Water Quality Trends for Port Jefferson Harbor

2015

This report summarizes water quality data for fecal coliform and total coliform in Port Jefferson Harbor for the years 2003-2015.

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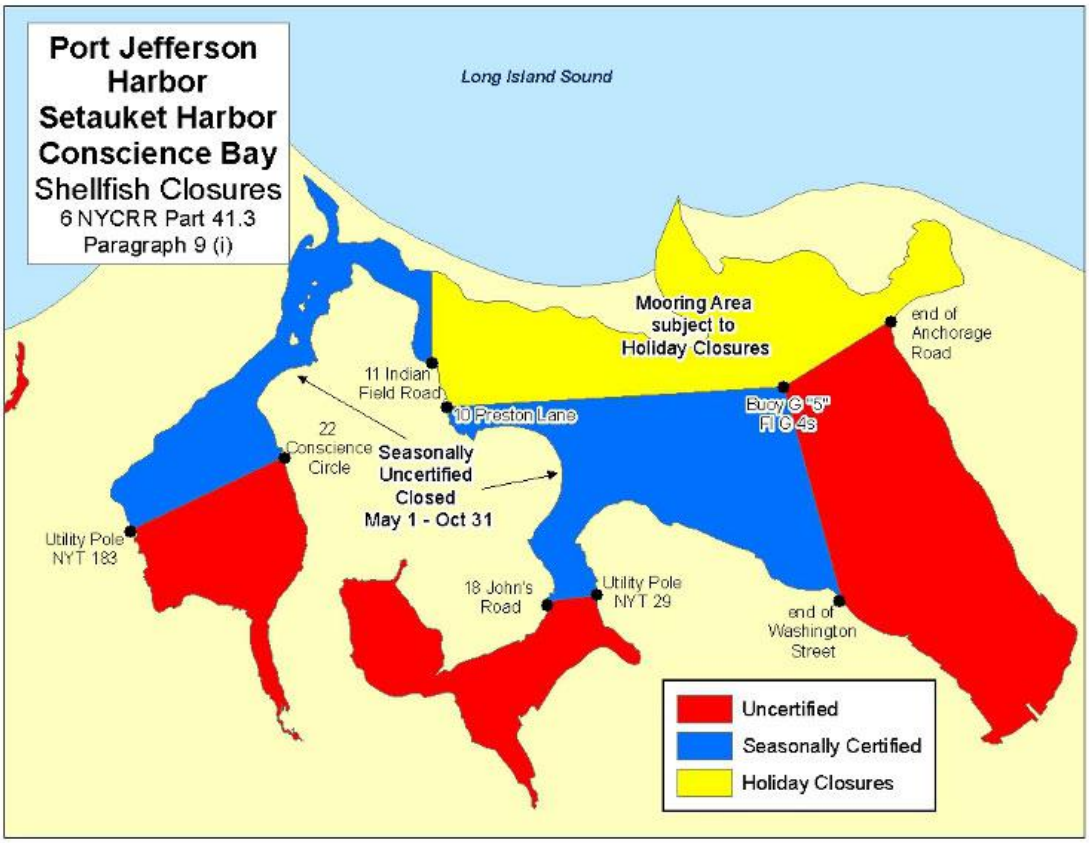
Introduction

The majority of Port Jefferson Harbor has long been closed (uncertified) to shellfishing by the New York State Department of Environmental Conservation (NYSDEC) due to water quality concerns. This area is permanently off-limits to shellfishing due to the proximity to actual or potential sources of pathogenic bacteria from sewage treatment plant outfalls, marinas, and high density mooring areas. However, it should be noted that the bacteria levels in Port Jefferson Harbor have been trending downward considerably over the past ten-plus years, which have coincided with upgrades to the Port Jefferson sewage treatment plant, the NYSDEC's designation of Port Jefferson Harbor as a No Discharge Zone for boat sewage waste, and the introduction of stormwater management regulations.

