The project site is located near the intersection of Lakeshore Boulevard and Luikart Drive in the City of Euclid. Coordinates: 41.568920, -81.530368

The project site is located on property owned by the Our Lady of Lourdes Shrine near the intersection of Euclid Avenue and East 214th Street in the City of Euclid. Coordinates: 41.573864, -81.521437

The project site is located on City-owned property near the intersection of Euclid Avenue and East 228th Street in the City of Euclid. Coordinates: 41.591985, -81.505322

The project site is located at the City-owned Tungsten Playground Park on Tungsten Road and between Babbitt Road and East 260th Street in the City of Euclid. The site is located immediately south of the railroad line.

References
Figures

Figure 1. Location of the City of Euclid-Frontal Lake Erie watershed assessment unit on the Portage Escarpment in Northeast Ohio ......................................................... 10

Figure 2. Municipalities within the City of Euclid-Frontal Lake Erie watershed assessment unit .......................................................... 11

Figure 3. Interstate, U.S, and State routes within the City of Euclid-Frontal Lake Erie assessment unit ........................................... 12

Figure 4. Northeast Ohio Regional Sewer District Storm Water Service Area indicated in orange ..................................................... 13

Figure 5. City of Euclid-Frontal Lake Erie on the Portage Escarpment: historical stream courses .............................................. 14

Figure 6. City of Euclid-Frontal Lake Erie shaded relief map .................................................................................................................. 17

Figure 7: Flyer for City of Euclid-Frontal Lake Erie NPS-IS public input meeting held on November 28, 2018 ........................................ 18

Figure 8. Stakeholders discuss challenges and opportunities at the City of Euclid-Frontal Lake Erie public open house, November 28, 2018 ........................................................................................................... 19

Figure 9: Bedrock profile (facing southeast), Chagrin to Cuyahoga Rivers, with Euclid-FLE (red outline) and neighboring streams ......................................................................................................................... 20

Figure 10: Facing west at E 222nd St in Euclid: bedrock and moraine profile ............................................................................................. 21

Figure 11: Euclid-Frontal Lake Erie surficial geology and hydrological zones ..................................................................................... 21

Figure 12. The Lilly Creek outfall to Lake Erie is culverted between two large jetties. Photo date: December 4, 2017 ............. 24

Figure 13. Babbitt Run as it flows into an in-line retention basin located in its west escarpment ravine (facing north/downstream) ......................................................................................................................... 25

Figure 14: Black cherry tree growing over a tributary to Burk Run. Photo date: October 12, 2017 ......................................................... 26

Figure 15: Mouth of Salt Run at Lake Erie. Photo date: December 4, 2017 ............................................................................................. 27

Figure 16: Tributary to Burk Run at Telshe Yeshiva. Photo date: December 5, 2018 ................................................................. 28

Figure 17: Mouth of Burnt House Brook on Lake Erie in Willowick, Ohio. Photo date: December 5, 2018 ......................................... 28

Figure 18: Euclid-Frontal Lake Erie natural sub-drainages .................................................................................................................... 29

Figure 19. Euclid-FLE sub-watersheds in Cuyahoga County: natural units (left) and current sewersheds (right) ................... 29

Figure 20: City of Euclid-Frontal Lake Erie: open water bodies (blue) ............................................................................................ 30

Figure 21. Euclid-Frontal Lake Erie had 53 miles of historical stream courses ................................................................. 31

Figure 22. Euclid-Frontal Lake Erie: current open courses (light blue) and culverted segments ................................................... 31

Figure 23. Euclid-Frontal Lake Erie: soil types and acreages ....................................................................................................................... 33

Figure 24. Euclid-Frontal Lake Erie: soil drainage class types (Data source: U.S. Department of Agriculture Web Soil Survey) .... 34

Figure 25. Euclid-FLE wetlands indicated by type (Data source: U.S. Fish and Wildlife Service National Wetlands Inventory) .... 37
Figure 26. Lilly Creek mouth: 1930s lagoon and present condition

Figure 27. Euclid-FLE land cover (Data source: Coastal Change Analysis Program, 2010).

Figure 28. Euclid-FLE impervious cover. Cuyahoga County data is provided through 2017 NEORSD impervious area data (City of Euclid omitted as it is not within the NEORSD service area) and Lake County data is provided through a 2004 CRWP impervious cover study.

Figure 29. Euclid-FLE protected lands in bright green (includes public and institutional lands, parks, conservation easements).

Figure 30. General Wetland Aquatic Life Use Designations (Mack, 2004).

Figure 31. Correlation of VIBI scores to general wetland aquatic life use designations (Mack, 2004).

Figure 32. Euclid-FLE Ohio EPA Aquatic Life Use Monitoring Stations (Data source: Ohio EPA).

Figure 33. Monitoring locations for wetland and headwater stream habitat assessments conducted by Bluestone Heights and CRWP.

Figure 34. Euclid-FLE Priority Development Areas and Priority Conservation Areas. Source: Chagrin River Watershed Balanced Growth Plan, 2009.

Figure 35. City of Euclid Master Plan, completed February 5, 2018.

Figure 36. Map of Critical Area 1 (Ravine Habitat).

Figure 37. Headwater ravine tributary to Lilly Creek.

Figure 38. Headwater tributary to Burk Run at Providence Missionary Baptist Church property.

Figure 39. Streambank erosion occurring on tributary to Burk Run at Providence Missionary.

Figure 40. Burnt House Brook adjacent to Lake Health West Medical Center. Photo date: December 5, 2018.

Figure 41. Streambank erosion along Burnt House Brook due to stormwater runoff has caused

Figure 42. Burnt House Brook is channelized with gabion baskets downstream of Kaiser Court in Willoughby, Ohio (photo location: Brookdale Apartments). Channelization has led to decreased aquatic habitat diversity and lack of floodplain access.

Figure 43. Map of Critical Area 2 (Wetland Restoration).

Figure 44. Lilly west shrine pond. Photo date: October 10, 2017.

Figure 45. Lilly east Knott pond. Photo date: October 10, 2017.

Figure 46. Wet woods at Lilly east shelf. Photo date: October 10, 2017.

Figure 47. Babbitt west retention basin. Photo date: October 10, 2017.

Figure 48. Wooded buffer area around Babbitt west retention basin. Photo date: October 10, 2017.

Figure 49. Lilly east Nickle plate basin. Photo date: October 13, 2017.

Figure 50. Tungsten playground wetland. Photo date: October 18, 2018.
Figure 51. Milkweed at Tungsten playground wetland. Photo date: October 18, 2018. ................................................................. 69

Figure 52. Burk Run as it flows through the Euclid spur borrow pit. Photo date: October 12, 2017 ...................................................... 70

Figure 53. Euclid spur borrow pit riparian wetland. Photo date: October 12, 2017 .......................................................... 71

Figure 54. Chase channel wetland. Photo date: October 13, 2017 .............................................................. 72

Figure 55. Chase channel wetland. Photo date: October 13, 2017 .............................................................. 72

Figure 56. Hillandale Areas F & D wetland. Photo date: October 12, 2017 ............................................................. 74

Figure 57. Maps of Critical Area 4 (Coastal Zone), west (left) and east (right). ................................................................. 82

Figure 58. Salt Run mouth, Euclid. Nor’easter, March 1-2, 2018 (courtesy of David Steger). .................................................. 83

Figure 59. Burnt House Brook shoreline ravine. Photo date: December 5, 2018 .......................................................... 84
Tables

Table 1. Euclid-FLE soil types, summarized by soil drainage class (Data source: U.S. Department of Agriculture Web Soil Survey). ........................................................................................................................................ 35

Table 2. Ohio Listed Species observed during citizen science bird surveys at Sims Park in the City of Euclid (Data sources: eBird, 2018; Ohio Division of Wildlife, Publication 5414). ........................................................................................................................................ 38

Table 3. Euclid-FLE invasive plant species identified during 2017 habitat assessments by Bluestone Heights and CRWP (not a complete list). ........................................................................................................................................ 40

Table 4. Ohio EPA monitoring data for two monitoring locations on Lake Erie slightly outside of the HUC12. (Data source: “Euclid Area Fish Metrics” Spreadsheet, Ohio EPA). ........................................................................................................................................ 44

Table 5. Biological criteria applicable to rivers and streams in the Erie-Ontario Lake Plains (EOLP). ........................................................................................................................................ 44

Table 6. The aquatic life use that applies to Lake Erie is Exceptional Warmwater Habitat (EWH). Since EWH criteria were developed for streams and rivers, an index of biotic integrity (IBI) proposed for Lake Erie shorelines and harbors was developed (Ohio EPA, 1999). ........................................................................................................................................ 44

Table 7. Assessment data for wetland and headwater stream habitat (Bluestone Heights and CRWP, 2017). ........................................................................................................................................ 48

Table 8. Euclid-FLE public input received regarding challenges, high quality areas, and potential protection and restoration activities. ........................................................................................................................................ 49

Table 9. Chemical water quality monitoring data for Babbitt Run west escarpment ravine collected by Bluestone Heights and Cuyahoga Community College. ........................................................................................................................................ 59

Table 10. Chemical water quality monitoring data for Babbitt Run east escarpment ravine collected by Bluestone Heights and Cuyahoga Community College. ........................................................................................................................................ 59

Table 11. Chemical water quality monitoring data for Burk Run northwest ravine collected by Bluestone Heights and Cuyahoga Community College. ........................................................................................................................................ 60

Table 12. HHEI assessment data collected in this critical area by Bluestone Heights and CRWP in 2017. ........................................................................................................................................ 61

Table 13. ORAM wetland assessment data collected in this critical area by Bluestone Heights and CRWP in 2017. ........................................................................................................................................ 75

Table 14. HHEI and ORAM assessment data collected in this critical area by Bluestone Heights and CRWP in 2017. ........................................................................................................................................ 76

Table 15. Ohio EPA monitoring data for two monitoring locations on Lake Erie slightly outside of the HUC12. (Data source: “Euclid Area Fish Metrics” Spreadsheet, Ohio EPA). ........................................................................................................................................ 84
Acknowledgements

This Nonpoint Source Implementation Strategy (NPS-IS) was developed by:

Chagrin River Watershed Partners, Inc.
P.O. Box 229
Willoughby, Ohio 44096-0229
440-975-3870
www.crwp.org

Bluestone Heights
Shore Cultural Centre
Euclid, Ohio
216-280-7506
bluestoneheights.org

Chagrin River Watershed Partners (CRWP) and Bluestone Heights collaborated on the development of this NPS-IS through both organizations’ participation in the Central Lake Erie Basin Collaborative (Collaborative). The Collaborative is a network of organizations and initiatives that work collaboratively to protect and restore natural areas and promote stormwater solutions for a healthy Lake Erie and local streams. More information about the Collaborative and participating organizations can be found at centrallakeerie.org. Other participating Collaborative organizations providing information, review, and other support for this plan include West Creek Conservancy, Lake County Soil and Water Conservation District, and Friends of Euclid Creek (Cuyahoga County Soil and Water Conservation District).

The development of this plan is supported through an Ohio Department of Natural Resources Office of Coastal Management Coastal Management Assistance Grant. The Northeast Ohio Regional Sewer District (NEORSD) has also provided support for data collection and plan development through Watershed Partner Service Agreements (WPSA) to Bluestone Heights and Chagrin River Watershed Partners in 2017 and 2018 and a Service Agreement to the Collaborative in 2018. Data collection in 2017 and 2018 was also supported through a grant from the Ohio Environmental Protection Agency and the United States Environmental Protection Agency, under the provisions of Section 319(h) of the Clean Water Act, and with generous funding support from the George Gund Foundation.
Chapter 1: Introduction

1.1 Report Background

Nonpoint Source Implementation Strategy (NPS-IS) plans meet U.S. Environmental Protection Agency (USEPA) nine minimum elements for impaired waters to maintain eligibility for state and federal sources of funding. This NPS-IS addresses the City of Euclid-Frontal Lake Erie HUC-12 (041100030502) watershed assessment unit, herein known as ‘City of Euclid-Frontal Lake Erie,’ ‘Euclid-FLE,’ ‘the assessment unit’ or ‘the unit.’ The Euclid-FLE plan is the first to improve and protect the small watersheds and Lake Erie shoreline between Euclid Creek and the Chagrin River. Euclid-FLE covers 21 square miles in eastern Cuyahoga and western Lake Counties, including portions of Cleveland, Eastlake, Euclid, Lakeline, Richmond Heights, Timberlake, Wickliffe, Willoughby, Willoughby Hills, and Willowick.* The Euclid-FLE plan will guide stakeholders to address non-point source pollution issues and aquatic life use impairment using the best available science. The more common restorative project types advocated herein include streambank and wetland restoration, green infrastructure, and stormwater management. Future versions of this plan will integrate updates on water quality and habitat impairments based on improved watershed management and additional monitoring data.

Existing monitoring and planning data for the assessment unit is limited. There are no Ohio Environmental Protection Agency (EPA) monitoring locations located within the unit and there is no Total Maximum Daily Load (TMDL) report available for the Lake Erie Central Basin Tributaries study area (including Euclid-FLE). In 2016, Bluestone Heights began conducting stream and wetland habitat assessments within Euclid-FLE. The Chagrin River Watershed Balanced Growth Plan (2009) identifies Priority Conservation Areas and Priority Development Areas and has been endorsed by the following communities within the unit: Eastlake, Wickliffe, Willoughby, and Willoughby Hills.

Portions of the assessment unit have received support from watershed organizations or volunteer-based initiatives such as Bluestone Heights and CRWP. Other areas within the unit have been supported in this manner only recently through the Central Lake Erie Basin Collaborative. To address unit impairments, Bluestone Heights and CRWP have worked with local communities, local and state agencies, and other conservation organizations.

Bluestone Heights was founded in 2009 to advocate for small watersheds and landforms in the Cleveland area. Bluestone brings long-term geo-science perspectives and a sense of place to urban environmental issues. Bluestone Heights began with on-site environmental education and stewardship advocacy. Ecological research and environmental assessments have since been added. Bluestone Heights works to illuminate buried natural features and regenerate local ecological functions.

Chagrin River Watershed Partners is a nonprofit organization that uses a regional watershed approach to enhance quality of life by preserving rivers, planning for better development and solving natural resource management problems. Sixteen communities, counties and park districts formed the Watershed Partners in 1996 to address rising infrastructure costs because of flooding, erosion and water pollution. Today, the Partners’ 34 members represent 91% of the land area in the watershed. CRWP member services extend to areas outside the Chagrin River Watershed within its member community boundaries. CRWP members located in this watershed include Eastlake, Lake County, Lake Metroparks, Wickliffe, Willoughby, and Willoughby Hills.
*The City of Euclid-Frontal Lake Erie assessment unit includes two separate sections located to the west and east of the Chagrin River Watershed. The eastern section has already been addressed in the Marsh Creek-Frontal Lake Erie NPS-IS endorsed by the Ohio EPA and U.S. EPA in 2017. The current address only the western section (per written guidance received by CRWP from Ohio EPA on October 12, 2018).

1.2 City of Euclid-Frontal Lake Erie Watershed Assessment Unit Profile & History

City of Euclid-Frontal Lake Erie Watershed Assessment Unit Profile

![City of Euclid-Frontal Lake Erie Watershed Assessment Unit Profile](image)

*Figure 1. Location of the City of Euclid-Frontal Lake Erie watershed assessment unit on the Portage Escarpment in Northeast Ohio.*
Figure 2. Municipalities within the City of Euclid-Frontal Lake Erie watershed assessment unit.
The City of Euclid-Frontal Lake Erie watershed assessment unit (HUC-12 041100030502) covers approximately 21 square miles between the Euclid Creek and Chagrin River watersheds. Euclid-FLE straddles the Cuyahoga County-Lake County border along the Lake Erie shoreline with nearly equal surface area in each. The unit encompasses all or parts of ten municipalities: Cleveland, Eastlake, Euclid, Lakeline, Richmond Heights, Timberlake, Wickliffe, Willoughby, Willoughby Hills and Willowick (Figure 1 and 2).

Most of the unit lies within the Lake Plain physiographic region. The southern headwater areas fall upon the Portage Escarpment and end moraine belt that separates the Lake Plain and Allegheny Plateau physiographic zones. The Lake Plain is characterized by glacial sediment overlaying Devonian shale, ranging from fine sand, silt and clay. The Lake Plain is relatively flat and is poorly drained in most places. Elevation ranges from 850 feet above sea level in the south to 580 feet along the Lake Erie shoreline, a change of nearly 300 feet (Figure 7).

Figure 3. Interstate, U.S, and State routes within the City of Euclid-Frontal Lake Erie assessment unit.

The City of Euclid-Frontal Lake Erie - Frontal Lake Erie assessment unit.
Stormwater Utilities

Portions of Euclid-FLE are served by the Lake County Stormwater Management Department, including the following member communities: Eastlake, Lakeline, Timberlake, Willoughby, Willoughby Hills, and Willowick. Member communities can use the services of the Department for implementation of their Phase II stormwater management programs and obtain funding assistance to maintain and upgrade the community’s storm sewer infrastructure.

The City of Euclid, in addition to portions of Richmond Heights, Wickliffe, Willowick, and Willoughby Hills, is served by the Euclid Sewer District. The Ohio EPA issued a consent decree to the City in 2010 mandating improvements to the City’s wastewater treatment plant and sewer system to remedy combined sewer overflows. Improvements include the construction of underground storage tanks to hold combined sewer overflow during heavy rains.

A small portion of the unit lies in the City of Cleveland is included in the Northeast Ohio Regional Sewer District’s (NEORSD) Storm Water Service Area (Figure 4). NEORSD communities receive benefits and resources provided by the Regional Stormwater Management Program. These include maintenance to the Regional Stormwater System, participation in a community cost-share program for stormwater management projects, ability to apply for green infrastructure grant funds, and fee credit incentives for residential and commercial property owners (NEORSD 2017).

Figure 4. Northeast Ohio Regional Sewer District Storm Water Service Area indicated in orange.
At the dawn of Euro-American settlement, the Lake Erie shoreline held ten small lake-direct watersheds: Gawne Run (160 acres), Frissell Run (480 acres), Lilly Creek (1,820 acres), Babbitt Run (1,770 acres), Creek Five (370 acres), Burk Run (1,580 acres), Salt Run (1,450 acres) Gilchrist Run (250 acres), Burnt House Brook (2,660 acres) and Jennison Ditch (460 acres). Most of the historical courses no longer exist as open streams. The natural flows have been either culverted or taken into municipal storm sewer systems. Nevertheless, numerous ghost features remain and the current storm sewersheds reflect the original watershed boundaries and drainage to Lake Erie. As much as is possible, the Euclid-FLE NPS-IS focuses upon the legacy stream courses as they traverse four critical areas of watershed impairment.

The base of the Portage Escarpment is a natural corridor for long distance movement along Lake Erie’s south shore. Final Pleistocene glacial retreat moraines and early Holocene beach ridges lie against the escarpment base and along the lake plain. These present as semi-continuous ribbons of high, well-drained surface. Paleontological and archaeological evidence indicates that prehistoric large mammals and Native Americans traversed these features during longer and shorter movements along the escarpment base. Yet millennia of prehistoric movement changed the channels and surrounding watershed features but slightly. During the last two centuries, Euro-Americans have greatly transformed the escarpment and marginal lands. In result, watershed vegetation, soils and even stream courses are greatly modified. Many open streams and other watershed features have been lost. The evolution of transportation technology indicates the basic sequence of long-term landscape change. Two centuries of landscape change can be summarized in five stages of transportation technology.
1) Walking and Riding (1796-1850). In settling the Portage Escarpment along the south shore of Lake Erie, Euro-Americans appropriated prehistoric trails along glacial ridges and stream channels. Westbound settlers often arrived along the Buffalo Road (current Euclid Avenue), the main trail from New England and New York State. East of Cleveland, the avenue followed the base of the Portage Escarpment and so traversed all watershed streams; small transport-dependent settlements grew at the crossings. For example, in 1797, Joseph Burk built an inn where the road crossed the mouth of the watershed’s largest escarpment ravine (Burk Run). During the 1830s, the Lloyd family established an inn where the Buffalo Road crossed Salt Run. During the late nineteenth century, the Buffalo Road became one of the country’s earliest National Roads (US-20, Boston to Seattle). While now long buried, the old fords continue to anchor the more densely occupied areas of the watershed. In 1798, the Connecticut Land Co. contracted for a new road to trend due eastward from the Burk ravine at Euclid Avenue to the Pennsylvania line. The western end of this Girdled Road, now Ridge Rd (OH-84) in Wickliffe, was laid primarily along the crest of the Painesville Moraine at the watershed’s south border.*

2) Steam Railroads (1850-1900): In 1852, the country’s first transcontinental railroad (currently CSX) opened along the base of the escarpment, giving rise to a century of industrial growth. Brick-making was a primary industry after the Civil War. Brickyards appeared close to the railroad where it crossed Burk, Gilchrist and Burnt House. At each place, brick clay was quarried in ravine walls which eventually created large pits. Nearly a century after brick-making ceased, the clay pits are still major watershed features. In addition, passenger stations were established where the line crossed Babbitt Run (Noble, in Euclid) and Salt Run (Wickliffe). As settlement expanded around the stations, segments of these streams were culverted. In 1881, a second transcontinental rail line (NKP) opened and an industrial corridor emerged between the lines. Stream burial accelerated. Between 1865 and 1910, grape-growing was the watershed’s major agricultural endeavor. Both railroads had siding facilities at Noble and Wickliffe dedicated to the export of table grapes.

3) Electric Railroads (1895-1925) During the 1890s and 1900s, electric power came to transportation, workplace, and home; economic activity accelerated greatly. Rapid settlement came to the watershed during the late 1890s as the Cleveland Painesville and Eastern Railroad laid two electric interurban rail lines across the lake plain. One ran along the shoreline (Lake Shore Boulevard and Vine Street), the other along Euclid Avenue. As settlements grew along these lines, agriculture diminished. Electrification attracted several Cleveland industrialists to establish summer estates on the elevated areas of the Euclid and Painesville Moraines. Burk Run, which had a deep escarpment ravine and numerous headwaters in the Painesville unit, saw the rise and fall of two large estates. On the west side of the ravine, in Euclid, steelman Joseph Outhwaite built ‘Hillendale.’ On the east side, in Wickliffe, financier Charles Deveraux assembled ‘Nutwood.’ Presently, these properties hold Hillendale Park in Euclid, and Borromeo Seminary and Telshe Yeshiva in Wickliffe. These areas retain open stream courses.

4) Early Automobiles (1910-1960): By the 1910s, many Clevelanders were self-propelled in personal automobiles. To facilitate the new movement, a local network of national, state and county roads was quickly established. It was at this time that Ridge Road (OH-84) became an important East-West thoroughfare south of Euclid Avenue. Rebuilding the road for motorized traffic may have included damming the Pete’s Pond north outfall, thereby removing it from the watershed.* Farther west on Ridge Road, in 1916, shipping magnate Harry Coulby created a 55-acre holding on a Burk headwater. The estate house now serves as Wickliffe City Hall and the grounds constitute Coulby Park. Farther east, in 1931, Pine Ridge Country Club opened on the moraine, with its front nine holes north of Ridge Road in Burnt House Brook headwater ravines; its back nine holes south of Ridge Road in the Gully Brook Watershed. Later, several Burnt House Brook channels were damned to create water obstacles.
5) **Interstate Highways** (1960-2010): By the 1960s, the regional manufacturing economy was in decline. Within the watershed, the Interstate Highway System initially disguised the downward economic trend by redistributing wealth in new places and ways. The new highways, Lakeland Freeway (I-90 and OH-2) and the Euclid Spur (connecting I-90 with I-271), effectively leapfrogged local commerce beyond the watershed to points east and south as the exurbs grew. The Interstate system introduced culverting as an efficient way to bridge small streams. No Interstate-related bridges were built within the watershed. The Euclid Spur represents the most significant interstate-era landscape transformation. This feature appropriated Burk Run as the ramp with which to traverse the escarpment. Burk’s mainstem escarpment ravine was entirely filled with six to eight highway lanes and associated ramps and cloverleafs. As a result, the Burk main stem was culverted for nearly a mile in two segments. Other Interstate-related Burk transformations were just as severe. Below the escarpment, a 1400-ft lake plain ravine segment was widened into a 12-acre borrow pit, now phragmites-dominated wetland. Just below, a 1000-ft segment has been dammed to create an 8-acre inundated wetland.

