



BARTRAM'S GARDEN

Bartram's Garden Community Boathouse
5400 Lindbergh Blvd
Philadelphia, PA 19143

February 12, 2020

Pennsylvania Department of Environmental Protection
Bureau of Clean Water
Water Quality Division
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Harrisburg, PA 17105-8774

Delaware River Basin Commission
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To Whom It May Concern:

We are a group of volunteers, high school interns, and staff who support public boating and fishing programs at Bartram's Garden Community Boathouse. We have been collecting water quality data over the past two years, and we write to you to provide our data for consideration in the assessment of Pennsylvania's water quality.

Bartram's Garden Community Boathouse has offered free and low-cost public boating and fishing programs on the tidal Schuylkill River since 2015. These programs are supported by a crew of over 100 dedicated volunteers and a youth crew of high school interns who facilitate a safe boating experience for all guests. On Saturdays between late April and late October,¹ our free kayaking and rowing program typically attracts between 100–300 participants, many of whom are first-time boaters. In 2019, over 5,600 people participated in our boating and fishing programs.

As a result of controls on many industrial point sources of pollution along the Schuylkill River, the vast improvement in water quality over the last few decades has made it feasible for people to safely access and enjoy this public waterway. However, the tidal portion of the Schuylkill is still subjected to frequent and persistent inputs of pollution, with direct impact on our program safety, from the approximately 40 combined sewer overflow discharge points that empty raw sewage into the river during many rain events. Our policy is to cancel public boating within 24 hours of rainfall of a quarter-inch or more, though we have sometimes been more conservative because the Philadelphia Water Department's CSOCast web site has indicated in the past that overflows can be triggered by as little as a tenth of an inch of rain. This cancellation policy is determined to be protective of our guests based on our understanding of the interactions of

¹ Note that our program season begins earlier and ends later than the Water Contact season defined by DEP as May–September.

weather, tides, bacterial counts, and other parameters. This understanding is limited by a lack of historical water quality data below Fairmount Dam, in the section of the river affected by CSOs. As far as we are aware, the USGS and Philadelphia Water Department only have sensors installed above the dam and thus do not document effects of CSOs. We also understand that DEP and DRBC have not assessed bacterial counts on the tidal Schuylkill, because this segment is not designated by the state for water contact, and is designated by DRBC for secondary contact recreation.

Seeing the lack of existing data as a constraint to our programming as well as an opportunity for community science to meaningfully contribute, Bartram's Garden River Programs staff decided to start collecting our own data and have been doing so over the last two years. In June 2018, we partnered with Stroud Water Research Center to install a Mayfly continuous monitoring sensor station that includes a CTD, turbidity sensor, and dissolved oxygen sensor, which collect readings every five minutes. In consultation with Stroud, Bartram's staff also designed protocols (see attachments) for active data collection by volunteers and interns.

We have just completed our first full season of active data collection from May to October 2019. A subset of Boathouse volunteers participated in this water quality monitoring program, collecting water samples weekly and testing levels of *E. coli*, phosphate, and nitrate. Additionally, during their six-week summer intensive, the high school River Crew interns tested for *E. coli* on other days of the week. Both volunteers and interns also measured pH, electrical conductivity, and water temperature using a handheld probe. Probe measurements and samples are collected from the Bartram's Garden dock, on the west bank of the tidal Schuylkill. All of these data have been recorded alongside sensor and rain gauge data from corresponding time points.

Data

Raw data actively collected by volunteers and interns in 2019 is provided as an attachment. For your convenience, here are links to raw data that are continually updated online:

- Live sensor data
 - <http://monitormywatershed.org/sites/PUSR2S/>
 - Use "Download Sensor Data" button to download all historical data
 - Note that DO sensor requires maintenance; it has periodically transmitted readings of -9999 and become inaccurate after the station was upgraded to 4G cell service on 9/24/2019.
 - Turbidity data are only reliable when sensor has been recently cleaned as the sensor fouls easily, so data is not continuously accurate.
 - Record of cleaning:
https://docs.google.com/document/d/1TaIDIWcYvzo63XcnuA3AfzDix6OPq-7m7_PtOZI2xko/edit
- Rain gauge data (AcuRite Digital Rain Gauge Model 00899A1)
 - <https://docs.google.com/spreadsheets/d/12-ZtajwsGS--oipUSNhraYvLErPE1aYRkwm78K1H5l/edit?usp=sharing>

