

# Water Quality Report 2025



## Purpose

As Hudson River water quality has improved over the past 40 years, Hudson River Park (The Park) remains committed to several environmental monitoring initiatives to inform students, the public, and the regional scientific community about the River's ever-changing conditions and contaminants. The Park's River Project achieves these goals through year-round continuous river conditions monitoring as part of the Hudson River Environmental Conditions Observing System (HRECOS) network and participation in the Community Water Quality Testing Program (CWQTP).

The Park's HRECOS station is comprised of both *in situ* hydrological and meteorological monitoring equipment at the northwestern corner of Pier 25 in Tribeca (**Fig. 1**). This station transmits data every 15 minutes to provide near-real time water and weather condition parameters, available on the HRECOS website and the Park's River Conditions Dashboard (**Fig. 2**).

The Park's River Project is also founding member of the CWQTP, a coalition of dozens of boathouses, NGOS, universities, and community scientists. Organized till recently by the Billion Oyster Project (BOP) and previously the New York City Water Trails Association (NYCWTA), the CWQTP's community-driven effort seeks to provide accurate and location-specific health and safety data to keep boaters and recreators informed of weekly sewage contamination in their waterways. These initiatives further the mission of education of the river's health inform the safety of tens of thousands of recreators each year.

Additionally, rainfall data from the HRECOS station and NOAA's central Park station have allowed Park staff to analyze the relationship between sewage contamination and rain events and create a model to loosely estimate risk of bacteria based on precipitation.



**Fig. 1** | Pier 25 HRECOS station with Vaisala WXT series weather sensor, solar panel, and telemetry equipment enclosure visible.

## Key Questions

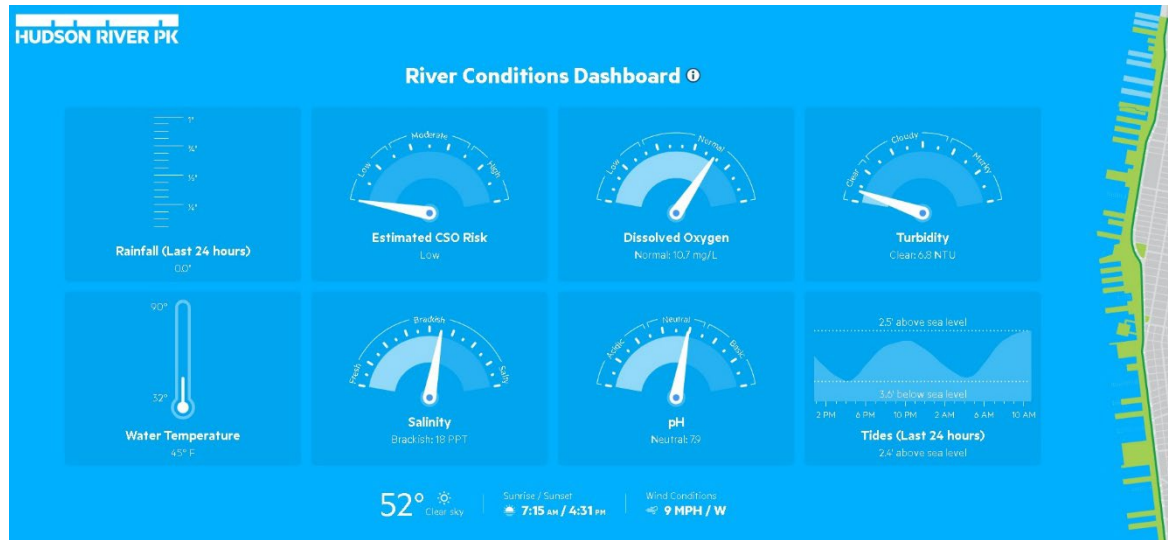
1. How does the Hudson River's temperature, dissolved oxygen, pH, salinity, and turbidity vary seasonally and interannually?
2. How do sewage contamination levels vary by year and site, both inside the Park and in NYC as a whole?
3. How does rainfall affect sewage contamination?

## Background

### Monitoring River Conditions with the HRECOS Network

The **HRECOS network** was established in 2008 and is supported by the New York State Department of Environmental Conservation (NYSDEC) and the United States Geological Survey (USGS). HRECOS monitoring stations oversee 232 miles of waterways year-round using physical sensors. Real-time conditions are recorded every 15 minutes to provide information needed for management and protection of river ecosystems. The Park joined the network in 2011.

