NYENVIRONCOM WATERINSIGHT 2022 ANNUAL WATER QUALITY REPORT

NYenvironcom High-Frequency Data Logger/Sensor Station Monitors & Bottle Testing

Abstract

In 2022 the NYenvironcom WaterInsight program's water quality data logger stations had their highest level of data retention since their first installations in spring of 2020. Updated data protocols were implemented to improve data analytics and maintain high-quality results. Logger stations recorded large runoff events from precipitation capturing spikes in conductivity to monitor pollution. Year-round weather data was analyzed to provide a more comprehensive view of the processes in the watershed. Bottle tests for fecal coliform tests continued with results recording the highest records of fecal bacteria found in surface waters tested to date.

Ken Johnston

NYenvironcom Water Quality & Wetland Technician

2022 Summary

The year 2022 was a formidable year for NYenvironcom's high-frequency water quality data logger/sensor stations. The stations. collected the most water quality data since the stations went online in the spring of 2020. Most stations collected high-quality data for long periods without data gaps or the need for data cleaning. In previous years, stations went offline for a variety of reasons; this year's results have shown tremendous improvement with more high-quality data collection and improved data retention at several stations.

The staff has also revamped their quality control and quality assurance protocols to ensure data analysis provides the best and most representative data results. Stations PKBK4S and PKBK7S performed the best for data retention. Observations of strong storms throughout the year were recorded showing an influx of runoff and consequent spikes in conductivity. Significant temperature swings in summer were recorded giving insight into variability in water temperatures when water levels are low.

NYenvironcom staff and volunteers continue to maintain, repair, monitor, and improve each high-frequency sensor station. Routine maintenance is scheduled to clean sensors and check the site to ensure sensor stations are functioning properly.

Our team has begun planning for future hardware and sensor installations. This spring 'turtles' will be installed at several stations. Turtles are sensor anchors to improve the robustness of sensors protecting them from large debris or other potential damage. This new sensor mount will make maintenance easier and installation/deployment more stable in rocky streams. In addition, our team has preliminary plans to install dissolved oxygen sensors. These sensors provide insight into the streams' metabolism and respiration rates. Dissolved oxygen data will provide important data when water temperatures are high; high water temperatures reduce dissolved oxygen concentrations affecting organism function and survival.

Bottles tests for the bacteria colonies' fecal coliform were conducted six times through summer and fall in the Basha Kill River and its adjacent pond. Nitrates, iron, and lead were tested once in August. IN four out of six samples, results showed consistently high and by state regulations unacceptable levels of fecal coliform. The highest levels were recorded in late August and mid-October.

High-Frequency Water Chemistry Results

Conductivity

Conductivity at all sites where data is available appears to follow a similar pattern throughout the year indicating consistent conditions throughout all sites. This observation was made in 2022 as well. Spikes in conductivity were observed at all sites during heavy precipitation events where runoff entered the Basha Kill from sewage effluent and other point and non-point sources. Short durations of high conductivity or spikes often indicate high concentrations of salts, sediment, and other dissolved substances normally resulting in lower water quality. Underlying geology contributes to observed high conductivity baseflow (times of no precipitation) in the water. Raw conductivity data for the year at all stations is shown in Figure 1.