Summary of findings we wish to highlight:

The Bartram’s Garden Community Boathouse program aims to offer safe, easy access to the tidal Schuylkill River for members of the public. Since safety is our primary concern, the tracking of rainfall and bacteria levels helps inform our cancellation policy. We take a conservative approach and follow the [EPA guidelines for primary contact](#) recreation—rather than secondary contact—because of the water exposure inherent in the use of sit-on-top kayaks, and because of the risk of capsizing. Indeed, kayaking is increasingly considered as a primary contact activity due to the chance of immersion and incidental water ingestion, which is heightened when participants are inexperienced.²

Table 1. Recommended 2012 RWQC.

Criteria Elements	Estimated Illness Rate (NGI): 36 per 1,000 primary contact recreators		OR	Estimated Illness Rate (NGI): 32 per 1,000 primary contact recreators	
	Magnitude			Magnitude	
Indicator	GM (cfu/100 mL) ^a	STV (cfu/100 mL) ^a		GM (cfu/100 mL) ^a	STV (cfu/100 mL) ^a
Enterococci – marine and fresh	35	130		30	110
OR					
<i>E. coli</i> – fresh	126	410		100	320

Duration and Frequency: The waterbody GM should not be greater than the selected GM magnitude in any 30-day interval. There should not be greater than a ten percent excursion frequency of the selected STV magnitude in the same 30-day interval.

^a EPA recommends using EPA Method 1600 (U.S. EPA, 2002a) to measure culturable enterococci, or another equivalent method that measures culturable enterococci and using EPA Method 1603 (U.S. EPA, 2002b) to measure culturable *E. coli*, or any other equivalent method that measures culturable *E. coli*.

Chart from EPA publication [Recreational Water Quality Data](#), Office of Water 820-F-12-058, p.6.

There are approximately 40 combined sewer outfalls on the tidal Schuylkill River, so we err on the side of caution after rain and regularly suspend boating. To support our decision, in 2019 we collected data on *E. coli* levels (Figures 1,2). These bacterial tests take 24 hours to culture, so we were not able to use them for scheduling decisions on the day of planned programming. Instead, we hope to use our combined data including rainfall, *E. coli*, and other variables to devise a reliable predictive model to keep our visitors safe from high bacteria counts in the river.

² See e.g. Philadelphia Water Department, Philly River Cast: A Daily Forecast of the Schuylkill River Water Quality in Philadelphia, http://www.phillyrivercast.org/Nav_definition.aspx (including kayaking as a primary contact use). See also EPA, Watershed Academy, Introduction to the Clean Water Act, https://cfpub.epa.gov/watertrain/moduleFrame.cfm?parent_object_id=1990 (including kayaking as a primary contact activity and noting that “Obviously, it can be difficult to draw distinct lines between these different activities, because the extent of exposure can be affected by factors such as the skill of the recreationist and weather conditions.”).

We are aware of DEP's plan to begin using *E. coli* rather than fecal coliform for its water contact criterion for May–September, but until the Triennial Review is approved by EPA, DEP continues to use fecal coliform as indicator bacteria year round. Thus, our measurements cannot be directly compared to current DEP or DRBC criteria, but our practices align with EPA guidelines for freshwater and position us proactively for DEP's shift from fecal coliform to *E. coli* for the time frame relevant to our visitors.

Our measurement of *E. coli* found a large range over the season, from 0 to over 7,000 CFU/100ml, and variability from day to day (Figures 1–3). That variability was evident even with low rainfall amounts (Figure 4), so rainfall alone did not account for *E. coli* levels above the EPA guideline. We plan to collect more data to develop a reliable model; some experimentation with multiple regressions yielded promising potential for a predictive, multi-variable model.

