Shade Creek Headwaters Alkaline Addition
Western Pennsylvania Conservancy
Coldwater Conservation Implementation Project

Public Meeting

Due to COVID-19 pandemic, a traditional public meeting was not able to be hosted. Since most of the regularly scheduled meetings of partnering organizations were also cancelled at the start of the project, the first opportunity to discuss the project at a public meeting was the Stonycreek-Conemaugh River Improvement Project (SCRIP) meeting on July 16, 2020. Additionally, the project was discussed and updates were given at many public meetings of SCRIP, Shade Creek Watershed Association (SCWA), and Mountain Laurel Trout Unlimited (MLTU) throughout the life of the project. Attendees of these meeting also include representatives for Somerset Conservation District (SCD), PA Fish & Boat Commission (PFBC), Conemaugh Valley Conservancy (CVC), St. Francis University Center for Watershed Research & Service (SFU CWRS), and other public participants.

Shingle Run limestone sand stockpile (left) and downstream view of dosing site (right)

Project Summary

Project implementation was significantly impacted and delayed by the COVID-19 pandemic, especially due to the amount of volunteer commitment and number of project partners involved in the project. Despite the pandemic, all pre-project macroinvertebrate sampling and electrofishing surveys were able to be completed on schedule and with volunteer support. WPC completed pre-project reconnaissance and monitoring at the proposed dosing sites on April 23, 2020. Pre-project monitoring macroinvertebrate sampling was completed on April 29, 2020 with the help of volunteers from SCWA and assistance from SCD. Macroinvertebrate samples were analyzed at WPC's laboratory over the summer (Appendix 1). Pre-project electrofishing surveys were completed on July 24, 2020 with volunteer support from MLTU, CVC, and SCD (Appendix 2).

After further evaluation of the project and the sustainability of the existing dosing sites, WPC and SCWA determined that the CHP funding would be better utilized for maintaining lime applications on Shingle, Panther, and Berkebile Runs, instead of establishing the new proposed sites (Appendix 3). Most importantly, maintaining the transplanted native brook trout population on Shingle Run was determined to be the highest priority of the project. Following a pre-application meeting with PA Department of Environmental Protection (PA DEP) and

PFBC, permitting of the originally proposed new dosing sites on Mile, Cub, and Piney Runs were determined not to be feasible within the budget and timeline of the CHP project. However, the macroinvertebrate and electrofishing surveys that were completed at these sites provide baseline data that may be utilized to re-visit those sites in the future (Appendices 1 & 2). WPC requested and received CHP board approval to revise the scope of work of project to focus on maintaining the existing sites on Shingle, Panther, and Berkebile Runs.

Another priority of the project that was determined after further evaluation and discussions with PA DEP and PFBC, is the need for more-consistent monitoring of the existing dosing sites. To accomplish this, CHP funds were utilized for continuous instream monitoring (CIM) using a datalogger. Due to the cost of dataloggers with pH capability, it wasn't possible to purchase datalogger for each site within the CHP budget. However, through an agreement with SFU CWRS, a datalogger was installed and maintained for one year on Shingle Run to serve as a pilot to better evaluate the effectiveness of project and determine if dataloggers should be placed at each dosing site permanently. The datalogger continuously monitored stage/level, pH, dissolved oxygen, temperature, and specific conductivity (Appendix 4).

SCWA completed maintenance at the Shingle and Panther Run dosing sites on November 7, 2021 to prepare for additional limestone sand placement. This involved using a skid-loader to reposition any remaining stockpiled limestone at the dosing sites to prepare for the next delivery. A load of limestone sand was delivered to the Panther, Shingle, and Berkebile Run dosing sites on June 3, 2022. Post-project electrofishing surveys were completed downstream from the Shingle, Panther, and Berkebile Run dosing sites on September 7, 2022. Also, on September 22, 2022, access to the Berkebile Run site was improved by installing a stabilized pad similar to limestone rock construction entrance to make it more accessible for trucks to deliver limestone sand and reduce erosion and sedimentation concerns.

Geotextile fabric and limestone placement prior to construction of stabilized pad at Berkebile Run

Project Outcomes

While the original goal of establishing new dosing sites was altered to amend the existing dosing sites, the project was an overall success. The ultimate goal of this project was to increase the pH of Shade Creek headwater tributaries to optimize wild trout reproduction and growth throughout the watershed, which was accomplished successfully.

