Pepper/Luce Creek Watershed Stream Assessment

Summary of Findings

CHAGRIN RIVER WATERSHED PARTNERS

Joshua Myers, Associate Director 5/23/23

Table of Contents

Appendices

Authors and Acknowledgements

This report was authored by Chagrin River Watershed Partners staff:

Josh Myers, Associate Director
Keely Davidson-Bennett, Director of Special Projects

Field assessments were conducted by:

Kevin Saracino, Project Manager, Chagrin River Watershed Partners
Eric Pretzlav, NOWCorps Watershed Steward, Chagrin River Watershed Partners
Volunteers from Cleveland Metroparks Watershed Volunteer Program

Executive Summary

Chagrin River Watershed Partners (CRWP), supported by the City of Pepper Pike, the Village of Hunting Valley, and the Ohio Sea Grant Program, evaluated headwater streams in the Pepper/Luce Creek subwatershed to achieve a better understanding of streambank erosion severity and habitat quality. The goals of this assessment project were to identify high-quality streams, document existing or potential problems, track changes over time, and identify possible solutions. Data will be utilized to determine appropriate objectives for the watershed and to support future grant applications.

Approach

In partnership with the City of Pepper Pike and the Village of Hunting Valley, CRWP identified potential sampling sites throughout the Pepper/Luce Creek subwatershed. Sites were selected depending on their location within the watershed and property owner willingness to proceed. The Northeast Ohio Regional Sewer District (NEORSD) collected data on larger streams to determine the Structural Business Risk Exposure (BRE). The BRE score indicates the risk of infrastructure (building, transportation, or utility) damage or loss due to erosion. Assessments for this project were focused in areas that were not already assessed by NEORSD.

CRWP assessed forty-two stream reaches for bank erosion severity and aquatic habitat. applied two surveys to collect data at forty-two sites:

- Bank Erosion Hazard Index (BEHI)
- Headwater Habitat Evaluation Index (HHEI) or Qualitative Habitat Evaluation Index (QHEI)

The BEHI, developed by David Rosgen of Wildland Hydrology, is a fluvial geomorphic assessment procedure used to evaluate the susceptibility of potential streambank erosion based on a combination of several variables that are sensitive to various processes of erosion. CRWP utilized the protocol as modified by Cleveland Metroparks in this study (Newton and Drenten 2015). The BEHI assigns a numerical value to the following metrics and allows for categorization of bank erosion from “very low” to “extreme”: root depth, root density, bank angle, surface protection, bank material, and stratification.

The HHEI was developed by the Ohio Environmental Protection Agency (EPA) to fill a void in stream classification methodology for extreme headwater streams, streams with a drainage area less than 1.0 mi^2. The HHEI is based on three physical measurements that have been found to correlate well with biological measures of stream quality (Ohio EPA 2009). These measurements include substrate type, maximum pool depth, and bank full width. The HHEI also includes two levels of biological assessment, one at order-family level of taxonomic identification and the other at genus-species. CRWP staff only utilized the physical measurements in this project to evaluate the 200-foot stream sections. The HHEI allows for classification of the primary headwater habitat (PHWH):

1. Class III-PHWH: cool-cold water adapted native fauna.
2. Class II-PHWH: warm water adapted native fauna.
3. Class I-PHWH: ephemeral stream, normally dry channel.

CRWP used the QHEI (Ohio EPA 2006) to assess stream habitat quality for streams draining one or more square miles that had not previously been assessed by NEORSD. The QHEI evaluates fish habitat and includes substrate, channel morphology, instream cover, and land use near the steam.

A press release was sent out in June 2022 to notify residents about the project. Sites were selected based on priorities of the community partners with guidance from CRWP staff (Figure 1). Targeted mailings were sent to identified properties to obtain permission for field staff to access the sites.

Surveys were conducted during the Summer and Fall of 2022. Quality analysis began in Winter 2022 and additional site visits were conducted once the growing season began in Spring 2023 to gather any additional required information.

Data analysis was conducted in Spring 2023 using ArcGIS software to map sampling points and compare survey metrics.

