WATERINSIGHT 2024 ANNUAL WATER QUALITY REPORT

NYenvironcom Monitoring Sites Mapped with Results of Data Collection & Bacterial Load Monitoring

Abstract

The WaterInsight program of NYenvironcom has been monitoring water quality in the Lower Basha Kill and Lower Neversink River drainages of the Delaware River basin from 2020. We aim to improve groundwater quality in the Basha Kill watershed for the local stakeholders of Mamakating, DeerPark and Cuddebackville, NY. In the last year, the program has added new measurement capabilities, continued its bacterial load grab sampling campaigns, worked with external partners to expand its reach and data analysis capacity, and found evidence of point-source pollution along these waterways. Our nine water monitoring stations are equipped with HYDROS 21 CTD- sensors, which monitor the parameters: specific conductivity, temperature and depth. In 2024 a Yosemitech Y511-A Auto-cleaning Optical Turbidity Sensor was added to the Basha Kill Downstream of Northern Dragon Springs (PKBK 3S) datalogger, which is installed in Deerpark, NY. Data from nearby USGS stations were assessed to verify results from our sites.

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Executive Summary

The NYenvironcom 2024 WaterInsight Annual Water Quality Report provides a comprehensive assessment of water conditions in a section of the Lower Basha Kill and Lower Neversink River drainages of the Delaware River basin using data loggers with multiple modality sensors and bacterial load grab sample lab test results. The study employs data loggers equipped with HYDROS 21 CTD sensors across nine monitoring locations to examine key parameters, including specific conductivity, temperature, and depth. These measurements, combined with precipitation and USGS streamflow data, help identify potential pollution sources, seasonal trends, and watershed health fluctuations.

Key findings show specific conductivity spikes at several sites suggesting potential contamination events unrelated to rainfall, pointing to possible industrial or agricultural runoff. Turbidity data from a newly deployed Yosemitech Y511-A sensor revealed irregular spikes, aligning with conductivity anomalies and indicating potential pollutant influxes that further suggest effluent runoff upstream at PKBK 3S.

A severe drought watch was declared by the New York State Department of Environmental Conservation (DEC) in October 2024, affecting Sullivan and Orange counties. Our monitoring stations showed the effects of the drought at 3 of our sites, losing temperature and conductivity data, and multiple depth readings of 0 mm.

Bacteria Load testing results reveal periodic exceedances of EPA and NYS standards for fecal coliforms, emphasizing the need for increased monitoring efforts. The report recommends expanding sensor coverage, enhancing turbidity and dissolved oxygen monitoring, and increasing sample collection frequency to strengthen future environmental assessments.

Overall, the 2024 Water Quality Report emphasizes the importance of continuous, high-resolution monitoring in maintaining environmental health for the Basha Kill watershed and identifying threats. The integration of sensor data with external weather and hydrology records provides a more complete understanding of water quality trends, supporting proactive management strategies for the region.

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Introduction

This report details the analysis of Conductivity, Temperature, and Depth (CTD) sensor data collected from various monitoring sites within the Basha Kill watershed in 2024. Specific conductivity (EC), a measure of water's ability to conduct electricity due to dissolved ions, is a key indicator of water quality. Common sources of dissolved ions include road salts, wastewater, industrial waste, and agricultural runoff. EC is measured in microsiemens per centimeter (µS/cm). Temperature influences conductivity and is a critical factor in riparian ecosystems, affected by weather, seasons, and thermal pollutants. Depth measurements provide insights into hydrological responses to weather events, seasonal changes, and potential environmental stressors. This study also incorporates turbidity data from a new sensor at site PKBK 3S to enhance the detection of environmental impacts and suspicious effluents. Furthermore, fecal coliform sampling was conducted to assess potential contamination from untreated wastewater or agricultural runoff. The integration of these datasets, along with comparative data from nearby USGS stations, aims to provide a comprehensive understanding of water quality dynamics and identify potential pollution sources within the Basha Kill watershed.

Map of Monitoring Stations

Geographical Information Systems and mapping technologies are a powerful tool to visualize watershed assessment data. Geospatial data assists in data collections by indicating where a site senses an effluent conductivity spike, how far downstream it occurs, and when in time this spike occurs, along with its total duration, as it moves through the watershed. Table 1 lists the sites with location details for reference. Figure 1 is a map of our stations and nearby USGS stations, which were used for demonstrating the trends, with a comparison to help interpret data. Watershed mapping can be used to show data of the surrounding topography, tributaries, adjacent wetlands, or likely pollution sources. In Figure 1, the map of monitoring stations provides a spatial overview of the nine sites along the Basha Kill, establishing the foundation for the data collected throughout 2024. All sites will be referenced in order from most upstream to furthest downstream throughout this report to show the annual trends in conductivity, temperature, and depth.

Table 1. Description of all monitoring stations with coordinates and the closest town.

Location of Site	Site name	Latitude, Longitude	Nearest town
Basha Kill above USGS station	(PKBK 7S)	41.50, -74.551	Mamakating
Basha Kill OCLT-2	(PKBK 10S)	41.46254, -74.58548	Cuddebackville
Basha Kill OCLT-1	(PKBK 8S)	41.46146, -74.58549	Cuddebackville

Basha Kill Upstream of Dragon Springs	(PKBK 2S)	41.45869, -74.58654	Deerpark
Basha Kill Downstream of Northern Dragon Springs	(PKBK 3S)	41.45218, -74.59112	Deerpark
Basha Kill Further Downstream of Dragon Springs	(PKBK 4S)	41.450909, -74.591978	Deerpark/Cuddebackville
Basha Kill just above the Neversink	(PKBK 6S)	41.45029, -74.592622	Deerpark
TNC Along Neversink	(PKBK 5S)	41.44769, -74.59511	Cuddebackville
Downstream of New Century Films	(PKBK 9S)	41.39888, -74.6459	Cuddebackville

