



Potential Climate Change Impacts on Disinfection Byproduct Precursors in the Catskill Watershed

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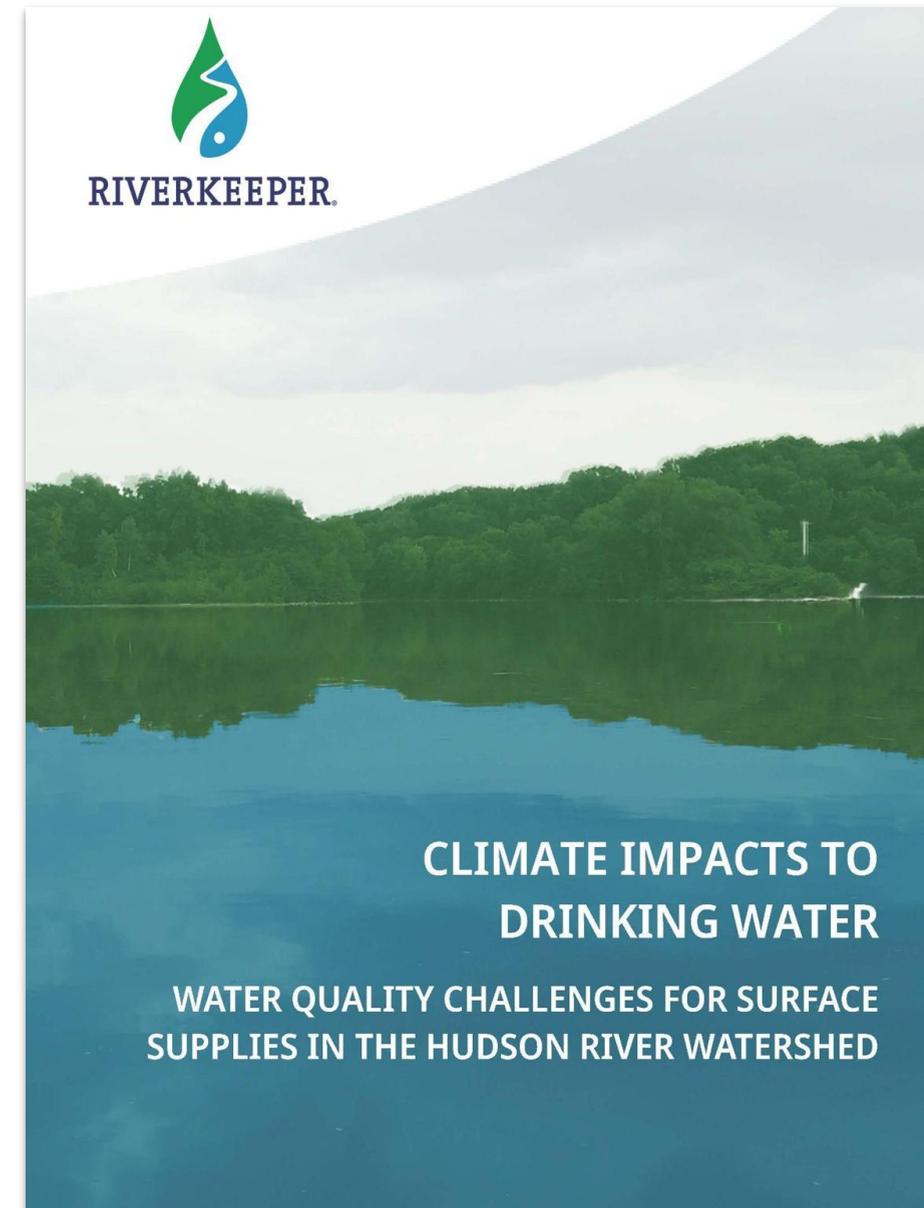


Riverkeeper's mission is to protect and restore the Hudson River from source to sea and safeguard drinking water supplies, through advocacy rooted in community partnerships, science and law.

