



Backyard Health Hazards: Fecal coliform contamination of the Fonteynkill creek in Poughkeepsie, NY

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Introduction

The Fonteynkill stream is a small tributary stream located Poughkeepsie, NY. The exact origin of the stream is unknown, as it emerges from a culvert on Park Avenue, several blocks from the Vassar College Campus. The water is a likely combination of groundwater, runoff, and sewage (Ekklesia et. al, 2015). The Fonteynkill feeds into the Casperkill Stream, an 11-mile long tributary of the Hudson River, and is the centerpiece of the Casperkill Watershed, which at 12 squares includes most of the Town and City of Poughkeepsie. Yet while the Casperkill Watershed contains a number of surface cover types, the subwatershed is highly impervious, situated within residential and urban development. (Dutchess Watersheds, Cunningham et. al 2009)

Sugar, red, and Norway maple can all be found along the Fonteynkill, along with black cherry, American elm, and a suite of native and non-native shrub species (Dutchess Watersheds). Despite the location, the stream provides important habitat for a variety of birds, aquatic insects, carp, algae, mussels, turtles, and at least one muskrat.

Fecal pathogens, indicated by *Escherichia coli* and other fecal coliforms also seem to flourish in the Fonteynkill. These bacteria and associated pathogens pose health risks to humans upon ingestion and contact (Ekklesia et. al 2015). Contamination of recreational and residential waterways by sewage and stormwater runoff poses a risk to suburban communities, such as those surrounding the Fonteynkill, which poses the question: how hazardous is this urbanized stream?

