Bell Run - South Fork Licking River HUC-12 (05040006 0406)

Nine-Element Nonpoint Source Implementation Strategic Plan (NPS-IS Plan)

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Version 1.0

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Voinovich School of
Leadership and Public Service

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Acknowledgements

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Chapter 1: Introduction to Bell Run – South Fork Licking River HUC-12

Bell Run - South Fork Licking River (05040006 0406) is a 26 square mile subwatershed in Licking County and part of Fairfield County, Ohio located approximately 30 miles east of Columbus (Figure 1). Bell Run - South Fork Licking River HUC-12 (Bell Run – SFLR HUC-12) is bisected by US 40 and Interstate 70. The area consists of about 55% row crop, 16% forest, 15% pasture, and 14% residential areas. Commencing on the South Fork Licking River at the Kirkersville dam and ending downstream from the confluence with Waste Weir Run, the Bell Run - South Fork Licking River HUC-12 assessment unit (26.0 mi^2) drains some of the flattest, glaciated topography in the Licking River watershed (Ohio EPA, 2012).

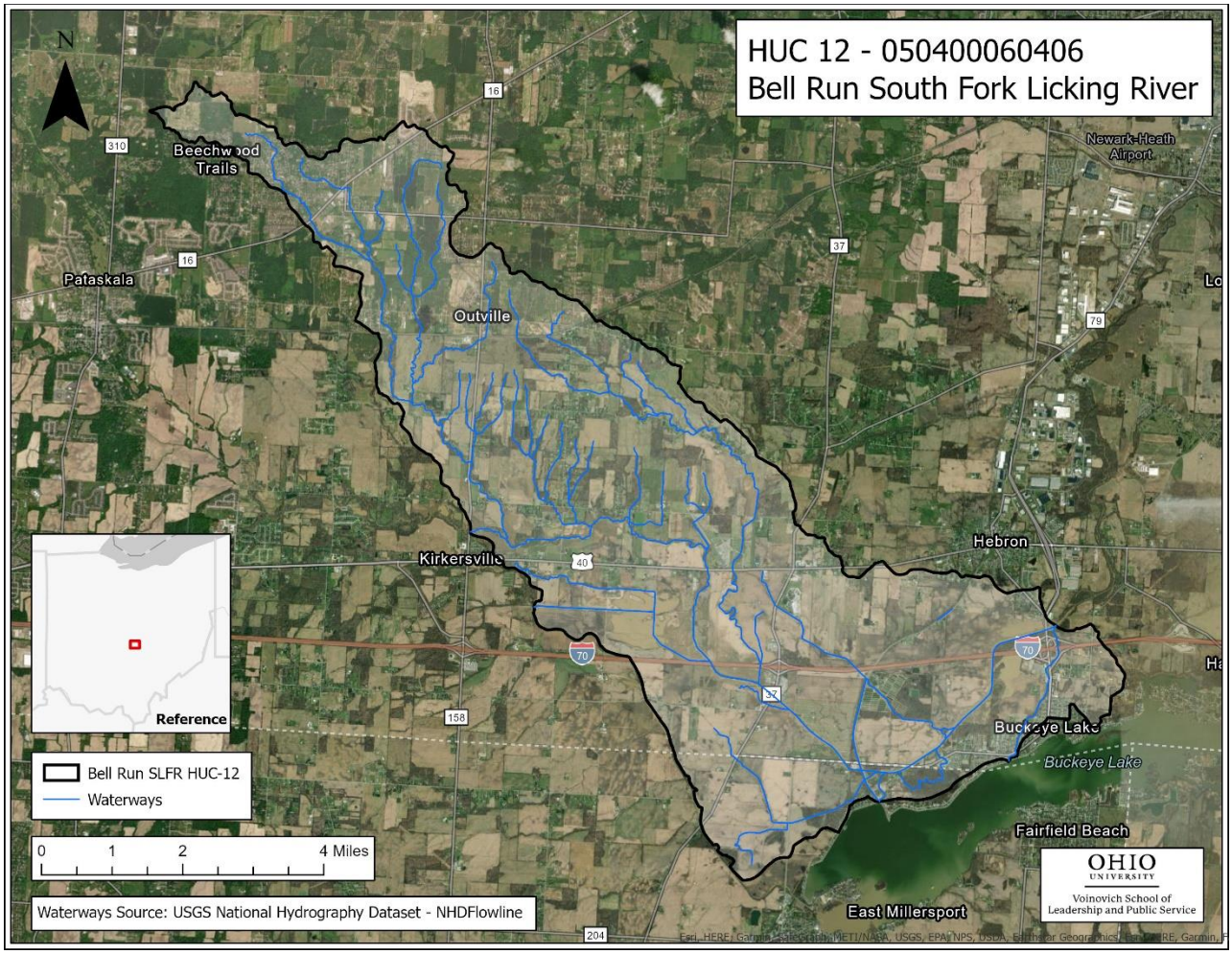

Figure 1. Map of Bell Run - SFLR HUC-12 boundary.

Due to recreational, economic, and ecological interest in the water quality health of Buckeye Lake and South Fork Licking River, partners are interested in examining all HUC-12 watersheds in the South Fork to improve land use and management practices in the area. Bell Run - South Fork Licking River HUC-12 has been identified as an area for riparian corridor improvement to reduce soil erosion, filter water pollutants, and reduce flooding impacts downstream. A riparian corridor is a strip of vegetation along a waterway that is characterized by the presence of permanent or ephemeral surface or ground water, flowing channels of water, and various types of vegetation.

The development of a Nonpoint Source Implementation Strategic Plan (NPS-IS) for Bell Run - South Fork Licking River HUC-12 has been funded in part by a joint grant between Ohio EPA and the Ohio Department of Natural Resources Division of Mineral Resources Management. Following the creation of this plan, implementation to target critical areas along the Bell Run - South Fork Licking River HUC-12 and its tributaries that lack a forested/vegetated buffer will be sought by stakeholders.

1.1 Report Background

In 2008, Ohio EPA Division of Surface Water studied the biological and water quality of tributaries in Fairfield, Knox, Licking, and Muskingum Counties. Four sample sites were located in the Bell Run - South Fork Licking River HUC-12: one downstream from the Village of Kirkersville Wastewater Treatment Plant (WWTP) (RM 21.24), one downstream from the Southwest Licking Community WWTP at US 40 (RM 19.10), and two sites bracketing the South Fork Buckeye Lake WWTP (RM 14.04) discharge (RM 15.75 and RM 12.96) (Ohio EPA, 2012) (Figure 2).

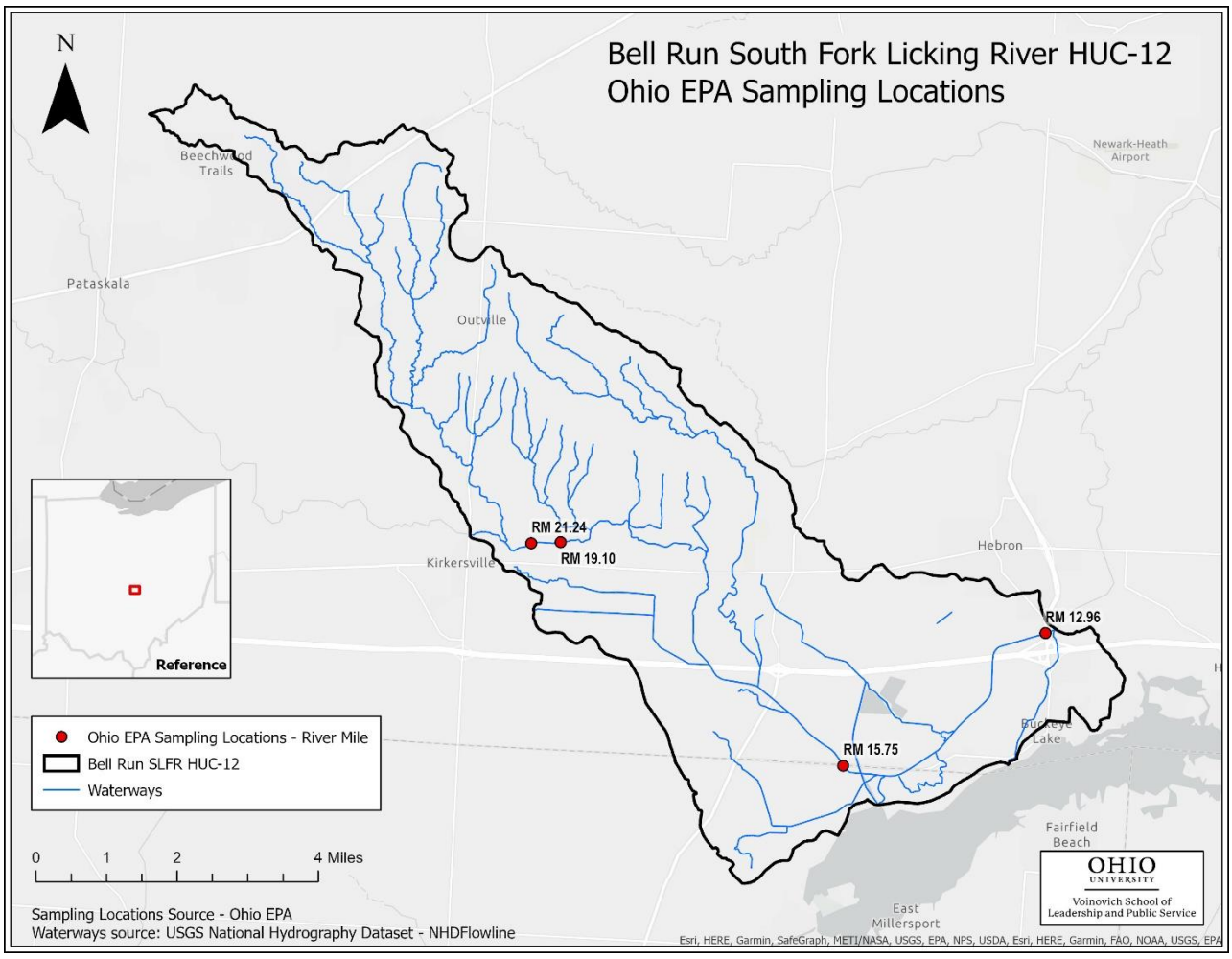

Figure 2. Ohio EPA biological and water quality sampling locations within Bell Run - SFLR HUC-12.

Ammonia, chloride, dissolved oxygen (DO), E. coli, and other nutrients associated with treated

wastewater were present in all samples. In 2008, E. coli samples that exceeded the recreational standards impaired recreation in this area (Ohio EPA, 2020). The most current data were collected in 2008 and serves as the basis for the State's determination of attainment status in this HUC-12. This NPS-IS plan will serve as a wide-reaching document, consolidating implementation strategies across Licking and Fairfield County that can be added to in the future. Currently TMDL information for Bell Run - South Fork Licking River HUC-12 is not available but marked as "in progress". Continuous monitoring and improvement of watershed land use and management practices are important to maintain water quality standards in this HUC-12 watershed (Ohio EPA, 2020).

1.2 Watershed Profile & History

Licking County was established in 1808. The county was predominately used for agriculture for its first 100 years. Licking County remains rural, with less than two percent of the county's 687 square miles consisting of urban areas. The county's largest community is Newark, with a population of 46,279 people. "Licking County has experienced a significant increase in population, roughly 13.4 percent, between 1990 and 2000, raising the total number of residents to 145,491 people. The county averages 212 people per square mile" (Ohio History Central, n.d.).

Bell Run - South Fork Licking River HUC-12 is a part of the Muskingum Watershed that spans 27 counties. HUC-12 Town of Kirkersville-South Fork Licking River (05040006 04 05), with a drainage area of 17 square miles flows into Bell Run - South Fork Licking River HUC-12, which then drains into HUC-12 Beaver Run - South Fork Licking River HUC-12 (05040006 04 09). South Fork Licking River as a whole is about 30 miles long. It initially flows southeast toward Kirkersville until it enters Fairfield County, where it changes direction and begins flowing northeast towards Heath, Ohio. To the south of the river, Buckeye Lake lies just outside of the Bell Run - South Fork Licking River subwatershed. The northern portion of the small Village of Buckeye Lake lies within the watershed boundary (Figure 3).

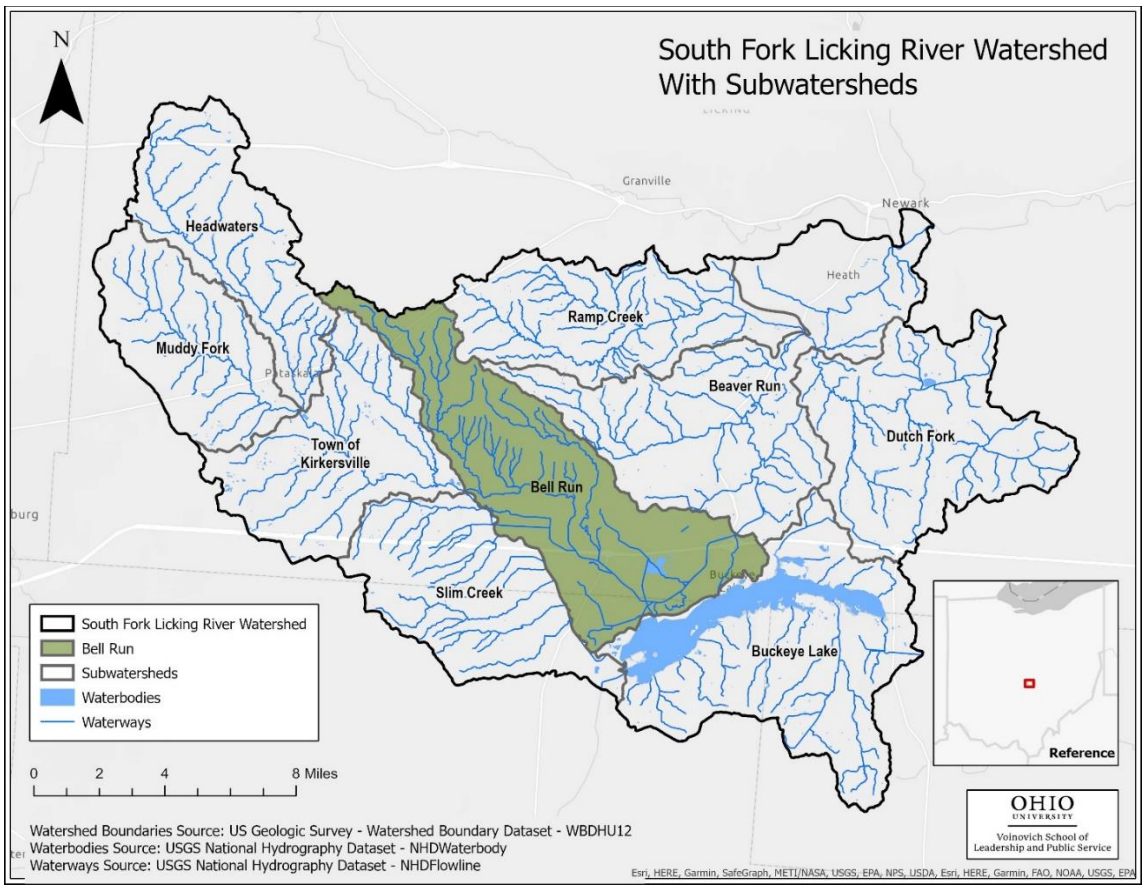

Figure 3. Map of Bell Run - SFLR HUC-12 in South Fork Licking River Watershed HUC-10.

As part of Ohio's historic canal system, the South Fork Licking River was modified to feed water to Buckeye Lake. The highly eutrophic Buckeye Lake is located on the watershed divide with Walnut Creek. Buckeye Lake's outflow enters the South Fork Licking River via two different tributaries (Unnamed at RM 15.5 and Waste Weir Run at RM 12.83). The Buckeye Lake Wastewater Treatment Plant (WWTP) (RM 14.04) is situated between these tributaries (Perry County SWCD, 2020).

Increased sedimentation and nutrient input are a concern in the South Fork Licking River and the Buckeye Lake area. Due to the predominant agricultural land use, an emphasis on best management practices on the land and along the stream riparian corridor to protect soil from eroding is of interest. Poorly vegetated stream corridors result in increased rates of erosion, and these critical areas are identified later in this report. Not only does soil erosion result in the loss of fertile land, but it also has the potential to increase pollution and sedimentation, causing declines in water quality and fish populations. Additionally, the infiltration rates along poorly vegetated riparian corridor lands are low, which can worsen flooding in downstream residential and urban areas. (Perry County SWCD, 2020).

1.3 Public Participation & Involvement

Watershed restoration plans require many partners to support their development. The Bell Run - South Fork Licking River HUC-12 Nine Element Watershed Plan engaged non-profit and government organizations in dialogue facilitated by Ohio University's Voinovich School of Leadership and Public Service. This NPS-IS Plan for the Bell Run - South Fork Licking River HUC-12 serves as a resource for future water quality improvement and preservation.

Strong partner engagement is critical to bringing NPS-IS projects to action, especially for implementation on private lands. To assist with future projects, Natural Resources Conservation Service (NRCS) and Muskingum Watershed Conservancy District both have interests in Bell Run - South Fork Licking River HUC-12 and could provide cost share on project implementation. For example, NRCS offers the Conservation Reserve Program (CRP) and the Environmental Equality Incentives Program (EQIP), two programs that provide financial support for property owners who want to apply best practices for improved water quality on their land.

Below are the partners who supported the development of this NPS-IS through information sharing, direct feedback, and stakeholder engagement.