New Report

Climate Impacts to Drinking Water

- Builds on NYS Climate Impacts Assessment, with focus on Hudson River Watershed
- Focuses on water quality impacts to rivers, reservoirs and lakes that serve as drinking water supplies for 12.6 million New Yorkers
- Uses a watershed perspective
- Meant to inform Drinking Water Source Protection and similar planning
- Available soon at riverkeeper.org



Thank You

Climate Impacts to Drinking Water

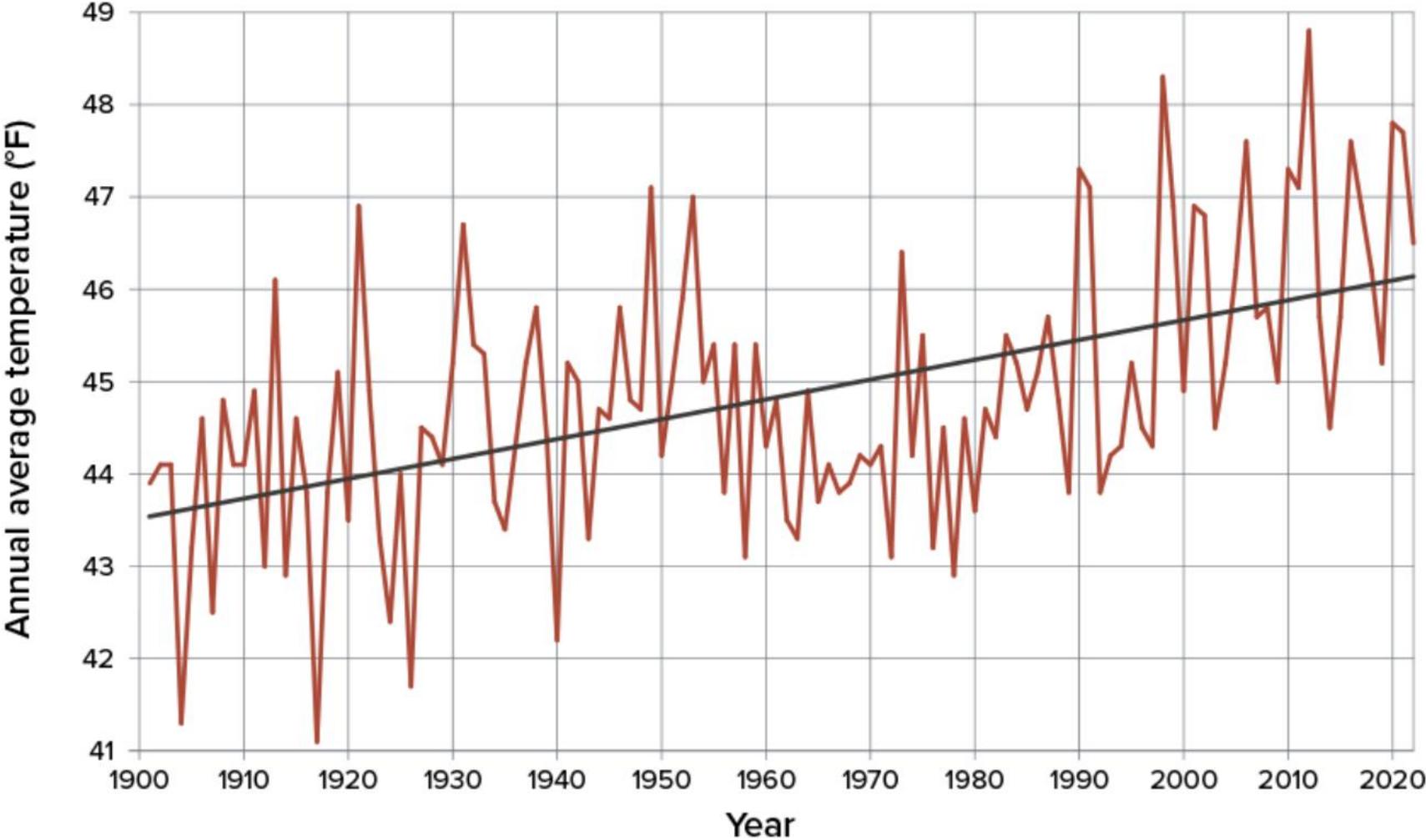
This project has been funded in part by a grant from the **New York State Environmental Protection Fund** through the **Hudson River Estuary Program** of NYS DEC.



**Department of
Environmental
Conservation**

We also wish to thank the authors of the NYS Climate Impacts Assessment, and the experts we interviewed to inform the report.