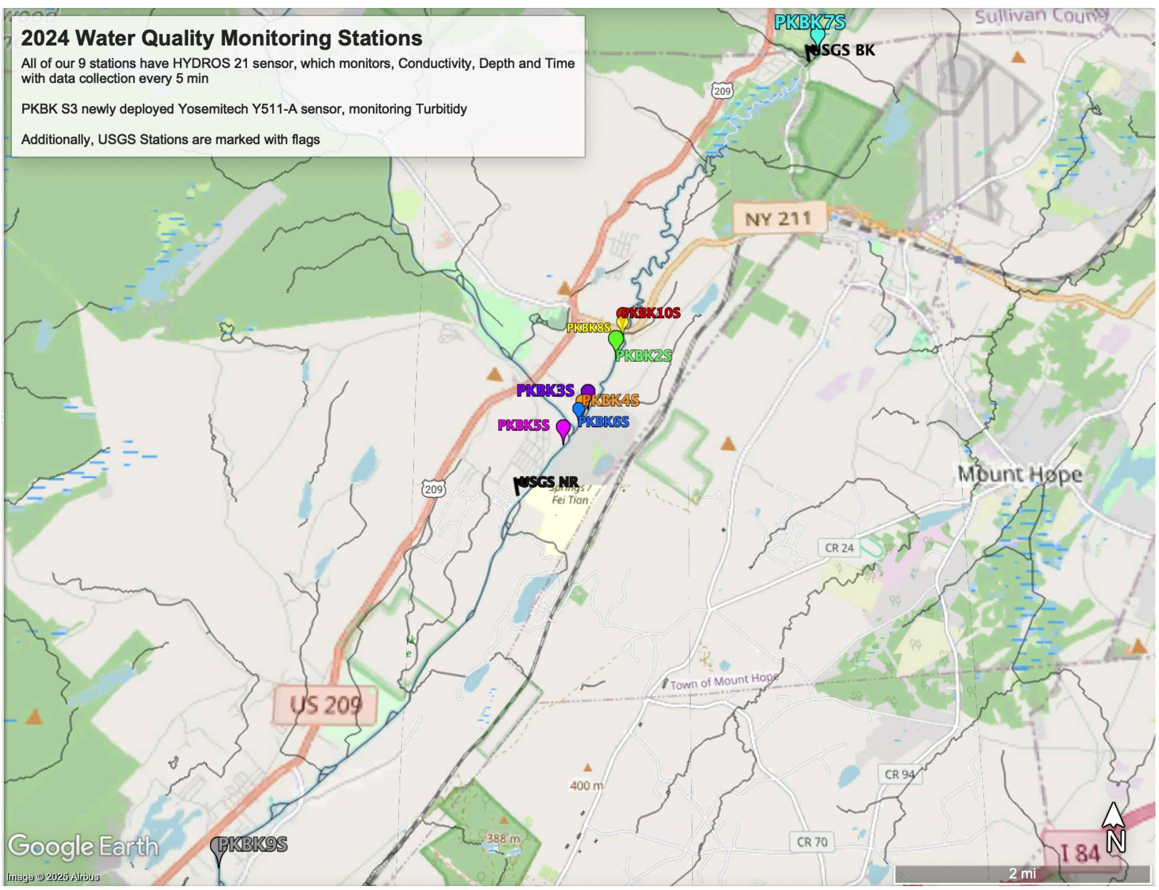

Figure 1. Map of Basha Kill Monitoring Stations A geographic overview of the nine sensor sites along the Basha Kill, arranged from the furthest upstream to the furthest downstream relative to the Neversink River. USGS Sites are labeled with flags, sensor stations from furthest upstream to downstream,in this order: PKBK 7S, PKBK 10S, PKBK 8S, PKBK 2S, PKBK 3S, PKBK 4S, PKBK 6S, PKBK 5S, PKBK 9S.

Methods

To assess the water quality dynamics within the Basha Kill watershed in 2024, a multifaceted data collection and analysis approach was employed. Continuous data on specific conductivity, temperature, and depth were gathered using HYDROS 21 CTD sensors deployed at nine monitoring sites (PKBK 7S, PKBK 10S, PKBK 8S, PKBK 2S, PKBK 3S, PKBK 4S, PKBK 6S, PKBK 5S, and PKBK 9S), with notations made for periods of sensor downtime or data loss due to drought. At site PKBK 3S, a Yosemitech Y511-A Turbidity Sensor was installed to measure turbidity in nephelometric turbidity units (NTU).

Additionally, data from two proximate USGS stations ("Basher Kill Blw Basha Kill Marsh at Westbrookville – 01437349" and "Neversink River at Godeffroy, NY – 01437500") served as benchmarks for specific conductivity, temperature, depth, and discharge rates. The analysis involved examining trends in specific conductivity for pollution indicators, calculating statistical summaries (mean, minimum, maximum, standard deviation) for conductivity and temperature, and correlating temperature with conductivity anomalies. Depth measurements were analyzed along with precipitation data to understand hydrological responses and drought impacts. Meteorological data, specifically precipitation and temperature from Port Jervis, were utilized for comparison against historical averages (1990-2023) to contextualize observed weather anomalies. A cross-sensor and comparative analysis, incorporating USGS data, was performed to achieve a comprehensive understanding of watershed dynamics, pollutant transport, and potential effluent sources.

Turbidity data from PKBK 3S were integrated with conductivity and depth to identify responses to rainfall and anomalous spikes. Bacteria load sampling was conducted at three key locations near site PKBK3 (Pond, Basha Kill Bridge/Tributary, and Basha Kill Stream) on four dates (5/03/2024, 6/05/2024, 7/10/2024, and 8/14/2024), with results reported as Most Probable Number (MPN) per 100mL. Fecal coliform results were compared against EPA/NYS standards and historical data.

Results

Specific Conductivity

The analysis of specific conductivity (EC) across monitoring sites, as depicted in Figure 2, revealed rapid spikes at PKBK 3S, PKBK 8S, PKBK 4S, PKBK 10S, and PKBK 6S, suggesting potential pollution events. Notably, PKBK 3S exhibited extreme EC variability that did not consistently correlate with storm events and showed spikes unique to this location, not mirrored upstream at PKBK 2S or downstream at PKBK 4S. Site PKBK 8S displayed constant high EC fluctuations, apparently linked to precipitation-driven groundwater runoff, a pattern supported by statistical data (Table 2.), which also indicated that upstream stations like PKBK 7S (mean 153.30 µS/cm), and PKBK 8S (mean 150.24 µS/cm) generally had higher average EC and variability than downstream sites.