Post-project electrofishing survey results showed multiple age-classes of native brook trout were present downstream of the Shingle and Berkebile Run sites. No fish were observed in Panther Run, which was attributed to the dosing site being located lower in the watershed than the other sites (Appendix 2). SCWA is considering the logistics of moving the Panther Run dosing site further upstream in the watershed to restore more stream mileage and hopefully establish a brook trout population there, as well.

This project is considered on-going, as additional limestone sand will be needed annually to maintain the improved water quality conditions and existing brook trout populations. SCWA is committed to pursuing additional funds to maintain and improve the results of the project.

Adult native brook trout collected during electrofishing survey on Shingle Run

Project Sustainability/Next Steps

The long-term sustainability of the project in dependent on the continued annual replacement of limestone sand at the dosing sites. If annual replacement doesn't continue, water quality conditions will degrade and established brook trout populations may decline or be lost. SCWA plans to continue monitoring and maintaining the project by fundraising for annual limestone sand replacement and potentially installing more dataloggers. Additionally, SCWA and WPC plan to meet with PA Game Commission (PGC) to discuss the possibility of relocating the Panther Run dosing site further upstream, and also improving fish habitat at the sites through the strategic addition of large woody materials (LWM) to the headwater streams on State Game Lands 228. In addition to providing habitat benefits, we believe increasing LWM with also help improve chemical water quality by increasing retention and interaction time with limestone sand in the system and retaining more natural organic material to increase buffering capacity.

Partners and Volunteers

Partners that provided volunteer service for this project include SCWA, SCD, MLTU, CVC, SFU CRWS, and SCRIP. SCWA provided six volunteers, donated 88 in-kind hours, and provided the skid-loader equipment for the project. SCD provide three volunteers and donated 32 in-kind hours. MLTU provided two volunteers and donated 16 in-kind hours. SCRIP provided one volunteer and donated eight in-kind hours. CVC provided 35 volunteer hours and 72 hours of staff time. SFU CWRS also provided 52 in-kind hours to the project.

Accomplishments and Outputs

It is challenging to accurately quantify the amount of stream miles improved due to the cumulative downstream benefits of the multiple dosing sites strategically placed around the receiving stream, but we conservatively estimate that improved water quality has been maintained on at least three miles of stream as a result of this project implementation.

The SFU CWRS report from the year-long datalogger survey on Shingle Run provides a good look into the water quality improvements of limestone sand dosing on acidified headwater streams. The datalogger showed average values of temperature, dissolved oxygen, and specific conductivity were all within acceptable values for a healthy, coldwater stream. Average pH and alkalinity were somewhat low, but showed positive improvements in relation to the dosing of limestone sand. The study concludes that dosing is most likely crucial to maintaining a healthy, fertile watershed in Shade Creek, because it increases buffering capacity (Appendix 4).

Ultimately, the greatest accomplishment of the project and best indicator of the effectiveness of limestone sand dosing, is that the brook trout population that was transplanted to Shingle Run in 2007 has been maintained and is actively reproducing. Berkebile Run also maintains a native brook trout population that would not persist without alkaline additions through dosing.