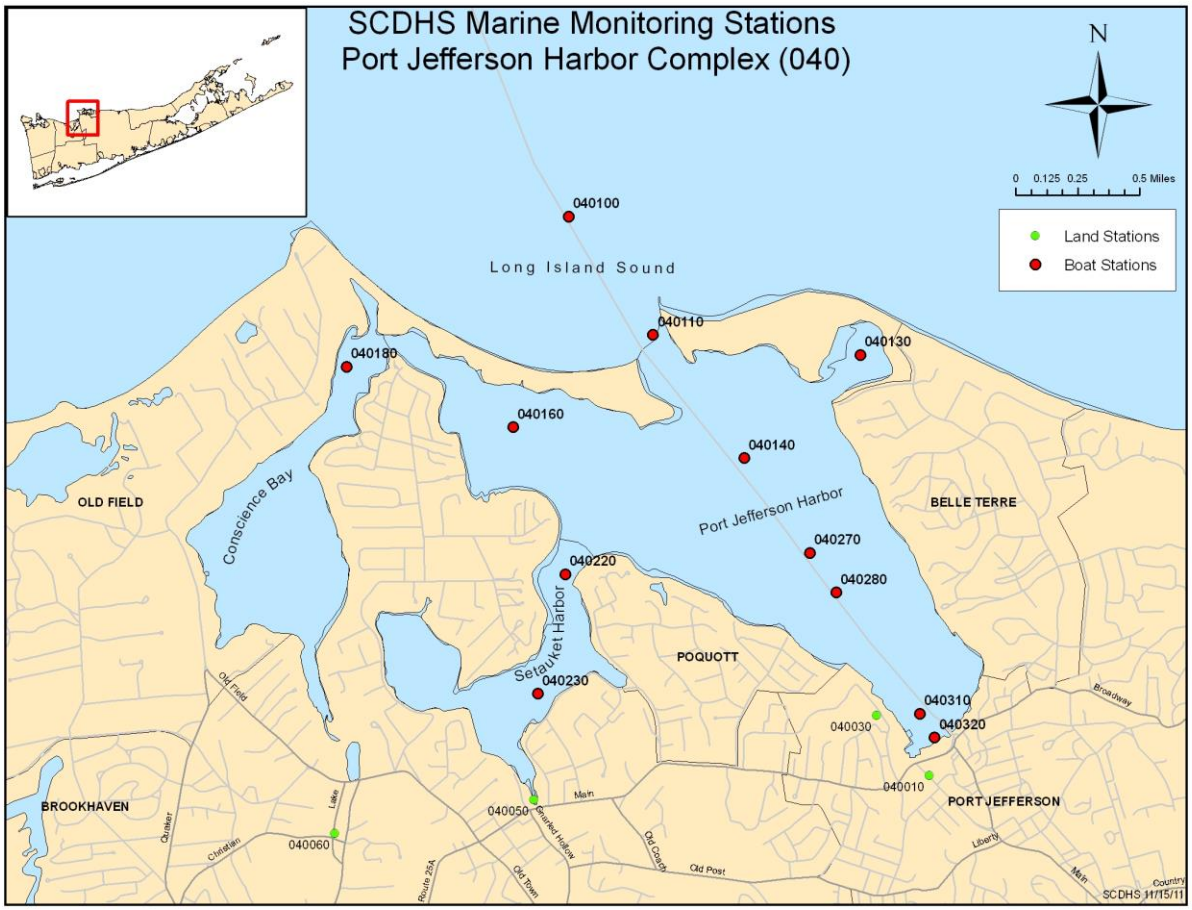


As part of the Village of Port Jefferson's "*Watershed Management Plan for Reducing Pathogen Loading in the Port Jefferson Harbor Complex Management Area*" (2011), the Village of Port Jefferson reviews collected microbiological indicator data to assess progress toward the goals of the Total Maximum Daily Loads (TMDL) for pathogens.

Fecal coliform and total coliform are considered to be microbiological indicator organisms, which are assumed to indicate the presence of pathogenic organisms associated with fecal material from warm blooded animals.

Sample Collection

Water samples are collected from Port Jefferson Harbor by the Suffolk County Department of Health Services (SCDHS) and analyzed for various water quality parameters. Sampling locations are shown below.



For the purposes of this water quality trend report, eight locations were selected for Port Jefferson Harbor. The locations are: 040140, 040270, 040280, 040310, and 040320.

These locations were selected to coincide with the sampling stations that exhibited exceedances for fecal and/or total coliform as presented in the "*Final Report for Shellfish Pathogen TMDLs for 27 303(d)-listed Waters*", prepared by Battelle (2007). It should be noted that the Battelle report listed stations 040140, 040290, 040300, 040305, 040310, and 040320; however, the SCDHS ceased collecting fecal and total coliform samples for stations 290 and 300 after January 31, 2008 and for station 305 after November 10, 2009. Additionally, station 280 was added as a sampling location by the SCDHS in March 2010.

Water Quality Standards

New York State participates in the National Shellfish Sanitation Program (NSSP) which recommends strict bacteriological water quality standards for shellfish harvesting areas to be designated as approved, or certified, for the harvest of shellfish for human consumption. The NSSP standards for fecal coliform and total coliform are as follows:

- Fecal Coliform – The geometric mean of samples shall not exceed 14 MPN / 100 mL
- Fecal Coliform – The 90th percentile value of the samples shall not exceed 49 MPN / 100 mL
- Total Coliform – The geometric mean of samples shall not exceed 70 MPN / 100 mL
- Total Coliform – The 90th percentile value of the samples shall not exceed 330 MPN / 100 mL

Data Analysis Methodology and Results

A 19-year record (1997 – 2015) of fecal coliform and total coliform data was used to calculate the statistical geometric mean ("geomean") and 90th percentile values.