At Hudson River Park, a **YSI EXO-2 sonde** is deployed 2m off-bottom via PVC pipe affixed to the support pilings of Pier 25. The sonde is connected via cable to a protected datalogger and modem. Equipped with temperature, dissolved oxygen, pH, salinity, and turbidity sensor probes, the sonde continuously collects a suite of water quality data to send to the HRECOS network. Every month, Park staff conduct routine cleaning, calibration, and repairs to maintain a high level of



**Fig. 2 |** River Conditions Dashboard accessible from Park website and in person at the Pier 40 Wetlab via smartboard touchscreen.

data quality. In addition to the HRECOS website and the Park's Dashboard. Historical data are available from a USGS repository. These robust datasets are useful for tracking environmental trends over time.

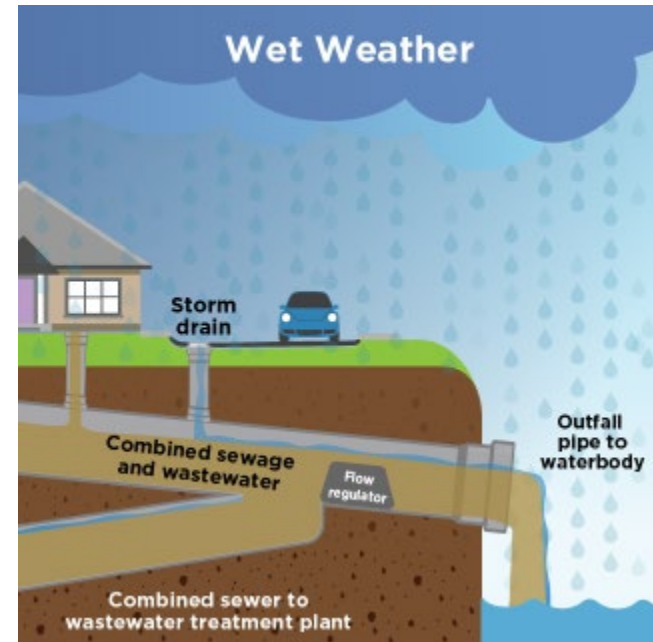
## Combined Sewer Outflows in New York City

**Combined sewer systems**, which make up 60% of New York City's sewage infrastructure, are designed to release untreated sewage and rainwater into local waterways when stormwater exceeds the system's capacity. In these systems, wastewater and stormwater flow through the same pipes. During dry weather, all wastewater is treated at treatment plants before being discharged, but during wet weather, the rush of stormwater can overwhelm the system, triggering permitted outfalls throughout the network that discharge untreated or partially treated sewage and stormwater into nearby waterbodies in events called **combined sewer overflows** (CSOs) (**Fig. 3**) (USEPA, 2025b). Around 20 billion gallons of combined sewage flows into New York City waterways every year, making rainfall a primary cause of sewage contamination in the Hudson River and New York Harbor (NYCWTA, 2025).

Despite the strong overall correlation between rainfall and contamination, the variability of fecal contamination spikes remains high, highlighting the need for frequent, site-specific sampling that many agencies often don't conduct. CSOs pose a major water pollution and public health concern for approximately 700 U.S. communities, as they can contain bacteria, debris, and hazardous substances harmful to people, pets, and wildlife, while also causing beach and shellfish bed closures, algae growth, reduced oxygen levels, and aesthetic impacts from floating debris or oil slicks (USEPA, 2025b).

## Water Quality Testing

The amendments of the **Clean Water Act** (CWA), also known as **Federal Water Pollution Control Act**, in 1972 implemented pollution control programs and national water quality criteria for pollutants to be enforced through the EPA



**Fig. 3** | Combined sewer system during a wet weather event, resulting in a CSO (from "Combined Sewer Outflow Basics", USEPA).

(USEPA, 2025a). While NYSDEC’s watershed protection program predates the CWA, the program now uses federal criteria as a baseline for water quality safety and recommended uses of water. Water quality standards for Hudson River testing are based off the NYS Regulation 6 NYCRR Part 703.4, where testing should occur between May 1<sup>st</sup> through October 31<sup>st</sup>, and results should remain below their standard of 35 MPN of *Enterococci* per 100 mL

The NYCWTA launched the **CWQTP**, in 2011 in partnership with the River Project, testing 12 locations. Since then, the program has expanded significantly over the years, growing to nearly 100 sites and 9 partner labs across the NY-NJ Estuary and New York Harbor.

