Joint Venture Team
albany pool

CAPITAL DISTRICT
Regional
Planning
Commission

2016 POST CONSTRUCTION COMPLIANCE MONITORING SUMMARY REPORT

Albany Pool Communities CSO LTCP

February 2017

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Albany Pool Communities CSO LTCP

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ACRONYMS AND ABBREVIATIONS

ACSD	Albany County Sewer District
APCs	Albany Pool Communities
APJVT	Albany Pool Joint Venture Team
CDRPC	Capital District Regional Planning Commission
CFU	Colony Forming Unit
CoCoRaHS	Community Collaborative Rain, Hail and Snow Network
CSO	Combined Sewer Overflow
CSS	Combined Sewer System
DMRs	Discharge Monitoring Reports
EB	East Bank of the River
LTCP	Long-Term Control Plan
mL	Milliliter
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NYS DEC	New York State Department of Environmental Conservation
NYS DOH	New York State Department of Health
PCCMP	Post Construction Compliance Monitoring Plan
QA/QC	Quality Assurance / Quality Control
RC	River's Center
RCSD	Rensselaer County Sewer District
RT	River Transect
SPDES	State Pollution Discharge Elimination System
TMDL	Total Maximum Daily Load
US EPA	United States Environmental Protection Agency
WB	West Bank of the River
WQS	Water Quality Standards
WWTP	Wastewater Treatment Plant

1 INTRODUCTION

1.1 Project Background

The Albany Pool Communities (APCs) have nearly 100 CSOs that discharge to the Hudson and Mohawk Rivers. To evaluate the impact the of the discharge from these CSOs, the City of Albany, City of Cohoes, City of Rensselaer, City of Troy, City of Watervliet, and the Village of Green Island joined in a comprehensive inter-municipal venture, led by the Capital District Regional Planning Commission (CDRPC). The CDRCP retained the Albany Pool Joint Venture Team (APJVT), comprised of Arcadis CE, Inc., CDM Smith, and CHA, Inc., to develop and assess the PCCMP and water quality data collected.

CSOs are point sources subject to SPDES permit requirements including both technology-based and water quality-based requirements of the Clean Water Act through the US EPA CSO Control Policy. Flows from the APCs are tributary to three WWTPs including the RCSD WWTP, and two ACSD WWTPs (North and South). The CSOs and the three WWTPs make up the discharge locations within the CSS, which are permitted under each community's SPDES permit.

In 2008, the APCs initiated a comprehensive receiving water conditions assessment designed to characterize the receiving water quality of the Hudson River. Samples were collected during dry and wet weather events at seven tributary locations and five Hudson River locations. Five of the tributaries sampled were generally at, or exceeded, the fecal coliform water quality standard. Therefore, in 2009 additional sampling was performed for the five tributaries of concern; Normans Kill, Mill Creek, Wynants Kill, Poesten Kill and Patroon Creek.

Following the 2009 sampling, the APJVT developed a CSO LTCP in accordance with the US EPA CSO Policy to address the CSOs permitted under each community's respective SPDES permits. The LTCP provided recommendations for improvements to both the combined sewer system and the WWTPs that comprise the project service area. The LTCP also stipulated that the APCs would begin performing PCCM starting with the first recreational season after upgrades for effluent disinfection to the three WWTPS were completed. The 2015 recreational season marked the first recreational season in which WWTP effluent was disinfected, and therefore, the first year for PCCM. Prior to the onset of the 2016 recreational season, upgrades to three Rensselaer County pump stations were completed. The upgrades included replacement of pumps and installation of a bar screen and washer compactors at two of the pump stations.

1.2 Water Quality Standards

The State of New York has promulgated standards for water quality in Part 703 based on the designated class of the receiving water. The 2014 Section 303(d) List of Impaired Water Requiring a TMDL/Other Strategy identifies those waters that do not support appropriate uses and, as the title states, which require development of a TMDL or other restoration strategy. A review of this list identifies the Hudson River Estuary in Albany County in Part 2b – "Multiple Segment/Categorical Impaired Waterbody Segments (fish consumption) for PCBs". The list also identifies Patroon Creek and Krum Kill in Part 1 – "Individual Waterbody Segments with Impaired Requiring TMDL Development" for oxygen demand, and aquatic

toxicity respectively. No investigation of PCBs was considered as part of this study. PCBs are not considered to be associated with CSO discharges.

The rivers and tributaries in this study area are generally designated as Class C receiving streams, however, both the Hudson River and the Mohawk River have Class A designations in the northern and western portions of the sampling region. The Mohawk changes from Class A to Class C at the School Street Dam approximately two miles southeast of the Route 9 Bridge (River Transect 1 [RT1], refer to Section 2.4.1) and the Hudson River changes from Class A to Class C at the confluence with the Mohawk River just south of Waterford. The Hudson River remains Class C for approximately 25 miles, after which it once again transitions to Class A just south of Schodack Island. All the tributaries are Class C with the exception of the Wynants Kill and Poesten Kill which are Class C(t).

Fecal coliform standards for both Class A and C designations states that the geometric mean of no less than 5 examinations (samples) shall be less than 200 CFU/100mL. For A-special waters, the rule states that the five samples must be taken over not more than a 30-day period. The standard does not differentiate between wet and dry weather sampling. There is no specific single sample maximum criterion applicable to these receiving waters. This study compared geometric means to these criteria as is appropriate, but also indicated the relative difference between individual samples and these geometric mean criteria as a point of reference for several sets of data.

New York State has not promulgated a water quality standard for Enterococci. The US EPA released recreational water quality criteria in 2012, aimed to protect human health for all waters designated for primary contact recreational use. Primary contact recreational use includes the following activities: swimming, bathing, surfing, water skiing, tubing, water play by children, and similar water contact activities where a high degree of bodily contact with the water, immersion, and ingestion are likely. This criterion consists of three components: magnitude, duration and frequency as described by a 30-day geometric mean and a statistical threshold value. This statistical threshold approximates the 90th percentile of the water quality distribution and should not be exceeded by more than 10 percent of the samples taken. The EPA provided two sets of thresholds, the first is a geometric mean of 35 CFU/100mL and a statistical threshold value of 130 CFU/100mL, the second is a geometric mean of 30 CFU/100mL and a statistical threshold value of 110 CFU/100mL. While these water quality criteria recommendations are not regulations themselves, they are intended as guidance in establishing new or revised water quality standards.

For comparison, New York State Department of Health (DOH) promulgated Part 6, Subpart 6.2 which pertains to bathing beaches and regulates the water quality requirements for swimming activities. Based on a single sample, the water quality should be less than 1,000 CFU/100mL for fecal coliform or 61 CFU/100 mL for enterococci. For the 30 day mean, the water quality should be less than 200 CFU/100mL for fecal coliform or 33 CFU/100mL for enterococci.

1.3 Sampling Program Goals and Objectives

The goal of the PCCM is to demonstrate the progression of the attainment of water quality standards of the Hudson River as the specific requirements of LTCP are implemented over time. The LTCP requires PCCM to assess the water quality of the Hudson River and some of its tributaries each recreational season for the first three years and every five years thereafter until all of the specific requirements of the LTCP are implemented. This PCCM assessment during the first three years of LTCP implementation is to develop a

sufficient dataset to effectively characterize the water quality and show water quality improvements after the implementation of disinfection at the three WWTPs.

The objective of this initial PCCM sampling program is to collect samples every Wednesday over a four-month to six-month period beginning May 1st through October 31st, spanning the recreational season of the River. In the event that the first four months (May through August) show consistent attainment of water quality standards, monitoring activities in that season would cease and would not continue into September and October. Should unseasonably dry weather conditions be encountered, additional sampling in September and October will be performed to assess the performance of CSO controls and to capture the five wet weather events for the season. The data would be assessed to determine the water quality of the River and evaluate sampling protocols and data collected to determine if modifications to the PCCM program would be required to meet the PCCM goal.

1.4 Methodology and Scope

This Report briefly describes the locations, methodologies, and data management protocols that were used by the APCs and the APJVT to gather water quality data for the 2016 sampling and summarizes the results of the data collection effort.

Water quality data was collected during dry and wet weather to examine the effectiveness of CSO controls and improvements to the river conditions after start-up of disinfection facilities at the ACSD and RCSD WWTPs. The sampling methodology was similar for all sample locations including parameters for which samples were analyzed. The *Receiving Water Quality Sampling Plan for Post Construction Compliance Monitoring* (April 2015) detailed the methodology of sampling including the sampling equipment required and sampling procedures (Appendix A). Fecal coliform samples were delivered to St. Peter's Hospital Environmental Laboratory within approximately five hours of sample collection to meet the six hour holding time required for these analyses. No significant deviations from the sampling methodology occurred during the 2016 sampling program.

The discussion in this Report includes:

- The 2016 PCCM water quality sampling program
- Results of the 2016 sampling program
- Comparisons of the 2016 results to previous studies

2 RECEIVING WATER QUALITY SAMPLING PROGRAM

2.1 Overview and Summary

Pursuant to the NYS DEC approved PCCMP, the sampling period began May 1, 2016 and was completed October 31, 2016. A total of 26 sampling events were completed at the 16 sampling locations during the 2016 recreational season. For each sampling event, one analytical sample was to be collected at each sampling location for a total of 21 fecal coliform samples per circuit (nine river transects, seven tributaries, and three WWTP discharges, and two duplicate samples). The APCs performed 42 additional sampling events at RT-9 to assess river response time. These sampling events were recommended at the conclusion of the 2015 recreational season.

Typical dry weather conditions were established as part of the Albany Pool CSO LTCP. Therefore, dry weather samples collected during this sampling effort were compared to similar dry weather events in 2008 and 2009. Wet weather samples were collected to assess the overall water quality attainment through the development of monthly fecal coliform geometric means.

2.2 Water Quality Sampling Locations

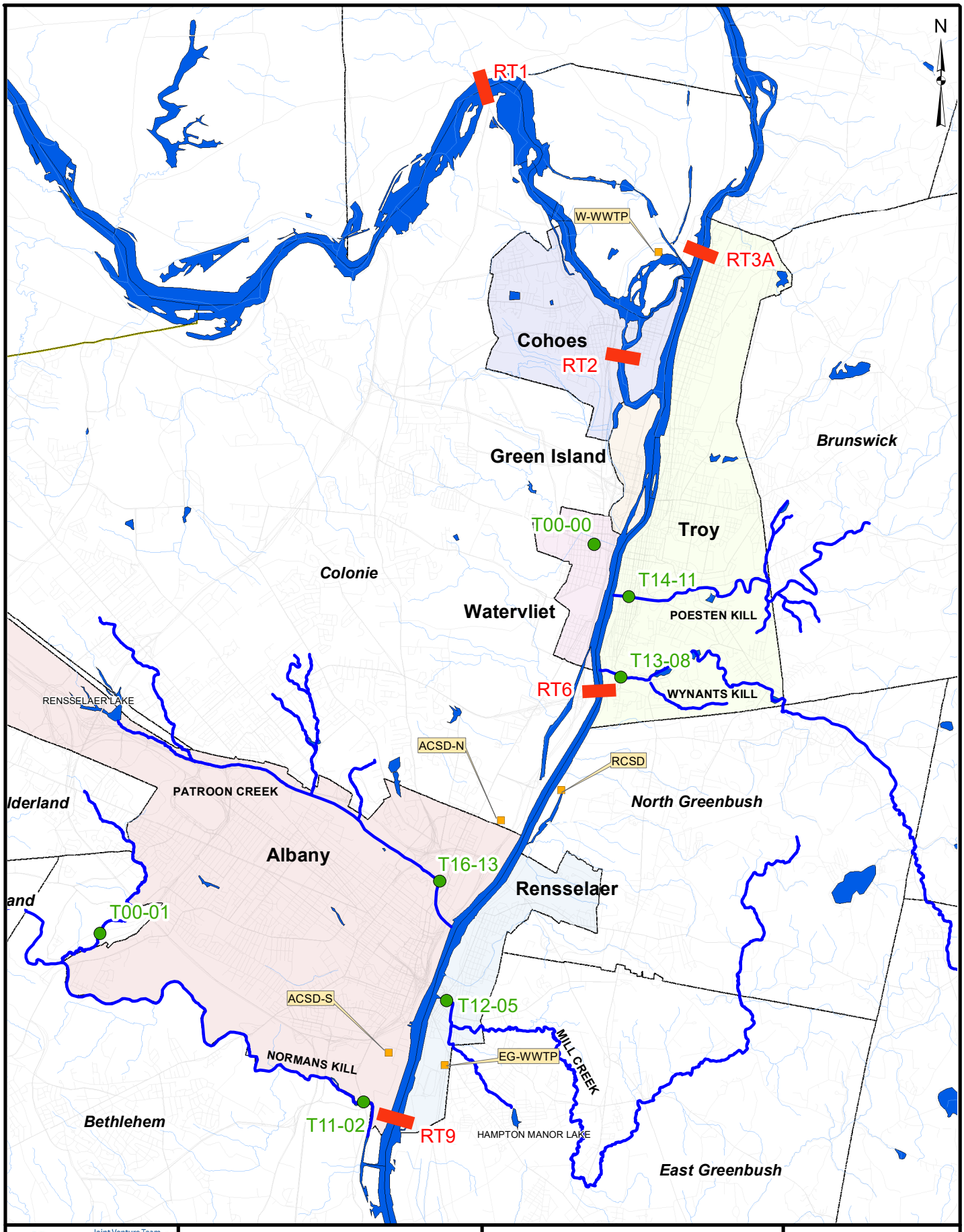
Discrete samples were collected for laboratory analyses at five transects along the Mohawk and Hudson Rivers for nine total samples and seven tributaries of these rivers. Routine effluent compliance sampling at the three APC WWTPs, as well as the Town of Waterford and East Greenbush WWTPs, were also compiled during the sampling period. Grab samples were collected at each river transect in the Mohawk and Hudson Rivers, at three laterally-spaced locations along transects RT-6 and RT-9 in the Hudson River, and the tributary streams. A description of the water quality sampling locations is provided in Appendix B and a visual representation of the sampling locations is shown in **Figure 2-1**. The figure is intended to present the general locations, the specific GPS coordinates for the river transect locations are provided in Appendix B. The sampling locations were field investigated by the APJVT and documented during the 2008 and 2009 sampling programs.

2.3 Sampling Event Classifications

Sampling events can be classified into three different types, dry weather events, wet weather events, and transition events. Dry weather events were defined as having a minimum of 72 hours antecedent dry weather prior to initiation of the sampling event. Wet weather events were defined to meet the following criteria:

- Be a community-wide storm event;
- Have a rainfall volume of 0.3 inches +/-50% (0.15 to 0.45 inches);
- Have a predicted duration of 6 hours +/- 50% (3 to 9 hours), and;
- Have a minimum of 48 hours of antecedent dry weather prior to a storm event.

Per the requirements of the PCCMP a minimum of five wet weather events were to be sampled.