We are also concerned about our findings of water temperature and dissolved oxygen (DO) levels in violation of DEP criteria for warm water fish (WWF), and the implications for river health. Temperature measurements from our sensor station have, on multiple occasions, exceeded WWF criteria (Figure 5), and this season we saw DO fall below the WWF minimum of 5.0 mg/L assigned by DEP (Figure 6). DO levels appear to be meeting DRBC criteria (seasonal averages of at least 6.5 mg/L and 24-hour averages of at least 3.5 mg/L), though with instantaneous minima as low as 3.4 mg/L. It is confusing to navigate the relationship between DEP and DRBC criteria in cases such as this, in which DEP defers to DRBC for a segment where DEP criteria still apply. We believe additional monitoring by DEP and/or DRBC would be helpful to better understanding water quality in the tidal Schuylkill, but there needs to be a clearly articulated approach to assessment when two agencies have authority.

Summary

We appreciate the work that DEP and DRBC put in to keep our waterways healthy. However, we need more support from your end. Currently, we understand your focus of assessment has been entirely on aquatic life, but we are submitting these data and information on our program to demonstrate that there is more to the river than just aquatic life, and we need you to look deeper into the river's health. There are other important factors to consider.

Other animals are also affected in this ecosystem. People come up and down the river for transportation. They have been doing it for hundreds of years. The river is used for sports and some people even depend on it for food. We have witnessed the river being used in many ways, including fishing, relaxing along the banks, evidence of ceremonies, personal and public boating and stand-up paddleboarding, and water sports. We have also witnessed a lot of trash and debris in the river after rain, evidence of combined sewer overflows that release sewage, stormwater, and trash from the streets.

Our boating program is a free community activity on Saturdays where anyone can come and spend the day on the river. We prioritize being inclusive of all, regardless of age, experience, or ability. Our River Crew of young adults practice rowing boats and teach young kids, adults and families to row. Because we serve such a wide range of participants, from very young children

to older adults whose immune systems may be weaker, the risk of health impacts from impaired water quality is of primary concern.

As mentioned above, DEP and DRBC have not assessed bacterial counts on the tidal Schuylkill. We submit our consistently high river program attendance, as well as the popularity of our site for personal boating and fishing, as evidence that water recreation is an existing use of the waterway and therefore warrants protection under the Clean Water Act. We thus see the need for an update to DEP's designated uses for the tidal Schuylkill River, if not the entire segment that currently encompasses the tidal Schuylkill. We offer the following suggestions to make DEP and DRBC standards better reflect and protect existing uses and improve consistency between the two agencies:

1. DEP should designate the tidal Schuylkill for water contact in accordance with its existing use.
2. Likewise, DRBC should update its designation of this segment from secondary to primary contact to more accurately reflect the risk of immersion and ingestion inherent in Bartram's Garden program activities (i.e., kayaking) and other forms of water contact we observe (e.g., paddleboarding, canoeing, jet skiing) as discussed above; see footnote 2.
3. DEP and DRBC should update bacterial criteria for water contact from fecal coliform to *E. coli* **year-round**.
4. DEP should assess the tidal Schuylkill for water contact and its existing warm water fish designation. The blanket "aquatic life" use that is currently assessed in this segment is inadequate and does not include assessment of the parameters that define WWF criteria. Our data point to exceedances of these criteria that call into question whether the segment can be considered "attaining" for all aquatic life. Based on assessment, the status of the tidal Schuylkill with respect to water contact and warm water fish should be listed in DEP's next Integrated Report. A TMDL should be developed to address any impairments and protect recreators.
5. DRBC should also monitor the tidal Schuylkill for the Stream Quality Objectives listed for Zone 4 and submit this data to DEP.

Because people use the river, DEP and DRBC need to make sure the environment is suitable for human interaction. Since CSOs are a significant source of pollution to the water, DEP and DRBC should look into their impacts on users. Our testing has indicated issues, but we ask you to conduct additional tests. Ensuring protective water quality should not fall entirely on the shoulders of civilians.