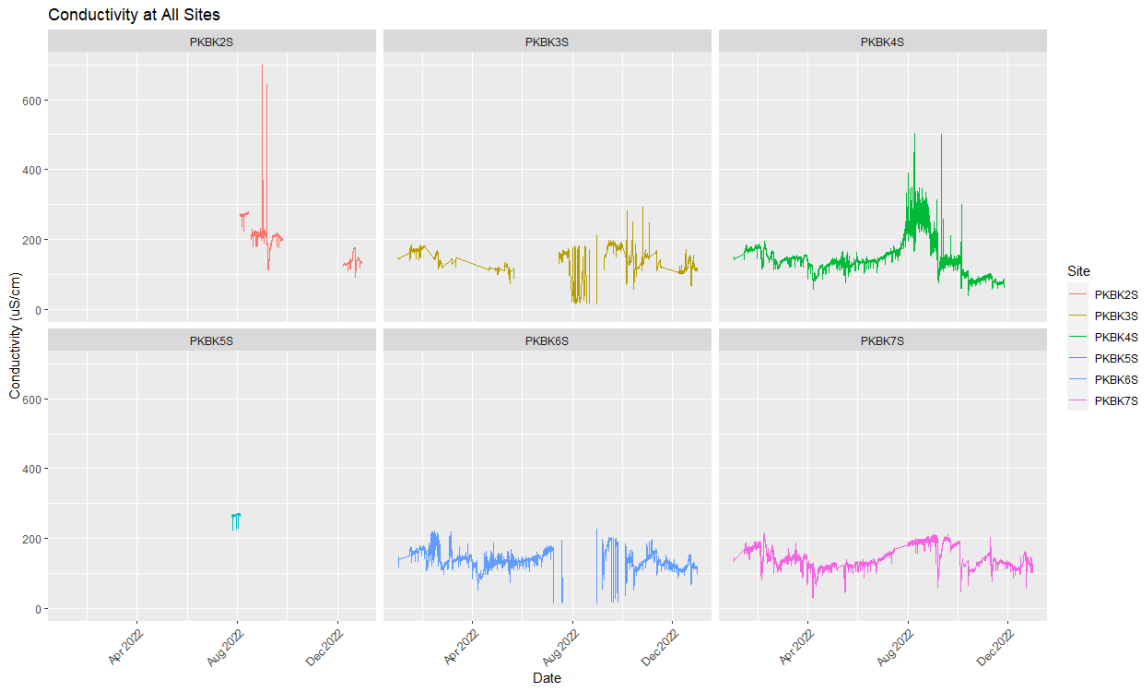

Figure 1. Raw conductivity data at all stations. Large spikes in September from a large rain event are presented in 2S and 4S. Conductivity data at stations 3S, 4S, and 6S become highly variable with large swings in daily values likely due to fouling of the sensor and low water levels increasing ion concentrations. Some known outliers from 6S were deleted.

Comparing the results to last year, data retention is significantly higher suggesting that volunteers and staff are becoming more proficient at checking station health. Stations 3S, 4S, 6S, and 7S performed the best for data retention while 2S and 5S had connectivity issues and suspected rodent damage to sensor wires.

Figure 2 presents specific conductance data at sites PKBK4S and PKBK7S. Both sites obtained high data retention and reliable results for the year. The figure shows large storm events spikes in specific conductance, followed by the coinciding reduced conductivity caused by the dilution

of ions from large amounts of water. Results show that water quality is a complex function of hydrologic, precipitation, and watershed characteristics. This is more evident in 7S data for reasons unknown but could be due to water levels, depth of sensor, station position on the river, and the stream physiology at the site. Additionally, when water levels were at their lowest in August and September, large daily fluctuations in conductivity were recorded. This could be due to fouling of the sensor in conjunction with low water levels creating higher ion concentrations during this period.

There is a need to determine year-round discharge calculations for the Neversink and Basha Kill Rivers using existing USGS stations and additional staff gauges. This would allow calculations of water volumes, validation of transducers and concentrations of ions and other materials. NYenvironcom is researching the requirements to install staff gauges at the upper and downstream stations of Neversink and Basha Kill. Flow curves should be created at the further upstream and downstream sites to effectively evaluate the discharge, annual loading, and water levels.

