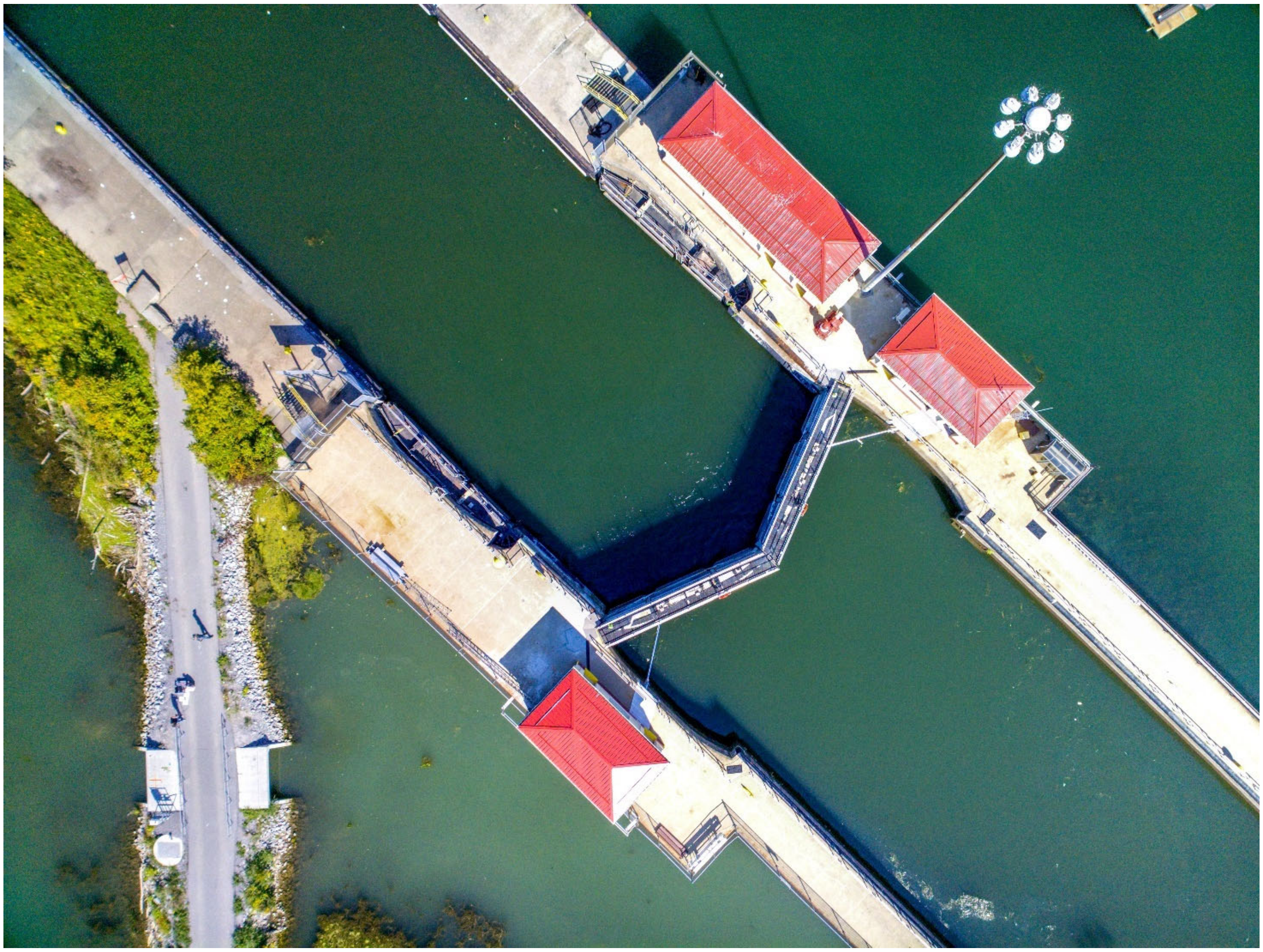
Sustainable Rivers Program

Black Rock Lock Ecological Analysis



Prepared by: U.S. Army Corps of Engineers, Buffalo District
478 Main St.
Buffalo, New York 14202

Above: Black Rock Lock in Buffalo District (USACE photo)

February 2026

Executive Summary

A major contributor to the success of the Erie Canal, the Black Rock Canal opened the interior of North America to settlement and forged the nation's identity. The centerpiece of the Black Rock Canal is the Black Rock Lock (BRL), a navigational lock in Buffalo, New York, that allows commercial and recreational vessels to bypass rapids in the upstream portion of the Niagara River at the outlet of Lake Erie. The BRL allows vessels to safely travel between Buffalo Harbor and Tonawanda Harbor. The Niagara River feeds into Lake Ontario, one of the five Great Lakes that has bicontinental ecological and socioeconomic significance that contains a diverse aquatic community which provides vital services (e.g., navigation, recreation, drinking water) to over 11 million people.

The overall goal of this study was to assess the operations of BRL, understand the potential barriers to fish passage, and identify operational opportunities to improve ecological function of the aquatic system, while maintaining authorized purposes and productive use of the lock. To do this, subject matter experts from the U.S. Army Corps of Engineers Buffalo District's (USACE LRB) Planning, Environmental Analysis, Hydrology and Hydraulic Engineering, and Operations and Maintenance teams reviewed available data to inventory existing conditions within the Black Rock Canal, including ecological conditions of the canal and infrastructure conditions at the lock. Relevant ecological data included fish species known to live in the upper Niagara River and use the canal (e.g., emerald shiners, lake sturgeon, walleye), dissolved oxygen levels, and water and habitat quality characteristics of tributaries that drain into the upper Niagara River. Hydrologic modeling identified existing conditions for flow velocities, depths, and sheer stress to characterize barriers to fish passage.

Based on this inventory, LRB investigated opportunities to modify operations to create environmental benefits to fish species at the BRL, specifically through strategic lock operations (e.g., conservation lockages). Any proposed modification to lock operations cannot impede the BRL's congressionally authorized purpose to lock vessels through the canal, nor can they create unacceptable risk of damage or excessive wear on equipment.

Preliminary recommendations for this study were developed by the USACE LRB based on potential benefits and limitations of each measure and targeted resources (i.e., labor requirements, probability of fish passage, improvement of habitat quality) as well as the major maintenance project that is anticipated to begin on the lock in fiscal year 2028 (FY28). The major maintenance project involves engineering and design for upper and lower guard gate removal, installation of miter gates, and installation of new maintenance bulkheads. Recommendations have been separated into pre-maintenance project and post-maintenance project time frames.

The recommended measures to be implemented pre-maintenance project are conservation lockages in the early spring and conduit (culvert) opening overnight. The recommended measures to be implemented post-maintenance project are conservation lockages in the early spring and butterfly valve opening overnight.

Table of Contents

1 **Introduction** **6**

1.1 Study Authority 7

1.2 Problem Statement 7

1.3 Study Objectives 7

1.4 Study Approach 7

2 **Inventory of Existing Conditions** **9**

2.1 Navigation Infrastructure and Canal 9

2.2 Navigation History and Trends 10

2.3 Niagara River Hydrology and Hydraulics 11

2.4 Biological Community 13

2.4.1 Fish Community and Aquatic Habitat 14

2.4.2 Threatened and Endangered Species 15

2.4.2.1 Species of Interest 16

2.5 Water Quality 21

3 **Major USACE Maintenance Project** **22**

4 **Opportunity Identification and Prioritization** **22**

4.1 Ecological Opportunities & Outcomes 22

4.2 Constraints and Considerations 23

4.2.1 Constraints 23

4.2.2 Considerations 23

5 **Assessment and Evaluation of Ecological Measures** **24**

5.1 No Action Measure 24

5.2 Conservation Lockages in the Early Spring – Pre-Maintenance 24

5.3 Conservation Lockages in the Early Spring – Post-Maintenance 25

5.4 Conservation Lockages During Peak Season – Pre-Maintenance 25

5.5 Conduit (Culvert) Openings Overnight – Pre-Maintenance 25

5.6 Opening Butterfly Valves Overnight – Pre-Maintenance 25

5.7 Opening Butterfly Valves Overnight – Post-Maintenance 26

5.8 Partially Opening Miter Gates Overnight – Pre-Maintenance 26

6 **Recommendation for Change in Operations** **27**

7 **Summary of Conclusions and Next Steps** **28**

Literature Cited **28**

Abbreviations and Acronyms

AOC	Area of Concern
BNWK	Buffalo Niagara Water Keeper
CFS	cubic feet per second
CNR	Canadian National Railroad
CSO	Combined Sewer Overflows
CPUE	Catch per unit effort
CWA	Clean Water Act
DO	Dissolved Oxygen
EPA	U.S. Environmental Protection Agency
ERDC	U.S. Army Engineer Research and Development Center
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
ft/s	Feet per second
HEC-RAS	Hydrologic Engineering Center-River Analysis System
H&H	Hydrologic and Hydraulic Engineering
IENC	Inland electronic navigation charts
IPaC	Information for Planning and Consultation
LRB	Buffalo District, U.S. Army Corps of Engineers
LTA	Long-term Average
LWD	Low water datum
NEPA	National Environmental Policy Act
NLCD	National land cover database
NYSDOH	New York State Department of Health
NYSDEC	New York State Department of Environmental Conservation
m/s	Meters per second
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated biphenyl
ppm	parts per million
RWA	Rapid watershed assessment
SAV	Submerged Aquatic Vegetation
SRP	Sustainable Rivers Program
TNC	The Nature Conservancy
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WRDA	Water Resources Development Act
WSE	Water surface elevation

List of Tables

Table 1. Fish species of the Upper Niagara River. 14
Table 2. Species of interest and anticipated to utilize the lock to reach Lake Erie through a less intense current or access the Niagara River if incidentally navigating/foraging within the Black Rock Canal. 18
Table 3. Measures considered. 24
Table 4. Results of measure screening. 26
Table 5. Implementable measures. 27

List of Figures

Figure 1. Black Rock Lock location with federal channel limits. 6
Figure 2. Risk-informed planning process of USACE. 8
Figure 3. Site regions. 11
Figure 4. Low flow velocities (ft/sec). Threshold of 2.66 ft/s corresponds to emerald shiner swim speed limits. 12
Figure 5. LTA flow velocities (ft/sec). Threshold of 2.66 ft/s corresponds to emerald shiner swim speed limits. 12
Figure 6. High flow velocities (ft/sec). Threshold of 2.66 ft/s corresponds to emerald shiner swim speed limits. 13
Figure 7. Structural components of the BRL and implementable measures (made by USACE Visual Information). 27

List of Appendices (published separately)

Appendix 1. Niagara River Hydrology and Hydraulics
Appendix 2. Fish Inventory Matrix

1 Introduction

Black Rock Lock (BRL) is located on the east bank of the upper Niagara River within the City of Buffalo, New York (Figure 1). The lock is 3.5 miles north of the Buffalo Harbor within the Black Rock Canal, a federal navigation channel, that is 13.5 miles in length. The Black Rock Canal was constructed to provide protection from reefs, rapids, and fast currents in the upper Niagara River. The lock permits safe vessel navigation between Buffalo Harbor in Lake Erie, and Tonawanda Harbor near the mouth of the Erie Canal. The original timber lock was constructed by New York State in 1825 to support the Erie Canal. The federal lock was authorized in 1905 under the Rivers and Harbors Act. Construction by the U.S. Army Corps of Engineers (USACE) began in 1908, and the project work included replacement of the old New York State Ship lock, construction of the Ferry Street Bridge, and excavation of the Black Rock Canal to improve capacity to accommodate larger Great Lakes vessels. The bulk of the contract was completed on July 28, 1914, with a final cost greater than $4,500,000 (USACE LRB, 2021).

