Tinkers Creek Watershed Action Plan

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Rediscover • Respect • Revitalize
Tinkers Creek
WATERSHED
PARTNERS

CUYAHOGA COUNTY
Board of Health
PREVENT ✦ PROMOTE ✦ PROVIDE™

Tinkers Creek Watershed Action Plan Community Endorsement

City of Beachwood, OH
Merle S. Gorden, Mayor

____

City of Warrensville Heights, OH
Clinton Hall, Mayor

____

Village of Highland Hills, OH
Robert Nash, Mayor

____

Village of North Randall, OH
David Smith, Mayor

____

Village of Orange, Ohio
Kathy U. Mulcahy, Mayor

____

Village of Valley View, OH
Randall Westfall, Mayor

____

City of Solon, OH
Kevin C. Patton, Mayor

____

Village of Glenwillow, OH
Donald N. Payne, Mayor

____

Village of Oakwood, OH
Gary V. Gottschalk, Mayor

____

Village of Walton Hills, OH
Marlene B. Anielski, Mayor

____

City of Bedford, OH
Daniel S. Pocek, Mayor

____

City of Bedford Heights, OH
Fletcher D. Berger, Mayor

____

Village of Northfield, OH
Victor F. Milani, Mayor

____

City of Twinsburg, OH
Katherine Procop, Mayor

____

City of Hudson, OH
William A. Currin, Mayor

____

City of Macedonia, OH
Don Kuchta, Mayor

____

City of Aurora, OH
Lynn E. McGill, Mayor

____

City of Streetsboro, OH
Arthur Scott, Mayor

____

Village of Reminderville, OH
Sam Alonso, Mayor

____

City of Maple Heights, OH
Jeffrey A. Lansky, Mayor

____

Twinsburg Township, OH
Carol L. Gasper, Chair

____

James C. Balogh, Vice-Chair

____

Thomas O. Schmidt, Trustee

____

Franklin Township, OH
Mark Beckwith, Trustee

____

Keith Benjamin, Trustee

____

Gary Falstad, Trustee

____

Bainbridge Township, OH
Matthew J. D. Lynch, Trustee

____

Jeffrey S. Markley, Trustee

____

Linda W. White, Trustee

____

Sugar Bush Knolls, OH

____

Tinkers Creek State Park

Thanks to all of the contributors to this Watershed Action Plan and to the communities of the watershed for supporting the Tinkers Creek Watershed Partners and caring about the health of the stream. It is up to us to make the difference.

Tinkers Creek Watershed Action Plan
Table of Contents

I. Tinkers Creek Watershed Characteristics

II. Watershed Plan Development

III. Watershed Inventory

IV. Watershed Impairments

V. Watershed Restoration and Protection Goals

VI. Implementation

Figures/Maps

Tables

I. Tinkers Creek Watershed Characteristics

A. Introduction, Defining the Watershed

Tinkers Creek Watershed Location

The Tinkers Creek Watershed is 96.4 square miles of drainage area with its main stem being approximately 30 miles in length. The watershed traverses four counties; Portage, Geauga, Summit, and Cuyahoga. Twenty –one municipalities and three townships are included in the watershed landscape. It is the largest tributary to the Cuyahoga River.

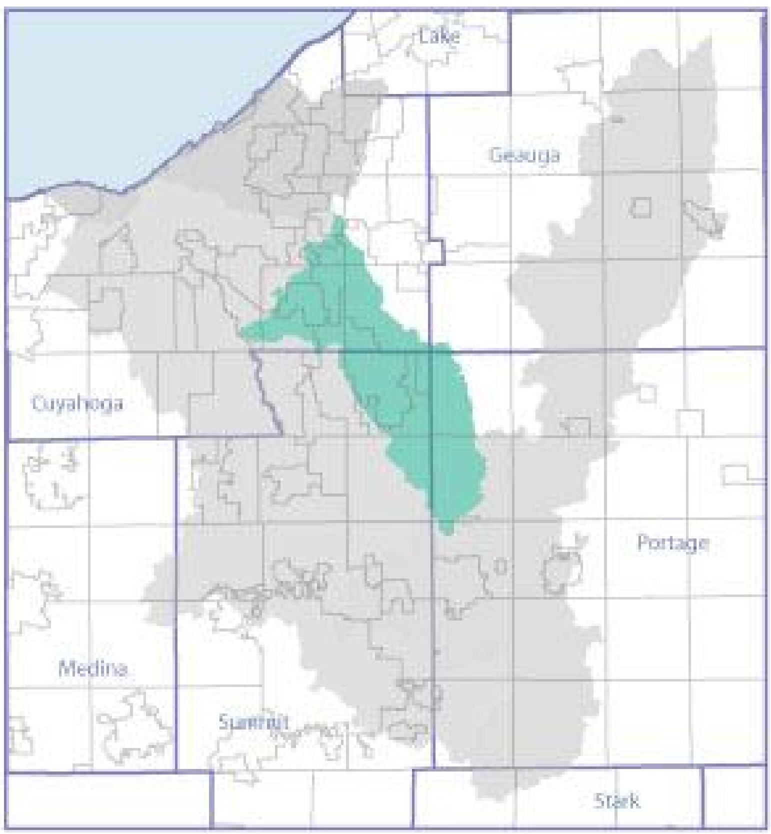
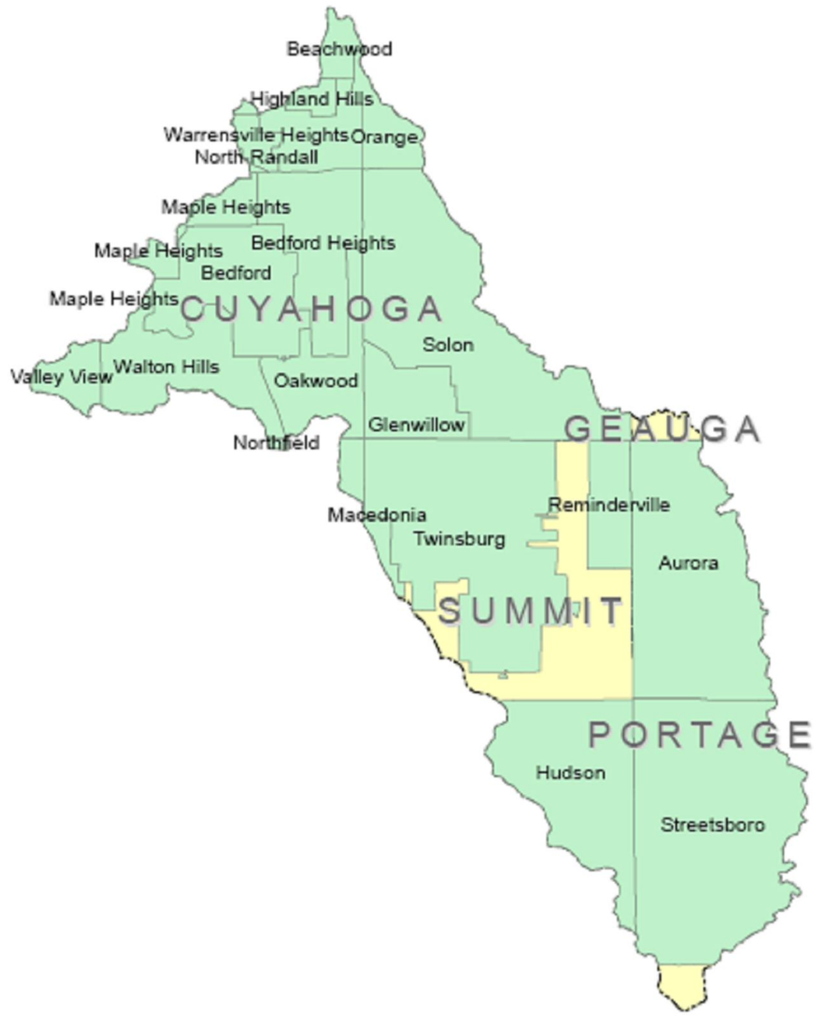


Figure 1: Tinkers Creek Location

Figure 2: Tinkers Creek Communities and Townships



The Tinkers Creek main stem flows south to north beginning in Franklin Township and meanders 30 miles to it's destination with the Cuyahoga River in Valley View, Ohio. Along the path, the main stem is met by several tributary streams. Pond Brook initially flows west beginning in Aurora at Pond Brook Lake through Reminderville and south until it meets Tinkers Creek at the Twinsburg Township/City of Twinsburg border. Hawthorne Creek flows north to south beginning in Beachwood and meeting the Tinkers Creek main stem in Bedford Heights within the Bedford Reservation. Beaver Meadow Run flows north to south beginning in Solon and meeting the main stem of Tinkers Creek in Glenwillow, Ohio. Bear Creek begins in Highland Hills and flows south through Warrensville Heights until it meets the Tinkers Creek main stem in Bedford Heights in the Bedford Reservation. Hemlock Creek begins in Bedford and flows south until it meets the Tinkers Creek main stem in Bedford in the Bedford Reservation. Deer Lick Run begins in Walton Hills and flows north into the

Bedford Reservation where it meets the Tinkers Creek main stem in the Bedford Reservation.

The watershed is both highly urbanized in the north and urbanizing in the south. Impervious cover ranges from 6.16% in the headwater area in the south to 43.7% in the Wood Creek sub-watershed located in the north.

Administrative Boundaries

Counties

Table 1: Counties in the Tinkers Creek Watershed

County	Percentage of County in Watershed
Cuyahoga	41.68%
Portage	27.18%
Summit	30.55%
Geauga	0.59%

Table 2: Municipalities

Municipality	TCWP Member	Phase 2	Percent in Watershed
Beachwood	No	Yes	14.57%
Bedford	Yes	Yes	100%
Bedford Heights	Yes	Yes	100%
Glenwillow	Yes	Yes	100%
Highland Hills	Yes	Yes	39.78%
Maple Heights	Yes	Yes	27.60%
North Randall	Yes	Yes	74.40%
Oakwood Village	Yes	Yes	89.17%
Village of Orange	No	Yes	40.85%
Solon	No	Yes	58.78%
Valley View	Yes	Yes	20.56%
Village of Walton Hills	Yes	Yes	65.48%
Warrensville Heights	Yes	Yes	53.92%
Aurora	No	Yes	43.85%
Streetsboro	Yes	Yes	58.51%
Village of Hudson	Yes	Yes	28.21%
Macedonia	Yes	Yes	9.29%
Northfield	No	Yes	8.42%
Reminderville	Yes	Yes	100%
Twinsburg	Yes	Yes	100%

Sugar Bush Knolls	No	Yes	1.94%

Township	TCWP Member	Phase 2	Percent in Watershed
Bainbridge	No	Yes	2.23%
Franklin	No	Yes	12.36%
Twinsburg	No	Yes	88.60%

Table 3: Watershed Townships

Special Districts

Park Districts

Four Park Districts have conserved land within the watershed. In addition, ODNR operates a relatively small State Park. It is important to note that CVNP and the Bedford Reservation meet at the confluence of the Cuyahoga River and Tinkers Creek. The Bedford Reservation is the largest protected area within the watershed and contains a Scenic Overlook, Bridal Veil Falls, and the Great Falls of Tinkers Creek, not to mention a long and winding gorge eroded by the stream.

Park District	TCWP Member	Park Acres
Cuyahoga Valley National Park	No	303 acres
Cleveland Metro Parks	No	2297 acres
Metro Parks Serving Summit County	No	1706 acres
Portage County Metro Parks	No	48 acres
Tinkers Creek State Park	No	370 acres

Table 4: Park Districts

Other Protected Areas

Protected Area	TCWP Member	Park Acres
Tinkers Creek State Nature Preserve	No	786 acres

Table 5: Protected Areas

NEORSD
Northeast Ohio Regional Sewer District

The District is responsible for wastewater treatment facilities and interceptor sewers in the greater Cleveland Metropolitan Area. This service area encompasses the City of Cleveland and all or portions of 60 suburban municipalities in Cuyahoga, Summit and Lorain Counties and includes a diversified group of manufacturing and processing industries.

Planning Agencies
Cuyahoga County Planning Commission
NEFCO
NOACA

Ohio EPA
Ohio EPA provides sampling and regulatory review of permits within the watershed pertaining to NPDES, Phase II Storm water, Air, and surface water and alteration or elimination of a wetland or stream. The Ohio EPA also conducts monitoring within the Watershed every five years to evaluate the water quality conditions.

Soil Water Conservation Districts
Cuyahoga County Soil Water Conservation District
Summit Soil Water Conservation District
Portage Soil Water Conservation District

ODOT District 12
The Ohio Department of Transportation Local District provides maintenance, upgrades and engineering studies on the watershed's major roadways, highways and bridges.

Summit/Cuyahoga/Portage Counties
Board of Health (CCBH, Summit & Portage Health Departments)
County Engineer (Cuyahoga, Summit)
County solid Waste Districts (Cuyahoga, Summit)

All of these agencies have been involved in activities with the Tinkers Creek Watershed Partners. All agencies will continue to work with the organization to further the mission of the group and help to provide sustainable water quality solutions to the Tinkers Creek Watershed.

Special Designations

Cuyahoga River Watershed Area of Concern

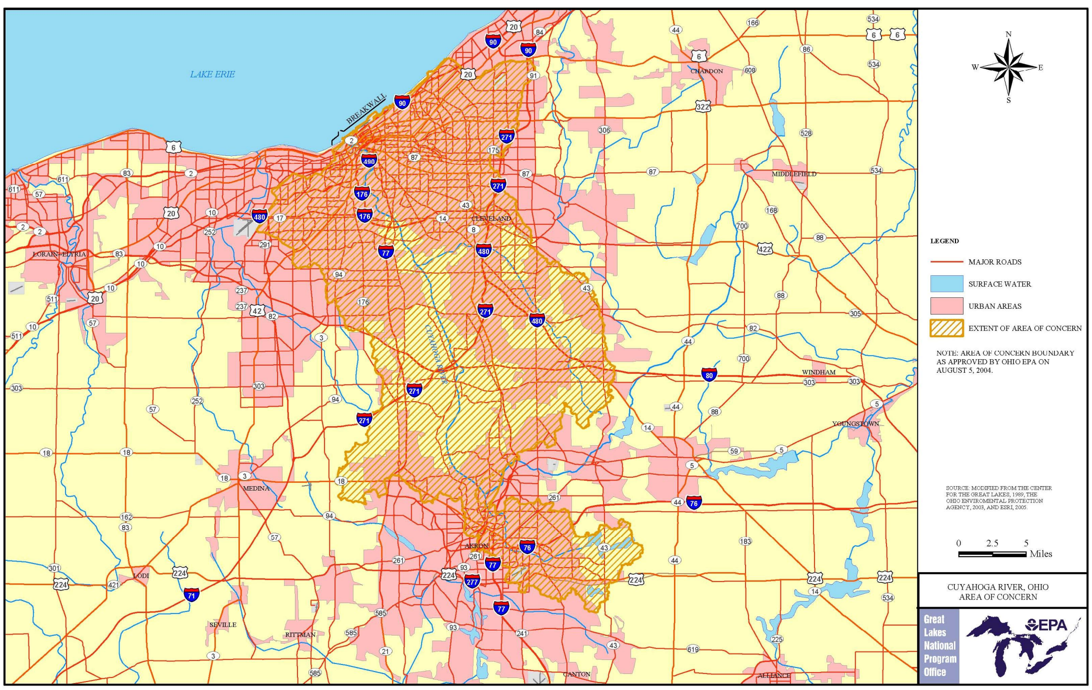
The Tinkers Creek Watershed is located within the lower Cuyahoga River Watershed. This area has been given special designation in 1988 by the Cuyahoga Remedial Action Plan Coordinating Committee (CCC) as an Area of Concern (AoC). Because of the historic pollution of the Cuyahoga River and this waterbody catching fire, the creation of the Clean Water Act, federal and state

EPA's and the Great Lakes Water Quality Agreement were formed to reverse the devastation to the Great Lakes region from pollution activities. The Great Lakes Water Quality Agreement calls for Remedial Action Plans (RAPs) to restore and protect 14 beneficial uses in Areas of Concern. An impaired beneficial use means a change in the chemical, physical or biological integrity of the Great Lakes system to which the Cuyahoga River flows. Therefore, the Tinkers Creek Watershed is an integral part of the process to "delist" the Cuyahoga River as an AoC entity.

Phase 2 Stormwater Communities

All 24 communities within the Tinkers Creek Watershed are considered phase 2 communities. This requires those communities to submit and perform requirements for stormwater management under the NPDES *(National Pollution Discharge elimination system)* program. The Tinkers Creek Watershed Partners are working with many of those communities to assist them with PIPE *(Public Involvement Public Education)* to help satisfy those requirements set forth in the permit.

Figure 3: Lower Cuyahoga River AoC



B. Demographics

Portions of the Tinkers Creek Watershed lie within heavily industrialized areas. Historically, Cuyahoga County and many adjacent counties employed a manufacturing workforce that provided steel and other goods to the world market place. Unfortunately, the vast majority of those jobs have been outsourced to other countries where cheaper labor and lax environmental regulations allow for maximum revenue making. Because of the retreat from the inner-ring communities to outlying suburbs, these "rusting" areas have seen a reduction in population within the watershed. Since 1990 all watershed counties have experienced population declines with Cuyahoga being the most significant.

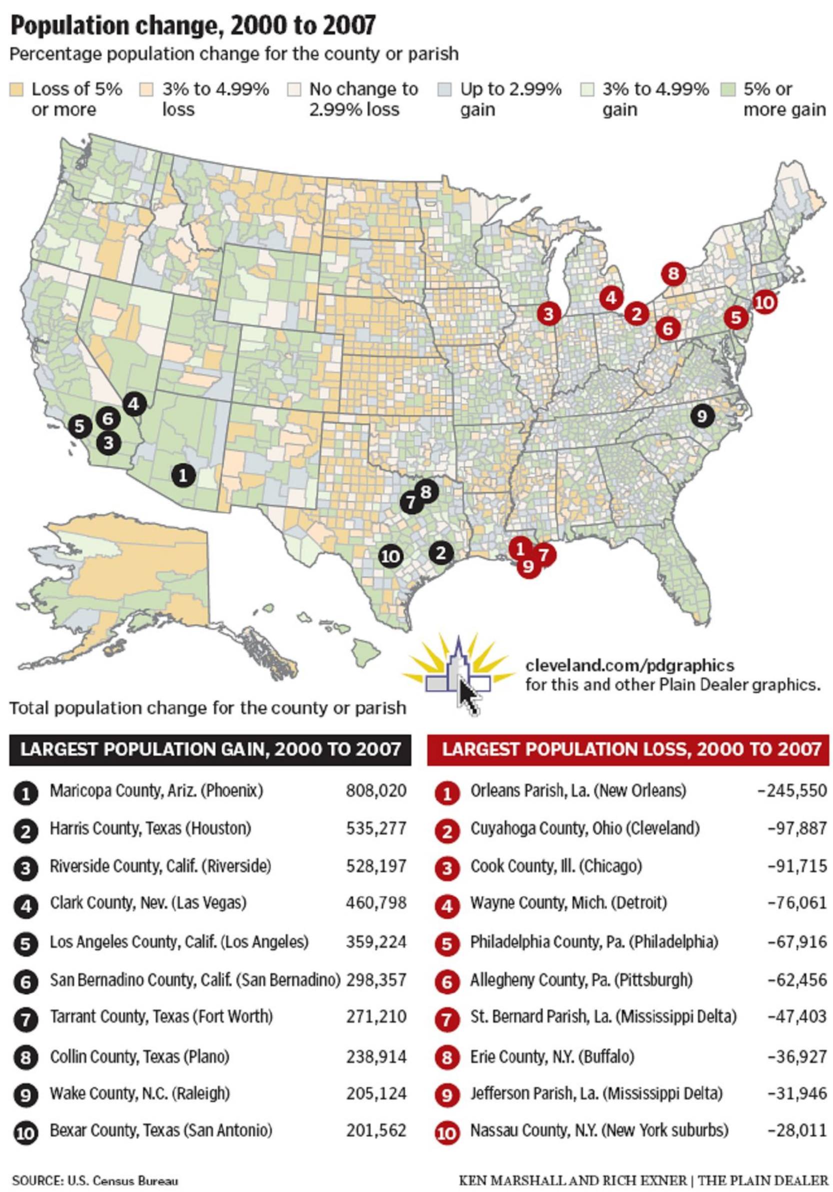


Figure 4: Population Regression for Cuyahoga County Ohio

The Tinkers Creek Watershed has a population of 109,389 people according to 2000 Census data. The following table demonstrates the population density of the watershed:

County	Political Subdivision	Size (acres)	% of Political Area of watershed	US Census Population Data 2003	2000	1990	Total Political Area (acres)	% of political subdivision in the watershed (%)	Population Density (#/sq mi)	Projected Population (by density)	% of Total Watershed Population	Stream (4-7) Length Miles
Tinkers Creek		**62,681**	**100%**							**109,389**	**100%**	**199.65**
CUYAHOGA COUNTY		**26,129**								**63,341**	**57.9%**	
CUY	Beachwood	490	0.78%	11,906	12,186	10,677	3,362	14.57%	575	440	0.40%	1.06
CUY	Bedford	3,402	5.43%	13,790	14,214	14,822	3,402	100.00%	2,674	14,214	12.99%	12.86
CUY	Bedford Hgts	2,901	4.63%	11,189	11,375	12,131	2,901	100.00%	2,509	11,375	10.40%	10.84
CUY	Glenwillow	1,830	2.92%	491	449	455	1,830	100.00%	206	590	0.54%	8.87
CUY	Highland Hgts.	504	0.80%	8,512	8,082	6,249	1,267	39.78%	856	674	0.62%	0.49
CUY	Maple Heights	916	1.46%	25,490	26,156	27,089	3,319	27.60%	4,905	7,020	6.42%	1.94
CUY	North Randall	372	0.59%	886	906	977	500	74.40%	1,335	776	0.71%	2.03
CUY	Oakwood Village	1,976	3.15%	3,643	3,667	3,392	2,216	89.17%	1,086	3,353	3.07%	5.18
CUY	Orange	993	1.58%	3,366	3,236	2,810	2,431	40.85%	781	1,212	1.11%	2.93
CUY	Solon	7,688	12.27%	22,248	21,802	18,548	13,080	58.78%	1,056	12,690	11.60%	21.32
CUY	Valley View	741	1.18%	2,157	2,179	2,137	3,604	20.56%	550	637	0.58%	2.79
CUY	Walton Hills	2,893	4.62%	2,391	2,400	2,371	4,418	65.48%	369	1,669	1.53%	10.39
CUY	Warrensville Heights	1,423	2.27%	14,719	15,109	15,745	2,639	53.92%	3,909	8,691	7.95%	4.20
GEAUGA COUNTY		**369**								**196**	**0.18%**	
GEA	Bainbridge Twp	369	0.59%	1,022	1,012	968	16,522	2.23%	340	196	0.18%	0.43
PORTAGE COUNTY		**17,036**								**15,408**	**14.1%**	
PORT	Aurora	6,765	10.79%	14,270	13,556	9,192	15,428	43.85%	652	6,889	6.30%	18.51
PORT	Franklin Township	1,146	1.83%				9,274	12.36%	303	543	0.50%	3.65
PORT	Streetsboro	9,122	14.55%	13,822	12,311	9,932	15,591	58.51%	560	7,976	7.29%	35.12
PORT	Sugar Bush Knolls	3	0.00%	226	227	211	155	1.94%	-	0	0.00%	-
SUMMIT COUNTY		**19,147**								**30,444**	**27.8%**	
SUM	Hudson Village	4,665	7.44%	23,053	22,439	17,108	16,534	28.21%	1,020	7,433	6.80%	10.96
SUM	Macedonia	576	0.92%	10,087	9,224	7,509	6,200	9.29%	1,288	1,159	1.06%	0.27
SUM	Northfield	58	0.09%	3,771	3,827	3,624	689	8.42%	3,719	337	0.31%	-
SUM	Reminderville	1,289	2.06%	2,377	2,347	2,163	1,289	100.00%	600	1,208	1.10%	6.42
SUM	Twinsburg	7,910	12.62%	17,236	17,006	9,606	7,910	100.00%	1,256	15,529	14.20%	25.01
SUM	Twinsburg Township	4,649	7.42%				5,247	88.60%	658	4,778	4.37%	14.38

Table 6: Population breakdown per political jurisdiction

Population Density

The Tinkers Creek Watershed has a diverse population density spanning 206 people per square mile in Glenwillow to 4,905 in Maple Heights. A correlation exists between high population densities and impervious cover. Comparatively, other Lake Erie basin watersheds have densities of 2,833 people per square mile in the Euclid Creek Watershed and the Chagrin River Watershed being 621 persons. Therefore, both impervious cover and population density will play a significant role in implementation strategies toward restoration work in the Tinkers Creek Watershed. In addition, the projected population growth is actually a reduction. As indicated in *Figure 4,* the population of the Cuyahoga County is reducing significantly. However, pockets of new home builds and resident migration tend to favor Twinsburg, Macedonia, Streetsboro, and Reminderville. These communities are located in Summit and Portage counties. The complexity of managing the watershed can be attributed to the movement of residents within the watershed. The older urban areas where population is leaving, homes are foreclosed upon, home values are declining, and taxes are increasing have created a management strategy where water quality improvement must be focused on retro-fitting Best Management Practices *(BMP's)* by reducing water quantity and reducing non-point source runoff into the system. On the other hand, developing communities pose the alternative which is to conserve/protect riparian areas, and wetlands, in addition to, implementing residential storm water management practices such as rain gardens and rain barrels. So the significant difference is that the urban environment calls for expensive retro-fitting of water quantity/quality practices versus suburban development providing opportunities to allow the natural feature to function as a free resource for the community as the management practice for water quality/quantity issues.

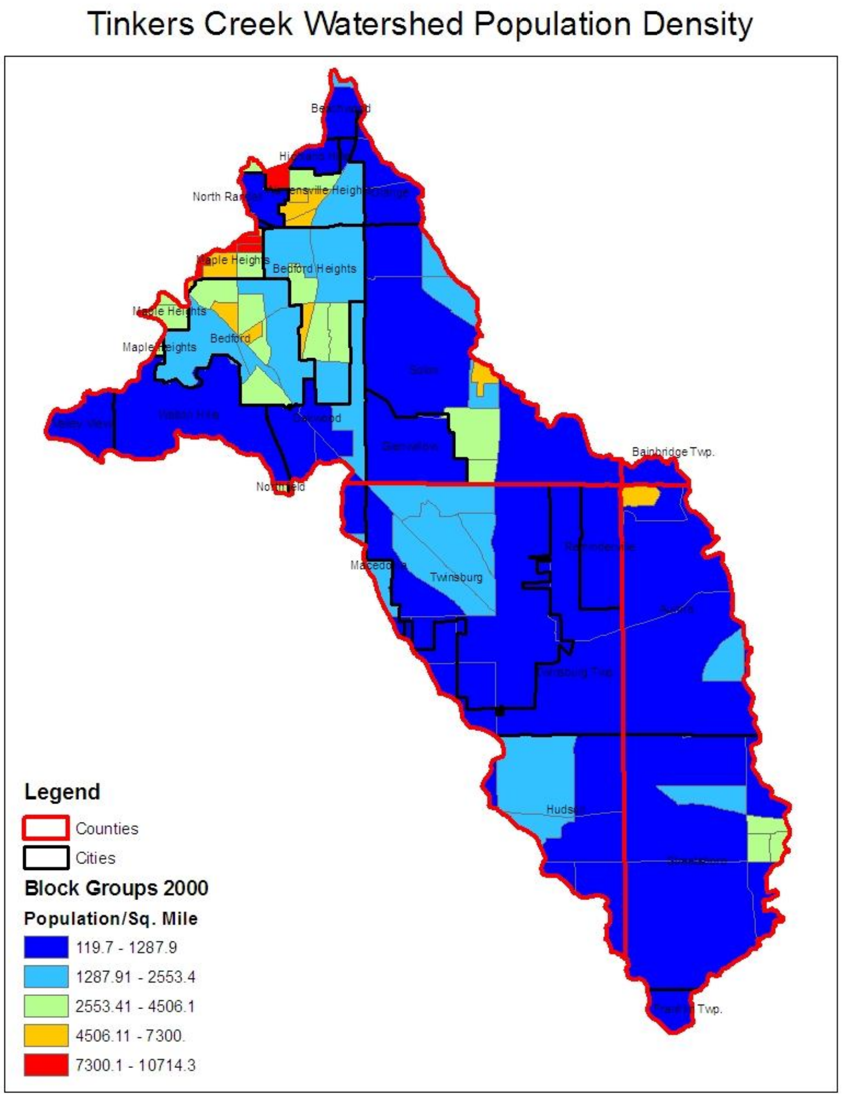


Figure 5: Tinkers Creek Watershed Population Density

Age

The watershed consists of varying ages, of which, the highest percentage lies between ages 34.61 – 43.7. Dissimilarly, the lowest percentage age group lies between 57.81 – 85.0.

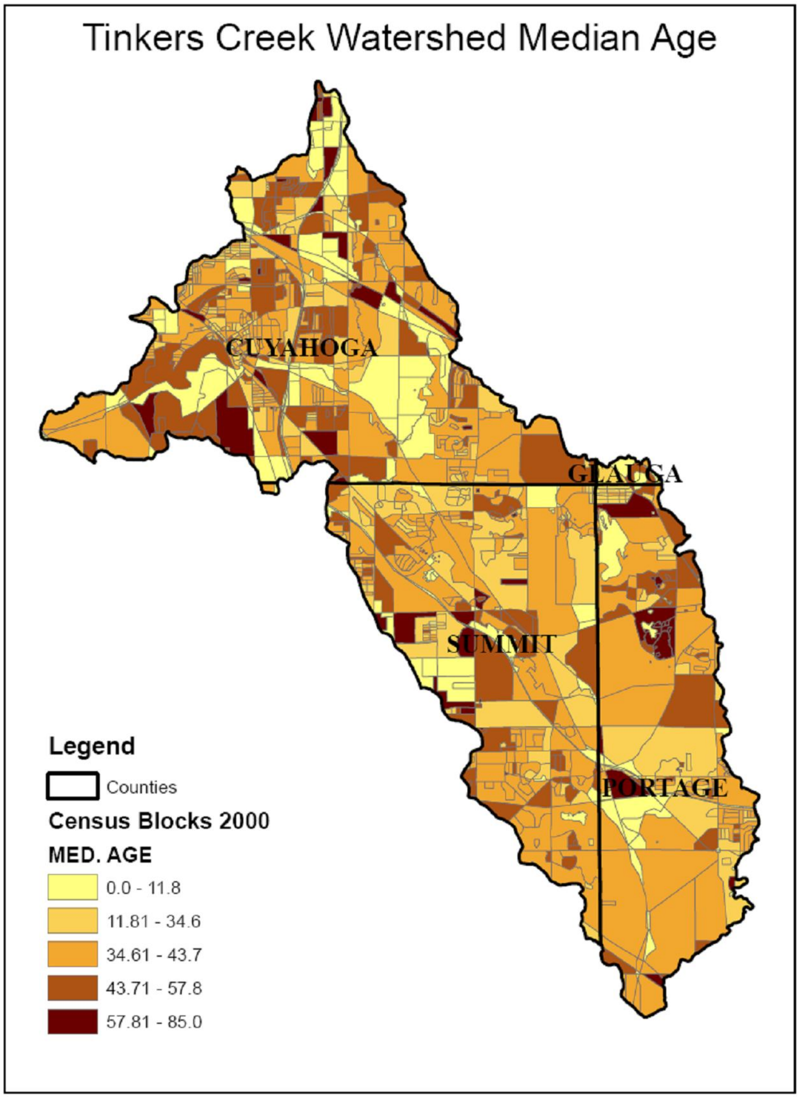


Figure 6: Tinkers Creek Median Age

Economic Trends

Population trends demonstrate that inner-ring suburbs are hit hardest by the downturn in the economy Northeast Ohio has been experiencing for decades. As residents move away from inner-ring suburbs of Cleveland to outlying suburban areas, the urban communities suffer from losing their tax base and therefore, have a difficult time continuing to provide services to the residents and to redevelop itself. In addition, this process of outward movement will result in additional lands consumed for development. This has been the trend in watershed communities such as Twinsburg and Streetsboro.

According to the Kerr + Borron Tinkers Creek Watershed Plan, most watershed communities experienced a positive growth rate since 1990. However, some experienced a loss and others remained stagnant. For instance, Hudson increased population from 17,108 to 23,053 and Twinsburg from 9,606 to 17,236. Bedford found a decrease of 1,032 people and Valley view remained virtually unchanged.

Historically, Northeast Ohio has been a staple in manufacturing and the distribution of those products. As those jobs have been outsourced to other countries for cheaper labor, fewer jobs are left to a population which takes pride in working with their hands. This reality has forced Northeast Ohio to re-position itself as a service providing economy.

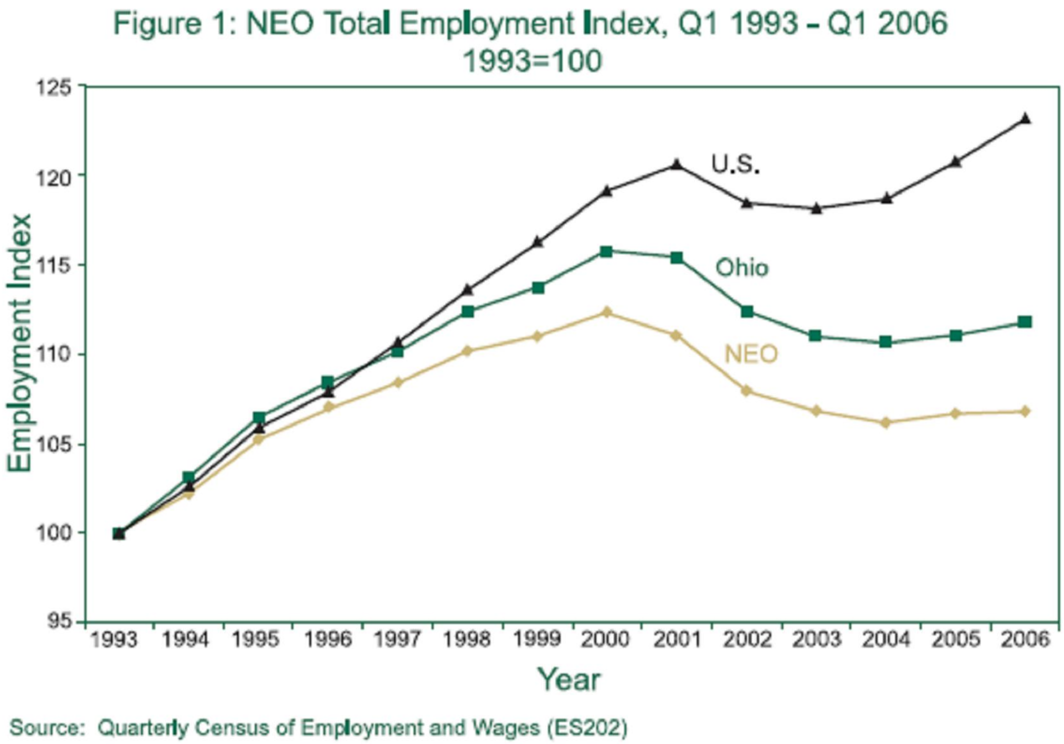


Figure 7: Northeast Ohio Employment Index

However, recently Cleveland was ranked as the 16th greenest city in America by sustainlane's annual survey. Both the City and the County have hired sustainability directors. Renewable energy companies and those companies which require the use of fresh water for production are being sought to help revitalize this economically challenged area. A movement to keep the economy local is also helping to promote good environmental stewardship. The connection between public health, creating a profitable "green" economy, and maintaining the integrity of the environment should be the focus of the region.

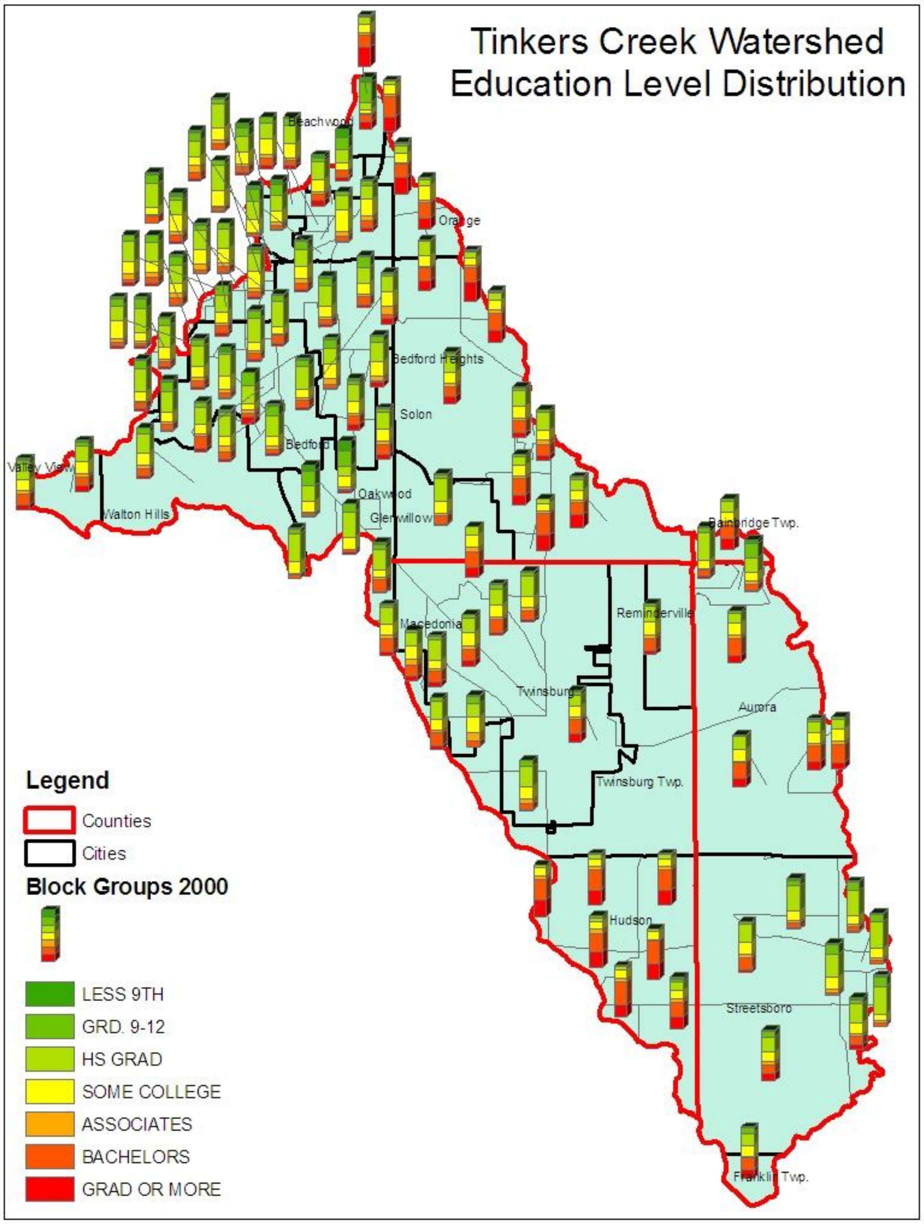


Figure 8: Tinkers Creek Watershed Education Level Distribution

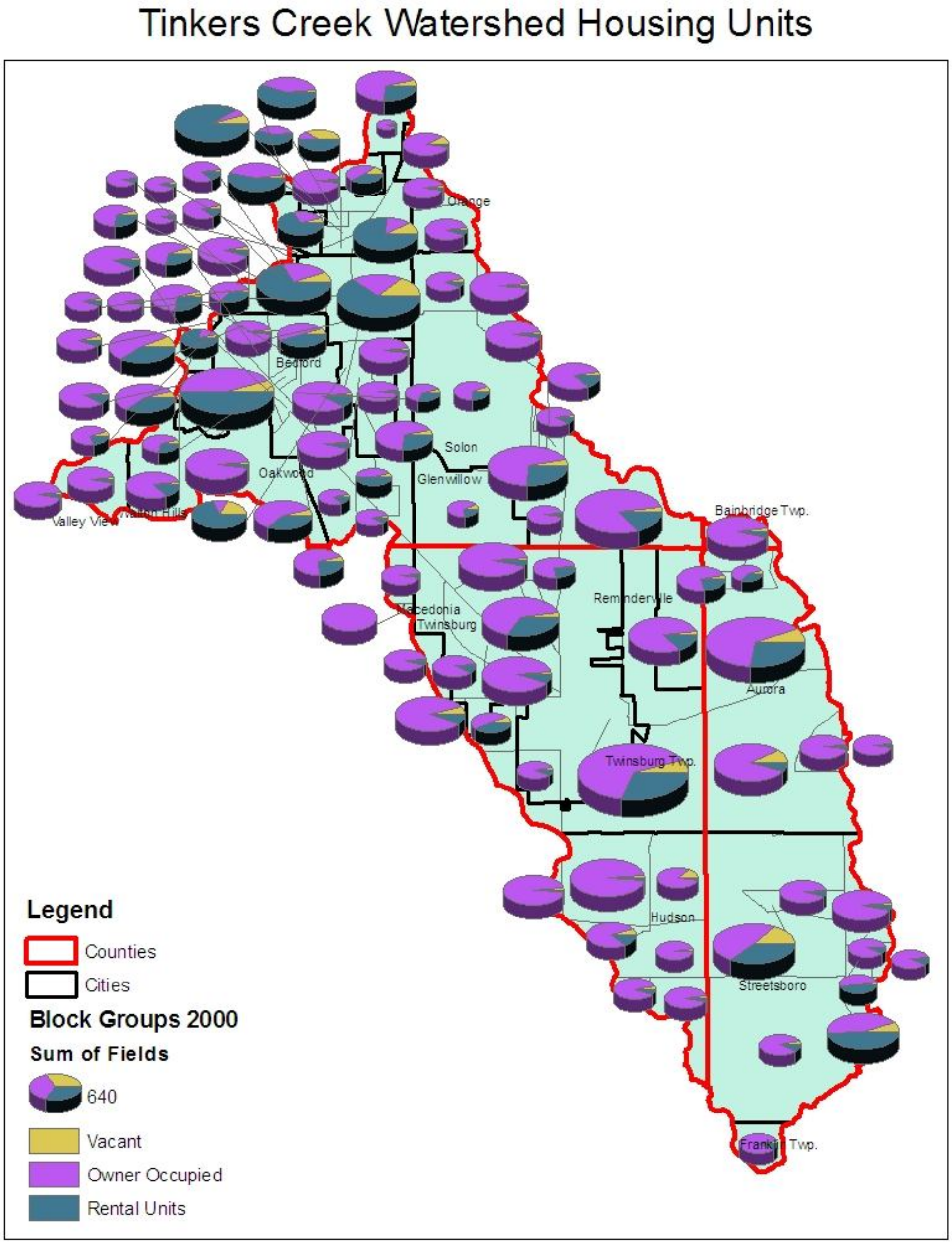


Figure 9: Tinkers Creek Watershed Housing Distribution

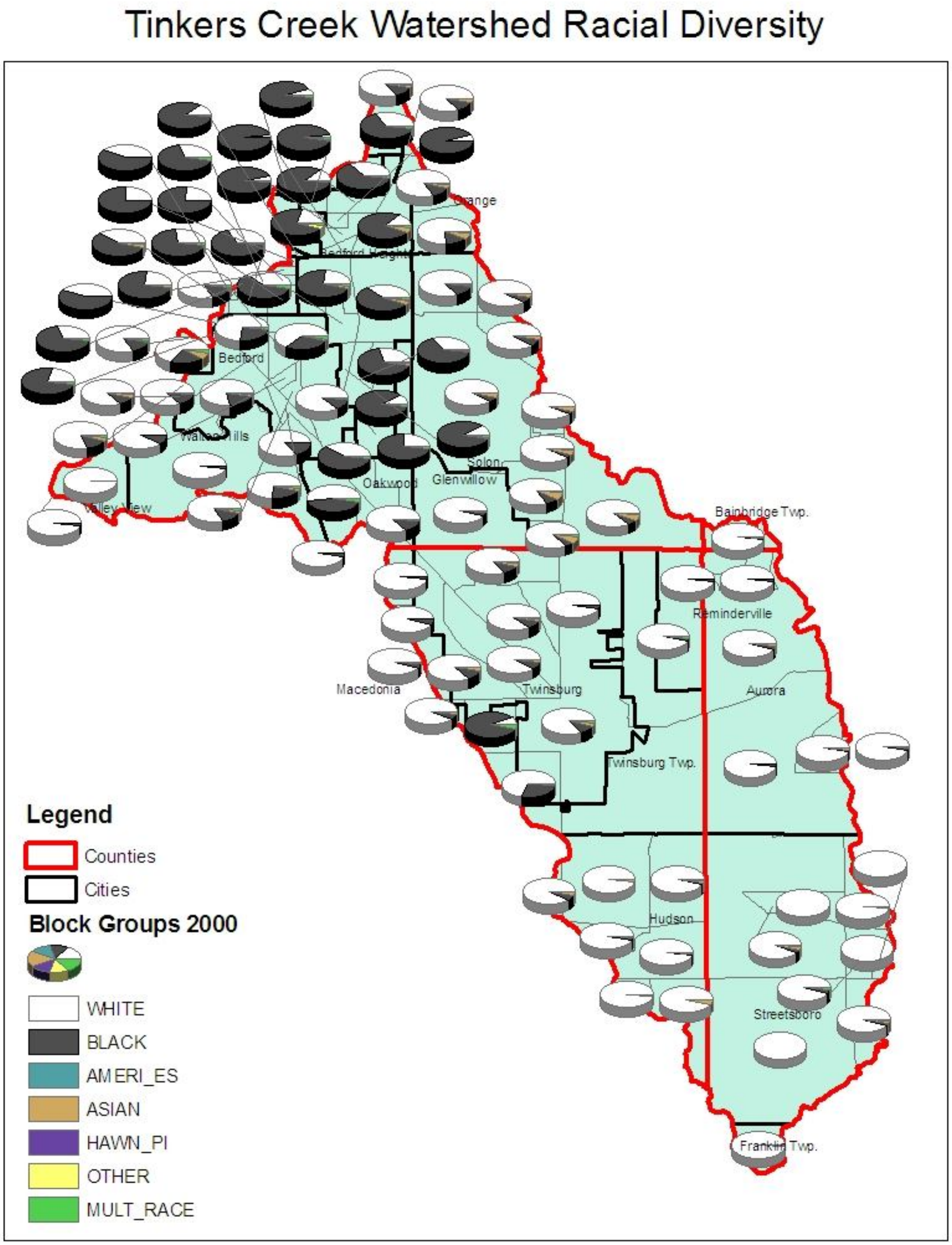


Figure 10: Tinkers Creek Watershed Racial Diversity Distribution

C. Geographic Locators

The USGS Hydrologic Unit Codes *(HUC)* for Tinkers Creek are:

04110002-050-030-Tinkers Creek headwaters to above Pond Brook
Subarea= 15,935 Acres

04110002-050-040-Pond Brook
Subarea= 10,179 Acres

04110002-050-050-Tinkers Creek below Pond Brook to Cuyahoga River
Subarea= 35,401 Acres

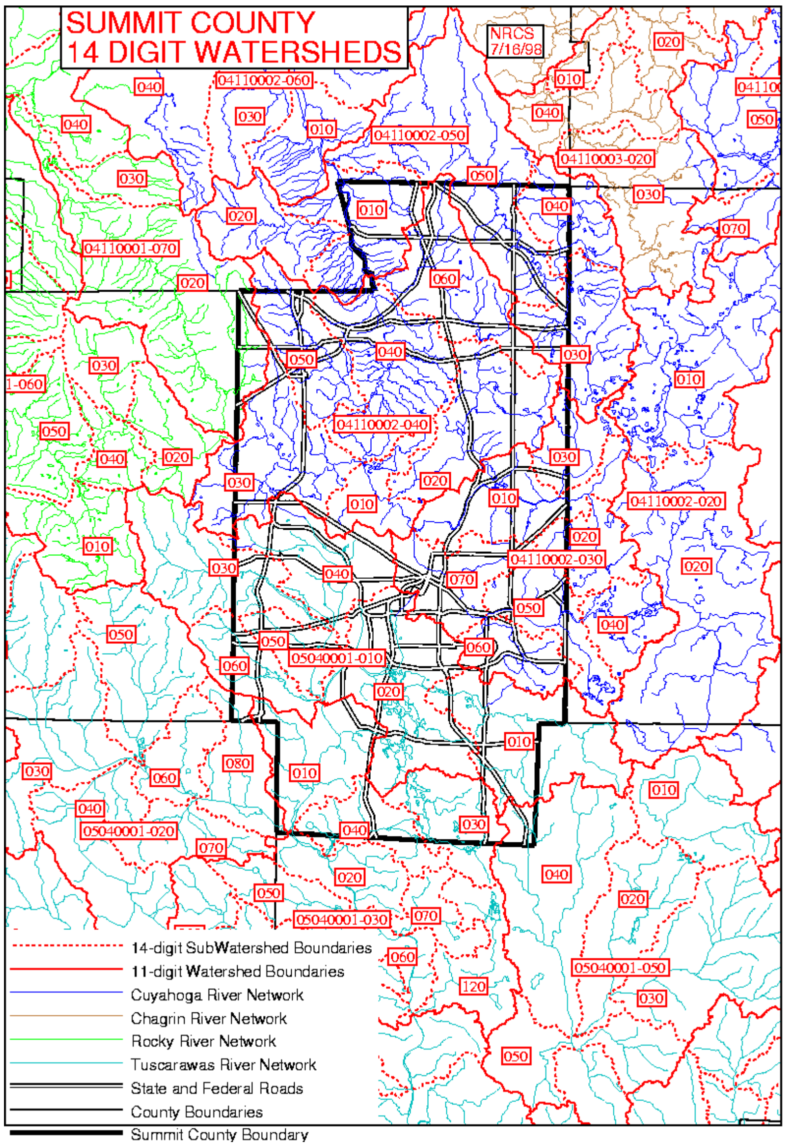


Figure 11: Tinkers Creek 14 Digit- HUC Code 04110002-050-040

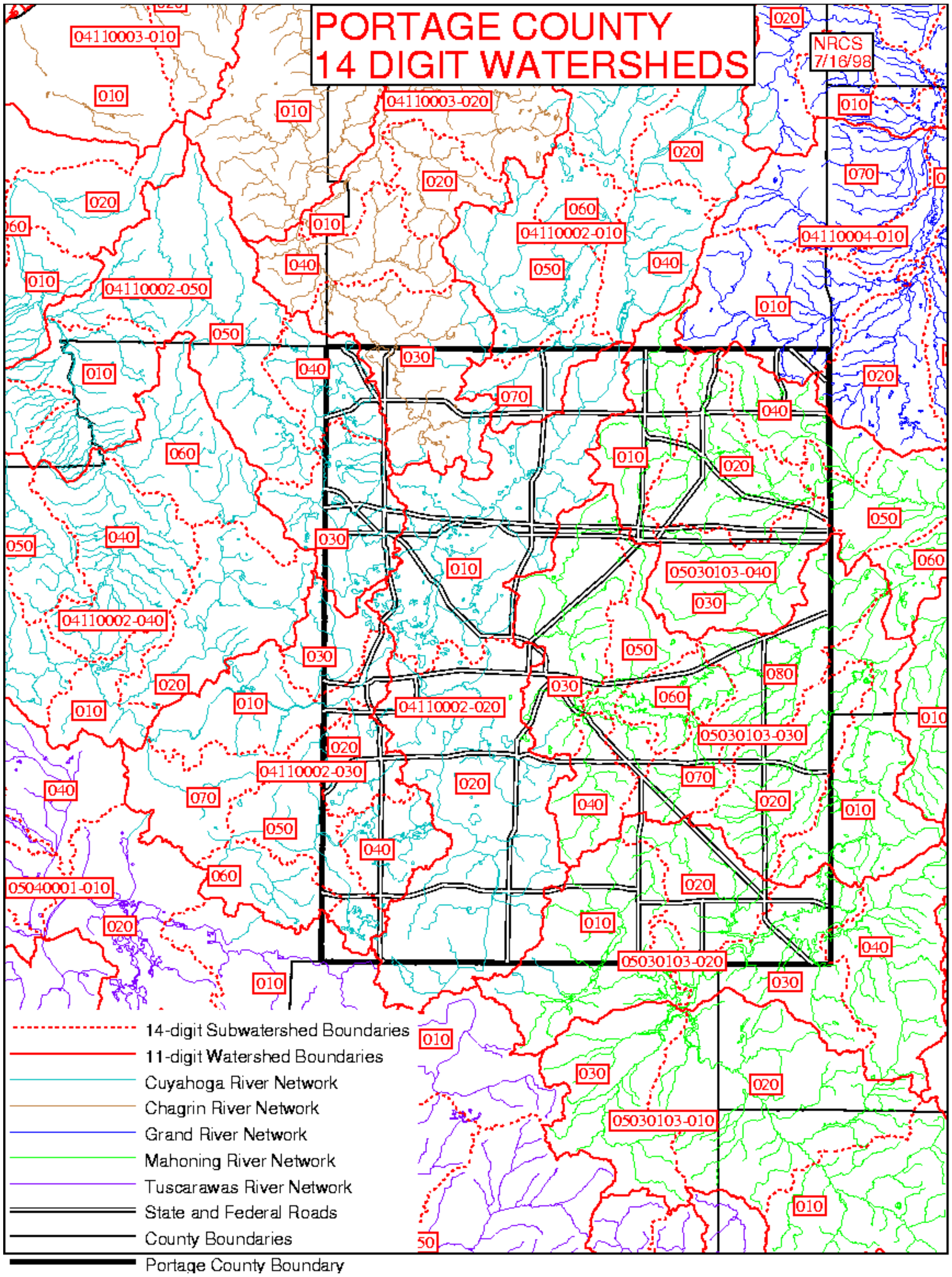


Figure 12: Tinkers Creek 14 Digit-HUC Code 04110002-050-030

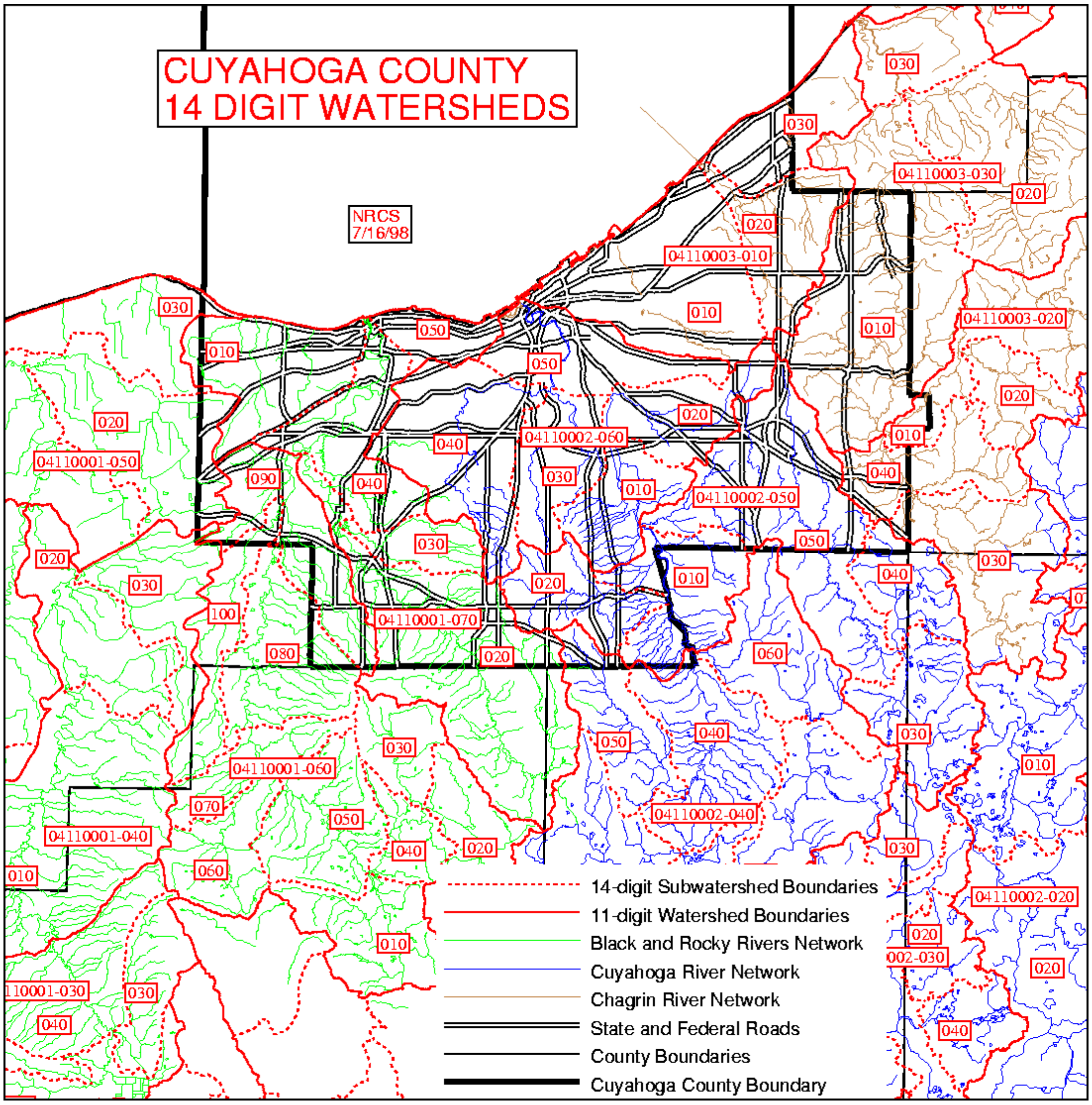


Figure 13: Tinkers Creek 14 Digit- HUC Code 04110002-050-050

Tinkers Creek has also been identified by 305(b) numbers. The water body sheet is as follows:

Ohio EPA 2008 Integrated Report Section M2
Watershed Assessment Unit (WAU) Results

HUC11	WAU Description	WAU Size (mi^2): 138.1
04110002 050	Cuyahoga River (downstream Brandywine Cr. to downstream Tinkers Cr.); excluding Cuyahoga R. mainstem	

Integrated Report Assessment Category: 5 **Priority Points: 6**

Next Scheduled Monitoring: 2020

Aquatic Life Use Assessment

Subcategories of ALU: WWH,MWH-C,LRW Sampling Year(s): 2000

Impairment: Yes (5)

Stream Size Category	Raw Data: Data Available	Raw Data: No. Attaining	% Attainment: Full	% Attainment: Partial	% Attainment: Non	WAU Score: Full	WAU Score: Partial	WAU Score: Non
Secondary Tributaries < 5 mi^2	12 Site(s)	5 Site(s)						
Primary Tributaries 5-20 mi^2	8 Site(s)	3 Site(s)	39.6	18.8	41.6	20	27	53
20-50 mi^2	Site(s)	Site(s)						
Principal Streams 50-500 mi^2	5 Site(s) 22.5 Miles	0.0 Miles	0.00	35.6	64.4			

High Magnitude Causes	High Magnitude Sources
Cause Unknown	Major Municipal Point Sources
Nutrients	Land Development/Suburbanization
Organic Enrichment/DO	Urban Runoff/Storm Sewers (NPS)
Flow Alteration	Onsite Wastewater Systems (Septic Tanks)
Direct Habitat Alterations	Natural
Oil and Grease	Source Unknown
Natural Limits (Wetlands)	

Recreation Use Assessment

Subcategory of Use: Primary Contact

Impairment: Yes (5) Cause: Pathogens Geometric Mean: 412

No. Ambient Sites: 0 No. Ambient Sampling Records: 0 75^{th} %ile: 900

No. of NPDES MOR Sites: 7 No. of NPDES MOR Records: 478 90^{th} %ile: 2210

Other:

Public Drinking Water Supply Assessment

Location(s): No Public Drinking Water Supply Intakes

Impairment: Nitrate Indicator:

Cause: Pesticide Indicator:

Fish Tissue Assessment

Waters Sampled: Yes Impairment: Yes (5)

Stream Miles Monitored: 11.20 Stream Miles Impaired: 11.20 Pollutants (Waterbody): PCBs (Tinkers Creek)

Lake Acres Monitored: 0.0 Lake Acres Impaired:

WAU Comments

A report developing TMDLs for pollutants impairing beneficial uses (aquatic life and recreation) in the lower Cuyahoga River basin including the Cuyahoga River mainstem reach was approved by U.S. EPA on September 26, 2003. Monitoring in support of the TMDLs was conducted in 1996, 1999, and 2000. The TMDL report is available at http://www.epa.state.oh.us/dsw/tmdl/index.html. The 2006 Integrated Report assessment of available fish tissue data from Tinkers Creek documented body burdens of one or more pollutants at levels exceeding the threshold level upon which Ohio Water Quality Standards human health criteria are based which resulted in listing as impaired for fish consumption.

M2- 83 3/28/2008

Figure 14: Tinkers Creek 305(b) sheet

D. General Watershed Information

History of Tinkers Creek Watershed

Prior to 1786 Ottawa Indians inhabited the watershed area, specifically along the ridges adjacent to Tinkers Creek Rd. in Walton Hills and Valley View. However, as settler encroachment and the westward expansion ensued, those Ottawa settlements disappeared. Shortly thereafter, a Moravian mission established itself. The pilgrims called it Pilgerruh or "Pilgrims Rest." In 1797 the Connecticut Western Reserve Land Company began to survey the land. A gentleman named Moses Cleaveland lead the survey crew along with a Principal Boatman named Joseph Tinker. Because no convenient communication technology existed then, all documents and recordings were meant to be hand delivered. On a journey back to Connecticut, Joseph Tinker drowned in a boating accident. Out of homage to him and his dedicated work, Pilgerruh was renamed Tinkers Creek. Since that time, Tinkers Creek has been rapidly developing both residentially and commercially. Water quality has seen a steady decline and much of the riparian area of its headwater tributary system is either in pipes or virtually contains no riparian cover.