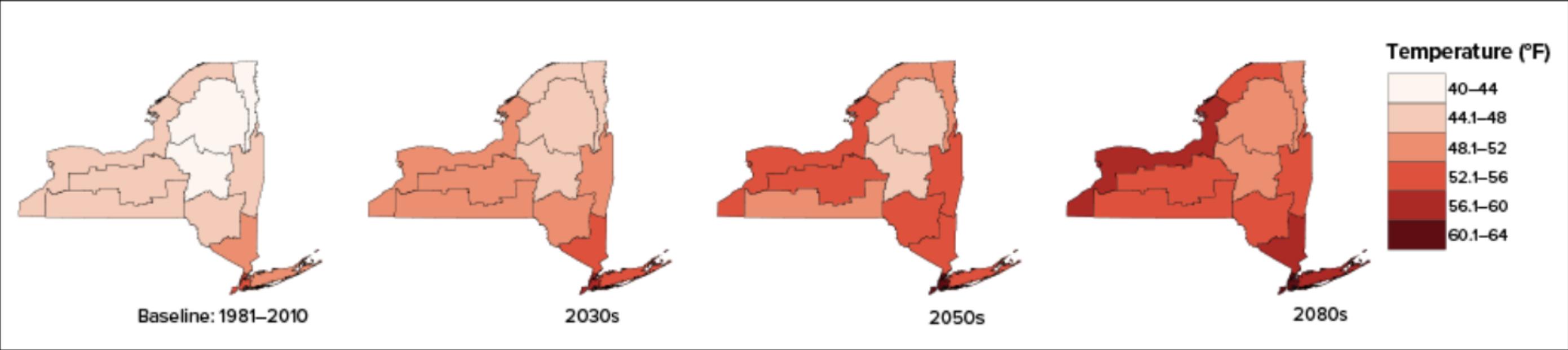
Climate Change in New York



From 1901 to 2022, average temperatures in New York State increased by almost 2.6°F