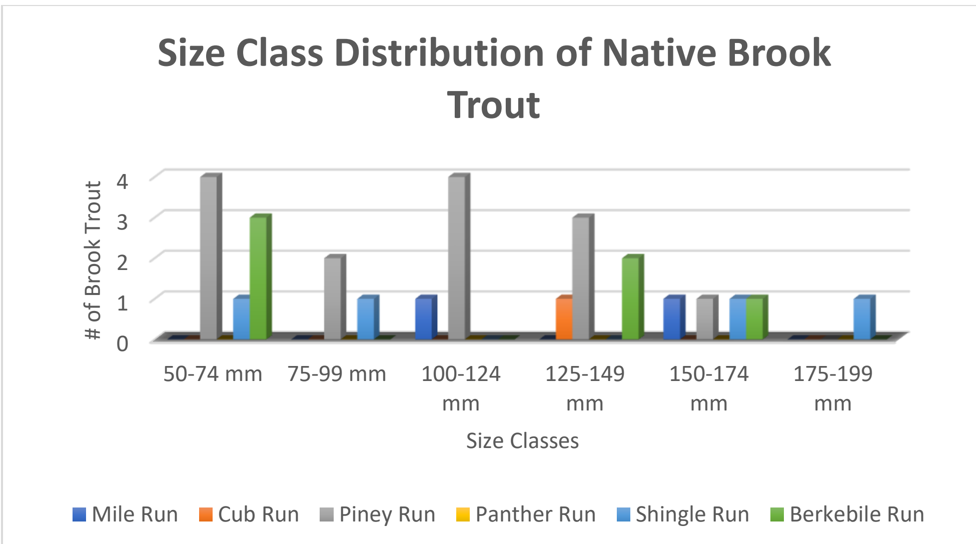
Appendix 1 – Macroinvertebrate Data

Macroinvertebrate Scores (4/29/2020)			
	Mile Run	Piney Run	Cub Run
Richness	16	21	30
Eveness (E)	0.651	0.810	0.788
Total Individuals (N)	169	193	203
Shannon Diversity (H)	1.805	2.467	2.682
Hilsenhoff (B)	3.899	4.440	4.286
PTI	27	29	30
PTI Interpretation	Excellent	Excellent	Excellent
Standardized EPT Taxa Richness (PTV 0-4)	26.32	57.89	84.21
Standardized Beck's Index (PTV 0, 1, 2)	23.68	42.11	47.37
Percent Sensitive Individuals (PTV 0-3)	41.3%	34.3%	43.7%
Standardized IBI Score*	39.54	53.13	64.52
* Impairment threshold Nov - May = 50.00			
PTI: scores 23+ are Excellent, 20-22 are Good			