Other Watershed Management Activities

Lower Cuyahoga River TMDL *(Total Maximum Daily Load)* Study

The Ohio EPA has completed a TMDL for the Lower Cuyahoga River basin and released its data in 2004. TMDL's are considered a snapshot of the condition of the watershed in which the study is conducted. The conclusions of TMDL's provide us with an opportunity to understand the water quality of the river/stream and what pollutants are fueling the non-attainment status for EPA water quality standards. TMDL's are an invaluable tool used in watershed management to understand water quality impairments and what are the possible sources of those pollutants. These studies determine how much of a pollutant needs to be removed from the system in order to achieve WWH water quality status.

Within the Tinkers Creek Watershed portion of the TMDL, several water quality issues have been indicated. Sedimentation, organic enrichment, low in-stream dissolved oxygen, nutrient enrichment, toxicity, habitat alteration, and yet unknown impairments are considered the main water quality issues facing Tinkers Creek. These unknown impairments could be contributed to the seven WWTP's which discharge into the stream. Elevated pharmaceutical levels are found within the Tinkers Creek waters and are being studied to find the connection between species diversity and QHEI scores.

Many of the actions contained within this plan focus on addressing these water quality impairments included within the TMDL report. However, reducing phosphorus loadings will require political elements to be considered as significant phosphorus loading occurs because of the WWTP effluent discharges.

Tinkers Creek Watershed Plan
(Tinkers Creek Watershed Land Conservation Priority Plan, Kerr+Boron Associates, Inc.)

The Tinkers Creek Land Conservancy, prior to merging with the Western Reserve Land Conservancy, commissioned Kerr+Boron to develop a priority parcel land acquisition/preservation study to determine where the most significant land features are in the Tinkers Creek Watershed. Within this study, much information has been researched including basic geographical features, land use, demographics, and watershed influences. The study contains information which helps to "paint a picture" in conjunction with the TMDL as to sources of non-point source pollution. This study will be integrated into the Tinkers Creek action items.

Tinkers Creek Stressor Study

The Ohio EPA in conjunction with USGS and the local communities with discharging WWTP's to Tinkers Creek have partnered to study the impact of effluent outputs from the plants to Tinkers Creek. Because Tinkers Creek has seven WWTP's within its drainage basin, it makes the watershed a unique study area for the impact of pharmaceuticals on aquatic species and biological diversity. The data is currently being analyzed and will provide insight into a growing issue which many water bodies will ultimately face. The study focuses on why fish populations are steadily decreasing while QHEI scores remain relatively stable. The increase of pill usage and a growing population makes this study and future studies even more important to water quality initiatives.

Tinkers Creek Watershed Comprehensive Wetland Assessment and Prioritization Plan for 2007/2008

The Tinkers Creek Watershed Partners were awarded a grant from the U.S. EPA to perform a study to assign an economic value of the wetlands within the watershed. The focus of this study is to provide an even playing field while making decisions to impact remaining wetlands within the watershed. Because most decisions are based on the "bottom line" and wetlands to most decision makers have no "value", this report sought to demonstrate the antithesis of that mindset. Using the economic valuation of these wetland resources offer a tool to use as a conservation technique when decisions at the local level are made regarding filling and impacts to the wetland. Valuation calculations include direct/indirect functions, non/personal use values, hedonic values, and how much money it would cost to engineer a storm water detention basin to perform the same function as the free resource. This study has been and will be used to further support the Watershed Action Plan and its action items.

II. Watershed Plan Development

A. Watershed Partners

Watershed Residents & Landowners

The Tinkers Creek Watershed Partners have garnered a modest watershed resident membership base. Currently, we have 65 members and this figure continues to grow. The group currently has a scaled membership fee ranging from $10 for an individual membership to $500 for a watershed steward membership. Each membership level consists of receiving different items such as a quarterly newsletter, a window decal and a mug or shirt depending on the level of commitment. The membership is yearly.

Local Businesses/Industries & Regulated Community

The Watershed Partners have also been reaching out for local community support in the business sector. Currently, EMH&T, Enviroscience, Stantec, Partners Environmental, Biohabitats, the Summit County Health District, and the Cuyahoga county Board of Health are our business and regulatory partners. These entities have worked with the organization either through grant writing processes or by participating in the 2008 Northeast Ohio Stormwater Conference. If any of our business partners would like presentations on watershed management, stormwater issues, BMP's, sustainability, recycling, and stewardship, the Watershed Partners provide those presentations to employees, owners, regulators, and others.

Local & State Government Agencies

The Tinkers Creek Watershed is comprised of 24 independent political jurisdictions. Some of these jurisdictions border other watersheds with active groups. The Partners have an agreement with the Chagrin River Watershed Partners to not delve into those communities to assist with watershed related work. Currently, the group has 15 dues paying member communities. They are: Beachwood, Bedford, Bedford Heights, Glenwillow, Highland Hills, Macedonia, Maple Heights, Northfield, North Randall, Oakwood, Reminderville, Streetsboro, Twinsburg, Valley View, and Walton Hills. The Watershed Partners offer similar services to these communities as we do to the business members. However, we often assist the community with satisfying PIPE requirements by performing litter/stream clean-ups, give presentations on the watershed and environmental related issues, and good housekeeping strategies. As the group continues to grow, we will be able to expand our services and combine the ever-important role of public health into the services and discussions with our member communities. In addition, the group serves as the liaison between the communities and the regulatory agencies regarding water quantity/quality issues. Often, letters of concern are sent to the regulatory agency in an effort to provide support for minimizing natural resource loss from development.

Nongovernmental Organizations

The Watershed Partners have collaborated with other organizations through co-presenting at symposiums, and offering support for grant writing techniques and letters of support for projects. Some examples include the Countrywide Program from Cleveland State University, First Energy on a stream restoration project, and recently the Friends of Big Creek Wetland Symposium.

Community Organizations

The Watershed Partners are in the process of beginning to provide educational speaking engagements to home owners associations and other community organizations about watershed stewardship and environmental health. The group has already given presentations to the Twinsburg Rotary Club and Garden Club, and the Kent Lion's Club. Further, the group understands that within the last few years environmental information is finally becoming mainstream. With the media sensationalizing catastrophic weather events, higher gas prices, the controversial topic of global climate change, flooding, economic downturns due to finite resources, and the renewed interest in becoming a self-sustaining society has created endless opportunities to partner and become "experts" on these types of issues. Partnering with community organizations to further sound environmental practices will be crucial to making strides in the watershed toward increases in water quality. In addition, these organizations can help make the connection between public health, environmental health, and economic stability.

Educational Institutions or Educators

The Tinkers Creek Watershed Partners find it vital to the sustainability and credibility of the organization to work with educational institutions to create partnerships for funding opportunities for projects, to assist in classroom education, and create future opportunities to further the group and its mission. We have elected an instructor from the Cuyahoga County Community College (Tri-C) to the Board, as well as, Board members who have educational backgrounds. The group has given several presentations to AP science classes on the impacts of storm water, climate change, and the built environment toward watershed management. In addition, the group has also been a guest speaker twice for the Ohio State University School of Natural Resources Honors program discussing how human decision making has influenced environmental health and watershed management. The Economic Wetland Valuation study also partnered with Auburn University by using some existing models to focus on natural resource valuation techniques. The Watershed Partners have also partnered with Tri-C Eastern Campus to host the 2008 Northeast Ohio Stormwater Conference. The group will continue to partner with educational institutions both in and outside of the watershed to work on projects, group sustainability, and most importantly educating the public.

B. Mission Statement

Mission:

To increase awareness and build support for the preservation and improvement of water quality, land use and habitat value throughout the Tinkers Creek Watershed by offering technical, educational and NPDES assistance to the communities that use and depend upon the wellbeing of their natural resource.

Goals:

Improve the appreciation and understanding, to community officials, regarding the natural and monetary value of protecting their water resources.

Promote low-impact and conservation development practices that demonstrate the tenuous balance between environmental integrity and human progression.

Educate watershed communities about the daily activities and habits that individuals perform which negatively impact their surrounding natural environment and provide alternative approaches to those practices.

Encourage a "no-net-loss" wetland mitigation policy where mitigation remains localized within the watershed rather than "outsourced" to other counties.

Lead a watershed based approach to decision making which advances the concept of connectivity between the different political jurisdictions within the watershed.

Increase recreational opportunities by connecting greenways, corridors, and bike-paths between the different jurisdictions within the watershed.

C. Organizational Structure

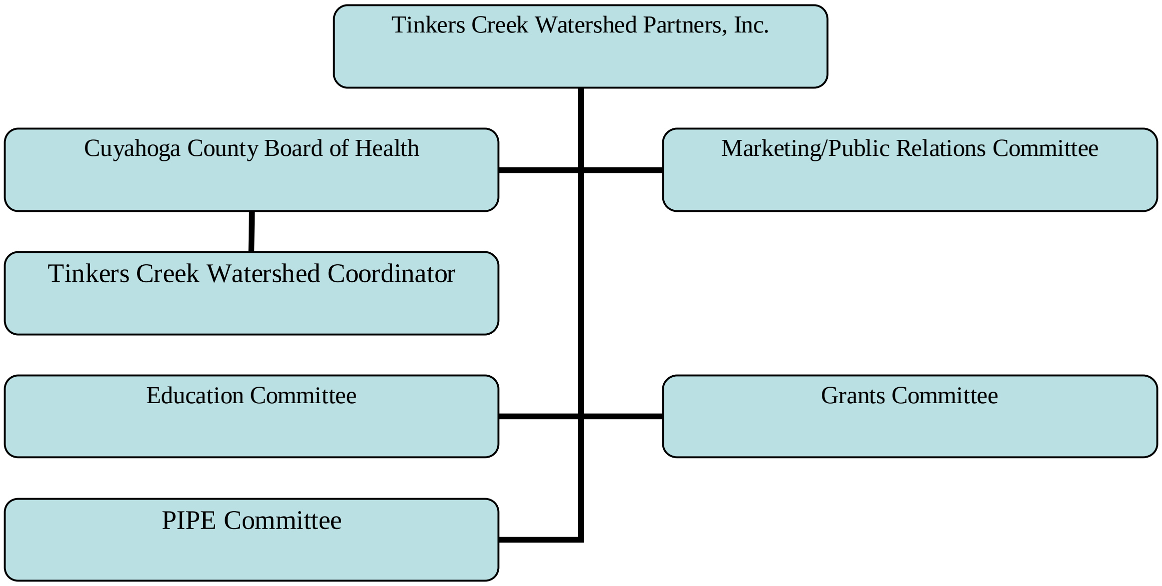


Figure 15: Tinkers Creek Organizational Structure

The Watershed Coordinator for the Tinkers Creek Watershed Partners is housed at the Cuyahoga County Board of Health. The Watershed coordinator takes direction directly from the Board of Directors from the Watershed Partners. The Coordinator takes specific orders from the supervisor and management at the Board of Health. Therefore, the Coordinator is managed by the Board of Health but functions as the "face" of the Watershed Partners and performs the functions set forth by the Watershed group. The group has a Chair, Co-Chair, Secretary, and Treasurer, as well as, a total of 15 Board members. The group consists of three subcommittees which meet bi-monthly to discuss progress of their committee focus. In addition, the Board meets quarterly and discusses the direction of the group.

Legal Status

The Tinkers Creek Watershed Partners are a 501c3 non-profit, tax exempt organization.

Partner Roles & Responsibilities Defined

The Tinkers Creek Watershed Partners act as the non-profit educational and advocacy group to the communities in the watershed. It is the goal of the organization to provide educational presentations, outreach activities, programs, and stances on environmental issues which impact water quality and the health of the stream and its residents. The group will act as a liaison between the community and federal/state entities to support the communities stand on issues pertaining to the environment.

The Cuyahoga County Board of Health (CCBH) acts as the house for the Watershed Coordinator and provides administrative support to the group. Recently, the two entities have been focusing on separating their roles and defining the term “support”. Further, CCBH will continue to provide printing, postage, GIS, and volunteer assistance to the Watershed Partners. Also, CCBH has written grant proposals for implementation projects within the watershed and will continue that collaboration when opportunities arise.

The Ohio EPA NEDO provides valuable assistance to the Watershed Partners through technical support and regulatory guidance. The Watershed Partners will continue to receive data and scientific support to bolster implementation strategies and overall Watershed Management activities.

The Portage, Summit, and Cuyahoga County Soil Water Conservation Districts continue to assist the Watershed Partners in providing technical data to the group to help develop sound Watershed Management techniques, as well as, assist in providing educational outreach opportunities to the communities within each entities jurisdictions.

Operational Procedures & Bylaws

The Tinkers Creek Watershed Partners (TCWP) operates as an independent entity from the CCBH which houses the Watershed Coordinator. Group functions and activities are based upon discussion and inclusion into the decision making process. Often, volunteer organizations exclude volunteers who do not or can not afford time to be more involved. The TCWP find that including personnel into all group activities, functions, and communication provides the best scenario for cohesiveness and interest in group functions.

Because of having an all volunteer Board, life often creates change which disallows a Board member to participate. Sometimes Board members will continue to serve but only in a guidance fashion. Others may be able to participate more extensively and give more time. Sometimes Board members will resign and the need to fill those positions arises. From the beginning of the organization, the group has sought to find members who could provide professional backgrounds and expertise to the group. As this is still an evolving process, new members will be added as term limits and resignations occur.

Group Decision Making Process

Decision making within the Watershed Partners organization consists of a majority vote. The voting initiatives can be conducted either at a Board meeting or by an email vote with a majority vote being the decision maker. The 15 member Board of Directors provide input and insight into decision making functions. The odd number of Directors is meant to provide a tie-breaking vote if necessary. Decisions are made based upon the economic sustainability of the organization, public relations, educational components, time commitment, and most importantly the benefit to Tinkers Creek. Recently, another factor has been discussed and is beginning to be included within these decision making parameters which is the role public health has in the organizations mission. Making the connections between educating the public about environmental stewardship and how the health of the environment will impact them and future generations is something the group will continue to focus on in the future.

Contact Information

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Tinkers Creek Watershed Partners
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Email: mmcnutt@ccbh.net
Website: www.tinkerscreekwatershed.org

Because the Watershed Coordinator is housed at the Cuyahoga County Board of Health another address can be used to exchange information:

Cuyahoga County Board of Health
c/o Mike McNutt
5550 Venture Dr.
Parma, OH 44130

In addition, the current list of current Board members is as follows:

Chair: Chris Hartman
Co-Chair: Harry Stark
Secretary: Lisa Perry
Treasurer: Justin Czekaij
Lou Raficci: Board Member
Stacey Yanetta: Board Member
Carla Regener: Board Member
Sandy Barbic: Board Member
Charlie Uray Jr.: Board Member
Ted Marten: Board Member
Jeff Pritchard: Board Member
Chris Vild: Board Member
Marlene Anielski: Board Member
Mershona Parshall: Board Member

D. General Plan Contents

The Tinkers Creek Watershed Action Plan provides a snapshot of the “State of the Watershed” by utilizing ODNR Appendix 8 guidelines. This plan discusses watershed impairment problems described in the Lower Cuyahoga TMDL and focuses on realistic problem solving strategies which will provide opportunities to initiate implementation projects to restore habitat, stream function, and water quality to the watershed. These strategies not only include actual implementation projects, but will also employ an aggressive educational campaign to instill the need to have the health of the watershed involved within the local decision making processes regarding development and redevelopment.

Outline of Plan

Watershed Inventory: A description of the geological, environmental, social, cultural, land use, and biological influences that have both historically occurred and may occur within the Tinkers Creek Watershed. In addition, the inventory will provide a background of previous decision making and thus provide a template to follow when addressing future problem solving within the watershed. The watershed has been divided into 13 sub-watersheds which will assist in strategizing restoration opportunities. These opportunities will vary depending upon imperviousness, available land use opportunities, local participation, conservation willingness, and educational awareness.

Impairments

The information provided in this section will assist in determining the problems facing the Tinkers Creek Watershed regarding water quality, habitat degradation, beneficial use impairments, recreational opportunities, and other environmental concerns. The Lower Cuyahoga TMDL will be used to provide data within this section, in addition to, the Kerr + Boron Land Use Study.

Water Restoration and Protection Goals

Realistic goals and strategies to improve water quality within the Tinkers Creek Watershed will be discussed within this section. These strategies will focus on the impairments and issues from studies performed within the watershed. In addition, the role of public health within these restoration goals cannot be under stated. The future of watershed management must incorporate the additional function of how public health and environmental health need to coexist both within restoration and future development/redevelopment strategies.

Implementation

This section focuses on how to perform the goals set forth within this plan.

Endorsement of Plan by Key Watershed Partners

The definition of key watershed partner’s means acceptance from the Ohio EPA, ODNR, the SWCD’s within the watershed, land conservancy groups, other non-profit organizations, and other sources of funding for implementation of the goals and strategies set forth within this plan.

Adoption of Plan by Local Units of Government

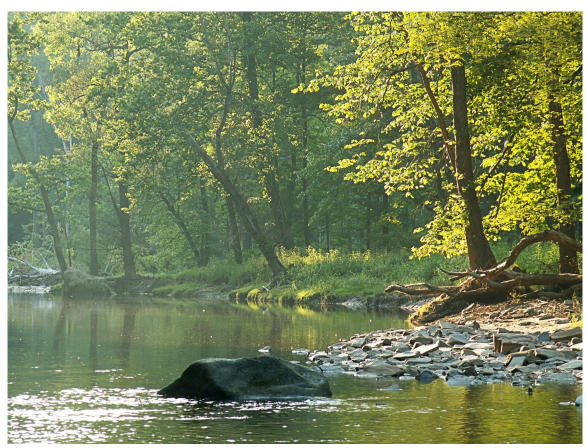
This plan will be presented to local governments after an initial review by the Ohio EPA and ODNR. Public meetings will be held to garner local input to the buy-in process this plan needs to become adopted. All 24 communities within the watershed will be asked to participate in this planning process. Highlights of the issues facing the watershed and the corresponding implementation strategies will be presented to gain local insight into focusing this plan toward acceptance at the local level. As environmental concerns increase, the economy taking a down turn, and the concept of sustainability becoming more important to the economic viability of the watershed, watershed management and the economic benefit of natural resources will become more important than in any time in history. This plan will be used to accelerate the process of making the leap toward combining human and environmental health into future decision making processes.

Information/Education Component for Public Understanding and Encourage Early and Continued Participation in the Plan

As stated within this plan, aggressive educational efforts will be needed to alter an ideological mindset that exists within the watershed. For too long, decision making has been based around controlling nature rather than coexisting with it. Because of the recent media attention given to global environmental issues, this educational process will focus upon how those global issues are impacting the watershed communities, governments, and residents. To be successful, this plan will need to include all relevant stakeholders as the implementation phase begins to take shape. Additional participation will be needed as the plan moves toward endorsement and use.

III. Watershed Inventory

Introduction



In order to solve problems one must look to the past to establish a foundation of what has transpired, if the problem is reoccurring, and what, if any, measures have been taken to solve the issue at hand. Northeast Ohio was once a booming manufacturing hub where both men and women worked with their hands to build and create steel, cars, engines, paint, mine salt, and transport those materials nationally and abroad. Little, if any, attention was given to the broader implications of those actions toward the environment. While Cleveland and the surrounding region were critically important to manufacturing and the production of goods and services the concept of sustainability was not invented. Booming economic viability took center stage in this region since the 1800's. Only within the last 40 years has this region seen an exponential decline from its once prosperous heyday.

Since those times, Cleveland has become a dying City where those manufacturing jobs have been sent across borders leaving a decaying infrastructure and no direction for the future. Because of the historic practices of times past, the natural resources in Northeast Ohio have paid a high price. The most visible being the Cuyahoga River catching fire on several occasions. Clearly, most urbanized streams in Northeast Ohio are polluted with man made products or man made influences. Tinkers Creek is no exception. However, since 1969, the last time the Cuyahoga caught on fire, significant steps toward environmental stewardship have been and are being discussed; the most significant being the creation and adoption of the Clean Water Act in 1972.

Current trends are demonstrating that the public and political factions of Northeast Ohio hold natural resources and the accessibility to those resources in high regard. This inventory section will look at the different facets of the Tinkers Creek Watershed including biological, cultural, chemical, and the physical characteristics that comprise this tributary to the Cuyahoga River. As discussed in earlier sections, the connection between environmental health and public health cannot continue to be overlooked. If we are to sustain our communities for the future, environmental health must be a high priority in all decision making processes. The idea that "Clean water makes a health community" is quite relevant to watershed management. Environmentalists are not just passionate advocates for the earth; they are becoming conduits to foster discussions about a much needed and urgent change that must commence for the future stability of our region and the global stability of the planet.

The following information will be used to provide a foundation to build upon by examining the past and current status of the Tinkers Creek Watershed in order to make sound judgments toward watershed restoration, educational, cultural, and water quality goals and to implement those goals to begin repairing the damage from past decisions and lifestyles.

A. Tinkers Creek General Watershed Description

Tinkers Creek main stem is approximately 30 miles in length and the watershed consists of 13 smaller tributary watersheds. 24 separate communities comprise the watershed and 4 different counties. The northern section of the watershed is highly urbanized while the middle is fairly sub-urban and the southern sections somewhat rural. The watershed drainage area is 96.4 square miles and the drainage pattern flows in several directions. Some small headwater tributaries flow south, while others flow north. Ultimately, the stream reaches its final destination in Valley View where it meets the Cuyahoga River. The watershed is nestled between the Cuyahoga and the Chagrin Rivers and is the largest tributary to the Cuyahoga River.

Elevations in the watershed vary, with the highest elevation point being 1200 feet above mean sea level, and the lowest elevation point lying at 620 feet above sea level, where Tinkers Creek flows into the Cuyahoga River. The watershed lies on a glaciated plateau, which consists predominantly of silty loam and clayey loam soils. Portions of the stream are on bedrock, which form waterfalls that act as a natural barrier to the passage of fish. The lower stream portions have carved the Tinkers Creek Gorge, which is listed as a National Natural Landmark within the National Park Service's program. (Source: Ohio EPA, Division of Surface Water), *(Source: Kerr + Boron (Tinkers Creek Watershed Conservation Priority Plan)*.

Because of global climate change, Tinkers Creek may experience an increase in growing seasons, increased rainfall amounts, increased cloudiness, and an influx of exotic species which will compete with local flora and fauna.

Geology of Tinkers Creek

Topography

Slopes vary greatly within the Tinkers Creek Watershed. They range from steep gorge areas where the river has cut its way down through the bedrock, to gentle slopes, flat areas, marshes and wetlands. Rock outcroppings exist in several areas. The pattern of slopes within the watershed is gentle, with the steepest gradients found along the stream banks, and where Tinkers Creek flows into the Cuyahoga River.

Deeply incised and steep slopes define the valleys and gorges nearer the confluence point, partially as result of increased downstream erosion, due to higher water flows Slopes are mapped using a scale that ranges from flat to steep. Steep slopes generally have the highest erosion potential from runoff, or from channel undercutting of the stream banks. Identifying the steepest slope areas that either would contribute to higher erosion potential or offer the most value for sensitive and unique habitats is a focus. For example, many portions of the middle Tinkers have steep slopes that create waterfalls and other unique topographic areas.

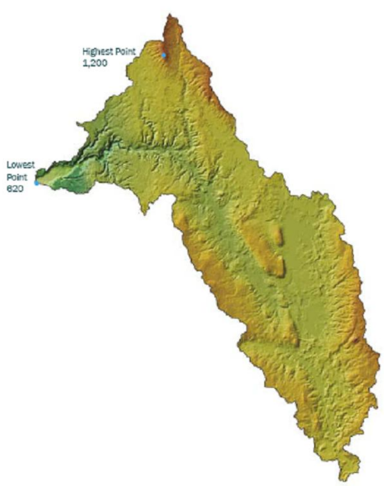


Figure 16: Tinkers Creek High/Low elevations Points

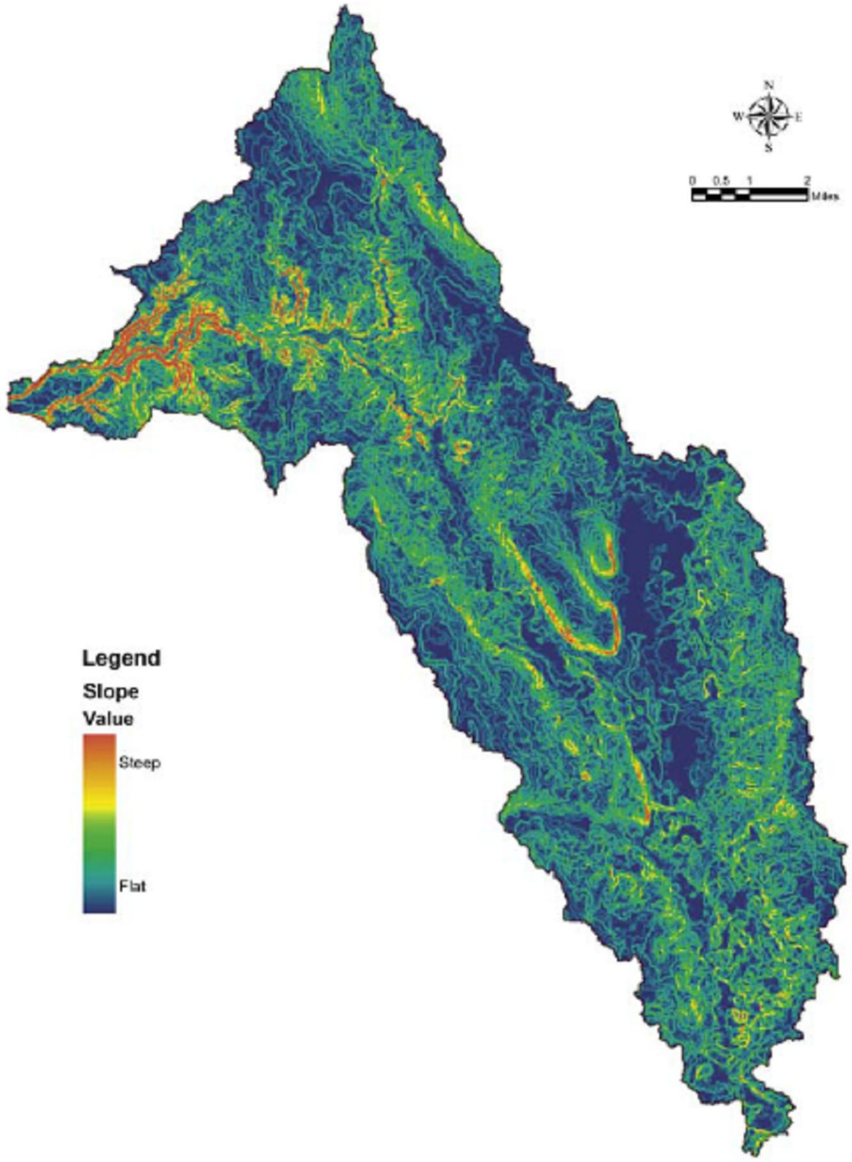


Figure 17: Tinkers Creek Slope Ranges

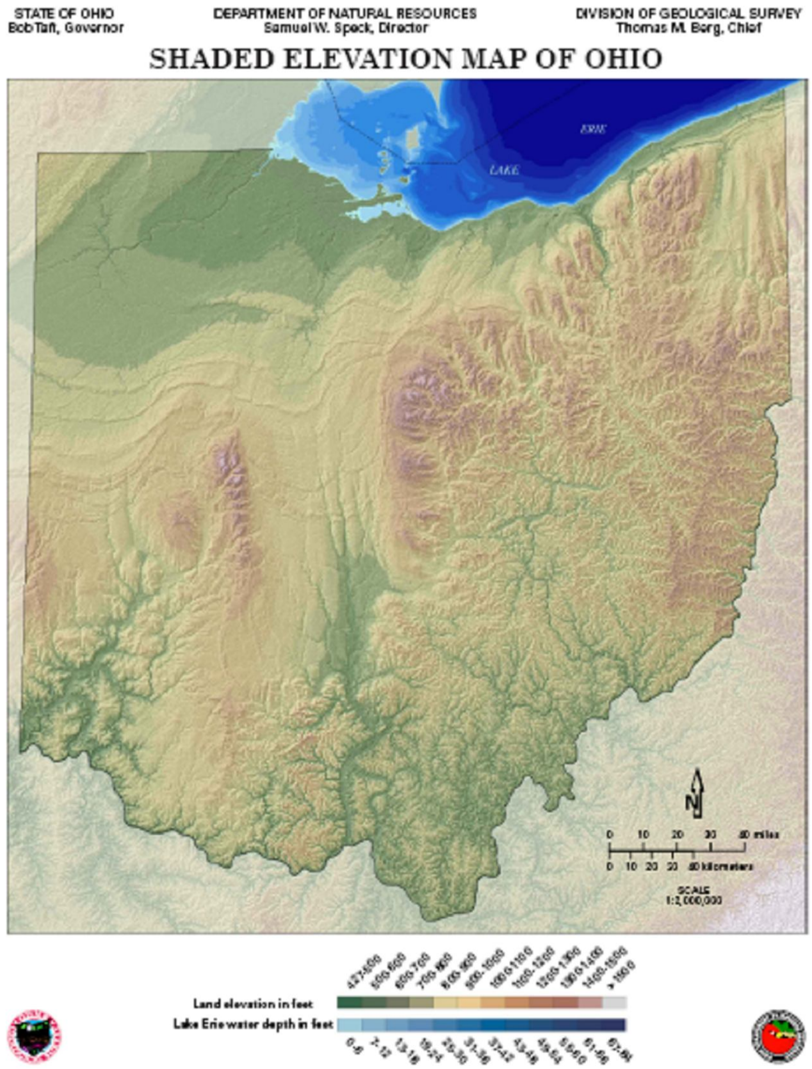


Figure 18: Ohio Elevation Map

Geologic Features

About 70,000 years ago, after a long, warm interglaciation following the Illinoian glaciation, ice once again began to build in northern Canada and slowly advance About 70,000 years ago, after a long, warm interglaciation following the Illinoian glaciation, ice once again began to build in northern Canada and slowly advance southward. This was the beginning of the last major glaciation in Ohio. By about 24,000 years ago, the Wisconsinan glacier reached Ohio and by about 18,000 years ago, the ice had reached its maximum southward extent, covering nearly two-thirds of the state. As the climate once again warmed, the Wisconsinan glacier began to melt and retreated northward, finally leaving Ohio about 14,000 years ago. Much of the landscape in the glaciated portion of Ohio is the result of the Wisconsinan glacier. Thick deposits of till, deposited as ground moraine, sand

and gravel outwash from the melting glacier along larger stream courses, lobate ridges or hills of till are recessional moraines, marking a pause of the retreating ice, and other features prominent in Ohio record the presence of this massive ice sheet only a few thousand years ago.

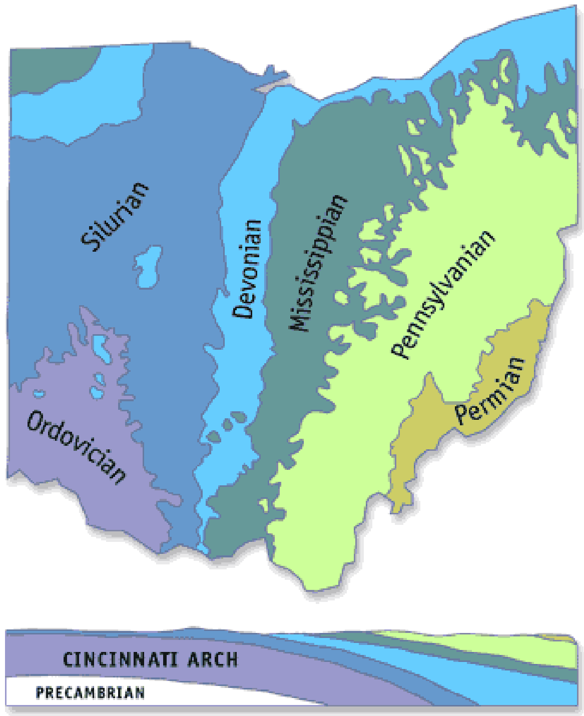


Figure 19: Geologic Map and Cross Section

The Lake Erie basin is underlain by Silurian and Devonian carbonates (limestone and dolomite) on the west and by Devonian shales on the east. The carbonate rocks are generally more resistant to erosion than are the shales; therefore, the western basin is comparatively shallow, averaging less than 25 feet in depth. Glacial ice was able to scoop out to a greater extent the less resistant shales underlying the central and eastern basins. The deepest point in Lake Erie is 210 feet in the eastern basin.

"The detailed history of the Lake Erie basin can be surmised only from the time of retreat of the last Pleistocene glacier, the Wisconsinan, about 14,000 years ago. It is probable that the basin was occupied by lakes as each of the three earlier ice sheets retreated, but geologists can only speculate on these events because the evidence was destroyed by the succeeding glaciers."

Tinkers Creek is located within the glaciated Appalachian plateau and has been carved by glaciers and ancient streams. This region is less hilly and lacks the rugged quality of the unglaciated landscape in southeastern Ohio. Following glaciation, many streams reversed their flow, cutting new paths throughout the region. Evidence of the region's glacial past includes bogs, kettle lakes, and a landscape marked by small hills of sand and gravel called "kames" Today, the area is marked by smaller tracts of forests, ranging from a few acres to hundreds of acres. Many of these characteristics are still visible, even in the highly developed regions in the Tinkers Creek basin such as Herrick, Beck and Gott Fen’s located in Portage County.

Soils

The composition and characteristics of soils within a watershed are important for their potential impacts on water quality. Soil properties related to this are their ability to store nutrients essential to plant growth, their erosion potential, permeability, that is, the soil's ability to allow precipitation to percolate into the ground and become part of the groundwater system, and for their hydric value.

Erosion Potential - K-factor

Soils within the watershed are classified and have been analyzed with respect to multiple attributes. One soil attribute that has been considered was the K-factor. The K-factor is defined as the soil's erosion potential, that is, how easily soil may be removed and transported away by natural processes such as water and wind.

The K-factor is based on the Universal Soil Loss Equation, and represents a relative index of bare, cultivated soil to erosion. The erosion potential of the soil is critical as eroded material or silt can be introduced into a stream as a component of runoff, clouding a stream, negatively impacting natural habitat, and impairing other stream functions. The potential for soil erosion is also a factor in the stream gradient, slopes and amount that a stream may incise its stream bed.

Hydric Soils

Soils defined as hydric have also identified within the watershed. Hydric soils are those that are typically found in wet or saturated environments, such as the edges of streams and rivers, or in wetlands. They support hydrophytic, or water adapted plant life. This type of vegetation provides shelter and habitat for aquatic organisms, and is part of a healthy riparian system.

Soil Class

Soils are also classified as being in one of four (4) groups which are also considered. The soil classes or groups are based upon hydrologic properties. Soils of the same group have similar runoff potential under similar storm and cover conditions. Soils in the United States are placed into four groups, A, B, C, and D, and three dual classes, A/D, B/D, and C/D. In the definitions of the classes, infiltration rate is the rate at which water enters the soil at the surface and is controlled by the surface conditions. Transmission rate is the rate at which water moves in the soil and is controlled by soil properties. Definitions of the classes are as follows:

Soil Class A - Low runoff potential soils Class A soils have a high infiltration rate even when thoroughly wetted. They chiefly consist of deep, well drained to excessively drained sands or gravels. They have a high rate of water transmission.

Soil Class B - Soils in this class have a moderate infiltration rate when thoroughly wetted. They are chiefly moderately deep to deep, moderately well drained to well drained soils that have moderately fine to moderately coarse textures. They have a moderate rate of water transmission.

Soil Class C - These soils have a slow infiltration rate when thoroughly wetted. They chiefly have a layer that impedes downward movement of water or have moderately fine to fine texture. They have a slow rate of water transmission.

Soil Class D - High runoff potential soils Class D soils have a very slow infiltration rate when thoroughly wetted. They chiefly consist of clay soils that have a high swelling potential, soils that have a permanent high water table, soils that have a clay pan or clay layer at or near the surface, and shallow soils over nearly impervious material. They have a very slow rate of water transmission.
From: U.S. Department of Agriculture, Natural Resources Conservation Service, 2002. National Soil Survey Handbook, title 430-VI. [Online] Available: http://soils.usda.gov/procedures/handbook/main.htm. (Source: Kerr + Boron (Tinkers Creek Watershed Conservation Priority Plan).

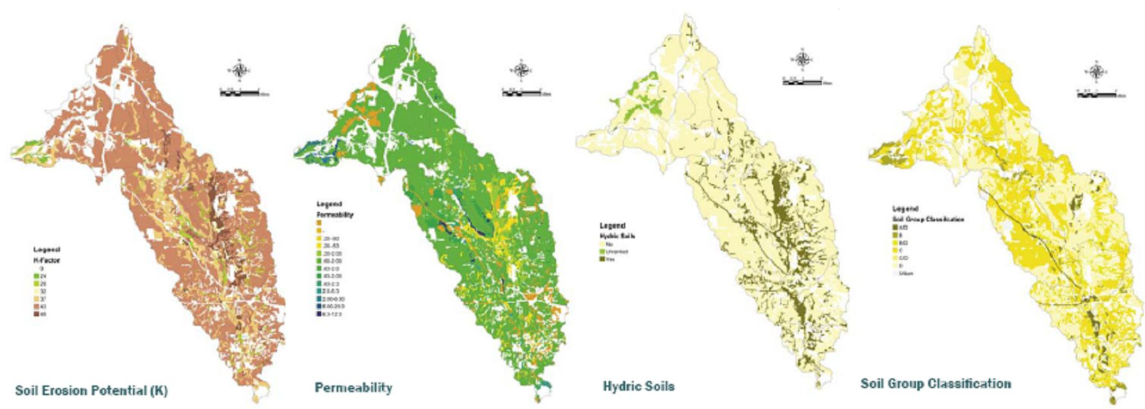


Figure 20: Soil Information of the Tinkers Creek Watershed

Tinkers Creek Watershed Soils

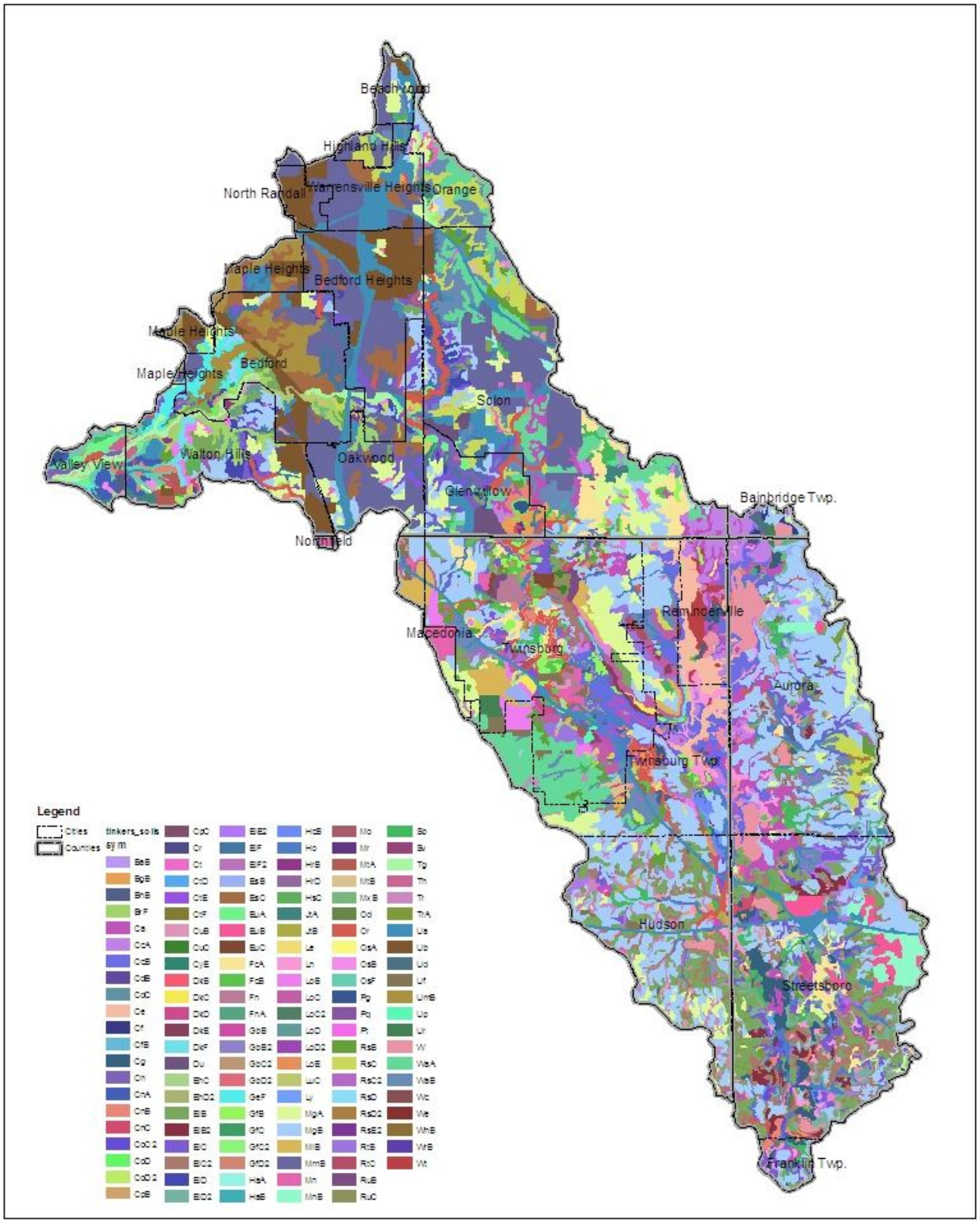


Figure 21: Tinkers Creek Soils

Glacial History

The majority of Tinker's Creek State Park is maintained in its original state as a swamp and marshland. These wetlands owe their existence to the glaciers that invaded Ohio during the Pleistocene Ice Age. Glacial features include moraines, kames and eskers. Moraines were formed when a glacier remained stationary for a long period of time leaving hills of boulders, sand and gravel. Kames are deposits of sand and gravel that fell through holes in the ice leaving circular hills. Eskers are deposits of sand and gravel that dropped through ice tunnels leaving long serpentine mounds. Many fine examples of these glacial features are found in the region.

This part of Ohio is known for the number of naturally occurring lakes. Huge blocks of ice broke free from the glaciers creating depressions which filled as the ice blocks melted. These are known as kettle lakes. Over the ensuing 10,000 years, these lakes have partially filled with sediment leaving boggy wetlands with unique assemblages of plants. Buttonbush, alder and swamp white oak are predominate (www.ohiodnr.com/parks/tinkers/tabid/793/Default.aspx).

Some features of the Tinkers Creek Watershed are a direct result of the glaciers that shaped Northeast Ohio. Beyond the Fens in Portage County, Twinsburg has rock outcroppings dating back to the Wisconsinan period. In addition, the scenic overlook owes itself to fine sediments which are highly erodible left behind from the glacier period. These sediments have allowed Tinkers Creek to slowly entrench itself in a gorge surrounded by cliffs and rock outcroppings.

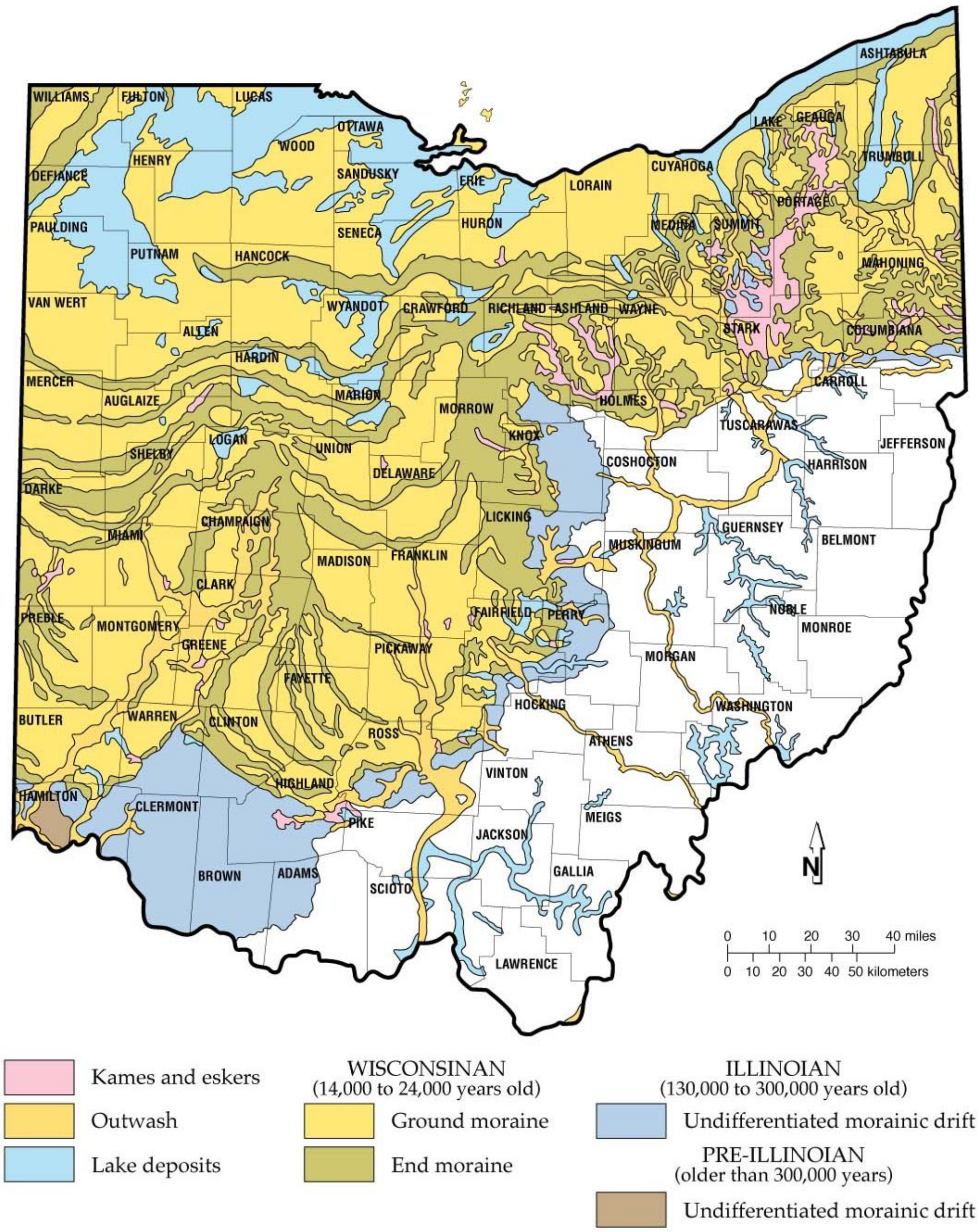


Figure 22: Ohio Glaciation History

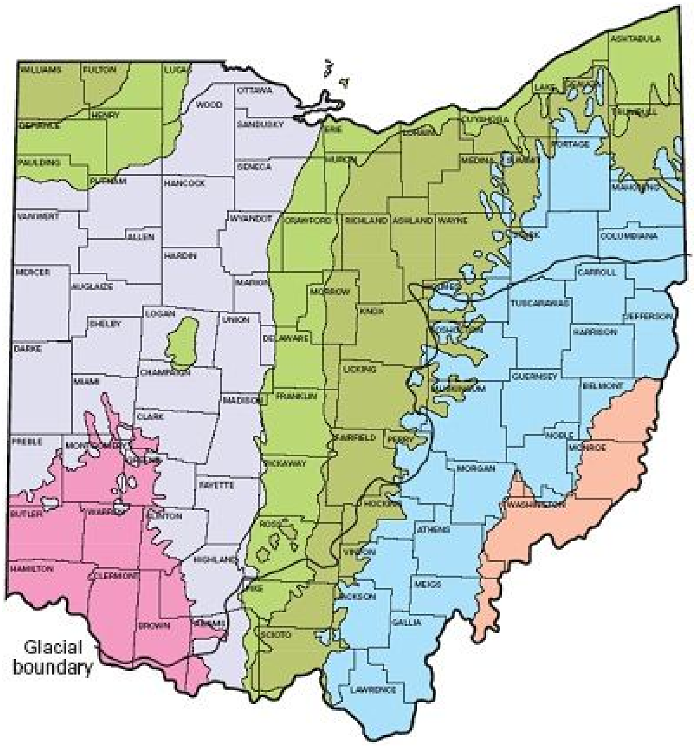


Figure 23: Ohio Bedrock Map

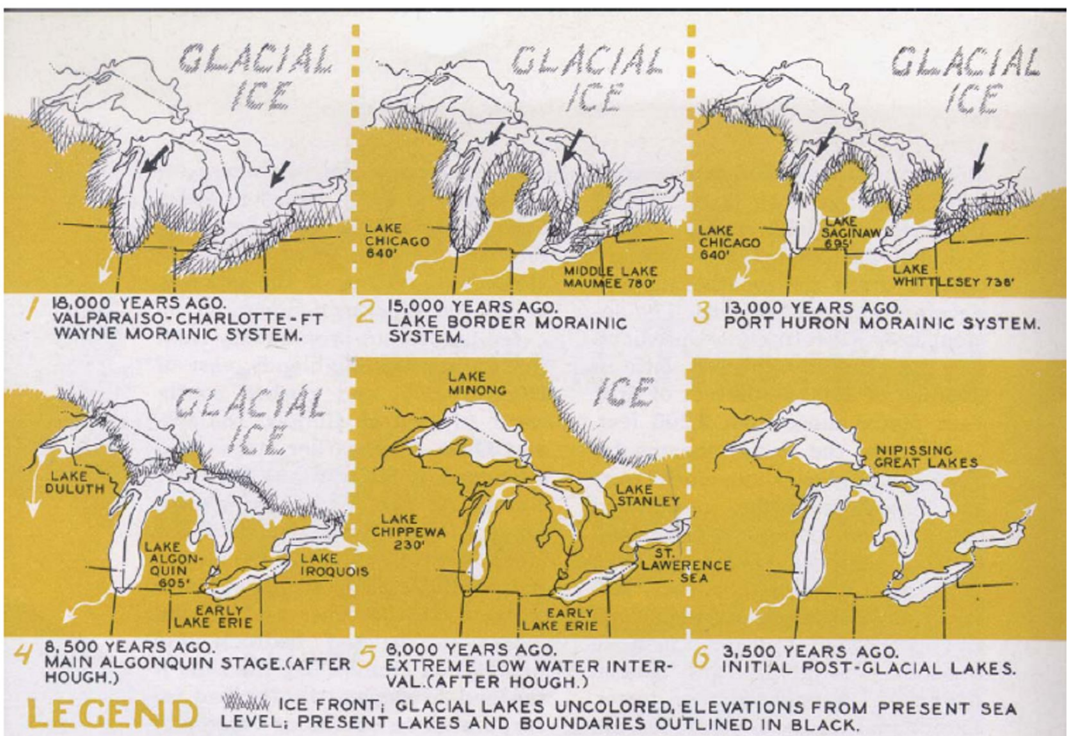


Figure 24: Advance and Retreat of Glacial Ice in the Great Lakes Basin

Source: Article originally published in *Michigan Conservation*, Special Great Lakes Issue, July-August 1960, Vol. XXIX, No. 4: Michigan Department of Conservation, Lansing, Michigan.

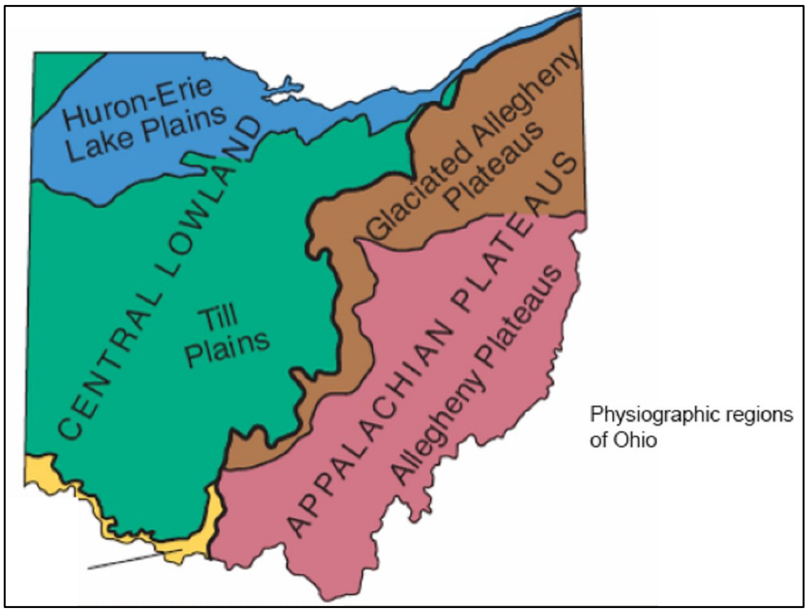
B. Biological Features

Landscape Types, Locations & Conditions

The physiographic features of the watershed are those characteristics related to both the topography and geology of the basin. The topography of the watershed relates to the physical properties and configuration of the land surface, including its relief and the position of natural and man-made features. Geology relates to the physical make-up of the earth's surface in relation to rocks and other inorganic material, and the study of the forms and structures that these materials make up.

Elevations in the watershed vary, with the highest elevation point being 1200 feet above mean sea level, and the lowest elevation point lying at 620 feet above sea level, where Tinkers Creek flows into the Cuyahoga River.

Figure 25: Physiographic regions of Ohio



Tinkers Creek is located within the Glaciated Appalachian Plateau physiographic region, which consists predominantly of silty loam and clayey loam soils. Portions of the stream are on bedrock, which form waterfalls that act as a natural barrier to the passage of fish. The lower stream portions have carved the Tinkers Creek Gorge, which is listed as a National Natural Landmark within the National Park Service's program. Carved by glaciers and ancient streams, this region is less hilly and lacks the rugged quality of the unglaciated landscape.

Rare & Endangered Species

The Natural Heritage Database, managed by the Division of Natural Areas & Preserves' Natural Heritage Program, was started in 1976. It now contains more than 17,000 records which represent known locations for Ohio's rare plants and animals, high quality plant communities and other natural features.

Ohio law grants authority to the chief of the Division of Wildlife to adopt rules restricting the taking or possession of native wildlife threatened with statewide extirpation and to develop and periodically update a list of endangered species (Ohio Revised Code 1531.25).

The first list of Ohio's endangered wildlife was adopted in 1974 and included 71 species. An extensive examination of the list is conducted every five years. During this process, the need for an additional state-list category was recognized and has been designated as "Special Interest." The name of the previous special interest category has been changed to "Species of Concern," but retains its original definition.

The Division uses six categories: endangered, threatened, species of concern, special interest, extirpated, and extinct, to further define the status of selected wildlife. These categories and the species contained within them are revised as our knowledge of the status of Ohio's wildlife evolves.

Currently there are 14 animals and 57 plants listed within the Tinkers Creek watershed, they are listed in the Tables 7 and 8 below. Only one animal, the Indiana Bat is also listed as federally endangered.

Scientific Name	Common Name	State Status	Federal Status
Catocala gracilis	Graceful Underwing	E	
Gomphaeschna furcillata	Harlequin Darner	T	
Chlidonias niger	Black Tern	E	
Myotis sodalis	Indiana Bat	E	FE
Clemmys guttata	Spotted Turtle	T	
Haliaeetus leucocephalus	Bald Eagle	T	
Condylura cristata	Star-nosed Mole	SC	
Etheostoma exile	Iowa Darter	SC	
Hemidactylium scutatum	Four-toed Salamander	SC	
Liochlorophis vernalis	Smooth Green Snake	SC	
Porzana carolina	Sora	SC	
Rallus limicola	Virginia Rail	SC	
Gallinago gallinago	Common Snipe	SI	
Troglodytes troglodytes	Winter Wren	SI	

State Status Code	Description
E	State Endandered
T	State Threatened
SC	Species of Concern
SI	Special Interest
Federal Status Code	**Description**
FE	Federally Endangered

Table 7: Rare, Threatened, and Endangered (Animal) Species in the Tinkers Creek Watershed

Scientific Name	Common Name	State Status	Scientific Name	Common Name	State Status
Hypnum pratense	Wrinkled-leaved Marsh Hypnum	E	*Phegopteris connectilis*	Long Beech Fern	P
Tomentypnum nitens	Fuzzy Hypnum Moss	E	*Platanthera flava*	Tubercled Rein Orchid	P
Carex arctata	Drooping Wood Sedge	E	*Poa paludigena*	Marsh Spear Grass	P
Carex bushii	Bush's Sedge	E	*Potamogeton natans*	Floating Pondweed	P
Cornus canadensis	Bunchberry	E	*Potentilla palustris*	Marsh Five-finger	P
Cypripedium parviflorum var. parviflorum	Small Yellow Lady's-slipper	E	*Rhododendron nudiflorum var. roseum*	Northern Rose Azalea	P
Juniperus communis	Ground Juniper	E	*Rhynchospora alba*	White Beak-rush	P
Myrica pensylvanica	Bayberry	E	*Salix myricoides*	Blue-leaved Willow	P
Sisyrinchium mucronatum	Narrow-leaved Blue-eyed-grass	E	*Salix serissima*	Autumn Willow	P
Viburnum opulus var. americanum	Highbush-cranberry	E	*Shepherdia canadensis*	Canada Buffalo-berry	P
Calla palustris	Wild Calla	P	*Sphenopholis pensylvanica*	Swamp-oats	P
Carex alata	Broad-winged Sedge	P	*Triglochin palustris*	Marsh Arrow-grass	P
Carex bebbii	Bebb's Sedge	P	*Viburnum alnifolium*	Hobblebush	P
Carex diandra	Lesser Panicled Sedge	P	*Zigadenus elegans*	White Wand-lily	P
Carex flava	Yellow Sedge	P	*Calopogon tuberosus*	Grass-pink	T
Carex lasiocarpa	Slender Sedge	P	*Carex pallescens*	Pale Sedge	T
Carex straminea	Straw Sedge	P	*Cypripedium reginae*	Showy Lady's-slipper	T
Castanea dentata	American Chestnut	P	*Deschampsia flexuosa*	Crinkled Hair Grass	T
Chamaedaphne calyculata	Leather-leaf	P	*Elymus trachycaulus*	Bearded Wheat Grass	T
Corallorhiza maculata	Spotted Coral-root	P	*Epilobium strictum*	Simple Willow-herb	T
Cornus rugosa	Round-leaved Dogwood	P	*Galium labradoricum*	Bog Bedstraw	T
Corydalis sempervirens	Rock-harlequin	P	*Melampyrum lineare*	Cow-wheat	T
Equisetum sylvaticum	Woodland Horsetail	P	*Melanthium virginicum*	Bunchflower	T
Eriophorum viridicarinatum	Green Cotton-grass	P	*Prenanthes racemosa*	Prairie Rattlesnake-root	T
Gentianopsis crinita	Fringed Gentian	P	*Salix candida*	Hoary Willow	T
Gentianopsis procera	Small Fringed Gentian	P	*Solidago squarrosa*	Leafy Goldenrod	T
Geum rivale	Water Avens	P	*Sparganium androcladum*	Keeled Bur-reed	T
Larix laricina	Tamarack	P	*Triantha glutinosa*	False Asphodel	T
Persicaria robustior	Coarse Smartweed	P			

State Status Code	Description
E	State Endandered
T	State Threatened
P	Potentially Threatened

Table 8: Rare, Threatened, and Endangered Plants in the Tinkers Creek Watershed

Invasive Species

The aquatic resource can be impacted by both plant and animal invaders. Inventories of invasive species have not been conducted for the Tinkers Creek watershed in its entirety.

Ohio EPA has identified the two most common invasive fish species in collections from 2000-2008 as gizzard shad and carp. To date, there have been no reports of any of the Eurasian goby species in the watershed. Carp can become a nuisance species due to its feeding practice of stirring up stream bottoms in search of food. This can lead to a turbid water column, a problem noted in Pond Brook.

Other potentially harmful invasive aquatic animal species include zebra mussels, not yet noted in the watershed, and the rusty crayfish (*Orconectes rusticus*), most likely in the watershed. Negative impacts associated with the rusty crayfish are not known at this time.

A number of plant species have invaded the aquatic/semi aquatic habitat which may have negative impacts. Their impacts generally result from out competing native plants resulting in decreased plant diversity, choking off habitat niches, and chemical impacts associated with decaying biomass. Plant species which fit this classification include the reed canary grass, narrow-leaved cattail, purple loosestrife, and Eurasian water milfoil. While present in the watershed, large scale impacts attributable to these species have not yet been investigated.

C. Water Resources

Climate and Precipitation

Northeast Ohio is located in a temperate zone, characterized by a climate with distinct seasons, including cold winters, and warm summers. Temperate climates have precipitation throughout the year. The average winter temperature is 30 degrees Fahrenheit and the average summer temperature is 70 degrees Fahrenheit. The term hydrologic cycle refers to the process of water movement from the atmosphere (precipitation) to the earth and its return to the atmosphere through various processes. As a generalization, total average annual precipitation is approximately 38 to 39 inches per year across the watershed, which includes the liquid equivalent of snowfall based on annual data for the last 30 years. Monthly precipitation varies, with the driest months being January and February, and the wettest period coming during the late spring and summer months, April to September. Within the watershed, precipitation is subject to some variance due to the climatic influence of Lake Erie, particularly as it impacts snowfall in the winter months due to "lake effect snow". Areas closer to the lake and at the higher elevations receive more snow than those further inland. These differences in snowfall amounts will have the greatest impact during the spring, when snowmelt contributes to runoff entering the stream system. This also affects the management of Lake Erie, in terms of water level and other coastal issues.