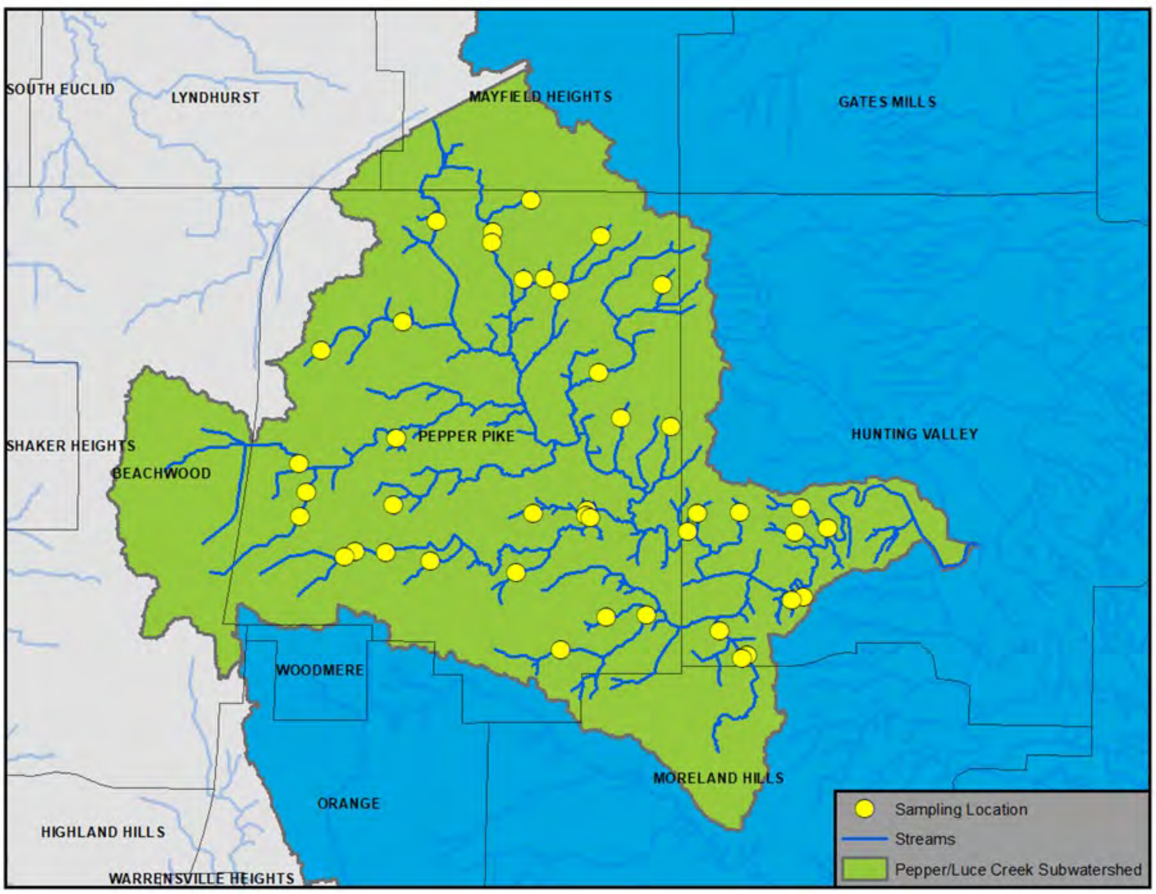

Figure 1. Map of sampling locations within the Pepper/Luce Creek Subwatershed.

Results

CRWP staff reviewed the field assessments and compiled the data into a spreadsheet and geographic information system (GIS) software to further analyze the information. In general, widespread erosion was witnessed throughout, which is indicative of watershed scale issues rather than localized problems. This widespread erosion can be caused by excess stormwater entering the system from impervious surfaces and lack of riparian vegetation.

Stream Habitat Data

Approximately 60% of streams were classified as Class II PHWH or Modified Class II PHWH. Modified Class II streams refer to channels modified by relocation, channelization, or dredging. These streams differ from natural channels which have little or no evidence of channel modification. The remaining 40% of streams were classified as Class III PHWH or Modified Class III (Table 1). Since biological data was not collected for this project, streams were not evaluated for their biotic community to aid in classification of Class II and Class III streams. Due to this, CRWP labeled nonnatural channels with an HHEI score equal to or greater than 70 as "Modified Class III" streams. Two sampling locations within the Village of Hunting Valley have drainage areas larger than 1 mi^2, therefore, a Qualitative Habitat Evaluation Index (QHEI) assessment was conducted. Both sites received a narrative score of "excellent" with habitat scores of 70 and 77.75 (Table 2). Figure 2 shows the location of each HHEI classification within the subwatershed.

