Appendix A

Lower Black River

Lorain, Ohio
Ecological Restoration Master Plan

APPENDIX A – AREA HISTORY AND EXISTING CONDITIONS

Early History

Earliest records of activity in the Black River Watershed indicate that the first contact by Europeans was the arrival of Jesuit missionaries in the 1600's. Early European arrivals found the area occupied by members of the Huron and Erie tribes. The southern shore of Lake Erie was apparently not home to specific tribes, but rather was used primarily as a hunting and fishing area for several tribes in the Iroquois Five Nations Alliance. Members of the Iroquois Five Nations Alliance apparently drove the Erie tribe from the south shore of Lake Erie by the mid-1600's. Surviving records from the period from the mid 1600's to the mid 1700's indicate much of northern Ohio was sparsely inhabited, due to the Iroquois Five Nations Alliance and the generally swampy terrain, which prevented Europeans from entering the area. Little archaeological material dates back to this time period.

In the late 1600's the Wyandot nation and small bands of Hurons moved into the south shore of Lake Erie and were still there in the 1800's when the area was finally settled by Europeans. The Wyandots were eventually relocated to reservations in Seneca and Sandusky Counties during the early 1800's and then moved out of Ohio around 1830. There are no active Wyandot historic sites on the Black River.

In 1786, Connecticut signed a Deed of Cession turning over most of its western lands to the Federal government, but retaining that land extending 120 miles west of the Pennsylvania-Ohio line, between the Lake Erie shore and the 41st parallel. The Black River watershed was part of this Western Reserve. Early settlers in his portion of the Western Reserve included Moravian missionaries. The first recorded permanent settlement near the current city of Lorain was established as a small trading post at the mouth of the Black River in 1807.

Connecticut eventually sold the Western Reserve to the Connecticut Land Company for $1,200,000. A member of the Connecticut Land Company, Justin Ely, started a small settlement at the current site of Elyria, Ohio, in 1817. Also in that year, Black River Township containing the City of Lorain, was mapped. Lorain County was officially established in 1822.

Shipbuilding, an important feature in the history of Lorain and the Black River, was first established in the area in 1820. Two brothers from Connecticut, whose shipbuilding business was destroyed by British raids during the War of 1812, accepted a land grant in the Western Reserve and relocated the shipyard to the mouth of the Black River. Other shipbuilders followed, by the 1830's the city was established as a center of shipbuilding on Lake Erie.

The City Grows

In the mid 1880's the Nickel Plate Railroad reached Lorain, connecting the city to markets and suppliers in the East. By the 1870's a rail connection was completed between the small city of Lorain and the Ohio River. The rail connections and the natural harbor offered by the mouth and estuary of the Black River made Lorain a convenient port and a logical location for heavy industries, including an expanded shipbuilding industry and steel making plants. Growth was rapid. By 1880 the city was home to some 1,600 people. By 1890 the population had grown to almost 5,000. In 1900, over 16,000 people called Lorain home.

Steel making, shipbuilding and other heavy industries continued to grow, and the city of Lorain along with them, through the 1970's.

Shipbuilding was established early, and became a major industry along the Lower Black River.

Current State

By the 1980's heavy industry was in decline in Lorain. Steel mills were closing. American Shipbuilding, a premier builder of Great Lakes freighters and other craft, closed in the 1980's. Currently, there are no shipbuilding operations left along the Black River. U.S. Steel and the Republic Engineered Products Plant are the remaining steel makers along the river.

In 1980, the census bureau listed just over 75,000 people in the city of Lorain. By 2000, that number had fallen to 68,652. The Census Bureau's estimate of population in 2006 was 70,592.

The Black River History

Industry, agriculture and other land uses have clearly left their marks on the Black River. Regulation of discharges to water bodies like the Black River began with the passage of the Clean Water Act in 1970. The Ohio EPA was established in 1972. In the Early 1980's, Ohio EPA and the U.S. EPA began studies of fish populations in the Black River.

A coking facility associated with the USX-USS/Kobe steel complex released polynuclear aromatic hydrocarbons (PAHs) into the River. These compounds contaminated the sediment near the coke plant and downstream, resulting in high concentrations of some PAH's (some as high as hundreds of parts per million (ppm) near the coke plant outfall). Early fish studies found a high incidence of liver and external tumors including cancers in native brown bullhead (*Ameiurus nebulosus*). Few fish appeared to survive past the age of four and none past age five. Ohio EPA issued a fish advisory and a primary contact advisory for the river during the 1980s.

When steel and coke operations began to decline after 1982, residues of PAH in bullhead caught in the Black River also declined to about one-tenth the levels found in fish captured in 1980 and 1981. Declines in tumors and cancer rates in captured fish continued to decline after coking operations ceased permanently in 1983.

Concern over pollution loads in the River, and the resulting damage to the health of fish and other aquatic organisms, led in 1984 to the listing of the Lower Black River as an Area of Concern (AOC) by the International Joint Commission (IJC). Aside from the concerns to fish and wildlife, there were concerns on the potential effect of the polluted river system on human health and a contact advisory was listed by Ohio Department of Health. The advisory warned people not to contact the waters and sediments of the lower river. Sources of contamination were suspected to be from the entire watershed. Shortly after the Lower Black River was listed as an AOC, the Black River Remedial Action Plan (RAP) Coordinating Committee expanded listing to the entire watershed, making the Black River one of the few AOC's that encompasses the entire watershed.

Clean up of the contaminated sediments in the Lower Black River began in 1989 and ended in 1990. The Black River Remedial Action Plan was formed in 1991. The Ohio EPA and others continued to study the River, through intensive biological surveys conducted in 1992 and 1997.

The hard work carried out by the Black River RAP, the city and county of Lorain, and a wide variety of other agencies and public groups, has resulted in improvements in the health of the Black River. In 2004, the Ohio Department of Health lifted the contact advisory. Also in 2004, the USEPA and IJC approved the re-designation of the Fish Tumors and Other Deformities beneficial use impairment from Impaired to In Recovery.

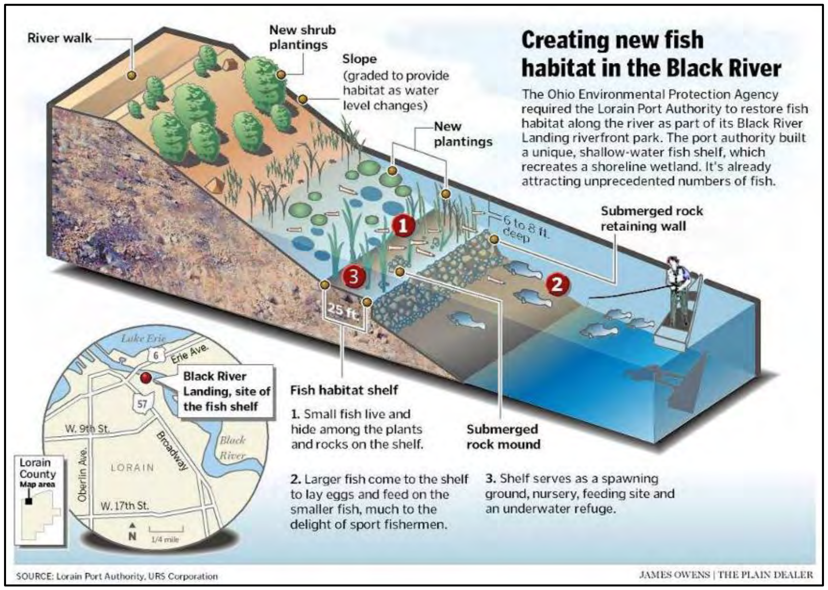
Ecological Importance

The Black River was notorious for the levels of pollution found up through the 1980's. Fish tumors and other malformations were prevalent in the water, due to the toxic effluents in the industrialized portion of the River. Establishing the Black River as an AOC brought attention to the ecological damage that had been done. USEPA lists 14 beneficial uses provided by surface waters like the Black River. Of those 14 uses, 10 were originally listed as impaired in the Black River.

Clearly, the "main street" of the city of Lorain has been damaged by the long history of pollution and physical alteration. Like any vital piece of infrastructure, the ecological repair of this aquatic "main street" is vital to the future economic health of the city.

The ecological goals of this Plan may be simply stated as developing a list of potential projects that address as many of the Beneficial Use Impairments as practical.

Some progress has been made. Fish tumors and other deformities are no longer listed as impaired, but rather since 2004 have been listed as "in recovery", a testimony to the extent to which carcinogens and other toxics have been removed from the water column and the sediments. Small gains have been made in in-stream habitat, as evidenced by the success of the "Fish Shelf" at the Black River Station complex.



The Black River Landing fish shelf provides fish habitat.

Economic Importance

Lorain is a city much like many others in the Great Lakes region. Once a center for transportation, steel making, manufacturing and a major shipbuilder for the Great Lakes, Lorain saw a loss of manufacturing employers and therefore jobs during the 1980's. While the former manufacturing base has largely eroded, some strong core firms remain. Also, the city realizes it is situated at the junction of several important natural features, including the Black River and the Lake Erie shoreline. Enhancement of these natural features, repair of the past damage, the strategic restoration of damaged areas and creation of new natural ecosystems, all can help remove the stigma attached to abandoned, damaged and blighted areas, and help spur new, appropriate and environmentally friendly development.

Ecological and Economic Goals

The ecological and economic recoveries of the Lower Black River corridor are inextricably linked. Thus we have developed linked goals that express the desire to achieve both simultaneously.

The overall desire is to establish a healthy river and riparian ecosystem in a thriving urban environment. The intent is not to return the entire Lower Black River to its condition prior to European settlement. Such a notion is simply not achievable, and clearly not in the interest of the linked economic and ecological recovery this plan seeks to achieve.

Project Area Climate

The city of Lorain has a humid, mid-continental climate, greatly influenced by the city's location on the shores of Lake Erie. Average rainfall in Lorain is at the Ohio statewide average of 37 inches per year. Snowfall averages 43 inches per year, somewhat more than most of the state, but less than that seen in the true "snow belt" east of Cleveland (Figure A.1). Precipitation is on average greatest from April through September of each year and falls on 135 of 365 days. High temperatures occur generally in July and average 85 degrees, January is generally the coldest month, low temperatures average around 19 degrees.

Figure A.1. Average precipitation in Ohio.

Project Area Geology and Soils

To an extent, the ability to successfully restore terrestrial systems along the Black River is dependent upon the soils underlying the area. Basic knowledge of the soils in the area will be important to those charged with carrying out the restoration activities suggested in the plan.

At the very mouth, the Black River lies on a broad, flat plain, mostly underlain by old lacustrine and riverine deposits. Some 360 million years ago northeast Ohio was covered in shallow seas. Thick deposits of glacial materials covered the marine deposits that form the bedrock of the system. Most of the current rivers that flow to Lake Erie in Northeast Ohio were formed by cutting down and eroding through these deposits, often generally following buried valleys that pre-dated the glacial periods. In Lorain County, as the Black River cut down, shale and sandstone formations were exposed, mostly along the northern banks. The Ohio Shale is the oldest exposed rock along the mainstem of the River. This black shale formation is some 360 million years old, and is formed from particles of clay and sand that came from the erosion of the Appalachian Mountains.

The Soil Survey of Lorain County (Soil Conservation Service, 2006) shows 10 soil units mapped as occurring within the study area. Soils in the project area are mainly Mahoning–Urban land complex, nearly level (MmA). This soil type is somewhat poorly drained and has approximately 6-18" depth to water table. The soil map units within the project area include:

AmA—Allis-Urban land complex, nearly level: This is a moderately shallow and level soil that is poorly drained and typically found in depressions. Permeability is moderately low to very low with a depth to the seasonal high water table typically at the surface or to 12 inches below the surface. According to the hydric soils list for the state of Ohio (NRCS), AmA is a hydric soil. AmA is only mapped in a small portion of the study area.

Ch – Chagrin silt loam: This is a deep, level soil that is well drained and typically found in floodplains. Permeability is moderately high to high with a depth to the seasonal high water table typically at 36 inches below the surface. Chagrin silt loam is listed as a hydric soil. This soil type accounts for 21.0% of mapped soils in the study area.

Cz – Udorthents: Udorthents are soils that have been altered by construction, mining, or other earth moving activities that result in a mixing of soil types and horizons. In the study area, these soils are characterized as deep soils and are found along the eastern border of the study area. The depth to the seasonal high water table generally beyond 80 inches below the surface. Cz is not a hydric soil.

HsA—Haskins loam, 0 to 2 percent slopes: This is a deep, level soil that is somewhat poorly drained and typically found in lake and till plains. Permeability is moderately low to very low with a depth to the seasonal high water table where HsA is mapped to be approximately at 6 to 18 inches below the surface. HsA is a hydric soil. HsA is located along the Lower Black River directly downstream of the confluence of French Creek

Lb — Lobdell silt loam: This is a deep, level soil that is moderately well drained and typically found in floodplains. Permeability is moderately high to high and the depth to the seasonal high water table is approximately at 18 to 30 inches below the surface. Lb is not a hydric soil. This map unit accounts for a very small portion (0.7%) of mapped soils in the study area and is located at the confluence of French Creek and the Black River.

MgA—Mahoning silt loam, 0 to 2 percent slopes: This is a deep, level soil that is somewhat poorly drained and typically found in till plains. MgA accounts for 15.6% of mapped soils in the study area and is located throughout the study area. Permeability is moderately low to very low with a depth to the seasonal high water table at 6 to 18 inches below the surface. MgA is a hydric soil.

MmA—Mahoning-Urban land complex, nearly level: This is a deep, level soil that is somewhat poorly drained and typically found in till plains. Permeability is low to very low with a depth to the seasonal high water table where MmA is mapped to be approximately at 6 to 18 inches below the surface. MmA is a hydric soil, and accounts for 33.7% of mapped soils in the study area.

Mr—Miner silty clay loam: This is a deep, level soil that is very poorly drained and typically found in depressions. Permeability is moderately low to moderately high; the seasonal high water table occurs at or near the surface. Mr is a hydric soil, and is a minor component of the soils in the study area.

RdC2—Rawson loam, 6 to 12 percent slopes, moderately eroded: This is a deep, non-hydric soil that is moderately well drained and typically found on hills and slopes. Permeability is moderately low to moderately high and the depth to the seasonal high water table is approximately at 18 to 30 inches below the surface. RdC2 accounts for 0.1% of mapped soils in the study area. Rawson loam is not a hydric soil.

Tg—Tioga fine sandy loam: This is a deep, level soil that is well drained and typically found in floodplains. Permeability is moderately high to high with a depth to the seasonal high water table where Tg is mapped to be approximately at 36 inches below the surface. According to the hydric soils list for the state of Ohio (NRCS), Tg is not a hydric soil. Tg accounts for 0.1% of mapped soils in the study area.

Portions of the area are covered in slag that was deposited during steel production, and in soils derived from fill and construction rubble. Such activities are typical of urban industrial areas. Restoration in these areas will require removal of the deposited slag, and, depending on the nature of the underlying material, potentially the amendment of remnant soils to ensure that sufficient nutrient and organic matter is present to support the desired plant communities.