Please direct responses and any questions to Chloe Wang, Bartram's Garden River Programs Coordinator, at cwang@bartramsgarden.org. Thank you for your consideration of our data and the suggestions we have raised. We look forward to hearing from DEP and DRBC.

Signed,

Bartram's Garden Water Quality Monitoring Volunteers:

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TJ Hunt

Bartram's Garden River Youth Crew:

Ammarava Mika-El
Aiyanah Martin
Rachael Etumnu
Yasir Hall

Bartram's Garden Staff:

Chloe Wang, River Programs Coordinator
Joanne Douglas, Watershed Interpretation and River Youth Program Manager

List of Attachments:

- Data Submission Form
- Map: NOAA Chart 12313 showing tidal Schuylkill River
- Table of raw data collected by volunteers and interns during 2019 season, cross-referenced to sensor station and rain gauge data from corresponding time points
 - Green cells in turbidity data represent times when sensors had been recently cleaned; other turbidity readings may not be accurate due to fouling
 - Red cells are outliers that represent likely errors
- 2019 Bartram's Garden Community Boathouse Water Quality Data Collection Protocols
 - As community scientists, the volunteers and interns take seriously the responsibility to produce technically consistent, scientifically valid water quality data. Accordingly, we are engaged in an iterative process of adjusting our protocols and QA/QC from season to season to improve the reliability, accuracy, and consistency of our data.
 - As recommended by Stroud Water Research Center, the *E. coli* testing protocol was adapted from that of the Georgia Adopt-A-Stream program, developed with support from the Georgia Department of Natural Resources Environmental Protection Division (this document also attached). As outlined in the protocols, QA/QC measures include use of gloves, sterile Whirl-Pak bags for sample collection, and disposable pipette tips, cleaning work surfaces with isopropyl alcohol, processing a procedural blank alongside each river water sample, and plating sample water in triplicate to obtain an average result and identify outlier results.
- Water Quality Data Collection Sheet referred to in protocols
- Georgia Adopt-A-Stream protocols