NY Temperature Projections

*dependent on global greenhouse gas emission rates

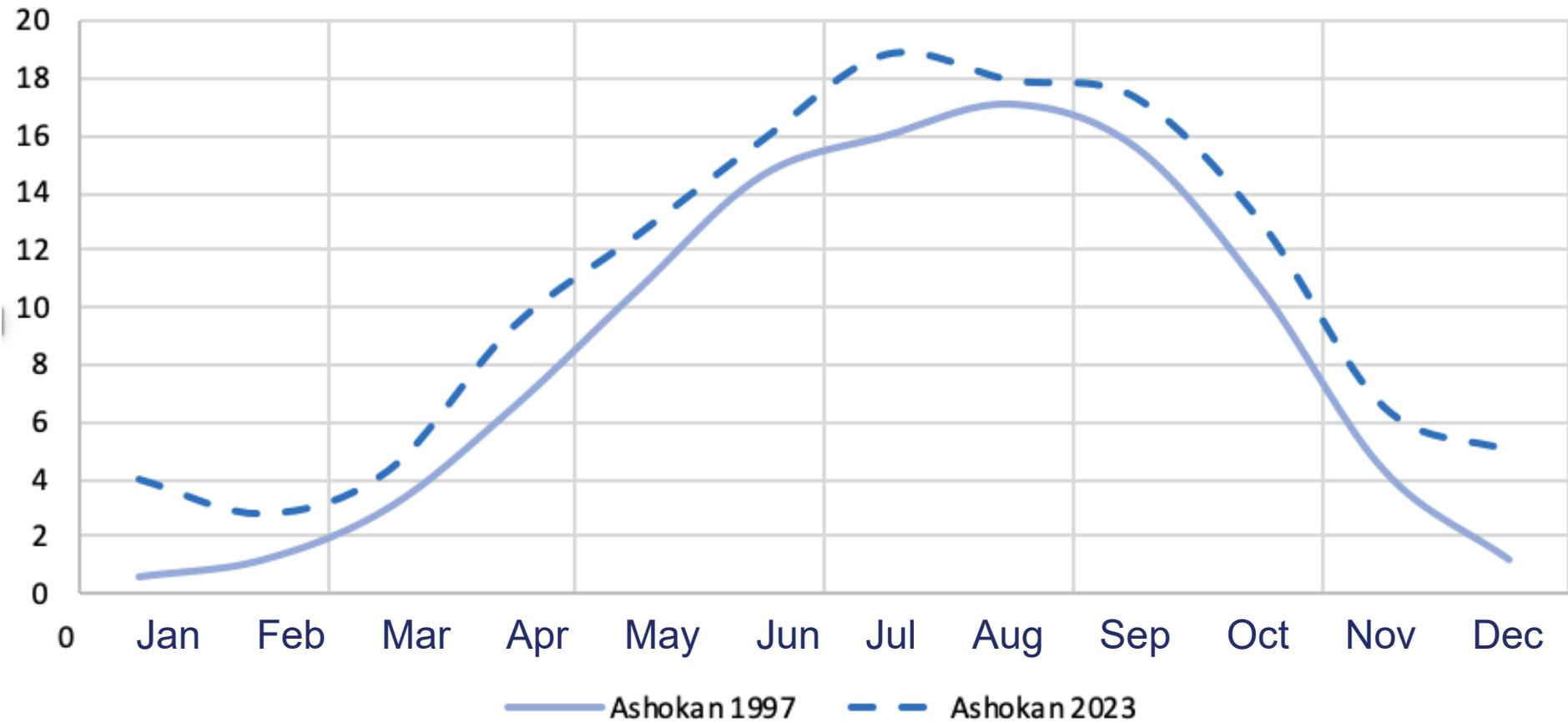


Temperature increase (°F) compared to 1981-2010 average

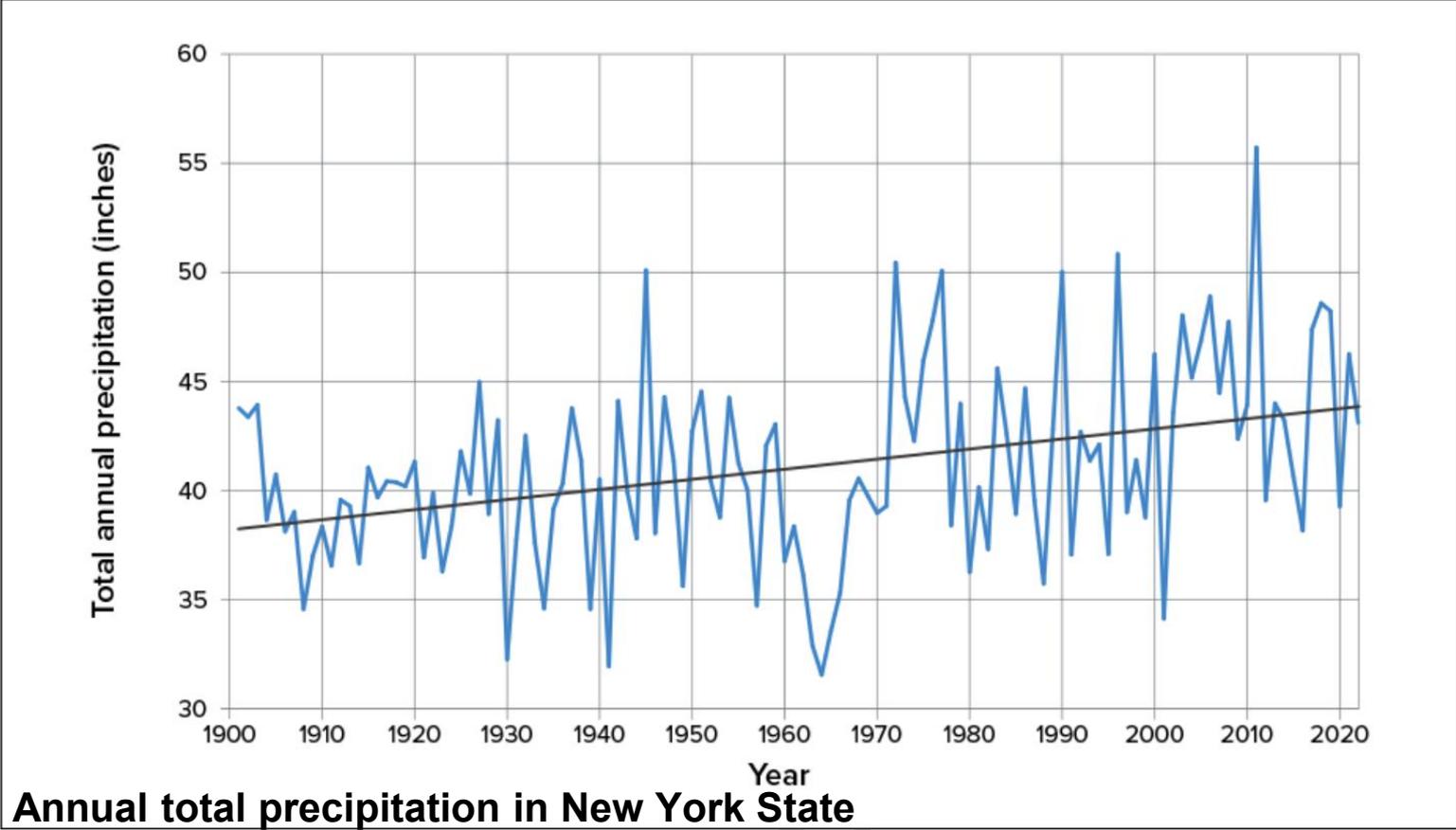
| Region | 2050s | 2080s | Regional characteristics |
|---------------------|---------|----------|---|
| South Hudson | 4.1-6.1 | 5.7-10 | largest increase in extremely hot days per year |
| North Hudson | 4.5-6.4 | 5.9-10.5 | largest increase in number of heat waves per year |
| Mohawk River Valley | 4.5-6.4 | 5.9-10.5 | |
| New York City | 4-6 | 5.6-9.8 | largest increase in extreme heat |