Surface Water

Tinkers Creek is the largest tributary of the Cuyahoga River and drains portions of Portage, Geauga, Summit and Cuyahoga counties. Tinkers Creek has a drainage area of approximately 96.0 square miles, a total stream length of about 30 miles and enters the Cuyahoga River at river mile 16.36.

Tinkers Creek is located in the Cuyahoga River 8-digit HUC (04110002) and comprises three 14-digit HUCS (Table 9: 04110002-050-030, 04110002-050-040, and 04110002-050-050) totaling 61,515 acres.

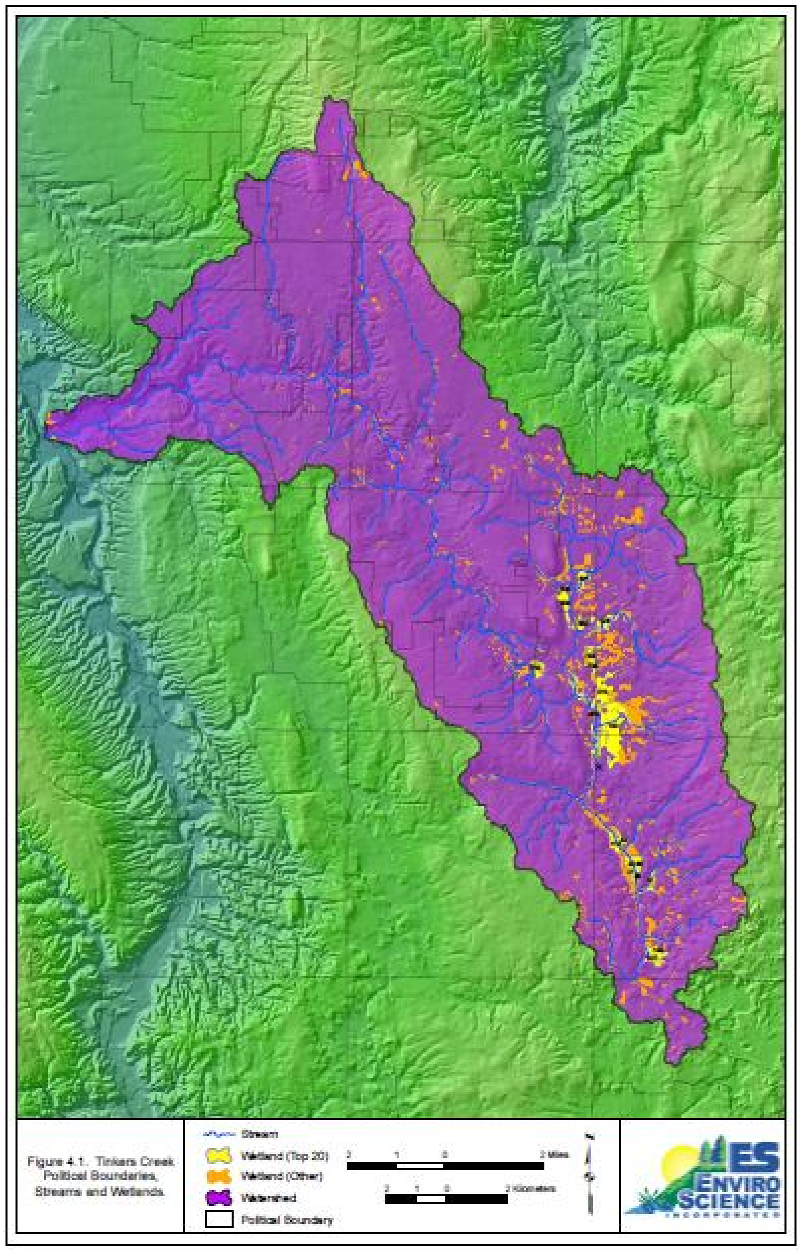
Table 9: Tinkers Creek 14-digit HUCs

HUC-14	Description	Subarea
04110002-050-030	Tinkers Creek headwaters to above Pond Brook	15,935 Acres
04110002-050-040	Pond Brook	10,179 Acres
04110002-050-050	Tinkers Creek below Pond Brook to Cuyahoga R.	35,401 Acres

Tinkers Creek becomes increasingly urbanized and effluent dominated as it flows towards the Cuyahoga River. Physical habitat at the mouth of Tinkers Creek is capable of supporting a typical warmwater stream fauna; the Ohio EPA habitat score (QHEI) score was 70.5. The channel was sinuous and well developed, and contained boulder, cobble and gravel substrates. Woody debris was also present in the channel. The creek receives inputs from six major WWTPs (flows >1 million gallons per day) in Streetsboro, Aurora, Twinsburg, Bedford, Bedford Heights, and Solon. Nutrient levels are persistently elevated downstream from the point sources.

The headwaters of Tinkers Creek are wetland influenced and support fair quality fish communities, fairly typical of swampy streams. Changes to the watershed include increased stretches of channelized habitat and increased suburban barriers to fish migration (i.e., waterfalls located downstream at RM 5.6), excessive turbidity, or other unknown causes and sources of impairment may contribute to the NON attainment.

Tinkers Creek contains approximately 951 remaining wetlands. The majority are located in suburban and generally rural locations. Most reside in the Pond Brook sub-watershed and are of moderate to high quality. The economic significance of these wetlands cannot be overlooked as they provide free storm water storage services to the communities in which they reside. However, like all other developing areas, wetlands tend to disrupt development and are filled and removed to provide area for structures and parking lots to exist. Unfortunately, standard engineering practices and outdated local development ordinances do not recognize and incorporate wetlands into development plans. **Figure 26: Tinkers Creek Wetlands**



Sub-Watershed Descriptions/Tributary Names

The HUC subwatershed descriptions are listed above. This section will describe specific streams within the Tinkers Creek basin.

The Tinkers Creek watershed can be divided into a number of subwatersheds as defined by the topography within the area of the entire watershed. Within the Tinkers Creek watershed, there are several major distinct sub-watersheds that can be identified.
The main subwatersheds described for the Tinkers Creek basin are: Beaver Meadow Run; Deer Lick Run; Hawthorne Creek; Mud Creek; Pond Brook; and, Wood Creek. Table 10 summarizes the sub-watershed data.

The upper reaches of the system are generally less urbanized with higher percentages of wetlands and undisturbed to minimally disturbed land when compared to the lower more urbanized area. They are currently experiencing increased development pressure as suburbanization expands into Streetsboro.

Table 10: Major Tinkers Creek Subwatersheds

Sub-Watershed	Drainage Area (mi^2)	% Urban/ Impervious Land Cover
Beaver Meadow Run	8.05	28.0
Deer Lick Run	3.15	40.5
Hawthorne Creek	5.12	49.3
Mud Creek	6.97	34.2
Pond Brook	15.84	15.4
Wood Creek	3.6	54.7

The subwatershed descriptions below were taken from the 2003 TMDL report.

Wood Creek (Confluence with Tinkers Creek RM 2.44)

Wood Creek is a small, urbanized, high gradient Tinkers Creek tributary. The headwaters receive urban drainage and wastewater from the Bedford WWTP and the lower reaches flow through a park. Habitat quality at the mouth (QHEI = 62) is adequate to support WWH. Nutrient levels (primarily nitrate) were elevated in 2000 and related to the WWTP discharge. There have been chronic problems in the past with pollutant spills and sewer overflows in the urban headwaters. These problems are similar to those found in the Mill Creek watershed as the Wood Creek and Mill Creek headwaters are adjacent to each other.

The existing LRW use was based on 1984 results. Steep gradient (91ft/mi.) and flashy flows were thought to preclude reestablishment of WWH communities. Fish were absent from 3 sites and macroinvertebrates were very low in density and diversity. 2000 results at the mouth show slight improvement in fish (IBI= 20/poor) and a significant increase in macroinvertebrate taxa (from 0 to 30).

The 2000 results, coupled with reanalysis of the 1984 results indicate WWH is the more appropriate use. Similar small, steep gradient tributaries in the Cuyahoga River, Euclid Creek, and Chagrin basins are designated or attain WWH.

Deer Lick Run (Confluence with Tinkers Creek RM 3.72)

Deer Lick Run is a small, severe gradient (93 ft/mile) tributary in the Tinkers Creek gorge. Waterfalls and shallow, glide-type flow on bedrock preclude the establishment of WWH fish communities and for these reasons the stream is designated LRW (Limited Resource Water). Primary Contact Recreation criterion for fecal coliform bacteria and WWH chemical/physical criteria were met. The nearly inaccessible, and unsampled, mouth of the stream has a lower gradient and is assumed to be suitable for the designated WWH use.

NON attainment of the LRW designation was due to absence of fish, primarily a result of small drainage (< 1 sq. mi.), high gradient, and possibly historical elimination caused by (now eliminated) wastewater discharges. Macroinvertebrates were fair but improved significantly when compared to the poor, toxic conditions found during a previous, 1984 survey. If fish populations had been present historically, they were probably eliminated by the toxic impacts.

The upper reaches of Deer Lick Run are designate LRW but should be considered candidates for the Primary Headwater Designation (PHWH) designation (currently under development) when, and if, the designation is adopted.

Beaver Meadow Run (Confluence with Tinkers Creek RM 10.62)

Beaver Meadow Run is a small tributary to Tinkers Creek that receives the discharges from Zircoa and the Solon municipal WWTP. Zircoa discharges to the very headwaters of Beaver Meadow Run and contributes high loads and concentrations of dissolved solids to the stream. The stream segment downstream from Zircoa and upstream from the Solon WWTP was in non-attainment for both fish and macroinvertebrate communities.

Nutrient levels increased sharply, an ammonia violation was detected, and D.O. levels declined below the WWTP. The condition of fish (good) and macroinvertebrates (fair) resulted in Partial attainment downstream from the WWTP. Macroinvertebrate communities were predominated by nutrient tolerant forms. Species diversity and EPT taxa richness also tended to be lower below the WWTP than in other, similar small tributaries in the basin.

Partial attainment in 2000 was an improvement over Non attainment in 1991. Positive changes appear the result of improved waste treatment and repair of a broken sewer line. Ultraviolet disinfection replaced chlorination at the WWTP in 1996.

Pond Brook (Confluence with Tinkers Creek RM 22.51)

Pond Brook is a channelized, wetland stream designated MWH based on its low habitat quality and ongoing channel maintenance under the Ohio Drainage Law (ORC 6131) (1991 survey results). The stream is mostly pooled, and receives drainage from adjacent wetlands, suburban development, and effluent from two WWTPs. Fish and macro-invertebrates were fair but met the designated MWH use and is now in FULL attainment of its designated use based on 2000 survey results.

Ground Water

Further data collection is needed to assess groundwater contamination in the watershed. Locations within the headwaters area and the middle Tinkers Creek area could contain groundwater wells which are used by homeowners within those areas. The following maps demonstrate the underground aquifers found within the different counties of the watershed.

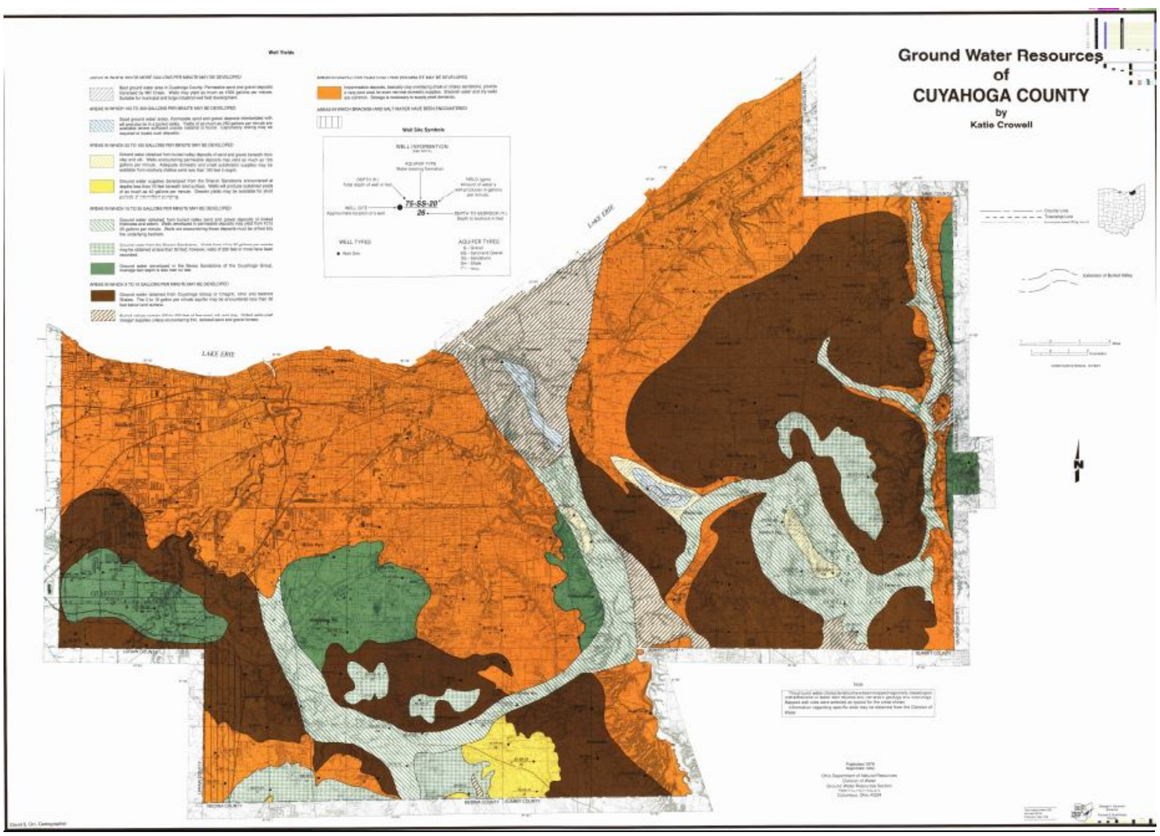


Figure 27: Cuyahoga County Groundwater Aquifers

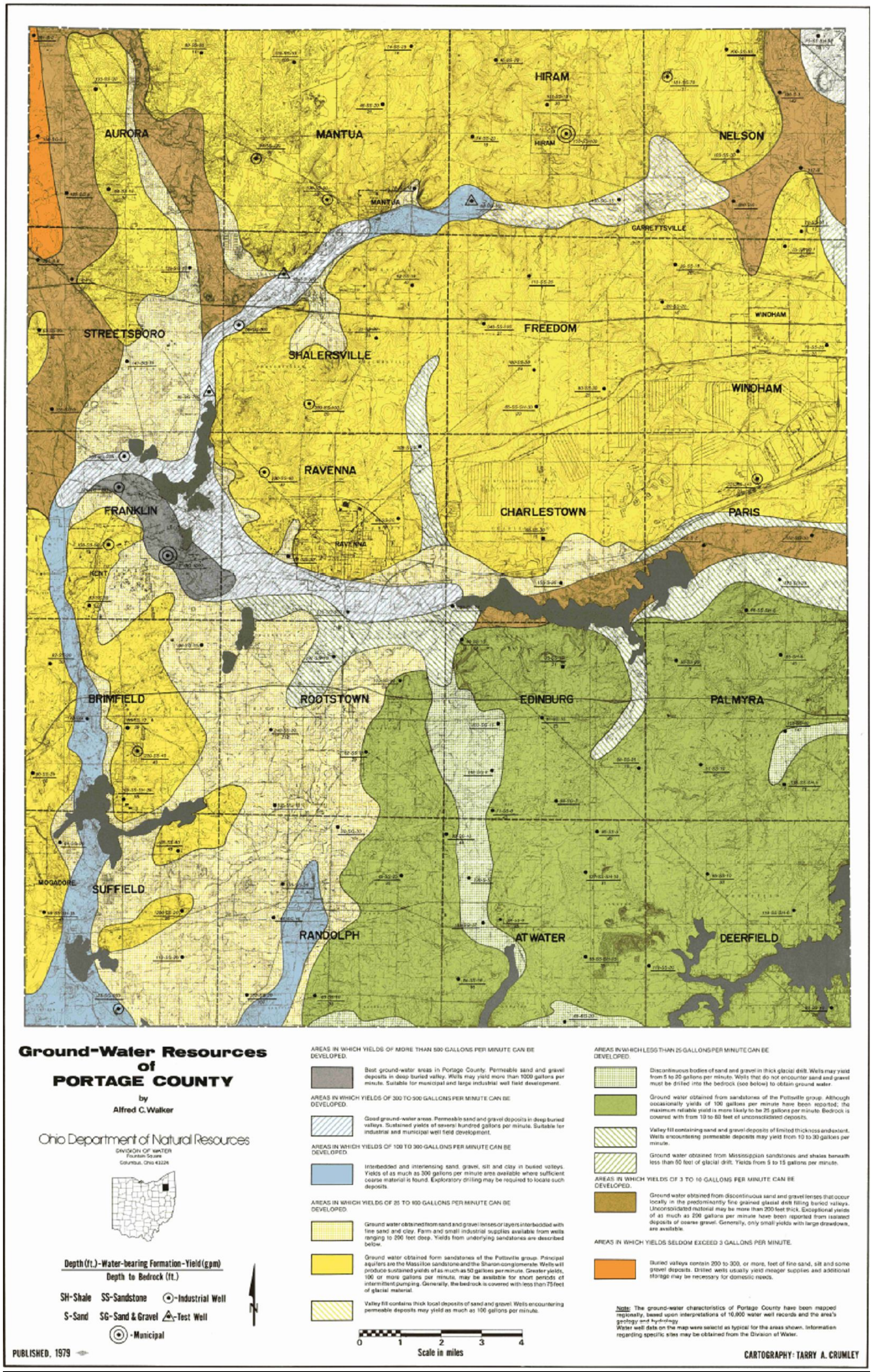


Figure 28: Portage County Groundwater Aquifers

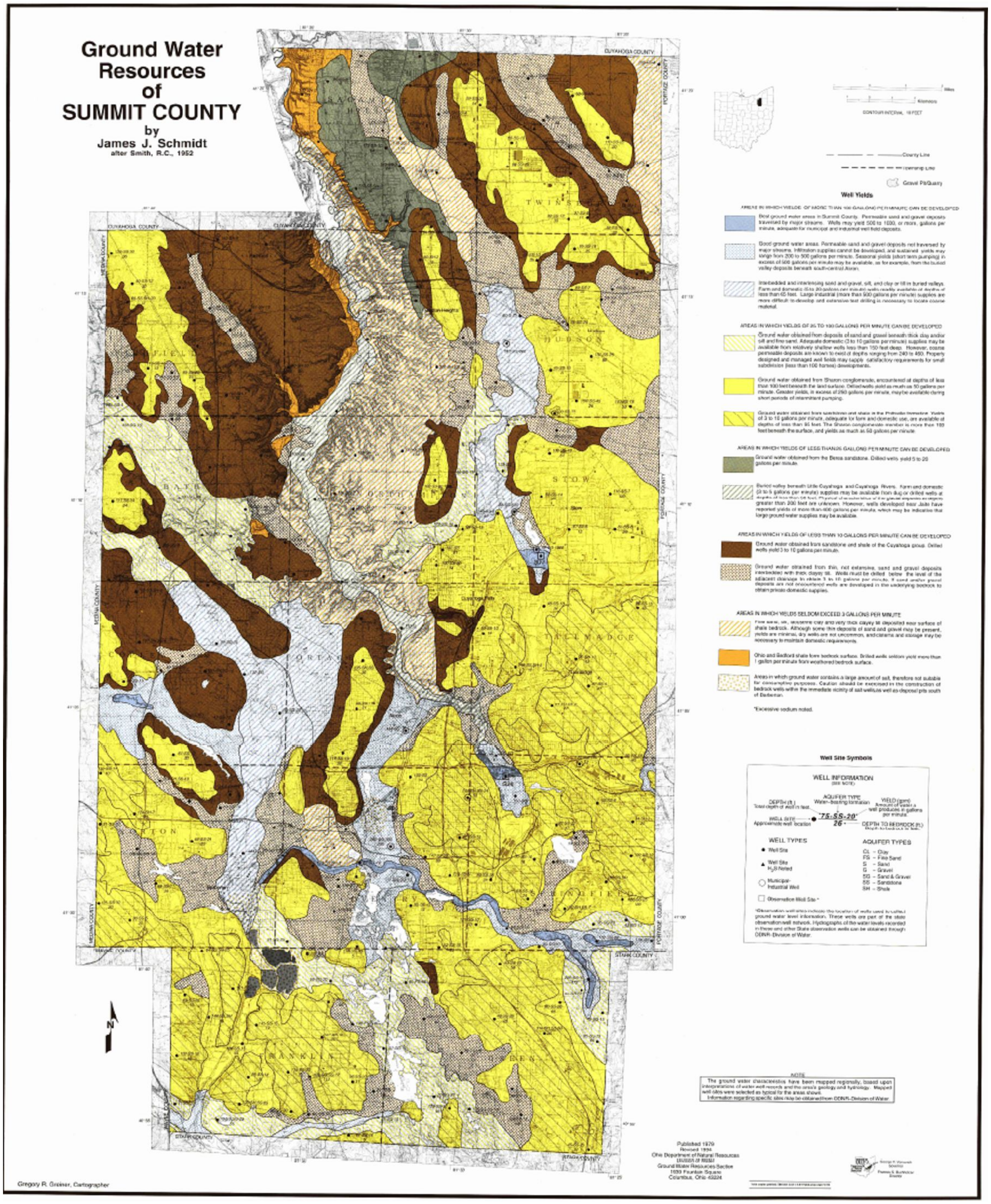


Figure 29: Summit County Groundwater Aquifers

Flow Regime

No data is available. The Ohio EPA and ODNR have been contacted to find data sources on this topic.

Source Water Assessment Plan (SWAP) Information
There are no SWAP designations located within the Tinkers Creek Watershed boundary.

Sensitivity of groundwater to local sources of contamination per DRASTIC maps

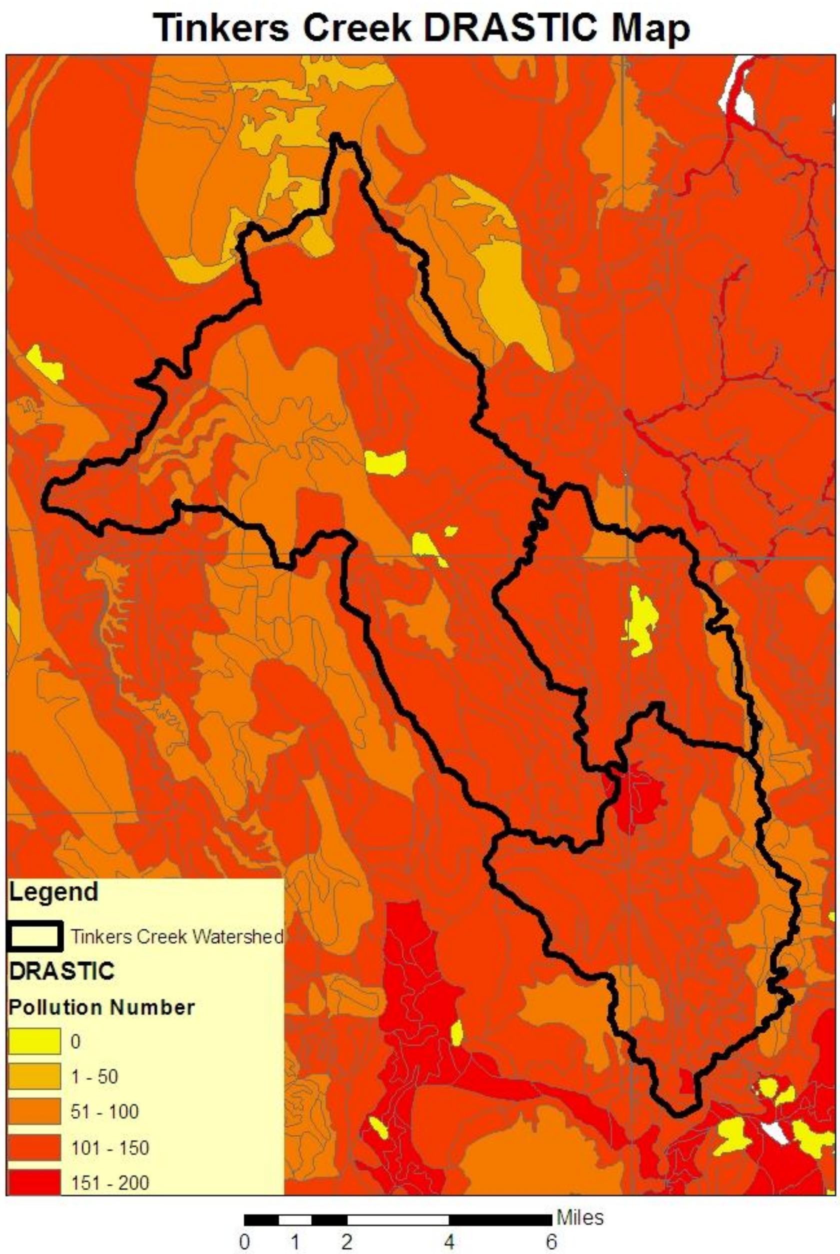


Figure 30: Tinkers Creek DRASTIC Map

The Tinkers Creek DRASTIC Map indicates the most of the watershed has a moderate to high potential for groundwater contamination.

D. Land Use

Table 11 below lists land cover type by HUC-14.

HUC14 (04110002-050-)	HUC14 Name	Open Water	Developed, Open Space	Developed, Low Intensity	Developed, Medium Intensity	Developed, High Intensity	Barren Land	Deciduous Forest	Evergreen Forest	Grassland/ Herbaceous	Pasture/ Hay	Cultivated Crops	Woody Wetlands	Emergent Herbaceous Wetlands
-030	Tinkers Creek headwaters to above Pond Brook	1.0%	16.9%	26.4%	4.8%	1.4%	6.1%	8.5%	0.1%	3.5%	0.6%	29.3%	1.3%	0.1%
-040	Pond Brook	0.0%	52.6%	31.9%	2.6%	0.0%	0.0%	9.3%	0.0%	3.3%	0.0%	0.0%	0.3%	0.0%
-050	Tinkers Creek below Pond Brook to Cuyahoga R.	0.7%	32.1%	34.1%	6.7%	3.6%	0.0%	19.0%	0.5%	0.6%	1.3%	0.1%	1.0%	0.3%

Table 11: Land Cover Type by HUC-14

As is shown in the above table, the watershed has experienced a fair amount of development over the years. Continued development pressure still exists within the watershed.

Urban/Impervious Cover

Impervious cover was partially listed above by subwatershed. Table 12 below lists impervious cover by HUC-14.

Table 12: Impervious Cover by HUC-14

HUC-14	Acres	Description	%Impervious Cover
4110002-050-030	15922.6	Tinkers Creek headwaters to above Pond Brook	9.29
4110002-050-040	10170.8	Pond Brook	12.29
4110002-050-050	35374.6	Tinkers Creek below Pond Brook to Cuyahoga R.	23.30

Home Septic Systems

The majority of HSTS located in the watershed are clustered within areas which are still less urbanized and are continuing to be sewered. These locations are continuously monitored by the local health departments for illicit discharges. Health departments are mandated by State regulations to enforce procedures for fixing failing systems or assisting in replacing outdated systems. Additionally, the City of Aurora will be providing locations for the known systems within their jurisdiction to complete the map. There are 2,101 HSTS in the watershed.

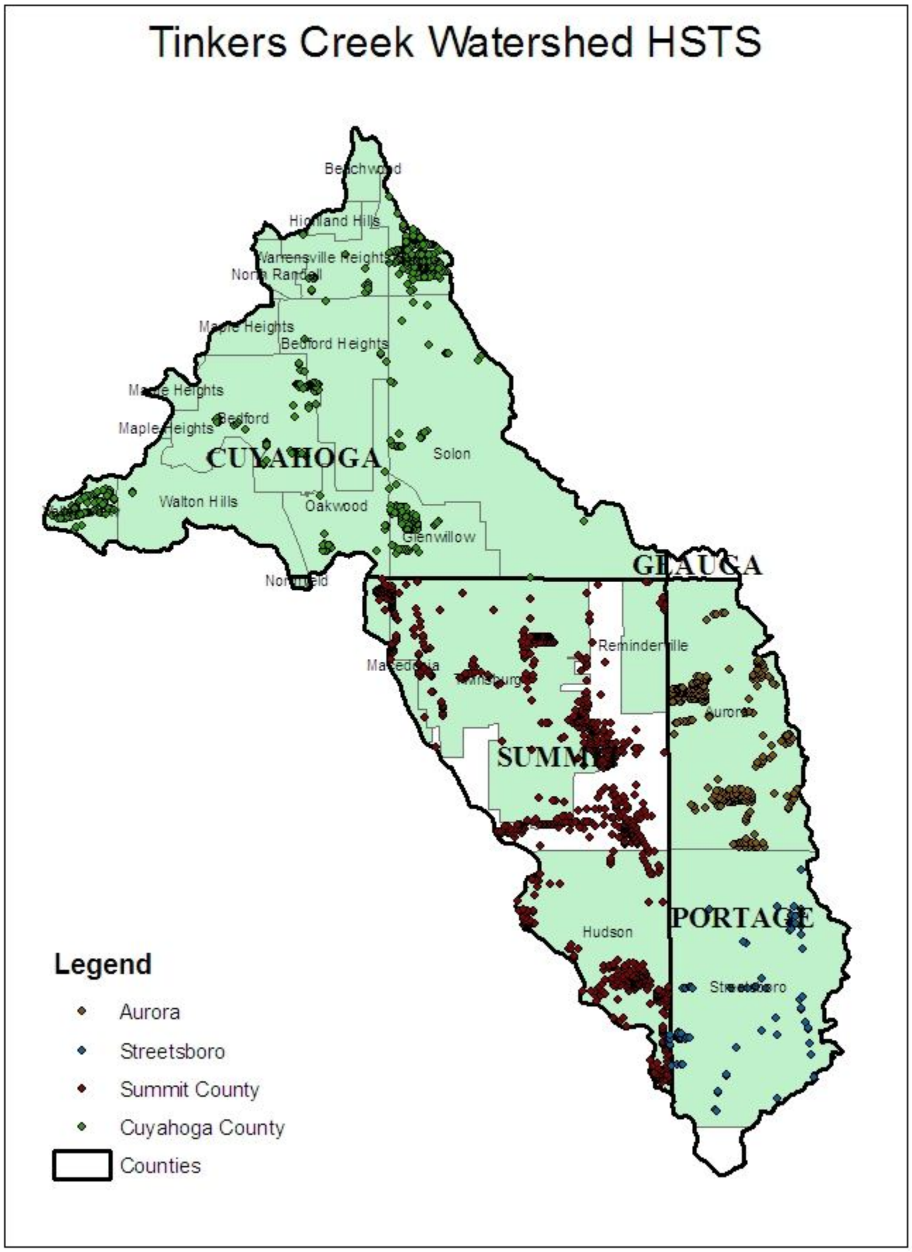


Figure: 31: Tinkers Creek Watershed Home Sewage Treatment Systems

Park Lands (Forest)

The Tinkers Creek watershed is fortunate in that it has protected lands at the federal, state, county, and local levels. The National Park Service has protected lands at the mouth of Tinkers Creek which total 380 acres. Tinkers Creek State Park managed by the Ohio Department of Natural Resources totals 786 acres. Cleveland Metroparks has protected parkland totaling 2300 acres within the watershed. The Metroparks Serving Summit County has protected 1662 acres, the majority within the Pond Brook Subwatershed. It should also be noted that the City of Twinsburg is also an active partner with Summit County Metroparks through assistance by land purchase in the creation of Liberty Park.

The above protected areas total 5128 acres, or 8.18% of the watershed (total area 62,681 acres). This preserved land calculation does not include areas within the jurisdiction of local parks and the Tinkers Creek/Western Reserve Land Conservancy, which could easily total an additional 1,000 acres.

Agriculture

No large-scale agricultural operations exist in the Tinkers Creek Watershed. A very few small agricultural plots however are present in the headwaters area (HUC#4110002-050-030) but do not seem to be utilized routinely.

Water

Because crop growing and agricultural are not a predominate land use in the watershed, surface water and ground water are not utilized for irrigation purposes or for other agricultural applications.

Non-Forested Wetland

According to the Tinkers Creek Wetland Prioritization Plan 2007/2008, 951 wetlands had been identified. Of those wetlands, 421 are thought to be non-forested. Of the non-forested wetlands in the watershed, the total acreage for those identified is 2,224 acres. Below is an example of a palustrine non-forested wetland.

Figure 32: Palustrine Non-Forested Wetland

Barren
N/A

Protected Lands
See Section 1 page 13.

Land Protected by Private Foundations or Land Trusts

Name	Acres	County	Community	Year
Aurora Wetlands II	119.00	Portage	Aurora	2005
Aurora Wetlands	130.00	Portage	Aurora	2005
Aurora Wetlands III	117.00	Portage	Aurora	2005
Peterson	39.00	Summit	Twinsburg Twp.	2004
Bainbridge Four Corners	44.00	Geauga	Bainbridge	2002
I-480 Preserve	32.00	Summit	Twinsburg	1997
Twinsburg Bog	43.00	Summit	Twinsburg	2002
Henderson	3.00	Summit	Hudson	2004
Winterberry Heights	6.00	Summit	Hudson	1994
Bissell	50.00	Portage	Aurora	2006
Snowy White Egret	48.00	Portage	Streetsboro	2006
Solon Wetlands	7.00	Cuyahoga	Solon	2002
Rynearson	21.00	Portage	Streetsboro	2007
Glenwillow Wetlands	15.00	Cuyahoga	Glenwillow	1999
Geis	51.00	Portage	Streetsboro	2002
Henry South	63.00	Geauga	Bainbridge	2001
Chagrin Highlands	45.00	Cuyahoga	Beachwood, Highland Hills, Orange, Warrensville	2002

Table 13: Western Reserve Land Conservancy Protected Lands

There is approximately 43,288 centerline linear feet of Tinkers Creek within the City of Twinsburg. Of which 81.85% of the eastern bank is adjacent to City owned land, Conservancy land or covered by a conservation easement. On the western bank 74% is adjacent to City owned land, Conservancy land or covered by a conservation easement. The remaining percentage on both banks is adjacent to privately owned lands.

Figure 33: Preserved Lands of the Western Reserve Land Conservancy

Status and Trends (Historical, Current, and Projected)

The Tinkers Creek Watershed is highly urbanized and is continuing to be developed for both commercial and residential purposes. Historically, the watershed has been heavily influenced by industrial practices in the north and agricultural practices in the south. Due to the population growth and the expansion of the City of Cleveland, the watershed experienced steady outward growth for decades. However, because of trying economic times, the loss of manufacturing jobs, and high unemployment, the watershed is no longer seeing rapid development or redevelopment. Many locations within the watershed sit idle, waiting for more prosperous times to arrive. Although construction has slowed, the timing is opportune for land trusts and other conservancies to purchase property at lower market value pricing or offer a land owner immediate sales opportunities.

Brownfields/Regulated Sites

There are no federal Superfund sites within the Tinkers Creek Watershed.

E. Cultural Resources

The History of the Tinkers Creek Watershed is typical of other urban watersheds throughout the United States, first facilitating the establishment of the earliest settlements with hydrological power and transportation options and then experiencing the outward migration from the central city into the suburbs and neighboring counties to the far reaches of the watershed. Today much of the Tinkers Creek Watershed is developed with a variety of land uses, mostly suburban residential development. The creek has the same problems as other urban streams, sedimentation, rapid runoff from impervious surfaces, high nutrient loads and numerous sewage treatments plants that discharge their effluent into the creek. On the other side of the coin, the Tinkers Creek Watershed is blessed with a generous amount of park land and protected natural areas within it’s borders.

Historical Perspective

Prehistoric History

The Tinkers Creek Watershed as we know it today started to take shape during the last glacial period when the Wisconsin Glacier covered much of Ohio over 22,000 years ago. The landscape today was formed when massive ice sheets were carried south from Canada creating the lakes, hills and valleys of the watershed. Some of notable glacial relics within the watershed are Geauga Lake, Herrick and Gott Fens. Many of the State listed species of plants found in the watershed were commonplace during the last glacial period but now are relegated to niche environments.

Approximately 9,000 year ago the first human inhabitants moved into the Tinkers Creek Watershed attracted by the abundant wildlife and rich bottomlands. Over the next several thousand years various native peoples called the Tinker Creek Watershed home as evidenced by archaeological activities within the area. The steep bluffs along the lower portion of the creek offered additional protection to hillside fortifications and the rich soils of the river bottoms produced abundant crops. Numerous salt licks located throughout the watershed provided much needed salt for consumption as well as an attraction for wildlife which the natives readily hunted.

The Erie Indians inhabited much of Northern Ohio including the lands within the watershed when the very first European came to this area. The earliest written accounts of the Erie were from French Trappers and Jesuit Priests. As European demand for beaver pelts grew the tribes to the East began to make forays into Erie Country in search of new lands where the beaver had not been depleted. Tensions rose between the Erie and their cousins, the Iroquois to the east. In 1652 the Iroquois Nation and the Erie went to war. With superior numbers and weapons, the Iroquois by 1660 defeated the Erie opening up vast lands to trap and hunt in. From this point on in history no one Indian tribe occupied the land within the watershed. Various tribes from the Greater Region traveled through and hunted here, it was a great no man's land until European settlement came.

1796 – 1915

In 1796 Moses Cleveland arrived to survey the Western Reserve, land claimed by the State of Connecticut. With their arrival, the land and water resources would never be the same. Changes in the landscape would take place, no longer would the land be used in a sustainable way, the Europeans saw the land as an resource to be exploited for their benefit. The very name of the creek comes from the tragic drowning of Joseph Tinker, one of the members of Moses Cleveland's survey party that drowned in the mouth of the Cuyahoga River where it meets Lake Erie. Soon after the establishment of the Village of Cleveland, the first community in the Western Reserve, a stage coach route was created to link Cleveland with Pittsburg using an old Indian path, the Mahoning Trail. Because the horses that pulled the stage coaches needed to changed every twenty miles, cities like Bedford and Hudson sprang up to meet that need. Both communities are approximately 20 miles apart from each other and the City of Cleveland. The City of Bedford, founded in 1797 is the oldest community in the watershed followed by the Cities of Hudson and Aurora both established in 1799, the remainder of the communities were largely rural townships and stayed that way for much of the 1800's. As more settlers arrived in the watershed the forests gave way to farms. Because of the relative shallow nature of the creek, it could not be used for transport. The creek did benefit the City of Bedford by providing water power which supported several mills and an electric power plant just above the Great Falls of Tinkers Creek, this industrial complex operated between 1821 to 1915.

Other industrial activities during this period in history included the quarrying of the Berea Sandstone in Bedford and Walton Hills and Sharon Conglomerate in Twinsburg. Much of the stone was fashion into foundation blocks that support the oldest buildings in the region. Quarry operations started to wane at the turn of the 20th century as other construction materials like concrete began to replace stone.

Much of the land within the watershed until now was used for agricultural purposes, there was very little residential development during this time in period. With the removal of the forests, soil that was once held in place by a network of tree roots now flowed freely into the creek from farming activities. The draining of the wetlands and fens that once filtered storm water runoff were eliminated for increased farmland, siltation of the water in the creek commenced. Also, any cool water species of fish if they did reside in the creek probably died off as a result of the removal of the forest canopy causing the temperature of the water to rise along with an increase in silt runoff choking the water and creek bed.

1916 – 1941

With the advent of the automobile new changes in land use began to occur. The number of roadways and their design changed dramatically. Gone were the dirt and gravel road used for the horse and buggy. With an ever increasing number of automobiles on the road the nature of their design changed to concrete and eventually to asphalt, both impervious type of pavements that increase the volume of storm water runoff directly into the creek and it's tributaries. Residential development started to expand in the nearest suburbs of Cleveland, communities like Maple Heights and Oakwood began to grow as well as an increase in the population in the City of Bedford, but much of the land use was still in agriculture. The Cleveland Metro Parks were established during this time period and started to acquire land along Tinkers Creek, primarily within the Tinkers Creek Gorge area in the lower reaches of the watershed.

1942- 1960

During the Second World War many heavy industries opened along Northfield Road in Bedford and Walton Hills and also along Solon Road in Bedford, this began a period where large "war time" industries sprang up to meet the nation's military needs. New industrial pollutants began to effect the water quality of the Creek, many were man made chemicals developed during and shortly after World War Two. Old timers living in the area began to lament the loss of the small mouth bass that used to inhabit the deeper pools in the creek. Bass populations began to disappear during the 1940's. After the war auto dealerships moved onto Broadway Ave. eventually creating the now famous Bedford Auto Mile. Also suburban growth began in earnest when returning GI's began to move out of Cleveland proper to suburbs like Bedford Heights, Oakwood, Maple Heights, North Randall and Warrensville Heights, growth in those communities increased significantly during the mid 1940's to 1960.

1960 – 1970

With the establishment and construction of the nation's interstate highway system communities like Solon, Twinsburg, Macedonia, Aurora and Hudson began to grow rapidly. Freeways now placed outer ring suburbs within an easy drive from downtown Cleveland and other employment centers. Cities like Solon and Twinsburg began to attract large industries because of their close proximity to I-422 and I-480 further stressing the creek. New suburban subdivisions sprang up throughout much of the watershed by this time. Another major impact to the water quality of the creek was the establishment of two regional landfills one in Solon and the other in Glenwillow, both of which directly border it.

1971 – Present

Suburban expansion has continued moving southward into the communities of Northern Summit and Portage Counties, cities like Twinsburg saw explosive grow throughout the 1990's. For several years, Twinsburg was the second fastest growing City in the State of Ohio. The development fringe is now into Aurora, Twinsburg Township, Glenwillow and Streetsboro, the outer reaches of the watershed and the head water region of the watershed. Today almost all of the land in the watershed is developed with a population of over 250,000 and growing, with a significant amount of industry in areas of Bedford, Bedford Heights, Walton Hills, Twinsburg, Aurora, Streetsboro, Glenwillow and Solon. On a positive note, land conservation efforts by the Cleveland Metro Parks, The Metro Parks Serving Summit County, The National Park Service, the State of Ohio, several local communities and conservation organizations have actively secured land throughout the watershed for the purpose preserving it. Thousands of acres have been protected from development, much of that land is along the Creek itself.

Recreational Resources

The Tinkers Creek Watershed is blessed with an abundance of publicly owned and protected land. Presently there are over 5,530 acres of land publicly owned and protected land within the Tinkers Creek Watershed. Various jurisdictions like the Tinkers Creek State Park and State Nature Preserve, The Cleveland Metro Parks (Bedford Reservation), The Metro Parks Serving Summit County (Liberty Park & Nature Preserve), and many of the Cities within the watershed all contribute to the land protection process. This does not include the Cuyahoga Valley National Park which contains another 33,000 acres, part of which lies within the lower portion of the watershed. Some of the publicly owned park land in the Tinker Creek Watershed:

Cuyahoga Valley National Park	33,000 acres
Hudson Springs Park	260 acres
Tinkers Creek State Park	355 acres
Tinkers Creek State Nature Preserve	786 acres
Twinsburg City Parks	418 acres
Herrick Fen	140 acres
Liberty Park & Nature Preserve	1,400 acres

There are many smaller municipally owned parks and play grounds that are too numerous to mention. In addition to publicly owned and accessible land, there are private organizations also working to protect sensitive lands throughout the watershed, most notably the Western Reserve Land Conservancy.

Virtually any type of outdoor activity can be accomplished within the various parks in the Tinkers Creek Watershed. Some of the activities offered by the park districts include hiking, swimming, fishing, canoeing, sledding, cross country skiing, bird watching, horse back riding, and various organized sports. Many of the larger park districts have paid naturalists on staff that provides additional services to the residents in the watershed like guided hikes and interpretative programs.

Much of the park land actually borders the creek itself offering miles of public access to Tinkers Creek and many of it's tributaries and well as protecting the riparian zone of the creek from development and disturbances.

For an urban stream where much of the land within it's borders is developed, the Tinkers Creek Watershed is fortunate to have thousands of acres of land under permanent protection by a host of government agencies, jurisdictions and private land protection organizations. Many of these park districts and private groups continue to seek additional acreage to protect especially along State Route 82 and Old Mill Road in Twinsburg Township and Aurora and in the headwaters area in Streetsboro.

F. Previous and Complimentary Efforts

No significant water quality efforts have been implemented within the Tinkers Creek Watershed. However, studies such as the NEORSD R.I.D.E. study, the USGS Stressor Study, and the Kerr/Boron Land Management study all have provided useful information to focus water quality initiatives.

Current Efforts that will help meet water quality standards

Hudson Stream Restoration Project

The Tinkers Creek Watershed Partners, Cuyahoga County Board of Health, City of Hudson, and the Hudson High school have submitted and have been awarded a 319 grant to perform a stream restoration project on 2,000 lineal feet of an unnamed tributary to Tinkers Creek. This project will produce an increase in water quality due to the design of the project. The stream, in its current state, is channelized and therefore does not have access to its floodplain and increases sediment loss downstream due to the cutting characteristics of the channel flow. This restoration project will provide additional water storage capacity in a constructed wetland area, provide access to its floodplain, create an outdoor land lab for the High school, and foster additional habitat such as vernal pools, and aquatic areas for amphibians and fish.

Liberty Park Restoration Project

Metro Parks Serving Summit County has restored 6,500 feet of the main channel of Pond Brook (HUC # 4110002-050-040). This summer we will begin construction on restoring 2,500 feet of a small tributary to Pond Brook and will begin the design work for a second tributary (about 2,000 feet). The main channel and tributaries have all been historically ditched. In addition, we have restored approximately 200 acres of wetlands to date. Most of this work is being funded via mitigation dollars from the Ohio DOT, US Army, The Cleveland Clinic, and a private land developer. The first tributary is being funded via a 319 grant.

Today, Metro Parks, Serving Summit County and The City of Twinsburg, have embarked on an ambitious effort to restore the habitat and ecological integrity of this waterway and hundreds of acres of riparian wetlands. To date, over **one mile** of Pond Brook has been restored along with an additional half mile of tributary. Over **100-acres** of riparian wetlands have also been restored or enhanced. Massive efforts have also been launched to jump-start the recovery of native species. Tens-of-thousands of native trees and shrubs have been planted and specially designed seed mixes have been used to enhance the natural vegetation and compete with invasives.

Metro Parks Serving Summit County also just acquired an additional 250 acres of CAT 3 wetlands south of Route 82 and an additional 40 acres of CAT 3 wetlands behind the Free Indeed Farm.

G. Physical Attributes of Streams and Floodplain Areas

Early Settlement Conditions

Tinkers Creek has its origins in the wetlands of Streetsboro and Hudson. As wetland streams function differently than free flowing streams, habitat for typical aquatic communities associated with free flowing streams is limited. As the stream enters Twinsburg habitat impacts associated with suburbanization, such as increased sediment load and substrate embeddedness, become evident. Floodplain access is sometimes limited resulting in stream bed down cutting and bank destabilization. This habitat characteristic generally remains until Center Valley Park in Twinsburg. From this point to the mouth habitat improves to the good to excellent range.

Table 14 contains habitat scores in the basin using the Qualitative Habitat Evaluation Index (QHEI). The QHEI is a stream evaluation method utilizing observations made for a number of habitat characteristics. The scoring system ranges from 0 to 100, a score of 60 or greater is generally considered adequate to meet aquatic community standards barring any other impacts. Additional information on this may be found on Ohio EPA's internet site at: http://www.epa.state.oh.us/dsw/bioassess/BioCriteriaProtAqLife.html.

A more detailed analysis of stream habitat evaluation results was conducted to better describe results depicted in Figure **##.** Data was evaluated utilizing the

Ohio EPA QHEI scores and the individual metric scores. When grouped by HUC 14, several observations become readily apparent.

Table 14: Average QHEI Scores								
Metric Titles	**QHEI**	**Substrate**	**Cover**	**Channel**	**Riparian**	**Pool**	**Riffle**	**Gradient**
Maximum Score	**100**	**20**	**20**	**20**	**10**	**12**	**8**	**10**
All Sites	65.8	12.6	12.9	14.2	7.1	8.6	3.7	6.6
HUC 050-030	55.1	7.1	13.1	11.2	6.9	7.7	1.8	7.4
HUC 050-040	38.8	2.5	9.0	9.5	8.7	4.0	0.5	4.7
HUC 050-050	69.1	14.0	12.9	15.1	6.9	9.2	4.4	6.6

At first glance the watershed averages indicate a system which (for monitored sites only) has overall QHEI scores exceeding the target of 60. When evaluated by HUC however, the Tinkers Creek upper watershed and Pond Brook (HUCs 050-030 and 050-040 respectively) do not meet the target score of 60. Pond Brook deviates strongly from the target, a result of extensive historical dredging. The upper Tinkers Creek watershed has also been dredged in several areas, lowering habitat scores.

The individual metric scores show where habitat problems are generally located, and can serve as a guide to habitat restoration efforts.

Pond Brook (HUC 050-040) has been severely altered by dredge activities. As a result, all of the metric scores, with the exception of Riparian, are lower. Opportunities to improve habitat exist in all the metrics, with the greatest potential in the substrate and riffle. Removal of substrates by dredging results in a more uniform stream profile and greater depth, which then eliminates riffles creating a substrate with very small particle sizes. The MetroParks Serving Summit County is currently completing restoration activities in part of Pond Brook which are designed to restore habitat and improve biological communities. The higher metric scores for riparian are a result of two forces, as a wetland dominated stream, development generally proceeded in other areas leaving the riparian corridor relatively undisturbed. Recent land acquisition activities in the stream have resulted in an increased amount of protected areas along the riparian corridor.

Habitat in the watershed below Pond Brook (HUC 050-050) is much better than that previously described. Parts of the watershed are protected by parks with areas showing lower habitat quality located in Twinsburg. The generally good habitat scores contrast with the poor fish community which is being studied as part of the Stressor Identification Project.

Channel and Floodplain Conditions

The majority of the Tinkers Creek Watershed is channelized due to down-cutting and erosion caused by inputs of too much water. Additionally, much of HUC# 4110002-050-030 (head waters area) has been dredged and the material side-casted causing further channelization and reducing the potential for the stream to access its floodplain. The northern urbanized watershed area is influenced by impervious surfaces and allows too much water to be inputted into the streams and tributaries. The southern portion of the watershed has been dredged in the past and will require extensive rehabilitation to provide access to floodplains and increase water influenced habitat such as vernal pools, riparian wetlands, and the riparian buffer.

Forested Riparian Corridor Assessment

Riparian corridors provide essential habitat, protection, and necessary floodplain accommodations to any stream. However, development and a lack of understanding regarding the functioning of streams have resulted in the removal of these critical areas. Forested riparian areas, not only allow for water storage, but also provide absorption of the flood waters by the trees that live next to the streams. Further, the trees provide a canopy to cool the stream with shade during hot summer months and hold the stream banks in place thus reducing erosion and sedimentation. Tinkers Creek does contain a significant forested area, but often the stream lacks access to these riparian wetland zones.

Wetland type	# of wetlands identified	Total size, ac
PEM – palustrine emergent	208	1345 ac
PFO – palustrine forested	**501**	**1670**
PSS – palustrine scrub-shrub	213	879
Stormwater basin	30	23

Table 15: Palustrine Wetland Acreage

Miles with Forested Riparian Buffer

Major Stream Data

Major streams from Kerr-Boron data	134. 0 miles
Streams with natural riparian corridor (forested or wetland)	**46.5 miles**
Streams with non-natural riparian corridor	87.5 miles

Table 16: Riparian Stream Length

of Miles with Permanent Protection

This information is currently not known.

of Miles with Natural Channel (Never Modified)

Approximately 46.5 miles of stream remain in its natural condition.

of Miles & Location of Modified Channels

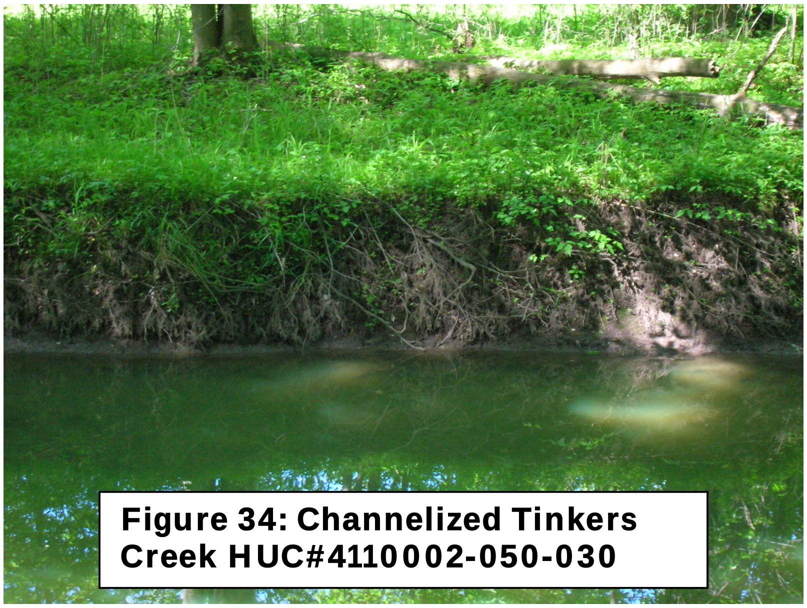


Figure 34: Channelized Tinkers Creek HUC#4110002-050-030

As stated previously, Tinkers Creek has highly modified stream channels as the result of dredging actions and an overabundance of storm water being introduced into the watershed streams. While it is not fully known the exact mileage of modified stream channels, it is approximated to be 52 miles. The majority of the modification area is in HUC# 4110002-050-030 and HUC# 4110002-050-040. As the Streetsboro WWTP was developed, dredging and side-casting activities occurred and has resulted in a modified stream channel. Additionally, the Pond Brook Watershed has experienced major stream modifications due to the desire to develop those lands for residential and commercial endeavors. Historically, those lands within the watershed were vast wetland areas. Pond Brook was created to drain those wetland locations and as a result was entrenched due to dredging activities. Major attention and restoration work is currently underway to restore the stream to allow for floodplain usage and wetland inundation.

Dams

The watershed does not contain many dams or impoundments. However, we do know of three existing structures. The first being a low-head dam located just upstream from the Great Falls in Bedford. The second is located between I-271 and Richmond Rd in Bedford Heights. Below are the locations of these dams.

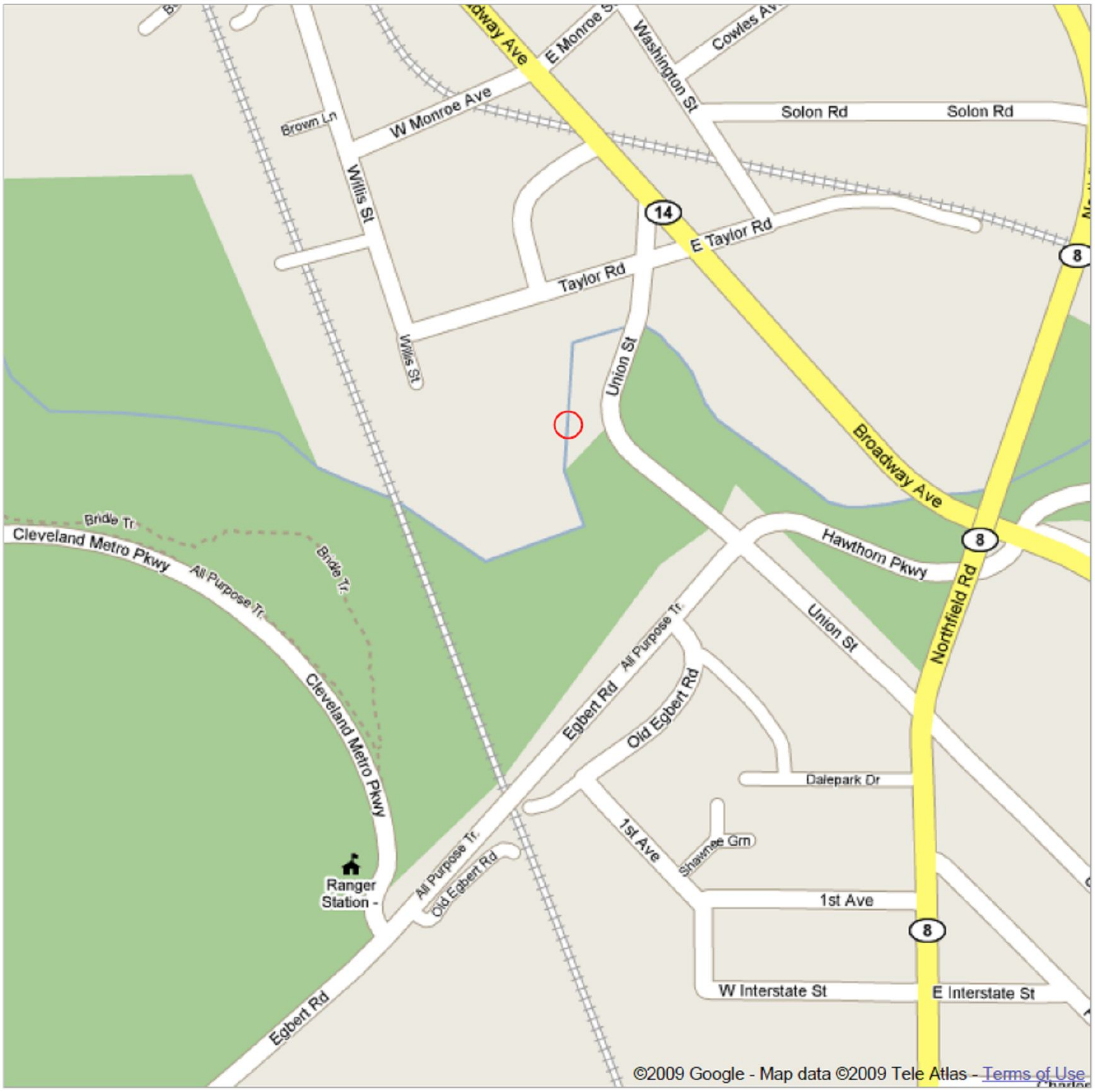


Figure 35: Low-Head Dam Structure; Bedford, Ohio

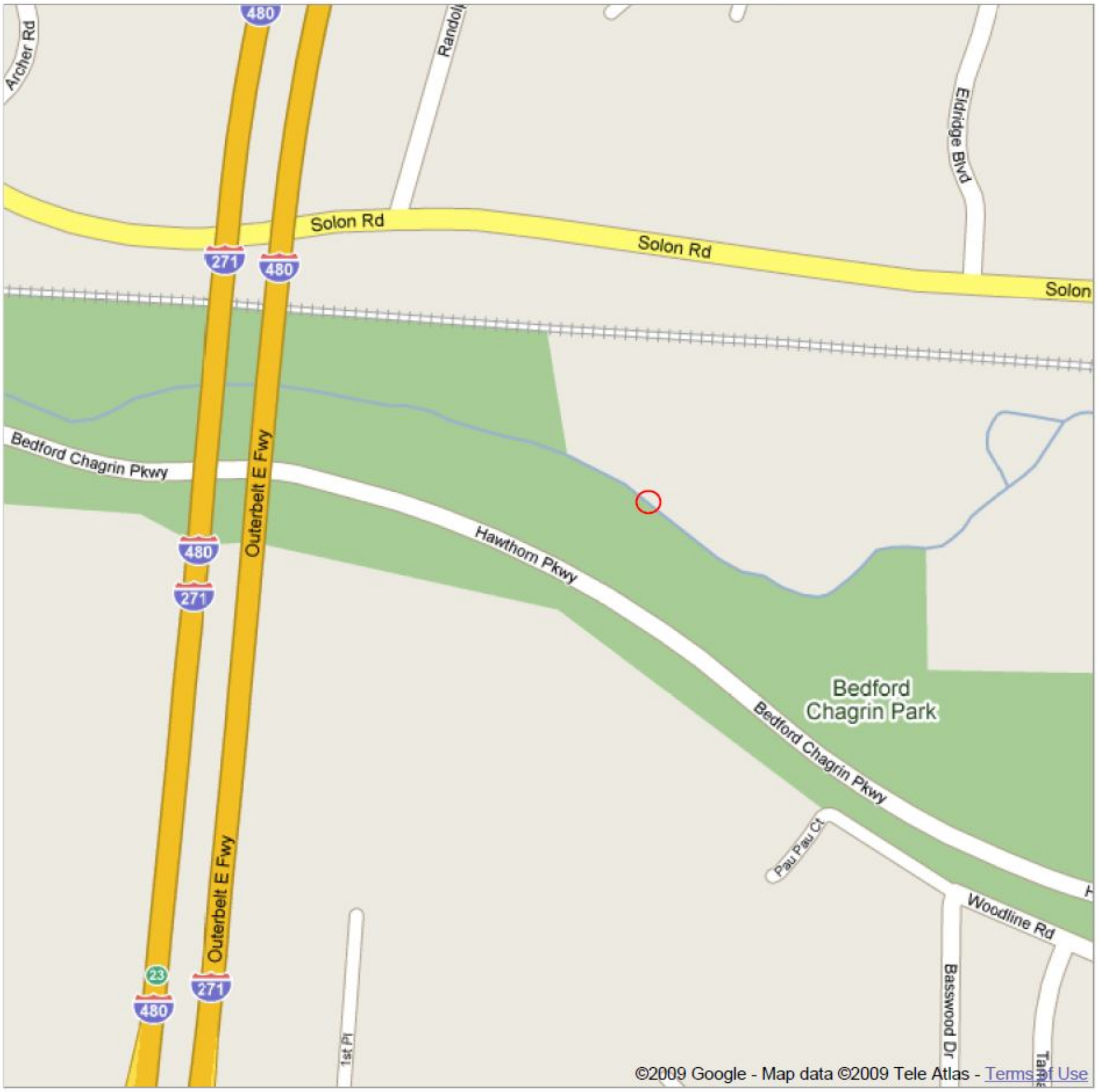


Figure 36: Low-Head Dam Structure; Bedford Heights, Ohio

Figure 37: Low-Head Dam Structure; Twinsburg, Ohio

Channelization

Determining channelization on a watershed wide scale is no easy task. As stated throughout this plan, the entire watershed could be considered channelized. Within the implementation section, several identified restoration locations have been determined. All of those identified have channelization issues. It depends on their exact locations as to the cause of this issue. The more urbanized northern section of the watershed reels from storm water influence both in terms of water quality and quantity. However, the quality of the water is directly influenced by the quantity of water being introduced to the tributary streams. As the overtaxed streams “pipe” the storm water into there respective receiving streams, down-cutting and severe erosion complicate the matter by not allowing the increased water input to have any access to its floodplain and riparian areas. Additionally, the middle and southern watershed areas have been dredged in the past and again have exasperated channelization issues by making access to the riparian areas obsolete. Therefore, it is safe to say that the Tinkers Creek Watershed has chronic channelization problems resulting from increases in water quantities and from specific man-made influences.

