Integrating Science and Developing Approaches to Inform Management for Chemicals of Concern in Agricultural and Urban Settings

Emily Majcher, Kelly Smalling, &
Scott Phillips, USGS

WQGIT April 2020

Final report summary of the STAC Workshop held May 2019

Watershed Agreement: *Toxic Contaminants Goal*

Policy and Prevention Outcome: focused on PCBs

Research Outcome

- Continually increase our understanding of the impacts and mitigation options for toxic contaminants.
- Develop a research agenda and further characterize the occurrence, concentrations, sources and effects of mercury, PCBs and other contaminants of emerging and widespread concern.
- In addition, identify which best management practices might provide multiple benefits of reducing nutrient and sediment pollution as well as toxic contaminants in waterways.

Workshop Objectives

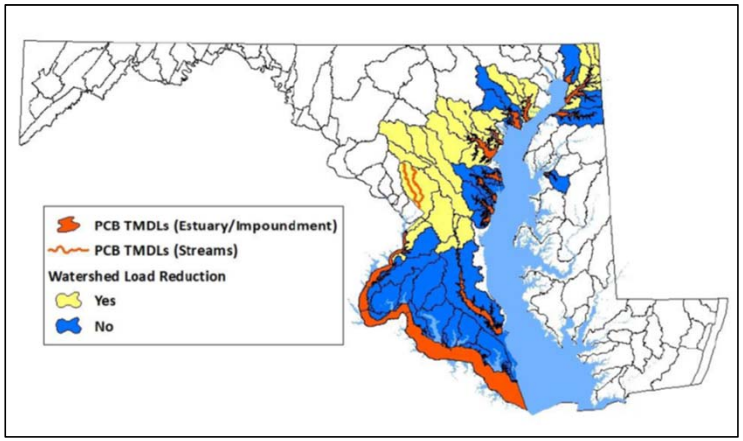
- Discuss contaminants related to fish consumption advisories, fish health, and emerging concern;
- Identify sources, occurrence, and transport of contaminants in agricultural and urban settings;
- Characterize opportunities to mitigate effects of contaminants in each setting by taking advantage of nutrient and sediment reductions, and other innovative approaches;
- Identify future needs for research and more integrated management approaches

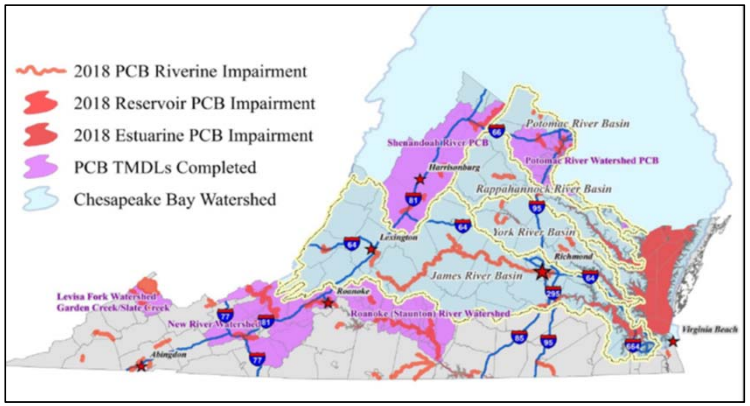
Workshop Agenda

- Jurisdictional Panel: Overview of issues and mitigation efforts
- Session 1: Primary contaminants related to fish consumption advisories and fish health
- Session 2: Primary contaminant sources, fate, and transport (included outside watershed perspectives)
  - Breakouts: Urban and agricultural groups
- Session 3: Mitigation and potential of nutrient and sediment management actions for contaminant reductions
  - Breakouts: Urban and agricultural groups

Jurisdictional Panel Highlights

- Most jurisdictions using local TMDLs to address toxic contaminants
  - PCB dominated
- NPDES permits
  - MS4
  - Industrial
  - Individual
- Other
  - DC coal tar sealant ban (PAHs)
  - Anacostia sediment study (megasite)
  - DE integrated cleanup and TMDL programs (WATAR)

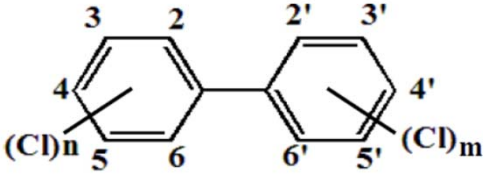




What are the chemicals contributing to fish consumption advisories?