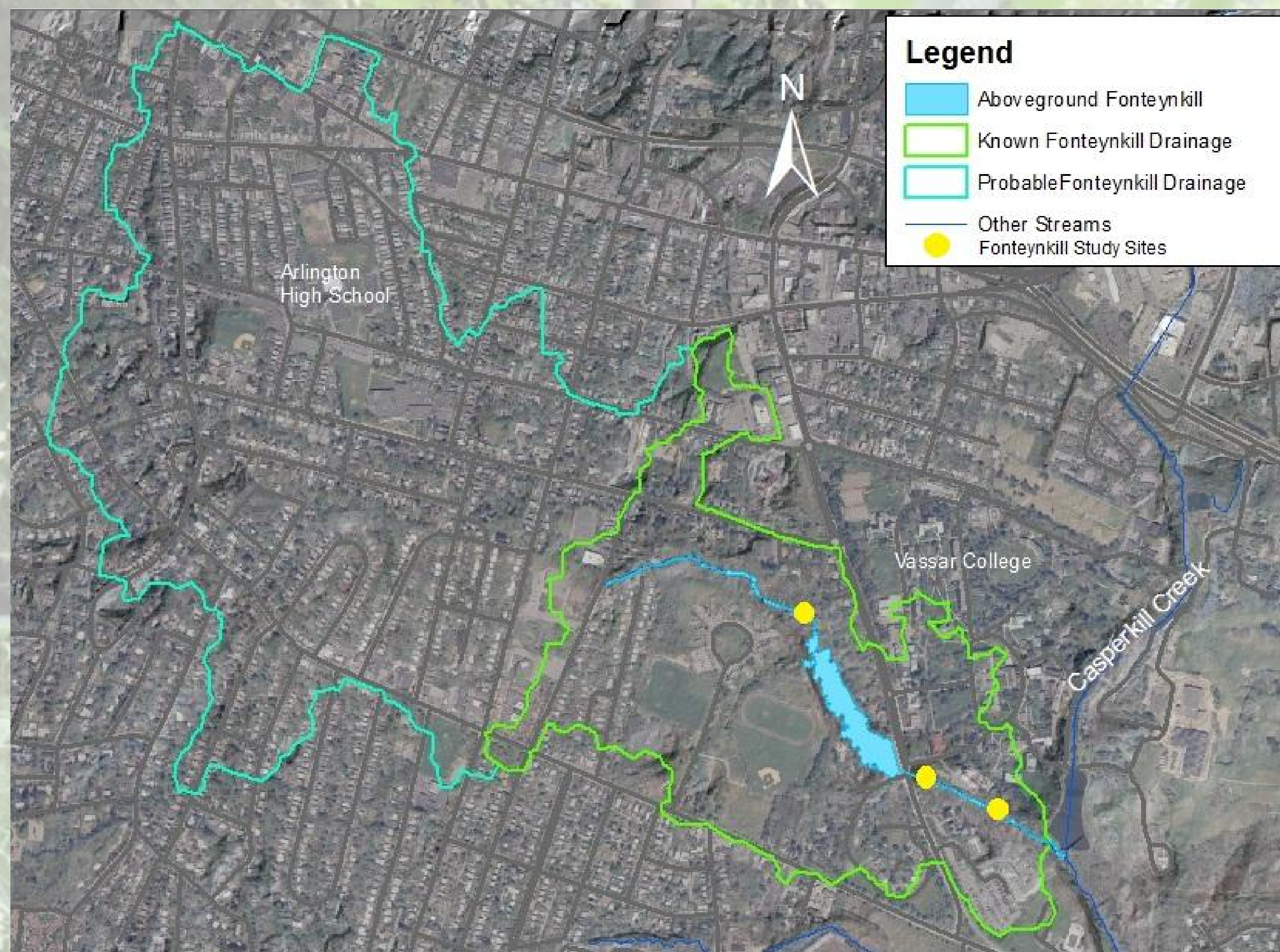


Figure 1: Fonteynkill Subwatershed, Stream, and Study Sites.
The Fonteynkill stream flows from Park Avenue in Poughkeepsie, NY, and southeast towards Vassar Lake, the Vassar College Campus, and eventually the Casperkill Creek. The study site north of the Lake is the Town House (TH) site, it is the most upstream, followed by Raymond Culvert (RC), downstream of where the stream crosses Raymond Avenue, and Shakespeare Garden (SG). Image courtesy of the Vassar College Environmental Research Institute.

Methods

Every two weeks three 30 mL samples of water were taken from each study site, in the center of the stream several inches below the surface. Excessive sediment collection was avoided by sampling upstream of disturbance.

Samples were never frozen prior to dilution and filtration, and were plated within one week of collection, although more frequently within 48 hours.

.5-2 mL of samples were diluted with distilled water and vacuum filtered through a gridded 47 µm sterile filter pad. Filter pads were then placed on sterile petri dishes with growth pads that were treated with 1.5 mL coliscan MF media.

Plated samples incubated at 35 ± 5° for 24-30 hours. Blue, grey, and purple colonies represent *E. coli*. Pink colonies are other fecal coliforms, and colorless and yellow colonies are non-fecal colony-forming coliforms.

Numbers were processed using the geometric mean of the samples per month, with a minimum of 5, in accordance with New York Department of Environmental Conservation standards.