Streams with Unrestricted Livestock Access

The Tinkers Creek Watershed contains no unrestricted livestock access to the stream.

Eroding Banks

According to the TMDL study of Tinkers Creek, sedimentation and turbidity are significant causes of water quality impairment. In addition to poorly maintained construction sites regarding erosion and sediment control, stream bank scouring caused from too much water being introduced into watershed tributaries is causing significant sedimentation to occur throughout the entire watershed. All tributary streams exhibit the characteristics of eroding banks and, therefore, continue to contribute large quantities of sediment to the main stem. Channelization, caused by the introduction of too much water into the stream, is causing the stream banks to erode and prohibits the stream from functioning as a stream should; having access to its floodplain. It is quite difficult to surmise the exact number of eroding banks due to the nature of the watershed as it exists now. It is safe to say that the entire watershed from the smallest of tributaries to the larger main stem all possess eroding banks.

Figure 38: Steep Slope Erosion; Wood Creek

Floodplain Connectivity

The Watershed, as stated in prior sections, has been decimated by the continued introduction of too much water and by human activity such as the vast storm sewer network and dredging procedures. Because of these influences, the watershed experiences flashiness during high precipitation events which promotes stream bank down-cutting. The result of this persistent action is entrenchment and a lack of access to the streams floodplain. Only during very high rainfall or snow melt events does the stream contain enough water to finally access its floodplain areas. However, due to bridges, culverts, and the entrenchment itself, the stream also promotes downstream flooding because of the lack of access to the streams floodplain.

Riparian Levees

There are no riparian levees in the watershed.

Entrenched Miles

The activity of dredging streams results in the stream becoming entrenched or straightened. This activity creates an abnormal stream channel as it removes the natural sinuosity from the stream. This activity results in reduced access to the streams floodplain and riparian zones and ultimately promotes water quality degradation by heightening the erosion potential to its stream banks and increases the probability of downstream flooding resulting from limited access to floodplain areas. As stated previously, Tinkers Creek contains two specific areas

of entrenchment as a result of dredging activities from the past. The majority of the modification area is in HUC# 4110002-050-030 and HUC# 4110002-050-040. The approximate mileage of stream entrenchment is thought to be 52 miles. This number was garnered through both field investigations and the use of the online Ohio EPA River Mile maps.
http://www.epa.state.oh.us/dsw/gis/RiverMileSystem.htm

Status & Trends (Expected Residential, Commercial, Road, Highway, and Bridge Construction)
Because of the slowing economy much development has ceased in the watershed. Additionally, the following information regarding development predominately exists in areas of the watershed that have not been developed fully.

HUC# 4110002-050-030

Streetsboro:

1. Transportation issues and proposed improvements:
    a. Address S.R. 303 flooding issues
    b. Frost Road improvement
    c. Connect Ethen Ave. to Philipp Parkway
    d. Address capacity and congestion along S.R. 14 between I-80 and Diagonal Rd.
    e. Widen S.R. 43 to four lanes w/turn lanes where needed along S.R. 43 between Market Square and S.R. 306
    f. Operational improvements for S.R. 43 from Ravenna Rd. to Seasons Rd.

2. Commercial Development:
    a. Streetsboro Commons will continue to develop
    b. Industrial Parks (Interstate Commerce Center, Frost Road Commerce Center and Streetsboro Industrial Park) will continue to develop

3. Housing:
    a. Approximately 535 residential units are proposed to be constructed within the Tinkers Creek Watershed area.

HUC# 4110002-050-040

Reminderville: Herrington Place 2nd Phase (A multi-family suburban style development), tire store-one acre at the intersection of Liberty and Glenwood Rd.

No road, bridge, or highway construction is planned at this time.

HUC# 4110002-050-050

Twinsburg Township: Twinsburg Township-Fashion Place-100 acres between the township and the City of Twinsburg-south of 480.

Twinsburg: A proposed widening of Route 91 to Solon Road to Glenwood to 4 lanes, and from Glenwood to Post, to 3 lanes.

MRK property at 91 and Glenwood is now under a lawsuit, because that area is zoned for 120 homes and the builder wants more.

A proposed addition of 27 lots is to be developed in the Canyon Falls Subdivision near Cannon Road, where the railroad comes in.

The Cleveland Clinic complex has 90 acres, with a 45 acre conservation easement, and there may be a 120 bed hospital built in 5 years time.
(Parcel #'s 6401207, 6402307, 6400135).

Valley View: The only development on the Valley View radar screen is the one that is being proposed directly adjacent to the Village Hall. Blossom Homes has been approved by Planning Commission to place 20 homes on the 10 acre parcel. The lots are available for $119,000. And so far there has been little activity.

Bedford: Rockside Road will be resurfaced from Broadway to Aurora Rd. in 2010.

H. Water Resource Quality

Attainment Status

The Tinkers Creek Watershed has seen some improvement in biological water quality over the years at its downstream reaches. Most of the main stem and tributaries however have seen little improvement in biological communities in recent years. Table 15 represents the most recent attainment status for the watershed.

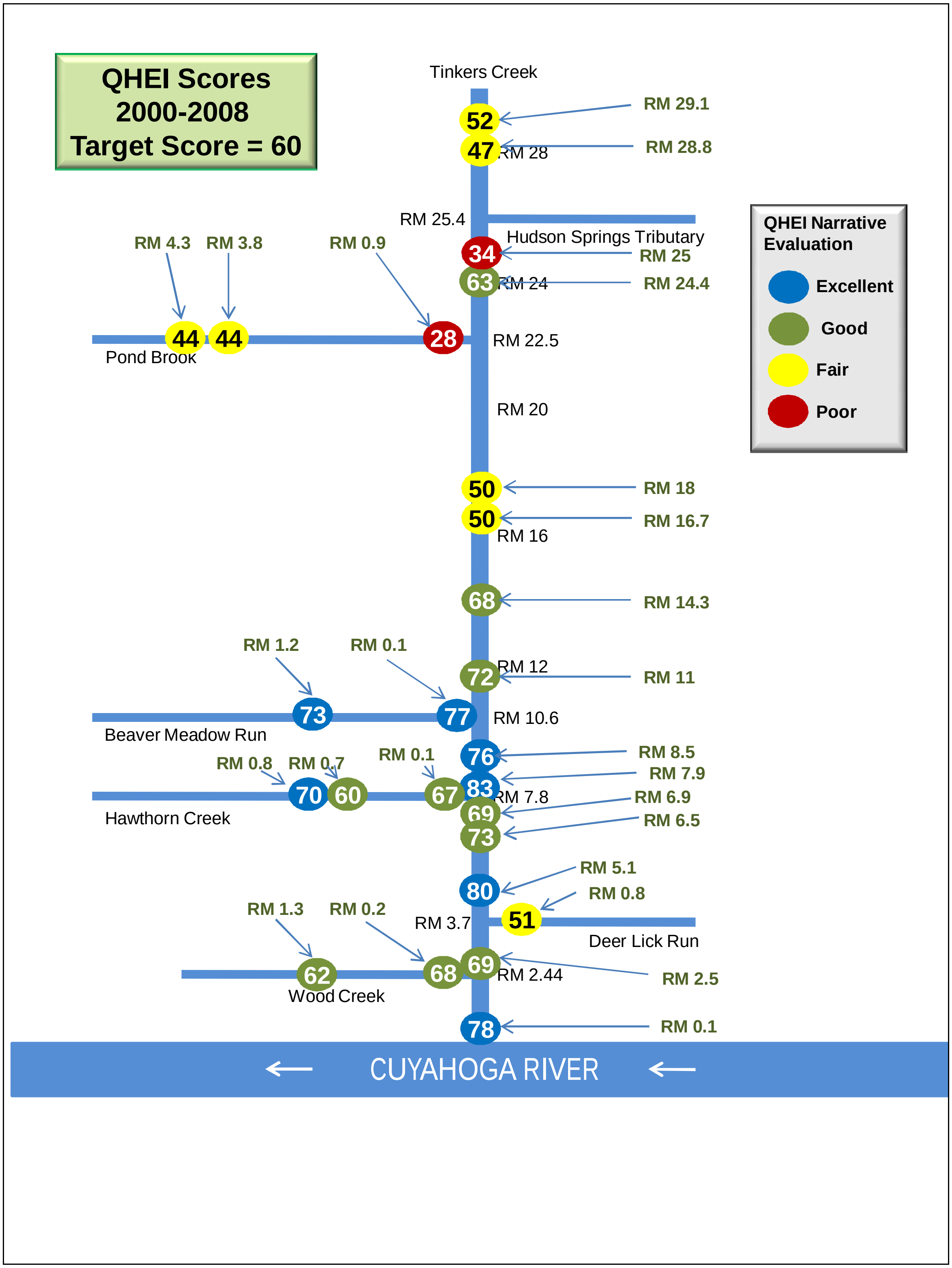


Figure 39: Tinkers Creek Qualitative Habitat Evaluation Index Scores

2000

Tinkers Creek (19-007) - WWH Use Designation

Fish/Invert.	IBI	Miwb	ICI	QHEI	Status	Comment
29.1^{W}/28.3	32*	na	48	52.5	PARTIAL	Seasons Road
25.0^{W}/25.2	24*	na	46	34.5	**NON**	Hudson-Aurora Road
17.5^{W}/18.0	25*	5.3*	40	50.0	**NON**	At Whitlach Development
14.3^{W}/14.3	28*	6.4*	40	56.0	PARTIAL	Adj. East Idlewood
8.5^{W}/8.5	21*	5.5*	44	76.5	**NON**	Dst. Inland Reclaimation
6.9^{W}/7.2	28*	7.5^{ns}	G	71.0	PARTIAL	Dst. Hawthorn Creek
0.1^{W}/0.1	32*	6.1*	36	78.0	PARTIAL	At mouth

Pond Brook (19-008) - MWH Use Designation

Fish/Invert.	IBI	Miwb	ICI	QHEI	Status^{b}	Comment
3.8^{H}/3.8	36	na	F	44.0	FULL	Ust. Aurora Shores WWTP
-/1.4	--	--	28	NA	(FULL)	SR 82 (wetland area)

Beaver Meadow Run (19-046) - WWH Use Designation

Fish/Invert.	IBI	Miwb	ICI	QHEI	Status	Comment
1.2^{H}/1.2	34*	na	F*	57.0	**NON**	Ust. Solon WWTP
0.2^{H}/0.2	38^{ns}	na	F*	70.5	PARTIAL	Old Cochran Road

Hawthorne Creek (19-064) - WWH Use Designation

Fish/Invert.	IBI	Miwb	ICI	QHEI	Status	Comment
0.7^{H}/0.7	32*	na	MG	60.0	PARTIAL	Richmond Road

Wood Creek (19-043) - LRW Use Designation

Fish/Invert.	IBI	Miwb	ICI	QHEI	Status	Comment
0.2^{H}/0.1	20*	na	F	62.5	FULL	At mouth

Table 17: Biological Attainment Status in the Tinkers Creek Watershed

2006-2007						
Tinkers Creek (19-007) - WWH Use Designation						
Fish/Invert.	**IBI**	**Miwb**	**ICI**	**QHEI**	**Status**^{b}	**Comment**
28.8^{H}/-	34^{ns}			53.0	(FULL)	Seasons Road
24.4^{H}/-	26*			63.0	**(NON)**	Ust. Ravenna Road
16.7^{W}/-	30*	6.6*		55.0	**(NON)**	Ust. SR 91
14.3^{W}/-	29*	6.8*		70.5	**(NON)**	Adj. East Idlewood
11.0^{W}/-	26*	5.3*		73.5	**(NON)**	Pettibone Road
10.1^{W}/-	28*	6.6*			**(NON)**	In Glenwood at power line crossing
6.4^{W}/-	20*	6.3*		88.5	**(NON)**	Ust. SR 8
2.2^{W}/-	38	7.6		76.0	(FULL)	Ust. Dunham Road and Wood Creek
0.1^{W}/-	40	8.3		78.0	(FULL)	At mouth
Pond Brook (19-008) - MWH Use Designation						
Fish/Invert.	**IBI**	**Miwb**	**ICI**	**QHEI**	**Status**^{b}	**Comment**
4.3^{H}/-	38			44.5	(FULL)	Ust. Glenwood Blvd.
0.9^{H}/-	30			28.0	(FULL)	Dst. SR 82
Beaver Meadow Run (19-046) - WWH Use Designation						
Fish/Invert.	**IBI**	**Miwb**	**ICI**	**QHEI**	**Status**^{b}	**Comment**
1.2^{H}/-	28*			77.0	**(NON)**	Ust. WWTP discharge
0.1^{H}/-	24*			77.0	**(NON)**	At mouth
Hawthorne Creek (19-064) - WWH Use Designation						
Fish/Invert.	**IBI**	**Miwb**	**ICI**	**QHEI**	**Status**^{b}	**Comment**
$0.8^{H/}$-	30*			70.5	**(NON)**	Richmond Road
0.1^{H}/-	24*			67.0	**(NON)**	At mouth
Wood Creek (19-043) - LRW Use Designation						
Fish/Invert.	**IBI**	**Miwb**	**ICI**	**QHEI**	**Status**^{b}	**Comment**
1.3^{H}/-	20*			62.0	**(NON)**	Ust. WWTP discharge
0.1^{H}/-	12*				**(NON)**	At mouth above waterfall

Ecoregion Biocriteria: Erie/Ontario Lake Plain (EOLP)

INDEX - Site Type	WWH	MWH
IBI - Headwaters	40	24.0
IBI - Wading	38	24.0
IBI - Boat	40	24.0
Mod. Iwb - Wading	7.9	6.2
Mod. Iwb - Boat	8.7	5.8
ICI	34	22.0

* = Indicates significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units).

Underlined scores are in the Poor or Very Poor range.

ns = Nonsignificant departure from biocriteria (<4 IBI or ICI units, or <0.5 MIwb units).

b = Use attainment status based on one organism group is parenthetically expressed.

H = Headwater site type

W = Wading method

Table 17 (Continued): Biological Attainment Status in the Tinkers Creek Watershed

The attainment status table presented above compiles Ohio EPAs three indicies for assessing the ecological quality of streams. Two utilize fish communities (IBI and Miwb), and one uses aquatic macroinvertebrates (ICI). Additional information on biological criteria is available on Ohio EPA's internet site at: http://www.epa.state.oh.us/dsw/bioassess/BioCriteriaProtAqLife.html .

During the time period 1984 thru 1996 a total of 70 fish sampling passers were conducted on Tinkers Creek. A total number of 11,511 fish were collected representing 35 species. The most common fish by number were bluntnose minnow (27.7%), white sucker (12%), creek chub (11.9%), and green sunfish (10.5%). These species are all considered pollution tolerant. The most common fish collected by weight were carp (52.4%) and white sucker (25.3%). The carp is also pollution tolerant.

During the time period 2000 thru 2008 a total of 27 fish sampling passers were conducted on Tinkers Creek. A total number of 11,835 fish were collected representing 36 species. The most common fish by number were stoneroller minnow (27.9%), white sucker (14.9%), and bluntnose minnow (11.9%). The stoneroller is no considered pollution tolerant. The most common fish collected by weight were white sucker (33.1%), and carp (32.2%).

Improvements in the fish community have occurred when comparing these two time periods. From 1984 thru 1996 six species of fish were collected which are considered moderately intolerant of pollution by Ohio EPA (rainbow darter, northern hog sucker, greenside darter, brook silverside, smallmouth bass, and golden redhorse). These fish totaled 0.03 % of the entire collection by number. This can be compared to the sample period from 2000 thru 2008 when eight species of fish were collected which are considered moderately intolerant of pollution by Ohio EPA (rainbow darter, northern hog sucker, greenside darter, brook silverside, smallmouth bass, sand shiner, logperch, and golden redhorse). These fish totaled 6.7 % of the entire collection by number. These improvements unfortunately are confined to the lower sections of Tinkers Creek.

Figure 31 presents results of the most recent fish community assessments (IBI score) for sites in the watershed. The scores for the IBI can range from 12 to 60. As is depicted in the figure, fish communities within the basin are demonstrating a fair amount of impairment.

Locationally-Referenced Use Designations

The attainment status of Tinkers Creek is mostly partial to non throughout the majority of the watershed. However, the confluence of Tinkers Creek upstream to the Great Falls in Bedford is in full attainment. This leads to the possibility that the waterfall is inhibiting fish passage to upstream locations and therefore is reducing IBI and ICI scores. In addition to the potential barrier problem, HUC# 4110002-050-040 (Pond Brook) is contributing significant sediment loading to the stream due to its channelization issues and fine sediments. Further, new studies indicate that global climate change in the Midwest is thought to produce heavier precipitation events and longer heat waves thus increasing the potential for further stream down-cutting, channelization, and increased sedimentation throughout the watershed.

The habitat evaluation scores were broken into groups based on HUCs. Data is presented in Figure 40. It is readily apparent that there are differences among the three HUCs. The differences can explained and better understood in the context of the HUCs themselves. Beginning with the lowest scores (Pond Brook, HUC 050-040); at no point do the scores meet the general target score of 60 for a general warmwater habitat (WWH). Pond Brook has been heavily modified by dredging, reflected in Ohio EPAs Modified Warmwater Habitat (MWH) classification, both the habitat and fish community reflect this disturbance.

The next grouping, (Tinkers Creek above Pond Brook, HUC 050-040) has a wider range with a median score around 56. This area of the watershed is showing signs of impairment due to historic channel modification and suburban development. Increased runoff flow volumes due to watershed development causes channel destabilization resulting in lower QHEI scores. As the smaller streams are impacted more directly by localized development their scores decrease and are also contributing to lower habitat quality at downstream sites.

The final HUC to be discussed (Tinkers Creek below Pond Brook, HUC 050-050) shows the highest median habitat score of the watershed with a 72. The range of scores is actually greater than those in the upper watershed. Lower habitat scores are found in the Twinsburg area where influences from upstream flow pattern changes continue. Channel destabilization and entrenchment are common in this section of the watershed on both the mainstem and tributaries.

As Tinkers Creek continues on its path towards the Cuyahoga River, an increasing amount of the stream becomes parkland with very little development in the riparian corridor. Gradient also increases allowing sediment transport to increase resulting in a more heterogeneous substrate.

Some of the highest QHEI scores are found in the Tinkers Creek gorge, where a nice riparian area dominated by larger sized substrate is present. Fish communities in recent years (2006-2008) have been documented as meeting Ohio's fish community standards at mainstem sites below the falls. Water quality improvements in Tinkers Creek are partially responsible for this recovery as is the extremely good habitat and vast improvement in the Cuyahoga River which is serving as a recruitment source. Fish communities above the falls remain impaired indicating the recovery is limited.

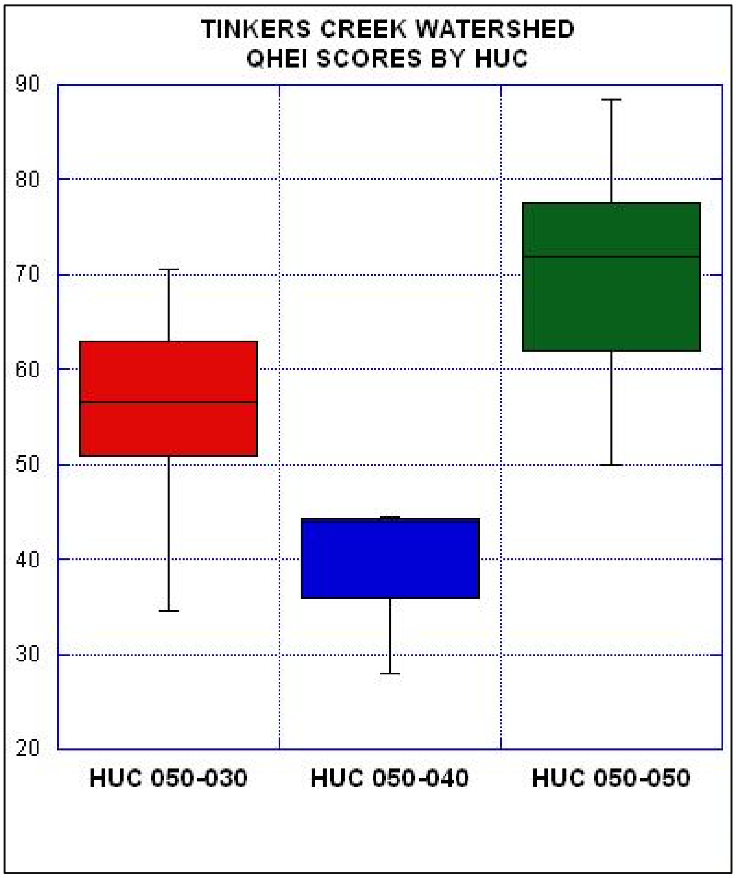


Figure 40: QHEI scores presented by HUC

Fish communities in the watershed were also grouped by HUC and the IBI scores are shown in Figure 41. Initially there appears to be c contrast between QHEI results and IBI scores. Pond Brook does have a higher median IBI score (30, N=4) and is meeting the Modified Warmwater Habitat standard of 24. Habitat availability plays an role in fish community scores. It is entirely plausible that habitat improvements could elevate scores higher, independent of the MWH classification.

Scores in the remaining HUCs are generally below the WWH standard of 38 for wadeable streams and 40 for headwater streams. While there have been improvements over the years, Figure 41 indicates that fish communities remain impaired.

The Tinkers Creek mainstem data when looked at purely for 2006-2008 results at sites above the waterfalls versus sites below the waterfalls tell a different story. Median IBI scores at sites above the falls was 26 (N=10) while the median score below the falls was 40 (N=5). There are clearly differences with the lowermost sections of Tinkers Creek in full attainment of fish community standards.

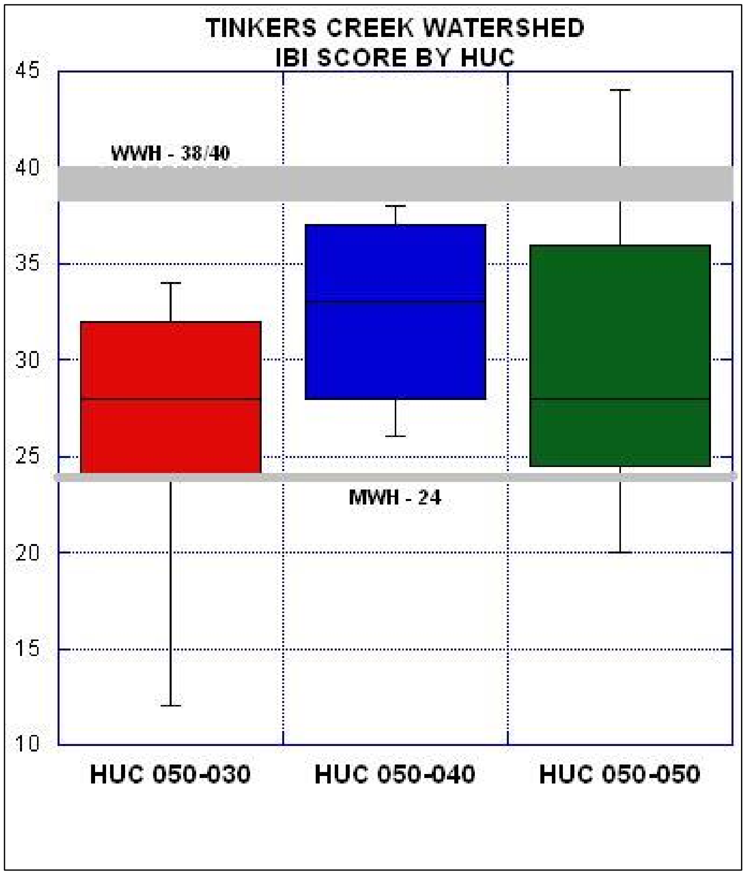


Figure 41: IBI Score presented by HUC

One final way to observe the data are by watershed size. QHEI and IBI scores were grouped according to two drainage area categories. Streams with drainage areas less than twenty square miles are considered headwater streams while those greater than twenty square miles in drainage area are considered small streams. Figures 42 and 43 below depict the results. Habitat scores are generally higher in the larger streams indicating disproportionate impacts associated with development in smaller watersheds. This is a common trend seen throughout the state and country. While still fairly similar, the fish communities in larger streams did generate some of the higher scores. None of the headwater streams met the IBI standard of 40. This also shows a disproportionate impact to smaller streams.

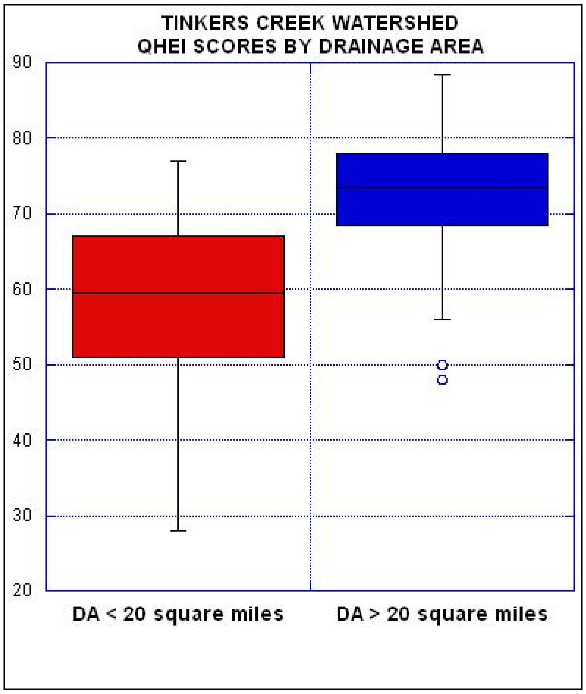


Figure 42: QHEI Scores by Drainage Area

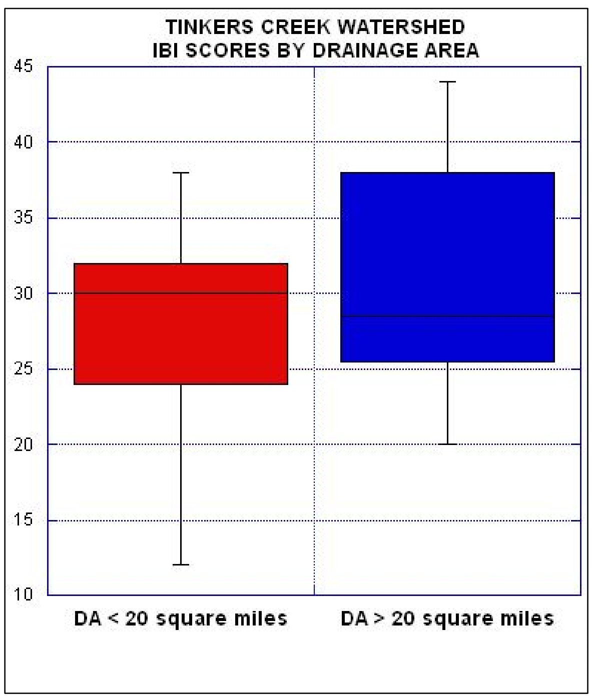


Figure 43: IBI Scores by Drainage Area

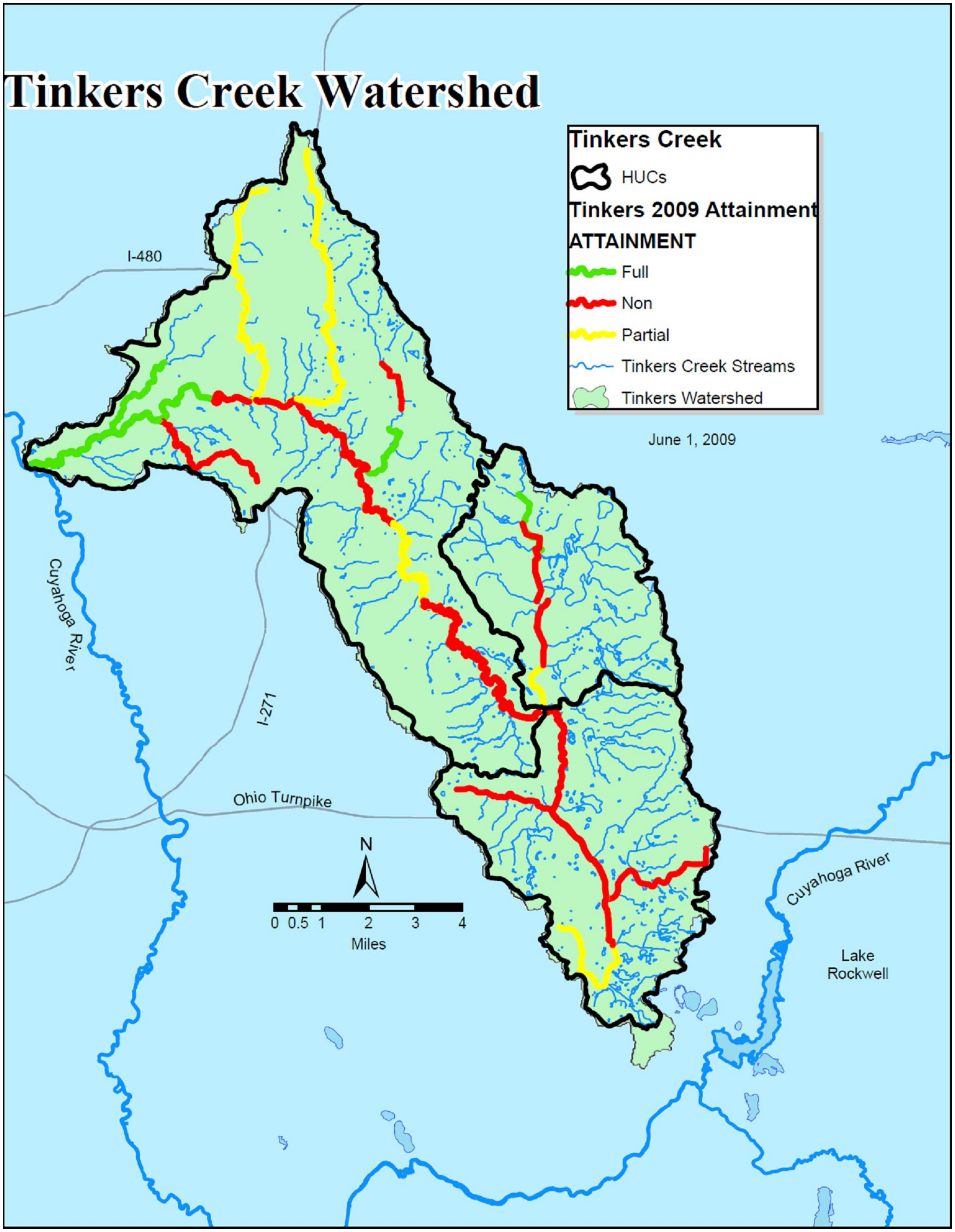


Figure 44: Tinkers Creek Watershed Attainment Status

 # Of Waterbodies/Miles in Full Attainment, # Of Threatened Miles, # Of Waterbodies/Miles in Partial Attainment, # Of Segments/Miles in Non-Attainment, # Of Streams Designated But Not Monitored

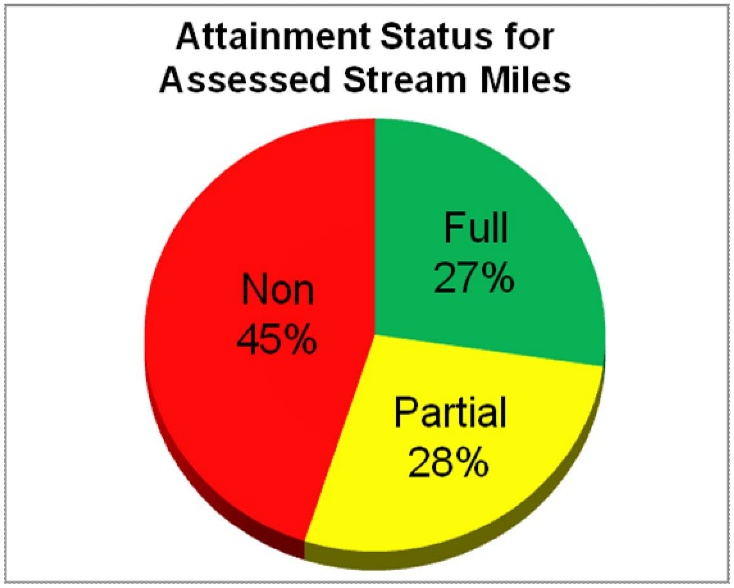


Figure 45: Tinkers Creek Attainment Status

Lakes Quality

Waterbody ID	Lake	Surface Area (Ac.)	County	Lake Uses	Lake Type
OH89 09-306	Tinkers Creek State Park Lake	5	Portage	Recreation	DPI
OH89 09-371	Hudson Springs Lake	45	Summit	Recreation	DPI

Source: Ohio Water Resource Inventory

Hudson Springs Lake in Summit County had been designated in 1997 as a targeted lake for non-point source pollution. According to the data sets, the lake had been experiencing eutrophication. Tinkers Creek State Park Lake had been monitored and tested back in the early 1990's but was concluded to contain insufficient data to determine trophic status.

Aurora Lake is privately owned and located in the Pond Brook watershed. It is estimated to have a surface area of 350 acres. There are a number of beach areas which have been maintained for the residents of the Aurora Shores development. The homeowners association has conducted monitoring for various parameters over the past 30 years.

Fecal Coliform data presented in Figure 46 show that recent sample results are meeting the bathing water standard of 200 MPN (# colonies per 100 ml) as an average and 400 MPN as a maximum. These samples were collected at various points in the lake and have been combined by year for this figure. Bacterial water quality has improved since the 1970's.

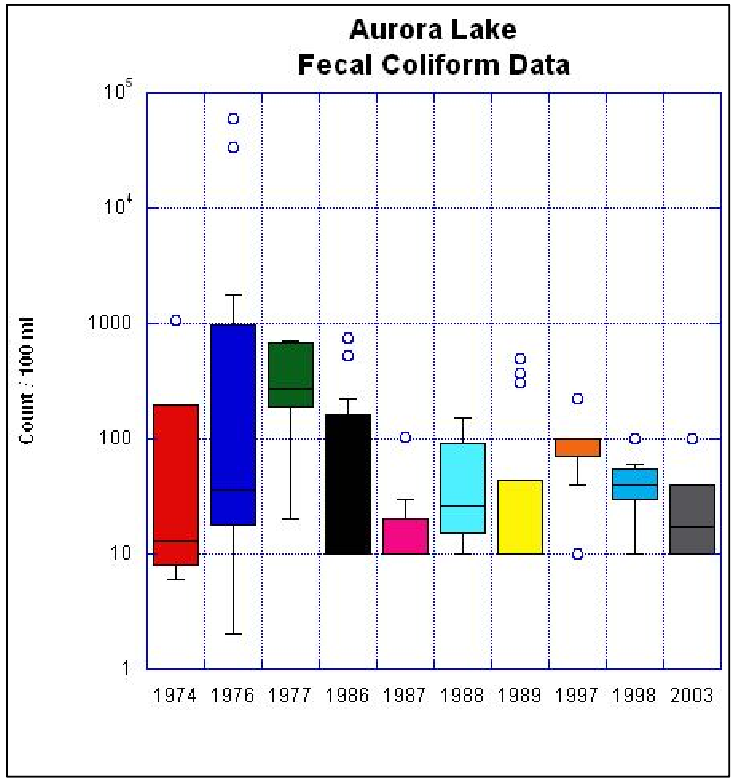


Figure 46: Aurora Lake Fecal Coliform

The secchi disc is a simple device consisting of a plastic disc divided into four alternating colors (black and white) which is lowered into a water body to determine clarity. Clarity is related to chlorophyll concentrations, phosphorus concentrations and trophic status among others. Research has shown that lakes with clarities greater than 5 meters are oligotrophic (low nutrients), those between 3 and 5 meters are mesotrophic (moderate nutrients), clarities between 1 and 3 meters eutrophic (nutrient enriched), and clarities less than 1 meter hypereutrophic (very nutrient enriched). These general descriptions have been applied to secchi disc measurements taken in Aurora Lake between 2001 and 2004. As can be seen in Figure 47, Aurora Lake falls in the hypereutrophic category.

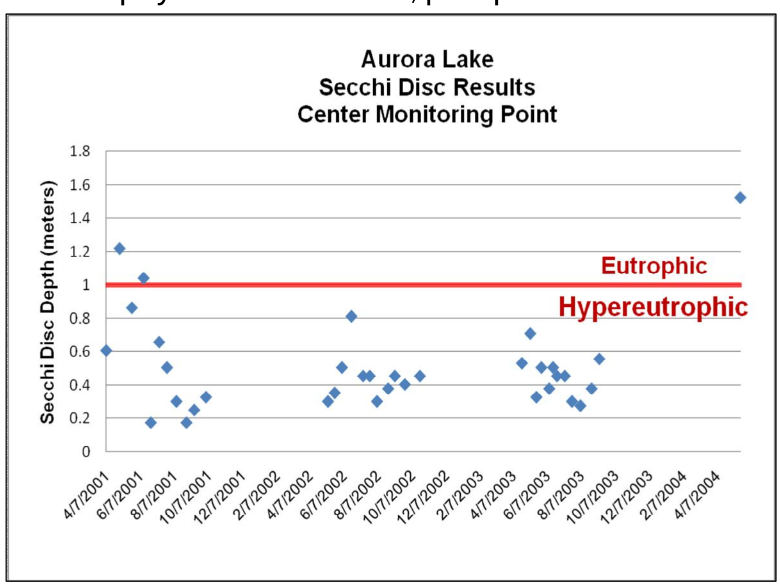


Figure 47: Aurora Lake Tropic Status

Wetlands Quality

Tinkers Creek has a greater number and acreage of wetlands when compared to other tributaries in the lower Cuyahoga River area. Tinkers Creek contains approximately 951 wetlands or 3,917 acres of wetlands throughout the watershed. Like most other impacted watersheds, the range of quality depends on the location of the watershed. The more urbanized locations in Tinkers Creek contain lower quality wetlands than areas that are currently developing or have not been developed yet. ORAM scores were deduced from previous field investigations performed by the Cuyahoga RAP, Davey Resource, and Enviroscience. Clearly, a significant amount of moderate to high quality wetlands exists in the watershed; according to acre size. The table below was taken from the GIS Wetlands Inventory and Restoration Assessment Cuyahoga River Watershed, Cuyahoga County, Ohio, October 2003 (http://www.cuyahogariverrap.org/Wetlands/davey03wetland/GISWetlandsDavey03Report.pdf) prepared by Davey Resources for the Cuyahoga RAP. Tinkers Creek has a relatively rich wetlands inventory, and consequently, a need to protect these important resources.

Watershed	Number of Wetlands	Average Wetland Size (Acres)	Number of Wetlands >1 Acre	Number of Wetlands >5 Acres	Number of Wetlands >10 Acres
Big Creek	91	1.7	46	7	0
Chippewa Creek	135	1.8	52	13	3
Mill Creek	50	1.7	26	4	4
Tinkers Creek	**283**	**2.1**	**132**	**24**	**8**
West Creek	54	1.5	17	3	1
Other*	168	1.5	54	9	2

Table18: Wetlands Statistics by Watershed, from page 7 of the Davey Resources report

ORAM Category	# of Wetlands	Area in Acres
Category 1	8	13
Category 2	61	703
Category 3	93	1,432
Not Categorized	**832**	**1,769**

Table 19: Watershed ORAM Scores *(Tinkers Creek Comprehensive Wetland Assessment and Prioritization Plan for 2007/2008)*

Figure 48: Category 2 Wetland: Hudson, Ohio

The Tinkers Creek Comprehensive Wetland Assessment and Prioritization Plan for 2007/2008 looked to assign a dollar figure to the wetlands located in the watershed. The study looked at the Ecological, Hydrological, and Economic significances of the wetlands to compute dollar figures for the 951 wetlands within the watershed. Variables such as housing values, recreation values, flood reduction benefits, storm water and nutrient retention, permitting costs, and avoided construction costs all were factors included in the models to determine economic values for the wetlands. The larger and higher the category of wetland, the higher the value. The following table demonstrates the average value of the wetlands according to specific needs or uses.

Table 4.3. Economic Values of Wetlands within the Tinkers Creek Watershed.

Category	Value in Perpetuity per Acre of Wetland (2007 U.S. Dollars)	Per Year Value (Perpetual Value*0.03)
Added Housing Value	$976	$29.28
Public Recreation Value (State Parks and Preserve)	$231,423 ($5,273 to $520,523)	$6,943 ($158 to $15,616)
Avoided Flood Costs	$663	$19.89
Avoided Permitting and Mitigation Costs	$110,000 ($85,000 to $135,000)	$3,300 ($2,550 to $4,050)
Stormwater Basin Replacement Costs (Not including water quality treatment)	$18,933	$567.99
Sum of Above per-Acre Values and Avoided Costs	$393,470 ($110,845 to $676,095)	$12,058.95 ($3,325.35 to $20,282.85)

Table 20: Summary of the Economic Value of Wetlands in the Tinkers Creek Watershed

Figure 49: Tinkers Creek State Nature Preserve Wetland

Table 4.1. Summary Table of Wetland Characteristics in the Tinkers Creek Subwatershed, 2007.

Cumulative subwatershed total number of wetlands exceeds entire watershed figure due to wetlands that crossed subwatershed boundaries.

Watershed	Communities	Total Area, ac	% Imperv. (KBA 2005)	# of Mapped Wetlands	Ac of Wetlands	Cat. 1 based on Field Visit	Cat. 2* based on Field Visit	Cat. 3** Based on Field Visit	Not Visited
Entire Watershed		62,942	18.84%	951	3,917	8	63	115	832
1-Tinkers Creek Confluence	Valley View, Walton Hills	1,572	7.16%	23	34.8	0	1	2	20
2-Wood Creek	Bedford, Maple Heights, Walton Hills	2,336	43.70%	10	5.2	0	1	2	7
3- Deer Lick Run	Oakwood, Bedford, Walton Hills	2,134	31.00%	26	24.1	0	0	8	18
4-Tinkers Creek Gorge	Oakwood, Glenwillow, Solon, Bedford Heights, Bedford, Walton Hills	5,113	24.80%	79	106.2	0	0	34	45
5-Hawthorn Creek	Beachwood, Highland Hills, Warrensville Heights, North Randall, Bedford Heights, Bedford, Maple Heights	3,383	39.25%	17	31.2	0	2	1	14
6-Mud Creek	Solon, Glenwillow, Orange Township	4,470	27.77%	63	107.6	0	8	1	54
7-Beaver Meadow Run	Solon, Oakwood, Bedford Heights, Warrensville Heights, Orange Township, Highland Hills, Beachwood	4,569	27.01%	75	129.0	0	4		71
8-Middle Tinkers Creek	Twinsburg, Twinsburg Township, Macedonia, Oakwood, Glenwillow	12,253	16.59%	166	361.5	0	6	8	152
9-Pond Brook	Aurora, Reminderville, Twinsburg, Twinsburg Township, Solon, Bainbridge Township	10,173	10.37%	219	1035.0	2	12	16	189
10-Tinkers Creek State Park	Aurora, Streetsboro, Hudson Village, Twinsburg Township	4,668	7.97%	90	1012.1	0	4	17	69
11-Hudson Springs	Hudson Village	3,084	12.99%	56	63.0	0	4	0	52
12-Bell Run	Streetsboro, Aurora	5,031	17.37%	98	565.4	6	7	13	72
13-Tinkers Creek Headwaters	Franklin Township, Streetsboro, Hudson Village	4,156	6.16%	96	441.4	0	14	13	69

Table 21: Tinkers Creek Watershed Wetland Summary

Figure 50: Wetland Map of Tinkers Creek Watershed

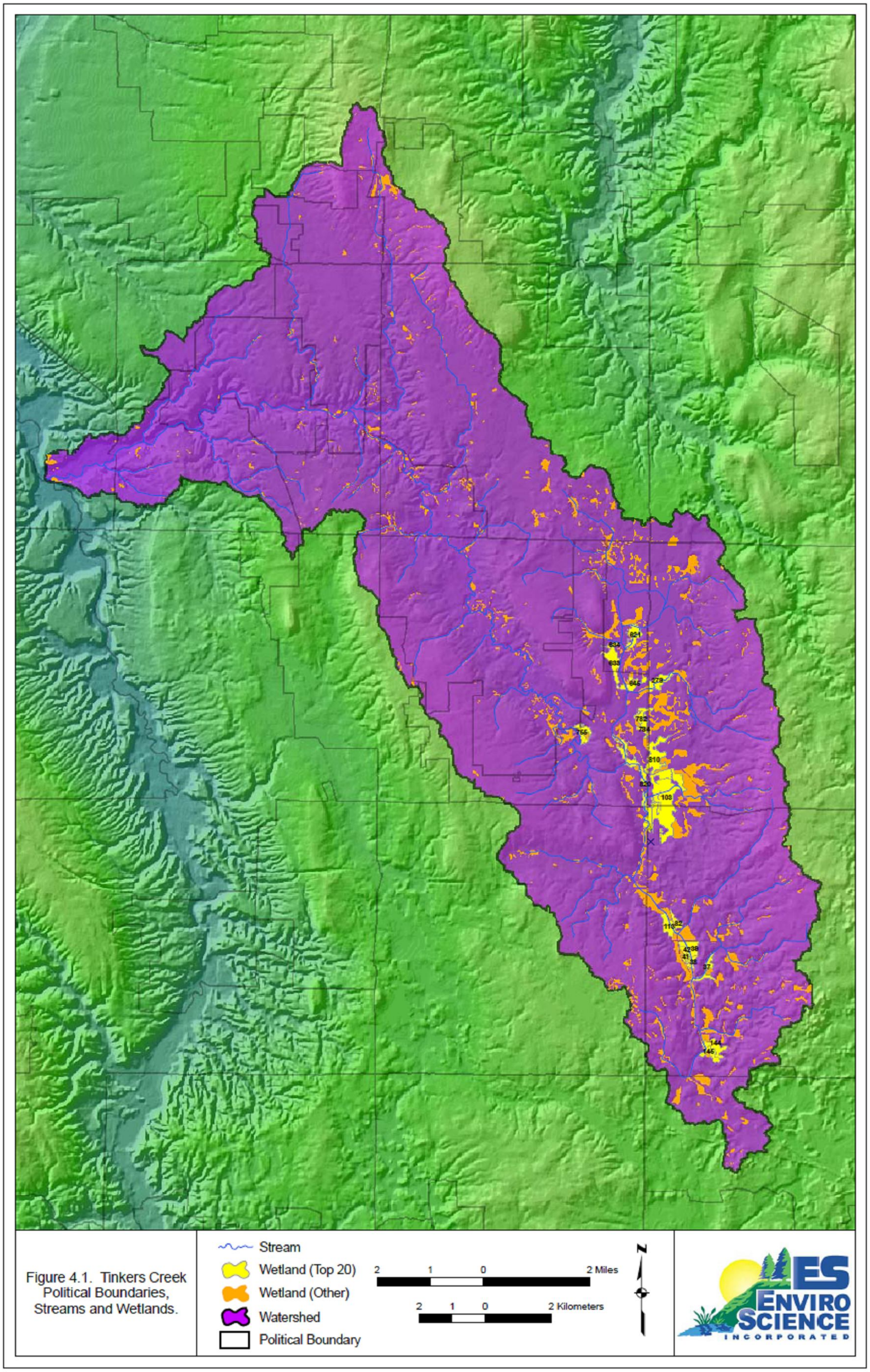


Figure 4.1. Tinkers Creek Political Boundaries, Streams and Wetlands.

Groundwater Quality

See Figure: (Tinkers Creel DRASTIC Map)

I. Causes and Sources of Impairment/Threats

The Ohio EPA has listed the following causes of non attainment as “high magnitude” within the Tinkers Creek HUC #04110002 050: Unknown Cause, Nutrients, Organic Enrichment/DO, Flow Alteration, Direct Habitat Alterations, Oil and Grease, and Natural Limits (wetlands). When listing the causes, Ohio EPA also lists the “high magnitude” sources of nonattainment in the HUC. The “high magnitude” sources are: Major Municipal Point Sources, Land Development/Suburbanization, Urban Runoff/Storm Sewers (NPS), Onsite Wastewater Systems (Septic Tanks), Natural, and Unknown.

Summary of TMDL/ Causes and Sources Continued

The Total Maximum Daily Load (TMDL) process, as established by the Clean Water Act (CWA), is a method for identifying and restoring impaired waterbodies. The CWA Section 303(d) and Chapter 40 of the Code of Federal Regulations Section 130.7 direct each State to identify and prioritize water quality limited segments for which pollution controls required by local, State or Federal authority are not stringent enough to achieve applicable water quality standards (WQS). Further, TMDLs for pollutants that prevent the identified segments from attaining WQS must be established. TMDLs are quantitative assessments of water quality problems contributing to the impairment of these segments.

The lower Cuyahoga River watershed has been identified as a priority impaired water on Ohio’s 303(d) list. Biological and chemical stream surveys indicate that organic enrichment, low dissolved oxygen, nutrients, and flow alteration are the primary causes of impairment in the watershed. A TMDL for the Lower Cuyahoga River was approved by the US EPA in September 2003. The TMDL report can be found on the Ohio EPA web site at: http://www.epa.state.oh.us/dsw/tmdl/CuyahogaRiverLowerTMDL.html. Tinkers Creek is part of the Lower Cuyahoga TMDL area and is addressed in the report. The goal of the TMDL is full attainment of Ohio’s WQS.

As part of the TMDL, a stressor identification study was recommended for the Tinkers Creek watershed. The reasons for this recommendation are to identify current unknown sources of impairment, and to present a methodology for addressing them. The study is ongoing with an anticipated completion in 2009. To date, a number of sources and causes have been explored which include: elevated nutrients, elevated water column turbidity, and PPCPs (pharmaceuticals and personal care products).

The US EPA approved TMDL assigned a phosphorus load to the major dischargers in Tinkers Creek of 59 lbs/day (26.76 kg/day) to meet the Lower Cuyahoga River nutrient target. The major dischargers in Tinkers Creek (Aurora Shores is excluded), have a combined permitted discharge volume of 26.85 MGD and a current weekly maximum permitted phosphorus load of 336.5 lbs/day

(152.64 kg/day). Based on the TMDL assigned load, a weekly maximum permit limit of 0.26 mg/l would need to be assigned to the dischargers. A corresponding monthly permit average of 0.17 mg/l would also need to be assigned. The stressor identification study currently being conducted in the watershed has indicated that nutrient elimination alone will not be adequate to address impairments in Tinkers Creek.

Ohio also uses the ICI index to assess the macroinvertebrate community. Again a maximum score for this index is 60.

Figure 32 presents results of the most recent macroinvertebrate community assessments (ICI score) for sites in the watershed. As is depicted in the figure, macroinvertebrate communities within the basin are generally in attainment with Ohio's biological standards. This is in contrast to the fish community results.

Use Designation

Use designations for the Tinkers Creek basin are contained in OAC Chapter 3745-1-26. Table 16 below contains the use designations for Tinkers Creek.

Water Body Segment			Use Designations							Comments
				Aquatic Life Habitat			Water Supply		Recreation	
			SRW	WWH	MWH	LRW	AWS	IWS	PCR	
Tinkers Creek	Richmond Rd.(RM 8.75) to mouth		☑	☑			☑	☑	☑	
	within boundaries of the J. Arthur Herrik nature preserve (RM 29.3 to 28.9)		☑	☑			☑	☑	☑	
	all other segments			☑			☑	☑	☑	
Wood Creek				☑			☑	☑	☑	
Deerlick Run	RM 0.37 to the mouth		☑	☑			☑	☑	☑	
	all other segments		☑			☑	☑	☑	☑	High gradient
	Southwest Branch of Deerlick Run	Egbert Road (RM 0.45) to mouth	☑			☑	☑	☑	☑	High gradient
		all other segments				☑	☑	☑	☑	High gradient
	South Branch of Deerlick Run		☑			☑	☑	☑	☑	High gradient
	North Branch of Deerlick Run		☑			☑	☑	☑	☑	High gradient
		Hukill tributary				☑	☑	☑	☑	High gradient
		Ferro tributary				☑	☑	☑	☑	High gradient
Bear Creek				☑			☑	☑	☑	
Hawthorne Creek				☑			☑	☑	☑	
Beaver Meadow Run				☑			☑	☑	☑	
Pond Brook					☑		☑	☑	☑	EOLP ecoregion - channel modification
Unnamed tributary (Tinkers Creek RM 25.44)				☑			☑	☑	☑	
	North branch (unnamed tributary RM 0.18)			☑			☑	☑	☑	
Unnamed tributary (Tinkers Creek RM 27.72)				☑			☑	☑	☑	

Table 22: Tinkers Creek Use Designations

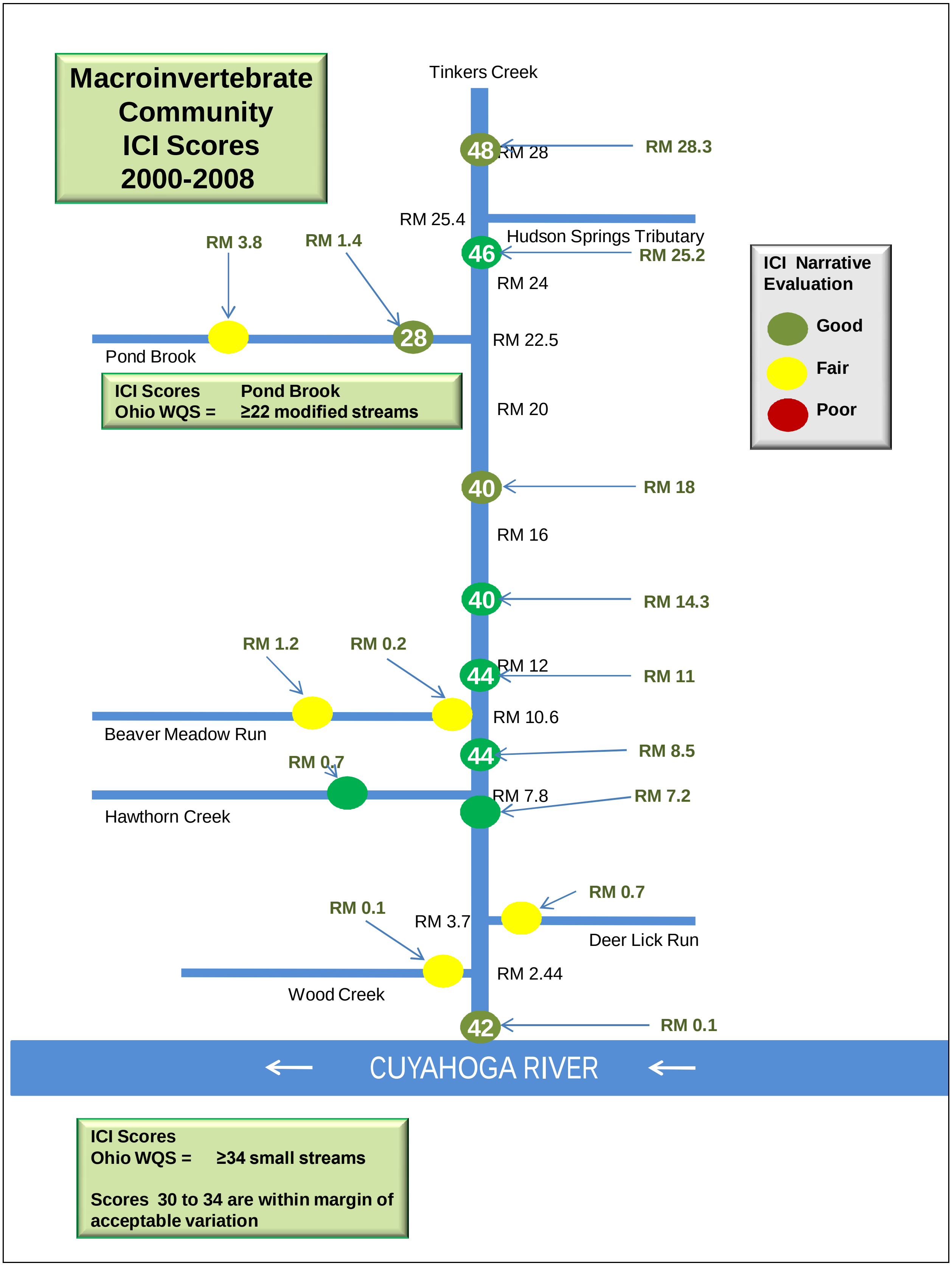


Figure 51: Tinkers Creek Invertebrate Community Index Scores

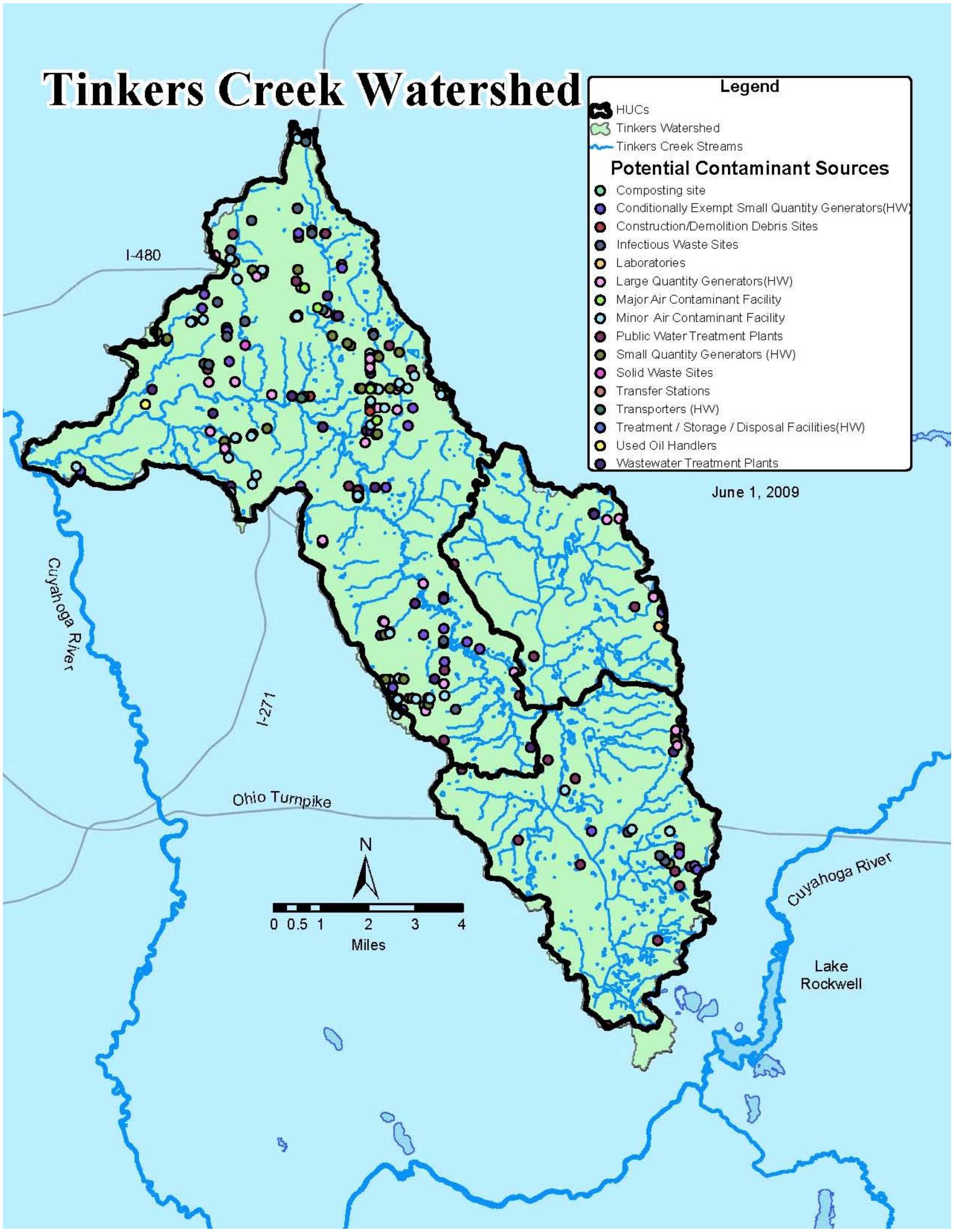


Figure 52: Tinkers Creek Potential Point Source Impairment Sources

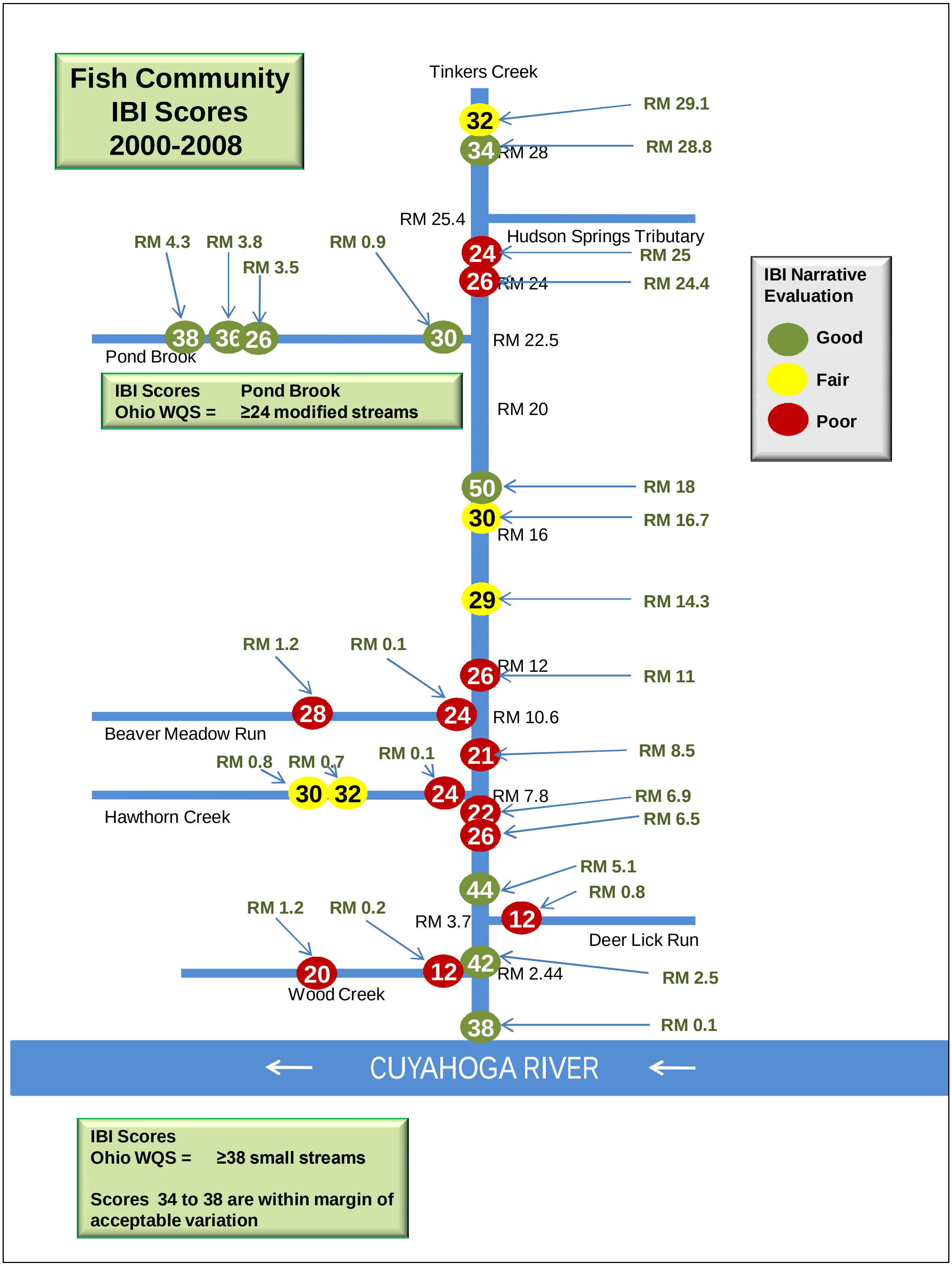


Figure 53: Tinkers Creek Index of Biological Integrity Scores

Point Source Impairments

Point source discharges to the Tinkers Creek watershed are regulated by the Clean Water Act. A regulated discharge requires a permit issued under the National Pollutant Discharge Elimination System (NPDES). There are currently seven larger wastewater treatment facilities which discharge in the watershed, several small package plants and 2,101 HSTS. A brief description of each is included in the following paragraphs.