Project Area Land Cover

Land cover can have direct and indirect effects on water quality. A number of studies have examined this relationship, and in general there seems to be some agreement that when impervious cover reaches values of around 10% of a watershed, water quality variables begin to decline. *Figures A.2* through *A.4* show views of land use along the river in the project area. Table A.1 shows a summary of land cover by acreage and percent within the study area. Data for this table came from the U.S. EPA 2001 land cover data set, the most recent data for which full metadata could be located. These data were derived from an analysis of satellite images.

Land cover in the study area is strongly dominated by urban, developed land cover types. Developed land, both high intensity and low intensity categories, accounts for 57.74% of the land cover.

Table A.1. Land Cover Summary		
Land Cover	**Acres**	**Percent**
High Intensity Developed	935.52	46.08
Low Intensity Developed	236.80	11.66
Deciduous Woods	195.40	9.62
Evergreen Woods	0.45	0.02
Mixed Woods	0.69	0.03
Scrub/Shrub	21.19	1.04
Grassland	49.60	2.44
Palustrine Forested Wetland	129.57	6.38
Palustrine Emergent Wetland	85.39	4.21
Water	375.70	18.50
Total	2,030.30	100.00

Water, predominantly in the Black River channel and the portions of the study area beyond the mouth of the river, account for just over 375 acres, roughly 18% of the study area. Two categories of wetlands were mapped in the study area. Palustrine wetlands are wetlands that are not associated with marine systems, large lakes, or located within the channels of larger rivers. Palustrine forested wetlands, typically referred to as swamps, occupy just over 129 acres, according to the U.S. EPA data. Palustrine emergent wetlands, generally marshes dominated by non-woody plant species, cover approximately 85 acres. Together, both wetland types comprise just over 10% of the landscape in the study area.

Deciduous woods (dominated by trees that drop their leaves) occupy almost 10% of the project area. Woodland areas offer habitat for a variety of terrestrial wildlife, even in urban areas. More importantly in this case, urban woodlands offer some respite from the heat island effect, the increase in temperatures seen as a result of the increase in the reflection of solar radiation associated with large paved areas. Both deciduous and coniferous woodland cover is important along riparian corridors. Forest habitats in riparian areas are particularly good at preventing excess soil erosion on banks, and in cooling nearshore stream waters. They also provide habitat for a variety of birds and other wildlife.

There is a clear need to increase the percentage of natural cover in the study area. Additional green areas, dominated by native plants, would be particularly beneficial in the very urban Section 1.

Wetlands are important features that provide habitat and a variety of other ecological functions. Unfortunately, they are particularly scarce in the urban landscape of Lorain. The National Wetland Inventory (NWI), a program of the U.S. Fish and Wildlife Service, has been mapping wetlands since the 1980's. NWI maps are created by analyzing color infra-red or black and white aerial photography. Wetlands identified in the imagery are mapped on USGS 7.5 minute quadrangle basemaps, and classified according to the U.S. Fish and Wildlife Service classification (Cowardin *et al*, 1982). In general, NWI maps tend to underestimate the number and extent of jurisdictional wetlands in an area, but they represent the best source of remotely sensed wetland data currently available.

The digital NWI map for the project area is shown in *Figure A.5.* Wetlands are shown as green polygons, the Black River as a light blue polygon, and ponds or small lakes are shown in grayish blue. Figure A.5 shows several rather small wetlands along the north side of the river, downstream from Bungart Island. There is a larger wetland and a larger pond (locally referred to as the "Beaver Pond") mapped near the southern end of the project area (the 31st Street Bridge forms the southern boundary). Two other ponds are mapped on the south bank downstream of Bungart Island.

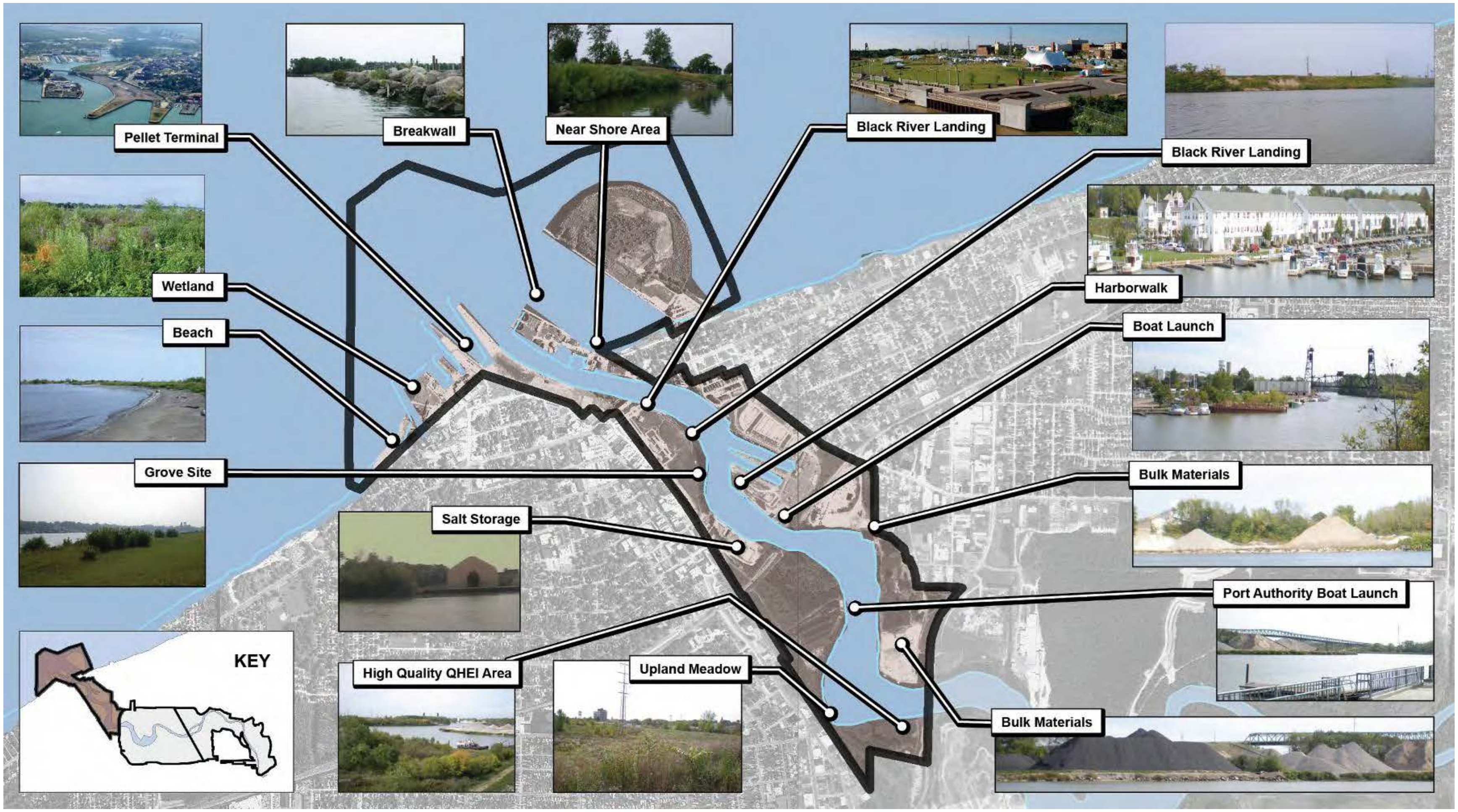


Figure A.2. Photo Inventory Showing Land Use and Land Cover in Section 1.

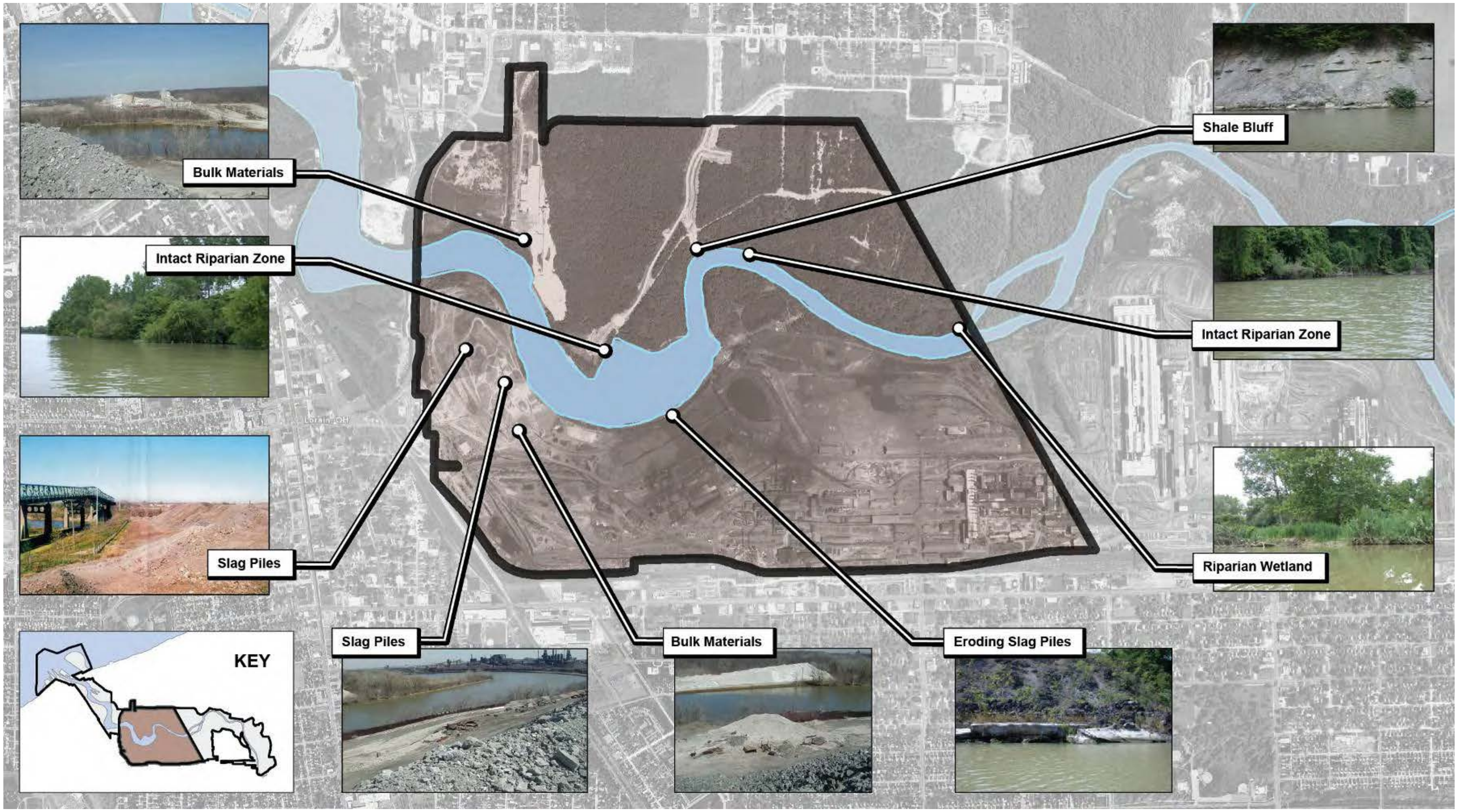


Figure A.3. Photo Inventory Showing Land Use and Land Cover in Section 2.

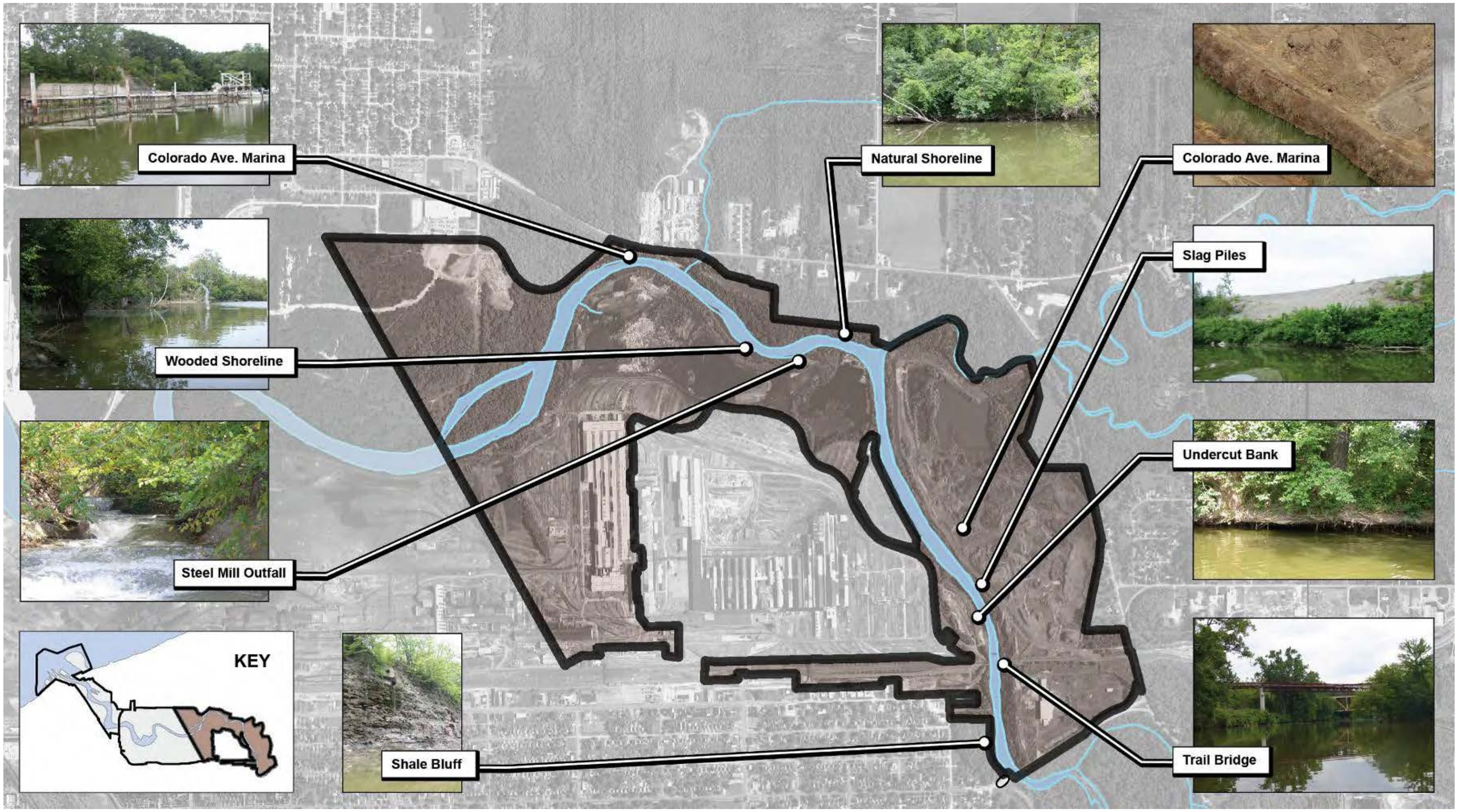


Figure A.4. Photo Inventory Showing Land Use and Land Cover in Section 3.