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ALBANY POOL CSO LONG TERM CONTROL PLAN

POST CONSTRUCTION MONITORING SAMPLING LOCATIONS

FEBRUARY 2017
FIGURE 2-1

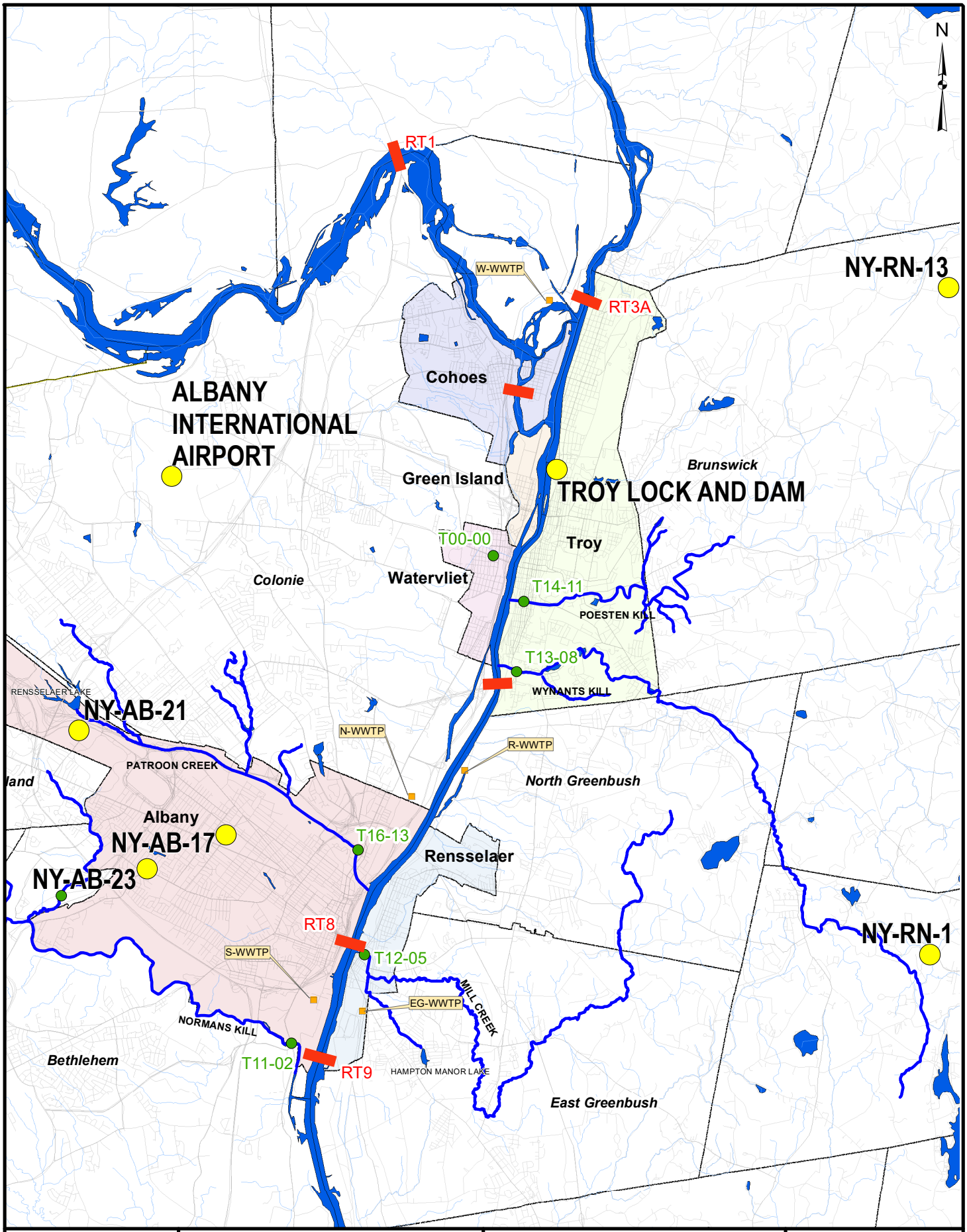
If a sampling event did not meet the antecedent dry weather criteria for the dry weather events and it did not meet the criteria listed above for wet weather events, then the sampling event is considered a transition event in which the data could be used to assess river recovery.

2.4 Rain Gauge Locations

As was the case for the previous sampling efforts, the primary rain gauge is located at the Albany International Airport. However, in order to get a better understanding and confirm that a wet weather event was community wide, multiple rain gauges were used from the Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) as was the case during 2015. A total of four rain gauges from the CoCoRaHS were used in conjunction with the two NOAA stations at the Albany International Airport and the Troy Lock and Dam to calculate an average rainfall amount over the area. **Figure 2-2** shows the location of the six rain gauges utilized in this report. The monthly rainfall data for the 2016 recreational season is presented in Appendix C.

2.5 Sampling Events

During the 2016 recreational season a total of 26 sampling events were conducted at all sampling locations with an additional 42 sampling events only at RT-9 for a total of 68 sampling events. The 26 sampling events where all locations were sampled resulted in 9 dry weather events, 8 wet weather events, and 9 transitional or river recovery events. The dates and times of each of the sampling events is provided in Appendix D. It should be noted that not all of the sampling events were completed on Wednesdays per the *Receiving Water Quality Sampling Plan for Post Construction Compliance Monitoring*. In an attempt to sample wet weather event for all locations late in the season, one sampling event was moved from Wednesday to Tuesday of that week (sampling event 56). Due to severe weather causing unsafe conditions on the River, sampling events that were scheduled for Tuesday and/or Thursday (RT-9 sampling events) were cancelled, these include the May 31, July 7, July 14, July 28, August 2, August 11, and September 1. Additionally, two other sampling events for RT-9 were cancelled (September 29 and October 27).



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ALBANY POOL CSO
LONG TERM
CONTROL PLAN

POST CONSTRUCTION
MONITORING
RAIN GAUGE LOCATIONS

FEBRUARY 2017
FIGURE 2-2

3 HUDSON RIVER SAMPLING RESULTS

Geometric means for fecal coliform counts were calculated for each five consecutive sampling events of the 2016 sampling program. A total of 22 geometric means were calculated for each sampling location. Individual results for fecal coliform counts collected during sampling are shown in Appendix E. The subsections to follow detail the Hudson River sampling results for the upper, middle, and lower regions of the Albany Pool.

3.1 Upper Albany Pool (RT1-RC, RT2-RC, and RT3A-RC)

The upper Albany Pool consists of three River transects; RT1-RC, RT2-RC, and RT3A-RC. RT1-RC is located at the Route 9 crossing of Mohawk River upstream of the Cohoes and Crescent Dam, RT2-RC is located at the Bridge Avenue crossing of the Mohawk River in Cohoes, and RT3A-RC is located at the 126th Street Bridge crossing of Hudson River just south of the City of Troy boundary. River transects RT-1 and RT3A-RC were sampled to monitor the background contributions of the headwaters, while transect RT-2 was sampled to monitor the attainment of the WQS. Each of the three transects were sampled from the associated bridge crossing at the river's center (RC).

Fecal coliform results for river transects RT1-RC, RT2-RC, and RT3A-RC are shown in **Figures 3-1 through 3-3**.

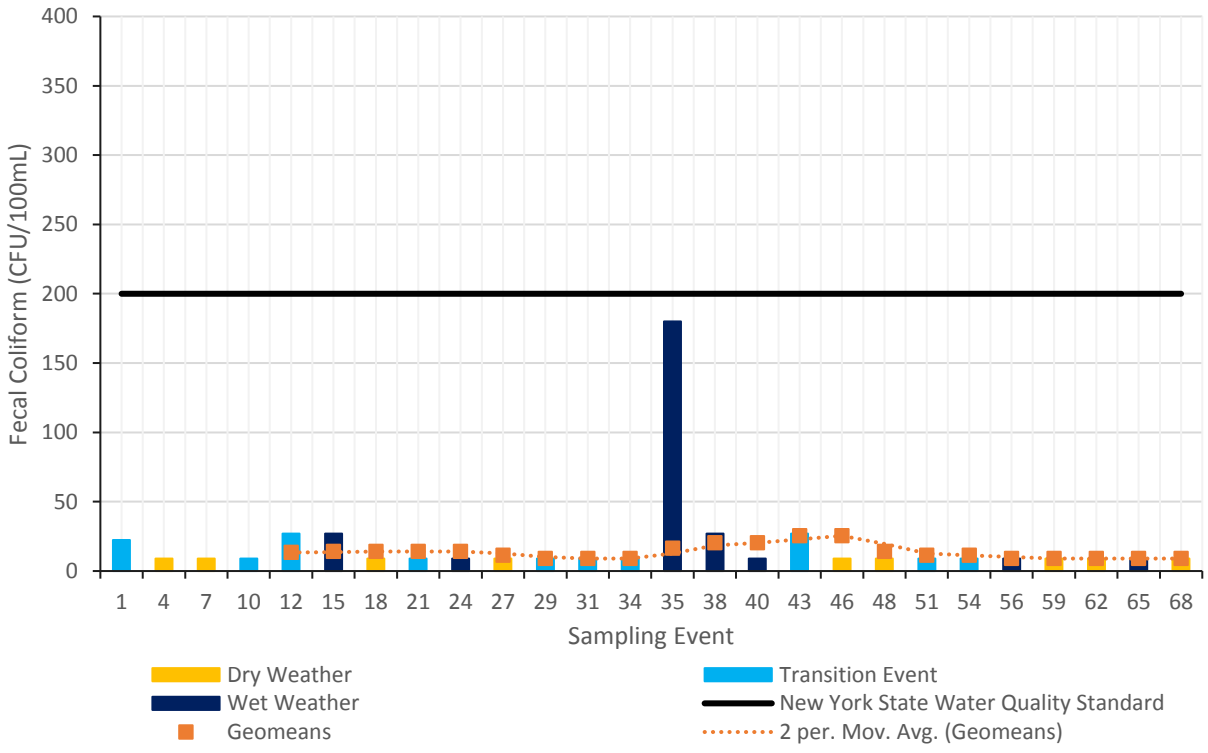

Figure 3-1. Fecal Coliform Sampling Results for RT1-RC

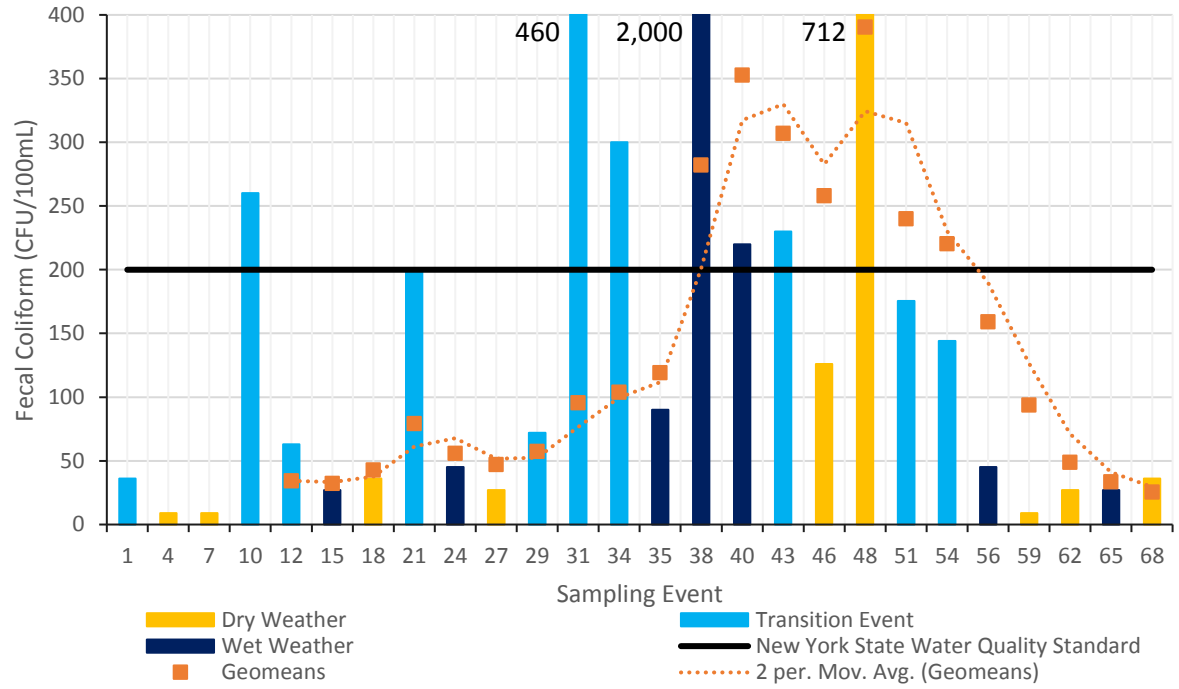

Figure 3-2. Fecal Coliform Sampling Results for RT2-RC

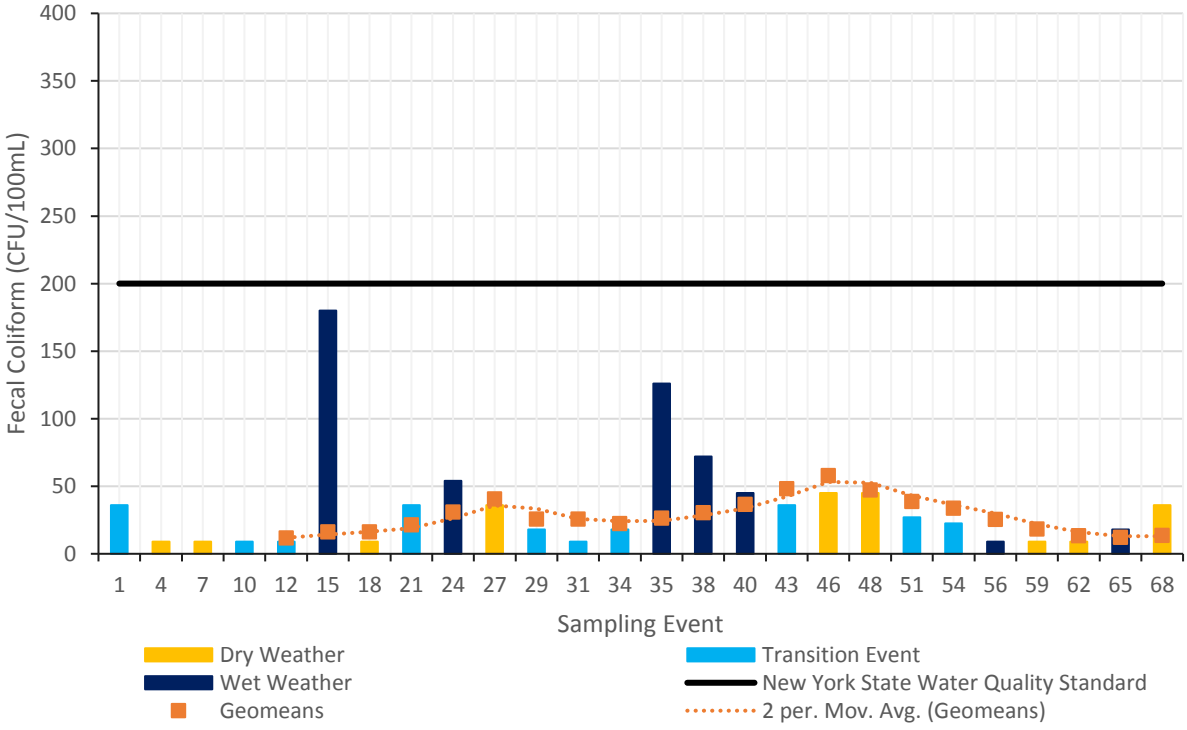

Figure 3-3. Fecal Coliform Sampling Results for RT3A-RC

The results depicted in **Figure 3-1** for RT1-RC indicate that the headwaters of the Mohawk River were in compliance with the WQS, as all of the calculated geometric means were below the 200 CFU/100mL threshold. Several individual sampling events had fecal coliform counts that were higher than what is normally observed, which is indicative of acute bacteriological contamination upstream of the Albany Pool, most likely resulting from wet weather. For example, sampling event 35 was exceptionally high due to significant rainfall accumulating over 3 inches in the 72 hours prior to the sampling event.