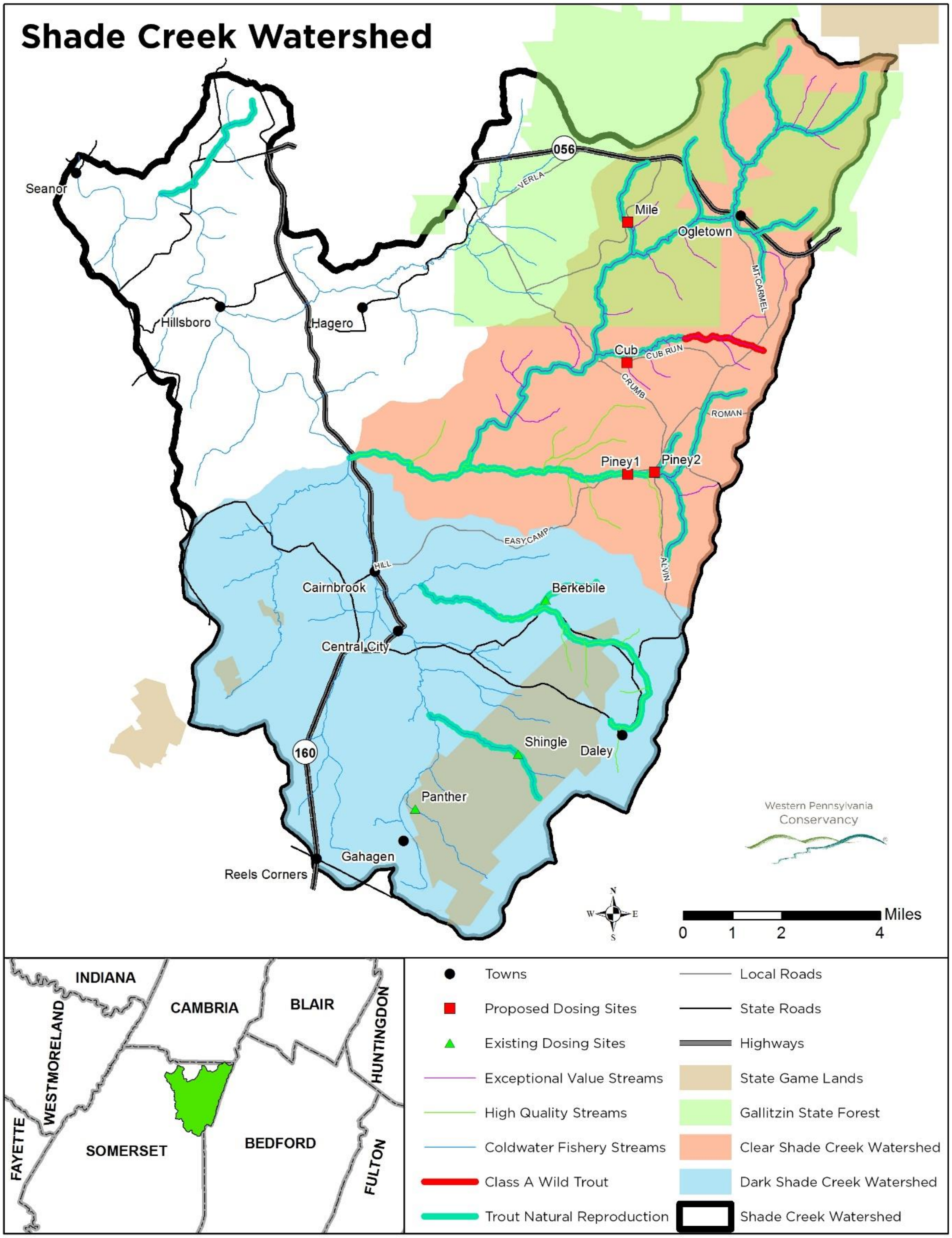
Macroinvertebrate Occurance (4/29/2020)					
Mile Run		**Piney Run**		**Cub Run**	
	Abundance		**Abundance**		**Abundance**
Ephemeroptera	**3**	**Ephemeroptera**	**12**	**Ephemeroptera**	**27**
Ephemerellidae	3	Heptageniidae	8	Heptageniidae	7
Plecoptera	**52**	Ephemerellidae	4	Ephemerellidae	14
Leuctridae	47	**Plecoptera**	**23**	Baetidae	4
Nemouridae	5	Perlodidae	2	Leptophlebiidae	1
Trichoptera	**8**	Peltoperlidae	2	Ephemeridae	1
Hydropsychidae	4	Leuctridae	11	**Plecoptera**	**38**
Rhyacophilidae	2	Nemouridae	8	Perlidae	1
Lepidostomatidae	2	**Trichoptera**	**30**	Perlodidae	3
Odonata	**2**	Hydropsychidae	6	Peltoperlidae	2
Gomphidae(dragonfly)	2	Glossosomatidae	4	Leuctridae	4
Decapoda	**1**	Rhyacophilidae	7	Nemouridae	26
Cambaridae	1	Limnephilidae	3	Chloroperlidae	1
Diptera	**101**	Lepidostomatidae	3	Pteronarcyidae	1
Tipulidae	5	Brachycentridae	7	**Trichoptera**	**17**
Chironomidae	62	Calamoceratidae	1	Hydropsychidae	4
Ceratopogonidae	2	**Odonata**	**1**	Philoptamidae	1
Empididae	4	Gomphidae(dragonfly)	1	Rhyacophilidae	2
Athericidae	1	**Coleoptera**	**18**	Limnephilidae	1
Simuliidae	27	Elmidae (riffle beetle)	18	Lepidostomatidae	7
Megaloptera	**1**	**Decapoda**	**2**	Uenoidae	2
Corydalidae (dobsonfly)	1	Cambaridae	2	**Odonata**	**1**
Worms	**1**	**Diptera**	**103**	Gomphidae(dragonfly)	1
Oligochaeta	1	Tipulidae	12	**Coleoptera**	**36**
		Chironomidae	62	Elmidae (riffle beetle)	35
		Empididae	10	Hydrophilidae	1
		Simuliidae	19	**Diptera**	**79**
		Worms	**3**	Tipulidae	3
		Oligochaeta	3	Chironomidae	32
		Other		Ceratopogonidae	1
		Water Mite	1	Tabanidae	1
				Empididae	16
				Athericidae	4
				Simuliidae	22
				Worms	**3**
				Oligochaeta	3
				Other	
				Clam (sphaeriidae)	2

Appendix 2 – Fish Data

Electrofishing Results: Fish Species Occurance					
Mile Run	**Cub Run**	**Piney Run**	**Panther Run**	**Shingle Run**	**Berkebile Run**
7/24/2020	7/24/2020	7/24/2020	9/22/2022	9/22/2022	9/22/2022
Brook Trout	Brook Trout	Brook Trout	No Fish	Brook Trout	Brook Trout
Brown Trout	Brown Trout	Brook Trout (stocked)			Blacknose Dace
Blacknose Dace	Brown Trout (stocked)	Brown Trout			Mottled Sculpin
White Sucker	Blacknose Dace	Brown Trout (stocked)			
Mottled Sculpin	White Sucker	White Sucker			
Creek Chub	Mottled Sculpin	Mottled Sculpin			
Johnny Darter	Fantail Darter				



Appendix 3 – Project Location Map



Appendix 4 – Shingle Run Datalogger Report

Monitoring the Impacts of Limestone Sand Dosing on Shingle Run, Somerset County, PA

September 2021 - September 2022

Prepared by: James Eckenrode and SFU Environmental Engineering students: Rachel Gibson and Nicole Himes

Introduction

Shingle Run, a tributary of Dark Shade Creek located in Central City Pennsylvania with a Chapter 93 designation for Aquatic Life of cold-water fishes (CWF), is of interest due to periodic limestone dosing by Shade Creek Watershed Association with Western PA Conservancy in an effort to reduce organic acidity in the stream.

