



# MASSACHUSETTS ENVIROTHON

## **2021 Current Issue: Water Management and Climate Change**

For the 2021 Current Issue, Mass Envirothon teams will investigate a wide range of water issues in their home communities, and look at how these issues interact and are changing as climate change accelerates. Teams will

- investigate the management of water supply, wastewater, and stormwater in their communities, and how these critical functions are being affected by changing climate.
- consider water's role in the ecosystem as well as human uses. Connections between water and forest, biodiversity, and soil resources must be part of their investigations.
- identify a critical issue in their community and propose the best way to address it.

**We live on the water planet.** Water shapes and defines the landscapes around us, taking a variety of forms – from soil moisture and groundwater; to wetlands, streams, and ponds; to rivers, estuaries, and bays. Water is essential to life – from the functioning of individual organisms to the functioning of ecosystems. Though we often take this resource for granted, decisions about the protection and shared use of water are some of the most important we make as a society. These decisions will become more and more consequential as climate change accelerates.

**We participate in the water cycle.** Our communities and economy depend on the natural water cycle to provide the quality and quantity of water we need to support a variety of uses, and the healthy biodiverse ecosystems that underpin them all.

We use water directly:

- for drinking and bathing.
- to help treat and carry away waste.
- for emergencies, like fire.
- as a source of aesthetic and recreational benefits.
- in many heating and cooling processes, in our homes as well as for industrial production, near and far.

We rely on water indirectly for:

- agriculture and forestry – and the soils for both – to produce food and fiber.
- electric power generation, often at a great distance from our communities.
- conservation of healthy and biodiverse ecosystems

**Our management of water resources includes both natural resource management and engineering.**

Management includes stewardship of the watershed – including minimizing nonpoint source pollution, maximizing infiltration, and managing flooding events. It also includes design, construction, and maintenance of water supply, wastewater, and stormwater systems.

Our water systems have always depended upon the landscape's natural forms and processes – including streams, rivers, lakes, wetlands, aquifers, and soil moisture-holding capacity of forests and fields – to supplement our engineered water management systems – including dams and levees, water treatment facilities, water distribution and sewage pipes, wastewater treatment plants, and storm drains.

**Designs for nature-based solutions** – practices that partner green with gray infrastructure (natural with engineered systems, as in Low Impact Development) – are gaining wide acceptance. Such solutions will be more and more important for water security in a less predictable world.

**Even before the climate crisis, managing water resources in Massachusetts has been an increasing challenge.**

The quality and quantity of our inland and coastal water resources have been experiencing stress from:

- Growing population
- Increasing consumption and waste
- New emerging contaminants
- Sprawling development

**Anthropogenic climate change is exacerbating these stresses and adding uncertainty.** Changes in the water cycle are emerging as primary markers of climate disruption. Scientists foresee

- increased precipitation in general
- increasingly unpredictable precipitation patterns
- longer and more extreme periods of drought
- more high precipitation events, with more run-off than groundwater recharge
- shorter winters with less snowpack accumulation, resulting in more rapid melting and less groundwater recharge in the spring
- increased flooding - from heavier precipitation coupled with increasing impervious surfaces, from storm surges in coastal areas, and from rising sea level

The result? Increasingly stressed ecosystems, undependable water quality and quantity, and disruption of food systems and economic functions around the globe. Changes and uncertainties are unique to each region, adding to the difficulties of planning for future water resource management.

**Sustainability is an important concept in water resource management.** *Our Common Future* (1986) defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Managing water resources sustainably requires that we consider

- Ecological health. Resource management, particularly water withdrawals, must balance human needs with the requirements of the ecosystems that provide the services.
- Economic costs and benefits. What are the true costs of supplying water to our communities? Are payments through the rate structure adequate in meeting the needs for a reliable and sustainable water supply? How should new water infrastructure be sized, given expectations for future growth? What are the most efficient combinations of gray and green infrastructure? What new technologies can save water and cut costs? Where are energy savings possible?
- Social justice. Access to safe, dependable, affordable, and adequate sources of drinking water is increasingly recognized as a human right.

**Resilience – defined as the capacity of a system to cope with change – is a high priority for water resource management.** The term has become popular recently, probably because it seems more appropriate than “sustainability” in an era when climate change is shifting the foundations of our ecological and social systems. Perhaps resilience in human systems can best be defined as the capacity of a community not only to anticipate, plan for, and mitigate the risks associated with environmental and social change, but to seize opportunities for ecologically sound, economically viable, socially just development.

**We tend to think about water management issues as disconnected,** fragmented problems – water supply, wastewater, stormwater, recreation. But they are all connected! To address these issues effectively in an era of climate disruption, they need to be understood in a larger sustainability/resilience framework.

**Perhaps more than any other environmental activity, water management is characterized by complex regulation and precise, technical language,** which can be bewildering and off-putting to the uninitiated. Getting to know the specifics of water use and management issues in your community is both challenging and worthwhile!

**Specific water resource management issues that Massachusetts communities are facing, or will face, as climate change accelerates include:**

- Drought-related water supply emergency declarations
- Drinking water source protection
- Safe yield for ecosystems (e.g. DEP Sustainable Water Management Initiative)
- Emerging contaminants
  - Pharmaceuticals
  - Personal Care Products
  - PFOAs and PFAs
  - Microplastics
  - Cyanobacteria toxins
- Nonpoint sources of pollution in stormwater runoff
  - Salt treatments for winter roads, increasing salinity in surface and groundwater
  - Bacteria and pathogens
  - Nutrients that act as fertilizers for algae and aquatic plants
- New development and increasing impervious surfaces, leading to less infiltration and more stormwater runoff
- Green infrastructure for urban stormwater management
  - Low Impact Development (LID)
  - Rain gardens
  - Green roofs
- Water conservation and efficiency, e.g. efficient fixtures in homes and businesses
- Energy conservation and efficiency in water systems
- Recreation
  - Harmful or unaesthetic algal blooms
  - Low flow in rivers and streams that affect fishing and boating
  - Poor water quality for swimming, particularly after storm events
- Private vs. public ownership of water supplies – is one better than the other to meet sustainability criteria?
- Nature-based infrastructure solutions for water supply protection, wastewater treatment, stormwater management in a changing climate
- Emergency preparedness – drought, storms, floods, protection of key water infrastructure

- Salt water encroachment on aquifers in coastal areas, due to unsustainable groundwater withdrawals and sea level rise
- Competing high demand for groundwater resources - agricultural irrigation, wells for domestic uses, new growth – leading to falling water tables
- Aging water supply and wastewater infrastructure, with questions about the sustainability of replacement
- Rising water and sewer rates – are charges reasonable? Are costs distributed fairly?
- New stormwater patterns and infrastructure needs that affect private property
- Suburban expectations for large, lush lawns
- Problems in implementing standards and Best Management Practices for water (e.g. stormwater at construction sites): Too much red tape? Uneven or lax enforcement? Inadequate for changing conditions?
- Effects large scale use of bottled water - on energy use and climate change? On attitudes toward protecting water supplies?
- Agriculture – agricultural practices (e.g. tilling, fertilizing, irrigating, applying pesticides) can have a net positive or negative impact on water resources

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