Discharges (NPDES Permitted)

The Portage County Hudson-Streetsboro WWTP was originally constructed in 1985. The average daily design flow was upgraded from 2.5 MGD to 4.0 MGD in 2001 with a peak hydraulic capacity of 10.0 MGD. Wet stream processes include influent screening, communation, grit removal, scum removal, contact stabilization, clarification, nitrification, sand filtration, and chlorination/dechlorination. Sludge is aerobically digested, dewatered using a belt filter press, and placed into drying beds. Sludge is ultimately disposed of by land application. The Streetsboro sewerage system is 100% separate. The County does not have an approved pretreatment program.

The City of Aurora Westerly WWTP was replaced by a new plant in 1988-89 and the last major modification was in 1999. The facility has a design flow of 1.4 MGD. The current system includes bar screening, grit removal, oxidation ditch, final clarification, phosphorus reduction, rapid sand filtration, ultraviolet disinfection, and post aeration. Sludge handling facilities include aerobic sludge digestion, and sludge drying beds. The Aurora Westerly WWTP collection system is 100% separate sewers. To minimize inflow and infiltration annual sewer inspections are performed on the system. No significant industrial users of this WWTP have been identified; therefore no pretreatment program is required.

The Summit County Aurora Shores WWTP was originally constructed in 1985. The average daily design flow was upgraded from 0.25 MGD to 0.5 MGD in a 1996 PTI. Wet stream processes include influent screening, communation, extended aeration, secondary clarification, tertiary sand filtration, and ultraviolet disinfection. Sludge is aerobically digested and dewatered using a belt filter press. Sludge is ultimately disposed of by land application. The Aurora Shores sewerage system is 100% separate.

The City of Twinsburg WWTP is an advanced treatment facility. The plant is designed to treat an average daily hydraulic flow of 4.95 MGD, with a peak hydraulic capacity of 10.2 MGD. Current wet stream processes at the facility include aerated flow equalization, aeration, screening and grit removal, primary settling, phosphorus removal, activated sludge aeration, secondary clarification, tertiary treatment using micro-strainers, disinfection by chlorination, and dechlorination by sodium bisulfite. Solid stream processes are sludge stabilization using anaerobic digestion, dewatering using a filter press, sludge storage, and sludge disposal in accordance with an approved sludge management plan. The City has an approved pretreatment program, with four categorical industrial users and five noncategorical industrial users discharging to the WWTP. The Twinsburg WWTP collection system is 100% separate.

The City of Solon Water Reclamation Facility was built in 1962 with a major modification occurring in 1997. The treatment process at the plant includes an equalization basin, bar screens, grit removal, primary settling, oxidation towers, aeration, secondary settling, rapid sand filters, ultraviolet disinfection, gravity thickeners, anaerobic sludge digestion, belt filter press, and lime stabilization. The plant design capacity is 5.8 MGD with a hydraulic capacity of 9.6 MGD. The Solon sewer system is 100% separate.

The city implements an approved industrial pretreatment program. Eight categorical industrial users and fifteen non-categorical significant industrial users discharge to the Solon WWTP. Among these are food processors, hair care product manufacturers, commercial laundries, bakeries, and metal plating facilities.

The City of Bedford Heights WWTP was built in 1958 and it treats both domestic and industrial wastewater using tertiary treatment technology. The average design flow for this facility is 7.5 MGD while the peak hydraulic capacity is 15 MGD. The last major modification to the Bedford Heights WWTP was in 1984. The wet stream processes include the preliminary treatment of the influent through the use of bar screens, grit removal and prearation. This is followed by primary settling, aeration, final settling, rapid sand filtration, and chlorination/dechlorination. The City of Bedford Heights WWTP collection system is 100% separate.

Bedford Heights' industrial pretreatment program was approved by the Ohio EPA on August 21, 1984. On November 27, 1991, Bedford Heights adopted their local sewer use ordinance and added the Pretreatment Implementation Review Task Force requirements to their program. The program's industrial user permits and the Enforcement Response Plan were both approved on October 27, 1992. Three categorical industrial users (IU) discharge to the treatment plant. These include two iron and steel manufacturers and one metal molding manufacturer.

The City of Bedford WWTP was originally constructed in 1937 its last major modification was in 2007. The average daily design flow is 3.2 MGD. Wet stream processes include influent screening, communation, grit removal, flow equalization, primary clarification, trickling filters, rapid sand filtration, and chlorination/dechlorination. Sludge is aerobically digested and dewatered using a belt filter press. Class B sludge is ultimately disposed of at the PPG Lime Lakes Reclamation site. The Bedford sewerage system is 100% separate. The City does not have an approved pretreatment program.

The WWTP does not have an approved pretreatment program. There is one Ohio EPA permitted industrial user tributary to the plant.

Table17 below contains a list of all individual NPDES permitted facilities in the basin.

Table 23: Individual NPDES permitted dischargers in the Tinkers Creek watershed

ENTITY	RECEIVING STREAM	DISCHARGE VOLUME GPD	PERMIT NO.
City of Bedford	Wood Creek (Tinkers Creek)	3,200,000	3PD00005
City of Bedford Heights	Hawthorne Creek (Tinkers Creek)	7,500,000	3PD00006
City of Solon	Beaver Meadow Run (Tinkers Creek)	5,800,000	3PD00019
City of Aurora Westerly WWTP	Pond Brook (Tinkers Creek)	1,400,00	3PD00046
Portage County Streetsboro WWTP	Tinkers Creek	4,000,000	3PK00014
City of Twinsburg WWTP	Tinkers Creek	3,400,000 (expansion to 4.95)	3PD00039
Mikulski Apartments (Summit Co., Hudson)	UT to Tinkers Creek	1,750	3PR00188
Aurora Shores, Summit Co.	Pond Brook	500,000	3PG00030
Glen Willow Properties	Tinkers Creek	Storm Water	3IN00164
Morgan Matroc, Inc.	UT to Tinkers Creek	Treated Groundwater (0.0144 MGD- system not yet installed)	3IE00067
Nestle Prepared Foods	Tinkers Creek	NCCW	3IH00061
Osborne Company	Tinkers Creek	Storm Water, Process	3IJ00041
Zircoa	UT to Tinkers Creek	Storm Water, Process (0.189 MGD)	3IE00014

Table 23: Individual NPDES permitted dischargers in the Tinkers Creek watershed			
ENTITY	RECEIVING STREAM	DISCHARGE VOLUME GPD	PERMIT NO.
Aurora Terminal & Transport	Tinkers Creek	Storm Water	3IG00033
Rotek Inc.	UT to Tinkers Creek	Storm Water	3II00158
Sea World	Geauga Lake to Tinkers Creek	Storm Water, NCCW	3IN00212
Aerosol Systems	UT to Tinkers Creek	Treated groundwater (0.014 MGD)	3IN00298
Conrail - Macedonia Yard	UT to Tinkers Creek	Storm Water	3IT00013
Cajon - Macedonia	Tinkers Creek	4,000 gpd sanitary, NCCW	3IG00021
Diamler Chrysler	UT to Tinkers Creek	Storm Water	3IS00030
Northfield Park	UT to Tinkers Creek	Storm Water	3IN00314
Tri County Concrete - Twinsburg	UT to Tinkers Creek	Storm Water, Process	3IN00319

The watershed contains significant operations that could contribute to the overall degradation of water quality in the creek. Figure 54 below indicates the approximate locations of those known point source dischargers. In addition, Figure 54 indicates the locations of the "significant" NPDES permit holders in the watershed. Sometimes illicit discharges occur and it is difficult to track them back to their source. WWTP's can handle the removal of organic materials but sometimes compounds such as pharmaceuticals, dyes, and an overabundance of heavy-metals can "pass through" this treatment process. It is becoming more evident that industries and commercial operations will need to create stricter protocols and standards to accommodate for illicit discharge potential.

Figure 54: Tinkers Creek "Significant" NPDES Permit Holder Locations

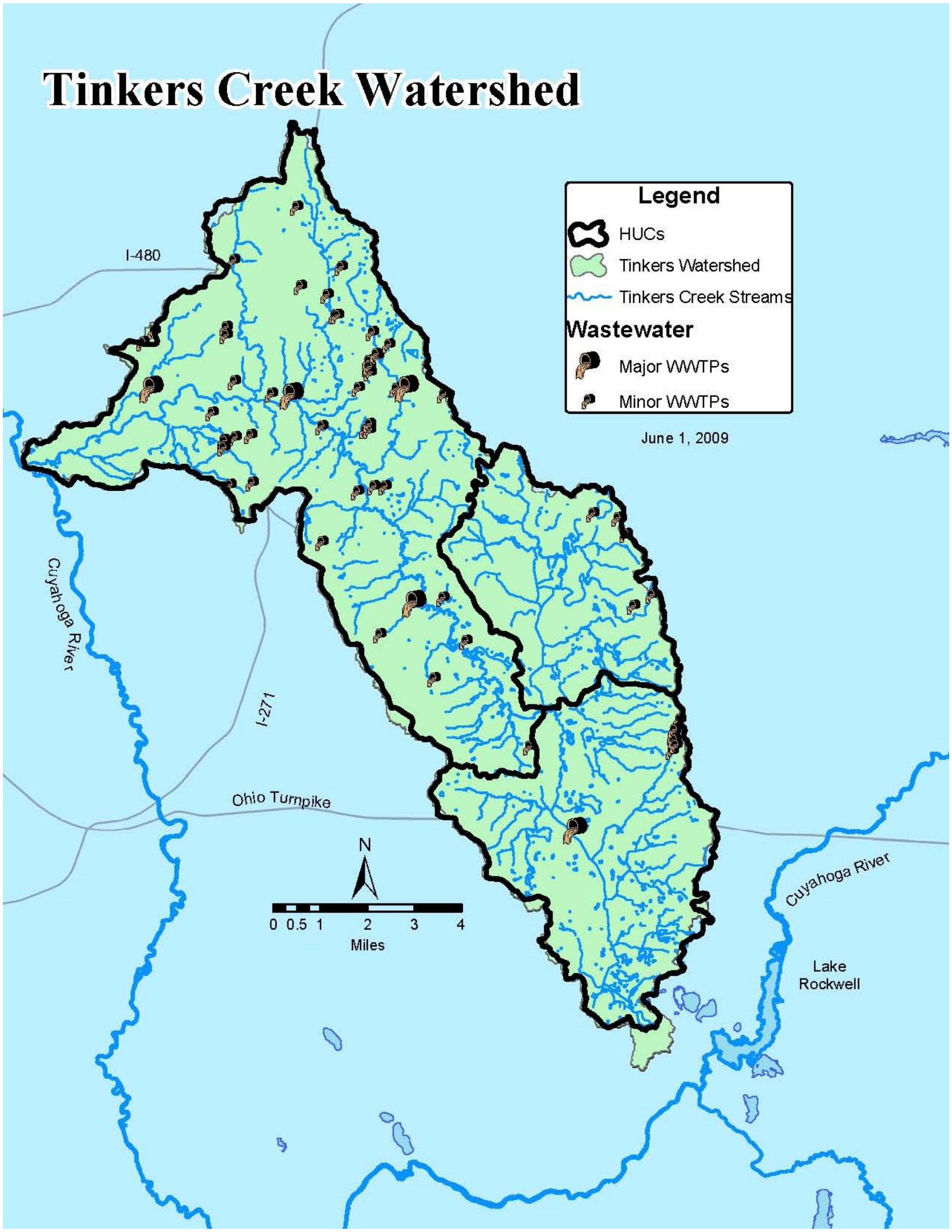


Figure 55: Tinkers Creek WWTP's (Municipal & Package)

Figure 56: Non-Permitted Illicit Discharge of Green Liquid into Tinkers Creek (Outfall from WWTP)

Spills & Illicit Discharges

A file has been created and is kept at the Cuyahoga County Board of Health (CCBH) which contains all historically reported spills and illicit discharges into Tinkers Creek. Any interested party can call Mike McNutt, Watershed Coordinator, at 216-201-2001 x1224 to request this information or write a letter to Mike McNutt, CCBH, 5550 Venture Dr. Parma, OH 44130.

J. Non-Point Sources

The major nonpoint source impacts in the watershed are a result of suburbanization and urbanization. Impacts associated with these sources include an increased sediment load to the streams which result in decreased substrate heterogeneity and overall habitat quality. This is observed in many smaller tributaries and the Tinkers Creek main stem from its headwaters into Twinsburg.

Increases in impervious surface area also results in flashier stream flows which are partially responsible for channel incision and bank destabilization, both noted as occurring in the watershed.

Headwaters Quality

Detailed assessments of headwater streams within the watershed are limited. It is fair to assume that the number of primary headwater streams (>1 square mile in drainage) has decreased since pre-settlement. These small streams are often lost due to development. There are still high quality headwater streams influenced by groundwater remaining in the watershed in such areas as Twinsburg and Aurora.

It is recommended that a watershed-wide assessment of primary headwater streams be conducted to determine overall quality of this watershed component.

Figure 57: Complete destruction of a primary headwater stream for development purposes (HUC # 4110002-050-050)

TMDL Pollutant Load Allocations

As discussed previously, a load limit of 59 lbs/day has been assigned to the major wastewater treatment plant dischargers in Tinkers Creek.

Appendix J of the 2003 TMDL report discusses load calculations completed for Tinkers Creek. Figure 33 taken from the TMDL report indicates that Tinkers Creek may be enriched for phosphorus under all flow conditions; Figure 34 taken from the TMDL report shows that exceedences of bacteria may only be occurring under wet weather conditions for Tinkers Creek. The relative contributions of the current total phosphorus load in Tinkers Creek is estimated in Figure 35 taken from the TMDL report.

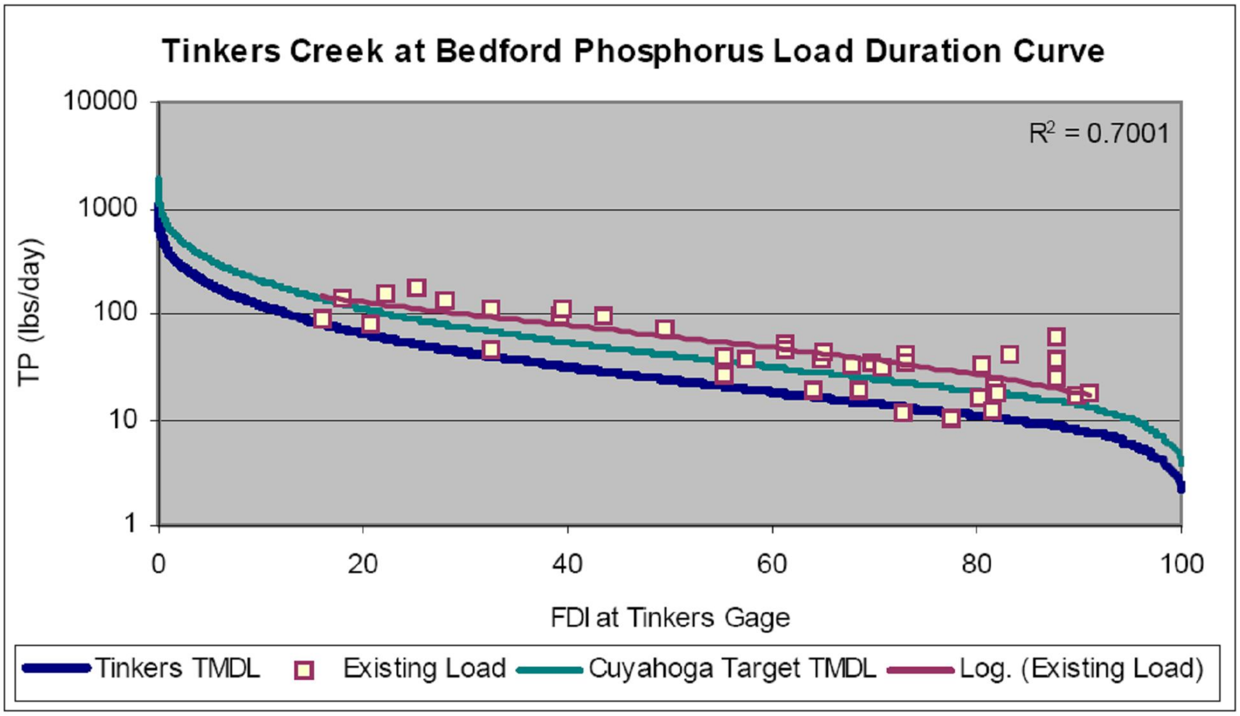


Figure 58: Phosphorus loads during different flow regimes

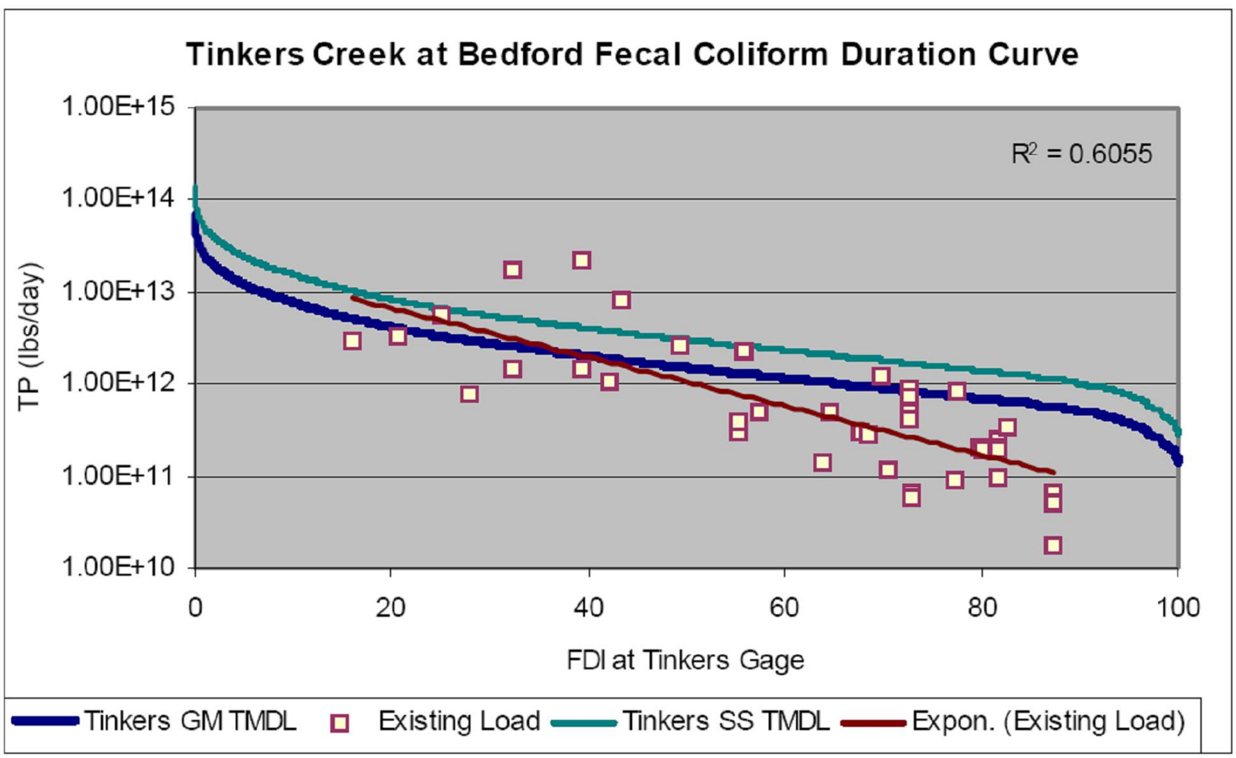


Figure 59: Bacteria Exceedences During Different Flow Regimes

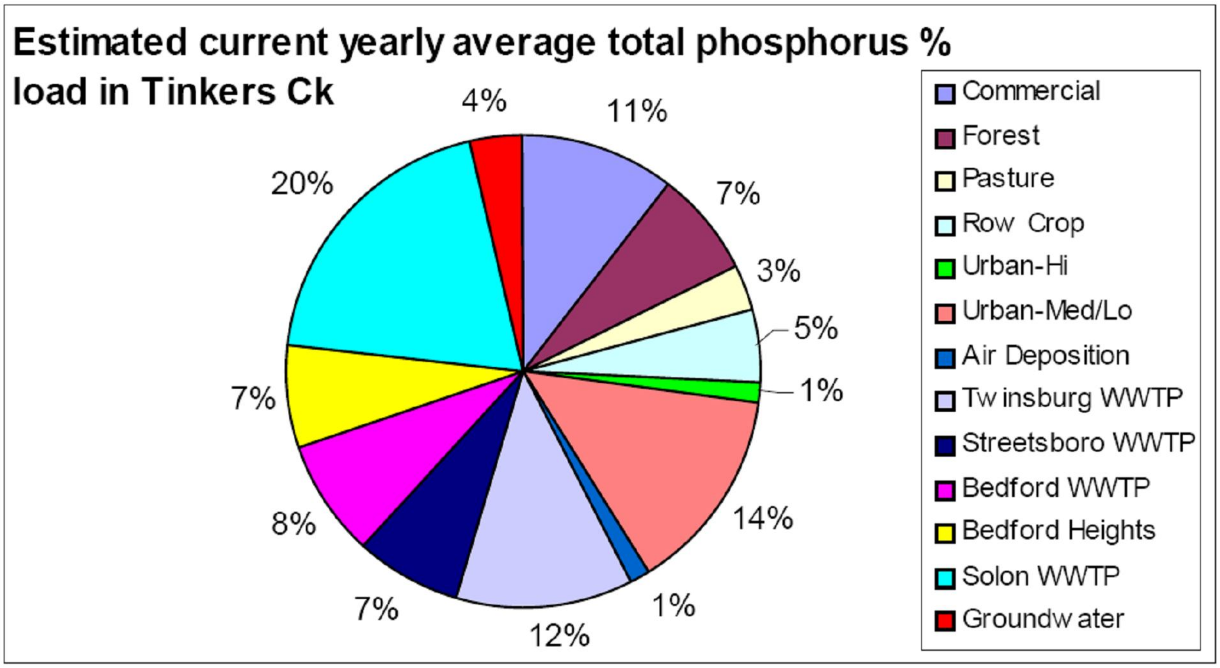


Figure 60: Phosphorus Load Contributions on the Tinkers Creek Watershed

Inventory of HSTS
There are 2,101 HSTS systems in the watershed. Of them, approximately 25.4% are failing or 534 systems. 270 are failing in Cuyahoga County alone.

of New Homes Being Built
Because of the shaky economy and the slow down of new home builds, the amount of new homes being built in 2009 is approximated to be 77. However, the potential exists for a total of 198 homes to be built started or actually built in within this year.

and Size of Animal Feeding Operations
N/A

Acres of Highly Erodible Land & Potential Soil Loss
Current data does not exist to accurately answer this section. Although, the watershed does contain soils that could be considered erodible and because sedimentation is a leading water quality problem in the watershed; the erodibility of soils is a concern.

Is the Stream Culverted?
Tinkers Creek, like any other urban watershed has many culverts to contend with. The watershed contains approximately 1,497 stream crossings or culverts.

Is the Stream Channelized?

As discussed in prior sections, the Tinkers Creek Watershed has approximately 52 miles of channelized streams. The channelization is mostly confined to HUC# 4110002-050-030 and HUC# 4110002-050-040.

Is Stream Levied?

N/A

Does Stream Exhibit Little Human Impact?

Tinkers Creek, like most other urban watersheds, receives significant impacts from human interaction either directly or indirectly. This urban watershed is impacted from point source discharging, non-point source pollution, careless behavior, and a lack of education toward local decision makers and residents alike. Many decisions made long ago are only now being recognized as a potential water quality impairment; i.e. too much water in a stream from standard development and engineering practices. The solution to this problem lies with an ideological shift toward recognizing that the health of watersheds is crucial to the health of humans.

Figure 61: Typical Litter in Urban Stream

What is the Effluent Volume?

Tinkers Creek is an effluent dominated stream. As shown in Table 24 below, the stream can consist of >75% effluent during low-flow periods in the summer. A stream dominated by effluent is likely to be heavily influenced by the quality of effluent in the dischargers.

The wastewater treatment plants included in Table 24 are the largest contributors of flow to the stream other dischargers exist in the basin but are not included in this evaluation. Between 1960 and 1970 the basin saw an 83% increase in median stream flows, most likely due to population increases in the suburban communities, which resulted in increased flows to the wastewater treatment plants. Over the years many improvements have been made at the individual plants which has resulted in the high level of treatment and excellent compliance records seen today. This has resulted in improved macroinvertebrate, communities (generally meeting goals of the Clean Water Act. Fish communities in the watershed, namely tributaries and Tinkers Creek upstream of the natural waterfall, continue to show signs of impairment. In this case the discharges from the plants are one of several factors considered responsible for the impairments.

Table 24: Effluent Volume

Decade Flow Averages				WWTP	Flow	Flow
1960's	Average	100.23	CFS		MGD	CFS
	Median	36.00	CFS	Aurora Shores	0.25	0.387
1970's	Average	142.67	CFS	City of Solon Water Reclamation	5.8	8.973
	Median	66.00	CFS	Bedford Heights WWTP	7.5	11.603
1980's	Average	133.42	CFS	Streetsboro WWTP	4	6.188
	Median	68.00	CFS	City of Twinsburg WWTP	4.95	7.658
1990's	Average	143.29	CFS	Aurora Westerly WWTP	1.4	2.166
	Median	69.00	CFS	**Flow at Gage**		**36.973**
2000's	Average	133.55	CFS	**2000's Summer**	**73.9%**	percent effluent at gage
	Median	70.00	CFS	Bedford WWTP	3.20	4.9504
2000's Summer	Average	137.97	CFS	**1970-2000's**	**54.4%**	percent effluent at gage
	Median	50.00	CFS	**2000's Summer**	**76.3%**	estimated percent effluent at Canal Road
1970-2000's	Average	139.10	CFS	**1970-2000's**	**57.5%**	estimated percent effluent at Canal Road
	Median	68.00	CFS			

Is the Streamed Dammed? How many Stream Miles are Impounded?
The watershed contains 3 low head dams and no water is impounded.

Officially Classified &/or Unofficially Maintained as a Petition Ditch (es)?
N/A

Status & Trends (Areas where Water Quality is in Attainment, but Local Information Indicates the Current Situation, if Unchanged, will likely Result in Water Quality Degradation)
All current data regarding water quality in Tinkers Creek according to the Ohio EPA is current and no local information exists to indicate otherwise.

IV. Watershed Impairments

Tinkers Creek Watershed Impairments have been identified through the data collection and reporting of the Lower Cuyahoga TMDL, as well as, the Great Lakes Water Quality Agreement which has designated the Lower Cuyahoga River as an Area of Concern (AOC) which assess and provides beneficial uses to a water body. In addition, community input from elected officials and residents has also provided a watershed resident perspective on the health of the stream. The identified impairments are used to develop problem statements and corresponding solutions.

A. Additional TMDL Information

The following information provided is from the Lower Cuyahoga River TMDL which was completed and finalized in September 2003.
Tinkers Creek is the largest tributary of the Cuyahoga River and drains portions of Portage, Geauga, Summit and Cuyahoga counties. Tinkers Creek has a

drainage area of 96.4 square miles and a total length of about 30 miles and enters the Cuyahoga River at RM 16.36. The watershed lies on a glaciated plateau. Soils are mostly silt loam and clayey silt loam. Wetland swamps, bogs and fens are common in the upper watershed.

Flows in the lower section of the creek are highly influenced by the discharge of treated wastewater from upstream WWTPs; in 1991 the combined effluent had a median discharge of 11.623 mgd or 17.9 cubic feet per second (cfs). Portions of the stream are on bedrock and form waterfalls which are a natural barrier to fish passage. The lower portions of the stream have formed the Tinkers Creek Gorge which is a National Natural Landmark. Recent acquisitions in the basin by MetroParks Serving Summit County and the Cleveland Metro Parks have increased the amount of protected watershed in the basin. Many local communities are also involved in protecting and acquiring parkland in the basin.

The 1996 Tinkers Creek water chemistry data collected at RM 0.1 showed no exceedences of WQS Criteria. However, nitrate concentrations continue to be markedly elevated with a mean 6.81 mg/l (the 1991 mean was 7.6 mg/l). In contrast to lower Tinkers Creek, the median nitrate concentration from similarly sized reference streams in the EOLP ecoregion is 0.425 mg/l (n=298) (Ohio EPA 1999c). The excessive nitrates reflect the effluent dominated nature of the creek and improved ammonia nitrification at the major municipal WWTPs in the basin.

While certainly less toxic than ammonia, it is possible that elevated nitrates may limit biological potential in Tinkers Creek. Water quality conditions at the mouth have not changed appreciably when compared to 1991results. The headwaters of Tinkers Creek are wetland influenced and support fair quality fish communities, fairly typical of swampy streams. Further downstream, fish communities drop to the poor range downstream from the Streetsboro WWTP. Changes to the watershed include increased stretches of channelized habitat and increased suburban development. Nutrient levels were elevated below the WWTP but other factors, such as barriers to fish migration (i.e., waterfalls located downstream at RM 5.6), excessive turbidity, or other unknown causes and sources of impairment may contribute to the NON attainment.

Tinkers Creek becomes increasingly urbanized and effluent dominated as it flows downstream. Physical habitat at the mouth of Tinkers Creek is capable of supporting a typical warmwater stream fauna; the QHEI score was 70.5. The channel was sinuous and well developed, and contained boulder, cobble and gravel substrates. Woody debris was also present in the channel. The creek receives inputs from major WWTPs in Aurora, Twinsburg, Bedford, Bedford Heights, and Solon. Nutrient levels were persistently elevated downstream from the point sources, particularly below the Solon WWTP (via Beaver Meadow Run) and Bedford Heights WWTP on Hawthorne Creek.

Fish communities in 2000 remained in the poor to fair range and have shown minimal improvement over the past decade. Macroinvertebrates meet WWH criteria but tended to decline from upstream to downstream. Significant improvement in the macroinvertebrates at RM 8.5 was related to the elimination of oil and grease contamination below the county garage since 1991.

B. Watershed Stressors

Organic Enrichment

Loss of the riparian area, lawn clippings and yard waste combine to increase the amount of organic material in the system.

Nutrient Enrichment

Loss of the riparian area, urbanization and the use of lawn fertilizers, pet and wild fowl waste, and the loss of a consistent tree canopy contribute to the increase of nutrients in the system.

Table 5. Target Concentrations for Phosphorus and Nitrate-Nitrite

Target Concentrations for Phosphorus		
Erie-Ontario Lake Plain		Phosphorus Concentration (mg/l)
Headwaters	<20 mi^2	0.05
Wadable	>20 mi^2 <200 mi^2	0.07
Small Rivers	>200 mi2 <1000 mi^2	0.12
Target Concentrations for Nitrate-Nitrite		
Erie-Ontario Lake Plain		Nitrate-Nitrite Concentration (mg/l) (75th % value)
Headwaters	<20 mi^2	1.0
Wadable	>20 mi^2 <200 mi^2	1.05
Small Rivers	>200 mi2 <1000 mi^2	1.42

Figure 62: Lower Cuyahoga TMDL Phosphorus/Nitrogen Targets

Low In-Stream Dissolved Oxygen

Decomposing organic material and high nutrient levels cause both algal blooms and corresponding decay when those plants die off. This process is exacerbated in the summer months and causes a reduction in biological diversity by robbing the aquatic life of oxygen.

Toxicity

Combining several of the water quality degraders produces conditions which are toxic to biological sustainability. The input of non-point source pollution from the surrounding landscape coupled with the effluent discharges has created toxic conditions for biological species.

Sedimentation

Tinkers Creek experiences very high sediment loading caused from significant increases in storm water loading. On average the watershed is 21% impervious cover. Most tributary streams and the main stem itself, are becoming incised as the increased water volumes scour the stream banks causing major sedimentation issues.

Habitat Degradation

The Tinkers Creek Watershed, like most urban watersheds, continues to experience a net loss of habitat both for terrestrial and aquatic species alike. Loss of riparian areas, poor water quality, loss of connectivity to green corridors, and urbanization has contributed to the low QHEI scores throughout most of the watershed.

Bacteria

Failing Septic systems, Combined Sewer Overflows (CSO's), and non-point source pollution from impervious land cover is contributing to high bacterial levels in the watershed.

Yet Unknown Impairments

The Lower Cuyahoga TMDL indicates a water quality degrader which of unknown composition. The likelihood of influence from the 7 WWTP's discharging within its watershed boundary could be influencing fish populations. Evidence of pharmaceutical compounds influencing aquatic biology negatively is being studied. These unknown impairments could be a direct result of those pharmaceutical compounds.

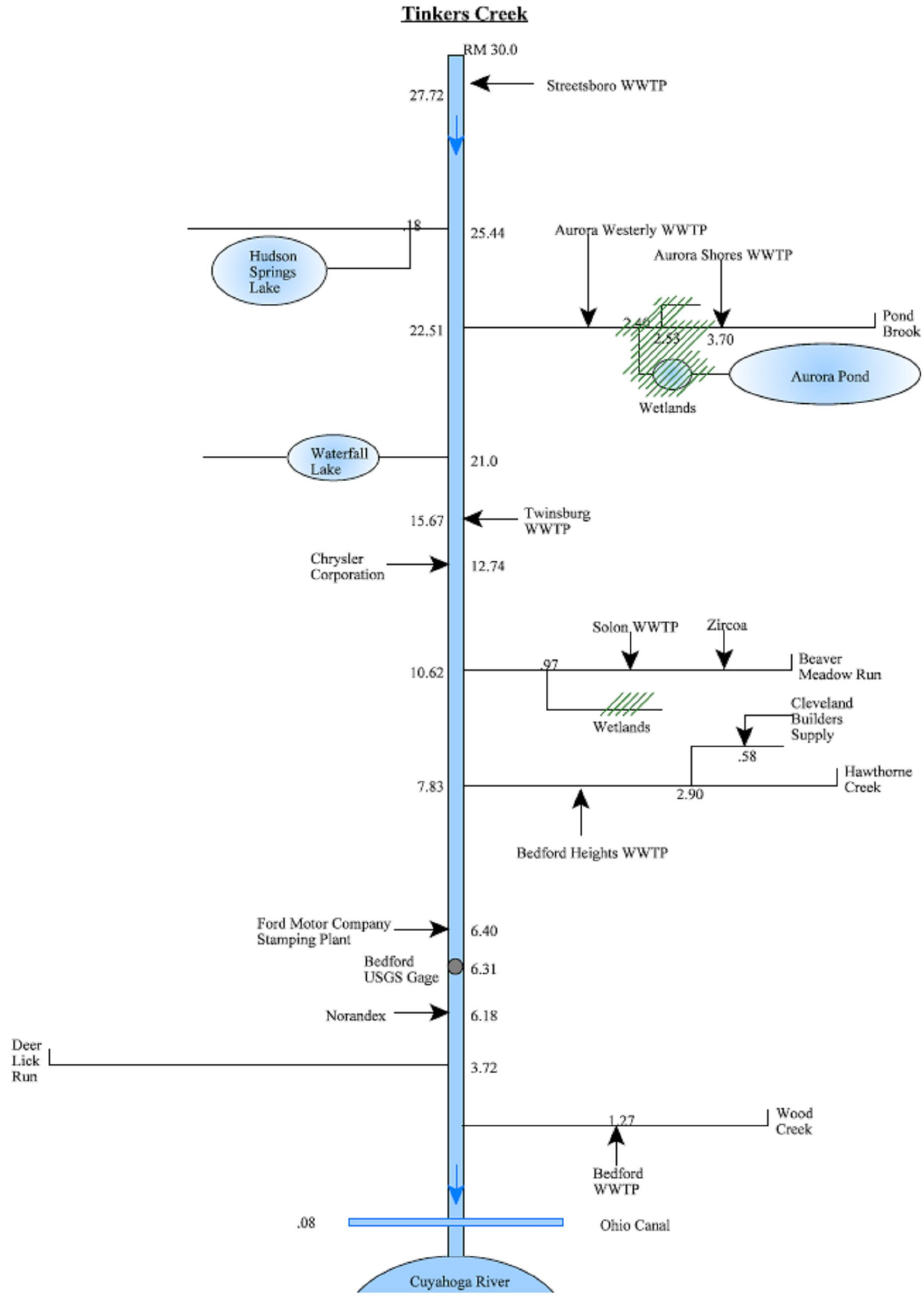


Figure 63: Schematic of the Tinkers Creek Watershed and its WWTP's

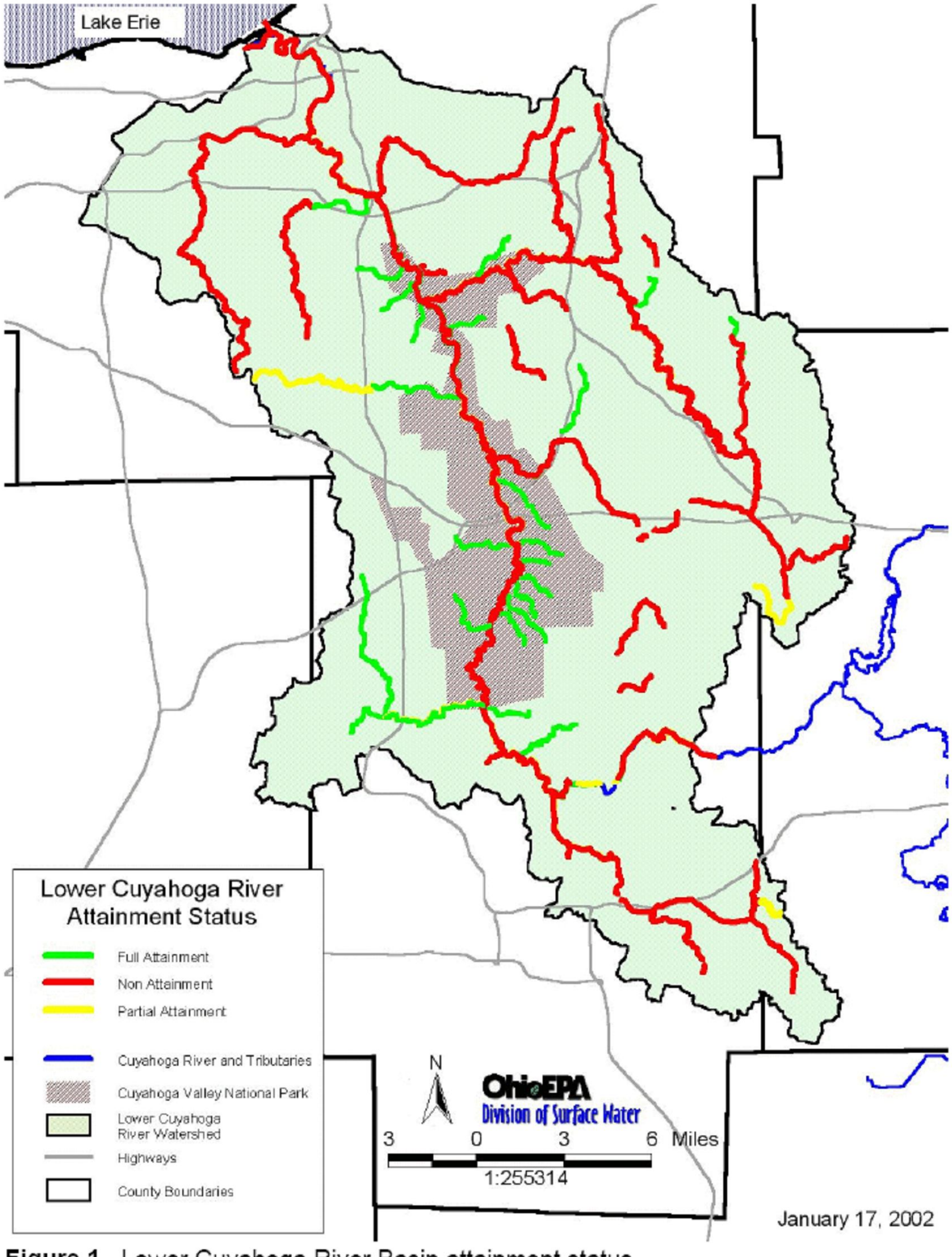


Figure 1. Lower Cuyahoga River Basin attainment status

Figure 64: Attainment status of the Lower Cuyahoga Watershed

C. Cuyahoga RAP AOC Beneficial Use Impairments Delisting

The Lower Cuyahoga River is part of the Cuyahoga River Remedial Action Planning Area. The Great Lakes Water Quality Agreement of 1978, and its 1987 Protocol Amendments, required identification of Areas of Concern and identified a list of 14 beneficial use impairments to be addressed in the Remedial Action Plan. Annex 2 of the Great Lakes Water Quality Agreement contains the following beneficial use impairments:

- restrictions on fish and wildlife consumption;
- tainting of fish and wildlife flavor;
- degradation of fish wildlife populations;
- fish tumors or other deformities;
- bird or animal deformities or reproduction problems;
- degradation of benthos;
- restrictions on dredging activities;
- eutrophication or undesirable algae;
- restrictions on drinking water consumption, or taste and odor problems;
- beach closings;
- degradation of aesthetics;
- added costs to agriculture or industry;
- degradation of phytoplankton and zooplankton populations; and
- loss of fish and wildlife habitat.

In 1988 the Ohio EPA appointed the Cuyahoga River RAP Coordinating Committee and charged them to identify the existing use impairments, their sources and causes, and to develop and implement remedial measures or actions to eliminate the impairments.

The 1992 *Cuyahoga River Remedial Action Plan Stage One Report - Impairments of Beneficial Uses and Sources of Pollution in the Cuyahoga River Area of Concern* identified loss of habitat, non-point sources of pollution, dams, and combined sewer overflows as the principle causes of the use impairments in the lower Cuyahoga River watershed *(Source: Lower Cuyahoga River TMDL)*.

Beneficial Use Impairments

BENEFICIAL USE IMPAIRMENTS	1996 ASSESSMENT	2001 ASSESSMENT	2008 ASSESSMENT
1.a Restrictions on Fish Consumption	IMPAIRED	IMPAIRED	IMPAIRED Consumption advisory still in place
1.b Restrictions on Wildlife Consumption *	UNKNOWN	POSSIBLY NOT IMPAIRED	NOT IMPAIRED No consumption advisory in place
2. Tainting of Fish and Wildlife Flavor*	UNKNOWN	POSSIBLY NOT IMPAIRED	NOT IMPAIRED
3.a Degradation of Fish Populations	IMPAIRED	IMPAIRED IN PLACES	IMPAIRED IN PLACES May be able to delist some tributaries or segments
3.b Degradation of Wildlife	UNKNOWN	UNKNOWN	NOT IMPAIRED

BENEFICIAL USE IMPAIRMENTS	1996 ASSESSMENT	2001 ASSESSMENT	2008 ASSESSMENT
Populations *			
4. Fish Tumors or Other Deformities	IMPAIRED	IMPAIRED IN PLACES	IMPAIRED IN PLACES Need new assessment
5. Bird or Animal Deformities or Reproductive Problems *	UNKNOWN	UNKNOWN	NOT IMPAIRED
6. Degradation of Benthos	IMPAIRED IN PLACES	IMPAIRED IN PLACES	IMPAIRED IN PLACES May be able to delist some tributaries or segments
7. Restrictions on Dredging	IMPAIRED IN NAV CHANNEL	IMPAIRED IN NAV CHANNEL	IMPAIRED IN NAV CHANNEL
8. Eutrophication or Undesireable Algae	IMPAIRED IN LAKE ERIE	IMPAIRED IN LAKE ERIE	IMPAIRED IN LAKE ERIE
9. Restrictions on Drinking Water Consumption	NOT APPLICABLE	NOT IMPAIRED	NOT IMPAIRED
10.a Beach Closings (Recreational Contact)	IMPAIRED PERIODICALLY	IMPAIRED PERIODICALLY	IMPAIRED PERIODICALLY
10.b Public Access and Recreation Impairments (Cuyahoga RAP BUI)	MAINSTEM NOT IMPAIRED NAV CHANNEL IMPAIRED	MAINSTEM NOT IMPAIRED NAV CHANNEL IMPAIRED	MAINSTEM NOT IMPAIRED NAV CHANNEL IMPAIRED
11. Degradation of Aesthetics	IMPAIRED	IMPAIRED PERIODICALLY	IMPAIRED PERIODICALLY
12. Added Costs to Agriculture or Industry	NOT IMPAIRED	NOT IMPAIRED	NOT IMPAIRED
13.a Degradation of Phytoplankton Populations **	POSSIBLY IMPAIRED	POSSIBLY IMPAIRED	NOT APPLICABLE
13.b Degradation of Zooplankton Populations **	UNKNOWN	UNKNOWN	NOT APPLICABLE
14.a Loss of Fish Habitat	NOT IMPAIRED IN MAINSTEM IMPAIRED IN NAV CHANNEL	NOT IMPAIRED IN MAINSTEM IMPAIRED IN NAV CHANNEL	NOT IMPAIRED IN MAINSTEM IMPAIRED IN NAV CHANNEL
14.b Loss of Wildlife Habitat*	IMPAIRED IN PLACES	IMPAIRED IN PLACES	NOT IMPAIRED

* now considered NOT IMPAIRED by local fish and wildlife managers
**now considered UKNOWN or NOT APPLICABLE by Ohio EPA due to lack of methodology for conducting plankton assessments. Waters achieving the target biological indices for fish and macro-benthos are considered to support healthy plankton communities.

Table 25: BUI Impairments of the Lower Cuyahoga TMDL

BU1: Restrictions on Fish and Wildlife Consumption

State of Ohio Delisting Target:
No fish or wildlife consumption advisories have been issued for Tinkers Creek. However within the AoC, fish consumption advisories remain in effect for consuming Carp, Brown/Yellow Bullhead, White Suckers, and Smallmouth Bass.

Current Applicability to Tinkers Creek:

Because Tinkers Creek lies within the Cuyahoga AoC, fish consumption advisories will be applicable to any fish caught and consumed within the Tinkers Creek Watershed boundary. However, there is no known fishing areas on Tinkers

Creek with the exception of Tinkers Creek State Park and the lower stretch of the creek as it flows through the Bedford Reservation to meet the Cuyahoga River. Fishing has also been documented at the mouth of Tinkers Creek and the Cuyahoga River.

Level of Impairment: Impaired for fish consumption

Wildlife Consumption:
The Cleveland MetroParks Bedford Reservation and Tinkers Creek State Park do not have a deer management program and hence do not allow for the culling of deer and other wildlife. Therefore, monitoring deer and other wildlife consumption within these areas is not conducted and data would not be known. Because the watershed is still rural in areas, wildlife consumption could exist, but the watershed is not known for its hunting locations.

Level of Impairment: Not Impaired

BU2: Tainting of Fish and Wildlife Flavor
State of Ohio Delisting Target:
Because little to no fishing occurs within Tinkers Creek and the AoC delisting targets indicates that no known impairment exists in the AoC to cause tainting of fish, phenolic pollution is not considered a threat.

Level of Impairment: Not Impaired

BUI3: Degradation of Fish Populations
The Index of well-being (Iwb) was developed by Gammon (1976). The Iwb consists of four measures of fish communities: numbers of individuals, biomass, Shannon Diversity based on numbers, and Shannon Diversity based on weight. Shannon Diversity models determine species richness and/or the corresponding weight of that representative fish community. Ohio EPA modified the Iwb by eliminating any of 13 highly tolerant species, hybrids, or exotic species from the numbers and biomass components of the Iwb, but not from the Shannon components (Ohio EPA, 1987), *(Source: acwi.gov/monitoring/conference/98proceedings/Papers/46-EDWA.htm).* MIwb *(Modified Index of Well Being)* represents an indicator of fish mass and density. This measurement is used along with IBI *(Index of Biotic Integrity)* to determine the health of fish populations in a stream or river. Like ICI scores, IBI scores range from 0-60. Tinkers Creek is found to contain scores ranging from 24 – 32. These scores would fall within the *fair* range. MIwb scores range from 0 – 12, with 12 being the maximum.

QHEI *(Qualitative Habitat Evaluation Index)* scores represent a measurement of stream and river habitat quality and indicate the importance of that habitat to fish communities and other aquatic species. Depending on the position within the Tinkers Creek main stem, QHEI scores range from 78.0 at the mouth to 52.5 in the headwaters area near Seasons Rd. Additionally, IBI scores range from 32.0 in the headwaters to 32.0 at the mouth of the stream. Lower IBI scores have been recorded throughout the middle stretches of the stream. Tinkers Creek is considered to be in non-attainment/partial attainment status according to Ohio EPA water quality standards based upon these scores and others. It is worth noting that within the watershed QHEI scores have been documented within the WWH (Warm Water Habitat) range of EPA water quality standards, while lower IBI scores have been documented at those same sampling locations. For instance downstream of Hawthorn Creek, Tinkers Creek achieves a QHEI score of 71.0 while having an IBI score of 28.0 In order to achieve WWH status an IBI score must be greater than or equal to 40 and the QHEI score must be greater than or equal to 60. This issue is of concern as the habitat score is greater than the minimum WWH requirement; however, the fish population is less than the minimum needed to achieve the WWH status. Reasons for this discrepancy can be attributed to impairments in fish passage possibly due to waterfalls or a yet unknown impairment which is reducing fish populations.

DRAFT

River Mile Fish/Invert.	IBI	MIwb[a]	ICI[b]	QHEI	Attainment Status[b]	Comment
Tinkers Creek (19-007)						
		WWH Use Designation (Existing)				
29.1^{w}/28.3	32*	na	48	52.5	PARTIAL	Seasons Road
25.0^{w}/25.2	24*	na	46	34.5	**NON**	Hudson-Aurora Road
17.5^{w}/18.0	25*	5.3*	40	50.0	**NON**	At Whitlach Development
14.3^{w}/14.3	28*	6.4*	40	56.0	PARTIAL	Adj. East Idlewood
8.5^{w}/8.5	21*	5.5*	44	76.5	**NON**	Dst. Inland Reclaimation
6.9^{w}/7.2	28*	7.5^{ns}	G	71.0	PARTIAL	Dst. Hawthorn Creek
0.1^{w}/0.1	32*	6.1*	36	78.0	PARTIAL	At mouth

Table 26: Water Quality Standard Data on Tinkers Creek Main Stem

Level of Impairment: Impaired in Places

Degradation of Wildlife Populations:

Sentinel Species, those biological species used to determine environmental health, such as Great Blue Herron, Bald Eagles, Otter, and Mink have not fully been identified or studied in the Tinkers Creek Watershed. However, within the Tinkers Creek State Nature Preserve, a pair of returning nesting Bald Eagles have been seen, documented, and studied.

If study is conducted, Cleveland MetroParks or ODNR will facilitate those studies.

Level of Impairment: Not Impaired

BUI4: Fish Tumors or Other Deformities
There are no known cases of fish tumors or other fish deformities in the Tinkers Creek Watershed. However, 25 years ago fish deformities such as tail rot were common along with some tumors. Over time these cases have become non-existent.

Level of Impairment: Not Impaired

BUI5: Bird or Animal Deformities or Reproductive Problems
There is no known information or data to determine the presence of bird or animal deformities within the Tinkers Creek Watershed.

Level of Impairment: Not Impaired

BUI6: Degradation of Benthos
Using the Lower Cuyahoga TMDL ICI *(Invertebrate Community Index)* scores, Tinkers Creek has both attainment and non-attainment status. ICI scores represent the macroinvertebrate diversity in streams and rivers. Data collection of species will help reveal the biological health of a stream or river based upon the number of pollutant tolerant species to non-pollutant tolerant species. ICI scores can range from 0-60. 0 being very poor water quality and 60 being exceptional water quality. ICI scores range from 48 in the headwaters to 36 at the mouth in Tinkers Creek.

DRAFT

River Mile Fish/Invert.	IBI	MIwb[a]	ICI[b]	QHEI	Attainment Status[b]	Comment
Tinkers Creek (19-007)						
			WWH Use Designation (Existing)			
29.1[w]/28.3	32*	na	48	52.5	PARTIAL	Seasons Road
25.0[w]/25.2	24*	na	46	34.5	**NON**	Hudson-Aurora Road
17.5[w]/18.0	25*	5.3*	40	50.0	**NON**	At Whitlach Development
14.3[w]/14.3	28*	6.4*	40	56.0	PARTIAL	Adj. East Idlewood
8.5[w]/8.5	21*	5.5*	44	76.5	**NON**	Dst. Inland Reclaimation
6.9[w]/7.2	28*	7.5[ns]	G	71.0	PARTIAL	Dst. Hawthorn Creek
0.1[w]/0.1	32*	6.1*	36	78.0	PARTIAL	At mouth

Table 27: Water Quality Standard Data on Tinkers Creek Main Stem

Level of Impairment: Impaired in Places

BUI7: Restrictions on Dredging
There are no dredging operations occurring within the Tinkers Creek Watershed.

Level of Impairment: Not Impaired

BUI8: Eutrophication or Undesirable Algae

The Ohio EPA has set forth target parameters within the Erie Ontario Lake Plain ecoregion, of which Tinkers Creek resides, for nutrient capacity, in the form of phosphorus, and achieve WWH status for streams and rivers. Figure 30 demonstrates those targeted goals.

Table 1. Nutrient and Habitat TMDL Targets

Watershed Size(D.A. = Drainage Area)	Ecoregion	Total P(mg/l)	Habitat(QHEI)
Headwaters (D.A. < 20 mi^2)	EOLP	0.08	60
(20 mi^2 < D.A. < 200 mi^2)	EOLP	0.10	60
Small Rivers (200 mi^2 < D.A. < 1000 mi^2)	EOLP	0.12	60

Table 28: Water quality nutrient goals for streams and rivers

Phosphorus is the limiting nutrient in the Cuyahoga River system. Cuyahoga River total phosphorus concentrations are elevated compared to reference values in the EOLP ecoregion, which creates enriched waters. Dissolved oxygen measurements, fish community responses and direct observation of aquatic plant communities are consistent with responses of aquatic systems to enriched nutrient conditions. Enrichment often contributes to non-attainment of Ohio's Water Quality Standards. Both non point and point source controls are needed to reduce phosphorus concentrations and loadings to the Cuyahoga River system in order to reduce eutrophication of the system *(Source: Appendix L, Lower Cuyahoga TMDL)*.

Nutrient enrichment can be both phosphorus and nitrogen inputs into fresh water systems. According to the Ohio EPA, within the EOLP region the threshold for nitrogen in WWH communities is 3 – 4 mg/l. Phosphorus concentrations are much lower however. Target values of 0.12 mg/l in the main stem and 0.07 mg/l in tributaries are needed to achieve WWH status in the EOLP region. According to the Lower Cuyahoga TMDL, the Cuyahoga River basin had an average of 0.17 mg/l of phosphorus concentration. This is above the targeted level of 0.12 mg/l. In addition, nitrogen compounds themselves do not impact the overall eutrophication issues within the basin.

In fresh water systems, phosphorus is the limiting factor for nutrient enrichment. A limiting nutrient is the nutrient in short supply relative to others that will be exhausted first and will thus limit cellular growth. Therefore, any reduction in a limiting nutrient causes a direct reduction in production (eutrophication). Reduction of other nutrients that are not limiting will not. Whenever the ratio of nitrogen to phosphorus, or the N/P ratio, in surface waters is greater than about 7-10:1, then phosphorus is considered the limiting factor in productivity. Because of the biochemical composition of algae, balanced algal growth requires a ratio of nitrogen to phosphorous to be in this 7:1 ratio. In the lower Cuyahoga River the N/P ratio of year 2000 sample averages was 19.5:1 which indicates the lower river productivity is unequivocally controlled by TP concentrations (Smith, 1982), *(Source: Appendix L, Lower Cuyahoga River TMDL)*.

Level of Impairment: Impaired

BUI9: Restrictions on Drinking Water Consumption
The majority of residents in the Tinkers Creek Watershed receive their drinking water supply from Lake Erie via the City of Cleveland water system. The position of the intake location in Lake Erie according to the Ohio EPA Source Water Assessment Report 2004 reduces major concern for intake of pollutants into the drinking water supply.

Level of Impairment: Not Impaired

BUI10: Beach Closings (Recreational Contact)
Tinkers Creek does not contain bathing beaches within its watershed boundary and therefore has no impairment associated with this BUI impairment.

Level of Impairment: Not Impaired

BUI11: Degradation of Aesthetics
Tinkers Creek contains seven discharging Waste Water Treatment Plants and Home Sewage Treatment Systems *(HSTS)* in some communities. Because not all HSTS are working properly, some fail and discharge untreated effluent into the Tinkers Creek system. According to OAC 3745-1-04, both the Ohio EPA and local health departments have jurisdiction to address these problems as public health nuisances. The criteria to determine a nuisance is bacteria sampling, odor and color, and other visual manifestations. Tinkers Creek does not have specific documentation to reveal these nuisances, but does contain these traits in areas at different times.

The continued reduction of nutrient input from point-source pollution control, a reduction in HSTS, and a reduction in illicit discharges from industry could improve water quality within the basin.

Level of Impairment: Impaired Periodically

BUI12: Added Costs to Agriculture or Industry
No agricultural uses exist in the watershed. There are industrial facilities throughout the watershed but it is not known the uses of water in their facilities.

Level of Impairment: Not Applicable

BUI13: Degradation of Zooplankton Populations
Tinkers Creek does not contain areas suitable for zooplankton or phytoplankton populations to exist.

