Roller Mill Dam Removal Effects on Chiques Creek

Interim Technical Summary: Additional Pre-Dam Removal Sampling

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INTRODUCTION

In 2020, the Susquehanna River Basin Commission (Commission) established a study area on Chiques Creek above and below Roller Mill Dam to study the effects of a proposed dam removal on stream channel dynamics, water quality, and aquatic communities (Figure 1). The Roller Mill Dam (RMD) was originally slated to be removed in Spring 2021, but now dam removal is not expected until Spring 2023 at the earliest. This delay was caused by potential regulatory effects as well as funding issues.

In early 2022, consultants estimated the dam to be holding back three times the entire sediment allotment given to the entire Chiques Creek Watershed in draft Total Maximum Daily Load (TMDL) calculations. The potential release of this sediment raised concerns by other watershed stakeholders who need to comply with sediment load allocations. These consultants also estimated partial removal of that sediment prior to dam removal to cost around 3 million dollars, with estimates for total removal topping 8 million dollars. The decision to spend this amount of money to remove a dam in a heavily impacted watershed with multiple other intact dams is facing numerous challenges and roadblocks.

Over the past few years, the Commission has attended periodic stakeholder meetings regarding the dam removal with American Rivers, National Resources Conservation Service (NRCS), PA Department of Environmental Protection (PADEP), PA Fish and Boat Commission (PFBC), consultants, academia, and local municipalities. While the project feasibility aspects are under investigation, the Commission continues in its role in collecting baseline data in the study area at a series of monitoring sites. The Quality Assurance Project Plan (QAPP) for the study on the effects of the dam removal as well as updates on data collection to date have been shared with American Rivers and their consultants to avoid duplication of monitoring efforts.

This project has two objectives:

1. To document a case study showing changes in physical, chemical, and biological characteristics of Chiques Creek after the removal of the RMD.
2. To quantify the elapsed time to achieve stability in physical and biological conditions following dam removal.

The Commission conducted additional pre-dam removal sampling in the study area in 2022. Like the sampling in 2020 and 2021, this additional sampling was funded in part by the U.S. Environmental Protection Agency through a Water Pollution Control (Section 106) grant.

This short technical memo will serve two purposes:

1. To summarize the sampling efforts conducted from October 2020 through August 2022 (Table 1).
2. To present the baseline data collected through August 2022.