*Euclid-FLE’s south border has a northerly indentation of interest. The segment bends north to skirt the north end of Pete’s Pond, a major, underfit erosional channel (likely a final Pleistocene glacial outwash feature) within the Painesville Moraine. The channel wholly bisects the moraine and, currently, drains southward to Gully Brook, a Chagrin River tributary. Nevertheless, the local topography suggests that the feature was eroded in a northward direction as part of Euclid-FLE. If so, it has is not determined if this change is natural or anthropogenic.

If human-induced, the change may have originated with the platting of the Girdled Road in 1798. Heading southwest from the Chagrin River, the Girdled Road appropriated the crest of the Painesville Moraine until crossing the SOM-Center Rd meridian, where, turning due west, it descends to the moraine's north edge. The directional change circumvented the channel's northern outfall. As a horse and wagon trail, the Girdled Road would have crossed the outfall as a ford. With transformation to motorized highway (OH-84) in the 1910s, damming the outfall may have been easier than bridging it. The outfall thus would have been shifted to the south opening at Gully Brook, essentially at the same elevation. Until this time, the pond (naturally a peat bog) may have had two outfalls, which state road engineers would have considered superfluous. Evidence for a ghost outfall channel can be seen in the topography immediately north of Ridge Rd, but it trails off within several hundred yards. There is no clear means to tie this channel definitively with either Salt or Gilchrist mainstems.
1.3 Public Participation and Involvement

In preparing this NPS-IS, Bluestone Heights and CRWP received input from a variety of community stakeholders, organizations, professional peers, and the public. Professional peers included staff of Cuyahoga Soil and Water Conservation District (SWCD) and Lake SWCD, in addition to other organizations participating in the Central Lake Erie Basin Collaborative, a regional network of organizations and initiatives that work collaboratively to protect and restore natural areas and promote stormwater solutions for healthy streams and Lake Erie. On November 28, 2018, Bluestone Heights and CRWP hosted a public input meeting at the Lake Metroparks’ Lakefront Lodge in Willowick (Figure 5). Twelve local residents and community representatives of Euclid, Eastlake, Richmond Heights, and Cleveland provided valuable input at this meeting to inform critical areas, needs and potential projects within the assessment unit (Figure 6). Two online surveys were also conducted by CRWP and Bluestone Heights to solicit additional input: a unit-wide survey and a City of Euclid-specific survey. Feedback gathered through these input-gathering efforts is summarized in Section 2.4.1 of this NPS-IS.
In 2017, Bluestone Heights hosted a Ravine Workshop within the assessment unit. Using a format from the Alliance for the Great Lakes, the workshop collected feedback from the 28 participants identifying assets, acknowledging issues, and brainstorming ideas for ways to protect and enhance their neighborhood ravines. Although some attendees resided outside of the Euclid-FLE assessment unit, their feedback is relevant to local landscape features and challenges and will help inform watershed protection efforts in greater Cleveland.

CRWP and Bluestone Heights will continue to update this document as further information is gathered from stakeholders and milestones are reached in the implementation of this plan.
Figure 8. Stakeholders discuss challenges and opportunities at the City of Euclid-Frontal Lake Erie public open house, November 28, 2018.
Chapter 2: Characterization and Assessment Summary

2.1 Character of the City of Euclid-Frontal Lake Erie assessment unit

2.1.1 Physical and Natural Features

Basic Geology

Between Euclid Creek and the Chagrin River, Euclid-FLE lies on the lower levels of the Portage Escarpment, the northwest-facing bedrock slope that joins North America’s Appalachian Highland with the Central Lowland (Brockman 1998). Here, streams fall ~300 ft through the bedrock sequence which holds Devonian-era sea bottom shale and siltstone (Figure 5). West of Burk Run, the very resistant Euclid bluestone (Bedford Fm informal unit) caps less resistant shale units (Cleveland and Chagrin members of the Ohio Shale). South of the assessment unit, later Devonian and Carboniferous rocks (Berea and Sharon units, respectively) cap the escarpment’s upper levels.

![Bedrock profile](image)

*Figure 9: Bedrock profile (facing southeast), Chagrin to Cuyahoga Rivers, with Euclid-FLE (red outline) and neighboring streams.*

After ~200 million years (2 Ma), the Paleozoic sea bottom units were uplifted to present elevation and subaerial erosion began to shape the landscape. About 2 Ma, Pleistocene glaciers began advancing southward across the escarpment with the general effect of filling valleys and sculpting summits. As the bluestone cap resisted glacial bulldozing, headwater sources are higher west of Burk Run and their escarpment courses are steeper.

From 16 thousand years (16 ka) to 12 ka, with the retreat of the final Wisconsinan ice sheet, several mantles of unconsolidated clastic materials were deposited on top of the bedrock substrate. As part of this complex, the Euclid and Painesville Moraines from prominent ridges on the lower escarpment. They constitute two segments of the assessment unit’s southern margin, with Euclid Creek and Gully Brook, respectively. Holocene beach ridges
appear at the escarpment base (Euclid Avenue) and on the lake plain (Lakeland Freeway). Smaller, unnamed beach ridges cover much of the lake plain.

Figure 10: Facing west at E 222nd St in Euclid: bedrock and moraine profile.

Figure 11: Euclid-Frontal Lake Erie surficial geology and hydrological zones.
Hydrology Zones

Within Euclid-FLE, the bedrock escarpment and glacial moraines give structure to the three hydrology zones. Each has a characteristic landform which has been subject to nonpoint source pollution impairment and which therefore is significant in defining the assessment unit’s critical areas.

**escarpment:** At Euclid-FLE’s headwater (southern) border, the Portage Escarpment presents substrates of Pleistocene retreat moraine (clay, silt and sand) and underlying Devonian sedimentary bedrock (shale and sandstone). In Cuyahoga County, the Euclid Moraine and Bedford Formation bedrocks are the headwater substrates for Lilly Creek and Babbitt Run. In Lake County, the Painesville Moraine and Ohio Formation bedrocks support the headwaters of Burk Run east to Burnt House Brook. Across its southern border, Euclid-FLE’s escarpment ravines (Critical Area 1) appear where headwater streams have incised through the substrates. North of Euclid Avenue, most of the escarpment ravine watercourses are integrated into municipal storm sewer systems. A few streams retain continuous culverted flow from the escarpment to Lake Erie.

**terraces:** Heading northward from escarpment base, Euclid-FLE presents three descending wave-cut terraces. These appeared as prehistoric Lake Erie descended in stages across a very shallow slope. At each short-lived stage, surface waves had enough time and energy to create a wave-cut bench or terrace. The highest terrace is the northern wave-cut portion of the Painesville Moraine (~720-700 ft above sea level) which lies south of Euclid Avenue in Lake County. The middle, 'St Clair terrace' (~670-650 ft above sea level) lies between Euclid Avenue and the Lakeland Freeway along the full width of the watershed. The lowest 'lake plain' terrace (~630-600 ft above sea level) lies between the Lakeland Freeway and the current shoreline. It also traverses the assessment unit’s whole width. While each terrace descends about 20 feet, they all appear to be flat and featureless at the human scale.

In prehistoric times, the headwater ravines coalesced upon the St Clair and lake plain terraces but remained shallow and sometimes ill-defined. During the last century, nearly all terrace ravines have been filled in with stream flows taken into the street-based storm sewer systems. The ephemeral nature of the prehistoric terrace courses suggests that they shifted laterally upon occasion. Some mainstems may have captured headwaters of neighboring streams. Some open watercourse segments remain on Euclid’s St Clair terrace Industrial Corridor (Lilly Creek, Babbitt Run and Burk Run). Salt Run retains an open watercourse through an older residential neighborhood just east of Lloyd Road. Otherwise, a few ghost segments remain in park settings and residential neighborhoods.

In Euclid, the terraces hold more than a score of water features. About a dozen show wetland development. The three largest are anthropogenic features in the Burk Run subwatershed and are assessed as part of Critical Area 3 (Cuy-La Escarpment Ravines and Terrace Wetlands). The remainder of the significant wetlands define Critical Area 2 (Escarpment and Terrace Wetlands in the City of Euclid).

**shoreline:** Lake Erie’s changing surface levels have had significant effect on shoreline erosion and associated ravine-cutting. The shallow, straight ravines of the terraces become deeper and more complex near the Ashtabula terrace bluff. Collectively, the shoreline ravines form a small area within Euclid-FLE but constitute a special hydrology zone. Most have significant entrenched meanders, floodplains and, when open, shoreline barrier bars. Several function as storm estuaries (lacustuaries), as temporarily raised lake levels can significantly inundate the ravines. The zone is delimited by the course of Lake Shore Boulevard which skirts the heads of the deepening ravines. The shoreline ravines are primary features within the assessment unit’s Critical Area 4 (Coastal Zone).
historical times, much of the shoreline has suffered from severe frontal erosion. The exception is the area in the lee of Moss Point within Euclid. Here, natural beach development protected the bluff area in historical times. Nevertheless, this beach disappeared during a precipitous lake level rise in the late 1960s. With the windward shoreline not fully armored, no replenishing sand has been available. The Moss Point lee now erodes in tandem with the rest of the shoreline. The eroding bluff is also an important feature of Critical Area 4.

Sub-watersheds

From west to east, Euclid-FLE holds nine natural subunits. Most of the individual stream courses arise on the escarpment moraines and descend in deeply incised escarpment ravines. The ravine courses tend to converge on the wave-cut terraces, and the terrace ravines are insubstantial features. There is some evidence to suggest that terrace courses shifted across the landscape over the millennia and were subject to capturing. On some streams the final convergence lies in a shoreline ravine. As a result, Euclid-FLE exhibits recurring zone-specific subaerial features. The nine sub-watersheds are, essentially, variations on a common pattern of zone-based geo-hydrology. East of the county line, the streams approach the lake in west flowing courses rather than north flowing courses. The subunits are as follows:

Gawne Run (160 a, 0.25 sq mi) lies wholly within the City of Cleveland. Dorchester exists as a ghost shoreline ravine and little else. The lake plain ravine was shallow enough that, during early years of the twentieth century, Gardner Rd/E 185th Street residential development filled in the feature without trace. Topographic data is not sensitive enough to tie the shoreline ravine with any escarpment ravine(s). Natural flow above Lake Shore Boulevard has been integrated into the street grid storm sewer system. The Dorchester shoreline ravine holds the common grounds of the East Shore Park Club homeowner’s association.

Frissell Run (480 acres, 0.75 sq mi) covers parts of Cleveland and Euclid. Frissell Run exists as a ghost shoreline ravine and little else. The lake plain ravine was shallow enough that, during early years of the twentieth century, Cut Rd/E 200th Street residential development filled in the feature without trace. Topographic data is not sensitive enough to tie the shoreline ravine with any escarpment ravine(s). All natural flow above Lake Shore Boulevard has been integrated into the street grid storm sewer system. The Frissell Run shoreline ravine holds the grounds of Euclid Hospital.

Lilly Creek (1,820 acres, 2.85 sq mi) flows wholly within the City of Euclid. Lilly Creek has several small escarpment ravines each having formed a separate branch in the past. A couple headwaters are open as ditches north of Euclid Avenue. The mainstem coalesces north of the Lakeland Freeway. The culvert flows through a residential neighborhood to cross Lake Shore Boulevard near E. 200th St. Lilly Creek has the widest shoreline ravine, with evidence for several entrenched meanders. The Lake Erie outfall is now culverted between two large jetties.
Figure 12. The Lilly Creek outfall to Lake Erie is culverted between two large jetties. Photo date: December 4, 2017.

*Babbitt Run* (1,770 acres, 2.77 sq mi) has two significant headwaters reaching into southern Richmond Heights. On the escarpment, Richmond and Brush Roads lie in the Babbitt Run east escarpment ravine. The City of Euclid maintains a large retention basin in the west escarpment ravine. The terrace ravines were insubstantial and have been filled in without trace. Very early in the nineteenth century, Babbitt Road was platted just west of the mainstem. This way may have derived from a prehistoric Native American trail. Babbitt Run’s large shoreline ravine, at Noble Beach Drive in Euclid, is now abandoned as the flow now passes through the Euclid wastewater treatment plant.
Creek Five (366 acres, 0.57 sq mi) has a short, poorly-defined course across the lake plain and a well-developed shoreline ravine, now mostly filled in. Creek Five cannot be attached to an escarpment ravine. Its headwaters may have been captured by either Babbitt Run or Burk Run in prehistoric times. The upper reach of the shoreline ravine was culverted during the 1930s. The lower reach maintained an open channel (through current Sims Park) until 1967 when the stream was truncated for building the Moss Point Interceptor Sewer. The current culverted outfall lies immediately east of the Sims Park fishing pier. Just to the west in Sims Park, a small shoreline ravine has, apparently, a small culverted stream under its raised bottom. An unidentifiable outfall issues flow even in the driest conditions. Bioretention projects in both shoreline ravines may be developed as part of the current Euclid Waterfront Improvement Project.

Burk Run (1,580 acres, 2.47 sq mi) is among the largest streams in the watershed and coalesces from several headwaters in the Painesville Moraine. In plan view, the headwaters converge from either side of a small basin in the moraine in a bilaterally symmetrical manner. From this substantial headwater drainage area, the mainstem cut a substantial ravine across the St Clair terrace, but shallower channel(s) across the lake plain. Burk Run’s historical shoreline ravine is among the least significant in the assessment unit. At some point, the lake plain stream segment may have shifted eastward to cut a new ravine. By chance, during the summer of 1796, the border between Euclid and Chagrin Townships (current Cuyahoga and Lake Counties) was laid to nearly bisect the headwater area. In 1962, construction of the Euclid Spur (I-90) culverted the mainstem and filled in its escarpment ravine. The remaining mainstem now flows through a 12-acre borrow pit.
Salt Run (1,450 acres, 2.98 sq. mi, 1.23)* Straddling the Cuyahoga-Lake County line in the north part of the watershed, Salt Run has two branches converging in an expansive shoreline ravine. Historically, this ravine held a salt seep frequented by large mammals and Native American human predators. It is the only watershed shoreline area to have yielded numerous prehistoric projectile points (Archaic through Woodland periods). Lloyd Road thus originated as a Native American trail linking the seep with the Buffalo Road along the west branch. Early Euro-American settlers also exploited the natural brine. The east branch is entirely culverted and cannot be tied definitively to an escarpment ravine. Warden Rd/E. 288th Street was laid along its lower course from St Clair Road to Lake Shore Boulevard. The west branch arises on the Painesville Moraine south of Ridge Road at Lloyd/Lincoln Roads. The west branch retains some open channel east of Lloyd Road.
Gilchrist Run (250 acres, 0.39 sq. mi, 1.70 mi*), in two branches, trends northwest through westernmost Lake County. The west branch is insubstantial and has little landscape presence. The east branch set the course for E. 305th Street between St Clair and Lake Shore Boulevard. The two branches converge above Lake Shore Boulevard. Gilchrist Run enters Lake Erie within a significant shoreline ravine just west of the Euclid line.

Burnt House Brook (266 acres, 4.15 sq. mi, 3.69 mi*) is the largest subunit in terms of acres drained and length of the original stream courses. At least two upper branches drained two or three escarpment ravines. A ravined open course remains in Willoughby, south of Euclid Avenue. It has been narrowed by apartments to the west and, on the east and south, by healthcare establishments dependent upon the Lake Health West Medical Center complex. Several segments of Burnt House Brook have been culverted across the lake plain, including at Dudley Park in Eastlake. The shoreline ravine is one of the longest and deepest but has recently been shortened, filled in and armored for residential development. The stream, with its distinctive name, is mentioned in a report of, at the time, the worst Great Lakes shipping loss of life. On June 17, 1850, the Steamer G.P. Griffith sank with the loss of 297 passengers and crew “off of the mouth of Burnt House Brook” (The Herald June 19, 1850).

Jennison Ditch (360 acres, 0.72 sq. mi, 1.42 mi*) is the watershed stream closest to the Chagrin River. Its due westward course arises on the lake plain; its natural flow has mostly been drawn into the street storm sewer grid. Lake County hydrology data shows an open course running on the north side of Jakse Park, but only a grassy swale exists in the area. A small but mostly filled in shoreline ravine remains west of Lakeshore Boulevard at E. 322nd Street in Eastlake.
Figure 16: Tributary to Burk Run at Telshe Yeshiva. Photo date: December 5, 2018.

Figure 17: Mouth of Burnt House Brook on Lake Erie in Willowick, Ohio. Photo date: December 5, 2018.
Figure 18: Euclid-Frontal Lake Erie natural sub-drainages.

Figure 19. Euclid-FLE sub-watersheds in Cuyahoga County: natural units (left) and current sewersheds (right).
Prehistoric and Current Stream Channels:

For the assessment unit’s known streams, nearly 50 miles of prehistoric channels can be identified. Approximately 45 miles of the system has been lost to culverting and abandonment (Figure 20 and Error! Reference source not found.). Several small, unnamed streams cannot be accounted for in this analysis. Could they be included, Euclid-FLE would show more than 60 miles of prehistoric stream courses.

Culverting on the lake plain began during the 1890s to create commercial and industrial real estate. During the early twentieth century, suburban land development accelerated. On the lake plain, all mainstem channels were culverted except for a segment of Burnt House Brook. Throughout the assessment unit, the early twentieth century residential street storm sewer grid was engineered to capture many natural flows. Between culverting and abandonment, nearly 90 percent of the prehistoric channel mileage has been eliminated.

Figure 20: City of Euclid-Frontal Lake Erie: open water bodies (blue)¹

¹ Blue=open (~23 mi); brown=culverted (~46 mi); green=abandoned (~18 mi)
Figure 21. Euclid-Frontal Lake Erie had 53 miles of historical stream courses.

Figure 22. Euclid-Frontal Lake Erie: current open courses (light blue) and culverted segments.
Soils

The presentation and use of soils data are complicated by the placement of the Cuyahoga-Lake county line, a survey demarcation of the Western Reserve survey of 1796. Natural drainage patterns vary, by chance, west and east of the line. The distinctions relate to the presence of the Euclid bluestone terrace in Cuyahoga County and to the broader reach of the lake plain in Lake County. West of the line, streams descend a bedrock escarpment to approach Lake Erie directly on NNW-trending (perpendicular) courses. East of the line, on a broader lake plain, they approach obliquely on westerly courses (Figures 3, 6 & 13).

Given the bimodal geological and hydrological contexts, some east-west variation in soil development could be expected. Nevertheless, recognizing such distinctions is complicated by the fact that different agencies have collected soils data on different sides of the line. Herein, the Soil Survey of Cuyahoga County, Ohio and the Soil Survey of Lake County, Ohio are used to illustrate soil types (Figure 16). The USDA Natural Resources Conservation Service Web Soil Survey is used to provide soil drainage capacity (Figure 17). The observational discrepancies among the three are significant.

Of many soil variables, drainage capacity is the important factor for siting Best Management Practices (BMPs). Infiltration facilities, such as rain gardens and pervious pavers, require better drained surfaces. Alternatively, wetlands and on-site storage BMPs can utilize poorly drained soils. Poorly drained soils can be amended to enhance infiltration potential, but the added costs can be significant.

Much of the assessment unit is relatively level and is covered by fine glacial retreat detritus in the form of retreat moraines and ground tills (Figure 6). As clay dominates the substrate, derived soils are generally moist and impermeable. Approximately 12,000 acres are covered by such poorly drained soils (Fig 17, Table 1).

A small area (~700 acres) has better-drained soils of two kinds (Figure 17, Table 1). One derives from fossil beach ridges which appear as narrow ribbons of slightly elevated sandy substrate. While small in aerial extent, beach ridge soils are generally amenable to infiltration BMPs. The other kind forms on the north faces of retreat moraines. The moraine faces are better drained primarily in having slopes greater than normal. Nevertheless, sloped surfaces make them generally less amenable to infiltration BMPs.

Running the full width of the assessment unit, the Lake Warren beach ridge (680-700 ft asl), has the longest and widest continuous strand of sandy soils. Also running the full width of the unit, the north face of the Painesville Moraine holds the greatest amount of sloped land with better-drained clay-dominated soils.

In Cuyahoga County, the Warren ridge lies adjacent to the base of the Painesville Moraine. Better-drained soils are found across the width of both strands. In Lake County, the Painesville Moraine has two north-facing components: along wave-cut and uncut faces. Each has a set of north-facing better-drained soils. Ridge Road (OH-84) lies on the uncut Painesville north face. Euclid Ave (US-20) sits atop the wave-cut north face which also holds Lake Warren beach ridge soils.

The Watershed also holds ~750 acres of udorthent soils put in place with the Lakeland Freeway and Euclid Spur during the early 1960s (Figure 16, Table 1). Local udorthents have high clay content and support turf coverings. The highway application frequently involves slopes in the moderate to severe range, which can render them moderately well drained. However, slope and highway location (danger zones) limits their potential for infiltrating stormwater.

As sorted by drainage class, assessment unit soils tend to crosscut hydrology zones. All three zones are dominated by poorly drained soils. The escarpment zone holds most of the better drained north-facing Painesville Moraine
slopes and the Lake Warren beach ridge in Cuyahoga County. In Lake County, the terraces zone holds the Painesville Moraine wave-cut north slope and the Lake Warren beach ridge. This zone also holds the Lakeland Freeway udorthents. The shoreline zone has poorly drained soils except for ravine mouth beaches and windward jetty beaches. These total fewer than 30 acres.

Figure 23. Euclid-Frontal Lake Erie: soil types and acreages.
Figure 24. Euclid-Frontal Lake Erie: soil drainage class types (Data source: U.S. Department of Agriculture Web Soil Survey).
Table 1. Euclid-FLE soil types, summarized by soil drainage class (Data source: U.S. Department of Agriculture Web Soil Survey).

