Middle Cuyahoga River Watershed Action Plan—Volume II
Problem Statements, Goals, Objectives, Actions, end pieces

June, 2012

7. Problem Statements, Goals, Objectives, Actions

Organization

This section combines several elements of the Appendix 8 outline into a single section. Whereas the outline includes separate sections for Problem Statements, Goals, Objectives, and Actions, this section includes all elements, with a separate sub-section for each subwatershed. Each subwatershed section includes:

- Overview maps and discussion,
- Tables of
    - Subwatershed characteristics,
    - Impairments,
    - Summary of actions, and
    - Detailed tables listing the problem statements and goals, policies, and actions to address the problem statements.

Introduction

The problem statements, goals, objectives, and actions for the watershed were developed through a series of discussions at monthly meetings of watershed partners. All stakeholders have had the opportunity to comment on the goals, objectives, and implementation statements via e-mail and open houses. *Note: The Appendix 8 outline refers to the problem statements, goals, objectives, and actions as chapters 5-7. In order to consolidate these related items, the entire section is numbered chapter 7.*

Mission

The Middle Cuyahoga River Watershed partners agreed on the following mission statement for the watershed:

Protect, restore, and improve Middle Cuyahoga River, its tributaries, and watershed by protecting the elements that are achieving a high quality, improving, enhancing, or restoring degraded systems, and reducing the effects of the altered watershed.

Problem Statements, Goals, Objectives, Actions

The format for problem statements, goals, objectives, and actions is very specific.

Problem Statements: Focus on one impairment and one cause of impairment, e.g., sediment affecting habitat.

Goals: How to improve one water quality indicator mentioned in the problem statement from one source. E.g., Tons of sediment from eroding stream banks, nitrogen from agricultural runoff. There are likely to be more than one goal per problem statement.

Objectives: Quantified reductions using various practices, i.e., the practices to achieve the goals. There are 4 types of objectives:

- Protective (e.g., easements)
- BMPs – cover crops, grass filter strips
- Restoration – moving things around on the ground

- Regulation – stormwater manual, zoning changes

Examples:
- XX tons of XX using rain gardens
- XX tons of XX using green infrastructure

The same types of objectives can be used to address multiple sources of impairment causes.

Actions:
More detailed, e.g., How the sediment reduction projects are going to be carried out, includes tasks such as:
- Submit grant proposal
- Hold workshops
- Assess farm practices

The actions may be modified as necessary to carry out the objectives. The actions will be used to define tasks for grants or work programs.

Table 7-1 summarizes the proposed actions for the entire watershed. Each subsection of this chapter includes an individual summary of actions for one subwatershed, in addition to the detailed tables that list the goals, objectives, and actions for each problem statement/area of concern. While not specifically listed for each objective, where feasible, it is important that the effectiveness of actions be monitored as part of the construction contract or as a separate monitoring effort.

Sections 8 and 9 are presented after Table 7-1, as they are brief. Following Sections 8 and 9, the problem statements, goals, policies, and actions of each subwatershed are presented in a separate section, with:
- Overview of conditions, with maps specific to the subwatershed
- Summary table of actions
- Detailed Problem Statement/Goal/Objective/Action tables.

Table 7-1 Action Item Summary by Subwatershed

12-digit HUC/ Water Body	Dams	CSOs	Contamin. Sites	Sed	Nutrients	GW contam	Flooding	Habitat	Recreation	Category/Practices	Target amt by 2023	Units	Priority (*high-mod*)	Time Frame (yr or On-going)	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
041100020305 Main Stem & tribs																		
										Dam Removal								
Main Stem	√			√	√			√		Remove low-head dams	**2**	Dams	*h*	0-1	1 million			
Main Stem	√			√	√			√		Remove Gorge dam	**1**	Dams	*h*	by 2018				
										CSO Containment/Diversion								
Main Stem watershed - Gorge		√								Containment	**105/yr reduced by 2028**	overflows reduced per yr (4 sites)	*h*	by 2028				
										Contamination								
Main stem watershed			√							Determine status of DERR listed sites	**9**	sites	*h*	yr 1				
MS watershed			√							Brownfields inventory	**1**		*h*	yr 1-5				
Main stem			√			√				Initiate cleanup	**2**		*m*	yr 4-8				
										Riparian Restoration								
Main stem tribs				√	√		√	√		Restore Streambank	**8,000**	Linear Feet	*h/m*	KC-1-3 others by 2023	$25-200/lf	490	686	264
Main Stem watershed				√	√		√	√		Riparian plantings - native plants/trees/shrubs	**25**	Acres	*m*	start in yr 1-2		11	150	20
Watershed, lakes								√		Remove/treat Invasive Species	**50**	Acres	*m*	yr 3-5				
MS watershed								√		Feasibility study low-head dam removal tribs	**1**	study	*m*	yr 3-5				
										Stream Restoration								
Main Stem tribs				√	√		√	√		Restore Flood Plain	**8**	Acre-foot	*h/m*	KC-1-3 others 3-10		3.5	50	7
Main stem tribs				√	√		√	√	√	Restore Channel	**4,000**	Linear Feet	*h/m*	KC 1-3	$100-200/lf			
										Wetland Restoration								
Main stem watershed				√	√		√	√		Reconstruct, Restore, Reconnect Wetlands	**10**	Acres	*m*	by 2023	$5k-100k/ac.	10	280	62
										Urban runoff and green infrastructure								
MS watershed				√	√		√			Rain gardens	**20,000**	sq feet	*m*	yr 3-10	$500,000		2	0.50

Select projects will be monitored for effectiveness.

12-digit HUC/ Water Body	Dams	CSOs	Contamin. Sites	Sed	Nutrients	GW contam	Flooding	Habitat	Recreation	Category/Practices	Target amt by 2023	Units	Priority (high-mod)	Time Frame (yr or On-going)	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
MS watershed		√		√	√		√			Parking lot retrofit - Bioinfiltration/ perm pavemt	10,000	sq feet	*h*	yr 3-10	$200,000		2	0.4
MS watershed				√	√		√			Storm water inventory	1	inventory	*h*	yr 1-3				
MS watershed				√	√					Storm water retrofits for water quality	100	ac treated	*h*	on-going	$400-17k/ ac	4.5	70	10
MS watershed				√	√					No-mow ditch/veg swale/ daylight	1,000	linear feet - treats 4 ac	*m*	yr 3-8		0.1	1	0.4
Middle Cuyahoga River watershed		√		√	√		√			Neighborhood-scale green infrastructure	1		*h*	by 2023	$25-50k design $20k bumpouts	5	200	25
										Conservation Easements								
MS watershed				√	√		√	√	√	Acquire Wetlands/ easements	25	Acres	*h*	by 2023	$5-25k/ac	25**	1,400**	316**
	√	√	√	√	√	√	√	√	√	**Education and Outreach**								
MS watershed										Develop Brochures/Fact Sheets	6	Brochures/ Fact Sheets	*m*	ongoing				
MS watershed										Watershed Festivals	10	Festivals	*h*	ongoing				
MS watershed										Websites	1	Website	*h*	yr 1				
MS watershed										Install Signs	10	Signs	*m*	ongoing	$200-500			
MS watershed										Stream Clean-Ups	15	Clean-Ups	*h*	ongoing				
MS watershed										New lake/stream stewardship groups	1	new group active	*m*	yr 2-6				
MS watershed										Golf course certification outreach	4	golf course contacted	*h*	yr 2-6				
MS watershed										Stencil Storm Drains	100		*m*	ongoing				
MS watershed										Workshops/ Training	5	Workshops	*h*	ongoing				
MS watershed										Develop Manual(s)	1	Manuals	*h*	by 2015				
MS watershed										Rain barrel workshops	50	rain barrels	*h*	ongoing				
MS watershed										Develop Newsletters	10	Newsletters	*m*	ongoing				
MS watershed										Outreach for dams	2	Press Relea	*h*	yr 1				
MS watershed										maintain stream database	1	database	*h*	ongoing				
										Local Policy								
MS watershed				√	√		√	√		Green code audit/update	2	audits/	*h*	yr 1-5				

Select projects will be monitored for effectiveness.

12-digit HUC/ Water Body	Dams	CSOs	Contamin. Sites	Sed	Nutrients	GW contam	Flooding	Habitat	Recreation	Category/Practices	Target amt by 2023	Units	Priority (high-mod)	Time Frame (yr or On-going)	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
										Monitoring								
Cuy River		√							√	Bacteria sampling	6	Samples	*h*	yr 1, O				
Cuy River/tribs					√			√		Chemical Sampling	3	Sites	*m*	yr 2-5				
Cuy River/tribs				√	√			√		Macroinv./Fish/QHEI Sampling	4	Sites	*m*	yr 3-6				
										Recreation								
Cuy river									√	Develop water trail	1	water trail	*h*	yr 1-10				
Cuy river									√	Construct/improve access	5	site	*m*	by 2023				
Cuy river/tribs									√	Boardwalk/trail	8,000	lf	*m*	by 2023				
MS watershed									√	Economic benefit study	1	study	*m*	yr 2-5				
MS watershed									√	Develop quest(s)/ virtual watershed tour	2 quests/		*m*	yr 2-5				
															subtotal	*674*	*1871*	*518*
041100020305 (part) Fish Creek																		
										Riparian Restoration								
Fish Creek				√	√		√	√		Restore Streambank ***	3,000	Linear Feet	*h*	start yr 1	$25-200/lf	34	54	20
Fish Cr. & tribs				√	√		√	√		Riparian plantings	25	Acres	*h*	start yr 1		25	200	35
Fish Cr. & tribs								√		Treat for Invasive Species	40	Acres	*m*	start yr 2				
										Stream Restoration								
Fish Creek				√	√		√	√		Restore Flood Plain	50	Acre-foot	*h*	start yr 1		22	300	41
Fish Creek & tribs							√			Hydrological study in flood-prone area	1	study	*m*	yr 3-5				
Fish Cr watershed								√		Feasibility study low-head dam removal tribs	1	study	*m*	yr 3-5				
										Wetland Restoration								
Fish Creek				√	√		√	√	√	reconnect/restore Wetlands	100	Acres	*h*	start yr 1	$5-100k/ ac.	100	2800	632
										Home Sewage Treatment Systems								
FC watershed					√					correction of failing HSTS	10	HSTS	*h*	O			311	122
										Urban runoff and green infrastructure								
FC watershed				√	√		√			Rain gardens	6,000	sq feet	*m*	start yr 3	$150,000		1	0.1
FC watershed				√	√		√			Retrofit parking lot - bioinfiltration/perm pavmt	10,000	square feet	*m*	start yr 3		0.04	2	0.2

Select projects will be monitored for effectiveness.

12-digit HUC/ Water Body	Dams	CSOs	Contamin. Sites	Sed	Nutrients	GW contam	Flooding	Habitat	Recreation	Category/Practices	Target amt by 2023	Units	Priority (high-mod)	Time Frame (yr or On-going)	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
FC watershed				√	√		√			Storm water inventory	1	inventory	*h*	yr 1-3				
FC watershed				√	√					Stormwater water quality retrofits	60	acres treated	*h*	ongoing	$400-17k/ ac	4.5	70	10.2
FC watershed				√	√					No-mow ditch/veg swale/ daylight	1,000	linear feet - treats 4 ac	*m*	yr 3-8		0.1	2	0.4
Mid Cuy R				√	√		√			Neighborhd green infrastr.	1		*h*	by 2023	see above			
										Conservation Easements								
FC watershed				√	√		√	√	√	Acquire Wetlands/easemts	75	Acres	*h*	by 2023	$5-25k/ac	75**	2100**	474**
			√	√	√	√	√	√	√	**Education and Outreach**								
FC watershed										Brochures/Fact Sheets	10	Fact Sheets	*m*	ongoing				
FC watershed										Websites	1	Website	*h*	yr 1				
FC watershed										Install Signs	5	Signs	*m*	ongoing	$200-500			
FC watershed										Stream Clean-Ups	3	Clean-Ups	*m*	start yr 3				
FC watershed										New stewardship groups	1	new group	*m*	start yr 2				
FC watershed										Workshops/ training	5	Workshops	*m*	ongoing				
FC watershed										Develop Manual(s)	1	Manuals	*h*	by 2015				
FC watershed										Rain barrel workshops	50	rain barrels	*h*	ongoing				
FC watershed										Develop Newsletters	10	Newsletters	*m*	ongoing				
										Local Policy								
FC watershed				√	√		√	√		Green code audit/update	2	audits/ updates	*h*	yr 1-5				
FC wshed				√	√		√	√		Riparian setback**	1	Jurisd.	*h*	yr 2-8		14**	200**	35**
										Monitoring								
Fish Creek					√			√		Chemical Sampling	3	Sites	*h*	start yr 2				
Fish Creek				√				√		QHEI/HHEI Sampling	3	Sites	*h*	start yr 2				
FC watershed				√	√		√	√	√	Maintain stream database	1	database	*h*	ongoing				
										Recreation								
Fish Creek				√	√		√	√	√	Acquire conserv. Land/trail	20	ac	*h*	ongoing				
Fish Creek									√	Construct trail	3	mi	*m*	by 2023				
Fish Creek									√	Construct access sites	1	site	*m*	by 2023				
FC watershed									√	Economic benefit study	1	study	*m*	yr 2-5				
FC watershed									√	quest/ virtual watershed tour	2	2 quests/1 tc	*m*	yr 2-5				
															Subtotal	*336*	*3849*	*867*

Select projects will be monitored for effectiveness.

12-digit HUC/ Water Body	Dams	CSOs	Contamin. Sites	Sed	Nutrients	GW contam	Flooding	Habitat	Recreation	Category/Practices	Target amt by 2023	Units	Priority (high-mod)	Time Frame (yr or On-going)	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
041100020301 Plum Creek and Tribs																		
										Riparian Restoration								
Plum Cr./tribs				√	√			√		Restore/stabilize eroding Streambank	1000	Linear Feet	*h*	yr 2-8	$25-200/lf	6	13	5
Plum Cr./tribs				√	√			√		streambank stabilization - pasture	3000	lf	*h*	yr 2-8		14	38	10
Plum Cr. Tribs				√	√		√	√		Riparian plantings	8	Acres	*h*	start in yr 1-2	$4,000 + labor	4	67	7
										Stream Restoration								
Plum Cr. Tribs				√	√		√	√		Restore Flood Plain	10	Acre-foot	*m*	yr 2-8		4	60	8
Plum Cr./tribs										Restore Channel	1000	Linear Feet	*h*	yr 2-8	$100-200/lf	20		
Plum Cr watershed								√		Feasibility study low-head dam removal tribs	1	study	*m*	yr 3-5				
										Wetland Restoration								
Plum Cr. Tribs				√	√		√	√		Reconstruct, Restore, Reconnect Wetlands	25	Acres	*h*	start in yr 1-2	$5k-100k/ac.	25	700	158
										Home Sewage Treatment Systems								
Plum Cr.					√					Repair/Replace HSTS	10	HSTS	*h*	ongoing			311	122
										Urban runoff and green infrastructure								
Plum Cr.				√	√		√			Rain gardens	6000	sq feet	*m*	yr 3-10			1	0.1
Plum Cr.										Parking lot retrofit - bioinfiltration/perm. pavemt	5000	sq ft	*m*	yr 2-8		0.02	1	0.14
Pl. C. watershed				√	√		√			Storm water inventory	1	inventory	*h*					
Plum Cr.				√	√					Storm water retrofits	60	acres treate	*h*	ongoing	$400-17k/	2.7	30	12
Pl. Cr watershed				√	√					No-mow ditch/veg swale/ daylight	500	linear feet	*m*	yr 3-8		0.05	0.4	0.2
Mid Cuy wshed										Neighborhd green infra.	1		*h*	by 2023	see above			
				√	√					**Agricultural BMPs**						150	110	6
Pl C watershed				√	√					Survey of practices	1	survey	*h*	yr 1-3				
Pl Cr/tribs				√	√					2-Stage Channel/overwide	500	Linear Feet	*m*	by 2023			147	46
Plum Cr. and tribs										Grassed Waterways/ vegetated buffer strips	50	Acres treate	*h*	yr 5-8		72	211	113
Pl Cr watershed										Cover crops	100	acres	*h*	yr 3-6		110	256	128
Pl Cr watershed										Residue applied to fields	50	acres	*h*	yr 3-6		55	128	64
Plum Cr. and tribs										Livestock Crossings	1	Crossings	*h*	yr 3-5				

Select projects will be monitored for effectiveness.

12-digit HUC/ Water Body	Dams	CSOs	Contamin. Sites	Sed	Nutrients	GW contam	Flooding	Habitat	Recreation	Category/Practices	Target amt by 2023	Units	Priority (high-mod)	Time Frame (yr or On-going)	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
Plum Cr. and tribs				√	√			√		Livestock Excl. Fence & accompanying measures	3,000	Linear Feet	*h*	yr 3-5	$11,300 + watering	7	56	12
										Conservation Easements								
Pl Cr and tribs				√	√		√	√	√	Acquire Wetlands/ conserv. land/ easemts	100	Acres	*h*	start in yr 1-2	$5-25k/ac	100**	2800**	632**
			√	√	√	√	√	√	√	**Education and Outreach**								
Pl Cr and tribs										Brochures/fact sheets	10	fact sheets	*m*	ongoing				
Plum Creek										Watershed Festivals	2	Festivals	*h*	ongoing				
Plum Creek										Websites	1	Website	*h*	ongoing				
Pl Cr watershed										Install Signs	10	Signs	*m*	ongoing	$200-500			
Plum Creek										Stream Clean-Ups	5	Clean-Ups	*h*	start yr 2				
Plum Creek										New stewardship groups	1	new group	*m*	yr 2-6				
Pl Cr watershed										Conduct Workshops	5	Workshops	*h*	ongoing				
Pl Cr watershed										Conduct Training		Training Ses	*h*	ongoing				
Pl Cr watershed										Develop Manual(s)	1	Manuals	*h*	by 2015				
Pl Cr watershed							√			Rain barrel workshops	50	rain barrels	*h*	ongoing				
Pl Cr watershed										Outreach for golf courses	2	golf courses	*h*	yr 2-4				
Pl Cr watershed										Develop Newsletters		Newsletters	*m*	ongoing				
										Local Policy								
Pl Cr watershed				√	√		√	√		Green code audit/update	2	audits/	*h*	yr 1-5				
										Monitoring								
Plum Creek					√			√		Chemical Sampling	1	Sites	*h*	start yr 1				
Plum Creek				√				√		Macroinv./Fish/QHEI Sampling	3	Sites	*h*	start yr 1				
										Recreation								
Pl Cr watershed									√	Construct trail	1	mile	*m*	by 2023				
Plum Creek									√	Construct access sites	1	site	*m*	by 2023				
Pl Cr watershed									√	Economic benefit study	1	study	*m*	yr 2-5				
Pl Cr watershed									√	Quest/ virtual watershed tour	2	2 quests/1 tc	*m*	yr 2-5				
															Subtotal	469.8	2129	691.4

Select projects will be monitored for effectiveness.

12-digit HUC/ Water Body	Dams	CSOs	Contamin. Sites	Sed	Nutrients	GW contam	Flooding	Habitat	Recreation	Category/Practices	Target amt by 2023	Units	Priority (*high-mod*)	Time Frame (yr or On-going)	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
041100020202 Breakneck Creek																		
										Brownfields								
Br Cr watershed			√			√				brownfields inventory	1	inventory	*h*	yr 2-5				
Br Cr watershed			√			√				status of listed sites	11	sites	*h*	yr 1				
Br Cr watershed			√			√				Brownfields plan	1	plan	*m*	yr 4-8				
										Initate clean-up	1		*m*	yr 4-10				
										Riparian Restoration								
Br Cr/tribs				√	√					Restore Streambank	3,000	Linear Feet	*h*	start yr 1	$25-200/lf	207	300	112
Breakneck Cr./tribs				√	√		√	√		Riparian plantings	12	Acres	*h*	start yr 1	$6,000 + labor	6	93	17
Br Cr. watershed										Treat Invasive Species	50	Acres	*m*	start yr 2				
										Stream Restoration								
Br Cr/tribs				√	√		√	√		Restore Flood Plain	50	Acre-foot	*h*	start yr 1		22	300	41
Br Cr/Tribs										Restore Channel	5000	Linear Feet	*h*	start yr 1	$100-			
Br Cr/tribs							√			Hydrological study in flood-prone area	1	study	*m*	yr 3-7				
Br Cr watershed								√		Feasibility study low-head dam removal tribs	1	study	*m*	yr 3-5				
										Wetland Restoration								
Br Cr watershed				√	√		√	√		Reconnect/Restore Wetlands	80	Acres	*h*	start yr 2	$5-100k/ac	80	2240	506
										Home Sewage Treatment Systems								
Br Cr. Wshed					√					Correction of failing HSTS	30	HSTS	*h*	ongoing			933	366
										Urban runoff and green infrastructure								
Br Cr watershed				√	√		√			Rain gardens	20,000	sq feet	*m*	yr 2-10	$500,000		2	0.50
Br Cr watershed					√		√			Parking lot retrofit - perm. pavemt/ biofilt.	10,000	sq feet	*h*	yr 3-8	$200,000		2	0.4
Br Cr watershed				√	√		√			Storm water inventory	1	inventory	*h*	yr 1-3				
Br Cr watershed				√	√					Storm water retrofits	100	acres		start yr 3	$400-17k/	4.5	70	10
Br Cr watershed				√	√					No-mow ditch/veg swale/ daylight	2,000	linear feet - treats 8 ac	*m*	yr 3-8		0.2	2	0.8
Middle Cuy Watershed										Neighborhd green infr.			*h*	by 2023	see above			
				√	√					**Agricultural BMPs**								
Br Cr watershed				√	√					Survey of practices	1	survey	*h*	yr 1-2				

Select projects will be monitored for effectiveness.