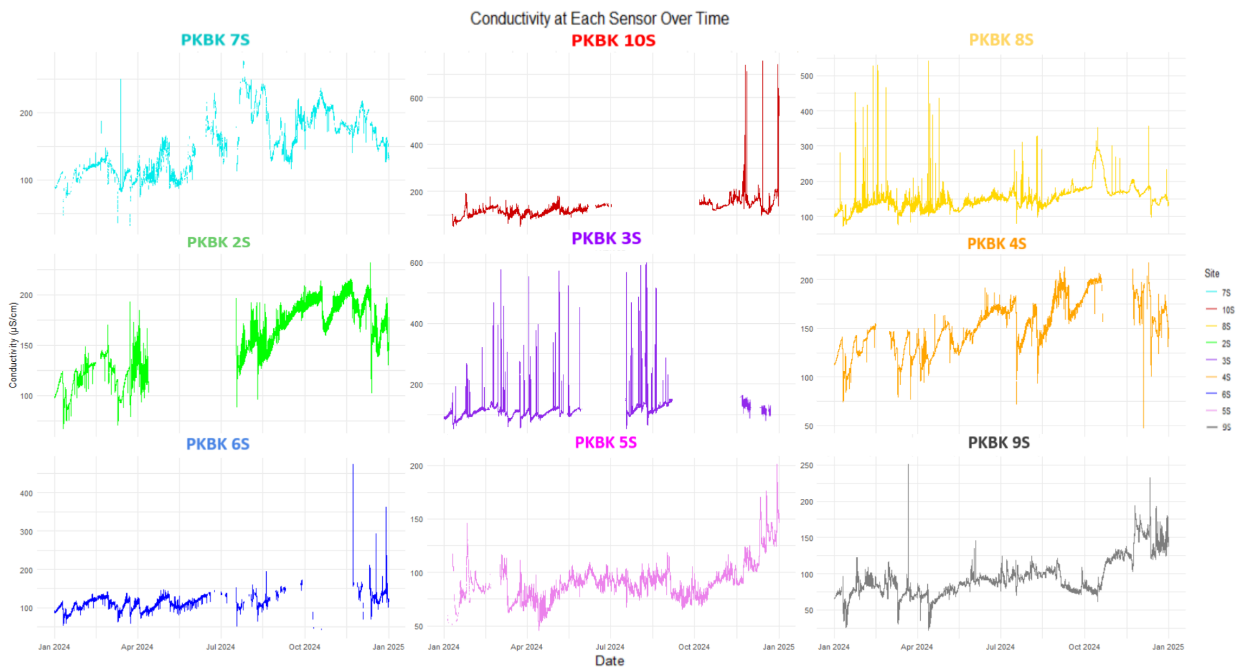

Figure 2. Specific Conductivity Trends across Monitoring Sites (2024)
Measurements (in µS/cm) at all sites, with annotations for sensor downtime (PKBK 10S: 7/1–10/5, PKBK 2S: 4/14–7/17, PKBK 3S: 5/30–7/17) PKBK 3S, PKBK 4S, and PKBK 6S, had sensors that lost data due to the drought in October and November. Rapid spikes at sites such as PKBK 3S, PKBK 8S, PKBK 4S, PKBK 10S, and PKBK 6S suggest potential pollution events, while gradual increases at other sites may indicate cumulative pollutant buildup.

Table 2. Summary Statistics for Specific Conductivity

Displays the mean, minimum, maximum, and standard deviation of EC values (µS/cm) for each monitoring site. Upstream stations (e.g., PKBK 7S, PKBK 8S) exhibit higher averages and variability compared to downstream sites. (n/a values are due to incomplete data sets)

Site:	PKBK 7S	PKBK 10S	PKBK 8S	PKBK 2S	PKBK 3S	PKBK 4S	PKBK 6S	PKBK 5S	PKBK 9S
Mean	153.30	n/a	150.24	n/a	n/a	n/a	n/a	90.61	94.00
Min	30.8	50	71.8	67.2	1.2	2	1.2	45.8	22
Max	276.7	756.2	541.3	231.8	599.5	417.3	473	200.8	250.3
Standard Deviation	41.23	n/a	35.52	n/a	n/a	n/a	n/a	17.71	26.26

Temperature

Temperature data, illustrated in Figure 3, showed typical seasonal fluctuations across all sites, generally following a bell curve. However, sites PKBK 2S, PKBK 3S, PKBK 4S, and PKBK 6S recorded slightly warmer temperatures during daily oscillations in the earlier months, and a notable temperature spike occurred across all sites in March, with another unseasonal spike in mid-October coinciding with sensor outages at three sites. Upstream sites PKBK 7S and PKBK 8S had slightly higher average temperatures (12.86°C and 12.22°C, respectively) compared to downstream sites PKBK 5S and PKBK 9S (12.18°C and 11.96°C, respectively), as detailed in Table 3.