- **PCBs & Mercury**: widespread fish consumption advisories
  - Range from “No consumption to 8 meals per month”
- **Organochlorine pesticides**: lesser extent

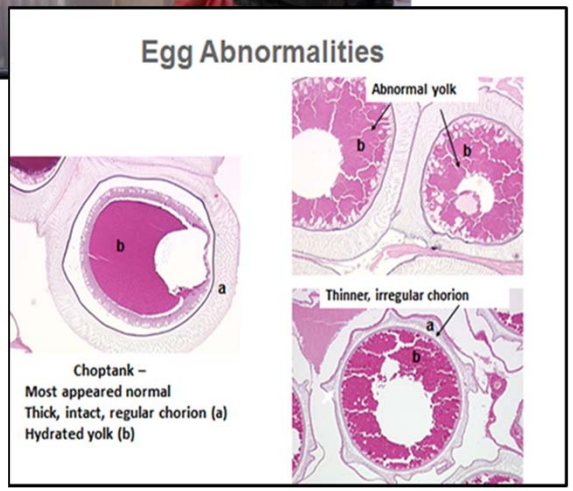
- **Emerging contaminants**: fish consumption advisories not established



(Photo: Kjellerup, 2019)

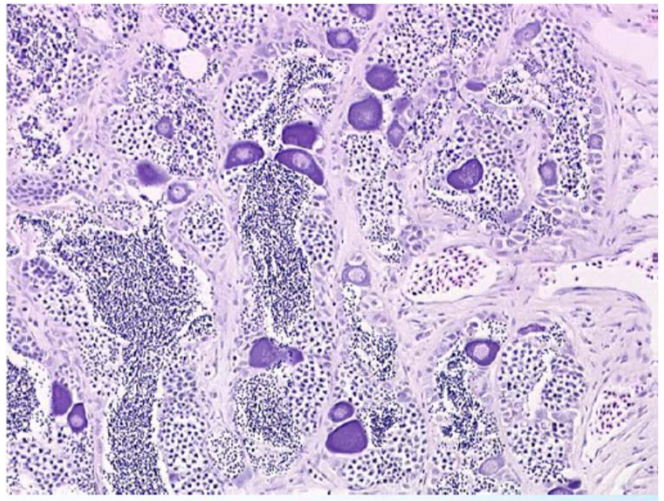
How are contaminants affecting fish health?

- **Urban settings**:
  - Neoplasia (abnormal tissue growth)
    - Tumors in Brown bullheads
    - DNA alteration
    - PAH exposure (PCBs and DDT)
  - Reduced reproductive success of yellow perch
    - Combined exposures to legacy (e.g., PCBs) and emerging contaminants



How are contaminants affecting fish health?

- **Agricultural settings**:
  - Fish kills, low chronic mortality, skin lesions, reproductive endocrine disruption observed
  - Increased susceptibility to infectious agents and disease susceptibility (ag land use and chemicals present)



Science needs and recommendations

- Fish health
  - Early indicators of sub-lethal effects
  - Risk factors contributing to skin tumors and skin lesion
  - Identify chemical concentration thresholds
- Management actions to reduce exposure
  - Sources of pollutants entering the food chain & causing consumption advisories
  - BMPs and effects on fish health
    - Monitoring in Potomac
    - Small mouth bass populations