The main benefit of using geometric means for trend charts (see Figures 1 through 6) is that they help smooth out the effects of occasional very high or very low values. It is common in microbiology to use a rolling geometric mean to analyze trends. For this report, data from the previous 30 sampling events are used to create one data point for the rolling geometric mean. A sample size of 30 is typically used in statistical analyses to reduce statistical errors.

The 90th percentile is a measure of statistical distribution. The 90th percentile tells you the value for which 90% of the data points are smaller and 10% are bigger. For this report, data from the previous 30 sampling events are used to create one data point for the rolling 90th percentile. A sample size of 30 is typically used in statistical analyses to reduce statistical errors.

Some of the SCDHS sampling data was expressed as "<20", indicating the minimum detection level. Since the actual measurement is not known, and choosing one would be random and arbitrary, a value of "19.9" was selected.

Some of the SCDHS sampling data was expressed as "<16000", indicating the maximum detection limit. Since the actual measurement is not known, and choosing one would be random and arbitrary, a value of "16001" was selected.

For dates in which two samples were collected in one day (e.g., morning and afternoon), the higher values of the set were used in the analyses.

The most recent geometric mean and 90th percentile data is presented in Table 1 below and is inclusive of data from 1997 to 2015.

Table 1. Summary of Stations for Fecal and Total Coliform

Station ID	Fecal Coliform (MPN/100 mL)		Total Coliform (MPN/100 mL)		No. of Samples	Effective Date
	Geomean (>14 MPN)	90th Percentile (>49 MPN)	Geomean (>70 MPN)	90th Percentile (>330 MPN)		
040-140	**18.80**	20	23.75	40	81	8/25/15
040-270	**18.19**	20	20.79	23	81	8/25/15
040-280	**21.93**	20	25.80	64	25	8/25/15
040-310	**66.25**	**500**	**158.34**	**1400**	81	8/25/15
040-320	**178.96**	**1700**	**746.61**	**11100**	78	8/25/15

Notes: Bold values indicate concentrations higher than the NSSP Standards

* - Beginning in 2000, the method detection limit for SCDHS analyses was 20 MPN / 100 mL.

Water Quality Trends

Trending charts for fecal coliform and total coliform are provided below.

Figure 1. Fecal Coliform Data – Rolling Geometric Mean for Stations 040310 and 040320.

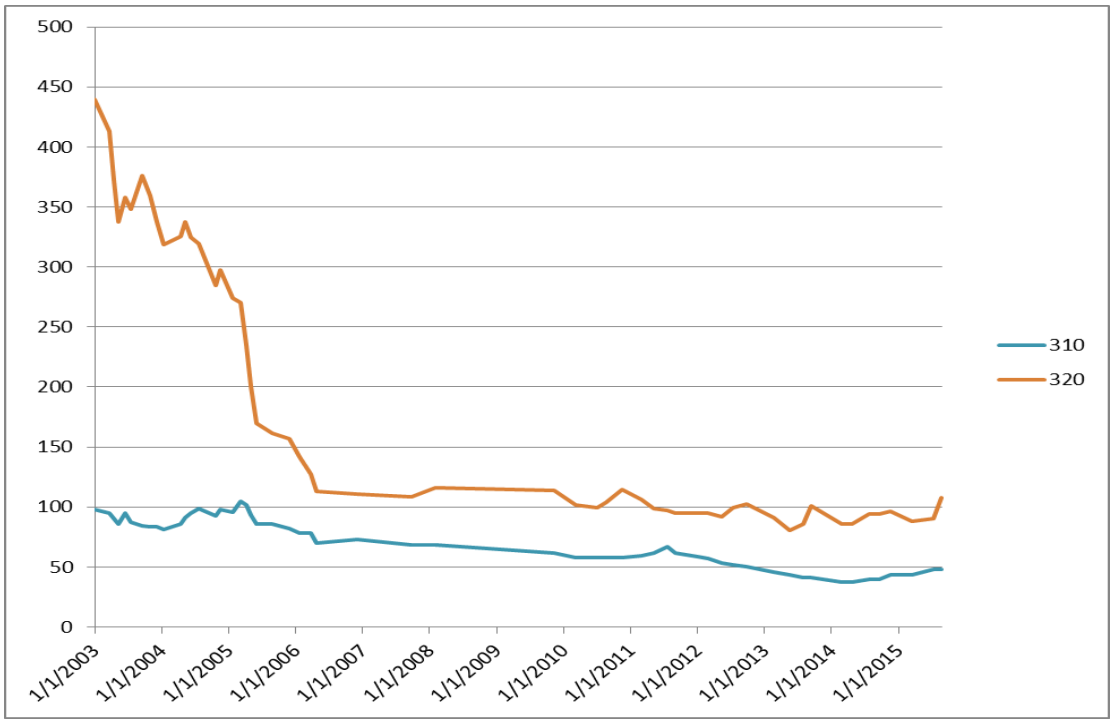


Figure 2. Fecal Coliform Data – Rolling Geometric Mean for Stations 040140, 040270, and 040280.