<table>
<thead>
<tr>
<th>Poorly Drained Soils</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>Type</td>
<td>Acres</td>
</tr>
<tr>
<td>As</td>
<td>Allis silt-loam</td>
<td>2,872</td>
</tr>
<tr>
<td>At</td>
<td>Allis-urban</td>
<td>642</td>
</tr>
<tr>
<td>CtA</td>
<td>Conneaut silt-loam</td>
<td>2,614</td>
</tr>
<tr>
<td>CtB</td>
<td>Conneaut s-l sloped</td>
<td>197</td>
</tr>
<tr>
<td>HrB</td>
<td>Hornell s-l 2-6%</td>
<td>46</td>
</tr>
<tr>
<td>HrC</td>
<td>Hornell s-l 6-12%</td>
<td>53</td>
</tr>
<tr>
<td>HsC</td>
<td>Hornell-urban</td>
<td>400</td>
</tr>
<tr>
<td>MgB</td>
<td>Mahoning silt-loam</td>
<td>423</td>
</tr>
<tr>
<td>Ub</td>
<td>Urban land</td>
<td>1,031</td>
</tr>
<tr>
<td>Uc</td>
<td>Urban-Allis</td>
<td>1,482</td>
</tr>
<tr>
<td>UeA</td>
<td>Urban-Elnora</td>
<td>2,047</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>~12,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Better Drained Soils</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>Type</td>
<td>Acres</td>
</tr>
<tr>
<td>BrF</td>
<td>Brecksville silt-loam</td>
<td>180</td>
</tr>
<tr>
<td>CyB</td>
<td>Conotton grav-loam</td>
<td>75</td>
</tr>
<tr>
<td>ElB</td>
<td>Ellsworth s-l 2-6%</td>
<td>38</td>
</tr>
<tr>
<td>ElC</td>
<td>Ellsworth s-l 6-12%</td>
<td>34</td>
</tr>
<tr>
<td>ElD</td>
<td>Ellsworth s-l &gt;12%</td>
<td>53</td>
</tr>
<tr>
<td>EnB</td>
<td>Elnora loam-sand</td>
<td>59</td>
</tr>
<tr>
<td>GoF</td>
<td>Gosport silty-clay</td>
<td>41</td>
</tr>
<tr>
<td>LuC</td>
<td>Loudenville-urban</td>
<td>141</td>
</tr>
<tr>
<td>TyB</td>
<td>Tyner loamy-sand</td>
<td>234</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>~700</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Udorthents</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>Type</td>
<td>Acres</td>
</tr>
<tr>
<td>Ua</td>
<td>Udorthents</td>
<td>270</td>
</tr>
<tr>
<td>UdB</td>
<td>Udor gently-sloped</td>
<td>169</td>
</tr>
<tr>
<td>UdD</td>
<td>U moderately-steep</td>
<td>307</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>~750</td>
</tr>
</tbody>
</table>


**Wetlands**

Euclid-FLE wetlands vary by hydrological zone. On the bluestone terrace, Babbitt Run has one soft-buffered inline pond in South Euclid. In the coastal zone, the engineered mouths of Salt Run and Burnt House Brook could be enhanced to function as estuarine wetlands.

With two centuries of watershed landscape transformation, it is impossible to identify natural or prehistoric wetlands. Most current wetlands are therefore anthropogenic features with either of two origins, neither of which is intentional. One set is the result of a barrier erected within a stream feature (channel, floodplain or small ravine) to create a pond. Wetlands have developed as the pond loses original use or naturally degrades over time and becomes subject to sedimentation. Thus, early settlers dammed small ravines to create ice ponds. With the advent of mechanical refrigeration, ice ponds lost function. Unmaintained, they became shallow with sedimentation. Wetlands are the result (E1, E2). One wetland of this type has developed around a floodplain stormwater detention basin subject to flood sedimentation (E6).

A larger set of characteristic wetlands has developed upstream of culvert inlets as they receive fluvial sediment enough to impede stream flow. Thus, early railroads used bridges to cross Euclid’s small terrace ravines. Later, short culverts replaced the bridges. During a century of less than adequate maintenance, areas upstream of some culverts have been sedimanted enough to raise stream gradient. Such areas now show wetland characteristics (T1, T2, T5, T8, T10, T11). Euclid-FLE has significant wetlands in the escarpment (E1, E2, E6) and terraces (T1, T2, T5, T8, T10, T11) hydrological zones. In result of intensive residential development, the coastal zone has lost all wetlands.
Figure 25. Euclid-FLE wetlands indicated by type (Data source: U.S. Fish and Wildlife Service National Wetlands Inventory).

**Fisheries and Wildlife**

Fish and wildlife densities and diversities largely correlate with the distribution and size of wetlands. The greatest presence lies in the coastal zone, especially near the mouths of Lilly Creek (Arcadia Beach Club), Creek Five (Sims Park), Salt Run (Wickliffe-on-the-Lake Club) and Gilchrist Run (Gilchrist Harbor Club) (Figure 26).
Euclid-FLE lies between two Important Bird Areas (IBAs) designated by Audubon, Ohio: the Cleveland Lakefront IBA (including Sims Park in the City of Euclid) and the Chagrin River Corridor IBA. The assessment unit is also located adjacent to the Lake Erie Central Basin IBA, which includes the open waters of Lake Erie along the unit shoreline. The presence of these IBAs indicate that these areas provide essential habitat to one or more bird species during some portion of the year. In the Cleveland Lakefront IBA, birds are attracted to fish that congregate around mixing waters at stream mouths and power plant outflows. The Lake Erie shoreline in this IBA also provides important resting habitat for birds during migration and in the winter season.² Citizen science surveys at Sims Park in the City of Euclid have included bird observations of Acadian flycatcher (*Empidonax virescens*), an indicator of riparian quality, in addition to observations of the Ohio Listed Species in Table 2 (eBird, 2018; Common Birds of Ohio, Ohio Division of Wildlife, Publication 5414).

² [https://www.audubon.org/important-bird-areas/cleveland-lakefront](https://www.audubon.org/important-bird-areas/cleveland-lakefront)

---

**Table 2. Ohio Listed Species observed during citizen science bird surveys at Sims Park in the City of Euclid (Data sources: eBird, 2018; Ohio Division of Wildlife, Publication 5414).**

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ohio Endangered Species</strong></td>
<td></td>
</tr>
<tr>
<td>American bittern (1987)</td>
<td><em>Botaurus lentiginosus</em></td>
</tr>
<tr>
<td>Northern harrier (2017)</td>
<td><em>Circus cyaneus</em></td>
</tr>
<tr>
<td><strong>Ohio Threatened Species</strong></td>
<td></td>
</tr>
<tr>
<td>Black-crowned night-heron</td>
<td><em>Nycticorax nycticorax</em></td>
</tr>
<tr>
<td><strong>Ohio Species of Concern</strong></td>
<td></td>
</tr>
<tr>
<td>Sharp-shinned hawk</td>
<td><em>Accipiter striatus</em></td>
</tr>
<tr>
<td><strong>Ohio Species of Special Interest</strong></td>
<td></td>
</tr>
<tr>
<td>American black duck</td>
<td><em>Anas rubripes</em></td>
</tr>
<tr>
<td>American coot</td>
<td><em>Fulica Americana</em></td>
</tr>
<tr>
<td>Black-billed cuckoo</td>
<td><em>Coccyzus erythropthalmus</em></td>
</tr>
<tr>
<td>Blackburnian warbler</td>
<td><em>Setophaga fusca</em></td>
</tr>
<tr>
<td>Bobolink</td>
<td><em>Dolichonyx oryzivorus</em></td>
</tr>
</tbody>
</table>
Brown creeper | Certhia Americana
--- | ---
Canada warbler | Wilsonia canadensis
Cerulean warbler | Setophaga cerulea
Common nighthawk | Chordeiles minor
Dark-eyed junco | Junco hyemalis
Eastern whip-poor-will | Caprimulgus vociferus
Gadwall | Anas Strepera
Golden-crowned kinglet | Regulus satrapa
Great egret | Ardea alba
Green-winged teal | Anas crecca
Hermit thrush | Catharus guttatus
Magnolia warbler | Setophaga magnolia
Marsh wren | Cistothorus palustris
Mourning warbler | Oporornis Philadelphia
Nashville warbler | Oreothlypis ruficapilla
Northern pintail | Anas acuta
Northern shoveler | Anas clypeata
Pine siskin | Carduelis pinus
Purple finch | Carpodacus purpureus
Redhead | Aythya Americana
Ruddy duck | Oxyura jamaicensis
Ruffed grouse | Bonasa umbellus
Sedge wren | Cistothorus platensis
Short-eared owl | Asio flammeus
Veery | Catharus fuscescens
Vesper sparrow | Poecetes gramineus
Winter wren | Troglodytes
Yellow-bellied sapsucker | Sphyrapicus varius

**Ohio Extirpated Species**

Golden-winged warbler (1988) | Vermivora chrysoptera

**Rare, Threatened, and Endangered Species**

Due to lack of biological monitoring, it is unknown whether rare, threatened, and endangered aquatic species exist in the assessment unit.

The U.S. Fish and Wildlife Service identifies the following federally listed species whose range covers portions of Cuyahoga County and the assessment unit: peregrine falcon (*Falco peregrinus*), piping plover (*Charadrius melodus*), Indiana Bat (*Myotis sodalis*), northern long-eared bat (*Myotis septentrionalis*), Kirtland’s warbler (*Dendroica kirtlandii*), red knot (*Calidris canutus rufa*), and bald eagle (*Haliaeetus leucocephalus*), protected under the Bald and Golden Eagle Protection Act. There are no known records of these species breeding in the unit, although they may be seasonally present as migrants. The peregrine falcon has been observed at Sims Park through citizen science surveys (eBird, 2018).

**Invasive Nuisance Species**

Due to lack of biological monitoring, it is unknown which invasive aquatic animal species exist in Euclid-FLE. Based on biological monitoring data from adjacent HUC-12 assessment units collected by Ohio EPA and NEORSD, the
presence of the invasive goldfish (*Carassius auratus*) is likely. Other potentially harmful invasive aquatic animal species most likely in the unit include zebra mussels and the rusty crayfish (*Orconectes rusticus*).

Headwater stream and wetland habitat assessments conducted by Bluestone Heights and CRWP in 2017 indicate the presence of several commonly observed invasive plant species, listed in Table 3.

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giant reed</td>
<td><em>Phragmites australis</em></td>
</tr>
<tr>
<td>Narrow-leaf cattail</td>
<td><em>Typha angustifolia</em></td>
</tr>
<tr>
<td>Multiflora rose</td>
<td><em>Rosa multiflora</em></td>
</tr>
<tr>
<td>Japanese barberry</td>
<td><em>Berberis thunbergii</em></td>
</tr>
<tr>
<td>Myrtle</td>
<td><em>Vinca minor</em></td>
</tr>
<tr>
<td>Butterbur</td>
<td><em>Petasites hybridus</em></td>
</tr>
<tr>
<td>Privet</td>
<td><em>Ligustrum sinense</em> or <em>L. vulgare</em></td>
</tr>
<tr>
<td>Canada thistle</td>
<td><em>Cirsium arvense</em></td>
</tr>
<tr>
<td>Common teasel</td>
<td><em>Dipsacus fullonum</em> (<em>sylvestris</em>)</td>
</tr>
<tr>
<td>Queen Anne’s Lace</td>
<td><em>Daucus carota</em></td>
</tr>
<tr>
<td>Crown vetch</td>
<td><em>Coronilla varia</em></td>
</tr>
<tr>
<td>Chickory</td>
<td><em>Cichorium intybus</em></td>
</tr>
</tbody>
</table>

As part of the City of Euclid’s Waterfront Improvements project that will improve public lakefront access and support environmental initiatives, a multi-phased plan has been developed to manage invasive plant species populations (including *Phragmites australis*) and enhance native habitats along the Lake Erie coast in Euclid.

### 2.1.2 Land Use and Protection

Euclid-FLE is highly urbanized, with land use being 97.7 percent developed, 1.5 percent forest, and 0.6 percent grass/pasture (Ohio EPA 2018). Commercial and industrial land uses are concentrated along major east-west thoroughfares (I-90, Euclid Avenue, St Clair Avenue, etc.). The assessment unit has several multi-acre institutional campuses derived from historical estates: Our Lady of Lourdes Shrine, Borromeo Seminary, and Telshe Yeshiva. Some of these institutions may serve as partners in watershed stewardship and outreach. Euclid-FLE also hosts major entities designated as utilities in terms of land use. These include the Euclid municipal wastewater treatment plant.

In Euclid, the St Clair terrace and lake plain hold several wetlands. Beach clubs (shoreline homeowners associations) operate at the historical mouths of Frissell, Lilly, Babbitt, Salt and Gilchrist creeks. Commercial and institutional owners maintain green spaces at the mouths of Creek Five and Burnt House Brook. Lake Metroparks owns and/or manages greenspace areas, including Green Ridge Golf Course, Pine Ridge County Club, and Lakefront Lodge. Municipal parks include Euclid Memorial Park and Sims Park in Euclid, Coulby Park in Wickliffe, and Dudley Park in Willowick. The parks provide opportunity for restoration projects and improved land management practices to provide beneficial impacts on stream and riparian quality. The existence of undeveloped and protected land in both the coastal areas and in the upland ravine stream segments present similar opportunities for possible restoration and improved land management.
Reflecting urban land use, Euclid-FLE is dominated by impervious surface area (Figure 28). Parks and open spaces represent the primary areas of pervious cover. This exemplifies the value of these spaces to the urban neighborhoods surrounding them. It also represents opportunities for green infrastructure projects that reduce impervious surface cover and associated storm water runoff to have a significant impact on stream quality.
Figure 28. Euclid-FLE impervious cover. Cuyahoga County data is provided through 2017 NEORSD impervious area data (City of Euclid omitted as it is not within the NEORSD service area) and Lake County data is provided through a 2004 CRWP impervious cover study.
2.2 Summary of Biological Trends

Ohio EPA adopted biological criteria into the Ohio Water Quality Standards in 1990. An aquatic life use (ALU) designation is assigned to a stream or river based on the potential aquatic potential aquatic biological community that can realistically be sustained given the biological, physical, and chemical attributes of the attributes of the waterway. Specifically, two fish and one macroinvertebrate indices are used to determine if a specific stream segment is reaching aquatic life use designation (IBI, ICI, QHEI). Table 5 lists the biological criteria for applicable aquatic life use (ALU) designations in the Erie-Ontario Lake Plains ecoregion. Since EWH criteria were developed for streams and rivers, Lake Erie Shoreline Targets for L-IBI and MIwb have been developed to evaluate ALU attainment for Lake Erie (Table 6).
Table 4. Ohio EPA monitoring data for two monitoring locations on Lake Erie slightly outside of the HUC12. (Data source: “Euclid Area Fish Metrics” Spreadsheet, Ohio EPA).

<table>
<thead>
<tr>
<th>Station Name</th>
<th>Year Fish Monitored</th>
<th>L-IBI Score</th>
<th>MIWB Score</th>
<th>Aquatic Life Use</th>
<th>Attainment Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAKE ERIE, E OF EUCLID CREEK</td>
<td>2014</td>
<td>38</td>
<td>7.38</td>
<td>EWH</td>
<td>Non</td>
</tr>
<tr>
<td>LAKE ERIE SHORELINE 1.0 MI. EAST OF EUCLID WWTP</td>
<td>1997</td>
<td>34</td>
<td>5.7</td>
<td>EWH</td>
<td>Non</td>
</tr>
</tbody>
</table>

Table 5. Biological criteria applicable to rivers and streams in the Erie-Ontario Lake Plains (EOLP).

<table>
<thead>
<tr>
<th>Biological Index</th>
<th>Assessment Method</th>
<th>Biological Criteria for the Applicable Aquatic Life Use Designations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>WWH</td>
</tr>
<tr>
<td>IBI</td>
<td>Headwater</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Wading</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>Boat</td>
<td>40</td>
</tr>
<tr>
<td>MIwb</td>
<td>Wading</td>
<td>7.9</td>
</tr>
<tr>
<td></td>
<td>Boat</td>
<td>8.7</td>
</tr>
<tr>
<td>ICI</td>
<td>All</td>
<td>34</td>
</tr>
</tbody>
</table>

Table 6. The aquatic life use that applies to Lake Erie is Exceptional Warmwater Habitat (EWH). Since EWH criteria were developed for streams and rivers, an index of biotic integrity (IBI) proposed for Lake Erie shorelines and harbors was developed (Ohio EPA, 1999).

<table>
<thead>
<tr>
<th>Lake Erie Shoreline Targets (EWH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat Type</td>
</tr>
<tr>
<td>Rubble</td>
</tr>
<tr>
<td>Sand</td>
</tr>
</tbody>
</table>

Ohio EPA has also established general ALU designations for wetlands (Figure 30). Scores of Vegetative Index of Biotic Integrity (VIBI), a quantitative plant assessment, can be correlated to these general wetland ALU designations in addition to wetland antidegradation categories (Figure 31) (Mack, 2004). Baseline and post-restoration (after maturation) metrics are measured for wetland restoration projects funded through the Ohio EPA Section 319 Grant Program (R. Wilson, pers. comm., December 17, 2019).
Table 5. General Wetland Aquatic Life Use Designations.

<table>
<thead>
<tr>
<th>code</th>
<th>designation</th>
<th>definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWLH</td>
<td>Superior Wetland Habitat</td>
<td>Wetlands that are capable of supporting and maintaining a high quality community with species composition, diversity, and functional organization comparable to the vegetation IBI score of at least 83% (five-sixths) of the 95th percentile for the appropriate wetland type and region as specified in Table 11.</td>
</tr>
<tr>
<td>WLH</td>
<td>Wetland Habitat</td>
<td>Wetlands that are capable of supporting and maintaining a balanced, integrated, adaptive community having a species composition, diversity, and functional organization comparable to the vegetation IBI score of at least 66% (two-thirds) of the 95th percentile for the appropriate wetland type and region as specified in Table 11.</td>
</tr>
<tr>
<td>RWLH</td>
<td>Restorable Wetland Habitat</td>
<td>Wetlands which are degraded but have a reasonable potential for regaining the capability of supporting and maintaining a balanced, integrated, adaptive community of vascular plants having a species composition, diversity, and functional organization comparable to the vegetation IBI score of at least 33% (one-third) of the 95th percentile distribution for the appropriate wetland type and region as specified in Table 11.</td>
</tr>
<tr>
<td>LQWLH</td>
<td>Limited Quality Wetland Habitat</td>
<td>Wetlands which are seriously degraded and which do not have a reasonable potential for regaining the capability of supporting and maintaining a balanced, integrated, adaptive community having a species composition, diversity, and functional organization comparable to the vegetation IBI score of less than 33% (one-third) of the 95th percentile for the appropriate wetland type and region as specified in Table 11.</td>
</tr>
</tbody>
</table>

Figure 30. General Wetland Aquatic Life Use Designations (Mack, 2004).
Table 7. Wetland Tiered Aquatic Life Uses (WTALUs) for specific plant communities and landscape positions. tbd = to be developed. LOWLH = limited quality wetland habitat, RWLH = restorable wetland habitat, WLH = wetland habitat, SWLH = superior wetland habitat. Equivalent antidegradation categories as specified in Ohio Administrative Code Rule 3745-1-54 are indicated in parentheses below the TALU category.

<table>
<thead>
<tr>
<th>HGM class</th>
<th>HGM subclass</th>
<th>plant community</th>
<th>ecoregions</th>
<th>SF* percentile</th>
<th>LOWLH (Category 1)</th>
<th>RWLH (modified Category 2)</th>
<th>WLH (Category 2)</th>
<th>SWLH (Category 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression all</td>
<td>Swamp forest, Marsh, Shrub swamp</td>
<td>all other regions</td>
<td>91</td>
<td>0 - 30</td>
<td>30 - 60</td>
<td>61 - 75</td>
<td>76 - 100</td>
<td></td>
</tr>
<tr>
<td>Impoundment all</td>
<td>Wet Meadow (incl. prairies and sedgedgrass dominated communities that are not slopes)</td>
<td>all regions</td>
<td>91</td>
<td>0 - 29</td>
<td>30 - 59</td>
<td>60 - 75</td>
<td>76 - 100</td>
<td></td>
</tr>
<tr>
<td>Impoundment all</td>
<td>Marsh, Shrub Swamp</td>
<td>all other regions</td>
<td>71</td>
<td>0 - 24</td>
<td>25 - 47</td>
<td>48 - 63</td>
<td>64 - 100</td>
<td></td>
</tr>
<tr>
<td>Riverine Headwater</td>
<td>all</td>
<td>all other regions</td>
<td>84</td>
<td>0 - 27</td>
<td>28 - 56</td>
<td>57 - 69</td>
<td>70 - 100</td>
<td></td>
</tr>
<tr>
<td>Riverine Mainstem</td>
<td>all</td>
<td>all other regions</td>
<td>71</td>
<td>0 - 23</td>
<td>24 - 47</td>
<td>47 - 59</td>
<td>60 - 100</td>
<td></td>
</tr>
<tr>
<td>Headwater or Mainstem</td>
<td>Wet Meadow (incl. prairies and sedgedgrass dominated communities that are not slopes)</td>
<td>all regions</td>
<td>64</td>
<td>0 - 20</td>
<td>21 - 41</td>
<td>42 - 52</td>
<td>53 - 100</td>
<td></td>
</tr>
<tr>
<td>Slope Fringing</td>
<td>Natural Lakes (excluding lakeshore lagoons and reservoirs)</td>
<td>all</td>
<td>92</td>
<td>0 - 29</td>
<td>30 - 59</td>
<td>60 - 75</td>
<td>76 - 100</td>
<td></td>
</tr>
<tr>
<td>Coastal</td>
<td>closed embayment, barrier-protected, river mouth</td>
<td>all</td>
<td>75</td>
<td>0 - 24</td>
<td>25 - 49</td>
<td>50 - 61</td>
<td>62 - 100</td>
<td></td>
</tr>
<tr>
<td>Coastal</td>
<td>open embayment, diked (managed or managed failed)</td>
<td>all</td>
<td>75</td>
<td>0 - 24</td>
<td>25 - 49</td>
<td>50 - 61</td>
<td>62 - 100</td>
<td></td>
</tr>
<tr>
<td>Bog</td>
<td>weakly ombrotrophic</td>
<td>all</td>
<td>100</td>
<td>0 - 32</td>
<td>33 - 65</td>
<td>66 - 82</td>
<td>83 - 100</td>
<td></td>
</tr>
<tr>
<td>Bog</td>
<td>moderately to strongly ombrotrophic</td>
<td>all</td>
<td>73</td>
<td>0 - 23</td>
<td>24 - 47</td>
<td>48 - 60</td>
<td>60 - 100</td>
<td></td>
</tr>
</tbody>
</table>

1. Depending on the circumstances, scoring breaks for depression, impoundment, or riverine may be used.
2. Scoring breaks for coastal embayment, barrier-protected, and river mouth may be used.

There are no Ohio EPA monitoring locations located within the assessment unit; Ohio EPA indicated that “there were no streams of sufficient size to warrant sampling in the unit during 2015.” (Ohio EPA 2018) Two Ohio EPA monitoring locations are located on Lake Erie, slightly outside of the unit (Table 4). These monitoring locations indicate non-attainment of exceptional warmwater habitat (EWH) for Lake Erie at this location due to low fish diversity scores. There is no Total Maximum Daily Load (TMDL) report available for the Lake Erie Central Basin Tributaries study area (including Euclid-FLE). A very small portion of the unit located in the City of Cleveland will be included in the Northeast Ohio Regional Sewer District’s Chagrin River-Lake Erie Direct Tributaries Stormwater Master Plan Study (CHALET-SWMP), estimated to be completed end of 2020. The CHALET-SWMP will identify and inventory runoff issues for Euclid-FLE.
Figure 32. Euclid-FLE Ohio EPA Aquatic Life Use Monitoring Stations (Data source: Ohio EPA).

Figure 33. Monitoring locations for wetland and headwater stream habitat assessments conducted by Bluestone Heights and CRWP.
Table 7. Assessment data for wetland and headwater stream habitat (Bluestone Heights and CRWP, 2017).