Water Temperature in the NYC Watershed

Water Temperature (C)



NY Precipitation Projections



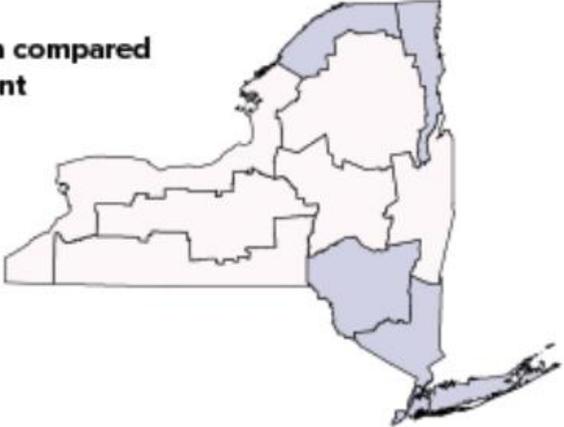
Largest percentage increases in annual precipitation are projected for the New York City, Catskills, and South Hudson

- Likely increases in winter and spring
- Summer and fall precipitation projections are less definitive

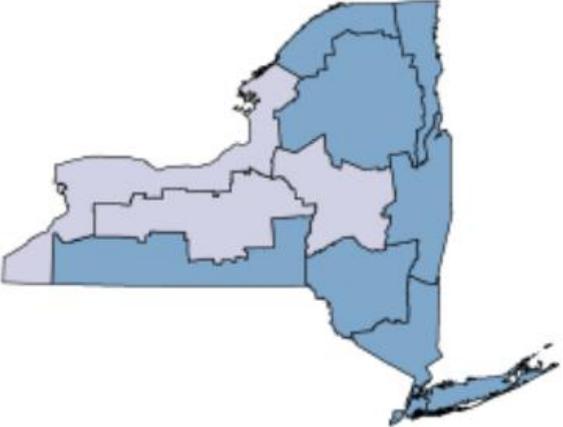
Projected annual precipitation in New York State

Projected change in precipitation compared with baseline (1981–2010), percent

- 2% to 4%
- 5% to 6%
- 7% to 8%
- 9% to 10%
- 11% to 12%



2030s



2050s



2080s

Drought and Deluge

- Days with more than 1 inch and days with more than 2 inches of precipitation are projected to become more frequent
 - Tropical cyclones will become more frequent
 - Severe convective storms (thunderstorms) will become more frequent
-
- Short-term seasonal droughts lasting from weeks to months could increase
 - Changes in the distribution of precipitation toward larger events could imply longer dry spells between large events
 - Higher temperatures in the warmer months could increase potential evapotranspiration and outweigh the influence of additional precipitation
 - Reduced snow cover and earlier spring snowmelt could increase drought risk in the summer as soils dry out earlier

Key Drinking Water Quality Concerns



Disinfection Byproducts: Increased abundance of precursors will increase the risk of forming both regulated and unregulated DBPs.



Harmful Algal Blooms: Conditions increasingly favorable to HABs will increase their frequency and severity.



Contaminants: Organic and inorganic contaminants – both regulated and unregulated – will be mobilized in new ways.



Treatment: Treatment and distribution infrastructure may be damaged during extreme events, and changes to water chemistry may result in the need to upgrade or alter treatment processes or distribution systems.

Underlying Pollution Burdens & Vulnerabilities



Excess nutrients: Phosphorus and nitrogen, from treated or untreated sewage, urban or agricultural runoff, erosion and other sources.



Toxic contaminants: Each water source will have different risks, depending on the presence of active or inactive users of hazardous substances **and soil or watershed characteristics.**



Salinity: Chloride and sodium, primarily due to use of road salt, contaminates groundwater in many source waters.