- Licking County Soil & Water Conservation District (SWCD) was instrumental as a point of contact for water quality activities and information in the Bell Run - South Fork Licking River HUC-12. In addition, Licking County SWCD provided information regarding water quality efforts in the adjacent HUCs. For example, if a BRIC grant is awarded to the Ohio Emergency Management Agency and the Licking County Commissioners, Licking County SWCD will administer the BRIC grant to conduct 2D modeling of the South Fork Licking River for debris management and flood mitigation. A pre-application has been submitted and the final application is due December 1, 2021.
- South Licking Watershed Conservancy District spans three counties: Licking, Fairfield, and Perry Counties. Their Board provided valuable feedback on the development of the report and information on project needs, such as site selection, local insights, and contacts.
- The Stream + Wetlands Foundation (SWF), located in Lancaster, Ohio, has an ongoing restoration project located on Bloody Run Swamp within the Bell Run - South Fork Licking River Watershed. SWF acquired an 80-acre parcel with the plans to restore a section of agricultural stream/ditch reconnecting it to the floodplain to create a wetland. SWF is partnering with Ohio University to conduct baseline pre-stream and wetland restoration sampling within the legacy Bloody Run Swamp and field-side ditches, draining fields, and the South Fork Licking River. Research objectives are to determine baseline water and sediment quality and hydrology in the north ditch of the proposed restoration site; to quantify erosion rates in the existing ditch; and to measure the effect of storm events on hydrology in the north ditch. Results from the baseline sampling and construction of the stream and wetland restoration are planned for summer 2022.
- The Ohio State University Extension Office in Licking County provided local resources that aided the analysis of this plan.
- Ohio Environmental Protection Agency provided requested water quality data as well as routine water monitoring report data that was a key source of information for this plan.

Chapter 2: Characterization and Assessment Summary for Bell Run - South Fork Licking River HUC-12

2.1 Summary of HUC-12 Watershed Characterization

2.1.1 Physical and Natural Features

The South Fork Licking River HUC-10 watershed is made up of nine subwatersheds, two of which drain into Buckeye Lake: "Buckeye Lake" and "Buckeye Lake Feeder Reservoir". This document focuses on the Bell Run - South Fork Licking River HUC-12 subwatershed, located in the center of the South Fork Licking River HUC-10 (Figure 3). The bedrock geology for Bell Run - South Fork Licking watershed consists of Maxville Limestone, Rushville, Logan, and Cuyahoga Formations, Undivided, of the Mississippian time period. These formations are interbedded shale, siltstone, and sandstone (USGS, n.d.). The soil descriptions for the Maxville series consist of very deep, well drained soils that can be found on alluvial fans and stream terraces. The silty soils of the Rushville and Logan series consist of very deep and poorly drained soils that form from lake sediments. These two formations are slowly permeable soils (USDA-NRCS, 2021).

Soils are also assigned to hydrologic soil groups. Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration soils. Only soils in their natural condition are in group D and are assigned to dual classes. If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas (USDA-NRCS, 2021).

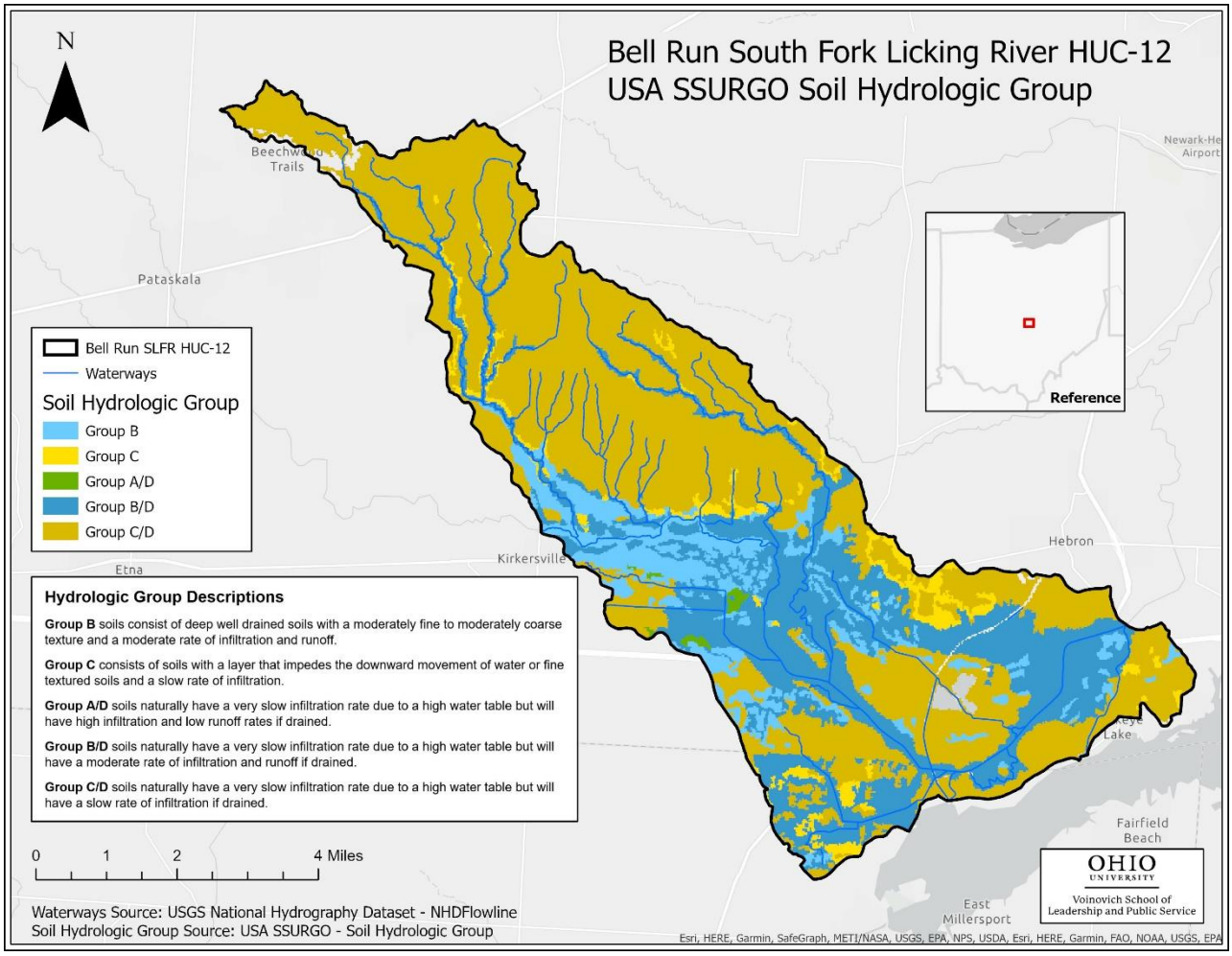

Figure 4. Map of hydrologic soil groups for Bell Run - South Fork Licking River HUC-12 (USDA-NRCS, 2021).

The predominant soil types in this subwatershed have high runoff potential and very slow infiltration rates. Type B/D soils are predominant along the channel of the Bell Run - South Fork Licking River HUC-12 and make up 26.8%of the region. In contrast, C/D envelops the surrounding main water courses with a total 58% of the watershed (Figure 4).

Agriculture accounts for more than half of the land use (69.4%) in the Bell Run – South Fork Licking River subwatershed, mostly in glacial till over Mississippian bedrock (Table 1). Development is secondary compared to cultivated and pastureland in the watershed.

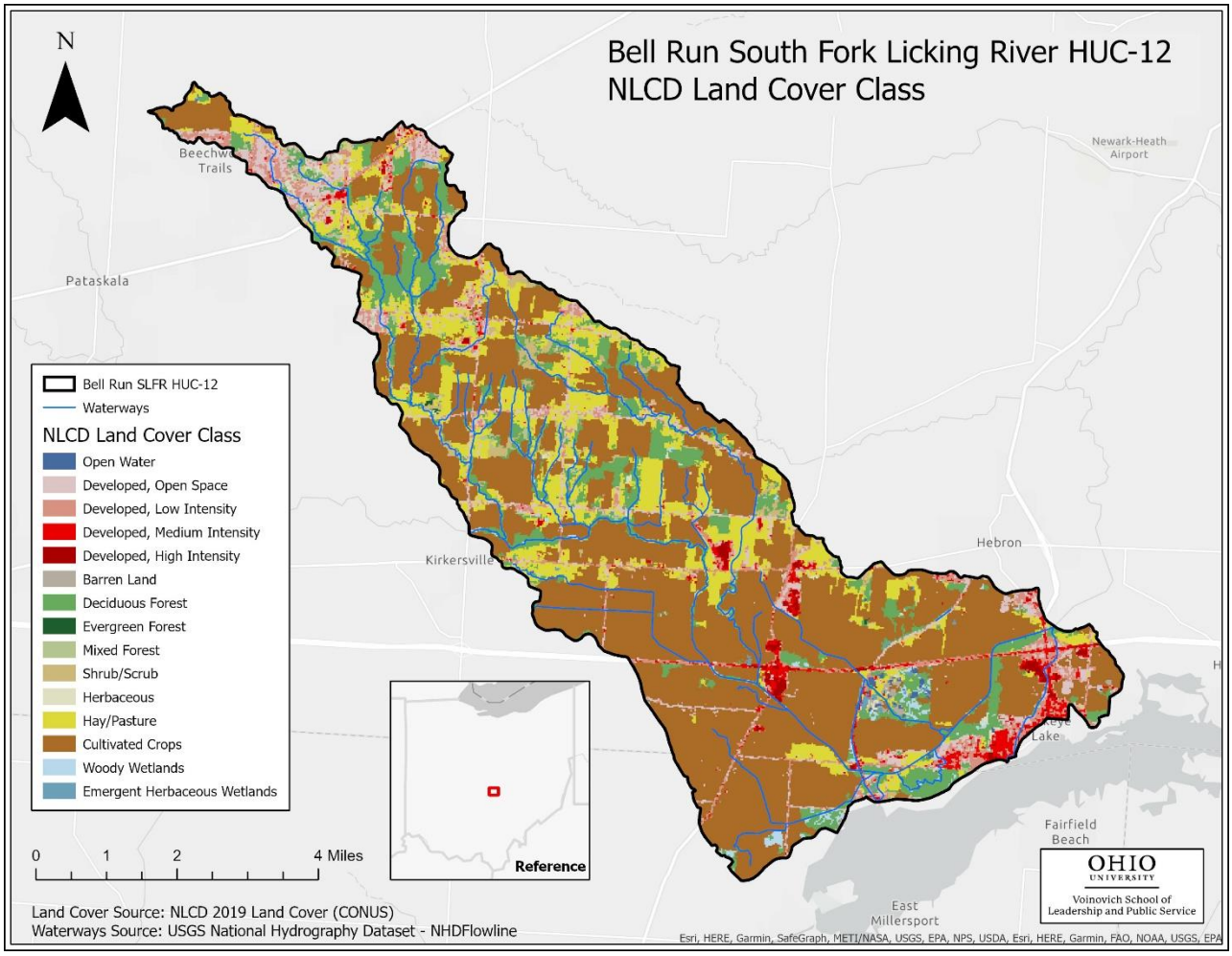

Figure 5. Map of land cover classes in Bell Run - SFLR HUC-12.

The primary land use in the Bell Run - South Fork Licking River HUC-12 is agriculture (69.4%), followed by residential or developed area (15%) and a smaller fraction is forested (13%) (Figure 5). Wetland areas make up an extremely small percentage of land use. Due to the high percentage of agricultural land in this area, land loss due to soil erosion, nutrient enrichment, and flooding are prominent issues.

Specific landmarks and features in this watershed include:

- Ohio Division of Wildlife Fish Hatchery
- Businesses and residential housing
- Churches
- Airport

Since this region consists of poorly drained soils and includes some of the flattest land in the Licking River watershed, businesses and residential areas have a high flooding potential. One action that can be taken to minimize erosion, soil loss, risk of flooding downstream, and pollution caused by overland flow is implementation of stream riparian corridors, which will be described later in this plan.

2.1.2 Land Use

As discussed earlier, the primary land use in the Bell Run - South Fork Licking River HUC-12 is agriculture, which equates to just under 70% of the land use in the region, including cultivated crops (54.77%) and hay or pasture (14.72%) (Table 1). Due to the high percentage of crop land in this area, flooding and land loss due to soil erosion are prominent issues. Additionally, nutrients, such as nitrogen and phosphorus, and pesticides, including herbicides, insecticides, and fungicides, in overland flow may cause significant water quality problems. According to the USGS, agriculture is the leading source of impairments in U.S. rivers and lakes (USGS, n.d.c).

Table 1. Land use by category in Bell Run - SFLR HUC-12 (USGS, 2019; USGS & USDA-NRCS, 2013).

Land Cover	Area (Acres)	Area Percentage
Cultivated Crops	9,105.50	54.77
Hay/Pasture	2,447.90	14.72
Deciduous Forest	2,016.23	12.13
Developed, Open Space	963.41	5.79
Developed, Low Intensity	943.18	5.67
Developed, Medium Intensity	405.20	2.44
Shrub/Scrub	232.18	1.40
Developed, High Intensity	127.43	0.77
Woody Wetlands	115.65	0.70
Mixed Forest	97.41	0.59
Herbaceous	64.05	0.39
Open Water	40.92	0.25
Barren Land	31.80	0.19
Emergent Herbaceous Wetlands	28.91	0.17
Evergreen Forest	6.45	0.04
Total	16,626.21	100.00

Developed space accounts for 14.67% of land use in the region ranging from high intensity to low intensity. A little more than 15% accounts for natural areas, such as wetlands (0.87%), shrubs (1.4%), and deciduous forest (12.13%). Wetlands account for approximately 147 acres of Bell Run - South Fork Licking River HUC-12 (Figure 6). Those 147 acres encompass freshwater emergent wetlands (69.59 acres) and freshwater forested/shrub wetlands (77.52 acres) (USFWS, 2020).

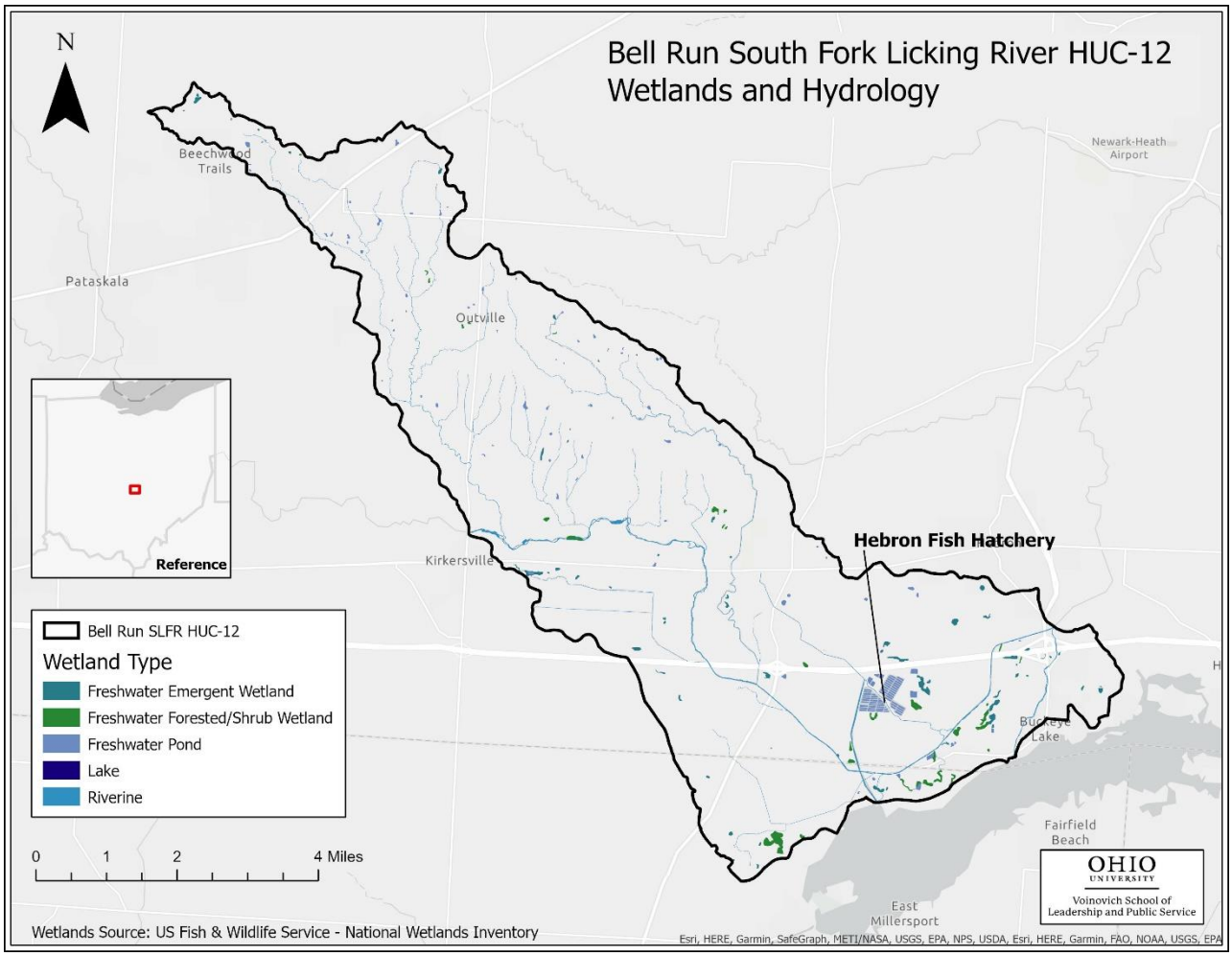

Figure 6. Map of wetland types in Bell Run - SFLR HUC-12 (USFWS, 2020).

2.2 Summary of Biological Trends

As reported in Biological and Water Quality Study of the Licking River (2012), the Ohio EPA sampled 10 locations in the Bell Run - South Fork Licking River subwatershed. Data were collected during the Ohio EPA's 2008 study of the Licking River basin (Ohio EPA, 2012).

Though site locations have changed slightly between the 1993 and 2012 studies, results are compared from each study to look at how the South Fork Licking River water quality has changed over time and infer how it may have changed up until the present. Table 2 shows data from river RM 0.3 to 21.4. However, sites immediately downstream of Bell Run - South Fork Licking River HUC-12, which include RM 15.3 (upstream Buckeye Lake WWTP), RM 13.0 (downstream Buckeye Lake WWTP), and RM 8.8 (Hebron WWTP/downstream Beaver Run), may be a better indicator of the health of the upstream section of the South Fork Licking River (Table 2).

Table 2. Summary of biological trends for Bell Run - SFLR HUC-12 comparison (light grey) and within the South Fork Licking River Watershed (Ohio EPA 1995, 2012).