Figures

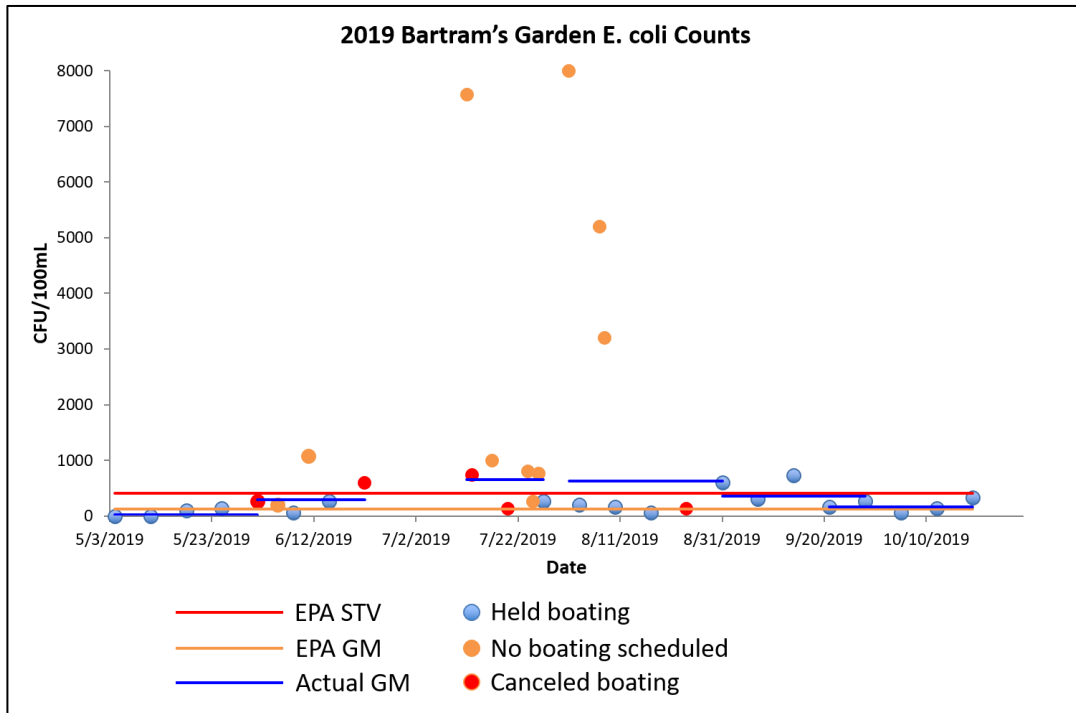


Figure 1. *E. coli* readings taken this season. Orange and red lines are EPA recommended geometric mean and statistical threshold value, blue lines are actual calculated monthly geometric means. Note that the result for the highest point on this plot was actually “too numerous to count,” but it is represented here as 8000 CFU/100mL. Cancellations were made for various reasons, not limited to rainfall.

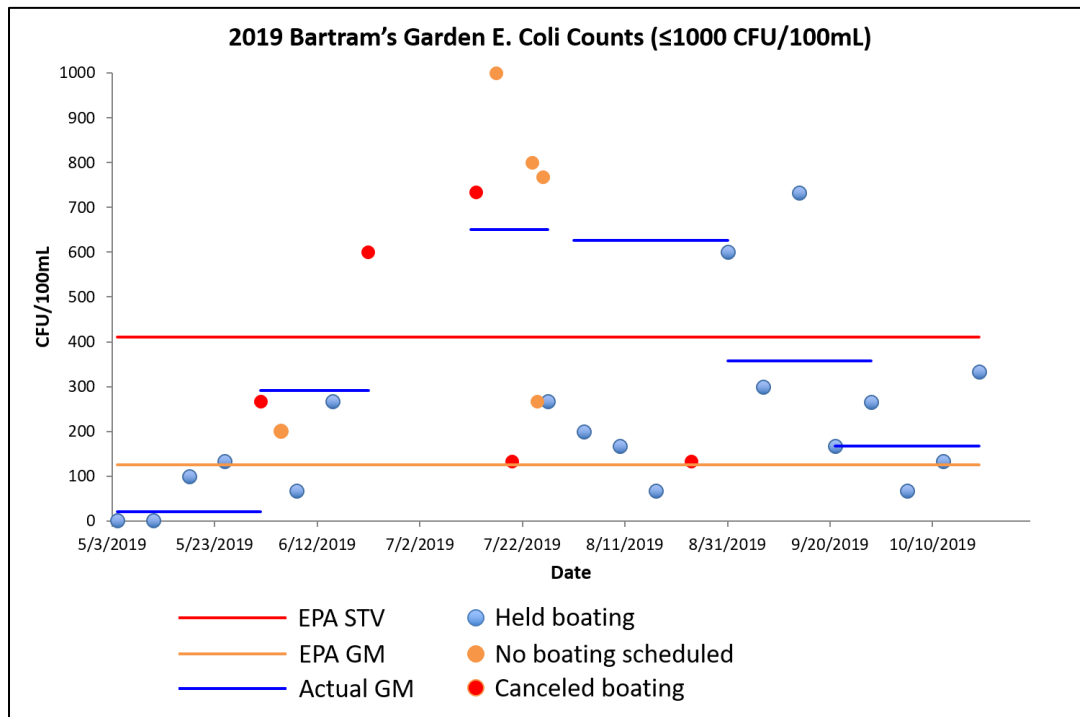


Figure 2. *E. coli* readings taken this season, only including readings ≤1000 CFU/100mL to better visualize the low range.