Table 1. Summary of HHEI classifications by community

	Class II PHWH	**Class III PHWH**	**Modified Class II PHWH**	**Modified Class III PHWH**
Hunting Valley	4	5	0	0
Pepper Pike	7	6	13	5
Total	**11**	**11**	**13**	**5**

Table 2. Summary of QHEI narrative scores by community

	Excellent
Hunting Valley	2
Pepper Pike	0
Total	2

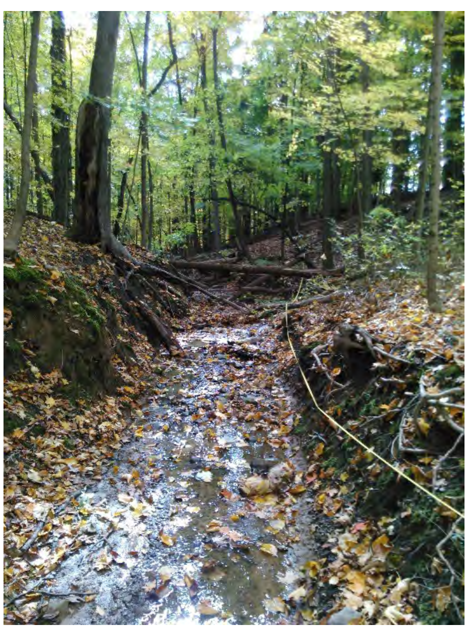

Figure 2. Class III PHWH Stream in Hunting Valley.

Figure 3. Streambank in Pepper Pike with a BEHI rating of "very high."