In general, river transect RT2-RC showed higher levels of fecal coliform when compared to RT1-RC, as shown in **Figure 3-2**. Over the course of the 2016 recreational season, this reach of the river, which is a distributary channel of the Mohawk River, was in compliance with the WQS 68% of the time, based on the data collected. Several of the sampling events had fecal coliform concentrations greater than what is normally observed, causing seven of the geometric means to exceed the WQS. While many of the elevated geomeans are correlated to wet weather events, it is unclear why select samples, such as sample event no. 48, had elevated fecal coliform results; however, it may be indicative of water quality response to acute wet weather events in the upper watershed or upstream illicit discharges.

The third river transect included in the upper boundary conditions of the Albany Pool is RT3A-RC. The RT3A-RC sampling point is located on the Hudson River due north of its confluence with the Mohawk River. **Figure 3-3** shows the fecal coliform results for this river transect. This section of the Hudson River was in compliance with WQS throughout the 2016 recreational season based on the samples collected.

Overall, the Mohawk and Hudson Rivers exhibited good water quality background conditions during the 2016 recreation season. However, there are acute events that result in water quality conditions that preclude the lower portions of the Albany Pool from attaining compliance with the WQS.

3.2 Middle Albany Pool (RT6)

The middle region of the Albany Pool is sampled at RT6, which is comprised of three sampling locations at the Hudson River's east bank (RT6-EB), river center (RT6-RC), and west bank (RT6-WB). The three sampling locations at RT6 were sampled via a boat downstream of the Troy Dam. Fecal coliform results for each location in the transect were averaged for each sampling event to create a composite fecal coliform value as shown in **Figure 3-4**.

As observed in **Figure 3-4**, based on the samples collected, 20 out of the 22 calculated geometric means, or 91 percent, were in compliance with WQS during the 2016 recreational season. Furthermore, the two-geometric means not in compliance with the WQS were associated with wet weather events. A comparison of the sampling results of RT6 to those of RT3A reveals similar trends in response to wet weather events.

Appendix E contains the individual fecal coliform sampling results along with calculated geometric means for RT6-RC, RT6-EB and RT6-WB. From these figures, it is observed that the east bank of the Hudson River was more sensitive to wet weather events than the samples collected from the river's center and west bank.

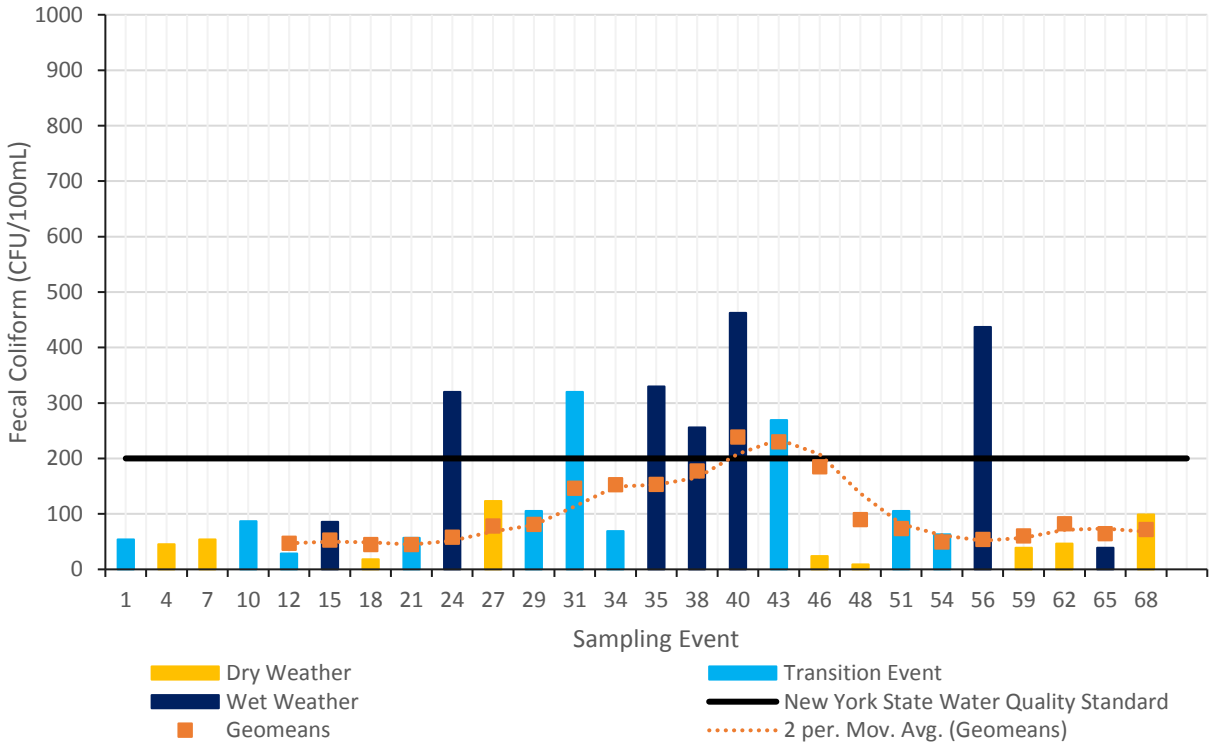

Figure 3-4. Fecal Coliform Sampling Results for RT-6

3.3 Lower Albany Pool (RT9)

The lower region of the Albany Pool is comprised of three sampling locations on the Hudson River at RT9 including the east bank (RT9-EB), river center (RT9-RC), and west bank (RT9-WB). RT9 is located south of Albany and upstream of the of the Rensselaer/East Greenbush boundary. The three sampling locations at RT9 were sampled from a boat. Fecal coliform results were averaged for each sampling event and the resulting data is shown in **Figure 3-5**. The RT9 transect was sampled an additional 42 times compared to the lower and middle Albany Pools transects as presented in **Figure 3-5**.

Of the 62 calculated geometric means shown in **Figure 3-5**, 44 were in compliance with the WQS during the 2016 recreational season which is equivalent to 71% compliance. The lower Albany Pool sampling results show a similar relationship between fecal coliform and wet weather events as compared to the upper and middle Albany Pool.

It is unclear, however, why select sampling events had elevated fecal coliform results during dry weather such as sampling events 58 - 63. Since the fecal coliform results were elevated for all three of the weekly sampling days, and considering that two labs were used to analyse the fecal coliform (St. Peter's Environmental Lab for the weekly sampling events where all locations were sample, and the ACSD in-house-lab for the other sampling event), lab error could be ruled out. The upper and middle Albany Pool sample results for this time period did not contain elevated fecal coliform therefore, the elevated samples observed at the RT9 transect are likely due to an unidentified source. A further discussion of these results is found in Section 6.2.

Appendix E contains fecal coliform sampling results and calculated geometric mean data for RT9-RC, RT9-EB and RT9-WB.

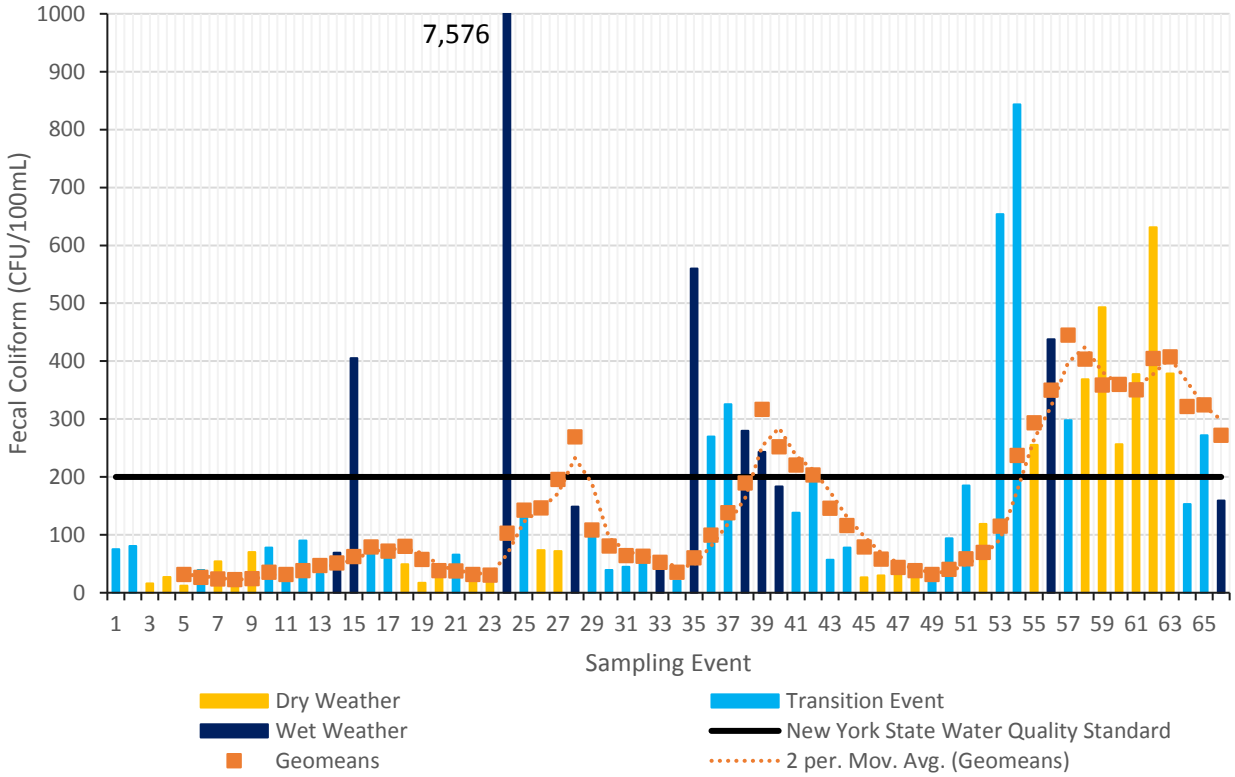

Figure 3-5. Fecal Coliform Sampling Results for RT9

3.4 Wastewater Treatment Plant Discharges

As required pursuant to their New York State SPDES Permits, individual WWTPs sampled wastewater effluent for disinfection compliance. The geometric means were calculated based on compiled data obtained for each WWTP. For the WWTPs that were staffed by APCs (ACSD-North, ACSD-South, and RCSD), the wastewater effluent was sampled as part of the sampling program. The two remaining WWTPs were solicited to voluntary provide effluent data.. The data that was received from the East Greenbush and the Waterford WWTPs does not cover the entire 2016 recreation season. There are gaps in the data for East Greenbush, and the data received for Waterford only covers the second half of the recreational season. However, the data from these two WWTPs provides an indication of the level of treatment that can be expected in the discharge. Fecal coliform results for ACSD-North, ACSD-South, RCSD, East Greenbush, and Waterford are shown in **Figures 3-6 through 3-10**.