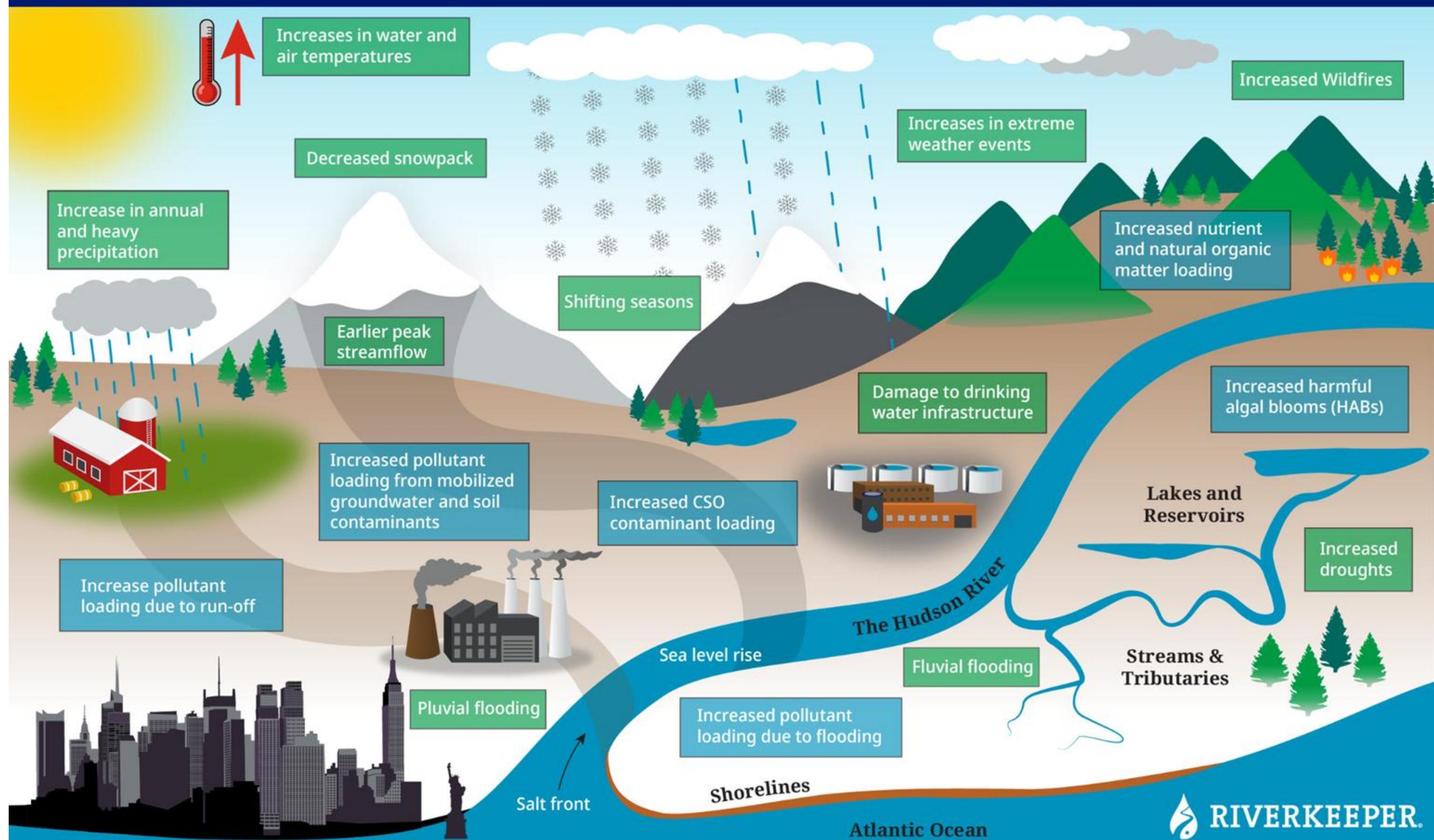


Land use: The quality and quantity of runoff and groundwater in a watershed is influenced by land uses, as well as hydrology and topography.