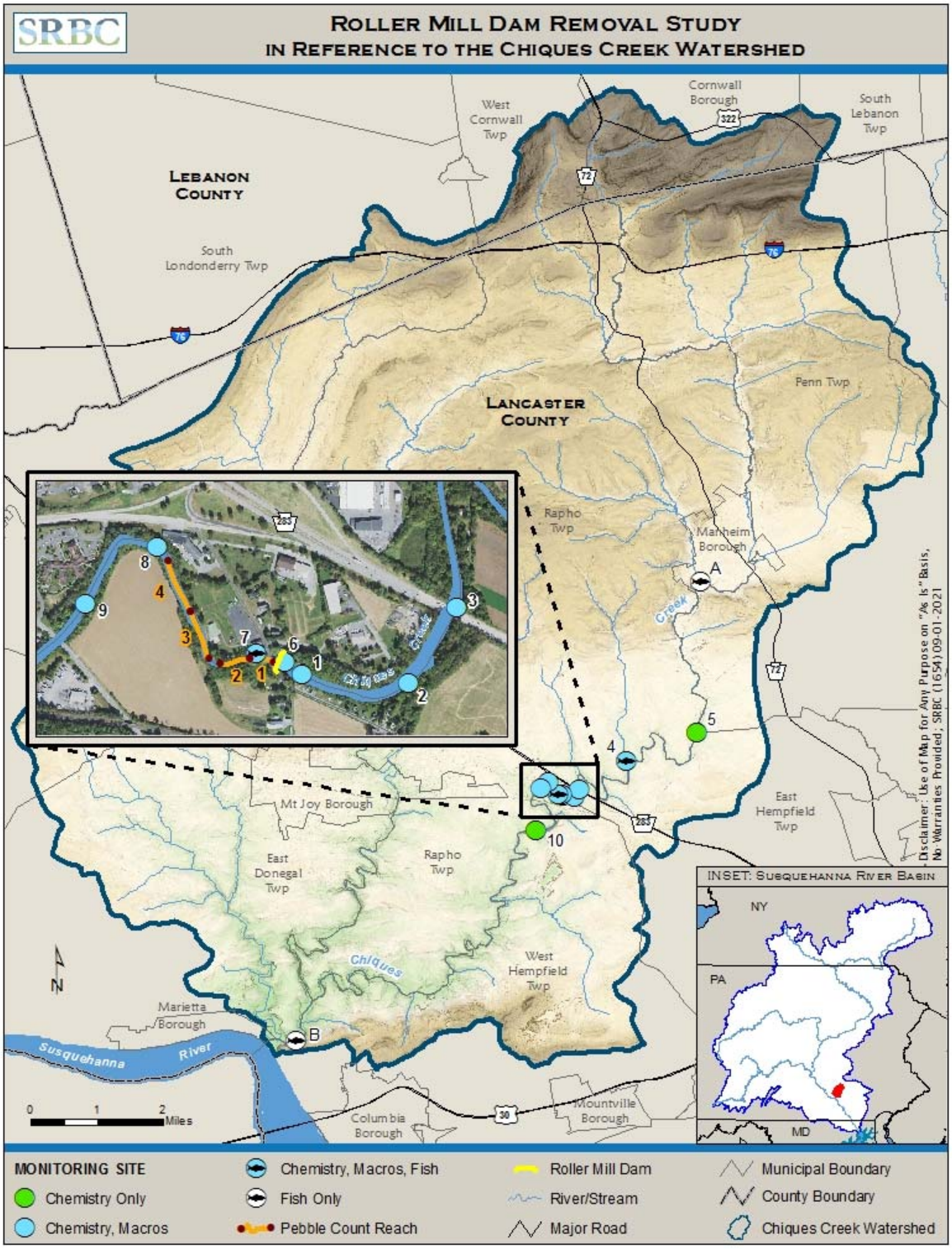

Figure 1. Map of All Monitoring Locations Associated with the Pre-Dam Removal Monitoring on Chiques Creek

METHODS

The Commission collected extensive pre-dam removal data in 2020 and 2021, and a report detailing those results is presented in Appendix A (Steffy, 2021). Since the dam has not yet been removed, the Commission targeted only a few parameters for additional sampling in 2022. Commission scientists followed the field methods outlined in the USEPA-approved QAPP (SRBC, 2020) to collect water quality and macroinvertebrate samples and physical habitat data and conduct data analysis (Table 1).

Table 1. Summary of Pre-Dam Removal Monitoring Activities (2022 activities in red)

Category	Activity	Date Completed
Physical Habitat	Cross-sectional and bathymetric analysis of the 200 m downstream of RMD	November 2020, November 2021
Physical Habitat	Pebble counts	October 2020 and May 2021, November 2021, April 2022
Physical Habitat	Bank pin deployment	November 2020, April 2022
Water Quality	Water sampling for WQI parameters above and below RMD	November 2020 and April 2021, March 2022
Biological	Macroinvertebrate sampling above and below RMD	November 2020 and April 2021, March 2022
Biological	Fish assemblage surveys above and below RMD	June – August 2021

Water Quality

Four additional water samples for laboratory analysis were collected in March 2022 to supplement the pre-dam removal dataset and answer some outstanding questions important to dam removal planning efforts. Susquehanna Water Quality Index (WQI) scores (Berry et al., 2020) were calculated for each of these samples to compare among sites and across time. WQI scores range between 0 and 100 (the greater the number, the better the water quality). Each of three categories (metals, nutrients, development) that make up the WQI are scaled similarly and have equal weight in the overall WQI score.

One sample was taken upstream of influence of the dam (Site 4) and one sample was taken below the dam at the Commission's long-term continuous instream monitoring site (Site 7). Although WQI scores at both sites were slightly higher scores than in 2021, both sites again were rated as Very Poor (Table 2). As in 2021, the WQI score at Site 4 was primarily driven by a very low development category score, reflecting high chloride and sodium concentrations. The low WQI score at Site 7 was driven by lower metal and nutrients category scores.