Location (RM)	Year	IBI	MIwb	ICI	QHEI	Status	Mi^2
RM. 21.1 -21.4	1993	52	9.6	good	67.0	full	
	2008	51	9.6	v. good	67.0	full	51.0
RM 19.0 (US 40)	1993	n/a	n/a	n/a	n/a	full	55.0
	2008	52	9.5	36	73.5	full	55.0
RM 15.3 - 15.4 (UST Buckeye Lake WWTP)	1993	49	8.6	50	59.5	full	64.0
	2008	48	8.8	46	69.5	full	64.0
RM 12.9 - 13.1 (downstream Buckeye Lake WWTP)	1993	37	8.9	34	39.0	full	69.0
	2008	n/a	n/a	44	n/a	full	69.0
RM 9.4 - 9.9	1993	51	9.9	42	76.5	full	
	2008	n/a	n/a	n/a	n/a	n/a	
RM 8.8 - 8.9(Hebron WWTP/downstream Beaver Run)	1993	51	9.8	42	75.0	full	133.0
	2008	44	8.4	38	63.5	full	133.0
RM 4.3 - 4.7	1993	49	9.6	44	85.5	full	
	2008	n/a	n/a	n/a	n/a	n/a	n/a
RM 2.2	1993	48	9.6	44	n/a	n/a	
	2008	n/a	n/a	n/a	n/a	n/a	
RM 1.7 - 1.8	1993	52	10.2	46	82.5	full	
	2008	48	9.3	44	80.0	full	183.0
RM 0.3 - 0.5	1993	53	10.2	36	60.5	full	
	2008	46	8.2	44	59.5	full	288.0

2.3 Summary of NPS Pollution Causes and Associated Sources

A Total Maximum Daily Load Report has not been prepared for the South Fork Licking River. Therefore, no "official" causes or associated sources of impairment have been identified. However, areas of concerns for this NPS-IS plan have been drawn from the Biological and Water Quality Study of the Licking River for data collected in 2008 and published in 2012.

While aquatic life use was determined by Ohio EPA in 2008 to be in full attainment, the recreational use attainment does not meet full attainment. The Ohio EPA noted while comparing other Licking River HUC-sections, the South Fork conveys the most effluent and proportionately the least number of bacteria. However, the E. coli concentrations still exceeded standard for the primary contact for recreation (PCR) class B criterion at all sites (E. coli<161 cfu/100 mL) with South Fork Licking River site US 40 at RM 19.1 showing a maximum of 12,000 cfu/100 mL. There are two wastewater treatment plants (WWTPs) just upstream of this HUC-12: Kirkersville WWTP at RM 21.82 and

Southwest Licking Community Water and Sewer WWTP at RM 21.48. Buckeye Lake Sewer District #1 WWTP is located within this HUC at RM 14.20. "Individual sample values under the threshold were obtained on three occasions from the Kirkersville WWTP and twice each at locations bracketing the Buckeye Lake facility. Waste Weir Run was created to convey excess water from Buckeye Lake in the canal era. Prior to 1992, Buckeye Lake WWTP discharged to Waste Weir Run. Chemical and bacteriological sampling in Waste Weir Run occurred at one location within a few hundred yards of the Buckeye Lake outlet structure. Absent any apparent source of bacteria, it was puzzling that three E. coli concentrations exceeded the PCR class B criterion as did the geometric mean value (180 cfu/100 mL at RM 1.6)" (Ohio EPA, 2012).

Home septic system failure may play a role in increased concentrations of E. coli found in and of Bell Run - South Fork Licking River HUC-12 (Ohio EPA, 2012). A Household Sewage Treatment System (HSTS), "often incorrectly referred to as a "septic system," is a system that serves a private residence, in an unsewered area, using biological, chemical, or mechanical methods to treat liquid and solid human waste materials" (MCHD, n.d.) HSTSs require routine maintenance and can be expected to need replacement between 12 to 20 years. A properly functioning HSTS protects water quality by treating sewage using aerobic bacteria. Malfunctioning or failing HSTSs can discharge untreated sewage and excess nutrients into waterways, polluting drinking water sources and creating disease-producing conditions. Excess nutrients throw the ecosystem out of balance resulting in algal blooms (including toxic algae), decreased oxygen, and fish kills (MCHD, n.d.). According to the Licking County Health Department (personal communication, September 15, 2021), failing home septic systems (HSTS) are not formally tracked. However, across Licking County there are approximately 40,000 home septic systems, and in general, the Licking County Health Department receives about two complaints a week, which are verified and resolved through an operation and maintenance program. It is unclear if home septic systems pose a major threat to water quality specifically in Bell Run - South Fork Licking River HUC-12.

Waste Weir Run (WWR) is a waterway that carries the effluent from Buckeye Lake to the South Fork Licking River. WWR enters South Fork Licking River at RM 12.8. WWR was assessed in two locations near the Buckeye Lake WWTP in 1984. Prior to the relocation of the Buckeye Lake WWTP outfall to discharge into the South Forking Licking River, the overall, biological performance was poor (Ohio EPA, 2012). The next assessment of WWR happened in 2008, samples from WWR included algal respiration from Buckeye Lake and the effluent from Buckeye Lake WWTP (Ohio EPA, 2012). Summer sampling indicated that anoxic conditions were present, "organic nitrogen (TKN $\bar{x}$ =0.76 mg/ L, n=5) and oxygen demand (COD $\bar{x}$=26 mg/ L, n=5) concentrations were elevated" (Ohio EPA, 2012) and aquatic life requirements were not met.

Due to agriculture being the predominant type of land use in the Bell Run South Fork Licking River HUC-12, the main pollution source of concern is overland flow, which may consist of sediment, pesticides, and fertilizers. This may account for the concentrations of ammonia-N and nitrogen found. Nitrite was recorded along sites from South Fork Licking River east of Kirkersville at Gale Road (RM. 21.85) to South Fork Licking River near State Route 360 and 79 (RM 14.5). Nitrite concentrations at these sites ranged from 0.058 mg/ L to 0.124 mg/ L, which is still below the measured maximum in reference stream for the local ecoregion of 0.171 mg/ L (Rankin et al., 1999 and Ohio EPA, 2019). The maximum combined level for Nitrate + Nitrite found at reference streams in this ecoregion is 10.4 mg/l while the maximum values found along seven sites (South Fork Licking River east of Kirkersville at Gale Road (RM 21.85)) to Heath WWTP 001 Outfall (RM. 1.6), are concentrations of 3.03 mg/ L - 14.5 mg/ L. The highest Nitrate + Nitrite concentrations of 14.5 mg/ L and 11.1 mg/ L were at sites from the Southwest Licking Sewer District WWTP Outfall to South Fork Licking River (RM. 21.57) and Heath WWTP 001 Outfall (RM. 1.6) to South Fork Licking River (Rankin et al., 1999 and Ohio EPA, 2019).

The maximum Total Phosphorus (TP) was recorded along the same seven sites (South Fork Licking

River east of Kirkersville at Gale Road RM 21.85 to Heath WWTP 001 Outfall RM 1.6). TP concentrations ranged from 0.851 mg/ L to 3.15 mg/ L with an average concentration of 1.58 mg/ L. The measured maximum of TP from reference streams in this ecoregion had a concentration of 2.28 mg/ L (Rankin et al., 1999 and Ohio EPA, 2019).

In addition to what has previously been discussed, bank erosion due to land use and lack of vegetation is a contributing source of sediment to the Bell Run - South Fork Licking River HUC-12. Maximum levels of Total Dissolved Solids (TDS) and Total Suspended Solids (TSS) were recorded along the seven sites mentioned above. Maximum values of TDS at these sites range between 630 mg/ L and 1,400 mg/ L. The largest concentrations are found between South Fork Licking River near State Route 360 and State Route 79 at RM 14.5 (1,060 mg/l) and Southwest Licking Sewer District WWTP Outfall to South Fork Licking River at RM 21.57 (1,400 mg/l). Both of these maximum recorded levels exceed the maximum level found at reference streams in this ecoregion for TDS (1,220 mg/l). Maximum recorded levels of TSS for these locations ranged between 0 and 185 mg/ L. However, these values are well below the maximum level found at reference stream conditions (1,710 mg/ L) (Rankin et al., 1999 and Ohio EPA, 2019).

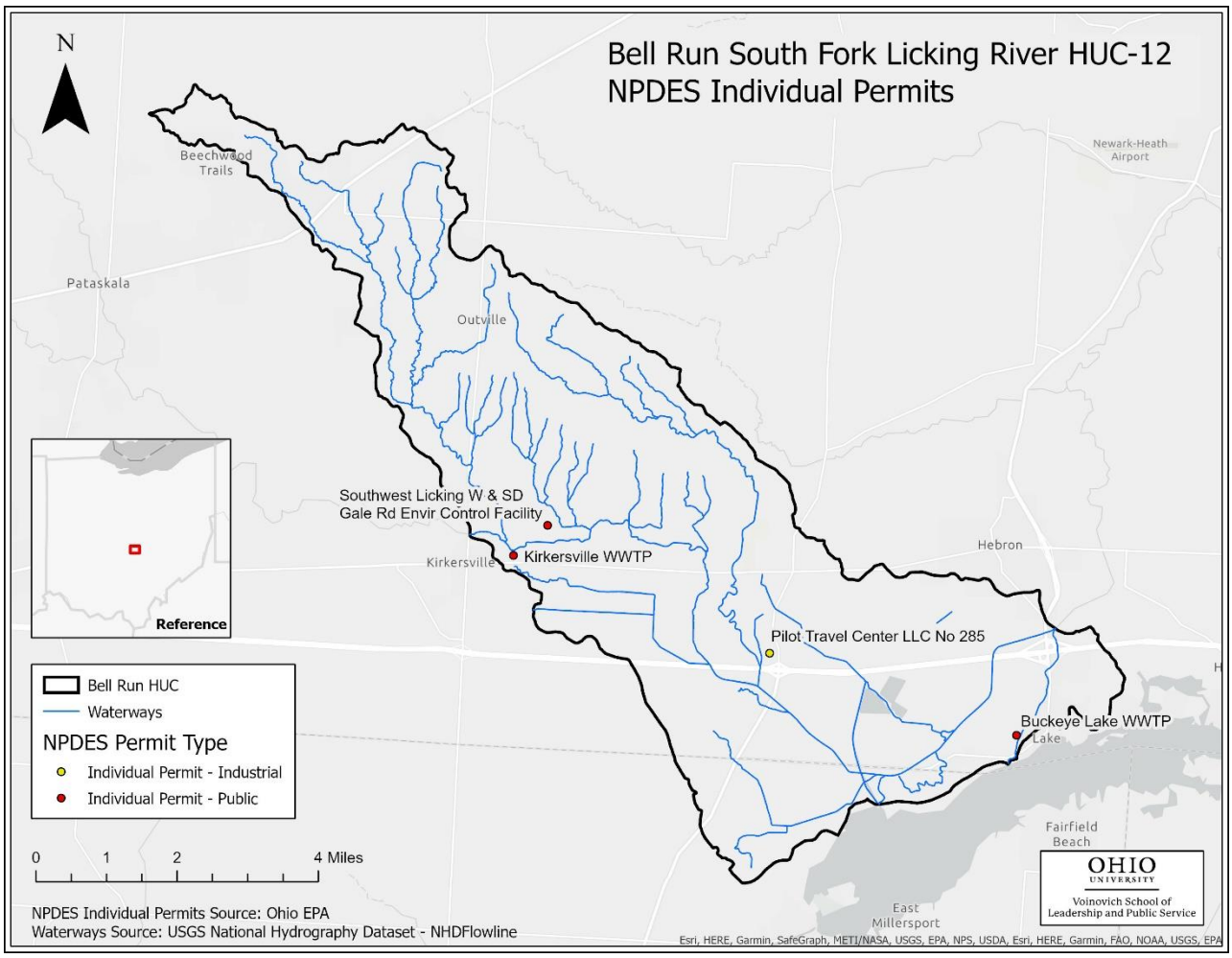

Figure 7. Map of NPDES permits in Bell Run - SFLR HUC-12.

The following are the four regulated National Pollutant Discharge Elimination System (NPDES) permit holders within the watershed (Figure 7):

- Kirkersville WWTP (RM. 21.85)
- Southwest Licking W & SD Gale Road Environmental Control Facility (RM 21.2)
- Pilot Travel Center LLC No 285 (RM. 17.5)
- Buckeye Lake WWTP (RM. 15.3)

Ohio EPA inspections from 2018 to 2021 showed noncompliance for 3 out of the 4 permit holders for at least 1 inspection QTR (each QTR represents 2 months out of the calendar year). For Pilot Travel Center LLC No. 285 (industrial permit), violations were identified in 2019 and 2021. The pollutants identified were oil and grease, which were 3500% above the allowable concentration. Kirkersville WWTP also showed a considerable number of violations. Out of 13 inspections QTRs, 9 of the 13 inspections have been reported as Significant / Category 1 Noncompliance. During 2018 to 2020, there was a failure to submit Discharge Monitoring Reports (DMR). More recently in 2020, Kirkersville WTTP was in noncompliance due to exceeding the monthly average limit effluent. Pollutants for these violations included nitrogen and ammonia, which were 550% and 200%, respectively, over the allowable concentrations. All other inspection reports for this permit holder recorded "Reportable Noncompliance". For Buckeye Lake WWTP permit holder violations were identified for every inspection between 2018 to 2021 and reported as "Reportable Noncompliance", for which pollutants included E. coli and suspended solids. Southwest Licking W & SD Gale Road Environmental Control Facility permit holder has no prior or current violations (Ohio EPA, n.d.).

2.4 Additional Information for Determining Critical Areas and Developing Implementation Strategies

2.4.1 Ohio University Voinovich School of Leadership and Public Service Riparian Buffer Analysis.

A geospatial analysis of the land use cover along the Bell Run - South Fork Licking River riparian corridors was conducted in summer 2021 by Ohio University to define critical areas in need of riparian improvement. Using ArcMap, both 30 and 120-foot buffers were applied to waterways identified in the Water Boundary Dataset from USGS. Both buffers were then clipped with data from the National Land Cover Database to identify land cover types in the riparian corridor zones. Partners on the NPS-IS plan reviewed the analysis maps and determined an initial approach would be to look at South Fork Licking River, Bell Run, and Bloody Run for possible projects with willing landowners. Results of the riparian buffer analysis are discussed in Chapter 3.

Chapter 3: Conditions and Restoration Strategies for Critical Areas in the Bell Run - South Fork Licking River HUC-12

3.1 Overview of Critical Areas

The critical areas identified in Bell Run South Fork Licking River HUC-12 address the primary land use and impacts in South Fork Licking River. This watershed is primarily impacted by agricultural sources (i.e., sedimentation, cropland soil loss, eroding streambanks) and elevated *E. coli* from unknown sources (i.e., failing home sewage treatment systems, wildlife, WWTP). The Bell Run - South Fork Licking River biological and QHEI data indicate good conditions meeting warmwater habitat standards. However, Bell Run South Fork Licking River HUC-12 has elevated *E. coli* , Total Dissolved Sediment (TDS), and phosphorus values, indicating sources of excess sediment, nutrients and bacteria. The goal for this section is to outline a strategy for:

- Revegetating inadequate riparian corridors and restoring severely eroding streambanks
- Understanding sources of *E. coli* and reducing sources of *E. coli*
- Reducing sedimentation and soil loss from agricultural fields draining into waterways
- Preserve and/or enhance wetland areas
- Restore stream access to floodplains in agricultural fields

There are four critical areas: inadequate riparian corridors, failing home sewage treatment systems, agricultural-rich uplands in the watershed, and lack of wetlands. Figure 8 shows the four critical areas for the Bell Run South Fork Licking River HUC-12.

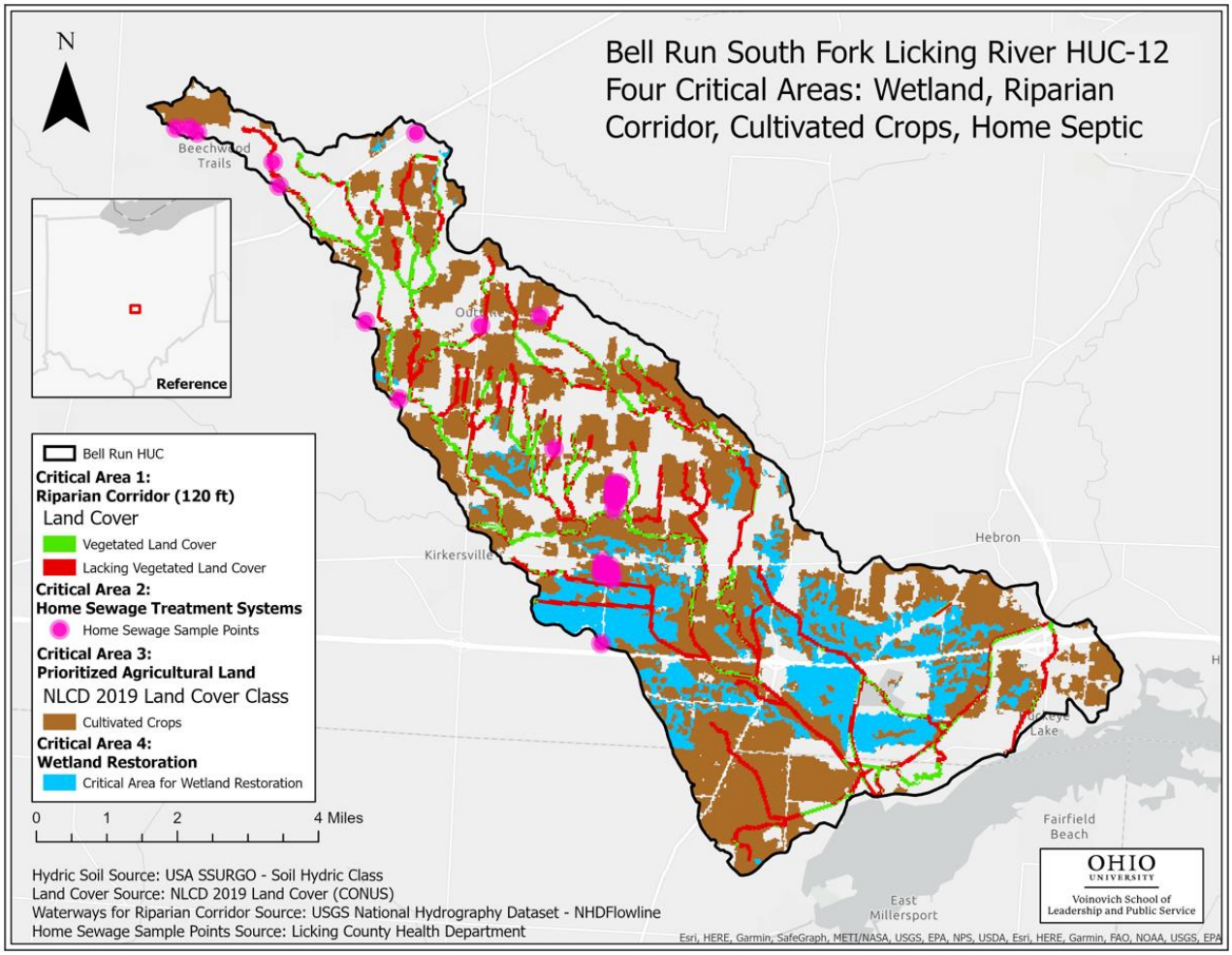

Figure 8 Critical Areas Bell Run - SFLR HUC-12

3.2 Critical Area 1: Conditions, Goals, & Objectives for Riparian Corridors

3.2.1 Detailed Characterization

Critical Area 1 contains the riparian zone of South Fork Licking River (120 ft) and Bell Run (75 ft) along the mainstem (Figure 9). Areas of concern or areas of improvement are driven by land use, and much of the riparian corridor along South Fork Licking River is poorly vegetated. All of Bell Run - South Fork Licking River's sampling sites (RM 21.24 - 12.96) that have available data are in full attainment (last accessed 2008). However, impacts are still present including sedimentation and *E. coli*. Projects that address these impacts are proposed to improve and/or maintain water quality and prevent further impacts within the Bell Run - South Fork Licking River HUC-12 and downstream.