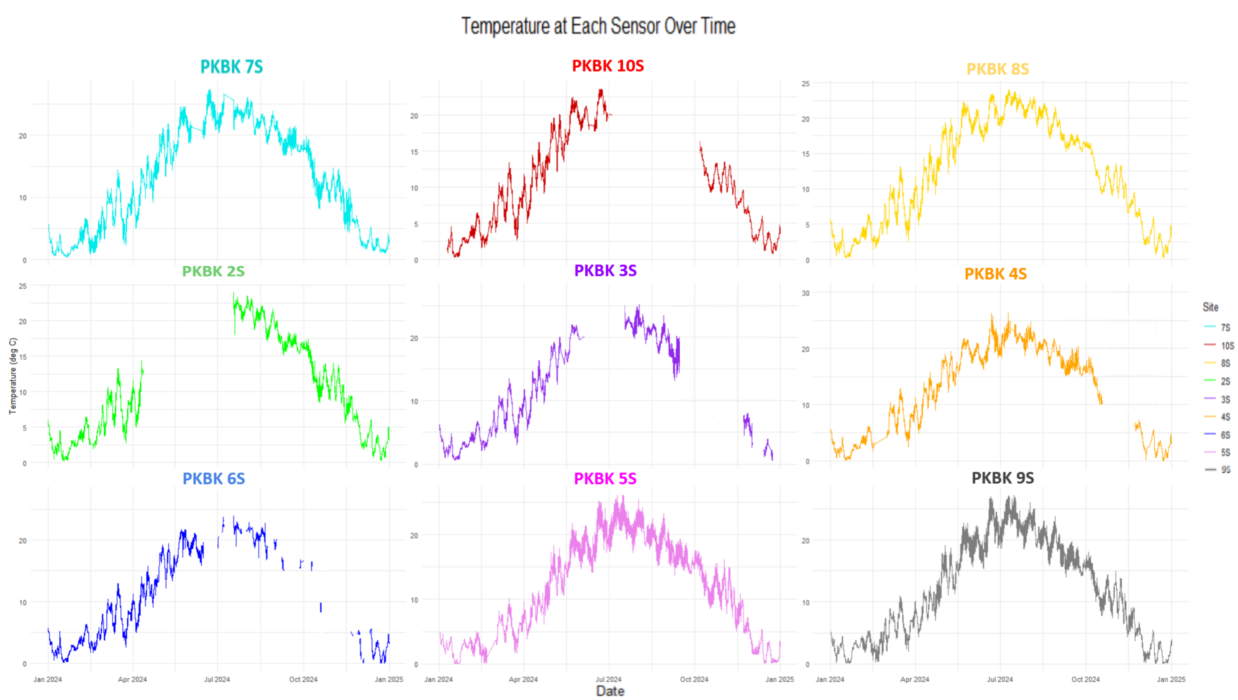

Figure 3. Water Temperature Trends (2024)

Seasonal water temperature profiles (°C) across monitoring sites. Note sensor outages (PKBK 10S: 7/1–10/5, PKBK 2S: 4/14–7/17, PKBK 3S: 5/30–7/17), and PKBK 3S, PKBK 4S, and PKBK 6S, had sensors offline in October and November.

Statistics were calculated for PKBK 7S, PKBK 8S, PKBK 5S and PKBK 9S (Table 3.). PKBK 7S and PKBK 8S, two upstream sites, had slightly higher averages than PKBK 5S and PKBK 9S the two most downstream sites. All sites experienced an unseasonal spike in Mid-October which is when PKBK 3S, PKBK 4S, and PKBK 6S went offline.

Table 3. Temperature Statistics for Select Monitoring Sites
mean, minimum, maximum, and standard deviation for water temperatures (°C) at four key sites, illustrating seasonal thermal variations across the watershed.

Site:	PKBK 7S	PKBK 8S	PKBK 5S	PKBK 9S
Mean	12.86	12.22	12.18	11.96
Min	0.35	0.3	0.1	0.1
Max	27.4	24.1	26.1	27.2
Standard Dev	7.64	7.16	7.05	7.67

Depth

Depth measurements (Figure 4 and Table 4) indicated increased fluctuations in post-precipitation events, but a significant drought between September and November led to 0 mm depth readings at PKBK 3S, PKBK 4S, and PKBK 6S, aligning with Port Jervis weather data that showed precipitation at less than 25% of the historical average (Figure 5, Table 4). Following this drought, sharp spikes in both EC and depth were observed at PKBK 4S and PKBK 6S in late November and December, suggesting discharge effluents, an anomaly first noted between PKBK 3S and PKBK 4S. By 2025, sites had recovered after significant precipitation.

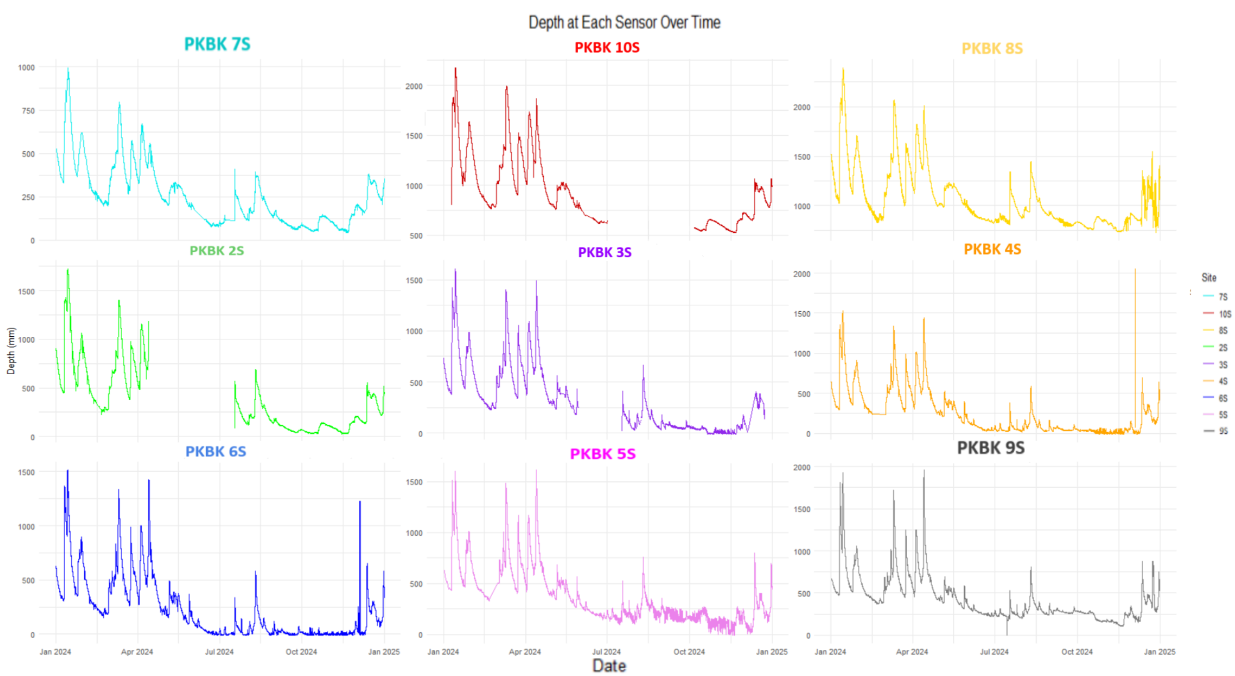

Figure 4. Depth Measurements across Monitoring Sites (2024)
Depth data (in mm) illustrating watershed response to rainfall events and drought conditions. Variations are evident, including periods of 0 mm readings at select sites during the drought.