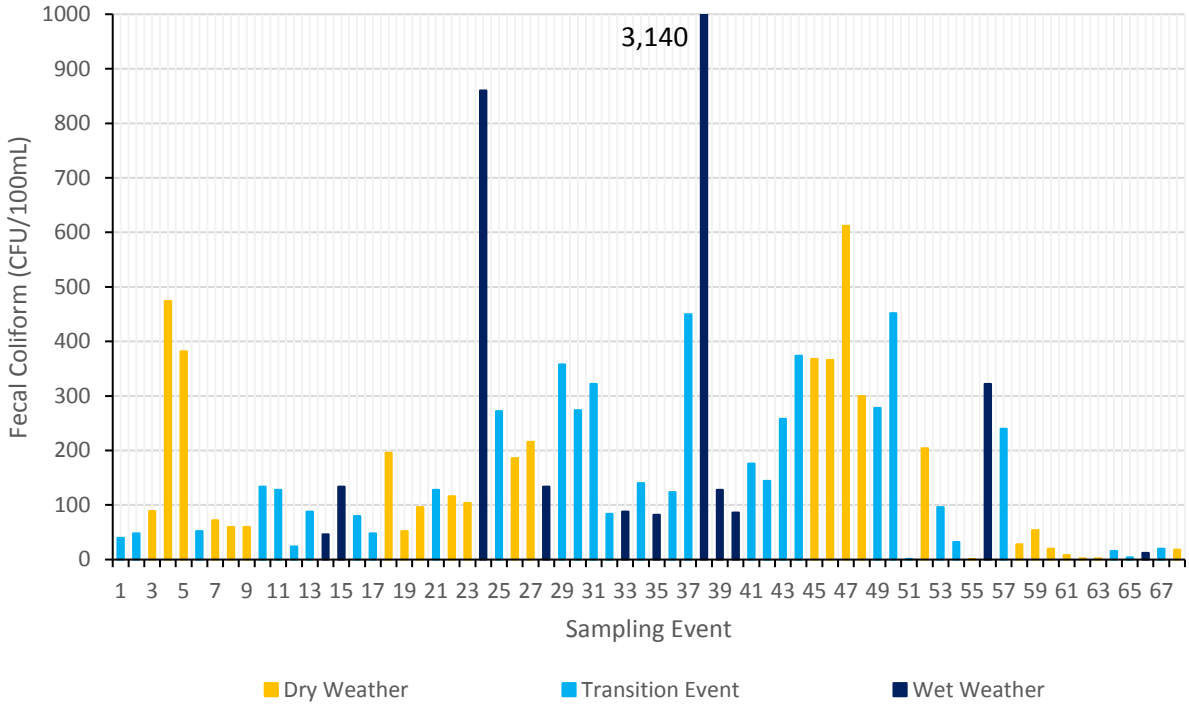

Figure 3-6. Fecal Coliform Sampling Results for ACSD - North WWTP

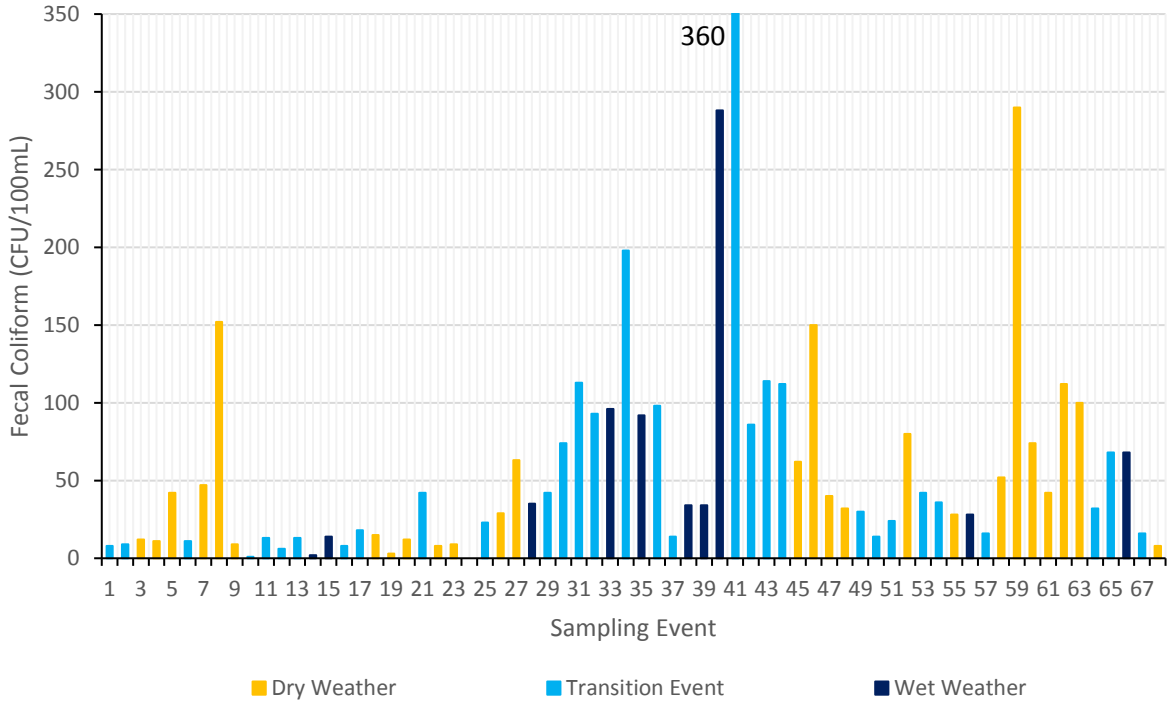

Figure 3-7. Fecal Coliform Sampling Results for ACSD - South WWTP

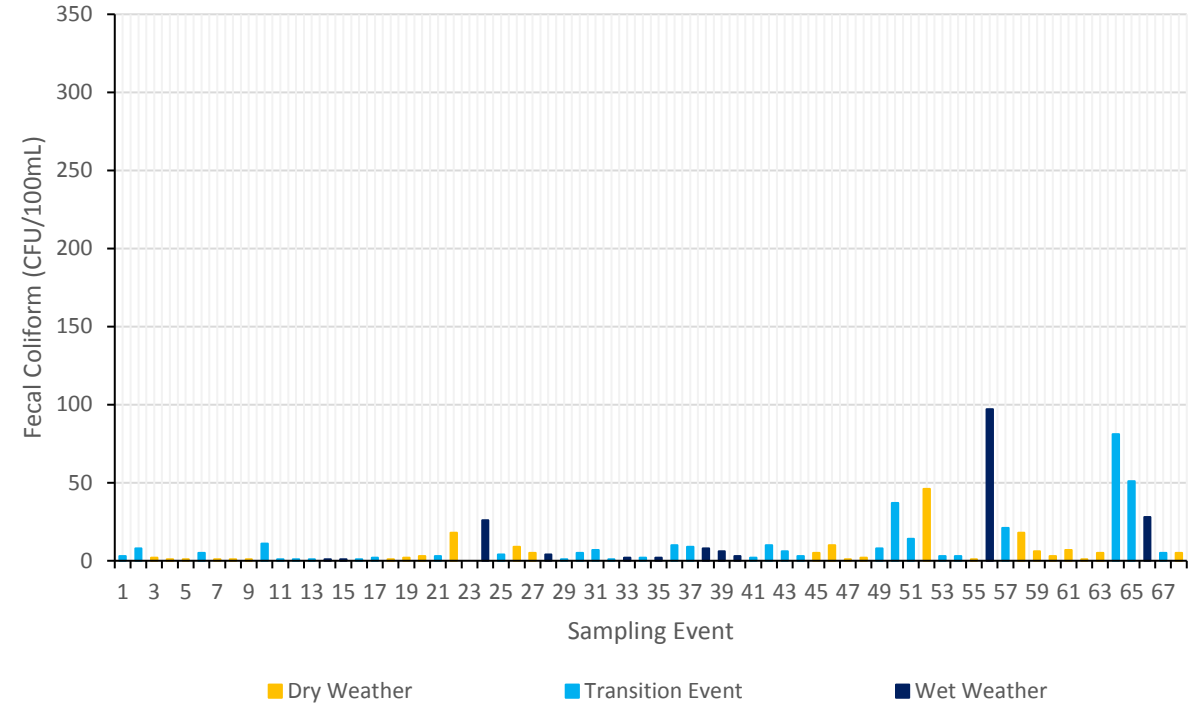

Figure 3-8. Fecal Coliform Sampling Results for RSCD WWTP

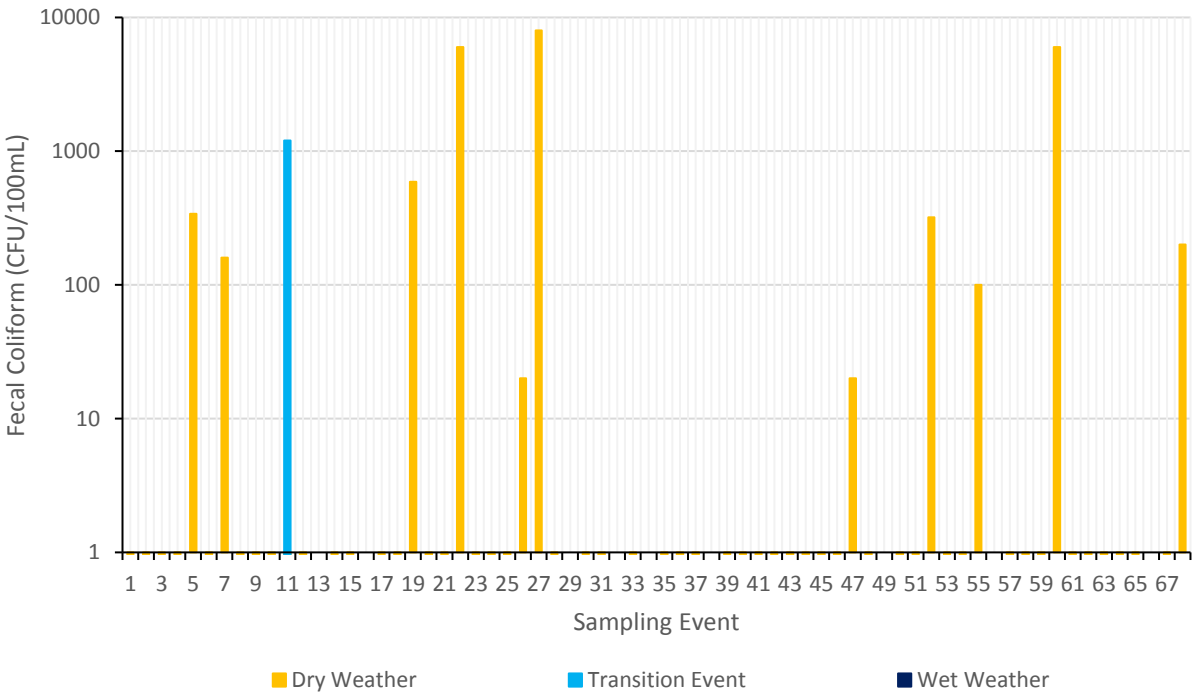

Figure 3-9. Fecal Coliform Sampling Results for East Greenbush WWTP

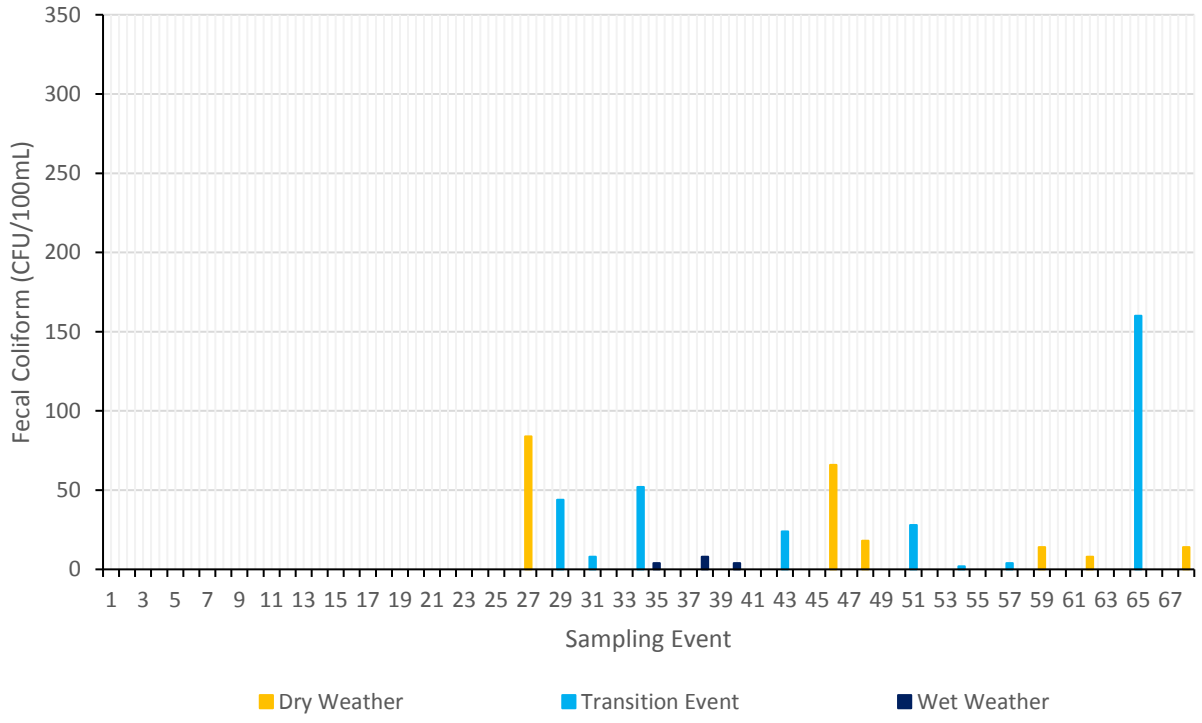

Figure 3-10. Fecal Coliform Sampling Results for Waterford WWTP

As shown in **Figure 3-6**, there were several days with above average fecal concentrations at the ACSD North WWTP during the 2016 sampling period. The above normal concentrations can be attributed in part to wet weather and transitional events, however, there are several dry weather samples that have abnormally high fecal concentrations. The results for ACSD-South WWTP are shown in **Figure 3-7**. There were only three occasions during the 2016 sampling period where the fecal coliform concentrations exceeded 200 CFU/100mL, two of which were associated with wet weather or transitional events. The third occasion was associated with a dry weather event, and is atypical when compared to similar events. The cause of the elevated fecal coliform concentrations that were recorded during dry weather events at the ACSD-North and ACSD-South WWTPs is unclear.

Fecal coliform results for RCSD are shown in **Figure 3-8**. The three occasions where the samples exceeded 50 CFU/100ML at the RCSD were correlated with wet weather or transitional events. **Figure 3-9** and **Figure 3-10** show the fecal coliform results for the East Greenbush WWTP and the Waterford WWTP, respectively. Although the data is partial, the East Greenbush WWTP results indicate elevated fecal coliform samples during times of dry weather and implies even higher fecal coliform concentrations during wet weather events. The Waterford WWTP fecal coliform discharge was below 200 CFU/100mL for the sampling period based on the available data, although it is noted that no samples were taken on days of with wet weather.

4 TRIBUTARY SAMPLING RESULTS

As was the case for the river transects, geometric means for fecal coliform counts were calculated for each five consecutive sampling events of the sampling program for a total of 22 geometric means. The subsections to follow detail the results for each of the seven tributaries to the Hudson River that were included in the PCCMP.

4.1 Dry River Creek (T00-00)

Samples were collected to characterize the Gas House Creek and Dry River Creek, both of which originate in the Town of Colonie and are conveyed underground through the City of Watervliet.

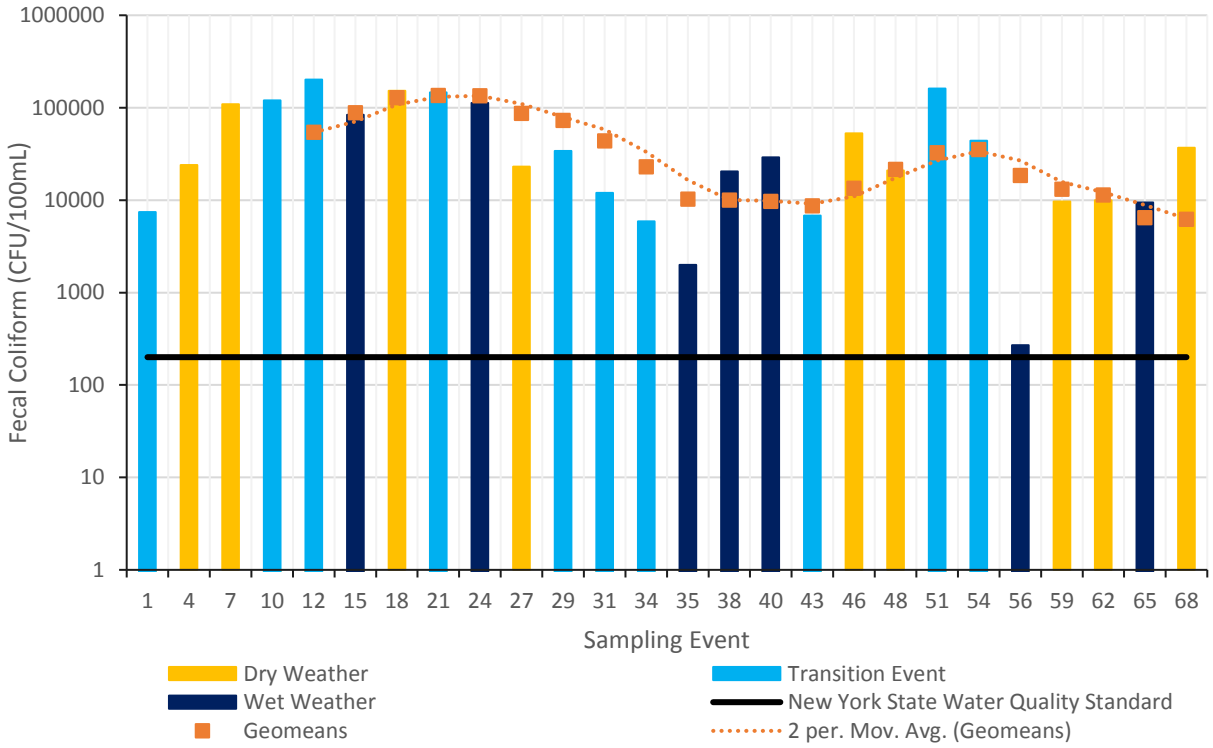

Figure 4-1. Fecal Coliform Sampling Results for Dry River Creek (T00-00)

As seen in **Figure 4-1**, the geometric means for Dry River Creek consistently exceeded the WQS and ranged between 6,000 and 140,000 CFU/100mL. This consistency in water quality between wet, transitional, and dry weather may be indicative of illicit discharges or failing septic systems with acute surface water runoff in urbanized or agricultural areas impacting water quality during wet weather.