Lesions decreasing

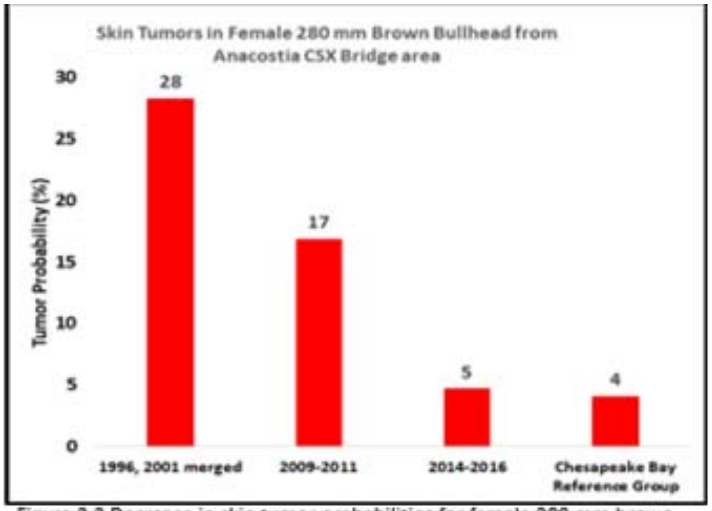
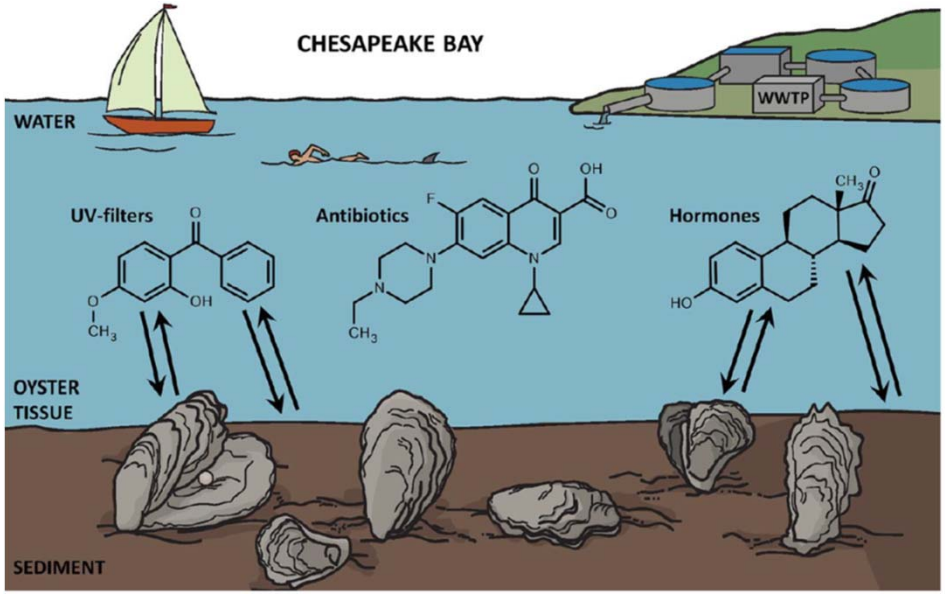
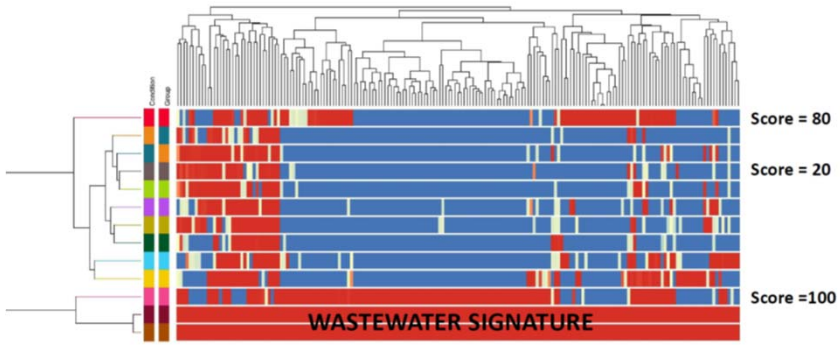


Figure 2.2 Decrease in skin tumor probabilities for female 280 mm brown bullhead from the Anacostia River (Pinkney et al. 2019)

Urban Areas: Contaminant Sources, Fate, Transport

- Fate and transport of CECs and transformation products are largely unknown
- While urban conveyance sources are well known (ww, stormwater, atm), complexity of urban systems complicates source definition and selection of appropriate management for habitat improvement
  - Puget Sound “fingerprinting” sources
  - Hudson R. sediment removal in upper portion has so far resulted in limited impacts to fish in lower portion ($1B effort)



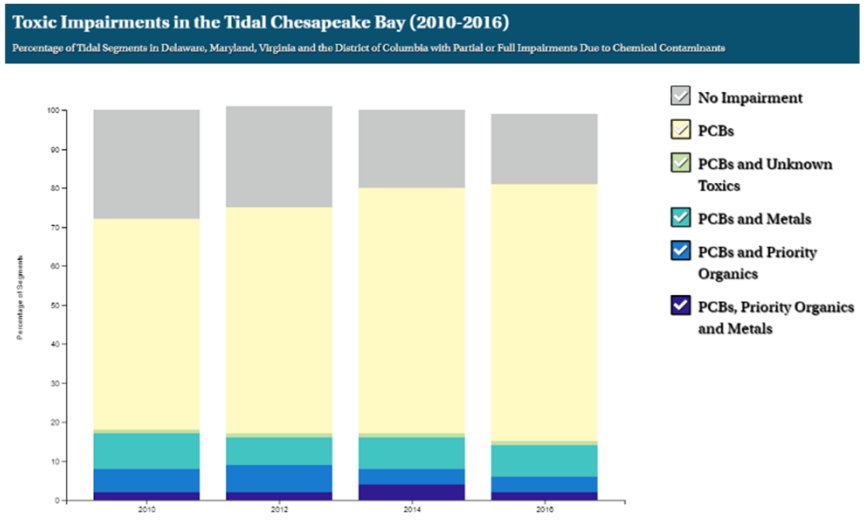


Urban Areas: Opportunities to Reduce Toxic Contaminants

- Sediment capture and reactive filter BMPs reduce concentration and toxicity related to urban stormwater runoff
- Iron-enhanced sand filtration reduces concentrations of pesticides and wastewater indicators
- In stream innovative treatment using activated carbon with and without bioamendments immobilizes and degrades PCBs