The facility consists of a one lock chamber made up of concrete gravity walls founded on bedrock. The chamber is 650 feet (198.1 m) long, 70 feet (21.3 m) wide, and 22 feet (6.7 m) deep; however, recreational watercraft and commercial vessels can only be 625 feet (191 m) long with drafts to 21 feet (6.4 m) to be allowed in the lock and canal. There are two sets of guard gates and two operating gates. Commercial cargo historically has included coal, iron ore, and petroleum products. In recent years, liquid asphalt has made up the bulk of commercial navigation through the lock, and recreational vessel traffic has proportionately increased.

A major maintenance project is anticipated to take place on lock infrastructure between FY28 through FY31, pending availability of funding. This effort will include upper and lower guard gate removal and sill recess modifications; and installation of rock anchors, miter gates, and new maintenance bulkheads.

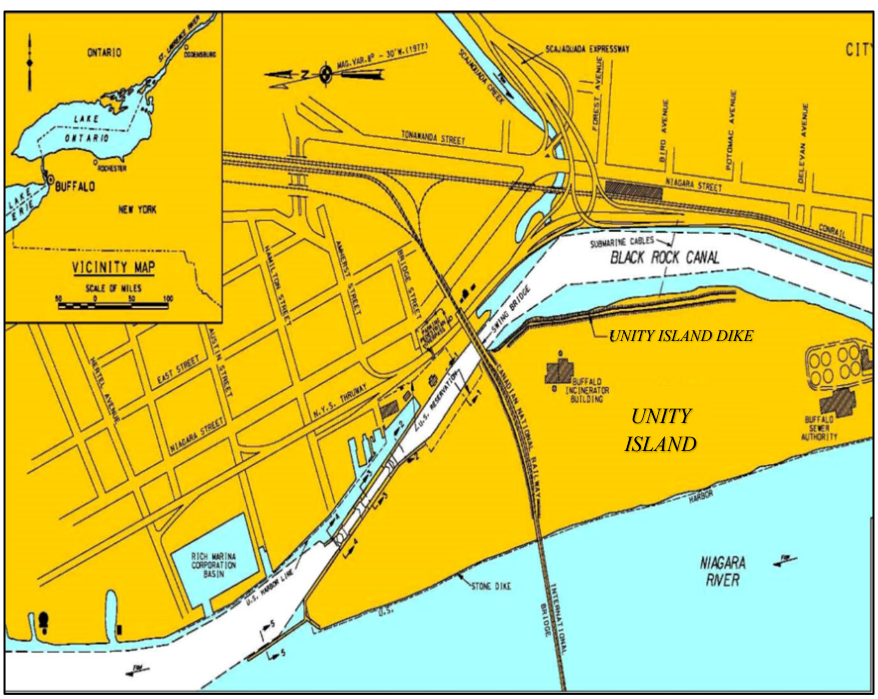


Figure 1. Black Rock Lock location with federal channel limits.

Through the Sustainable Rivers Program (SRP), USACE Buffalo District (LRB) assessed the potential for modifications to lock operations to minimize barriers to fish passage through the BRL to improve the ecological quality of the upper Niagara River.

1.1 Study Authority

This study was conducted as part of the SRP, a partnership between USACE and The Nature Conservancy (TNC). The SRP aims to improve the ecological quality of rivers through change in water infrastructure operations that may restore or protect ecosystems, while maintaining or enhancing other project benefits and continuing to meet congressionally authorized purposes. Traditionally, the SRP focused on environmental flows, defined as the "quantity, timing, and quality of water flows required to sustain ecosystems." Recently, the SRP has expanded its approach to explore additional actions at water infrastructure projects with potential to provide ecological benefit (USACE HEC, 2025).

1.2 Problem Statement

Current operation of the BRL, particularly in the winter months, may serve as a barrier to passage by fish seeking refuge from the fast currents in the upper Niagara River. The lock structure and associated flow regime restrict the natural movement of aquatic species, limiting access to calmer areas and sheltered habitats. This barrier reduces connectivity between upstream and downstream habitats and may contribute to restriction on seasonal movement to spawning, nursery, and feeding areas.

1.3 Study Objectives

The overall goal of this study was to assess the operations of BRL, understand the potential barriers to fish passage, and identify operational opportunities to improve ecological function of the aquatic system, while maintaining authorized purposes and productive use of the lock. Potential ecological opportunities and changes to lock operations were qualitatively considered to the extent that such changes could impact or improve fish movement through the Black Rock Canal in the upper Niagara River.

The specific objectives of this study were to:

1. Characterize barriers to fishery movement through the BRL and identify potential opportunities to maximize ecological benefits.
2. Evaluate alternatives to current BRL operations to produce environmental benefit.
3. Engage regional stakeholders to develop a coordinated approach to further study and implement the final array of alternatives identified.

Successful completion of this study provides the foundation needed to inform future changes to the operation of the BRL, with the goal of improving ecological conditions. The study area includes the upper Niagara River, specifically in the vicinity of the Black Rock Canal. This study relies upon the assumption that fish species that use the upper Niagara River to move into Lake Erie may find refuge in the canal.

1.4 Study Approach

To facilitate collaboration and efficiency, the Buffalo District's project delivery team consisted of subject matter experts from Planning, Environmental Analysis, Hydrology and Hydraulic (H&H) Engineering, and Operations and Maintenance teams. The study utilized an iterative plan formulation framework to understand potential barriers to fish passage and identify opportunities and measures to maximize ecological function of the aquatic ecosystem while continuing to perform authorized operations.

The project delivery team followed the USACE Planning Process, consisting of a series of steps that provide an orderly and systematic approach to providing technical assistance in developing an array of alternatives for the selection of a plan. Plan formulation and evaluation is an iterative process, whereby steps may be iterated one or more times as new information becomes available, new alternatives are developed, or as planning objectives are reevaluated. Each step of the planning process provides information needed for the steps that follow. As described in ER 1105-2-103 (USACE, 2023), the USACE planning process consists of the following major steps:

1. Identify problems and opportunities
2. Inventory and forecast conditions
3. Formulate alternative plans
4. Evaluate effects of alternative plans
5. Compare alternative plans and
6. Recommend plan

In practice, the steps of the planning process are iterative, and risk analysis is critical to successful planning and, therefore, integrated into the planning process as detailed below (Figure 2).

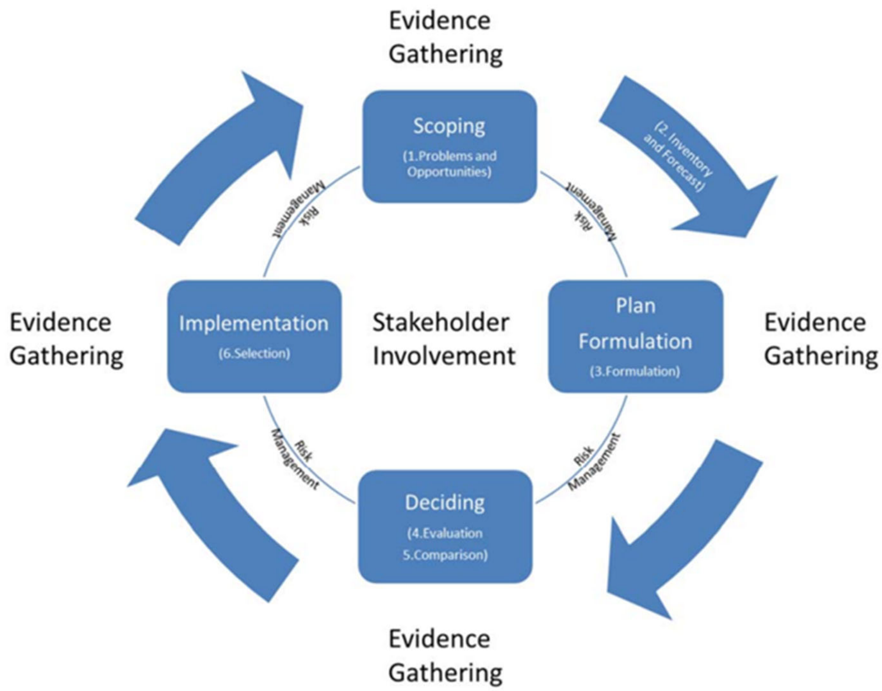


Figure 2. Risk-informed planning process of USACE.

Existing conditions were defined as the current characteristics of the infrastructure, biological community, and environmental conditions within the Black Rock Canal and the upper Niagara River. Information regarding existing conditions was retrieved from existing literature, databases, modeling, and navigation charts by the Planning, Environmental and H&H team members.

Using the initial inventory of existing conditions, the Environmental team identified ecological opportunities defined as the desirable environmental outcomes that are possible from future modifications to operations at the USACE managed lock.

The project delivery team then identified the specific changes to operations at the lock (i.e., measures) that would be required to realize specific ecological opportunities. Opportunities under current conditions (pre-maintenance) and future (post-maintenance) conditions were considered and broken out. A total of seven measures were identified, five pre-maintenance measures and two post-maintenance measures. The team researched the benefits and additional considerations for each measure presented in Sections 4 and 5 of this report.