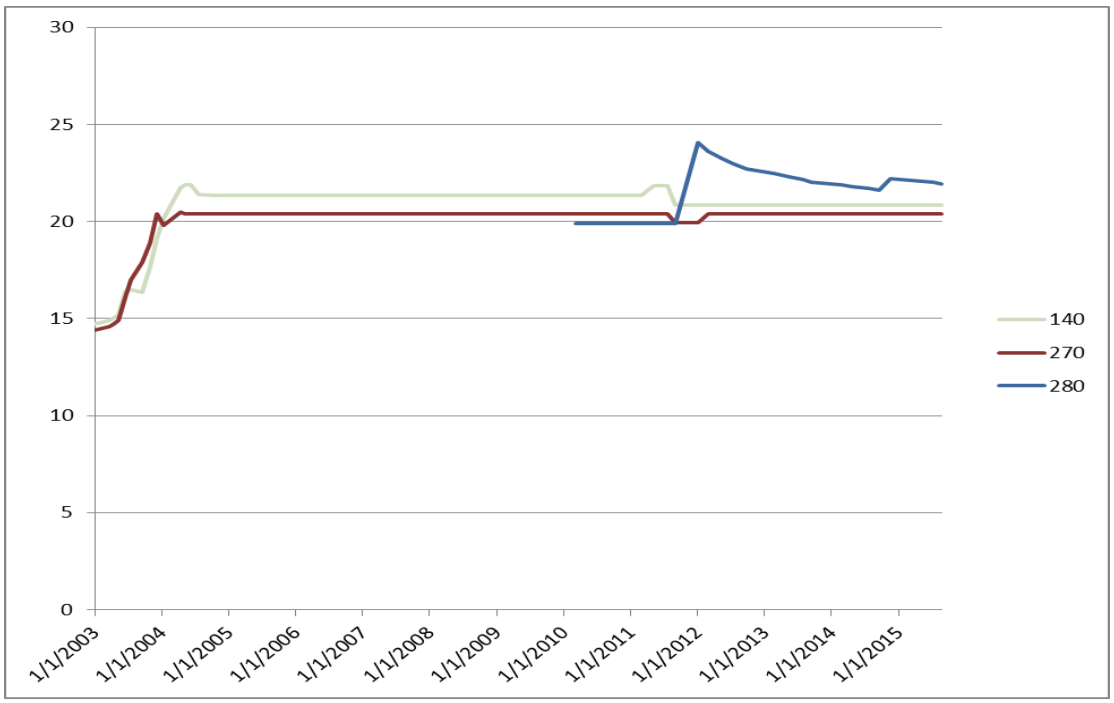


Figure 3. Total Coliform Data – Rolling Geometric Mean for Stations 040310 and 040320.

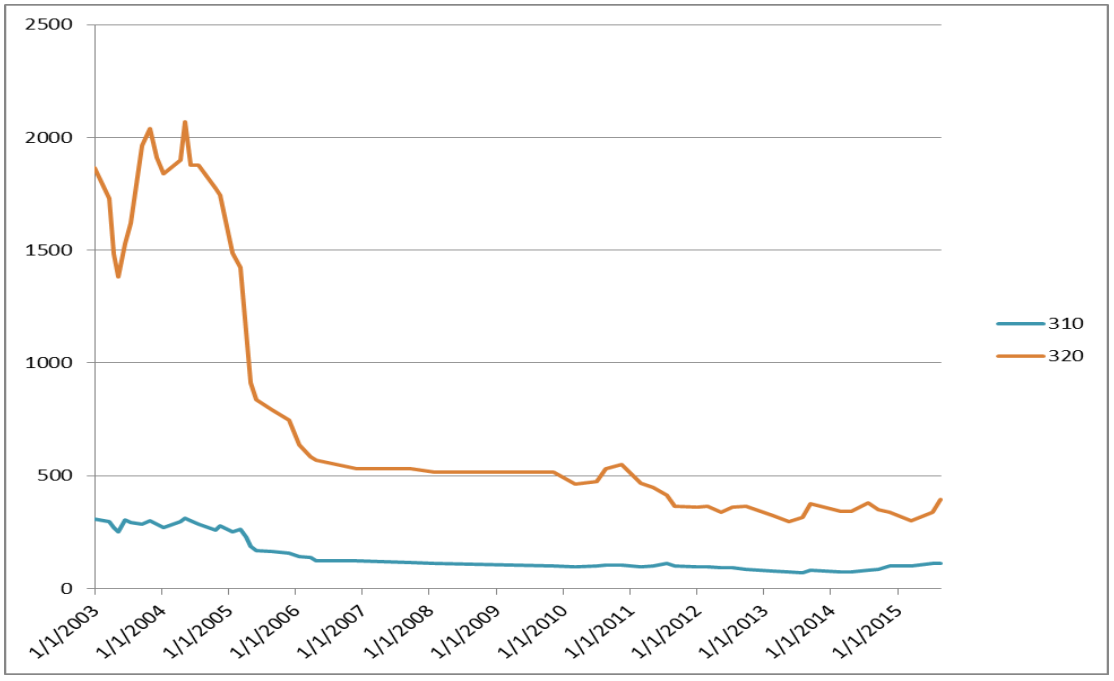


Figure 4. Total Coliform Data – Rolling Geometric Mean for Stations 040140, 040270, and 040280.