Table 4. 2024 Baseline Depth Statistics by Monitoring Site
Summarizes depth data (in mm) for each station, including mean, minimum, maximum, and standard deviation values, with emphasis on site-specific variability and drought impacts

Site	PKBK 7S	PKBK 10S	PKBK 8S	PKBK 2S	PKBK 3S	PKBK 4S	PKBK 6S	PKBK 5S	PKBK 9S
Mean	233.61	956.75	1062.08	374.98	399.00	261.92	262.18	341.31	419.87
Min	41.7	524	724.5	26	0	0	0	0	104.8
Max	994	2177.3	2395.2	1721.7	1606.3	2051.5	1512.7	1613.7	1956.8
Standard Deviation	157.08	352.10	290.91	344.26	327.37	283.38	289.45	254.43	258.61

Weather data

PKBK 3S, PKBK 4S, PKBK 6S and PKBK 5S had minimum depth values of zero during September through mid-November due to the drought illustrated in Figure 5. and Table 5., with precipitation data for Port Jervis these months. Sustained low depth values indicate a poor base flow in midstream sites and may signal a threat to groundwater recharge rates. By 2025 the sites were able to recover after heavy precipitation events. Figure 6. compares rainfall during this time to historical averages. Between September 1st and November 19th precipitation accumulation was just below 2.5 inches, historical average during these dates was approximately 11 inches.

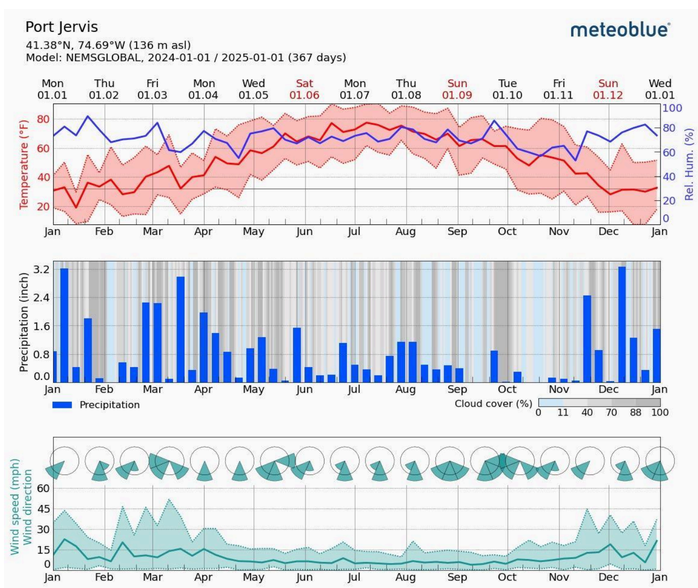

Figure 5. 2024 Meteorological Monthly Averages vs. Historical Averages
Compares monthly precipitation (in inches) and average temperatures (°F) from Port Jervis in 2024 with historical averages (1990–2023), providing context for the observed weather anomalies.

Table 5. 2024 Meteorological Data vs. Historical Averages
Compares monthly precipitation (in inches) and average temperatures (°F) from Port Jervis in 2024 with historical averages (1990–2023), providing context for the observed weather anomalies. Provided by NOAA

Precipitation in Inches	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual*
2024 Accumulation	7.00	1.77	6.04	4.25	4.67	1.85	3.30	8.06	1.80	0.13	4.05	3.11	46.03
1990-2025 Average	3.21	2.59	3.62	3.69	3.67	4.39	4.51	4.73	4.52	4.59	3.18	3.99	46.58
Temperature in degrees °F	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual*
2024 Averages	29.5	32.2	40.9	48.6	62.2	70.4	75.0	69.9	62.5	52.7	44.1	28.9	51.4
1990-2025 Average	26.4	28.4	36.8	48.5	59.4	67.9	72.9	70.9	63.4	52.1	40.8	31.6	49.3

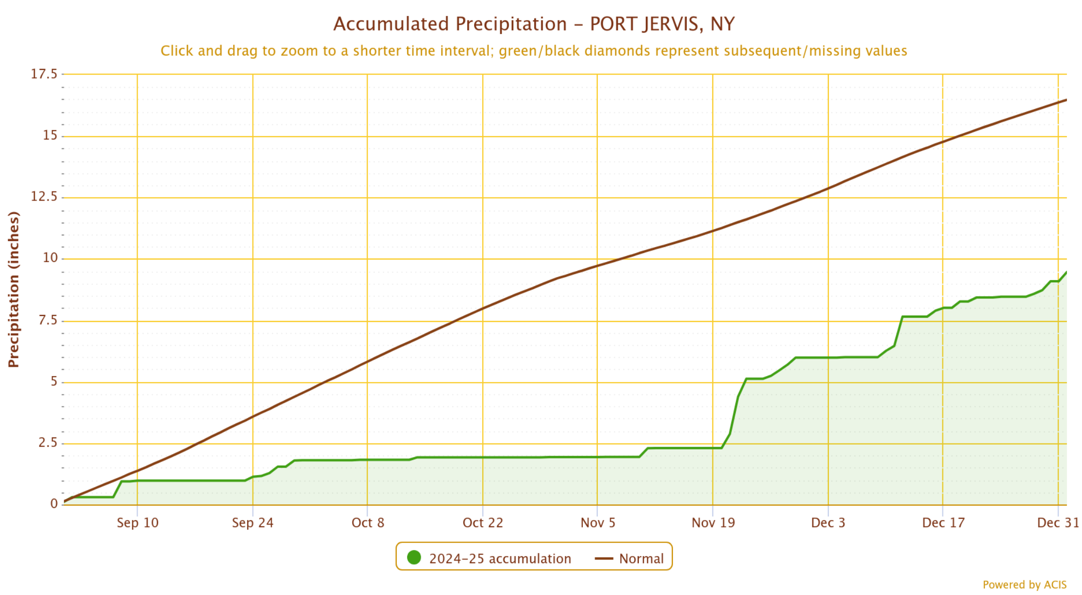

Figure 6. 2024 Precipitation Trends from Port Jervis
Monthly precipitation accumulation compared to historical averages, highlighting a pronounced dry period between September 1 and November 19.

CTD sensors are an amazing tool to collect valuable data for conservationists and stakeholders to understand patterns about their local watershed, but there are limitations to what can be determined from that information. Our new turbidity sensor provides a more comprehensive view of the watershed dynamics occurring at PKBK 3S.