Urban Areas: Science Needs and Recommendations

- Improve best practices for source evaluation and conceptual model improvement for management selection
  - Example Anacostia R sediment project
- Better define the fate and transport of toxic contaminants in different settings including stormwater control structures (effectiveness and OM knowledge gaps)
- Compile and communicate efficiencies and effectiveness of BMPs and in stream mitigation for concentration reduction and improvement of aquatic organism health



Agricultural Areas: Contaminant Sources, Fate, Transport

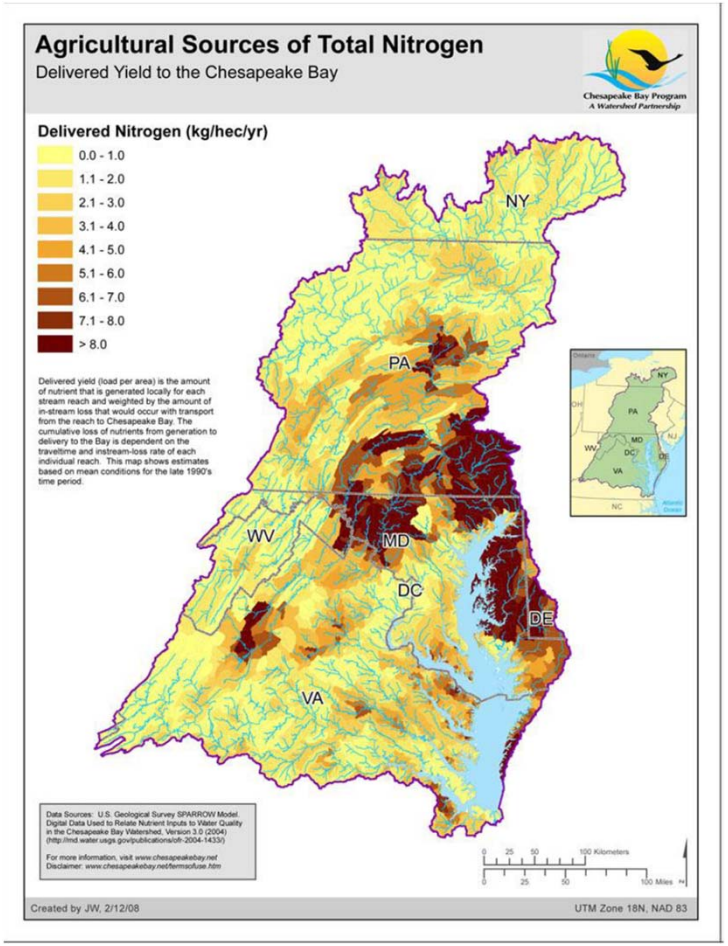
- Sources of contaminants are relatively well defined
  - Pesticide use
  - Manure storage/application
  - Biosolid application
  - Irrigation treated WW, septic
- Detailed information on many CECs is currently limited

Agricultural Areas:Opportunities to Reduce Toxic Contaminants

- Activated carbon or biochar to established BMPs effectively reduces contaminant transport
- Retention ponds and vegetative treatment reduces pesticide loading
- Manure management including composting, subsurface application, buffer strips, etc. reduce antibiotics and antibiotic resistance

Agricultural Areas: Science Needs and Recommendations

- Help prioritize BMP implementation
  - Identify contaminants that require reduction (exposure)
  - Desired outcome (e.g., fish health)
  - Establish how the BMP functions in relation to this outcome
- Compile/communicate findings of nutrient and sediment BMPs effectiveness to reduce toxic contaminants
- Build qualitative frameworks to answer questions related to co-benefits for toxic contaminants



Products

STAC Report

- https://www.chesapeake.org/stac/document-library/integrating-science-and-developing-approaches-to-inform-management-for-contaminants-of-concern-in-agricultural-and-urban-settings/

Workshop materials

- https://www.chesapeake.org/stac/events/integrating-science-and-developing-approaches-to-inform-management-for-contaminants-of-concern-in-agricultural-and-urban-settings/