2 Inventory of Existing Conditions

The Black Rock Canal is a regionally significant economic and ecological resource for Federal navigation. The channel was constructed on the east bank of the upper Niagara River to provide protection from the reefs, rapids, and fast currents of the Lake Erie outlet to the upper Niagara River for vessels. The lock permits safe marine traffic between Buffalo Harbor in Lake Erie and Tonawanda Harbor near the mouth of Erie Canal (USACE LRB, 2021a). As part of the current effort, the Team inventoried existing conditions related to the ecology, infrastructure, and operations at the BRL. A summary of the existing conditions documented within the canal is provided in the following sub-sections.

2.1 Navigation Infrastructure and Canal

The Black Rock Canal and Lock have long served a critical role in the navigational framework of the upper Niagara River and the Great Lakes system. Originally constructed in the early 19th century, the canal was engineered to provide a safe, navigable channel circumventing the hazardous currents, reefs, and rapids of the adjacent river. The canal extends approximately four miles from Buffalo Harbor to the BRL and is 200 feet wide at its widest point, creating a vital corridor for both commercial and recreational vessels transiting between Lake Erie and inland waterways (USACE LRB, 2021a).

Three bridges span the canal, each presenting height restrictions. The Peace Bridge, managed by the Niagara Falls Bridge Commission and south of the entrance of the canal, offers a vertical clearance of 200 feet above low water datum (LWD). The Ferry Street Bridge, operated by the City of Buffalo, is a lift bridge with a reduced clearance of 17.3 feet. Similarly, the International Railroad Bridge, a swing bridge operated by Canadian National Railroad (CNR), has a clearance of 17.3 feet above LWD.

The BRL includes a concrete monolithic lock chamber with an elevation lift of approximately five feet and upstream guide walls and downstream guide piers of various types of construction. The lock walls are mass concrete gravity walls founded on bedrock forming a lock that is capable of accommodating vessels up to 625 feet in length, 68 feet in width, and with drafts up to 21 feet.

The USACE LRB is responsible for the ongoing operation and maintenance of the canal and its associated lock infrastructure.

Communication between vessels, bridges, and the lock is coordinated via marine band radio or telephone. Operating hours from October through May are 8:00 am to 3:30 pm. From June through September, operating hours are 8:00 am to 9:30 pm. Down bound is traffic heading north from Buffalo and operates at the top of each hour. Up bound is traffic heading south towards Lake Erie and operates on the bottom of each hour. Vessel masters desiring to enter the Black Rock Canal and lock call via radio or telephone approximately 15 minutes before estimated time of arrival. The Ferry Street Bridge and the International Railroad Bridge require requests from a vessel captain, the BRL Lockmaster, or their representative for bridge passage. All vessels pass through the canal in order of their arrival at the canal limits unless otherwise directed by the lockmaster. Recreational watercrafts are required to yield the right-of-way to commercial vessels due to the confined space within the canal (USACE LRB, 2021a). It takes eight to eleven minutes to fill the lock with the maximum amount of water, approximately 285 million gallons. The maximum number of lockages that can occur during operating hours per day is 22; however, it is unusual that there is enough traffic to warrant 22 lockages/day. After-hours, a 24-hour notice is required for commercial traffic to schedule transit time with the BRL.

2.2 Navigation History and Trends

Prior to 1825, larger vessels could not navigate the shallower draft Erie Canal or the swift currents of the upper Niagara River. The first lock in the Black Rock Canal was constructed of timber in 1825 by the state of New York. By 1907, specifications were drawn up for a new lock to be built at the foot of Bridge Street. The lock opened for vessel traffic on August 17, 1914, and provided capacity to accommodate larger Great Lakes vessels (USACE LRB, 2021a). Historically, the canal facilitated heavy industrial and shipping traffic associated with Buffalo's emergence as a manufacturing and transportation hub. During the height of the region's industrial activity, land use along the canal was characterized by a dense concentration of grain elevators, shipyards, steel mills, and rail infrastructure. Although much of the heavy industry has declined, remnants of these historical uses remain visible, and several sites have been repurposed for commercial, recreational, or ecological restoration purposes. The canal's entrance at Lake Erie is based on a LWD of 569.2 feet above mean tide at Father Point, Quebec (IGLD, 1985).

Today, land use along the Black Rock Canal reflects a more diverse and transitional character. Urban redevelopment initiatives and environmental remediation have contributed to a shift toward mixed-use development, with growing emphasis on waterfront access, green spaces, and heritage preservation. Public parks, trails, and residential developments now coexist alongside operational infrastructure, preserving the canal's navigational function while enhancing its environmental and community value.

Trends indicate that although commercial freight activity has declined from historical levels, the canal remains actively used for regional shipping, especially for bulk goods, and continues to support a growing volume of recreational boating. This dual-purpose functionality—commercial and recreational—is expected to persist as future land use planning efforts along the Buffalo waterfront increasingly prioritize sustainable development and multi-modal transportation access. In the past, commercial vessels transported commodities essential to business and industry including substantial amounts of coal, iron ore, and petroleum products.

2.3 Niagara River Hydrology and Hydraulics

The Buffalo District previously developed a 2-dimensional Hydrologic Engineering Center River Analysis System (HEC-RAS) model of the Upper Niagara River to evaluate the cumulative impacts of various projects on water surface elevation (WSE) within the river and Lake Erie. The model was run using typical high flow, low flow, and long-term average (LTA) flow hydrographs. These model results were used to identify existing conditions, particularly flow velocities, depths, and shear stress throughout four regions within the upper Niagara River in the vicinity of BRL (Figure 3).

Results for regions 1, 2, and 3 indicate no barriers to fish passage concerning flow velocity, depth, and shear stress under existing conditions. This velocity threshold corresponds to swimming speeds for emerald shiner, which are a particular species of interest for upstream passage within the upper Niagara River. Additional swim speeds and velocity thresholds can be considered for other species of fish as well. The lock itself is a physical barrier, which likely significantly restricts most fish passage under current operations. Velocities in region 4 indicate that upstream passage may be limited within the main channel of the upper Niagara River for certain species, further supporting the consideration for conservation lockage of the BRL for upstream fish migration. Velocities within the river downstream of region 3 could impede fish movement upstream into the canal and towards the lock, which can be further investigated.

Figure 3. Site regions.

In Figure 4, Figure 5, and Figure 6, areas with flow velocity greater than 0.81 m/s (2.66 ft/s) are displayed in red, while areas with lower velocities are marked in green.

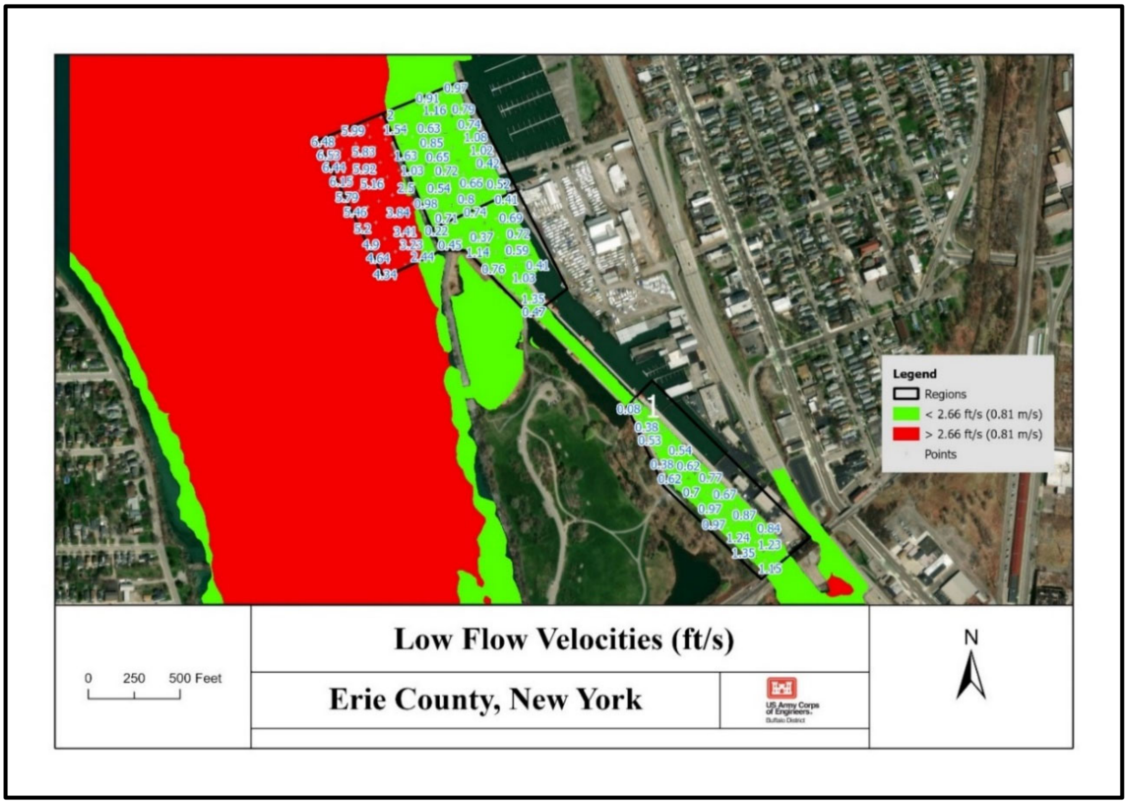


Figure 4. Low flow velocities (ft/sec). Threshold of 2.66 ft/s corresponds to emerald shiner swim speed limits.