Level of Impairment: Not Applicable

BUI14: Loss of Fish and Wildlife Habitat
32 sampling locations throughout the Tinkers Creek Watershed were studied for habitat integrity; QHEI scores in 2000. Of the 32, 19 sampling locations met or

exceeded the WWH threshold of 60 using the QHEI criteria. Conversely, 13 sampling locations failed to meet the 60 threshold. The majority of low QHEI scores were found between RM 25.0 to RM 16.60 and ranged from 57.5 – 34.5. Despite a mix QHEI scores, the habitat of the watershed is fairly sound. In addition to human impacts to habitat in the watershed, fish migration into the upper reaches of the stream is limited by waterfalls. Several tributary streams see significant habitat impacts from impervious cover and increased volumes of water being input into the system. Habitat loss due to flashing water volumes does not allow for solidifying fish communities due to constant habitat loss.

Level of Impairment: Impaired

D. Problem Statement

The following problem statements are based upon the impairments identified within the Tinkers Creek Watershed. These statements will assist in developing goals and implementation strategies for the watershed to improve water quality.

1. Increased phosphorus nutrient loads are the result of effluent discharge from WWTP's, remaining HSTS, and urbanization.

2. Increased amounts of water from urbanization and impervious cover, create stream flashing during and after precipitation events causing significant erosion, habitat loss, and channelization.

3. Outsourcing of wetland mitigation to other watersheds due to development and human progression result in the continued loss of habitat and water storage capacities causing increases in the speed at which water volume enters the Tinkers Creek system.

4. Impaired fish populations and species diversity may be attributed to elevated nutrients, habitat alteration, and increased turbidity in the water column.

5. Sedimentation increases to Tinkers Creek are a consequence of stream bank scouring and poor land use planning which has resulted in continued habitat degradation.

E. Linking Sources and Causes in the Tinkers Creek Watershed

The Lower Cuyahoga River TMDL and the Ohio EPA 303(b) list have outlined the following linkages to developing solutions to the water quality impairments to Tinkers Creek.

Source	Causes
Organic and nutrient inputs increase phosphorus levels to exceed water quality thresholds	WWTP's, Urbanization, HSTS

Habitat loss Reduced species diversity	Increased impervious run-off Waterfalls preventing fish migration Loss of riparian cover/tree canopy Development practices
Increased rate of erosion and sedimentation	Channelization and hydromodification Development practices Impervious cover
Endocrine disrupters and pharmaceuticals in water	WWTP's effluent discharge

Table 29: Sources and Causes of Water Quality Impairments

V. Watershed Restoration and Protection Goals

A. Mission Statement

It is important to develop a mission statement to implement the Tinkers Creek Watershed Action Plan. We have developed the following vision to assist us in guiding our decision making processes toward rehabilitating the creek.

Preserve and restore Tinkers Creek, its tributaries, wetlands, habitat, and other natural features; to promote watershed stewardship to all communities in order to create a sustainable watershed for the use and enjoyment of future generations.

B. Goals

1. Restore the beneficial uses of Tinkers Creek.
2. Reduce the ecological footprint and impact that urbanization and impervious cover have upon the physical nature and water quality of the watershed.
3. Advocate and educate local decision makers about preserving wetlands and other natural areas and to incorporate them into future planning decisions.
4. Focus on lessening phosphorus and nutrient loading into the watershed through innovative strategies using community collaboration, homeowner education, and restoration projects.
5. Reduce sedimentation by restoring the physical and biological integrity of the riparian corridor, as well as, the upland land cover.

C. Priority Areas of the Watershed to Target Restoration & Protection Goals

The Tinkers Creek Watershed is diverse in land use, socio-economics, ethnicity, educational background, environmental stewardship, and the opportunities for preservation and restoration endeavors. The linkages between watershed communities because of tributary streams dictate that the entire watershed is prioritized. Generally, the northern section of the watershed is highly urbanized, the middle section suburbanized, and the lower section slightly suburban/rural.

In order to focus restoration and protection implementation efforts, the following priority zones are identified.

1. **Tributary Streams.** The majority of tributary stream lengths within the watershed are in non-compliance with EPA water quality standards. Continued culverting of the streams, loss of riparian areas, wetland outsourcing, and a consistent increase of water input through development have resulted in drastic negative impacts on the entire watershed. The cumulative influence of these issues is resulting in lower water quality and a reduction in overall watershed integrity.

2. **Tinkers Creek Main Stem.** Tinkers Creek main stem receives all of the runoff and pollution inputs from the entire watershed. Because of the amount of impervious land cover, the stream experiences precipitation events that promote flashy stream flows and cause increased channelization, sedimentation, and reduction of habitat.

3. **Upper/Middle Tinkers Creek.** Much of Tinkers Creek in the upper portion of the watershed still contains high quality wetlands and marsh areas. Both Summit and Portage Counties, in conjunction with land conservancies, have purchased substantial sensitive land for the creation of parkland and preserves. Acquisition of properties adjacent to already preserved areas is a priority to creating green corridors and connectiveness between these areas. Conserving land from development is the most cost effective way to prevent future water quality degradation by ensuring that the natural resources which reside upon the land are protected.

4. **Pond Brook.** The Pond Brook subwatershed of Tinkers Creek is located in the eastern portion of the watershed. Aurora, Solon, and Reminderville all reside within its boundaries. Significant development has occurred over the last 15 years and has drastically increased urban runoff into the Pond Brook stream itself. Additionally, fine sediments and glacial till are commonly found in this area and substantially increase the amount of sediment flowing into the Pond Brook system. Turbidity and sedimentation continue to cause habitat degradation throughout the watershed, as well as, channelization of the system. Much of the turbidity down stream of Pond Brook in the main stem of Tinkers Creek could be attributed to this tributary. Further, this area is dominated by wetlands and the terrain is fairly flat. Establishing designated riparian areas, preserving the integrity of the remaining wetlands, and stabilizing stream banks of Pond Brook will assist in reducing the amount of sediment entering the system and therefore help stabilize habitat loss.

D. Prioritization of Actions through Public Input

Public sentiment for the Tinkers Creek Watershed has been discussed at functions through presentations to different clubs and organizations. Future meetings will be scheduled to specifically discuss the Watershed Action Plan to gain further knowledge of what the public deems as important toward the implementation and restoration goals outlined in this plan. The following items have been derived from conversations with students, local government officials, and other watershed organizations. These items are being used to assist the Tinkers Creek Watershed Partners in guiding the implementation and action items contained within this plan.

1. Reduce impervious cover through use of BMP's
2. Preservation/Conservation of wetlands and land parcels
3. Restoration of stream and riparian corridors
4. Preservation and restoration of wildlife habitat
5. Education

VI. Implementation

Introduction

The goals and priorities of the Watershed Action Plan have been developed by focusing on the three priority areas identified in the previous section. Because of the size of the watershed and the problems associated within certain sections of the basin, different activities and implementation measures are needed to achieve water quality goals based upon the different issues identified in those sections of the watershed. The following action items and priority objectives have been identified to address the water quality problems within the Tinkers Creek Watershed.

A. Overall targeted goals to meet to achieve WWH water quality Status:

1. QHEI scores of > 60 throughout the entire watershed
2. ICI and IBI scores which meet Ohio water quality standards throughout the entire watershed
3. A reduction of phosphorus loading into the watershed by implementation of BMP's and restoration of riparian corridors

B. Priority Actions

1. Land Use

- Protection of sensitive areas
- Restoration of stream corridors and riparian areas
    - **Site Specific Projects**
      Specific sites have been identified to incorporate practices which will improve overall water quality in the watershed. These sites will become models to utilize throughout the other portions of the watershed. Providing in-the-ground projects will allow for education and replication of these projects to a watershed wide scale.
- Retro-fitting developed areas with BMP's for storm water runoff
- Low-Impact Development/Redevelopment

2. Reduction of Nutrient Inputs

3. Education

4. Restoration of Beneficial Uses

5. Implementation of Coastal Non-Point Control Measures

Priority Action 1: Land Use Recommendations

Problem Statement

The Tinkers Creek Watershed has a long history of development and industrial use dating back to the establishment of Cleveland proper. As the City grew, a number of the Tinkers Creek communities were populated and are considered first and second ring suburbs. Because of the decisions made long ago regarding development techniques, the watershed continues to experience significant water quality problems associated with urbanization and its corresponding stresses. Although the watershed is not completely considered urbanized, land use decisions continue to be an imposing threat to the overall integrity of the watershed. Accepted development, design, and engineering practices remain one of the biggest threats to the health of the watershed; resulting in the continuation of Tinkers Creek not meeting EPA water quality standards.

Goals

Create a template for watershed development and redevelopment activities which focuses on low impact/conservation development strategies that will help ensure the preservation of the remaining resources within the watershed and rehabilitate the damaged resources within the watershed. These suggested strategies will be used on a watershed wide scale and allow the local communities to remain in control of the implementation of them. Development regulations regarding pre/post construction activities and storm water management are a standard component of all SWP3 plans and development site plans. The following list of recommendations could be applied to bolster existing development regulations for future development and redevelopment within the watershed.

- All new build and rebuilds contain raingardens or bioswales (residential and commercial)
- Detention ponds have additional wetland cells to assist in cleaning the water before re-introduction back into waters of the state
- Preservation of all existing wetlands on-site

A New Approach for Land Use in the Tinkers Creek Watershed

Tinkers Creek, like so many urban watersheds, continues to experience water quality and habitat degradation due to typical development design practices and subsequent urban runoff. The Tinkers Creek Watershed Action Plan focuses on changing the overall direction and strategy for future and redevelopment projects. Maintaining environmental integrity while increasing the economic viability of the watershed is crucial to the overall health of the stream and the economic well-being of the watershed communities. The following objectives will be used as a template of decision making processes throughout the watershed.

Overall Watershed Protection and Restoration Goals

- **Preserve**: Green corridors and sensitive areas must be preserved in perpetuity. This is both the most cost effective and necessary strategy for the advancement of water quality/quantity initiatives and for the protection of habitat.

- **Restore:** Urbanization in the watershed is a direct correlation to water quality degradation. High nutrient loads and increased water in the stream channels has encouraged biological problems and sedimentation issues throughout the watershed. Restoring riparian areas, access to floodplains, and stream bank stabilization will assist in reducing nutrient loads and sedimentation downstream.

- **Development/Redevelopment:** Current development techniques exacerbate known water quality impairments in the Tinkers Creek Watershed by producing significant non-point source pollution run off from impervious surfaces and allow for dramatic amounts of water to be inputted into the stream system from the storm sewer system. Using conservation and low impact development techniques will help reduce these water quality problems.

- **Use BMP's:** The implementation of Best Management Practices throughout the watershed will provide an immediate relief to the stresses that human activity has upon the creek. New development and retro-fits to existing structures are one of the best strategies that can be implemented to restore the integrity of stream health to the watershed.

Preserve: Preserve areas in the watershed are those areas which have been identified as sensitive and critical to both water quality and wildlife habitat integrity. Many of these areas are headwater streams, riparian areas, and lands adjacent to already preserved lands such as parks, preserves, land trusts, and sensitive natural resources. These lands allow the streams to have access to floodplains which will filter water, increase habitat, reduce stream inputs of water, and provide needed tree canopy amongst other water quality attributes such as temperature reduction, green connectedness, and recreational opportunities.

Restore: Tributary stream stretches often fall victim to urbanization and can no longer function in the manner they once did. Most watershed communities possess locations in which stream restoration work is necessary due to urbanization and flow alterations. Some of these areas have been identified and others still are yet to be determined. Additional areas will be established from field surveying and local community input.

Development/Redevelopment Current development techniques for both housing and retail establishments do not employ tactics which reduce impacts to the environment. Creating additional impervious cover, draining water to detention areas with no water quality treatment, and building structures with little to no overall environmental consideration continues to promote watershed decay. Identifying target areas to employ conservation and low-impact development will begin to provide the needed techniques for rehabilitation throughout the watershed.

Use BMP's: Because of Tinkers Creeks' impervious cover, the tributary streams are suffering significant channelization problems which intensify the sedimentation loading occurring throughout the watershed. The use of management practices such as raingardens and bioswales are needed to reduce the volume of water entering the system. Additionally, simple but effective implementation of these management practices will provide a reduction in pollutants, increase habitat, recharge groundwater, assist in reducing thermal pollution, and educate the communities of the watershed.

1.1 Preservation of Habitat & Sensitive Areas **Land Use Recommendations**

Problem Statement: Habitat degradation continues to be a concern throughout the watershed due to residential and commercial urbanization, in addition to, the property management practices employed. Wetland outsourcing for mitigation purposes, encroachment of riparian corridors, the piece mealing of land parcels, and over development are assisting in causing the lowering of QHEI, IBI, and ICI scores.

Goal: Preserve land parcels within the watershed through out-right land acquisition which are adjacent to protected lands or are within the riparian corridor of headwater streams and the main stem. Preserving sensitive areas will provide insurance that further habitat and water quality degradation will be reduced. Purchasing sensitive land parcels for preservation is the most cost effective strategy to maintaining environmental integrity, preserving natural habitat, and reducing non-point pollution.

Tasks	Task Activities	Task Partners	Funding	Time Frame	Final Indicator of Completed Task
Continue to identify sensitive land parcels for acquisition	Use the Kerr-Boron study and the priority parcel recommendation list as a template for investigating parcel acquisition	TCWP, Private Property Owners, WRLC, Watershed SWCD's, TPL, Watershed Communities	No actual dollars needed All in-kind time	Start: 2010 End: 1/1/11	15 additional properties identified, in addition to the Kerr-Boron study list, to be of a sensitive nature and adjacent to already protected land parcels by 2011
Land Purchasing To ensure complete protection of land, out-right purchasing will provide the insurance that the sensitive areas will be protected in perpetuity	Use the identified properties list to rank in order of importance based upon connectivity, resource sensitivity, and purchase price Collaborate with established partnerships as to how to proceed Identify grant opportunities and their RFP deadlines as to how to proceed with purchasing parcels	TCWP, Private Property Owners, WRLC, Watershed SWCD's, TPL, Watershed Communities	ODNR, Coastal Management, Clean Ohio Fund, Land Trusts, Private Property Owners, Watershed Communities	Start: 1/2/11 Ongoing	Goal of acquiring 40 acres of sensitive land by 2018
Riparian / Wetland setback ordinances & local wetland mitigation ordinances Provide technical support to communities regarding codified ordinance adoption of setbacks and the incorporation of local wetland mitigation	Survey all communities to identify ordinance adoption of setback regulations Promote and provide a draft ordinance for local wetland mitigation to all watershed	TCWP, SWCD's, Watershed Communities, NOACA	No actual dollars needed All in-kind time	Start: 1/1/11 End: 12/31/11	Goal of 10 communities to adopt these specific details in ordinances by the end of 2011 Goal of 2 communities to adopt local wetland mitigation ordinance by the end of 2011 Overall objective is to provide complete stream protection in the watershed. This task

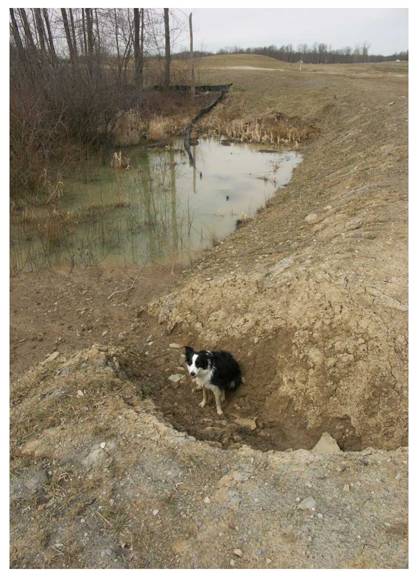
	communities Make sure that setback ordinances are in agreement with NOACA draft setback regulations; 300 feet on both sides of drainage areas of > 300 sq. miles, 120 feet on both sides with drainage areas between 20 and up to 300 sq. miles, 75 feet on both sides with drainage areas of ½ and up to 20 sq. miles, and 25 feet on both sides of watercourses draining 0 and up to ½ sq. mile				will be on-going
Conservation Easements To establish a protected riparian corridor on privately owned lands throughout the watershed	Establish a criteria to identify and facilitate easement opportunities with the TCWP and SWCD's Identify properties along stream corridors for possible easement discussion initiation Approach land owners in identified areas Create a partnership with the SWCD's to hold and monitor acquired easements	TCWP, Private Property Owners, WRLC, Watershed SWCD's, TPL, Watershed Communities	ODNR, Coastal Management, Clean Ohio Fund, Land Trusts, Private Property Owners, Watershed Communities Federal and State grants to help with acquisition, monitoring, and stewardship fees	Start: 2011 Ongoing	Annually send 50 informational pieces to landowners in the watershed regarding the easement opportunity beginning in 2012 Acquire 3 easements by 2012 totaling 10 acres Establish a target of 200 acres of easement acquisition by 2016

Land Parcel Preservation Examples

The following land parcels have been identified as being important to the overall health and riparian corridor connectiveness to Tinkers Creek. These properties will be the focus of land acquisition opportunities to ensure a lengthy and continuous riparian area for the stream.


Sorrick Property: Season Rd. Streetsboro, OH

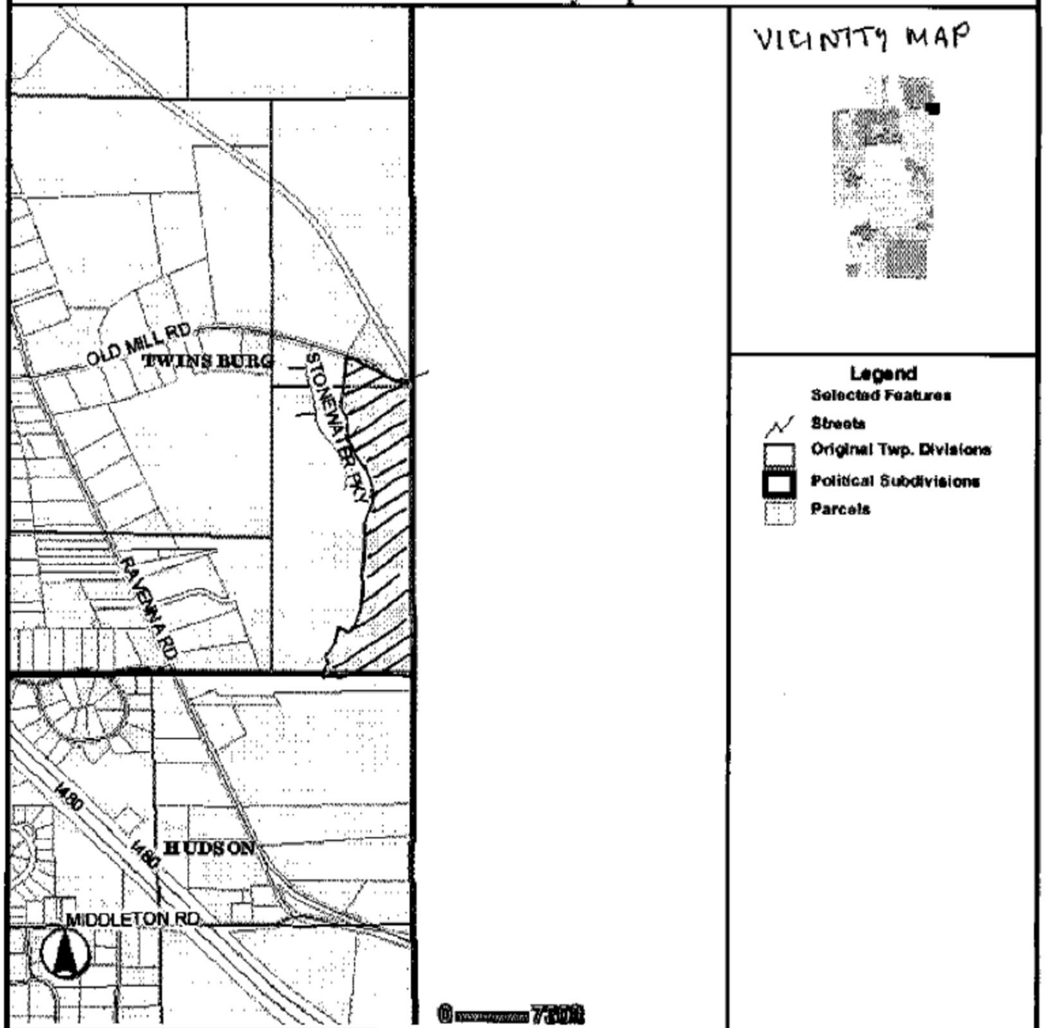
Marilyn Sorrick's property is a key land parcel acquisition due to its placement near Herrick Fen. It is an upland property and will assist in the preservation of this rare resource.

Stonewater Development: Old Mill Rd. Twinsburg Township, OH

This land parcel is more than 80 acres. It sits adjacent to Tinkers Creek and, if acquired, would create a green corridor connecting Metro Parks Serving Summit County land and Western Reserve Land Conservancy property. The property has been denuded and has been the centerpiece of much debate as it is an unbuildable property due to its soil composition.

Summit County Map



Parcels

Rec	Alt ID	ParId	Address	Owner 1	Owner 2
1	TW00035A4040000	6205495	STONEWATER CT	OLD MILL ROAD LIMITED PARTNERSHIP	

John A. Donofrio, **Fiscal Officer**
Greg Bachman, P.E.,P.S., **Engineer**
Russell M. Pry, **Executive**

GIS SUMMIT COUNTY

PRINT

Hall property: Old Mill Rd. Twinsburg Township, Ohio

This property lies next to the Stonewater property and is still in good condition. A recent CMAG grant has been written for acquisition by the Township. This parcel will also allow the development of a green corridor between Summit Metro Parks and the Western Reserve Land Conservancy parcels already preserved.

THE TRUST *for* PUBLIC LAND

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Howitt Preserve

Location

Streetsboro, Portage County

Size

127 acres

Features

High quality wetland Protection

Protection of Mature Forest

Implementation of Countywide Greenspace Plan

The Howitt property encompasses 127 acres of wetlands, forest and pastureland in one of the fastest growing cities in the state of Ohio. The property's preservation will be part of the City and County greenspace goals for expansion and trail connections for its growing population of residents. The property, is also in one of the primary areas of water resources for the Cuyahoga River and will provide protection for both groundwater and surface water quality. This project is part of the Howitt family land holdings, who have dedicated their lives to the stewardship of this property over the years and seek to preserve it for the benefit of all in the community and the watershed.

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REV 110408

The Howitt property contains acres of high category wetlands which are currently protecting ground water and surface water to Tinkers Creek and ultimately the Cuyahoga River. Because of the location of this property in HUC# 4110002-050-030, and the rapidly developing City of Streetsboro, the protection and acquisition of this property is a top priority.

Figure 65: Unnamed Tributary to Tinkers Creek (HUC# 4110002-050-050); notice that the stream is not entrenched and has adequate flood plain

THE TRUST *for* PUBLIC LAND

CONSERVING LAND FOR PEOPLE

Tinker's Creek Headwaters

Location

City of Hudson, Summit County

City of Streetsboro, Portage County

Size

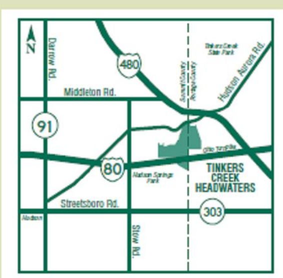
140 acres

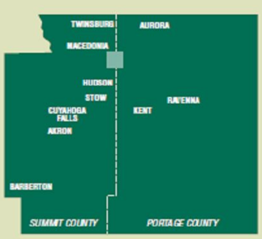
Features

2,500 feet of Tinker's Creek mainstem

3,000 feet of tributary to Tinker's Creek

Over 35 acres of Category 2 and 3 wetlands





Located within the cities of Hudson (Summit County) and Streetsboro (Portage County), the approximately 140-acre Tinker's Creek Headwaters property is one of the area's highest conservation priorities. The natural resources at this property are staggering – over 2,500 linear feet of Tinker's Creek mainstem, over 3,000 linear feet of tributary to Tinker's Creek, and over 35 acres of high-quality wetlands and vernal pools. The Tinker's Creek Headwaters property also consists of approximantly 100 acres of old-growth, hardwood uplands (primarily a mixed oak forest), and riparian corridor.

In addition to the property's aquatic and ecological benefits, it will also further the effort to create a contiguous natural corridor and future trail connection from Hudson Springs Park, to Tinker's Creek State Park, and on to Liberty Park in Twinsburg Township.

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Rank	MEAN SCORE	RECORD ACRES	CALC ACRES	ADDR	PARID	CLASS	LUC	OWN1	OWNADDR1	CITYNAME	OWNZIP 1
1	62.92	50.95	50.95	LIBERTY RD	6600257	A	100	BOARD OF COMMISSIONERS OF METRO	975 TREATYLINE RD	AKRON	44313
2	58.89	118.46	118.46	LIBERTY RD	6408644	A	100	CITY OF TWINSBURG	9701 BROOKPARK RD	CLEVELAND	44129
3	58.55	33.85	33.85	8579 RAVENNA RD	6200894	A	101	ODEN VICTOR J & VICTOR L	8579 RAVENNA RD	TWINSBURG	44087
4	58.32	56.95	56.95	MILL RD	6201065	E	610	STATE OF OHIO	705 OAKWOOD ST	RAVENNA	44266
5	58.03	30.05	30.05	AURORA RD	6200733	A	100	POND BROOK DEVELOPMENT INC	32145 OLD S MILES RD	SOLON	44139
6	56.66	29.08	29.08	8613 RAVENNA RD	6200893	A	101	JOHNSON CHRISTINE L & PIAZZA MARCIA J	8207 STOW RD	HUDSON	44236
7	55.96	88.34	95.23	LIBERTY RD	6408642	A	100	CITY OF TWINSBURG	9701 BROOKPARK RD	CLEVELAND	44129
8	55.93	0.00	0.86	SHADELAND ST	6500413	R	500	COOPER HOLDINGS LLC	15288 VIA PINTO	LOS GATOS	95030
9	55.87	23.03	23.03	3973 E AURORA RD	6200197	R	599	BOARD OF COMMISSIONERS OF METRO	975 TREATYLINE RD	AKRON	44313
10	55.71	25.11	25.11	RAVENNA RD	6200383	A	100	3279 OLD MILL ROAD LLC	6360 ROTHERBY CIRCLE	HUDSON	44236
11	55.69	108.00	108.00	AURORA RD	6200730	A	100	POND BROOK DEVELOPMENT INC	32145 OLD S MILES RD	SOLON	44139
12	55.37	18.16	18.16	RAVENNA RD	6200384	A	100	3279 OLD MILL ROAD LLC	6360 ROTHERBY CIRCLE	HUDSON	44236
13	55.20	0.00	5.96	RAVENNA RD	6201274	U	840	WHEELING & LAKE ERIE RAILWAY COMPANY			
14	54.57	46.74	46.74	LIBERTY RD	6600258	A	100	BOARD OF COMMISSIONERS OF METRO	975 TREATYLINE RD	AKRON	44313
15	54.30	0.00	327.28	LIBERTY RD	6601041	E	680	BD OF COMMISSIONERS OF METRO PARKS	975 TREATYLINE RD	AKRON	44313
16	54.12	0.23	0.23	8944 RAVENNA RD	6201250	R	500	BALOGH JAMES C & MARY BETH	8944 RAVENNA RD	TWINSBURG	44087
17	53.72	11.00	11.00	LIBERTY RD	6600256	R	500	BOARD OF COMMISSIONERS OF METRO	975 TREATYLINE RD	AKRON	44313
18	53.49	59.10	55.64	AURORA RD	6408643	A	100	CITY OF TWINSBURG	9701 BROOKPARK RD	CLEVELAND	44129
19	53.44	0.00	40.00	STONEWATER CT	6205495	R	500	PULTE HOMES OF OHIO LLC	30575 BAINBRIDGE RD SUITE 15	SOLON	44139
20	52.88	0.00	0.43	SHADELAND ST	6500119	R	500	GORDON WILLIAM L	1395 ANTLER ALLEY	JAMESTOWN	16134
21	51.76	0.00	8.60	HERRICK RD	6201275	U	840	WHEELING & LAKE ERIE RAILWAY COMPANY			
22	51.70	0.00	0.43	SHADELAND ST	6500039	R	500	COLLURA CHERYL		AURORA	44202
23	51.69	56.95	56.95	MILL RD	6201065	E	610	STATE OF OHIO	705 OAKWOOD ST	RAVENNA	44266
24	51.65	0.00	0.29	CONNECTICUT ST	6500208	R	500	COOPER HOLDINGS LLC	15288 VIA PINTO	LOS GATOS	95030
25	51.63	23.32	23.32	RAVENNA RD	6200449	A	100	HILLVIEW COMPANY ET AL	C/O STEVE MARTON	CHAGRIN FALLS	44022
26	51.60	11.18	11.18	RAVENNA RD	6201650	R	500	PAPESCH BONITA J & ROBERT J	8954 RAVENNA RD	TWINSBURG	44087
27	51.56	0.00	0.86	EAST BLVD	6500120	R	500	DIERSING RAYMOND F & MARCELLA	3500 CANNON RD	TWINSBURG	44087
28	51.32	60.82	60.82	E AURORA RD	6200731	A	100	POND BROOK DEVELOPMENT INC	32145 OLD S MILES RD	SOLON	44139
29	50.91	0.86	0.86	MAY AVE	6500301	R	500	COLLURA CHERYL		AURORA	44202
30	50.69	0.00	0.29	GEORGIA ST	6500202	R	500	COOPER HOLDINGS LLC	15288 VIA PINTO	LOS GATOS	95030
31	50.64	0.00	42.79	RAVENNA RD	6205380	A	100	WOLSTEIN SCOTT A TRUSTEE	C/O STEVE MARTON	CHAGRIN FALLS	44022
32	50.61	12.50	12.50	3575 ANTHONY LN	6200015	R	510	FREELAND DALE E & TAYLOR JAMETTA	3575 ANTHONY LANE	TWINSBURG	44087
33	50.58	26.90	26.90	RAVENNA RD	6200450	A	100	HILLVIEW COMPANY ET AL	C/O STEVE MARTON	CHAGRIN FALLS	44022
34	50.52	22.31	22.31	E AURORA RD	6200196	A	100	BOARD OF COMMISSIONERS OF METRO	975 TREATYLINE RD	AKRON	44313
35	50.43	24.46	24.46	E AURORA RD	6200200	E	640	CITY OF AURORA TWINSBURG TOWNSHIP			
36	50.39	0.00	0.32	3663 SEA RAY COVE	6600332	R	510	POT JAMES A	3663 SEA RAY COVE	AURORA	44202
37	50.38	11.21	11.21	9020 RAVENNA RD	6400693	A	199	ENSTEN LOUIS H		TWINSBURG	44087
38	50.38	96.01	96.01	3210 HUDSON AURORA RD	3003549	A	120	TENBROECK ELSIE M TRUSTEE	3210 AURORA RD	HUDSON	44236
39	50.15	7.51	7.51	HERRICK RD	6200363	R	500	WOLSTEIN SCOTT A TRUSTEE	C/O STEVE MARTON	CHAGRIN FALLS	44022
40	49.92	0.00	0.86	EAST BLVD	6500289	R	500	COLLURA CHERYL		AURORA	44202
41	49.85	228.84	228.84	9577 LIBERTY RD	6408640	A	101	CITY OF TWINSBURG	9701 BROOKPARK RD	CLEVELAND	44129
42	49.81	0.00	0.29	GEORGIA ST	6500334	R	500	PARKER WILLIAM R	904 LAUREL GLENS DR	MEDINA	44256
43	49.78	0.00	31.18	RAVENNA RD	6205379	A	100	TINKER CREEK LAND CONSERVANCY	PO BOX 805	TWINSBURG	44087
44	49.71	0.00	0.17	CONNECTICUT ST	6500213	R	500	COOPER HOLDINGS LLC	15288 VIA PINTO	LOS GATOS	95030
45	49.59	0.00	0.86	EAST BLVD	6500355	R	500	SAVIC ALEKSANDER SR TRUSTEE	7300 BROMPTON ST	HOUSTON	77025
46	49.53	0.00	0.86	EAST BLVD	6500315	R	500	NOVAK LOUIS A & IRENE N	2080 HERITAGE DR	TWINSBURG	44087
47	49.36	31.77	31.55	9372 LIBERTY RD	6406444	A	120	TWINSBURG TWO LLC	1718 PREYER AVE	CLEVELAND	44118
48	49.26	0.00	0.29	CONNECTICUT ST	6500002	R	500	ABELT RICHARD M AND CHARLOTTE R	4755 BLYTHIN RD	CLEVELAND	44125
49	49.03	0.00	1.10	ABRAMS DR	6408451	R	500	ABRAMS FARMS COMMUNITY ASSOCIATION INC	9345 RAVENNA RD	TWINSBURG	44087
50	48.99	23.99	23.99	E AURORA RD	6200199	A	100	BOARD OF COMMISSIONERS OF METRO	975 TREATYLINE RD	AKRON	44313

*Parcel Data Includes Cuyahoga & Summit County. Portage and Geauga County Data is not available.

Table 30: Kerr-Boron Tinkers Creek Watershed Land Conservation Plan top parcels list

Often, purchasing and protecting property through outright land acquisition ensures that the resources located on the property are kept intact. This particular property contains over 2,500 linear feet of main stem and over 3,000 linear feet of unnamed tributary. Not to mention that this property contains over 35 acres of category 3 wetlands. This property is located in an area that is developing slowly but could help anchor the beginnings of a riparian corridor that will connect Hudson Springs Lake and other potential property acquisitions.

1.2 Restoration of Stream Corridors and Riparian Area **Land Use Recommendations**

Problem statement: Urbanization and standard development practices have had a negative influence on the integrity of the watershed. Loss of riparian areas, rapid wetland removal and outsourcing, significant impervious cover, and non-point runoff has resulted in the non-attainment status of EPA water quality standards. As a result, channelization, sedimentation, limited access to floodplains, decreased habitat, and stream flashing have lowered all EPA water quality indicators of stream health.

Goal: To restore stream integrity by increasing EPA water quality indices; QHEI, IBI, ICI, and MiWB scores. To attain this expectation, physical, hydrological, and chemical alterations to stream stretches are needed to increase these EPA water quality scores. It is understood, however, that some areas will never again be restored, but it is the focus to provide a habitat upgrade, allow water to slow down, and reduce a scouring effect and therefore sedimentation in the stream.

Tasks	Task Activities	Task Partners	Funding	Time Frame	Final Indicator of Completed Task
Gain local support for execution of restoration projects Establish criteria as to what watershed problems are most likely to get community buy-in from the watershed communities and proceed to garner commitment to seek restoration funding and in-kind match	Create a presentation to watershed communities that discusses the state of the watershed, where wetlands are located within their communities, low-impact development strategies, BMP's, and case studies of implemented practices	TCWP. SWCD's, Watershed Communities, local planning commissions	In-kind support from all task partners	1/1/10 Ongoing	Perform presentation to 12 watershed communities by the end of 2010 Establish a priority list of areas of concern within 6 of those communities by the end of 2010 Continue to give presentation to the other 12 communities to be completed by the end of 2011 Establish a priority list of areas of concern within another 6 communities by the end of 2011
Work with watershed communities to identify problem areas within those communities which pose threats to public health, stream bank stabilization, nutrient loading, and access to floodplain	Continue to identify restoration areas and project locations	TCWP, SWCD's, Watershed Communities, local health departments, local planning commissions	In-kind support from all task partners	Start: 1/1/10 Ongoing	Goal of 4 restoration sites identified with community support (in-kind match and monetary commitment) by 2011 from the first 6 communities with an established priority list

Execute stream restoration projects to permit floodplain access from the stream, nutrient removal, a reduction in channelization and sedimentation, and an increase in habitat quality	Write grants to state and federal funding agencies to gain monetary support to perform restoration projects from the identified list of identified sites	TCWP, SWCD's, Watershed Communities, local health departments, local planning commissions	Ohio EPA 319 funds, CMAG, U.S. EPA, ODNR, Watershed Communities for local match	Start: 8/1/10 Ongoing	Write 1 restoration grant by the end of 2010 to restore 1 of the identified areas with community support Write 2 restoration grants by the end of 2011 to restore 1 of the identified areas with community support
Day light stream channels from culverts and pipes Standard practices of piping streams cause a bottlenecking effect which has a domino impact upstream from the pipe or culvert. Stream bank destabilization, increased sedimentation, flooding, and habitat loss are only a few of the problems associated with these engineering practices. Allowing the stream to function naturally will ultimately improve hydrologic function, reduce flooding potential, and increase water quality	Develop relationships with ODOT, and county engineers, and planners regarding the application of BMP practices for capital improvement projects Identify future road, bridge, overpass, and other projects Discuss BMP opportunities to be implemented on those projects identified Integrate environmentally friendly BMP's into the new proposed projects	ODOT, Watershed Communities, local planning commissions, county and local engineers	County agencies, capital improvement funds, state funds, ODOT, watershed communities	Start: 6/1/10 Ongoing	Influence decision making on future projects and retrofits of BMP's from stream crossings and piping Unknown quantity of opportunities. The goal will be determined by the amount of projects to be commenced
Detention basin design and retrofit Detention basins allow for water collection from both commercial and residential development projects. These basins control volume outputs back into waters of the state. They, however, do not take into account a water quality objective and therefore lack nutrient and other pollutant removal abilities. Working with watershed communities to improve these basins by using bio-removal techniques will be a cost effective way to reduce nutrient and other pollutant inputs. Additionally, retro-fitting	Determine locations of existing detention basins within the watershed Assemble a brief **"canned"** presentation on detention basins with additional bio-removal aspects and their effectiveness Give presentation to local planning agencies and developers Seek funding for	TCWP, SWCD's, local health departments, ODNR, OEPA, watershed communities, academic institutions, corporations	ODNR, OEPA, watershed communities, academic institutions, corporations	Start: 1/1/11 Ongoing	Gain support from 1 local entity to supply in-kind or monetary donations toward retrofit project Write grant for model/study of retrofitting detention basins for the purpose of pollutant removal Retrofit 1 basin by end of 2011 Provide "canned" presentation to 12 local communities by end of 2011 Present findings presentation to 12 watershed communities regarding the

existing basins with bio-removal management practices can be another cost effective way of reducing non-point pollution	retrofit model structures to employ for pollutant removal and monitoring of the effectiveness Identify 1 basin to implement retrofits and monitor Create additional presentation with the results of before and after results of retrofit to perform to local planning agencies and developers Repeat the process for other basins			effectiveness of the retrofit basin

Restoration of Stream and Riparian Corridor Examples

HUC # 4110002-050-040 (Restoring Pond "Ditch")

1. Project Description

Pond Brook (HUC 050-040) has been severely altered by dredge activities. As a result, all of the metric scores, with the exception of Riparian, are lower. Opportunities to improve habitat exist in all the metrics, with the greatest potential in the substrate and riffle. Removal of substrates by dredging results in a more uniform stream profile and greater depth, which then eliminates riffles creating a substrate with very small particle sizes. The MetroParks Serving Summit County is currently completing restoration activities in part of Pond Brook which are designed to restore habitat and improve biological communities. The higher metric scores for riparian are a result of two forces, as a wetland dominated stream, development generally proceeded in other areas leaving the riparian corridor relatively undisturbed. Recent land acquisition activities in the stream have resulted in an increased amount of protected areas along the riparian corridor.

Table X-X. Average QHEI Scores								
Metric Titles	**QHEI**	**Substrate**	**Cover**	**Channel**	**Riparian**	**Pool**	**Riffle**	**Gradient**
Maximum Score	**100**	**20**	**20**	**20**	**10**	**12**	**8**	**10**
All Sites	65.8	12.6	12.9	14.2	7.1	8.6	3.7	6.6
HUC 050-030	55.1	7.1	13.1	11.2	6.9	7.7	1.8	7.4
HUC 050-040	**38.8**	**2.5**	**9.0**	**9.5**	**8.7**	**4.0**	**0.5**	**4.7**
HUC 050-050	69.1	14.0	12.9	15.1	6.9	9.2	4.4	6.6

Problem: Although the official name is Pond "Brook", the actual waterway is far from the picturesque image brought to mind by babbling brooks and meandering streams. Beginning in the early part of the last century (and continuing into modern times) Pond Brook has been ditched, drained, moved, dammed, deforested, devegetated, and devoided of most life. The reasons for these actions include draining land for agriculture, development, and flood control. In many instances, these actions were taken with no real reason as these practices were simply considered better for the human environment and many of these projects were classified as "land reclamation". Pond Brook contributes substantial sediment to Tinkers Creek and is considered to be a major focus for reducing the turbidity in Tinkers Creek.

Goal: To restore Pond Brook (HUC# 4110002-050-040) by the re-establishment of natural channel morphology, re-connecting Pond Brook to its floodplain, hydration of ditched and drained wetlands, and the treatment and removal of invasive plant species.

MEASURABLE OUTCOMES:
Increase the likelihood to meet applicable biological criteria (IBI, Miwb, ICI) for main stem and tributaries.
Increase water storage capacity by reintroducing stream to floodplain in available areas
Reduce flooding potential to downstream communities
Reduce sediment loading into Tinkers Creek by 2,720 lbs/yr
Reduce phosphorus loading by 2,720 lbs/yr
Reduce nitrogen loading by 5,440 lbs/yr

Tasks	Task Partners	Funding	Time Frame	Final Indicator of Completed Task
Restore an additional 16,000 feet of Pond Brook main stem & tributary streams Write grant proposals to garner money for land acquisition and easement expenses	Reminderville, TCWP, Wetlands Resource Center, Oxbow, EMH&T, Davey Resource, Enviroscience, ODOT, U.S. Army, Cleveland Clinic, ACOE, OEPA	Ohio EPA 319 grant, ODOT mitigation, EPA SEP funds, NOAA, Federal Stimulus Funds	Hold 2 meetings 1/10 – 2/10 to discuss strategy of acquiring easements on private property Seek funding to acquire easement property 6/10	Awarded grant funding to perform project 16,000 linear feet of Pond Brook restored A minimum of 2,720 lbs of sediment removed from the stream per year A minimum of 2,720 lbs of phosphorus per year A minimum of 5,440 lbs of nitrogen per year

Acquire an additional 100 acres of category 2 & 3 wetlands	Reminderville, TCWP, Wetlands Resource Center, Oxbow, EMH&T, Davey Resource, Enviroscience, ODOT, U.S. Army, Cleveland Clinic, ACOE, OEPA	Ohio EPA 319 grant, ODOT mitigation, EPA SEP funds, NOAA, Federal Stimulus Funds, Clean Ohio Funds	Hold 2 meetings 1/10 – 2/10 to discuss strategy of acquiring property where wetlands are located Seek funding to acquire easement property 6/10	100 acres of wetlands protected

Site ID	Pond Brook
Description	Tributary to Tinkers Creek
Impervious Cover Percentage	10.37%
14-Digit HUC#	04110002-050-040
Problem	Sedimentation/Habitat Degradation
Priority	High
Cost (Stream Restoration Only)	Approx~ $3,200,000
Based on $200 per lineal foot	16,000 ft. x $200 ft. = $3.2 million
Other Costs	Soil/Asphalt Removal Engineering of new Wetland/Floodplain Area Wetland Vegetation Cost of Engineering Project

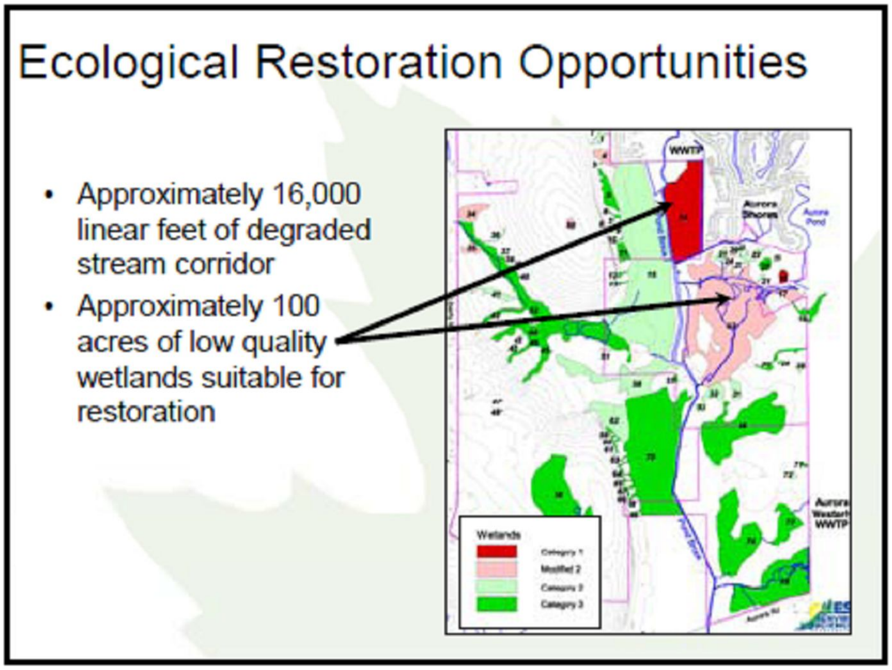


Figure 66: Pond Brook restoration opportunities exist for the majority of the watershed stream lengths due to the collaboration between several interested partners

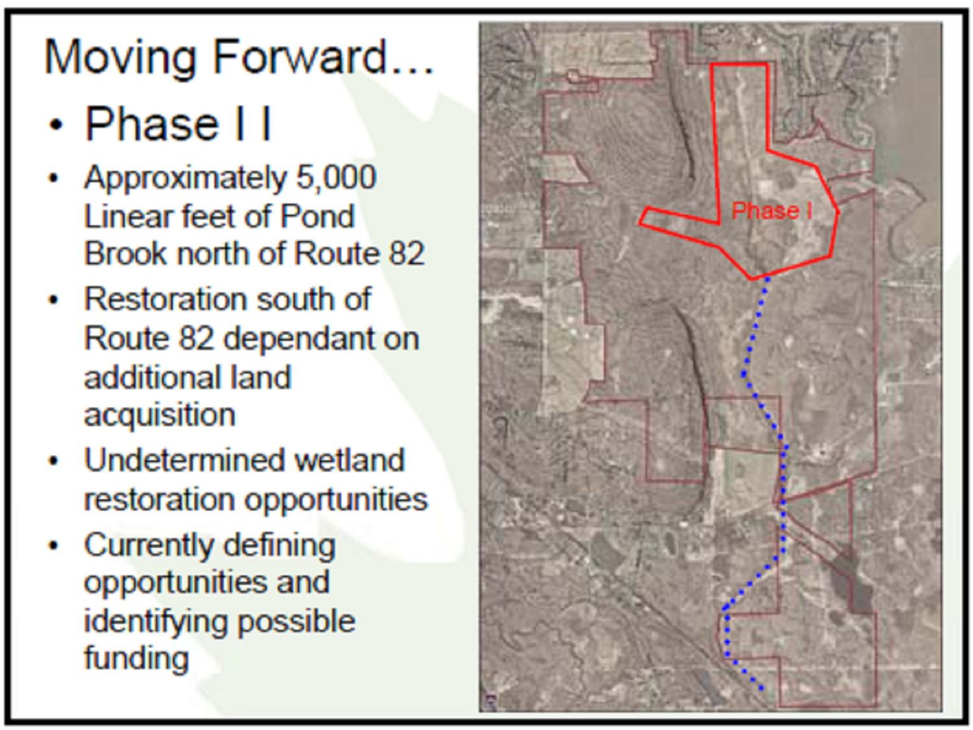


Figure 67: Ideas of where future restoration projects exist in the Pond Brook Watershed

Pond Brook is an example of how human impacts including dredging, channelization, wetland draining, and the introduction of too much water into the stream can have significant consequences to the overall water quality of Tinkers Creek. However, this tributary stream has also demonstrated that stream restoration can provide immediate results in enhancing water quality and habitat scores.

Figure 68: (Above) A typical stretch of Pond Brook with severe down-cutting

Figure 69: (Below) Severe bank destabilization

Figure 70: (Above) Down-cutting causing the drainage of adjacent wetland

Figure 71: (Below) Massive stream entrenchment

Figure 72: A restored portion of Pond Brook

The Pond Brook Watershed, as seen in the above photographs, has been channelized, drained, eroded, and left to decay from historic land uses of generations ago. This watershed contributes significant amounts of sediment to Tinkers Creek and could be a leading cause of non-attainment due to the increased turbidity throughout the watershed. The continued efforts to restore this watershed will have far-reaching impacts to the other areas of Tinkers Creek. Because this watershed is predominately wetlands, marshes, and open space; the restoration will provide much needed habitat, water detention, and water quality improvement.

HUC # 4110002-050-030

1. Project Description

As stated in previous sections of this plan, HUC# 4110002-050-030 is the headwaters to Tinkers Creek. This area of the watershed is still developing at a rapid rate. Many wetlands, fens, and marsh areas populate this part of the watershed while development is promoting additional pressure on the natural resources to function and perform in a manner that can accommodate the added water. For years, State Route 303 has experienced significant flooding due to increases in development and the corresponding impervious surfaces. Further, Tinkers Creek sits at one of the lowest points on the highway and often floods the road creating frequent road closures. The problem area is a “pinch-point” that has been created by inadequate culvert pipes. Protected wetlands and fens populate the adjacent landscape and can accept inundation from higher precipitation events; the topography suggests that this area of the watershed is quite wet..

The location of this project is in Streetsboro, Ohio on SR 303 east of SR 14 and west of the City of Hudson border. The population of this community is approximately 14,270 as of July 2007 (a 15.1% increase since the 2000 census). This area contains approximately 6.16% impervious cover. As stated in prior sections, this area of the watershed is rapidly developing but still has significant natural areas. This project looks to create a bridge over the problem area while then re-opening Tinkers Creek to a day-lighted stream with additional access to its floodplain; thus improving water quality and reducing the concern for flooding problems and access for EMT vehicles.

Problem: Culverting streams are a necessity in some circumstances. However, the SR 303 pipes are inadequate to allow Tinkers Creek water quantities to pass through. Additionally, these pipes are removing the stream from having access to its floodplain and therefore depriving it from the cleansing properties of the adjacent wetland areas. Further, this area consistently is closed from even small precipitation events and puts residents at risk due to the road block that occurs from the flooding road. The continued channelization of Tinkers Creek in this area will have similar impacts to the adjacent wetlands as those found in the Pond Brook Watershed (04110002-050-040).

Goal: Remove culverts from stream and re-introduce Tinkers creek to its flood plain, therefore improving water quality, and to construct an overpass bridge to remove any risk of future flooding and the potential health risks to humans.				
MEASURABLE OUTCOMES: Increase the likelihood to meet applicable biological criteria (IBI, Miwb, ICI) for main stem. Increase water storage capacity by reintroducing stream to floodplain in available areas Reduce/Eliminate flooding on SR 303				
Tasks	**Task Partners**	**Funding**	**Time Frame**	**Final Indicator of Completed Task**
Review Arcadis study of SR 303 flooding issues to determine parameters of project Create a collaboration between the City of Streetsboro, Portage County SWCD, TCWP, NEFCO, TPL, and the WRLC Seek funding to develop a project scope to both re-introduce Tinkers Creek to the floodplain, engineer a new floodplain where the road currently exists, and to determine the most appropriate engineering capacity of an overpass bridge Seek capital improvement funds, 319 funds (for water quality portion ONLY) to cover project costs	TCWP, City of Streetsboro, Ohio EPA, NEFCO, Portage SWCD, TPL, WRLC, ODOT	ODOT mitigation needs, Ohio EPA SEP funds, 319 funds, Capital Improvement Funds, Stimulus dollars	1/1/10 – 6/30/10 7/1/10 – 7/1/11 Seek and apply for funding for project tasks 10/1/11 – 12/31/11 RFP process 1/20/12 – 3/1/12 Review of RFP's 5/1/12 – Completion 11/1/12 – 12/31/15 Water quality monitoring	Hold 3 meetings with collaborative partners to begin review of the recommendations of the Arcadis study of SR 303 Awarded project funds Offer RFP bidding process to interested parties for project scope Review submitted RFP's and select best candidate Perform project construction activities and stream restoration project Complete project activities and sample water quality improvements at the site Improved water clarity and functioning of the floodplain and adjacent wetlands

Site ID	Tinkers Creek Headwaters
Description	SR 303/Tinkers Creek Flooding
Impervious Cover Percentage	6.16%
14-Digit HUC#	04110002-050-030
Problem	Sedimentation/Flooding/Culverting/Poor Flood Plain Access
Priority	High
Cost (Stream Restoration Only)	Approx~ $400,000
Based on $200 per lineal foot	2,000 ft. x $200 ft. = $400,000
Other Costs	Soil/Asphalt Removal Engineering of new Wetland/Floodplain Area Wetland Vegetation Cost of Engineering Project

1 of 2 culvert pipes Tinkers Creek flows through looking south

SR 303 pull off over Tinkers Creek (Flood Area) looking east

SR 303 pull off over Tinkers Creek (Flood Area)

1 of 2 culvert pipes Tinkers Creek flows through


Adjacent wetland discharge (notice water clarity)


Tinkers Creek (looking south) flowing through adjacent wetland area

Figure 73: Aerial location of restoration project

Figure 74: Tinkers Creek meets SR 303 (Notice that SR 303 is no more than 3 feet above the stream itself)

2. Project Description:

The 303 Drainage Ditch Restoration Project is located in Streetsboro, Ohio in Portage County in HUC# (04110002-050-030) on an unnamed tributary to Tinkers Creek. The population for this community is approximately 13,000 people according to the 2000 census. The project location is located on Route 303, in the North West portion of Streetsboro. In its current condition, this ditch is jeopardizing the integrity of Route 303 due to significant erosion and flooding and the proximity to the road.

This could be a collaborative project between the Cuyahoga County Board of Health, Tinkers Creek Watershed Partners and the City of Streetsboro. The project would be design and build. However, there has been some preliminary designs completed but further development and finalization is required for these designs.

The RFP process would be a design/build RFP. The anticipated timeline would be to have the RFP be advertised no later then July 1, 2010. The winning bidder would then be placed under contract no later then September 1, 2010. This would then allow for the designs to be finalized over the winter months with constructing starting no later then June 1, 2011. The unnamed tributary is a smaller tributary stream to Tinkers Creek; the largest tributary to the Cuyahoga River. Currently, a TMDL has been created for the Lower Cuyahoga River, of which, Tinkers Creek and this unnamed tributary are a part of. Additionally, the aforementioned areas are also a part of the Cuyahoga River “Area of Concern” which addresses the 14 Beneficial Use Impairments designed to provide safety indicators for human recreational use and overall stream quality.

This project is being specifically identified as a restoration project which will reduce sedimentation and nutrient loading into Tinkers creek, as well as, address the non-point source pollutants associated with the non-attainment status to EPA water quality standards for Tinkers Creek. Preliminary project designs have been completed for this project, but further design and planning are needed. The following information is a summary of the proposed project (see below diagrams).

When first designed, the entire area as shown in Exhibit No. 1 was meant to be both a polishing area for existing streams and a water retention area for the flow passing over outlet structure no. 2, located at the bottom right of Exhibit No. 1. The purpose of the retention area was to provide a staging area for excess flow in the existing stream channel, created by moderate to heavy rainfall. The retention area was to decrease the flow rate in the stream, thereby reducing the amount of erosion and sedimentation carried by this stream to the Tinkers Creek Tributary, and eventually to Tinkers Creek.

Exhibit No. 2 is an enlargement of the retention area and outfall structure no. 2. Outfall Structure No. 2 has an overflow elevation of 1027.00. The retention area to the east was to have an elevation of 1026.6. At the present time this retention area has an elevation in excess of 1027.5, effectively eliminating the intended benefits. In addition, the outfall structure which is a gabion wall has developed many areas of damaged wire boxes and missing stone fill. This also allows a greater flow rate than intended.

The elements of this project would be to: Item 1. Reduce stream scouring by rebuilding the gabion wall using natural engineering techniques, to again provide an overflow point of 1027.00. Item 2. Remove all silt and debris from the retention area, between the brush line and the berm wall to an elevation of 1026.00 or less, if possible. Item 3. Remove all fallen trees, brush and debris from the existing stream beginning at a point immediately south of the gabion wall to the north side of State Route 303 and continuing from the south side of State Route 303 for a distance to be determined.

Item 3, removal of fallen trees, brush and debris from the existing stream, is extremely important on the south side of State Route 303. Due to the various materials impeding the stream flow, a rain of either medium or heavy intensity will cause a back up of the stream flow, resulting in water flooding State Route 303 making the road impassable.

The re-establishment of the retention area and removal of debris from the existing stream will not only allow for a slower flow of water reducing the amount of turbulence and sediment that is eventually carried to Tinker’s Creek, but could also assist in reducing the flooding of State Route 303 which would eliminate a health and safety factor for the traveling public.

Exhibit 3 is provided to show elevation layout. Impacts to stream corridors from impervious land cover in urbanized environments cause increases in channel volume and the likelihood for channel and bank destabilization. Both water quantity and quality concerns are becoming increasingly important to the health of both the stream and the public.

Problem: Increased development in the City of Streetsboro is causing harmful impacts to small headwater streams to Tinkers Creek. Additional inputs of water are found to cause the stream to channelize and no longer function as a healthy waterway. This area of the watershed still contains significant wetland and headwater stream resources and will have either positive or negative impacts to communities down stream depending on the preservation and restoration efforts exhibited here. This tributary to Tinkers Creek ultimately drains new development from the SR 14 and SR 303 intersection and typically will contribute to flooding problems, increased sedimentation, poor habitat quality, and nutrient inputs due to the lack of available floodplain usage.

Goal: Restore tributary stream to Tinkers Creek using bio-engineering techniques to reduce downstream flooding problems on SR 303 and to improve water quality by reintroducing the stream to its floodplain and wetland areas while reducing water quantity issues in the area.