12-digit HUC/ Water Body	Dams	CSOs	Contamin. Sites	Sed	Nutrients	GW contam	Flooding	Habitat	Recreation	Category/Practices	Target amt by 2023	Units	Priority (high-mod)	Time Frame (yr or On-going)	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
Br Cr/tribs				√	√			√		Livestock Excl. Fencing, accompanying measures	3,000	Linear Feet	*h*	yr 2-8	$11,300 + watering	140	280	140
Br Cr/tribs				√	√			√		Alternative Water Supplies	1	Supplies	*h*	yr 2-8				
Br Cr tribs				√	√			√		2-Stage Chan./overwide	1,000	Linear Feet	*m*	yr 6-10			295	91
Br Cr/tribs				√	√					Grass. Waterw/veg. buffer	100	Ac. treated	*h*	start yr 3		177	466	26
Br Cr watershed				√	√					Cover crops	100	acres	*h*	start yr 3		101	240	120
Br Cr watershed				√	√					Residue applied to fields	200	acres	*h*	start yr 3		202	480	120
Br Cr/tribs				√	√			√		Livestock Crossings	1	Crossings	*h*	yr 2-8				
										Conservation Easements								
Br Cr watershed				√	√		√	√	√	Acquire Wetlands/easemts	100	Acres	*h*	start yr 1	$5-25k/ac	100**	2800**	632**
Br Cr watershed			√	√	√	√	√	√	√	**Education and Outreach**								
Br Cr watershed										Brochures/Fact Sheets	10	Brochure	*m*	ongoing				
Br Cr watershed										Watershed/trib Festivals	10	Festivals	*h*	ongoing				
Br Cr watershed										Websites	1	Website	*h*	yr 1, O				
Br Cr watershed										Install Signs	24	Signs	*m*	yr 3-10	200-500			
Br Cr watershed										Stream Clean-Ups	3	Clean-Ups	*h*	ongoing				
Br Cr watershed										New stewardship groups	1	new group	*m*	yr 2-6				
Br Cr watershed										Workshops/Training	5	Workshops	*h*	ongoing				
Br Cr watershed										Develop Manual(s)	1	Manuals	*h*	ongoing				
Br Cr watershed							√			Rain barrel workshops	250	barrels	*h*	ongoing				
Br Cr watershed										Develop Newsletters	10	Newsletters	*m*	ongoing				
										Local Policy								
Br Cr watershed				√	√		√	√		Riparian setback	1	code	*h*	yr 2-6		22**	320**	57**
Br Cr watershed				√	√		√	√		Green code audit/update	2	audits/	*h*	yr 1-5				
										Monitoring								
BCr/ feeder Canal/ Lake H					√					Chemical Sampling	4	Sites	*h*	yr 1-3				
Br Cr/tribs										Fish (IBI) Sampling	3	Sites	*m*	yr 2-6				
Br Cr/tribs										QHEI/HHEI Sampling	3	Sites	*m*	yr 2-6				
										Recreation								
Br Cr watershed									√	Construct trail	2	miles	*m*	yr 3-10				
Breakneck Cr.									√	water trail/access sites	1	site	*m*	yr 5-10				
Br Cr watershed									√	Economic benefit study	1	study	*m*	yr 2-5				
Br Cr watershed									√	Quest/virtual wshed tour	3	Quests/1 tr	*m*	yr 2-5				
															Subtotal	939.7	5703	1551

Select projects will be monitored for effectiveness.

12-digit HUC/ Water Body	Dams	CSOs	Contamin. Sites	Sed	Nutrients	GW contam	Flooding	Habitat	Recreation	Category/Practices	Target amt by 2023	Units	Priority (high-mod)	Time Frame (yr or On-going)	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
041100020201 Potter Cr. (and Congress Lake Outlet, CLO)																		
										Riparian Restoration								
Po Cr/CLO/tribs				√	√			√		Restore streambank	1,600	Linear Feet	*h*	start yr 3	$25-200/lf	110	160	60
Po Cr/CLO/tribs				√	√		√	√		Riparian plantings	5	Acres	*m*	start yr 3	$2,500 + labor	2.8	40	7
Po Cr watershed								√		Remove/treat Invasive Species	50	Acres	*m*	start yr 3				
										Stream Restoration								
Po Cr/CLO/tribs				√	√		√	√		Restore Flood Plain	10	Acre-foot	*m*	start yr 3		4.4	60	8
Po Cr watershed								√		Feasibility study low-head dam removal tribs	1	study	*m*	yr 3-5				
										Wetland Restoration								
Po Cr/CLO/tribs				√	√		√	√		Reconnect/Restore Wetlds	50	Acres	*h*	start yr 3	$5-100k/ac	50	1400	316
										Home Sewage Treatment Systems								
Po Cr watershed					√					Repair/Replace HSTS	15	HSTS	*h*	ongoing			466	183
										Urban runoff and green infrastructure								
Po Cr watershed				√	√		√			Rain gardens	1000	sq feet	*m*	start yr 4			0	0.04
Po Cr watershed				√	√					Storm water retrofits	20	acres treate	*m*	start yr 3	$400-17k/	0.9	10	4
Po Cr watershed				√	√					No-mow ditch/veg swale	500	linear feet	*m*	yr 3-8		0.05	0	0.2
Mid Cuy wshed										Neighborhd green infrastr.	1				see above			
				√	√					**Agricultural BMPs**								
Po Cr/CLO				√	√					Survey of practices	1	survey	*h*	yr 1-3				
Po Cr/tribs				√	√			√		Livestock Excl. Fence, accompanying measures	3,000	Linear Feet	*h*	yr 2-8	$11,300 + watering	140	280	140
Po Cr/tribs				√	√					Alternative Water Supplies	1	Supplies	*h*	yr 2-8				
Po Cr/tribs				√	√					2-Stage Channel/overwide	1,000	Linear Feet	*m*	yr 6-10			295	91
Po Cr/CLO/tribs				√	√			√		Grassed Waterways/ vegetated buffer strips	100	Acres treate	*h*	start yr 3		177	466	26
Po Cr wshed				√	√					Cover crops	100	acres	*h*	start yr 3		101	240	120
Po Cr wshed				√	√					Residue applied to fields	200	acres	*h*	start yr 3		202	480	120
Po Cr wshed				√	√					Conservation cover	100	acres	*h*	start yr 3		101	240	120
Po Cr/tribs				√	√					Livestock Crossings	1	Crossings	*h*	yr 2-8				

Select projects will be monitored for effectiveness.

12-digit HUC/ Water Body	Dams	CSOs	Contamin. Sites	Sed	Nutrients	GW contam	Flooding	Habitat	Recreation	Category/Practices	Target amt by 2023	Units	Priority (high-mod)	Time Frame (yr or On-going)	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
										Conservation Easements								
Potter Cr.watershed				√	√		√	√	√	Acquire riparian buffer/ Wetlands/ easements	50	Acres	*h*	start yr 1	$5-25k/ac	50**	1400**	316**
Po Cr wshed			√	√	√	√	√	√	√	**Education and Outreach**								
Po Cr wshed										Brochures/Fact Sheets	4	Fact Sheets	*m*	ongoing				
Po Cr wshed										Websites	1	Website	*h*	ongoing				
Po Cr wshed										Field Days/workshops	3	workshops	*h*	start yr 2				
Po Cr wshed										Develop Manual(s)	1	Manuals	*h*	yr 1-2				
										Local Policy								
Po Cr wshed				√	√		√	√		Riparian setback	1	jurisdiction	*h*	yr 2-6		25**	400**	71**
Po Cr wshed				√	√		√	√		Green code audit/update	1	audits/ updates	*m*	yr 1-5				
										Monitoring								
Po Cr/VLO					√			√		Chemical Sampling	3	Sites	*h*	yr 1-2				
Po Cr./tribs				√				√		(QHEI/HHEI) Sampling	1	Sites	*h*	yr 3-5				
															Subtotal	889.2	4138	1195
															Total	3,309	17689	4,822

* Contingent on Long Term Control Plan, assumes reduce all but 3 overflows/yr at each of 4 locations.

** Amount of additional loading prevented by preservation.

*** Primary reasons for restoring this streambank are flood management and habitat. Pollutant loading calculated for 200 lf of eroding bank.

Select projects will be monitored for effectiveness.

8/9 Monitoring and Plan Revision

Important aspects of the watershed plan include tracking progress, maintaining contact with partner communities/organizations, and amending/updating the plan to reflect newly identified needs and opportunities. The watershed coordinator has held meetings with community officials during the plan development and will be holding workshops and meetings during plan review to identify items not included in this original plan, which will allow the plan to be revised in the year(s) following approval. It is planned that the partners will revisit the goals and objectives at least once per year as a group and will continue to meet on an approximately quarterly basis or as necessary to manage individual projects.

Monitoring

The watershed partners will continue to meet in years following plan adoption. The watershed coordinator will be responsible for demonstrating and assessing progress toward the stated goals, to allow the partners to target projects and revise/amend the watershed action plan. The list of actions in Section 7 allows the partners to assess progress in the following manner:

- Limited sampling is proposed along the Cuyahoga River and tributaries.
- Use of BMPs assumes typical pollutant reduction and often does not involve monitoring. The watershed coordinator will document the amount, location, and type of BMPs installed relative to the plan items, which will allow pollutant load reductions to be modeled.
- Select projects will be monitored for effectiveness (e.g., pollutant reduction), as part of the project contracts or as a separate monitoring effort.
- These efforts will be included in watershed coordinator activities, partner contributions, and specific BMP efforts, which will be funded through sources such as grants or partner contributions, depending on the BMP.

These data will be compiled yearly. The partners will meet approximately quarterly to coordinate on projects and share results. Each year the partners will review progress and assess whether revised goals are needed. The watershed coordinator will report construction of projects as required to Ohio DNR/Ohio EPA.

Plan Update/Revision

To assess progress and update partners, the watershed coordinator will:

- Track progress using the summary tables;
- Hold meetings with partners and discuss plan progress, pending projects, and newly identified project needs at least four times per year or as appropriate to manage projects;
- Maintain contact with/update partners by telephone, e-mail, and newsletter;
- Work with individual partners to implement projects and conduct cleanups; and
- Present updates at regional meetings, e.g., NEFCO/ERTAC, NPDES stormwater general permit Public Involvement Public Education groups.

NEFCO will retain the watershed plan documents and use the web page to post updates, information, discussion materials, upcoming events/coordination, and contact information for those wishing hard copies. Summary packages for each subwatershed based on the summary materials from Section 7 are available for broad distribution.

The e-mail list used during plan preparation included over 100 contacts, including the entities listed on the endorsement sheet, as well as parks districts, the Akron-Summit Homebuilders Association, local resource management consulting firms, soil and water conservation districts,

7-MS Cuyahoga River Main Stem

HUC 041100020305 and a small portion of HUC041100020203 (Upper Cuyahoga, L. Rockwell dam to Breakneck Creek), except Fish Creek

1 Summary of Existing Conditions

Tables MS-1 and 2 summarize key characteristics and impairments of this subwatershed. Figure MS-1 presents a map of the subwatershed and its jurisdictions. Figures MS-2 and 3 show potential areas of concern and resource areas for protection. (Greater detail is shown in the various maps in Vol. I.) Also see photos in Section 4P, Main Stem.

The primary concerns in this watershed focus on continued restoration of the river, protecting the Cuyahoga Falls public water supply, addressing impacts from the altered, urbanized landscape (including non-point source pollution, flooding, bank erosion and channel incision), and increasing recreational opportunities, such as the proposed water trail.

The main stem has been assessed for water quality attainment frequently as part of development and implementation (and follow-up for the Middle Cuyahoga) related to the Middle and Lower Cuyahoga River TMDLs. The tributaries have not been assessed, except for the tributary in Munroe Falls MetroPark, which appears to be in attainment. Limited information is available about the tributaries. Field work has been confined to visual assessments at parks and road crossings.

The descriptions below reflect the information available at this scale. However, in most cases, additional field work is necessary to further assess or quantify various characteristics of specific locations. Additional problem areas or resources may become apparent later. For instance, there is limited water quality sampling along tributaries; mapped buffer characteristics may not accurately reflect actual channel conditions; problems such as erosion or damaging floods may only become apparent after storms; and some areas of interest will be apparent only after more field work is done.

Non-Attainment due to Dams *(Refer to Problem statement MS-1, Table MS 4.1)*

Following decades of hydromodification by dams along the main stem, efforts are on-going to restore 14 miles of the Middle Cuyahoga River to attain biological standards through dam removal. Recent removal or alteration of two dams has restored eight miles of the river between Kent and Brust Park. Downstream of Brust Park, the river is in non-attainment due to the presence of two low-head dams and the 60-foot Ohio Edison dam in the Cuyahoga Falls Gorge. Removal of the remaining three dams would restore flow along an additional five to six miles of river. Improving the water quality will require continued efforts to address existing impairments, provide public information, and restore riverbank and tributaries following dam removal.

CSOs *(Refer to Problem Statement MS-2, Table MS 4.2)*

In the lower reaches of this watershed, the City of Akron has four CSOs. These are the subject of a Long Term Control Plan that is currently being negotiated. The CSO reduction effort may open up opportunities for reducing stormwater flow with green infrastructure.

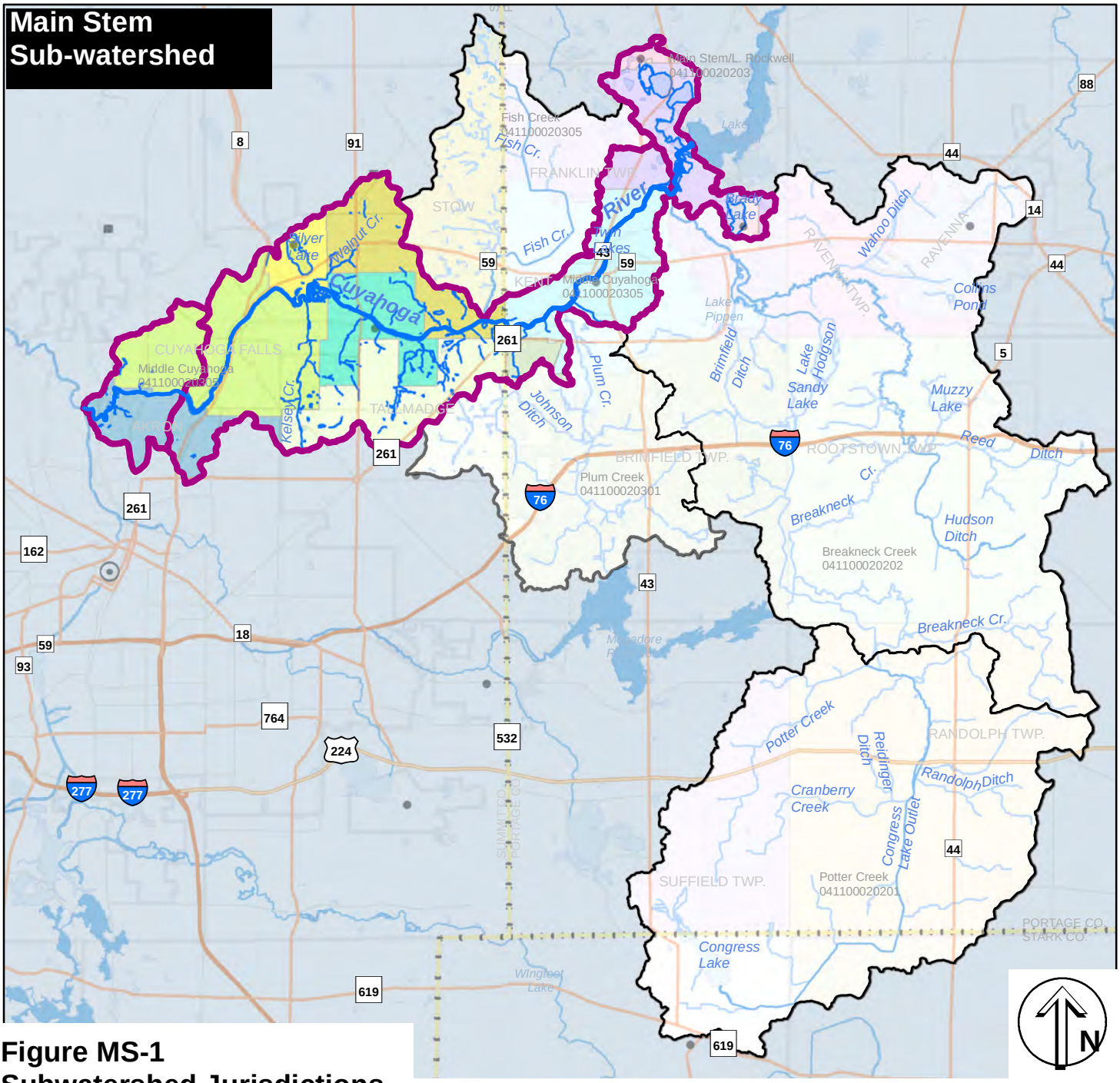


Figure MS-1
Subwatershed Jurisdictions

- Streams and Rivers
- Lakes
- Main Stem Subwatershed
  12-Digit HUC: 041100020305
- Fish Creek 041100020305 — Other Sub-watersheds
- Counties
- Jurisdictions outside watershed
- Interstate Highways
- State Divided Highways
- State Numbered Rtes
- Local Roads

Subwatershed Local Jurisdictions

- SILVER LAKE
- STOW
- CUYAHOGA FALLS
- MUNROE FALLS
- TALLMADGE
- AKRON
- STREETSBORO
- KENT
- FRANKLIN TWP.
- BRIMFIELD TWP.
- SUGAR BUSH KNOLLS
- BRADY LAKE

Sources: NEFCO, 2010; Portage County GIS 2010; Summit County GIS 2009; Stark County Planning Commission 2010; Ohio DNR GIS 2010

Figure MS-2 Problem Areas - Main Stem Subwatershed

Main Stem Subwatershed
041100020305 Fish Creek — Other Subwatershed, 12-Digit HUC
Streams and Rivers
Lakes
WWH — Aquatic Life Use Designation

Land Use Related Concerns

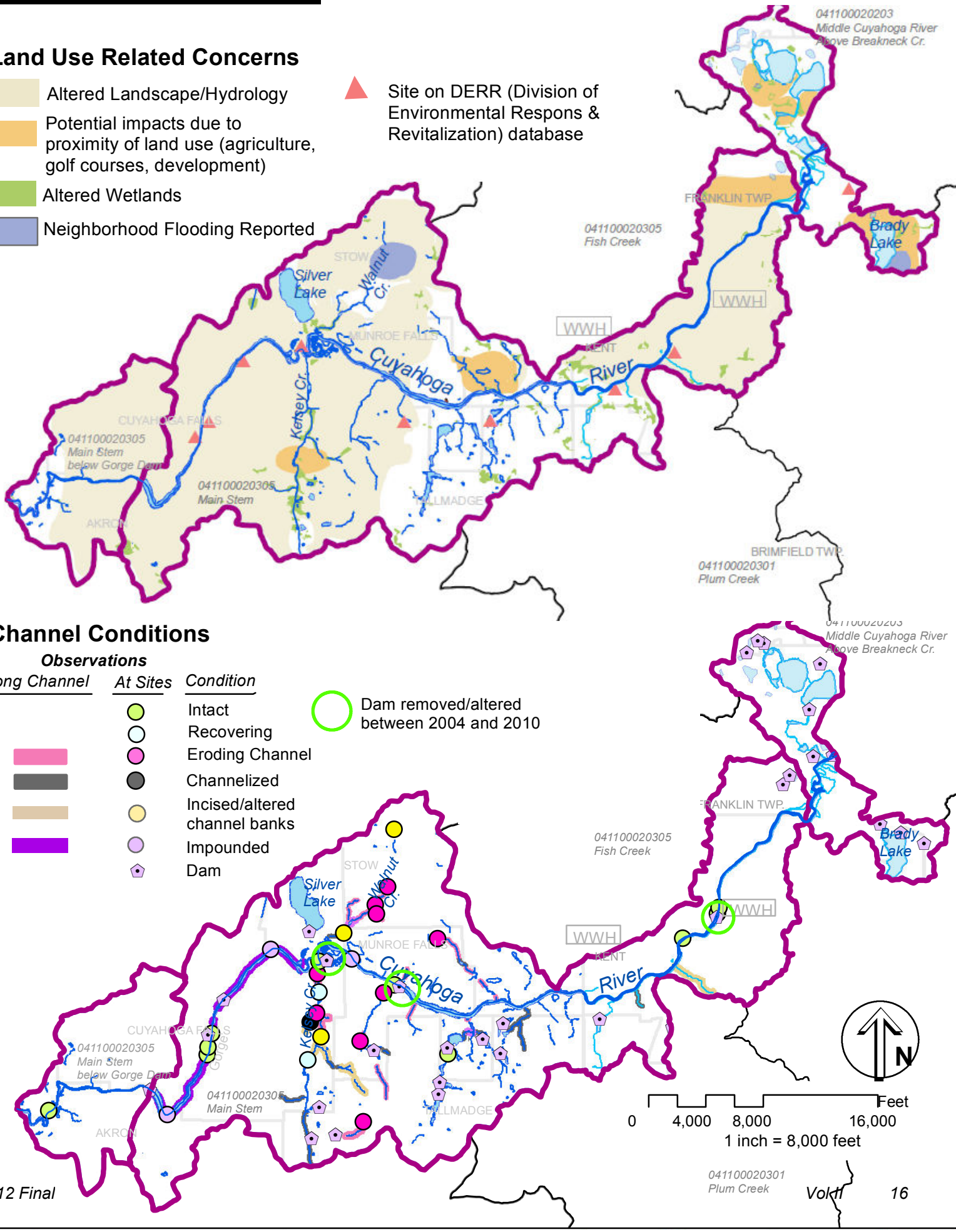
- Altered Landscape/Hydrology
- Potential impacts due to proximity of land use (agriculture, golf courses, development)
- Altered Wetlands
- Neighborhood Flooding Reported
- Site on DERR (Division of Environmental Respons & Revitalization) database

Channel Conditions

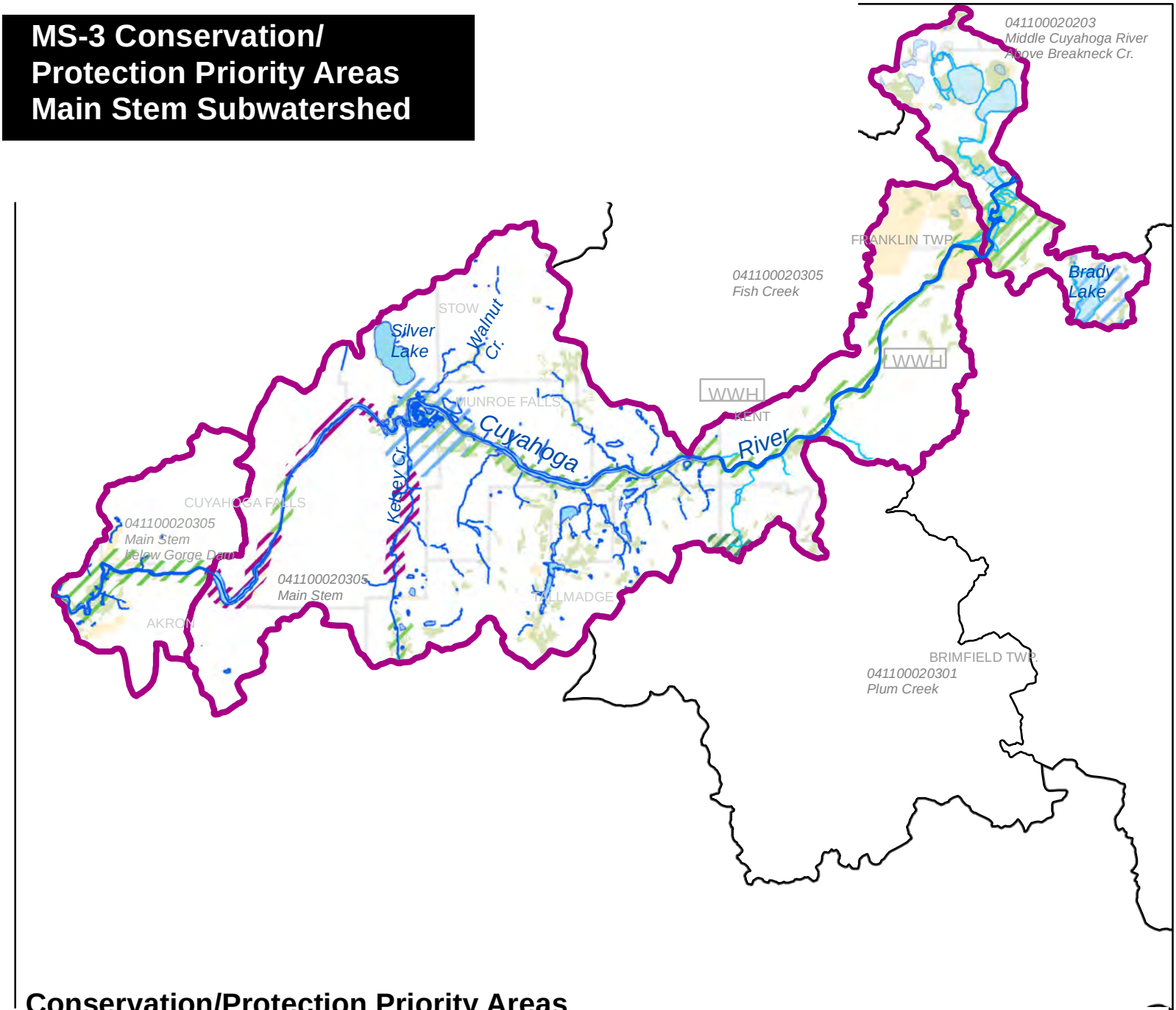
Observations

Along Channel	*At Sites*	*Condition*
		Intact
		Recovering
		Eroding Channel
		Channelized
		Incised/altered channel banks
		Impounded
		Dam

Dam removed/altered between 2004 and 2010



MS-3 Conservation/ Protection Priority Areas Main Stem Subwatershed



Conservation/Protection Priority Areas

- Riparian Corridor/Wetland
- Wetlands of Additional Importance (e.g., buffering) - enhance/protect
- Water Supply Protection - Conservation/BMPs/Outreach
- Restoration/Conservation of Riparian Area/Wetlands
- Mapped Wetlands
- Habitats or Species of Concern
  Identified on DNR biodiversity database spanning 30 years; Western Reserve Land Conservancy workshop, 2010.)