Turbidity Analysis at Site PKBK 3S

The recent installation of a turbidity sensor at site PKBK 3S has yielded significant insights into water quality dynamics (Figure 7). Analysis of the data revealed a notable inverse relationship between water depth and both specific conductivity (EC) and turbidity levels following a heavy rainfall event on September 8th. During this event, EC levels decreased as water depth rose, peaking at 110.2 mm. Subsequently, as the water depth returned to normal levels, a distinct turbidity spike of 24.7 NTU was recorded on September 10th.

Of particular concern are the multiple turbidity spikes observed on dates with minimal or no rainfall, such as September 14th and 18th, and October 6th and 9th. These occurrences, which were often accompanied by fluctuations in conductivity and depth, suggest potential point-source pollution events or the resuspension of internal sediments rather than typical runoff patterns. These findings underscore the value of continuous turbidity monitoring in identifying atypical water quality changes.

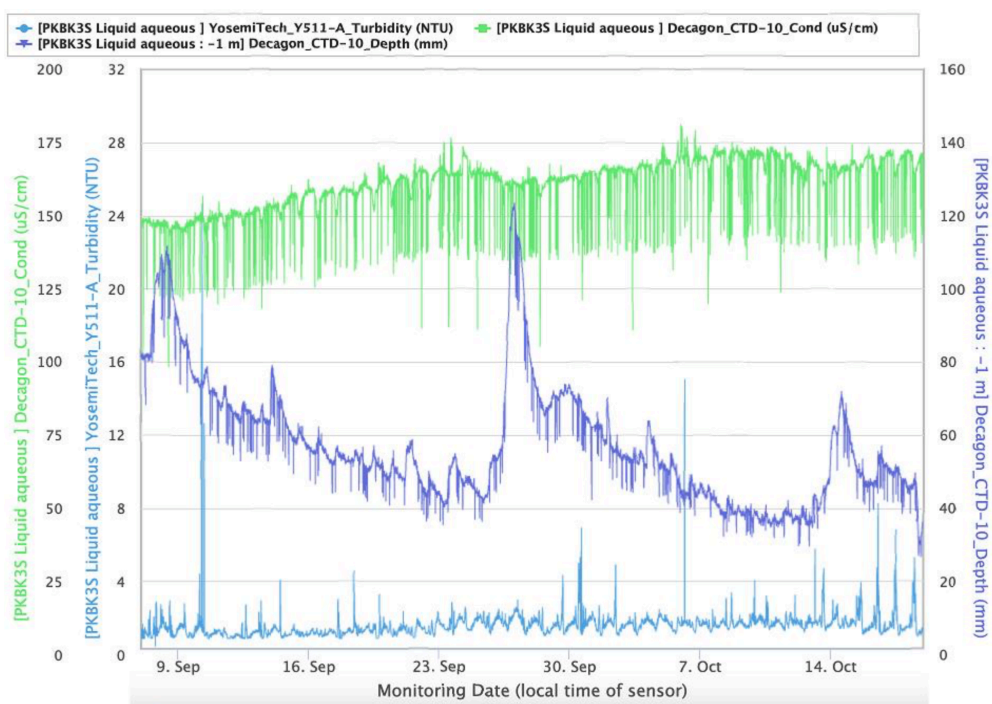

Figure 7. Integrated Turbidity, Conductivity, and Depth Analysis at PKBK 3S. Dark blue is depth, with the y axis on the right, Light blue is turbidity with the y axis on the left, and Conductivity is in green with the y axis on the left. Data is from the newly installed turbidity sensor (NTU),along with specific conductivity and depth measurements. The graph captures responses to rainfall events as well as anomalous spikes on non-precipitation days (e.g., September 14, 18; October 6, 9) that suggest possible point-source pollution.

Bacteria Load Testing

Monitoring fecal coliform bacteria is a critical component of assessing the environmental health of the Basha Kill watershed. These bacteria originate in the intestines of warm-blooded animals, and their presence in water can indicate contamination from sources such as untreated wastewater or agricultural runoff, potentially signaling the presence of other harmful pathogens.

In 2024, samples were collected on May 3rd, June 5th, July 10th, and August 14th from three key locations: the Pond (BK2A), upstream of the pond at the Basha Kill Bridge/Tributary (BK1A), and downstream of the Dragon Springs Facility and adjacent to the Pond (BK2B). Sampling sites are illustrated in Figure 8.