<table>
<thead>
<tr>
<th>ID</th>
<th>W’shed</th>
<th>Local hydro</th>
<th>Feature type</th>
<th>Site name</th>
<th>Owner</th>
<th>Tool</th>
<th>Score</th>
<th>Narrative</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>Lilly W</td>
<td>mor escarp</td>
<td>depressional wetland &amp; retention</td>
<td>Shrine Pond</td>
<td>SMHT</td>
<td>ORAM</td>
<td>36</td>
<td>Md Cat. 2</td>
</tr>
<tr>
<td>E2</td>
<td>Lilly W</td>
<td>mor escarp</td>
<td>depressional wetland</td>
<td>Knott Pond</td>
<td>Euclid</td>
<td>ORAM</td>
<td>26</td>
<td>Cat. 1</td>
</tr>
<tr>
<td>E3</td>
<td>Lilly E</td>
<td>bed escarp</td>
<td>wooded wetland</td>
<td>Oakhill terr</td>
<td>private</td>
<td>ORAM</td>
<td>64.5</td>
<td>Cat. 3</td>
</tr>
<tr>
<td>E3</td>
<td>Lilly E</td>
<td>bed escarp</td>
<td>ravine headwater</td>
<td>Oakhill terr</td>
<td>private</td>
<td>HHEI</td>
<td>64</td>
<td>Rheocrene</td>
</tr>
<tr>
<td>E6</td>
<td>Babbitt W</td>
<td>bed escarp</td>
<td>in-line retention &amp; wetland</td>
<td>Braeburn</td>
<td>Euclid</td>
<td>ORAM</td>
<td>52</td>
<td>Cat. 2</td>
</tr>
<tr>
<td>E6</td>
<td>Babbitt W</td>
<td>bed escarp</td>
<td>ravine headwater S of retention</td>
<td>Braeburn</td>
<td>Euclid</td>
<td>HHEI</td>
<td>68</td>
<td>Cl II PHWH</td>
</tr>
<tr>
<td>E10</td>
<td>Burk NE</td>
<td>bed escarp</td>
<td>ravine headwater S of ball field</td>
<td>Hillandale</td>
<td>PMBC</td>
<td>HHEI</td>
<td>62</td>
<td>Rheocreneel</td>
</tr>
<tr>
<td>E10</td>
<td>Burk NE</td>
<td>bed escarp</td>
<td>ravine headwater, small branch</td>
<td>Hillandale</td>
<td>PMBC</td>
<td>HHEI</td>
<td>43</td>
<td>Cl II PHWH</td>
</tr>
<tr>
<td>E10</td>
<td>Burk NE</td>
<td>bed escarp</td>
<td>ravine headwater, shale bed</td>
<td>Hillandale</td>
<td>PMBC</td>
<td>HHEI</td>
<td>65</td>
<td>Cl III PHWH</td>
</tr>
<tr>
<td>E10</td>
<td>Burk NE</td>
<td>mor escarp</td>
<td>depressional wetland</td>
<td>Hillandale</td>
<td>PMBC</td>
<td>ORAM</td>
<td>41</td>
<td>Md Cat. 2</td>
</tr>
<tr>
<td>E10</td>
<td>Burk NE</td>
<td>mor escarp</td>
<td>depressional wetland</td>
<td>Hillandale</td>
<td>PMBC</td>
<td>ORAM</td>
<td>63</td>
<td>Cat. 3</td>
</tr>
<tr>
<td>E10</td>
<td>Burk NE</td>
<td>mor escarp</td>
<td>depressional wetland, NE br</td>
<td>Hillandale</td>
<td>PMBC</td>
<td>ORAM</td>
<td>36</td>
<td>Md Cat. 2</td>
</tr>
<tr>
<td>E10</td>
<td>Burk NE</td>
<td>mor escarp</td>
<td>depressional wetland SE br</td>
<td>Hillandale</td>
<td>PMBC</td>
<td>ORAM</td>
<td>43</td>
<td>Md Cat. 2</td>
</tr>
<tr>
<td>E10</td>
<td>Burk NE</td>
<td>mor escarp</td>
<td>riparian wetland, areas F &amp; D</td>
<td>Hillandale</td>
<td>PMBC</td>
<td>ORAM</td>
<td>53</td>
<td>Cat. 2</td>
</tr>
<tr>
<td>T1</td>
<td>Lilly W</td>
<td>St Clair terr</td>
<td>riparian wetland (wet woods)</td>
<td>railroad</td>
<td>private</td>
<td>ORAM</td>
<td>48</td>
<td>Cat. 2</td>
</tr>
<tr>
<td>T1</td>
<td>Lilly W</td>
<td>St Clair terr</td>
<td>terrace headwater</td>
<td>railroad</td>
<td>private</td>
<td>HHEI</td>
<td>56</td>
<td>M Cl II PHWH</td>
</tr>
<tr>
<td>T2</td>
<td>Lilly W</td>
<td>St Clair terr</td>
<td>riparian wetland</td>
<td>Linderme</td>
<td>private</td>
<td>ORAM</td>
<td>44</td>
<td>Md Cat. 2</td>
</tr>
<tr>
<td>T5</td>
<td>Babbitt E</td>
<td>St Clair terr</td>
<td>riparian wetland</td>
<td>Manor</td>
<td>private</td>
<td>ORAM</td>
<td>36</td>
<td>Md Cat. 2</td>
</tr>
<tr>
<td>T6</td>
<td>Babbitt E</td>
<td>St Clair terr</td>
<td>riparian wetland</td>
<td>Reliance</td>
<td>private</td>
<td>ORAM</td>
<td>44</td>
<td>Md Cat. 2</td>
</tr>
<tr>
<td>T7</td>
<td>Babbitt E</td>
<td>St Clair terr</td>
<td>terrace headwater</td>
<td>Reliance</td>
<td>Euclid</td>
<td>HHEI</td>
<td>53.5</td>
<td>Rheocrene</td>
</tr>
<tr>
<td>T8</td>
<td>Babbitt E</td>
<td>St Clair terr</td>
<td>depressional wetland</td>
<td>Playground</td>
<td>Euclid</td>
<td>ORAM</td>
<td>35</td>
<td>Md Cat. 2</td>
</tr>
<tr>
<td>T10</td>
<td>Burk main</td>
<td>St Clair terr</td>
<td>riparian wetland</td>
<td>barrow pit</td>
<td>Euclid</td>
<td>ORAM</td>
<td>45</td>
<td>Cat. 2</td>
</tr>
<tr>
<td>T11</td>
<td>Burk main</td>
<td>St Clair terr</td>
<td>inundated wetland</td>
<td>Chase ravine</td>
<td>Wickliffe</td>
<td>ORAM</td>
<td>52</td>
<td>Cat. 2</td>
</tr>
<tr>
<td>T11</td>
<td>Burk main</td>
<td>St Clair terr</td>
<td>inundated wetland</td>
<td>Chase ravine</td>
<td>Wickliffe</td>
<td>ORAM</td>
<td>64</td>
<td>Cat. 3</td>
</tr>
</tbody>
</table>

Abbreviations: mor escarp=moraine-based escarpment; bed escarp=bedrock-based escarpment; terr=terrace; SMHT=Sisters of the Most Holy Trinity; Euclid=City of Euclid; PMBC=Providence Missionary Baptist Church; Rheocrene=potential for Renocrene development.
2.3 Summary of Pollution Causes and Associated Sources

As Euclid-FLE holds no Ohio EPA monitoring locations, no local causes and sources of impairment are identified in the Ohio EPA’s 2018 Integrated Water Quality Monitoring and Assessment Report. Due to the assessment unit’s highly urban and suburban environments, suspected causes and sources of impairment for open watercourses likely resemble those of the similarly impacted Doan Brook-Frontal Lake Erie HUC-12 unit located to the west. Causes of impairment in Doan Brook-Frontal Lake Erie include flow regime modification, habitat alterations, and pollutants in urban stormwater. Sources of impairment in Doan Brook-Frontal Lake Erie include sediment resuspension (contaminated sediment), combined sewer overflows, channelization, municipal (urbanized high density area) and urban runoff/storm sewers. The high percentage of impervious surfaces in Euclid-FLE (Figure 28) leads to a greater variation of high and low flow regimes. The amount of impervious surface also increases sediment loads and substrate embeddedness, resulting from erosion-caused sediment deposition. Limited floodplain access and a lack of riparian vegetation cause streambed down-cutting and bank destabilization in many open watercourses.

2.4 Additional Information for Critical Areas and Implementation Strategies

2.4.1 Public Input

Euclid-FLE residents and stakeholders contributed valuable input at a City of Euclid-Frontal Lake Erie Public Open House on November 28, 2018. Twelve local residents and community representatives of Euclid, Eastlake, Richmond Heights, and Cleveland provided input at this meeting to inform on critical areas, needs and projects. Two online surveys were also conducted by CRWP and Bluestone Heights to solicit additional input: a unit-wide survey and a City of Euclid-specific survey. Verbal and written input was also encouraged during the development of this NPS-IS. Feedback identified through these input-gathering processes is summarized in Table 6.

Table 8. Euclid-FLE public input received regarding challenges, high quality areas, and potential protection and restoration activities.

<table>
<thead>
<tr>
<th>Euclid-FLE non-point source pollution and other challenges:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Erosion of Lake Erie shoreline</td>
<td></td>
</tr>
<tr>
<td>- Near East Shore Park Club and along Dorchester Road in the City of Cleveland</td>
<td></td>
</tr>
<tr>
<td>- Near Moss Point Club</td>
<td></td>
</tr>
<tr>
<td>- Along shoreline in the City of Euclid</td>
<td></td>
</tr>
<tr>
<td>- Excessive litter and plastic debris carried to streams and Lake Erie by stormwater runoff</td>
<td></td>
</tr>
<tr>
<td>- Bacteria contamination of Lake Erie due to sanitary pollution</td>
<td></td>
</tr>
<tr>
<td>- Excessive use of road salt</td>
<td></td>
</tr>
<tr>
<td>- Effects of water pollution on wildlife</td>
<td></td>
</tr>
<tr>
<td>- Poorly functioning storm drains</td>
<td></td>
</tr>
<tr>
<td>- Degraded stream habitats</td>
<td></td>
</tr>
<tr>
<td>- Culverting of streams</td>
<td></td>
</tr>
<tr>
<td>- Sand starvation on the Lake Erie shore</td>
<td></td>
</tr>
<tr>
<td>- Invasive plants throughout watershed (especially Phragmites australis)</td>
<td></td>
</tr>
<tr>
<td>- Invasive plants at Sims Park in the City of Euclid</td>
<td></td>
</tr>
<tr>
<td>- Beaches affected by algae</td>
<td></td>
</tr>
</tbody>
</table>
| High quality ecosystems and natural resources that would benefit from resource protection: | - Undeveloped wooded area between 260th and 250th streets and north of Interstate 90 in the City of Euclid  
- Lake Erie shoreline  
- Babbitt Run  
- Greenspaces in the City of Euclid |
| Euclid-FLE potential protection and restoration strategies to address watershed challenges: | - Education for residents, community leaders, and the business community  
- Stormwater control measures  
- Improve sanitary control systems  
- Posting signage to deter littering  
- Providing trash and cigarette disposal areas  
- Install trash collection systems to catch litter before it enters storm sewers  
- Remove/treat invasive species  
- Educate businesses and landowners about *Phragmites australis* removal and management  
- Install a native plant garden to educate landowners about native plants  
- Stream restoration  
- Restoration of natural floodplain access and function  
- Dam/levee modification or removal  
- Wetland restoration  
- Restoration of riparian vegetation  
- Protect streams and wetlands through conservation easements  
- Adopt and implement local watershed conservation codes |

CRWP and its watershed communities collaborated on the development of the Chagrin River Watershed Balanced Growth Plan from 2006 - 2009. Through this process, Priority Conservation Areas (PCAs) and Priority Development Areas (PDAs) were identified and mapped for the watershed’s communities and incorporated into the communities’ comprehensive land use plans. PCAs are locally designated areas for protection and restoration. They may be important ecological, recreational, heritage, agricultural, and public access areas that are significant for their contribution to Lake Erie water quality and general quality of life. PDAs are locally designated areas where development and/or redevelopment is to be encouraged in order to maximize development potential, maximize the efficient use of infrastructure, promote the revitalization of cities and towns, and contribute to the restoration of Lake Erie (*Chagrin River Watershed Balanced Growth Plan*, 2009). This Plan has been endorsed by the following communities within this Watershed: Eastlake, Wickliffe, Willoughby, and Willoughby Hills. PCAs and PDAs identified for the City of Euclid-Frontal Lake Erie assessment unit are summarized in the map below and can help guide the identification of critical protection areas.
City of Euclid Master Plan of 2018

A municipal master plan inventories current conditions, outlines a community’s vision for the future, and lays out concrete steps to meet the vision. The City of Euclid completed master plans in 1971 and 1996, and in 2016 engaged the Cuyahoga County Planning Commission to begin anew. The project team drew from city administrators and staff. A steering committee brought in other city officials as well as residents, business owners, and other stakeholders. Public input included a survey sent to 1,400 households, three public meetings and online questionnaires. Euclid City Council adopted the new plan in February 2018 with a decade time frame for implementation.
The Euclid Master Plan is an economic development approach to land use. Surface area is either developed or undeveloped (and so in need of development); it is either occupied or vacant (and so in need of occupancy). Water pollution control is currently an important topic in Euclid, as the City has a consent degree from the US EPA to better cleanse its sewer outflows to Lake Erie. As such the Euclid plan mentions the need to slow and store stormwater and build green infrastructure, but always in relation to the greater need for the economic development of local real estate. Thus, the stormwater goals and objectives are set at a general level, but concrete plans are not developed. Yet it is worthwhile to outline the stormwater-related plan features, both to show laudable goals and planning limits.

Under Current Conditions (pp. 19-69), Infrastructure Profile, Stormwater Management (p. 48), three means are given by which to limit polluted outflows to Lake Erie: eliminate Sanitary Sewer Overflows; upgrade the capacity of the wastewater treatment plant capacity; limit Combined Sewer Overflows. To date, most effort has gone to build storage tanks and reconfigure the wastewater treatment to better cleanse its inflows.

In a stormwater control perspective, Euclid's natural watercourses and steeply-sloped land (undeveloped and, therefore, wooded) would constitute process assets to be enhanced. Alternatively, in an economic development perspective, such 'land use features' are "limits [on] developable land" (p. 54). Tree canopy is considered more of an asset but is not expressly tied to runoff control. Vacant land is decidedly an economic development asset, especially larger parcels on the St Clair terrace and escarpment. Still, "Many of these vacant areas include environmentally sensitive features such as wetlands, wooded areas, or steep slopes that may make development difficult" (p. 58).
Within the Goals and Action section, the Preservation Strategy (pp. 106-109) addresses the use of green infrastructure and the need to maintain the green habitat corridor (the escarpment woodland band). Goal 1 seeks to "Restore, preserve and enhance environmentally sensitive features throughout the city--including steep slopes, wetlands, waterways and the waterfront." Objectives include (p. 108):
--Work with the developers of Providence Park to ensure green space is included ... at that site
--Purchase land or easements along the East Branch of the Euclid Creek ...
--Purchase land or easements along the Portage Escarpment’s vacant steep slopes ...

Goal 2: seeks to "Use green infrastructure to slow and store stormwater." Objectives include (p. 108):
--Incorporate green infrastructure in existing parks and open spaces when reconstructed
--Expand the number of trees in neighborhoods and along roads to capture stormwater ...
--Preserve deep setbacks of [Euclid Ave] manufacturing and ... incorporate GI features

In sum, the Euclid Master Plan of 2018 presents mixed messages for planning around nonpoint source pollution control. On one hand, it sets a goal for green enhancements (green space and green infrastructure) where convenient (parks and streets) and where green can add value to parkscapes and streetscapes. On the other hand, the plan does not tie green enhancements to consent decree issues or to larger concerns such as climate resiliency. To the latter point, the plan views the city’s increasing amount of vacant land as the object of traditional real estate development, not as a stormwater control resource.

This is to be expected in a plan to maximize the use of real estate in standard development terms. The current plan extends the land use tradition that, a century ago, installed a storm sewer system to clear real estate of stormwater and to create building platforms on otherwise unproductive natural features. In this, process, natural means for nonpoint source pollution control were, essentially, buried. As such, the City of Euclid-Frontal Lake Erie NPS-IS constitutes a competing approach to traditional land use goals.

Chapter 3: Critical Area Conditions & Restoration Strategies

3.1 Overview of Critical Areas

The following critical areas have been identified for the City of Euclid-Frontal Lake Erie assessment unit:
- Critical Area 1: Ravine Habitat
- Critical Area 2: Wetland Restoration
- Critical Area 3: Green Infrastructure
- Critical Area 4: Coastal Zone

None of the Euclid-FLE streams have been assessed for water chemistry or biology by Ohio EPA or local authorities. As there are no Ohio EPA monitoring locations, it is unknown whether stream resources are in attainment of aquatic life uses. All four critical areas have a rate of imperviousness higher than 20%, which is more than two times the tipping point for channel stability and macroinvertebrate diversity. Aquatic communities have been demonstrated to show water quality and habitat impairments when their drainage area exceeds 10% impervious cover (Center for Watershed Protection 2003). Habitat assessment data are available for the escarpment ravines (HHEI stream assessments) and terrace wetlands (ORAM wetland assessments) in the Cuyahoga County segment of the assessment unit (Table 5).

There is less habitat assessment data available for the Lake County portion of the unit. There are no data for evaluating sediment supply or areas where the water quality is impaired from total suspended sediments. In sum, given the level of impervious cover and general urban development in areas draining to streams, it may be
assumed that all Euclid-FLE watercourses are in non-attainment of their aquatic life uses. As such, causes of impairment common to all three areas are assumed to include flow alteration, organic enrichment and oxygen depletion resulting from sources of impairments such as development impacts, inadequately managed stormwater runoff, and stream channelization. Therefore, critical areas have been developed to protect existing high-quality areas and restore impaired areas with the greatest potential for recovery.

Nonpoint source restoration goals are typically to improve IBI (fish diversity), MIWB (fish diversity), ICI (macroinvertebrate diversity), and QHEI (habitat quality) scores such that an assessment unit is brought into full attainment of its designated aquatic life use (ALU). Due to the lack of Ohio EPA monitoring data and unknown attainment status for Euclid-FLE, nonpoint source restoration goals are developed to improve IBI and MIWB scores so that two non-attaining sites on Lake Erie can achieve full attainment of exceptional warmwater habitat (EWH). It is recommended that fish and macroinvertebrate diversity and ALU be assessed for this watershed unit in the future, after which goals may be based on achieving full attainment of the ALU for this watershed unit. A goal is also developed to reduce total annual phosphorus load to Lake Erie, as recommended in the U.S. Action Plan for Lake Erie (U.S. EPA 2018).

3.2 Critical Area 1 (Ravine Habitat): Conditions, Goals & Objectives

Critical Area 1 addresses non-point source pollution issues in Euclid-FLE ravines holding open stream channels. The ravines provide opportunity for restoration projects oriented toward erosion control and habitat enhancement. Public outreach to diminish deliberate and inadvertent dumping can also be addressed.

The most relevant ravines lie near the assessment unit's southern border where headwater streams incise within the local Portage Escarpment segment. There are approximately 20 escarpment ravines with 4.7 miles of open stream courses (Table 12). The escarpment ravine area holds the majority of the assessment unit's total pervious surface. Habitat assessments (HHEI headwater stream assessments) are available for the open watercourses of Lilly, Babbitt west and Burk escarpment ravines. Three shoreline ravines with open courses lie in the coastal zone, holding the open mouths of Creek Five, Salt Run and Burnt House Brook. These were not assessed (QHEI).
3.2.1 Detailed Characterization

In Cuyahoga County, the escarpment ravines have headwaters in Euclid and in northern Richmond Heights. Headwater sources lie on the Euclid Moraine (~850 feet above sea level). Approximately 50 feet thick, the Euclid Moraine lies atop the lowest levels of the Euclid bluestone. Immediately below, the Cleveland and Chagrin shales (Ohio Formation) are much less resistant and subject to subaerial erosion. On this slope, deep forested ravines hold 2.7 miles of headwaters within a local catchment of 1.3 square miles. With sides too steep for traditional building methods, the Euclid ravines are mostly free of roads and structures. Nevertheless, all are surrounded by dense residential neighborhoods featuring small lots typical of post-WWII inner ring suburban development. Many lots have a stream-side parcel boundary extending downslope to the ravine thalweg.

Lilly Creek has several small escarpment ravines, three of which hold short, spring-fed perennial headwaters. One has an HHEI assessment (Table 12). Only Lilly Creek has its flows culverted in place from headwater ravines to its Lake Erie mouth. Babbitt Run has two larger ravines with significant perennial flows. The Babbitt west ravine headwaters are protected as part of the Saint John’s of the Cross campus in Richmond Heights. Downstream, the City of Euclid has more than 20 acres of miscellaneous parcels. These are the basis for a 3-acre wet stormwater retention basin. On the Babbitt east ravine, the City of Euclid owns a crucial 26-acre parcel encompassing the open escarpment channel. Babbitt’s west and east ravines have water quality assessments (Tables 9 and 10).

Deeply entrenched and north-facing, the Cuyahoga ravines harbor slightly cooler microclimates. Their second growth mixed mesophytic forests are dominated by pin oak, tulip and sugar maple. Deer over-browsing now keeps the understory clear in all ravines. Escaped ground covers, such as English ivy, myrtle and pachysandra are the most common invasive plants. *Phragmites australis* is currently invading all uplands. At the base of the
escarpment, all open watercourses enter culverts. The smaller streams flow directly into the Euclid Avenue storm sewers. Larger culverted flows continue northward under Euclid Avenue to be absorbed into storm sewers farther downstream.

**Burk Run** has three escarpment ravines. On the east side of the Euclid Spur, much of the east ravine is owned by the Telshe Yeshiva (rabbinical seminary) and has sparse institutional and residential buildings. On the west side of the spur, the southwest ravine is owned by the City of Wickliffe and is, for the moment, landlocked and free of building. Also, on the west side of the spur, the northwest ravine lies mostly in Cuyahoga County in the southeast corner of the City of Euclid. It has a long history of occupation but remains the largest undeveloped area within the municipality. In the mid-1800s, the Charles F. Brush family owned 258-acres in several parcels. By 1900, several industrialists had partitioned the Brush land for estates. During the 1920s, the largest 'Hillandale' estate was subdivided for housing but the Great Depression ended the plan. At present the northwest ravine has a second growth beech-maple-oak forest. The legacy ecosystem condition constitutes a major sylvan asset for the City of Euclid. This NPS-IS is based upon a re-evaluation of hydrology and habitat in the northwest ravine. One Burk ravine course has basic water quality data (Table 9). Three Burk Run headwater stream segments have been assessed via HHEI (Table 12).
With sources on the Painesville Moraine (~770 ft asl), lower in altitude than the Euclid escarpment segment, the Lake County ravines have lower gradients and shallower depths. The Lake ravines are of two kinds: those incised into the southern uncut Painesville Moraine and those in the northern wave-cut part of the moraine. Uncut moraine ravines have culverted watercourses integrated into the storm sewer grid and will not be considered in the plan. **Salt, Gilchrist** and **Burnt House** have highly modified escarpment ravines in the northern foot of the
wave-cut Painesville Moraine. Only Burnt House Brooks has an open watercourse in the wave-cut substrate that is subject to reduction in nonpoint source impairments. None of the Lake County escarpment ravines was subject to HHEI assessment.