- Streams and Rivers
- Lakes
- WWH — Aquatic Life Use Designation
- 041100020305 Main Stem — Subwatershed, 12-Digit HUC
- Local Jurisdictions

N

0 4,000 8,000 16,000 Feet
1 inch = 8,000 feet

*Sources: NEFCO 2010, Summit, Portage, and Stark Co. GIS 2009-2010; Ohio DNR GIS base map, biodiversity data; 2011. Western Reserve Land Conservancy GIS mapping of conservation areas, 2010; Summit and Portage Counties wetland mapping conducted by Davey Resource Group, 2000-2004. Stark County -2003 land cover mapping; CCAP - NOAA coastal Change Analysis Program 2006 mapping.

Table MS-1
Summary of Main Stem Subwatershed Characterisitcs

Concern	Amount/Item	Comments
Water Quality Attainment, latest assessed	Main Stem – upper 8 miles in attainment, 5-6 miles in Non attainment; Full attainment below Edison dam; partial at lower end; most recently assessed 2007-2010; occasionally elevated *e. coli* counts at water works park after a storm; Tributaries – mostly not assessed	Causes: organic & nutrient enrichment , low DO, toxicity, habitat mod. Sources: dam pools, CSOs, habitat/riparian mod., urbanization/suburbanization
Public water supplies	Cuyahoga Falls well/river recharge	Developing Source Water Protection Plan, land largely owned by City
Land Cover acres, %	Developed 12,054 66.5% • *High Density* *873* *4.2%* • *Moderate Density* *2,396* *12.0%* • *Low Density* *6,214* *36.2%* • *Dev. Open Space* *2,571* *14.1%* Agricultural 655 5.1% Grassland/scrub-shrub 370 1.9% Woods/wetlands 4,150 23.6%	
Impervious/runoff	25.7% **Additional runoff ¾ in storm**: 62 million gal.	
75 foot buffer	**Walnut Cr. Kelsey Cr. Cuy R.** Developed 96% 90% 60% *- Dev. Open Space* *24%* Agricultural Woods/wetlands 3% 36%	Mapped developed land in buffer may be greater than actual, possibly due to mapping scale, steep valley walls.
Wetlands (ac)	**Mapped** 1,510 **Converted** 451 (hydric) (2167 hydric incl.)	Urban areas may mask earlier wetlands
Development potential	Limited development on few remaining large parcels	
Channel quality (Cuy. River/tributaries)	**Intact Altered/channelized Impounded Eroding Recovering** 12.8/2 0.1/9.7 3.1/0.3 0/4.9 0/1.5	
Non-pt source load/yr	**Tot. N (lb)** 53,882 **Tot. P (lb)** 9,391 **Sed. (tons)** 2,338	
Septic systems	Minimal amounts outside sewer service, most areas few limitations	
Problem areas	Incised tribs. at nearly all stream crossings, highly altered watershed	Water volume; tribs intact in woods
Resource areas	Public water supply 5 year zone, habitat/species of concern, wetlands	
Park/ conserv./inst.	Local & park district parks, hiki/bike trails; schools, municipal facilities	
Riparian setback	Tallmadge, Munroe Falls, Kent	
Recreational opportunities	Main stem: canoeing, fishing, water trail, bike-hike trail, city/park district parks/trails; Tribs.– Parks on Walnut & Kelsey Cr., greenway potential	Limited direct access

Table MS-2 Main Stem Impairments
HUC 041100020203, 041100020305

Attainment issue/other concern	Cause	Source	Other likely sources
L. Rockwell – Breakneck Cr. HUC: 041100020203 Partial attainment	Organic enrichment/DO (high) Habitat alteration Siltation Flow regulation/ modification	Development (high) Minor municip. point source Land development Non-irrigated crop production	Most of -0203 is above the L. Rockwell dam
HUC: 041100020305 Cuyahoga River below Breakneck Creek	Habitat alteration Flow alteration Nutrients Organic enrichment Siltation Total Toxics, unknown toxics	Channelization CSO Dam Major municipal point source Natural Septic tanks Sewer line construction Urban runoff/nps	Imperv. 26%. Stream ero-sion/incising streams
Middle Cuyahoga TMDL Breakneck Creek – Water Works Park (Middle Cuy TMDL) – portions of 0203 and -0305 Elevated nutrient levels noted in 2007 OEPA report No change in habitat scores below Brust Park			
Lower Cuyahoga TMDL	Organic enrichment Toxicity Low DO Nutrients Flow alteration bacteria	Municipal discharges CSOs Urban runoff Industrial/ municipal discharges Upstream impoundments	
Support Designated Recreational use (bacteria, debris, water trail)			
Local Concerns:			
Increase stewardship and understanding			
Protect water supply			

Effects of Altered Landscape

Much of the remaining problems that the partners wish to address in this subwatershed relate to the high degree of alteration of the landscape: Sediment, nutrients (nitrogen and phosphorous), flooding, habitat alteration, even the potential for groundwater contamination.

The Main Stem subwatershed is 26 percent impervious, resulting in increased loading of pollutants and water volume as shown in Table MS-1. Streams tend to degrade when imperviousness reaches around 10 percent, and degradation can be reduced or aggravated by the condition of the riparian zone and riparian buffer. In this subwatershed, the increased runoff, combined with the steep slopes and altered riparian features, has resulted in increased channel loading, incised channels at most stream crossings, loss of floodplain access and flood storage, stream instability, sedimentation, nutrient loading, degraded habitat, localized flooding problems, and adverse impacts downstream. Severe erosion has been noted along Kelsey and Walnut Creeks. Nutrients, sediment, bank erosion, and damaging floods are all concerns in downstream communities, the Cuyahoga River, and river bank erosion has become severe in the National Park downstream.

The main stem and tributaries are lined with debris from decades of dumping trash. The debris detracts from the aesthetic and recreational appeal of the river and may affect water quality or habitat as materials spill, leak, or interfere with substrate.

Non-Point Source Pollution (Sediment, Nutrients) from Urban Runoff and Overloaded Channels *(Refer to Problem Statements MS-3, 4, and 5, Tables MS 2.3, 4, and 5, for Sediment, Nitrogen, and Phosphorous, respectively.)*

The largely urbanized Main Stem subwatershed generates 9,391 lb per year of phosphorous, 53,882 lb per year of nitrogen, and 2,338 tons per year of sediment. These contribute to downstream habitat degradation and elevated nutrient levels. Four lakes in the main stem watershed are surrounded by residential development and may be affected by nonpoint source pollution.

- *Sediment* - In addition to urban runoff, tributaries in this subwatershed are undergoing severe bank erosion and loading of sediment and nutrients due to excess volume and reduced flood storage. Approximately 2 miles of headwater tributaries are eroding from excess storm water and inadequate flood storage. Included in this total, approximately 2,500 linear feet of Kelsey Creek in Kennedy Park is incised with banks up to 6 feet tall and is threatening infrastructure. Lower banks in Brookledge Golf Course, upstream of Kennedy Park, and Water Works Park, downstream of Kennedy Park, are also eroding. Walnut Creek in Adell Durbin Park is incised from one foot to several feet, depending on the slope. Small headwater tributaries in Munroe Falls and Stow are incised by one foot.
- *Nutrients* - The Ohio EPA 2007 Aquatic Life Use study indicates that phosphorous levels in the Cuyahoga River are elevated compared to state criteria. Because higher levels tend to occur after rain events, it appears that a component is related to runoff. Nutrients also enter the streams along with sediment eroded from stream banks. The highly altered watershed and riparian features have reduced the natural ability of the system to assimilate or store sediment and nutrients. So far the biological communities in the river have not been adversely affected. However, with an increased concern for nutrients entering Lake Erie, it is important to reduce input and improve uptake as much as possible upstream.

Groundwater Contamination *(Refer to Problem Statement MS-6, Table MS 4.6)*

This subwatershed contains one public water supply, the Cuyahoga Falls wellfield, which relies on a shallow sand and gravel aquifer that is highly susceptible to pollution, and which receives recharge from the river. The City of Cuyahoga Falls owns much of the 5 year time of travel zone of the wellfield, but more than half is privately owned, the DERR database indicates one or more potential sources of contamination, and an abutting landowner has expressed interest in oil and gas drilling, all of which raise concerns of potential contamination.

Flooding *(Refer to Problem Statement MS-7, Table MS 4.7)* Flooding problems and erosion have been observed along tributary sections of Walnut Creek, Kelsey Creek, and un-named tributaries entering the river. These likely reflect altered hydrology and increased runoff.

Habitat and Conservation Areas *(Refer to Problem Statements MS-8,9 - Tables MS 4.8,9)*

Based on preliminary mapping and limited field assessments, it appears that 3,305 acres riparian buffer along headwater tributaries and 451 acres of wetlands on hydric soils have been altered, degrading habitat and reducing water quality. Much of the riparian corridor nearest the Cuyahoga River is undisturbed, due to the steeply sloping river valley. Headwater tributaries in this subwatershed have been culverted and channelized, and many of the tributaries are incised, impairing habitat. Urban encroachment has likely degraded some of the remaining wetlands, as evidenced by large stands of the common reed, *Phragmites* in the more urbanized portion of the watershed. The total amount of altered headwater habitat is likely much higher than estimated, as much of the previous streams and wetlands were altered by development prior to mapping. Development continues to encroach on and damage the remaining wetland and riparian resources. Where dams have been removed, the riparian area is in transition and may lack tree canopy over the creek/river, increasing water temperatures in the area. Numerous small low-head dams are found in the watershed, which often impair upstream habitat.

Within the Main Stem subwatershed, habitats or species of concern have been identified along the cliffs in the Gorge MetroPark, in Munroe Falls MetroPark, Cascade Valley MetroPark, at the Twin Lakes and near Lake Rockwell and the confluence of Breakneck Creek. Local, state, and County park districts protect portions of many resource areas, including intact riparian environments along headwater tributaries and portions of the Cuyahoga River. These can provide nuclei and nodes for larger, more connected habitat areas. Unprotected habitats or species of concern are found near Twin Lakes and the upper portions of the Middle Cuyahoga River. Outside of MetroParks and the immediate vicinity of the river, there are few remaining wetlands in the subwatershed, along headwater tributaries in Tallmadge and Munroe Falls, and they are on land that is privately owned.

Recreation *(Refer to Problem Statement MS-9, Table 6b-MS 4.9)*

Numerous city and park district parks and the bike-hike trail along the Main Stem provide direct access to the river and tributaries at several locations in Kent, Munroe Falls, Cuyahoga Falls, Stow, Silver Lake, and Akron. The Freedom Secondary Bike-Hike trail will provide a continuous trail between Summit and Portage Counties, with links to the Portage bike-hike path along the river. The existing parks could provide the framework for developing further trail connections.

The Cuyahoga River is designated as a Category A recreational water and is being developed as a water trail. Various partners are collaborating in increasing recreational opportunities and access along the Cuyahoga River. A recently completed canoe livery in Kent has increased

the number of paddlers on the river. Partners in the region are seeking to establish a Water Trail, which would draw visitors to the entire region. Expert paddling waters are found along a short stretch in Kent and in the Gorge section of the river. Should the Ohio Edison dam and the two smaller dams in Cuyahoga Falls be removed, it is likely that additional expert class rapids will be exposed. Fishing opportunities are likely to change with the removal of the dams, as well.

While recreational use and facilities are increasing along the river, there is a lack of centralized information and adequate pull-outs/access points. Large debris and tires are still found along the Middle Cuyahoga River. Encouraging recreation along the river will require maintenance of additional access, signage, debris removal, and information sites.

Upstream of the combined sewer overflows, levels of *e. coli* are occasionally elevated, possibly related to high flows. With increased recreational use along the river and designation as a Category A recreational waterway, it is important to more fully understand the source and frequency of the high bacteria levels, which could be a result of watershed runoff or localized sources, such as concentrations of waterfowl.

2 Problem Statements, Goals, Objectives, Actions

Table MS 3 summarizes the actions proposed in the subwatershed and their associated pollutant load reductions, listing which problem statements are addressed by these tools, and which tables they can be found in. Tables MS 4.1 through 4.10 present the problem statements, goals, objectives, and actions for each problem area. The tables are numbered to reflect each problem statement number, e.g., Table MS 4.1 corresponds to Problem Statement MS-1. It should be noted that because many of the objectives address more than one goal, the actions associated with each objective are listed only once, in the first table in which they appear (most frequently, Table MS 4.1). All other listings of the same objective refer back to the actions at their first occurrence.

Refer to Sections 6 and 7 Introduction for a discussion of the format of the problem statements, goals, objectives, actions, and considerations for implementation.

Table MS-3 Action Item Summary by Subwatershed: Main Stem

12-digit HUC/ Water Body	Dams	CSOs	Contamin. Sites	Sed	Nutrients	GW contam	Flooding	Habitat	Recreation	Category/Practices	Target amount by 2023	Units	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
041100020305																
Main Stem & tribs										**Dam Removal**						
Main Stem	√			√	√			√		Remove low-head dams - CF lead	**2**	Dams	1 million			
Main Stem	√			√	√			√		Remove Gorge dam - lead by Ohio EPA	**1**	Dams				
										CSO Containment/Diversion						
Main Stem watershed - Gorge		√								Containment	**105/yr reduced by 2028**	overflows reduced per yr (4 sites)				
										Contamination						
Main stem watershed			√							Determine status of DERR listed sites	**9**	sites				
Main stem watershed			√							Brownfields inventory	**1**					
Main stem			√			√				Initiate cleanup	**2**					
										Riparian Restoration						
Kelsey Cr., incised tribs Stow, MF, CF,				√	√		√	√		Restore Streambank (Bio-Engineering/ re-contouring/ re-grading)	**8,000**	Linear Feet	$25-200/lf	490	686	264
Lg properties schools, golf courses, dam pools, public				√	√		√	√		Plant Native plants, trees, or shrubs in Riparian Areas	**25**	Acres		11	150	20
Watershed, lakes								√		Remove/treat Invasive Species	**50**	Acres				
										Stream Restoration						
Kelsey Cr., other tribs				√	√		√	√		Restore Flood Plain	**8**	Acre-foot		3.5	50	7

12-digit HUC/ Water Body	Dams	CSOs	Contamin. Sites	Sed	Nutrients	GW contam	Flooding	Habitat	Recreation	Category/Practices	Target amount by 2023	Units	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
Kelsey Cr., other tribs				√	√		√	√	√	Restore Channel	4,000	Linear Feet	$100-200/lf			
Main Stem watershed	√				√			√		dam removal feasibility study	1					
										Wetland Restoration						
Main stem watershed				√	√		√	√		Reconstruct, Restore, Reconnect Wetlands	10	Acres	$5k-100k/ac.	10	280	62
										Urban runoff and green infrastructure						
MS watershed				√	√		√			Rain gardens - residential/ parks	20,000	sq feet	$500,000		2.00	0.50
MS watershed		√		√	√		√			Bioinfiltration/ permeable pavement - parking lot retrofit	10,000	sq feet	$200,000		2	0.4
MS watershed				√	√		√			Storm water inventory	1	inventory				
MS watershed				√	√					Storm water retrofits - assume 1/2 wetland, 1/2 wq inlet+sand filter	100	acres treated	$400-17k/ ac	4.5	70.1	10
MS watershed				√	√					Retrofit drainage - No-mow ditch/ grassed swale/ daylighting	1,000	linear feet - treats 4 ac		0.1	0.8	0.4
Middle Cuyahoga River watershed		√		√	√		√			Neighborhood-scale green infrastructure	1		$25-50k design $20k bumpouts	5	200	25
										Conservation Easements						
See Fig. MS3				√	√		√	√	√	Acquire Wetlands/ easements	25	Acres	$5-25k/ac	prevent 25	prevent 1,400	prevent 316
MS watershed	√	√	√	√	√	√	√	√	√	**Education and Outreach**						
										Develop Brochures/Fact Sheets	6	Brochures/ Fact Sheets				
										Watershed Festivals	10	Festivals				
										Websites	1	Website				
										Install Signs	10	Signs	$200-500/ sign			

12-digit HUC/ Water Body	Dams	CSOs	Contamin. Sites	Sed	Nutrients	GW contam	Flooding	Habitat	Recreation	Category/Practices	Target amount by 2023	Units	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
										Stream Clean-Ups	15	Clean-Ups				
										New lake/stream stewardship groups	1	new group active				
										Golf course certification outreach	4	golf courses contacted				
										Stencil Storm Drains	100					
										Conduct Workshops/ Training sessions	5	Workshops				
										Develop Manual(s)	1	Manuals				
										Rain barrel workshops	50	rain barrels				
										Develop Newsletters	10	Newsletters				
										Outreach for dams	2	Press Releases				
										Local Policy						
				√	√		√	√		Green code audit/update Develop or Customize	2	audits/ updates				
										Monitoring						
		√							√	Bacteria sampling	6	Samples				
					√			√		Chemical Sampling	3	Sites				
				√	√			√		Macroinv./Fish/QHEI Sampling	4	Sites				
										Recreation						
									√	Develop water traill	1	water trail				
									√	Construct/improve access sites - incl. 3 access sites Cuy Falls	5	site				
									√	Boardwalk/trail	8,000	lf				
									√	Economic benefit study	1	study				
									√	Develop quest(s)/ virtual watershed tour	2 quests/ 1 tour					
													Total	674	1871	518

* Contingent on Long Term Control Plan, assumes reduce all but 3 overflows/yr at each of 4 locations.

Table MS-4.1 Main Stem - Dam Removal

041100020305 and 20203 (part)

Problem Statement MS 1: Non-attainment due to dams

The 1999 Cuyahoga River TSD indicated that QHEI scores in the dam pools of the Middle Cuyahoga River ranged from 46.5 to 56 due to hydromodification and embedded substrate, and thus were in non-attainment of WWH standards. Three of the dam pools, totalling 4.7 miles, remain.

Goals ***Objectives*** Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal MS 1a Restore 4.7 miles of the Cuyahoga River to WWH habitat standards by restoring free-flowing conditions.			
MS 1a-1 Remove two low-head dams in Cuyahoga Falls, thereby restoring QHEI along 3 miles of river to WWH standards			2 dams removed by 2014
1 Hire contractor	city of Cuyahoga Falls	Contractor. Funding from NEORSD	
2 Hold informational meetings			
3 Publish brochure or web page article			
4 Monitor for changes			
MS 1a-2 Remove Ohio Edison Dam, restoring QHEI along 1.7 miles of river to WWH attainment			
		Ohio EPA/property owner lead	remove dam by 2019
1 Sediment disposal study and plan	Ohio EPA		
2 Historical investigation?			
3 Permitting			
4 Remove and dispose of sediment			
5 Hire contractor for dam removal			
6 Coordinate with downstream communities and MetroParks, Serving Summit County			
7 Publicity			
8 Remove dam			
9 Monitor for changes			

Table MS-4.2 Main Stem - CSOs
041100020305 and 20203 (part)

Problem Statement MS 2: Bacteria from CSOs or other sources.

OEPA samples and Akron modeling indicate that the Cuyahoga River within and downstream of the CSO area may not comply with recreational water criteria 5 of the 6 months of the recreational season due in part to CSO discharges. Each of the 4 CSOs in the Middle Cuyahoga typically discharges 3-49 times per year, total volume of 64.8 million gallons. OEPA monitoring also indicated single e. coli measurements of 2,600 at RM 48.38, upstream of the CSOs during higher flow.

Goals				**Amount to complete, time frame**
Objectives	Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	(contingent on funding, resources, landowner willingness)
Goal MS 2a Reduce number of combined sewer overflows by 105/year at 4 sites in the Gorge area by 2028.				
MS 2a-1 Implement Long-term control plan construction of 4 containment tanks				4 sites by 2028
	1 Design studies for tanks	City of Akron		
	2 Construct four containment facilities by 2028	City of Akron		
MS 2a-2 Conduct 5 wet-weather monitoring samples at 6 sites to document fecal coliform from other (non-point) sources.				
	1 Work with partners to establish protocol			
	2 Conduct wet-weather sampling for fecal coliform and TSS		sampling and analysis costs	
	3 Document occurrences, work with university students and USGS			
Goal MS 2b Reduce volume of water entering the storm drains in the affected area.				
MS 2b-1 Retrofit existing impervious areas to infiltrate/treat runoff from 10,000 square feet within CSO drainage area e.g., bioinfiltration, permeable pavement)				
MS 2b-2 Conduct outreach concerning reduction of storm water volume				

Table MS-4.3 Main Stem Sediment
041100020305 and -20203 (part)

Problem Statement MS 3: Sediment

Siltation has been identified as a cause of non-attainment in the Middle Cuyahoga River. Excess sediment is of concern downstream in the shipping channel and in Lake Erie, because of the nutrients that enter the water with the sediment. The STEP-L model indicates that the watershed contributes 1,342 tons of sediment from runoff and 995 tons per year from approximately 2 miles of eroding streambanks due to excess storm water and inadequate flood storage. Included in this total, approximately 3,500 linear feet of Kelsey Creek in Kennedy and Water Works Parks and Brookledge Golf Course is incised with eroding banks up to 6 feet tall. Walnut Creek in Adell Durbin Park is incised from one foot to several feet, depending on the slope. Small headwater tributaries in Munroe Falls and elsewhere are incised by one to five feet. Mapping indicates alteration of at least 451 acres of wetland (after soils mapping),loss of riparian features (floodplain access, riparian zone) of nearly 15.5 miles of streams, and alteration of 60-96% of riparian corridor within 75 feet. These figures do not reflect altered pre-existing wetlands or culverted streams in the older urban areas. The loss of beneficial watershed features reduces the flood-storage capacity and vertical stability of watershed tributaries. Potential loss of riparian vegetation with further development could result in increased loading and reduced storage in the future.