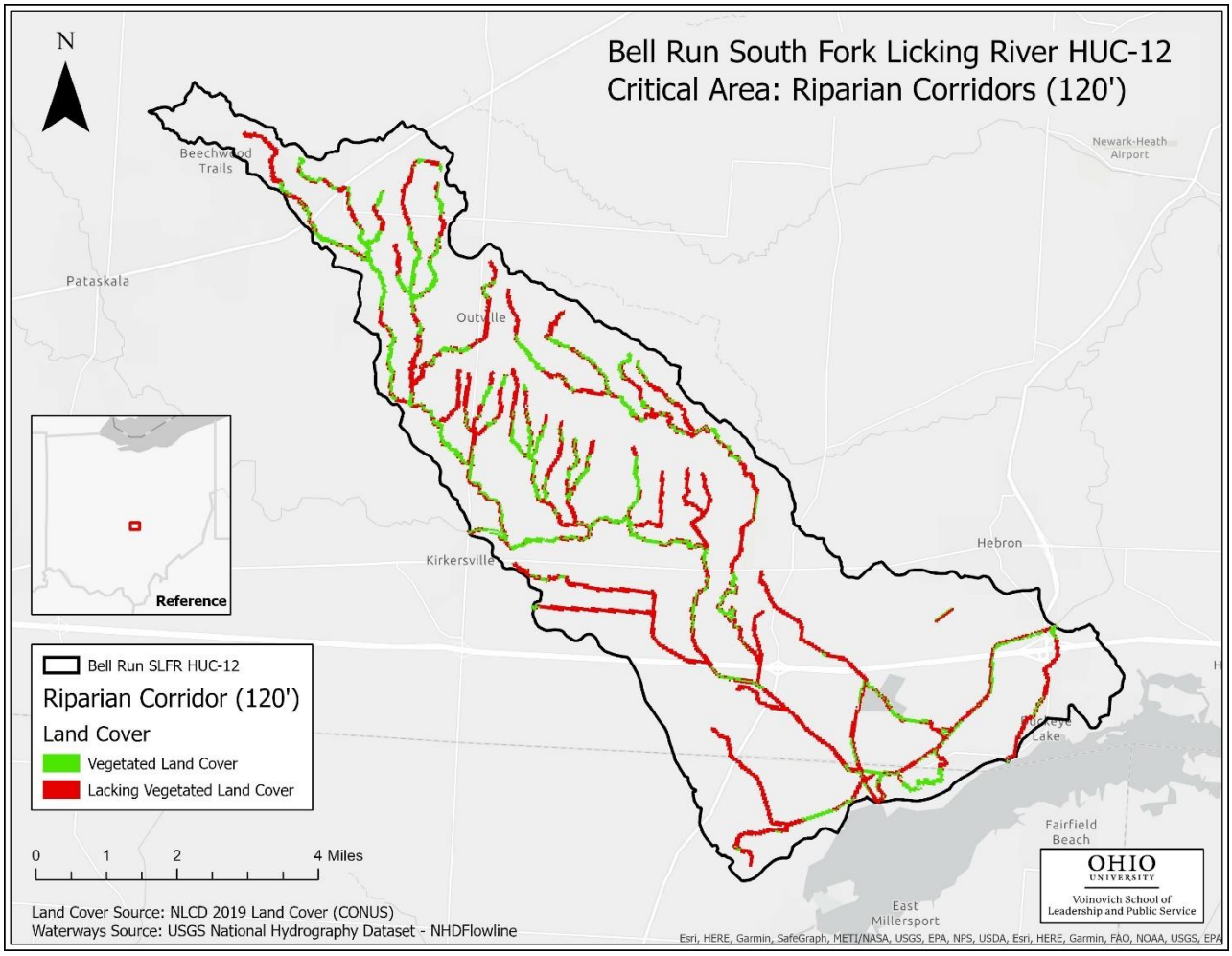

Figure 9 Critical Area 1: Riparian Corridor 120ft buffer

A riparian zone, or buffer, is the land alongside a stream that separates the water from the surrounding landscape. When appropriately sized and well vegetated, riparian buffer strips provide a wide range of ecosystem services in agricultural landscapes. In addition to increasing the aesthetic value of the landscape, riparian buffers harbor economic and ecological benefits. Economically, riparian buffers minimize encroachment on stream channels which prevents future spending on dams or riprap. Additionally, the green space may improve property values in the area. Most importantly however, they may also minimize costly effects of flooding on surrounding farmland. Ecologically, riparian corridors stabilize stream banks to reduce erosion and sediment transport to areas. By minimizing sedimentation in the river, the health of aquatic life can be sustained. Woody riparian corridors also provide streams with shade thereby decreasing the temperature of the underlying water. Cooler, shaded water holds more oxygen and supports diverse communities of aquatic life. Not only does this aid aquatic health, but it also provides a habitat for terrestrial animals like birds and amphibians. Regarding water quality, riparian buffers reduce pollutants in the stream by filtering, settling, and removing excess nutrients and other chemicals from the surrounding areas. Vegetated riparian buffers can be a mix of trees, shrubs, and grasses. Catchment management plans can take an integrative approach to spatially target the placement of riparian corridors and buffer strips to where the greatest

benefit can be derived (Chagrin River Watershed Partners, 2020).

Table 3 shows the percentage of area that has been identified as in critical need of a riparian buffer based on the riparian buffer analysis conducted by Ohio University (OHIO) in 2021. When a 30-foot buffer was applied to the waterways, 56.0% of the land cover fell into a "poorly vegetated land cover" (Figure 10) and with a 120-foot buffer, 63.2% fell into that category (Figure 9). As discussed previously, the lack of a vegetated riparian corridor can have impacts on soil erosion, excess nutrients entering the waterways, and flooding.

Table 3. Land use within a 120-ft and 30-ft riparian buffer analysis on all water bodies within the Bell Run - SFLR HUC-12.

Land Cover	Quality	Area (Acres)	120 ft buffer (Percentage)	30 ft buffer (Percentage)
Deciduous Forest	Vegetated	582.90	29.95	35.82
Shrub/Scrub	Vegetated	77.62	3.99	4.91
Woody Wetlands	Vegetated	28.69	1.47	1.88
Mixed Forest	Vegetated	16.23	0.83	0.87
Herbaceous	Vegetated	8.01	0.41	0.35
Emergent Herbaceous Wetlands	Vegetated	3.11	0.16	0.14
Total		**716.56**	**36.82**	**43.97**
Cultivated Crops	Poorly Vegetated	679.42	34.91	28.50
Hay/Pasture	Poorly Vegetated	306.24	15.74	15.51
Developed, Open Space	Poorly Vegetated	101.19	5.20	4.70
Developed, Low Intensity	Poorly Vegetated	94.52	4.86	4.74
Developed, Medium Intensity	Poorly Vegetated	42.25	2.17	2.44
Developed, High Intensity	Poorly Vegetated	5.56	0.29	0.14
Barren Land	Poorly Vegetated	0.22	0.01	0.00
Total		**1229.40**	**63.18**	**56.03**

According to the riparian buffer analysis, more than 63% of the area is categorized as "poorly vegetated" (Table 3). These areas are in critical need of improvement. The intention of implementing a robust riparian corridor along the South Fork Licking River is to build resilience into this watershed by improving and maintaining water quality, minimizing ongoing flooding in farther reaches (Heath and Hebron), providing habitat structure, and reducing the loss of agricultural soil and sedimentation. Stream sedimentation due to streambank erosion is of concern in this HUC-12 due to highly erodible soils. Subsequently, Bell Run South Fork Licking River HUC-12 is sensitive to changes in stream hydrology that may be caused by heavy precipitation storm events, climatic changes, excess runoff, and changes in land use.

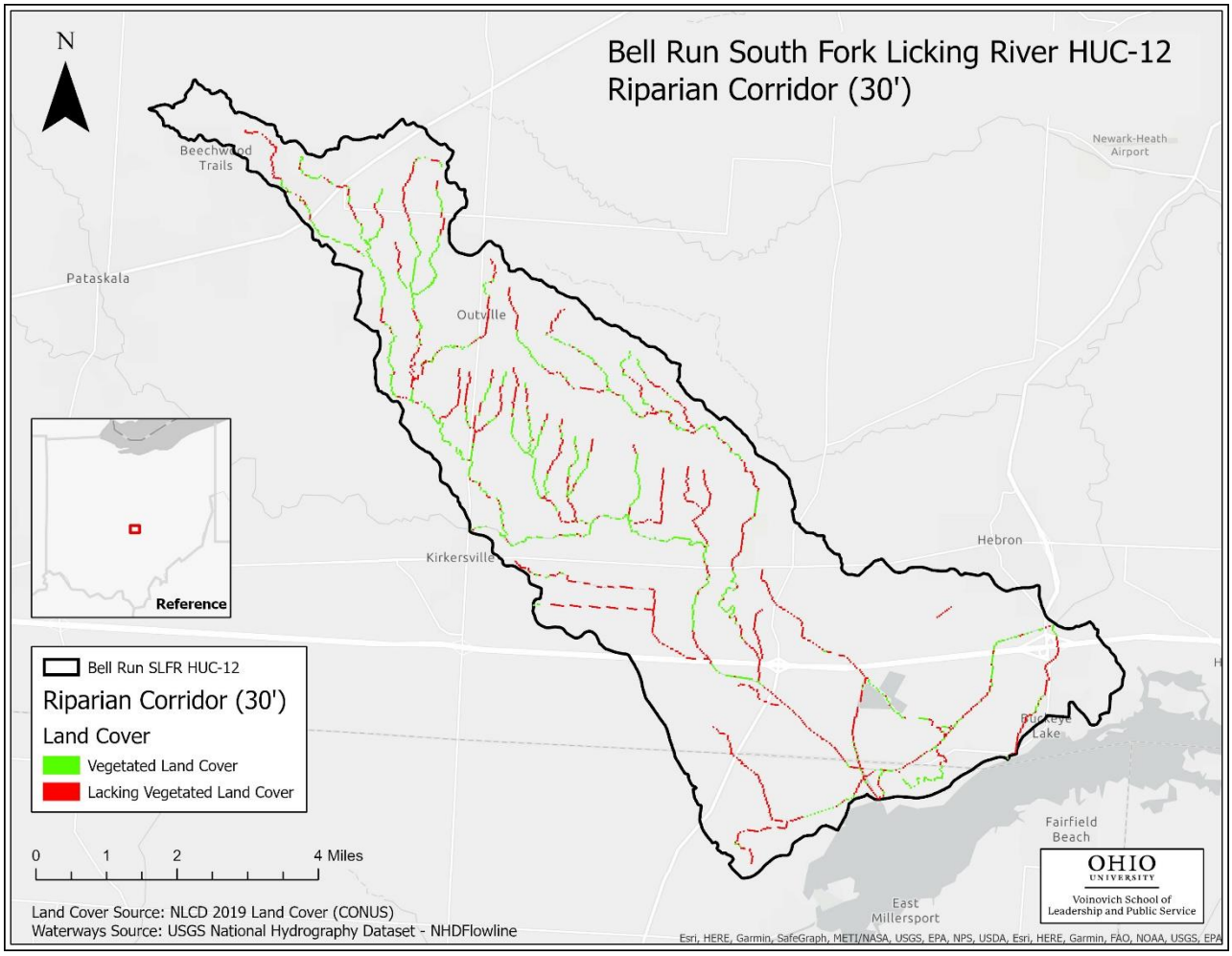

Figure 10. Map of Bell Run - SFLR HUC-12 using 30-ft riparian buffer analysis.

Additionally, riparian areas that lack adequate vegetation contribute to streambank instability and stream sedimentation. Critical Area 1 will address riparian zone improvements to decrease stream sedimentation and improve physical and biological conditions on-site and to reaches. The strategies recommended for Critical Area 1 include woody riparian reforestation.

Critical areas in need of riparian improvement are found throughout the entirety of Bell Run South Fork Licking River HUC-12. Common sources of streambank erosion include removal or lack of riparian vegetation. In-stream channel erosion can be a significant contributor of stream TSS loadings (Nelson and Booth, 2002). Due to the absence of TMDL data for this HUC, the need for reductions in TSS is unknown. However, TSS data collected by the EPA for NPDES permit holders show that the TSS in particular locations of this watershed are in noncompliance. According to Chagrin River Watershed Partnership's model for riparian setback, streams draining 20 square miles or more should be protected with a 120 ft buffer on either side and streams draining a half square mile to 20 square miles should be protected with a 75 ft vegetated buffer (Chagrin Watershed River Partnership, 2017). For the Bell Run - South Fork Licking River NPS-IS plan, we will focus on 120 ft buffers along the South Fork Licking River and 75 ft along Bell Run. Nonpoint sources of pollution identified in this critical area include urban runoff (Nitrogen and ammonia N), E. coli, and erosion/incision from loss of riparian

cover (Ohio EPA, n.d., 2012). Figure 11 shows a stream reach along the South Fork Licking River where the riparian buffer varies in width for zero feet to over 120 feet. Some cut banks, where all vegetative buffers are absent, are severe and contribute to direct soil loss from agricultural fields as the river meanders and migrates within its floodway. Sections of streambank where erosion is severe and located on a cutbank are identified for streambank stabilizing practices including but not limited to, rock riprap, lunkers, and natural channel stream design will reduce sedimentation and erosion in the Bell Run South Fork Liking River watershed. Of the nine miles of streams along South Fork Licking River and Bell Run evaluated, 0.9 miles suffer from severe erosion putting adjacent waterways at a risk of sedimentation and increasing the loss of cultivatable land.

Benefits of streambank stabilization include:

- reducing loss of land and reducing damage to land uses or other facilities adjacent to the banks.
- maintaining the flow or storage capacity of the channel or impoundment.
- reducing the downstream effects of sediment resulting from bank erosion.
- maintaining or restoring channel meanders that enhance stream conditions.
- improving or enhancing the stream corridor for fish and wildlife habitat, aesthetics, and recreation.

Figure 11. Example of South Fork Licking River varying stream riparian corridor

This NPS-IS plan focuses on the main stem of the South Fork Licking River and the mouth of Bell Run, a tributary to South Fork Licking River. Other headwater tributaries that were identified in the buffer analysis (Figure 9) can be added to this plan in the future. The riparian areas and streambank stabilization in need of improvement included in this NPS-IS plan were identified starting in the western (upstream) reaches of the watershed then moved to the eastern reaches of the watershed just north of Buckeye Lake. Projects are named by their location in river miles along the South Fork Licking River and Bell Run and can be found in Chapter 4.

3.2.2 Detailed Biological Conditions

A total of 31.7 river miles (RM) of the South Fork Licking River were assessed in 1993. The sampling effort included 32 chemical, physical and ambient biological sampling stations located between RM 31.6 (Cable Rd.) and RM 0.3 (Second St.). Based upon ambient biological performance, the entire study area (31.7 miles) was considered to be in full attainment of the designated warmwater habitat (WWH) aquatic life use (Figure 12). The majority of the sampling stations within the South Fork Licking River contained fish and macroinvertebrate communities characterized as near exceptional. The assemblages were generally diverse and well organized, with environmentally sensitive taxa well represented. Four municipal WWTPs were evaluated during the 1993 field sampling effort: Pataskala, Buckeye Lake, Hebron, and Heath. No significant ambient biological or chemical impact was evident of these facilities in 1993 (Ohio EPA, 1995).

River Mile Fish/Invert.	IBI	Modified Iwb	ICI[a]	QHEI	Attainment Status[b]	Comment
South Fork Licking River (1993)						
Eastern Corn Belt Plains WWH Used Designation (Existing)						
31.5/31.6(H)	47	N/A	Good	60.0	FULL	Headwaters
28.3/28.4(W)	47	9.4	32ns	64.5	FULL	Ust. Pataskala WWTP
27.6/27.6(W)	49	9.6	36	83.0	FULL	Dst. Pataskala WWTP
Erie Ontario Lake Plain WWH Use Designation (Existing)						
24.6/24.1(W)	46	9.1	40	83.0	FULL	
21.3/21.1(W)	52	9.6	Good	67.0	FULL	
15.3/15.4(W)	49	8.6	50	59.5	FULL	Ust. Buckeye L. WWTP
13.1/13.0(B)	37ns	8.9	34	39.0	FULL	Dst. Buckeye L. WWTP
9.4/9.9(B)	51	9.9	42	76.5	FULL	Ust. Hebron WWTP
8.8/8.9(B)	51	9.8	42	75.0	FULL	Dst. Hebron WWTP
4.3/4.7(B)	49	9.6	44	85.5	FULL	Ust. Heath WWTP
2.2/2.2(mz,B)	48	9.6	44	-	-	Mixing Zone
1.7/1.7(B)	52	10.2	46	82.5	FULL	Dst. Heath WWTP
0.5/0.4(B)	53	10.2	36	60.5	FULL	Near Mouth

Figure *12*. Summary of biological trends for Bell Run - SFLR HUC-12 (Ohio EPA, 1995).