![Burnt House Brook adjacent to Lake Health West Medical Center. Photo date: December 5, 2018.](image)

**Figure 40.** Burnt House Brook adjacent to Lake Health West Medical Center. Photo date: December 5, 2018.

**Water Chemistry**

During the spring and summer of 2016, water quality was assessed in the headwaters of three escarpment ravines within the City of Euclid. Assessments were made in the ravines of Babbitt Run west, Babbitt Run east and Burk northwest (Figure 29). The Lilly Creek ravines were excluded from the assessment as none showed perennial base flows. The assessment was developed under Level 2 data quality standards prescribed by the Ohio Environmental Protection Agency (OEPA).

The program was completed in two stages. The first, in March and April 2016, was undertaken by five undergraduate students in the Cuyahoga Community College Environmental, Health and Safety Program. It fulfilled requirements for a group Professional Practice Project within the program. The work was supervised by Louis Rifici, MA, Assistant Professor of Environmental, Health and Safety Technology/Biology at Tri-C, and OEPA Level 2 Quality Data Collector for Water Quality.

Later in 2016, under the direction of Roy Larick and Paul Kovalcik, five Bluestone Heights volunteers extended the Tri-C program into the warm season. Professor Rifici trained the participants during a first round of testing on June 27. The work continued, monthly, into July and August of the year. The summer project revisited the winter monitoring stations.
In general, the Euclid escarpment ravine water chemistry parameters lie within the state water quality criteria (Tables 9 - 11). The exception is for phosphate; the Euclid escarpment ravines have PO4 values above the upper limit for good water quality. There are no water quality criteria for turbidity, but the readings on July 30, 2016 were elevated due to the area receiving approximately ¼ inch of rain during the previous evening. Babbitt Run east had slightly elevated conductivity values, most likely due to road salt applied to major roads upstream of the monitoring station. The Burk northwest ravine best exemplifies healthy water quality in the area. Density of urbanization of the area is the most likely contributor to the differences between the streams.

Table 9. Chemical water quality monitoring data for Babbitt Run west escarpment ravine collected by Bluestone Heights and Cuyahoga Community College.

<table>
<thead>
<tr>
<th>Sampling Season</th>
<th>Criteria¹</th>
<th>Winter/Spring²</th>
<th>Summer³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature (°F)</td>
<td>n/a</td>
<td>35.5</td>
<td></td>
</tr>
<tr>
<td>Water temperature (°C)</td>
<td>n/a</td>
<td>6.38</td>
<td>20.8</td>
</tr>
<tr>
<td>Dissolved oxygen (mg/L)</td>
<td>≥4.0</td>
<td>12.35</td>
<td>7.5</td>
</tr>
<tr>
<td>Turbidity (mg/L)</td>
<td>No criteria set</td>
<td>14</td>
<td>37</td>
</tr>
<tr>
<td>Ammonia (mg/L)</td>
<td>≤2.2</td>
<td>0.048</td>
<td>0.166</td>
</tr>
<tr>
<td>Phosphate (mg/L)</td>
<td>≤0.15</td>
<td>0.45</td>
<td>0.61</td>
</tr>
<tr>
<td>Conductivity (µmhos/com)</td>
<td>≤2400</td>
<td>1227.5</td>
<td>0.39</td>
</tr>
<tr>
<td>Total dissolved solids (mg/L)</td>
<td>n/a</td>
<td>895</td>
<td>15</td>
</tr>
<tr>
<td>pH</td>
<td>6.0 – 9.5</td>
<td>8.58</td>
<td>8.3</td>
</tr>
</tbody>
</table>

¹Criteria as indicated in OAC 3745-1-07 Table 7-1 for statewide aquatic life criteria.
²Winter/spring data based on average data for sampling on 4/2/16 and 4/9/16.
³Summer data based on average data for sampling on 7/2/16, 7/30/16, 8/27/16
⁴Criteria for ammonia is 2.2 mg/L at 16 – 20°C and at pH of 7.1 – 7.7 spring through fall.
Monitoring results outside of criteria indicated in red

Table 10. Chemical water quality monitoring data for Babbitt Run east escarpment ravine collected by Bluestone Heights and Cuyahoga Community College.

<table>
<thead>
<tr>
<th>Sampling Season</th>
<th>Criteria¹</th>
<th>Winter/Spring²</th>
<th>Summer³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature (°F)</td>
<td>n/a</td>
<td>33.5</td>
<td></td>
</tr>
<tr>
<td>Water temperature (°C)</td>
<td>n/a</td>
<td>4.9</td>
<td>19.7</td>
</tr>
<tr>
<td>Dissolved oxygen (mg/L)</td>
<td>≥4.0</td>
<td>10.78</td>
<td>5.49</td>
</tr>
<tr>
<td>Turbidity (mg/L)</td>
<td>No criteria set</td>
<td>5.3</td>
<td>32.7</td>
</tr>
<tr>
<td>Ammonia (mg/L)</td>
<td>≤2.2</td>
<td>0.017</td>
<td>0.21</td>
</tr>
<tr>
<td>Phosphate (mg/L)</td>
<td>≤0.15</td>
<td>0.378</td>
<td>0.26</td>
</tr>
<tr>
<td>Conductivity (µmhos/com)</td>
<td>≤2400</td>
<td>2475</td>
<td>1.4</td>
</tr>
<tr>
<td>Total dissolved solids (mg/L)</td>
<td>n/a</td>
<td>1275</td>
<td>7.3</td>
</tr>
<tr>
<td>pH</td>
<td>6.0 – 9.5</td>
<td>7.9</td>
<td>7.8</td>
</tr>
</tbody>
</table>

¹Criteria as indicated in OAC 3745-1-07 Table 7-1 for statewide aquatic life criteria.
²Winter/spring data based on average data for sampling on 3/26/16 and 4/10/16.
³Summer data based on average data for sampling on 7/2/16, 7/30/16, 8/27/16
⁴Criteria for ammonia is 2.2 mg/L at 16 – 20°C and at pH of 7.1 – 7.7 spring through fall.
Monitoring results outside of criteria indicated in red
Table 11. Chemical water quality monitoring data for Burk Run northwest ravine collected by Bluestone Heights and Cuyahoga Community College.

<table>
<thead>
<tr>
<th>Sampling Season</th>
<th>Criteria¹</th>
<th>Winter/Spring²</th>
<th>Summer³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature (°F)</td>
<td>n/a</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Water temperature (°C)</td>
<td>n/a</td>
<td>4.53</td>
<td>21.0</td>
</tr>
<tr>
<td>Dissolved oxygen (mg/L)</td>
<td>≥4.0</td>
<td>11.13</td>
<td>3.95</td>
</tr>
<tr>
<td>Turbidity (mg/L)</td>
<td>No criteria set</td>
<td>9</td>
<td>258</td>
</tr>
<tr>
<td>Ammonia (mg/L)</td>
<td>≤2.2</td>
<td>0.02</td>
<td>0.27</td>
</tr>
<tr>
<td>Phosphate (mg/L)</td>
<td>≤0.15</td>
<td>0.19</td>
<td>0.36</td>
</tr>
<tr>
<td>Conductivity (µmhos/com)</td>
<td>≤2400</td>
<td>750</td>
<td>0.76</td>
</tr>
<tr>
<td>Total dissolved solids (mg/L)</td>
<td>n/a</td>
<td>395</td>
<td>5</td>
</tr>
<tr>
<td>pH</td>
<td>6.0 – 9.5</td>
<td>8.06</td>
<td>7.8</td>
</tr>
</tbody>
</table>

¹Criteria as indicated in OAC 3745-1-07 Table 7-1 for statewide aquatic life criteria.
²Winter/spring data based on average data for sampling on 4/2/16 and 4/10/16.
³Summer data based on average data for sampling on 7/2/16, 7/30/16, 8/27/16
⁴Criteria for ammonia is 2.2 mg/L at 16 – 20°C and at pH of 7.1 – 7.7 spring through fall. Monitoring results outside of criteria indicated in red

3.2.2 Detailed Biological Conditions

As Euclid-FLE holds no Ohio EPA monitoring locations, and there is no TMDL; the assessment unit has no available biological data. Biological health is likely impacted by habitat alterations due to surrounding urbanization and effects on sediment load, substrate embeddedness, and extreme stormwater flow fluctuations caused by channelized and culverted stream courses and impervious cover.

Headwater Habitat Evaluation Index (HHEI)

The Ohio EPA Primary Headwater Habitat Evaluation Index (HHEI) for headwater streams was performed at several escarpment ravines. The HHEI was developed to assess and classify the quality of primary headwater streams (streams draining ≤ 1 square mile). Classification is based on the type of biological community that may be supported by the stream and include the following stream classes: Class I (ephemeral streams with no significant habitat and limited potential to achieve higher class functions), Class II (typically intermittent streams that support moderate biological diversity of warmwater species seasonally or year-round), and Class III (perennial streams influenced by groundwater and exhibiting moderately to highly diverse biological diversity year-round, including coldwater species). Biological assessments further classify Class III primary headwater streams. Streams can also be classified as Modified Primary Headwater Habitat (PHWH) if they are channelized, if other permanent channel modifications exist, or if permanent structures impound free-flowing water. Rheocrene streams are those where groundwater springs have formed a well-defined channel. Streams are identified as having potential rheocrene habitat if they have constant flowing water, a defined bed and bank, and a watershed size ≤0.1 square mile. A biological assessment should be used to evaluate the biological diversity of streams with potential rheocrene habitat.

HHEI assessment data collected by Bluestone Heights and CRWP for this critical area are summarized in Table 12. All assessments indicate Class II PHWH streams or streams with rheocrene potential where additional biological monitoring should be conducted. This data suggests that these stream segments have the potential to support warmwater biological communities, but this should be confirmed through biological monitoring.
Table 12. HHEI assessment data collected in this critical area by Bluestone Heights and CRWP in 2017.

<table>
<thead>
<tr>
<th>Site ID</th>
<th>Site Description/Stream Name</th>
<th>Assessment Score</th>
<th>Assessment Narrative</th>
</tr>
</thead>
<tbody>
<tr>
<td>E3</td>
<td>Lilly Creek</td>
<td>64</td>
<td>Rheocrene potential</td>
</tr>
<tr>
<td>E6</td>
<td>Babbitt West upstream of in-line retention pond</td>
<td>68</td>
<td>Class II PHWH</td>
</tr>
<tr>
<td>E10</td>
<td>Hillandale Park, Burk Run tributaries (south of baseball field)</td>
<td>62</td>
<td>Rheocrene potential</td>
</tr>
<tr>
<td>E10</td>
<td>Hillandale Park, Burk Run tributaries (small branch)</td>
<td>43</td>
<td>Class II PHWH</td>
</tr>
<tr>
<td>E10</td>
<td>Hillandale Park, Burk Run tributaries (upstream/shale)</td>
<td>65</td>
<td>Class III PHWH</td>
</tr>
</tbody>
</table>

3.2.3 Detailed Causes and Associated Sources

Suspected causes of impairment in ravine watercourses include habitat alterations, flow regime modifications (channel entrenchment and bank erosion) and pollutants in urban stormwater. Suspected impairment sources include impervious surfaces, combined sewer overflows, channelization, and urban runoff/storm sewers and contaminated sediment re-suspension and re-sedimentation. The ravines also receive storm runoff laden with yard waste, pet wastes, fertilizers and pesticides. Residential property owners introduce an abundance of yard waste and solid refuse.

![Figure 41. Streambank erosion along Burnt House Brook due to stormwater runoff has caused infrastructure failure at the end of Kilarney Road in Willoughby, Ohio. Photo date: December 5, 2018.](image)
Figure 42. Burnt House Brook is channelized with gabion baskets downstream of Kaiser Court in Willoughby, Ohio (photo location: Brookdale Apartments). Channelization has led to decreased aquatic habitat diversity and lack of floodplain access.

3.2.4 Outline of Goals and Objectives for Critical Area 1 (Ravine Habitat)

Goals

Due to the lack of Ohio EPA monitoring data and unknown attainment status for Euclid-FLE, nonpoint source restoration goals are developed to improve IBI and MIWB scores so that two non-attaining sites on Lake Erie can achieve full attainment of exceptional warmwater habitat (EWH). It is recommended that fish and macroinvertebrate diversity and ALU be assessed for this watershed unit in the future, after which goals may be based on achieving full attainment of the ALU for this watershed unit. The goals for this critical area are as follows:

**GOAL 1.** Achieve an L-IBI score of 42 for attainment of exceptional warmwater habitat at Lake Erie, E of Euclid Creek (OEPA Lake Erie Shoreline Target for rubble nearshore habitat, Ohio EPA, 1999)

*Not Achieved:* Current score is 38 (Ohio EPA, 2014)

**GOAL 2.** Achieve a MIWB score of 8.9 for attainment of exceptional warmwater habitat at Lake Erie, E of Euclid Creek (OEPA Lake Erie Shoreline Target for rubble nearshore habitat, Ohio EPA, 1999)

*Not Achieved:* Current score is 7.38 (Ohio EPA, 2014)
GOAL 3. Achieve an L-IBI score of 42 for attainment of exceptional warmwater habitat at Lake Erie, 1.0 mile E of Euclid WWTP (OEPA Lake Erie Shoreline Target for rubble nearshore habitat, Ohio EPA, 1999)

Not Achieved: Current score is 34 (Ohio EPA, 1997)

GOAL 4. Achieve a MIWB score of 8.9 at Lake Erie Shoreline 2.0 Mi. East of Chagrin R. (OEPA Lake Erie Shoreline Target for rubble nearshore habitat, Ohio EPA, 1999)

Not Achieved: Current score is 5.7 (Ohio EPA, 1997)

Objectives

To achieve these objectives for Critical Area 1, the following objectives need to be achieved:

OBJECTIVE 1: Reforest 188 acres of ravine, riparian, upland and coastal areas with native vegetation.

OBJECTIVE 2: Restore 1,550 linear feet of in-stream and lacustrine estuarine habitat using natural channel design and bioengineering features and principles (e.g. restoration of floodplain access, streambank stabilization using bioengineering techniques).*

*This objective is based on estimated proportion of open stream segments requiring restoration and planned in-stream and lacustrine estuarine habitat restoration areas.

OBJECTIVE 3: Permanently protect 58.9 acres of riparian areas along escarpment ravines.

- Permanently protect riparian areas through fee-simple acquisition or conservation easements.
- Riparian setback adoption for Wickliffe and Willoughby.
- Riparian setback enforcement for Euclid, Richmond Heights.
- Adoption of conservation development or other ordinances to protect streams, wetlands, riparian zones, and other sensitive areas as communities are developed or re-developed.

As these objectives are implemented, water quality monitoring (both project related and regularly scheduled monitoring) will 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. For instance; many agricultural BMPs can be “stacked” (a systems approach) that will also incrementally improve the quality and quantity of runoff and drainage waters and in-stream water quality. When reevaluating, the committee will reference the Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013), which has a complete listing of all eligible NPS management strategies to consider including:

- Urban Sediment and Nutrient Reduction Strategies;
- Altered Stream and Habitat Restoration Strategies;
- Nonpoint Source Reduction Strategies; and
- High Quality Waters Protection Strategies

3.3. Critical Area 2 (Wetland Restoration): Conditions, Goals & Objectives

Critical Area 2 addresses non-point source pollution issues for numerous wetlands located primarily within the City of Euclid. The damp-surface features are found in the escarpment and terraces hydrology zones. Eight Euclid-
FLE wetlands have been identified and assessed via ORAM. In result of intensive residential development, the lake plain and coastal zone have lost all wetlands.

All Euclid-FLE’s current wetlands are anthropogenic features with one of three man-made origins—all accidental. One set is the product of damming a stream channel, floodplain or small ravine to create a pond. Wetlands have developed as the pond’s intended use has been outmoded and pond maintenance abandoned. Such ponds have accumulated sediment and, therefore, wetland characteristics. The most common example of this type is ice ponds of the late nineteenth century. With the advent of mechanical refrigeration, ice ponds lost function; they are now wetlands (E1, E2). One degraded pond has developed around a floodplain stormwater detention basin subject to flood sedimentation (E6).

A larger set of characteristic wetlands has developed upstream of culvert inlets as they receive fluvial sediment enough to impede stream flow. Early railroads used bridges to cross Euclid’s small terrace ravines. Later, short culverts replaced the bridges. During a century of less than adequate maintenance, areas upstream of some culverts have been sedimented enough to raise stream gradient. Such areas now show wetland characteristics (T1, T2, T5, T8, T10, T11).

The third set of wetlands result from quarrying operations. Wetland T12 derives from a deep clay quarry in use for 60 years (1882-1942) for brickmaking on the Cuy-La county line. Wetland T10 is a large earth borrow-pit used for building the Euclid Spur (OH-2/I-90/I-271) in 1961 and 1962.

Figure 43. Map of Critical Area 2 (Wetland Restoration).
3.3.1 Detailed Characterization

Escarpment wetlands

E1: Lilly west Shrine pond: 0.4 acres, ~21500 Euclid Avenue, 41.570671 -81.529690, ORAM Modified Cat. 2 (Score: 36).

The pond lies in the Lilly Creek watershed, but the outflow drains directly to the Euclid Avenue south side storm sewer. The pond bottom is earthen. The sides are lined with a decorative dry-laid retaining wall of local sandstone, 50-90 cm in height. The plan is bi-lobate with an island at the larger eastern end. It is the remnant of a 1920s landscape pond, probably derived from a nineteenth century ice pond and, possibly, yet further derived from an early Holocene beach lagoon. During the late twentieth century, the south (bluff) side has slumped into the feature, especially at the east end. About 20 years ago, the owner attempted to slow the slump. Habitat includes a stand of catalpa trees; myrtle is overtaking ground cover.

Figure 44. Lilly west shrine pond. Photo date: October 10, 2017.

E2: Lilly east Knott pond: 0.2 acre, ~22900 Euclid Avenue, 41.573864 -81.521437, ORAM Cat. 1 (Score: 26).

The Knott pond lies on the divide between Lilly Creek (west) and Babbitt Run headwater ravines. It is probably the remains of a nineteenth century ice pond or another agricultural feature. The topography may derive from a lagoon area on a beach ridge back slope. The site has been modified to be fed from one or both headwater ravines, east and west. The City of Euclid acquired the feature in the early 2000s. The Services Department filled in the south half the pond with construction debris-laden earth during 2013-2014. Habitat includes narrow-leaf cattail and water lilies.
**E3: Lilly east shelf:** 7.25 acres, ~24300 Glenbrook Boulevard, 41.575579 -81.514192, ORAM Cat. 3 (Score: 65). This feature is part of a large, unbuilt bluestone promontory defined by two Lilly Creek headwater ravines (Sherwood west and Oakhill east) and the escarpment north edge. In addition to the defining perennial stream courses, two north-opening incipient ravines drain the north edge. The feature drains eastward, with convergence to a point above the Oakhill ravine, where, in wet weather, a head cut delivers runoff to the Oakhill stream below. As the head cut (knick point) controls a substantial portion of the plateau drainage, its height can be managed as a weir to enhance wetland function. The forest floor is seasonally damp with vernal pond features.
**E6: Babbitt west retention basin**: 0.36 acres, ~25200 Euclid Avenue, 41.581807 -81.504801, ORAM Cat. 2 (Score: 52). Babbitt west is a primary City of Euclid stormwater retention basin. The pond covers much of the floodplain in this deep ravine. It is highly sedimented as a shale clast delta aggrades upstream. The local habitat has recently become heavy with phragmites and reed canary grass. The pond has a covering of duck weed and narrow-leaf cattail.

*Figure 47. Babbitt west retention basin. Photo date: October 10, 2017.*

*Figure 48. Wooded buffer area around Babbitt west retention basin. Photo date: October 10, 2017.*
Terrace wetlands

**T5: Lilly east Nickel Plate basin**: 1.28 acres, 41.583795 -81.517724, ORAM Cat. 1 (Score: 26).
The Nickel Plate wetland represents a stream confluence south of the NKP railroad tracks. It is one of several such features along this railroad alignment. The feature presents as a small ravine deepened with the excavated material set on the west side as a dike. A Lilly Creek east headwater flows on the west side of the ravine. A larger, more active headwater merges from the west at the culvert. The extensive ravine bottom is hummocky. Phragmites is invading.

![Figure 49. Lilly east Nickle plate basin. Photo date: October 13, 2017.](image)

**T6-T7: Lilly east retention basin**: 1.1 acres, 41.581672 -81.513607, ORAM Modified Cat. 2 (Score: 44).
This large City-of Euclid-excavated basin has a control gate at the north end and is fully enclosed with a 6 ft-high chain link fence. A Lilly east perennial stream supplies the permanent pond, which has a heavy phragmites infestation. To the east, an underused asphalt-paved parking lot of nearly 4 acres in size partially drains to the T6 wetland. To the south, the T7 wetland is an extension of the T6 retention basin. Smaller wetlands exist on private property neighboring to the west and on north side of Rockwell.

**T8: Tungsten Playground**: 0.99 acres, 41.591969 -81.505237, ORAM Modified Cat. 2 (Score: 35).
The playground is a ghost ravine feature related to a Babbitt east headwater on the St Clair terrace. It presents as a swale with downstream barrier formed by the NKP raised railbed. The wetland infiltrates runoff from several City-owned acres. The catchment could be extended to include surrounding private property. The site floral assemblage, unique among the Euclid wetlands, consists of a large stand of invasive yellow iris with lesser representation of reed canary grass, milkweed, willow and poplar. The stand of yellow irises, while monocultural, creates friable soil within a dense root network.
Figure 50. Tungsten playground wetland. Photo date: October 18, 2018.

Figure 51. Milkweed at Tungsten playground wetland. Photo date: October 18, 2018.
Burk Cuy-La Wetlands

In 1962, construction of the Euclid Spur (OH-2/I-90/I-271 interchange) transformed the Cuy-La area. The highway used Burk Run’s mainstem escarpment ravine as a ramp through the Portage Escarpment. North of the escarpment, the highway was laid just east of and parallel to Burk Run’s natural channel northward across the St Clair terrace. A great amount of fill was required to elevate the highway; a large borrow pit was established in the stream ravine between Euclid Avenue and the NKP railroad tracks (T10 wetland). Just to the north, between the NKP and CSX railroad tracks, construction apparently raised the level of Burk Run to inundate a ravine, thereby creating a flooded wetland (T11 wetland).

Just north of the Lakeland Freeway, the large Forest Park residential area in the historical Burk Run watershed has greatest frequency of CSO events and street flooding within the City of Euclid (e.g. Gary Avenue & E 272nd Street). If it can be determined that street storm sewers carry Burk Run headwaters contribute to these problems, the enhancement of the Burk Cuy-La wetlands could reduce total flow north of the Lakeland Freeway. Descriptions of the individual wetlands are as follows.

**T10: Euclid Spur borrow pit:** 8.14 acres, 41.599735 -81.490312, ORAM Cat 2 (Score: 45) [USGS NWI: 12.41 acres, Freshwater Pond (PUBGx) PLFK: Palustrine-lacustrine-flat-artificially flooded] Owned by the City of Euclid, this borrow pit represents the widening of the Burk Run ravine from its Portage Escarpment exit northward to the NKP tracks. In 1962 the borrow pit had an area of 12 acres. The City of Euclid has filled in along the western edge, reducing the feature to ~8 acres. The pit is ~400 m/430 yds long, north to south and averages ~20 ft deep. The bottom is relatively flat, thereby increasing the gradient of Burk run at the upstream end and causing erosion. In recent years, phragmites has encroached from the Euclid Spur highway. The basin is now entirely filled with this species.

*Figure 52. Burk Run as it flows through the Euclid spur borrow pit. Photo date: October 12, 2017.*
Figure 53. Euclid spur borrow pit riparian wetland. Photo date: October 12, 2017.