Goal *Objective*	**Actions**	**Lead/ cooperating organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal MS 3a Reduce streambank erosion, thereby reducing sedimentation by 490 tons per year.				
MS 3a-1 Stabilize 4,000 lf of Kelsey Creek banks and restore vertical stability/channel morphology thereby reducing sediment erosion by 245 tons per year.				
	1 Assemble advisory team			
	2 Assess stream segment characteristics and opportunities	City of Cuyahoga Falls	outside consultant	
	3 Develop restoration strategies based on assessment		restoration team	
	4 submit grant proposal(s)	city of CF/wc		
	5 Outreach with neighborhoods/Schnee school			
	6 Restoration work - vertical stability, banks, floodplain		$100-250/linear foot plus plantings	
	7 Encourage volunteer assistance with riparian plantings etc.	City of CF, consultant	plants, planting plan	
	8 Install signage - riparian buffer, etc.			
	9 Coordinate with neighboring communities to reduce stormwater impact, develop stewardship			
MS 3a-2 Develop master plan for Kelsey Creek				
MS 3a-3 Stabilize 4,000 lf of other eroding tributary banks, improve morphology, and restore vertical stability, thereby reducing sediment loading by 245 tons/year. Target areas: eroding streams Cuy Falls, MF, Stow, Silver Springs, Tallmadge, Kent, etc.				
	1 Identify target areas for stabilization using mapping			
	2 Work with communities, partners to determine priorities			
	3 submit grant proposal(s)			

Table MS-4.3 Main Stem Sediment
041100020305 and -20203 (part)

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
	4 Develop restoration strategies based on assessment			
5-9	Submit grant proposal, design/build, coordination, signage - see 4-8 in MS 3a-1			
Goal MS 3b Restore riparian features to reduce existing sediment loading by 24.5 tons/year.				
MS 3b-1. Plant 25 ac of deep-rooted riparian vegetation, preferably native vegetation, reducing loading of sediment by 11 tons/yr.				
Target areas: former dam pool sediments, riparian banks lacking deep-rooted vegetation				
	1 Submit grant applications e.g., OEEF	WC/SWCDs/partners		
	2 Targeted outreach to public, institutional, and other owners of large properties	WC**/SWCDs/ Communities	Lists of golf courses, lake associations, homeowners' associations; maps of large parcels; printed outreach materials.	Target 1 group every 3 years (3 by 2022); improvements to best management practices or riparian management at one site every 4 years(2 sites by 2020); 2 outreach contacts per year
	3 Outreach to golf course owners encouraging Audubon-certification		labor, printing	
	4 Assist with plantings	SWCDs, master gardeners	native plants/trees and shrubs $250 ($500-1,000 per acre);	
	5 Construct and install signage	communities, partners, volunteers (scouts?)	$300-500/sign	
	6 Follow-up outreach (individualized guide to riparian zone) and publicize		funding for handouts/brochures	
MS 3b-2 Restore 10 ac of wetland, reducing loading of sediment by 10 tons/year.				
	1 Map target areas to investigate for wetland, floodplain, riparian, habitat, or stream corridor restoration/protection/ enhancement	WC, partners	available mapping - compile and build on previous efforts	1 map by 2014, revisit and update if necessary every 3 years
	2 Hold meetings with landowners to determine interest	WC, partners		
	3 Identify wetland restoration site for clearinghouse	WC, Communities, other partners	meetings with landowners; readily available mapping, outside assistance from consultant, possible assistance from Kent State University wetland ecology class	5 concept plans by 2020; 1 every 2 years afterward.
	4 Submit grant application			
	5 Restore/protect/enhance wetlands	Partners	$5,000-$100,000 per acre, design/build consultant, sites -protection by ease- ments would be at the low end of the range	20 ac by 2022; 10 ac every 5 years afterward
MS 3b-3 Restore 8 acre-feet of floodplain access, storing 3.5 tons/yr sediment. E.g., Kelsey Cr.				

Table MS-4.3 Main Stem Sediment
041100020305 and -20203 (part)

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
	1 Map target areas to investigate for wetland, floodplain, riparian, habitat, or stream corridor restoration/protection/ enhancement	WC, partners	available mapping - compile and build on previous efforts	1 map by 2014, revisit and update if necessary every 3 years
	2 Meet with landowners to determine interest	WC, partners		
	3 Submit grant proposals			
	4 Design & Restore floodplain access/flood storage			
	5 Public outreach			
MS 3b-4 Restore 4,000 lf of incised channel, stabilizing the channels to reduce erosion				
Goal MS 3c Reduce/treat urban runoff to reduce annual loading of sediment by 4.6 tons.				
MS 3c-1 Retrofit stormwater volume devices to improve water quality from 100 acres , reducing loading of sediment by 4.5 tons/year .				
	1 Stormwater retrofit inventory		WC/NEFCO with communities	
	2 Submit grant application.			
	3 Design/construct retrofit for existing stormwater (volume) infra-structure to improve water quality	Communities	Varies, depending on treatment provided (e.g., $400/acre treated to $17,000 per acre treated)	Retrofit approx. 5 by 2022 to treat 100 ac res.
MS 3c-2 Retrofit 1,000 lf of existing drainage as no-mow grass, vegetated swale, or through daylighting to reduce sediment load by 0.1 tons/yr				
	1 Workshop on improving drainage/maintaining ditches for water quality improvements	SWCD		
	2 Install no-mow grass/retrofit			
	3 Stormwater management design manual for Portage County	Portage SWCD	In-house task	1 manual by 2014
MS 3c-3 Facilitate review and update of local codes to include measures for green infrastructure				
	1 Green code audit workshop			
	2 Review codes in two communities for green infrastructure language	partners	volunteers/consultant	
	3 update code language		possibly outside consultant/funding	1 community by 2022
MS 3c-4 Conduct workshops on use BMPs at urban sites				
	1 Stormwater management design manual for Portage County	Portage SWCD	In-house task	1 manual by 2015
	2 Workshops for community officials on developing/enforcing riparian setbacks	partners, PIPE		2 workshops by 2015; additional workshops - included in general workshop series
	3 Workshops for community officials on enforcing bmp requirements			

Table MS-4.3 Main Stem Sediment
041100020305 and -20203 (part)

Goal				Amount to complete, time frame
Objective	**Actions**	**Lead/ cooperating organizations**	**Resources needed/cost**	(contingent on funding, resources, landowner willingness)
MS 3c-5 Update, increase, and disseminate available information concerning sediment from urban runoff				
	1 Continue to compile, centralize, and make available studies, data, information sources on the watershed, including recreational opportunities, volunteer needs, permitting or regulatory issues; green infrastructure information sources, etc.	WC	Website, technical information and outreach materials	Update and develop pages for website by Dec. 2013, then on-going
	2 Chemical or biological sampling/assessment along streams - volunteer, intern, or class	Community/partner sponsors, Ohio EPA, KSU interns/classes	possibly funding for stipends, analysis, equipment	Sampling at 1 location every 3 years. 3 sample sets by 2022.
	3 Survey of yard management practices	WC/partners		
	4 Continue to develop stream database			
	5 e-newsletter or article issued 3 times per year	wc	website, share with partners	
	6 Develop/reproduce informational brochure/ website article concerning topics of interest, e.g., reducing runoff, recreational opportunties, private wells, septic systems etc.	WC, health depts, SWCDs	technical/outreach materials, possibly printing costs	10 by 2022; 1 each year
MS 3c-6 Increase/sponsor 25 stewardship activities related to non-point source pollution and watershed issues.				
	1 Establish clean-up/monitoring/planting efforts at additional tributaries and lakes	WC, communities, parks, residents, home-owners' associations, lake associations	Funding or donation of trash disposal, refresh-ments, monitoring supplies, crew leaders, volunteers; training for monitoring/planting	1 new tributary or lake monitoring, clean-up, or other stewardship program by 2018
	2 Distribute 50 rain barrels through workshops	SWCDs/ Communities	Space for workshop; rain barrel kits	50 rain barrels distributed
	3 Survey of yard management practices	WC/partners		
	4 Develop/reproduce informational brochure or website article concerning topics of interest, including reducing runoff, recreational opportunties, private wells, septic systems etc.	WC, health depts, SWCDs	technical/outreach materials, possibly printing costs	10 by 2022; 1 each year
	5 Educational outreach workshops on topics of importance, including LID/green infrastructure, restoration, field trips for examples	Partners, WC, communities	Location, speaker, supplies	5 workshops by 2022; 1 every 2 years
	6 Work with schools or city day camps to develop/encourage use of watershed care activities/curricular items	WC, SWCDs, partners, schools		1 educational outreach program/curriculum item by 2018
	7 Breakneck Creek Day (others?)	Portage Parks, partners		1 per year
	8 Watershed "brand," logo, art project	WC, Kent State/ Standing Rock Gallery/River Day communities	Host for project, graphic design capabilities	1 logo or art project by 2015, 1 every 3 years after;
	9 Create social network or google presence	WC		1 by 2014

Table MS-4.3 Main Stem Sediment
041100020305 and -20203 (part)

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
MCR-1 Establish 1 neighborhood-scale green infrastructure projects as demonstration within the developed areas of one of the Middle Cuyahoga River subwatersheds, where suitable neighborhoods are identified, reducing loading of nitrogen by 200 lb/year, phosphorous by 25 lb/yr, and sediment by 5 tons/yr				
	1 Work with communities to identify suitable target neighborhoods	WC, partners		
	2 Workshops/meetings to gauge neighborhood support			
	3 Determine/establish maintenance framework (e.g., easements, homeowner participation)	partner community		
	4 Get grant(s)			
	5 Design/build	outside consultant	Site, outside funding. Design ~$25-50,000; Rain gardens $15-20/sq. foot; Green street bump-outs $20,000 each; per-meable concrete $12-15/ sq. ft	1 project by 2022
	6 Outreach, neighborhood participation			
Goal MS 3d Reduce causes of streambank erosion by reducing channel loading/increasing flood storage by 360,980 cu ft. in a 3/4 in storm.				
MS 3d-1 Increase coordination between communities to reduce stormwater effects				
	1 Coordinate with nearby communities/schools to identify areas of concern or opportunity			2 meetings/yr
	3 Coordinated stormwater study on target areas??		outside funding or assistance	
	2 Workshops with public officials to address shared stormwater concerns			2 workshops
MS 3d-2 Install biofiltration at developed sites totaling 20,000 square feet and reducing runoff by 3,750 cubic feet in a 3/4-inch storm. Target gorge area, other urban				
	1 Identify parcel(s) and landowner(s) for project	partners, WC		
	2 Grants	WC/partners		
	3 Design/construct BMPs	outside consultant		
MS 3d-3 Restore 10 ac of wetland, reducing channel loading by 6,600 cu ft in a 3/4 in event.				
	Actions: See MS 3b-2			
MS 3d-4 Restore 8 acre-feet of floodplain access, increasing storage volume by 348,480 cu ft.				
	Actions: See MS 3b-3			
MS 3d-5 Install 20,000 square feet of rain gardens, to reducing channel loading by 3750 cu ft in a 3/4 in storm				
	1 Identify partners	WC, partners		
	2 Submit grant application	WC/partners		
	3 Workshop/installation	WC/partners		

Table MS-4.3 Main Stem Sediment
041100020305 and -20203 (part)

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
MS 3d-6 Facilitate installation of 50 rain barrels, thereby reducing stream channel loading by 275 cu ft in a 3/4-inch storm.				
	1 Submit grant proposal/seek community funding			
	2 Obtain rain barrel materials		barrels, plumbing e.g., $40 per barrel setup	
	4 Workshop			2 workshops
	5 Outreach			
Goal MS 3-e Protect wetlands and beneficial watershed features to reduce future loading of sediment by 31 tons/yr				
MS 3e-1 Protect 8,000 linear feet of riparian buffer by increasing the use and effectiveness of riparian setbacks, reducing loading of sediment by 6 tons/yr				
	1 Workshops for community officials on developing/enforcing riparian setbacks	partners, PIPE		2 workshops by 2015; additional workshops - included in general workshop series
	2 Comment on wetland alteration permit applications concerning impacts to watershed functions/riparian setbacks	WC and partners		on-going
	3 Increase the number of communities using riparian setbacks	WC, communities, Counties	Outreach	1 additional community with riparian setbacks by 2022
	4 Install signage for riparian areas in publicly visible places	Partners	$200-$500 per sign. Outside funding or community sign facility	Signs at 2 locations by 2022; signs at 1 additional location every 5 years afterward
	5 Continued outreach	Partners		brochure, workshops on enforcement, outreach to homeowners etc.
MS 3e-2 Protect 25 acres of wetlands through acquisition of land/easements, preventing increased loading of sediment by 25 tons /yr ***Target areas: remaining wetlands in NE Tallmadge, upstream end of Kelsey Creek, other remaining wetlands***				
	1 Mapping			
	2 Contact landowners/partner land trusts			
	3 Submit grant proposal			
	4 Acquire wetlands/easements			

Table MS 4.4 Main Stem Nitrogen
041100020305, -20203 (part)

Problem Statement MS 4: Nitrogen

Middle Cuyahoga River nitrate+nitrogen levels measured in 2007 range from 0.9 to 6 mg/l, often exceeding the EOLP median (1.0 mg/l) and the state guidelines (1.5 mg/l). The STEP-L model indicates that the watershed contributes 53,882 lb of nitrogen from runoff and 1,354 lb per year from approximately 2 miles of eroding streambanks due to excess stormwater and and inadequate flood storage. Included in this total, approx. 3,500 linear feet of Kelsey Cr. in Kennedy Park, Water Works Park, and Brookledge Golf Course is incised with eroding banks up to 6 feet tall. Walnut Creek in Adell Durbin Park is incised from one foot to several feet, depending on the slope. Small headwater tributaries in Munroe Falls and other areas are incised by one to five feet. Mapping indicates alteration of at least 451 acres of wetland (after soils mapping), loss of riparian features (floodplain access, riparian zone) of nearly 15.5 miles of streams, and alteration of 60-96% of riparian corridor within 75 feet. These figures do not reflect altered pre-existing wetlands or culverted streams in the older urban areas. The loss of The loss of beneficial watershed features reduces the natural uptake/denitrification of nitrogen, as well as the flood-storage capacity and vertical stability of watershed tributaries, which contributes to bank erosion and associated nitrogen loading.

Loss of riparian vegetation with further development would result in increased loading and reduced storage in the future.

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Goal MS 4a Reduce streambank erosion, thereby reducing nitrogen loading by 668 lb per year.				
MS 4a-1 Stabilize 4,000 lf of Kelsey Creek banks and restore vertical stability/channel morphology thereby reducing nitrogen loading by 334 lb/yr.				
	Actions: See MS 3a-1			
MS 4a-2 Develop master plan for Kelsey Creek				
MS 4a-3 Stabilize 4,000 lf of other eroding tributary banks, improve morphology, and restore vertical stability, thereby reducing nitrogen loading by 334 lb/year.	Target areas: eroding streams Cuy. Falls, MF, Stow, Silver Springs, Tallmadge, etc.			
	Actions: See MS 3a-3			
MS 4a-4 Restore 4,000 lf of incised channel, improving vertical stability and reducing streambank erosion.				
Goal MS 4b Restore/improve riparian/channel features to reduce existing nitrogen loading by 530 lb/year.				
MS 4b-1. Plant 25 ac of deep-rooted riparian vegetation, reducing loading of nitrogen by 200 lb/yr.				
	Actions: See MS 3b-1			
MS 4b-2 Restore 10 ac of wetland, reducing loading of nitrogen by 280 lb/year.				
	Actions: See MS 3b-2			
MS 4b-3 Restore 8 acre-feet of floodplain access, storing 50 lb/yr nitrogen. E.g., Kelsey Cr., other incised/channelized streams				
	Actions: See MS 3b-3			
Goal MS 4c Reduce NPS pollution from urban runoff to reduce annual loading of nitrogen by 76.8 lb/yr.				
MS 4c-1 Retrofit stormwater volume devices treating 100 acres to improve water quality, reducing loading of nitrogen by 70 lb/yr.				
	Actions: See MS 3c-1			
MS 4c-2 Retrofit 1,000 lf of existing drainage with no-mow grass, vegetated swale, or daylighting to reduce nitrogen load by 0.8 lb/yr				
	Actions: See MS 3c-2.			
MS 4c-3 Retrofit 20,000 sq ft of developed sites with bioinfiltration/permeable pavement to reduce nitrogen by 4 lb/yr				
	Actions: See MS 3d-2.			
MS 4c-4 Install 20,000 square feet of rain gardens to reduce nitrogen by 2 lb/yr				

Table MS 4.5 - Main Stem Phosphorous
041100020305, -20203 (part)

Problem Statement MS 5: phosphorous

Ohio EPA documents note large diurnal swings in dissolved oxygen and appearance of algae, indicating nutrient enrichment, and phosphorous is the limiting nutrient. Phosphorous levels range from 0.04 to 0.46 mg/l in the Middle Cuyahoga, occasionally exceeding EOLP and state guidelines especially after a rain event. The STEP-L model indicates that the watershed contributes 9,391 pounds/year of phosphorous from runoff and 2 miles of eroding streambanks due to excess storm water and inadequate flood storage. Included in this total, approx. 3,500 linear feet of Kelsey Cr. in Kennedy and Water Works Park, and Brookledge Golf Course is incised with eroding banks up to 6 feet tall. Walnut Creek in Adell Durbin Park is incised from one foot to several feet. Small headwater tributaries throughout the subwatershed are incised by one to five feet. Mapping indicates alteration of at least 451 acres of wetland (after soils mapping), loss of riparian features (floodplain access, riparian zone) of nearly 15.5 miles of streams, and alteration of 60-96% of riparian corridor within 75 feet. These figures do not reflect altered pre-existing wetlands or culverted streams in the older urban areas. The loss of beneficial watershed features reduces the flood-storage capacity and vertical stability of watershedtributaries. Potential loss of riparian vegetation with further development could result in increased loading and reduced storage in the future.

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Goal MS 5a Reduce streambank erosion, thereby reducing phosphorous loading by 264 lb per year.				
MS 5a-1 Stabilize 4,000 lf of Kelsey Creek banks and restore vertical stability/channel morphology thereby reducing phosphorous loading by 132 lb/yr.				
	Actions: See MS 3a-1			
MS 5a-2 Develop master plan for Kelsey Creek				
MS 5a-3 Stabilize 4,000 lf of other eroding tributary banks, improve morphology, and restore vertical stability, thereby reducing phosphorous loading by 132 lb/year.	Target areas: eroding streams Cuy. Falls, MF, Stow, Silver Springs, Tallmadge, etc.			
	Actions: See MS 3a-3			
MS 5a-4 Restore 4,000 lf of incised channel, improving vertical stability and reducing streambank erosion.				
Goal MS 5b Restore/improve riparian features to reduce existing phosphorous loading by 104 lb/year.				
MS 5b-1. Plant 25 ac of deep-rooted riparian vegetation, preferably native vegetation, reducing loading of phosphorous by 35 lb/yr.				
	Actions: See MS 3b-1			
MS 5b-2 Restore 10 ac of wetland, reducing loading of phosphorous by 62 lb/year.				
	Actions: See MS 3b-2			
MS 5b-3 Restore 8 acre-feet of floodplain access, storing 7 lb /yr phosphorous. E.g., Kelsey Cr., other incised/channelized streams				
	Actions: See MS 3b-3			
Goal MS 5c Reduce NPS pollution from urban runoff to reduce annual loading of phosphorous by 11.9 lb/yr.				
MS 5c-1 Retrofit stormwater volume devices treating 100 acres to improve water quality, reducing loading of nitrogen by 10 lb/yr.				
	Actions: See MS 3c-1			
MS 5c-2 Retrofit 1,000 lf of drainage with no-mow grass, vegetated swale, or daylighting to reduce phosphorous load by 0.4 lb/yr				
	Actions: See MS 3c-2.			
MS 5c-3 Retrofit 20,000 sq ft of developed sites with bioinfiltration/permeable pavement to reduce phosphorous by 0.9 lb/yr				
	Actions: See MS 3d-2.			

Table MS 4.5 - Main Stem Phosphorous
041100020305, -20203 (part)

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
MS 5c-4 Install 20,000 square feet of rain gardens to reduce phosphorous by 0.6 lb/yr				
	Actions: See MS 3d-5.			
MS 5c-5 Facilitate review and update of local codes to include measures for green infrastructure				
	Actions: See MS 3c-3.			
MS 5c-6 Conduct workshops on use BMPs at urban sites				
	Actions: See MS 3c-4.			
MS 5c-7 Update, increase, and disseminate available information concerning pollutants from urban runoff				
	Actions: See MS 3c-5.			
MS 5c-8 Increase/sponsor 25 stewardship activities related to non-point source pollution and watershed issues.				
	Actions: See MS 3c-6.			
MCR-1 Establish 1 neighborhood-scale green infrastructure projects as demonstration within the developed areas of one of the Middle Cuyahoga River subwatersheds, where suitable neighborhoods are identified, reducing loading of phosphorous by 25 lb/yr.				
Goal MS 5d Reduce causes of streambank erosion by reducing channel loading by 360,980 cu ft in a 3/4 inch storm.				
MS 5d-1 Increase coordination between communities to reduce stormwater effects				
	Actions: See MS 3d-1			
MS 5d-2 Install biofiltration at developed sites totaling 20,000 square feet and reducing runoff by 3,750 cubic feet in a 3/4-inch storm. Target gorge area, other urban				
	Actions: See MS 3d-2			
MS 5d-3 Restore 10 ac of wetland, reducing channel loading by 6,600 cu ft in a 3/4 in event.				
	Actions: See MS 3b-2			
MS 5d-4 Restore 8 acre-feet of floodplain access, increasing storage volume by 348,480 cu ft.				
	Actions: See MS 3b-3			
MS 5d-5 Install 20,000 square feet of rain gardens, to reducing channel loading by 3750 cu ft in a 3/4 in storm				
	Actions: See MS 3d-5.			
MS 5d-6 Facilitate installation of 50 rain barrels, thereby reducing stream channel loading by 275 cu ft in a 3/4-inch storm.				
	Actions: See MS 3d-6			
MS 5d-7 Increase stewardship and understanding of watershed protection				
	Actions: See MS 3c-5, 3c-6			
Goal MS 5-e Protect wetlands and beneficial watershed features to reduce future loading of phosphorous by 172 lb/yr				
MS 5e-1 Protect 8,000 linear feet of riparian buffer by increasing the use and effectiveness of riparian setbacks, reducing loading of phosphorous by 14 lb/yr				
	Actions: See MS 3e-1.			
MS 5e-2 Protect/enhance 25 acres of wetlands, preventing additional phosphorous loading of 158 lb/yr. ***Target areas: remaining wetlands in NE Tallmadge, upstream end of Kelsey Creek, other remaining wetlands***				
	Actions: See MS 3e-2			

Table MS 4.4 Main Stem Nitrogen
041100020305, -20203 (part)

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
	Actions: See MS 3d-5.			
MS 4c-5 Facilitate review and update of local codes to include measures for green infrastructure				
	Actions: See MS 3c-3.			
MS 4c-6 Conduct workshops on use BMPs at urban sites				
	Actions: See MS 3c-4.			
MS 4c-7 Update, increase, and disseminate available information concerning sediment from urban runoff				
	Actions: See MS 3c-5.			
MS 4c-8 Increase/sponsor 25 stewardship activities related to non-point source pollution and watershed issues.				
	Actions: See MS 3c-6.			
MCR-1 Establish 1 neighborhood-scale green infrastructure projects as demonstration within the developed areas of one of the Middle Cuyahoga River subwatersheds, where suitable neighborhoods are identified, reducing loading of nitrogen by 200 lb/year, phosphorous by 25 lb/yr, and nitrogen by 5 lb/yr				
	Actions: See MS 3a-1			
Goal MS 4d Reduce causes of streambank erosion by reducing channel loading by 360,980 cu ft in a 3/4 inch storm.				
MS 4d-1 Increase coordination between communities to reduce stormwater effects				
	Actions: See MS 3d-1			
MS 4d-2 Install biofiltration at developed sites totaling 20,000 square feet and reducing runoff by 3,750 cubic feet in a 3/4-inch storm. Target gorge area, other urban				
	Actions: See MS 3d-2			
MS 4d-3 Restore 10 ac of wetland, reducing channel loading by 6,600 cu ft in a 3/4 in event.				
	Actions: See MS 3b-2			
MS 4d-4 Restore 8 acre-feet of floodplain access, increasing storage volume by 348,480 cu ft.				
	Actions: See MS 3b-3			
MS 4d-5 Install 20,000 square feet of rain gardens, to reducing channel loading by 3750 cu ft in a 3/4 in storm				
	Actions: See MS 3d-5.			
MS 4d-6 Facilitate installation of 50 rain barrels, thereby reducing stream channel loading by 275 cu ft in a 3/4-inch storm.				
	Actions: See MS 3d-6			
MS 4d-7 Increase stewardship and understanding of watershed protection				
	Actions: See MS 3c-5, 3c-6			
Goal MS 4-e Protect wetlands and beneficial watershed features to reduce future loading of nitrogen by 1,480 lb/yr				
MS 4e-1 Protect 8,000 linear feet of riparian buffer by increasing the use and effectiveness of riparian setbacks, reducing loading of nitrogen by 80 lb/yr				
	Actions: See MS 3e-1.			
MS 4e-2 Protect 25 acres of wetlands through acquisition of land/easements, preventing increased loading of nitrogen by 1400 lb/yr Target areas: remaining wetlands in NE Tallmadge, upstream end of Kelsey Creek, other remaining wetlands				
	Actions: See MS 3e-2.			