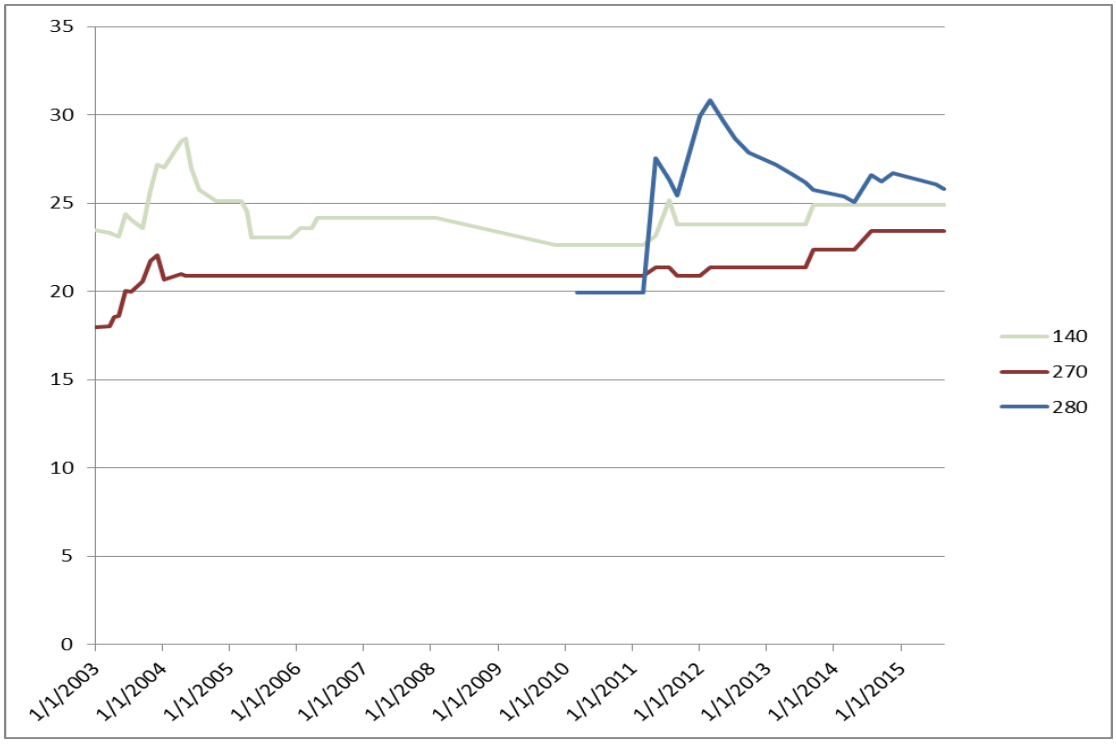
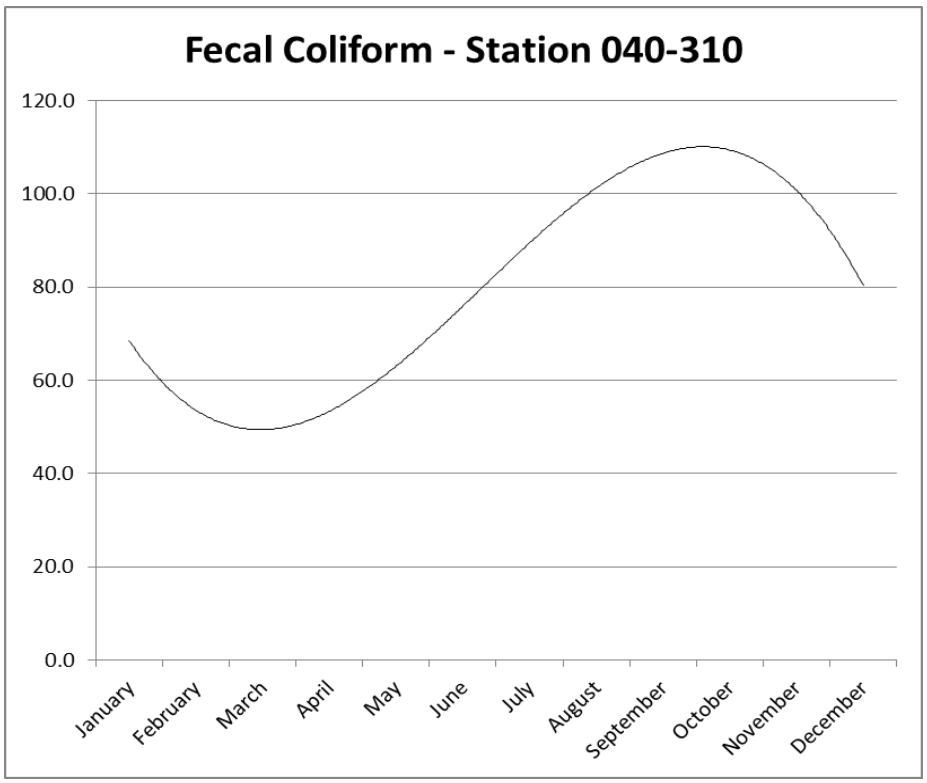