In 2008, four sample sites were located from the Village of Kirkersville WWTP, from the Southwest Licking Community WWTP at US 40, and two sites bracketed the South Fork Buckeye Lake WWTP discharge (Figure 13). Ammonia, nutrients, and parameters associated with treated effluent were present in all water column samples. The highest average concentrations were measured at the US 40 site (NO2+NO3-N =7.8 mg/ L, TP =1.0 mg/ L, and TDS =914 mg/ L, RM 19.1). Elevated ambient chloride concentrations correlated with effluent sample values. Average chloride in the 2008 Licking River TSD January 20, 2012, sample content (299 mg/ L) was highest at RM 19.1. The low gradient of this reach is most noticeable from Buckeye Lake WWTP. Average DO concentrations declined here (6.4

mg/ L, RM 13.0) and ammonia-N was detected in all samples (0.11 mg/ L) (Ohio EPA, 1995).

RM	IBI / MIwb[a]	ICI[b]	STATUS	QHEI	MI[2]	Location
South Fork WWH -EOLP-						
24.5	47/ 8.9	-	(FULL)	75.5	43.0	Ust. SW Licking WWTP
21.3	51/ 9.6	VG	FULL	67.0	51.0	Dst. SW Licking WWTP
19.1	52/ 9.5	36	FULL	73.5	55.0	US 40
15.3	48/ 8.8	46	FULL	69.5	64.0	Ust. Buckeye Lake WWTP
13.0	-	44	(FULL)	-	69.0	Dst. Buckeye Lake WWTP
8.8	44/ 8.4	38	FULL	63.5	133.0	Dst. Beaver Run, TR 308
1.8	48/ 9.3	44	FULL	80.0	183.0	Dst. Heath WWTP
0.3	46/ 8.2	44	FULL	59.5	288.0	S. Second St.

Figure 13. Summary of Biological trends for Bell Run -SFLR HUC-12 (Ohio EPA, 2012).

"The existence of an additional Buckeye Lake outlet structure complicates biological index score calculation based on drainage area. By design, higher flows are released from the Sellers Point structure. Both outlets have control mechanisms that could be used to appreciably change lake water level. The Waste Weir outlet is designed to rapidly release water below normal lake levels as needed in an emergency. Under lower summer influent flow conditions, lake discharge from both structures is minimized. The construction of Waste Weir Run was accomplished so that some water remains in the channel even if no flow is contributed by Buckeye Lake. It is a rock lined trapezoidal low gradient ditch which offers poor habitat quality (QHEI=41) to aquatic communities. In 1984 it contained an array of lake type fish. In 2008, 16 Waste Weir fish species could be described the same way. A few less tolerant types and the singular instance of capturing a mudminnow helped the 2008 community into the fair IBI score range. The poor macroinvertebrate community will improve when Buckeye Lake water quality conditions improve. Allowing some water to perennially flow through the channel will help stabilize habitat conditions" (Ohio EPA, 2012).

The Ohio EPA sampled ten locations in the Bell Run - South Fork Licking River subwatershed. Data were collected during the Ohio EPA's 2008 study of the Licking River basin. Though site locations have changed slightly between the 1993 and 2008 studies, results are compared from each study to evaluate how the South Fork Licking River water quality has changed over time and infer how it may have changed up until the present. Table 13 shows data from river RM 0.3 to 21.4. However, sites immediately downstream of Bell Run - South Fork Licking River HUC-12, which include RM 15.3 (upstream Buckeye Lake WWTP), RM 13.0 (downstream Buckeye Lake WWTP), and RM 8.8 (Hebron WWTP/downstream Beaver Run), may be a better indicator of the health of the upstream section of the South Fork Licking River (Table 4) (Ohio EPA, 2012).

Table 4. Summary of biological trends for Bell Run - SFLR HUC-12 comparison (light grey)

and within the South Fork Licking River Watershed (Ohio EPA 1993, 2012).

Location (RM)	Year	IBI	MIwb	ICI	QHEI	Status	Mi²
RM. 21.1 -21.4	1993	52	9.6	good	67.0	full	
	2008	51	9.6	Very good	67.0	full	51.0
RM 19.0 (US 40)	1993	n/a	n/a	n/a	n/a	full	
	2008	52	9.5	36	73.5	full	55.0
RM 15.3 - 15.4 (upstream Buckeye Lake WWTP)	1993	49	8.6	50	59.5	full	
	2008	48	8.8	46	69.5	full	64.0
RM 12.9 - 13.1 (downstream Buckeye Lake WWTP)	1993	37	8.9	34	39.0	full	
	2008	n/a	n/a	44	n/a	full	69.0
RM 9.4 - 9.9	1993	51	9.9	42	76.5	full	
	2008	n/a	n/a	n/a	n/a	n/a	
RM 8.8 - 8.9(Hebron WWTP/downstream Beaver Run)	1993	51	9.8	42	75.0	full	
	2008	44	8.4	38	63.5	full	133.0
RM 4.3 - 4.7	1993	49	9.6	44	85.5	full	
	2008	n/a	n/a	n/a	n/a	n/a	n/a
RM 2.2	1993	48	9.6	44	n/a	n/a	
	2008	n/a	n/a	n/a	n/a	n/a	
RM 1.7 - 1.8	1993	52	10.2	46	82.5	full	
	2008	48	9.3	44	80.0	full	183.0
RM 0.3 - 0.5	1993	53	10.2	36	60.5	full	
	2008	46	8.2	44	59.5	full	288.0

In 1993 Ohio EPA found the habitat conditions to be 'fair' to 'good' and were associated with 'good' to 'very good' aquatic community. All IBI scores are meeting the WWH target of 44 for wadable streams except site RM 12.96 with a score of 37 recorded in 1993 (Ohio EPA, 1995). According to the Ohio EPA 2012 study, the 2008 data show gains in biological index scores, which were indicative of very good to exceptional aquatic assemblages. "These gains have occurred at the same time effluent volume from wastewater treatment plants have also increased. In both surveys, modest nutrient enrichment and other effluent constituents could have easily overwhelmed water quality expectations....Normally the last process before discharge to a receiving stream, most WWTPs are required to disinfect effluent. Consequently, effluent dominated streams convey proportionately less bacteria than would be present, absent the addition of artificial flow" (Ohio EPA 2012).

When analyzing the section of the South Fork Licking River (RM 0.3 - 0.5), the physical habitat conditions for 2008 were slightly lower than the target of 60. No data was collected directly from the Bell Run - South Fork Licking River tributary at RM 13.0 (downstream Buckeye Lake WWTP). In 1993, the QHEI for this location was 39.0, which indicates poor stream habitat. To accurately assess the habitat of this site, there needs to be updated data. When comparing the QHEI values between 2008 and 1993, there are some locations in which the QHEI improves or remains constant such as at RM 15 and RM 21. However, most of the locations' (RM 0.3 - 0.5, RM 1.7 - 1.8, RM 8.8 - 8.9) data show a

decrease in QHEI habitat scores for Bell Run - South Fork Licking River HUC-12, even though they were still meeting the QHEI target of 60 (Ohio EPA, 2012). No biological or QHEI data have been collected since 2008 eliciting a need for updated data, as current data may not be reflective of current conditions.

3.2.3 Detailed Causes and Associated Sources

The causes and sources of impairment for the Bell Run - South Fork Licking River have not been identified by Ohio EPA. However, from the available data collected and work in the HUC-12 conducted by watershed partners, potential causes of nonpoint source pollution impairment include sedimentation, nutrients, and habitat alteration. The sources of impairment appear to be from a lack of native vegetation along the river and agricultural land use without wetland retention throughout (Table 5).

Table 5. Causes and Sources of Pollution for Critical Area 1 in Bell Run - SFLR HUC-12.

Causes	Sources
Sedimentation	**Eroding stream banks**
Habitat alteration	**Lack of riparian vegetation**

Goal 1: Maintain QHEI score of ≥60.0 at RM 21.24 South Fork Licking River
ACHIEVED: Site accessed in 2008 has a QHEI score of 67.0.

Goal 2: Maintain QHEI score of ≥60 at RM 19.10 South Fork Licking River
ACHIEVED: Site accessed in 2008 has a QHEI score of 73.5.

Goal 3: Maintain QHEI score of ≥60 at RM 15.75 South Fork Licking River
ACHIEVED: Site accessed in 2008 has a QHEI score of 69.5.

Goal 4: Maintain QHEI score of ≥60 at RM 12.96 South Fork Licking River **NOT ACHIEVED**: Site accessed in 1993 has a QHEI score of 39.0.

Goal 5: Maintain IBI score of ≥44.0 at RM 21.24 South Fork Licking River.
ACHIEVED: Site accessed in 2008 has an IBI score of 51.0.

Goal 6: Maintain IBI score of ≥44.0 at RM 19.10 South Fork Licking River
ACHIEVED: Site accessed in 2008

has an IBI score of 51.0.

Goal 7: Maintain IBI score of ≥44.0 at RM 15.75 South Fork Licking River ACHIEVED: Site accessed in 2008 has an IBI score of 48.0.

Goal 8: Maintain IBI score of ≥44.0 at RM 12.96 South Fork Licking River **NOT ACHIEVED**: Site accessed in 1993 has an IBI score of 37.0.

Goal 9: Reduce 2,080 lbs/yr phosphorus and 33,140 lbs/yr nitrogen loading to achieve 20% far-field nutrients reduction targets **NOT ACHIEVED**

To achieve these goals for Critical Area 1, the following objectives need to be achieved. The partners of the NPS-IS plan feel these would be achievable over the lifetime of this plan, these quantities represent 75% of the total acres and linear feet detailed in projects found in Chapter 4.

Objective 1: Reforest 51 acres of riparian buffer with native vegetation along South Fork Licking River within a newly installed 120 ft vegetative buffer and 10 acres along Bell Run within a 75 ft vegetative buffer.

Objective 2: Restore 3,700 linear feet of eroding streambanks through bioengineered streambank stabilization and natural channel design along South Fork Licking River.

As these objectives are implemented, water quality monitoring will need to be conducted to determine progress toward meeting the identified goals (i.e., water quality standards). These objectives will be reevaluated and modified if determined to be necessary. The Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013), which has a complete listing of all eligible NPS management strategies to consider includes:

- Altered Stream and Habitat Restoration Strategies
- Nonpoint Source Reduction Strategies

3.3 Critical Area 2: Conditions, Goals, & Objectives for Household Sewage Treatment Systems (HSTS)

3.3.1 Detailed Characterization

Within the Bell Run South Fork Licking River Watershed not all resident structures are connected to a centralized sewer system and instead use household sewage treatment systems (HSTS) which range in age from recently constructed or inspected to decades old (Figure 14). In partnership with the county health departments, HSTSs need to be assessed for functionality. The map shows a sampling of 42 locations found on Licking County Health Department online database. These vary in age from 1970 to 2005. Eleven were shown to be failing or were inspected due to a nuisance complaint.

Buckeye Lake WWTP, discharges to the South Fork Licking River (RM 15.3) had "Reportable Noncompliance" for E. coli and suspended solids from 2018 to 2021. For Outfall 001, 2017 data indicates that observed E. coli concentrations have an average of 274 cfu/100ml (Ohio EPA, n.d.). Additionally, according to data collected in 2008, for four locations from RM 19.0 to 1.0 the geometric mean E. coli concentrations were greater than the PCR class B criterion (*E. coli*<161 cfu/100ml). "Individual sample values under the threshold were obtained on three occasions downstream from the Kirkersville WWTP (RM 21.85) and twice each at locations bracketing the Buckeye Lake facility" (Ohio EPA, 2012). Waste Weir Run, a few hundred yards downstream from Buckeye Lake (RM 1.6), had three E. coli concentrations that exceeded the PCR class B criterion as did the geometric mean value of 180 cfu/100ml.

Home septic system failure may play a role in increased concentrations of E. coli found in and around Bell Run South Fork Licking River HUC-12 (Ohio EPA, 2012). Implementation of HSTS replacement and repair initiatives could help reduce or prevent nonpoint sources of E. coli pollution found in Bell Run South Fork Licking River. As mentioned previously, a Household Sewage Treatment System (HSTS), "is a system that serves a private residence, in an unsewered area, using biological, chemical, or mechanical methods to treat liquid and solid human waste materials" (MCHD, n.d.) HSTSs require routine maintenance and can be expected to need replacement between 12 to 20 years.

A properly functioning HSTS protects water quality by treating sewage using aerobic bacteria. Malfunctioning or failing HSTSs can discharge untreated sewage and excess nutrients into waterways, polluting drinking water sources and creating disease-producing conditions. Excess nutrients throw the ecosystem out of balance resulting in algal blooms (including toxic algae), decreased oxygen, and fish kills (MCHD, n.d.). According to the Licking County Health Department (personal communication, September 15, 2021), failing home septic treatment systems (HSTS) are not formally tracked. However, across Licking County there are approximately 40,000 home septic treatment systems, and in general, the Licking County Health Department receives about two complaints a week, which are verified and resolved through an operation and maintenance program.

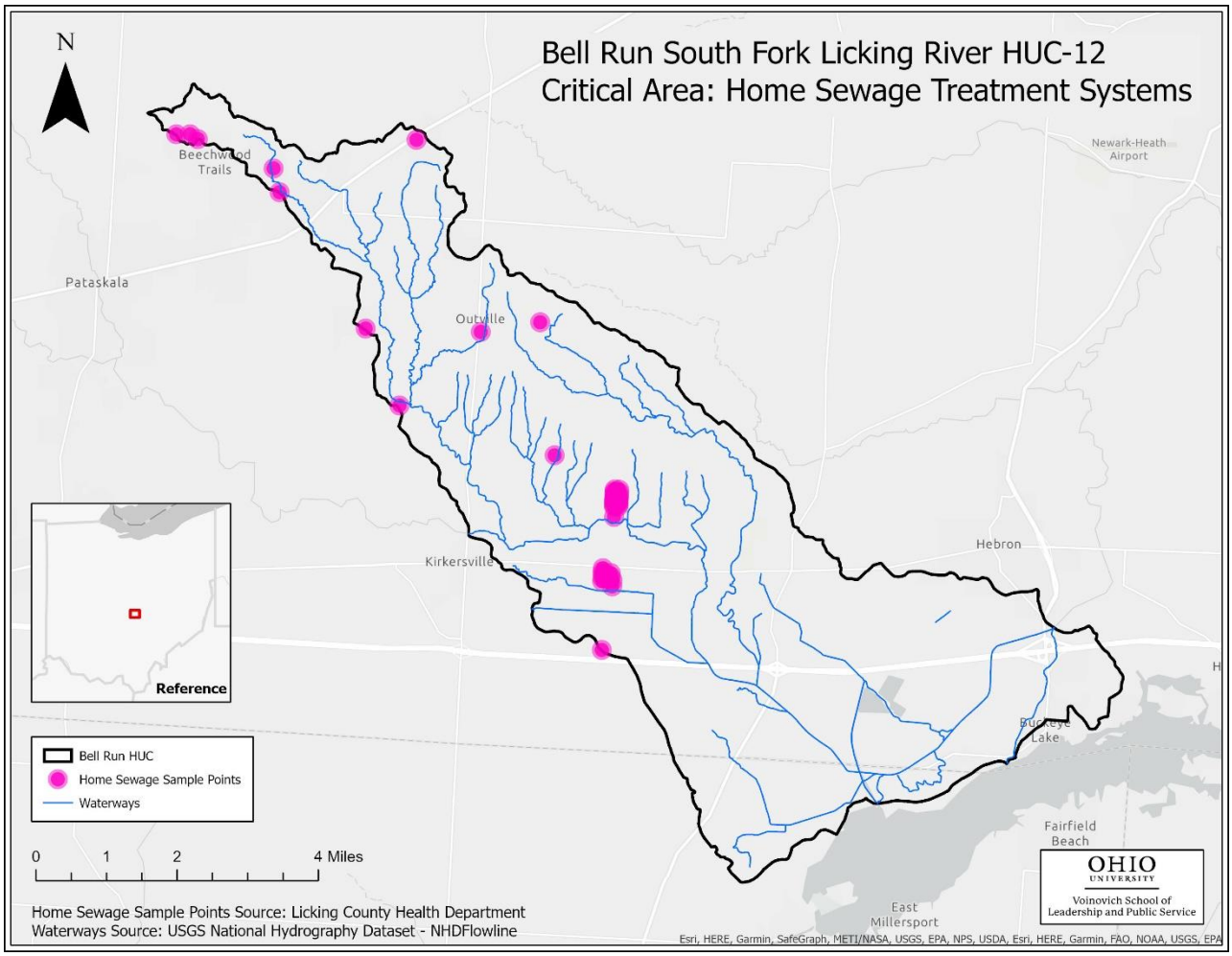

Figure 14. Critical Area 2 Map of HSTS systems in Bell Run South Fork Licking River in need of maintenance.