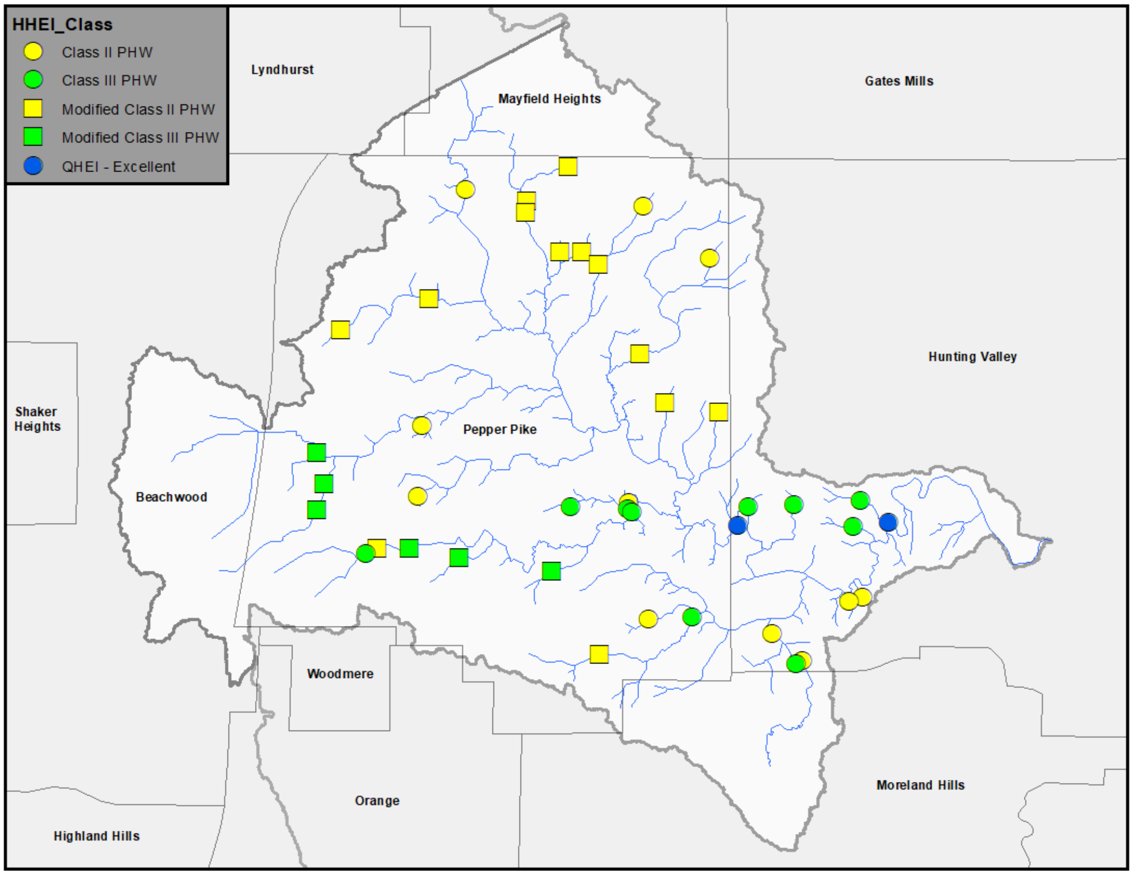

Figure 4. HHEI stream classifications within the Pepper/Luce Creek Subwatershed.

The HHEI also includes a description of the riparian zone and floodplain quality where the riparian width is measured from "none" to "wide" and the floodplain quality is characterized by the predominant land use type per bank. Approximately 50% of sites had at least one side of the streambank that lacked a vegetated riparian buffer.

Bank Erosion Data

Bank erosion throughout the sampling area ranged from "moderate" to "extreme" with no sites scoring as "low". Only one site, 2% of the assessment area, received a BEHI narrative rating of "extreme" with a score of 38.5, this is primarily due to the streambank lacking root density and surface protection while being comprised of highly erodible materials (silt, sand, and gravel). For the remaining sites, 17% received a narrative rating of "moderate," 71% received a narrative rating of "high," and 10% received a narrative rating of "very high" (Table 3). The BEHI scores were distributed throughout the watershed. Figure 3 shows the location of each narrative score along with the NEORSD Structural Business Risk Exposure rating.

Table 3. Summary of BEHI narrative scores by community

	Low	Moderate	High	Very High	Extreme
Hunting Valley	0	3	7	0	1
Pepper Pike	0	4	23	4	0
Total	**0**	**7**	**30**	**4**	**1**