### Enterolert and Enterococcus

**Enterococcus** is a genus of bacteria found primarily in the intestines of humans and other terrestrial vertebrates. While these bacteria are not particularly pathogenic, they are highly associated with more virulent microbes. When observed in river water, they can indicate that fecal matter has entered the waterway through septic and wastewater systems along with potentially harmful pathogens, such as *E. coli* (USEPA, 2025). Because of this, they are considered “fecal indicator bacteria” (FIB). This makes *enterococci* particularly valuable for water contamination research in urban environments because it is abundant in human sewage but does not carry the same health risks as enumerating and culturing coliform bacteria, requiring fewer protective measures and equipment.

To help monitor the safety of recreational waters, tests are done to quantify fecal pollution based on culturable FIB. While there are different methods to quantify FIB, the CWQTP and Park use **IDEXX Enterolert assays**. Used by the U.S. Environmental Protection Agency (USEPA) to test



**Fig. 4** | HRPK staff and CUNY interns analyzing the results of a Quanti-tray water sample after incubation.



**Fig. 5** | Park Seasonal Field Assistants collecting CWQT water samples and metadata at Pier 40.

marine, fresh, and estuarine water, Enterolert is a defined substrate method of selectively culturing bacteria. *I.e.*, the Enterolert reagent is a sugar compound (substrate) chemically tailored (defined) to be compatible only with genus *Enterococcus* bacteria's cell membrane, meaning that only the desired *Enterococcus* bacteria can consume the reagent. The consumption of the Enterolert reagent subsequently causes fluorescent tags to break free, making positive cultures fluoresce under UV light (Sercu et al., 2011).

**MPN** stands for the Most Probable Number of colony-forming units (CFUs) of bacteria in 100mL of water, quantitatively estimating the concentration of bacteria in that sample (Budnick et al., 1996). A MPN below 35 is considered safe for indirect/secondary water contact (boating, fishing, etc.), levels between 35 and 105 are unsafe if they persist, and readings above 105 are always unsafe, according to the NYS Department of Health.

## Methods

Annually, May through September/October, Hudson River Park participates in the CWQTP, collecting and testing water samples from the NY-NJ Hudson River Estuary to quantify the *Enterococcus* on a weekly basis.

- 100 mL Water samples are collected from 4 sites in the Park – Piers 26, 40, and the north and south sides of Gansevoort Peninsula – with partner sites in Hoboken and Battery Park
- Samples are diluted 1:10 with sterile water and *Enterolert* reagent is mixed in.
- Samples are transferred to IDEXX Quanti-Tray/2000s, sealed, and incubated for 24-26 hours at 41°C (106°F).
- After incubation, Quanti-Trays are exposed to UV light.
  - Blue, fluorescent wells indicate a positive result, and the ratio of glowing wells is used to calculate MPN
- *Enterococcus* levels are assessed according to Department of Health standards of water safety and reported to the CWQTP network every week.



**Fig. 6** | IDEXX Quantitrays are enumerated using and MPN value chart are pictured along with a completed data sheet from testing. after 24-26 hrs of incubation at 41C.