4.2 Krum Kill (T00-01)

Fecal coliform results and calculated geometric means for T00-01 are presented in **Figure 4-2**, and as can be observed 19 out of the 22 geometric means exceeded the WQS and showed a slight improvement at the end of the sampling season where it was relatively dry. The geometric mean ranged between 100 and

1600 CFU/100mL, and while the data shows a slight improvement during the last three months of the 2016 sampling program, the consistency of the water quality between dry, wet, and transitional weather maybe be indicative of unknown sources of surface water runoff in urbanized or agricultural areas.

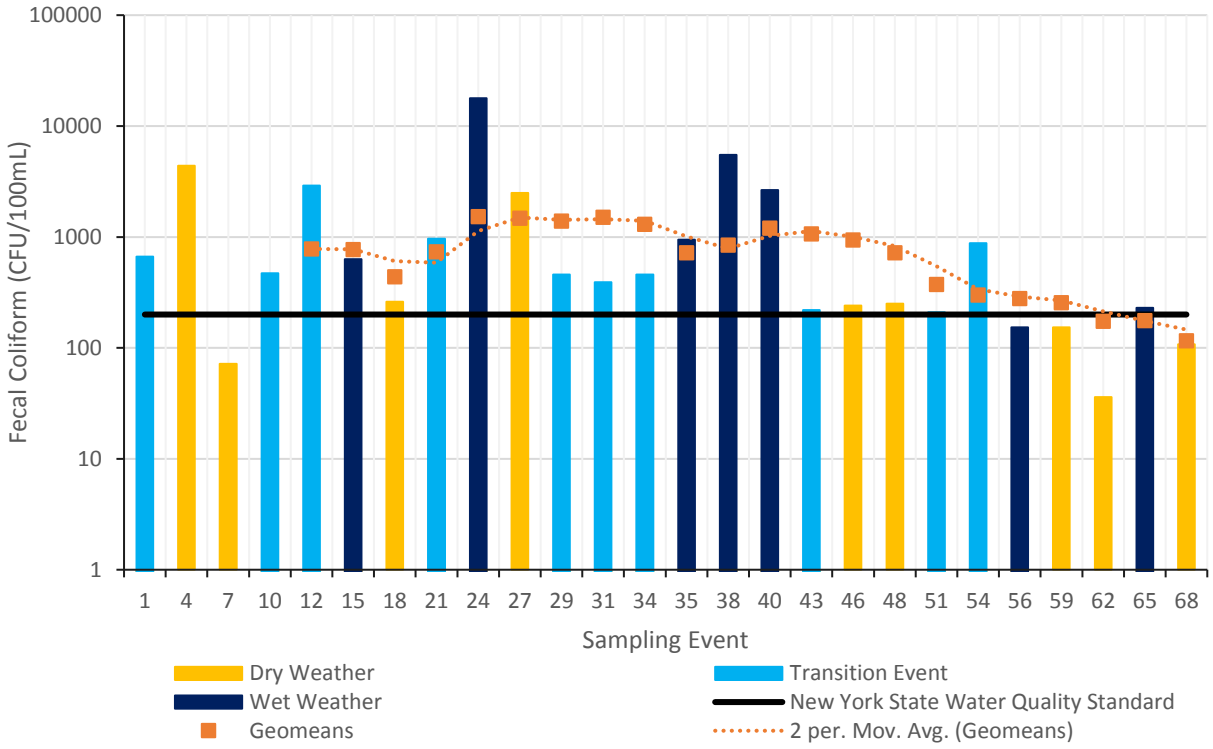

Figure 4-2. Fecal Coliform Sampling Results for Krum Kill (T00-01)

4.3 Normans Kill (T11-02)

The Normans Kill was sampled at the same location on River Road near its confluence with the Hudson River as it was during the previous sampling efforts, including 2008 and 2009 water quality sampling for the development of the LTCP. The data collected in 2016 is compared to the previous data collected in 2008, 2009, and 2015 are in Section 6.4.

The fecal coliform results for T11-02 along with the geometric means are shown in **Figure 4-3**. Based on the samples collected, the results show that the tributary was in compliance with the WQS for 45% of the recreational season. The geometric mean ranged between 100 and 300 CFU/100mL, a slight improvement over 2015. The results indicate that the fecal coliform counts in the tributary are more responsive to wet weather and suggests that stormwater runoff from urban or agricultural sources may cause the increase in fecal coliform during wet weather.

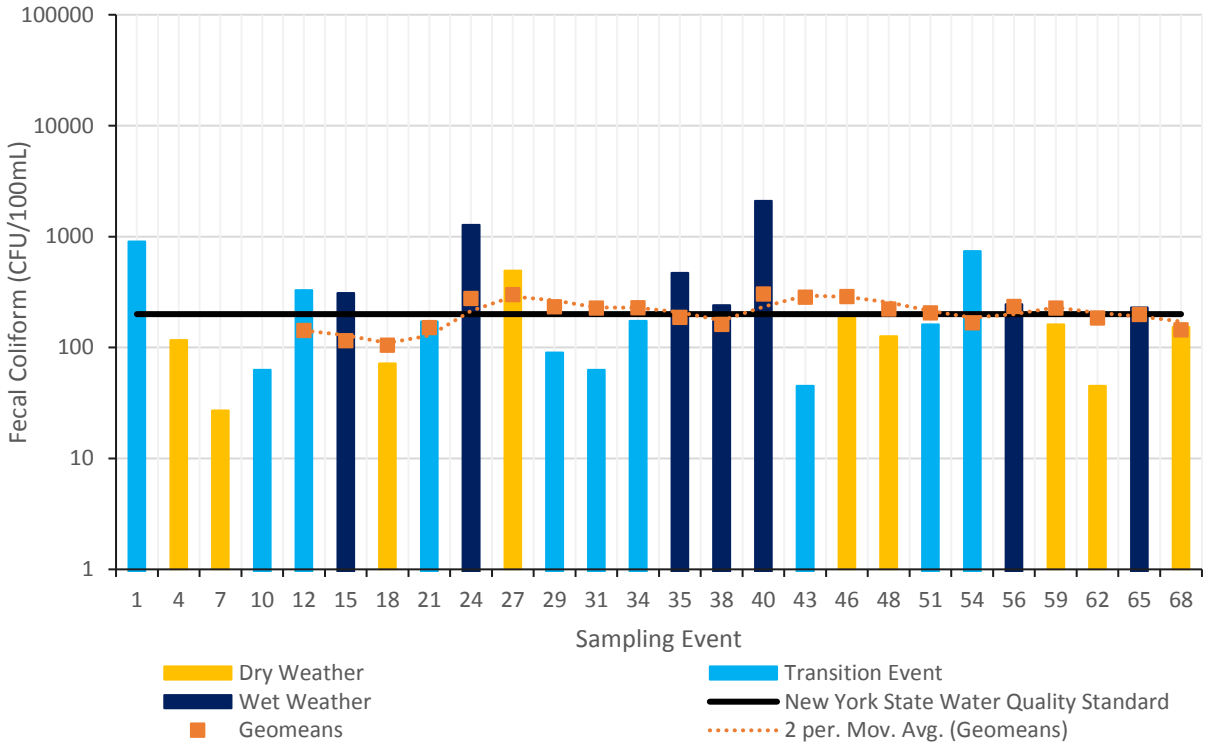

Figure 4-3. Fecal Coliform Sampling Results for Normans Kill (T11-02)

4.4 Mill Creek (T12-05)

The Mill Creek was sampled at Washington Avenue near its confluence with the Hudson River as was the case for the previous sampling programs. The results of the 2016 sampling are compared to the previously reported data in Section 6.4

The fecal coliform results and geometric means for T12-05 are presented in **Figure 4-4**. It should be noted that no results are shown for sampling event no. 18 as no data is available on this date for T12-05 due to a lab error. As seen in **Figure 4-4**, all the geometric means exceeded the WQS and were consistently between 200 and 1,500 CFU/100mL. This water quality consistency between wet, transitional and dry weather may be indicative of unknown sources, failing septic systems with acute surface water runoff in urbanized or agricultural areas impacting water quality during wet weather.

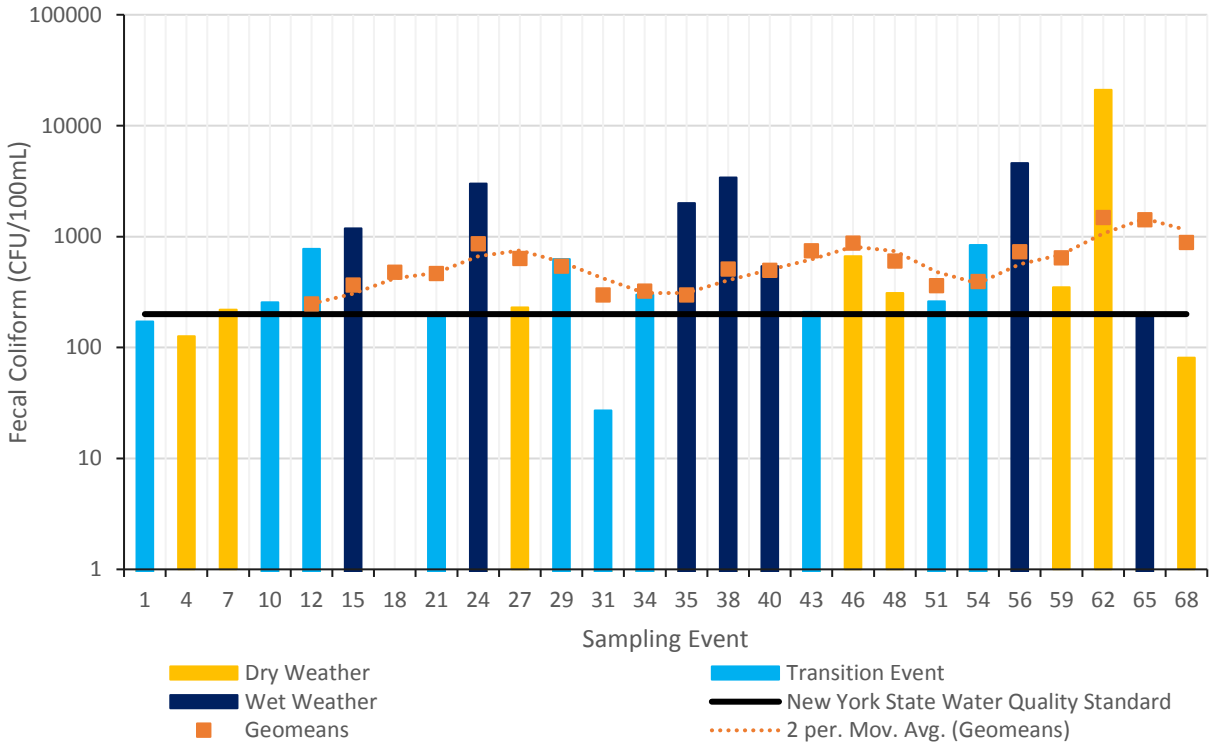

Figure 4-4. Fecal Coliform Sampling Results for Mill Creek (T12-05)

4.5 Wynants Kill (T13-08)

As was the case for the previous sampling programs, the Wynants Kill was sampled at Burden Avenue near its confluence with the Hudson River. The sampling data for 2016 is compared to the previous sampling data in Section 6.4.

Figure 4-5 presents the fecal coliform and geometric means for T12-05. As seen in this figure, 19 out of the 22 geometric means exceeded the WQS; being in compliance only 14% of the recreational season, based on the samples collected. The geometric mean ranged from 100 to 410 and appears to be an improvement over the 2015 results. However, the water quality consistency between wet, transitional and dry weather that can be seen in **Figure 4-5** may be indicative of unknown sources, failing septic systems with acute surface water runoff in urbanized or agricultural areas impacting water quality during wet weather.

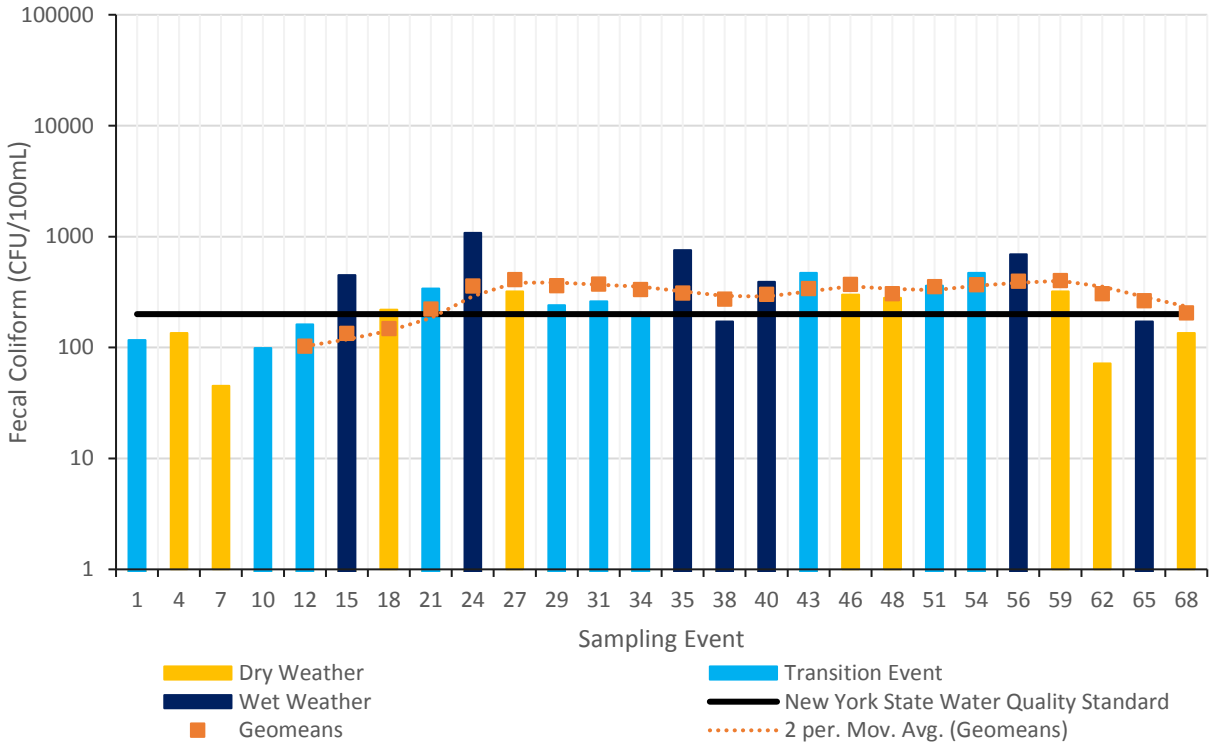

Figure 4-5. Fecal Coliform Sampling Results for Wynants Kill (T13-08)

4.6 Poesten Kill (T14-11)

Samples from the Poesten Kill were collected at 2nd Street near its confluence with the Hudson River, the same location that was sampled during 2008, 2009, and 2015. The 2016 sampling results are compared to previously reported sampling results in Section 6.4.