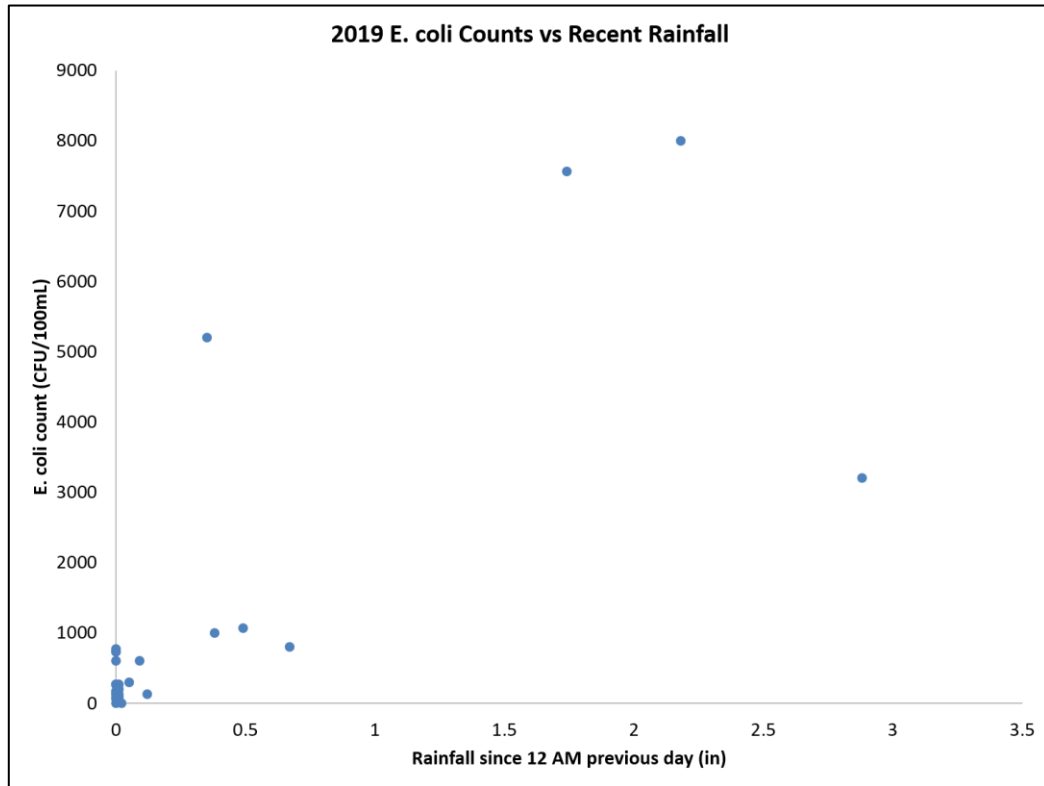


Figure 3. 2019 *E. coli* counts plotted against rainfall measured by rain gauge since 12 AM the previous day.