**T11: Chase channel**: 8.1 acres (total), 41.602521 -81.492578, ORAM Cat 2 (Score: 52) and ORAM Cat 3 (Score: 64) [USGS NWI: 4 acres, Freshwater Forested/Shrub Wetland (PSS1F) PLFK: Palustrine-lacustrine-flat-artificially flooded] Fully within the City of Euclid but owned by the City of Wickliffe, the Chase channel is deep water wetland within a 300 yd segment of the Burk Run mainstem ravine. It was formed by, apparently, an unnaturally high culvert threshold at or within the Lakeland Freeway culvert. In result, the shallow ravine has thus become a reservoir, with water filling the ravine between the NPK and CSX railroad lines. The inundated ravine is the wetland (3.1 acres). The full parcel (8.1 acres), therefore holds 5 acres of wetland buffer. The floodplain trees have been subject to die-off for many years. The standing dead trunks are nearly all fallen. Phragmites is encroaching from the east (from the Euclid Spur highway), but the inundated wetland is still free of this species. Except for the flooding, the Chase channel represents the least-altered segment of the prehistoric Burk Run stream course north of Euclid Ave.
Figure 54. Chase channel wetland. Photo date: October 13, 2017.

Figure 55. Chase channel wetland. Photo date: October 13, 2017.
**T12: Cuy-La clay pit**: 6.8 acres, 41.604034 -81.488976, ORAM N/A [USGS NWI: 8.42 acres, Freshwater Pond (PUBGx) PLFK: Palustrine-lacustrine-flat-artificially flooded] This feature began to emerge in the 1870s, immediately west of the county line, as a local DeKalb clay deposit was excavated for making bricks. During the 1890s, as the clay deposit was exhausted, the underlying Chagrin Shale was used to make shale brick. Production continued into the twentieth century, closing definitively in 1942. Currently, the wetland, owned by the City of Wickliffe, lies protected as part of a commercial mulching operation.

**E10: Burk Escarpment complex**
In 2002, the Providence Missionary Baptist Church (PMBC) recombined estate subdivisions to create two parcels totaling 68 acres surrounding the Burk northwest escarpment ravine. The church hired American Church Builders (ACB) to build a church and numerous detached housing units in a campus setting. In 2003, in application for a USACE wetland construction permit, Stantec Consultants delineated seven small wetlands. Development plans included preservation of the buffer areas of three stream-adjacent wetlands and demolition of four stream-isolated wetlands with environmental impacts to be mitigated off-site. The ACB project languished. No construction was attempted on-site, and no mitigation initiated off-site. In 2015, nevertheless, PMBC reprised planning for the northwest ravine as part of a new Providence Park initiative with Community Integrated Services as the developer. As of December 2019, the Providence Park project is proceeding to create a Tax Increment Finance zone. The zone will solidify near term funding endeavors. With a lapse of 12 years, the environmental impact assessment must be recommenced. The following data will be relevant.

**E10a: Hillandale wetland 1**: 0.2 acres, 41.589530 -81.494028, ORAM Cat 2 mod: 41

**E10b: Hillandale wetland 2**: 0.75 acres, 41.587941 -81.492773, ORAM Cat 3: 63

**E10c: Hillandale Brush northeast wetland**: 2.5 acres, 41.590151 -81.492966, ORAM Cat 2 mod: 36

**E10d: Hillandale Brush south-center wetland**: 1.5 acres, 41.589133 -81.492758, ORAM Cat 2 mod: 43
Wooded vernal pool

**E10e Hillandale Areas F & D wetland**: 1.2 acres, 41.590143 -81.490174, ORAM Cat 2: 53
3.3.2 Detailed Biological Conditions

Euclid-FLE holds no Ohio EPA monitoring locations and there is no TMDL. In consequence, the assessment unit has no available biological data. Biological health is likely impacted by habitat alterations due to surrounding urbanization and effects on sediment load, substrate embeddedness, and extreme stormwater flow fluctuations caused by channelized and culverted stream courses and impervious cover.

Ohio Rapid Assessment Method for Wetlands

The Ohio Rapid Assessment Method (ORAM) for Wetlands (Version 5.0) was developed by Ohio EPA as a rapid tool to assess the habitat quality of wetlands and make wetland category assignments. Categories are based on factors such as size, surrounding land use, hydrology, habitat alteration, plant communities, and the presence of special wetland types. Category 1 wetlands provide minimal wildlife habitat and hydrological functions and do not provide critical habitat for rare, threatened, or endangered species. Category 1 wetlands may also have low plant species diversity and a predominance of non-native plant species. Category 2 wetlands support moderate quality wildlife habitat and hydrological functions. Category 2 wetlands generally to not provide habitat for rare, threatened, or endangered species. Category 2 wetlands are comparable to Ohio EPA’s “warmwater habitat” stream designation. Category 2 also includes wetlands that are degraded but restorable (described as Modified Category 2 wetlands). Category 3 wetlands provide superior wildlife habitat and hydrological functions and typically support high levels of plant diversity, a high proportion of native species, and/or high functional values. Category 3 wetlands may also provide habitat for rare, threatened, or endangered species and may include rare habitats such as high quality mature forested wetlands, vernal pools, bogs, or fens (Ohio EPA 2001).

ORAM assessment data collected by Bluestone Heights and CRWP for this critical area are summarized in Table 13. Assessments indicate a range of wetland habitat quality in this critical area, suggesting that both preservation and restoration of wetland areas is needed.
Table 13. ORAM wetland assessment data collected in this critical area by Bluestone Heights and CRWP in 2017.

<table>
<thead>
<tr>
<th>Site ID</th>
<th>Site Description/Name</th>
<th>Hydrological Zone</th>
<th>Acres</th>
<th>GPS Coordinates</th>
<th>Assessment Score</th>
<th>Assessment Narrative</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>Lilly west Shrine pond</td>
<td>Escarpment</td>
<td>0.4</td>
<td>41.570671, -81.529690</td>
<td>36</td>
<td>Mod. Cat. 2</td>
</tr>
<tr>
<td>E2</td>
<td>Lilly east Knott pond</td>
<td>Escarpment</td>
<td>0.2</td>
<td>41.573864, -81.521437</td>
<td>26</td>
<td>Cat. 1</td>
</tr>
<tr>
<td>E3</td>
<td>Lilly east shelf</td>
<td>Escarpment</td>
<td>7.25</td>
<td>41.575579, -81.514192</td>
<td>65</td>
<td>Cat. 3</td>
</tr>
<tr>
<td>E6</td>
<td>Babbitt west retention basin</td>
<td>Escarpment</td>
<td>0.36</td>
<td>41.581807, -81.504801</td>
<td>52</td>
<td>Cat. 2</td>
</tr>
<tr>
<td>T5</td>
<td>Lilly east Nickel Plate basin</td>
<td>Terrace</td>
<td>1.28</td>
<td>41.583795, -81.517724</td>
<td>26</td>
<td>Cat. 1</td>
</tr>
<tr>
<td>T6-T7</td>
<td>Lilly east retention basin</td>
<td>Terrace</td>
<td>1.1</td>
<td>41.581672, -81.513607</td>
<td>44</td>
<td>Mod. Cat. 2</td>
</tr>
<tr>
<td>T8</td>
<td>Tungsten playground</td>
<td>Terrace</td>
<td>0.99</td>
<td>41.591969, -81.505237</td>
<td>35</td>
<td>Mod. Cat. 2</td>
</tr>
</tbody>
</table>

Suspected causes of impairment for escarpment and terrace wetlands in Critical Area 3 include habitat alterations and pollutants in urban stormwater. Suspected impairment sources include impervious surfaces, combined sewer overflows, and urban runoff/storm sewers. Many wetlands are impacted by heavy cover of invasive plant species.

Headwater Habitat Evaluation Index (HHEI)

The Ohio EPA Primary Headwater Habitat Evaluation Index (HHEI) for headwater streams was performed at several escarpment ravines. The HHEI was developed to assess and classify the quality of primary headwater streams (streams draining ≤ 1 square mile). Classification is based on the type of biological community that may be supported by the stream and include the following stream classes: Class I (ephemeral streams with no significant habitat and limited potential to achieve higher class functions), Class II (typically intermittent streams that support moderate biological diversity of warmwater species seasonally or year-round), and Class III (perennial streams influenced by groundwater and exhibiting moderately to highly diverse biological diversity year-round, including coldwater species). Biological assessments further classify Class III primary headwater streams. Streams can also be classified as Modified Primary Headwater Habitat (PHWH) if they are channelized, if other permanent channel modifications exist, or if permanent structures impound free-flowing water. Rheocrene streams are those where groundwater springs have formed a well-defined channel. Streams are identified has having potential rheocrene habitat if they have constant flowing water, a defined bed and bank, and a watershed size ≤0.1 square mile. A biological assessment should be used to evaluate the biological diversity of streams with potential rheocrene habitat.

HHEI assessment data collected by Bluestone Heights and CRWP for this critical area are summarized in Table 14. All assessments indicate Class II PHWH streams or streams with rheocrene potential where additional biological monitoring should be conducted. This data suggests that these stream segments have the potential to support warmwater biological communities, but this should be confirmed through biological monitoring.
Table 14. HHEI and ORAM assessment data collected in this critical area by Bluestone Heights and CRWP in 2017.

<table>
<thead>
<tr>
<th>Site ID</th>
<th>Site Description/Name</th>
<th>Hydrological Zone</th>
<th>Acres</th>
<th>GPS Coordinates</th>
<th>Assessment Type</th>
<th>Assessment Score</th>
<th>Assessment Narrative</th>
</tr>
</thead>
<tbody>
<tr>
<td>E10 (1)</td>
<td>Hillandale Burk Run escarpment ravine downstream moraine</td>
<td>Escarpment</td>
<td>89</td>
<td>41.589361-81.490648</td>
<td>HHEI</td>
<td>62</td>
<td>Rheocrene potential</td>
</tr>
<tr>
<td>E10 (2)</td>
<td>Hillandale Burk Run small branch</td>
<td>Escarpment</td>
<td>6.4</td>
<td>41.589731-81.490667</td>
<td>HHEI</td>
<td>43</td>
<td>Class II PHWH</td>
</tr>
<tr>
<td>E10 (3)</td>
<td>Hillandale Burk Run escarpment ravine upstream shale</td>
<td>Escarpment</td>
<td>32</td>
<td>41.588278-81.490444</td>
<td>HHEI</td>
<td>65</td>
<td>Class III PHWH</td>
</tr>
<tr>
<td>E10a</td>
<td>Hillandale wetland 1</td>
<td>Escarpment</td>
<td>0.2</td>
<td>41.589530-81.494028</td>
<td>ORAM</td>
<td>41</td>
<td>Mod. Cat. 2</td>
</tr>
<tr>
<td>E10b</td>
<td>Hillandale wetland 2</td>
<td>Escarpment</td>
<td>0.75</td>
<td>41.587941-81.492773</td>
<td>ORAM</td>
<td>63</td>
<td>Cat. 3</td>
</tr>
<tr>
<td>E10c</td>
<td>Hillandale Brush northeast wetland</td>
<td>Escarpment</td>
<td>2.5</td>
<td>41.590151-81.492966</td>
<td>ORAM</td>
<td>36</td>
<td>Mod. Cat. 2</td>
</tr>
<tr>
<td>E10d</td>
<td>Hillandale Brush south-center wetland</td>
<td>Escarpment</td>
<td>1.5</td>
<td>41.589133-81.492758</td>
<td>ORAM</td>
<td>43</td>
<td>Mod. Cat. 2</td>
</tr>
<tr>
<td>E10e</td>
<td>Hillandale Areas F &amp; D wetland</td>
<td>Escarpment</td>
<td>1.2</td>
<td>41.590143-81.490174</td>
<td>ORAM</td>
<td>53</td>
<td>Cat. 2</td>
</tr>
<tr>
<td>T10</td>
<td>Euclid spur borrow pit</td>
<td>Terrace</td>
<td>8.14</td>
<td>41.599735-81.490312</td>
<td>ORAM</td>
<td>45</td>
<td>Cat. 2</td>
</tr>
<tr>
<td>T11a</td>
<td>Chase channel</td>
<td>Terrace</td>
<td>8.1</td>
<td>41.601436-81.492228</td>
<td>ORAM</td>
<td>52</td>
<td>Cat. 2</td>
</tr>
<tr>
<td>T11b</td>
<td>Chase channel</td>
<td>Terrace</td>
<td>8.1</td>
<td>41.602252-81.492515</td>
<td>ORAM</td>
<td>64</td>
<td>Cat. 3</td>
</tr>
<tr>
<td>T12</td>
<td>Cuy-La clay pit</td>
<td>Terrace</td>
<td>6.8</td>
<td>41.604034-81.488976</td>
<td>ORAM</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

3.3.3 Detailed Causes and Associated Sources

Suspected causes of impairment for Critical Area 2 include habitat alterations and pollutants in urban stormwater. Suspected impairment sources include impervious surfaces, combined sewer overflows, and urban runoff/storm sewers. Many wetlands are impacted by heavy cover of invasive plant species.

3.3.4 Outline Goals and Objectives for Critical Area 2 (Wetland Restoration)

Goals

Due to the lack of Ohio EPA monitoring data and unknown attainment status for Euclid-FLE, nonpoint source restoration goals are developed to improve IBI and MIWB scores so that two non-attaining sites on Lake Erie can achieve full attainment of exceptional warmwater habitat (EWH). It is recommended that fish and macroinvertebrate diversity and ALU be assessed for this watershed unit in the future, after which goals may be
based on achieving full attainment of the ALU for this watershed unit. The goals for this critical area are as follows:

**GOAL 1.** Create and maintain greenspaces to reduce effective impervious cover to <25% for the watershed unit. This is included as one of the draft regional goals of the Central Lake Erie Basin Collaborative.  
**Not Achieved:** Impervious cover for the watershed unit currently exceeds 25%

**GOAL 2.** Achieve a VIBI score or ≥45 at Lilly west Shrine pond (E1) to achieve wetland ALU of Restorable Wetland Habitat (RWLH) or greater.  
**Not Achieved:** Wetland currently identified as Modified Category 2 and assumed VIBI score of <45

**GOAL 3.** Achieve a VIBI score or ≥45 at Lilly east Knott pond (E2) to achieve wetland ALU of Restorable Wetland Habitat (RWLH) or greater.  
**Not Achieved:** Wetland currently identified as Category 1 and assumed VIBI score of <30

**GOAL 4.** Achieve a VIBI score or ≥45 at Lilly east shelf (E3) to achieve wetland ALU of Restorable Wetland Habitat (RWLH) or greater.  
**Achieved:** Wetland currently identified as Category 3 and assumed VIBI score of >45 (VIBI assessment should be conducted to confirm)

**GOAL 5.** Achieve a VIBI score or ≥45 at Babbitt west retention basin (E6) to achieve wetland ALU of Restorable Wetland Habitat (RWLH) or greater.  
**Not Achieved:** Wetland currently identified as Category 2 and assumed VIBI score of <45

**GOAL 6.** Achieve a VIBI score or ≥45 at Lilly east Nickel Plate basin (T5) to achieve wetland ALU of Restorable Wetland Habitat (RWLH) or greater.  
**Not Achieved:** Wetland currently identified as Category 1 and assumed VIBI score of <30

**GOAL 7.** Achieve a VIBI score or ≥45 at Lilly east retention basin (T6-T7) to achieve wetland ALU of Restorable Wetland Habitat (RWLH) or greater.  
**Not Achieved:** Wetland currently identified as Modified Category 2 and assumed VIBI score of <45

**GOAL 8.** Achieve a VIBI score or ≥45 at Tungsten playground (T8) to achieve wetland ALU of Restorable Wetland Habitat (RWLH) or greater.  
**Not Achieved:** Wetland currently identified as Modified Category 2 and assumed VIBI score of <45

**GOAL 9.** Achieve a VIBI score or ≥45 at Hillandale wetland 1 (E10a) to achieve wetland ALU of Restorable Wetland Habitat (RWLH) or greater.  
**Not Achieved:** Wetland currently identified as Modified Category 2 and assumed VIBI score of <45

**GOAL 10.** Achieve a VIBI score or ≥45 at Hillandale wetland 2 (E10b) to achieve wetland ALU of Restorable Wetland Habitat (RWLH) or greater.  
**Achieved:** Wetland currently identified as Category 3 and assumed VIBI score of >45 (VIBI assessment should be conducted to confirm)
GOAL 11. Achieve a VIBI score or ≥45 at Hillandale Brush northeast wetland (E10c) to achieve wetland ALU of Restorable Wetland Habitat (RWLH) or greater.
Not Achieved: Wetland currently identified as Modified Category 2 and assumed VIBI score of <45

GOAL 12. Achieve a VIBI score or ≥45 at Hillandale Brush south-center wetland (E10d) to achieve wetland ALU of Restorable Wetland Habitat (RWLH) or greater.
Not Achieved: Wetland currently identified as Modified Category 2 and assumed VIBI score of <45

GOAL 13. Achieve a VIBI score or ≥45 at Hillandale Areas F & D wetland (E10e) to achieve wetland ALU of Restorable Wetland Habitat (RWLH) or greater.
Achieved: Wetland currently identified as Category 2 and assumed VIBI score of >45 (VIBI assessment should be conducted to confirm)

GOAL 14. Achieve a VIBI score or ≥45 at Euclid spur borrow pit (T10) to achieve wetland ALU of Restorable Wetland Habitat (RWLH) or greater.
Achieved: Wetland currently identified as Category 2 and assumed VIBI score of >45 (VIBI assessment should be conducted to confirm)

GOAL 15. Achieve a VIBI score or ≥45 at Chase channel (T11a) to achieve wetland ALU of Restorable Wetland Habitat (RWLH) or greater.
Achieved: Wetland currently identified as Category 2 and assumed VIBI score of >45 (VIBI assessment should be conducted to confirm)

GOAL 16. Achieve a VIBI score or ≥45 at Chase channel (T11b) to achieve wetland ALU of Restorable Wetland Habitat (RWLH) or greater.
Achieved: Wetland currently identified as Category 3 and assumed VIBI score of >45 (VIBI assessment should be conducted to confirm)

Objectives
To achieve these goals for Critical Area 2, the following objectives need to be achieved:

OBJECTIVE 1: Reforest 10.4 acres of wetland buffer areas with native vegetation.

OBJECTIVE 2: Restore 7.25 acres of wetland habitat, including removal and treatment of non-native invasive plant species.*
*This objective is based on estimated proportion of wetlands requiring restoration.

OBJECTIVE 3: Permanently protect 8 acres of wetland.
- Permanently protect wetland areas through fee-simple acquisition or conservation easements.
- Wetland setback adoption for Wickliffe.
- Wetland setback enforcement for Euclid.
Adoption of conservation development or other ordinances to protect streams, wetlands, riparian zones, and other sensitive areas as communities are developed or re-developed.

As these objectives are implemented, water quality monitoring (both project related and regularly scheduled monitoring) will 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. For instance; many agricultural BMPs can be “stacked” (a systems approach) that will also incrementally improve the quality and quantity of runoff and drainage waters and in-stream water quality. When reevaluating, the committee will reference the Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013), which has a complete listing of all eligible NPS management strategies to consider including:

- Urban Sediment and Nutrient Reduction Strategies;
- Altered Stream and Habitat Restoration Strategies;
- Nonpoint Source Reduction Strategies; and
- High Quality Waters Protection Strategies

3.4 Critical Area 3 (Green Infrastructure): Conditions, Goals & Objectives

Critical Area 3 includes opportunities to reduce impervious surface coverage and replace with green infrastructure in the watershed unit. Green infrastructure may include trees and other native vegetation, bioretention systems, rain gardens, permeable pavement, and other infiltrating practices that reduce stormwater runoff to streams and Lake Erie.

3.4.1 Detailed Characterization

Streams in this watershed unit have been impacted by increased stormwater loadings and resulting habitat impairments due to urban development. Primary headwater streams (identified as OEPA as headwater streams draining <1 square mile) are important for the health of downstream systems and the overall health of a watershed. Headwater streams provide several services to downstream systems, including the following: contribution of organic matter, reduction of stream siltation, habitat refugia for amphibians and unique aquatic species including coldwater taxa, and contribution of biodiversity and biomass to downstream reaches. Despite their importance for overall watershed health, primary headwater streams are particularly vulnerable to the effects of urban development. These effects include physical, chemical, and biological impacts due to nonpoint sources such as increased stormwater runoff and channel modification. Increased stormwater runoff leads to increased peak flows, flow variability, and frequency of high flows, all leading to impacts such as streambank erosion/siltation, channel incision, stream channel widening, and lower habitat diversity. Stormwater also contributes to warmer stream temperatures and impairs the chemical health of headwater streams and downstream reaches by carrying pollutants from the urban landscape (Davidson-Bennett 2011).

This watershed unit has significant impervious surface coverage; estimates for impervious cover range from approximately 40 – 60% coverage based on analysis through U.S. Geological Survey’s StreamStats tool. Aquatic communities have been demonstrated to show water quality and habitat impairments when their drainage area exceeds 10% impervious cover (Center for Watershed Protection, “Impervious Cover Model”). Additionally, the Central Lake Erie Basin Collaborative has developed draft regional goals for Central Lake Erie Basin watersheds, including reduction of effective impervious cover to <25% in highly impervious watersheds; this target is more realistic for this highly developed (97.7%) watershed unit (Ohio EPA Integrated Report 2018).

Lake Erie is influenced by the health of its many tributaries, including headwater streams, which can provide benefits to larger streams if they are high quality with adequate vegetated buffer. Headwater streams in this HUC-12 are impacted by urban development and are not currently providing benefits to larger streams and Lake Erie.
Instead, the significant presence of impervious surfaces and stormwater pollution in this watershed unit is leading to burdens on local and public stormwater systems and nonpoint source inputs such as nutrients and sediment to streams and Lake Erie.

3.4.2 Detailed Biological Conditions

Euclid-FLE holds no Ohio EPA monitoring locations and there is no TMDL. In consequence, the assessment unit has no available biological data. Given the level of impervious cover and general urban development in areas draining to streams, it may be assumed that all Euclid-FLE watercourses are in non-attainment of their aquatic life uses. There are Ohio EPA monitoring locations located on Lake Erie, slightly outside of the unit. These monitoring locations indicate non-attainment of exceptional warmwater habitat (EWH) for Lake Erie at these locations due to low fish diversity scores.

3.4.3 Detailed Causes and Associated Sources

Suspected causes of impairment for Critical Area 3 include habitat alterations and pollutants in urban stormwater. Suspected impairment sources include impervious surfaces, combined sewer overflows, and urban runoff/storm sewers.

3.4.4 Outline Goals and Objectives for Critical Area 3 (Green Infrastructure)

Goals

Due to the lack of Ohio EPA monitoring data and unknown attainment status for Euclid-FLE, nonpoint source restoration goals are developed to improve IBI and MIWB scores so that two non-attaining sites on Lake Erie can achieve full attainment of exceptional warmwater habitat (EWH). It is recommended that fish and macroinvertebrate diversity and ALU be assessed for this watershed unit in the future, after which goals may be based on achieving full attainment of the ALU for this watershed unit. The goals for this critical area are as follows:

**GOAL 1.** Create and maintain greenspaces to reduce effective impervious cover to <25% for the watershed unit. This is included as one of the draft regional goals of the Central Lake Erie Basin Collaborative. 