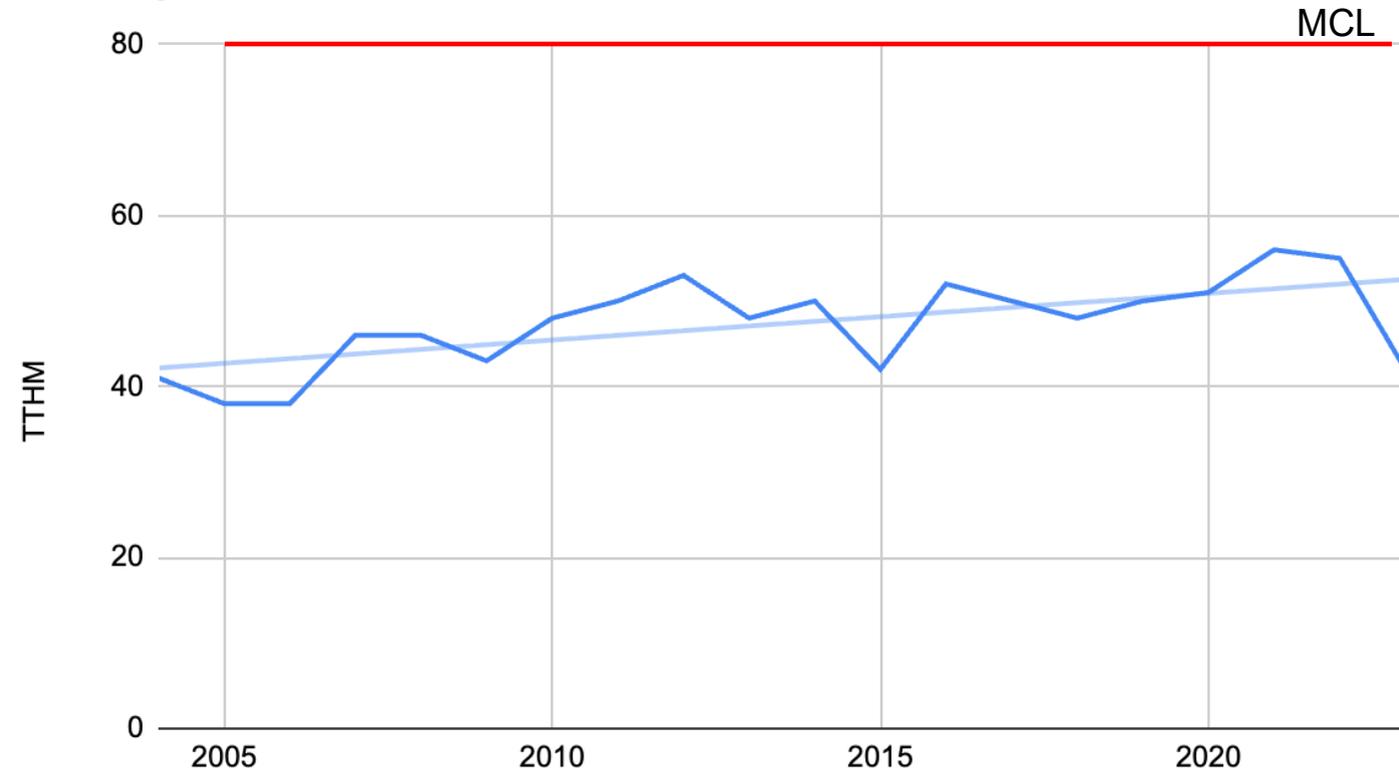
Treatment: The proximity of treatment and distribution infrastructure to flood plains or other risk factors, as well as treatment technologies in use, will influence the degree to which climate impacts create unmanageable risks.

Impacts of Climate Change on Drinking Water Quality in the Hudson River Watershed