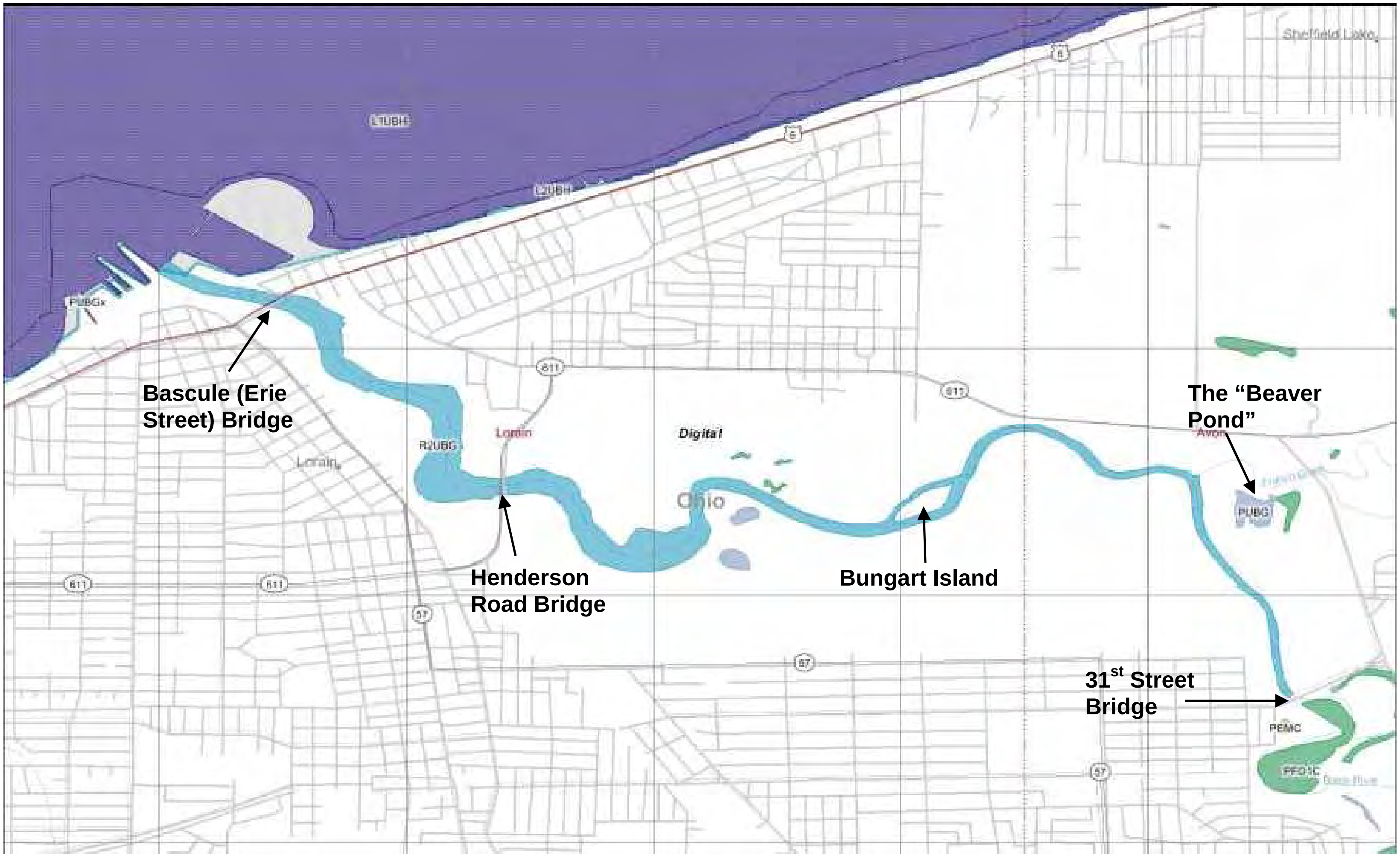


Figure A.5. The National Wetland Inventory Map for the Project Area.

Project Area Fish and Wildlife

Aquatic life is defined as the organisms that live all or most of their life cycles in the water. Many regulatory agencies, including Ohio EPA, monitor the health and community make-up of aquatic life to indicate stresses that may degrade the environment. These aquatic life studies are able to show problems or environmental stressors that might otherwise be underestimated or even missed.

Table A.2 lists the aquatic life use attainment status for segments of the Black River sampled within the project area for this Master Plan. Scores are shown by river mile (distance along the stream from the mouth). Scores are given for the Index of Biotic Integrity (IBI), a water quality metric that assess the health of fish populations; the Modified Index of Well-Being (MIwb), another metric based on fish population data; and the Invertebrate Community Index, a water quality metric based on invertebrate population data (Descriptions of the IBI, ICI MIwb and QHEI may be found in: Ohio EPA, 1999a; 1999b; 1990; 1989a; 1989b; 1987a;1987b; Rankin, 1989). The QHEI (Qualitative Habitat Evaluation Index) is a rapid index that assesses the quality of fish habitat in a river reach. The last column indicates the water quality use designation attainment status. Note that most of the reaches are not attaining the current status for Warm Water Habitat streams.

Ohio EPA reports 37 fish species found during their surveys at stations from just downstream of the confluence of French Creek and the Black River, to the mouth of the River (*Table A.3*). The surveys which are the source of this data were completed in 1997. In general, species richness decreases as one approaches the mouth of the river. Species richness ranged from a low of 6 species at the mouth of the river, to 22 species at river mile 2.3. The average species richness for the 15 stations sampled by Ohio EPA was 16.2.

Table A.2 Use Attainment Status for the Lower Black River. Source: *Biological and Water Quality Study of the Black River Basin, 1997 Lorain and Medina Counties March 31, 1999 Revised October 2, 2009 Ohio EPA Technical Report MAS/1998-11-4 (Ohio EPA, 1999b)*

River Mile	IBI	MIwb	ICI	QHEI	Status
5.8	36*	7.6	--	58.0	Partial
5.5	32*	6.5*	10*	42.5	NON
5.2	36*	6.8*	10*	48.5	NON
4.8/4.9	25*	6.1*	24*	55.0	NON
3.7	32*	*7.4ns*	--	--	
3.6			12*		NON
3.1	37*	*7.3ns*		53.5	Partial
2.3	34*	*7.2ns*	20*	45.0	NON
0.9	45	8.5	18*	34.5	NON
0.1	24*	6.2*	12*	27.0	NON

** - Indicates significant departure from applicable biocriteria*

ns - Non-significant departure from biocriteria

The populations and health of fish communities in the river are driven by water and sediment quality and the availability of quality habitat. Water and sediment quality, particular in terms of the concentrations of toxic compounds in the Black River are, improving. Water quality has been improving since the 1980s and now the sediments of the Outer Harbor and 80% of the federal navigation channel no longer need to be confined in a disposal facility. With the restoration of habitat associated with this plan, the number of species and the numbers of individuals of each species, especially the more desirable species, are expected to increase.

The Lake Erie shore is a haven for a wide variety of birds. Passerines (perching birds) particularly warblers, as well as waterfowl cross the lake during spring and fall migrations. Raptors generally follow the lake shore, preferring not to cross large stretches of open water. *Table A.4* lists the confirmed, probable and possible breeding birds in the project area, extracted from the Ohio Breeding Bird Survey for 2006 through 2010. Twenty species of birds are confirmed breeders in the area. These species have been directly observed on nests or otherwise exhibiting breeding behavior. Twenty-five species are listed as probable breeders, these species were observed in the are, during the breeding period for each species, but nest sites could not be confirmed. Eleven bird species are listed as possible breeders. These species were observed in the area, but not during the breeding window for the species. Avian diversity is increased by the number of migrants and accidental species that are found along the lake shore. Shorebirds, such as plovers and sandpipers, move through the area in spring and fall. A large number of waterfowl pause in the nearshore areas and in the river during their spring and fall movements. Hooded mergansers can be particularly abundant. Herring and Ring-billed Gulls are resident in the area, but other species, such as the small, black-headed Bonaparte's Gull move through the area. A large colony of Great Blue Herons nests in the project area. Common raptors in the area include the ubiquitous Red-tailed Hawk, and Red-shouldered and Cooper's Hawks. Peregrine Falcons have been reported but not confirmed as breeders in the area. Bald Eagles are often seen cruising along the river and its banks, even in the dense urban area. The former Pellet Terminal and the CDF are both locations where snowy owls may be found during some winters.

Most of the mammals found in the project area are common species typically seen in urban areas. Deer are certainly found, and coyotes are likely to inhabit the area. Common urban species such as gray and fox squirrels, mice, eastern cottontail rabbits, skunks and various species of bats are no doubt found. A re-introduction of the otters to Ohio began in 1986 and efforts continued for seven years. Although no otters were introduced to the Black River watershed, members of the Black River RAP located an otter in a French Creek tributary.

Hooded mergansers often congregate in the central portion of Lake Erie.

Table A.3. Fish found in the project area. Source: *Appendices to Biological and Water Quality Study of the Black River Basin, 1997 Lorain and Medina Counties March 31, 1999 Revised October 2, 2009 Ohio EPA Technical Report MAS/1998-11-4*

Common name	Scientific Name	Common name	Scientific Name
Alewife	*Alosa pseudoharengus*	White Crappie	*Pomoxis annularis*
Longnose Gar	*Lepisosteous osseus*	Black Crappie	*Pomoxis nigromaculatus*
Gizzard Shad	*Dorsoma cepadianum*	Rock Bass	*Ambloplites rupestris*
Northern Hog Sucker	*Hypentelium nigricans*	Smallmouth Bass	*Micropterus dolomieu*
White Sucker	*Catostomus commersonii*	Largemouth Bass	*Micropterus salmoides salmoides*
Spotted Sucker	*Minytrema melanops*	Freshwater Drum	*Aplodinotus grunniens*
Smallmouth Buffalo	*Ictiobus bubalus*	Logperch	*Percina caprodes*
Golden Shiner	*Notemigonus crysoleucas*	Green Sunfish	*Lepomis cyanellus*
Emerald Shiner	*Notropis atherinoides*	Bluegill Sunfish	*Lepomis macrochirus*
Spottail Shiner	*Notropis hudsonius*	Pumpkinseed Sunfish	*Lepomis gibbosus*
Mimic Shiner	*Notrpois volucellus*	Orangespot Sf X Pumpkseed	*Lepomis humilis* x *gibbosus*
Fathead Minnow	*Pimephales promelas*	Green Sf X Bluegill Sf	*Lepomis cyanleeus* x *macrochirus*
Shorthead Redhorse	*Moxostoma macrolepidotum*	Green Sf X Hybrid	*Lepomis cyanellus*
Bluntnose Minnow	*Pimephales notatus*	Green Sf X Pumpkinseed	*Lepomis cyanellus x humilis*
Yellow Bullhead	*Ameiurus natalis*	Yellow Perch	*Perca flavescens*
Brown Bullhead	*Ameiurus nebulosus*	Common Carp	*Cyprinus carpio*
Channel Catfish	*Ictalurus punctatus*	Common Carp X Goldfish	*Cyprinus carpio*
White Bass	*Morone chrysops*	Round Goby	*Neogobius melanostomus*
White Perch	*Morone americana*		

Table A.4. Breeding birds in the Project Area (Ohio Breeding Bird Survey Blocks Lorain 4 and Lorain 5), According to 2006 to 2010 Ohio Breeding Bird Survey data. Status codes: Con = confirmed breeder; Prob = probable breeder; Poss = possible breeder.

Common Name	Scientific Name	Status	Common Name	Scientific Name	Status
Canada Goose	*Branta canadensis*	Con	American Crow	*Corvus brachyrhynchos*	Poss
Mallard	*Anas platyrhynchos*	Con	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Con
Wood Duck	*Aix sponsa*	Prob	Cliff Swallow	*Petrochelidon pyrrhonota*	Con
Great Blue Heron	*Ardea herodias*	Con	Barn Swallow	*Hirundo rustica*	Con
Green Heron	*Butorides virescens*	Poss	Carolina Wren	*Thryothorus ludovicianus*	Prob
Red-shouldered Hawk	*Buteo lineatus*	Prob	House Wren	*Troglodytes aedon*	Prob
Cooper's Hawk	*Accipiter cooperii*	Con	Eastern Bluebird	*Sialia sialis*	Prob
Peregrine Falcon	*Falco peregrinus*	Prob	Wood Thrush	*Hylocichla mustelina*	Prob
Killdeer	*Charadrius vociferus*	Con	American Robin	*Turdus migratorius*	Con
Ring-billed Gull	*Larus delawarensis*	Con	Gray Catbird	*Dumetella carolinensis*	Con
Herring Gull	*Larus argentatus*	Prob	Brown Thrasher	*Toxostoma rufum*	Prob
Rock Pigeon	*Columba livia*	Poss	Northern Mockingbird	*Mimus polyglottos*	Prob
Mourning Dove	*Zenaida macroura*	Prob	European Starling	*Sturnus vulgaris*	Con
Common Nighthawk	*Chordeiles minor*	Prob	Yellow Warbler	*Dendroica petechia*	Con
Chimney Swift	*Chaetura pelagica*	Prob	Common Yellowthroat	*Geothlypis trichas*	Prob
Belted Kingfisher	*Megaceryle alcyon*	Poss	Hooded Warbler	*Wilsonia citrina*	Prob
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Poss	Eastern Towhee	*Pipilo erythrophthalmus*	Prob
Red-bellied Woodpecker	*Melanerpes carolinus*	Poss	Chipping Sparrow	*Spizella passerina*	Prob
Northern Flicker	*Colaptes auratus*	Con	Song Sparrow	*Melospiza melodia*	Prob
Ruby-throated Hummingbird	*Archilochus colubris*	Con	Northern Cardinal	*Cardinalis cardinalis*	Con
Eastern Wood-Pewee	*Contopus virens*	Prob	Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Poss
Willow Flycatcher	*Empidonax traillii*	Prob	Indigo Bunting	*Passerina cyanea*	Prob
Great Crested Flycatcher	*Myiarchus crinitus*	Prob	Common Grackle	*Quiscalus quiscula*	Poss
Eastern Kingbird	*Tyrannus tyrannus*	Poss	Brown-headed Cowbird	*Molothrus ater*	Prob
White-eyed Vireo	*Vireo griseus*	Prob	Baltimore Oriole	*Icterus galbula*	Con
Red-eyed Vireo	*Vireo olivaceus*	Con	House Finch	*Carpodacus mexicanus*	Con
Tufted Titmouse	*Baeolophus bicolor*	Prob	American Goldfinch	*Carduelis tristis*	Poss
White-breasted Nuthatch	*Sitta carolinensis*	Con	House Sparrow	*Passer domesticus*	Poss

Project Area Water and Sediment Quality

The Black River TMDL (Ohio EPA, 2008) lists sediment, elevated nutrient concentrations and elevated bacteria levels as the major pollution problems in the watershed. From the confluence of the East and West Branches, the Black River is listed as a Warm Water Habitat.

Nutrient concentrations are also elevated within the Black River and its major tributaries. Phosphorus and nitrates reach the river through numerous point source discharges, agricultural runoff, and discharges from home septic systems. The results are algal blooms, and the accompanying decrease in available dissolved oxygen, which lead to changes in aquatic community structure and composition (Ohio EPA, 1999a).