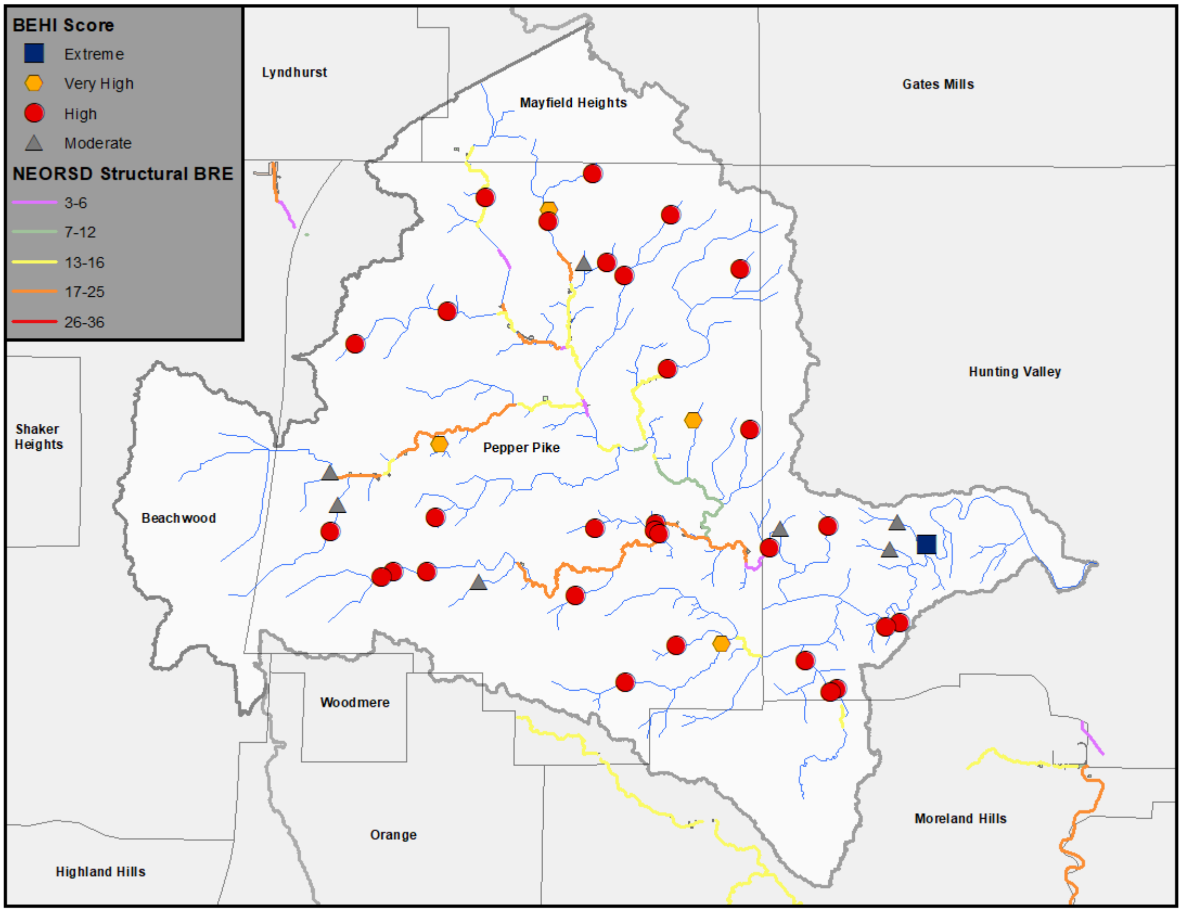

Figure 5. BEHI scores throughout the Pepper/Luce Creek Subwatershed.

Findings

The goals of this assessment project were to identify high-quality streams, document existing or potential problems, track changes over time, and identify possible solutions. By conducting HHEI assessments, we have identified stream channels that should be prioritized for protection (Class III Primary Headwater Habitat). The BEHI assessments identified which stream channels should be targeted for restoration projects such as streambank stabilization or riparian revegetation or addition of stormwater control measures to reduce the frequency of scouring flows reaching the stream. For example, the stream channel located at 2733 Sinton Place in Pepper Pike may benefit from a nature-based approach to address the failing gabion baskets that currently exist at the site. Appendix 2 includes recommendations for each property owner based on the data that was collected.

Figure 6. Gabion baskets are present at 2733 Sinton Place, Pepper Pike, Ohio.

HHEI and BEHI scores were compared to the percent of impervious surface from the 2019 National Land Cover Database. All high-quality, Class III stream channels were located in areas of the watershed with 0% impervious surface at the sampling site. Where possible, efforts should be made to ensure that these areas remain healthy by maintaining native vegetation in the riparian zone (Figure 4).