The fecal coliform results are presented for T14-11 along with the geometric means in **Figure 4-6**. It should be noted that there is no data available for sampling event no. 18 due to a lab error. However, based on the samples that were collected, the tributary was incompliance with the WQS only 14% of the recreational season with 19 out of the 22 geometric means exceeding the WQS. The geometric mean ranged from 100 and 900 CFU/100mL. The consistency of the water quality between wet, transitional, and dry weather suggests that the tributary may receive fecal coliform from unknown sources, such as failing septic systems with acute surface water runoff in urbanized or agricultural areas impacting water quality during wet weather.

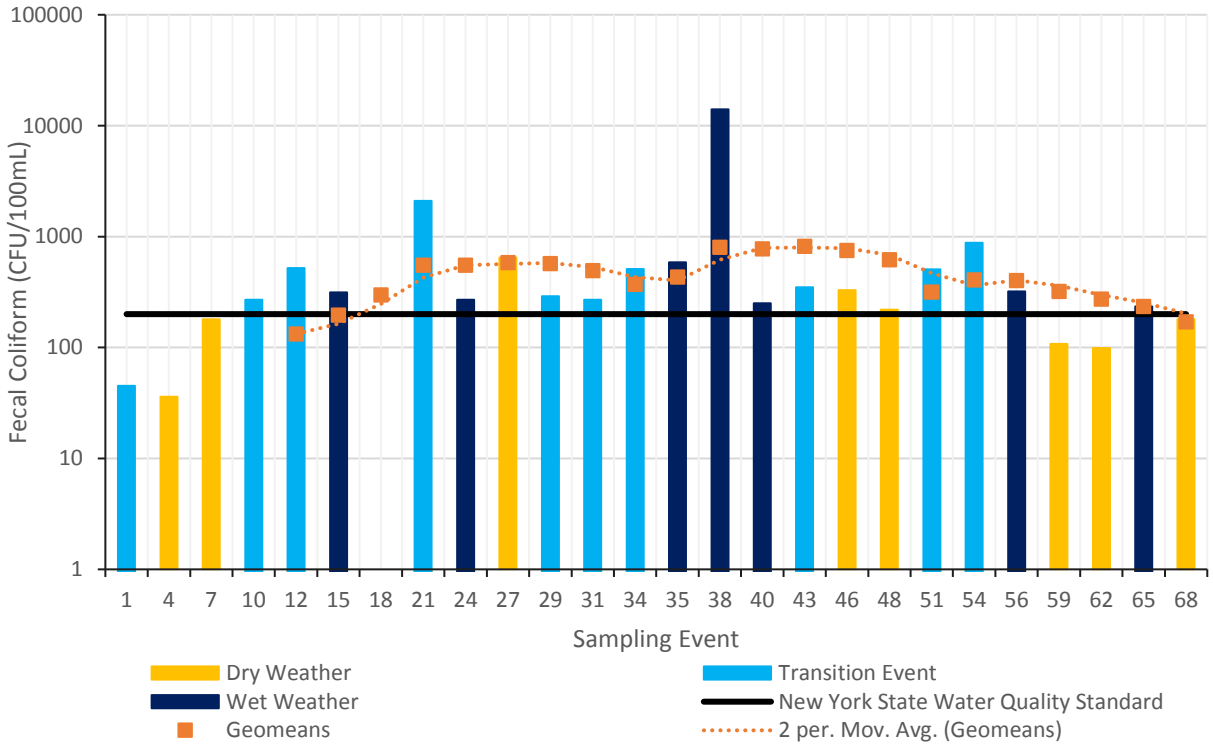

Figure 4-6. Fecal Coliform Sampling Results for Poesten Kill (T14-11)

4.7 Patroon Creek (T16-13)

The Patroon Creek was sampled at Tivoli Street near its confluence with the Hudson River as it was in previous sampling efforts.

The geometric means that were calculated for T16-13 as well as the fecal coliform results are presented in **Figure 4-7**. Based on the samples collected for the 2016 recreational season, this tributary was not in compliance with the WQS. As shown in **Figure 4-7** all of the geometric means consistently were between 400 and 1,500 CFU/100mL. These results consisting of elevated wet, transitional and dry weather may suggest that the water quality is impacted by unknown sources or surface water runoff in areas during wet weather.

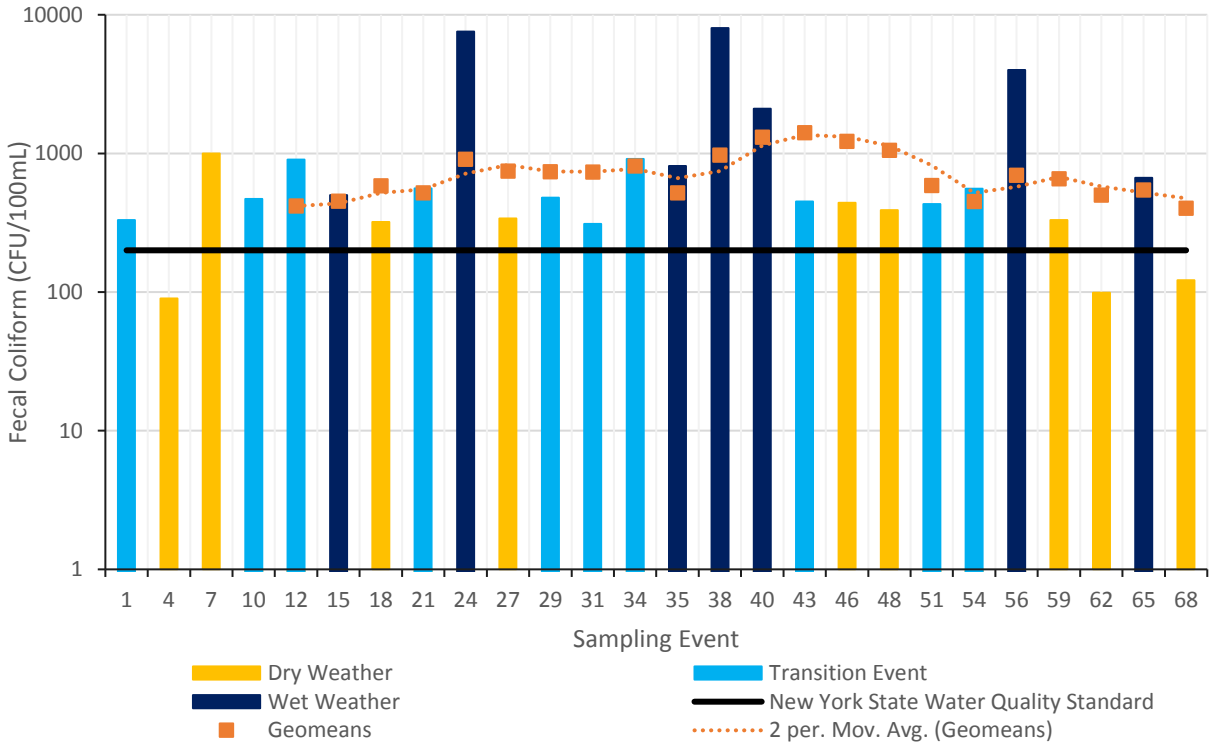

Figure 4-7. Fecal Coliform Sampling Results for Patroon Creek (T16-13)

5 QUALITY ASSURANCE / QUALITY CONTROL

5.1 Overview

The Quality Assurance and Quality Control (QA/QC) protocols for this sampling program were defined in the Sampling Plan. Field QA included requirements for record keeping and chain of custody. In addition, training was conducted with the field crews prior to the sampling season.

Lab QA/QC performance was stipulated to meet certification standards as acceptable to NYS DEC. In addition to the internal lab QA/QC, each field team collected duplicate samples at one of their sampling sites for each event.

5.2 Field Sampling QA/QC

The field crews provided standardized notations on field sheets for each station and for each sampling location corresponding to the chain of custody that was attached to the samples being submitted to the laboratory for bacteriological analysis. Complete chain of custodies are available for all lab samples along with the original field summary sheets recorded by the sampling teams.

5.3 Laboratory QA/QC

St. Peter's Hospital Environmental Laboratory performed analysis on all river and tributary samples, while the individual WWTPs provided fecal coliform results that were reported as part of their Discharge Monitoring Reports (DMR). St. Peter's Environmental Laboratory provided internal chain of custody documentation for all samples and additional documentation showing that their internal QA/QC checks for the data were met. The range of dilutions for fecal coliform samples provided quantification down to 10 CFU/100mL and up to approximately 100,000 CFU/100mL. Several samples from the lab were cancelled due to indeterminate lab errors.

Analysis of the duplicate samples shows a strong correlation for fecal coliform concentrations for all duplicate samples except for one, which had a 14,000 CFU/100mL difference. The relationship for the bacteria samples to their duplicate samples is shown in **Figure 5-1**. This figure contains two trend lines; one for each data series. Series 1 is all inclusive while series 2 excludes the outlying duplicate sample discussed above. The difference in the coefficient of determination between series 1 and 2 is represents the removal of the outlier from the series 2 statistical analysis. Some deviation between the original and duplicate samples was anticipated due to the variability of bacteria in water samples and the errors inherent in dilution based analysis. Despite these known challenges the difference between the measured values and their duplicates were within a range that is acceptable for this type of test with the exception of the isolated duplicate sample mentioned herein.

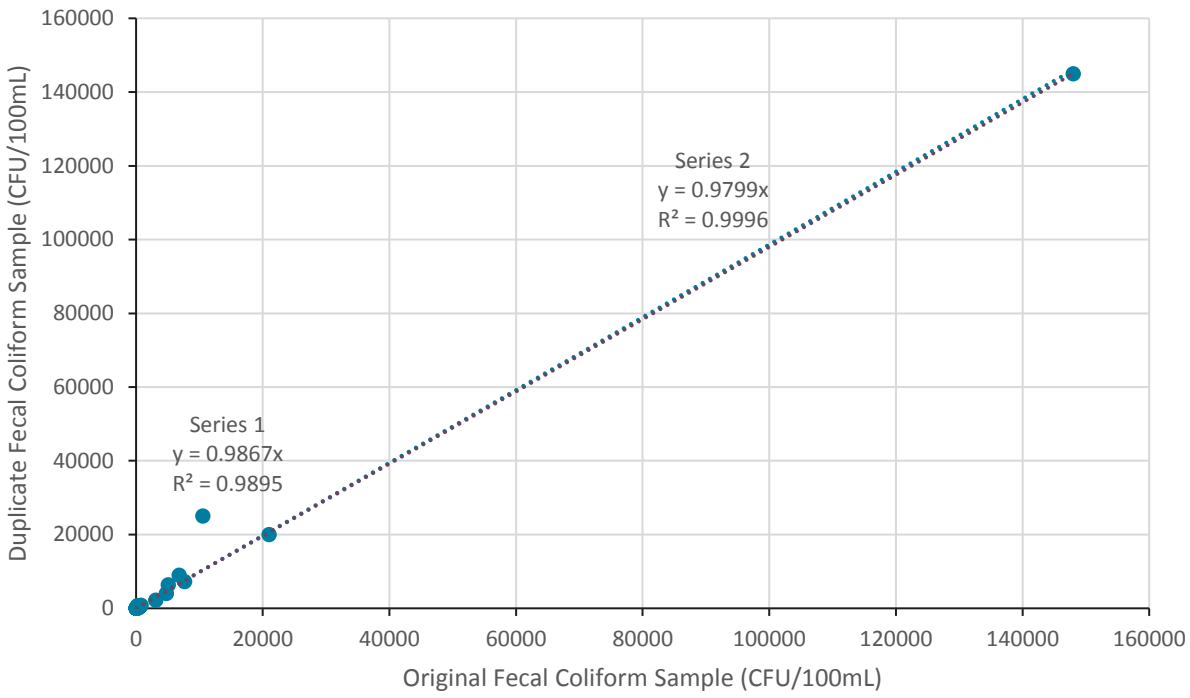

Figure 5-1. Comparison of Fecal Coliform Duplicate Samples

6 DATA ASSESSMENT AND OBSERVATIONS

Fecal coliform results and calculated geometric means for the 2016 recreational sampling season were presented in sections 3 and 4 of this report. This section presents an assessment of the collected data along with a comparison of the 2016 results with those of previous years.

6.1 Weather Observations

A total of 68 sampling events were administered in the 2016 season, 42 of the events were exclusive to RT9 and the remaining 26 sampling events included the other sampling locations . Of these 26 sampling events, a total of eight wet weather, nine dry weather, and nine transitional weather days were observed. **Table 6-1** and **Table 6-2** present the monthly rainfall amounts in inches during 2008, 2009, 2015, and 2016 and the historically reported normal rainfall at the Albany International Airport and the Troy Lock and Dam, respectively.