Figure 5. Seasonal Variation at Station 040-310 with Fourth Order Polynomial Trendline



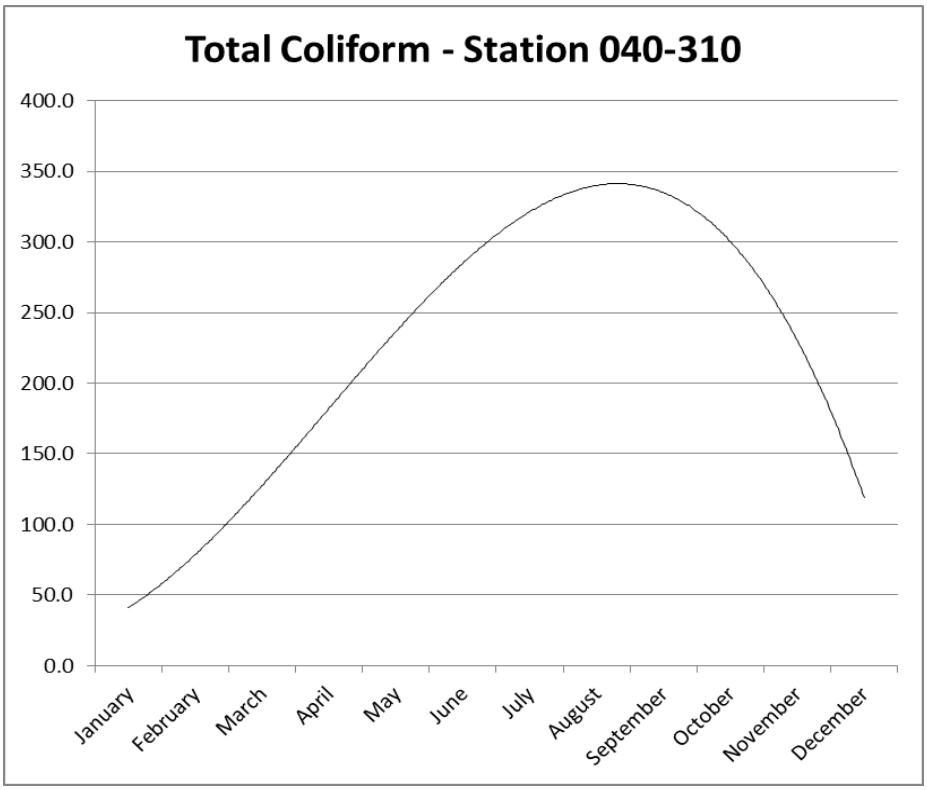
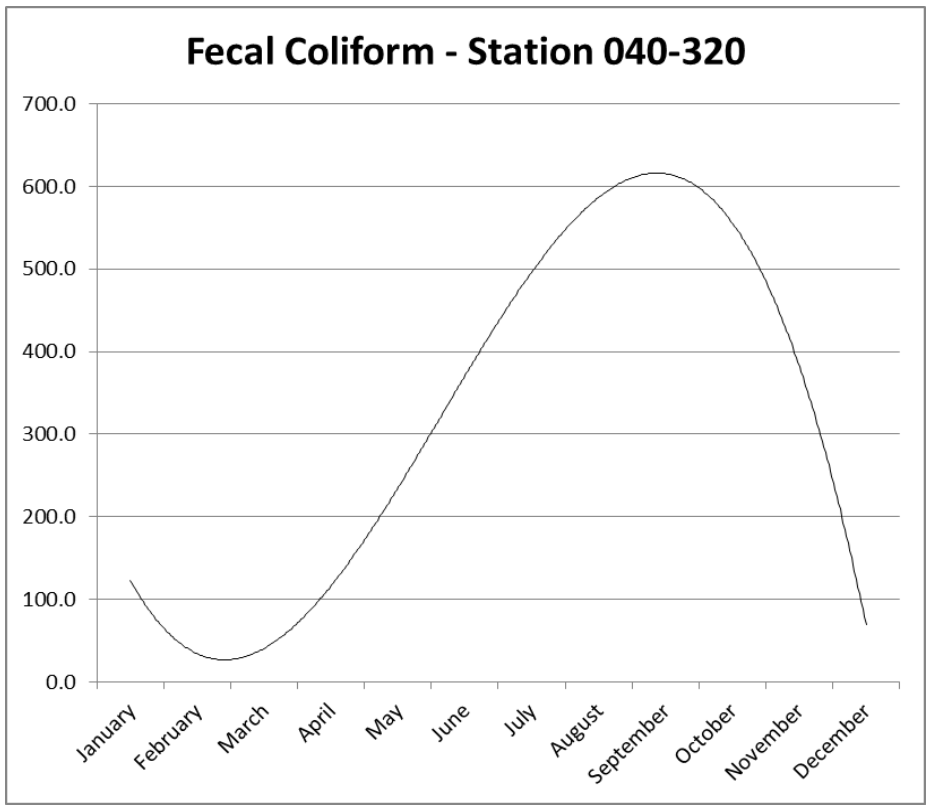
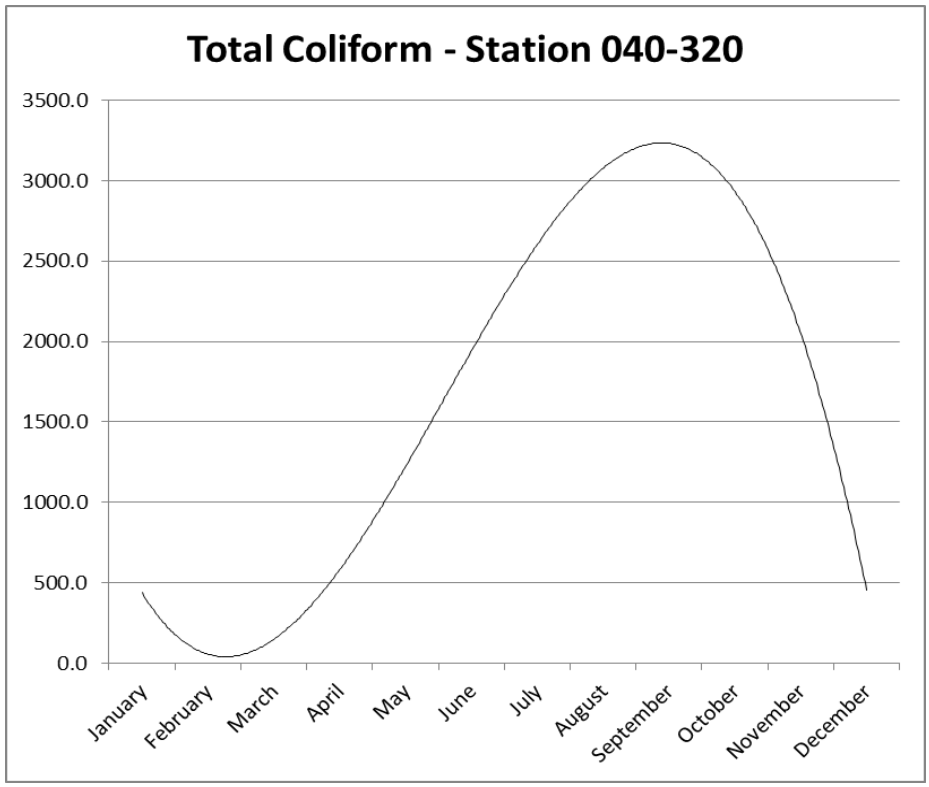