Table 6. Licking County Health Department HSTS upgrades and funding implemented in Licking County from 2016 to 2021

Year	Number of Upgrades Completed	Funding Required to Complete Upgrades	Funding Available through Ohio EPA Loan Program
2016	20	$347,696.68	-
2017	22	$307,708.60	$300,000
2018	13	$200,000	$200,000
2019	15	$147,636	$150,000
2020	15	$179,371.44	$150,000
2021	20	$310,098	$300,000

The number of permitted HSTS throughout Bell Run South Fork Licking River watershed is unknown. The Licking Health Department maintains an online database of permits however they are not able to be sorted by 'Well' versus 'HSTS' permit. "The Licking County Health Department (LCHD) utilizes funds from Water Pollution Control Loan Fund (WPCLF) program from the Ohio Environmental Protection

Agency. These funds can be used to assist homeowners with the cost of repairing or replacing their failing household sewage treatment system (HSTS) or connecting to a public sewage system and are based on household income and first come, first serve basis (LCHD, n.d.)". From 2016 to 2021, LCHD helped to upgrade approximately 17 home septic treatment systems each year. The greatest number of HSTS were replaced in 2017 and the fewest in 2018. The number of household septic treatment systems able to be replaced each year is directly related to available funding (Table 6). In addition to the HSTS upgrades that are funded, there are 5 to 15 requests that must wait until the next funding cycle (personal communication, November 5, 2021). It is unclear if household septic treatment systems pose a major threat to water quality specifically in Bell Run South Fork Licking River HUC-12; however, implementing upgrades to failing HSTS operates as a preventative measure to maintain overall ecosystem health. The Muskingum Watershed Conservancy District and USGS plan to conduct microbial source tracking (PCR) monitoring along the mainstem of South Fork Licking River to provide clarity to the sources of elevated *E. coli* counts.

3.3.2 Detailed Biological Conditions

Biological data for Critical Area 2 are reflected in the conditions listed in Critical Area 1.

3.3.3 Detailed Causes and Associated Sources for Critical Area

The causes and sources of impairment for the Bell Run South Fork Licking River have not been identified by Ohio EPA. However, from the available data collected and work in the HUC-12 conducted by watershed partners, potential causes of nonpoint source pollution impairment include bacteria. Failing septic tanks may also contribute to organic enrichment in Bell Run South Fork Licking River leading to the increase level of E. coli (Table 7).

Table 7. Causes and Sources of Pollution for Critical Area 2 in Bell Run - SFLR HUC-12.

Causes	Sources
Municipal wastewater	**WWTP**
Organic Enrichment (E. coli)	**Failing home sewage treatment systems**

3.3.4 Outline Goals and Objectives for Critical Area

Goals:

1. Reduce *E. coli* from a geometric mean of 274 cfu/100ml to consistently less than 161 cfu/100ml in the lower section of South Fork Licking River (RM 15.3) in order to meet PCR Class B criterion for recreational water quality. NOT ACHIEVED

2. Maintain *E. coli* concentrations below 161 cfu/100ml in the upper section of South Fork Licking River (RM 21.85). UNKNOWN- NOT ACHIEVED

Objectives:

1. Repair and replace 10 identified failing or malfunctioning HSTS systems.
    a. Work in conjunction with the county health departments, sort through permits and

develop a process of inspection. This will aid in identifying aerators as they age and begin to fail.

3.4 Critical Area 3: Conditions, Goals, & Objectives for Prioritized Agricultural Lands

3.4.1 Detailed Characterization

Critical Area 3 includes prioritized agricultural lands for the reduction of sediment and nutrients runoff to waterways across the entire Bell Run South Fork Licking River HUC-12 watershed. While sample locations meet full attainment, water quality stressors exist due to the prevailing agricultural land use throughout the 26 square mile watershed. Approximately 9,105.5 acres of agricultural land are in use for cultivated crops (55%) land use. Historically, the Bell Run South Fork Licking watershed has had limited prioritized land for targeted BMP adoption, leaving the agricultural landscape vulnerable to excessive sedimentation, nutrient loss, and bank erosion. Cultivated cropland may contribute substantially to nutrient and sediment loads within the watershed and are therefore prioritized for BMP implementation (Figure 15).

Agricultural BMPs that target sedimentation, such as cover crops and conservation till practices, will incrementally make progress towards preserving the water quality of Bell Run South Fork Licking River. Critical agricultural lands within this area should be targeted for maximum progress towards sedimentation reduction. At least 40% of the agricultural lands in Critical Area 3 are estimated to meet one or more of the following conditions that make them vulnerable to excess sediment loss:

- Lands without current cover crop use
- Lands that are not currently utilizing conventional tillage practices
- Lands that are adjacent to the streams and ditches listed in Critical Area 1

The implementation of BMPs on these prioritized lands will begin to reduce sediment and nutrient loading in waterways and improve in-stream habitat by reducing stress on aquatic communities. Objectives in this section will be reviewed and expanded in the future with watershed partners to increase type and quantity of best management practices as part of a living document.

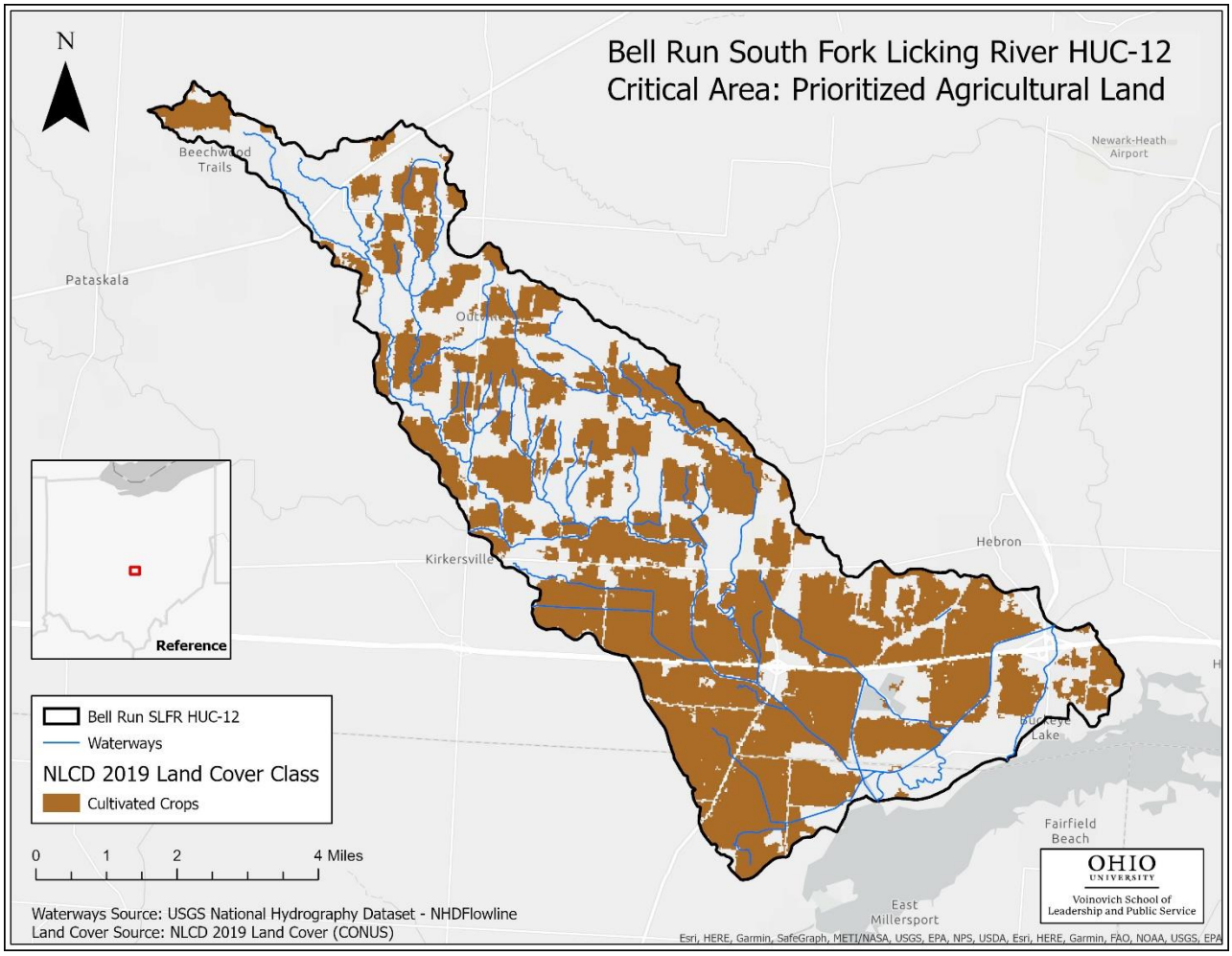

Figure 15. Critical Area 3 Map of Prioritized Agricultural Lands in Bell Run – SFLR HUC-12

3.4.2 Detailed Biological Conditions

The biological conditions for this critical area can be assumed to be similar to the conditions listed in Critical Area 1.

3.4.3 Detailed Causes and Associated Sources for Critical Area 3

The causes and sources of impairment for the Bell Run South Fork Licking River have not been identified by Ohio EPA. However, from the available data collected and work in the HUC-12 conducted by watershed partners, potential causes of nonpoint source pollution impairment include sedimentation. Bell Run South Fork Licking River is in low density residential and highly productive agriculture land uses. Total Suspended Solids (TSS) values for Buckeye Lake WWTP were measured in 2017 for Outfall 001 and Influent Monitoring Station 601 which showed a data range between 0-20 mg/l and 24-474 mg/l, respectively. The daily concentration for outfall 001 had an average of 12 mg/l and an average daily loading of 136.3 kg/day (Ohio EPA, n.d.). In 1994 TSS data was collected from RM 32 to 0.4. This data found that the mean concentration of TSS between RM 32 and RM 15 were

close to 0 mg/l. After RM 15, located near Buckeye Lake WWTP the mean concentration spikes to 0.5 mg/l and continues to decrease until RM 8 (Ohio EPA, 1994). According to data collected from 1999-2019 the maximum concentration of TSS was 1710 mg/l (Ohio EPA, 1999). More recent data has been gathered for Kirkersville WWTP 2019 to 2021. The weekly max TSS concentrations range from 0 mg/l to 30 mg/l. The highest concentration of 30 mg/l was measured in 2021 which is higher than the approximately 20 mg/l weekly maximum limit (Ohio EPA, n.d.). TSS concentrations show a correlation with the presence of WWTP, however sedimentation from surrounding agriculture may also play a role, and therefore are addressed in Critical Area 3.

Table 8. Causes and Sources of Pollution for Critical Area 3 in Bell Run - SFLR HUC-12.

Causes	Sources
Nutrients	**Agricultural field runoff**
Sedimentation	**Row-crop agriculture, eroding stream banks**
Habitat alteration	**Lack of riparian vegetation near streams and ditches**

3.4.4 Outline Goals and Objectives for Critical Area

Goals

1. Reduce 2,080 lbs/yr phosphorus and 33,140 lbs/yr nitrogen loading to achieve 20% far-field nutrients reduction targets **NOT ACHIEVED**

Objectives

1. Plant 1,000 acres of cover crop annually in Bell Run South Fork Licking River Watershed through the Licking Soil and Water Conservation district cost share program to improve soil health and organic matter and reduce soil loss over the winter.
    a. 1,000 acres represents 10% of total cultivated cropland acres. Target tracts that have not used cover crops and are adjacent to streams.
    b. Encourage 10% new applicants into the cover crop cost share program each year
2. Implement conservation till practices on 500 acres/annually.

3.5 Critical Area 4: Conditions, Goals, & Objectives for Wetland Restoration

3.5.1 Detailed Characterization

Critical area 4 identifies potential areas for wetland enhancement, restoration, and floodplain connectivity throughout the Bell Run South Fork Licking HUC 12 watershed (Figure 16). Bell Run - South Fork Licking River is impacted by direct habitat alterations, lack of instream habitat, and sedimentation and siltation from stream bank erosion. Although water quality data do not suggest stream impairment, habitat restoration, sediment capture, and stream bank stabilization are needed to improve and maintain aquatic community health in this watershed and downstream sections. This critical area is divided into two restoration strategies: stream and floodplain connectivity and wetland restoration. The majority of land in this critical area is cultivated crop and pasture lands (nearly 70%).

Developed space accounts for 14.67% of land use in the region ranging from high intensity to low intensity. A little more than 15% accounts for natural areas, such as wetlands (0.87%), shrubs (1.4%), and deciduous forest (12.13%). Wetlands account for approximately 147 acres of Bell Run South Fork Licking River HUC-12 (Figure 6). Those 147 acres encompass freshwater emergent wetlands (69.59 acres) and freshwater forested/shrub wetlands (77.52 acres) (USFWS, 2020). Hydric soils account for 3,055.6 acres of land with this HUC. The overlap of existing cultivated land with hydric soils relieves 2,223.4 acres of the existing cropland could be restored to a wetland habitat creating valuable diverse habitat for aquatic organisms and wildlife while also providing and sink for excess nutrients and sediment.

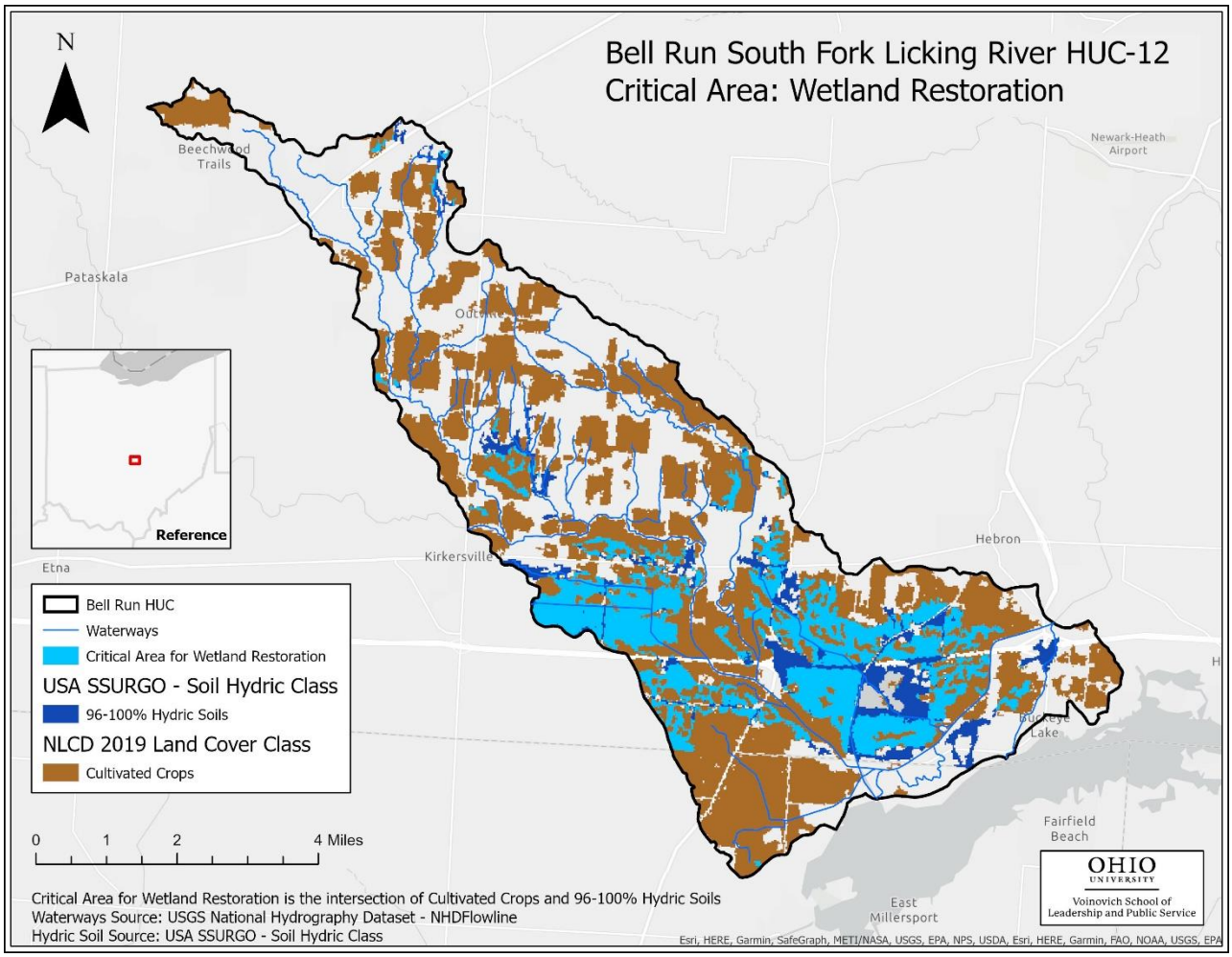

Figure 16. Critical Area 4 Map of Wetland Restoration Potential in Bell Run – SFLR HUC-12

Wetlands are among the most productive ecosystems in the world. The combination of shallow water and high levels of nutrients is ideal for many organisms, including fish, amphibians, and insects. Many species of birds and mammals also rely on wetlands for food, water, and shelter. Benefits of wetlands include natural water quality improvement, flood protection, shoreline erosion control, and opportunities for recreation. Wetlands function as natural sponges that trap and slowly release surface water, rain, snowmelt, groundwater, and flood waters. Wetland vegetation slows the speed of flood waters and distributes them over the floodplain at a reduced pace. This in effect, lowers flood heights and reduces erosion. "Wetlands within and downstream of urban areas are particularly valuable,

counteracting the greatly increased rate and volume of surface water runoff from pavement and buildings. The holding capacity of wetlands helps control floods and prevents water logging of crops. Preserving and restoring wetlands together with other water retention can often provide the level of flood control otherwise provided by expensive dredge operations and levees" (US EPA, n.d.). On a global scale, wetlands store carbon instead of releasing it into the atmosphere as carbon dioxide. Thus, wetlands help to moderate global climate conditions.

3.5.2 Detailed Biological Conditions

Biological data for Critical Area 4 are reflected in the conditions listed in Critical Area 1.

3.5.3 Detailed Causes and Associated Sources for Critical Area 4

The causes and sources of impairment for the Bell Run South Fork Licking River have not been identified by Ohio EPA. However, from the available data collected and work in the HUC-12 conducted by watershed partners, potential causes of nonpoint source pollution impairment include sedimentation and habitat alteration (Table 9).

Table 9. Causes and Sources of Pollution for Critical Area 4 in Bell Run - SFLR HUC-12.

Causes	Sources
Sedimentation	**Eroding stream banks**
Habitat alteration	**Lack of riparian vegetation, lack of wetlands**

3.5.4 Outline Goals and Objectives for Critical Area

Goal

1. Reduce 2,080 lbs/yr phosphorus and 33,140 lbs/yr nitrogen loading to achieve 20% far-field nutrients reduction targets **NOT ACHIEVED** (Note: Wetlands will also aid in filtering sediment, providing wildlife habitat, and increasing water retention to help alleviate downstream flooding).