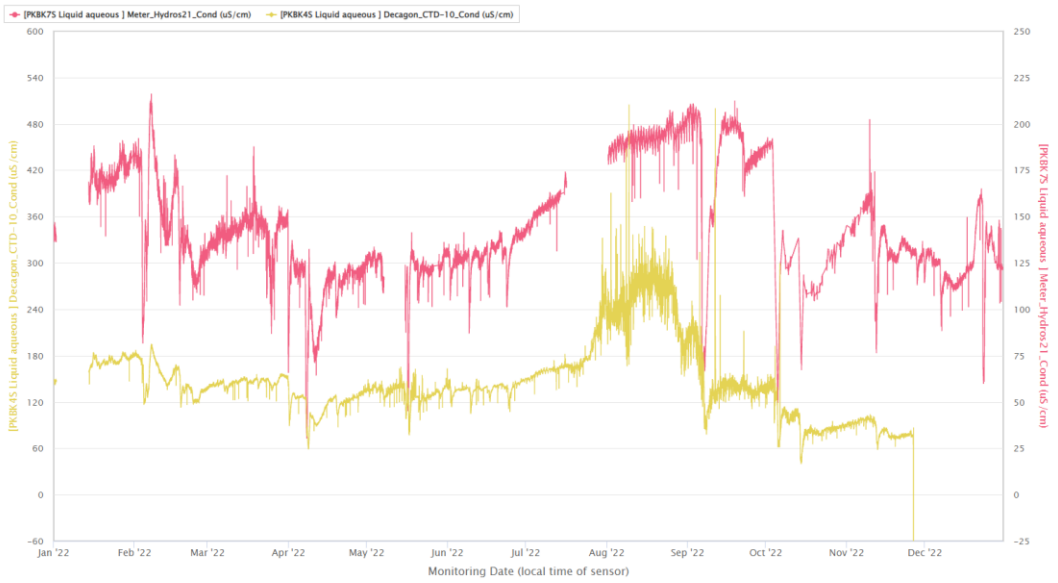

Figure 2. Conductivity at stations PKBK4S & PKBK7S: Station PKBK7S is further downstream from PKBK4S which is reflected by the differences in baseline conductivity. This suggests more runoff from nonpoint and point sources discharged into the river. The data output from 4S shows large variability of conductivity in August and September likely due to lower water levels during drier periods of the year indicating higher concentrations of ions in the water.

Water Temperature

At all stations water temperature data differed slightly. This is due to varying sensor depths, positions in the water (pool, riffle, bend, reach, etc.), water velocity, tree shade - all these factors are expected to influence water temperature.

Figure 3 PKBK4S water temperature oscillates significantly on a seasonal basis, which was observed in 2020 data. This could be due to the depth of the sensor. The sensor may be recording significant changes in temperature near the water's surface. This gives some insight into the variability of shallow water stream ecosystems. It also could be due to the confluence of water creating temperature differences. More investigation is needed to confirm. Several sites follow a distinct seasonal cycle, cold waters in winter, spring runoff, and high-water temperatures when the water depth becomes shallow in the mid and late-summer months.

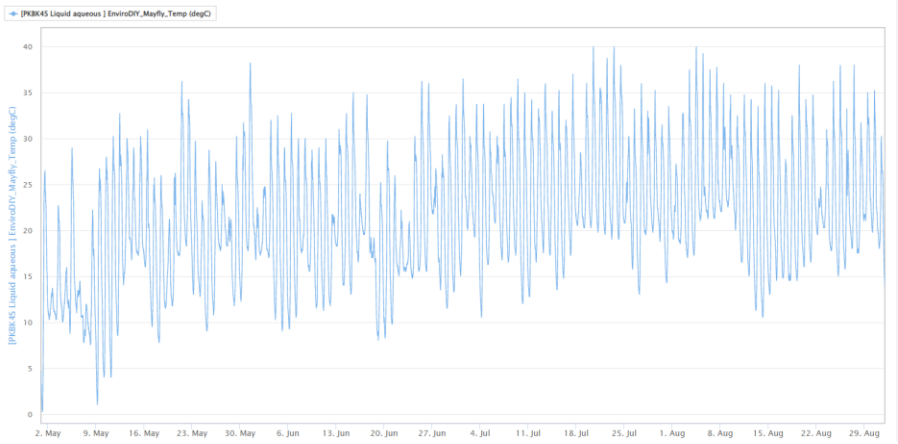

Figure 3. Sensor Water Temperature Celsius: High-frequency temperature data from PKBK4S (May 1st- August 31st, 2022), data presents a large diel (24 hr) fluctuation of water temperature. This indicates that the sensor depth is shallow where water temperatures can rise and fall rapidly within a 24hr period.