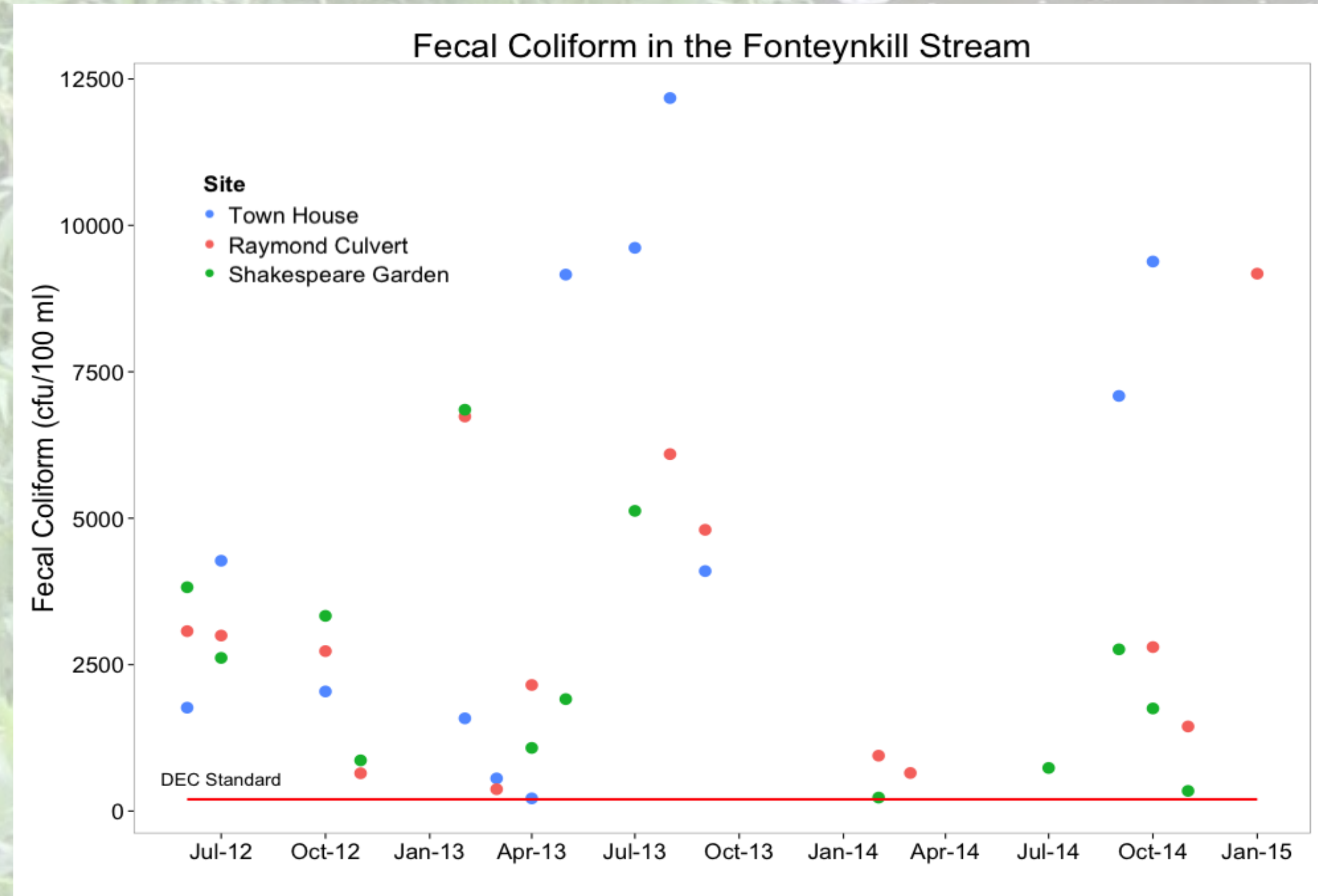


Figure 2: Geometric Mean of Fecal Coliform in the Fonteynkill Stream.
The geometric mean of fecal coliforms, including *E. coli*, defined by the *n*th root of the product of *n* numbers, as observed in the Fonteynkill stream from July 2012 until January 2015. Each point represents the geometric mean of no fewer than 5 samples over the course of the month, in keeping with NY DEC sampling standards. The red line represents the DEC limit for safe contact, 200 CFU's/ 100 mL.