Objectives

1. Reconnect 3,300 linear feet of agricultural streams and ditches to functional floodplains, allowing for increased flood water storage capacity and natural ecosystem services.
2. Restore hydrologic connections and create at least 222 acres of wetland, this represents 10% of the currently cultivated cropland on 100% hydric soils (2223.4 acres) in Critical Area 4.
3. Establish conservation easements and protect 60 acres of existing forested wetlands (40% of existing wetlands).

Chapter 4: Projects and Implementation Strategy for Bell Run - South Fork Licking River HUC-12

4.1 Overview Table and Project Sheets for Critical Areas

An overview of the planned projects and strategies for removing impacts in the Bell Run South Fork Licking River HUC-12 includes 15 projects with four planned in the short term (Table 11). Monitoring will be necessary to assess the impact of these projects. Any nonpoint source impacts or impairments identified in the future will be added to the project table below. Priority is given to projects that specifically address the objectives listed in Chapter 3, projects where landowner engagement makes the process of addressing impairment feasible, and projects that promote education among the public. Any causes of impacts other than nonpoint source pollution will need to be addressed under different initiatives and may not be accomplished by the same projects, which address the nonpoint source pollution issues.

Project Summary Fact Sheets are listed in order by Critical Area and project numbers (Table 11 – Table 14). These summary sheets provide the essential nine elements for short-term and/or next step projects that are in development and/or in need of funding. As projects are implemented and new projects developed these sheets will be updated. Any new summary sheets created will be submitted to the State of Ohio for funding eligibility verification (i.e., all nine elements are included).

The cost estimate used in this report for installation of riparian buffers was based on a 2005 study conducted by NRCS in West Central Maine on the economics and survival of hand-planted riparian buffers (USDA-NRCS, 2005). When site preparation and plant survival are accounted for in the establishment (i.e., success) of the riparian buffer installation, an estimated cost of installation per acres is about $2,500. Site preparation includes a combination of activities, such as mowing, tillage, and herbicide application, which "is essential to the survival of riparian forest buffer plants" (USDA-NCRS, 2005). This estimate includes the labor and materials to install trees planted with shelters and shrubs planted with geotextile mats. Bioengineered streambank restoration and natural channel design costs are based on existing projects and project estimates from Clemson University in North Carolina at $550 per linear foot (Templeton et al., 2008).

Load reductions calculations were based on Ohio EPA spreadsheet distribution of NPS load (agriculture, developed, and natural land uses) to HUC-12 scale based on Nutrient Mass Balance Study for 2020 report (Rick Wilson, 2021).

Nutrient load reductions were based on the far-field targets set by the Mississippi River Gulf of Mexico Watershed Nutrient Task Force (HTF, 2014). "An Interim Target of a 20% reduction1 of nitrogen and phosphorus loading by 2025 is a milestone for immediate planning and implementation actions, while continuing to develop future action strategies to achieve the final goal through 2035. Federal agencies, States, Tribes and other partners will work collaboratively to plan and implement specific, practical and cost-effective actions to achieve both the Interim Target and the updated Coastal Goal" (HTF, 2014).

Table 10.1. Estimated nutrient loadings, target loads, and 20% reduction targets in Bell Run - SFLR HUC-12.

	Agricultural Load (lbs/yr)		Developed/Urban Load (lbs/yr)	
	Total Nitrogen	Total Phosphorus	Total Nitrogen	Total Phosphorus
Current Estimates	146,844	9,243	15,513	951
Target Loadings	117,475	7,394	12,411	761
Load Reduction needed (20%	29,369	1,849	3,103	190

reduction)

4.1.1 Overview Table for Projects and Implementation Strategy for all Critical Areas

Table 11. Project and Implementation Strategy Overview for all Critical Areas in the Bell Run – SFLR HUC-12.

For *Bell Run South Fork Licking River (HUC-12)* (05040006 04 06) —Critical Area #1								
Applicable Critical Area	**Goal**	**Objective**	**Project #**	**Project Title** *(EPA Criteria g)*	**Lead Organization** *(EPA Criteria d)*	**Time Frame** *(EPA Criteria f)*	**Estimated Cost** *(EPA Criteria d)*	**Potential/Actual Funding Source** *(EPA Criteria d)*
Altered Stream and Habitat Restoration Strategies								
1	1-8	1,2	1	RM 21.85 - 21.70 Riparian Corridor and Streambank Restoration	Licking SWCD, MWCD, USDA-NRCS	mid-term	$130,500	Ohio EPA 319, CRP, EQIP, MWCD
1	1-8	1, 2	2	RM 21.2 -20.6 Riparian Corridor and Streambank Restoration (Segments 3 and 5)	Licking SWCD, MWCD, USDA-NRCS	mid-term	$600,000	Ohio EPA 319, CRP, EQIP, MWCD
1	1-8	1, 2	3	RM 20.15 - 20.25 Riparian Corridor and Streambank Restoration	Licking SWCD, MWCD, USDA-NRCS	mid-term	$220,000	Ohio EPA 319, CRP, EQIP, MWCD
1	1-8	1, 2	4	RM 19.80 -19.20 Riparian Corridor and Streambank Restoration (Segments 2, 4, 5, and 6)	Licking SWCD, MWCD, USDA-NRCS	mid-term	$700,000	Ohio EPA 319, CRP, EQIP, MWCD
1	1-8	1, 2	5	RM 18.95 -17.85 Riparian Corridor and Streambank Restoration	Licking SWCD, MWCD, USDA-NRCS	long-term	$900,000	Ohio EPA 319, CRP, EQIP, MWCD

				(Segment 6)				
1	1-8	1	6	RM 17.80-17.05 Riparian Corridor Improvement	Licking SWCD, MWCD, USDA-NRCS	mid-term	$32,000	Ohio EPA 319, CRP, EQIP, MWCD
1	1-8	1	7	RM 17.05-16.0 Riparian Corridor Improvement	Licking SWCD, MWCD, USDA-NRCS	mid-term	$60,000	Ohio EPA 319, CRP, EQIP, MWCD
1	1-8	1	8	RM 14.50-14.05 Riparian Corridor Improvement	Licking SWCD, MWCD, USDA-NRCS	mid-term	$16,000	Ohio EPA 319, CRP, EQIP, MWCD
1	1-8	1	9	RM 13.6-13.0 Riparian Corridor Improvement	Licking SWCD, MWCD, USDA-NRCS	mid-term	$12,000	Ohio EPA 319, CRP, EQIP, MWCD
1	1-8	1	10	RM Riparian Corridor Improvement 1.7-0.2 along Bell Run	Licking SWCD, MWCD, USDA-NRCS	Short	$33,500	Ohio EPA 319, CRP, EQIP, MWCD

For *Bell Run South Fork Licking River (HUC-12)* (05040006 04 06) —Critical Area #2								
Applicable Critical Area	**Goal**	**Objective**	**Project #**	**Project Title** *(EPA Criteria g)*	**Lead Organization** *(EPA Criteria d)*	**Time Frame** *(EPA Criteria f)*	**Estimated Cost** *(EPA Criteria d)*	**Potential/Actual Funding Source** *(EPA Criteria d)*
Urban Sediment and Nutrient Reduction Strategies								
2	1, 2	1, 2	11	Upgrade failing HSTS	County Health Departments, MWCD	short	$150,000	Local sources, Ohio EPA 319

For *Bell Run South Fork Licking River (HUC-12)* (05040006 04 06) —Critical Area #3								
Applicable Critical Area	**Goal**	**Objective**	**Project #**	**Project Title** *(EPA Criteria g)*	**Lead Organization** *(EPA Criteria d)*	**Time Frame** *(EPA Criteria f)*	**Estimated Cost** *(EPA Criteria d)*	**Potential/Actual Funding Source** *(EPA Criteria d)*
Agricultural Nonpoint Source Reduction Strategies								
3	1	1	12	Cover Crop program	SWCD	Short	$30,000 annually	Ohio EPA 319, CRP, EQIP, MWCD
4	1	1,2	13	Bloody Run Swamp Stream and Wetland	Stream and Wetland Foundation	Short	$3,100,000	In-lieu fee mitigation

For *Bell Run South Fork Licking River (HUC-12)* (05040006 04 06) —Critical Area #4								
Applicable Critical Area	**Goal**	**Objective**	**Project #**	**Project Title** *(EPA Criteria g)*	**Lead Organization** *(EPA Criteria d)*	**Time Frame** *(EPA Criteria f)*	**Estimated Cost** *(EPA Criteria d)*	**Potential/Actual Funding Source** *(EPA Criteria d)*
High Quality Habitat Protection Strategies								
4	1	3	14	Old South Fork Riverbed Wetland	Fairfield SWCD, MWCD,	Long-term	$35,000	Ohio EPA 319, MWCD, H2Ohio

Tables 11 through 20 show the critical area, the length of area lacking a 120-foot buffer, the existing buffer width, and the area of the needed buffer. Figures 17 through 26 show the total area of buffer needed.

Based on aerial images (Figures 17 - 26) and buffer analysis, widespread streambank erosion has been identified as an impact and potential cause of impairment in the Bell Run South Fork Licking River HUC-12. Common sources of streambank erosion include removal or lack of riparian vegetation. In-stream channel erosion can be a significant contributor of stream TSS loadings (Nelson and Booth, 2002). Due to the absence of TMDL data for this HUC, the need for substantial reductions in TSS is unknown. However, TSS data collected by the EPA for NPDES permit holders show that the TSS in particular locations of this watershed are in noncompliance. The tables and images below identify stream reaches where the riparian buffer is less than the 120 feet of vegetated land cover conducive to preventing soil loss.

Project #1: Site RM 21.85 to 21.70, total length 257 ft (Kirkersville low-head dam)

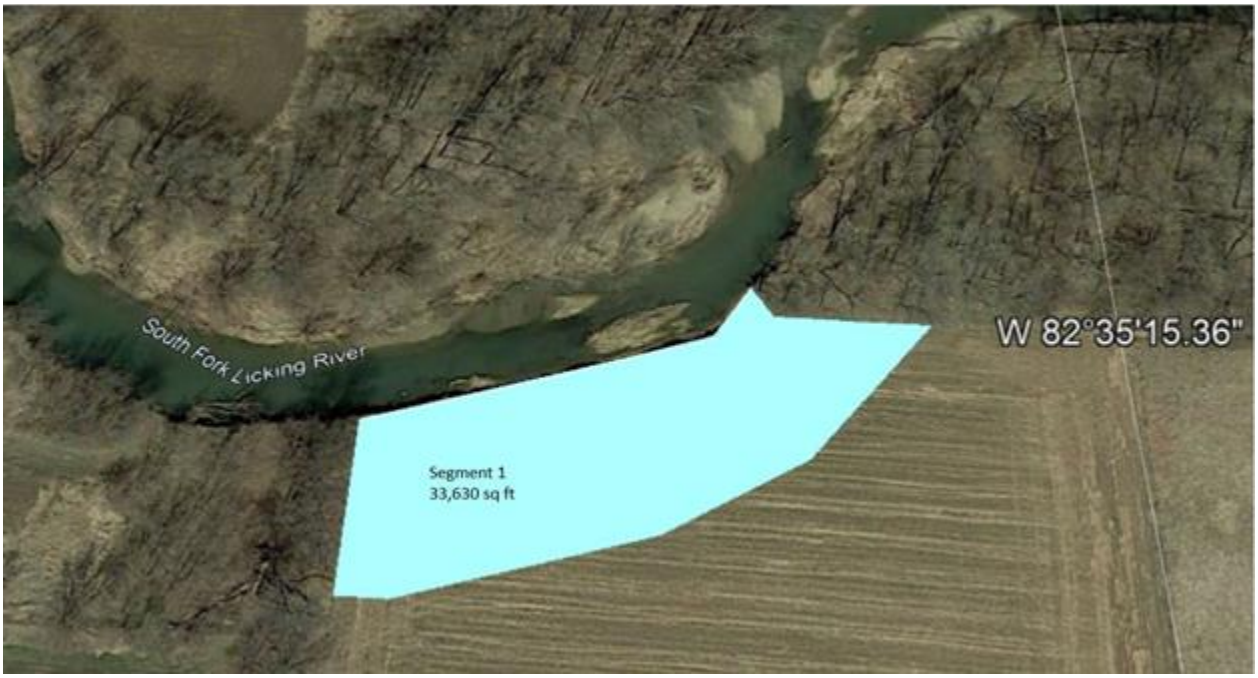

Figure 17. Site: RM 21.85 to 21.70 of critical area 1 within the Bell Run – SFLR HUC-12.

Table 12. Land use within a 120-ft and 30-ft riparian buffer analysis on all waterbodies within the Bell Run – SFLR HUC-12.

Name	Buffer Length (ft)	Current Buffer (ft)	Needed Buffer (ft)	Needed Buffer (sq ft)	Location
RM 21.85 to 21.70 Seg. 1	257 *	10	110	33,630	NW corner of field, just upstream SW Licking Sewer WWTP (right bank)

Project #2: Site RM 21.2 to 20.6., total length 2,818 ft

Figure 18. Site: RM 21.2 to 20.6 of critical area 1 within the Bell Run – SFLR HUC-12.

Table 13. Site: RM 21.2 to 20.6 of critical area 1 within the Bell Run – SFLR HUC-12. An asterisk (*) in the 'Buffer Length' column signifies a riparian corridor planting project coupled with a stream restoration or area where a natural channel design is needed.

Name	Buffer Length (ft)	Current Buffer (ft)	Needed Buffer (ft)	Needed Buffer (sq ft)	Location
RM 21.2 to 20.6 Seg. 1	928	12	108	68,384	Section 4(right bank) South of Wooded Hills (east of intersection of Rt. 30 and 141)
RM 21.2 to 20.6 Seg. 2	226	0	120	35,676	Small bend #2 (left bank) South of Wooded Hills (east of intersection of Rt. 30 and 141)
RM 21.2 to 20.6 Seg. 3	802 *	15	105	90,659	Big bend (right bank) South of Wooded Hills (east of intersection of Rt. 30 and 141)
RM 21.2 to 20.6 Seg. 4	568	20	100	40,060	Left bank between 3 and 5
RM 21.2 to 20.6 Seg. 5	294 *	0	120	45,511	Small bend (right bank) South of Wooded Hills (east of intersection of Rt. 30 and 141)

Project #3: Site RM 20.15 to 20.25, total length 427 ft

Figure 19. Site: RM 20.15 to 20.25 of critical area 1 within the Bell Run – SFLR HUC-12.

Table 14. Site: RM 20.15 to 20.25 of critical area 1 within the Bell Run – SFLR HUC-12. An asterisk (*) in the 'Buffer Length' column signifies a riparian corridor planting project coupled with a stream restoration or area where a natural channel design is needed.

Name	Buffer Length (ft)	Current Buffer (ft)	Needed Buffer (ft)	Needed Buffer (sq ft)	Location
RM 20.15 to 20.25	427 *	0	120	53,041	South of CTS Automotive (East of intersection of Rt. 30 and 141)

Project #4: Site RM 19.80 to 19.20, total length 2,571 ft

Figure 20. Site: RM 19.80 to 19.20 of critical area 1 within the Bell Run – SFLR HUC-12.

Table 15. Site: RM 19.80 to 19.20 of critical area 1 within the Bell Run – SFLR HUC-12.

Name	Buffer Length (ft)	Current Buffer (ft)	Needed Buffer (ft)	Needed Buffer (sq ft)	Location
RM 19.80 to 19.20 Seg. 1	919	25	95	87,305	(Right bank) North of route 40, west of National Trail Raceway, North of Suburban Propane
RM 19.80 to 19.20 Seg. 2	528 *	20	100	37,425	(Left bank) North of route 40, west of National Trail Raceway, North of Suburban Propane
RM 19.80 to 19.20 Seg. 3	294	16	104	21,008	(Right bank) North of route 40, west of National Trail Raceway, North of Suburban Propane
RM 19.80 to 19.20 Seg. 4	232 *	0	120	36,718	(Left bank) North of route 40, west of National Trail Raceway, North of Suburban Propane
RM 19.80 to 19.20 Seg. 5	246 *	0	120	55,209	(Left bank) North of route 40, west of National Trail Raceway, North of Suburban Propane
RM 19.80 to 19.20 Seg. 6	352 *	0	120	28,494	(Right bank) North of route 40, west of National Trail Raceway, North of Suburban Propane

Project #5: Site RM 18.95 to 17.85, total length 3,850 ft

Figure 21. Site: RM 18.95 to 17.85 of critical area 1 within the Bell Run – SFLR HUC-12.

Table 16. Site: RM 18.95 to 17.85 of critical area 1 within the Bell Run – SFLR HUC-12. An asterisk (*) in the 'Buffer Length' column signifies a riparian corridor planting project coupled with a stream restoration or area where a natural channel design is needed.

Name	Buffer Length (ft)	Current Buffer (ft)	Needed Buffer (ft)	Needed Buffer (sq ft)	Location
RM 18.95 to 17.85 Seg. 1	342	0	120	28,816	(Left bank) West of Route 37, between the inter. of Rt. 37 and 70 and the inter. of 40 and 70 (Eastern segment)
RM 18.95 to 17.85 Seg. 2	350	8	112	27,660	(Left bank) West of Route 37, between the inter. of Rt. 37 and 70 and the inter. of 40 and 70
RM 18.95 to 17.85 Seg. 3	523	10	110	46,017	(Right bank) West of Route 37, between the inter. of Rt. 37 and 70 and the inter. of 40 and 70
RM 18.95 to 17.85 Seg. 4	244	7	113	25,297	(Left bank) West of Route 37, between the inters. of Rt. 37 and 70 and the inter. of 40 and 70
RM 18.95 to 17.85 Seg. 5	676	6	114	57,801	(Left bank) West of Route 37, between the inters. of Rt. 37 and 70 and the inter. of 40 and 70
RM 18.95 to 17.85 Seg. 6	1715 *	5	115	169,077	(Right bank) West of Route 37, between the inter. of Rt. 37 and 70 and the inter. of 40 and 70 (Southern segment)

Project #6: Site RM 17.80 to 17.05, total length 6,019 ft

Figure 22. Site: RM 17.80 to 17.05 of critical area 1 within the Bell Run – SFLR HUC-12.