Figure 6. Seasonal Variation at Station 040-320 with Fourth Order Polynomial Trendline





Source Tracking

Phase 1

In late 2014, the Village contracted with Cornell Cooperative Extension (CCE) of Suffolk County to collect and analyze stormwater from ten (10) outfalls discharging to Port Jefferson Harbor and Mill Creek. The purpose of the study was to determine possible source locations of pathogenic bacteria in order to focus source tracking and elimination efforts. After careful inspection of the harborfront area for locations most likely to have high pathogenic discharges, four outfalls discharging to Port Jefferson Harbor and six outfalls discharging to Mill Creek were selected. The ten stations are illustrated below.

Methodology

Sampling was conducted during three rainfall events in July and September 2014 when there had not been any rainfall in the prior 72 hours and a minimum of 0.10 inches of rainfall in a 24-hour period was achieved. Water sampling followed guidelines established in the Standard Methods for the Examination of Water and Wastewater. All samples were taken to CCE's marine water quality laboratory located at Cedar Beach in Southold, New York for analysis. Discussions with CCE resulted in a recommendation that, following enumeration, the samples be saved for possible future DNA analysis.

Results

Sampling results indicated that the outfalls that directly drain into Port Jefferson Harbor (Stations 1 through 4) contained some of the lowest fecal coliform numbers seen in this study; with geometric means ranging from 2.9 MPN/100 mL to 152 MPN/100 mL.

