemistry results.**
- **ER & AR transactivation and binding assays protocols need to be revisited to make sure that they are applicable to highly colored water.**



# Questions?



# References

- **Alvarez, D et al. (2007) Chapter 8 Tool for monitoring hydrophilic contaminants in water: polar organic chemical integrative sampler (POCIS). Comprehensive Analytical Chemistry. 48, 171-197. doi:10.1016/S0166-526X(06)48008-9**
- **Smith, R. (2018) Product: Semipermeable Membrane Device (SPMD) and its Deployment. <http://www.est-lab.com/spmd.php>**