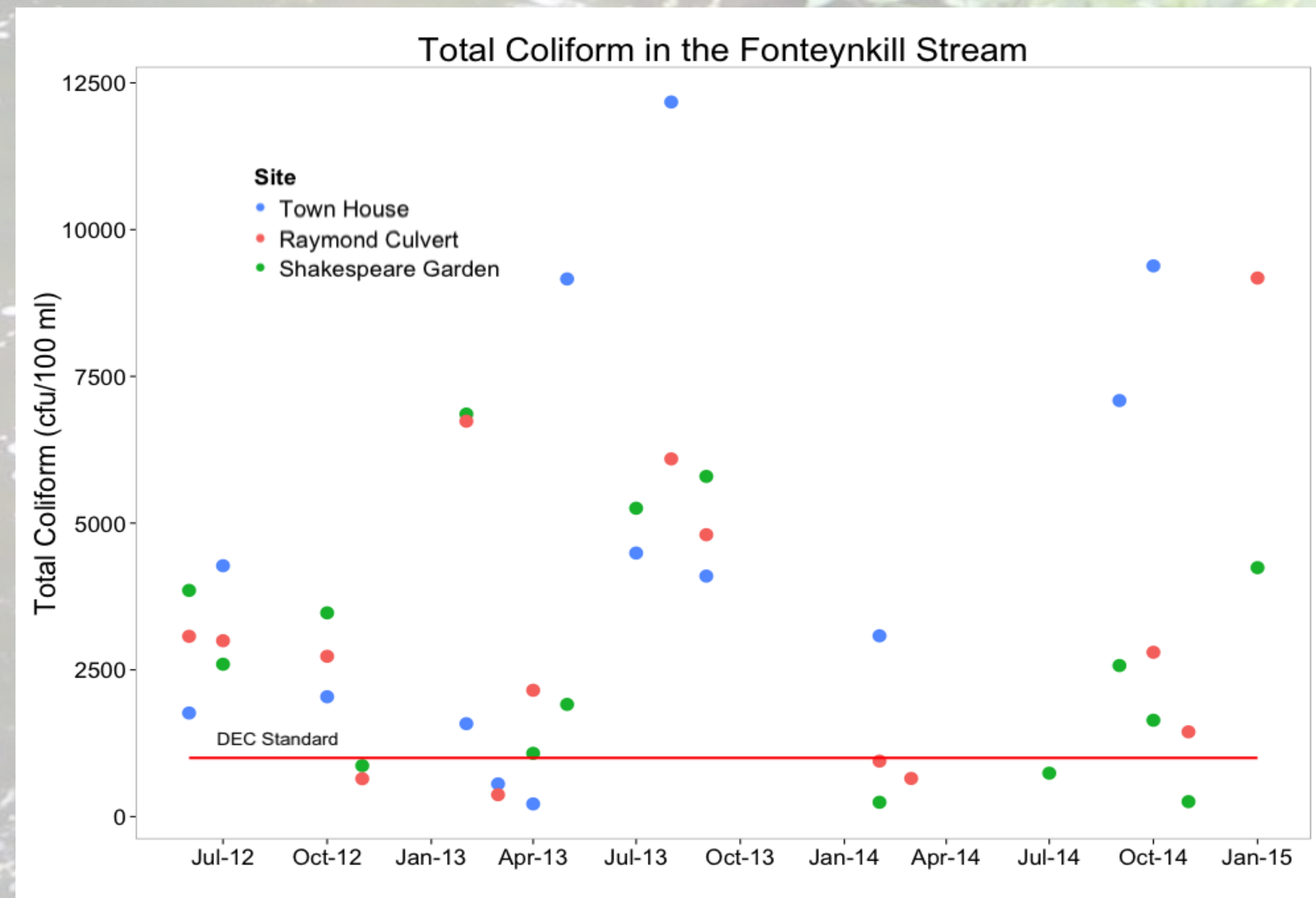


Figure 3: Geometric Mean of Coliforms in the Fonteynkill Stream.
The geometric mean of fecal and non-fecal coliforms in the Fonteynkill stream from July 2012 until January 2015. Each point represents the geometric mean of no fewer than 5 samples over the course of the month, in keeping with the NY DEC sampling standards. The red line represents the standard allowable limit for an A-special classification, in which water is safe for contact and drinking.

Conclusion

It is extremely likely that the ageing sewage infrastructure within the Fonteynkill's watershed is contributing fecal matter into the stream, increasing the concentrations of coliforms to unsafe levels. Over the course of the last two years, the stream has consistently remained above the DEC limit for safe primary contact. The seasonal trend observed in coliform concentrations also indicates that the stream is most health-hazardous in the summer months, when recreational contact is likely to be highest.

However, it appears that even a minimal distance with increased riparian buffer, as seen on the Vassar campus, can reduce the concentrations of fecal coliforms. Closer examination of seasonal trends, required distances for dilution to safe bacterial concentrations, and increased riparian buffer along the length of the Fonteynkill are all necessary before the stream will meet state health standards.

Results

At each of the three study sites, the geometric mean of fecal coliforms (Fig. 2), including *E. coli* exceeded the state limit of 200 CFU's/ 100 mL for safe contact (Part 703.4 NYS DEC Regulation).

The concentrations appear to be highest at the most upstream site, TH, with a gradual decline as the stream moves downstream towards SG.

Concentrations of fecal coliforms peak in the summer times, reaching concentrations in the tens of thousands per 100 mL at TH and RC in late spring and early summer months. The lowest concentrations observed over the course of the sampling period fall between January and April.

The total coliforms (Fig. 3), which include *E. coli* in addition to other colony-forming bacteria, also demonstrate a slight concentration gradient from upstream to downstream. The lowest concentrations, in January and April, fall below the total coliform standard for safe contact and drinking water.

The monthly medians of the samples only fell below 2400 CFU's / 100 mL (Part 703.4) sporadically, mostly during the months of October, November, March, and April. 20% of the samples exceeded the 5000 CFU/ 100 mL limit most months at all sites, with the exceptions of the same months listed as above.

Discussion

The consistent and exceptionally high concentrations of fecal and non-fecal coliforms in the stream limits the Fonteynkill from reaching even a "D" NYS DEC classification. Regulation 701.9 (NYS DEC) limits the usage of such a stream to fishing, and primary and secondary contact when water quality does not impact such purposes. In this case, excluding the consideration of other parameters, such as pH, salinity, and turbidity, the stream is not suitable for primary contact, as the DEC limit for a stream suitable for swimming is 200 CFU's/ 100 mL.

The concentration peaks in the summer months and the low concentrations observed in the months of October, November, March, and April indicate a seasonal trend in fecal and non-fecal coliform bacteria.

There also seems to be a slight downstream or dilution effect, as the highest concentrations, well into the tens of thousands, occur with the most frequency at the Town Houses, and even the short distance downstream to the Shakespeare garden site decreases the concentration throughout the year.

References

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