Saint Francis University faculty and students began monitoring Shingle Run (located at approximately 40.086225, -78.781752) on September 21, 2021, with a Eureka Manta +20 water quality sonde and a HOBO, U20L barometric pressure logger. The sonde collected readings in fifteen-minute intervals and measured stage, temperature, pH, dissolved oxygen, and specific conductance. The pressure logger recorded the barometric pressure at the site also in fifteen-minute intervals.

The objective of the study was to analyze the continuous water quality data from Single Run to determine the potential impact of the limestone sand dosing that occurs less than 1 mile upstream of the sonde location. An additional area of interest will be to see how long the beneficial effects of the limestone dosing last in Shingle Run.

Method

During the duration of sonde deployment, the probes accumulate fouling and calibration drift that can impact the accuracy of readings. As a result, the data should be corrected based on specific readings that are taken during maintenance. These values include readings in the stream before and after cleaning the probes with a soft brush and water, and a comparison between the reading given by the sonde in a calibration standard to the known value of that standard. An Excel macro is currently under development at Saint Francis University that can quickly and easily complete these corrections, and this macro was utilized in the correction of the Shingle Run data. The data was corrected if the fouling or calibration error were beyond correction criteria (*Table 1).* This table was adapted from USGS and PA DEP protocols for continuous instream monitoring data management.

Table 1. Correction criteria used to determine whether or not to correct the sonde data.

Parameter	Correction Criteria
Temperature	± 0.2 °C
Specific Conductance	±3% of the measured value
Dissolved Oxygen	±0.3 mg/L
pH	±0.2 pH unit

The data included in this report was corrected using the macro. The raw data (the original, uncorrected readings from the sonde), corrected data, and a sheet of compiled corrected data can be found in the excel file attached to this report. The parameters used to correct the data can be found on the sheet called “corrected” followed by the start date for each deployment period. Since the sonde and probes were new, a correction was often unnecessary and therefore not completed.

Maintenance was performed on the sonde on the following dates: September 28, November 9, and December 17 of 2021 and February 17, April 22, May 20, July 1, August 3, and September 10 of 2022 (*Table 2*). The maintenance process included cleaning the sonde, calibrating the probes, retrieving data, and changing the sonde batteries. The dates chosen for maintenance were based on recommendations outlined in PA Department of Environmental Protection’s Continuous Instream Monitoring Protocol, manual (Shull & Lookenbill, 2015). During most of the maintenance visits, an alkalinity measurement was taken using a HACH alkalinity kit, and a flow measurement was collected three times throughout the study using a YSI FlowTracker.

Table 2. Alkalinity and flow measurements of Shingle Run taken during maintenance visits.

Date	**Alkalinity (mg/L)**	**Flow (ft^3/s)**
09/21/21	13.50	
09/28/21	4.35	4.1495
11/09/21	8.95	
12/17/21		1.1018
2/17/22	39.70	
04/22/22	6.00	
05/20/22	5.00	
07/01/22	11.25	
08/03/22		0.3496
09/10/22	13.50	

Results

Analysis of the continuous instream data in relation to flow and alkalinity measurements indicated the potential impacts of the limestone dosing. While dosing only occurred once during the monitoring period, pH and alkalinity data indicated the potential for additional benefit if dosing were to continue.

Data from the first week of sonde deployment was excluded from this report because the sensors got buried under the sandy substrate, resulting in inaccurate readings. In addition, data for April 2022 was excluded due to battery failure. Batteries designed to last for 7-8 weeks did not hold a charge for 4 weeks between monitoring dates and all data was unfortunately lost for this time period.

The average values of temperature, dissolved oxygen, and specific conductivity were within acceptable values for a healthy stream (*Table 3*). The average pH was somewhat low, which is not surprising due to the natural acidity of the stream and would be expected to increase with limestone dosing. Minimum and maximum values for these parameters are likely interrelated to seasonal changes and limestone dosing.

Table 3. Average, maximum, and minimum values for each parameter from 9/28/21 to 9/10/22.