# Major Findings

## Pathogens

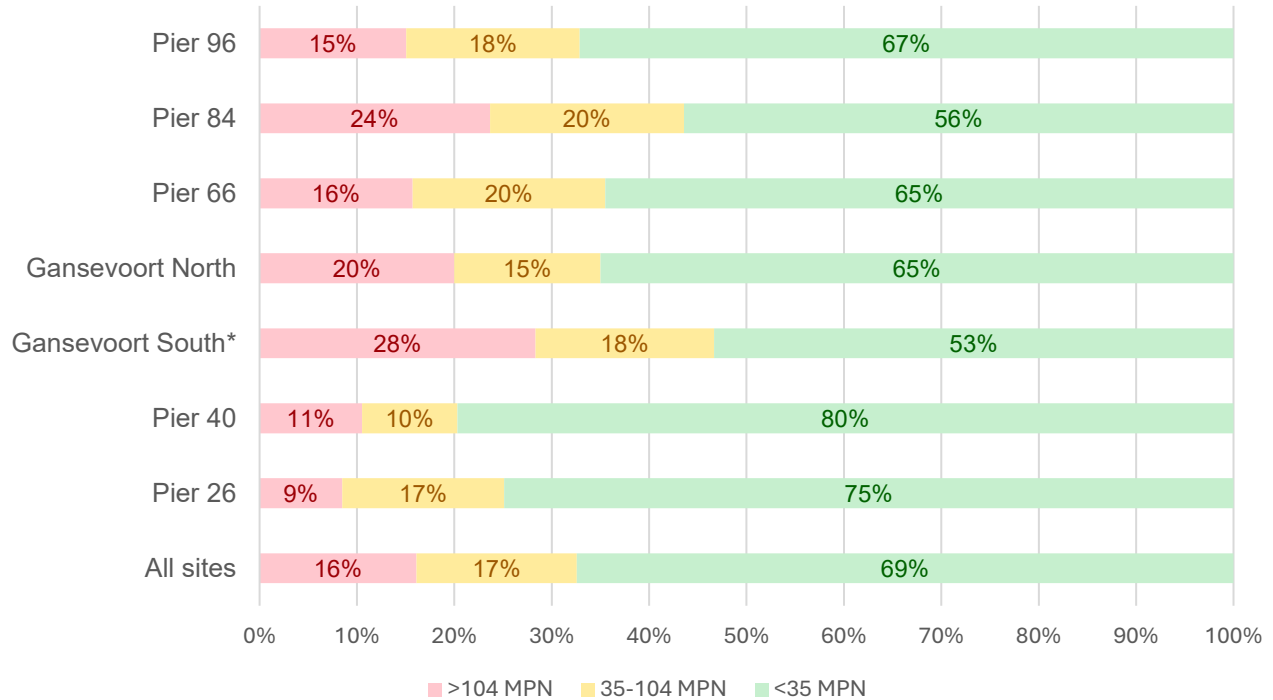
Park sites frequently exhibit MPN levels in line with EPA recreational standards (<35) despite the presence of ~30 CSOs in the Park (**Fig. 7**).

This year, seasonal (Year-to-date/YTD) geometric means for Piers 26, 40, 66, and 96 were found to be below 35 MPN, with Gansevoort North just above the 35 MPN threshold (37 MPN) (**Table 1**).

Gansevoort South had no geometric mean below 35 MPN throughout the entire sampling season – 89% of sampling dates were considered advisory warnings and Pier 84 had an

equal amount of safe and unsafe days, both at 28%. Pier 84 and Gansevoort South had a significantly higher average MPN when compared to every site but each other. Notably, Gansevoort South had a significantly higher average MPN than Gansevoort North. Piers 40 and 26 were the only sites that had a significantly higher MPN in wet weather compared to dry (**Fig. 8**). This is likely in part due to very few “dry” weather sampling days this season, with only 4 out of 20 exhibiting rainfall lower than 7.5mm leading up to collection. With only four dry days, the variance between groups was

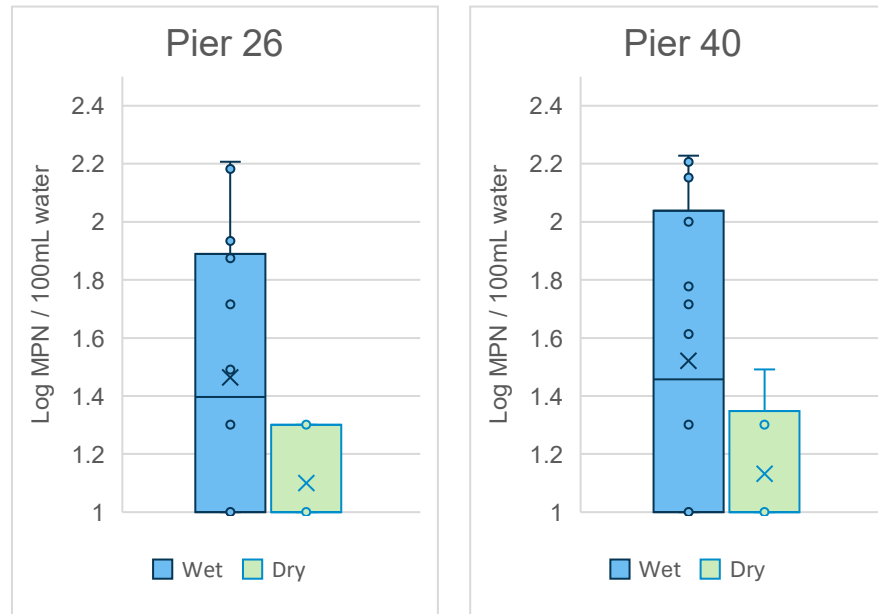
**Enterococcus levels by site, 2012-2025**



**Fig. 7 |** Overall Park site contamination trends across 13 years. Sites are organized from north to south, top to bottom. \*Gansevoort South was a combination of several sampling points in 2023 and since reduced to one to better mirror North.