Weather & Precipitation Results

Precipitation

Weather station data from Port Jervis Fire Department Helipad and Orange County Airport were analyzed. Heavy precipitation events recorded in Port Jervis where daily rainfall was over 40mm (1.58in), occurred in January, June, August, and September (Figures 4 and 5). June is the wettest month averaging 2.31in followed by May with a 2in average. Annual total precipitation for 2022 was 21.11 inches, close to the long-term average of 21.14 inches per year (1985-2015) recorded at Orange County Airport.

A storm event in September measured by Port Jervis Fire Department was 52mm or 2.05in. This one storm produced more rain than the long-term monthly precipitation average: 45.2mm or 1.78in. High conductivity spikes from the February runoff event and melt from unseasonal high temperatures were captured by station PKBK7S shown in Figure 2. The large storm in September

was captured by PKBK7S resulting in a significant dilution of ions due to the water levels. However, no large spike in conductivity following the storm was observed. PKBK7S conductivity data is more responsive to storm events when compared to PKBK4S which may be due to PKBK7S being further downstream and more inorganic dissolved solids being carried downstream from precipitation events. Data where conductivity is observed above baseline are not temporally associated with precipitation events, suggesting that conductivity in these watersheds is not always driven by precipitation.

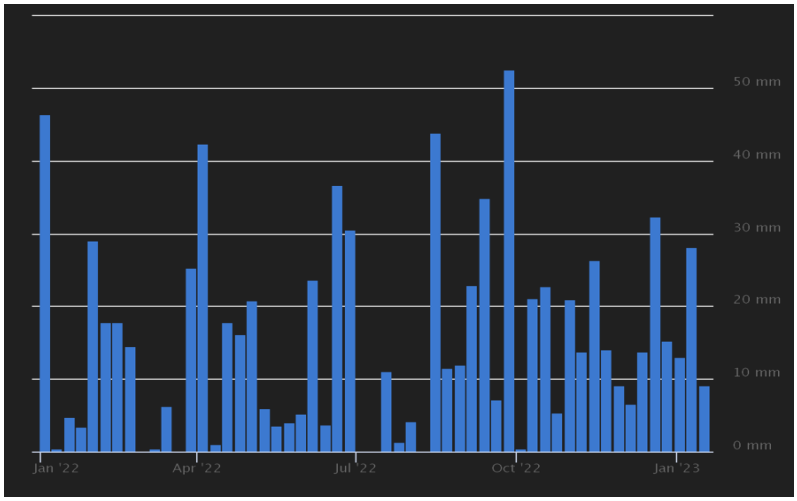

Figure 4. Precipitation amounts (mm) in Port Jervis: Largest precipitation events and amounts occurred in January, April, August, and the largest single event at the end of September. Rain amounts in the September event were measured at 52mm or 2.05in.

Weather & Climate

Weather data for the year is shown in Figure 5. The bottom graph of the figure presents wind direction and speed, 2022 had several windstorms and the strongest winds in the winter months. There is a discrepancy in precipitation data from Figure 4 and Figure 5. Strong precipitation of 2in in September was observed in Port Jervis (Figure 4) where Figure 5 shows less rain at approximately 1.5in. Figure 6 shows the annual temperature with the number of frost days indicated by a black line. July and August had more significant degree days (>86F) than the annual average. This suggests summer months may be getting warmer.

Throughout the northeast, areas are becoming warmer and wetter. Port Jervis's long-term temperature data (1979-2022) shows an upward trend, and it is becoming warmer although not significantly. Long-term precipitation data (1985-2022) shows no trend and Port Jervis is seeing little to no change in precipitation amounts. However, more frequent strong precipitation events (>1.0in) bring larger amounts of water occurring more often.