	Temperature (ºC)	pH	Dissolved Oxygen (mg/L)	Specific Conductance (µS/cm)
Average	9.6	6.40	11.11	27.6
Maximum	17.6	7.00	14.53	55.9
Minimum	0.2	5.56	7.35	11.7

Alkalinity was measured on sonde maintenance dates, and readings are denoted by maroon dots *(Figure 1)*. The highest alkalinity reading was reported as 39.70 mg/L in February 2022 and was most likely a result of the dosing of limestone on November 7, 2021. These few months were sufficient time for the limestone to be washed 1 mile downstream from the dosing site to the sonde. pH also increased after limestone dosing, however pH data from December 17, 2021 to February 17, 2022 was removed from this report due to failure of the pH probe.

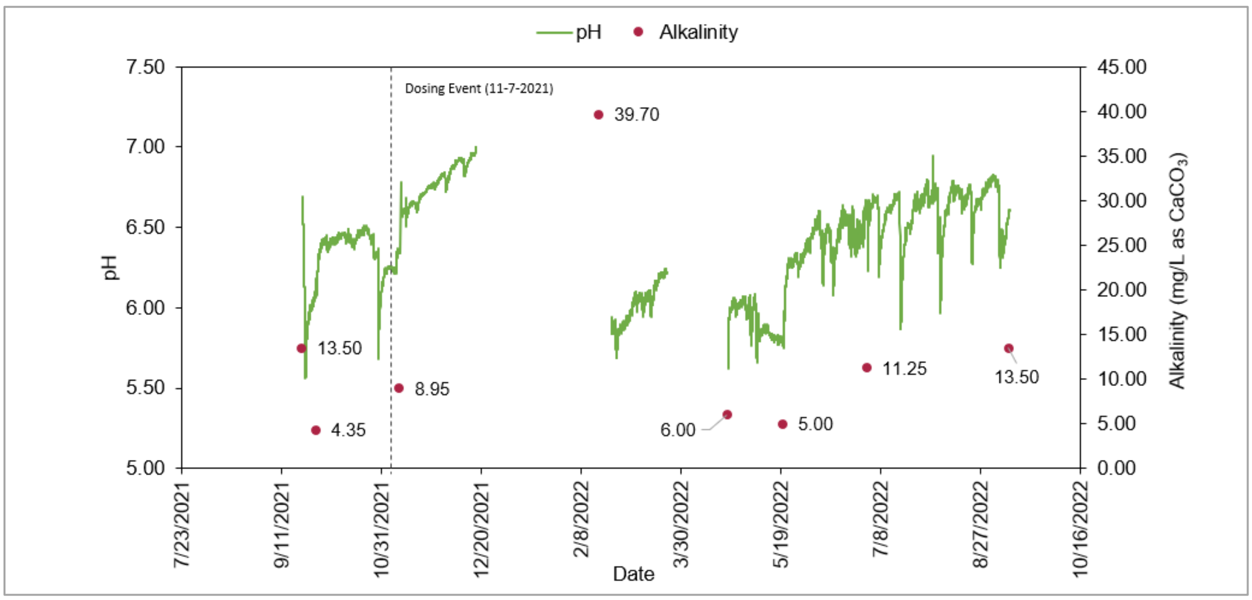


Figure 1. Shingle Run sonde data for pH (green) and alkalinity (maroon) for September 2021-September 2022.

Limestone material was delivered to the site on June 3, 2022; but no dosing had been done within this monitoring period with the exception of the previous dosing on November 7, 2021. However, some limestone could have potentially entered the stream during large storm events, which may explain the increase in pH or specific conductivity after the delivery on June 2, 2022. Specific conductivity for a two-week period during the month of May 2022 was removed due to inaccurate readings most likely due to the probe being submerged in sandy substrate material for a prolonged period of time.

There are several peaks in specific conductivity and pH throughout May 2022-August 2022, but these are not due to scheduled dosing. These peaks are more likely due to storm events in which the runoff increased, and stockpiled limestone material is washed downstream. (*Figures 2, 3*).