**Table 1 |** Rolling, 30-day geometric means of HRP sites, 2025 season. Each mean MPN value is comprised of 5 sampling days.

Sample Site	YTD Mean	30 Day Geometric Mean MPN Value																		
		5/9 - 6/6	5/15 - 6/13	5/22 - 6/20	5/29 - 6/27	6/5 - 7/4	6/12 - 7/11	6/19 - 7/18	6/26 - 7/25	7/3 - 8/1	7/10 - 8/8	7/17 - 8/15	7/24 - 8/22	7/31 - 8/29	8/7 - 9/5	8/14 - 9/12	8/21 - 9/19	8/28 - 9/26	9/4 - 10/3	
Pier 96	23.42	26.78	24.53	23.33	15.87	14.14	55.68	155	155	24.93	23.6	23.13	24.36	21	24.36	21.21	12.46	13.26	16.52	
Pier 84	66.98	54.26	57.76	56.52	34.03	35.65	61.75	93	93	249.23	314.38	354.88	311.53	175.62	70.67	30.85	17.92	13.26	26.86	
Pier 66	28.72	45.39	52.39	44.8	26.87	25.62	44.38	61.48	51.38	47.52	34.8	42.83	33.09	26.57	21.32	21.32	12.46	11.49	11.49	
Gans., N.	36.93	43.96	43.96	35.97	32.63	27.94	35.2	27.94	28.67	22.32	23.83	36.94	48.75	38.87	29.46	46.6	26.17	40.79	40.79	
Gans., S.	70.7	44.14	67.88	56.05	48.39	40.1	74.07	52.71	61.4	44.12	49.06	67.12	81.33	71.24	62.02	91.9	46.49	145.34	121	
Pier 40	25.38	49.02	42.67	30.62	17.96	12.6	30.51	48.83	32.85	27.62	28.27	26.35	28.44	28.44	28.44	22.68	14.31	11.49	11.49	
Pier 26	22.65	23.53	36.18	30.15	27.02	25.81	32.52	27.5	21.36	21.36	21.08	31.62	39.64	39.64	34.51	30.04	17.43	10	10	