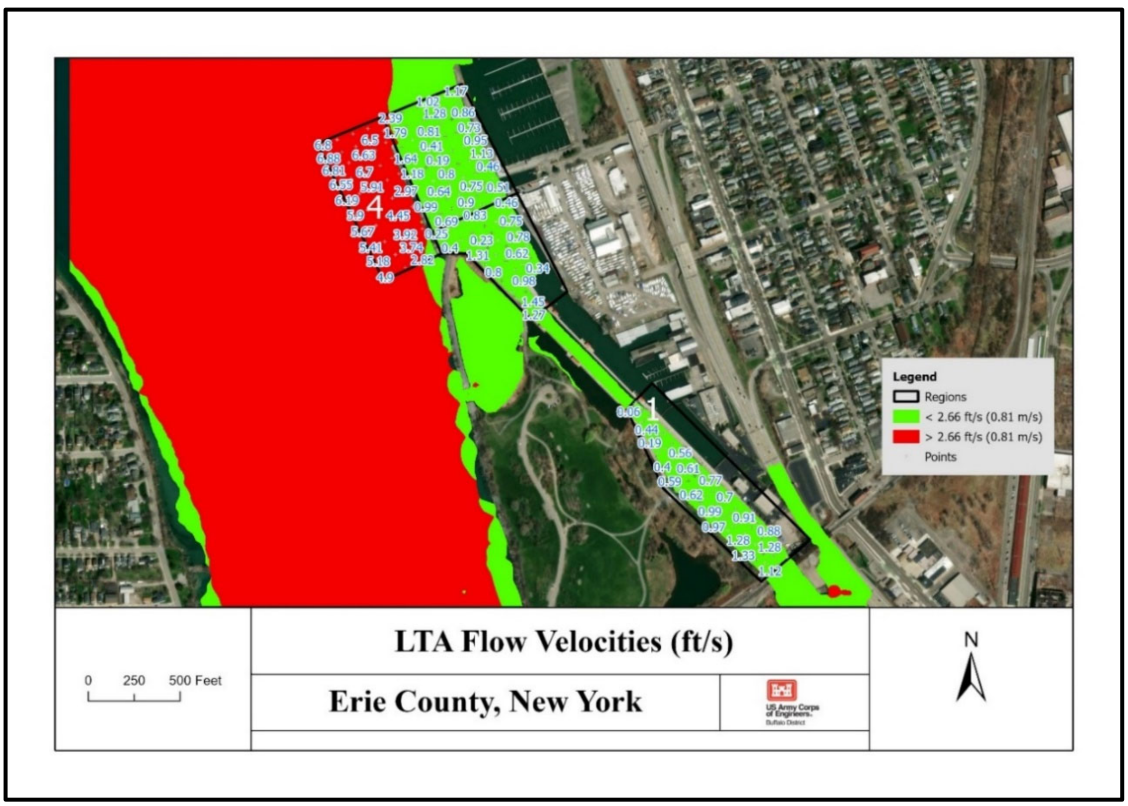


Figure 5. LTA flow velocities (ft/sec). Threshold of 2.66 ft/s corresponds to emerald shiner swim speed limits.

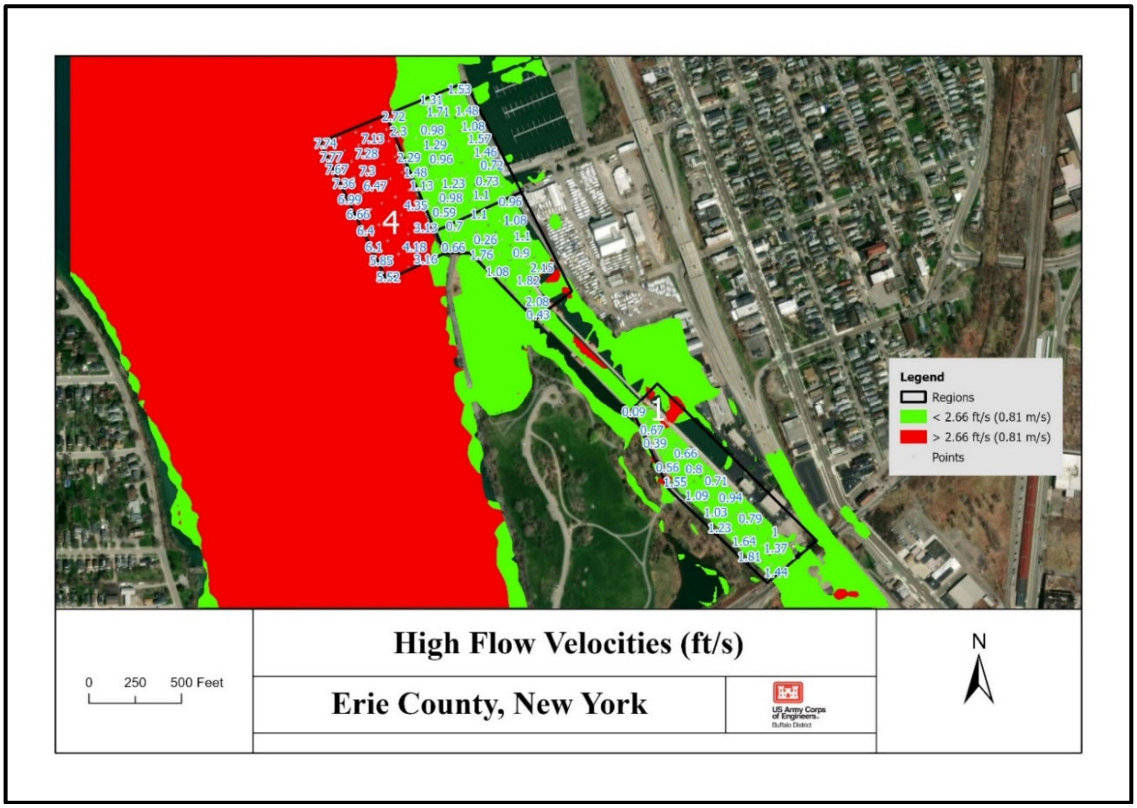


Figure 6. High flow velocities (ft/sec). Threshold of 2.66 ft/s corresponds to emerald shiner swim speed limits.

2.4 Biological Community

The Niagara River sustains an ecologically diverse and nationally significant biological community. With over 75 species of fish observed within the upper Niagara River and over 1,250 species of birds, mammals, reptiles, amphibians, mussels, and plants observed within the Niagara River corridor, the region provides unique biodiversity for both Ontario, Canada and New York state (Niagara River Remedial Action Plan, 2025).

However, anthropogenic changes to the landscape and environment have significantly altered the composition of this community. For example, fortification of the Niagara River's banks hinders migratory species' abilities to traverse the shoreline as they move with or against the high velocity of the river. Species of trophic and economic importance for the region, such as the emerald shiner, have shown decline in the area due to the fortification of natural shorelines, removal of natural slack waters, and installation of barriers to the fish's movement.

Another anthropogenic change is introduction of non-native species. In a 2001 study, New York State Department of Environmental Conservation (NYSDEC) recorded 89 species of fish within the upper Niagara River, 36 of which are non-native species introduced to the system since 1960 either intentionally or accidentally (Carlson, 2001). Since 2001, it is likely that this number of introduced non-native species has increased, as species such as the freshwater tubenose goby (*Proterorhinus semilunaris*) were not documented in the eastern Lake Erie basin until after 2011 (Fuller et al., 2025). Invasive species, like the zebra mussel, have also been introduced within the Niagara River and Black Rock Canal, impacting ecology through displacement, competition, or predation of native species.

2.4.1 Fish Community and Aquatic Habitat

While total number of species within the upper Niagara River varies depending on the source, a table of potential fish species within the Black Rock Canal area and upper Niagara River was compiled (Table 1). Using a combination of unpublished electrofishing studies from the U.S. Fish and Wildlife Service (USFWS) and NYSDEC, as well as Niagara River watershed fish community assessment from the Ontario Ministry of Natural Resources (Yagi and Blott, 2012), a list of 77 potential species was compiled.

Table 1. Fish species of the Upper Niagara River.

Fish Species					
Family			**Family**		**Common Name**
Acipenseridae	*Acipenser fulvescens*	Lake sturgeon	**Leuciscidae**	*Cyprinella spiloptera*	Spotfin shiner
Amiidae	*Amia calva*	Bowfin		*Luxilus chrysocephalus*	Striped shiner
Atherinopsidae	*Labidesthes sicculus*	Brook silverside		*Luxilus cornutus*	Common shiner
Catostomidae	*Carpoides cyprinus*	Quillback		*Nocomis biguttatus*	Hornyhead chub
	Catostomus commersonii	White sucker		*Nocormis micropogon*	River chub
	Hypentelium nigricans	Northern hog sucker		*Notemigonus crysoleucas*	Golden shiner
	Minytrema melanops	Spotted sucker		*Notropis atherinoides*	Emerald shiner
	Moxostoma anisurum	Silver redhorse		*Notropis heterodon*	Blackchin shiner
	Moxostoma duquesnei	Black redhorse		*Notropis heterolepis*	Blacknose shiner
	Moxostoma erythrurum	Golden redhorse		*Notropis hudsonius*	Spottail shiner
	Moxostoma macrolepidotum	Shorthead redhorse		*Notropis rubellus*	Rosyface shiner
	Moxostoma valenciennesi	Greater redhorse		*Notropis stramineus*	Sand shiner
Centrarchidae	*Ambloplites rupestris*	Rock bass		*Notropis volucellus*	Mimic shiner
	Lepomis cyanellus	Green sunfish		*Pimephales notatus*	Bluntnose minnow
	Lepomis gibbosus	Pumpkinseed		*Pimephales promelas*	Fathead minnow
	Lepomis macrochirus	Bluegill		*Scardinius erythrophthalmus*	Rudd
	Micropterus dolomieu	Smallmouth bass		*Semotilus atromaculatus*	Creek chub
	Micropterus salmoides	Largemouth bass	**Moronidae**	*Morone americana*	White perch
	Pomoxis nigromaculatus	Black crappie		*Morone chrysops*	White bass
	Pomoxis annularis	White crappie	**Osmeridae**	*Osmerus mordax*	Rainbow smelt
Clupeidae	*Alosa pseudoharengus*	Alewife	**Percidae**	*Etheostoma caeruleum*	Rainbow darter
	Dorosoma cepedianum	Gizzard shad		*Etheostoma exile*	Iowa darter
Cottidae	*Cottus bairdii*	Mottled sculpin		*Etheostoma flabellare*	Fantail darter
Cyprinidae	*Carassius auratus*	Goldfish		*Etheostoma nigrum*	Johnny darter
	Cyprinus carpio	Common carp		*Etheostoma olmstedi*	Tesselated darter
Esocidae	*Esox americanus*	Grass pickerel		*Perca flavescens*	Yellow perch
	Esox lucius	Northern pike		*Percina caprodes*	Logperch
	Esox masquinongy	Muskellunge		*Sander vitreus*	Walleye