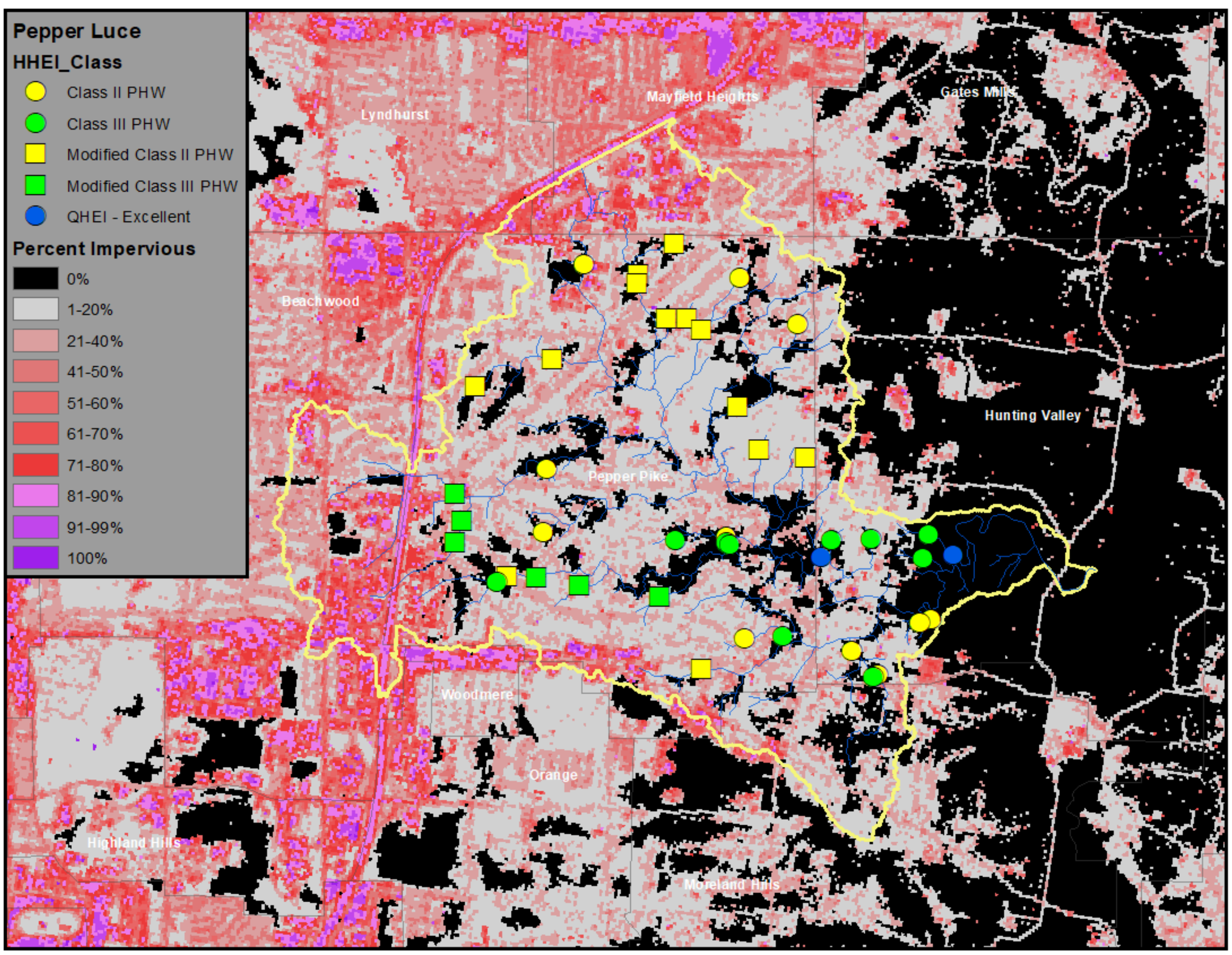

Figure 7. Percent impervious compared to HHEI scores.

Communities should consider implementing watershed wide stormwater management practices to lessen the erosion that is occurring within the Pepper/Luce Creek subwatershed.

The dominant land use in the Pepper Luce Creek watershed is low-density single family residential development. The downspouts on many homes in Pepper Pike are connected to the storm sewer system. Since the majority of Pepper Pike has one acre lots, there is ample space for downspout disconnection. WinSLAMM modeling of communities in the Chagrin River watershed indicated that disconnecting impervious surfaces from the storm sewer system in residential subdivisions would result in annual runoff reductions of 32 to 53% (Dorsey et al. 2009. Incorporating rain gardens and permeable pavement on residential properties could result in even greater stormwater volume reduction.

Pepper Pike could also consider green infrastructure projects alongside roads to incorporate additional stormwater control measures without acquiring land. Nearby communities of Orange Village (Darner and Dumouchelle 2011) and Chagrin Falls Village have decreased road and yard flooding and improved water quality by incorporating bioswales in the right-of-way. Trees could be incorporated into roadside bioretention to help meet goals of increasing tree canopy while also managing stormwater.

Generally, green infrastructure has been shown to be an effective stormwater management tool. Monitored bioretention cells on clayey soils in northern Ohio reduced outflow volume by 36 - 60% through exfiltration and evapotranspiration. Additionally, the monitored bioretention cells reduced 90th percentile peak flow rates by 83 – 93% (Winston et al. 2015). Monitored permeable pavement applications on poorly draining soils reduced outflow by 16 – 99% and reduced 90th percentile peak flow rates by 30 – 97% (Winston et al. 2015). A subdivision in Connecticut designed with permeable pavement, bioretention, rain gardens, swales, and shared driveways and open space did not increase runoff volumes after development. A nearby traditional subdivision developed at the same time had substantial and significant increases in runoff volumes (Dietz and Clausen 2008). Additionally, Stack et al. (2010) predicted that retaining the first inch of precipitation on-site for new development in the Oyster River watershed in New Hampshire would reduce the number of culverts that would need to be replaced due to future increases in precipitation.