MEASURABLE OUTCOMES:
Increase the likelihood to meet applicable biological criteria (IBI, Miwb, ICI) for main stem.
Increase water storage capacity by reintroducing stream to floodplain in available areas
Reduce/Eliminate flooding on SR 303
Increase habitat scores

Tasks	Task Partners	Funding	Time Frame	Final Indicator of Completed Task
Establish a collaborative partnership with the City of Streetsboro to support the restoration project Seek funding to perform the project Hire project engineer Perform restoration project construction	TCWP, City of Streetsboro, Ohio EPA, NEFCO, Portage SWCD, TPL, WRLC	ODOT mitigation needs, Ohio EPA SEP funds, 319 funds, Stimulus dollars	1/1/10 – 6/30/10 7/1/10 – 7/1/11 Seek and apply for funding for project tasks 10/1/11 – 12/31/11 RFP process 1/20/12 – 3/1/12 Review of RFP's 5/1/12 – Completion	Hold 2 meetings with collaborative partners to begin review of the previous engineering specs Awarded project funds Offer RFP bidding process to interested parties for project scope Review submitted RFP's and select best candidate Perform project

			11/1/12 – 12/31/15 Water quality monitoring	construction activities and stream restoration project Complete project activities and sample water quality improvements at the site Improved water clarity and functioning of the floodplain and adjacent wetlands

Site ID	Unnamed Tributary Restoration Project
Description	Stream Restoration/Habitat Improvement
Impervious Cover Percentage	6.16%
14-Digit HUC#	04110002-050-030
Problem	Sedimentation/Flooding/Culverting/Poor Flood Plain Access
Priority	Medium
Cost (Stream Restoration Only)	Approx~ $300,000
Based on $200 per lineal foot	1,500 ft. x $200 ft. = $300,000
Other Costs	Soil Removal Overall Construction Costs Engineering of new Wetland/Floodplain Area Wetland Vegetation Cost of Engineering Project

EXHIBIT NO. 1

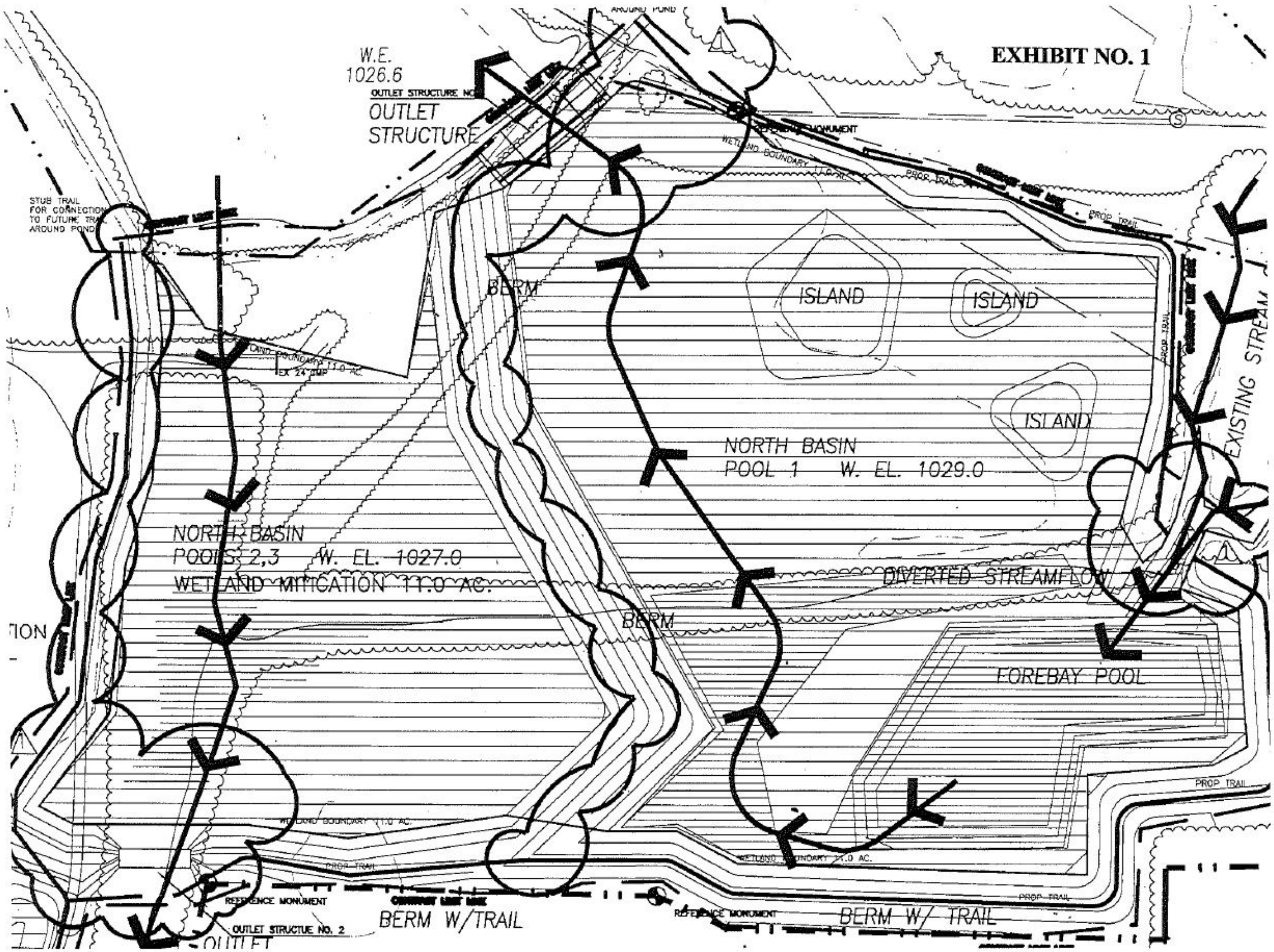
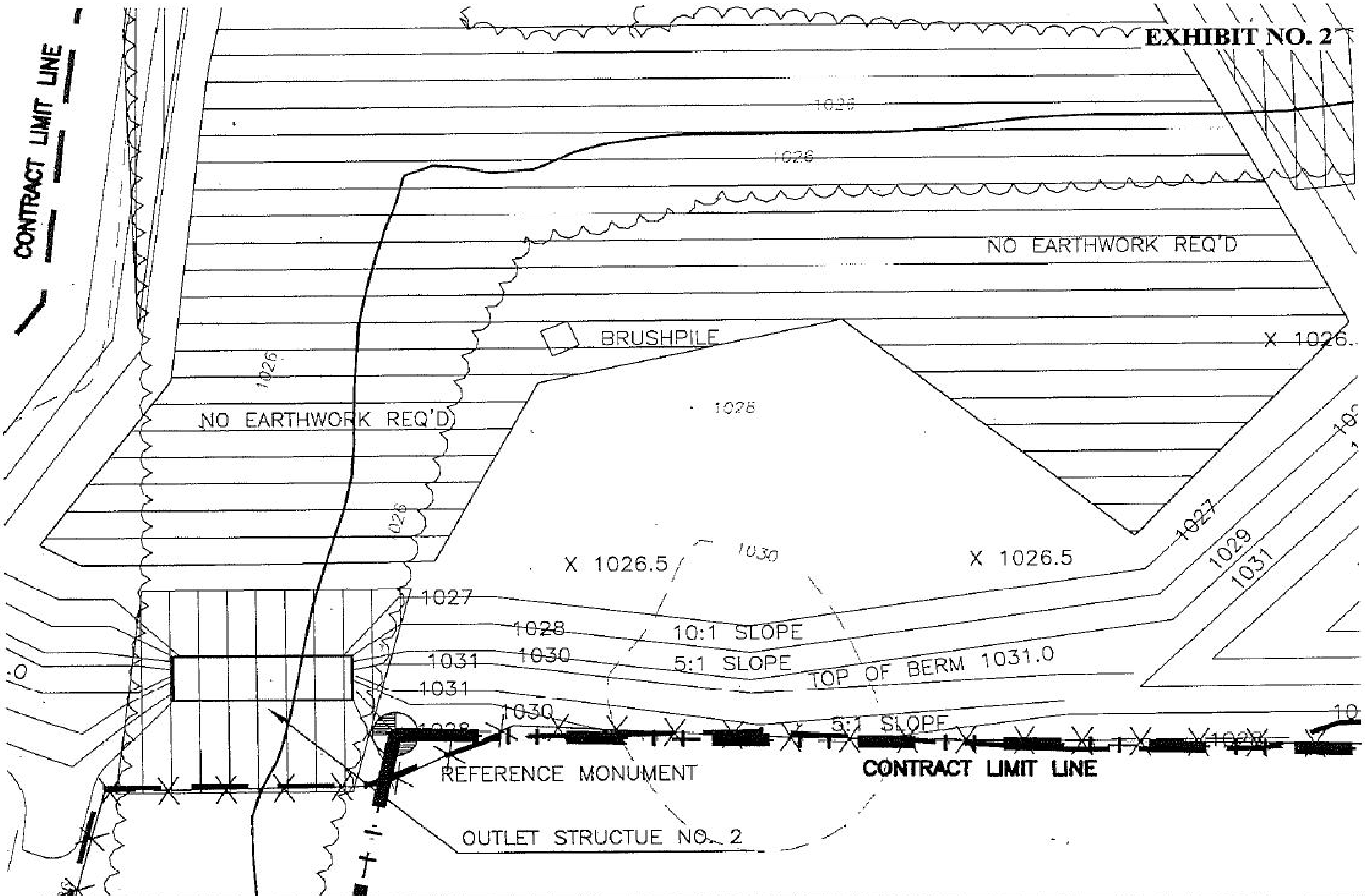
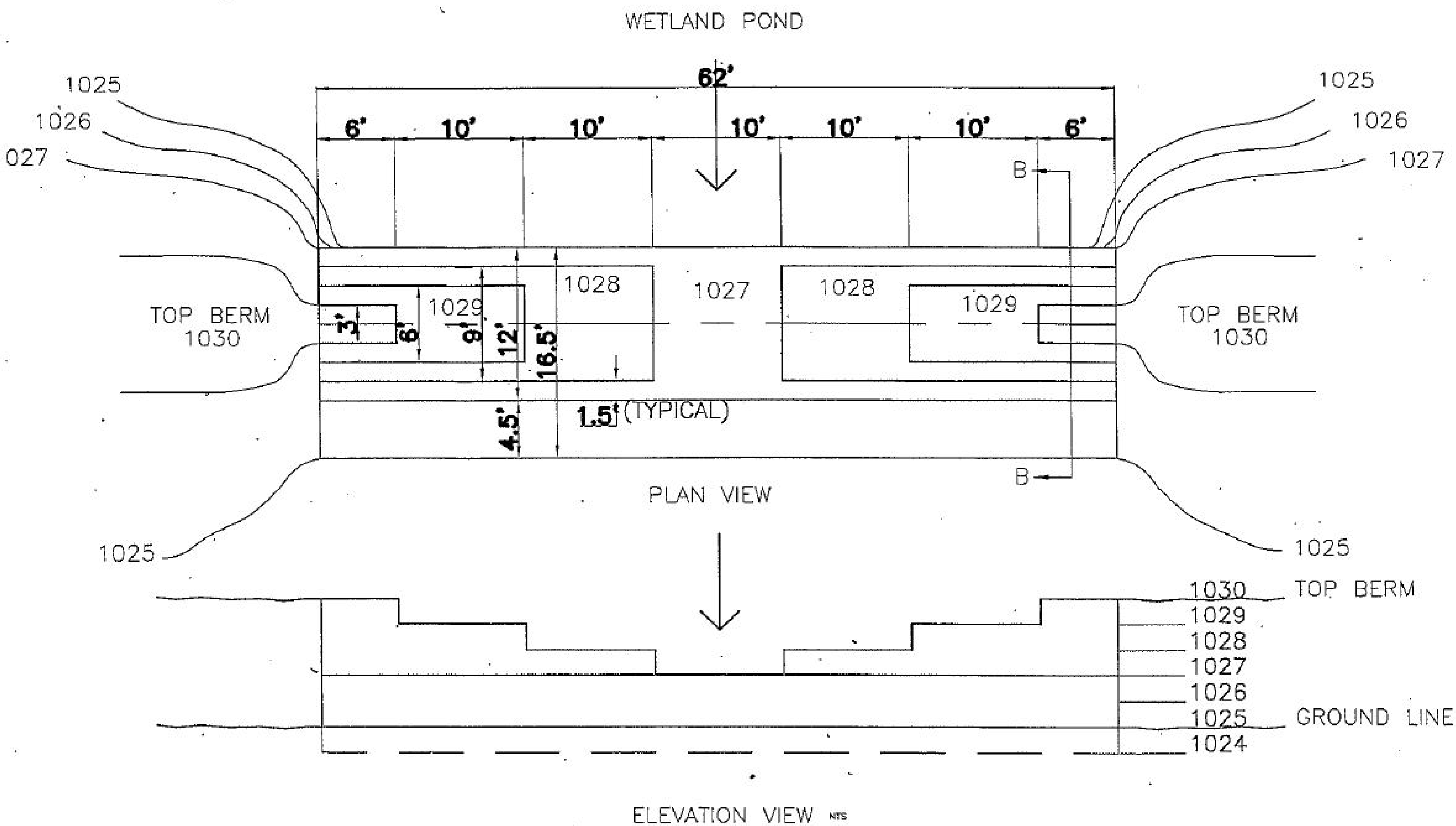

W.E.
1026.6
OUTLET STRUCTURE
STUB TRAIL FOR CONNECTION TO FUTURE TRAIL AROUND POND
BERM
ISLAND
ISLAND
ISLAND
NORTH BASIN
POOL 1 W. EL. 1029.0
EXISTING STREAM
NORTH BASIN
POOLS 2,3 W. EL. 1027.0
WETLAND MITIGATION 11.0 AC.
DIVERTED STREAMFLOW
BERM
FOREBAY POOL
WETLAND BOUNDARY 11.0 AC.
PROP TRAIL
REFERENCE MONUMENT
OUTLET STRUCTUE NO. 2
BERM W/TRAIL
BERM W/ TRAIL
OUTLET

EXHIBIT NO. 2



[redacted]

EXHIBIT NO. 3



OUTLET STRUCTURE NO. 2

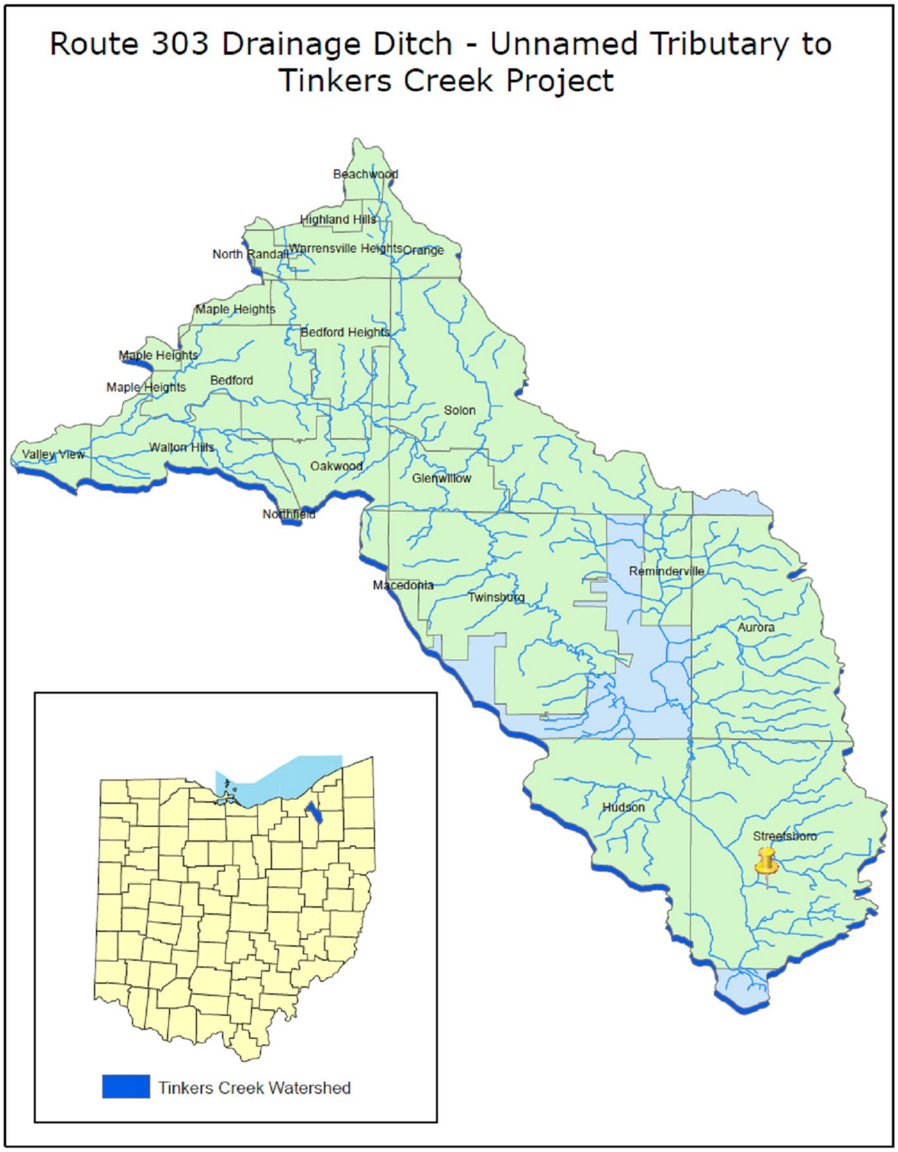


Figure 75: SR 303 Unnamed Tributary Restoration Project Location

Figure 76: Aerial Project Location

Figure 77: Connection Point of Unnamed Tributary to Tinkers Creek

3. Project Description

Tinkers Creek from SR 303 to approximately SR 14 has been channelized through dredging techniques and additionally has had the sediment side-casted onto the adjacent stream banks furthering the channelization of the stream. This is thought to be the result of a need for increasing channel capacity for the addition of effluent discharge from the Streetsboro WWTP. This process has resulted in the degradation of QHEI scores and especially the riparian wetlands and vernal pools in this area. Further, channel capacity has been increased but disallows the stream to function normally due to the restraints of the high stream banks. Down stream problems could become more alarming as flashy stream flows become more prevalent due to climate change and the forecast that precipitation events will become more acute. This evolving new circumstance will continue to promote more down-cutting and significant increases in sedimentation resulting in higher stream turbidity, lower IBI, ICI scores, and an overall reduction in water quality.

High quality riparian zones surround the stream throughout the project description area. The stream length needed to be restored is approximately 4 miles in length. Some of the property is publicly owned land while the majority is on privately owned property. This project will look to provide the stream proper use of flood plain space by either elevating the stream bottom or removing soil to provide adequate access to the riparian areas surrounding the stream. Small depressional wetlands and vernal pool areas will be created to increase available habitat and high water volume storage capacity. Sinuosity will be restored to enable the stream to function in its historic fashion and reduce the sedimentation into Tinkers Creek.

Problem: The sedimentation occurring in Tinkers Creek is contributing to the consistent non-attainment status of water quality. Throughout the watershed, upstream activities are influencing downstream QHEI scores. This stretch of Tinkers Creek could be providing significant sedimentation throughout the rest of the watershed. Further, the lack of proper access to the streams floodplain has completely negated the function of the riparian area as a source for water sequestration during high water volumes and the cleansing properties that these areas provide for increasing water quality.

Goal: Improve water quality and water quantity issues while assisting to improve down stream flooding potential and provide opportunity for the stream to clean the water due to the reintroduction of the floodplain.

MEASURABLE OUTCOMES:

Increase the likelihood to meet applicable biological criteria (IBI, Miwb, ICI) for main stem.
Increase water storage capacity by reintroducing stream to floodplain in available areas
Increase habitat scores
Increase QHEI scores immediately upon completion of restoration

Tasks	Task Partners	Funding	Time Frame	Final Indicator of Completed Task
Establish a partnership with the represented communities, and hold private land owner meetings Seek funding to perform the project Hire project engineer Perform restoration project construction	TCWP, City of Streetsboro, Ohio EPA, NEFCO, Portage SWCD, TPL, WRLC	ODOT mitigation needs, Ohio EPA SEP funds, 319 funds, Stimulus dollars	6/1/10 – 10/30/10 1/15/11 – 9/30/11 Private Landowner Meetings 1/1/12 – 7/1/12 Seek and apply for funding for project tasks 1/1/13 – 4/30/13 RFP process 5/1/13 – 6/15/13 Review of RFP's 9/1/13 – Completion Construction 3/1/14 – 12/31/17 Water quality monitoring	Hold 2 meetings with collaborative partners to begin review of the project scope Conduct 4 meetings with home owner associations regarding "buy-in" for the project Awarded project funds Offer RFP bidding process to interested parties for project scope Review submitted RFP's and select best candidate Perform project construction activities and stream restoration project Complete project activities and sample water quality improvements at the site Improved water clarity and functioning of the floodplain and adjacent wetlands

Site ID	Tinkers Creek De-Channelization Project
Description	Stream Restoration/Habitat Improvement
Impervious Cover Percentage	6.16%
14-Digit HUC#	04110002-050-030
Problem	Sedimentation/Flooding/Poor Flood Plain Access/Channelization
Priority	Medium
Cost (Stream Restoration Only)	Approx~ $4,224,000
Based on $200 per lineal foot	21,120 ft. x $200 ft. = $4,224,000
Other Costs	Soil Removal Overall Construction Costs Engineering of new Wetland/Floodplain Area Wetland Vegetation Cost of Engineering Project

Tinkers Creek behind the Streetsboro WWTP
(Notice the depth to bank ratio)

The banks are fairly straight and have virtual 90 degree slopes

Erosion from the flashy stream is causing important trees to become fragile

Notice how straight the stream channel is and the side-casted material making the stream even more channelized

Figure 78: Tinkers Creek Channelization Restoration Project

4. Project Description

The proposed project is located in Hudson Ohio within Summit County. The site is located on property owned by the Hudson City Schools. It is depicted on the USGS 7.5 minute series topographical maps Twinsburg Ohio quad (32SW) – see attached sheet. Stream restoration is proposed for a section of an unnamed tributary of Tinkers Creek, within the Cuyahoga River watershed. The tributary has a drainage area of approximately 0.27 square miles. It discharges to Tinkers Creek at river mile 25.4 via another unnamed tributary. The stream is located within the 14 digit hydrologic unit code (HUC14) 04110002-050-030. Land use in the area is primarily single-family residential. Major impervious surfaces are concentrated at the high school itself and roadways, which includes a section of the Ohio Turnpike. The HUC14 area has approximately 9.3% impervious surface area.

Primary soil types in the watershed consist of the Mahoning and Ellsworth series. Soil types located in the immediate stream corridor consist of Bogart series at the upstream end of the project and Trumbull series at the downstream end. The Trumbull soils are considered as hydric.

The stream corridor reflects that of a typical disturbed urbanized area. At several points the canopy is open as a result of landscape maintenance. The section of stream proposed for restoration consists of approximately 2000 linear feet. The channel is entrenched at the upstream portion to a depth of up to five feet. As is progresses to the downstream site it has a small section which may reflect original conditions.

Two headcuts exist in the channel each of which has been stopped by a man-made structure. The upstream progression stops at the Ohio Turnpike where two culverts have caused a grade change of about two feet. Downstream, about midpoint in this section, another head cut is stopped by a stream crossing consisting of twin corrugated metal culvert pipes and fill. The immediate grade change is about one foot. At this time the stream appears to be in a quasi-equilibrium state. Down cutting appears to have stopped, due in part to the two artificial grade controls.

The stream banks are still unstable and it is a source of sediment to the stream. Lateral channel migration is occurring in an attempt to reestablish sinuosity, which was eliminated in the middle portion of the site due most likely to dredging. Dominant stream substrate consists of sand and gravel with a moderate to severe amount of embeddedness. Several riffles have developed in the stream and they consist of mostly large gravel and small amounts of cobble. Where current is flowing over the riffles they have remained relatively silt-free. Several pools exist in this section of stream with a maximum depth of 2 feet. Pool substrate consists of sand and silt.

Based on the U.S. EPA Region 5 model, the restoration project will remove an estimated:

- 640 lbs/yr Total Nitrogen (TN)
- 320 lbs/yr Total Phosphorus (TP)
- 320 lbs/yr Sediment

Problem: Headwater streams are the capillaries to the larger streams within a watershed. Providing restoration and protection to these small streams will have a cumulative positive impact on the rest of the watershed. Most urban headwater streams are piped, channelized, or culverted and no longer function as the life blood of stream systems.

Goal: Restore and protect an impacted unnamed tributary stream, which provides excessive sediment and nutrient loading in Hudson, Ohio, by creating a wetland detention area and implementing a natural channel design on City/Hudson High school owned property adjacent to an the unnamed stream.
MEASURABLE OUTCOMES: Meet applicable biological criteria (IBI, Miwb, ICI) for tributary. Qualitative Habitat Evaluation Index (QHEI) score of 60 or > Reintroduce stream to floodplain and reduce sediment loading to system by 320 tons/yr (minimum) Remove 320 pounds of TP per year Remove 640 pounds of nitrogen per year

Tasks	Task Partners	Funding	Time Frame	Final Indicator of Completed Task
Restore 2,000 linear feet of unnamed tributary to Tinkers Creek (HUC#04110002-050-030) using natural channel design in Hudson, Ohio Establish strong partnership with the participating entities to ensure project success Assist in developing land lab monitoring program	CCBH, TCWP, Hudson High School, City of Hudson, and Hudson School District	Ohio EPA 319 grant, City of Hudson, TCWP, Hudson High School	Hold several meetings with funding parties RFP to go out 8/09 Award job 9/09 Project to commence 4/10 Project Completed by 10/10	CCBH awarded grant and project will commence by the 2009 2,000 linear feet of stream restored 320 pounds of sediment removed 320 pounds of TP per year 640 pounds of nitrogen per year Creation of land lab and daily monitoring station
Obtain Conservation Easement	TCWP, Hudson High school, City of Hudson	Ohio EPA 319 grant program	11/10	Obtain conservation easement

Site ID	Unnamed Tributary
Description	Tributary to Tinkers Creek
Impervious Cover Percentage	9.3%
14-Digit HUC#	04110002-050-030
Problem	Sedimentation/Erosion/Nutrient removal
Priority	High
Cost (Stream Restoration Only)	Approx~ $320,000
Based on $200 per lineal foot	1,600 ft. x $200 ft. = $320,000
Other Costs	Soil Removal Overall Construction Costs Engineering of new Wetland/Floodplain Area Wetland Vegetation Cost of Engineering Project

Massive Erosion and soil displacement can be seen throughout this project area

Channelization and culverts have contributed to the overall stream degradation

Figure 79: Hudson High School Stream Restoration Project

HUC # 4110002-050-050

1. Project Description:

The *Twinsburg - Laurel Creek Stream Restoration/Low-head Dam Removal Project* is specifically located in Twinsburg, Ohio in Summit County in HUC# (04110002-050-050). This project will be performed on both publically owned and privately owned property, of which, the private land owners are in support of the project. The population for Twinsburg is approximately 17,006 people according to the 2000 census.

The project location is on the north and south sides of Ravenna Rd. near the intersection of E. Idlewood Dr. The stream flows through a large sub-division with significant impervious cover which has caused excessive erosion of the stream prior to meeting the south end of Ravenna Rd. As the stream flows underneath Ravenna Rd. and daylights on the north side, Laurel Creek enters a detention area with a low-head dam barrier. This detention area was originally constructed to function as a recreational pond. However, the detention area is highly influenced by an accumulation of sediment from the up-stream erosion occurring. Further, eutrophication is evident by the observation of algae and turbid water assumed to be the result of up-stream homeowner lawn fertilizer application. Because of the significant impervious cover Laurel Creek cannot accommodate the amount of water inputted into the system. Like most urban watersheds, Laurel Creek has been entrenched and no longer has access to its floodplain causing in-stream erosion, significant sediment loading, and potential down stream flooding.

This is set to become a collaborative project between the Cuyahoga County Board of Health, Tinkers Creek Watershed Partners and the City of Twinsburg. The RFP process would be a design/build RFP.

Laurel Creek is a smaller tributary stream to Tinkers Creek; the largest tributary to the Cuyahoga River. Currently, a TMDL has been created for the Lower Cuyahoga River, of which, Tinkers Creek and Laurel Creek are a part of. According to the TMDL, the Tinkers Creek Watershed Action Plan, and the 2008 Ohio EPA Integrated Report Section M2 (305 (b)) sheet, the Tinkers Creek Watershed has been found to be impaired by:

- Organic enrichment
- Nutrient Enrichment
- Low in-stream dissolved oxygen
- Toxicity
- Sedimentation
- Habitat Degradation
- Oil & Grease
- Unknown Impairment(s)

The *Twinsburg - Laurel Creek Stream Restoration/Low-head Dam Removal Project* will address the use impairment issues of nutrient enrichment, sedimentation, habitat degradation, a reduction of oil and grease contamination, and an increase in habitat creation through the dam removal to allow for fish migration. The process of engaging the stream and its floodplain to function properly throughout the restoration project will eradicate the need for the detention area by allowing the water to be stored in its floodplain. Further, the project will assist in reducing downstream erosion, flooding potential, and increase nutrient removal by utilizing the vegetated floodplain for storage, reducing water velocities, and uptake in excess nutrients.

Additionally, Laurel Creek is part of the Cuyahoga River “Area of Concern” which addresses the 14 Beneficial Use Impairments designed to provide safety indicators for human recreational use and overall stream quality. Further, the Cuyahoga County Board of Health in partnership with the Tinkers creek Watershed Partners has submitted a Watershed Action Plan which is currently under review by ODNR for State endorsement. Within this plan, this project has been specifically identified as a restoration project which will reduce sedimentation and nutrient loading into Tinkers creek, as well as, address the non-point source pollutants associated with the non-attainment status to EPA water quality standards for Tinkers Creek.

Based on the U.S. EPA Region 5 model, the restoration project will remove an estimated:

- 114.2 lbs/yr Total Nitrogen (TN)
- 57.2 lbs/yr Total Phosphorus (TP)
- 57.2 lbs/yr Sediment

Problem: Regionally, development including commercial, residential, and industrial building, are contributing to stream degradation through riparian loss, wetland removal, and intense sedimentation caused by poor management of construction areas and a drastic influx of storm water into the stream channel.

Goal: Restore impacted tributary stream, which provides excessive sediment loading in Twinsburg, Ohio, by creating wetland detention areas on City owned property adjacent to Laurel Creek.

MEASURABLE OUTCOMES:
Increase the likelihood to meet applicable biological criteria (IBI, Miwb, ICI) for main stem and tributaries.
Increase water storage capacity by reintroducing stream to floodplain in available areas
Reduce flooding potential to downstream communities
Reduce sediment loading into Laurel Creek by 57.2 lbs/yr

Tasks	Task Partners	Funding	Time Frame	Final Indicator of Completed Task
Restore 1,600 feet of city & privately owned stretches" of Laurel Creek (tributary to Tinkers Creek) HUC#(04110002-050-050) using natural channel design and bioretention in Twinsburg, Ohio.	TCWP, City of Twinsburg, Ohio EPA, ODNR, Summit SWCD, SCHD	ARRA, Ohio EPA 319 grant, City of Twinsburg, TCWP, EPA SEP funds, Cleveland Foundation	RFP for proposals 6/10 Select Design/Build Partner from RFP's 8/10 Design Project 4/11 Construction of Project 6/11 Completion of Construction 9/11	Completed Restoration Project Reduction of 114.2 lbs of Nitrogen per year 57.2 lbs of phosphorus and sediment reduced per year Low-head dam removed Improved QHEI score by 3 points
Obtain Conservation Easement on restored areas	TCWP, City of Twinsburg, Ohio EPA, ODNR, Summit SWCD, SCHD,	City of Twinsburg, Summit SWCD	N/A	Conservation Easement applied to restored areas

Site ID	Laurel Creek
Description	Tributary to Tinkers Creek
Impervious Cover Percentage	16.59%
14-Digit HUC#	04110002-050-050
Problem	Sedimentation
Priority	Medium-High

Cost (Stream Restoration Only)	Approx~ $320,000
Based on $200 per lineal foot	1,600 ft. x $200 ft. = $320,000
Other Costs	Soil Removal Overall Construction Costs Engineering of new Wetland/Floodplain Area Wetland Vegetation Cost of Engineering Project Dam Removal

Impervious surfaces like this parking lot provide too much runoff into streams such as Laurel Creek and then undercut and erode stream banks to ultimately cause channelization

Notice the severe erosion and the significant loss of property due to extreme water velocity

Property loss due to severe erosion

Small Impoundment Area

Low-Head Dam structure

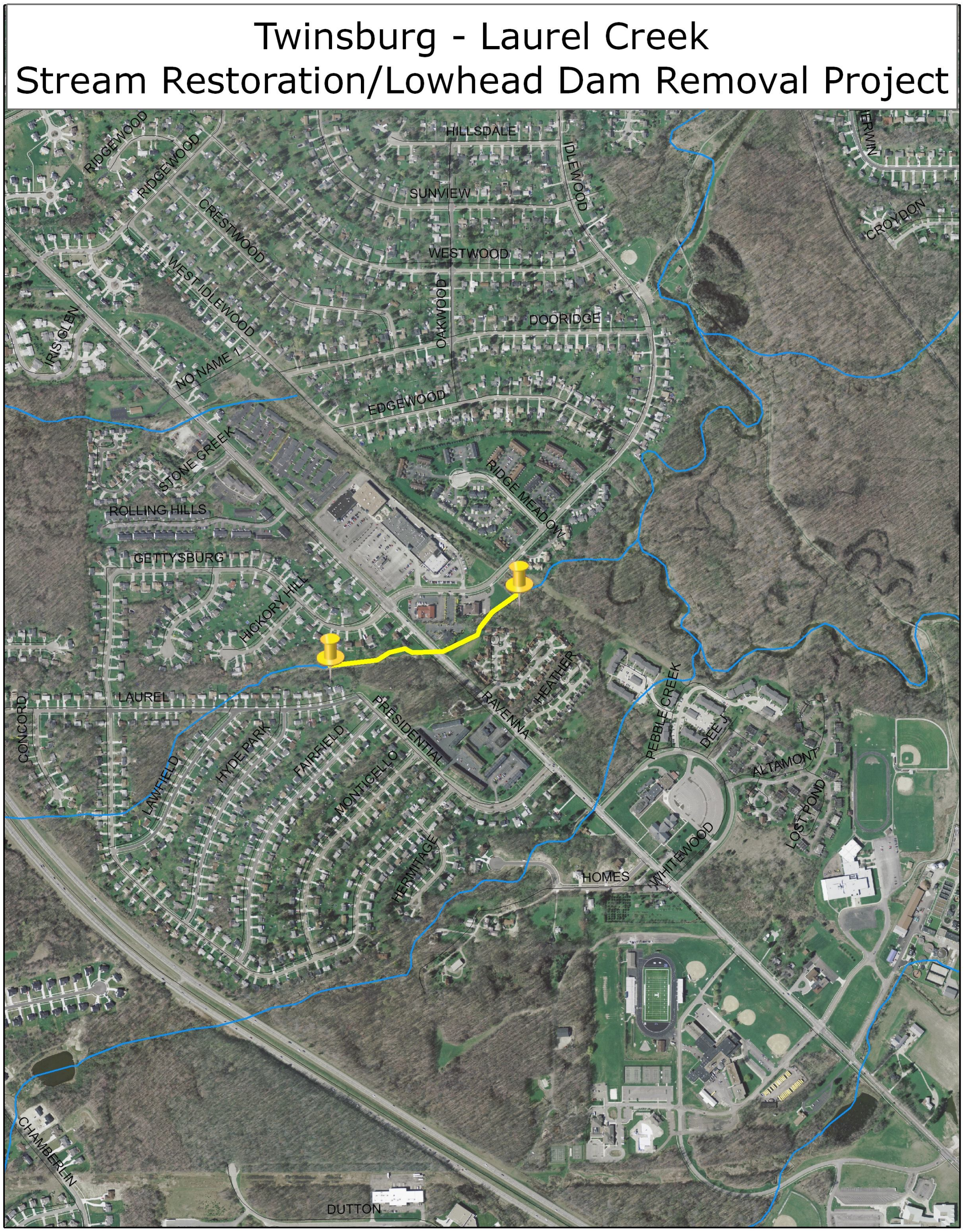


Figure 80: Location of Laurel Creek Stream Restoration/Lowhead Dam Removal Project

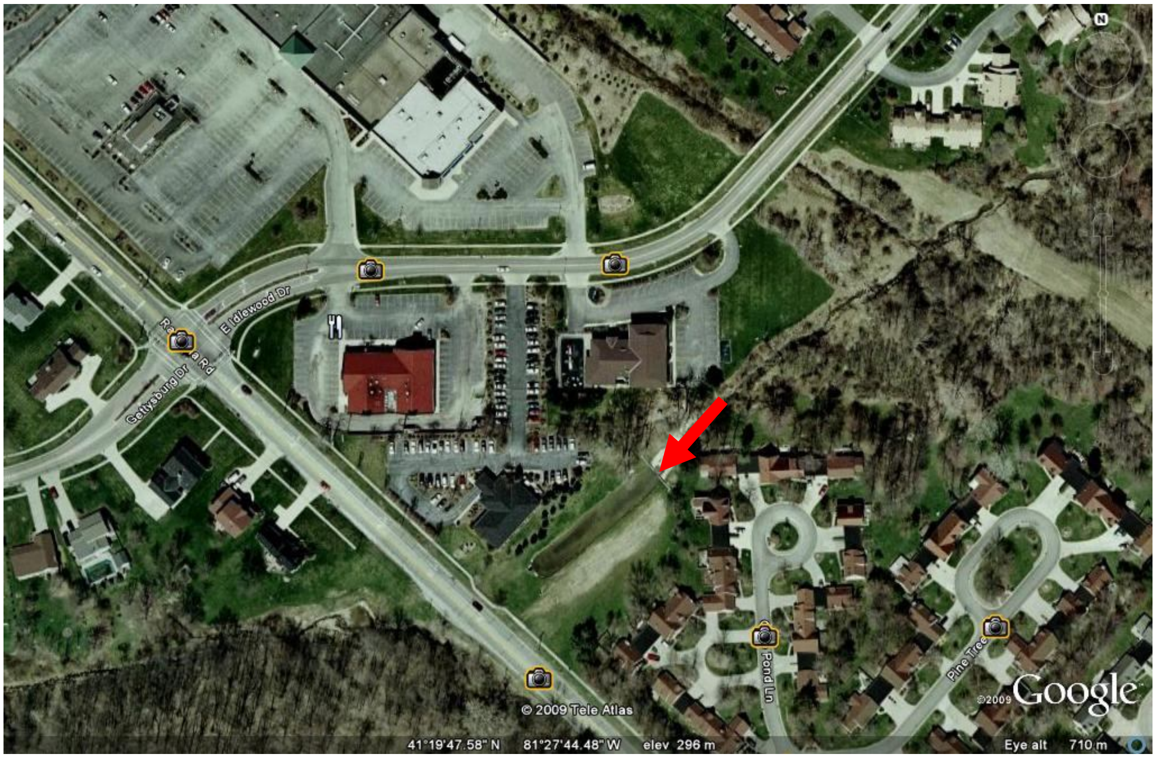


Figure 81: Lowhead Dam location

2. Project Description

This project will perform a stream restoration project on 1,600 linear feet of stream located in the Tinkers Creek Watershed. The *Bear Creek Stream Restoration Project* is specifically located in Warrensville Heights, Ohio in Cuyahoga County in HUC# (04110002-050-050). The population for this Cleveland "inner-ring" suburb is approximately 15,000 people according to the 2000 census. The project location is on Clarkwood Parkway north of Emery Rd. and east of Northfield Rd. and is positioned on privately owned property, to which, the property owners have agreed to be collaborative partners in this endeavor. Bear Creek receives runoff from the adjacent community of Highland Hills, Ohio.

In its current condition, the stream is jeopardizing the integrity of Clarkwood Parkway due to significant erosion and the proximity to the road. Clarkwood School is also located nearby and City buses provide transportation for the students which drive over this location daily causing concern for the roadway integrity and the safety of the public. Additionally, Warrensville Heights has significant impervious cover and therefore Bear Creek cannot accommodate the amount of water inputted into the system. Like most urban watersheds, Bear Creek has been entrenched and no longer has access to its floodplain causing instream erosion, significant sediment loading, and potential down stream flooding.
This is a collaborative project between the Cuyahoga County Board of Health,

Tinkers Creek Watershed Partners and the City of Warrensville Hts. The project would be design and build. However, there have been preliminary designs completed but further development and finalization is required for these designs. The RFP process would be a design/build RFP.

Bear Creek is a smaller tributary stream to Tinkers Creek; the largest tributary to the Cuyahoga River. Currently, a TMDL has been created for the Lower Cuyahoga River, of which, Tinkers Creek and Bear Creek are a part of. According to the TMDL, the Tinkers Creek Watershed Action Plan, and the 2008 Ohio EPA Integrated Report Section M2 (305 (b)) sheet, the Tinkers Creek Watershed has been found to be impaired by:

- Organic enrichment
- Nutrient Enrichment
- Low in-stream dissolved oxygen
- Toxicity
- Sedimentation
- Habitat Degradation
- Oil & Grease
- Unknown Impairment(s)

The *Bear Creek Stream Restoration Project* will address the use impairment issues of nutrient enrichment, sedimentation, habitat degradation, and a reduction of oil and grease contamination through the process of engaging the stream and its floodplain to function properly throughout the restoration project. Further, the project will assist in reducing downstream erosion and flooding potential by utilizing two vegetated detention areas within the outdoor educational land lab location.

Additionally, the aforementioned areas are also a part of the Cuyahoga River "Area of Concern" which addresses the 14 Beneficial Use Impairments designed to provide safety indicators for human recreational use and overall stream quality. Preliminary project designs have been completed for this project, but further design and planning are needed.

The following information is a summary of the proposed project:

1. Restores the embankment of Clarkwood Ave. where it bends westbound adjacent to the culvert outfall.
2. Replaces the dilapidated and undermined culvert headwall.
3. Realigns the upper portion of the creek channel to avoid future erosive impacts with the edge of roadway.
4. Establishes a bank full flow path for daily rainfall events while containing the inundation area within the floodway limits avoiding impact to neighboring properties during less frequent, more severe storm events.
5. Minimizes the creek flow velocity to 6 ft/s during the 5-year storm event (100-yr max is 7.6 ft/s) deceasing sediment transport downstream and allowing the ecosystem that will be reestablished the opportunity to thrive.

6. Provides 6,700 cubic yards of stormwater detention volume for the 16+ Acre Warrensville Heights property(s) by means of above ground ponds with control structures, (*Note that 1.2 Acres of the City property would be utilized for stormwater management decreasing the available usable property area to 15 Acres*).
7. Based on the U.S. EPA Region 5 model used for 319 applications, the detention basin will remove an estimated:

- 367 lbs/yr BOD
- 1,885 lbs/yr COD
- 10,856 lbs/yr TSS
- 8 lbs/yr Lead,
- 5 lbs/yr Zinc,
- 101 lbs/yr Total Nitrogen (TN)
- 5 lbs/yr Total Phosphorus (TP)

The project also provides an outdoor education learning lab utilizing pervious brick pavers and sedimentary stone, accessibility to Bear Creek for macroinvertebrate monitoring opportunities, and replaces aged, damaged and expired landscaping with new native vegetation. This outdoor education lab will provide the students of Warrensville Heights an opportunity to have a "hands-on" learning experience with a natural resource in their community; something that they do not currently have. The Tinkers Creek Watershed Partners in conjunction with the City of Warrensville Heights and The Cuyahoga County Board of Health will work with the local school system to facilitate a competition to create signage throughout the project to educate the public about the endeavor. The top art pieces will used in the outdoor land lab.

Impacts to stream corridors from impervious land cover in urbanized environments cause increases in channel volume and the likelihood for channel and bank destabilization. Both water quantity and quality concerns are becoming increasingly important to the health of both the stream and the public.

Problem: Impacts to stream corridors from impervious land cover in urbanized environments cause increases in channel volume and the likelihood for channel and bank destabilization. Both water quantity and quality concerns are becoming increasingly important to the health of both the stream and the public.

Goal: Restore impacted tributary stream, which provides excessive sediment loading in Warrensville Heights, Ohio, and a public health risk because of road decay by using a 2-stage stream channel design model for a restoration project and re-introducing the stream to its floodplain.				
MEASURABLE OUTCOMES: Increase the likelihood to meet applicable biological criteria (IBI, Miwb, ICI) for main stem and tributaries. Achieve Qualitative Habitat Evaluation Index (QHEI) score of 60 or > Increase water storage capacity by reintroducing stream to floodplain Reduce flooding potential to downstream communities **Stop road decay from erosion**				
Tasks	**Task Partners**	**Funding**	**Time Frame**	**Final Indicator of Completed Task**
Restore 1,600 feet of Bear Creek (tributary to Wood Creek) HUC# (04110002-050-050) using a 2-stage channel design and bio elements to combat high storm water velocities. Create an outdoor land lab for local school system	TCWP, Warrensville Heights, Ohio EPA, ODNR, Cuyahoga SWCD, CCBH, Highland Hills, Ohio, CCPC	Ohio EPA 319 grant, City of Warrensville Heights, TCWP, EPA SEP funds, Cleveland Foundation	Apply for funding: 3/10 Finalize design/build component 8/10 Establish Signage competition 9/10 Construction 3/11-7/11 Planting/seeding 7/11 Land lab installation 8/11-9/11 Signage installation 8/11-9/11 Project complete 12/11	Project Completed The removal of: 367 lbs/yr BOD 1,885 lbs/yr COD 10,856 lbs/yr TSS 8 lbs/yr Lead 5 lbs/yr Zinc 101 lbs/yr Total Nitrogen (TN) 5 lbs/yr Total Phosphorus (TP) Land lab created and utilized by local schools
Obtain Conservation Easement on restored areas	TCWP, Warrensville Heights, Ohio EPA, ODNR, Cuyahoga SWCD, CCBH, Highland Hills, Ohio, CCPC, Private Land owners	City of Warrensville Heights, Private property owners	Easement obtained by the project contract signage time	Conservation Easement applied to restored areas

Site ID	Bear Creek
Description	Tributary to Tinkers Creek
Impervious Cover Percentage	16.59%
14-Digit HUC#	04110002-050-050
Problem	Sedimentation/Erosion
Priority	High

Cost (Stream Restoration Only)	Approx~ $320,000
Based on $200 per lineal foot	1,600 ft. x $200 ft. = $320,000
Other Costs	Soil Removal Overall Construction Costs Engineering of new Wetland/Floodplain Area Wetland Vegetation Cost of Engineering Project


Bear Creek eroding, channelized, and jeopardizing the integrity of the road due to increased storm water runoff


High water velocities are clearly significant and causing massive erosion

Bear Creek: Warrensville Heights, Ohio

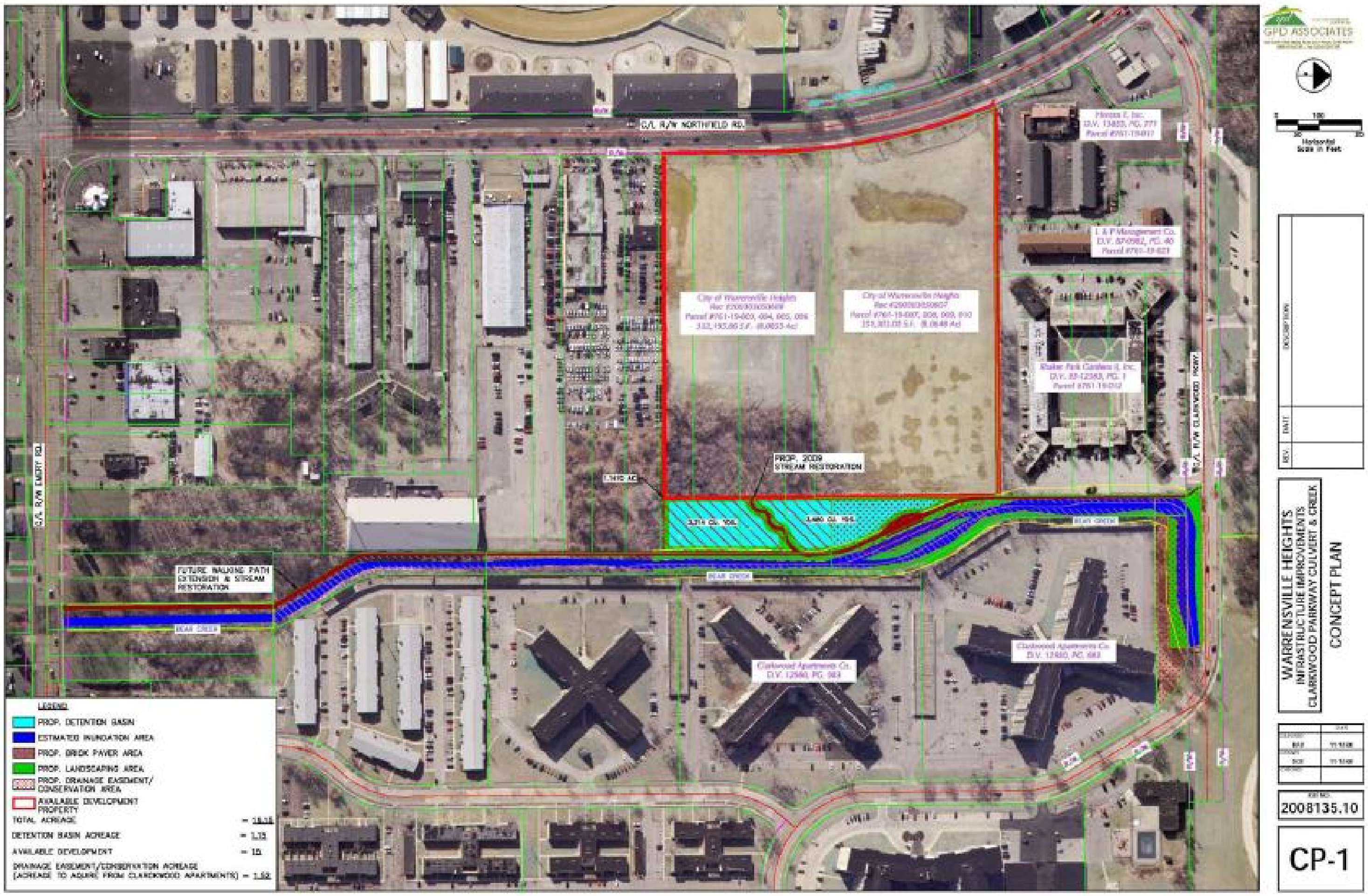


Figure 82: Bear Creek Stream Restoration Project location

Figure 83: Adjacent Institutional Lands occupy a significant portion of the watershed

3. Project Description

This project will be performed to restore 2,000 linear feet of stream located in the Tinkers Creek Watershed. The *Bedford-Wood Creek Stream Restoration Project* is specifically located in Bedford, Ohio in Cuyahoga County in HUC# (04110002-050-050). Wood Creek is a sub-watershed of Tinkers Creek with a drainage area of 3.6 square miles. The stream flows through the communities of Bedford, and Maple Heights and contains a combined population of 52,312 people according to the 2,000 census.

This project will be implemented on both publicly and privately owned property, of which, the private property owners are in support of this project. The Wood Creek sub-watershed is highly urbanized and has an approximate impervious cover of 54.7%. This has caused severe erosion to occur within the stream channel due to the amount of surface runoff generated during precipitation events causing rapid flashy stream flows.

In addition, stream channel incising, lack of access to floodplain, stream bank stabilization, and fallen trees due to under-cutting are exacerbating the in-stream erosion. This is a collaborative project between the Cuyahoga County Board of

Health, Tinkers Creek Watershed Partners and the City of Bedford. The RFP process would be a design/build RFP.

Due to the flashy stream flows as stated in the Lower Cuyahoga River TMDL, excessive sedimentation due to stream bank scouring is one of the leading water quality degraders in the Tinkers Creek Watershed, as well as, Wood Creek. Additionally, organic and nutrient enrichment are causing low in-stream dissolved oxygen issues and therefore, negatively influencing the reestablishment of WWH communities.

Further, the TMDL and the 2008 Ohio EPA Integrated Report Section M2 (305 (b)) sheet indicates that the Tinkers Creek Watershed is additionally impaired by:

- Organic enrichment
- Nutrient Enrichment
- Low in-stream dissolved oxygen
- Toxicity
- Sedimentation
- Habitat Degradation
- Oil & Grease
- Unknown Impairment(s)

The *Bedford-Wood Creek Stream Restoration Project* will address the use impairment issues of nutrient enrichment, sedimentation, habitat degradation, and a reduction of oil and grease contamination through the process of engaging the stream and its floodplain to function properly throughout the restoration process, in addition to, significant stream bank stabilization efforts. The *Bedford-Wood Creek Restoration Project* will focus on limiting erosion potential by reintroducing the stream to its floodplain and stabilizing the severe bank erosion concerns. Fallen trees (4 feet in diameter minimum) are causing “pinch points” where the stream is flowing around the fallen tree jams exacerbating the erosion problem.

The project will restore 3,000 linear feet of entrenched stream and therefore significantly reduce sedimentation and nutrient input into Tinkers Creek. Based on the U.S. EPA Region 5 model, the restoration project will remove an estimated:

- 3,900 lbs/yr Total Nitrogen (TN)
- 1,950 lbs/yr Total Phosphorus (TP)
- 1,950 lbs/yr Sediment

Impacts to stream corridors from impervious land cover in urbanized environments cause increases in channel volume and the likelihood for channel and bank destabilization. Both water quantity and quality concerns are becoming increasingly important to the health of both the stream and the public.
Problem: Impacts to stream corridors from impervious land cover in urbanized environments cause increases in channel volume and the likelihood for channel

and bank destabilization. Both water quantity and quality concerns are becoming increasingly important to the health of both the stream and the public.

Goal: Restore impacted tributary stream (Wood Creek), which provides excessive sediment loading, has become increasingly channelized, and has severely eroded the stream banks in Bedford, Ohio by stream bank stabilization, re-introducing the stream to its floodplain, and adopting a steep slope ordinance to ensure slope stability.

MEASURABLE OUTCOMES:
Stabilize stream bank and steep slopes
Achieve Qualitative Habitat Evaluation Index (QHEI) score of 60 or >
Increase water storage capacity by reintroducing stream to floodplain
Reduce flooding potential to downstream communities
Address TMDL report by emphasizing a reduction in erosion from increases in stream flows

Tasks	Task Partners	Funding	Time Frame	Final Indicator of Completed Task
Consider adoption of steep slope ordinances for the City of Bedford.	TCWP, Bedford, Ohio, EPA, ODNR, Cuyahoga SWCD, CCBH, CCPC	City of Bedford, Ohio in-kind	Hold 2 meetings with the City Planning Commission, Mayor, Council, Engineer, and provide explanation and draft examples of steep slope ordinances by 12/31/10.	Drafted and adopted ordinance.
Obtain Conservation Easements on publicly owned adjacent lands	TCWP, Bedford, Ohio, EPA, ODNR, Cuyahoga SWCD, CCBH, CCPC	Ohio EPA 319 grant, City of Bedford, Ohio, TCWP, EPA SEP funds, Cleveland Foundation, CMAG, Clean Ohio Fund	Create a priority parcel land acquisition map of distressed areas and other publicly owned lands 2011 Apply for funding for easement acquisition 2012	Conservation Easements applied to needed areas.
Stream Bank Stabilization Obtain funding to assist in stabilizing eroding steep banks and to reintroduce the stream to its floodplain	TCWP, Bedford, Ohio, EPA, ODNR, Cuyahoga SWCD, CCBH, CCPC	Ohio EPA 319 grant, City of Bedford, Ohio, TCWP, EPA SEP funds, Stimulus funds, ODOT mitigation need, Capital Improvement projects	RFP for proposals 2013 Select Design/Build Partner from RFP's 2013 Design Project 2014 Construction of Project 2014 Completion of Construction 2015	Seek funding opportunities Awarded funding Stabilize stream banks to reduce sediment flowing into Tinkers Creek Reduce sediment loading by 1,950 lbs/yr Reduce phosphorus inputs by 1,950 lbs/yr Reduce Nitrogen inputs by 3,900 lbs/yr Working floodplain

Site ID	Wood Creek
Description	Tributary to Tinkers Creek
Impervious Cover Percentage	43.70%
14-Digit HUC#	04110002-050-050
Problem	Sedimentation/Erosion/Channelization
Priority	High

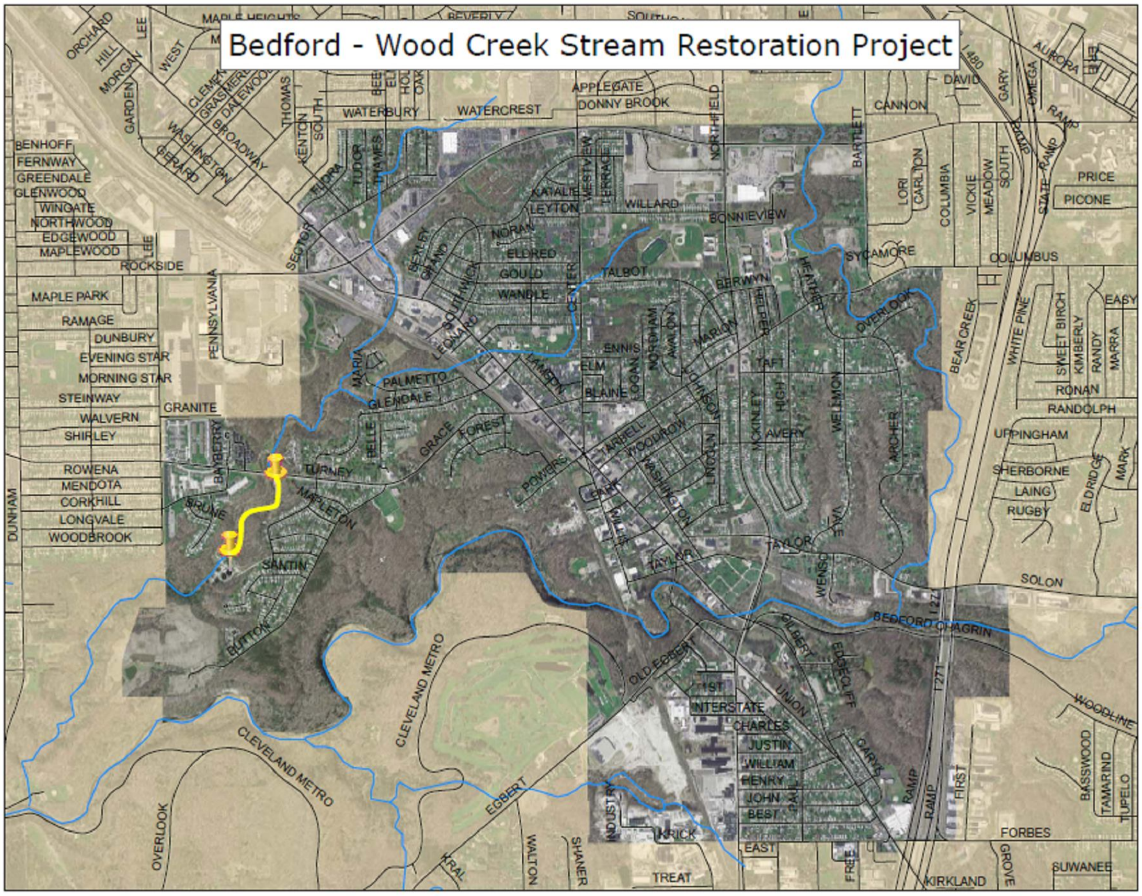
The project cost for this project will be quite significant due to the incredible amount of soil which needs to be removed from the project location. Therefore, it is difficult to associate a dollar value to a project with this amount of erosion and extreme bank de-stabilization.

Wood Creek has severe erosion problems resulting in large trees being toppled over due to incredible high water velocities and flashy storm events

Fallen trees pile on top of each other resulting in barricades for water flow. The result is increased erosion due to the impass the trees provide the stream channel


Steep slopes and clay lenses are prevalent throughout this stream


Slope erosion like the one pictured above cause massive sedimentation both in the stream channel and down stream to other locations



Figure(s) 84-85: Location of Restoration Project

4. Project Description

Increased urbanization has resulted in a larger percentage of impervious areas and has contributed large quantities of stormwater runoff and significant quantities of debris and other pollutants (e.g., litter, oils, sediments, nutrients, organic matter) that reach the receiving waters of Tinker's Creek. Chagrin Valley Engineering is proposing a stream restoration project that will decrease sediment load, improve bank stability, increase biological diversity and most importantly in-stream water quality to an impaired urban tributary to Tinker's Creek.

The adjacent land use practices have encroached into the riparian buffers causing stream bank erosion, loss of vegetated habitat, and provided an avenue for the propagation of invasive species (*Phragmites* sp.). The proposed project would re-establish and stabilize the riparian buffer to improve the health and water quality of the tributary. This would be accomplished through the removal of invasive species within the stream corridor, natural plantings, stream bank stabilization, and stream channel restoration using natural channel design techniques.

The perennial tributary is located east of Interstate 271 and north of Forbes Road and extends into the Bedford Reservation of the Cleveland Metroparks. The total length of stream channel located within Oakwood and Bedford Heights is 4,000 feet.

The tributary is surrounded on the west by a commercial development and residential development and woodlands along the east. The downstream reach of the tributary is extends into the Bedford Reservation of the Cleveland Metroparks.

Further, the TMDL and the 2008 Ohio EPA Integrated Report Section M2 (305 (b)) sheet indicates that the Tinkers Creek Watershed is additionally impaired by:

- Organic enrichment
- Nutrient Enrichment
- Low in-stream dissolved oxygen
- Toxicity
- Sedimentation
- Habitat Degradation
- Oil & Grease
- Unknown Impairment(s)

The project will restore 3,000 linear feet of entrenched stream and therefore significantly reduce sedimentation and nutrient input into Tinkers Creek. Based on the U.S. EPA Region 5 model, the restoration project will remove an estimated:

- 1,920 lbs/yr Total Nitrogen (TN)
- 960 lbs/yr Total Phosphorus (TP)
- 960 lbs/yr Sediment

Problem: Urban watersheds must contend with significant stream degradation caused by the input of high quantities of storm water. Small headwater tributary streams function as the lifeblood of any larger river. The restoration of these smaller watersheds will continue to be gravely important to the continued recovery of the Tinkers Creek Watershed.

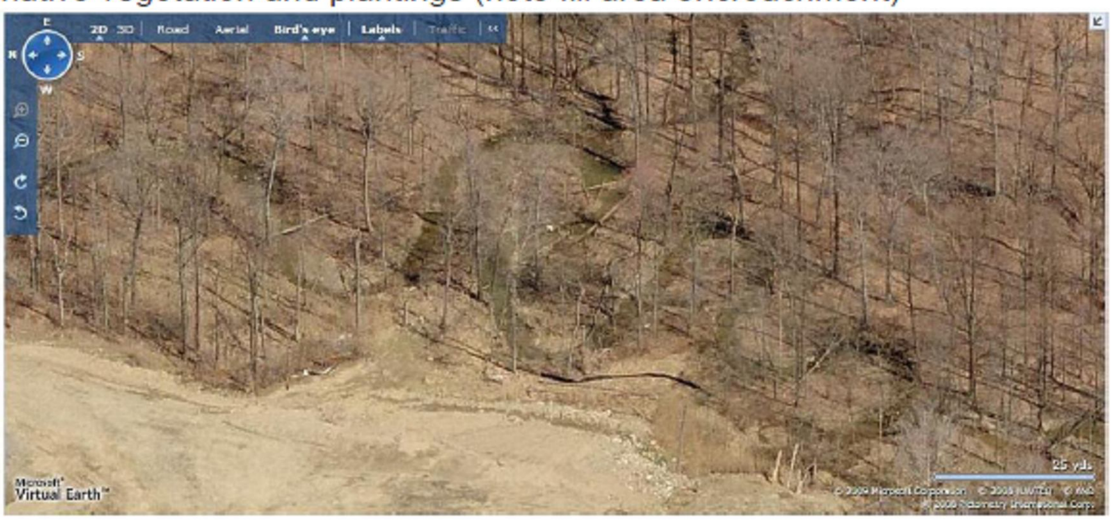
Goal: Restore impacted tributary stream (Unnamed Tributary), which provides excessive sediment loading, has become increasingly channelized, and has severely eroded the stream banks in Oakwood, Ohio by stream bank stabilization techniques, re-introducing the stream to its floodplain, and increasing the habitat within the riparian area of the project.