Next Steps: STAC Letter to CBP

- Gaps in compiling and communicating potential removal efficiencies for contaminants
  - Continued expansion and compilation of BMP studies
  - Examine known and emerging contaminants
  - Capitalize on possible co-benefits
- BMPs are necessary investment to reduce contaminant loads and improve water quality
  - Research investment to understand co-benefits or negative impacts
  - Close working relationship between researches and management community to develop tools

- Prepare CBP responses to STAC

Potential CBP Responses to STAC

STAC:

- Gaps in compiling and communicating removal efficiencies
- Close working relationship between researches and management community

CBP Action 1: Enhance Interaction with Audiences for Contaminant Information

- Jurisdictions:
  - Implementing Phase 3 WIPs
- Water Quality GIT & workgroups
  - Ag, Stormwater, WWTP
- Local TMDL implementation
  - States, DC, and local jurisdictions
- Science providers

Potential CBP Responses

STAC: Close working relationship between researches and management community

CBP Response 2: Take advantage of Phase 3 implementation

- Nutrient and sediment BMPs with contaminant benefits
- Jurisdictions consider BMP planning
- New findings provided 2 years
- Materials to inform decisions

2020	2021	2022	2023	2024	2025
Phase 3 WIPs	New findings		New findings		New findings

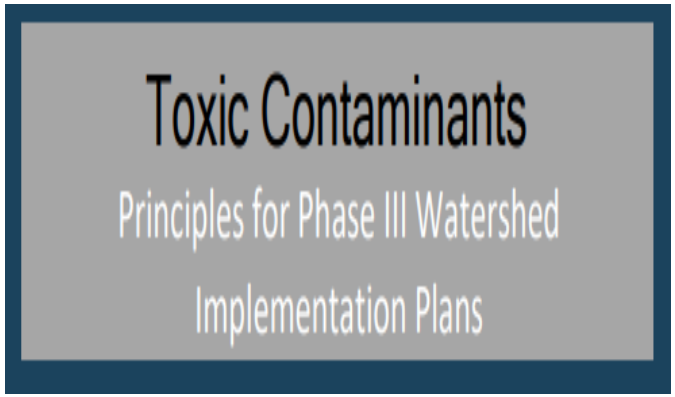
Potential CBP Responses

STAC: Gaps in compiling and communicating removal efficiencies; close working relationships

CBP 3: Enhance Communication Materials to Inform Decisions

- Stakeholder input on most useful topics
  - Ag, Urban, WWTP WGs
- Fact Sheets/

Briefing Materials

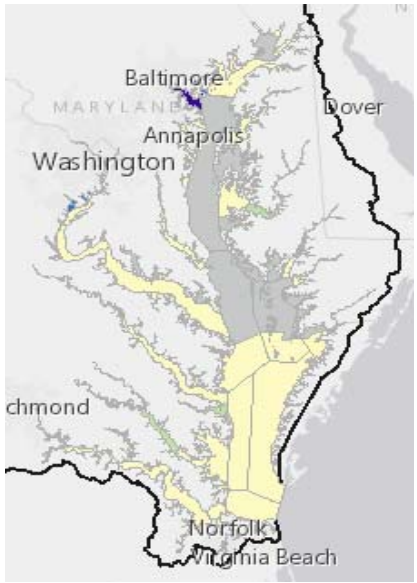


Best Management Practice	Urban Pollutants	Agricultural Pollutants
Ag Forest Buffer		4
Streamside Forest Buffers		3
Narrow Forest Buffer	3	3
Runoff Reduction	2.5	
Wet Ponds	2.5	
Urban Forest Buffers	2.5	
Filtering Practices	2	
Infiltration Practices	2	
Dry Ponds	2	
Bioretention	1.5	

Potential CBP Responses

STAC:

- Research investment to understand co-benefits or negative impacts;
- Gaps in compiling and communicating potential removal efficiencies for contaminants



CBP 4: Compile results and expand BMP studies

- Science needs updated
- Synthesis of BMPs from existing studies
- Expand studies for contaminants of most concern
- Monitoring for progress in reducing contaminants/impacts

CBP 5: Selected BMP results into CBP tools

- Watershed Dashboard, modeling, and CAST

Next Steps and Questions

- Present findings and draft response to WQ GIT and WGs
- Response through CBP to STAC
- Progress on responses
- Build into TCW action plans

- Questions?
- Follow-up:
- Scott Phillips
- swphilli@usgs.gov
- Emily Majcher
- emajcher@usgs.gov