Increased bacteria levels, particularly levels of fecal coliforms, can come from failing home septic systems and illegal dumping of septic materials (Boddy, 2002), combined sewer overflows, manure application in agricultural fields, and runoff from both feedlots and urban areas (Ohio EPA, 1999a). Elevated bacteria counts are often associated with increases in sediment and nutrient concentrations as well. In addition to concerns regarding the health of ecological communities, human health is also a concern, particularly when bacteria levels are elevated. Although bacteria levels in surface waters can vary under different meteorological conditions, improvements have been noted in the lower river by Ohio EPA. In their 2008 Integrated Water Quality Monitoring and Assessment Report, the agency determined that recent bacteria data indicate that a prior impairment listing for recreational use in the main stem is no longer supported and the impairment has been removed. Future monitoring of bacteria levels in the Lower Black River will determine if this improvement continues.

Lorain Harbor – Sediment, Dredging and the CDF

Sediment has a major impact in the river (Ohio EPA, 1999a). Agricultural land uses, which comprise of 44% of the total watershed, contribute substantial amounts of sediment. Stream bank erosion is also a significant source of sediment (USAED Buffalo, 1977). When riparian areas are cleared and the native vegetation is removed, banks are prone to erosion. Erosion can also be acerbated by increased runoff volumes and velocities associated with urban areas.

The excess sediment loads throughout the Black River basin causes both environmental and economic stresses. Environmentally, highly turbid waters can hinder light transmission and therefore photosynthesis and is the main reason efforts to introduce aquatic vegetation at the Black River Landing Fish Habitat Shelf failed in the past. Sediment suspended in the water column can clog fish gills and in extreme circumstances can lead to fish kills. Deposition of sediment on the river bottoms can smother habitat sites for aquatic invertebrates.

Economically, excess sediment can stress the local economy, especially for ports as active as in the City of Lorain. Based on 2005 data of total tonnage handled (3,055,000), Lorain Harbor is the 25th busiest port on the Great Lakes and 102nd busiest port in the nation. Iron ore has been the dominant commodity moving through Lorain Harbor and in 2005 accounted for 49 percent of all traffic at the harbor. Stone (limestone, gypsum, sand, and gravel) accounted for 41 percent and other bulk commodities for the remaining 10 percent of the harbor's waterborne bulk traffic. As a Federal harbor, the maintenance of authorized channel depths, disposal of dredged material, and dredging and dredged material disposal by other harbor interests is required to meet shipping requirements. A portion of the sediments dredged are not suitable for open-lake placement and have to be confined to a confined disposal facility. Since 1979, the average volume of dredged material has been 135,400 cubic yards. Due to sediment contamination, all sediments dredged from the river, from the late 1970s until recently, had to be contained in specially designed facilities.

In 1978, the USACE constructed a CDF for discharge of material periodically dredged from the harbor to maintain its adequate authorized project depths for deep-draft commercial navigation. The CDF is a semicircular structure that adjoins the East Breakwater Shorearm. The CDF is 58 acres and has an estimated design capacity of 1,850,000 cubic yards (cy). In 2006 (end of dredging season), the Lorain Harbor CDF was filled to design capacity. Starting in 2007, USACE initiated a DMMP study to provide a new CDF or alternative method of managing dredged material by 2014. As a part of the study, interim dredged material management options were developed 2008 through 2013, when a new facility or other option becomes available.

It was determined that sufficient additional capacity can be obtained at the existing CDF using a fill management plan (FMP) internal to the CDF (e.g., dewatering, consolidation of dredged material, raising interior berms). It has been determined that the CDF will be transferred to the non-Federal sponsor for future waterfront use when it is no longer able to accept any more dredged material. The Lorain Port Authority and the Lorain Metro Parks have developed a Master Plan which will guide reuse of the CDF once filing of the site has been completed.

In addition to disposal of sediments in the existing CDF, USACE and Ohio EPA determined that a portion of the River sediments meet guidelines for unconfined open-lake placement. In their decision, the two agencies determined that the sediments from these locations posed no significant threat to human health or the environment.

Aerial view of the Lorain Confined Disposal facility.

Finally, the USACE - Buffalo District is working with the City of Lorain to provide technical guidance in preparing an upland brownfield parcel, a former coke plant site to be used for dredged material placement (location of proposed relocated wastewater treatment plant – *Figure 1.2*). The 130 acre site is considered a viable location with a minimum 15 year capacity for placement of dredged material and this use is consistent with the City of Lorain's Master Plan for brownfields redevelopment. A Memorandum of Agreement (MOA) will be negotiated with the City. Under the MOA, the City will be required to obtain applicable State and Federal permits, and modify the property as necessary to comply with those permits and other applicable regulations at 100 percent non-federal cost (Source: USACE – Buffalo District, Lorain Harbor Final DMMP/EIS, April 2009).





Appendix B

Lower Black River
Lorain, Ohio
Ecological Restoration Master Plan

APPENDIX B – MASTER PLAN DEVELOPMENT PROCESS

Plan Development Process

The project team adopted a planning concept that is geared toward the eventual adoption and shepherding of the plan by the City of Lorain, in cooperation with the USEPA and other agencies. As such, it was critical to first develop an advisory committee that would help develop the plan, and work in partnership the city and Lorain Port Authority to adopt, implement and manage the ideas presented here. Advisory Committee members are shown on page 13 of this plan. Most members of the Advisory Committee have attended all of the meetings held to date, and all have contributed to the understanding of the challenges faced, and development of potential solutions.

The following page shows a schematic of the planning process used and important milestones for this project.

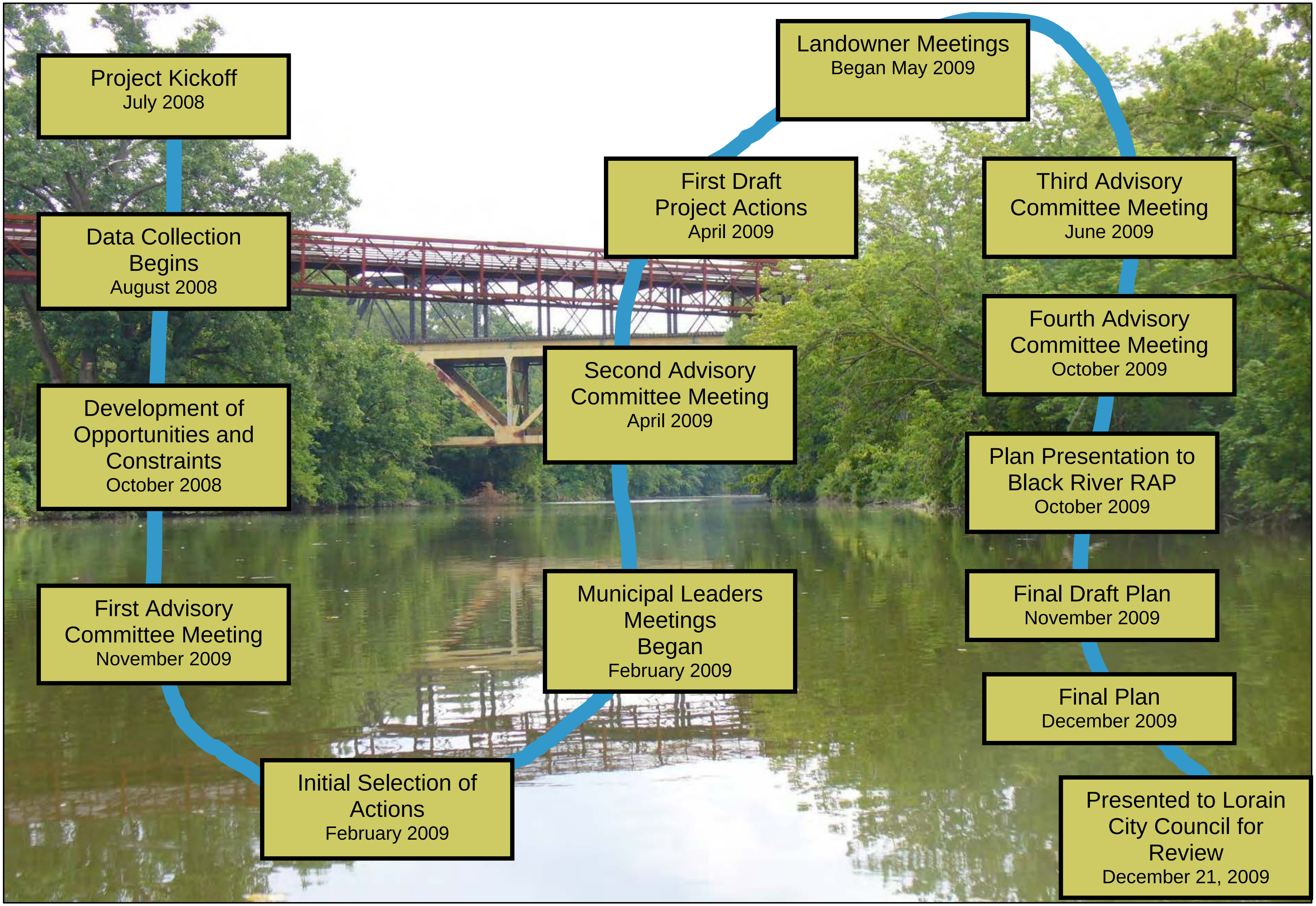
After kicking off the project, the project consultant team began the process of collecting data on the river. Reference material collected included Ohio EPA and U.S. EPA reports on the river, materials from the Black River RAP, planning documents and other data from the city of Lorain, historical data from a wide variety of sources, and data from Ohio DNR. We also assembled the GIS data sets needed to map and analyze data on the River.

The consultant staff spent two weeks performing an assessment of the habitat conditions in the River, along the shoreline and on lake areas near the mouth. The crew cruised up and down the river, gathering data on fish and macroinvertebrate communities. The team assessed habitat in the stream and along the lakeshore using Ohio EPA's Lacustrine Qualitative Habitat Evaluation Index (LQHEI), to assess lakeshore habitats. Field crews performed an assessment of the qualities of all bank areas, and mapped features along the banks. This gave the team an idea of the condition of the riparian areas along the Lower Black River.

All the data were compiled and analyzed to develop an "existing conditions" assessment of the Lower Black River. Data sets used included:

- Hydrologic conditions.
- Geology.
- Soil and sediment conditions.
- Upland, wetland, shoreline, and riparian vegetation communities.
- Invasive species populations.
- Black River channel maps.
- Zoning and land use.
- Known data on fish, bird, wildlife, and insect communities.
- Data on populations of rare, threatened, and endangered species.
- Recreational features and amenities.
- Site history.
- Proposed developments.

During August, September and October of 2008, data were analyzed and a series of thematic maps were developed. The maps helped the team define potential opportunities for and constraints upon future restoration efforts. A "toolbox" of potential actions was started. Maps depicting topography, land use and other important features were developed. All were important tools for the first Advisory Committee Meeting.


Project Kickoff
July 2008
Data Collection Begins
August 2008
Development of Opportunities and Constraints
October 2008
First Advisory Committee Meeting
November 2009
Initial Selection of Actions
February 2009
Municipal Leaders Meetings Began
February 2009
Second Advisory Committee Meeting
April 2009
First Draft Project Actions
April 2009
Landowner Meetings
Began May 2009
Third Advisory Committee Meeting
June 2009
Fourth Advisory Committee Meeting
October 2009
Plan Presentation to Black River RAP
October 2009
Final Draft Plan
November 2009
Final Plan
December 2009
Presented to Lorain City Council for Review
December 21, 2009

First Advisory Committee Meeting: The first major project meeting was held in November 2008. At this meeting, the history of how the plan came about was discussed. A brief history of the Black River was presented. Results of the preliminary analyses of current conditions were presented, the toolbox was reviewed, and a list of "early action projects" was proposed.

Following the first meeting, and relying on feedback from the participants, the team began to develop the first round of potential actions.

Municipal Leaders Meetings: It is obvious that strong leadership from the local government will be a key to accomplishing the goals and objectives of this plan. Staff from the city Planning Department, and the Utilities department, were integral members of the advisory committee from the start of this process. A series of meetings were held with the Mayor and his staff, other city department leaders and City Council members, to outline the goals and objectives of the plan, and to present some of the findings to date. At these meetings the team helped guide the municipal leaders to the understanding that the project was not intended to result in additional regulatory burdens, but rather would help spur potential and appropriate development along the Black River corridor. To date, all city departments and staff that the team has met with are solidly in favor of and actively contributing to the project. Meetings with city leaders continued throughout the project.

Second Advisory Committee Meeting: After meeting with city officials, and further developing potential options, a second Advisory Committee meeting was held in April, 2009. At this meeting, the discussions centered around updates as to the progress to date. The toolbox was presented to the group, and discussions as to the efficacy of the various restoration techniques ensued. Areas where specific techniques might be implemented were outlined and discussed.

Finally, draft goals and objectives were developed, and comment on these was sought from the Committee.

First Draft, Project Actions: A first, very rough partial draft of the Ecological Restoration Master Plan was developed and forwarded to the Advisory Committee. This draft focused on the description of the plan's proposed Actions.

Landowner Meetings: Meetings with large landowners began in May of 2009, once the proposed Actions had been initially developed. It was felt that this timing was appropriate, given that the landowners could have something rather concrete to react to, and conversely that the Actions had not been developed to the point that changes requested by the landowners could not be made. These meetings continued throughout the rest of the project, and landowners were brought into subsequent Advisory Committee meetings.

Third Advisory Committee Meeting: A third Advisory Committee meeting was held in June of 2009. At this meeting, the city and the Agencies presented their individual visions for the plan, and an exercise was held to identify those areas where visions were held in common, and those areas where parties may need to be brought closer together, to accomplish this complex plan. A detailed discussion of the proposed Actions was held, and a rough prioritization exercise was undertaken, during which participants were able to express their choices for which actions were most important to them. Finally, suggestions for additional outreach were solicited. Participants at this meeting were able to tour the river on the Port Authority's boat.

Fourth Advisory Committee Meeting: In October 2009, the fourth Advisory Committee meeting was held. A second, partial rough draft of the plan was circulated prior to the meeting. At this meeting, Participants were broken into small groups to discuss the proposed actions and their locations. There was a strong sense from these discussions that fish baskets and floating wetlands were best left as experimental actions, to be funded only if applicants interested in these techniques could identify a source of money. In addition, there was a strong desire expressed to ensure that slag and other materials that could potentially be sources of pollution not be used as materials to provide bottom structure in the river.

Presentation to the Black River RAP: Also in October, 2009, the draft plan was presented to and discussed with the Black River RAP. This meeting was an attempt to broaden the participation beyond the Advisory Committee, city staff and Council. Comments obtained at this meeting were similar to those obtained from the October Advisory Committee meeting.

Final Draft Plan: Substantial revisions to the second rough draft were made, and a reformatted final draft was developed and submitted in November 2009.

Presentation to Council and Adoption of the Plan: The plan will be presented to the Lorain City Council on December 21, 2009. The intent is that Council formally will adopt the plan so that it may serve as the basis for future land use decisions within the project area. Current plans call for the plan to be sent to a City Council committee for review in January, adoption should occur after this review is complete.