In Mill Creek, the fecal coliform concentrations from the three sampling events increased when traveling downstream from Station 10 (geometric mean of 920 MPN/100 mL) to Station 8 (geometric mean of 630 MPN/100 mL). The fecal coliform concentrations then increased dramatically beginning at Station 7 (geometric mean of 1,958 MPN/100 mL) through Station 5 (8,484 MPN/100 mL).

Discussion

The dramatic increase in fecal coliform concentrations between Stations 7 and 5 may be attributed to the large volume of stormwater discharging to Mill Creek during wet weather. Outfall pipes at those locations convey stormwater from Main Street and parking lots in the downtown area. It is also possible that there are direct non-stormwater inputs (e.g., broken sanitary line, wildlife) at those locations.

Phase 2

Since a sanitary force main runs parallel to and in the vicinity of Mill Creek, it was hypothesized that the line may possibly be leaking into Mill Creek. To ascertain whether the presence of fecal coliform in Mill Creek was a result of human, domestic animal, or wildlife sources, Cornell Cooperative Extension of Suffolk County was contracted in March 2015 to conduct DNA analyses on the samples collected in the Phase 1 study. For budgetary reasons, DNA analyses were performed only on samples collected from Stations 5 and 6, which represented the downstream portion of Mill Creek and had the highest fecal coliform concentrations.

Methodology

The Cornell Cooperative Extension of Suffolk County Marine Program developed a molecular methodology to use DNA fingerprinting to identify sources of *E. coli* bacteria found in surface waters. Using pulsed field gel electrophoresis (PFGE), CCE developed a large DNA fingerprint library of *E. coli* bacteria isolated from 14 species of common animals, including humans.

Samples from the Phase 1 effort were cultivated and grown on E. coli selective media by CCE. Results were compared to CCE's DNA fingerprint library.

Results

The DNA testing identified that the major sources of fecal coliform in Mill Creek at Stations 5 and 6 were from birds, specifically Mallard Ducks, Mute Swans, and Canada Geese. A secondary source of bacteria

was identified as originating from dogs. It should be noted that the DNA testing did not identify humans as a contributing source of pathogenic bacteria.

Findings and Conclusions

The data illustrates that the concentrations of the bacterial indicator fecal coliform and total coliform have been trending downward at the southern end of Port Jefferson Harbor. Additionally, concentrations of fecal coliform and total coliform in the middle and upper portions of Port Jefferson Harbor have been asymptotically decreasing and approaching the method detection limit of 20 MPN/100 mL. Therefore, the data suggests that the waters of Port Jefferson Harbor, with the exception of the southern end, meet the National Shellfish Sanitation Program (NSSP) standards for fecal coliform and total coliform.

Seasonality appears to play a strong role in fecal coliform and total coliform concentrations in Port Jefferson Harbor, as illustrated in Figures 5 and 6. The highest precipitation totals typically occur in the winter months / early spring in Port Jefferson, coinciding with the lowest seasonal concentrations of fecal coliform and total coliform in the Harbor. Therefore, wet weather stormwater runoff does not appear to play a role in contributing to fecal and total coliform contamination in the Harbor. However, concentrations of fecal indicators peak in the June to October months corresponding to boating season and drier weather. Therefore, due to the large number of boat slips and moorings in Port Jefferson Harbor, it is plausible that sanitary discharges from boats are a significant source of pathogenic bacteria in the Harbor.

The fecal coliform data collected in Phase 1 of the Source Tracking Study suggests that stormwater discharges directly to the Harbor are not a significant source of pathogenic bacteria. Mill Creek, on the other hand, exhibited elevated fecal coliform concentrations and may contribute pathogenic bacteria to the Harbor. However, given the limited data set, tidal effects on flow direction and concentration of contaminants, and unknown flow volume, further study will be required to determine how significant of a role Mill Creek plays in contributing to pathogenic bacteria contamination in the Harbor.

The DNA testing was largely successful in eliminating humans as a source of pathogenic bacteria (from failing septic systems or a leaking sanitary force main) in Mill Creek, and identifying the sources as wild waterfowl and domestic dogs.

Based upon the data, stormwater runoff appears to play a very minor role in contributing pathogenic bacteria to the Harbor; whereas wild waterfowl, domestic dogs, and boaters may play a much more significant role.

The results of the Source Tracking projects and in-depth analyses of fecal and total coliform data suggest that efforts to reduce pathogen loading in Mill Creek and Port Jefferson Harbor should focus on wildlife management and an aggressive public education campaign specifically targeting boaters and pet owners.

References

Battelle, 2007. *Final Report for Shellfish Pathogen TMDLs for 27 303(d)-listed Waters*.

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Suffolk County Department of Health Services. *North Shore Embayments Water Quality Data & Information*.