Fundulidae			**Salmonidae**		
Gadidae	*Lota lota*	Burbot		*Salmo trutta*	Brown trout
Gasterosteidae	*Culaea inconstans*	Brook stickleback	**Sciaenidae**	*Aplodinotus grunniens*	Freshwater drum
Gobiidae	*Neogobius melanostomus*	Round goby	**Petromyzontidae**	*Lethenteron appendix*	American brook lamprey
Ictaluridae	*Ameiurus melas*	Black bullhead	**Umbridae**	*Umbra limi*	Central mudminnow
	Ameriurus natalis	Yellow bullhead	**Percopsidae**	*Percopsis omiscomaycus*	Trout-perch
	Ameiurus nebulosus	Brown bullhead	-		
	Ictalurus punctatus	Channel catfish			
	Noturus flavus	Stonecat			
	Noturus gyrinus	Tadpole madtom			
	Noturus miurus	Brindled madtom			
Lepisosteidae	*Lepisosteus osseus*	Longnose gar			

Aquatic vegetation communities within the upper Niagara River vary based on the location of the site surveyed. Due to the range of environmental conditions in the main channel of the Niagara River, aquatic vegetation tends to be sparse in the high velocity areas and dense in slow velocity areas. Some of submerged aquatic vegetation (SAV) species observed by USACE biologists within the upper Niagara River include coontail (*Ceratophyllum demersum*), Eurasian watermilfoil (*Myriophyllum spicatum*), eel grass (*Valsineria americana*), various waterweeds (*Elodea spp.*), hydrilla (*Hydrilla verticillata*), white-stem pondweed (*Potomageton praelongus*), long leaf pondweed (*Potamogeton nodosus*), curly-leaf pondweed (*Potomageton crispus*), water stargrass (*Heteranthia dubia*), and brittle naiad (*Naja minor*). Other species observed at the Black Rock Canal during the USACE Niagara River Emerald Shiner Study includes slender waternymph (*Najas gracillima*), nodding waternympth (*Najas flexilis*), fragrant water lily (*Nymphaea odorata*), algae-like pondweed (*Potamogeton confervoides*), ribbon-leaved pondweed (*Potamogeton epihydrus*), Richardson's pondweed (*Potamogeton richardsonii*), leafy pondweed (*Potamogetons foliosus*), swaying bulrush (*Schoenoplectus subterminalis*), sago pondweed (*Stuckenia pectinata*), horned pondweed (*Zannichellia palustris*), and American pondweed (*Elodea canadensis*) (USACE LRB, 2016). Due to the site's proximity to the Black Rock Canal, it can be assumed that many of the same species of SAVs would be present within the canal itself; however, due to the barrier created by the lock, differing flow regimes, and differing nutrient availabilities, the density and diversity of SAVs cannot be predicted based on the studies conducted in 2016.

2.4.2 Threatened and Endangered Species

No Federally listed threatened and endangered aquatic species share a range with the Black Rock Canal or the upper Niagara River; however, the salamander mussel (*Simpsonaias ambigua*), a proposed endangered species, and the monarch butterfly (*Danaus plexippus*), a proposed threatened species potentially do (USFWS IPaC, 2025b). The tricolor bat (*Perimyotis subflavus*), a proposed endangered species, does not share a range with the Black Rock Canal, but does have a range nearby within the upper Niagara River in the vicinity of Grand Island. This species would only be affected by the removal of trees and terrestrial disturbances, which are not being considered as part of this project (USFWS IPaC, 2025b).

The New York State Environmental Mapper Tool was used to identify any potential state threated and endangered species that share a range with the Black Rock Canal and upper Niagara River. Lake sturgeon (*Acipenser fluvescens*) is a state threatened species that is known to inhabit the upper Niagara River. Also, near the southern tip of Grand Island, the mapping tool identified a state listed endangered plant species which is not disclosed within the tool and will require further consultation with NYSDEC to identify and avoid detrimental impacts to this population. The mapping tool also identified the upper Niagara River and Black Rock Canal as a mussel screening stream for imperiled mussels; however, no state listed species are identified in this area. Further coordination with NYSDEC is suggested to confirm that changes in operations and management of the BRL will not negatively impact state listed mussels. Lastly, the mapping tool identified a significant gull colony and significant waterfowl winter concentration area within the area surrounding Black Rock Canal and Bird Island Pier. This also suggests further coordination with NYSDEC to ensure changes in lock operations will not affect these populations.

2.4.2.1 Species of Interest

Several aquatic species are present within the mainstem of the Niagara River (see Section 2.4.1). A list of species likely to be present in the canal was developed to guide identification of ecological opportunities (Appendix 2, Fish Species Matrix). Species of interest were species with specific habitat requirements as well as species that have significant recreational value (i.e., game fish, bait fish, waterfowl). Non-target species, those who prefer the swift waters of the Niagara River (i.e., lake sturgeon), were also identified to refine ecological opportunities and identify potential considerations. The list of target and non-target species was generated from data collected by USACE, NYSDEC, and USFWS. While all species found within the upper Niagara River will utilize the Black Rock Canal differently due to their ecological requirements (Table 2), certain species have been targeted due to their recreational importance to the region, listed status, and/or ecological importance. Though species like emerald shiners, lake sturgeon, smallmouth bass (*Micropterus dolomieu*), redhorses (*Moxostoma* spp.), white suckers (*Catostomus commersonii*), and rainbow trout (*Oncorhyncus mykiss*) have all been observed within the Black Rock Canal, these species are unlikely to use the Black Rock Canal for spawning. It is likely that these species are only incidentally observed or transient within the Black Rock Canal due to the conditions of the habitat such as low water velocity, higher water temperatures than the Niagara River, lower dissolved oxygen (DO) levels than the Niagara River, and potentially higher presence of contaminants/nutrients that may limit or discourage these species from regularly inhabiting the canal. Some species, such as smallmouth bass and rainbow trout, are likely only utilizing the canal and lock while chasing and/or following schools of emerald shiners. Anecdotal evidence from lock operators at the site confirms this behavior in both species as well as walleye (*Sander vitreus*).

There is a potential for species such as largemouth bass (*Micropterus salmoides*), northern pike (*Esox lucius*), and muskellunge (*Esox masquinongy*) to consistently inhabit the canal, as these species prefer backwater and slack water habitats with woody debris and vegetation present for year-round habitation and spawning. However, it is not known if spawning within the canal by these species happens as limitations for spawning or habitat selection occur within the canal. Muskellunge prefer spawning in areas with flooded vegetation and require habitat diversity throughout the species life stages (Cook and Solomon, 1987). Northern pike prefer dissolved oxygen (DO) levels over 7.0 ppm for consistent growth and survival (Inskip, 1982), and largemouth bass prefer DO levels above 8.0 ppm for growth and development and will actively avoid areas with DO levels below 3.0 ppm (Stuber et al., 1982) (see Section 2.5 for DO and water quality within the area).

A non-fish species of interest considered is the common mudpuppy (*Necturus maculosus*). Common mudpuppies sit in a mid-tier predatory role within the ecosystem, predating on and being predated by multiple species. Mudpuppies have been recorded eating both native and non-native species including crawfish, dreissenid (zebra and quagga) mussels, round gobies, amphibians (including other mudpuppies), small forage fish, and their own eggs. Mudpuppies are also often predated by larger predatory fish, water snakes, and herons. However, one of the most prominent relationships exhibited by this species is with the salmander mussel, which is proposed endangered by the USFWS (USFWS IPaC, 2025b). These species have a host-parasite relationship in which the salamander mussel requires the common mudpuppy for range expansion and reproduction. The glochidia (microscopic larval mussels) clamp on to the mudpuppy's gills and create a cyst with the mudpuppy's gill tissue (encystment). This cyst remains on the mudpuppy until water temperatures decrease and the mudpuppy becomes more active. When this happens, the glochidia goes through metamorphosis, breaks through the tissue, and drops to the substrate surface (excystment) thus completing the mussel's reproduction (USFWS, 2025a). This parasitic relationship with the common mudpuppy does not significantly hinder the health or success of the parasitized mudpuppy while it is a host.

In a study conducted in 2018, juvenile and adult mudpuppies were both captured and observed within Black Rock Canal. The adult that was captured was observed to have a partially digested juvenile mudpuppy within its stomach. These individuals were captured using baited minnow traps, and not by turning over rocks, which may have identified nesting females. However, the presence of multiple life stages of mudpuppies in this area, as well as cannibalism of the juveniles, suggest Black Rock Canal or even the Upper Niagara River may be home to a dense population of mudpuppies (Haines, 2021). It can be assumed that the common mudpuppies are also using the canal for breeding and/or nesting purposes, though no direct observations of which have been recorded.

Table 2. Species of interest and anticipated to utilize the lock to reach Lake Erie through a less intense current or access the Niagara River if incidentally navigating/foraging within the Black Rock Canal.

Common Name:	Scientific Name:	Ecological Requirements:
Emerald shiner	*Notropis atherinoides*	Mostly recognized as a pelagic species, emerald shiners prefer large open lakes to pools and runs of medium to large rivers with gravel or sand substrates. This species is tolerant of turbidity and can be found in a range of water clarity, though is sensitive to low levels of dissolved oxygen. Emerald shiners do not require a specific substrate or structure to spawn, as spawning occurs via midwater broadcast in shallower waters. Preferred temperatures range from 9-23°C, but spawning temperatures range from 20-24°C between June and August. The species forages on a wide range of foods including zooplankton, algae, and other small invertebrates. Emerald shiners exhibit a strong schooling behavior, forming "bait balls" that are trophically important to native game fish species like smallmouth bass and walleye.
Lake sturgeon	*Acipenser fulvescens*	Found in large lakes and rivers with mud, sand, hard clay, or gravel substrates. Lake sturgeon require clear waters with large rubble (cobble, boulders, trees) substrate for spawning. The preferred spawning depth is between 2-15 ft in rivers with swift currents, rapids or waterfalls (Collier et al., 2022). Larval sturgeon prefer slower moving water (0.1-0.7 m/s), and finer sediments such as silt and sand, than the faster moving waters that they will hatch from (Holtgren and Auer, 2004).
White sucker	*Catostomus commersonii*	Preferred habitat for suckers includes pools and riffles of creeks and rivers with preferred water temperature ranging from 17 to 29°C with a maximum temperature range of 30.8°C. Spawning occurs between April and June, starting at dusk and continuing through the night, when temperatures reach 10°C and end when water temperatures reach 20°C. White sucker spawning normally takes place at night, starting at dusk. Spawning occurs in gravelly areas of creeks and rivers, where males create a "trough" like nest that is cleared of the gravel and allows for the female to place her eggs. Once spawning has occurred, the eggs are then dispersed by the movement of the spawning adults. Optimal DO levels for white suckers are >4.3 ppm, with adult white suckers actively avoiding areas with DO < 2.4 ppm (Twomey et al., 1984).
Smallmouth bass	*Micropterus dolomieu*	Smallmouth bass prefer clear, gravel-bottomed runs and flowing pools of small to large rivers and shallow, rocky, and sandy areas of lakes. Smallmouth bass, at all life stages, seek cover and protection from sunlight. Bass will use all forms of submerged cover to avoid sunlight or seek deep dark water when light penetration is high. Smallmouth bass require >6.0 ppm of dissolved oxygen for optimal growth, but growth/success will reduce if DO drops to <4.0 ppm with DO levels near 1.0 ppm being lethal. Spawning for smallmouth bass begins when water temperatures reach 13-20°C. Nest are created within tributaries or backwaters, with clean stone, rock, or gravel substrate. Nests are usually built in areas with less plant material and protection from rough waters. Once spawning has occurred, like other centrarchids, smallmouth bass will guard the nest even after the eggs have hatched, until the fry are approximately one inch long (Edwards et al., 1983).