Table MS 4.6 Main Stem Groundwater/Contamination
041100020305, -20203

Problem Statement MS-6: Groundwater, Public Water Supplies

The subwatershed contains the Cuyahoga Falls public water supply, a groundwater supply recharged by surface water and susceptible to contamination from surface spills and leaks to groundwater. The City of Cuyahoga Falls has developed a source water protection plan and owns approximately one-third of the five-year zone of contribution. However, the 5-year zone of influence is partially privately owned and controlled, and the wellfield is recharged by the Cuyahoga River, susceptible to spills.

Goals ***Objectives*** Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal MS 6a Reduce risks of groundwater contamination from fracking or other releases from existing sites.			
MS 6a-1 Determine status of 9 DERR listed sites			
Coordinate with Ohio EPA to determine status of nearby DERR site.			
MS 6a-2 Increase awareness of potential hazards and protective measures associated with fracking			
1 Coordinate with state agencies and communities concerning fracking and controls			
2 Coordinate with state agencies to receive notification of drilling permit requests			
2 Outreach to communities and property owners - website, brochures, etc.			
Goal MS 6b Reduce risks of groundwater contamination from land use or spills.			
MS 6b-1 Provide public and agency outreach efforts to assist with implementation of 2 source water protection plans			
1 Coordinate with water suppliers concerning outreach/education needs			
2 Apply for funding as needed for printing/outreach			
3 Develop and disseminate outreach materials - written, website			
MS 6b-2 Update, increase, and disseminate available information concerning watershed protection			
Actions: See MS 3c-9			
MS 6b-3 Increase/sponsor 25 stewardship activities related to non-point source pollution and watershed issues.			
Actions: See MS 3c-10			

Table MS 4.7 Main Stem Flooding Problems

041100020305. 20203 (part)

Problem Statement MS 7: Flooding/overloaded channels

While flooding is not an extensive problem in this subwatershed, excess water volume and alteration of floodplains and wetlands is causing problems locally and downstream in the Cuyahoga River. Local flooding has been noted at the headwaters, where wetlands and floodplains have been altered by residential development, as shown on Figure MS-2. Downstream in the lower Cuyahoga watershed, neighborhoods are experiencing repeated flooding, roads are threatened or washed out during extreme events, and steep banks of the Cuyahoga River in the National Park are eroding, threatening the historic/recreational towpath trail and scenic railroad. The local bank erosion has been noted under Problem Statement MS-3. The subwatershed is nearly 26% impervious, generating an additional 1 million cubic feet in a 3/4-inch storm compared to an undeveloped watershed. Mapping indicates alteration of at least 451 acres of wetland (after soils mapping), loss of riparian features (floodplain access, riparian zone) along nearly 15.5 miles of streams, and alteration of 60-96% of riparian corridor within 75 feet. These figures do not reflect altered pre-existing wetlands or culverted streams in the older urban areas. The loss of beneficial watershed features reduces the flood-storage capacity and vertical stability of watershed tributaries. Loss of riparian vegetation with further development could result in increased loading and reduced storage in the future.

Goal *Objective*	**Actions**	**Lead/ cooperating organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal MS 7a Address flooding problems in one area by restoring altered watershed hydrology/watershed characteristics				
MS 7a-1 Conduct 1 stormwater management study focusing on flooding problem area to identify potential landscape restoration opportunities that will reduce problem flooding.				
	1 Develop detailed maps for areas of interest identifying topography, existing and altered wetlands, drainage, and imperviousness.			
	2 Conduct engineering study	partner community	Outside funding for consultant	
	3 Outreach with neighborhoods to discuss feasible approaches			
	4 Submit grant proposal	wc/city or county staff		
	5 Construct improvements		outside consultant	
Goal MS 7b Reduce channel loading or increasing storage by 360,980 cu ft in a 3/4 in storm.				
MS 7b-1 Increase coordination between communities to reduce stormwater effects				
	Actions: See MS 3d-1			
MS 7b-2 Install biofiltration at developed sites totaling 20,000 square feet and reducing runoff by 3,750 cubic feet in a 3/4-inch storm. Target gorge area, other urban				
	Actions: See MS 3d-2			
MS 7b-3 Restore 10 ac of wetland, reducing channel loading by 6,600 cu ft in a 3/4 in event.				
	Actions: See MS 3b-2			
MS 7b-4 Restore 8 acre-feet of floodplain access, increasing storage volume by 348,480 cu ft.				
	Actions: See MS 3b-3			
MS 7b-5 Install 20,000 square feet of rain gardens, to reducing channel loading by 3750 cu ft in a 3/4 in storm				
	Actions: See MS 3d-5.			
MS 7b-6 Facilitate installation of 50 rain barrels, thereby reducing stream channel loading by 275 cu ft in a 3/4-inch storm.				
	Actions: See MS 3d-6			
MS 7b-7 Restore 4,000 lf of incised channel, improving vertical stability and reducing streambank erosion.				
MS 7b-8 Increase stewardship and understanding of watershed protection				

Table MS 4.7 Main Stem Flooding Problems
041100020305, 20203 (part)

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
	Actions: See MS 3c-5, 3c-6			
MCR-1 Establish 1 neighborhood-scale green infrastructure projects as demonstration within the developed areas of one of the Middle Cuyahoga River subwatersheds, where suitable neighborhoods are identified, reducing loading of phosphorous by 25 lb/yr.				
Goal MS-7c Protect wetlands and beneficial watershed features to reduce future channel loading by 26,400 cu ft in a 3/4 in storm				
MS 7e-1 Protect 8,000 linear feet of riparian buffer by increasing the use and effectiveness of riparian setbacks, reducing channel loading by 9,900 cu ft in a 3/4 in storm.				
	Actions: See MS 3e-1.			
MS 7e-2 Protect 25 acres of wetlands through acquisition of land/easements, preventing increased channel loading by 16,500 cu ft /yr ***Target areas: remaining wetlands in NE Tallmadge, upstream end of Kelsey Creek, other remaining wetlands***				
	Actions: See MS 3e-2			

Table MS-8 Main Stem Habitat - Incised
041100020305. 20203 (part)

Problem Statement MS 8: Habitat - Incised Channels

Approximately 4.9 miles of stream channel are incised due to excessive runoff, lack of riparian vegetation, and low-head dam removal. The QHEI analysis for 1800 lf of Kelsey Creek in Kennedy Park (Cuy. Falls) results in a score of 53.5 or "fair." The habitat is affected by unstable form and substrate, reduced pools, lack of riparian features. The QHEI analysis indicates the stream will continue to degrade without stabilization. The remaining incised streams (4.5 miles) present similar characteristics but with less severe downcutting.

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Goal MS 8a Restore stable form, floodplain access, and vegetated riparian corridor along 2,000 lf of Kelsey Creek, raising QHEI by 5 points to 58.5 in Kennedy Park.				
MS 8a-1 Re-establish floodplain access on 2 banks of Kelsey Creek along 1,000 lf of channel in Kennedy Park.				
	Actions: See MS 3a-1			
MS 8a-2 Replace 1.5 acres of riparian lawn with native shrubs, trees, and wet meadow along Kelsey Creek.				
MS 8-3 Re-establish floodplain access along 1,000 lf of channel in Brookledge Golf Course.				
Goal MS 8b Improve habitat along 2,000 lf of other eroding tributaries.				
MS 8b-1 Stabilize tributary banks along 1,000 lf of other eroding tributaries, improve morphology, and restore vertical stability				
	Target areas: eroding streams MF, Stow, Silver Springs, Tallmadge, etc.			
	Actions: See MS 3a-2			
MS 8b-1 Plant deep-rooted riparian vegetation along 23.5 ac of other eroding tributaries and former dam pool sediment.				
	Target areas: eroding streams MF, Stow, Silver Springs, Tallmadge, etc.			
	Actions: See MS 3b-2			
Goal MS 8c Reduce causes of streambank erosion by reducing channel loading by 360,980 cu ft in a 3/4 inch storm.				
MS 8c-1 Increase coordination between communities to reduce stormwater effects				
	Actions: See MS 3d-1			
MS 8c-2 Install biofiltration at developed sites totaling 20,000 square feet and reducing runoff by 3,750 cubic feet in a 3/4-inch storm. Target gorge area, other urban				
	Actions: See MS 3d-2			
MS 8c-3 Restore 10 ac of wetland, reducing channel loading by 6,600 cu ft in a 3/4 in event.				
	Actions: See MS 3b-2			
MS 8c-4 Restore 8 acre-feet of floodplain access, increasing storage volume by 348,480 cu ft.				
	Actions: See MS 3b-3			
MS 8c-5 Install 20,000 square feet of rain gardens, to reducing channel loading by 3750 cu ft in a 3/4 in storm				
	Actions: See MS 3d-5.			
MS 8c-6 Facilitate installation of 50 rain barrels, thereby reducing stream channel loading by 275 cu ft in a 3/4-inch storm.				
	Actions: See MS 3d-6			
MS 8c-7 Increase stewardship and understanding of watershed protection				
	Actions: See MS 3c-5, 3c-6			
MCR-1 Establish 1 neighborhood-scale green infrastructure projects as demonstration within the developed areas of one of the Middle Cuyahoga River subwatersheds, where suitable neighborhoods are identified, reducing loading of nitrogen by 200 lb/year, phosphorous by 25 lb/yr, and sediment by 5 tons/yr				

Table MS-9 Main Stem Habitat Alterations
041100020305. 20203 (part)

Problem Statement MS 9: Habitat Impacts due to Altered Riparian Characteristics

Riparian habitat has been degraded throughout the subwatershed by development, bank erosion/siltation due to overloaded channels, and alteration of watershed features such as riparian zones, floodplains, and wetlands. Mapping indicates alteration of at least 451 acres of wetland (after soils mapping), loss of riparian features (floodplain access, riparian zone) along nearly 11 miles of streams, and alteration of 60-96% of riparian corridor within 75 feet. These figures do not reflect altered pre-existing wetlands or culverted streams in the older urban areas. Further development could encroach on/fragment remaining riparian vegetation, wetlands, or connected habitat complexes, especially where riparian setbacks are lacking. Removal of three dams will restore river habitat, but the newly exposed dam pool sediments will lack forest cover. Removal of the Kelsey Creek dam left 1 acre of sparsely vegetated dam pool sediment. Former dam pool sediments along the river are growing in slowly with woody vegetation.

Goal ***Objective***	**Actions**	**Lead/ cooperating organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal MS 9a Restore 3 miles of riverine habitat and associated riparian vegetation				
MS 9a-1 Remove two low-head dams in Cuyahoga Falls		City of Cuyahoga Falls		
	Actions: See MS 1a-1			
MS 9a-2 Coordinate with partners and community to assist as appropriate with removal of Ohio Edison Dam				
	Actions: See MS 1a-2			
Goal MS 9b Improve habitat by restoring 53 acres of altered watershed hydrology/watershed characteristics				
MS 9b-1 Plant 25 ac of deep-rooted native riparian vegetation along former dam pool margins/sediments and unvegetated tributary banks.				
	Actions: See MS 3b-1			
MS 9b-2 Restore/enhance 10 ac of wetland.				
	Actions: See MS 3b-2			
MS 9b-3 Restore 8 acre-feet of floodplain access.				
	Actions: See MS 3b-3			
MS 9b-4 Treat/remove 10 acres of invasive species				
MS 9b-5 Conduct dam removal feasibility for small low-head dams				
Goal MS 9c Protect 40 ac wetlands and beneficial watershed features *target - remaining intact systems, areas providing multiple ecological benefit, habitat connectivity*				
MS 9c-1 Protect 8,000 linear feet of riparian buffer by increasing the use and effectiveness of riparian setbacks.				
	Actions: See MS 3e-1.			
MS 9c-2 Protect/enhance 25 acres of intact wetlands. Target areas: remaining wetlands in NE Tallmadge, upstream end of Kelsey Creek, other remaining wetlands				
	Actions: See MS 3e-2			

Table MS 4.10 Main Stem Recreational Opportunities
041100020305, 20203

Problem Statement MS-10: Recreational Opportunities

The Cuyahoga River is designated a category A recreational water. Recreational opportunities and use are increasing along the river, with the addition of the new canoe livery in Kent. Local communities and MetroParks offer several parks along the river and tributaries, providing an opportunity for stewardship, linked parks, and additional conservation. Cuyahoga River partners are working toward designating the Cuyahoga River a water trail, with maintained access points. The Gorge offers extreme rapids for kayakers, and could grow as a destination with the removal of the two low-head dams and the Ohio Edison dam. Several detriments to recreational use still remain.

CSOs in the Gorge present health risks. Debris remains in the river, posing hazards for boating or wading. After heavy rains, high levels of bacteria have been found upstream of the CSO discharge area from an undetermined source. Access for pullouts is limited in the Gorge, and there is limited direct access to the river along much of its length.

There is no centralized source of information concerning recreational opportunities along the river and tributaries.

Goal				**Amount to complete, time frame**
Objective	**Actions**	**Lead/ cooperating organizations**	**Resources needed/cost**	(contingent on funding, resources, landowner willingness)
Goal MS 10a Increase safety for recreational users				
MS 10a-1 Conduct 15 river/riverbank clean-ups to remove debris fro		partners (KSU, Kent, Cuy. Falls, WC, Summit Co. etc.)		
	1 Continue coordination with river community partners			
	2 Seek funds (grants, donations, budgets) for refreshments, materials, waste disposal			
	3 Conduct spring (River Day) and fall cleanups on approximately annual basis			
MS 10a-2 Conduct 3 clean-ups at additional tributaries or lakes.				
	1 Outreach with neighborhoods, lake associations			
	2 Seek funds (grants, donations, budgets) for refreshments, materials, waste disposal			
	3 Clean-up events			
MS 10a-3 Monitor the river for e. coli following six rain storms at canoe launch/pull-out areas..				
	1 Coordinate sampling/assessment with local WWTPs			
	2 Monitor following six rain events			
	3 Coordinate results with communities/Ohio EPA.			
	4 Identify likely hot spots or sources			
	4 Develop outreach for website			
Goal MS 10b Increase/improve recreational opportunities related to the Cuyahoga River and Main Stem tributaries.				
MS 10b-1 Construct 3 miles of boardwalk/trail to/along the Cuyahoga River or its tributaries				
MS 10b-3 Plan additional bike-hike/greenway link				
	1 Identify potential locations to connect parks/tributaries			

Table MS 4.10 Main Stem Recreational Opportunities
041100020305, 20203

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
	2 Hold meetings to determine feasibility			
	3 Submit grant proposal			
	4 Develop conceptual design for links			
MS 10b-3 Increase/improve access points along Cuyahoga River or tributary by 3 publicly accessible location				
	1 Submit grant proposal			
	2 Work with communities and water trail partners to design appropriate access			
	3 Construct access points and related facilities (e.g., parking, signs, etc.) as appropriate			
MS 10b-4 Develop 2 quests or 1 virtual watershed tour				
	1 Determine appropriate River Quest structure (cuyahoga canalway or new one)	WC, partners, volunteers, parks	Permission to develop quests, printing costs	2 quests by 2017 or 1 watershed tour by 2017
	2 Public workshop concerning River quests			1 workshop by 2014
	3 Seek quests from volunteer groups	WC, partners, volunteers, parks	reviewers, outreach	
	4 Review, print, distribute		funding for printing, place on website	
Goal MS 10c: Increase awareness of recreational opportunities, stewardship, and watershed issues.				
MS 10c-1. Economic impact study recreational uses		WC with KSU	outside funding	1 study by 2018
	1 Coordinate with KSU and others on study			
	2 Submit grant proposal			
	3 Conduct study			
	4 Publicize			
MS 10c-2. Increase signage related to watershed at local parks.				
	1 apply for funding			
	2 Design, install signs			
	3 Continued outreach with local communities			
MS 10c-3 Update, increase, and disseminate available information concerning recreational opportunities and care of Cuyahoga River, its tributaries, and watershed.				
	1 Web page of recreational opportunities/access	wc		
	2 Monitor 8 wet-weather events for coliform in river	wc, partner with WWTP		
	3 Other Actions - see MS 3c-9			
MS 10c-4. Increase stewardship activities related to watershed issues				
	1 Annual river/tributary/lake clean-ups			
	Actions - See MS 10a-1, 9a-2			
	2 Additional stewardship activities - see MS 3c-10			

7-Fi Fish Creek

HUC 041100020305 (part)

1 Summary of Conditions

Table Fi 1 summarizes some of the key characteristics of this subwatershed. Table Fi 2 presents a summary of identified impairments, causes, and sources. Figure Fi 1 presents an index map showing the subwatershed and jurisdictions. Figures Fi 2 and 3 have been compiled from mapping in Volume I and show potential areas of concern and resource areas for protection. (Greater detail is shown in the various maps in Vol. I.) Also see photos in Section 4P, Fish Creek.

The primary concerns focus on addressing the effects on water quality and flooding from non-point source pollution and the altered, urbanized landscape – impervious surfaces and altered riparian corridors, channels, floodplains, and wetlands. The problem statements in Tables Fi-4.1 through Fi-4.6) address individual problems related to these broader concerns and may overlap. For instance, urban runoff, septic system failure, and agricultural runoff all contribute to the problems of nitrogen and phosphorous enrichment in Fish Creek and the Cuyahoga River.

Water Quality Assessment and Attainment *(Refer to Problem Statements Fi 1, 2, and 3, Tables Fi 4.1 through 4.3)*

Fish Creek was briefly described in the 2000 TMDL, using data from 1997 and 2000. Fish Creek chemistry was monitored during the 2007 re-assessment of the Middle Cuyahoga River. Upstream of RM 1.3, Fish Creek has been re-designated MWH-C to reflect the channelized nature of the creek and was in attainment of MWH-C standards when assessed. The lower portion of Fish Creek was in non-attainment of WWH standards due to degraded fish populations rather than habitat limitations. Fish Creek has shown slightly elevated levels of phosphorous relative to EOLP targets. Causes and sources contributing to non-attainment in the lower portion of Fish Creek include non-point source pollution from urban and agricultural sources.

With the removal of the Munroe Falls dam, the base level of Fish Creek has dropped; and it remains to be seen if the steeper slope and more rapid flow in the lower portion of the creek will result in improvements to bioassessment scores. However, the highly altered channel, riparian, and watershed conditions in the upper watershed do little to reduce the large loads of incoming pollutants, and may have adverse effects downstream.

Nonpoint source pollution – Nutrients (nitrogen, phosphorous) *(Refer to Problem Statements Fi-1, 2, and 3, Tables Fi 4.1 through 3)*

Fish Creek and the Cuyahoga River are somewhat enriched in nutrients. Limited water chemistry data indicate several instances when state median or criteria values were exceeded for phosphorous or nitrogen. Because higher values often coincide with increased flows (apparently post-storm), runoff is likely a contributing factor.

The STEPL model indicates that the Fish Creek watershed contributes 30,766 pounds per year of nitrogen, 5,810 lb per year of phosphorous, and 895 tons per year of sediment from a combination of urban, rural residential, and agricultural sources, eroding stream banks, and septic systems.