Table 17. Site: RM 17.80 to 17.05 of critical area 1 within the Bell Run – SFLR HUC-12.

Name	Buffer Length (ft)	Current Buffer (ft)	Needed Buffer (ft)	Needed Buffer (sq ft)	Location
RM 17.80 to 17.05 Seg. 1	2904	80	40	172,826	Mouth of Bell Run (upstream, west of route 37, left bank)
RM 17.80 to 17.05 Seg. 2	3115.2	65	55	372,772	Mouth of Bell Run (upstream, west of route 37, right bank)

Project #7: Site RM 17.05 to 16.0, total length 10,084 ft

Figure 23. Site RM 17.05 to 16.0 of critical area 1 within the Bell Run - SFLR HUC-12

Table 18. Site: RM 17.05 to 16.0 of critical area 1 within the Bell Run – SFLR HUC-12.

Name	Buffer Length (ft)	Current Buffer (ft)	Needed Buffer (ft)	Needed Buffer (sq ft)	Location
RM 17.05 to 16.0 Seg. 1	5491.2	12	108	578,688	East of intersection of route 37 and 79 (right bank)
RM 17.05 to 16.0 Seg. 2	1003	33.2	86.8	91,788	East of intersection of route 37 and 79 (left bank)
RM 17.05 to 16.0 Seg. 3	3590.4	60	60	304,189	East of intersection of route 37 and 79 (left bank)

Project #8: Site RM 14.50 to 14.05, total length 2,570 ft

Figure 24. Site: RM 14.50 to 14.05 of critical area 1 within the Bell Run – SFLR HUC-12

Table 19. Site: RM 14.50 to 14.05 of critical area 1 within the Bell Run – SFLR HUC-12.

Name	Buffer Length (ft)	Current Buffer (ft)	Needed Buffer (ft)	Needed Buffer (sq ft)	Location
RM 14.50 to 14.05	2570	15	105	276,446	(Right bank) North of Buckeye Lake Columbus East KOA Holiday, South of intersection between Rt. 70 and 79

Project #9: Site RM 13.6 to 13.0, total length 3,379 ft

Figure 25. Site: RM 13.6 to 13.0 of critical area 1 within the Bell Run - SFLR HUC-12

Table 20. Site: RM 13.6 to 13.0 of critical area 1 within the Bell Run – SFLR HUC-12.

Name	Buffer Length (ft)	Current Buffer (ft)	Needed Buffer (ft)	Needed Buffer (sq ft)	Location
RM 13.6 to 13.0	3379.2	0	120	207,449	(Left bank) Immediately North of intersection between Rt. 70 and 79

Project #10: Site RM 1.7 to 0.2 total length 7,961 ft

Figure 26. Site: RM 1.7 to 0.2 of critical area 1 within the Bell Run - SFLR HUC-12

Table 21 Site: RM 1.7 to 0.2 of critical area 1 within the Bell Run – SFLR HUC-12.

Name	Buffer Length (ft)	Current Buffer (ft)	Needed Buffer (ft)	Needed Buffer (sq ft)	Location
RM 1.7 to 0.2 Seg. 1	705	20	55	36,151	Immediately NW of the intersection of Rt 70 and 37 (right bank)
RM 1.7 to 0.2 Seg. 2	631	7	68	47,131	Immediately NW of the intersection of Rt 70 and 37 (left bank)
RM 1.7 to 0.2 Seg. 3	1,453	40	35	61,262	Immediately NW of the intersection of Rt 70 and 37 (left bank)
RM 1.7 to 0.2 Seg. 4	1,884	44	31	88,221	Immediately NW of the intersection of Rt 70 and 37 (right bank)
RM 1.7 to 0.2 Seg. 5	349	15	60	24,195	Immediately NW of the intersection of Rt 70 and 37 (left bank)

RM 1.7 to 0.2 Seg. 6	3,568	20	55	168,979	Immediately NW of the intersection of Rt 70 and 37 (right bank)
RM 1.7 to 0.2 Seg. 7	339	45	30	11,223	Immediately NW of the intersection of Rt 70 and 37 (left bank)
RM 1.7 to 0.2 Seg. 8	2,742	35	40	143,024	Immediately NW of the intersection of Rt 70 and 37 (left bank)

4.1.2 Overview of Fact Sheets for Critical Area 1

Table 22. Project Summary Fact Sheet 1 for Bell Run - SFLR HUC-12.

Critical Area 1: Bell Run Riparian Improvement		
Nine Element Criteria	Information needed	**Explanation**
n/a	Title	**Bell Run Riparian Corridor Improvement Project**
criteria d	Project Lead Organization & Partners	**Licking SWCD, USDA-NRCS, MWCD**
criteria c	HUC-12 and Critical Area	**Bell Run - South Fork Licking River HUC-12 Critical Area 1: Riparian Improvement**
criteria c	Location of Project	
n/a	Which strategy is being addressed by this project?	**Altered Stream and Habitat Restoration Strategies**
criteria f	Time Frame	**Short (1-3 years)**
criteria	Short Description	**The mouth of Bell Run riparian buffer will be planted with native trees and shrubs to a buffer of 75 ft from the river.**
criteria g	Project Narrative	**The mouth of Bell Run riparian buffer lacks sufficient vegetative cover along a total of 2.2 miles of stream (both banks). This stream reach will be planted with native trees and shrubs to a buffer of 75 ft width from the river's edge. Along this 1.5 mile stretch of meandering stream, 13.3 acres will be planted to protect the adjacent land from erosional soil loss.**
criteria d	Estimated Total Cost	**$33,500**
criteria d	Possible Funding Source	**CRP, EPA 319, EQIP, MWCD**
criteria a	Identified Causes and Sources	**Cause: Sedimentation and habitat alteration. Source: Eroding streambanks and lack of riparian corridors**
criteria b & h	Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?	**The goal of this critical area is to reduce nutrients transport to South Fork Licking River. Far-field targets of 20% reduction of nutrients are established at a reduction of 2,080 lbs/yr phosphorus and 33,140 lbs/yr nitrogen loading.**
	Part 2: How much of the needed improvement for the whole Critical Area is	**It is estimated that the riparian and stream restoration at RM 1.7 to 0.2 on Bell Run will decrease nutrient transport across the 13.3 acres converting agricultural cropland to**

	estimated to be accomplished by this project?	**vegetated riparian by 5% phosphorus and 1% nitrates.**
	Part 3: Load Reduced?	**For 2.2 miles of riparian corridor installed at 75 ft width estimated reductions are Sediment: 93 tons/year Nutrients: 93 lbs/year phosphorus and 186 lbs/yr nitrogen**
criteria i	How will the effectiveness of this project in addressing the NPS impairment be measured?	**The Ohio EPA routinely take water samples from the South Fork Licking River. These samples will test for nutrient concentrations.**
criteria e	**Information and Education**	**The project will be promoted to landowners and other stakeholders with public meetings, news releases, social media and personal contacts from the SWCDs and NRCS.**

4.2.2 Overview of Fact Sheets for Critical Area 2

Table 23. Project Summary Fact Sheet 2 for Bell Run - SFLR HUC-12.

Critical Area 2: Project 2 NEW TEMPLATE		
Nine Element Criteria	Information needed	**Explanation**
n/a	Title	**HSTS Replacement or Upgrades**
criteria d	Project Lead Organization & Partners	**Fairfield and Licking SWCD** **County Health Departments**
criteria c	HUC-12 and Critical Area	**Bell Run South Fork Licking River HUC-12** **Critical Area 2: Home Sewage Treatment Systems**
criteria c	Location of Project	**Bell Run South Fork Licking River HUC-12** On parcels containing aging septic tank systems
n/a	Which strategy is being addressed by this project?	**Urban Sediment and Nutrient Reduction Strategies**
criteria f	Time Frame	**Short (1-3 years)**
criteria	Short Description	**Failing septic tanks contribute to Bell Run South Fork Licking River's *E.coli* levels. Updating failing units will reduce this source of bacteria from seeping into the watershed.**
criteria g	Project Narrative	42 systems were identified as a sampling of the HSTS systems in Bell Run South Fork Licking River that range in age from 1970 to 2005, with the support of the county health departments, each aerator will be inspected for signs of failure, these systems will be replaced or upgraded. It is estimated that 10 units need to be replaced currently, costing about $15,000 each. Each year 5-10 residents with failing HSTS that qualify for assistance funding are not able to be fulfilled due to lack of funds.
criteria d	Estimated Total Cost	**$150,000**
criteria d	Possible Funding Source	**County Health Departments, Ohio EPA-DEFA, Local sources**
criteria a	Identified Causes and Sources	**Cause: Organic Enrichment. Source: Failing home sewage treatment systems**
criteria b & h	Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?	**The goal of Critical Area 2 is to reduce *E.coli* levels below recreational water quality limits (<161 cfu/100ml). To remove home sewage treatment systems as an impairment, all identified aerators in the watershed will need to be replaced with updated models.**
	Part 2: How much of the needed improvement for the whole Critical Area is	**25% of the critical area (10 HSTS) will be addressed initially. PCR testing conducted by MWCD will assist in identifying the source of *E.coli*, plans to address additional**

	estimated to be accomplished by this project?	**sources of *E.coli* will be developed as new information is learned. Reduce E.coli levels to below the recreational water quality limits (<161 cfu/100ml). Data collection will be needed to identify *E.coli* levels.**
	Part 3: Load Reduced?	**PCR testing conducted by MWCD will assist in identifying the source of *E.coli*, plans to address additional sources of *E.coli* will be developed as new information is learned. It is estimated that each HSTS (2-person household) replaced or updated reduces phosphorus by 4.3 lbs/yr and 17.0 lbs/yr nitrogen.**
criteria i	How will the effectiveness of this project in addressing the NPS impairment be measured?	**County health departments will continue doing routine inspections of HSTS.**
criteria e	**Information and Education**	**The project will be promoted to landowners and other stakeholders with public meetings, news releases, social media and personal contacts from the SWCDs and county health departments.**

4.2.3 Overview of Fact Sheets for Critical Area 3

Table 24. Project Summary Fact Sheet 3 for Bell Run - SFLR HUC-12.

Critical Area 3: Project 3 NEW TEMPLATE		
Nine Element Criteria	Information needed	**Explanation**
n/a	Title	**Cover Crop Program**
criteria d	Project Lead Organization & Partners	**Fairfield, and Licking SWCD County Health Departments**
criteria c	HUC-12 and Critical Area	**Bell Run South Fork Licking River HUC-12 Critical Area 3: Prioritized Agricultural Lands**
criteria c	Location of Project	**Bell Run South Fork Licking River HUC-12** On parcels where land use is designated as cultivated crops.
n/a	Which strategy is being addressed by this project?	**Agricultural Nonpoint Source Reduction Strategies**
criteria f	Time Frame	**Short (1-3 years)**
criteria	Short Description	**Lack of BMPs on agricultural lands contribute to Bell Run - South Fork Licking River's TSS levels and streambank erosion. Implementing BMPs on agricultural lands will minimize this and the impact downstream.**
criteria g	Project Narrative	In the 26 square mile Bell Run South Fork Licking River watershed approximately 70% is used for agriculture. Of that 70% agricultural land, approximately 40% of agricultural lands do not have sufficient BMPs, leaving the agricultural landscape vulnerable to excessive sedimentation and nutrient loss. 1,000 acres (10%) have been identified as prioritized lands for BMP implementation, costing about $30,000 annually to address winter cover crops.
criteria d	Estimated Total Cost	**$30,000 annually**
criteria d	Possible Funding Source	**H2Ohio, USDA, EPA 319, Local sources**
criteria a	Identified Causes and Sources	**Cause: Sedimentation, Nutrients, Habitat alteration. Source: Agricultural field runoff, Row-crop agriculture, eroding stream banks, lack of buffer vegetation nears streams and ditches**
criteria b & h	Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?	**The goal of Critical Area 3 is to reduce 2,080 lbs/yr phosphorus to achieve 20% far-field nutrients reduction targets**

	Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?	**19% of the critical area will be addressed yearly, 400 lbs/yr of phosphorus will be reduced each year through the cover crop program.**
	Part 3: Load Reduced?	**1,000 acres of cultivated cropland utilizing winter cover crops will reduce Phosphorus loading to Bell Run South Fork Licking River by 400 lbs/yr.**
criteria i	How will the effectiveness of this project in addressing the NPS impairment be measured?	**SWCDs will gauge landowner interest in participation, Ohio EPA will monitor TSS in the South Fork Licking River**
criteria e	**Information and Education**	**The project will be promoted to landowners and other stakeholders with public meetings, news releases, social media and personal contacts from the SWCDs and county health departments.**

4.2.4 Overview of Fact Sheets for Critical Area 4

Table 25. Project Summary Fact Sheet 4 for Bell Run - SFLR HUC-12.

Critical Area 4 Project 4 NEW TEMPLATE		
Nine Element Criteria	Information needed	**Explanation**
n/a	Title	**Bloody Run Swamp Stream and Wetland Restoration Project**
criteria d	Project Lead Organization & Partners	**Stream and Wetland Foundation**
criteria c	HUC-12 and Critical Area	**Bell Run South Fork Licking River HUC-12** **Critical Area 4: Wetland Restoration**
criteria c	Location of Project	**Bell Run South Fork Licking River HUC-12** On parcels currently in cultivated cropland land use and on 96-100% hydric soils.
n/a	Which strategy is being addressed by this project?	**Agricultural Nonpoint Source Reduction Strategies**
criteria f	Time Frame	**Short (1-3 years)**
criteria	Short Description	**Bell Run South Fork Licking River is impacted by direct habitat alterations, lack of instream habitat, and sedimentation and siltation from stream bank erosion. Redefining stream and floodplain connectivity and incorporating wetland restoration will minimize the impacts from nutrients and sediments.**
criteria g	Project Narrative	**The intersection of cropland with 96-100% hydric soils reveals 25% of the existing cropland could be repurposed and restored to a wetland habitat creating valuable diverse habitat for aquatic organisms and wildlife while also providing and sink for excess nutrients and sediment. The 'Bloody Run Swamp Stream and Wetland Restoration' project located in Licking County will reconnect a 3,300 linear foot section of Bloody Run to the floodplain and create a 70-acre wetland across an 80-acre parcel.**
criteria d	Estimated Total Cost	**$3,100,000**
criteria d	Possible Funding Source	**In-lieu Fee Mitigation**
criteria a	Identified Causes and Sources	**Cause: Sedimentation, Habitat alteration Source: Eroding streambanks, lack of wetlands, lack of buffer vegetation**

criteria b & h	Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?	**The goal of Critical Area 4 is to decrease 10% percent of the agricultural cropland on existing hydric soils across the HUC-12 by transitioning land into wetlands where landowners are willing. Wetlands will aid in filtering nutrients and sediment, providing wildlife habitat, and increasing water retention to help alleviate downstream flooding**
	Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?	**20% of the Critical Area 4 will be addressed initially through establishment of wetlands by this project (70 acres). 3% of the phosphorus and nitrogen far-field target reduction will be accomplished.**
	Part 3: Load Reduced?	**Reduce 2,080 lbs/yr phosphorus and 33,140 lbs/yr nitrogen loading to achieve 20% far-field nutrients reduction targets. 3,300 linear feet of stream restoration and 70 acres of created wetlands will reduce nutrient loading, helping to reduce the nutrient transport by 3% of the far-field nutrient target. Flow and nutrients are being measured on-site pre-construction and post construction planned for 2022.**
criteria i	How will the effectiveness of this project in addressing the NPS impairment be measured?	**On-going monitoring and testing will be conducted by Ohio University Voinovich School with support from the Stream and Wetland Foundation.**
criteria e	**Information and Education**	**This project will be promoted as a demonstration for other landowners in the area through meetings, news releases, social media and personal contacts from the SWCDs.**

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Appendices

Appendix A: Acronyms and Abbreviations

The acronyms and abbreviations listed below are either common among organizations working to restore Ohio's watershed or were created for this NPS-IS plan.

C

CRP	*Conservation Reserve Program*
CRWP	*Chagrin River Watershed Partnership*

D

DMR	*Discharge Monitoring Report*
DO	*Dissolved Oxygen*

E

EOLP	*Erie/Ontario Lake Plain Ecoregion*
EQIP	*Environmental Quality Incentives*
Program EWH	*Exceptional Warmwater Habitat*

G

GVS	*George Voinovich School of Leadership and Public Service*

H

HUC	*Hydrologic Unit Code*
HSTS	*Home Sewage Treatment System*

I

IBI	*Index of Biotic Integrity*
ICI	Invertebrate Community Index

L

LCHD	*Licking County Health Department*
lbs	*Pounds*

M

Mg/ L	*Milligram per Liter*
MIwb	*Modified Index of Well Being*
mL	*Milliliter*
mi	*Mile*

N

N	*Nitrogen*
NPS	*Nonpoint Source*
NPS-IS	*Nonpoint Source Implementation*
Strategy NRCS	*Natural Resources Conservation Service*
NPDES	*National Pollutant Discharge Elimination System*

O

Ohio EPA	*Ohio Environmental Protection*
Agency	

P

P	*Phosphorus*
PCR	*Primary Contact Recreation*

Q

QHEI	*Qualitative Habitat Evaluation Index*
QTR	*Quarter*

R

RM	*River Mile*

S

SWCD	*Soil and Water Conservation District*
SWF	*The Stream and Wetland Foundation*
SD	*Sewer District*
SFLR	*South Fork Licking River*

T

TKN	*Total Kjeldahl Nitrogen*
TMDL	*Total Maximum Daily Load Limits*
TP	*Total Phosphorus*
TSD	*Technical Support Document*
TSS	*Total Suspended Solids*
TDS	*Total Dissolved Solids*

U

µg/L	*Micrograms per Liter*
USDA	*United States Department of Agriculture*
USGS	*United States Geological Survey*

W

WWH	*Warmwater Habitat*
WWR	*Waste Weir Run*
WWTP	*Wastewater Treatment Plant*

W	*West*

Appendix B: Index of Figures and Tables

Appendix B.1: List of Figures

Appendix B.2. List of Tables