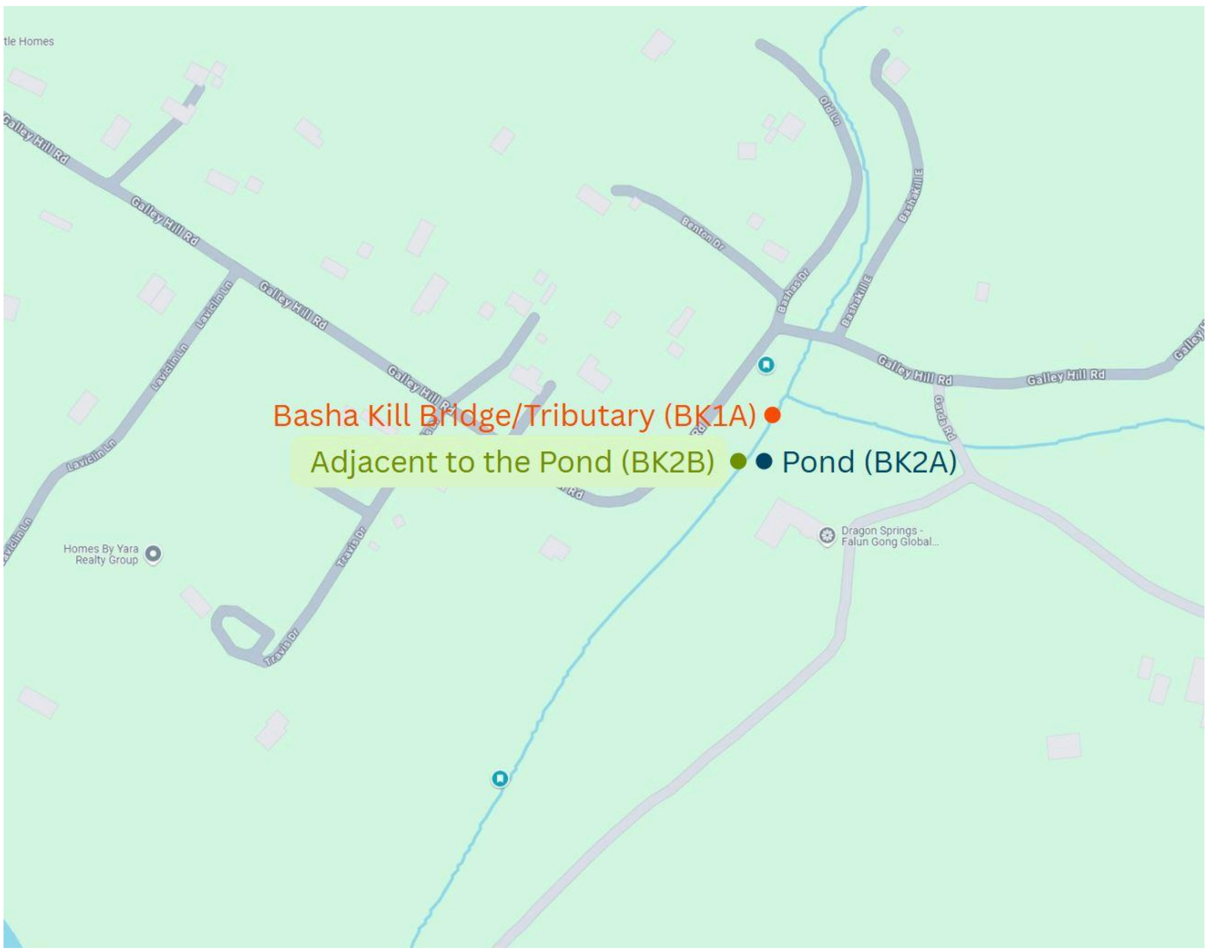

Figure 8. Map of sampling sites: the Pond (BK2A), upstream of the pond at the Basha Kill Bridge/Tributary (BK1A), and downstream of the Dragon Springs Facility and adjacent to the Pond (BK2B).

Results are reported as Most Probable Number (MPN) per 100 mL, with the EPA and New York State standard for Class B and C waters set at 200 MPN/100mL.Out of twelve samples collected in 2024, eleven showed fecal coliform presence greater than 1 MPN/100mL. Four of these samples exceeded the 200 MPN/100mL standard. Results for 2024 are shown in Figure 9.

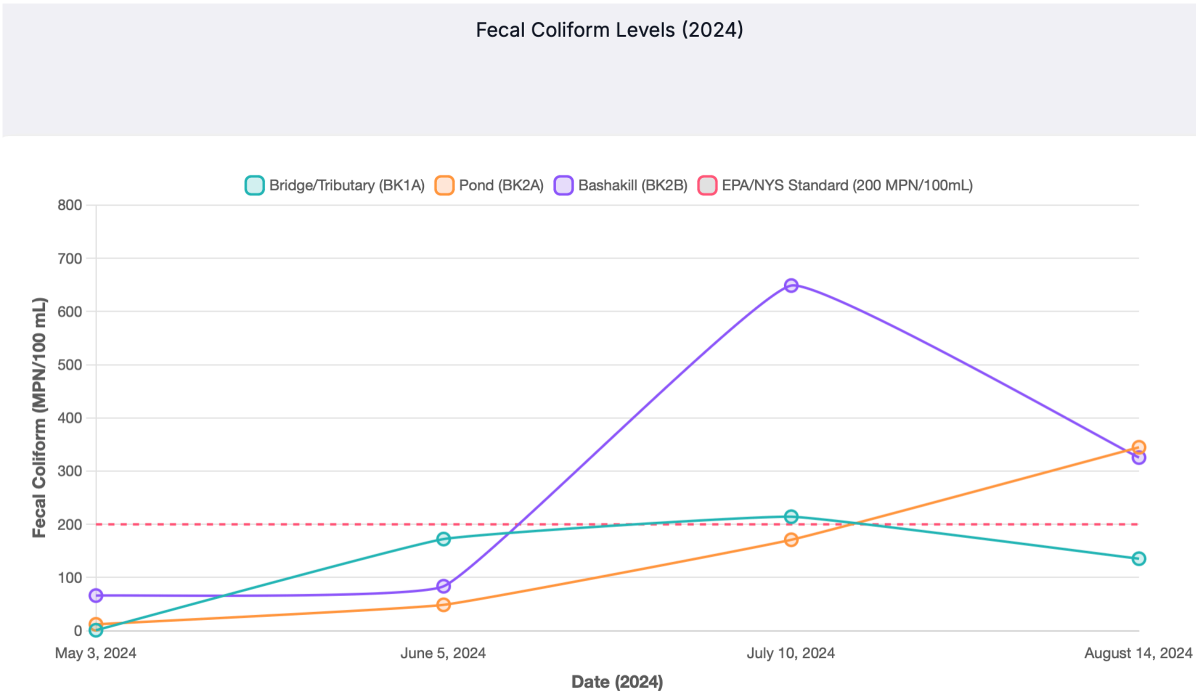

Figure 9. Fecal Coliform levels for the three sites (Bridge/Tributary BK1A, Pond BK2A, and Basha Kill BK2B). On July 10th, the Bridge/Tributary (BK1A) site measured 214.3 MPN/100mL and the Basha Kill downstream site (BK2B) recorded a significantly higher level of 648.8 MPN/100mL. On August 14th, two sites surpassed the standard: the Pond (BK2A) site at 344.8 MPN/100mL and the Basha Kill downstream site (BK2B) at 325.5 MPN/100mL.

The significant difference in fecal coliform counts between the upstream site BK1A and the downstream site BK2B, along with the elevated levels observed, suggests potential upstream effluent contamination impacting the Basha Kill watershed. These findings underscore the need for further investigation to identify and verify the specific sources of this fecal coliform pollution.

