Day 2: Rising Watershed and Bay Water Temperatures:

Ecological Implications and Management Responses

Session 3: Urban Waters and Habitats

Watershed Subgroup

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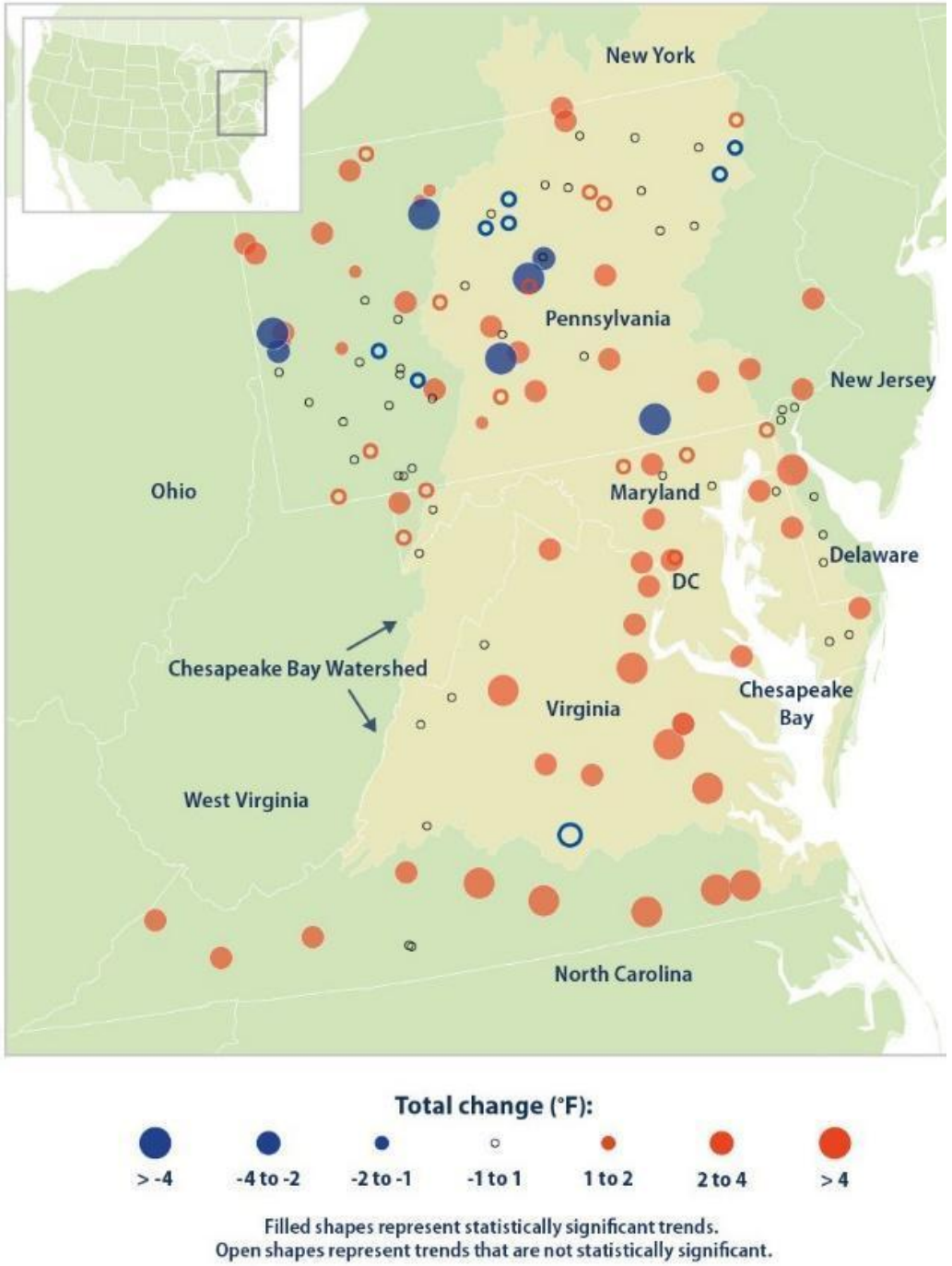
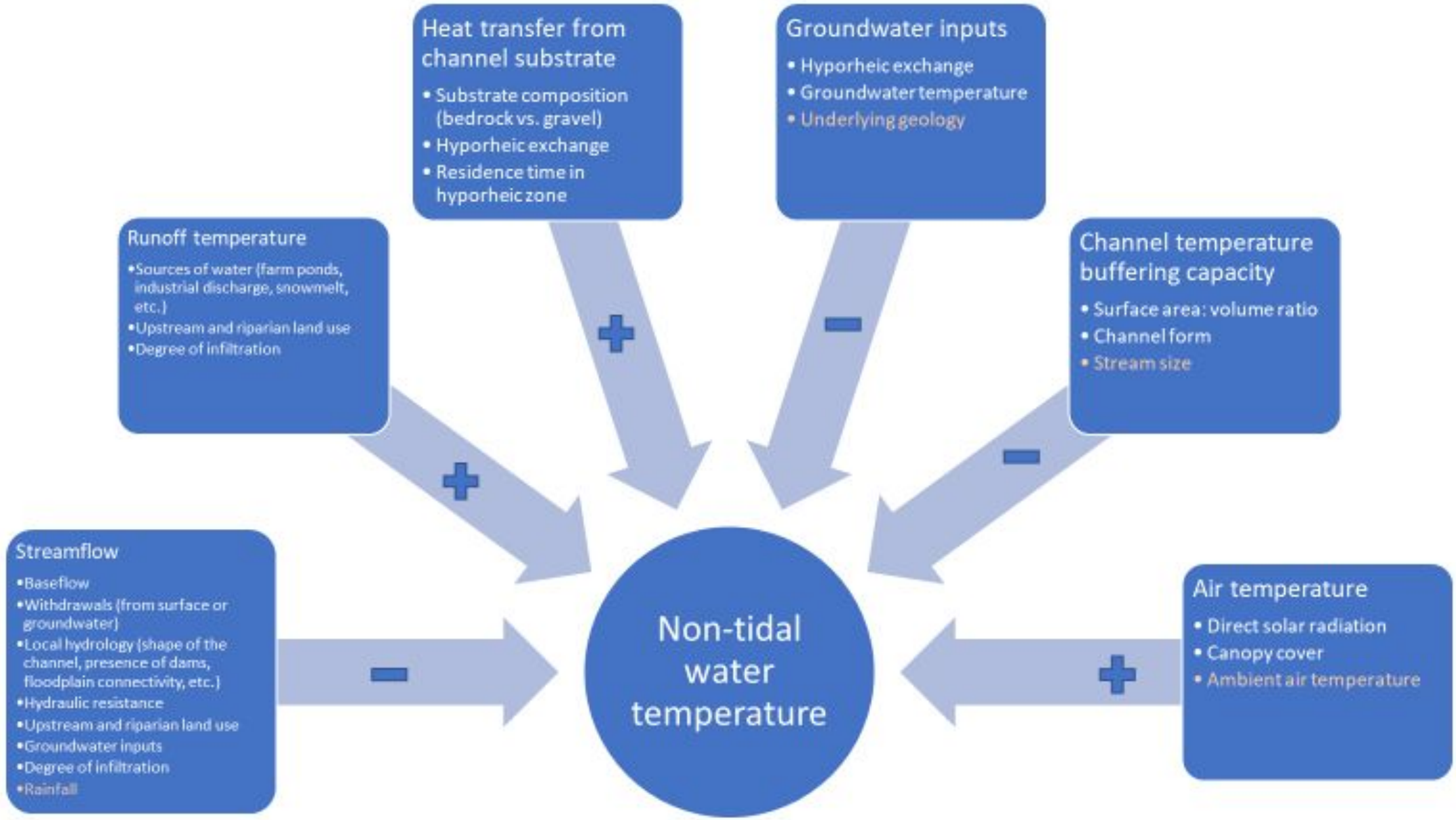
Developed areas are highly variable