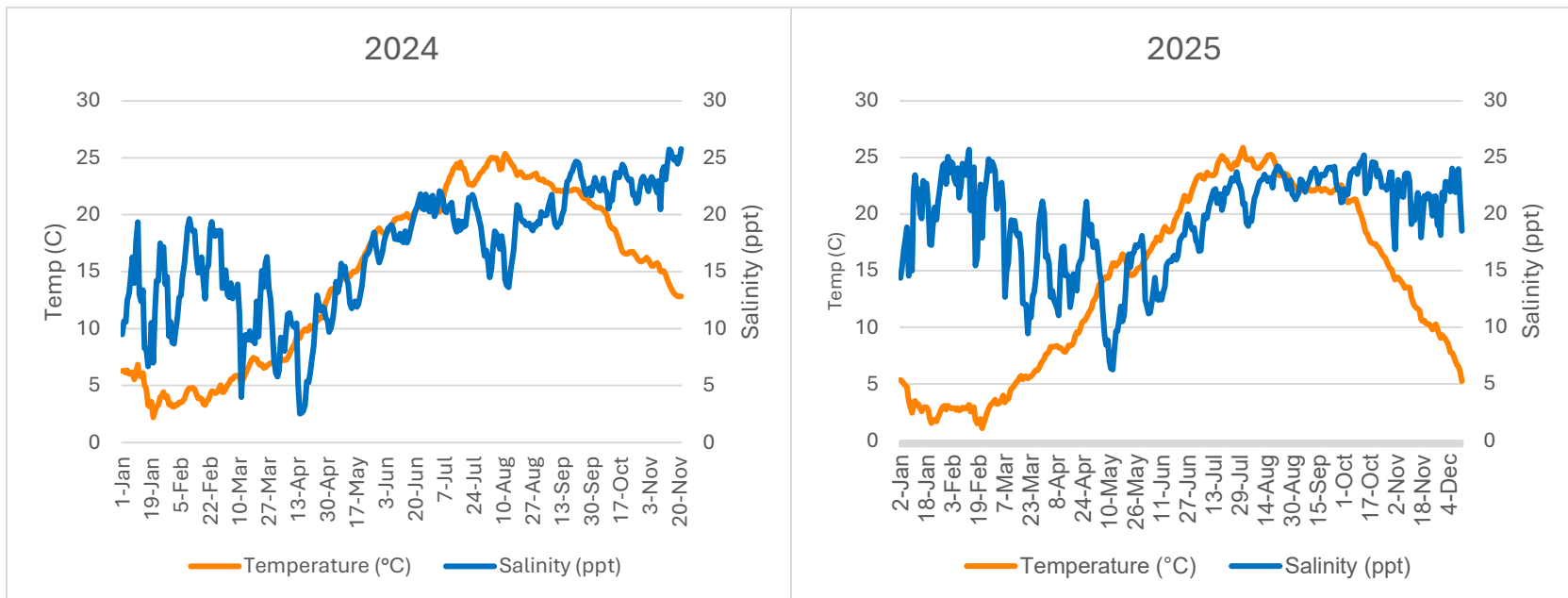


**Fig. 8 |** Wet vs dry weather *Enterococcus* concentrations at Piers 26 and 40 throughout the 2025 sampling season. Wet weather is defined as >7.5mm of rain within the week prior to sampling – rainfall data is sourced from the NOAA Central Park monitoring station. Both piers showed significantly higher mean bacterial concentrations in wet weather ( $p < 0.05$ ).

highly irregular, making statistical comparison difficult and potentially confounding results at the other, higher concentration sites. This does, however, illustrate that even sites that are relatively “clean” can experience significant contamination from rainfall, even if raised wet weather concentrations are still lower than more contaminated sites.

Park sites routinely exhibit some of the lowest *Enterococcus* levels within the entire CWQT program; this year only 15 sites out of the 93 total saw seasonal means under the MPN safety threshold, with 4 of those 15 sites located within the Park (Piers 26, 40, 66, and 96). This is due to the Park’s position near the mouth of the Hudson River, as it enjoys substantial and frequent tidal exchange with the harbor and ocean, quickly carrying away effluent and diluting it to non-issue concentrations.

## River Conditions



**Fig 9 |** Water temperature and salinity compared across the 2025 and 2024 calendar year using data from the Pier 25 HRECOS station. Data represent daily averages of ~96 measurements (approx. 1 data point every 15 minutes).

Data from the Pier 25 HRECOS station indicates that this season saw temperature highs slightly sooner than in 2024, with waters hitting 15C by early May instead of late May. Salinity was 5 parts per thousand (ppt) higher in 2025 than 2024 from January to May ( $p < 0.001$ ) (**Fig. 9**). This difference is even more dramatic when compared to 2023, where the River reached near fresh at almost 0ppt in several instances, hovering well below 10 ppt for much of that winter. These interannual variations in biologically critical parameters like salinity can have significant impacts on biota and the system at large. The Park's fish ecology survey caught significantly more fishes with the same effort this season compared to 2024 (~500 vs 300) and saw larger fishes such as adult toadfish earlier than usual. This is likely due to the higher salinities this year compared to previous. Check out our Fish Survey report for more information on our fishy friends!

## Takeaways

Testing sites within the Park's boundaries frequently show single sample and mean MPN levels consistent with EPA recreational standards (below 35 MPN) despite the presence of multiple CSO outfalls in the area, likely due to the Hudson River's high flow rates and proximity to NY-NJ Harbor. *Enterococcus* contamination remains highly variable between years and even month to month, exhibiting significant stochastic variation, highlighting the need for continued high-frequency monitoring and innovative modeling techniques. The Trust generally recommends caution when interacting with waterways after periods of significant rainfall, even though because of the Hudson's strong tides and currents, contamination typically dissipates within 24-48 hours as it moves out into deeper waters where it becomes diluted — a pattern that does not hold true across all bodies of water in the city. The Hudson is hugely variable season to season and year-to-year, making continuous monitoring a necessity to understand the complex effects of changing conditions, especially as the planet continues to warm.

## Future Directions

Hudson River Park will continue its participation in the HRECOS network and CWQTP to provide robust river condition & contamination data for New York City's public, students, researchers, recreators, and water users while gathering important information on sewage contamination levels and baseline conditions within the Estuarine Sanctuary. As the Park works to reduce rainfall runoff through bioswales and green infrastructure, and as the City improves sewage capacity, this data will prove invaluable for tracking progress in mitigating the release of pathogens into the environment

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