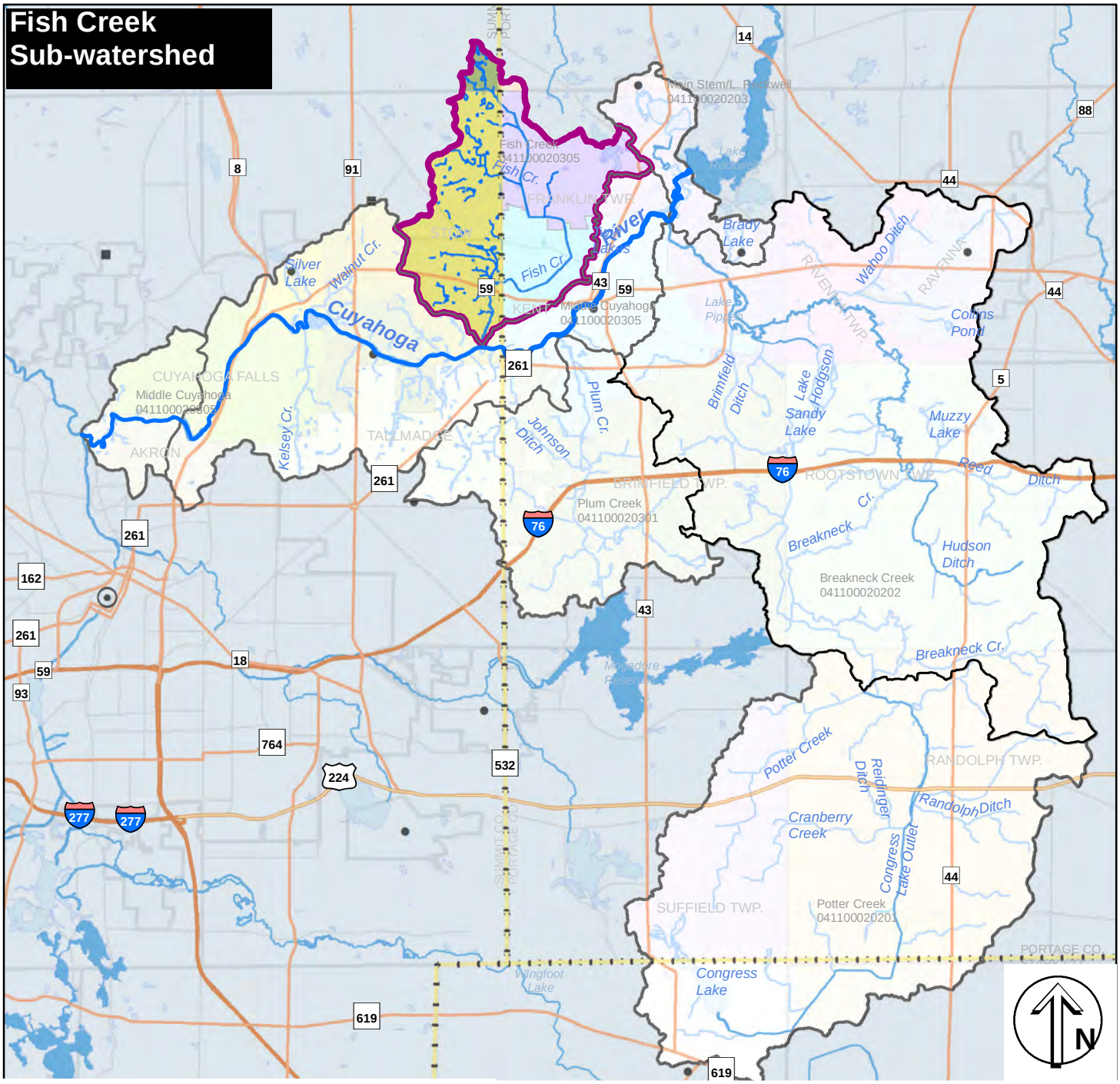


Figure Fi-1
Subwatershed Jurisdictions

- Streams and Rivers
- Lakes
- Fish Creek Subwatershed
  12-Digit Huc: 041100020305 (part)
- Fish Creek 041100020305 — Other Sub-watersheds
- Counties
- Jurisdictions outside watershed

- Interstate Highways
- State Divided Highways
- State Numbered Rtes
- Local Roads

Subwatershed Local Jurisdictions

- HUDSON
- STOW
- KENT
- FRANKLIN TWP.
- STREETSBORO

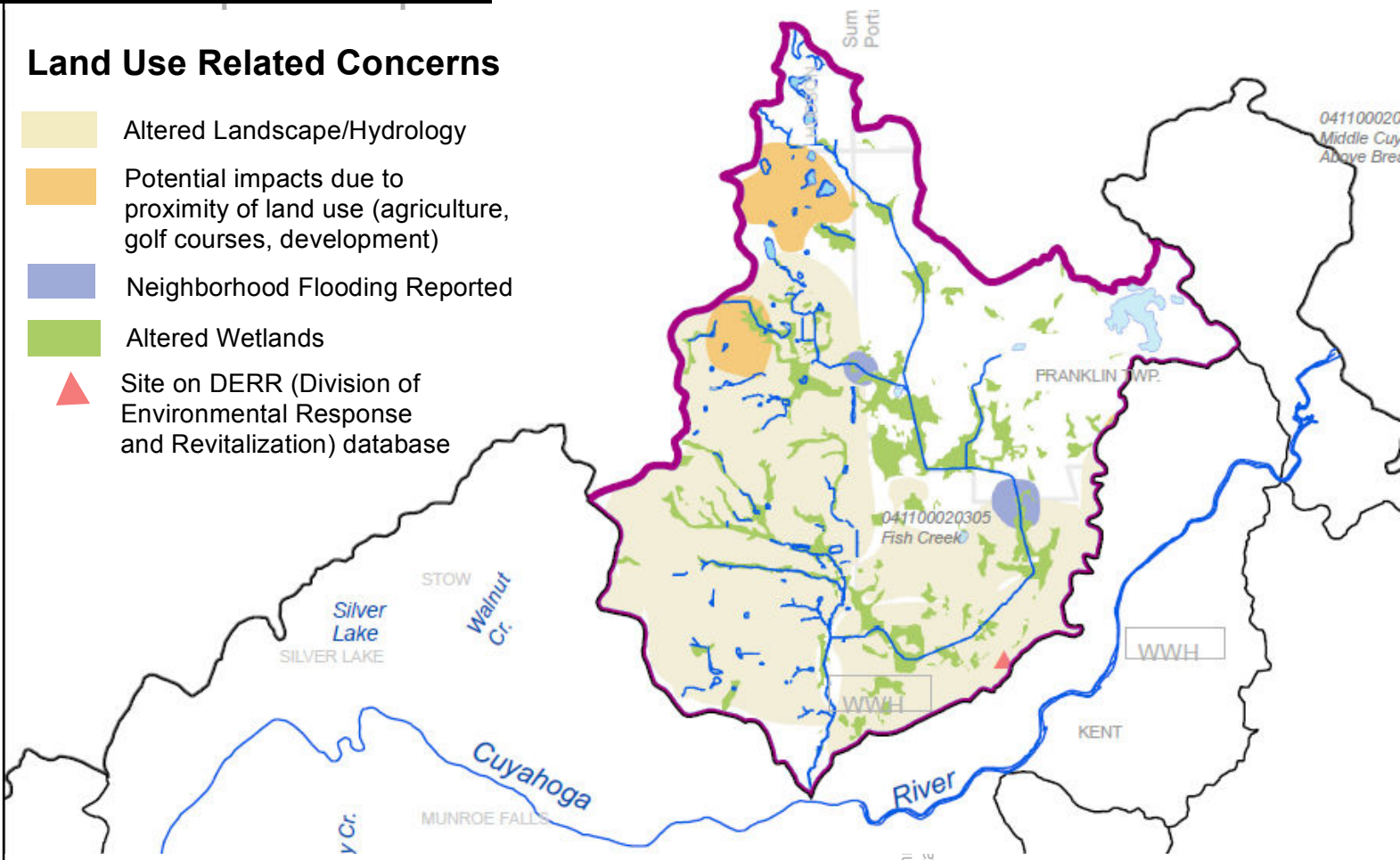
Sources: NEFCO, 2010; Portage County GIS 2010; Summit County GIS 2009; Stark County Planning Commission 2010; Ohio DNR GIS 2010

Figure Fi-2 Problem Areas Fish Creek Subwatershed

Fish Creek Subwatershed
041100020301 Plum Creek — Other Subwatershed, 12-Digit HUC
Streams and Rivers
Lakes
WWH — Aquatic Life Use Designation

Land Use Related Concerns

- Altered Landscape/Hydrology
- Potential impacts due to proximity of land use (agriculture, golf courses, development)
- Neighborhood Flooding Reported
- Altered Wetlands
- Site on DERR (Division of Environmental Response and Revitalization) database

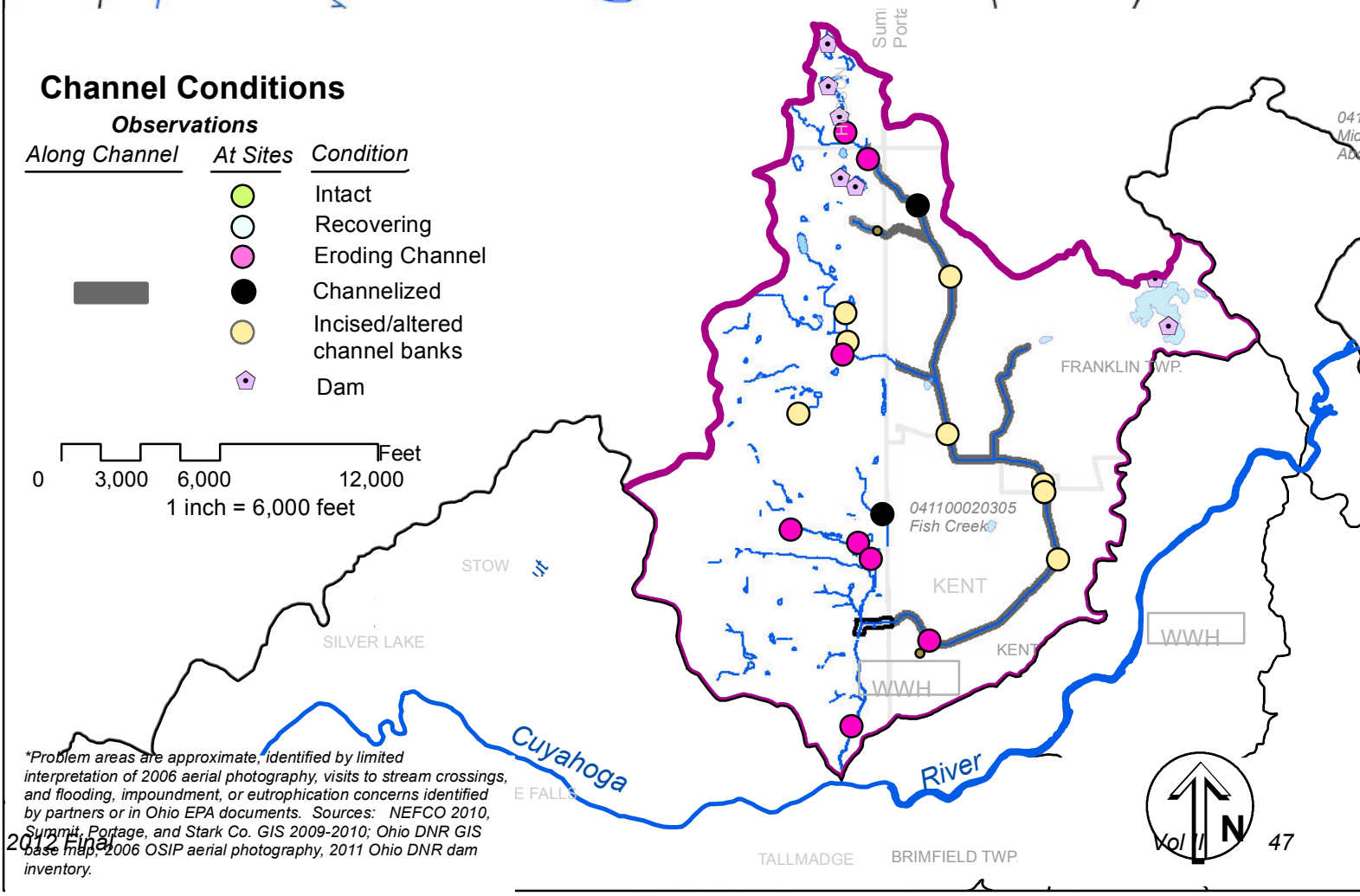


Channel Conditions

Observations

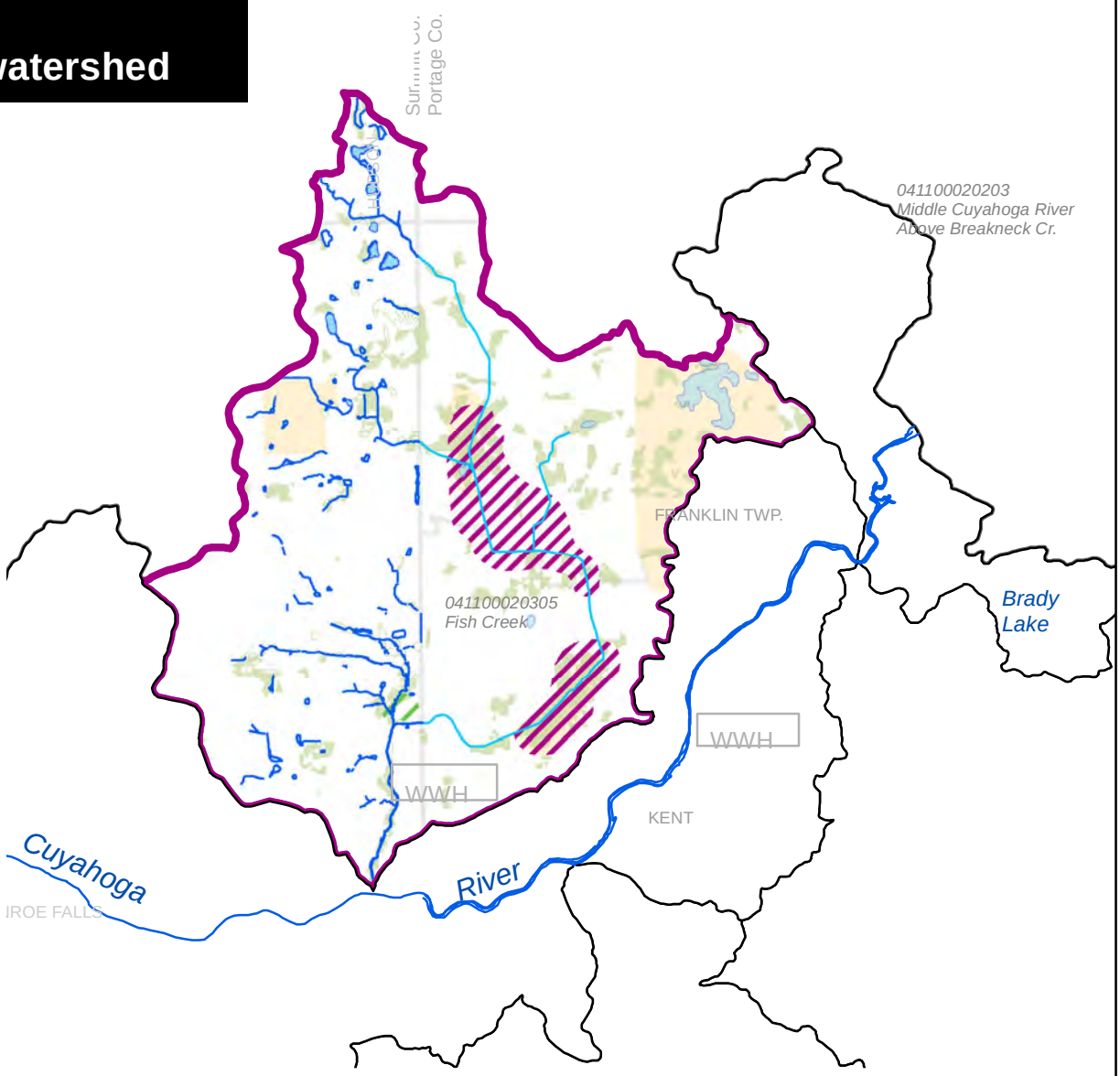
Along Channel	*At Sites*	*Condition*
		Intact
		Recovering
		Eroding Channel
▬		Channelized
		Incised/altered channel banks
		Dam

0 3,000 6,000 12,000 Feet
1 inch = 6,000 feet



**Problem areas are approximate, identified by limited interpretation of 2006 aerial photography, visits to stream crossings, and flooding, impoundment, or eutrophication concerns identified by partners or in Ohio EPA documents. Sources: NEFCO 2010, Summit, Portage, and Stark Co. GIS 2009-2010; Ohio DNR GIS base map; 2006 OSIP aerial photography, 2011 Ohio DNR dam inventory.*

Fi-3 Conservation/Protection Priority Areas
Fish Creek Subwatershed



Conservation/Protection Priority Areas

- Riparian Corridor/Wetland
- Wetlands of Additional Importance (e.g., buffering) - enhance/protect
- Restoration/Conservation of Riparian Area/Wetlands
- Mapped Wetlands
- Habitats or Species of Concern - Identified on DNR biodiversity database spanning 30 years; Western Reserve Land Conservancy workshop, 2010.)

- Streams and Rivers
- Lakes
- WWH — Aquatic Life Use Designation
- 041100020305 Fish Creek — Subwatershed, 12-Digit HUC
- Local Jurisdictions

N

0 3,000 6,000 12,000 Feet

1 inch = 6,000 feet

*Sources: NEFCO 2010, Summit, Portage, and Stark Co. GIS 2009-2010; Ohio DNR GIS base map, biodiversity data; 2011. Western Reserve Land Conservancy GIS mapping of conservation areas, 2010; Summit and Portage Counties wetland mapping conducted by Davey Resource Group, 2000-2004. Stark County -2003 land cover mapping; CCAP NOAA coastal Change Analysis Program 2006 mapping.

Table Fi-1
Summary of Fish Creek Subwatershed Characterisitcs

Concern	Amount/Item	Comments
Water Quality Attainment, latest assessed	Assessed 1997, 2000, 2007. Upstream of RM 1.4, Fish Creek is MWH-C and is in attainment of water quality standards. Downstream of RM 1.3, Fish Creek is WWH, is in non-attainment.	Latest assessment prior to dam removal at Munroe Falls. Change in slope may improve flow in Fish Creek.
Public water supplies	No major public water supplies	
Land Cover acres, %	Developed 4,095 50.2% • *High Density* *113* *1.2%* • *Moderate Density* *366* *4.0%* • *Low Density* *1,987* *42.1%* • *Dev. Open Space* *1,629* *22.9%* Agricultural 724 7.5% Grassland/scrub-shrub 72 0.8% Woods/wetlands 1,641 19.6%	
Impervious % runoff	20.7% **Excess runoff from 3/4" storm**: 5.5 million gal.	
75 foot buffer	Developed 7,038 ac. 67% *Dev. Open Space 1,802 17%* Agricultural 960 ac. 9% Woods/wetlands 2,077 21%	
Wetlands (ac.)	**Mapped** 745 **Altered:** 737 hydric (hydric inclusions 1,461)	
Likelihood of future development	Within Stow and Kent – limited development on remaining few large parcels. Beyond Kent – potential if annexed	
Channel quality (miles of observed conditions)	**Intact** **Altered/channelized** **Eroding** **Recovering** 1.4 15.5 0.1	
Non-point source load/yr:	**Total N (lb)** 30,766 **Tot. P (lb)** 5,810 **Sediment (tons)** 895	
Septic systems	¼ or more of watershed soils have 2 or more severe limitations for septic systems, indicating high potential for older septic system failure, with > 100 suspected illicit discharging systems in 2011.	
Problem areas	Flooding on Newcomer Rd.., McKinney Ave., excess volume, bank erosion Spaulding. Channelized section embedded.	
Resource areas	Remaining wetlands, woods	
Park/ conserv./inst.	Kent is assembling parcels along Fish Creek. Kent, Portage Co. and Stow have parks. There are numerous open space parcels in subdivisions, and the Stow-MF High School is on a large parcel.	
Riparian setback	Kent	
Recreational opportunities	City of Kent parks and conservation land; Small conservation lands along the tributaries	

Table Fi 2 - Impairments
Fish Creek
Part of HUC 041100020305

Attainment issue/other concern	Cause	Source	Other likely sources
HUC: 041100020305 Cuyahoga River below Breakneck Creek	Habitat alteration Flow alteration Nutrients Organic enrichment Siltation Total Toxics, unknown toxics	Channelization CSO Dam Major municipal point source Natural Septic tanks Sewer line construction Urban runoff/nps	
RM 1.3 to River Non-attainment Fair ranking for fish, macroinvertebrates, habitat not limiting		Unknown (high) Urban runoff (high) NPS from construction, ag Highway maintenance Spills Natural (slight)	Imperviousness: 21% Channelization
UST RM 1.3 MWH-C			
LOCALLY IDENTIFIED CONCERNS			
Flooding along Fish Creek from Johnson Rd. downstream			Urban runoff, loss of flood storage and wetlands, channelization
Bank erosion along Fish Creek in modified section and at river			Urban runoff, loss of flood storage, vertically unstable
Wetland alteration/loss of habitat			Channelization, wetland fill Invasives Urban encroachment

Factors contributing to non-point source pollution include

- *High percent of imperviousness* - 21% in this subwatershed
- *Runoff from development* in Stow and Kent
- *Septic systems* - Approximately one-quarter of the subwatershed presents two or more severe limitations for septic systems and is not served by sewers, indicating the potential for failure of older systems. Of the 232 potential illicit discharges identified in Franklin Township in 2010, it is likely that approximately 100 are in the subwatershed..
- *Channelization and alteration of channels, floodplain access, and wetlands*. Approximately 15.5 miles of remaining stream corridor, 8,000 acres of riparian corridors within 75 feet, and 737 acres of wetland on hydric soils have been channelized or altered in the agricultural and urbanized areas, reducing their ability to absorb, filter, and store storm water, sediment, and the non-point source pollutants entering the streams from the landscape. Observations indicate that much of the riparian area now consists of mown sod. Without stabilizing vegetation, the channels are likely to begin incising, degrading habitat and increasing local and downstream flooding, erosion, and sedimentation. The altered riparian corridor reduces the ability of the landscape to treat and store contaminants and excess water. Fish Creek and its headwaters are largely channelized or altered. The stream network itself has been fragmented through extensive use of culverts.
- *Eroding streambank.* These contribute nitrogen, phosphorous, and sediment, and are often associated with high volumes, lack of floodplain access, and unstable banks. Eroding streambanks have been observed along the lower portion of Fish Creek, especially at Spaulding, and near the confluence with the Cuyahoga River. The channel erosion generally appears to be associated with stormwater volume and lack of floodplain access. Some of the erosion at the lower end of Fish Creek may be related to the lowering of the base level at the Cuyahoga River with the recent dam removal. There may be potential for improving flood storage by reconnecting the channel to portions of the extensive channelized wetlands.
- *Potential for degradation of riparian/wetland features* – Many of the existing wetlands and floodplains flanking Fish Creek have been altered but still provide some treatment and storage of nonpoint source pollution and floodwater. Certain areas appear less altered than others. It is important that the remaining wetlands not be further altered or filled in.

Flooding *(Refer to Problem Statement FI-4, Table Fi 4.4. Note, flooding also addressed under non-point source pollution, due to bank erosion from overloaded channels.*

Flooding problems (where floods interfere with use of structures or roads) have been observed at McKinney Rd. and at Johnson Rd. The heavily altered watershed contributes additional stormwater loading and reduces the ability of the landscape to store or absorb stormwater.

Habitat and Conservation Areas *(Refer to Problem Statement Fi-5 Table Fi 4.5, also problem statements related to non-point source pollution and flooding)*

Approximately 15.5 of Fish Creek and its tributaries has been channelized, including nearly the entire length of Fish Creek in Portage County, removing it from contact with adjacent wetlands and creating a ditch that provides little beneficial watershed functions. Approximately 4,235 acres riparian buffer and 734 acres of wetlands on hydric soils have been altered, degrading habitat and reducing water quality. Remaining intact wetlands and important habitats are at risk of encroachment, fragmentation, degradation, or conversion due to the high degree of development that has been occurring in Fish Creek. As with other subwatersheds, small low-head dams may degrade downstream habitat.

Several areas of important habitats have been identified in this subwatershed. Only a portion of these is held as conservation land, the rest is susceptible to development. The most significant habitat areas are the remaining woods and wetland areas, especially along streams and in larger, connected complexes and corridors. The lower portion of the creek remains a wooded valley. Remaining wetlands have become degraded but nevertheless still provide substantial ecological benefit, and they may represent a good an opportunity for enhancement. There are numerous parcels owned by public or institutional uses. The City of Kent has been acquiring parcels along Fish Creek and its floodplain. These may provide additional restoration opportunities.