- 1,800+ units of local government
  - varying governance and powers, staff and budgets
- Over 18 million residents (and growing)
- Physiographic regions (options are different in karst vs. coastal plain)
- Variety of landscapes
  - “Peculiarities of perviousness” – not all green spaces are the same
  - Impervious surfaces; compacted soils



Combatting heat in developed/urban areas

- Regulated and non-regulated stormwater
- Towns and cities are also hot-spots for our shared histories and for economic activity
- Beyond Environmental Benefits case studies, searchable database (https://gis.chesapeakebay.net/casestudies/)
  - Richmond
  - Havre de Grace
  - DC
  - …and more (162 total in database; 18 results for “temperature”)


Heat transfer from channel substrate
• Substrate composition (bedrock vs. gravel)
• Hyporheic exchange
• Residence time in hyporheic zone
Groundwater inputs
• Hyporheic exchange
• Groundwater temperature
• Underlying geology
Runoff temperature
•Sources of water (farm ponds, industrial discharge, snowmelt, etc.)
•Upstream and riparian land use
•Degree of infiltration
Channel temperature buffering capacity
• Surface area: volume ratio
• Channel form
• Stream size
+
+
−
−
Streamflow
•Baseflow
•Withdrawals (from surface or groundwater)
•Local hydrology (shape of the channel, presence of dams, floodplain connectivity, etc.)
•Hydraulic resistance
•Upstream and riparian land use
•Groundwater inputs
•Degree of infiltration
•Rainfall
−
Non-tidal water temperature
+
Air temperature
• Direct solar radiation
• Canopy cover
• Ambient air temperature

Category	BMP types	Available research	Strength of BMP temp effect			Lag Time to Change Temp?	Can Impact be Enhanced or Mitigated?
			Baseflow	Runoff	G/W		
Known Heaters	Wet ponds, created wetlands, dry ED ponds, farm ponds, CAFO lagoon	Strong	+++	++	?	None	Limited ability to mitigate, unless deeper than 10 ft
Suspected Heaters	Sand filters, MTDs,	Weak	++	+	-	None	Limited ability to mitigate
Shaders/ Interceptors	Upland and stream corridor forestry practices. Ag and urban forest buffers	Strong	- -	?	?	10 to 15 yrs	Enhanced by practices that accelerate tree canopy
Shade Removers	Land clearing, some channel restoration practices, open channels ag ditches	Weak	++	+	?	None, unless the site is reforested	Can be mitigated in headwater streams (e.g., forest buffer)
Known Coolers	Bioretention, porous pavement, infiltration, w/o underdrains	Strong	-	-	-	Weeks	Limited ability to enhance w/ urban soils
Suspected Coolers	LID practices w/ under-drains, floodplain habitat restoration	Weak	-	-	-	Hours	Need more data about GW & hyporheic exchange
Uncertain/ Unknown	Stream and floodplain restoration, Ag practices, Wetlands restoration	Weak	??	??	??	??	N/A
Thermally Neutral	Street cleaning, ag & urban NMPs, IDDE	Weak	?	?	?	??	No evident mechanism to change temps

Urban Waters and Habitats: Management Actions

U-1. Encourage use of stormwater “cooler” BMPs over “heater” BMPs in the Bay watershed for pollutant reduction going forward.

U-2. Update urban and forestry BMP plant lists to make sure the species we are planting are appropriate for the future hardiness zones in our warming watershed. Encourage diversity in plant selection to hedge against potential losses to invasive pests and plants.

U-3. Encourage the retention and expansion of urban tree cover (both in the riparian zone and upstream), especially in under-served urban areas which historically suffer the worst heating and human health outcomes.

U-4. Use aquatic habitat restoration to improve connectivity between suitable habitat patches and improve access to thermal refugia.

Urban Waters and Habitats: Science Needs

U-5. Update the CBP watershed model to simulate expected trends in future stream warming in urban watersheds and determine whether it is possible to mitigate warming with BMPs.

U-6. Investigate the benefits of retrofitting older legacy ponds to reduce downstream warming and pollutant reduction performance

U-7. Conduct BMP field monitoring to determine the temperature impact of widely used stormwater LID practices, such as bioretention, permeable pavement, infiltration and green roofs.

U-8. Institute Temperature Screening analysis for urban CBP BMPs—this entails a rapid effort to synthesize existing research on BMP temperature impacts for the most common BMPs applied to urban and suburban watersheds. A structured expert elicitation process could be used to establish Bay-wide delta-Ts for each class of urban BMPs and to develop recommendations for stormwater BMP design and construction criteria to mitigate stream warming.

U-9. Utilize higher-frequency continuous monitoring of urban streams and floodplains to better understand the ecological implications of stream warming for urban waters.

U-10. Explore the use of a proffer system for development that incorporates cooler BMPs.

Questions for the breakouts…

1. Do the proposed management actions need to be modified or adapted to address rising water temperatures? Are there entirely new options that should be considered? (Right actions?)

2. How do we best implement these management actions? Could current management or policy be adapted to address rising water temperatures or do we need an entirely new approach? (Right plan?)

3. What additional science and/or information would you need to better understand the effects of rising stream temperatures and to consider new management or policy actions? (Right knowledge?)