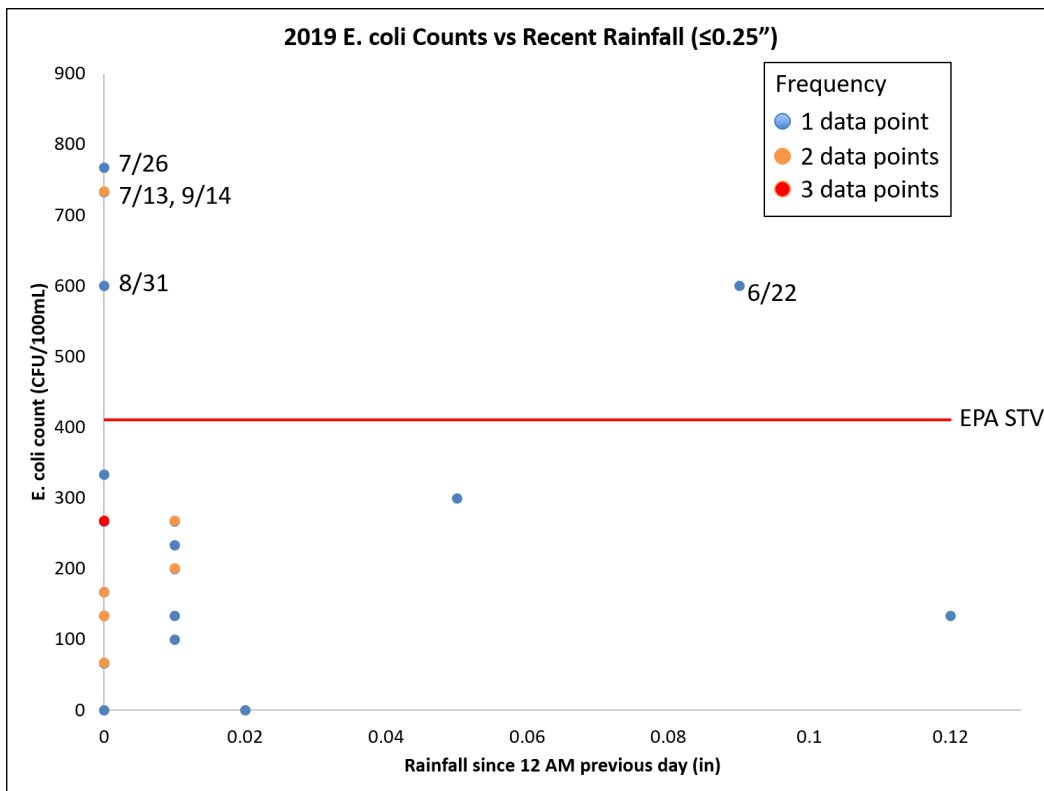


Figure 4. 2019 *E. coli* counts plotted against rainfall measured by rain gauge since 12 AM the previous day, only including rainfall $\leq 0.25''$ to better visualize the low range and with colors indicating frequency of repeated values. The 6/22 and 7/13 samples were taken within a week of heavy flooding. On 7/26 there had been heavy rain 3 and 4 days prior. 8/31 and 9/14 were not preceded by heavy rain or flooding.