Developing Actions and Setting Priorities

From the beginning, this plan was intended to result in the restoration and protection of habitat in and along the Lower Black River. There are several reasons for this focus on habitat. First, aquatic and terrestrial habitat has been affected by the long history of urban development in the project area. Land use changes that removed native plant communities, particularly from riparian areas, have resulted in a lowering of water quality.

Some progress has been made in cleaning up chemical contamination in the Black River. Most of the toxic sediments have been removed, and as a result the incidence of fish tumors has decreased. The remaining water quality problems have affected habitat, largely through sedimentation and nutrient enrichment.

In addition, Ohio is a leader in using biological criteria to assess water quality and set standards. As a result, measures of the availability of aquatic habitat have been developed to assess conditions in streams. A focus on restoring habitat is therefore consistent with the measurements Ohio uses to assess water quality.

As a result, the actions selected for this plan were developed to restore in-stream and riparian habitat. In-stream habitat is primarily restored in the short term through the construction of fish shelves. As conditions in the river improve, and as sediment controls are instituted upstream in the remainder of the watershed, the hope is that the rest of the river bottom habitat will be restored through natural processes. Actions upstream of the 31st Street Bridge are beyond the scope of this document, but such actions will be needed to fully restore the lower section of the mainstem.

Potential actions were prioritized using a simple ranking system. Draft systems were tried, including one that took into account non-ecological factors such as cost of the actions, and whether an action was located on public or private property. Eventually, we settled on a system that ranks projects according to their weighted, predicted LQHEI scores. To do this, we first assigned predicted scores based on conservative estimates of the metric scores that might be achieved by accomplishing each action. These scores were developed by the consultant team, and vetted by Black River RAP staff. Once agreement was reached on the scores, we weighted the scores using graduated weighting factors. The weighting process is described on page 28 of the plan, and the resulting ranks are shown in *Table 2.1*.

The ranks express the notion of the ecological importance of each action. A clear importance is assigned to those actions that preserve and enhance the remaining existing higher quality systems in the project area. Protecting those existing systems helps to stem the tide of the loss of ecosystem functions in the project area, and preserves the best of the systems as reference areas against which to gauge other restoration efforts. Projects to accomplish the recommended actions may not be carried out in the order shown in the plan. Rather, it is likely, and logically expected, that projects will be completed as funds become available. Still, consideration should be given to accomplishing the actions in the order presented, to the degree possible.

The Future of the Ecological Restoration Master Plan

The Lorain Utilities Department and the Lorain Port Authority have agreed to be the main City of Lorain sponsors of this plan. They will be jointly responsible for carrying out the actions recommended here. After its adoption by the Lorain City Council, this plan will serve to guide the city's actions in restoring the ecological health of the Black River. The actions presented in this plan are a shopping list of activities for which the city will seek funding. Further, the plan is meant to be a guide for future actions taken by the city in the project area, particularly as redevelopment decisions are made in the riparian setback zone. Data in this plan can be used to help guide development toward those parcels on which it is most appropriate. The Best Management Practices in Appendix C are presented to help the city choose and encourage the use of those practices that will help maintain and protect the investment made in restoring habitat along the Lower Black River.

Almost all plans include statements expressing the desire for the plan to be a "living document". That is a particular need for this plan. Without careful referral to this document during the city's redevelopment planning, without the insistence on incorporating suggested best management practices in new developments, without the enforcement of the city's current riparian setback ordinance, any gains realized by the habitat restoration actions outlined here would be lost.

No timeline for accomplishing this plan has been set, in recognition of the notion that it is to be a "living document". We do recommend that the plan be revisited every 5 years, to check progress and set goals for the upcoming period, and to make amendments and changes.

Appendix C

Lower Black River

Lorain, Ohio
Ecological Restoration Master Plan

APPENDIX C - RESTORATION TOOLBOX

Introduction

The purpose of this restoration tool box is to highlight the current City of Lorain ordinances that guide development to appropriate locations and forms, and to identify specific Best Management Practices which:

- Advance the ecological restoration goals set forth in this plan and their identified benefits.
- Support City of Lorain economic development goals and job creation needs by improving the overall livability of the community and thus attracting businesses and redevelopment opportunities.
- Potentially reduce infrastructure costs associated with managing stormwater runoff and thus save development and operation and maintenance costs.
- Serve as a guide to help identify measures that can be incorporated into redevelopment projects which will compliment the actions identified in this plan (shoreline stabilization and restoration, wetland creation, riparian preservation, etc.) as a way to create additional restoration opportunities.
- Sustain existing green infrastructure and expand green infrastructure assets (which slow, store, and purify rain and runoff water) in the Lower Black River while complying with applicable regulatory requirements.

An important objective of this Lower Black River Ecological Restoration Master Plan is to share information with the City's decision-makers on the importance of the natural resource that is the Black River. Another objective of the document is to point the decision-makers to local, regional and federal tools and techniques that will enable restoration and protection efforts while the City undergoes an economic rebirth. Toward that end, this restoration toolbox has been developed.

It is not the purpose of the Restoration Toolbox to be used as a design manual or present all of the BMPs that could be used or required. For more information on the BMPs highlighted in this appendix, please see the following for more specific information (complete references are supplied in the Bibliography at the end of this appendix).

- ODNR Rainwater Manual (adopted by reference by City of Lorain's stormwater ordinance).
- LID Center.
- Center for Watershed Protection.

As noted earlier in the plan, a series of restoration and protection actions have been identified that when completed will help substantially improve habitat and near shore water quality and support economic development. At the same time, redevelopment and other land use changes which are driven by community economic development priorities and private sector interests (some of which are identified in the plan), will provide additional opportunities to advance restoration goals through incorporation of measures which protect restored ecological assets and also assure compliance with community and agency environmental goals & regulatory requirements. Finally, it presents an opportunity to creatively protect restoration investments recommended by this plan through minimizing impacts of land use changes.

Ordinances and regulations designed to protect and sustain the ecological assets of the Lower Black River include:

- City of Lorain Riparian Setback Ordinance (Ord. 109-04),
- City of Lorain Stormwater Management Ordinance,
- U.S. Army Corps of Engineers Section 404 Fill and Dredge Permit Rules,
- Ohio EPA Section 401 Certification requirements,
- Ohio EPA NPDES General Permit.

Each of these either control development in sensitive areas (such as riparian setbacks) subject to certain conditions and protect aquatic resources by requiring permits and measures to mitigate impact from actions (Dredge and Fill Permits) or use of specific best management practices to reduce water quality impacts typically associated with increased stormwater runoff and land use changes.

City of Lorain Planning

The City of Lorain has no comprehensive plan; Ohio law does not require that cities prepare comprehensive plans. A comprehensive plan can be the foundation for municipal decision-making regarding land use, and would clearly be a useful tool in helping to guide the restoration of ecological and economic health in the city. Completing a Comprehensive Plan, in particular one which adopts the recommendations of this Ecological Restoration Master Plan, would be a substantial step in documenting Lorain's vision for its future growth, and help ensure that ecological and economic restoration truly go hand in hand. Lorain's Department of Community Development has developed a number of different plans over the last decade, many of these plans focus on the area encompassed by this plan. Master plans were developed for two prime development areas, the Upper Black River Master Plan, which was the foundation for developing the Riverbend Commerce Park, and the Black River Lorain Harbor Shoreline Master Plan, which is being used to assist the City in determining the redevelopment of the former Lorain Pellet Terminal. Riverbend Commerce Park has been designed, and the infrastructure (roads and major utilities) have been installed. No businesses have located there yet. These plans were reviewed during the development of this Restoration Master Plan, to avoid potential conflicts with Lorain's aims for these properties. As the Riverbend Commerce and Harbor Shoreline plans are put into action, the city is encouraged to make use of Lower Black River Habitat Restoration Master Plan as well. Incorporating the suggested actions into these two development plans will help reach the goals of ecological and economical enhancement.

In 1998, Lorain began the first of several Urban Renewal eligibility surveys and planning initiatives. The Urban Renewal designation provides several benefits to the city and the planning areas. The designation allows the city to issue bonds for public improvements, property acquisition, demolition, environmental clean-up and other activities that are consistent with the plan. The plan is formally adopted by both the Planning Commission and City Council and is a document that guides the redevelopment of the plan area, providing insight to the private development community of the desires of the community for the specific area. It provides additional review requirements to ensure that developments that occur within the plan area are consistent with the plan and require that the developer enter into a development agreement with the city.

Currently the City has adopted 8 Urban Renewal plans, those in bold lie within this plan's area:

- **Revised Riverfront Urban Renewal Plan.**
- **Colorado Avenue Industrial Area Urban Renewal Plan.**
- Washington Avenue Urban Renewal Plan.
- Central Lorain Urban Renewal Plan.
- **Lighthouse Village Urban Renewal Plan.**
- Lorain West Urban Renewal Plan.
- South Lorain Urban Renewal Plan.
- **Lakefront Urban Renewal Plan.**

Again, as these plans are implemented, the city is encouraged to use the Lower Black River Habitat Restoration Master Plan as a guide to include ecological restoration in those urban renewal areas. Such restoration could do much to restore the quality of life and help economic recovery in these designated areas.

City of Lorain Ordinances

Riparian and Wetland Setback: The City of Lorain has adopted, in Chapter 1533 of Codified Ordinances, Riparian and Wetland Setback requirements. The specific purpose of such regulation is to regulate uses and developments within the setback zone which impair riparian and wetland areas to:

- Reduce flood impacts, slow floodwater velocity, and regulate base flow.
- Reduce watercourse bank erosion and downstream sedimentation.
- Reduce pollutants already in the watercourse through filtering, settling and transformation.
- Reduce pollutants before they enter the watercourse through filtering, settling and transformation.
- Provide shade and food in watercourses.
- Provide aquatic and wildlife habitat.
- Avoid costly engineering solutions to flooding and erosion.
- Reduce property damage costs from flooding.
- Contribute to the scenic beauty and quality of life in Lorain and corresponding property values.

Ordinance requirements include a riparian setback of 300 feet on

Riparian setbacks help protect a variety of functions that help support water quality.

both sides of the Black River. City required setbacks from delineated wetlands are defined in the ordinance as based on drainage area; a minimum 25' setback is defined.

Uses permitted in the riparian setback include:

- Passive recreational uses such as hiking, fishing, hunting, picnicking, and similar uses.
- Removal of damaged or diseased trees.
- Revegetation or reforestation.
- Maintenance of lawns, gardens, and landscaping which existed at the time of the ordinance passage in 7/19/04.

Uses prohibited in the riparian setback include:

- Construction. There shall be no structures of any kind.
- Dredging or Dumping.
- Roads or Driveways.
- No use of Motorized Vehicles.
- No disturbance of natural vegetation.
- Parking Lots.
- New surface or subsurface sewage disposal or treatment areas.
- Utility crossings without regulatory permits.

Non Conforming Uses or structures in the Riparian Setback in existence at the time of ordinance passage (7/19/04) may continue, however they may not be changed or enlarged. A non conforming use or structure which is discontinued or abandoned for six months or more, may not be revived or re-established.

A property owner can try and obtain a variance from the setback requirements by demonstrating hardship. When setback variances are granted, compensatory mitigation is typically required.

City of Lorain Stormwater Management, Water Quality Requirements: The City of Lorain has adopted Post Construction Water Quality Control Plan requirements contained in Ordinance 1531.

Proposed new development projects require a Post Construction Water Quality Control Plan which includes a: Construction Site Conservation Plan, and a Riparian and Wetland Setback Plan.

BMPs used must comply with the latest edition of Ohio's Rainwater and Land Development Manual, ODOT Post Construction stormwater standards, or other manual acceptable to the City Engineer or Ohio EPA. BMPs selected must be sized to treat the water quality volume (WQ) complying with Ohio's Water Quality Standards (OAC 3745-1) equivalent to the volume of runoff from a 0.75 inch rainfall.

City of Lorain Stormwater Management, Quantity Requirements: The City of Lorain has adopted Post Construction Water Quality Control Plan requirements contained in Ordinance 1529.

The peak rate of runoff from new development projects must not be greater after development than before development. Calculations must prove no increase in runoff rates for the 1, 2, 5, 10, 25, 50 and 100 year design storm events.

If site constraints exist which compromise the intent of the ordinance, the City Engineer may approve practical alternatives, which may include fees, off site mitigation, watershed restoration, or retrofitting of existing city facilities.

Emerging Approaches

LID: Low-Impact Development (LID) has emerged in the past 10 years as a way which systematically integrates stormwater management tools into sites to control stormwater runoff. Initiated in Prince George's County, Maryland and introduced initially into Northeast Ohio by the Chagrin River Watershed Partners in 1999, LID is focused on an entirely different approach to managing stormwater. Instead of the "end of pipe" approach that typically have driven stormwater management, LID looks at the entire site to identify ways to manage stormwater at its source using an array of structural and nonstructural tools. LID design can be applied to both new development and to existing development (retrofits). LID measures can include a range of structural and non-structural measures such as bioretention, vegetated swales, pervious pavement, constructed wetlands, green roofs, soil amendments, disconnecting pervious surfaces, rain barrels and open space preservation.

Green Infrastructure: U.S. EPA defines green infrastructure as an approach to wet weather management that is cost-effective, sustainable, and environmentally friendly. Green infrastructure management concepts infiltrate, evapotranspire, capture and reuse stormwater to maintain or restore natural hydrology.

At the largest scale, the preservation and restoration of natural landscape features (such as forests, floodplains and wetlands) are critical components of green stormwater infrastructure. By protecting these ecologically sensitive areas, communities can improve water quality while providing wildlife habitat and opportunities for outdoor recreation.

Low impact development preserves green space and provides ecological functions.

On a smaller scale, green infrastructure integrates LID practices such as rain gardens, porous pavements, green roofs, infiltration planters, trees and tree boxes, and rainwater harvesting for non-potable uses such as toilet flushing and landscape irrigation.

Green roofs such as this one in Wisconsin help filter rainwater, cool buildings and provide added green areas.

Economic Benefits of Green Infrastructure: Investments in ecological restoration and green infrastructure measures must be seen in the broader context of Lorain's movement to re-invent itself as a more sustainable 21st century city. Lorain, like many major American cities, is faced with an array of economic, social, and environmental challenges. These challenges require that government agencies break out of their traditional roles of providing narrowly defined services and seek to work together toward larger goals.

The Green Infrastructure approach provides multiple measurable economic benefits. These benefits include:

- Enhance recreation.
- Reduce flooding.
- Reduce flood damages.
- Improve water quality.
- Enhance wildlife habitat.
- Improve community quality of life.
- Improve community property values.
- Create green jobs.
- Help revitalize distressed neighborhoods and commercial districts.
- Reduce urban heat island effect.
- Improve air quality.
- Save energy.
- Offset climate change.

A Triple Bottom Line (TBL) analysis of the environmental, social, and economic benefits means expanding the traditional financial reporting framework to take into account ecological and social performance so that the total benefits can be evaluated against the financial investment. The City of Philadelphia has announced a Green Infrastructure program to significantly reduce Combined Sewer Overflows. The $1.6 billion plan, the largest in the U. S., calculates the total benefits at over $2.2 billion in present value. The TBL concept should be applied as Lorain moves to accomplish the goals of the Ecological Restoration Master Plan, and in particular as the city incorporates the concepts presented in this plan into their other planning exercises.