This watershed does offer some opportunities for restoration. Substantial areas of altered wetlands in Portage County are no longer used for their original agricultural purpose (muck farming). The City of Kent is assembling open space parcels along Fish Creek that could be used for preservation or restoration. Even in the developed areas, there are small parcels of undeveloped open space along the streams. It may be possible to work with homeowners' associations to restore some of the riparian vegetation or other features in these areas.

Key areas to focus preservation efforts include:

- Remaining intact wetlands along Fish Creek
- Larger intact systems and corridors and habitat areas in close proximity
- Small pocket wetlands in the northeastern portion of the watershed – some of these are associated with species of concern.
- Degraded wetland systems should be targeted for enhancement or restoration, where feasible.
- Floodplain access should be restored along heavily altered (channelized) portions of the creek where feasible without threatening homes.
- The planned conservation/recreation loop centered along Fish Creek should be completed.
- Some stream corridor segments are relatively intact within steeply walled valleys.
- Homeowners Associations own a considerable amount of riparian land, much of which has been altered to sod. These potentially could be restored to native vegetation, enhancing the stream corridors.

Recreational Opportunities *(Refer to Problem Statement Fi-6 Table Fi 4.6)*

There are limited opportunities for access to and recreation along Fish Creek. The City of Kent has been acquiring and developing segments of a planned loop trail centered on Fish Creek and wishes to continue to do so. The Summit County MetroParks bike-hike trail crosses Fish Creek in its steep wooded lower reaches.

2 Problem Statements, Goals, Objectives, and Actions

Table Fi 4.3 summarizes the actions proposed in the subwatershed and their associated pollutant load reductions, listing which problem statements are addressed by these tools, and which tables they can be found in. Tables Fi 4.1 through 6 present the problem statements, goals, objectives, and actions for each problem area. The tables are numbered to reflect each problem statement number, e.g., Table Fi 4.1 corresponds to Problem Statement Fi-1. It should be noted that because many of the objectives address more than one goal, the actions associated with each objective are listed only once, in the first table in which they appear (most frequently, Table Fi 4.1). All other listings of the same objective refer back to the actions at their first occurrence.

Refer to Sections 6 and 7 introduction for a discussion of the format of the problem statements, goals, objectives, actions, and considerations for implementation.

Table Fi 3 Action Item Summary by Subwatershed: Fish Creek

12-digit HUC/ Water Body	Sed	Nutrients	Flooding	Habitat	Recreation	Category/Practices	Target amount by 2023	Units	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
041100020305 (part)												
						Riparian Restoration						
Fish Creek	√	√	√	√		Restore Streambank (Bio-Engineering/ re-contouring/ re-grading)*	3,000	Linear Feet	$25-200/lf	34	54	20
Fish Creek & tribs	√	√	√	√		Plant Native plants, trees, or shrubs in Riparian Areas	25	Acres		25	200	35
Fish Creek & tribs				√		Remove/treat Invasive Species	40	Acres				
						Stream Restoration						
Fish Creek	√	√	√	√		Restore Flood Plain	50	Acre-foot		22	300	41
Fish Creek & tribs			√			Hydrological study in flood-prone area	1	study				
tribs				√		Feasibility Study to remove small dams	1	study				
						Wetland Restoration						
Fish Creek	√	√	√	√	√	Reconstruct/reconnect/ restore Wetlands	100	Acres	$5k-100k/ac.	100	2800	632
						Home Sewage Treatment Systems						
Fish Creek watershed		√				Obtain correction of failing HSTS	10	HSTS			311	122
						Urban runoff and green infrastructure						
Fish Creek watershed	√	√	√			Rain gardens	6,000	sq feet	$150,000		0.5	0.1
Fish Creek watershed	√	√	√			Bioinfiltration/ permeable pavement - parking lot retrofit	10,000	square feet		0.04	2.2	0.2
Fish Creek watershed	√	√	√			Storm water inventory	1	inventory				
Fish Creek watershed	√	√				Stormwater water quality retrofits	60	acres treated (50% wq inlet+sand filter, 50% wetland)	$400-17k/ ac	4.5	70	10.2

Table Fi 3 Action Item Summary by Subwatershed: Fish Creek

12-digit HUC/ Water Body	Sed	Nutrients	Flooding	Habitat	Recreation	Category/Practices	Target amount by 2023	Units	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
Fish Creek watershed	√	√				Retrofit drainage - no-mow/ veg swale/ daylighting	1,000	linear feet		0.1	0.8	0.4
Middle Cuyahoga River	√	√	√			Neighborhood-scale green infrastructure	1		$25-50k design $20k bumpout	5	200	25
						Conservation Easements						
Fish Creek watershed	√	√	√	√	√	Acquire Wetlands/ easements	75	Acres	$5-25k/ac	prevent 75	prevent 2100	prevent 474
Fish Creek watershed	√	√	√	√	√	**Education and Outreach**						
						Develop Brochures/Fact Sheets	10	Brochures/Fact Sheets				
						Websites	1	Website				
						Install Signs	5	Signs	$200-500/ sign			
						Stream Clean-Ups	3	Clean-Ups				
						New lake/stream stewardship groups	1	new group active				
						Conduct Workshops/ training	5	Workshops				
						Develop Manual(s)	1	Manuals				
						Rain barrel workshops	50	rain barrels				
						Develop Newsletters	10	Newsletters				
						Local Policy						
Fish Creek watershed	√	√	√	√		Green code audit/update Develop or Customize	2	audits/ updates				
Fish Creek watershed	√	√	√	√		Adoption of Riparian setback**	1	Jurisdictions		*prevent 14*	*prevent 200*	*prevent 35*
Fish Creek watershed						**Monitoring**						
		√		√		Chemical Sampling	3	Sites				
	√			√		Habitat (QHEI/HHEI) Sampling	5	Sites				
	√	√	√	√	√	Maintain stream database	1	database				

Table Fi 3 Action Item Summary by Subwatershed: Fish Creek

12-digit HUC/ Water Body	Sed	Nutrients	Flooding	Habitat	Recreation	Category/Practices	Target amount by 2023	Units	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
						Recreation						
Fish Creek	√	√	√	√	√	Acquire conservation land for trail loop	**20**	ac				
Fish Creek					√	Construct trail	**3**	mi				
Fish Creek					√	Construct access sites	**1**	site				
Fish Creek watershed					√	Economic benefit study	**1**	study				
Fish Creek watershed					√	Develop quest(s)/ virtual watershed tour	**2 quests/ 1 tour**					
								Total		341	4,049	892

* Streambank erosion is a minor consideration. The primary reasons for restoring streambank are flood management and habitat. Pollutant loading calculated for 200 lf of eroding bank.

**assume 36,000 lf x 30' = 25 ac., treats 7x area

Table Fi 4.1 Fish Creek - Sediment
HUC 041100020305 (part)

Problem Statement Fi-1: Sediment

Siltation has been identified as a cause of non-attainment in the Middle Cuyahoga River. Excess sediment is of concern downstream in the shipping channel and in Lake Erie, because of the nutrients that enter the water with the sediment. The STEP-L model indicates that the watershed contributes 895 tons of sediment per year from runoff and 34 tons per year from eroding banks due to overloaded channels. Alteration of at least 737 acres of wetland, 76% of vegetated riparian corridor, and loss of riparian features (e.g., riparian zone, floodplain access) along an estimated 15.5 miles of watercourses has reduced the natural sediment storage of the system. Potential loss of riparian vegetation in the undeveloped 30% of the riparian corridor could result in increased loading in the future.

Goal *Objective*	**Actions**	**Lead/ cooperating organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal Fi-1a Reduce non-point source pollution from runoff to reduce annual loading of sediment by 17.5 tons.				
Fi 1a-1. Plant 25 ac. of deep-rooted riparian vegetation, reducing loading of sediment by 13 tons/yr.				
	1 Submit grant applications e.g., OEEF	WC/SWCDs/partners		
	2 Targeted outreach to public, institutional, and other owners of large properties	WC**/SWCDs/ Communities	Lists of golf courses, lake associations, homeowners' associations; maps of large parcels; printed outreach materials.	Target 1 group every 3 years (3 by 2022); improvements to best management practices or riparian management at one site every 4 years(2 sites by 2020); 2 outreach contacts per year
	3 Outreach to golf course owners encouraging Audubon-certification		labor, printing	
	4 Assist with plantings	SWCDs, master gardeners	native plants/trees and shrubs $500-1,000/ac	25 ac
	5 Construct and install signage	communities, partners, volunteers (scouts?)	$300-500/sign	
	6 Follow-up outreach (individualized guide to riparian zone) and publicize		funding for handouts/brochures	
Fi 1a-2 Retrofit stormwater volume devices for water quality to treat 60 ac of residential use, reducing loading of sediment by 4.5 tons /year.				
	1 Stormwater retrofit inventory		WC/NEFCO with communities	
	2 Submit grant application.			
	3 Design/construct retrofit for existing stormwater (volume) infra-structure to improve water quality	Communities	Varies, depending on treatment provided (e.g., $400/acre treated to $17,000 per acre treated)	Retrofit 3 by 2023 to treat 60 ac res., 1 every 3 years afterward
Fi 1a-3 Retrofit 1,000 lf of drainage with no-mow grass/vegetated swale/daylighting to reduce sediment by 0.2 tons /yr				
	1 Workshop on maintaining ditches/improving drainage for water quality improvements	SWCD/pipe		
	2 Install retrofit/no-mow grass along 1,000 lf			
Fi 1a-4 Facilitate review and update of local codes to include measures for green infrastructure				
	1 Green code audit workshop			
	2 Review codes in two communities for green infrastructure language	partners	volunteers/consultant	
	3 update code language		possibly outside consultant/funding	1 community by 2022

Table Fi 4.1 Fish Creek - Sediment
HUC 041100020305 (part)

Goal				Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Objective	**Actions**	**Lead/ cooperating organizations**	**Resources needed/cost**	
Fi 1a-5 Update, increase, and disseminate available information concerning sediment from urban runoff				
	1 Continue to compile, centralize, and make available studies, data, information sources on the watershed, including recreational opportunities, volunteer needs, permitting or regulatory issues; green infrastructure information sources, etc.	WC	Website, technical information and outreach materials	Update and develop pages for website by Dec. 2013, then on-going
	2 Chemical or biological sampling/assessment along streams - volunteer, intern, or class	Community/partner sponsors, Ohio EPA, KSU interns/classes	possibly stipends, analysis, equipment	Sampling at 3 locations by 2022.
	3 Continue to develop stream database			
FI 1a-6 Increase stewardship activities related to non-point source pollution and watershed issues by 21 activities				
	1 Establish clean-up/monitoring efforts at additional tributaries	WC, communities, parks, residents, home-owners' assoc.		1 new tributary or lake monitoring, clean-up (3 cleanups), or other stewardship program by
	2 Distribute 50 rain barrels through workshops	SWCDs/ Communities	Space for workshop; rain barrel kits	2 workshops/50 rain barrels distributed
	3 Survey of yard management practices	WC/partners		
	4 Develop/reproduce informational brochure or website article concerning topics of interest, including reducing runoff, recreational opportunties, private wells, septic systems etc.	WC, health depts, SWCDs	technical/outreach materials, possibly printing costs	10 by 2022; 1 each year
	5 Educational outreach workshops on topics of importance, including LID/green infrastructure, restoration, field trips for examples	Partners, WC, communities	Location, speaker, supplies	5 workshops by 2022; 1 every 2 years
	6 Work with schools or city day camps to develop/encourage use of watershed care activities/curricular items	WC, SWCDs, partners, schools		1 educational outreach program/curriculum item by 2018
	7 Watershed "brand," logo, art project	WC, Kent State/ Standing Rock Gallery/River Day communities	Host for project, graphic design capabilities	1 logo or art project by 2015, then 1 every 3 years;
	8 Create social network or google presence	WC		1 by 2014
FI 1a-7 Develop stormwater management design manual for Portage County				
	1 Stormwater management design manual for Portage County	Portage SWCD	In-house task	1 manual by 2014
Fi 1a-8 Facilitate review and update of local codes to include measures for green infrastructure				
	1 Green code audit workshop			
	2 Review codes in two communities for green infrastructure language	partners	volunteers/consultant	
	3 update code language		possibly outside consultant/funding	1 community by 2022
MC-1 Establish 1 neighborhood-scale green infrastructure projects as demonstration within the developed areas of one of the Middle Cuyahoga River subwatersheds, where suitable neighborhoods are identified, reducing loading of nitrogen by 200 lb/year, phosphorous by 25 lb/yr, and sediment by 5 tons /yr				
	1 Work with communities to identify suitable target neighborhoods	WC, partners		
	2 Meetings to gauge neighborhood support			2 meetings

Table Fi 4.1 Fish Creek - Sediment
HUC 041100020305 (part)

Goal / Objective		Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
	3	Determine/establish maintenance framework (e.g., easements, homeowner participation)	partner community		
	4	Get grant(s)			
	5	Design/build	outside consultant	Site, outside funding. Design ~$25-50,000; Rain gardens $15-20/sq. foot; Green street bump-outs $20,000 each; per-meable concrete $12-15/ sq. ft	1 project by 2022
	6	Outreach, neighborhood participation			
Goal Fi 1b Restore altered riparian/watershed landscape to reduce sediment in the stream by 122 tons/yr.					
Fi 1b-1. Restore 100 ac of wetland, reducing loading of sediment by 100 tons /year.					
	1	Map target areas to investigate for wetland, floodplain, riparian, habitat, or stream corridor restoration/protection/ enhancement	WC, partners	available mapping - compile and build on previous efforts	1 map by 2013, revisit and update if necessary every 3 years
	2	Meetings with landowners to determine interest	WC, partners		2 meetings
	3	Identify wetland restoration site for clearinghouse	WC, Communities, other partners	meetings with landowners; readily available mapping, outside assistance from consultant, possible assistance from Kent State University wetland ecology class	5 concept plans by 2020; 1 every 2 years afterward.
	4	Submit grant application			
	5	Restore/protect/enhance wetlands	Partners	$5,000-$100,000 per acre, design/build consultant, sites -protection by ease- ments would be at the low end of the range	20 ac by 2022; 10 ac every 5 years afterward
Fi 1b-2 Restore 50 acre-ft of floodplain access, to reduce annual sediment loading by 22 tons					
	1	Map target areas to investigate for wetland, floodplain, riparian, habitat, or stream corridor restoration/protection/ enhancement	WC, partners	available mapping - compile and build on previous efforts	1 map by 2013, revisit and update if necessary every 3 years
	2	Meet with landowners to determine interest	WC, partners		
	4	Submit grant application			
	5	Restore floodplain access/flood storage			
	6	Public outreach			
Fi 1b-3. Plant 25 ac. of deep-rooted riparian vegetation, reducing loading of sediment by 13 tons/yr.					
		Actions: See Fi 1a-1.			
Goal Fi 1c Reduce bank erosion from overloaded channels to reduce sediment loading by 34 tons/yr.					
Fi 1c-1 Stabilize 200 l.f. of 5-foot tall stream bank, reducing sediment loading by 34 tons/yr. *Focus areas, e.g., Spaulding Ave. area*					
	1	Map target areas to investigate for wetland, floodplain, riparian, habitat, or stream corridor restoration/protection/ enhancement			1 map by 2013, revisit and update if necessary every 3 years
	2	Meet with landowners to determine interest			
	4	Submit grant applications			
	5	Stabillize banks/restore floodplain access			200 lf bank
	6	Public outreach			

Table Fi 4.1 Fish Creek - Sediment
HUC 041100020305 (part)

Goal / Objective	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
FI 1c-2 Install 6,000 square feet of rain gardens, to reducing channel loading by 262 cu ft in a 3/4 in storm				
	1 Identify partners	WC, partners		
	2 Submit grant application	WC/partners		
	3 Workshop/installation	WC/partners		
Fi 1c-3 Install biofiltration in a commercial/institutional site totaling 10,000 square feet and reducing runoff by 1,600 cubic feet in a 3/4-inch storm.				
	1 Identify parcel(s) and landowner(s) for project	partners, WC		
	2 Grants	WC/partners		
	3 Design/construct BMPs	outside consultant		
	4, 5, 6 Green infrastructure workshops, code revision	(see FI 1a-4)		
Fi 1c-4 Restore 50 acres of floodplain access, reducing volume by 2,178,000 cubic feet in a 3/4-inch storm.				
	Actions: See Fi 1a-3			
Fi 1c-5 Restore 100 acres of wetland, reducing volume by 65,000 cubic feet in a 3/4-inch storm.				
	Actions: See Fi 1b-1			
Fi 1c-6 Facilitate installation of 50 rain barrels, thereby reducing stream channel loading by 275 cu ft in a 3/4-inch storm.				
	1 Submit grant proposal/seek community funding			
	2 Obtain rain barrel materials		barrels, plumbing e.g., $40 per barrel setup	
	4 Workshop			2 workshops
	5 Outreach			
MC 1 Establish 1 neighborhood-scale green infrastructure project as a demonstration within the developed areas of one of the Middle Cuyahoga River subwatersheds, where suitable neighborhood is identified, reducing volume of water by 32,670 cu ft in a 1-inch storm.				
	Actions - See MC 1 above			
Goal Fi 1d Protect riparian resources, thereby preventing future sediment loading by 89 tons/year				
FI 1d-1 Protect 36,000 linear feet of riparian buffer by increasing the number of communities using riparian setbacks, reducing loading of sediment by 14 tons/yr				
	1 Workshops for community officials on developing/enforcing riparian setbacks	Portage County Regional Planning Commission	Workshops would occur during regularly scheduled zoning inspector meetings, etc.	2 workshops by 2015; additional workshops - included in general workshop series
	2 Comment on wetland alteration permit applications concerning impacts to watershed functions/riparian setbacks	WC and partners		on-going
	3 Increase the number of communities using riparian setbacks	WC, communities, Counties	Outreach	1 additional community with riparian setbacks by 2022
	4 Install signage for riparian areas in publicly visible places	Partners	$200-$500 per sign. Outside funding or community sign facility	Signs at 2 locations by 2022; signs at 1 additional location every 5 years afterward
	5 Continued outreach	Partners		brochure, workshops on enforcement, outreach to homeowners etc.
FI 1d-2 Protect 75 acres of wetland/riparian corridor/conservation land through purchase of easement/wetlands, preventing increased loading of sediment by 75 tons /yr				
	1 Mapping			
	2 Contact landowners/partner land trusts			
	3 Submit grant proposal			
	4 Acquire wetlands/easements			

Table Fi 4.2 Fish Creek - Nitrogen
041100020305 (part)

Problem Statement Fi 2: Nitrogen

The 2000 TMDL determined that Fish Creek biological communities are stressed due to urban runoff. Nitrate+nitrogen levels in Fish Creek during/after a rain event in 2007 slightly exceeded state EOLP median values of 0.43 mg/l for WWH streams, with measurements of approx. 0.48 mg/l. Cuyahoga River nitrate+nitrogen levels measured in 2007 frequently the EOLP median (1.0 mg/l) and the state guidelines (1.5 mg/l), ranging from 0.9 mgl/l to 6 mg/l. The STEP-L model indicates that the Fish Creek subwatershed generates 30,766 lb/ year from non-point sources, including urban runoff, failing septic systems, and eroding stream banks. Alteration of at least 737 acres of wetland, 76% of vegetated riparian corridor, and loss of riparian features (e.g., riparian zone, floodplain access) along an estimated 15.5 miles of watercourses has reduced the nitrogen uptake of the system. Potential loss of riparian vegetation in the undeveloped 30% of the riparian corridor could result in increased loading in the future.

Goals ***Objectives*** Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal Fi 2a Reduce non-point source pollution from urban runoff to reduce annual loading of nitrogen by 273.2 lb			
Fi 2a-1 Plant 25 ac of deep-rooted riparian vegetation, reducing loading of nitrogen by 200 lb/yr *Focus areas: large parcels single ownership, headwaters.*			
Actions - See Fi 1a-1, Table Fi 4.1			
Fi 2a-2 Retrofit stormwater volume devices to treat 60 acres of residential land and improve water quality, reducing loading of nitrogen by 70 lb/yr			
Actions - See Fi 1a-2, Table Fi 4.1			
Fi 2a-3 Retrofit 1,000 lf of drainage with no-mow grass/vegetated swale/daylighting, to reduce annual nitrogen loading by 0.8 lb.			
Actions - See Fi 1a-3, Table Fi 4.1			
FI 2a-4 Install 6,000 sq. ft of rain garden to reduce annual nitrogen loading by 0.5 lb/yr			
Actions - See Fi 1c-2, Table Fi 4.1			
Fi 2a-5 Install 10,000 sq. ft of biofiltration in a developed site to reduce nitrogen loading by 2.2 lb per year			
Actions - See Fi 1c-3, Table Fi 4.1			
Fi 2a-6 Facilitate review and update of 2 local codes to include measures for green infrastructure			
Actions - See Fi 1c-4, Table Fi 4.1			
Fi 2a-7 Update, increase, and disseminate available information concerning phosphorous from urban runoff			
Actions - See Fi 1a-5, Table Fi 4.1			
FI 2a-8 Increase stewardship activities related to non-point source pollution and watershed issues by 21 activities			
Actions - See Fi 1a-6, Table Fi 4.1			
Fi 2a-9 Facilitate review and update of local codes to include measures for green infrastructure			
Actions - See Fi 1a-8, Table Fi 4.1			
FI 2a-10 Develop stormwater management design manual for Portage County			
Actions - See Fi 1a-7, Table Fi 4.1			
MCR 1 Establish 1 neighborhood-scale green infrastructure project as demonstration within the developed areas of one of the Middle Cuyahoga River subwatersheds, where suitable neighborhoods are identified, reducing loading of nitrogen by 200 lb/year			
Actions - See MCR-1, Table Fi 4.1			
Goal Fi 2b Restore altered watershed landscape to reduce nitrogen in the stream by 3,100 lb/yr.			
Fi 2b-1. Restore 100 ac of wetland, reducing loading of nitrogen by 2,800 lb/yr. *Focus areas -altered wetlands in central watershed or headwaters.*			
Actions - See Fi 1b-1, Table Fi 4.1			

Table Fi 4.2 Fish Creek - Nitrogen
041100020305 (part)

Goals Objectives Actions	Lead/ cooperating Organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Fi 2b-2 Restore 50 acre-foot of floodplain access/storage, reducing annual nitrogen loading by 300 lb. *Focus areas - areas with modified floodplain access. and at/upstream of flooding problem areas, e.g., upstream of McKinney Ave. neighborhood*			
Actions - See Fi 1b-2, Table Fi 4.1			
Goal Fi 2c Reduce bank erosion from overloaded channels to reduce nitrogen loading by 34 lb/year.			
Fi 2c-1 Stabilize 200 l.f. of 5-foot tall stream bank, reducing nitrogen loading by 34 lb/yr. *Focus areas, e.g., Spaulding Ave. area*			
Actions - See Fi 1c-1, Table Fi 4.1			
Fi 2c-2 Plant 25 ac of deep-rooted riparian vegetation, thereby reducing channel loading by 5,400 cu ft in a 3/4 inch storm .			
Actions - See Fi 1a-1, Table Fi 4.1			
Fi 2c-3 Restore 100 acres of wetland thereby reducing channel loading by 1,300,000 cubic feet of water in a 3/4 inch storm.			
Actions - See Fi 1b-1, Table Fi 4.1			
Fi 2c-4 Increase floodplain storage by 50 acre-ft, thereby reducing stream channel loading by 2,178,000 cubic feet.			
Actions - See Fi 1b-2, Table Fi 4.1			
Fi 2c-5 Construct bioinfiltration or permeable pavement demonstration projects totalling 10,000 square feet, to reduce channel loading by 1600 cu ft in a 3/4 inch storm.			
Actions - See Fi 1c-3, Table Fi 4.1			
Fi 2c-6 Construct 6,000 square feet of rain garden to reduce channel loading by 262 cu ft in a 3/4 inch event.			
Actions - See Fi 1c-2, Table Fi 4.1			
Fi 2c-7 Facilitate installation of 50 rain barrels, thereby reducing stream channel loading by 275 cu ft in a 3/4-inch or 1-inch storm .			
Actions - See Fi 1c-7, Table Fi 4.1			
Goal Fi 2d Reduce septic system failure to reduce annual loading of nitrogen by 300 lb			
Fi 2d-1 Correct 1 failing HSDS per year, reducing nitrogen loading by 300 lb/yr Focus areas: vicinity of water courses			
1 Inspect systems	PCHD		
2 Correct failing/discharging home sewage treatment systems	Portage County Health District, landowners	Continued inspection and enforcement of illicit discharge regulations. Remedies depend on	10 by 2022; 1 per year afterward
3 Continue to investigate funding sources	PCRPC, PCHD, wc		
4 Outreach:			
Goal Fi 2e Protect beneficial watershed features to prevent future nitrogen loading by 2,300 lb/yr.			
FI 2e-1 Protect 36,000 linear feet of riparian buffer by increasing the number of communities using riparian setbacks by 1, reducing loading of nitrogen by 200 lb/yr			
Actions - See Fi 1d-1, Table Fi 4.1			
FI 2e-2 Protect 75 acres of wetlands/riparian corridor/conservation land, preventing increased loading of nitrogen by 2100 lb/yr			
Actions - See Fi 1d-2, Table Fi 4.1			

Table Fi 4.3 Fish Creek - Phosphorous
HUC 041100020305 (part)

Problem Statement Fi 3: Phosphorous

The 2000 TMDL determined that Fish Creek biological communities are stressed due to urban runoff. In approximately half of the reported samples, total phosphorous levels in Fish Creek exceed state/EOLP median values of 0.08 and 0.05 mg/l, respectively, for WWH streams, with measurements in Fish Creek of 0.02 to 1.08 mg/l. The Cuyahoga River has shown signs of slight nutrient enrichment. The STEP-L model indicates that the Fish Creek subwatershed generates 5,810 pounds per year of total phosphorous from non-point sources, including urban runoff, eroding stream banks from overloaded channels, and failing septic systems. Alteration of at least 737 acres of wetland, 76% of vegetated riparian corridor, and loss of riparian features (e.g., riparian zone, floodplain access) along an estimated 15.5 miles of watercourses has reduced the natural phosphorous removal capacity of the system. Potential loss of riparian vegetation in the undeveloped 30% of the riparian corridor could result in increased loading in the future.