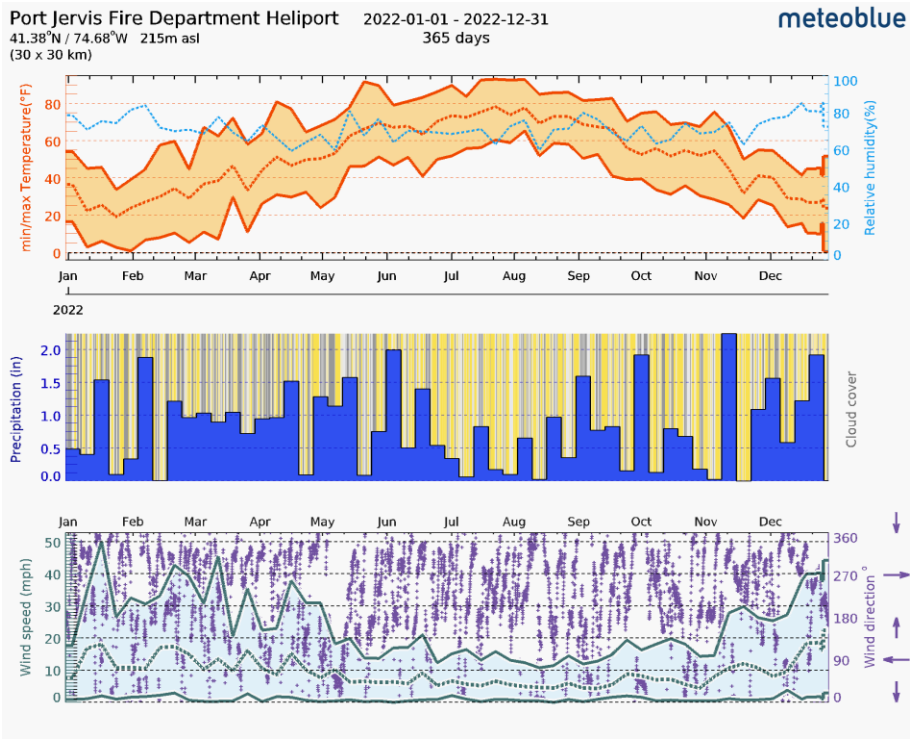

Figure 5. Air temperature, precipitation, and windspeed data in Port Jervis: Top graph shows daily air temperatures. Topmost solid red line is maximum temperature, and the minimum is the bottom solid red line. Average air temperatures indicated by a red dashed line. Relative humidity in blue dashed line. The middle figure shows precipitation amounts in blue and cloud cover with background lines for the year. Bottom figure shows largest winds occurred in January at speeds measured at 50mph. Most common wind directions came from the south and westerly directions.

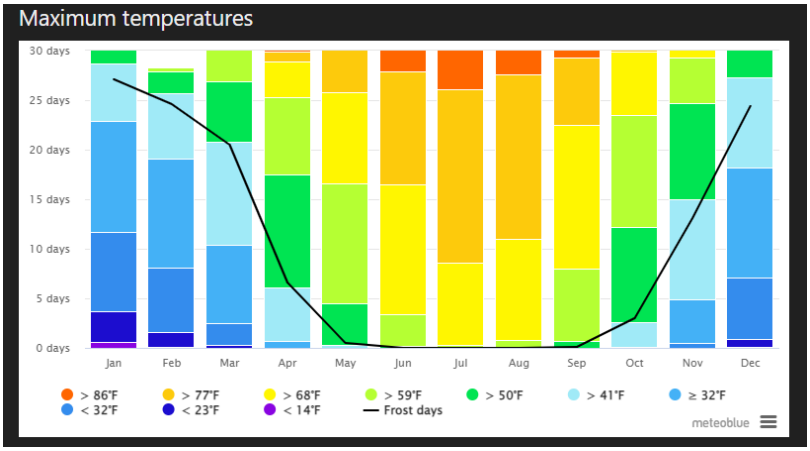

Figure 6. Maximum air temperatures at Port Jervis: Black line indicates the number of frost days in each month. Red shading shows significant heat days (>86F) in each month.