Green Space Design: Green Space Design is an approach that requires new developments to provide green space either in the proposed development or at least within the community. The concept is intended to provide and protect the open space that the community desires before development pressures dictate how a community will look. In the past, the look of the river corridor was dictated by industrial need. As the City of Lorain re-invents itself and now sees the Black River corridor as its Main Street, the community has been given a second chance to decide how it grows and develops.

Green spaces can perform important functions on their own. These functions can be amplified and enhanced when green space design is used to connect patches of natural area and habitat, through connecting corridors. Appropriate connecting corridors increase the "functional size" of the areas they connect. They protect the long term viability of the patches they connect by providing paths along which animals and plant propagules (seeds and vegetative reproductive parts by which plants reproduce and spread) can move among patches. This movement helps ensure that wildlife populations can survive. Connecting corridors need not be single use, appropriate designs can provide for both ecological function and recreational use as bike and hike paths.

Compensatory Mitigation and Banking: Compensatory mitigation is required by the state and federal agencies that oversee wetland and stream impact permits, to offset unavoidable degradation of ecological areas or functions caused through permitted activities. Strictly speaking, compensatory mitigation is the last step in a three step process. Under Section 404(b)(1) of the Clean Water Act, the required mitigation sequence is:

- Avoid – Adverse impacts to aquatic resources should be avoided if practicable.
- Minimize - If impacts cannot be avoided, appropriate and practicable steps to minimize adverse impacts while still meeting the project purpose and need must be taken.
- Compensate - Appropriate and practicable compensatory mitigation is generally required for any unavoidable adverse impacts which remain.

There are at present no mitigation banks in the lower Black River area but one could be potentially be established or sponsored by the city, or by a corporation or other entity such as a nonprofit organization. In the past, ecologically functions have been "exported" from the Black River watershed, through compensatory mitigation supplied by mitigation banks outside the watershed. Some of the preservation sites identified in the Lower Black River Ecological

A good example of local compensatory mitigation efforts is this developing wetland in the Colorado Industrial Park.

Restoration Master Plan could be established as mitigation banks, or as consolidated mitigation areas, or as individual compensatory mitigation sites. Under current Corps of Engineer's rules, there is a preference for banking as opposed to smaller individual compensatory wetland projects cited on or near developments. To establish a bank, a banking plan and prospectus must be developed, following Corp's of Engineers and Ohio EPA guidelines. All banks in Ohio must be approved by the Mitigation Banking Review Team.

Barring the official establishment of a mitigation bank site, this plan can serve as a tool to guide permit applicants to potential mitigation sites called out as action locations in the Lower Black River Habitat Restoration Master Plan.

Best Management Practices

Best Management Practices (BMPs) are methods, measures, or practices used to manage the quantity and quality of runoff. They include management practices such as street sweeping or structural practices such as rain gardens designed to reduce runoff volume and to remove pollutants, such as sediment, nitrogen, phosphorous, and heavy metals, that are washed by rain and snow melt into nearby water ways.

Effective control or reduction of non-point source loads will require implementation of best management practices or BMPs in the Black River watershed. BMPs may involve efforts to change land-use practices or watershed activities in ways that reduce pollutant runoff or the construction and operation of features that reduce the rate at which pollutants runoff from the watershed.

BMPs for urban and residential watersheds follow two strategies: reducing or preventing runoff and resultant pollutant loading, and treating runoff water. Limiting the amount of impervious surface is a prime consideration for reducing runoff and the resulting reduction of pollutants. This often involves the inclusion of infiltration features (infiltration trenches or basins) in landscape designs, limitations in the use of curbs on streets and driveways, and parking lot designs that include permeable, vegetated areas.

The specific BMP's discussed in this section include:

- Stormwater wetlands.
- Filter strips.
- Grassed swales.
- Bioretention.
- Tree box filters.
- Green streets.
- Green roofs.
- Urban forestry.
- Cisterns.

Table C.1, located on page C 18, is a decision matrix designed to help users of this plan determine appropriate BMPs for a variety of situations.

Local Application of BMPs: Future development in Lorain Ohio and the Black River corridor present significant opportunities to reduce runoff and improve water quality. BMPs have been installed or are being designed at numerous projects in Northeast Ohio.

One prominent local example of development which exemplifies this approach is the proposed expansion of the Cuyahoga Community College (Tri-C) Eastern Campus. Tri-C required the design to incorporate as many appropriate green technologies as appropriate. Techniques that were incorporated into TriC's plan include:

- Minimized wetland impacts.
- Preserve native vegetation.
- Roof runoff for rain gardens.
- Extended wet detention basin.
- Green roofs.
- Parking lot Bioswales.
- Porous pavement of various types.
- Native plantings.
- Preservation of quality natural areas.
- Stream and wetland restoration.

Figure C-1 shows the conceptual layout for Tri-C's Eastern campus, with the various BMP's and other "green" suggestion called out.

Figure C-1. Multiple Best Management Practices Employed in Tri-C's new Campus Master Plan

"Natural" BMPs Needing Little Design

Some BMPs can be realized using existing areas of natural vegetation. Techniques in this category might be accomplished with little or no engineering design.

Filter Strips: Filter strips are land areas of either planted or indigenous vegetation, situated between a potential, pollutant-source area and a surface-water body that receives runoff. Often located along stream, lake, or pond boundaries, filter strips help remove pollutants from runoff, and may also serve as habitat for wildlife.

The purpose of a filter strip is to trap sediment, plant nutrients, organic matter and chemicals as runoff from urban areas passes through the vegetated area. Filter strips generally are more effective in trapping sediment, and therefore, sediment-bound nutrients and pesticides, than soluble nutrients and pesticides. Nutrients that bind to sediment include phosphorus and ammonium; soluble nutrients include nitrate.

Filter strips have been employed rather extensively in agricultural settings, less so in urban areas. Developing an effective filter strip requires information on the pollutants to be treated, contributing slope and drainage area, and soil and plant characteristics of the proposed filter strip.

Location of the filter strip is important. In general, the most efficient strips are those that intercept shallow, uniform flow. Filter strips do not tend to perform well when flow enters in concentrated channels. The structure and composition of the plant community is important. Species selected should have a dense growth of stems, and a dense, fibrous root system. Clearly, native species should always be used. Because of their fibrous and often rhizomatous roots, the dense sod they form and the dense pattern of stem growth, grasses tend to be more effective than broadleaf plants. From many perspectives, cool-season grasses are more desirable than warm-season grasses since they grow more vigorously in the spring and

The vegetated areas surrounding this urban stream, pond and wetland restoration area serve as urban filter strips to help treat runoff. This example is located in Akron. Ohio.

fall when other species have not sprouted or have senesced, and rainfall can be intense.

The width of filter strips is an important factor in their function. Again, width is in part dependent upon drainage area and slope. Studies in the Midwest indicate widths between 10 and 40 feet seem to be effective in trapping phosphorous and sediment. For slopes of one percent or less, strips of 10 feet appear to be functional. For areas where the contributing slope is 20 percent or more, filter strip widths of 25 feet or more may be required.

Well designed filter strips generally require little maintenance, therefore costs may be reduced compared to other methods of handling stormwater. Mowing twice a year should help keep woody vegetation from dominating. Mowing frequencies much greater than two or three times a year could promote the growth of non-native grasses. Mowing should not be close-cropped, mowed heights of six inches are desirable.

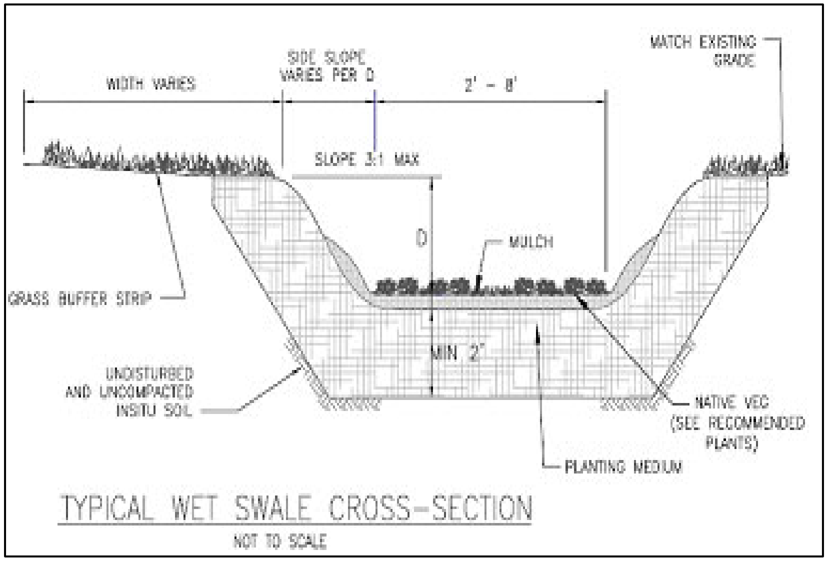
A good primer on filter strips in Ohio, with an admitted agricultural focus, is: http://ohioline.osu.edu/aex-fact/0467.html.

Grassed Swales: Swales are a low cost low maintenance option to remove sediments, nutrients and pollutants. They increase stormwater infiltration and add a visually aesthetic component to a site.

A grassed swale is a graded and engineered landscape feature appearing as a linear, shallow, open channel with trapezoidal or parabolic shape. The swale is planted with flood tolerant, erosion resistant plants.

The design of grassed swales promotes the conveyance of storm water at a slower, controlled rate and acts as a filter medium removing pollutants and allowing stormwater infiltration. When properly designed to accommodate a predetermined storm event volume, a grassed swale results in a significant improvement over

Grassed swales are often used in rural settings, but as shown in the photo above, the concept can be applied in the urban environment as well. A typical design is shown below.

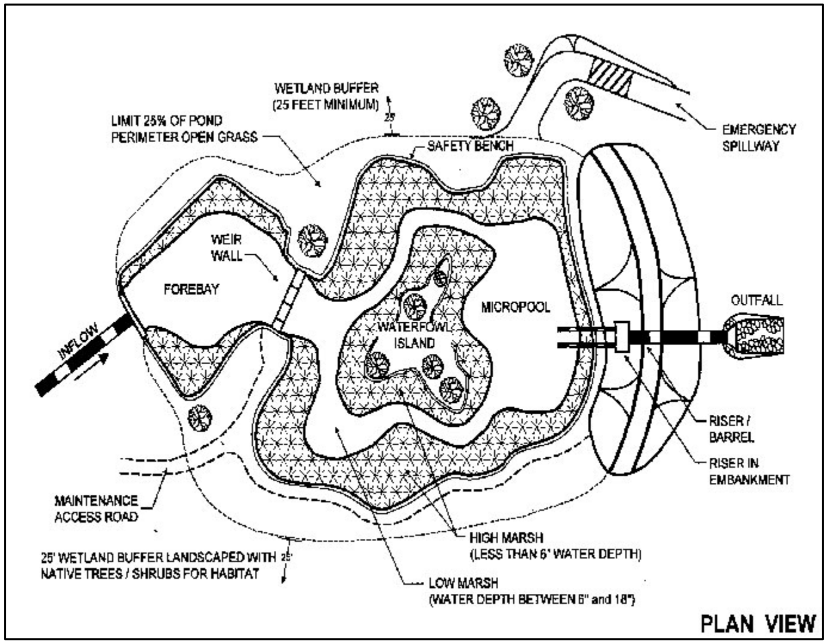


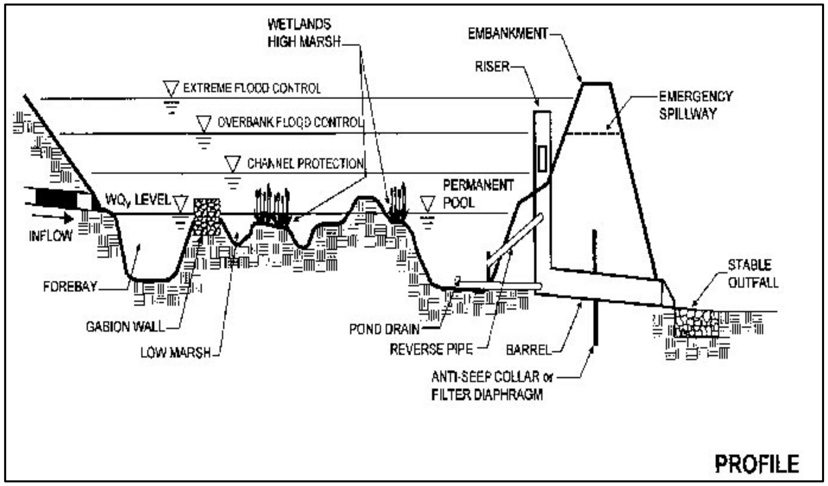
the traditional drainage ditch in both slowing and cleaning of water.

Stormwater Wetlands: Stormwater wetlands (constructed wetlands) are structural practices that in their simplest form incorporate wetland plants in a shallow pool. As stormwater runoff flows through the wetland, pollutant removal is achieved by settling, biological uptake, and the anaerobic chemical pathways in wetland soils. Wetlands are among the most effective stormwater practices in terms of pollutant removal, and also offer aesthetic value.

Stormwater wetlands are fundamentally different from natural wetland systems. Stormwater wetlands are designed specifically to optimize the treating stormwater runoff, and may have lower levels of species richness and diversity than natural wetlands or compensatory mitigation wetlands, since high diversity is sometimes not a design goal for constructed wetlands. Stormwater wetlands may provide some habitat and other values that natural wetlands offer, but their designs necessarily include features such as forebays (deeper pools located at the inlet of stormwater wetlands, these are designed to retain sediment) that typically require regular maintenance. Stormwater wetlands are quite different in intent and design from wetlands developed as part of a compensatory mitigation plan. The maintenance needs, and the difference in intent of design, generally preclude stormwater wetlands from receiving credit as part of a compensatory mitigation package.

The conceptual plans below show typical stormwater treatment wetland designs. Designs for stormwater wetlands generally feature a forebay. The most effective designs mix wetland communities, with shallow areas dominated by emergent plant (high marshes in the diagrams), and deeper areas dominated by submerged aquatic and floating leaved plants (low marsh in the diagrams). These systems are primarily detention systems, and the effectiveness of the treatment depends largely on the retention time (time that water is held in the system) and the surface area and volume for contact of the water with soil and plant roots.