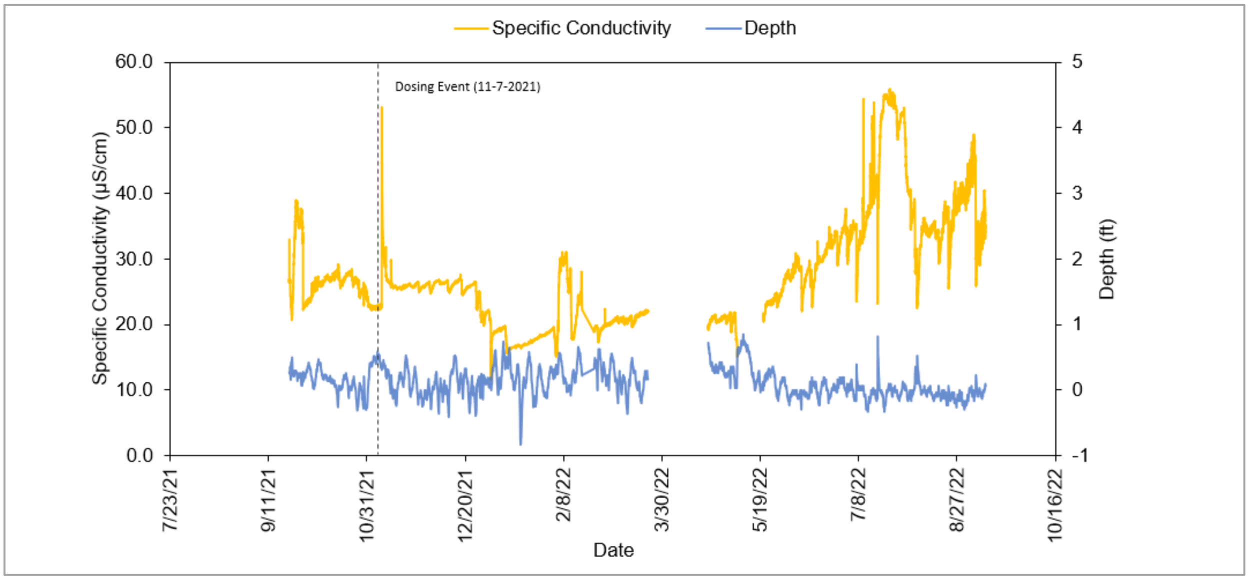


Figure 2. Shingle Run sonde data for specific conductivity (yellow) and depth (blue) for September 2021-September 2022.

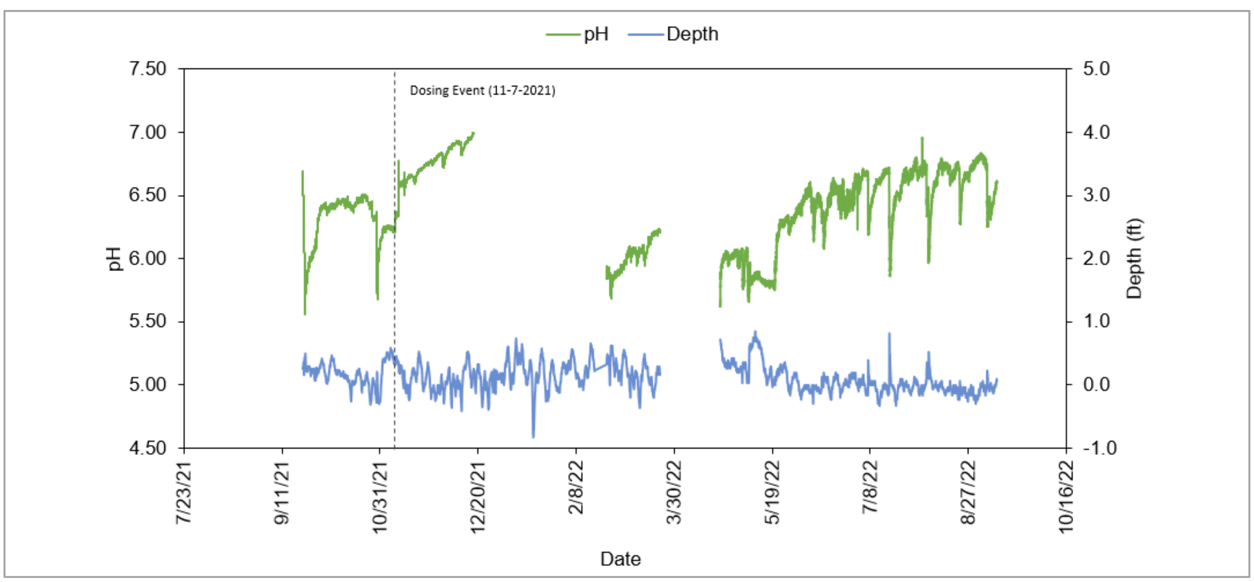


Figure 3. Shingle Run sonde data for pH (green) and depth (blue) for September 2021-September 2022.