Another strategy that could be useful for reducing streambank erosion in the Pepper/Luce watershed is retrofitting stormwater basins in commercial and industrial areas in Mayfield Heights and Beachwood to reduce the rate at which stormwater from frequent, small storms is released from the basins. CRWP has identified five pre-2003 stormwater basins in Mayfield Heights and two in Beachwood in the Pepper/Luce watershed. The Ohio State University (OSU) may be able to include the basins in Mayfield Heights in a retrofit feasibility study that CRWP and OSU are partnering on funded by the Ohio Water Development Authority. If the Mayfield Heights basins are included in the study, OSU will complete modeling for retrofits and produce engineering drawings for these sites if retrofits are feasible. Collectively, stormwater retrofits on residential properties reduce stormwater runoff and benefit your community by:

- Increasing the amount of water that soaks into the ground, recharging aquifers and groundwater-fed streams
- Safeguarding communities from flooding and drainage problems
- Protecting streams and lakes from pollutants carried by urban stormwater
- Reducing potential for streambank erosion
- Enhancing the beauty of yards and neighborhoods, and
- Providing habitat for birds, butterflies, and many beneficial insects

Private landowners may consider the following:

- Disconnecting downspouts, where applicable, and routing the flow to a vegetated filter strip or an alternate practice such as:
    - Rain barrel
    - Rain garden
- Riparian buffer revegetation
- Installation of native trees and shrubs in the landscape
- Impervious surface reduction (e.g. driveways, parking pads, large patios)
- Replacement of impervious surfaces with pervious pavers or pavements
- Installation of rain gardens and vegetated swales to infiltrate stormwater

Municipal buildings can also benefit from reducing impervious pavement, utilizing permeable pavement or bioretention systems wherever possible, adding native trees and vegetation to the landscape, and utilizing larger scale rainwater harvesting to reduce stormwater inputs from buildings while allowing for the use of this water for landscape watering or vehicle washing. Communities also have the opportunity to explore retrofitting pre-2003 stormwater basins to improve water quality and decrease downstream erosion.

CRWP has a range of resources available on our website for private landowners to refer to when lessening their stormwater impact. CRWP is also available to assist each community with development and prioritization of projects and can help to find funding that will reduce the widespread erosion that was discovered through this study.

Literature Cited

Darner, R.A., and D.H. Dumouchelle. 2011. Hydraulic characteristics of low-impact development practices in northeastern Ohio, 2008–2010:U.S. Geological Survey Scientific Investigations Report 2011–5165, 19 pp.

Dietz, M.E. and J.C. Clausen. 2008. Stormwater runoff and export changes with development in a traditional and low impact subdivision. *Journal of Environmental Management* 87: 560-566.

Dorsey, J., R. Webb, J. Witter, D. Mecklenburg, A. Brennan. 2009. Modeling the Effectiveness of Traditional and Innovative Stormwater Management Strategies in the Chagrin River Watershed: Part 1-Development Site Scale. Available from Chagrin River Watershed Partners.

Newton, S.E., Drenten, D.M. (2015). Modifying the Bank Erosion Hazard Index (BEHI) protocol for rapid assessment of streambank erosion in northeastern Ohio. Journal of Visualized Experiments. 2015 Feb 13;(96). doi: 10.3791/52330.

Ohio EPA. 2009. Field Evaluation Manual for Ohio's Primary Headwater Habitat Streams (Version 2.3).

Ohio EPA. 2006. Methods for assessing habitat in flowing waters using the Qualitative Habitat Evaluation Index. Ohio EPA Technical Bulletin EAS/2006-06-1.

Stack, L., Simpson, M.H., Crosslin, T., Roseen, R., Sowers, D., Lawson, C. (2010). *The Oyster River culvert analysis project*. Syntectic International, Antioch University New England, Climate Techniques, the University of New Hampshire, and the Piscataqua Region Estuaries Partnership. Prepared for the Piscataqua Region Estuaries Partnership, Durham NH, and the EPA Climate Ready Estuaries Program.

Winston, R.J., J.D. Dorsey, and W.F. Hunt. 2015. *Monitoring the Performance of Bioretention and Permeable Pavement Stormwater Controls in Northern Ohio: Hydrology, Water Quality, and Maintenance Needs.* Report to Chagrin River Watershed Partners, Inc., August 15, 2015. https://crwp.org/nerrs-science-collaborative/