Comparative analysis with USGS data (Specific conductance at Westbrookville)

By integrating USGS data, we can also detect tributaries that potentially dilute point-source pollution and verify any suspicious trends observed in our sensors. However, the USGS stations alone are too far apart to provide a complete picture of water quality in the Basha Kill watershed. There was a USGS station previously located in Cuddebackville between sites PKBK 2S and PKBK 3S that was discontinued in 2020. Our monitoring sites at PKBK 3S, PKBK 4S, and PKBK 6S now fill this gap, especially with their proximity to bacteria load sampling locations. This further strengthens our overall data collection.

The discharge rates at upstream Basha kill wetlands USGS station serve as a major hydrological input for the Basha kill watershed (Figure 10.). This data concurrent with our monitoring station with depth and specific conductivity (EC) can provide a generalization of how discharge moves through the watershed. In figure 2. baselevels of EC increase at sites; PKBK 10S, PKBK 8S, PKBK 2S, PKBK 3S, PKBK 4S, and PKBK 6S show an inverse relationship with discharge rate data at USGS monitoring station. This observation alone provides insight on how impactful this hydrological input is on the watershed.

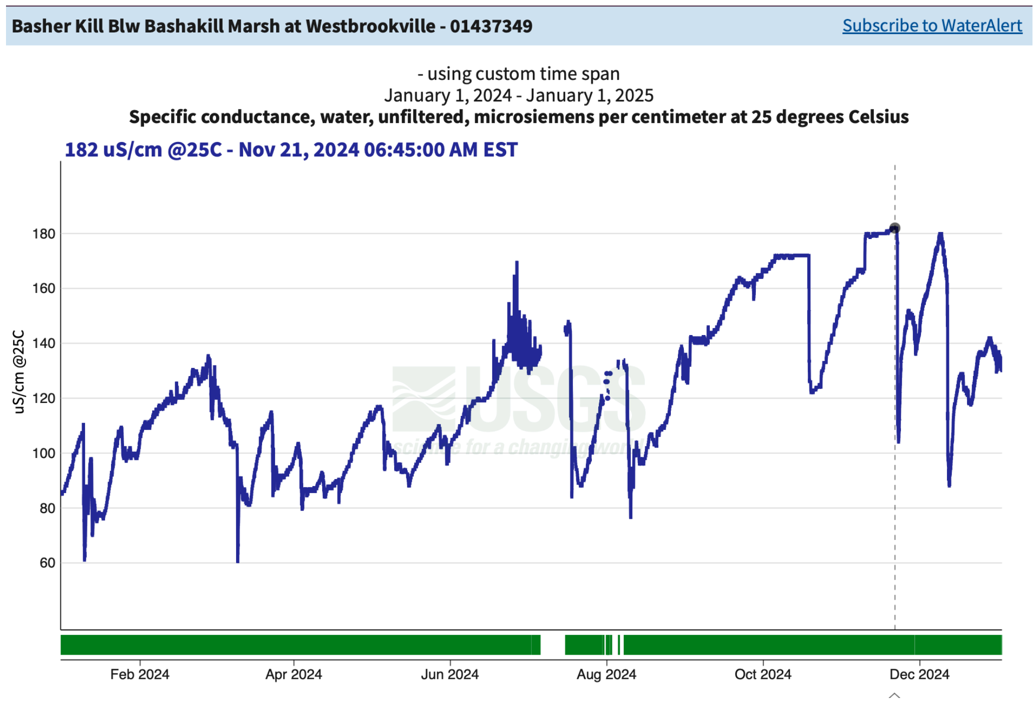

Figure 10. Comparative analysis with USGS data revealed that base EC levels at several PKBK sites (10S, 8S, 2S, 3S, 4S, and 6S) showed an inverse relationship with discharge rates from the upstream USGS station.

Conclusions

The comprehensive 2024 analysis of CTD sensor data, turbidity, bacteria loads, and meteorological information for the Basha Kill watershed identified several irregularities and potential environmental concerns, highlighting specific contamination hotspots, particularly upstream at sites PKBK 3S and PKBK 8S. While EC spikes at PKBK 8S appeared linked to precipitation-driven runoff, those at PKBK 3S did not consistently correlate with such events; integrated turbidity, depth, and EC data from PKBK 3S during the September-November drought suggested irregular activity not associated with rainfall, indicating a need for further investigation into potential point-source pollution. The watershed experienced alarmingly low water depths during a prolonged dry period, and USGS discharge data pointed to potential baseflow instability, signaling possible climate vulnerability. Fecal coliform results frequently exceeded standards, with 2024 averages at upstream and pond-adjacent sites being higher than previous records, suggesting potential upstream effluent contamination requiring source identification. Although 2024 EC spike values were lower than the previous year, data gaps prevented a definitive conclusion on frequency changes. Overall, EC values were relatively higher in the Basha Kill before its confluence with the Neversink River. This multifaceted data approach has proven crucial in pinpointing areas and periods of concern, underscoring the need for continued monitoring and targeted investigations to protect the Basha Kill watershed's environmental health, with the new turbidity sensor and USGS data integration significantly enhancing the ability to discern watershed dynamics and pollution origins.

Future Work

To further enhance our understanding and protection of the Basha Kill watershed, several initiatives are planned for the future. Our data collection will be improved by installing turbidity sensors at additional strategic sites and introducing dissolved oxygen sensors, which will provide crucial data for a more thorough assessment of the watershed's ecosystem health. We will also be repositioning existing sensors at sites PKBK 2S, PKBK 3S, and PKBK 4S to ensure they are better prepared for all weather conditions, thereby preventing data loss in 2025. Seasonal routine checkups on all sites will further aid in proactively addressing potential issues and minimizing data gaps due to extreme weather. Given the indications of point-source pollution, particularly at site PKBK 3S, and recurrent high fecal coliform counts, future efforts will include targeted investigations to pinpoint the origins of these contaminants, potentially involving more intensive upstream sampling. Furthermore, we would like to conduct a comprehensive analysis correlating water quality data with surrounding land use pattern, such as agricultural, industrial, or residential development, using Geographic Information Systems (GIS) to identify potential non-point sources of pollution and better understand their influence on the Basha Kill, which will inform targeted management and conservation strategies. Finally, we will continue to increase the frequency of sampling for fecal coliform counts when initial results exceed surface water standards. In line with New York regulations, if samples indicate an average of 200+ MPN/100mL over a minimum of five tests within a 30-day period, NYenvironcom will ensure State authorities are notified to facilitate public information and investigation of the violation.

Resources:

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