Common Name:	Scientific Name:	Ecological Requirements:
Largemouth bass	*Micropterus salmoides*	Largemouth bass prefer clear, warm, shallow lakes, bays, ponds, marshes, and backwaters and pools of creeks and small to large rivers, often with soft mud or sand substrate and dense aquatic vegetation. Similar to other centrarchids, largemouth bass prefer areas with an abundance of cover/structure and thrive in rivers with a higher percentage of pools and backwaters. Spawning for this species occurs between May and June, when water temperatures reach between 15-21°C. Nest construction and egg rearing is not limited by substrate type, as largemouth bass will use vegetation, roots, mud, sand, cobble, and gravel. DO levels do limit growth and success of largemouth bass, but largemouth bass can survive in DO conditions as low as 1.0 ppm. Optimal DO ranges for largemouth development is >8.0 ppm, but distress is not evident until conditions are <5.0 ppm. This species will begin to relocate due to low DO at <3.0 ppm (Stuber et al., 1982).
Muskellunge	*Esox masquinongy*	Muskellunge are most commonly found and prefer to live in densely vegetated areas (i.e., weed beds) in waterbodies like clear lakes, backwaters, quiet pools, and ponds. However, muskellunge can also be found within clear, sterile lakes with almost no weed beds. Spawning occurs when water temperature reach near 12°C, but can be limited heavily by fluctuating water temps, low oxygen, predation, and prey availability. However, when spawning does occur, it occurs in shallow waters with dense aquatic vegetation beds and/or woody debris. Each life stage requires various habitat types, but the most consistently required factor for each life stage is dense vegetation and weed beds. Adult muskellunge are the most common life stage to be found within riverine habitats and will consistently use rivers for spawning migrations and movement within its territory. Muskellunge, compared to other similar species, are relatively intolerant of hypoxic conditions and require ≥ 3.0ppm of DO during winter, ≥3.2 ppm during spring spawning, and a preference of ≤6.0 ppm of DO year-round (Cook and Solomon, 1987).
Northern pike	*Esox lucius*	Pike are more readily found in backwaters, pools, and lakes; however, northern pike will inhabit a wide variety of habitats including small to large rivers and reservoirs. Spawning habitat is often considered the largest limiting factor for northern pike, as highly vegetated areas with slower/weaker currents often provide the most ideal spawning habitat. Spawning tends to occur in the daylight hours between April and May and begins as soon as winter ice begins to dissipate, where the pike will begin to move upstream from deeper waters into tributaries or rivers. Northern pike are relatively tolerant to low levels of DO, with the ability to survive gradually decreasing when the DO is 0.1 ppm for several days; however, optimal DO levels for growth and survival is ≥7.0 ppm. This species is not adapted for life in high flowing systems and prefers to seek shelter in slow flowing back waters with dense vegetation (Inskip, 1982).

Common Name:	Scientific Name:	Ecological Requirements:
Redhorse spp.	*Moxostoma spp.*	Redhorses live in creeks and small to large rivers with a rock or gravel bottom, where they live in large schools on the bottom of the waterbodies. They spawn within tributaries of the Niagara River from April through May over rubble with gravel and sand. The species is dependent on suitable riverine habitat for spawning, moderate to swift current, riffle-run habitat and clean coarse substrates. Most spawning habitat is always adjacent or downstream of deep pools that serve as refuge during spawning. Greater redhorses will not begin spawning until mid-day water temperatures reach above 13°C in April or May, and will not usually end the spawn when temperature reach over 19°C. All *Moxostoma* species listed by NYSDEC within the area are listed as either sensitive or meso-tolerant regarding dissolved oxygen levels (Kwak and Skelly, 1992).
Common mudpuppy	*Necturus maculosus*	Common mudpuppies remain active throughout the entirety of the year, even remaining active under the ice of frozen-over waterbodies. Mudpuppies are found in a variety of permanent water bodies, both standing and moving, including the largest waterways, deep cold lakes, shallow weedy ponds, and fast-moving clean streams. They are often associated with areas that have an abundance of submerged cover as they are known to rest there during the day. This species is primarily nocturnal, mostly seeking cover during the day and foraging for food at night. Mating occurs in fall and winter (internal fertilization), and eggs are laid in May and June. Eggs are laid in nest created in depressions beneath rocks, logs, boards, and other submerged structures. The female will remain and guard the eggs, even months after the eggs have hatched (Haines, 2021).

2.5 Water Quality

The Black Rock Canal and the greater surrounding area of the Niagara River has been designated as an Area of Concern (AOC) as part of the Great Lakes Water Quality Agreement of 1987 (USEPA, 2025a). In the early 20th century, as part of the greater Buffalo area's urbanization and industrialization, there was significant expansion of the steel and chemical manufacturing as well as the milling of grain along the Niagara River. This expansion, and later decline, lead to a degradation of water quality due to post-industrial and municipal discharge characterized by an increase in the presence of contaminated soil and degraded habitat for wildlife and fisheries alike due to chemicals such as polychlorinated biphenyls (PCBs), dioxin, dibenzofuran, pesticides, and polycyclic aromatic hydrocarbons (PAHs; USEPA, 2025b). Presence of these chemicals and other habitat degrading factors have led to identification of seven beneficial use impairments within the Niagara River: restrictions on fish and wildlife consumption, fish tumors and other deformities, degradation of benthos, restrictions on dredging activities, loss of fish and wildlife habitat, degradation of fish and wildlife populations, and bird or fish deformities or reproduction properties (USEPA, 2025b).

As of 2016, the use impairment of fish tumors or other deformities has since been removed for Niagara River. Niagara River is still classified as an AOC in the Buffalo Niagara Waterkeeper's Riverwatch (BNWK) Water Quality Report and the NYSDEC classified the Niagara River as a Class A fresh surface water (BNWK, 2023). This classification designates a best use of the Niagara River as a source of water for consumption (after proper decontamination), primary and secondary contact recreation, and fishing. Water quality issues mentioned in this report for the Niagara River include contamination from toxic sediments and combined sewer overflows (CSO) and stormwater runoffs. While the Niagara River is designated as safe for consumption by the NYSDEC, Black Rock Canal is classified as a Class C fresh surface water (BNWK, 2023). The report states that best uses for Class C waterways include fishing, "these waters shall be suitable for fish, shellfish, and wildlife propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes" (BNWK, 2023). Furthermore, the report states, "fish consumption is impaired due to a New York State Department of Health (NYSDOH) health advisory for the Niagara River. Some species of fish have elevated PCB levels. Stormwater runoff, habitat modification, and combined sewer overflows also impact the canal" (BNWK, 2023).

Tributaries that contribute water to the Black Rock Canal face similar water quality issues that affect the habitat quality for fish within Black Rock Canal. Scajaqauda Creek is a tributary of the Niagara River and Black Rock Canal. The mouth of Scajaquada Creek is approximately 2,360 feet (0.44 miles) from the southern gates of the BRL and is likely to directly affect water quality of the canal during periods of high discharge such as storms. Scajaquada Creek's water quality issues directly stem from the presence of CSOs and stormwater runoffs, which contribute to the creek's low DO, excess nutrients, pathogens, and odors (BNWK, 2023). Samples were taken by BNWK during periods of both high-water discharge and dry weather and found that both Black Rock Canal and Scajaquada Creek saw an increase in the presence of *E. coli* during wet weather days (BNWK, 2023). Scajaquada Creek has differing ratings depending on the reach of the creek, but the mouth of Scajaquada Creek is classified as a Class B creek. Class B creeks' best uses include primary and secondary contact recreation and fishing, the waters are usually suitable for fish, shellfish and wildlife propagation and survival (BNWK, 2023).

The Buffalo River is also a tributary to the Niagara River, that likely contributes to the water quality of the Black Rock Canal, due to the mouth of the Buffalo River's proximity to the entrance of the canal (approximately 3,750 feet or 0.7 miles). The Buffalo River is classified as a Class C stream; contributing factors to this river's water quality issues include streambank erosion, urban stormwater runoff, and agricultural runoff (BNWK, 2023).

While conducting a literature review of potential fish species observed within or utilizing the Black Rock Canal, USACE biologists identified DO as a common limiting factor for many of the species. Many fish such as bass (*Micropterus* spp.) and channel catfish (*Ictalurus punctatus*) will actively avoid areas with summer DO levels below 5.0 mg/l (5.0 ppm). During a 2014-2015 survey of emerald shiners within the Black Rock Canal and Lock, DO was measured at the seining sites from July-October 2014 and May-June 2015. DO was not found to fluctuate over 9.4 mg/L (ppm) or below 5.9 mg/L (ppm) (USACE LRB, 2021b). There is no available data for DO during winter months or specifically during periods of high flow when DO could be affected by higher input from Scajaquada Creek. It is noted within the BNWK Water Quality Report that Scajaquada Creek does experience issues with DO and that would likely affect the canal during period of high input such as storm events (BNWK, 2023).

3 Major USACE Maintenance Project

Major USACE maintenance projects are underway at the BRL to update the over century-old infrastructure. With no replacement of the original miter guard gates since the lock's construction in 1913, the BRL miter guard gates are over 100 years old and inspection reports indicate that the gates are due for replacement. In 2021, the Buffalo District hosted a value-based design charrette in coordination with the Inland Navigation Design Center to investigate alternatives to the existing miter guard gates and all related elements with a 100-year design life. The recommended path forward was to install full chamber bulkheads and bulkhead slots, with retrofitting of the guard gate pockets and sill to accommodate. The scope and design of the project increases safety and meets standardization initiatives across USACE. The scope of the project includes removal of the existing miter guard gates; fabrication of new bulkhead sections and appurtenances, such as a lifting beam; construction of bulkhead slots; and delivery and installation of bulkheads and appurtenances. As work continues, the upper miter guard gates are expected to be installed in FY30 and the lower miter guard gates are expected to be installed the following fiscal year.