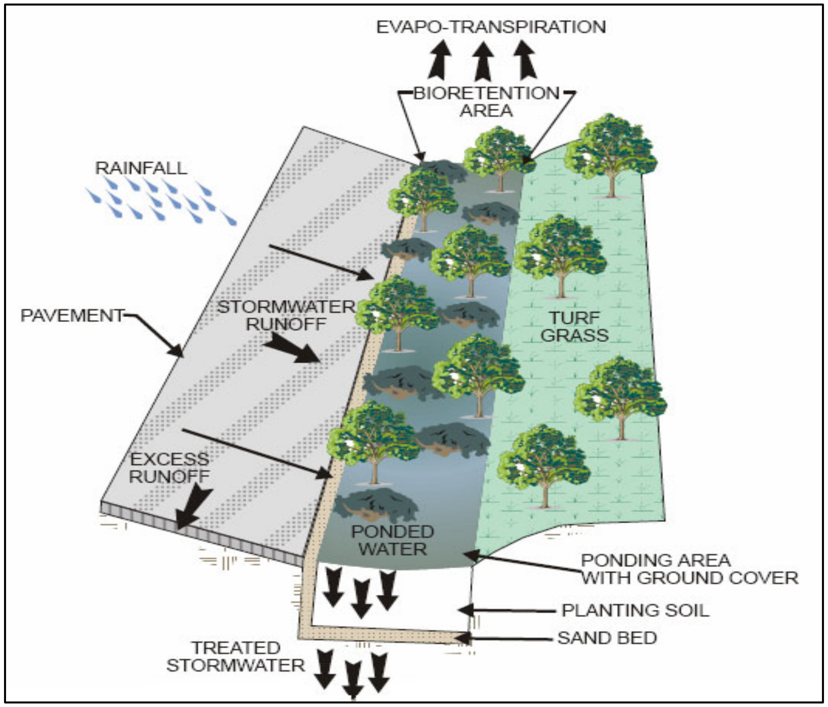
Typical plan and cross section for a stormwater treatment wetland.

Advantages:

- Improvement in downstream water quality.
- Settlement of particulate pollutants.
- Reduction of oxygen-demanding substances and bacteria from urban runoff.
- Biological uptake of pollutants by wetland plants.
- Flood attenuation.
- Reduction of peak discharges.
- Enhancement of vegetation diversity and wildlife habitat in urban areas.
- Aesthetic enhancement and valuable addition to community green space.

Well designed Bioswales provide a mechanism for infiltration and filtering stormwater.

Bioretention: Bioretention areas function as soil and plant-based filtration devices that remove pollutants through a variety of physical, biological, and chemical treatment processes. Rather than simply conveying the stormwater flows to an outfall, where stormwater and all the pollutants the flow has collected reach the receiving stream,



Cross section through a typical bioswale design. The general design for a Raingarden would follow the same concepts, but the structure would be less linear in shape .

these BMPs help reduce pollutant loads. The reduction of pollutant loads then helps cities and other permitted entities achieve their regulated water quality goals. Ohio Stormwater Code requires the collection and filtration of the first 0.75” of rainfall. Studies have found that properly designed and constructed bioretention cells are able to achieve excellent removal of heavy metals and other pollutants. Raingardens, and bioswales are types of bioretention.

Raingardens and bioswales generally function by providing a mechanism for the slow infiltration of runoff through a plant and soil matrix. As this infiltration occurs, water is physically filtered as it slowly moves through the porous medium. Further, some nutrients and other pollutants are taken up into plants, or adsorbed onto clay particles. Some nutrients and other materials are broken down by soil microbes.

Small bioswale located in a curb cut.. Runoff from the road surface enters the curb cut in the foreground, and is filtered through the soil and vegetation.

In order to function best, bioretention areas should be placed over soils that show at least moderate permeability. Locating over such soils allows the bioretention areas to function as a means to hold water for longer terms in the soil. There are some situations where these BMPs can be sited over soils that are not permeable. In brownfield and other industrial areas, and may not be desirable to infiltrate water through deeper contaminated layers. In such cases, raingardens and bioswales can be constructed as beds of permeable material (sand and gravel generally) over an impermeable layer that prevents contact with deeper strata. In these cases, designed holding times for storm flows are on the order of 48 hours., and the treatment is largely reduced to physical filtering of the flows through the permeable sand and gravel layers. Treated waters are then discharged to the receiving stream or storm sewer system.

One of the primary objectives of Low Impact Development site design is to minimize, detain, and retain post development runoff uniformly throughout a site so as to mimic the site's predevelopment hydrologic functions. Originally designed for providing an element of water quality control, bioretention cells can achieve quantity control as well. By infiltrating and temporarily storing runoff water, bioretention cells reduce a site's overall runoff volume and help to maintain the predevelopment peak discharge rate and timing.

Permeable Pavement: Alternative paving materials can be used to infiltrate rainwater and reduce the runoff leaving a site. This can help to decrease downstream flooding, the frequency of combined sewer overflow (CSO) events, the frequency of sanitary sewer overflows (SSO) events, and the thermal pollution of sensitive waters. Use of these materials can also eliminate problems with standing water, provide for groundwater recharge, control erosion of streambeds and riverbanks, facilitate pollutant removal, and provide for a more aesthetically pleasing site. Alternative pavers can even eliminate the requirement for underground sewer pipes and conventional stormwater retention / detention systems.

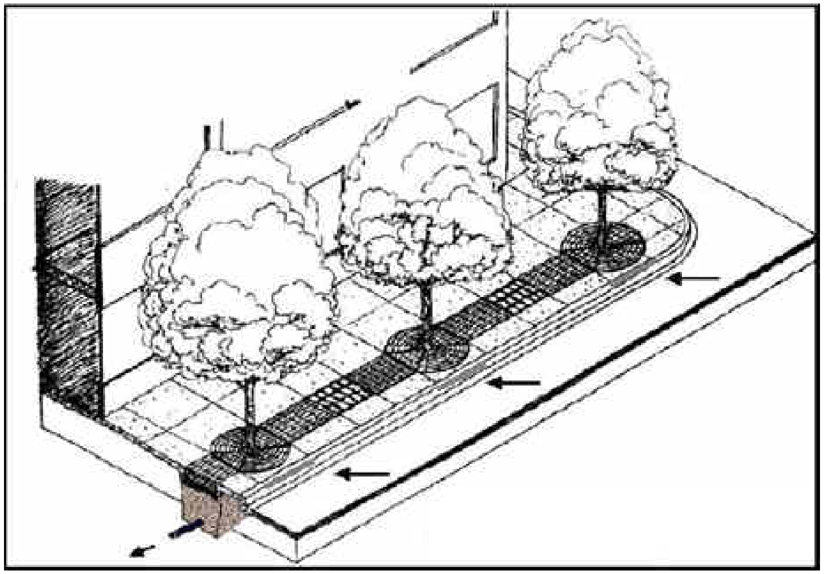
Permeable pavement comes in four forms: permeable concrete, permeable asphalt, permeable pavers, and grid pavers. Permeable concrete and asphalt are similar to their impervious counterparts but are open graded or have reduced fines and typically have a special binder added. Permeable pavers and grid pavers are modular systems. Permeable pavers are installed with gaps between them that allow water to pass through to the base. Grid pavers are typically a durable plastic matrix that can be filled with gravel or vegetation. All of the permeable pavement systems have an aggregate base in common which provides structural support, runoff storage, and pollutant removal through filtering and adsorption.

Nearby examples of the use of, permeable paving materials can bee seen at Cleveland State University's campus, and in the streetscapes of Cuyahoga Falls.

Some permeable pavement systems are indistinguishable from traditional impermeable pavement.

Tree Box Filter: Tree box filters are mini bioretention areas installed beneath trees that can be very effective at controlling runoff along streets or parking lots. Runoff is directed to the tree box, where it is cleaned by vegetation and soil before entering a catch basin. The runoff collected in the tree-boxes helps irrigate the trees.

Tree box filters are based on an effective and widely used "bioretention" technology with improvements to enhance pollutant removal, increase performance reliability, increase ease of construction, reduce maintenance costs and improve aesthetics. Typical landscape plants (shrubs, ornamental grasses, trees and flowers) are used as an integral part of the bioretention / filtration system. They can fit into any landscape scheme increasing the quality of life in urban areas by adding beauty, habitat value, and reducing urban heat island effects.



A typical tree box filter design.

The system consists of a container filled with a soil mixture, a mulch layer, under-drain system and a shrub or tree. Stormwater runoff drains directly from impervious surfaces through a filter media. Treated water flows out of the system through an under drain connected to a storm sewer / inlet or into the surrounding soil. Tree box filters can also be used to control runoff volumes / flows by adding storage volume beneath the filter box with an outlet control device.

Green Streets: Urban Street right-of-ways integrated with green techniques are often called "green streets". In most cities, street right of ways represent about 25% of land area. Green streets achieve multiple benefits, such as improved water quality and more livable communities, through the integration of stormwater treatment techniques which use natural processes and landscaping. Green streets can incorporate a wide variety of design elements previously described such as permeable pavements, roadside bioinfiltration swales, tree box filters,

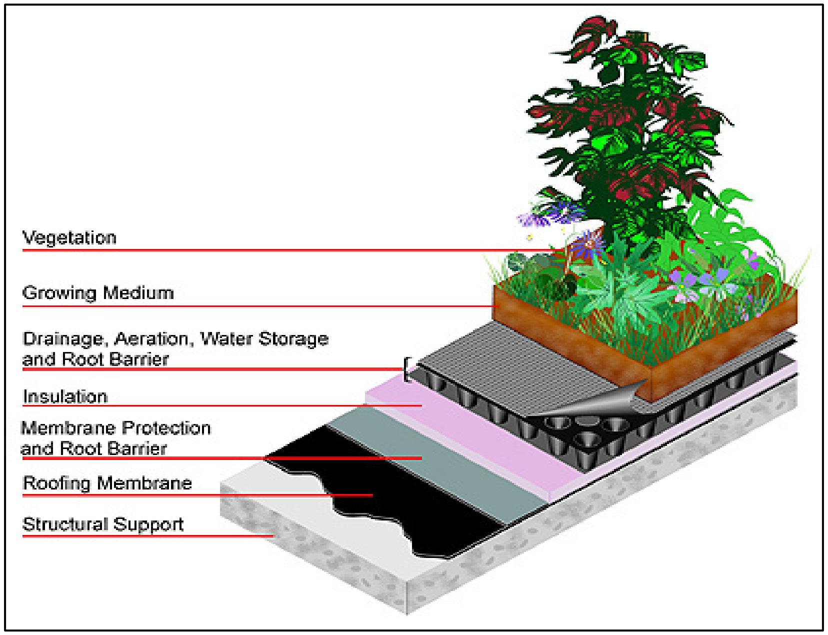
Green streets provide ecological benefits and improve the local quality of life for residents.

and urban forestry. Although the design and appearance of green streets will vary, the functional goals are the same: provide source control of stormwater, limit its transport and pollutant conveyance to the collection system, and provide environmentally enhanced roads.

Green Streets provide multiple benefits including:

- Integrated system of stormwater management within the right-of-way.
- Volume reductions in stormwater which reduce the volume of water discharged via pipe into receiving streams, rivers and larger bodies of water.
- Key linking component in community efforts to develop local green infrastructure networks.
- Improves local air quality by providing interception of airborne particulates and shade for cooling.
- Enhanced economic development along the transit corridor.
- Improved pedestrian experience along the street right of way.

Green Roofs: Green roofs are structural components that help to mitigate the effects of urbanization on water quality by filtering, absorbing or detaining rainfall. They are constructed of a lightweight soil medium, underlain by a drainage layer, and a high quality impermeable membrane that protects the building structure. The soil is planted with a specialized mix of plants that can thrive in the harsh, dry, high temperature conditions of the roof and tolerate short periods of inundation from storm events.



Cross section through a typical green roof design.

Green roofs provide stormwater management benefits by:

- Utilizing the biological, physical, and chemical processes found in the plant and soil complex to prevent airborne pollutants from entering the storm drain system.
- Reducing the runoff volume and peak discharge rate by holding back and slowing down the water that would otherwise flow quickly into the storm drain system.

Green roofs are not only aesthetically pleasing, but they also:

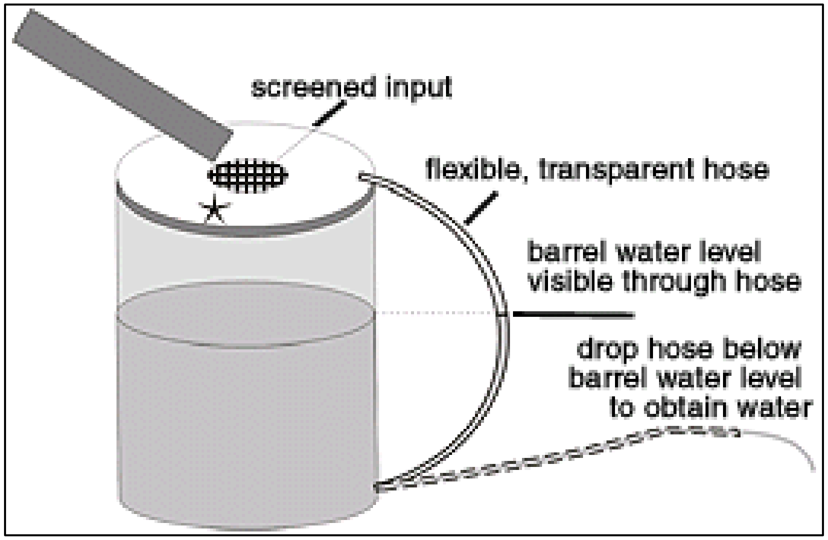
- Reduce city "heat island" effect.
- Potentially lengthen roof life 2 to 3 times.
- Treat nitrogen pollution in rain.
- Help reduce volume and peak rates of stormwater.

Urban Forestry: Trees are indicators of a community's ecological health. Trees and soils function together to reduce stormwater runoff. Trees reduce stormwater flow by intercepting rainwater on leaves, branches, and trunks. Some of the intercepted water evaporates back into the atmosphere, and some soaks into the ground reducing the total amount of runoff that must be managed in urban areas. Trees also slow storm flow, reducing the volume of water that a containment facility must store.

For example, in the Metropolitan Washington DC region, the existing 46% tree canopy reduces the need for retention structures by 949 million cubic feet, valued at $4.7 billion per 20-year construction cycle (based on a $5/cubic foot construction cost). The Green Build-out Model integrates GIS land cover data and hydrologic processes using rainfall storage and coverage areas for trees and green roofs. For an average year, the intensive greening scenario prevents over 1.2 billion gallons of stormwater from entering the sewer systems, resulting in a reduction of 10% or over 1 billion gallons in discharges to the District's rivers, and a 6.7% reduction in cumulative CSO frequencies (74 individual CSO discharges).

A widespread and systematic increase in tree canopy in Lorain will result in reduced runoff, and a reduced incidence of combined sewer and sanitary sewer overflows.

Rain Barrels: A rain barrel connected to a roof downspout is a great way to reduce stormwater going to the storm sewer system and to provide free water for gardening. Because runoff is collected right off the roof, it has few contaminants and is perfect for landscape watering. Rain barrels may be installed on single family homes, apartments, as well as commercial and public buildings.



Typical rain barrel design.

Diverting water from a downspout into rain barrels has several advantages:

- Lowers the percentage of roof top rainfall as a component of urban runoff.
- Reduces the volume of water flowing to the sewer treatment facility.
- Provides a backup source of water during times of drought or between rain showers.

- Helps to keep our creeks and beaches clean.
- Provides naturally softened water, great for delicate houseplants, auto cleaning and window washing.
- Saves money by lowering residents' water bill.
- Reduces the need for additional tax dollars earmarked for sewer expansion.
- Provides chlorine-free water helps maintain a healthy biotic community in the soil.
- Can be used as an educational tool for teaching residents about water conservation.