Table 6-1. Albany International Airport Rainfall Amounts

Month	2008	2009	2015	2016	Normal[1]
May	1.24	4.08	1.05	2.43	3.61
June	5.45	5.02	6.70	2.31	3.79
July	6.94	9.91	3.42	6.44	4.12
August	3.01	3.58	4.30	3.94	3.46
September	4.21	1.73	6.89	2.18	3.30
October	5.09	4.16	3.20	0.68	3.68
Recreational Season Total	25.94	28.48	25.56	17.98	21.96
Monthly Average	4.30	4.76	4.30	3.00	3.66

Note: 1. Based on NOAA 1981-2010 Climate Normals for the Albany International Airport

Table 6-2. Troy Lock and Dam Rainfall Amounts

Month	2008	2009	2015	2016	Normal[1]
May	1.77	4.58	1.05	2.83	3.77
June	6.96	4.71	5.81	2.58	4.28
July	6.41	8.44	4.41	3.69	4.30
August	4.61	5.92	4.15	5.83	4.12
September	3.85	1.97	6.64	2.12	3.52
October	5.48	3.45	3.93	2.30	4.01
Recreational Season Total	29.08	29.07	25.99	19.35	24.00
Monthly Average	4.85	4.85	4.33	3.23	4.00

Note: 1. Based on NOAA 1981-2010 Climate Normals for the Troy Lock and Dam

The 2016 recreational season rainfall totals for the Albany International Airport and the Troy Lock and Dam were below the 2008, 2009, and 2015 totals as well as the recorded normals. Although the Albany

International Airport and the Troy Lock and Dam rain gauges are only 6 miles apart, an analysis of the rainfall data indicates that there is significant variability in the rainfall distribution throughout the Albany Pool communities. At times, there was as much as 1.5 inches difference in recorded daily rainfall amounts between the two gauges. Additionally, there were several days when one rain gauges recorded over a 0.5 inch of rain while other gauges did not record any rainfall, it is believed that this is due to isolated thunderstorm systems. The spatial distribution of rainfall throughout the study area should be considered and may explain isolated increases in fecal coliform samples. The months of July and August were the two months with largest observed rainfall during the 2016 recreational season, with rainfall totals above normal for both months at the Albany International Airport location and above normal for the month of August at the Troy Lock and Dam. When compared to rainfall amounts during the previous sampling seasons, the 2016 recreational season received approximately 8-inches less rain.

6.2 River Transects

River transects were sampled and analyzed in 2008 and 2009 for the development of the LTCP. In 2008, samples were collected for fecal coliform, E. coli, and field parameters (dissolved oxygen, pH, temperature, and specific conductance). The 2009 sampling effort only included samples from two of the river transects, RT1-RC and RT3A-RC, for biological oxygen demand, nutrients (ammonia nitrogen, total phosphorous), and field parameters. Starting in 2015, samples were collected for fecal coliform. Therefore, the discussion in this section will only compare 2016 coliform data to 2008 and 2015.

It is also important to note that during the 2008 sampling effort, river transect RT3 was sampled via a boat just north of the City of Troy boundary and downstream of Lock 1. In 2009 this transect was moved to the 126th Street Bridge and was sampled from above on the bridge, thus the reason for the RT3-RC and RT3A-RC designations.

6.2.1 Dry Weather Data Assessment and Observations

The 2008 dry weather data included a total of 15 discrete sampling events to develop the seasonal dry weather average. Six sampling events, in 2015, were classified as dry weather, and as was previously mentioned, nine events were classified as dry weather during the 2016 sampling effort. A comparison of the dry weather data at each river transect is shown in **Figure 6-1**.

The data collected for river transect 9, at the southern boundary of the Albany Pool, shows an overall improvement in water quality, as shown in **Figure 6-1**. The apparent water quality improvements may be a result of disinfection at the RCSD and ACSD WWTPs. The RT1, RT3, RT2, and RT6 river transects also show a slight improvement in water quality compared to 2015.

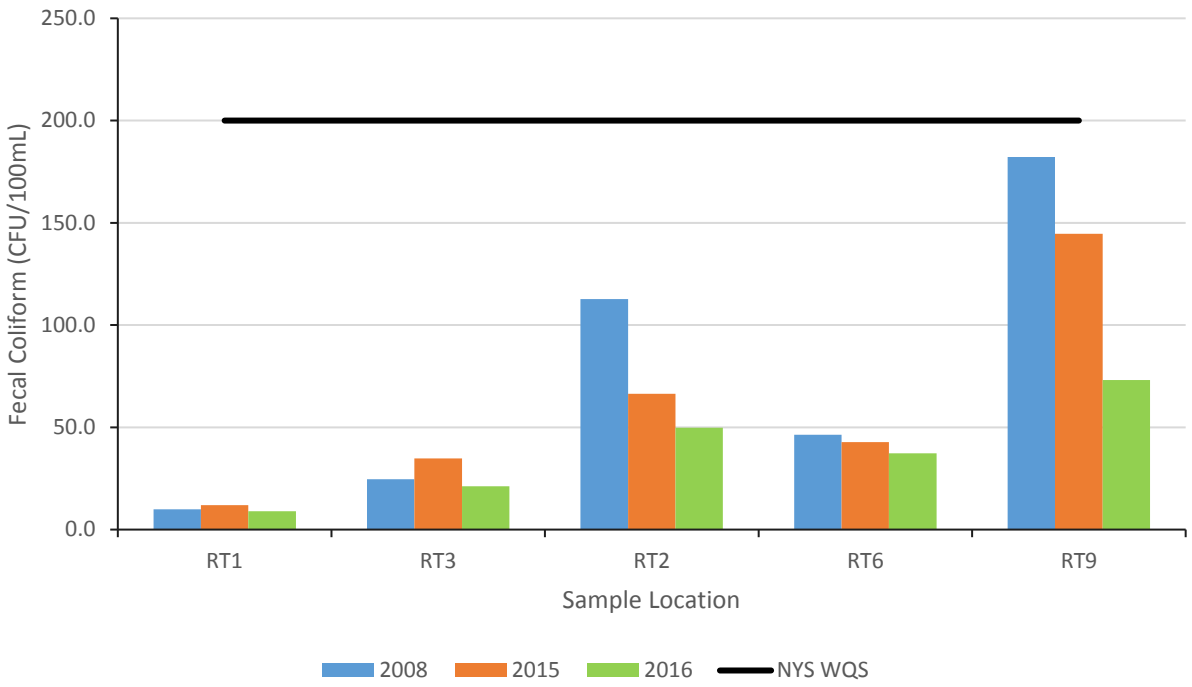

Figure 6-1. Average Fecal Coliform Dry Weather Comparison

6.2.2 Wet Weather Data Assessment and Observations

Wet weather data collected in 2008 was not sampled in the same manner as in 2015 and 2016 thus making it more difficult to compare. In 2008, a total of 11 samples were collected at each location over a course of approximately two days to characterize the water quality as a function of time during a wet weather event. The overall storm was then characterized as a single geometric mean of the event. This geometric mean over a short time series typically resulted in lower fecal coliform counts when compared to the single grab samples per events in 2015 and 2016.

While the data from 2008 is not directly comparable to that of the 2015 and 2016 data, **Figure 6-2** establishes a consistency within the wet weather water quality data, as both the 2015 and 2016 data are between the minimum and maximum values sampled for wet weather events in 2008. It is noteworthy that the data indicates an overall improvement in water quality over 2015 but is within the margin of error when compared to 2008.

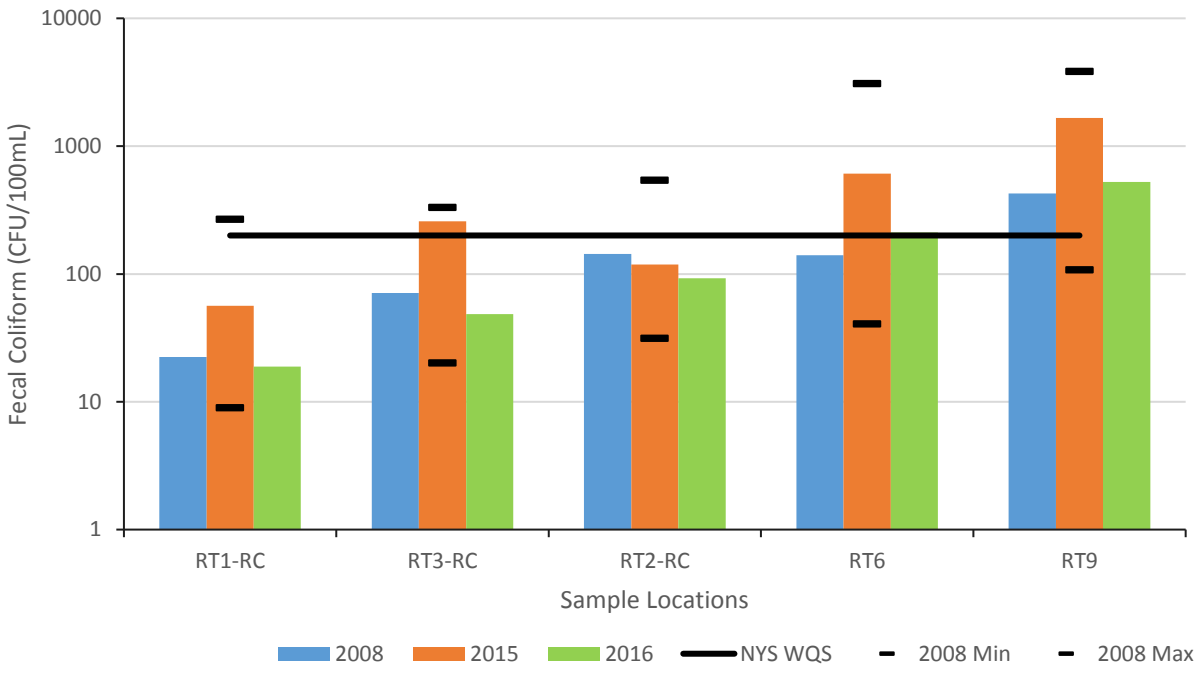

Figure 6-2. Average Fecal Coliform Wet Weather Comparison

6.2.3 River Transect 9 Data Assessment and Observations

Monthly geometric means were calculated based on the weekly sampling results collected for RT9. The grab samples collected on Tuesday and Thursday were excluded from this analysis, thus allowing for a direct comparison to the 2015 season. The monthly geometric means for RT9 are depicted in **Figure 6-3**. The 2016 data showed improvement over the 2015 season with all of geometric means lower in 2016 then 2015. Additionally, five out of the six months showed attainment of WQS at the lower boundary of the Albany Pool, whereas only one month was in compliance with WQSs during 2015.

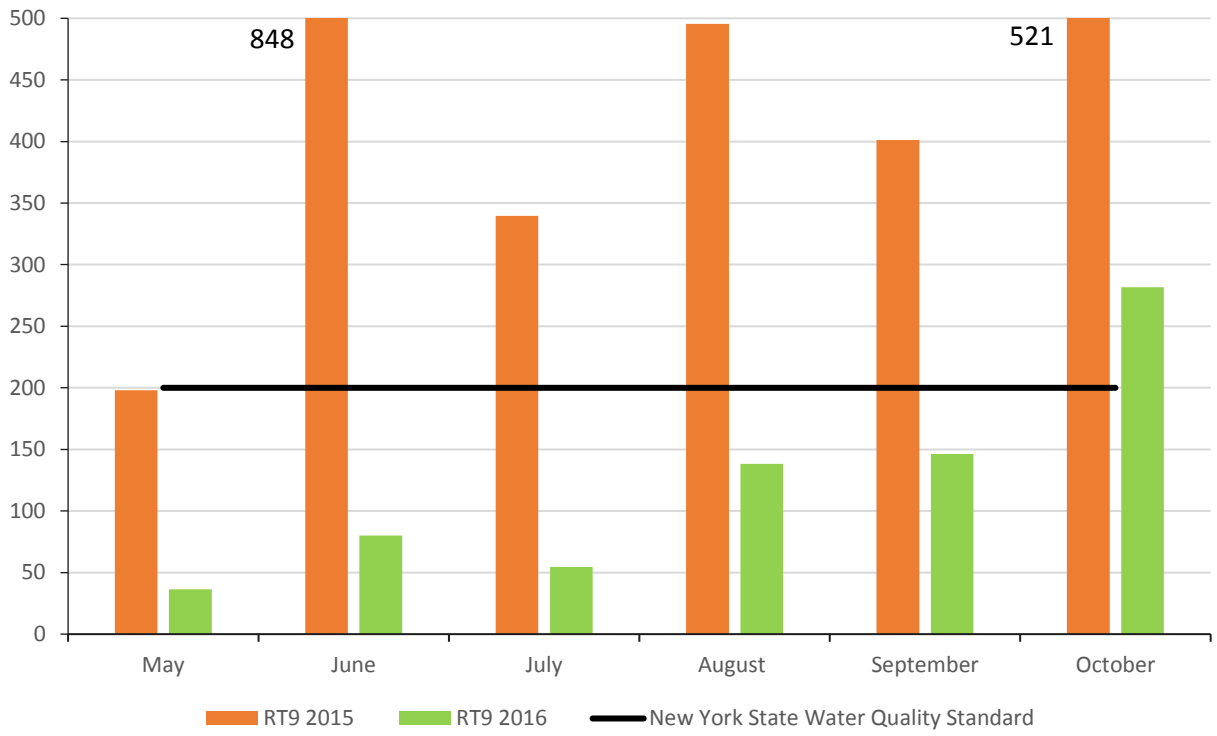

Figure 6-3. Monthly Geometric Mean Comparison for RT9

As discussed previously, the fecal coliform results at RT9 for the end of September through October were elevated and were consistent between dry and wet weather events. In order to compare the influence of each source of fecal coliform upstream of RT9, a comparison of the fecal coliform loading from upper boundary condition sites, the tributaries, and the WWTPs was performed. The results of this comparison are shown in **Figure 6-4**. Flow data at the Troy Lock and Dam was unavailable until the end July of 2016, therefore the comparison is only shown for the months of August through October.

The APCs have been implementing various projects required by the LTCP, which seems to be positively impacting the water quality of the Hudson River. Several green infrastructure projects have been implemented, however, most notably may be the pump station improvements completed by RCSD to reduce CSOs in Troy and Rensselaer.

However, as noted in Section 3.3, the fecal coliform concentrations observed at RT9, after September 22, were elevated for both dry and wet weather events as compared to historical data analysis. These elevated fecal coliform concentrations are unknown sources and if this trend continues during the 2017 sampling season, the APCs may want to consider performing DNA testing to determine if the source is from humans or animals.

6.2.4 River Recovery

Appendix N of the LTCP provided a table of various river recovery times depending on the storm size and transect, showing the time elapsed for various size storms before bacteria concentrations returned to a

level of 1,000 CFU/100mL (bathing beach fecal coliform threshold requirement) or less. By collecting three grab samples at RT9 for most weeks of the 2016 season, the data shows that the river is recovering within 24 hours or less. **Figures 6-5 and 6-6** show rainfall and fecal coliform data verses time, for two different sized storms. During the week of the June 27th, 2016, a rain event occurred on Tuesday evening and continued into early Wednesday morning, depositing 0.26 inches of rain (based on hourly rainfall data from the Albany International Airport) over an eight-hour period. **Figure 6-5** shows that the fecal coliform results collected during Wednesday's sampling event were over 7,500 CFU/100mL, however, by Thursday morning the fecal coliform count was measured below the bathing beach requirements at 145 CFU/100mL.