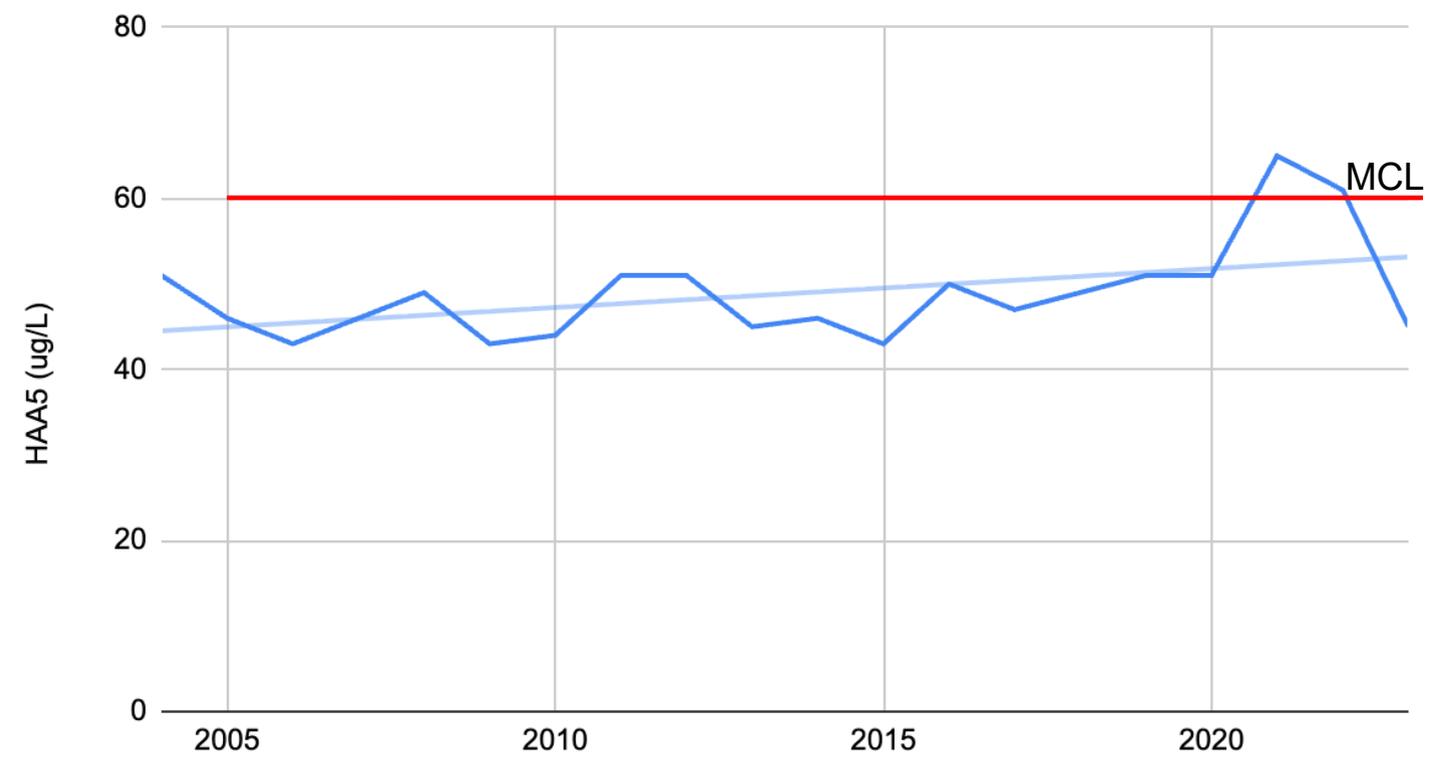


Disinfection Byproducts in NYC Finished Water

Average TTHM Concentration



Average HAA Concentration



DBP Precursors

Catalysts

Halides

- Bromide, iodide

Regulated DBPs

Allochthonous NOM

- decay of terrestrial biomass

Autochthonous NOM

- *in situ* sources, mainly algal organic matter (AOM)

EfOM

- depends on the drinking water source and the type of wastewater treatment applied

Unregulated DBPs

Anthropogenic compounds

- PPCPs, biocides, industrial chemicals

Climate Impacts on DBP Precursor Loading: More Precipitation

- More surface run off → OM, nutrients, trace organics, halide catalysts
 - Urban run-off
 - Agricultural run-off
- More winter and spring time flows
- More sewage overflow events
 - Nutrients → algae/cyano, N-DBPs
 - Trace organics
 - EfOM

Climate Impacts on DBP Precursor Loading: Hotter Temperatures

- More algae/cyano growth → AOM, N-DBPs
- Increased nutrient mineralization
 - More algae/cyano growth → AOM, N-DBPs
- Wildfire risk increases → pyDOM
 - Wildfire retardants ($(\text{NH}_4)_2\text{SO}_4$ and $(\text{NH}_4)_3\text{PO}_4$ fertilizers)
 - More algae/cyano growth
- Drought
 - Produces OM that is more difficult to remove
 - Increases wildfire risk
 - Increases algae/cyano growth
 - Decreases root strength → increases run-off

Climate Impacts on DBP Formation During and Post Treatment

- Heat increases DBP formation reaction rate
 - NY state UCMR4 data shows higher HAA concentrations in summer
- Heat increases biofilms in DS
 - More chlorine required
- Large influxes of OM during storm events

Regulatory Challenges

- New disinfection rules
- Higher chlorine residual requirements
- Additional DBP regulation

Facing Challenges

- Develop a common understanding of the issues
- Define research needs and conduct research
- Define and analyze alternatives from a "whole system" approach (i.e., from watershed management to distribution system management)
- Identify interventions to address the problem as efficiently and cost-effectively as possible, and with as many environmental co-benefits as possible
- Implement approaches via the next FAD and other mechanisms

Conclusions

- Rising air and water temperatures, increased precipitation and increased likelihood of short-term droughts
- Increased OM loading of all types
- Increased challenges for DWTPs
- Innovation of OM source control is critical

Hudson River Watershed Communities

A History of Water Innovation

1872 Poughkeepsie becomes the first drinking water system to use slow sand filtration.

1907 Gloversville becomes the first community in the nation to implement secondary treatment for its sewage.

1908 Jersey City becomes the first drinking water system to use chlorine disinfectant.

1997 New York City's watershed management program is established to protect the nation's largest unfiltered drinking water source.

2021 New York State launches the Drinking Water Source Protection Program.



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Thank you

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