Bacteria Bottle Test Results

Annual bottle testing for fecal bacterial colonies, metals, and nutrients was conducted through the summer and fall months. Grab sampling efforts were executed to continue environmental health monitoring of the Basha Kill watershed. Fecal coliform presence and numeration of colonies were conducted six times. Nitrate, iron, and lead were only tested once to conduct a presence or absence of metals not a total discharge of these materials.

Fecal bacteria are one of the largest impairment sources to streams and rivers. Fecal coliform is found in the digestive tracts of warm-blooded animals. Streams with fecal bacteria often have other issues such as high sediment and nutrient loads and thus an indicator for pollution. Culture test results for bacteria are in CFU (Colony Forming Units) or MPN (Most Probable Number). Laboratories In New York State can report and accept both units as they are similar with minor differences. Our test results report the number of colonies counted per 100 mL according to the general formula: CFU/100 mL = (# of colonies counted ÷ sample volume filtered in mL) x 100. For recreational waters, this group was the primary bacteria indicator until relatively recently, when EPA began recommending E. coli and enterococci as better indicators of health risks from water contact. Fecal coliforms are still being used in many states as indicator bacteria. General guidelines for swimming standards indicate that fecal coliform results of less than 200 CFU or MPN/100mL are acceptable.

The Basha Kill River and Basha Kill Pond tested positive for fecal coliform during each sampling effort. All June samples were acceptable. The Basha Kill pond was tested on 8/22/2022 and the results determine 2419 CFU. Two samples were taken from the lower Basha Kill on 10/17/2022, resulting in 1414 CFU and 2420 CFU in the second sample. Both sample results are significantly higher than acceptable limits of 200 CFU. The pond was also sampled on the same day and was within acceptable limits. The pond was analyzed on 11/9/2022 and 12/13/2022, 345 CFU and 1396 CFU respectively. These results show that bacterial contaminants in the surface waters of these two systems are significant and consistently above acceptable limits determined by New York State.

Nutrients and metals were tested on 8/5/2022, from an effluent pipe discharging into the Basha Kill. The pipe discharge was tested for nitrate, iron, and lead. Nitrate was 0.22 µg\L which is well within the state's guidelines. The pipe also tested positive for fecal coliform, however, results were within acceptable limits with a level of 70 CFU. Nitrates are an indicator for nutrient pollutants such as fertilizers, sewage, and various types of runoffs. However, since nitrate was only tested once and was acceptable it cannot be determined that nitrate is or is not a potential pollutant. Nitrate was not tested on the dates that the pond or river was beyond acceptable limits for fecal coliform. Future sampling efforts will consider this approach.

Iron was 180000 µg\ L or 180mg/L and lead tested 32µg\ L. New York States' allowance in ambient or surface waters for iron is 300µg\L and 50µg\ L. Anything at or higher than these values are considered Not Acceptable according to Ambient Water Quality Standards and Guidance values and Groundwater Limitations of NYS.

Future Work

In the coming seasons and years, NYenvironcom plans to incorporate many more features and aspects into the WaterInsight program. As mentioned in the introduction we will install new hardware to protect our valuable and expensive water quality sensors. This hardware will be valuable in the rocky and more destructive reaches of our rivers. Our organization would also like to add dissolved oxygen and chlorophyll sensors. This will provide valuable insights into water chemistry, stream productivity, and ecology. The addition of staff gages to measure water levels will help create flow discharge calculations to better understand how much water and materials are being transported through our waters. This is an invaluable water monitoring metric. Lastly, coordination with our drone mapping project would be beneficial in visualization of our watersheds, station locations, land use metrics, and changes in land use or urbanization in the years to come.

Resources

Our live and historical Water Quality Data on our website (https://www.nyenvironcom.ngo/tools-resources/water-monitoring/monitoring-stations/) as well at the Stroud Water Research Center's Monitor my Watershed portal (https://monitormywatershed.org/)

NYenvironcom's advocacy, research, past reports, projects, photos, and materials can be found on our website: https://www.nyenvironcom.ngo/