Cisterns: Cisterns are built to catch and store rainwater. They are larger versions of rain barrels and range in capacity from a few gallons to several thousand gallons.

Stormwater runoff cisterns are roof water management devices that provide retention storage volume in above or underground storage tanks. They are typically used for water supply. Cisterns are generally larger than rain barrels, with some underground cisterns having the capacity of 10,000 gallons or more. On-lot storage with later reuse of stormwater also provides an opportunity for water conservation and the possibility of reducing water utility costs.

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Table C.1. Guide to Selection of Best Management Practices.

Service Area Characteristics	Best Management Practice (BMP)											
				Bioretention								
	Stormwater wetlands	Filter strips	Grassed swales	Bioswale	Raingarden	Tree box filter	Permeable Pavement	Green streets	Green roofs	Urban forestry	Rain Barrels	Cisterns
Residential Areas												
High Density Single Family												
Existing Residential property				■	■	■	■	■			■	
Residential property with flat roofs				■			■	■			■	
Vacant lots				■	■	■		■		■		
Streets with smaller ROW				■		■	■	■				
Low Density Single Family												
Existing Residential Property				■	■		■	■		■	■	
New Residential Development	■	■	■	■	■		■		■	■	■	
Residential feeder streets with flat grades	■		■	■			■	■		■		
Multifamily												
Flat roof buildings									■			■
Shared parking lots, open space, etc.	■	■	■	■			■	■	■	■		
Commercial/Industrial/Public Spaces/Institutional												
Flat roof buildings									■			■
Building(s) with water intensive landscaping												■
Shared parking lots, open space, etc.	■	■	■	■		■	■	■		■		
Vacant lots/brownfields				■						■		
Streets with flat grades and curbs				■		■	■	■		■		
Streets with flat grades without curbs			■	■			■	■		■		
Parkland/Natural areas	■	■	■	■	■		■			■		

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Appendix D

Lower Black River
Lorain, Ohio
Ecological Restoration Master Plan

APPENDIX D – ECONOMIC BENEFITS OF ECOLOGICAL RESTORATION, CASE STUDIES

Overview

Ecological Restoration of the Lower Black River Corridor holds significant potential to produce a wide variety of environmental, social, public health, and economic benefits for the City of Lorain. Measurable economic benefits associated with Ecological Restoration are listed below:

- Improved water quality.
- Increased tourism for sports fishing, bird watching.
- Create a recreational destination for visitors and residents.
- Beautification.
- Community image enhancement.
- Attract redevelopment.
- Property values increase.
- Create green jobs.

Economic Benefit Strategies

Clean up of degraded sites must begin before old industrial sites can be used, this project sets priorities for restoration which may attract grant funds to spur further clean up. The plan complements current removal of marketable materials, such as slag, thus helping to advance the City's redevelopment vision for these areas along the river.

Continued restoration of the Black River will help the City to attract development to the core of the City, the area along the river. This plan will guide restoration toward those areas where it is most appropriate, while maintaining the core parcels that should be redeveloped to draw jobs, people and money to the core of the City.

Grant Funds are available for "quick-hit", short term restoration projects that will show an immediate benefit. These could be high visibility restoration projects, are relatively inexpensive, that help quickly improve the River's health while drawing important attention to the City's redevelopment efforts, and the greater plan itself.

Potential dollars from permit applicants needing mitigation elsewhere could be brought to the project. The Plan is the vehicle for helping secure these funds by identifying locations and priorities.

Potential exists to provide mitigation sites for potential development projects along the river, thereby reducing development costs and permitting time frames. This creates a winning situation for all.

Improvements along the river provide an important symbol to visitors, who are currently supporting the very popular river tours sponsored by the Lorain Port Authority.

The Staubach Report, a general plan for the city developed in 2006, assessed the development feasibility of Lorain's waterfront areas. Some of the fundamental conclusions of this report included:

- Old and deteriorating industrial facilities were highly visible, and left a bad impression on residents and visitors.
- Environmental issues will make redevelopment a "non-starter" for most developers unless the issues are cleaned up.
- There was a pervasive lack of confidence in the city's resurgence among residents.

An ecological restoration program for the Black River could respond to each of the above issues.

Where Has Ecological Restoration Created Economic Benefits Before?

There are numerous examples of big and medium sized cities undertaking major ecological restoration initiatives which are part of significant economic development strategies.

An initiative to restore the lower 6.8 miles of the long abused Anacostia River in southwest Washington DC has a goal of restoring riparian functions and providing a swimmable river by 2025. This initiative is envisioned as stimulating the redevelopment of over 2800 acres of urban land area in 5 separate neighborhood districts.

The City of Philadelphia has published a Triple Bottom Line (TBL) Analysis of the environmental, social, and economic benefits of their proposed $1.6 billion green infrastructure and watershed restoration program. This TBL analysis calculates $2.2 billion in current value benefits, not including redevelopment values, from the Green Infrastructure program.

The attached case studies profile the restoration and redevelopment successes of mid sized, Great Lakes cities comparable to Lorain.

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SUCCESS STORIES

Toledo Marina District, Toledo OH

- 100 acre brownfield, site of former Acme Power Plant along Maumee River.
- 15 acre Riverfront Park created as an amenity for $320 million mixed-use development containing 1000 new housing units.
- Naturalized habitat edge, aquatic baskets, Green Infrastructure.
- Population 313,619; Median income $32,546.

City of Sheboygan Promenade, Sheboygan WI

- Population 50,792; Median Income $40,066.
- Former manufacturing community, polluted river, superfund site, significant job loss 1980's.
- Remediated contaminated sites- used creative developer finance mechanisms.
- $12 million in public infrastructure assessment.
- $54 million in hotel/resort development.
- 300-400 new jobs, $1 million in tax revenue.

Lower Don Lands Urban Redevelopment, Toronto Ontario

- Transformed port to sustainable green city.
- Former brownfield and channelized edges.
- Created an estuary to spark 150 acre development.
- Urban estuary, naturalized edge, floodway, 80 acre recreational park.
- Highend parkfront or riverfront property to support $900 million mixed use neighborhood.

SUCCESS STORIES

Waukegan Harbor, Waukegan IL

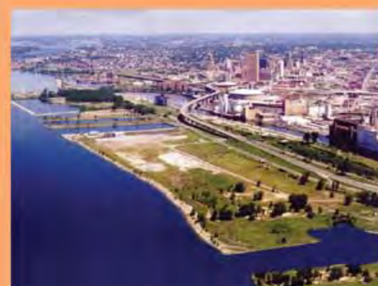


"We all agree that no single project is more important to Waukegan's economy than the environmental restoration of the harbor" ~U.S. Rep. Mark Kirk

- Waukegan population 87,901.
- $2.6 million in environmental restoration, sediment decontamination
- Will remove the harbor from the "Area of Concern" list to the "Area of Recovery" list.
- Over 1,600 acres of lakefront property to be restored.
- Will attract new homeowners and tourists, commercial and recreational investments.
- Property values could increase an average of $53,000 per home.
- Harbor cleanup could add over $800 million.

Old First Ward, Buffalo Riverfront, Buffalo, NY

- **Studies show homebuyers were willing to pay 15% more for homes near the Buffalo River if contamination was eliminated.**
- Contaminated former factories and steel mills.
- Water quality improvements, habitat restoration, brownfields.
- Could trigger an additional $543 million in taxable value for properties near the river.
- Buffalo population 292,648; Median income $24,536.
- Sparked plans for $1 billion waterfront mixed-use redevelopment on a brownfield.
- Ecological restoration, riverfront trail, aquatic & bird habitat enhancement.



Collingwood Harbor, Ontario



- Area of Concern, Remedial Action Plan for Lake Huron.
- Ecological restoration.
- Removal of 8,000 cubic meters of contaminated sediment.
- Improvements to sewage treatment plant.
- Cleaner water, stabilized stream slopes, improved fish habitat, increased recreational areas.
- Over $8 million invested to cleaup the contamination; over $3 million has been raised to continue improvements.
- Sparked sustainable growth along the waterfront.

SUCCESS STORIES

Grand Calumet River Remediation Project, Gary IN




- **Removing contaminated sediments could increase home values by 27%**
- Formal analysis of economic benefits of ecological remediation.
- Highly contaminated sediment remediation project, U.S. Steel brownfields.
- $41 million in restoration and river clean-up.
- Redevelopment opportunities along restored river.
- Gary population 102,746; Median income $27,195.

Stamford Harbor Redevelopment Project, Stamford CT

- Former gas plant, fuel oil depot, and manufacturing complex.
- Highly contaminated brownfields.
- Cleanup and redevelopment of 3 brownfields will leverage $370 million in private investment.
- Will create 600 construction and 1,300 permanent jobs.
- 25% of families currently below poverty level.
- Stamford population 118,475.


New Bedford Port Cleanup, New Bedford MA

- Federal Portsfield Program.
- One of the goals of NOAA.
- Superfund site cleanup.
- Attracting federal money from habitat restoration & brownfield cleanup.
- Habitat restoration as part of port revitalization, waterfront planning.
- Redeveloped brownfields in port areas can improve marine transportation wile providing environmental, eocnomic, and social benefits.
- New Bedford population 93,768.

Appendix E

Lower Black River

Lorain, Ohio
Ecological Restoration Master Plan

APPENDIX E – GLOSSARY OF TERMS

AOC: Area of Concern. They are defined by the U.S.-Canada Great Lakes Water Quality Agreement (Annex 2 of the 1987 Protocol) as "geographic areas that fail to meet the general or specific objectives of the agreement where such failure has caused or is likely to cause impairment of beneficial use of the area's ability to support aquatic life."

Aquatic: Living or growing in or on water.

Assemblage: A group of species found together in a particular area.

Beneficial Use Impairment (BUI): A potential use or trait of an area that is compromised by current ecological conditions

BMP: Best Management Practice. Refers to a design or technique that is generally adopted as a control, in this case generally as a control for surface run-off of stormwater.

Brownfield: Abandoned or underused industrial or commercial properties where redevelopment is complicated by actual or potential environmental contamination. Brownfields vary in size, location, age and past use.

Bulkhead: A large metal wall built to shore up and hold back river banks, particularly in navigation channels.

Carcinogenic: A substance or agent capable of causing cancer.

Community: A group of organisms that occupy a particular area. In general, community structure and composition is driven by environmental conditions. Thus, over particular soils, on particular slopes and in particular regions, one expects to find similar assemblages of plants and animals.

Conservation Easement: An easement placed to conserve or protect natural resources on a property or portion of a property.

Delisting: Removal of the AOC designation for a location after it has been sufficiently restored. Delisting requires removing the BUI targets.

Easement: An easement is a permanent restriction put on a piece of or an entire property, generally restricting its use or providing for a specific use. Easements are legally binding and are transferred when the property is transferred.

Ecological enhancement: Actions taken to improve the quality of an existing ecosystem. Actions may include stabilization of soils, planting, altering local hydrology, the removal of invasive species and others.

Ecological function: A measurable property of an ecosystem that characterizes that system. Examples include rates primary productivity and nutrient cycling.

Ecological restoration: Ecological restoration is an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability.

Ecoregion: A geographic area defined by a shared set of physical and ecological characteristics including climate, geology, and vegetation.

Ecosystem: An assemblage of plant and animal communities, and the physical environment in which they live, linked by a variety of processes that allow for the transfer of energy and materials between and among the component communities.

Fauna: The sum total of the animal species in an area.

Flora: The sum total of the plant species in an area.

Geographic Information System (GIS): A computer analysis system that combines an electronic map with an electronic data base which contains attributes describing various properties of the mapped features.

Great Lakes Legacy Act: This act, adopted in 2002, provides funding to take the necessary steps to clean up contaminated sediment in "Areas of Concern located wholly or partially in the United States," including specific funding designated for public outreach and research components.

Great Lakes National Program Office (GLNPO): A federal EPA office created in 1978 to oversee the U.S. fulfillment of its obligations under the Great Lakes Water Quality Agreement with Canada.

Green Infrastructure: Natural solutions that take the place of hardened, engineered structures, generally for storing and treating stormwater in this context.

Habitat: The area or environment in which an organism or community of organisms lives. There are many components to habitat, for most animals these include feeding, breeding, nesting or rearing, and escape habitat.

Impervious: The quality of not allowing water to pass. Most developed surfaces are impervious in that they do not allow water to percolate to the soil.

Infiltration: The process by which water moves from the surface to pore spaces in the soil.

Invasive species: Plants and animals that are not native to an area, and that since they generally have no natural predators or consumers in the area to which they were introduced, may thrive to the point that they crowd out native species.

Invertebrate: Species in the kingdom Animalia that lack backbones.

Lacustrine: Of or relating to lakes.

Low Impact Development: Land development techniques intended to alleviate some of the environmental impacts associated with residential, commercial and industrial development.

LQHEI: Lacustrine Qualitative Habitat Evaluation Index. A rapid assessment technique developed by the Ohio EPA for assessing lake shores and the banks of large rivers that drain to Lake Erie.

Macroinvertebrate: Invertebrate species that are greater than 5 microns in size. Typical aquatic macroinvertebrates include insect larvae and pupae, worms, arthropods and crustaceans.

Mitigation: The process of alleviating the effects of an impact. When used in wetland and stream regulation, the term involves a three-step process by which impacts to wetlands and streams are first avoided to the extent possible, the reduced to the extent possible, and finally compensated for by restoring damaged systems, or constructing new ones.

Morphology: The shape or structure of an object.

Mutagenic: A substance or agent that tends to increase the rate of genetic mutations.

Non-native: In this report, these are species that are not native to the northeast Ohio area, meaning they were not part of the flora and fauna prior to European settlement.

Polynuclear (or Polycyclic) Aromatic Hydrocarbons (PAHs): Chemical compounds that consist of three or more fused benzene (aromatic) rings. PAHs occur in oil, coal, and tar deposits, and are produced as byproducts of fuel burning. As pollutants, they are of concern because some compounds have been identified as carcinogenic, mutagenic, and teratogenic.

QHEI: Qualitative Habitat Evaluation Index. A rapid assessment technique developed by the Ohio EPA for habitat in rivers.

Reference ecosystem: A reference ecosystem can serve as the model for planning an ecological restoration project, and later serve in the evaluation of that project. Existing, high quality streams and wetlands can serve to document restoration targets for this Plan.

Remediation: The act of improving restoring a contaminated site involving enclosure, encapsulation, capping or removal of the material.

Riparian area: The land area extending from the banks of a river or stream landward, within which activities have direct impacts on stream ecosystem function.

Setback: A protection area set around a resource. Riparian setbacks are set around streams, and limit activities within the protection zone.

Slag: Rock like deposits that are by-products of steel production. Slags are mildly alkaline rocks that are often used as construction materials, particularly for road sub-grades.

Teratogenic: A substance or agent that tends to cause developmental malformations.

TMDL: Total Maximum Daily Load. A limit set on the total amount of pollution a stream may receive and still meet water quality standards.

Triple Bottom Line: An accounting theory that takes into account fiscal, ecological and social costs and profits.

Watershed: An area of land from which water drains to a river, pond or lake.

WWTP: Waste Water Treatment Plant. A plant used for treating sewage and other liquid wastes.