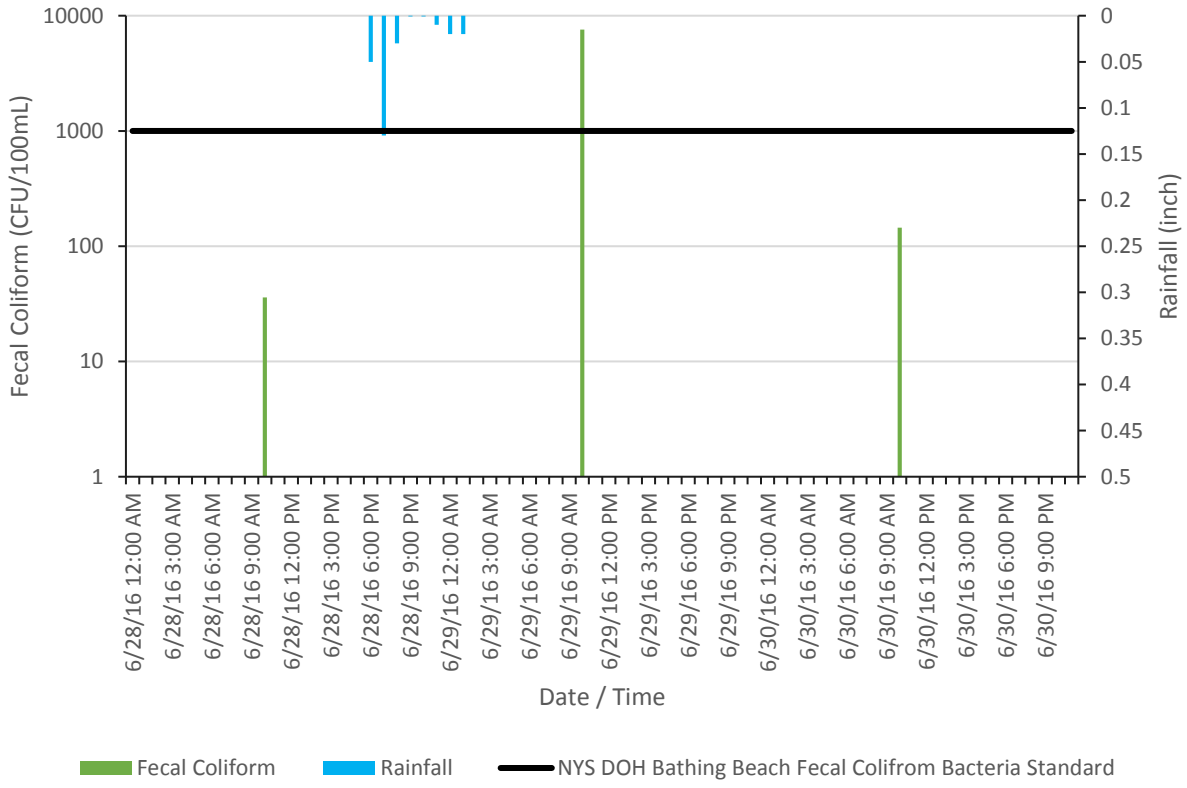

Figure 6-4. River Recovery - June 28-30, 2016

Similarly, for the week of August 1st a storm event occurred during the early morning hours of Tuesday, August 2nd with 1.13 inches of rain falling over a five-hour period. Due to the heavy rain and dangerous river conditions the sampling event was cancelled for Tuesday morning, however it is believed that if samples were collected at RT9 that morning the fecal coliform results would be well above the bathing beach threshold requirements. By Wednesday's sampling event, the fecal coliform concentration had fallen to 560 CFU/100mL and by Thursday morning the fecal coliform concentration had fallen to 270 CFU/100mL

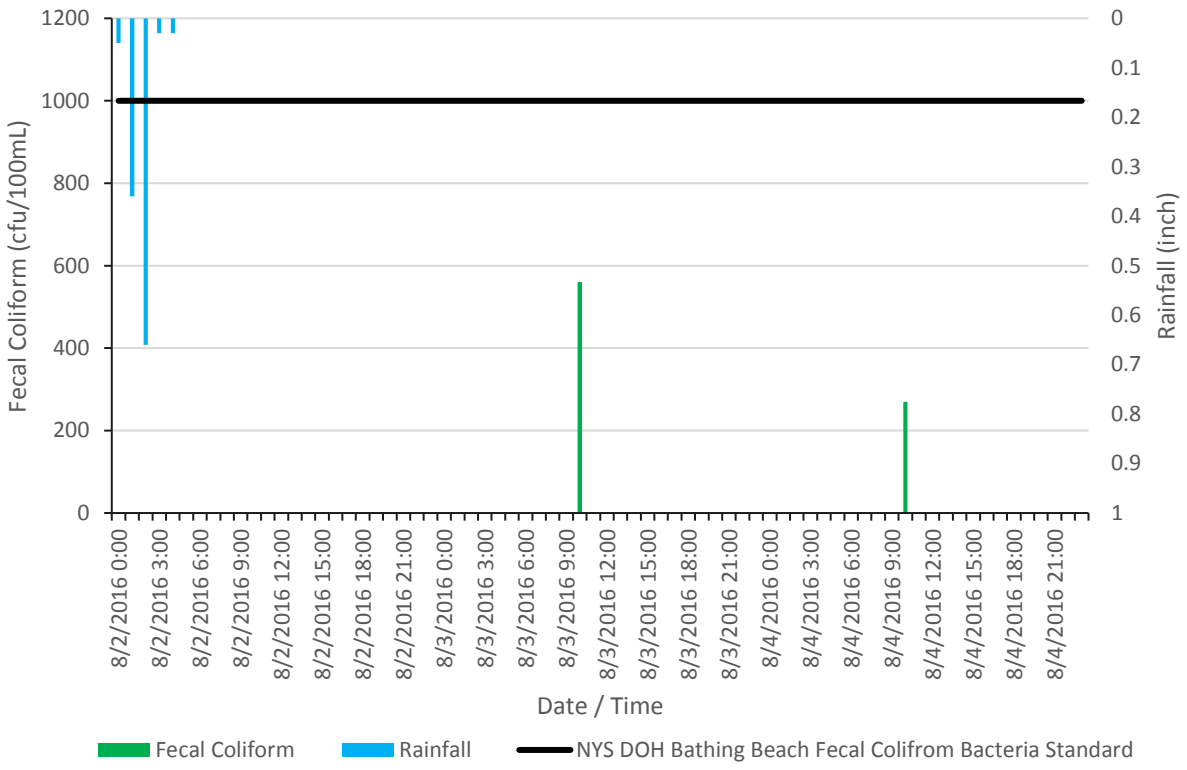

Figure 6-5. River Recovery - August 2-4, 2016

In both cases, the bacteria concentration was below 1,000 CFU/100mL within 24 hours. There were other storm events that resulted in lower fecal coliform spikes based on the grab samples collected, not resulting in exceedances of the bathing beach threshold, nevertheless, they showed recovery within 24-hours to below 200 CFU/100mL.

6.3 Tributaries

In the previous sampling programs completed in 2008 and 2009, only five of the seven tributary sampling locations were included in the PCCMP. The following section discusses the fecal coliform results of the sampling locations that were common to all four years of sampling including Normans Kill (T11-02), Mill Creek (T12-05), Wynants Kill (T13-08), Poesten Kill (T14-11), and Patroon Creek (T16-13).

6.3.1 Dry Weather Data Assessment and Observations

The dry weather geometric means for 2008, 2009, 2015, and 2016 are portrayed in **Figure 6-7**. Based on the data collected, of the five tributaries included in **Figure 6-7**, three were below 200 CFU/100mL for dry-weather events in 2016. While this is an improvement when compared to 2015, it may be due to abnormally dry conditions as discussed in section 6.1. However, the 2016 dry-weather geometric means are consistently greater than that of 2009 with the exception of Patroon Creek. There does not appear to be a conclusive trend in fecal coliform reduction in the tributaries based on the data collected thus far in the

PCCM. The inconsistent fecal coliform samples in the tributaries during dry weather is indicative of unknown sources or watershed impairments.

As discussed in section 4.1 and 4.2, T00-00 and T00-01 were consistently at or exceed the WQS in 2016 and no data is available for comparison in 2008, 2009, or 2015.

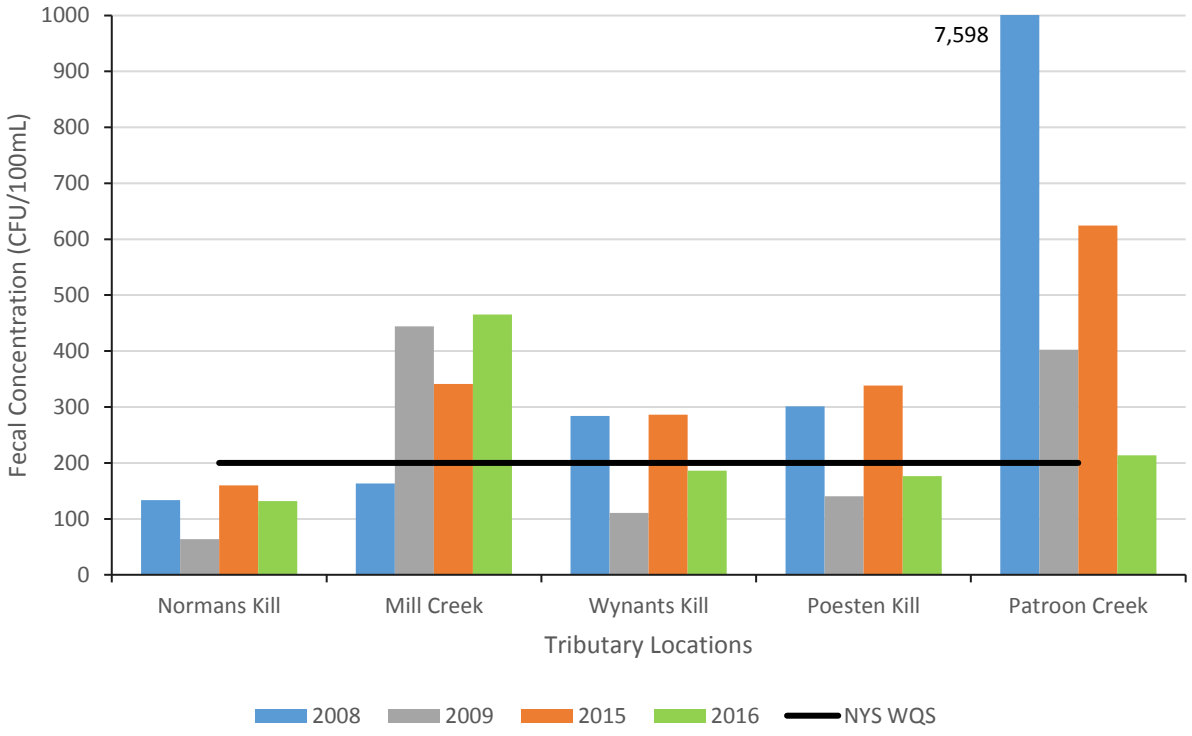

Figure 6-6. Average Dry Weather Geometric Mean Comparison of the Tributaries

6.3.2 Wet Weather Data Assessment and Observations

The wet weather geometric means are portrayed in **Figure 6-8.** The wet weather data suggests a slight improvement in water quality within the tributaries during the 2016 recreational season but the geometric means remained elevated and well above the WQS. The 2016 water quality data shows the single grab samples are within the minimum and maximum ranges of the 2008 and 2009 results. However, the data is fairly consistent between all of the sampling events and shows that wet weather is impacting the tributaries. Based on the consistency of fecal coliform in the tributaries during acute wet weather events, it is evident that the tributaries remain exposed to unidentified sources of fecal coliform and thus contribute to the fecal coliform loading of the Hudson River. What is unknown, if this is from urban stormwater runoff, unknown sources or if bacterial loading is occurring further upstream in the watershed possibly due to urban or agricultural runoff.

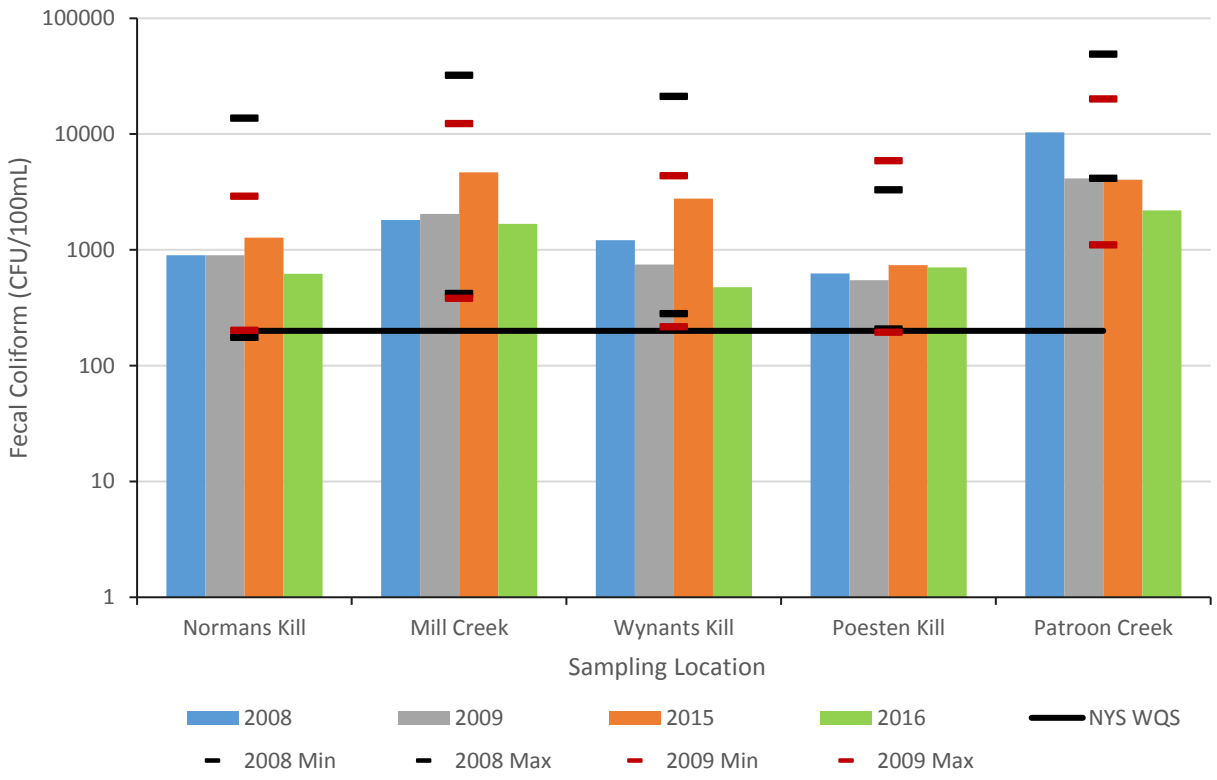

Figure 6-7. Average Wet Weather Geometric Mean Comparison of the Tributaries

7 RECOMMENDATIONS

Based on the data collected and the results obtained in the execution of the second year of the PCCMP, the APJVT offers the following recommendations for modifications of the PCCMP in 2017:

- The APCs should consider installing three new rain gauges capable of recording hourly rainfall data. Rain gauges should be considered at the Troy Water Treatment Plant, and the ACSD North and South Plants

APPENDIX A

Receiving Water Quality Sampling Plan for Post Construction Compliance Monitoring (April 2015)