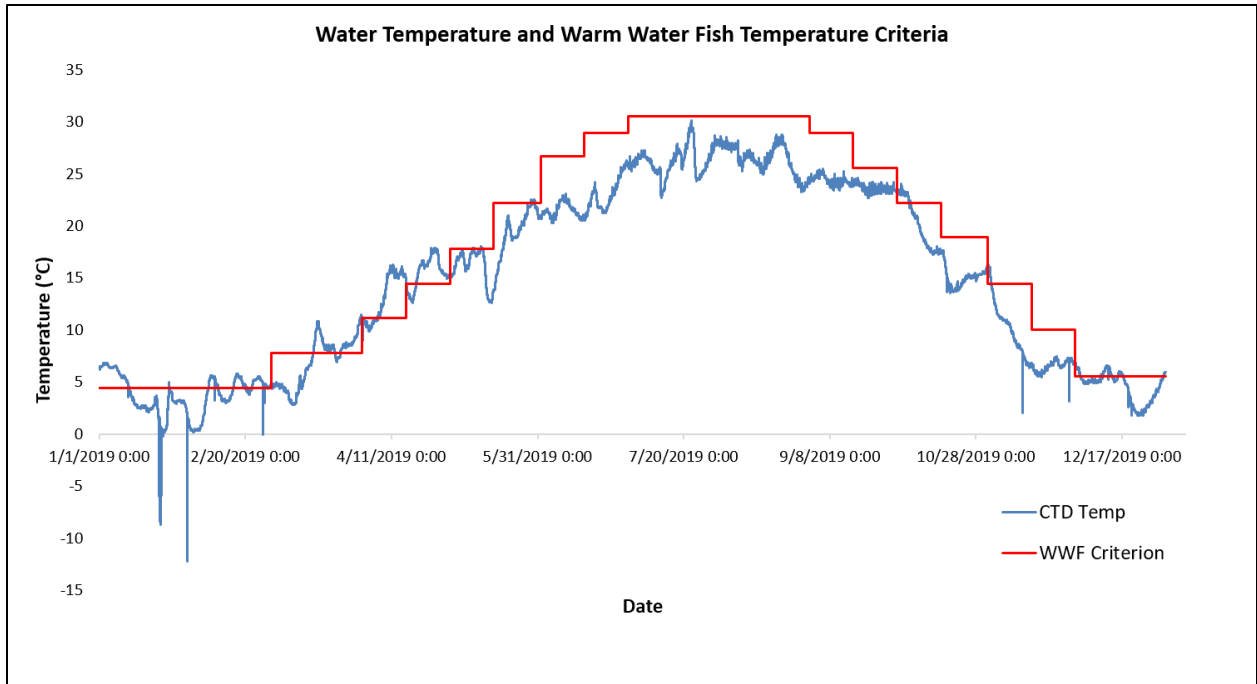


Figure 5. Continuous water temperature data measured by CTD, plotted with WWF temperature criteria. Temperature spikes below 0 degrees C correspond to exceptionally low tide events when water level fell below sensors.

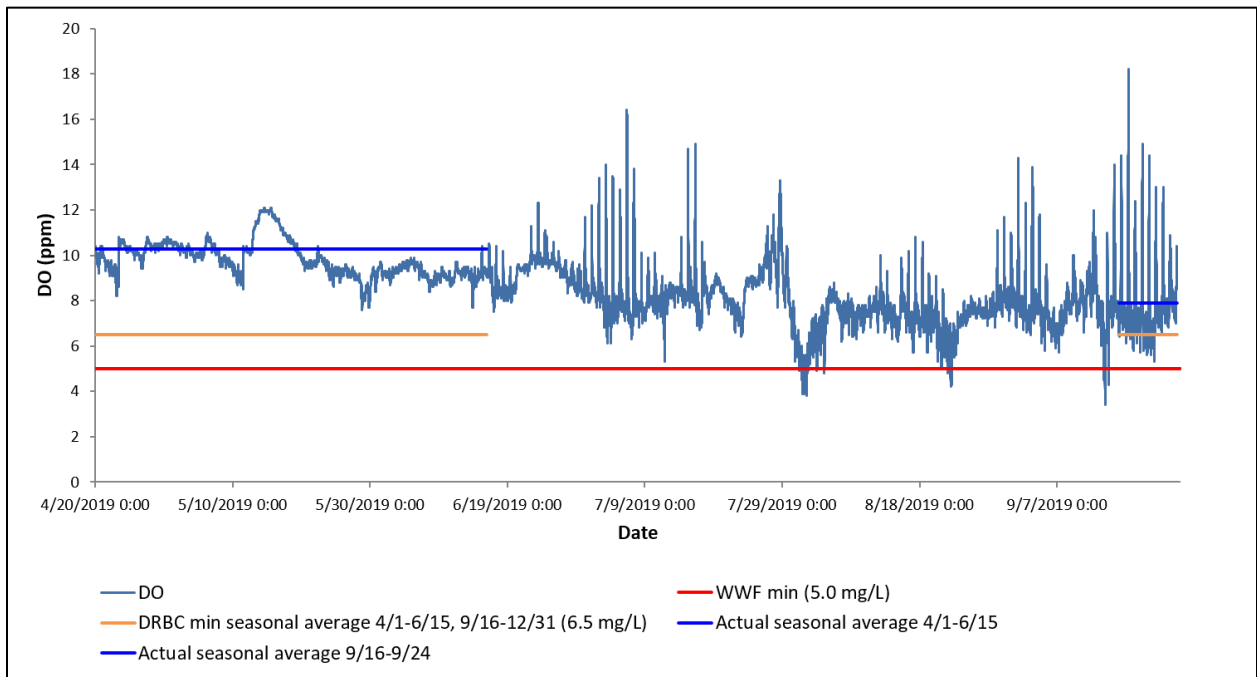


Figure 6. Continuous dissolved oxygen concentration measured by DO sensor, plotted with WWF DO minimum (5.0 mg/L), DRBC minimum seasonal average for 4/1 to 6/15 and 9/16 to 12/31 (6.5 mg/L), and actual averages calculated from sensor data for 4/1/19 to 6/15/19 and 9/16/19 to 9/24/19 (DO sensor data has been unusable since 9/24/19).