MEASURABLE OUTCOMES:
Stabilize stream bank
Achieve Qualitative Habitat Evaluation Index (QHEI) score of 60 or >
Increase water storage capacity by reintroducing stream to floodplain
Reduce flooding potential to downstream communities
Address TMDL report by emphasizing a reduction in erosion from increases in stream flows

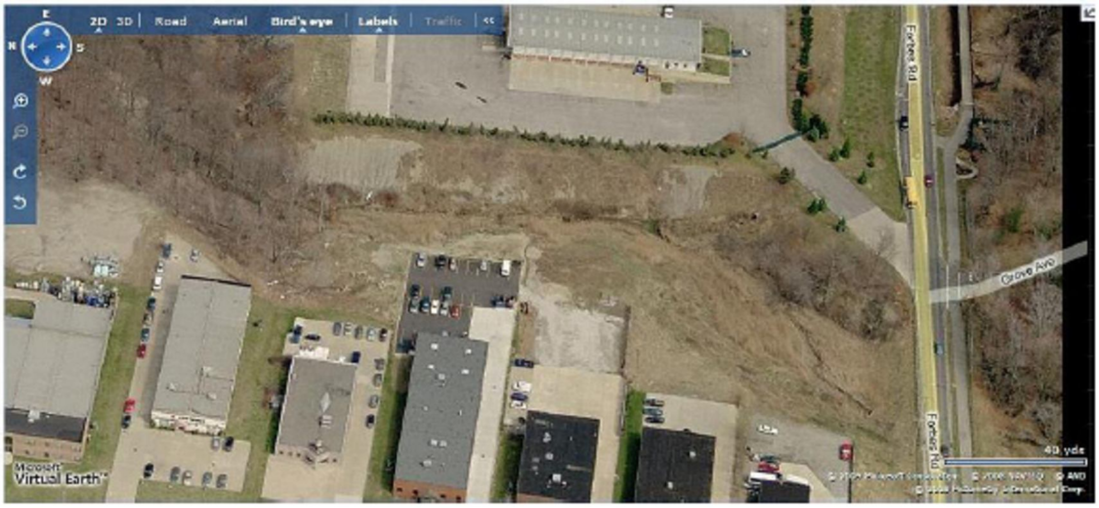
Tasks	Task Partners	Funding	Time Frame	Final Indicator of Completed Task
Obtain Conservation Easements on privately owned adjacent lands	TCWP, Project Communities, Ohio, EPA, ODNR, Cuyahoga SWCD, CCBH, CCPC	Ohio EPA 319 grant, City of Project Communities, TCWP, EPA SEP funds, Cleveland Foundation, CMAG, Clean Ohio Fund	Create a priority parcel land acquisition map of distressed areas and other publicly/privately owned lands 2011 Apply for funding for easement acquisition 2012	Conservation Easements applied to needed areas
Stream Bank Stabilization Obtain funding to assist in stabilizing eroding steep banks and to reintroduce the stream to its floodplain	TCWP Project Communities, EPA, ODNR, Cuyahoga SWCD, CCBH, CCPC	Ohio EPA 319 grant, City of Project Communities, TCWP, EPA SEP funds, Stimulus funds, ODOT mitigation need, Capital Improvement projects	RFP for proposals 2013 Select Design/Build Partner from RFP's 2013 Design Project 2014 Construction of Project 2014 Completion of Construction 2015	Awarded funding Stabilize stream banks to reduce sediment flowing into Tinkers Creek Reduce sediment loading by 960 lbs/yr Reduce phosphorus inputs by 960 lbs/yr Reduce Nitrogen inputs by 1,920 lbs/yr Working floodplain

Site ID	Unnamed Tributary (Oakwood)
Description	Tributary to Tinkers Creek
Impervious Cover Percentage	23.3%
14-Digit HUC#	04110002-050-050
Problem	Sedimentation/Erosion/Nutrients
Priority	High
Cost (Stream Restoration Only)	Approx~ $800,000
Based on $200 per lineal foot	4,000 ft. x $200 ft. = $800,000
Other Costs	Soil Removal Overall Construction Costs Engineering of new Wetland/Floodplain Area Wetland Vegetation Cost of Engineering Project

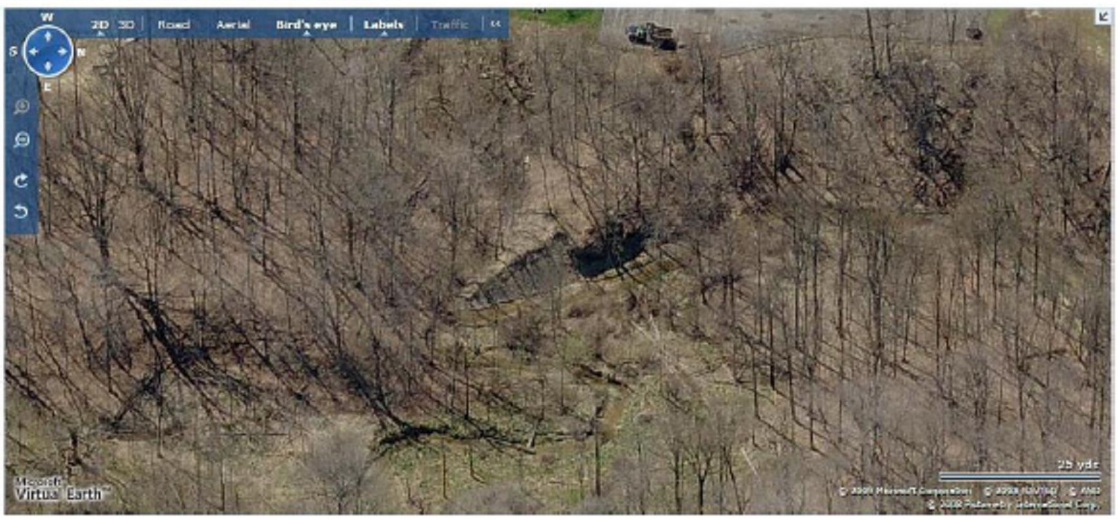
North end of project area looking east -- restoration of riparian buffer using native vegetation and plantings (note fill area encroachment)



South end of project area looking east – removal of invasive species, native plantings for riparian restoration, new channel design to add sinuosity



Central project area looking east -- potential stream bank stabilization & stream channel restoration



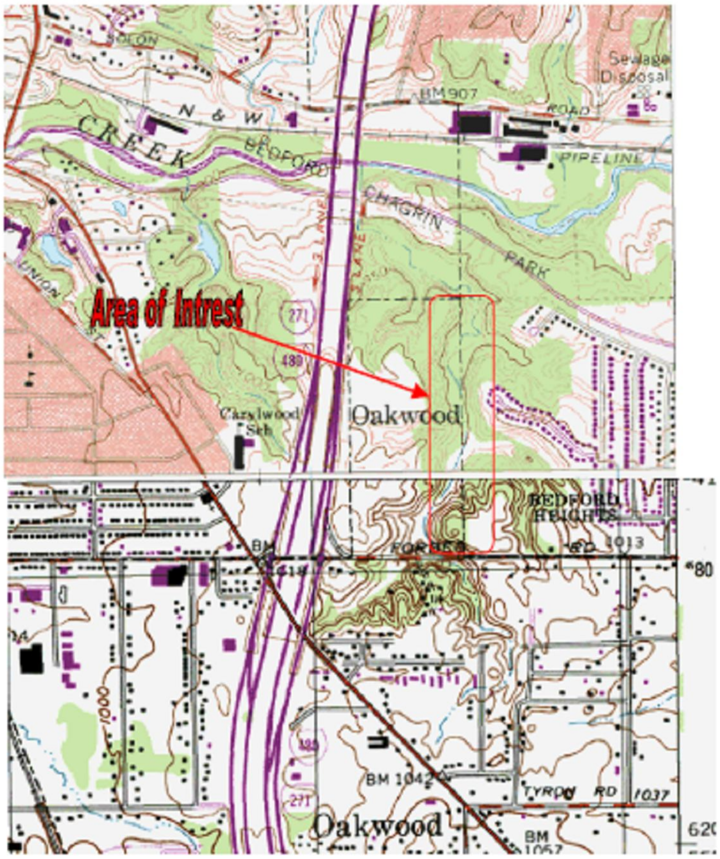


Figure 86: Project Location

1.3 Retro-Fitting Developed Areas with BMP's for Storm Water Runoff & Non-Point Pollution

Land Use Recommendations

Problem Statement: Urbanization from development, design, and engineering practices has resulted in stream and riparian habitat degradation, in addition to, permanently altering the watershed landscape. For the most part, these urban areas will remain urban and therefore continue to negatively impact the watershed and its water quality. Because of these "traditional" urbanization practices, watershed integrity has seen an exponential decline due to increases in impervious land cover, a lack of water infiltration, and too much water inputted into the stream system resulting in increases in sedimentation, higher nutrient levels, channelization, and habitat loss.

Goal: To restore the watershed's natural functions by implementing innovative water management practices which will reduce water inputs, remove non-point pollutants, lessen nutrient loading, and increase habitat. Reducing non-point source pollution requires the application of BMP's upon different types of urban developments which all have different demands than others. The cumulative impact of these applications will result in increases in water quality and a reduction of non-point source pollution.

Tasks	Task Activities	Task Partners	Funding	Time Frame	Final Indicator of Completed Task
Examine and determine which water management practices are applicable to which type of urban development The watershed contains significant commercial, industrial, and residential development which poses the challenge of incorporating the correct BMP for each site. Extracting potential management practices from standard BMP's for each type of site will allow for a baseline to build the proper retrofit for that specific parcel	Create a "standard" handout for either a commercial, industrial, or residential development which provides the best BMP types for each site This will be coordinated with SWCD participation Create a presentation for each category to be used by any interested party and to be given to designers, engineers, local governments and developers	TCWP, SWCD's	All in-kind time	Start: 6/1/10 End: 12/31/10	Create 3 color 1 sided handouts to be distributed at presentations and functions which revolve around development and retro-fitting discussions Create 3 presentations for each development category which provides case studies, photographs, water storage capacity data, pollution removal information, construction costs, and maintenance requirements Perform presentations to 6 different audiences by the end of 2009
Residential Storm water BMP's Water management on the personal level can be implemented using several techniques. Installing rain gardens or rain barrels is an effective practice to divert water from entering the storm sewer system and allowing it to either be stored for future use or provide an avenue for infiltration into the soil. Additionally, disconnecting downspouts and allowing the water to flow into the yard is an easy and free way to participate in reducing your personal storm water footprint	Partner with the SWCD's to develop a rain garden program where a "canned" presentation and handouts are available for public use Perform regular rain garden demonstrations/installations to watershed communities and residents Seek funding to install 1 rain garden/ rain barrel for demonstration in a watershed community	TCWP, SWCD's, Watershed communities, local health departments	Presentations and handouts are in-kind donations from the TCWP and SWCD's Demonstrations and installations can be funded through OEEF, watershed communities, homeowners associations, ODNR	Start: 6/15/10 Ongoing	Create a homeowner water management handout which includes environmentally friendly water management options including ballpark costs Create a residential homeowner presentation to perform at demonstration and installation programs Perform 2 residential water management programs or presentations by the end of 2009 Obtain funding and perform installation project in a watershed community
Industrial Storm water BMP's and environmental management	Use the standard handout for industry to provide a synopsis of sustainable practices to be introduced	TCWP, SWCD's, local health departments,	In-kind time and donation from the TCWP, SWCD's,	Start: 6/15/10	Establish a partnership with 2 watershed industries and

Industrial facilities and complexes often have large parcels of land in which the facility resides. Additionally, these developments have large flat roofs or parking lots and produce significant water contributions to the storm sewer system. Further, the International Organization for Standardization (ISO) offers suggestions (ISO 14000) as to how to minimize an organizations impact to the environment. ISO 14001 was created which addresses the services, activities, and products of a company and how they impact the environment.	to watershed industries Create a presentation specific to industry regarding water management BMP's and sustainable practices to employ in the facility Visit possible partner sites to determine what BMP's are plausible and which ones would provide the biggest improvement Seek funding to implement plausible BMP's for the site	watershed industries, local chambers of commerce	chambers of commerce, participating company Grant to perform retrofit project could be sought from Clean Ohio Fund, OEEF, American Water Funds, Federal grant opportunities	Ongoing	provide presentations and handouts to both; working to initiate the ISO 14001 criteria Work with facility management to determine which BMP's are appropriate for their site Obtain the funding to assist in installing the BMP's on site. *These 2 installations will be used as a model for others to follow* Use nutrient and other environmental quality models to ascertain the reductions in pollutants from the site after BMP and ISO 14001 implementation
Commercial Storm water BMP's and environmental management Commercial facilities include retail and office space. These facilities range from large to small and can include vast impervious surfaces and unused grass areas. In addition, the facilities can also employ many or few people. BMP's for these facilities will range from similar practices outside for water management, but also provide more sustainable practices inside. Opportunities exist to provide high visibility environmental management strategies which will both improve water quality and reduce the environmental footprint, but also afford the	Use the standard handout for commercial and office locations to provide a synopsis of sustainable practices to be introduced to watershed companies Create a presentation specific for commercial entities regarding water management BMP's and sustainable practices to employ in the facility Provide a synopsis of LEED certification options for the facility Visit possible partner sites to determine what BMP's are plausible and which ones would provide the biggest improvement *(i.e. greenroofs, pervious pavement, bioswales, secondary storm water treatment, parking lot trees)* Seek funding to implement plausible BMP's for the site Initiate incentives such as PR opportunities and	TCWP, SWCD's, local health departments, watershed companies, local chambers of commerce	In-kind time and donation from the TCWP, SWCD's, chambers of commerce, participating company Grant to perform retrofit project could be sought from Clean Ohio Fund, OEEF, American Water Funds, Federal grant opportunities, LEED building grants	Start: 6/15/10 Ongoing	Perform presentations and offer handouts to the organizations Assess willingness of the entity to participate in BMP and LEED certification process Establish which BMP's provide the most benefit to the location Partner with 2 entities by 2011 and establish a timeline for installation Obtain funding for sites by 2012 Install BMP's and monitor effectiveness Proceed with LEED certification steps when monetary restrictions permit

opportunity to educate many people at once.	monetary benefits from LEED implementation. Assist in establishing a comprehensive recycling program for facilities including a how, why, and what tutorial			A recycling program established with a system of weighing and recycling the products USE Step L model to calculate nutrient removal from the installation of BMP's

Examples of Residential, Commercial, and Industrial BMP's

Figure 87: Example of a sustainable commercial site fit with several types of BMP's

Figure 88: Rain garden installed at the Twinsburg Waste Water Treatment Plant Twinsburg, Ohio

Figure 89: Doty and Miller Architects Gold LEED certified building Bedford, Ohio

Figure 90: Vegetated Storm water detention area from a commercial building, Portland, OR

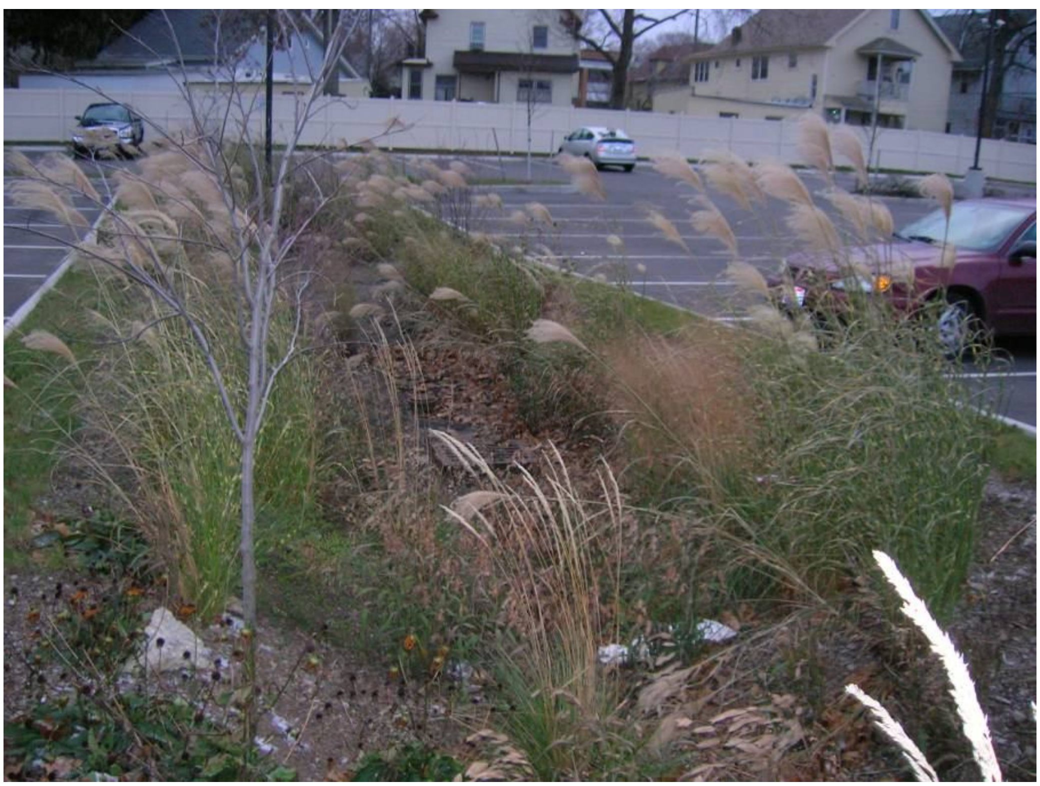


Figure 91: Lakewood YMCA Bioswale, Lakewood, OH

Figure 92: Constructed Wetland/Detention basin used to filter parking lot runoff, Lansdale, PA

1.4 Sustainable Development/Redevelopment **Land Use Recommendations**

Problem Statement: Typical development practices continue to use and promote hard scape design with the use of significant amounts of impervious cover. These techniques increase urban runoff and exacerbate non-point source pollution. High density residential developments, large "box" commercial stores, huge parking lots, and industrial complexes all contribute to this watershed wide issue. Because forest land and green spaces have been replaced by urbanization, water can no longer be absorbed into the ground and instead is piped into the nearest stream, river, or lake. This conventional process is directly correlated to stream channelization, sedimentation, habitat loss, downstream flooding, and overall water quality degradation.

Goal: To incorporate sustainable, low impact development practices into current and future development plans. These practices will enhance the economic viability, aesthetics, and infrastructure costs of the community while assisting in attaining water quality objectives. Integrating these measures will immediately reduce nutrient, water volume inputs, thermal pollution, and urban runoff from entering the watershed system.

Tasks	Task Activities	Task Partners	Funding	Time Frame	Final Indicator of Completed Task
Facilitate the use of water management BMP's Integrate on-site water management practices into development and	Create a "canned" presentation about sustainable development and business practices to share and perform at panel discussions, companies, and other partnering organizations with the intent to educate the	TCWP. SWCD's. watershed communities, local planning commissions, community engineers, designers,	Foundations, EPA grants, ODNR grants, local match funds, U.S. EPA grants	6/15/10 Ongoing	Assemble a small group of professionals within the watershed to help develop a strategy to create an educational presentation, as well as, advance

redevelopment plans to satisfy storm water permit requirements. These practices will reduce nutrient loading, water volumes, thermal pollution, and other urban runoff pollutants	decision making personnel about these techniques Build a partnership with local representation from engineers, designers, planning commissions, SWCD personnel, industry and commercial entities to begin discussing BMP usage and collaboration to create model sites for others to replicate throughout the watershed Seek funding to apply BMP strategies at a newly developed facility or to retrofit an existing facility Use the Step L model to ascertain the reduction of nutrient loading going into the system by the installation of these BMP's				the implementation of BMP's to create model facilities in the watershed The creation of a presentation which can be used in any situation where the audience are professionals who would be inclined to use the information for sustainable development and design implementation Perform presentation to 5 groups comprised of those interested professionals by the end of 2010 Install a retrofit or new development water management practices at a facility as a model demonstration by 2012 A reduction in pounds of nutrients, sedimentation, and water volume which will be determined upon pre-installation of BMP's
Watershed Community sustainable development objectives and ordinance formation Because development parameters are dictated at the local level through local codified ordinances, altering or revamping these traditional regulations will advance the concepts of sustainable development. In addition, local NPDES permits for storm water can and will be satisfied with the adoption and implementation of	Assemble draft ordinances from other locations to provide a guideline for local watershed communities to consider implementing and adopting Ordinances should include: 1. Consideration in the reduction of available parking spaces and total impervious cover for commercial and industrial sites 2. Consideration for allowing the disconnect of downspouts from homes in residential neighborhoods 3. Consideration of the installation of bioswales and rain gardens for parking lots and hard scape areas at commercial and industrial facilities	TCWP. SWCD's. watershed communities, local planning commissions, community engineers, designers,	All in-kind time from communities Small grant from OEEF, ODNR, or EPA to help create ordinances	6/15/10 Ongoing	All watershed communities with same or very similar adopted sustainability ordinances

these newly developed regulations on development and redevelopment. Integrating these sustainable concepts into all development practices will have a cumulative impact on water quality throughout the entire watershed	4. *Require* bio secondary treatment practices for detention areas prior to returning water to streams, rivers, and lakes These ordinances will be subject to variability and should offer options for the need to increase water infiltration, nutrient removal, and the elimination of other harmful non-point pollutants through bio-remediation techniques				
Ordinance implementation and assessment Adopting sustainable ordinances is a great first step in creating a more sustainable community. However, implementation of those ordinances may not occur unless oversight is used to ensure proper execution. Therefore, a process must be set up between the developer and the local community to allow for transparency of the installation, maintenance, and monitoring of the sustainable BMP	Assist watershed communities with establishing a protocol for overseeing the BMP installation, monitoring, and maintenance of the structural water management BMP's within the community	TCWP, SWCD's. watershed communities	All in-kind time	Start: 6/15/10 Ongoing	100% of new development has sustainable BMP practices employed The inspection and maintenance of all sites in watershed communities

Priority Action 2: Reduction of Nutrient Inputs

Problem Statement: Nutrients, such as phosphorus, in freshwater systems often create unwanted algal blooms in the summer months. When this occurs, oxygen is consumed from the water column causing a significant decline in what is available for fish and other aquatic organisms. Further when the algae dies and begins to decay, more oxygen is depleted from the water column due to the decomposition process. Tinkers Creek, like so many other urban watersheds, has significant non-point runoff due to its vast impervious cover and often contains high nutrient levels, while homeowners and golf courses apply lawn fertilizers and pesticides which contain phosphorus and other nutrients which are harmful to the integrity of the stream. Additionally, the Tinkers Creek Watershed has 7 discharging wastewater treatment plants (WWTP) which input significant amounts of phosphorus into the system. The combination of these nutrient loadings has resulted in non-attainment of EPA water quality standards.

Goal: To reduce nutrient loading into Tinkers Creek by 1,000 lbs. per year using water best management practices to reduce non-point runoff, educating watershed residents about applying organic fertilizers and pesticides to lawns, working with golf courses to implement management practices to lessen nutrient runoff into streams, and facilitating a nutrient trading program with the watershed WWTP's. Educating homeowners to make small personal behavioral changes, implementing BMP's to golf courses and development/redevelopment endeavors, and instituting a nutrient trading program will reduce phosphorus and other nutrient loading to tinkers Creek and achieve EPA water quality nutrient parameters by 2018.

2.1 Actions for implementation **Reduction of Nutrient Inputs**

Tasks	Task Activities	Task Partners	Funding	Time Frame	Final Indicator of Completed Task
Create a sustainable lawn care program Homeowners take pride in how green their yards are. Often, too much fertilizer and pesticides are applied to lawns and the excess will runoff during heavy precipitation events. This runoff is nutrient rich with nitrogen and phosphorus and ultimately finds its way into a nearby waterway causing algal blooms and water quality impairments. Initiating a sustainable watershed lawn care program by working with homeowners associations by implementing the use of organic products can significantly reduce the amount of nutrients entering the watershed system	Commence a TCWP committee to work with the SWCD's, local homeowners associations and organic lawn care companies to create a program and workshop for homeowners about sustainable lawn care practices Prioritize the implementation of the program to homeowner associations based upon watershed communities which have a total or majority of their political boundary within the watershed Write a grant to receive funding for program expenses including signage for yards participating in the program Design a logo for the signage about the program Promote the National Wildlife Fund backyard certified wildlife habitat program	TCWP, SWCD's, local watershed communities, local homeowners associations, organic lawn care companies	In-kind time from watershed communities, TCWP, and SWCD's Grants from OEEF, CMAG, EPA, and ODNR to help fund the program, NWF	Start: 6/15/10 Ongoing	Perform program to 3 homeowner associations by the end of 2010 Sign up at least 10 homeowners to participate in the program and allow for signage in their yards to promote the program Reduce phosphorus loading by 300 lbs through this program by the end of 2012 using the organic lawn applications and measuring the effectiveness with the Step L model
Sustainable Golf Course Management Program Traditional management of golf courses entail keeping	The TCWP lawn care committee will also initiate discussions with golf course managers about sustainable management practices including easements, bmp's, organic lawn care products, and native	TCWP, SWCD's, golf course managers	EPA, Audubon Society, golf courses for in-kind match and program funds TCWP & SWCD's as in-	Start: 1/1/2011 by approaching golf course managers and assembling	Discuss program with 2 golf courses in watershed Implement program with 1 golf course by 2012

the greens, fairways, and landscape “green” and well manicured. While this is important to the sport of golf, considerable amounts of fertilizer are applied to the property regularly. Because only a portion of this fertilizer is absorbed into the vegetation at one time, much is runoff during precipitation events causing water quality degradation	vegetation usage Discuss and present information about the Audubon Cooperative Sanctuary Program for Golf Courses Seek funding to implement sustainable practices on watershed golf courses and to assist in the cost of executing the program		kind time	committee to address the program 6/15/2011 write grant to install and initiate program 1/1/2012 Implement program	Reduce phosphorus loading with BMP’s and organic fertilizers, increase native habitat Certification by Audubon as a wildlife sanctuary
Nutrient Trading Program Because the WWTP’s input significant quantities of phosphorus to the stream annually, an option of instituting a program which allows treatment facilities who produce less phosphorus to offer plants which produce more phosphorus the opportunity to perform restoration work in the watershed to reduce phosphorus inputs could be a viable option as an innovative way to achieve the desired reduction results. Currently, WWTP permits allow for an average discharge permit limit of 1 mg/L of phosphorus to be discharged in the effluent. Most WWTP’s in the watershed release less than that; about 0.7 mg/L. However, the TMDL indicates that in order to meet EPA water quality requirements the discharge should be .24 mg/L.	Hold meetings with all WWTP’s in watershed to discuss program details and achieve “buy-in” from the communities Establish specific program structure and outline for the nutrient trading parameters Create program protocol between communities and investigate all legal requirements for “cross-community” work Identify restoration areas Determine necessary restoration strategy needed to assimilate nutrients including area, vegetation, and design Write a grant to seek funding to assist in project implementation Obtain conservation easements for restoration areas Calculate estimated phosphorus reduction amounts for each restoration project Institute a data collection and QA/QC protocol to accurately assess effectiveness of restoration project on nutrient assimilation	TCWP, SWCD’s, EPA, local health departments, WWTP’s, local communities	TCWP, EPA, local health departments, SWCD’s as in-kind donations and time Watershed WWTP’s, local communities, EPA 319, CMAG, LaMP	2010 build partners	2010 build partnerships with WWTP’s and communities to garner *100%* support for the program 2010-2011 Formulate program structure with EPA and WWTP’s into a written and approved EPA program document 2010-2011 identify 10 restoration sites Obtain funding to perform 1 nutrient trading restoration project by 2013 Reduce phosphorus loading from restoration project by 300 lbs annually Conservation easement on project area An EPA approved QA/QC for nutrient trading program

Examples of Nutrient Reduction Practices

Figure 93: Stream riparian area on a golf course; Pennsylvania Environmental Council

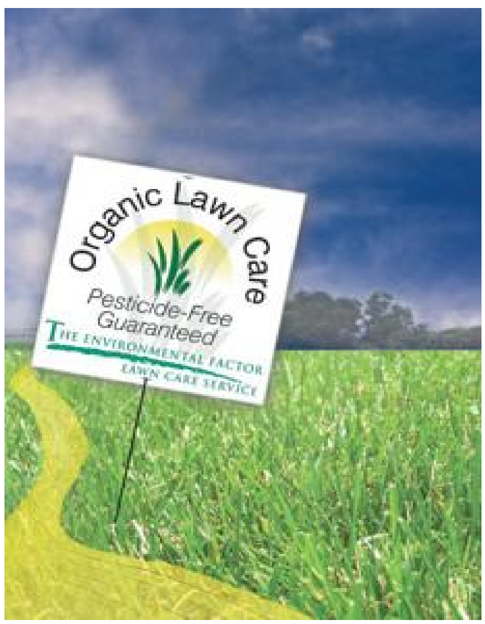


Figure 94: Organic Lawn Care does not harm the environment

Priority Action 3: Education

Problem Statement: Watershed stewardship begins at the local level; in homes, businesses, schools, and through the decision making processes in our local governments. Environmental issues have traditionally been revered as either a lifestyle through which you live or a type of person with certain beliefs. Only now with increases in fuel costs and the conversation of climate change has our collective awareness made it to dinner table discussions and in science class textbooks. To bring the necessary change to enhance and restore the watershed, an understanding that personal behavioral alterations can collectively benefit the integrity of the watershed has to be embraced by both watershed residents and community decision makers.

Goal: To increase the understanding of the linkages between human progression and personal behaviors toward environmental sustainability. Developing strategies to create a sense of importance and appreciation for the watershed will create the foundation for change. Initiating programs which provide the catalyst for behavior modifications will afford the opportunity for a cultural shift toward a sustainable society which will ultimately benefit both humans and the watershed.

3.1 Actions for Implementation — **Education**

Tasks	Task Activities	Task Partners	Funding	Time Frame	Final Indicator of Completed Task
Continue to provide educational presentations to watershed schools (grades 1 -12) and strengthen the educational committee of the TCWP Continue to establish relationships with science teachers from watershed schools and offer watershed presentations to the class regarding environmental issues, water quality, wetlands, human impacts, land use, BMP's etc…	Contact science instructors to set up guest speaking engagements Create different presentations to offer the schools: *(climate change, water quality, BMP's, residential sustainable practices, Tinkers Creek Stressor Study, watershed concerns)*	TCWP, watershed schools, science instructors	All in-kind time	Ongoing	5 presentations to 5 different schools annually Quantity of students participating Quantity of teachers participating
PIPE Committee development All local watershed governments are under an EPA NPDES Phase 2 storm water permit which, as a requirement, has an educational outreach	Create a storm water BMP presentation to perform for communities Create a good housekeeping presentation to perform for communities Schedule stream clean-ups with communities	TCWP, watershed communities	All in-kind time for educational components OEEF, ODNR, CMAG, EPA grants for rain garden project	Ongoing	Perform 2 stream clean-ups per year with watershed communities Perform 5 presentations to local officials regarding storm water BMP's

component. The TCWP has performed several educational presentations to Phase 2 communities regarding storm water and other environmental issues, as well as, held litter and stream clean-ups. Additionally, an official PIPE Committee will be formed to further assist watershed communities in satisfying their Phase 2 permit requirements and create more opportunities for public involvement in "hands-on" watershed activities	Schedule litter pick-up programs with communities Seek funding for rain garden installation project Write articles for local newsletter distribution regarding storm water and other environmental issues				Perform 5 good housekeeping presentations to community service department staff Perform 2 litter pick-up programs with watershed communities Obtain funding to install 1 rain garden project on community owned property as a demo for the community Publish articles in local newsletters about storm water issues and management strategies: goal 100% of communities involved
Create a volunteer monitoring program Volunteer monitoring of macroinvertebrates and fish populations is a great way to collect data on the health of the stream. In addition to resident volunteers, science instructors from local colleges and high schools offer a good fit for both watershed education and biological stream population data collection	Create a protocol and guide on the procedures for a volunteer stream monitoring program Create an EPA sanctioned QA/QC policy manual Establish monitoring locations Provide training opportunities with an EPA accredited level 2 or 3 data collector Create a standard data collection sheet for proper reporting Establish a data reporting protocol and database to store and collect information	TCWP, local academic institutions, resident volunteers, EPA	All in-kind time OEEF, OSU Extension grants	June 2010 start Ongoing	An EPA endorsed collection and reporting protocol and QA/QC Number of volunteers collecting data Number of sites which are monitored Quantity of information collected and reported
Create a technical advisory committee to assist watershed communities Communities often need additional input regarding ordinance development, storm water management, sustainable development, and other environmentally related concerns. The TCWP will offer crucial recommendations to	Establish a technical advisory committee with members from the TCWP, local engineering companies, the EPA, ODNR, OSU Extension, and community officials Discuss actions and recommendations for communities with committee Initiate communication with local planning commissions, city councils, and city	TCWP, local engineering companies, the EPA, ODNR, OSU Extension, and community officials, local academic institutions, SWCD's	All in-kind time	Start June 2010 Ongoing	Minimum of 4 meetings per year Number of times the committee provides input to communities Quantity of personnel on the committee

communities about becoming a more sustainable municipality	managers about the advisory committee with the intention of being utilized for future issues regarding impacts to the watershed Conduct committee meetings at a minimum quarterly or when a community seeks input from the committee				
Perform technical workshops to Planning Commissions, developers, and local decision makers Environmental training focusing on ordinance development, storm water management, sustainable development, and other environmentally related concerns will provide the tools needed to change course on standard development and water management practices	Furthering the Technical Committee's function of assisting communities in environmental decisions making, the committee will also create workshops to offer watershed communities that will help them make better informed decisions about environmental impacts Identify the audience Create the workshops based upon the watershed needs discussed in the WAP	TCWP, local communities, EPA, ODNR, local engineering firms, local health departments, SWCD's		Start June 2010 Ongoing	Number of participants 2 workshops minimum per year Education from workshops implemented into local community or decision making process Workshop survey sheets
Watershed Signage Because most people either drive a vehicle or take some form of mass transit to commute, watershed name signs at watershed boundary lines and stream crossings offer an effective, inexpensive, less laborious opportunity to educate the public about watersheds. Signs also offer a sense of recognition about feeling as if you are a part of something else	Create partnerships for the project with ODNR, EPA, OSU Extension, NEORSD, and SWCD's Determine locations of the where the signs will be posted Discuss project with watershed communities and service departments Seek funding for the project Hold a contest with high school arts classes to design the sign for the project	TCWP, local communities, SWCD's, EPA, OSU Extension, ODNR, NEORSD, ODNR, local health departments, watershed high schools	TCWP, local communities, SWCD's, All in-kind time ODNR, EPA, NEORSD, OSU Extension for grant match	OEEF, arts grants, education grants	Obtain funding for the project Number of high schools participating in program Number of signs installed Signage art student winner
Paint the Creek Science and Art Program Educating arts and science students from four different community schools in a 1 week long, hands-on, program about watershed	Establish a partnership with the participating communities Gain letters of support for the project Write a grant to fund the project Obtain in-kind time from	TCWP, SWCD's, CCBH, local communities and schools, Tri-C	OEEF, arts grants, other possible educational grants	Start: 1/1/10 End: 6/15/10	Funding obtained Number of students enrolled in the program 4 participating communities 4 participating schools

stewardship using science and art. The students will paint banners expressing their experience at the program. These banners will then be displayed in the community town center on poles to bring watershed awareness to at a focal point in the communities	other partners of the project Advertise through the summer programs offered for children in the watershed, through the TCWP website, and in the participating schools Create a survey to find out the effectiveness of the program from the students			4 art installation exhibits Number of letters of support Survey results

Priority Action 4: Restoration of Beneficial Uses

Problem Statement: Beneficial Use Impairments *(BUI's)* provides an opportunity to demonstrate how environmental degradation at the watershed scale impacts humans and the relationship those humans have with their surroundings. Because Tinkers Creek is a significant part of the Cuyahoga River Area of Concern, these BUI's are important to measuring water quality improvement results, but they have not been specifically studied in the Tinkers Creek Watershed. Measuring the BUI's is difficult but Tinkers Creek does have some impaired beneficial uses. The TCWP will work with the Cuyahoga RAP delisting committee to discuss strategies to begin delisting the BUI's from the watershed.

Goal: To achieve full attainment of all 14 BUI's in the Tinkers Creek Watershed. This process will include partnering with the Cuyahoga RAP delisting committee to prioritize and strategize actions to begin the process of delisting the watershed. Because this endeavor is complex, the timeline for this process has been created to flexible and realistic.

4.1 Actions for Implementation			Restoration of Beneficial Uses			
Beneficial Use Impairment	**Current Status**	**Restoration Activities**	**Resources**	**Timetable**	**Funding**	**Performance Indicators**
BUI: 1 Restrictions on fish and wildlife consumption	Impaired for fish consumption Not impaired for wildlife consumption	Sedimentation analysis for heavy metal pollutants Tinkers Creek Stressor Study fish tissue sampling results Work with wildlife biologists from Cleveland metro-parks to assess any wildlife concerns and impairments	**To be determined with collaboration with the Cuyahoga RAP delisting committee in 2010-2011**			
BUI: 2 Tainting of fish and wildlife flavor	Not Impaired	If needed, discuss concerns with U.S. Fish & Wildlife Service				
BUI: 3 Degradation of fish populations Degradation of wildlife populations	Impaired in some places Not Impaired	Tinkers Creek WAP recommendations and implementation of TMDL suggestions				
BUI: 4 Fish tumors or other deformities	Not Impaired	Communicate with EPA during field season regarding fish sampling and indications of				

		deformities and tumors	
BUI: 5 Bird or Animal Deformities or Reproductive Problems	Not Impaired	Communicate with metro park ornithologists, Audubon Club members, and birding associations for photographs or information about this issue	
BUI: 6 Degradation of Benthos	Impaired	The TCWP WAP, SWCD and RAP recommendations for storm water management, and sediment control	**To be determined with collaboration with the Cuyahoga RAP delisting committee in 2010-2011**
BUI: 7 Restrictions on Dredging	Not Impaired	No dredging occurs in the watershed	
BUI: 8 Eutrophication or Undesireable Algae	Unknown	The TCWP WAP, SWCD and RAP recommendations for storm water management, and sediment control including nutrient reduction efforts	
BUI: 9 Restrictions on Drinking Water Consumption	Not Impaired	Communicate with local utility works departments, WWTP's, and local health departments	

		about any concerns with water contamination	
BUI: 10 Beach Closings (Recreational Contact) and Public Access/ Recreation Impairments (Cuyahoga RAP BUI)	N/A	Information can be found at www.ohionowcast.info Or From local health departments	**Tinkers Creek does not contain bathing beaches**
BUI: 11 Degradation of Aesthetics	Impaired	Tinkers Creek WAP recommendations and implementation of TMDL suggestions	**To be determined with collaboration with the Cuyahoga RAP delisting committee in 2010-2011**
BUI: 12 Added Costs to Agriculture Added Costs to Industry	Not Impaired Not Impaired	Tinkers Creek does not have agricultural activity occurring There are industries using water from Tinkers Creek but they are monitored and posses NPDES permits (See Table:	**N/A** **To be determined with collaboration with the Cuyahoga RAP delisting committee in 2010-2011**
BUI: 13 Degradation of Phytoplankton Populations	N/A		

Degradation of Zooplankton Populations	N/A		**N/A**
BUI: 14 Loss of Fish Habitat Loss of Wildlife Habitat	 Impaired Impaired	Tinkers Creek WAP recommendations and implementation of TMDL suggestions Tinkers Creek WAP recommendations and implementation of TMDL suggestions	**To be determined with collaboration with the Cuyahoga RAP delisting committee in 2010-2011**

Priority Action 5: Implementation of Coastal Non-Point Control Measures

The Tinkers Creek Watershed lies within the Lake Erie Watershed boundary and therefore must incorporate management measures from the Coastal Nonpoint Plan into the Tinkers Creek Watershed Action Plan. Many of the urban and hydromodification management measures addressed in the Coastal Nonpoint Plan are bolstered by the actions set forth within the implementation section of this plan.

This section demonstrates the how the Tinkers Creek Watershed Action Plan incorporates management measures of the Coastal Nonpoint Plan. All Tinkers Creek Watershed communities are *Phase 2* and therefore fall under the NPDES permitting process.

Introduction

In recognition of the intense pressures facing our nation's coastal regions, Congress enacted the Coastal Zone Management Act (CZMA) which was signed into law on October 27, 1972. To address more specifically the impacts of nonpoint source pollution on coastal water quality, Congress enacted § 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) in November 1990. Section 6217 requires that each State with an approved coastal zone management program develop and submit for approval a Coastal Nonpoint Pollution Control Program (CNPCP) to the U.S. Environmental Protection Agency (USEPA) and the National Oceanic and Atmospheric Administration (NOAA). The purpose of the program "shall be to develop and implement management measures for nonpoint source pollution to restore and protect coastal waters, working in close conjunction with other State and local authorities.” (www.dnr.state.oh.us/Portals/12/programs/coastalnonpoint/cnpcp/chapter%2001.pdf)

Program Specifics

Guiding Principles

1. Local groups organized to protect or improve water resources are vital to the successful implementation of nonpoint source programs and projects.
2. The State of Ohio shares responsibility with local agencies and organizations in the implementation of watershed protection projects.
3. Protection and restoration of stream integrity (sinuosity, riparian habitat and flow) is one of the highest priorities of Ohio's nonpoint program.
4. Program priorities are set by involving multiple stakeholders including, but not limited to, government, academia, industry, environmental groups and local citizens.
5. Attention and funding is focused on local watershed and aquifer projects that directly improve water quality.
6. Water resources are prioritized and programs and projects targeted to priority areas.
7. Federal, state and locally funded best management practices have coordinated cost sharing amounts and requirements.
8. Existing regulations that target nonpoint sources are uniformly enforced.
9. Funding is available for nonpoint source research and evaluation of nonpoint source programs and best management practices.
10. Education and training are integral to the success of nonpoint source programs.

Ohio Coastal Nonpoint Pollution Control Program *Applicable* Management Measures

Agriculture: N/A

Urban:
(5.3.3) Site Development
(5.6.1) New On-Site Disposal Systems (Part 3)
(5.6.2) Operating On-Site Disposal Systems
(5.8.1) Planning, Siting, and Developing Roads and Highways
(Local Roads and Highways Only)
(5.8.2) Bridges (Local Roads and Highways Only)

Hydromodification:
(7.4.1) Channelization and Channel Modification- Physical and Chemical Characteristics of Surface Waters
(7.4.2) Channelization and Channel Modification- Instream and Riparian Habitat Restoration

(7.5.1) Dams – Erosion and Sediment Control
(7.5.2) Dams – Chemical and Pollutant Control
(7.5.3) Dams – Protection of Surface Water Quality and Instream and Riparian Habitat
(7.6.1) Eroding Streambanks and Shorelines

Urban Watershed Protection Measures

(5.3.2) Watershed Protection

There are no specific watershed management plans, ordinances, regulations or objectives that any community within the Tinkers Creek Watershed has adopted or adhere to. Therefore, the Tinkers Creek Watershed Action Plan will hope to fill the role and function of the criteria needed to assist in bringing the watershed into attainment, along with the Coastal Nonpoint Management Measures.

(5.3.3) Site Development: Plan, design, and develop sites to:

1. Protect areas that provide important water quality benefits and/or are particularly susceptible to erosion and sediment loss;

2. Limit increases of impervious areas, except where necessary;

3. Limit land disturbance activities such as clearing and grading, and cut and fill to reduce erosion and sediment loss; and

4. Limit disturbance of natural drainage features and vegetation.

Urbanization and development will continue with the watershed with certain areas becoming more urbanized and others becoming re-urbanized. As this trend continues, implementation of the Tinkers Creek Watershed Action Plan Land Use Management recommendations will assist in meeting the Coastal Nonpoint Management Measures.

Practices to meet Site Development Measures

Erosion and Sediment Control ordinances
All communities within the Tinkers Creek Watershed are Phase 2 communities and require plans to control storm water runoff. As development continues, local adoption of erosion and sediment control ordinances is a first step in beginning to implement sustainable practices in the community. NOACA, and the Chagrin River Watershed Partners both have excellent draft ordinance templates for communities to consider. Additionally, the watershed SWCD's serve as a great resource for education and technical assistance. Ordinance adoption is a priority for Tinkers Creek watershed communities and is discussed in the Land Use Management section of this plan.
Further, all watershed communities require that erosion control be performed on all sites less than, equal to, or greater than 1 acre of land disturbance. However,

virtually no community with the exception of Warrensville Heights contains requirements for abbreviated SWP3 plans. This requirement makes mandatory that all soil disturbances that are greater than 1/10 acre to have a plan to accommodate sheet runoff and control excessive precipitation events.

The City of Twinsburg has an ordinance that requires all land disturbances to follow the same regulations that the Phase 2 requirement regulates:
1343.05 of our erosion control regulation states: "For parcels less than one acre in size a SWP3 may not be required; however the owner shall comply with all other provisions of this ordinance." These means that silt fence, construction drives, inlet protection, re-vegetation are required. The plan is reviewed by City Engineer and not necessarily SSWCD unless referred by the City.

The rest of the communities will follow the County SWCD regulations regarding site development and erosion and sediment control. However, most communities will make decisions on a case-by-case basis and review the parameters of the proposed project in order to make a determination.

Riparian and Wetland Setback Ordinances

In addition to controlling sediment, riparian and wetland setback ordinances offer a natural solution to sediment loss, nutrient removal, storm water storage and protection of the natural resource. NOACA and the Chagrin River Watershed Partners have draft setback ordinances which the TCWP find to would serve as the Tinkers Creek Watershed well. In addition to serving as a buffer between the stream and development, these features also provide important habitat and a needed tree canopy to the watershed inhabitants and for stream shade. Because of increased water volumes in the watershed, these riparian areas also provide anchorage for stream banks and reduce soil loss from increases in impervious cover.

Preserving Natural Drainage Features

The TCWP has a GIS layer file of all known wetlands within the watershed, in addition to, a stream GIS layer file. Both sets of data are encouraged to be used in local decision making processes regarding development. Further, the Tinkers Creek Wetland Prioritization and Assessment Study conducted in 2007-2008 provides an economic valuation of the wetlands within the watershed. This information gives communities additional information about the tangible and intangible values the wetlands provide. The information is meant to create a more even “playing field” for communities as they decide on development characteristics. The Tinkers Creek Watershed Land Conservation Priority Plan also provides information regarding crucial land parcels in the watershed which contain natural water and drainage features. These parcels are provided in figure XXX of this plan. Some of the communities Phase 2 storm water requirements are additionally satisfied by the preservation of these natural resources.

Conservation Easements
Protection of the natural drainage way can be accomplished through the riparian setback ordinance adoption and through conservation easements. These easements are areas next to streams which are the natural floodplain for that stream and are kept in perpetuity. Often the easement is held by the local SWCD, Land Conservation Organization, watershed group, or the local community. This measure is also outlined in the Coastal Watershed Protection Measure.

Implementation of Best Management Practices to limit surface water inputs into the existing storm water system
Increased impervious surfaces are a direct result of standard development practices. Reducing the input of storm water into the system by implementing the Tinkers Creek WAP BMP suggestions outlined in the Land Use Management section of this document is an effective strategy to lessening the volume of water flowing off the site of a development or other impervious surface. This Plan advocates for the use of bio-filtration through the use of the combination of detention ponds and wetlands, rain gardens, bio-swales, pervious pavement, greenroofs, and unrestricted access to floodplains. Additionally, both NOACA and the Chagrin River Watershed Partners have draft Post Construction Management Practice ordinances which the TCWP find to would serve as the Tinkers Creek Watershed well.

(5.6.1) New On-Site Disposal Systems (Part 1)

New On-Site Disposal Systems are declining in the Tinkers Creek Watershed. Most developed areas are all now attached to sanitary sewer lines with new lines being distributed to more rural areas of the watershed. All watershed county local health departments already incorporate regulations that require new systems to consider local soil conditions, lot size, and the design and type of system. Local health departments annually perform illicit discharge locating by point source tracking to find the locations of failing systems, sewer connections, and other pollutant laden discharges. The TCWP will continue to work with local health departments to assist in educating communities about watershed related issues and the need for keeping septic systems working properly.

(Part 2) Non-residential

Non-residential on-site disposal systems in Cuyahoga County are routinely inspected by registered sanitarians employed with the Cuyahoga County Board of Health. Other watershed health departments often do not have the capacity to monitor these systems and therefore will only inspect them based upon complaints from adjacent property owners or malodorous smells. These systems could be considered package plants for mobile home parks, small motels, or other small compact dwellings in which humans inhabit.

(Part 3) Establish Protective Setbacks

Protective setbacks for the implementation of on-site waste disposal can provide additional protection to the stream. No watershed community has adopted specific ordinances or regulations that require disposal systems to have additional setback lengths from streams, rivers, or creeks. The Tinkers Creek Watershed Partners will assist communities in developing language to be attached to existing disposal system regulations that will require additional spacing from natural resources as an added precaution to maintain the integrity of that resource.

(Part 4) Non-residential

No regulations exist in any watershed community that requires additional setbacks for non-residential on-site disposal systems.

(Part 5) Reducing Nitrogen Loading by 50%

No watershed requirement exists for the reduction of nitrogen discharges by 50%. It is assumed that new systems will already reduce nitrogen significantly. In addition, nitrogen is not considered a water quality impairment in the Tinkers Creek Watershed.

(5.6.2) Operating On-Site Disposal Systems

Management Measure Goals

1. Establish and implement policies and systems to ensure that existing OSDS are operated and maintained to prevent the discharge of pollutants to the surface of the ground and to the extent practicable reduce the discharge of pollutants into ground waters that are closely hydrologically connected to surface waters. Where necessary to meet these objectives, encourage the reduced use of garbage disposals, encourage the use of low-volume plumbing fixtures, and reduce total phosphorus loadings to the OSDS by 15 percent (if the use of low-level phosphate detergents has not been required or widely adopted by OSDS users). Establish and implement policies that require an OSDS to be repaired, replaced, or modified where the OSDS fails, or threatens or impairs surface waters;

2. Inspect OSDS at a frequency adequate to ascertain whether OSDS are failing;

3. Consider replacing or upgrading OSDS to treat influent so that total nitrogen loadings in the effluent are reduced by 50 percent. This provision applies only:

   - where conditions indicate that nitrogen-limited surface waters may be adversely affected by significant ground water nitrogen loadings from OSDS, and
   - where nitrogen loadings from OSDS are delivered to ground water that is hydrologically connected to surface water.

Existing Programs & Enforceable Policies and Mechanisms: State and Local

All of the Tinkers Creek Watershed Communities fall under the EPA NPDES Phase 2 water management program. Watershed municipalities are required to have a review of any known illicit discharges from the EPA and local health departments. Some communities will include review of these known illicit discharges in their annual storm water reports to the EPA.

Reduction of On-Site Disposal Systems

As stated in the Watershed Inventory, Tinkers Creek contains XX Home Sewage Treatment Systems *(HSTS)*. Local Capital Improvement Projects are currently underway to connect many existing systems to the new sanitary lines and reduce the amount of systems left in the watershed. Additionally, local health departments monitor streams and storm sewer lines for potential illicit discharges and will further perform source tracking to locate the source of the discharge.

Perform Regular Inspections and Maintenance

Local health departments employ registered sanitarians to inspect HSTS's and OSDS for proper functioning and performance. Often effluent discharge from failing or questioned systems will be sampled to discern if elevated bacteria levels are being inputted into waters of the state. Additionally, local health departments and the TCWP work with communities to educate the residents about watershed integrity. This is done through PIPE workshops, oral presentations to Councils, and literature distribution.

(5.8.1) Planning, Siting, and Developing Roads and Highways (Local Roads and Highways Only)

All watershed communities require that erosion and sediment control assurances are taken to reduce the sedimentation impacts from earth disturbances associated with these activities. No specific ordinance, regulation, or requirement exists at the local level for projects less than 1 acre.

Management Measure Goals

Plan, site, and develop roads and highways to:

1. Protect areas that provide important water quality benefits or are particularly susceptible to erosion or sediment loss;

2. Limit land disturbance such as clearing and grading and cut and fill to reduce erosion and sediment loss; and

3. Limit disturbance of natural drainage features and vegetation

Existing Programs & Enforceable Policies and Mechanisms: State and Local

All Tinkers Creek Watershed Communities currently have ordinances in place to control sediment and erosion, additionally, other agencies such as ODOT, and county engineers have there own. These regulations are part of the State mandated EPA Phase 2 storm water program which requires all State, County, and municipalities to have measures in place to control illicit discharges and sedimentation.

Practices to meet Measures

Erosion Control and Enforcement of Regulations

All Tinkers Creek Watershed Communities have adopted sediment and erosion control ordinances because of the mandate from the EPA NPDES Phase 2 storm water program. All construction of over 1 acre is required to follow the erosion and sediment control plan from the community or sponsoring agency. This includes new road and bridge development, residential home construction sites, capital improvement sites, commercial and industrial development, or any other construction activity within the municipal boundary. As stated within the plan, Tinkers Creek experiences significant sedimentation loading from stream scouring and development. Proper management of construction sites and the local enforcement of the ordinances can assist in the reduction of unnecessary sediment entering the system.

Find local mitigation sites, if needed

The TCWP will continue to identify watershed locations where mitigation from disturbing a resource can be kept within the watershed. Additionally, the TCWP will continue to work with communities to educate them about the importance of wetlands and keeping streams day-lighted and encourage integrating them into any road, bridge, or capital improvement project site design.

Local Street, Road, and Siting Requirements

All watershed communities have regulations to ensure that proper development practices and design are implemented on any new and existing roadway construction project. Consideration of future suburban development road widths to be reduced using conservation development practices could provide assistance to reducing impervious surfaces.

(5.8.2) Bridges (Local Roads and Highways Only)

Bridge work often is performed by ODOT personnel and follows their guidelines for construction. No local ordinance, regulation, or requirement exists that dictates specific storm water requirements for bridge construction activities of less than 1 acre.

Management Measure Goal:

Site design, and maintain bridge structures so that sensitive and valuable aquatic ecosystems and areas providing important water quality benefits are protected from adverse effects.

Existing Programs & Enforceable Policies and Mechanisms: State and Local

ODOT, County, and local municipalities all have procedures that utilize erosion and sediment control activity. In addition, any bridge construction requires the submission and acceptance of the storm water pollution prevention plan. The TCWP will work with communities to monitor the plans and to help ensure proper maintenance.

Storm Water Pollution Prevention Plans

Proper management of storm water near sensitive aquatic systems is crucial to the long term integrity of the resource being threatened. Additionally, site design and the implementation of BMP's will help ensure that proper precautions are taken. Enforcement of those regulations is vital to protecting the stream. Because bridge repair work or construction activities are directly over water, special care is important to minimizing the stream impact. All State, County, and local entities already have adopted procedures and policies for designing SWPPP's.

Hydromodification Protection Measures:

Tinkers Creek has been developed for over 100 years. Standard development practices, and massive impervious cover installation have permanently altered significant stretches of the watershed. The result has been intense channelization of many headwater and tributary streams, stream bank destabilization, loss of habitat, drastic increases in sedimentation, and sometimes flooding. The Tinkers Creek WAP identifies the strategies needed to begin reversing the damage from previous development practices.

(7.4.1) Channelization and Channel Modification- Physical and Chemical Characteristics of Surface Waters

There are no local regulations that require any operation and maintenance of modified or channelized stream channels.

Management Protection Goal

Management Measure Goals:

1. Evaluate the potential effects of proposed channelization and channel modification on the physical and chemical characteristics of surface waters in coastal areas;

2. Plan and design channelization and channel modification to reduce undesirable impacts; and

3. Develop an operation and maintenance program for existing modified channels that includes identification and implementation of opportunities to improve physical and chemical characteristics of surface waters in those channels.

Assessment of modified stream channels
A portion of the North East Ohio Regional Sewer District's service area is within the Tinkers Creek Watershed. In 2001 the District's R.I.D.E. study provided an assessment of the service area watersheds and stream morphology. Other sewer jurisdictions and county agencies have not performed such a study in the Tinkers Creek Watershed as of now.

Tinkers Creek Watershed Action Plan
Several of the implementation strategies discussed in the Priority Action 1: Land Use section, provides strategies and BMP use to reduce the impacts from human disturbances and results from activities. These include, rain gardens, wetlands, sustainable development practices, and nutrient reduction.

(7.4.2) Channelization and Channel Modification- Instream and Riparian Habitat Restoration

There are no local regulations that require any operation and maintenance of modified or channelized stream channels or to perform restoration on these modified stream stretches.

Management Protection Goal

1. Evaluate the potential effects of proposed channelization and channel modification on instream and riparian habitat in coastal areas;

2. Plan and design channelization and channel modification to reduce undesirable impacts; and

3. Develop an operation and maintenance program with specific timetables for existing modified channels that includes identification of opportunities to restore instream and riparian habitat in those channels

Existing Programs & Enforceable Policies and Mechanisms: State and Local
The ODNR Watershed Coordinator Program provides the opportunity to employ a watershed coordinator to identify areas for restoration within the watershed. The Tinkers Creek WAP has identified channelized streams and other areas in which restoration is needed and has provided strategies to satisfy this management measure.

Inventory of Existing Habitat Conditions
QHEI scores have been studied at several watershed locations. These locations often have channelized streams and degrading habitat. As outlined in the Land

Use section of the Plan, restoration, preservation, and conservation of special areas and disturbed areas alike are a priority for reversing the instream and riparian habitat areas.

Erosion Control and Enforcement of Regulations

All Tinkers Creek Watershed Communities have adopted riparian set back ordinances to allow for riparian function and habitat preservation. In addition to the set backs, stream restoration areas are continuing to be identified throughout the watershed.

(7.5.1) Dams – Erosion and Sediment Control
(7.5.2) Dams – Chemical and Pollutant Control
(7.5.3) Dams – Protection of Surface Water Quality and Instream and Riparian Habitat

Request for exemption

The Tinkers Creek Watershed contains 3 low-head dams, none of which contain significant impoundment.

(7.6.1) Eroding Streambanks and Shorelines

There are no ordinances that exist in the watershed that address streambank or shoreline erosion specifically. All 14 digit HUC's experience significant erosion problems specifically HUC# 04110002-050-050, and 04110002-050-040. The subwatershed streams typically are found to contribute substantial sediment loading due to poor stream bank stabilization and health.

Tinkers Creek experiences quickly changing stream flows during high precipitation events which causes stream channelization, and stream bank destabilization. The cause of this impairment is due to significant impervious cover and urban runoff due to development. The Tinkers Creek WAP proposes action strategies which address this problem and will continue to identify slope and bank stabilization problem areas.

Management Measure Goals:

1. Where streambank or shoreline erosion is a non-point source pollution problem, streambanks and shorelines should be stabilized. Vegetative methods are strongly preferred unless structural methods are more cost-effective, considering the severity of wave and wind erosion, offshore bathymetry, and the potential adverse impact on other streambanks, shorelines, and offshore areas.

2. Protect streambank and shoreline features with the potential to reduce NPS pollution.

3. Protect streambanks and shorelines from erosion due to uses of either the shorelands or adjacent surface waters.

Existing Programs & Enforceable Policies and Mechanisms: State and Local

Stream setback ordinances have been adopted by most communities within the Tinkers Creek Watershed. These ordinances assist in allowing the stream access to its floodplain and provide protection of the resource by establishing a buffer area. Additionally, local land conservancy programs and SWCD's have easement programs available for community use.

Practices to Meet Management Measures

Inventory of Streambanks

As stated before, the NEORSD commissioned a R.I.D.E. study to evaluate stream channelization and bank stabilization within its service area. Information in Cuyahoga County is available for community use. No other study has been commissioned in other District jurisdictions within the watershed. No other agency has commissioned a study to determine bank stability or channelization in the watershed.

Tinkers Creek WAP

The Land Use implementation section of this Plan identifies proper BMP strategies to assist in stabilizing stream banks. Community participation, ordinance adoption and enforcement, and education of the local decision makers will be crucial to restoring Tinkers Creek and its stream integrity.

VII. Evaluation

The Tinkers Creek Watershed Action Plan can be evaluated using 2 separate criteria; *short term and long term goals.*

Short Term Goals: Performance Based Measurement of Results
Throughout section 5 of this plan, several goals, tasks, and indicators of success have been discussed. Many of those items have associated timing requirements and can be evaluated using those measurements of success. Many short term tasks include formations of committees within the group structure, partnerships established, presentations performed, grants written, and additional credibility established within the watershed. These performance based measurements can be tracked through the annual work plans and semi-annual technical reports.

Bringing Tinkers Creek into attainment is the end result of the measureable outcomes of short term goals. Water quality improvement on a scale of this magnitude will require cooperation from partners, the TCWP, funding opportunities, and the local community will. Tinkers Creek, like many other urban watersheds, face significant challenges in the future. Funding, prioritization of importance, and education are only a few of the actions required to restore this resource. Perseverance of actions and measuring their results will be essential to improving performance for future activities and rallying support from the communities. This process is cumulative. 1 restoration project will show minimal water quality improvement overall. However, 100 restoration projects will.

The establishment of local partnerships will be essential to the success of these short term goals. The County SWCD's, EPA, local health departments, and watershed communities, will serve as supporters and task partners assisting the TCWP with implementing the actions contained within this plan.

Long Term Goals: Water Quality Improvement, as stated earlier, the cumulative impact of the successes of short term goals provides the roadmap to achieving the targeted water quality goals of:

1. QHEI scores of > 60 throughout the entire watershed

2. ICI and IBI scores which meet Ohio water quality standards throughout the entire watershed

3. A reduction of phosphorus loading into the watershed by implementation of BMP's and restoration of riparian corridors

The success of the long term goals will not only be a direct result of the success of the overall program, but through innovative strategies, persistence, the willingness of the partners to implement the actions outlined in this plan, and education. Most projects entail a monitoring program to constantly evaluate the success of the program through on-the-ground monitoring. The establishment of the volunteer monitoring program, and through work with the EPA monitoring, the success of the long term goals can be evaluated.

VIII. Plan Update/Revision

The Tinkers Creek Watershed Action Plan will be distributed to all 24 communities, be available to school teachers, libraries, and on the internet. Like all studies performed in the watershed, the WAP will be posted online for public availability.

Because this document is a snapshot in time, the plan will be updated as new information becomes available. At a minimum of every 2 years, updated information will be added to the plan.

IX. Conclusion

Environmental Stewardship continues to be low on the priority list for most local, state, and federal government entities, in addition to the vast population of Northeast Ohioans. For most, a lack of education and proper understanding of the intricate relationship between human activity and environmental sustainability is at the core of this tenuous dilemma. This *Plan* alone will not be enough to sustain the Tinkers Creek Watershed in the future, but it will begin to address the known problems that prevent this stream from functioning and attaining the water quality standards that the EPA has set forth. A sweeping prioritization of putting the health of the environment at the top of decision making from household activities to large-scale commercial and industrial development is needed in order to achieve significant advancements in undoing the impacts that we have inflicted upon the earth.