Table 2. WQI Results from March 2022 Sampling in Chiques Creek

Site #	**7**		**2**	**2**	**4**
Distance (m) above/below RMD	100 m below		300 m above Bottom	300 m above Surface	3,500 m above
Date	4/14/22	**RMD**	3/29/22	3/29/22	3/22/22
Metals	42.4		56.93	71.33	53.7
Nutrients	19.8		32.73	34.83	25
Development	15.3		11.23	12.7	10.8
WQI SCORE	**25.9**		**33.63**	**39.62**	**29.83**
WQI Rating	**Very Poor**		**Poor**	**Poor**	**Very Poor**

In the pool above the dam (Site 2), water samples were taken both on the surface and also just above the bottom substrate (~ 2 meters deep). Metals concentrations (aluminum, iron, and manganese) were higher at the bottom than on the surface, which may reflect the presence of metals sorbed to the fine sediment. As a result, the metals category score and the overall WQI score for the bottom sample were lower than the surface sample (Table 2). No differences were seen in the scores for the nutrients and development categories in surface and bottom samples. Overall WQI scores for both the surface and bottom samples at Site 2 were rated as Poor.

Macroinvertebrates

Macroinvertebrates were collected at multiple locations along the pool length above RMD using an Eckman dredge and at one site below RMD using a standard D-frame net. PADEP IBI scores (PADEP, 2013) were calculated for all samples (Table 3). Not surprisingly, taxa richness, diversity, EPT taxa with low tolerance to pollution, relative abundance of sensitive taxa, and overall IBI scores were lowest in the pool above the dam.

The low IBI scores seen in 2022 are consistent with results from macroinvertebrate samples collected across multiple years in free-flowing sections throughout the Chiques Creek Watershed and have always shown the presence of impaired macroinvertebrate communities. One of the expected benefits of dam removal is the improvement of macroinvertebrate habitat in the nearly 2 kilometers of upstream channel currently impounded by the dam where the substrate currently is dominated by fine sediment, clay, and muck in depths of up to 8 feet. The macroinvertebrate communities in the pool above the dam were dominated by Chironomids. While Chironomids dominated the macroinvertebrate community below the dam, the slightly more complex substrate and free-flowing hydrology supports a more diverse, but still impaired, community downstream of the RMD.

Table 3. Summary of Mean IBI Score and Select Metrics Above and Below RMD

Metric	**Upstream 2022**	**Downstream 2022**
Taxa Richness	4	17
Hilsenhoff	6.6	8.0
EPT PTV 0-4	1	7
IBI Score	**11.6**	**25**

Next Steps

The Commission will continue to track the progress of the proposed removal of Roller Mill Dam and participate in stakeholder meetings over the next few years. Additional pre-removal monitoring will occur as needed until the dam is removed. The Commission operates and maintains a continuous instream monitoring station downstream of the dam, which will be a key component for collecting instream data, particularly turbidity, during the removal process.

In the weeks and months after the dam is removed, the Commission will sample for the same parameters to assess change. Additionally, the Commission plans to sample biological communities at longer intervals post-dam removal (i.e., every 1-3 years).

REFERENCES

Berry, J., L. Steffy, and M. Shank. 2020. Development of a Water Quality Index (WQI) For the Susquehanna River Basin. Susquehanna River Basin Commission Publication No. 322. Harrisburg, Pennsylvania.

PA Department of Environmental Protection (PADEP). 2013. A Benthic Macroinvertebrate Index of Biological Integrity for Wadeable Freestone Riffle Run Streams in Pennsylvania. Pennsylvania Department of Environmental Protection. Division of Water Quality Standards.

Susquehanna River Basin Commission (SRBC). 2020. Quality Assurance Workplan. Dam Removal Study, Chiques Creek Watershed, Lancaster County, PA. Document Control Number SRBC-QA074. Harrisburg, Pennsylvania.

Steffy, L. 2021. Roller Mill Dam Removal, Effects on Chiques Creek, Interim Technical Summary. Susquehanna River Basin Commission. Harrisburg, Pennsylvania.

Appendix A. Electronic copy of QAPP

Appendix B. Electronic copy of 2021 technical report