**Not Achieved:** Impervious cover for the watershed unit currently exceeds 25%

Objectives

To achieve these goals for Critical Area 3, the following objectives need to be achieved:

**OBJECTIVE 1:** Remove 250 acres of impervious surfaces and install infiltrative green infrastructure practices in areas draining to escarpment ravines, open streams, and wetlands to reduce stormwater volumes/flashiness and loads contributed by these impervious surfaces.*

- Install green infrastructure and stormwater retrofits (e.g. rain gardens, rain barrels, depaving and revegetation, downspout disconnection, bioretention, permeable pavement) on residential, commercial and institutional properties to reduce pollutant loads, stormwater volumes, and flashiness.
*This target was developed by determining the acreage of impervious surfaces that must be removed and replaced with green infrastructure in order to achieve <25% impervious coverage for the watershed unit. A 10% participation rate was applied to this acreage.*

As these objectives are implemented, water quality monitoring (both project related and regularly scheduled monitoring) will 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. For instance; many agricultural BMPs can be “stacked” (a systems approach) that will also incrementally improve the quality and quantity of runoff and drainage waters and in-stream water quality. When reevaluating, the committee will reference the Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013), which has a complete listing of all eligible NPS management strategies to consider including:
- Urban Sediment and Nutrient Reduction Strategies;
- Altered Stream and Habitat Restoration Strategies;
- Nonpoint Source Reduction Strategies; and
- High Quality Waters Protection Strategies

### 3.5 Critical Area 4 (Coastal Zone): Conditions, Goals & Objectives

Critical Area 4 covers the glacial till bluff areas and beaches touching directly upon Lake Erie (Figure 19). The critical area southern boundary follows that set by the Ohio Department of Natural Resources Lake Erie Coastal Zone, approximately following Lake Shore Boulevard.

The Coastal Zone has a high degree of residential land use which, during the last three decades, is trending upscale. During more than a century, fully 90% of the Euclid-FLE littoral has been armored for erosion control with strategies ranging from ineffective concrete rubble to more engineered revetments and seawalls (ODNR 2012). Many older erosion control structures need repair. The coastal zone reach from Euclid Creek to Sims Park is almost entirely protected by with erosion control structures and generally has a low erosion rate (ODNR 2012). All hydrological features show anthropogenic transformation, usually as degradation. Ecological process has been compromised in all Coastal Zone habitats. In that they are insulated from the effects of littoral erosion, the historical mouth ravines hold significant beaches. For this reach (Euclid Creek to Sims Park), ODNR recommends monitoring existing erosion control structures and limiting development along areas of natural shoreline where erosion and accretion may occur naturally. Other recommendations include sand conservation and management, toe protection, and bluff/bank modifications (ODNR 2012).

East of Sims Park, residential development is generally less intense and less upscale. Erosion control is less constant, dependent upon owners’ financial means. In Euclid, east of Sims Park, a significant new coastal zone conservation factor comes with the Euclid Waterfront Improvements (EWI) of 2018-2020. In its current form, the project provides erosion control, public access (littoral mixed use trail) and habitat enhancement along a shoreline reach 0.3 mi long, from Sims Park east to E 242nd St. In late 2019, the much-heralded EWI became the basis for a Cuyahoga County-wide plan for erosion control, public access and habitat enhancement. Governmental interest in western Lake County could extend this kind of project eastward into Willowick.

Of interest to NPS pollution reduction is habitat enhancement which depends upon new substrates, alternating between hard-immobile (boulder partial breakwaters and islands) and soft-mobile (sand/gravel/cobble tombolos). There are significant small embayments which, depending upon lake level, will provide some wetland and estuarine function. EWI also has a small bioretention feature within Sims Park. It may be possible to enhance the habitat and bioretention features as the future trend of lake levels becomes clear.
3.5.1 Detailed Characterization

Salt Run and Burnt House Brook have open course mouths of 0.21 and 0.11 mi, respectively. Under normal stream flow and lake swell conditions, the mouths of these courses develop small barrier bars at the beach. A back-beach lagoon with wetland characteristics is usually present. Strong northerly winds and swell conditions serve to inundate the courses with lake water. The inundations, laden with surf nutrients, can extend several hundred feet into the ravines. Incoming surf also concentrates woody and other debris within the stream channel. The opposite effect occurs as fluvial flooding overwhelms and scours the lagoons, pushing stream life into the lake. High lake levels increase inundation substantially. Given this type of storm-related hydrological coursing, the mouths of Salt Run and Burnt House Brook are herein called storm estuaries. Estuarine function can be enhanced in these streams. Creek Five has a mouth open course of 0.05 mi, perched too high to facilitate a storm estuary. Nevertheless, habitat enhancements are possible within the ravine.

Salt Run In the late 1940s, most of the Salt Run west branch flow was culverted under Lloyd Road with the outfall placed at the foot of this way. Currently, the east branch exits from its culvert approximately 700 feet from the lake. The shoreline ravine is served only by this reduced flow. Suspected causes of impairment for the Salt Run shoreline ravine include habitat alterations due to stream bed scouring and entrenchment, stream bank erosion and downstream sedimentation. The primary upstream source of habitat impairment is flash flood flows generated on impervious surfaces.
Burnt House Brook  This stream is mostly open within the coastal zone but is greatly transformed. Historical maps show several entrenched meanders with floodplain along a total of 1,500 feet. In the last several years, the shoreline ravine has been shortened, straightened and armored with heavy limestone riprap for nearly all its length, now just 800 feet (Figure 20).
3.5.2 Detailed Biological Conditions

Euclid-FLE holds no Ohio EPA monitoring locations and there is no TMDL. In consequence, the assessment unit has no available biological data. However, two Ohio EPA monitoring locations are located on Lake Erie, slightly outside of the unit. These monitoring locations indicate non-attainment of exceptional warmwater habitat (EWH) for Lake Erie at these locations due to low fish diversity scores (Table 15). Within Critical Area 4, biological health is likely impacted by habitat alterations due to surrounding urbanization and effects on sediment load, substrate embeddedness, and extreme stormwater flow fluctuations caused by channelized and culverted stream courses and impervious cover.

Table 15. Ohio EPA monitoring data for two monitoring locations on Lake Erie slightly outside of the HUC12. (Data source: “Euclid Area Fish Metrics” Spreadsheet, Ohio EPA).

<table>
<thead>
<tr>
<th>Station Name</th>
<th>Year Fish Monitored</th>
<th>L-IBI Score</th>
<th>MIWB Score</th>
<th>Aquatic Life Use</th>
<th>Attainment Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAKE ERIE, E OF EUCLID CREEK</td>
<td>2014</td>
<td>38</td>
<td>7.38</td>
<td>EWH</td>
<td>Non</td>
</tr>
<tr>
<td>LAKE ERIE SHORELINE 1.0 MI. EAST OF EUCLID WWTP</td>
<td>1997</td>
<td>34</td>
<td>5.7</td>
<td>EWH</td>
<td>Non</td>
</tr>
</tbody>
</table>
3.5.3 Detailed Causes and Associated Sources

The Coastal Zone covers less than 10% of the area of the assessment unit. The individual stream segments within the zone represent less than 10% of their full lengths. The chemical and biological conditions of these streams are therefore determined upstream of the Coastal Zone. The primary upstream source of habitat impairment is flash flood flows generated on impervious surfaces. Most of the culverted streams have CSO outfalls upstream of the Coastal Zone boundary; these are a primary suspected source of chemical and biological impairment.

Suspected causes of impairment within the critical area include habitat alterations, flow regime modifications, and pollutants in urban stormwater. Suspected sources of impairment at these sites include municipal (urbanized high-density area), sediment resuspension (contaminated sediment), combined sewer overflows, channelization, and urban runoff/storm sewers.

3.5.4 Outline Goals and Objectives for Critical Area 4 (Coastal Zone)

Goals

Due to the lack of Ohio EPA monitoring data and unknown attainment status for Euclid-FLE, nonpoint source restoration goals are developed to improve IBI and MIWB scores so that two non-attaining sites on Lake Erie can achieve full attainment of exceptional warmwater habitat (EWH). It is recommended that fish and macroinvertebrate diversity and ALU be assessed for this watershed unit in the future, after which goals may be based on achieving full attainment of the ALU for this watershed unit. The goals for this critical area are as follows:

GOAL 1. Achieve an L-IBI score of 42 for attainment of exceptional warmwater habitat at Lake Erie, E of Euclid Creek (OEPA Lake Erie Shoreline Target for rubble nearshore habitat, Ohio EPA, 1999)
   Not Achieved: Current score is 38 (Ohio EPA, 2014)

GOAL 2. Achieve a MIWB score of 8.9 for attainment of exceptional warmwater habitat at Lake Erie, E of Euclid Creek (OEPA Lake Erie Shoreline Target for rubble nearshore habitat, Ohio EPA, 1999)
   Not Achieved: Current score is 7.38 (Ohio EPA, 2014)

GOAL 3. Achieve an L-IBI score of 42 for attainment of exceptional warmwater habitat at Lake Erie, 1.0 mile E of Euclid WWTP (OEPA Lake Erie Shoreline Target for rubble nearshore habitat, Ohio EPA, 1999)
   Not Achieved: Current score is 34 (Ohio EPA, 1997)

GOAL 4. Achieve a MIWB score of 8.9 at Lake Erie Shoreline 2.0 Mi. East of Chagrin R. (OEPA Lake Erie Shoreline Target for rubble nearshore habitat, Ohio EPA, 1999)
   Not Achieved: Current score is 5.7 (Ohio EPA, 1997)

Objectives

To achieve these goals for Critical Area 4, the following objectives need to be achieved:
OBJECTIVE 1: Restore and/or enhance 5,362 linear feet of Lake Erie coastline and estuarine habitat using bioengineering techniques including revegetation with native plantings.

As these objectives are implemented, water quality monitoring (both project related and regularly scheduled monitoring) will 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. For instance; many agricultural BMPs can be “stacked” (a systems approach) that will also incrementally improve the quality and quantity of runoff and drainage waters and in-stream water quality. When reevaluating, the committee will reference the Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013), which has a complete listing of all eligible NPS management strategies to consider including:
- Urban Sediment and Nutrient Reduction Strategies;
- Altered Stream and Habitat Restoration Strategies;
- Nonpoint Source Reduction Strategies; and
- High Quality Waters Protection Strategies

Chapter 4: Projects and Implementation Strategy

4.1 Critical Area 1: Overview Table and Project Sheets

This section outlines projects and evaluations that are believed to be necessary to remove the impairments to the City of Euclid-Frontal Lake Erie assessment unit as a result of the suspected, identified causes and associated sources of nonpoint source pollution. Because attainment status is based on biological conditions, it will be necessary to periodically re-evaluate the status of the critical area to determine if the implemented projects are enough to achieve restoration. Time is an important factor to consider when measuring project success and overall status. Biological systems in some cases can show response quickly (i.e., one season); others system may take longer (i.e., several seasons, years) to show recovery. There may also be reasons other than nonpoint source pollution for the impairment. Those issues will need to be addressed under different initiatives, authorities, or programs which may or may not be accomplished by the same implementers addressing the nonpoint source pollution issues.

The projects described in the Overview Table have been prioritized using the following three step prioritization method:

Priority 1: Projects that specifically address one or more of the listed Objectives for the Critical Area.

Priority 2: Projects where there is land-owner willingness to engage in projects that are designed to address the cause(s) and source(s) of impairment or where there is an expectation that such potential projects will improve water quality in one of the assessment unit’s waterways

Priority 3: Input from the public on water quality issues and/or project ideas gathered from key stakeholders will be evaluated for potential project development and implementation.
For *City of Euclid-Frontal Lake Erie HUC-12* (041100030502)

<table>
<thead>
<tr>
<th>Applicable Critical Area</th>
<th>Goal</th>
<th>Objective</th>
<th>Project #</th>
<th>Project Title <em>(EPA Criteria g)</em></th>
<th>Lead Organization <em>(criteria d)</em></th>
<th>Time Frame <em>(EPA Criteria f)</em></th>
<th>Estimated Cost <em>(EPA Criteria d)</em></th>
<th>Potential/Actual Funding Source <em>(EPA Criteria d)</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Urban Sediment and Nutrient Reduction Strategies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1, 2</td>
<td>2</td>
<td>1</td>
<td>Lilly West Shrine Pond Restoration</td>
<td>Bluestone Heights; City of Euclid</td>
<td>1 - 3 years</td>
<td>$250,000</td>
<td>319; GLRI; SWIF; SOGL; H2Ohio; private foundations</td>
</tr>
<tr>
<td>2</td>
<td>1, 3</td>
<td>2</td>
<td>2</td>
<td>Lilly East Knott Pond Restoration</td>
<td>Bluestone Heights; City of Euclid</td>
<td>1 - 3 years</td>
<td>$200,000</td>
<td>319; GLRI; SWIF; SOGL; H2Ohio</td>
</tr>
<tr>
<td>1</td>
<td>1-4</td>
<td>1-3</td>
<td>3</td>
<td>Sherwood-Oakhill Shelf Restoration</td>
<td>Bluestone Heights; City of Euclid</td>
<td>3 – 7 years</td>
<td>$250,000</td>
<td>319; GLRI; SWIF; SOGL</td>
</tr>
<tr>
<td>2</td>
<td>1, 5</td>
<td>2</td>
<td>4</td>
<td>Babbitt West Retention Basin Restoration</td>
<td>Bluestone Heights; City of Euclid</td>
<td>3 – 7 years</td>
<td>$750,000</td>
<td>319; GLRI; SWIF; SOGL; H2Ohio</td>
</tr>
</tbody>
</table>

<p>| <strong>Altered Stream and Habitat Restoration Strategies</strong> | | | | | | | | |
| 2                        | 1, 2 | 2         | 1         | Lilly West Shrine Pond Restoration | Bluestone Heights; City of Euclid | 1 - 3 years                  | $250,000                          | 319; GLRI; SWIF; SOGL; H2Ohio; private foundations |
| 2                        | 1, 3 | 2         | 2         | Lilly East Knott Pond Restoration | Bluestone Heights; City of Euclid | 1 - 3 years                  | $200,000                          | 319; GLRI; SWIF; SOGL; H2Ohio |
| 1                        | 1-4  | 1-3       | 3         | Sherwood-Oakhill Shelf Restoration | Bluestone Heights; City of Euclid | 3 – 7 years                  | $250,000                          | 319; GLRI; SWIF; SOGL |
| 2                        | 1, 5 | 2         | 4         | Babbitt West Retention Basin Restoration | Bluestone Heights; City of Euclid | 3 – 7 years                  | $750,000                          | 319; GLRI; SWIF; SOGL; H2Ohio |</p>
<table>
<thead>
<tr>
<th>#</th>
<th>Page</th>
<th>Range</th>
<th>Priority</th>
<th>Description</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Budget</th>
<th>Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1-9</td>
<td>2</td>
<td>5</td>
<td>Burk escarpment Hillandale Wetland Restoration and Protection</td>
<td>Bluestone Heights; City of Euclid; private landowner</td>
<td>3 – 7 years</td>
<td>$800,000</td>
<td>319; GLRI; SWIF; SOGL; H2Ohio</td>
</tr>
<tr>
<td>2</td>
<td>1,7</td>
<td>2</td>
<td>6</td>
<td>Lilly East Terrace Wetland Restoration</td>
<td>Bluestone Heights; City of Euclid; private landowner</td>
<td>3 – 7 years</td>
<td>$400,000</td>
<td>319; GLRI; SWIF; SOGL; H2Ohio; private landowner</td>
</tr>
<tr>
<td>2</td>
<td>1,8</td>
<td>2</td>
<td>7</td>
<td>Babbitt West Tungsten Playground Wetland Restoration</td>
<td>Bluestone Heights; City of Euclid</td>
<td>1 - 3 years</td>
<td>$200,000</td>
<td>319; GLRI; SWIF; SOGL; H2Ohio</td>
</tr>
<tr>
<td>1</td>
<td>1-4</td>
<td>1-3</td>
<td>8</td>
<td>Burnt House Brook East Lake Health Escarpment Ravine Restoration</td>
<td>Bluestone Heights; CRWP; City of Willowby</td>
<td>3 – 7 years</td>
<td>$500,000</td>
<td>319; GLRI; SWIF; SOGL; private landowner</td>
</tr>
<tr>
<td>4</td>
<td>1-4</td>
<td>1</td>
<td>9</td>
<td>Salt Run Mouth Restoration</td>
<td>Bluestone Heights; City of Euclid; private landowner</td>
<td>3 – 7 years</td>
<td>$750,000</td>
<td>319; GLRI; SWIF; SOGL; private landowner</td>
</tr>
<tr>
<td>4</td>
<td>1-4</td>
<td>1</td>
<td>10</td>
<td>Burnt House Brook Mouth Restoration</td>
<td>Bluestone Heights; CRWP; City of Willowick; private landowner</td>
<td>3 – 7 years</td>
<td>$1,000,000</td>
<td>319; GLRI; SWIF; SOGL; private landowner</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td>11</td>
<td>Coastal Zone Ravine and Wetland Enhancement; Community Bioretention</td>
<td>Bluestone Heights; City of Euclid; private landowners</td>
<td>1 - 3 years</td>
<td>$305,800</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td>12</td>
<td>City of Euclid Service Complex Green Infrastructure Improvements</td>
<td>Bluestone Heights; City of Euclid</td>
<td>3 – 7 years</td>
<td>$150,000</td>
</tr>
<tr>
<td>4</td>
<td>1-4</td>
<td>1</td>
<td></td>
<td>13</td>
<td>East Shore Park Club Coastal Stabilization</td>
<td>Bluestone Heights; City of Cleveland; East Shore Park Club</td>
<td>3 – 7 years</td>
<td>$400,000</td>
</tr>
</tbody>
</table>

**Agricultural Nonpoint Source Reduction Strategies**

**High Quality Waters Protection Strategies**

<p>| | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-4</td>
<td>3</td>
<td></td>
<td>13</td>
<td>Burnt House Brook Tributary Preservation - Willoughby-Eastlake Transportation Center</td>
<td>Bluestone Heights; City of Euclid; private landowner</td>
<td>3 – 7 years</td>
</tr>
</tbody>
</table>

**Other NPS Causes and Associated Sources of Impairment**

*Table 13: Project Overview Table*
### 4.2 Project Summary Sheets

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).

<table>
<thead>
<tr>
<th>Nine Element Criteria</th>
<th>Information needed</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/a</td>
<td>Title</td>
<td>Coastal Zone Ravine and Wetland Enhancement; Community Bioretention</td>
</tr>
<tr>
<td>criteria d</td>
<td>Project Lead Organization &amp; Partners</td>
<td>City of Euclid; Bluestone Heights; private landowners</td>
</tr>
<tr>
<td>criteria c</td>
<td>HUC-12 and Critical Area</td>
<td>City of Euclid-Frontal Lake Erie (HUC-12: 04110003 05 02); Critical Area 3</td>
</tr>
</tbody>
</table>
| criteria c            | Location of Project | Coordinates: 41.616829, -81.517498  
The project site is located near the intersection of Lakeshore Boulevard and Luikart Drive in the City of Euclid. |
| n/a                   | Which strategy is being addressed by this project? | Reduce stormwater runoff |
| criteria f            | Time Frame         | Short-Term (Priority) (1-3 yr) |
| criteria g            | Short Description  | The Cody project is an extension of the Euclid Waterfront Improvements (EWI) currently under construction. The two-acre Cody parcel is the EWI staging area. The Cody project focuses on partially reopening the buried ravine (but not daylighting the stream) and neighboring wetland depressions. It provides community bioretention for ~24,000 sq ft of impermeable surfaces on adjacent private land. It also revegetates the two acres as a wetland forest. The goal is to enhance the runoff control potential of legacy watershed features. As part of EWI staging restoration, results are obtained at minimum expense and landscape disruption. |
| criteria g            | Project Narrative  | Euclid Waterfront Improvements Phase 2 is implementing erosion control and a littoral trail along the Moss Point Lake Erie bluff. The trail will run ~3,000 ft from 23131 Lake Shore Blvd (Sims Park) to 24701 LSB. With initial construction (Phase 2a) complete in late 2019, a north-south connector trail will be built on the City-owned Cody parcel at 23701 LSB. Sited near littoral trail midpoint, the connector will traverse the length of the 2-acre Cody parcel from Lake Shore Blvd to bluff base. During Phase 2 construction, the Cody parcel functions as a staging area and is highly transformed. The Cody project addresses legacy stormwater issues on the parcel as it is restored from staging.  
**Cody parcel hydrology**  
The long, narrow Cody parcel (~930 ft N-S x 92 ft E-W) lies in the Euclid-FLE Creek 5 sub-watershed and traverses the buried stream course ~600 ft north of Lake Shore Blvd. Historically, the stream cut a 90-ft-wide, 14-ft deep ravine across the parcel; all surfaces, north and south, drained to the ravine. During the 1930s, the stream was culverted and the ravine filled in. As such, Cody parcel historical sewers (now abandoned) were diverted south to join the City sewer system at |
Lake Shore Blvd. Phase 2 construction has further transformed the Cody landscape. A heavy equipment staging area now occupies 0.8 acres (36,000 sq ft) in the northern zone which includes the buried ravine. The staging area has been excavated to depth of 18” and filled with coarse gravel.

The Cody parcel west boundary abuts nine residences on the east side of Luikart Dr. Most lots have accumulated topsoil enough to lie a few inches above Cody grade level. Lot fronts drain westward to the street; lot rears run eastward to Cody. Collectively, the lots have ~24,000 sq ft of impermeable roofs and driveways that drain westward into the City sewer system at the Luikart Dr centerline.

Upon completing Phase 2 construction (mid-year 2020), the whole parcel will be restored to a parklike setting. In this context, the Cody project adapts staging area restoration to: 1) restore the Creek 5 legacy riparian corridor and small wetlands; 2) establish bioretention for the Luikart east impermeable surfaces. The project focuses on three legacy landscape features:

1) Concrete driveway trench. On the west side of Cody, an early 1960s concrete driveway runs north, 480 linear ft from Lake Shore Blvd to the south edge of the old ravine. The driveway is 10 ft wide and 15 in thick with bedding. Upon Phase 2 completion, the driveway will be removed, leaving a below-grade trench of ~5,000 cu ft directly behind (3 ft east of) the Luikart east houses and garages.

2) Creek 5 buried ravine. As it spanned the Cody parcel, 92 ft E-W, the natural ravine was ~90 ft wide (N-S) and 12-14 ft deep. It was filled completely during the early 1960s with material excavated for the driveway, a swimming pool and a house basement (latter two now demolished). The gravel staging area now covers the ravine segment. Upon Phase 2 completion, the gravel will be removed and the legacy ravine footprint exposed.

3) Natural dampness. The north end of the parcel was planted in grapevines during the late nineteenth century but was soon let go to fallow; a dense stand of catalpa trees took over (now removed to create the staging area). During the twentieth century, Cody held several depressions with vernal pool features; these may indicate the reemergent natural condition. Dampness may be a reason that the northern end never held a residence—a rare occurrence on the Euclid shoreline. As the Cody parcel is restored, its inherent dampness can be managed to benefit local natural habitat.

**Project components**
The Cody project restores or enhances four small yet significant hydrological features:

1) N-S bioswale. With the concrete driveway removed, the resulting trench would 480 ft long, 10 ft wide and more than a foot deep. With the staging area gravel removed, the driveway trench can be extended northward another 350 ft. The full feature would be a below-grade bioswale 830 ft long with 9,000 cu ft of capacity, located a few feet behind the Luikart east hard surfaces. As storage is large and stretches several hundreds of feet, pooling should be minimal. Basal soil may need little or no amending to enhance infiltration. With shallow grading and grassy vegetation, the swale can be mowed two or three times during the summer months, or planted with herbaceous plants, shrubs and trees. The primary expense arrives in redirecting downspout and driveway drains toward the east.
2) E-W bioswale. Upon Phase 2 completion, the area above the Creek 5 culvert can be excavated to provide an eastward extension of the N-S bioswale to the Larick property line. Measuring 80 ft long and 18 ft wide and ~1 ft deep, the E-W bioswale can provide a storage capacity of ~1,000 cu ft. Just 10 ft east of the Larick line (on Larick property), a legacy manhole can serve as a combined swale overflow leading directly into the Creek 5 culvert. Small expense may arrive in disposing of surplus excavated earth.