Dissolved oxygen in Shingle Run never dropped below 6mg/L; the minimum needed for cold water species (*Figure 4*). The increase in dissolved oxygen concentrations in winter and spring months are best supported by the increased solubility of oxygen in water at lower temperatures. D.O. data for June of 2022 was removed due to inaccurate measurements from the sonde.

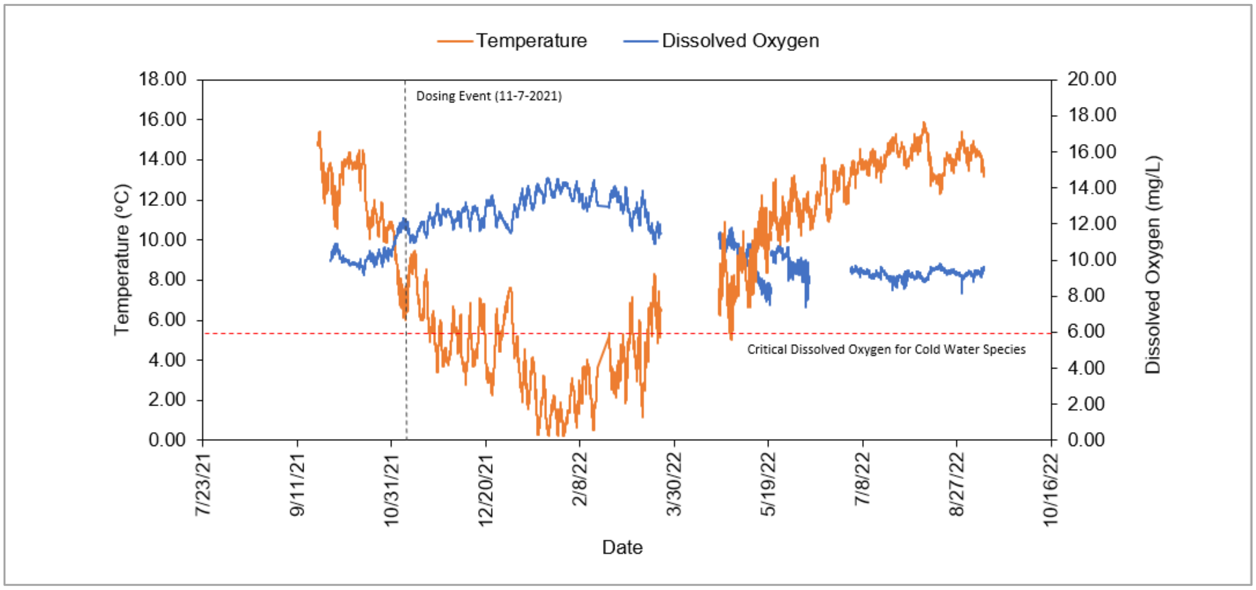


Figure 4. Shingle Run Sonde data for temperature (orange) and dissolved oxygen (blue) for September 2021-September 2022.

Recommendations/Conclusion

Based on the data generated from this study it appears that monitoring pH, temperature, dissolved oxygen, and specific conductance at fifteen-minute intervals through the use of continuous instream monitoring provides a sufficient view of the impacts of limestone sand dosing on headwater streams. It is also clear that being able to correct that data for both fouling and calibration is an important part of generating accurate and reproducible data. That being said, there will always be challenges in the monitoring of an active natural stream system.

Expansion on this report may include rerunning this experiment over a longer period which could include multiple dosing events in order to gain a better understanding of how pH, specific conductivity, and dissolved oxygen are impacted after the limestone dosing. If a multi-year experiment could not be run, it would be of interest to at least monitor data from December to May to account for the several data gaps created due to equipment failure seen in this experiment. Additional factors that may have impacted the monitoring cycle and could possibly occur in other experiments may include storm events that wash large amounts of debris that cannot be otherwise accounted for with the correction macro, unknown pollution events upstream, or changes in land use upstream of the monitoring site.

Finally, it appears that there is positive impact to Shingle Run from the limestone sand dosing. Shingle Run is in a critical condition where there is little buffering capacity, shown by low alkalinity values prior to dosing, so although the stream has a healthy pH, any small pollution event of acidic nature could have significant impact to the stream's health. Overall, dosing is most likely crucial to maintaining a healthy, fertile stream because it allows for the generation of an increased buffer capacity.

Reference

Shull, D. & Lookenbill, J, Continuous Instream Monitoring Protocol, 2015, Pennsylvania Department of Environmental Protection – Bureau of Clean Water