4 Opportunity Identification and Prioritization

Opportunities, constraints, and considerations were identified to develop and prioritize potential future modifications of USACE operations with the goal of improving the ability for fish species to pass through the lock and maximizing habitat quality. These opportunities, constraints, and considerations were specifically defined within the scope of current operations and maintenance initiatives that are ongoing.

4.1 Ecological Opportunities & Outcomes

Within the context of this study, opportunities are defined as desirable environmental outcomes that are possible from future modifications to operations at BRL. Based on the inventory of existing conditions, five potential ecological opportunities were identified:

1. Restoration of more natural hydrologic and hydraulic regimes – Development of the navigation system deviated the Black Rock Canal from the mainstem of the upper Niagara River from a free-flowing system to a protected canal. Restoration of more natural hydrologic and hydraulic regimes may benefit native species through changes in seasonal flow patterns, habitat variability, and water quality.

2. Improvement in water quality – Reductions in stratification or concentrations of pollutants in the canal may increase the quality of the biological community and the sustainability of the ecosystem.

3. Improvement in quality of the aquatic community – Development of the navigation system altered the quality and quantity of habitat in the upper Niagara River by transforming the east bank of the mainstream river into a canal. This transformation reduced the size of river habitats, subsurface vegetation at the downstream portion of the lock, and altered sediment transport such that habitats may experience less sedimentation or erosion than preconstruction conditions. An increase in the number of lockages over a period of time may increase the variability within the system and provide additional resources for foraging, spawning, and other activities.

4. Connectivity of habitats – Presence of the BRL reduced habitat connectivity throughout the Black Rock Canal. Improvement in the connectivity of habitats across the canal may increase species movement and result in an overall increase in resource availability.

4.2 Constraints and Considerations

Identification of constraints and considerations is a critical step towards identifying and prioritizing realistic actions designed to improve ecological conditions. Within the context of this study, constraints are defined as factors that limit the ability to realize ecological opportunities and would require significant resources to overcome. Considerations are defined within the context of this study as factors that may affect the feasibility or likelihood of realizing ecological opportunities. As such, considerations should be taken into account when attempting to realize ecological opportunities; however, they generally exert less control over realizing ecological opportunities than constraints.

4.2.1 Constraints

Two operations and maintenance constraints were identified:

1. Excessive wear on the lock – Any measures implemented cannot cause any excessive wear on lock infrastructure.

2. Maintaining the authorized project purpose of the lock – Any measures implemented cannot interfere with the authorized purpose of BRL. Navigation is the primary purpose, and any measure cannot prevent normal procedures and vessel traffic through the lock.

4.2.2 Considerations

Two considerations were identified:

1. Potential impacts to labor hours for lock operators – Navigation is the primary authorized purpose for the BRL and additional labor added to lockmasters implementing any measures should be considered.

2. Major lock maintenance project – A major lock maintenance project is anticipated to take place in FY30. This effort will include engineering and design for upper miter guard gate removal and sill recess modifications, installation of new miter guard gates, and fabrication and installation of new maintenance bulkheads. Any implemented measure should consider this project's construction window and the change in infrastructure.

5 Assessment and Evaluation of Ecological Measures

Five pre-maintenance and two post-maintenance operational measures were analyzed under the current effort and are summarized below (Table 3).

Table 3. Measures considered.

Measure	Description	Pre/Post Maintenance
Conservation Lockages – Early Spring	Additional lockages prior to peak season to allow fish passage. Increase in opportunity for fish passage and water exchange.	Pre- and post-
Conservation Lockages – Peak Season	Additional lockages at the beginning and/or end of shift timed with natural fish movement. Increase in opportunity for fish passage and water exchange.	Pre-
Partially Opening Miter Gates Overnight	During non-operating hours, partially open the gates to allow transfer of water through the lock.	Pre-
Opening Butterfly Valves Overnight	Leaving the butterfly valves open at night to allow fish to pass through.	Pre- and post-
Opening Conduit (Culvert) Valves Overnight	Open 6-foot conduits on opposite side of miter gates to allow water exchange.	Pre-

The team identified potential benefits and limitations associated with implementation of each measure in the BRL and screened based on limitations (Table 4). This information was then synthesized to develop recommendations and create a recommended implementation plan.

5.1 No Action Measure

The No Action measure assumes no new Federal action and continuation of current operations.

5.2 Conservation Lockages in the Early Spring – Pre-Maintenance

Conservation lockage is the act of operating lock systems in the absence of traffic, specifically to enhance fish passage. Conservation lockages have the potential to impact species dispersal through the Black Rock Canal. During the late winter and early spring months, the lock operators already conduct debris/ice clearing lockages throughout daily operations. The proposed inclusion of conservation lockages would be in addition to these regular operations during natural movement times. This measure proposes implementation of conservation lockages in the early spring months (March through May) prior to the peak season to target natural fish movement in the dawn or dusk. Conservation lockages will allow for greater chance of fish passage through the BRL.

There is risk that additional lock operations will cause excessive wear on aged lock operational infrastructure, potentially leading to increased maintenance cost. However, limiting conservation lockages to only the early spring minimizes this risk. Scheduling additional lock operations could also increase labor costs, which may be supported through future SRP funding requests. Based on the potential ecological benefits, this measure was retained for pre-maintenance.

5.3 Conservation Lockages in the Early Spring – Post-Maintenance

This measure is the same as described in Section 1.2; however, it would be implemented following completion of the maintenance project. The limitations are also as described in Section 1.2 and the study team has chosen to retain this measure for post-maintenance.

5.4 Conservation Lockages During Peak Season – Pre-Maintenance

This measure would be implemented during the BRL peak season (June through September). During the peak season, lockages for commercial and recreational boating are much more frequent – upwards of 20 lockages per day. The conservation lockages for this measure will be performed at dawn or dusk to target natural fish movement and to avoid impact to regular operations. These extra lockages will allow for greater chance of fish passage through the BRL at natural movement times.

The limitation with this measure is the same as described in section 1.2; however, this measure is taking place during peak season. Many lockages are completed throughout the day during this season, so the addition of one or two extra conservation lockages at dawn or dusk is likely to have minimal additional benefit. Due to the additional labor along with limited quantifiable benefit, this measure was screened out.

5.5 Conduit (Culvert) Openings Overnight – Pre-Maintenance

The lock culverts are two six feet openings found adjacent to the upper and lower operating gates. The flow and discharge of water through the culverts are controlled by butterfly valves located at each end of the culverts (USACE LRB, 2012). For implementation of this measure, the butterfly valves to the culverts would remain open overnight to allow for water exchange and increase the DO levels inside the pool.

The limitation with this measure is that the increased use of the culvert valves may cause excessive wear of the operating gates. This measure was retained for pre-maintenance.

5.6 Opening Butterfly Valves Overnight – Pre-Maintenance

The miter guard gates have two horizontal rectangular butterfly valves in each gate leaf toward the middle of the gate and about six feet from the bottom of the canal floor (USACE LRB, 2012). For implementation of this measure, the butterfly valves would remain open overnight to allow for water exchange and increase the DO levels inside the pool.

Due to the placement of the butterfly valves on the current miter guard gates, constant flow of water through the values may cause excess erosion on the sills. This measure was screened out due to impacts on the lock structure and professional input from the Lock Master.

5.7 Opening Butterfly Valves Overnight – Post-Maintenance

The implementation of this measure is the same as described in Section 1.6; however, it would be implemented following completion of the major maintenance project. One key difference for this measure is that the position of where the butterfly valves are on the new miter guard gates has changed. The butterfly valves will be positioned vertically and above the canal floor. This new positioning causes the risk of erosion on the sills to decrease substantially, and therefore, this measure has been retained for post-maintenance.

5.8 Partially Opening Miter Gates Overnight – Pre-Maintenance

After the hours of operation, the miter gates are left in a closed position overnight. The implementation of this measure would have the lower miter gates opened partially to allow water exchange and possible fish movement overnight into the pool. A conservation lockage first thing in the morning will allow for any fish that may have accumulated in the pool to be locked through the canal.

However, when the gates are left in a partially open position, there is significant risk that too much pressure will be placed on the miter gates and cause a rise in water that may dislodge the gate itself. Due to the severe consequences associated with this and professional input from the Lock Master, the measure was screened out.

Table 4. Results of measure screening.

Measure	Pre- or Post-Maintenance	Measure Screening Justification	Decision
Conservation Lockages – Early Spring	Pre-	Additional lockages may provide an increase in opportunity for fish passage and water exchange.	Retain
Conservation Lockages – Early Spring	Post-	Justification is the same as described above for pre-maintenance.	Retain
Conservation Lockages – Peak Season	Pre-	Many lockages are routinely completed throughout the day. One or two additional lockages are likely to have minimal benefit with risk of additional labor necessary.	Screen out
Conduit (Culvert) Openings Overnight	Pre-	Allow for water exchange and increase in DO levels inside the pool.	Retain
Butterfly Valve Openings Overnight	Pre-	Placement of butterfly valves on current miter gates may cause excess erosion on the sills.	Screen out
Butterfly Valve Openings Overnight	Post-	Placement of butterfly valves on new miter gates significantly reduces erosion risk and allows for water exchange and increase in DO levels.	Retain
Partially Opening Miter Gates Overnight	Pre-	When left in partially open position, significant risk of excess pressure can cause the gate to dislodge.	Screen out

6 Recommendation for Change in Operations

Preliminary recommendations for this study were developed by the USACE LRB based on potential benefits and limitations of each measure and targeted resources (i.e., labor requirements, probability of fish passage, improvement of habitat quality). The recommendation of measures to be implemented at the BRL can be found in Table 5 and is shown in Figure 7. Conduit (culvert) opening was not carried forward as a measure for post-maintenance because the butterfly valves on the new gates allow for additional volume of water to pass through the lock. The volume of water exchange should be calculated prior to implementation to ensure no adverse effects to lock equipment.

Table 5. Implementable measures.

