



How do Rainfall Levels Affect Bacteria Contamination in Water Sources in NYC?



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INTRODUCTION

Urban water systems are shaped by the complex infrastructure beneath cities and the forces of nature that interact with them. In New York City, the majority of the comprehensive sewer network was built decades ago. As weather patterns continue to change and rainfall increases, the existing system appears increasingly outdated. According to data from Hudson Park, around 60% of NYC relies on a combined sewer system.¹ A combined sewer system moves both storm water and wastewater through the same pipelines.¹ During heavy rainfall these pipes can exceed capacity and overflow, as shown in figure 2, causing a release of untreated sewage into local waterways often referred to as combined sewer overflow.¹ This research will explore data from the Hudson River Park examining how Enterococcus concentrations rise during wet weather monitoring periods to examine possible correlations between rising bacteria levels in water sources and rainfall levels.

HUDSON RIVER PROJECT

The Hudson River Project strives to conduct research and environmental education to spread the importance of the park's astonishing 400-acre Estuarine Sanctuary.² As a founding member of the Community Water Quality Testing Program (CWQTP), the park's piers and other water sources are tested regularly on an annual basis for water quality.³ This effort, organized by the Billion Oyster Project, is carried out with the help of boathouses, universities and citizen scientists across New York City.³ The data aims to help keep the public informed of weekly sewage contamination in their waterways.³

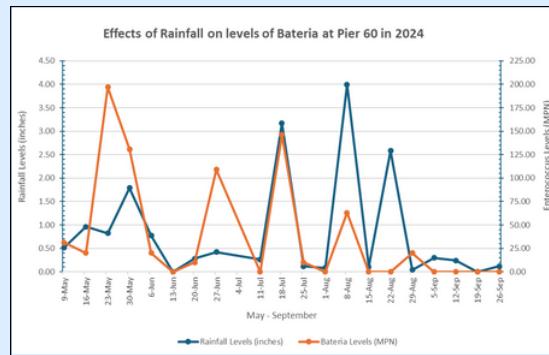


Fig. 1: Effects of Rainfall on Levels of Bacteria at Pier 60 in 2024

METHODOLOGY

Each year from May to October, over 90 recreational water-use sites across New Jersey and the five boroughs are sampled for the presence of bacteria of the genus Enterococcus (found in the human gut and sewage).³ This fecal indicator bacteria helps determine the level of bacteria contamination in the water. For the purpose of our research, we will be utilizing the data collected from Pier 60 in 2024 by the Hudson River Park Project to evaluate how rainfall affects levels of bacteria contamination in NYC's water sources.



Fig. 2: Image showing Wet Weather Conditions in the Combined Sewer System

WHAT IS MPN?

MPN stands for the Most Probable Number of colony-forming units (CFUs) of bacteria in 100mL of water, which estimates the concentration of bacteria in that sample.³ Data is measured based on levels of MPN.

- MPN < 35 is safe for indirect water contact.³
- MPN between 35 and 105 is unsafe for direct water contact if levels persist.³
- MPN > 105 is always unsafe³

RESULTS

Looking at the trends in figure 1, where there is an increase in the rainfall levels, there is also an increase in Enterococcus levels in the water in Pier 60. This trend indicates that there is a correlation between wet weather conditions and the increase in bacteria in water sources in and around the Hudson River. On May 23rd, May 30th, June 27th and July 18th, the highest amounts of rainfall were recorded. We see that on these four of the twenty days that the water at Pier 60 was sampled, the MPN of bacteria in the water exceeded 105.

According to the Department of Health standards, this level of bacterial contamination is unsafe for human contact and poses a health risk to the public.¹ The higher amounts of bacteria on days with higher reported rainfall suggests that the heavier rainfall caused higher levels of bacteria to enter the Pier, further emphasizing NYC's sewers declining state and need for improvement.

CONCLUSION

The data presented shows a consistent and possible cause and effect relationship between rainfall and the elevated bacterial levels in NYC's waterways. According to Hudson River Park, even relatively small increases in rainfall of about 7.5 mm or (½ inch) correspond with higher MPN readings often surpassing the Department of Health's safety limit.² These patterns show how easily NYC's combined sewer system can become overwhelmed during storms causing untreated sewage to enter surrounding waters.

RECOMMENDATIONS

Valuable next steps include expanding sampling to more varying locations and comparing bacteria levels immediately before and after rainfall in order to get a better grasp on exact contamination timing and severity. Sewer system upgrades for the outdated system are necessary, including separate storm water pipelines that would prevent rain and wastewater from mixing and in turn, reduce the chances of contamination and overflow of sewage into the Hudson River.

SOURCES

1. New York City Department of Environmental Protection. (n.d.). *Combined sewer overflows. Combined Sewer Overflows - DEP.*
2. Hudson River Park. (n.d.). *Report and Data Archive — Hudson River Park.* Hudson River Park.
3. Hudson River Park. (n.d.). *Water quality report 2024.* Hudson River Park.