3) Ghost ravine. Coinciding with the E-W bioswale, areas 35 ft north and south of the culvert centerline can be graded to drain into the swale. This would reestablish a shallow (1 ft deep) ravine segment of 0.18 acre surrounding the E-W bioswale. With this inward grading on Cody, Creek 5 would have a continuous, inward-draining ghost ravine extending some 600 linear ft and covering ~0.98 acre. The corridor would traverse Stevenson (City-owned), Larick (privately owned) and Cody (City-owned) parcels. Small expense may arrive in disposing of surplus excavated earth.

4) Small wetlands. Up to three wetlands of 0.10-acre each can be created on the Cody parcel. A north feature can achieve depth through removing the staging area gravel infill. A central wetland can form where the prior demolition of two houses and swimming pool has left a depression. A southern feature can occupy a current low spot. Small expense may arrive in disposing of surplus excavated earth.

**Significance**

On the City of Euclid’s Cody parcel, a ghost ravine segment and small wetlands can be rehabilitated from a highly transformed construction zone. The Cody project rehabilitates small legacy hydrological features in a compromised part of the Creek 5 watershed. The project also adds community bioretention to a trail corridor on public land. The bioretention component will sequester impermeable surface runoff from the immediately adjacent Luikart east residences. With capacity of ~10,000 cu ft, the bioswales likely provide more than what is needed for Luikart east. Should the project demonstrate surplus capacity, Luikart west downspouts and driveway drains could eventually be directed to the Cody bioswales and wetlands.
### Estimated Total Cost

Total estimated project cost: $305,800

Costs may need to be updated at time of grant application.

### Possible Funding Source

Ohio EPA Section 319 Grant Program; Great Lakes Restoration Initiative; Sustain Our Great Lakes program; private foundations

### Identified Causes and Sources

Causes of impairment for Lake Erie shoreline 2.0 miles east of Chagrin River:

- Not identified by Ohio EPA

Sources of impairment for Lake Erie shoreline 2.0 miles east of Chagrin River:

- Not identified by Ohio EPA

### Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?

One objective to reach the goals of Critical Area 3 is to remove 250 acres of impervious surfaces and install infiltrative green infrastructure practices in areas draining to escarpment ravines, open streams, and wetlands to reduce stormwater volumes/flashiness and loads contributed by these impervious surfaces (Objective 1).

### Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?

This project will reduce 0.6 acres of impervious surfaces and meet 0.2% of the green infrastructure target (Objective 1) for Critical Area 3.

### Part 3: Load Reduced?

Total estimated load reductions for this project:

- Sediment: 181 tons/year
- Phosphorus: 760 pounds/year
- Nitrogen: 4,518 pounds/year
How will the effectiveness of this project in addressing the NPS impairment be measured?

The success of this project will be evaluated by project partners in the following ways:

1) Effective reduction of impervious surfaces and associated stormwater inputs to local storm sewer system.
2) Proper establishment of bioretention vegetation.
3) Feedback from collaborators regarding attainment of project goals and objectives.

Success will also be measured by contributing to achievement of full attainment of exceptional warmwater habitat for Lake Erie, E of Euclid Creek and Lake Erie shoreline 1.0 mile east of Euclid WWTP. This sampling will be conducted by Ohio EPA.

<table>
<thead>
<tr>
<th>Nine Element Criteria</th>
<th>Information needed</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/a</td>
<td>Title</td>
<td>Lilly Creek West/Our Lady of Lourdes Shrine Green Infrastructure Project</td>
</tr>
<tr>
<td>criteria d</td>
<td>Project Lead Organization &amp; Partners</td>
<td>City of Euclid; Bluestone Heights; Our Lady of Lourdes Shrine</td>
</tr>
<tr>
<td>criteria c</td>
<td>HUC-12 and Critical Area</td>
<td>City of Euclid-Frontal Lake Erie (HUC-12: 04110003 05 02); Critical Area 3</td>
</tr>
<tr>
<td>criteria c</td>
<td>Location of Project</td>
<td>Coordinates: 41.568920, -81.530368</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The project site is located on property owned by the Our Lady of Lourdes Shrine near the intersection of Euclid Avenue and East 214th Street in the City of Euclid.</td>
</tr>
<tr>
<td>n/a</td>
<td>Which strategy is being addressed by this project?</td>
<td>Passively Treat Stormwater Runoff</td>
</tr>
<tr>
<td>criteria f</td>
<td>Time Frame</td>
<td>Short-Term (Priority) (1-3 yr)</td>
</tr>
<tr>
<td>criteria g</td>
<td>Short Description</td>
<td>This project will install green infrastructure at the Our Lady of Lourdes Shrine campus to capture, treat, and infiltrate stormwater runoff at this site. This project will help reduce the volume of stormwater flowing over an eroding slope and reduce stormwater flow to the City’s storm sewer system.</td>
</tr>
</tbody>
</table>
**Project Narrative**

The Our Lady of Lourdes Shrine is located at the top of the Portage escarpment. Currently, the Shrine campus is receiving stormwater through surface runoff and stormwater pipes from upslope areas. The volume and rate of stormwater runoff are contributing to localized flooding, slope erosion, and water quality concerns at this site. Stormwater flowing over the property is also contributing to damage to trees and shifting of Shrine monuments. In the previous couple decades, the Shrine raised approximately $1 million to address slope erosion on the property; however, stormwater runoff is continuing to impact the campus.

This project will remove existing asphalt for the installation of approximately 5,000 ft$^2$ of permeable pavers and 2,500 ft$^2$ of linear bioretention installed with native vegetation along the southern side of the Shrine parking lot to capture, treat, and infiltrate stormwater runoff at this site. Overflow will be diverted to existing Chardon Road storm sewers. This project will help reduce the volume of stormwater flowing over an eroding slope, reduce erosion, and reduce stormwater flow to the City’s storm sewer system. Shrine stakeholders require minimal disruption of daily programs or access to the Shrine as a result of this project.

---

**Estimated Total cost**

Total estimated project cost: $250,000

Costs may need to be updated at time of grant application.

**Possible Funding Source**

319; GLRI; SWIF; SOGL; H2Ohio; private foundations

**Identified Causes and Sources**

Causes of impairment for *Lake Erie, east of Euclid Creek*:
- Not identified by Ohio EPA

Sources of impairment for *Lake Erie, east of Euclid Creek*:
- Not identified by Ohio EPA

**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**

One objective to reach the goals of Critical Area 3 is to remove 250 acres of impervious surfaces and install infiltrative green infrastructure practices in areas draining to escarpment ravines, open streams, and wetlands to reduce stormwater volumes/flashiness and loads contributed by these impervious surfaces (Objective 1).

**Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?**

This project will reduce 0.17 acres of impervious surfaces and meet 0.07% of the green infrastructure target (Objective 1) for Critical Area 3.

**Part 3: Load Reduced?**

Total estimated load reductions for this project (estimated using the USEPA Region 5 Model):
- Sediment: 0.0 tons/year
- Phosphorus: 6.21 pounds/year
- Nitrogen: 29.33 pounds/year

**How will the effectiveness of this project in addressing the**

The success of this project will be evaluated by project partners in the following ways:
NPS impairment be measured?

1) Effective reduction of impervious surfaces and associated stormwater inputs to local storm sewer system.
2) Proper establishment of bioretention vegetation.
3) Feedback from collaborators regarding attainment of project goals and objectives.

Success will also be measured by contributing to achievement of full attainment of exceptional warmwater habitat for Lake Erie, east of Euclid Creek. This sampling will be conducted by Ohio EPA.

criteria e  Information and Education

1) One project site tour for landowner representatives, elected officials and the public.
2) The project will be highlighted on Bluestone Heights and City websites and social media outlets.
3) The City, with assistance from Bluestone Heights, will create a news release for publishing in local newspapers highlighting the project.

<table>
<thead>
<tr>
<th>Nine Element Criteria</th>
<th>Information needed</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/a</td>
<td>Title</td>
<td>Lilly East Knott Pond Restoration</td>
</tr>
<tr>
<td>criteria d</td>
<td>Project Lead Organization &amp; Partners</td>
<td>City of Euclid; Bluestone Heights</td>
</tr>
<tr>
<td>criteria c</td>
<td>HUC-12 and Critical Area</td>
<td>City of Euclid-Frontal Lake Erie (HUC-12: 04110003 05 02); Critical Area 2</td>
</tr>
</tbody>
</table>
| criteria c            | Location of Project | Coordinates: 41.573864, -81.521437
The project site is located on City-owned property near the intersection of Euclid Avenue and East 228th Street in the City of Euclid. |
| n/a                   | Which strategy is being addressed by this project? | Passively Treat Stormwater Runoff |
| criteria f            | Time Frame         | Short-Term (Priority) (1-3 yr) |
| criteria g            | Short Description  | This project will restore approximately 0.5 acres of wetland that has been partially filled with dirt fill and other debris. Restoration will include removal of fill materials, reshaping of impacted area to create a diversity of wetland features, treatment of invasive species such as narrow-leaf cattail, and installation of native wetland plant species. This project will improve the ability of this wetland to capture, store and treat stormwater runoff of the hillside in an urban environment. This project will also include placement of a conservation easement on all areas restored through this project. |
Knott pond is a remnant early Holocene lagoon area behind (south of) the Lake Warren fossil beach ridge. The ponded area was originally fed by two Lilly Creek headwaters issuing from ravines on the north face of the Portage Escarpment. During the late nineteenth century, the remnant lagoon was enlarged and deepened to form an ice pond. During the early twentieth century, the streams were culverted around the basin and the pond became a suburban landscape feature holding somewhat stagnant water. During the early 2000s, the City of Euclid acquired the Knott parcels. The pond became a receptacle for unwanted fill. Currently, the City of Euclid Sewer Dept would like to restore retention function to the pond. The Knott Pond restoration proceeds with this goal.

Total estimated project cost: $200,000
Costs may need to be updated at time of grant application.

319; GLRI; SWIF; H2Ohio; SOGL

Causes of impairment for Lake Erie, east of Euclid Creek:
- Not identified by Ohio EPA

Sources of impairment for Lake Erie, east of Euclid Creek:
- Not identified by Ohio EPA

One objective to reach the goals of Critical Area 2 is to restore 7.25 acres of wetland habitat, including removal and treatment of non-native invasive plant species. (Objective 2).

One objective to reach the goals of Critical Area 2 is to permanently protect 8 acres of wetland. (Objective 3).

This project will meet 6.9% of the wetland restoration target (Objective 2) and 2.5% of the wetland protection target (Objective 3) for Critical Area 2.

Sediment: 2.7 tons/year
Phosphorus: 12 pounds/year
Nitrogen: 29 pounds/year

Model inputs: C type soils; 38 acres single-family residential, 2 acres transportation (total 40 acres drainage area); wetland detention BMP; average 25% imperviousness

The success of this project will be evaluated by project partners in the following ways:
1) Effective reduction of stormwater inputs to local storm sewer system.
2) Proper establishment of wetland vegetation.
3) Post-restoration ORAM assessment of Category 2 or higher.
4) Feedback from collaborators regarding attainment of project goals and objectives.
Success will also be measured by contributing to achievement of full attainment of exceptional warmwater habitat for Lake Erie, east of Euclid Creek. This sampling will be conducted by Ohio EPA.

<table>
<thead>
<tr>
<th>criteria e</th>
<th>Information and Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) One permanent, educational sign displayed at the project site.</td>
<td></td>
</tr>
<tr>
<td>2) One project site tour for elected officials and the public.</td>
<td></td>
</tr>
<tr>
<td>3) The project will be highlighted on Bluestone Heights and City websites and social media outlets.</td>
<td></td>
</tr>
<tr>
<td>4) The City, with assistance from Bluestone Heights, will create a news release for publishing in local newspapers highlighting the restoration project.</td>
<td></td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Nine Element Criteria</th>
<th>Information needed</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/a</td>
<td>Title</td>
<td>Babbitt West Tungsten Playground Park Wetland Restoration</td>
</tr>
<tr>
<td>criteria d</td>
<td>Project Lead Organization &amp; Partners</td>
<td>City of Euclid; Bluestone Heights</td>
</tr>
<tr>
<td>criteria c</td>
<td>HUC-12 and Critical Area</td>
<td>City of Euclid-Frontal Lake Erie (HUC-12: 04110003 05 02); Critical Area 2</td>
</tr>
<tr>
<td>criteria c</td>
<td>Location of Project</td>
<td>Coordinates: 41.591985, -81.505322</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The project site is located at the City-owned Tungsten Playground Park on Tungsten Road and between Babbitt Road and East 260th Street in the City of Euclid. The site is located immediately south of the railroad line.</td>
</tr>
<tr>
<td>n/a</td>
<td>Which strategy is being addressed by this project?</td>
<td>Passively Treat Stormwater Runoff</td>
</tr>
<tr>
<td>criteria f</td>
<td>Time Frame</td>
<td>Short-Term (Priority) (1-3 yr)</td>
</tr>
<tr>
<td>criteria g</td>
<td>Short Description</td>
<td>This project will restore approximately 0.6 acres of wetland at the margin of a City of Euclid playground. The goal is to diversify wetland habitat features, remove invasive species, and install native wetland plant species. This project will also install a buffer area around the restored wetland with native plants to help treat stormwater flowing into the wetland. This project will improve the ability of this area to capture, store and treat stormwater runoff and reduce flow to the City’s storm sewer system.</td>
</tr>
<tr>
<td>criteria g</td>
<td>Project Narrative</td>
<td>This Tungsten Playground lies upon a buried headwater ravine of the Babbitt Run subwatershed. The site’s north border is the NPK Railroad which, in 1881, culverted the stream under its railbed. Later, most of the headwater flow south of the site was taken into the city street grid storm sewers. The culvert was thus abandoned; there is no record of any conveyance under the wetland or railbed. In</td>
</tr>
</tbody>
</table>
consequence, the railbed acts as a berm to hold surface water in the playground area.

The existing wetland is fed by precipitation and drainage from the immediately adjacent land within the park. Currently, the feature is dominated by invasive yellow iris (*Iris pseudacorus*). The restoration would eradicate most of the yellow iris and confine it to an easily maintained small area. The wetland itself would be slightly regraded to provide a damp area well into the summer.

Immediately north of the railroad lies a 49-acre industrial site upon which Amazon Inc is completing a large warehouse. One of the site’s three large storm water retention basins has been built on the north side of the railroad, just west of the Tungsten Playground. The Tungsten project would approach Amazon site management about coordinating native plantings on both the wetland and the neighboring retention basin.

### Estimated Total cost

<table>
<thead>
<tr>
<th>criteria</th>
<th>Estimated Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total estimated project cost:</strong></td>
<td>$200,000</td>
</tr>
<tr>
<td><strong>Costs may need to be updated at time of grant application.</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Possible Funding Source

<table>
<thead>
<tr>
<th>criteria</th>
<th>Possible Funding Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>319; GLRI; SWIF; H2Ohio; SOGL</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Identified Causes and Sources

<table>
<thead>
<tr>
<th>criteria</th>
<th>Identified Causes and Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Causes of impairment for Lake Erie, east of Euclid Creek:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not identified by Ohio EPA</td>
</tr>
<tr>
<td><strong>Sources of impairment for Lake Erie, east of Euclid Creek:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not identified by Ohio EPA</td>
</tr>
</tbody>
</table>

### Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?

<table>
<thead>
<tr>
<th>criteria</th>
<th>Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>One objective to reach the goals of Critical Area 2 is to reforest 10.4 acres of wetland buffer areas with native vegetation (Objective 1).</strong></td>
<td></td>
</tr>
<tr>
<td><strong>One objective to reach the goals of Critical Area 2 is to restore 7.25 acres of wetland habitat, including removal and treatment of non-native invasive plant species. (Objective 2).</strong></td>
<td></td>
</tr>
<tr>
<td><strong>One objective to reach the goals of Critical Area 2 is to permanently protect 8 acres of wetland. (Objective 3).</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?

<table>
<thead>
<tr>
<th>criteria</th>
<th>Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>This project will meet 5% of the wetland buffer reforestation target (Objective 1), 8.3% of the wetland restoration target (Objective 2) and 7.5% of the wetland protection target (Objective 3) for Critical Area 2.</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Part 3: Load Reduced?

<table>
<thead>
<tr>
<th>criteria</th>
<th>Part 3: Load Reduced?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total estimated load reductions for this project (estimated using the USEPA Region 5 Model):</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sediment: 0.008 tons/year</td>
</tr>
<tr>
<td></td>
<td>Phosphorus: 0 pounds/year</td>
</tr>
<tr>
<td></td>
<td>Nitrogen: 0 pounds/year</td>
</tr>
<tr>
<td><strong>Model inputs:</strong></td>
<td>C type soils; 0.4 acres open space; wetland detention BMP; average 10% imperviousness</td>
</tr>
</tbody>
</table>

### How will the effectiveness of this

<table>
<thead>
<tr>
<th>criteria</th>
<th>How will the effectiveness of this</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The success of this project will be evaluated by project partners in the following ways:</strong></td>
<td></td>
</tr>
</tbody>
</table>

---
<table>
<thead>
<tr>
<th>project in addressing the NPS impairment be measured?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Effective reduction of stormwater inputs to local storm sewer system.</td>
</tr>
<tr>
<td>2) Proper establishment of wetland vegetation.</td>
</tr>
<tr>
<td>3) Post-restoration ORAM assessment of Category 2 or higher.</td>
</tr>
<tr>
<td>4) Feedback from collaborators regarding attainment of project goals and objectives.</td>
</tr>
</tbody>
</table>

Success will also be measured by contributing to achievement of full attainment of exceptional warmwater habitat for *Lake Erie, east of Euclid Creek*. This sampling will be conducted by Ohio EPA.

<table>
<thead>
<tr>
<th>criteria e</th>
<th>Information and Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) One permanent, educational sign displayed at the project site.</td>
<td></td>
</tr>
<tr>
<td>2) One project site tour for landowner representatives, elected officials and the public.</td>
<td></td>
</tr>
<tr>
<td>3) The project will be highlighted on Bluestone Heights and City websites and social media outlets.</td>
<td></td>
</tr>
<tr>
<td>4) The City, with assistance from Bluestone Heights, will create a news release for publishing in local newspapers highlighting the restoration project.</td>
<td></td>
</tr>
</tbody>
</table>
References


Appendix A: Calculations for Development of Objectives for Each Critical Area

Critical Area 1 (Ravine Habitat) – Objectives Calculations

OBJECTIVE 1: Reforest 188 acres of riparian and upland area with native vegetation.
- Clipped land cover data (CCAP 2010) to the critical area
- All acreage in critical area = 3,537 acres
- “developed land” (all intensity levels) = 88.5% of critical area or 3,130 acres
- “developed, open space” = 20% of critical area or 626 acres
- Target = 30% reforestation goal for 626 acres = 188 acres

OBJECTIVE 2: Restore 1,550 linear feet of in-stream and lacustrine estuarine habitat using natural channel design and bioengineering features and principles (e.g. restoration of floodplain access, streambank stabilization using bioengineering techniques).*  
*This objective is based on estimated proportion of open stream segments requiring restoration and planned in-stream and lacustrine estuarine habitat restoration areas.

OBJECTIVE 3: Permanently protect 58.9 acres of riparian areas along escarpment ravines.
- Permanently protect riparian areas through fee-simple acquisition or conservation easements.
  - Euclid land preservation efforts = 9.8 acres
- 31 acres could be protected through riparian setback adoption for Wickliffe and Willoughby (escarpment ravines only)
- Riparian setback enforcement for Euclid, Richmond Heights (9.8 acres + 31 acres)
- Permanently protect Cuy-Law wetland areas through fee-simple acquisition or conservation easements.
  - 4.75 acres of Cat. 3 wetlands in critical area
  - 17.5 acres of Cat. 2 wetlands in critical area
  - Total Cat 2 and 3 wetlands in critical area = 22.25 acres
  - 30% preservation target = 6.7 acres
- Riparian and wetland setback adoption for Wickliffe.
  - Oh_hydro lines layer clipped to critical area and to City of Wickliffe boundary = 8,850 LF
  - 25-ft setback applied to these streams = 486,750 sq ft = 11.2 acres
- Riparian and wetland setback enforcement for Euclid.

Critical Area 2 (Wetland Restoration) – Objectives Calculations

OBJECTIVE 1: Reforest 10.4 acres of wetland buffer areas with native vegetation.
- Acreage of wetlands in critical area based on ORAM assessments:
  - Cat 1 wetlands = 0.2 acres
    - CRWP wetland setback model does not apply to Category 1 wetlands
    - 0 acres to be reforested
  - Cat 2 wetlands = 4 acres
    - Apply 75-ft buffer based on CRWP wetland setback model code = 6 acres
  - Cat 3 wetlands = 12 acres
    - Apply 120-ft buffer based on CRWP wetland setback model code = 28.8 acres
- Total wetland buffer acres that could be reforested = 34.8 acres
- 50% target = 17.4 acres
- 30% target = 10.4 acres
OBJECTIVE 2: Restore 7.25 acres of wetland habitat, including removal and treatment of non-native invasive plant species.*

*This objective is based on estimated proportion of wetlands requiring restoration.

- Euclid plain wetlands
  - Total acreage of Cat 1 and Cat 2 wetlands = 4.2 acres
  - 50% target = 2.1 acres
  - 30% target = 1.3 acres

- Cuy-La wetlands
  - Cat 2 wetlands in this critical area = 17.5 acres
  - 50% target = 8.75 ac
  - 30% target = 5.25 ac

OBJECTIVE 3: Permanently protect 8 acres of wetland.

- Permanently protect wetland areas through fee-simple acquisition or conservation easements.
  - 16.2 acres of wetlands assessed by BH/CRWP in Euclid, none permanently protected
  - 50% target = 8.1 acres

- Wetland setback enforcement for Euclid.

Critical Area 3 (Green Infrastructure) – Objectives Calculations

OBJECTIVE 1: Remove 250 acres of impervious surfaces and install infiltrative green infrastructure practices in areas draining to escarpment ravines, open streams, and wetlands to reduce stormwater volumes/flashiness and loads contributed by these impervious surfaces.*

- Acreage of HUC12: 20.57 sq mi (13,165 acres)
- Currently ~45% impervious or 5,924 acres
- To make <25% impervious, need to have <3,291 acres impervious areas
- 5,924 ac – 3,291 ac = Need to remove 2,633 acres of impervious cover to meet <25% impervious cover goal.
- 10% application rate = 2,633 x 10% = 263 acres

Critical Area 4 (Coastal Zone) – Objectives Calculations

OBJECTIVE 1: Restore and/or enhance 5,362 linear feet of Lake Erie coastline and estuarine habitat using bioengineering techniques including revegetation with native plantings.

- Includes 500 LF planned restoration reaches at the mouths of Burnt House, Salt Run, Lilly Creek
- Includes planned restoration or enhancement of 4,862 linear feet of Lake Erie coast line using bioengineering techniques including revegetation with native plantings.
  - ~48,642 feet of coast in this critical area (~9.2 miles)
  - 10% target = 4,862 LF