Measures	
Conservation Lockages – Early Spring	Pre-Maintenance
Conduit (Culvert) Opening	
Conservation Lockages – Early Spring	Post-Maintenance
Opening of Butterfly Valves	

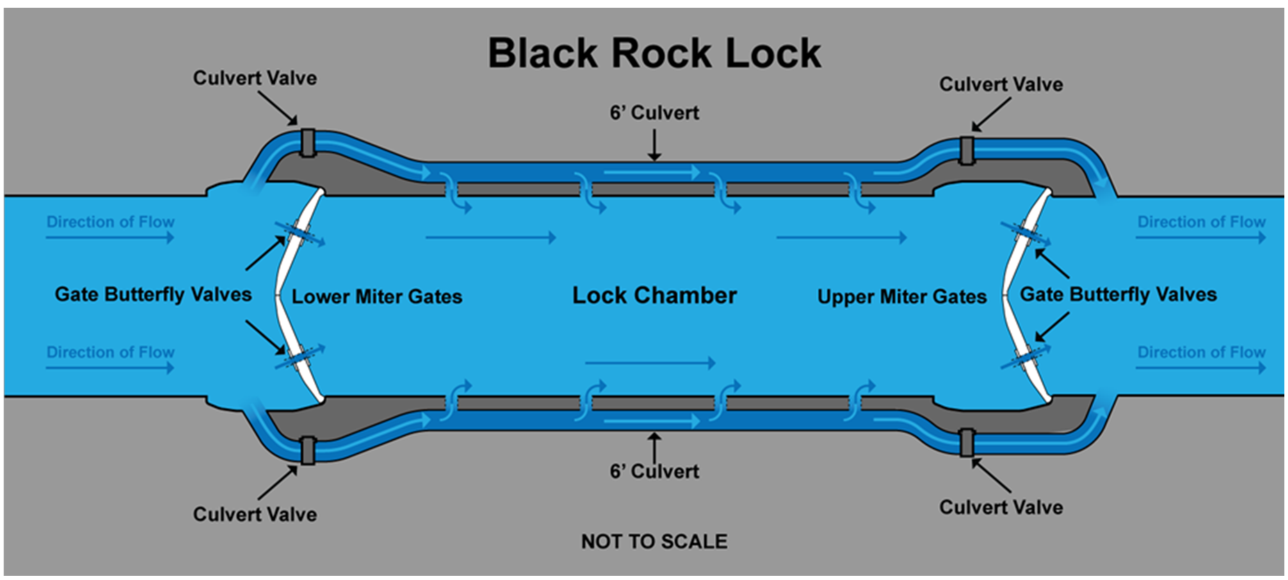


Figure 7. Structural components of the BRL and implementable measures (made by USACE Visual Information).

A stakeholder meeting was conducted to inform local associations and agencies of the identified opportunities to alter lock operations. The meeting prompted interest in collaboration amongst all participating entities. Current datasets can be referenced and/or expanded upon to strengthen the knowledge of known fish presence for utilization in future monitoring. A monitoring project to determine the success of this study is proposed. Monitoring objectives could include evaluation of changes in hydraulic parameters and DO levels as well as quantify change in fish movement in the canal as a result of modified lock operations via gill nets or seining. A "before-after" monitoring design is suggested to quantify the effectiveness of the changes to lock operations. Fish and water velocity data could be collected concurrently so that correlations between hydraulic conditions (e.g., velocity) and biological responses (e.g., abundance, passage) can be identified. The monitoring program may be conducted in collaboration with other interested stakeholders, such as NYSDEC, USFWS, and Buffalo State University, among others.

Funding to support implementation of these recommendations will be requested from the SRP beginning in FY27. It is anticipated that funding will be required to support additional labor requirements for lock operators, monitoring project success, outreach, and limited project management tasks. Ongoing funding needs are anticipated to be within the range of $40,000 to $50,000, but funding needs will be re-evaluated prior to submittal of proposals to the SRP.

Recommendations presented in this report are considered preliminary, and ongoing communication with the lock operators will continue as the major lock maintenance tasks are completed.

7 Summary of Conclusions and Next Steps

Within the scope of this project, three viable measures were identified to increase the ability for fish passage at BRL. Benefits and drawbacks of each opportunity documented in this report should be referenced when making decisions regarding further study or implementation of any ecological measure. Preliminary monitoring is recommended prior to implementation of any measure to conduct a comprehensive analysis of the potential benefits, limitations, and drawbacks of implementation at a finer scale than was possible under this study.

This study assumes that modifications to lock operations will result in habitat quality improvement on the Black Rock Canal. However, the extent to which these operational changes will impact the canal is not quantitatively understood. After implementation, monitoring will occur to observe and understand the effectiveness of the measures and how they are impacting the quality of habitat and ability for fish to pass through.

Additionally, recommendations and findings presented in this report are based on existing data. Therefore, further investigation of species-specific movement within the Black Rock Canal should be monitored prior to and post implementation of operational changes. The team intends to broaden and build upon the initial stakeholder engagement efforts utilizing future SRP or other project funding. This report will serve as the foundation to build partnerships and identify and implement specific operational changes to improve fish passage and habitat conditions in the Black Rock Canal.

Literature Cited

Buffalo Niagara Waterkeeper (BNWK). 2023. 2023 Riverwatch Water Quality Report. Accessed April 30, 2025. https://bnwaterkeeper.org/wp-content/uploads/2024/01/2023-Riverwatch-report.pdf

Carlson, D.M. 2001. *List of Fishes of the Niagara River in New York State*. Draft for NYS DEC.

Collier, J.J., Chiotti, J.A., Boase, J., Mayer, C.M., Vandergoot, C.S., Bossenbroek, J.M., 2022. Assessing habitat for lake sturgeon (*Acipenser fulvescens*) reintroduction to the Maumee River, Ohio using habitat suitability index models. J. Great Lakes Res. 48 (1), 219–228.

Cook, M.F., and R.C. Solomon. 1987. Habitat suitability index models: muskellunge. U.S. Fish Wild1ife Service. Biol. Rep. 82(10.148). 33 pp.

Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data. 1995. Establishment of International Great Lakes Datum (1985). Joint publication of the U.S. and Canada.

Edwards, E. A., G. Gebhart, and O. E. Maughan. 1983. Habitat Suitability Index Models: Smallmouth Bass. U.S. Dept. Interior Fish and Wildlife Service. FWS/OBS-82/10.36. 47 pp.

Fuller, P., L. Nico, E. Maynard, M. Neilson, J. Larson, T.H. Makled, A. Fusaro, and R. Sturtevant, K.M. Reaver. 2025. *Proterorhinus semilunaris* (Heckel, 1837): U.S. Geological Survey (USGS). Nonindigenous Aquatic Species Database, Gainesville, FL. https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=714. Accessed August 27, 2025.

Haines, Adam M. 2021. Common Mudpuppy (*Necturus maculosus*) distribution, diet and seasonality in western New York and morphological condition in lake and stream habitats. Biology Theses. https://digitalcommons.buffalostate.edu/biology_theses/.

Holtgren, J.M., and Auer, N.A., 2004. Movement and habitat of juvenile lake sturgeon (Acipenser fulvescens) in the Sturgeon River/Portage Lake system. Michigan. J. Freshwater. Ecol. 19 (3), 419–432.

Inskip, P. D. 1982. Habitat suitability index models: northern pike. U.S. Department of the Interior, Fish and Wildlife Service. FWS/OBS-82/10.17. 40 pp.

Kwak, T.J., and Skelly, T.M. 1992. Spawning habitat, behavior, and morphology as isolating mechanisms of the golden redhorse, *Moxostoma erythrurum*, and the black redhorse, *M. duquesnei*, two syntopic fishes. Environ Biol Fish 34, 127–137. https://doi.org/10.1007/BF00002388.

Niagara River Remedial Action Plan. 2025. A Unique Natural Resource. Accessed August 27, 2025. https://ourniagarariver.ca/niagara-river-ecology/.

Stuber, R. J., G. Gebhart, and O. E. Maughan. 1982. Habitat suitability index models: Largemouth bass. U.S. Dept. Int. Fish and Wildlife Service. FWS/OBS-82/10.16. 32 pp.

Twomey, K. A., K. L. Williamson, and P. C. Nelson. 1984. Habitat suitability index models and instream flow suitability curves: White sucker. U.S. Fish Wildlife. Service FWS/OBS-82/10.64. 56 pp.

U.S. Army Corps of Engineers (USACE). 2023. Planning policy for conducting civil works planning studies. Engineer Regulation (ER) 1105-2-103. 97 pp.

U.S. Army Corps of Engineers (USACE), Buffalo District (LRB). 2012. Black Rock Lock Operations and Maintenance Manual. USACE LRB, Buffalo, New York.

U.S. Army Corps of Engineers (USACE), Buffalo District (LRB). 2016. Niagara River Area of Concern Emerald Shiner (*Notropis atherinoides*) Study: Great Lakes Remedial Action Plans Program Habitat Characterization. USACE LRB, Buffalo, New York.

U.S. Army Corps of Engineers (USACE), Buffalo District (LRB). 2021a. Black Rock Lock Operations and Maintenance Manual. USACE LRB, Buffalo, New York.

U.S. Army Corps of Engineers (USACE), Buffalo District (LRB). 2021b. Emerald Shiner Fish Passage Project at Broderick Park: Environmental Assessment. USACE LRB, Buffalo, New York.

U.S. Army Corps of Engineers (USACE), Hydrologic Engineering Center (HEC). 2025. Strategic Management Plan. Sustainable Rivers Program. USACE HEC, Davis, California. https://www.hec.usace.army.mil/sustainablerivers/publications/

U.S. Environmental Protection Agency (USEPAa). 2025. Lake Erie. Retrieved August 27, 2025. https://www.epa.gov/greatlakes/lake-erie

U.S. Environmental Protection Agency (USEPAb). 2025. Niagara River Area of Concern (AOC). Retrieved April 30, 2025. https://www.epa.gov/great-lakes-aocs/niagara-river-aoc-0

U.S. Fish and Wildlife Service (USFWS). 2025a. Environmental Conservation Online System: Salamander Mussel (*Simpsonaias ambigua*). Accessed April 10, 2025. https://ecos.fws.gov/ecp/species/6208#lifeHistory

U.S. Fish and Wildlife Service (USFWS). 2025b. Information for Planning and Consultation. Retrieved from Information for Planning and Consultation (08 April 2025): https://ipac.ecosphere.fws.gov/.

Yagi, A. R., and Blott, C. 2012. Niagara River watershed fish community assessment (1997-2011). Ontario Ministry of Natural Resources, unpublished report. 168 pp.