Goal				**Amount to complete, time frame**
Objective	**Actions**	**Lead/ cooperating organizations**	**Resources needed/cost**	(contingent on funding, resources, landowner willingness)
Goal Fi 3a Reduce non-point source pollution from urban runoff to reduce annual loading of phosphorous by 46 lb.				
Fi 3a-1 Plant 25 ac of deep-rooted riparian vegetation, reducing loading of phosphorous by 35 lb/yr				
	Actions - See Fi 1a-1, Table Fi 4.1			
Fi 3a-2 Retrofit stormwater volume devices to treat 60 acres of developed land and improve water quality, reducing loading of phosphorous by 10.2 lb/yr				
	Actions - See Fi 1a-2, Table Fi 4.1			
Fi 3a-3 Retrofit 1,000 lf of drainage with no-mow grass/vegetated swale/daylighting, reducing loading of phosphorous by 0.4 lb/yr				
	Actions - See Fi 1a-3, Table Fi 4.1			
FI 3a-4 Install 6,000 sq ft of rain garden, to reduce phosphorous loading by 0.1 lb/yr				
	Actions - See Fi 1c-2, Table Fi 4.1			
Fi 3a-5 Install demo project of 10,000 sq. ft. of biofiltration in a commercial/institutional site, to reduce phosphorous loading by 0.3 lb per year				
	Actions - See Fi 1c-3, Table Fi 4.1			
Fi 3a-6 Facilitate review and update of local codes to include measures for green infrastructure				
	Actions - See Fi 1a-4, Table Fi 4.1			
Fi 3a-7 Update, increase, and disseminate available information concerning phosphorous from urban runoff				
	Actions - See Fi 1a-5, Table Fi 4.1			
FI 3a-6 Increase stewardship activities related to non-point source pollution and watershed issues by 21 activities				
	Actions - See Fi 1a-6, Table Fi 4.1			
FI 3a-7 Develop stormwater management design manual for Portage County				
	Actions - See Fi 1a-7, Table Fi 4.1			
MC 1 Establish 1 neighborhood-scale green infrastructure project as a demonstration within the developed areas of one of the Middle Cuyahoga River subwatersheds, where suitable neighborhoods are identified, reducing loading of phosphorous by 25 lb/year				
	Actions - See MCR-1, Table Fi 4.1			
Goal Fi 3b Restore altered riparian/watershed landscape to reduce phosphorous in the stream by 673 lb/yr.				
Fi 3b-1. Restore 100 ac of wetland, reducing loading of phosphorous by 632 lb/yr				

Table Fi 4.3 Fish Creek - Phosphorous

HUC 041100020305 (part)

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
	Actions - See Fi 1b-1, Table Fi 4.1			
Fi 3b-2 Restore 50 ac-ft of floodplain access/storage, reducing annual phosphorous loading by 41 lb.				
	Actions - See Fi 1b-2, Table Fi 4.1			
Goal Fi 3c Reduce bank erosion from overloaded channels thereby reducing phosphorous loading by 20 lb/year.				
Fi 3c-1 Stabilize 200 l.f. of 5-foot tall eroding stream bank, reducing phosphorous loading by 20 lb/year.				
	Actions - See Fi 1c-1, Table Fi 4.1			
Fi 3c-2 Plant 25 ac of deep-rooted riparian vegetation, thereby reducing channel loading by 5,400 cu ft in a 3/4 inch storm .				
	Actions - See Fi 1a-1, Table Fi 4.1			
Fi 3c-3 Restore 100 acres of wetland, reducing volume by 65,000 cubic feet in a 3/4-inch storm.				
	Actions: See Fi 1b-1, Table Fi 4.1			
Fi 3c-4 Increase floodplain storage by 50 acre-ft , thereby reducing stream channel loading by 2,178,000 cubic feet.				
	Actions - See Fi 1b-2, Table Fi 4.1			
Fi 3c-5 Construct 10,000 sq ft of bioinfiltration or permeable pavement in a developed setting to reduce channel loading by 1,600 cu ft in a 3/4 in storm				
	Actions - See Fi 1c-3, Table Fi 4.1			
Fi 3c-6 Construct 6,000 square feet of rain garden as a demonstration project to reduce channel loading by 262 cu ft in a 3/4 inch event.				
	Actions - See Fi 1c-2, Table Fi 4.1			
Fi 3c-8 Facilitate installation of 50 rain barrels, thereby reducing stream channel loading by 275 cu ft in a 3/4-inch storm .				
	Actions - See Fi 1c-6, Table Fi 4.1			
Goal Fi 3d Reduce septic system failure to reduce annual loading of phosphorous by 122 lb				
Fi 3d-1 Correct 1 failing HSTS per year, reducing loading of phosphorous by 122 lb/yr				
	Actions - See Fi 2d-1, Table Fi 4.2			
Goal Fi 3e Protect beneficial watershed features to prevent future phosphorous loading by 509 lb/yr.				
FI 3e-1 Protect 36,000 linear feet of riparian buffer by increasing the number of communities using riparian setbacks by 1 , preventing an additional 35 lb/yr of phosphorous loading.				
	Actions - See Fi 1d-1, Table Fi 4.1			
FI 3e-2 Protect 75 acres of wetlands/riparian corridor/conservation land through acquisition of land/easements, preventing increased loading of phosphorous by 474 lb/yr				
	Actions - See Fi 1d-2, Table Fi 4.1			

Table Fi 4.4 Damaging Floods

HUC 041100020305 (part)

Problem Statement Fi-4: Damaging Floods

Repeated flooding problems (floooding that affects structures or roads) occur along Fish Creek at McKinney Ave., Johnson Road, and along primary headwaters.

The subwatershed is 21% impervious, generating excess runoff. Fish Creek has been straightened - 15.5 miles of the creek is channelized. At least 737 acres of wetlands on hydric soils and 75% of the 75-foot riparian buffer have been altered, and the channelized water courses can no longer access floodplain/wetland. Many of the headwater tributaries have been culverted.

The combination of excess runoff and lost storage/absorption capacity in the watershed contributes to flooding. Continued development in the watershed will contribute further to the flooding problem unless these concerns are addressed.

Goal				**Amount to complete, time frame**
Objective	**Actions**	**Lead/ cooperating organizations**	**Resources needed/cost**	(contingent on funding, resources, landowner willingness)
Goal Fi 4a Reduce stream channel loading by reducing runoff/increasing flood storage by 2,251,945 cubic feet in a 3/4-inch rain event				
Fi 4a-1 Increase infiltration with 25 ac of deep-rooted riparian plantings /native species, reducing runoff by 5,400 cubic feet in a 3/4-inch storm.				
	Actions: see Fi 1a-1 Table Fi 4.1			
Fi 4a-2 Restore 100 acres of wetland , reducing runoff by 65,000 cubic feet in a 3/4-inch storm				
	Actions: see Fi 1a-2 Table Fi 4.1			
Fi 4a-3 Restore 50 acre-foot of floodplain access, reducing volume by 2,178,000 cubic feet in a 1-inch storm.				
	Actions: see Fi 1a-3 Table Fi 4.1			
FI 4a-4 Install 6,000 sq ft of rain garden, reducing stream channel loading by 150 cubic feet in a 3/4-inch storm.				
	Actions: see Fi 1c-2 Table Fi 4.1			
Fi 4a-5 Install 10,000 sq ft of biofiltration/permeable pavement in a developed site to reduce runoff by 3,120 cubic feet in a 3/4-inch storm.				
	Actions: see Fi 1c-3 Table Fi 4.1			
Fi 4a-7 Facilitate installation of 50 rain barrels, thereby reducing stream channel loading by 275 cu ft in a 3/4-inch storm .				
	Actions - See Fi 1c-6, Table Fi 4.1			
Fi 4a-8 Facilitate review and update of local codes to include measures for green infrastructure				
	Actions - See Fi 1a-4, Table Fi 4.1			
Fi 4a-9 Update, increase, and disseminate available information concerning urban runoff				
	Actions - See Fi 1a-5, Table Fi 4.1			
FI 4a-10. Increase stewardship activities related to watershed issues				
	Actions - See Fi 1a-6, Table Fi 4.1			
MC-1 Establish 1 neighborhood-scale green infrastructure project as a demonstration within the developed areas of one of the Middle Cuyahoga River subwatersheds, where suitable neighborhood is identified, reducing volume of water by 32,670 cu ft in a 1-inch storm.				
	Actions: See MC-1 Table Fi 4.1			
Goal Fi 4b Reduce flooding in targeted area by improving/restoring function to watershed features				
Fi 4b-1 Restore floodplain/wetland connection in one area of severe flooding, thereby reducing flooding problems				
	1 Conduct neighborhood/community meetings to determine interest			
	2 Apply for funding			

Table Fi 4.4 Damaging Floods

HUC 041100020305 (part)

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
	3 Flood reduction/watershed restoration study	outside consultant		
	4 Design-build watershed improvements			
	5 Neighborhood outreach during process	potential for tree planting		
Goal Fi 4c Protect beneficial watershed features to prevent future channel loading by 55,284 cu ft in a 3/4 inch storm.				
FI 4c-1 Protect 36,000 linear feet of riparian buffer by increasing the number of communities using riparian setbacks, reducing channel loading by 6,534 cu ft in a 3/4 inch rain event.				
	Actions: See Fi 1d-1 Table Fi 4.1			
FI 4c-2 Protect 75 acres of wetlands/riparian corridor/conservation land through acquisition of land/easements, preventing increased channel loading by 48,750 cu ft/yr				
	Actions - See Fi 1d-2, Table Fi 4.1			

Table Fi 4.5 Fish Creek - Habitat
HUC 041100020305 (part)

Problem Statement Fi-5: Habitat

Fish Creek, its tributaries, and watershed have been substantially altered, degrading habitat. Approx. 15.5 miles of the creek is channelized. At least 737 acres of wetlands on hydric soils and 75% of the 75-foot riparian buffer have been altered. Channelizing the creek has removed it from its adjacent wetlands. Many of the headwater tributaries have been culverted. Remaining wetlands have been degraded by urban encroachment and invasive species. Continued development in the watershed will contribute further to the degradation of the remaining habitat unless these concerns are addressed.

Goal				**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Objective	**Actions**	**Lead/ cooperating organizations**	**Resources needed/cost**	
Goal Fi 5a Restore 22 acres of altered habitat.				
Fi 5a-1 Plant 25 ac. of deep-rooted riparian plantings /native species, improving riparian habitat.				
	Actions: see Fi 1a-1 Table Fi 4.1			
Fi 5a-2 Restore/enhance 100 acres of wetland. Focus areas - e.g., altered wetlands on hydric soils, wetlands along channelized sections, potentially at formerly farmed sites.				
	Actions: see Fi 1a-2 Table Fi 4.1			
Fi 5a-3 Restore 50 acres of floodplain access . Target areas - headwaters, Johnson Rd.-McKinney				
	Actions: see Fi 1a-3 Table Fi 4.1			
Fi 5a-4 Treat/remove invasive species in 40 acres of altered habitat.				
Fi 5a-5 Restore 3,000 lf of streambank/wetland-stream connection				
Fi 5a-6 Conduct feasibility study for removing small low-head dams.				
Goal Fi 5b Protect 255 acres of intact habitat.				
Target - intact wetlands, riparian corridor, areas with species of concern, larger intact or connected complexes				
Fi 5b-1 Protect 36,000 linear feet/ 180 acres of riparian buffer by increasing the number of communities using riparian setbacks.				
	Actions: See Fi 1d-1 Table Fi 4.1			
FI 5b-2 Protect 75 acres of wetlands/riparian corridor/conservation land through acquisition of land or easements.				
	Actions - See Fi 1d-2, Table 6.2-1			
Fi 5b-3 Update, increase, and disseminate available information concerning care of the watershed and habitats.				
	Actions - See Fi 1a-4, Table 6.2-1			
FI 5b-4. Increase stewardship activities related to watershed issues				
	Actions - See Fi 1a-5, Table 6.2-1			
Fi 5b-5. Continue to acquire 25 ac of conservation land in the planned Kent Parks Fish Creek loop.				

Table Fi 4.6 Fish Creek - Recreation

HUC 041100020305 (part)

Problem Statement Fi-6: Recreational Opportunities

There are limited recreational opportunities along or related to Fish Creek. The City of Kent is developing a trail loop along Fish Creek. Although some Kent parks are located along Fish Creek, the connection to the creek is not highlighted in the parks.

Goal / ***Objective***	**Actions**	**Lead/ cooperating organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal Fi-6a: Increase recreational opportunities along Fish Creek and in the subwatershed by 3 miles and 1 sites.				
Fi 6a-1 Continue to develop 3 miles of the planned Kent Parks loop and trail centered on Fish Creek				
	1 Submit grant proposal	City of Kent	funding, plans, design - Kent State University students could help with assessments, etc.	
	2 Wetland delineations		Assistance from KSU classes	
	3 Design/build			
	4 signs			
	5 Brochure/outreach			
FI 6a-2. Develop 1 River Quest or virtual watershed tour				
	1 Determine appropriate River Quest structure (cuyahoga canalway or new one)	WC, partners, volunteers, parks	Permission to develop quests, printing costs	2 quests by 2017 or 1 watershed tour by 2017
	2 Public workshop concerning River quests			
	3 Seek quests from volunteer groups			
	4 Review, print, distribute		funding for printing, place on website	
Fi 6a-3 Improve access points at 1 location				
Goal Fi 6b: Increase awareness of recreational opportunities, stewardship, and watershed issues.				
Fi 6b-1. Economic impact study recreational uses		WC with KSU	outside funding	1 study by 2018
	1 Coordinate with KSU and others on study			
	2 Submit grant proposal			
	3 Conduct study			
	4 Publicize			
Fi 6b-2. Increase signage related to Fish Creek at local parks by 6 signs.				
	1 apply for funding			
	2 Design, install signs			
	3 Continued outreach with local communities			
Fi 6b-3 Update, increase, and disseminate available information concerning recreational opportunities and care of Fish Creek, its tributaries, and watershed.				
	1 Web page of recreational opportunities/access	wc		
	2 Other Actions - see Fi 1a-6			
FI 6b-4. Increase stewardship activities related to watershed issues				
	Actions - See Fi 1a-7			
Fi 5b-5. Continue to acquire 25 ac conservation land in the planned Kent Parks Fish Creek loop.				

7 Plum Creek
HUC 041100020301

1 Summary of Existing Conditions

Tables Pl 1 and 2 summarize key characteristics and impairments of this subwatershed. Figure Pl-1 shows the subwatershed and jurisdictions. Figures Pl-2 and 3 show potential areas of concern and resource areas for protection. Greater detail is shown in the various maps in Vol. I.) Also see photos in Section 4P, Plum Creek.

The landscape of the Plum Creek subwatershed is somewhat evenly divided between woods/wetlands/scrub-shrub (28 percent), agriculture (24 percent), and low-moderate intensity development (33 percent, with 11 percent developed open space). Prior to the economic downturn beginning in 2007-2008, several communities in this subwatershed were experiencing rapid development. When new development starts occurring in the region, it is likely that these communities will be the focus of new growth again.

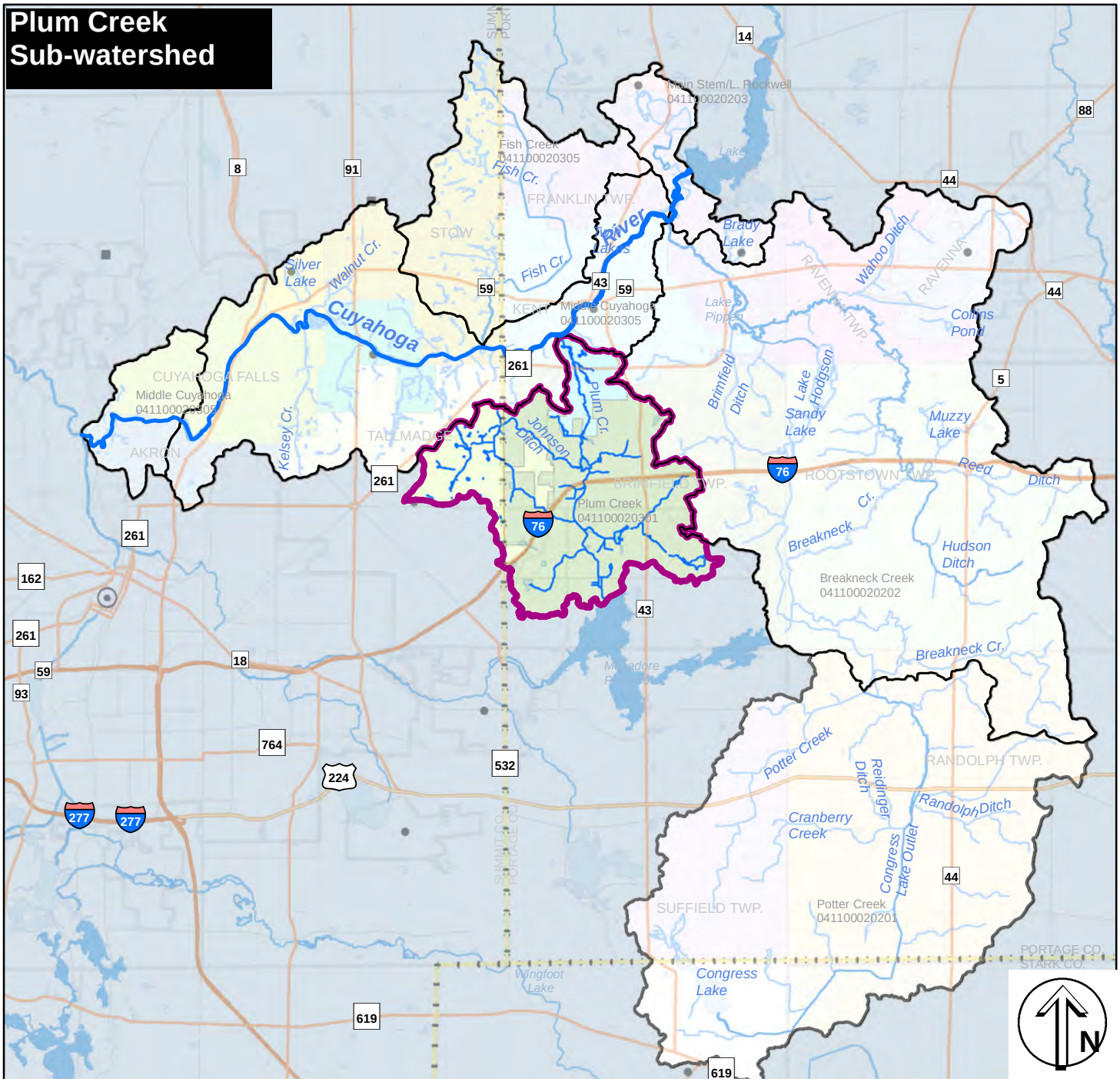
Approximately 12 miles of the streams, primarily headwaters, are channelized. Approximately 4.7 miles of streams in this subwatershed is intact, primarily along the main stem of Plum Creek and flowing through extensive wetland systems. Some of the large wetland complexes contain species of concern. The Tom S. Cooperrider-Kent Bog protects one of the largest tamarack stands in the state, but much of the remaining wetlands are privately owned. The watershed contains three golf courses, one of which occupies much of a five-year time of travel zone of the Portage County public water supply wellfield.

In this subwatershed, priorities include:
- reducing negative effects of potential development,
- protecting key resources (riparian/wetland/habitat corridors, especially along Plum Creek, and the wellfield),
- addressing non-point source pollution from agricultural, construction sources, and septic systems
- improving stream function in channelized areas,
- and protecting the Portage County public water supply.

Several large portions of land are held by a few landowners, suggesting the potential for a coordinated approach to management, restoration, or conservation, with these land owners.

Assessment and Attainment
Plum Creek was assessed at two locations in 2000, with chemical monitoring at both locations in 2007. In 2000, it was in attainment of WWH standards. Based on limited observations, it appears that the sampling location is within an area surrounded by woods, wetlands, and accessible floodplains, and would likely continue to meet WWH standards. Impairments noted include flow/habitat alteration and non-point source pollutants (nutrients and siltation). Sources noted include dams, channelization, urban runoff, and septic systems. The dam at Plum Creek Park has been removed, but 12 miles of the streams remain channelized, mostly along tributaries. In addition to the noted sources of non-point source pollution, erosion from agricultural fields and pastures (with unrestricted livestock access) has also been observed.

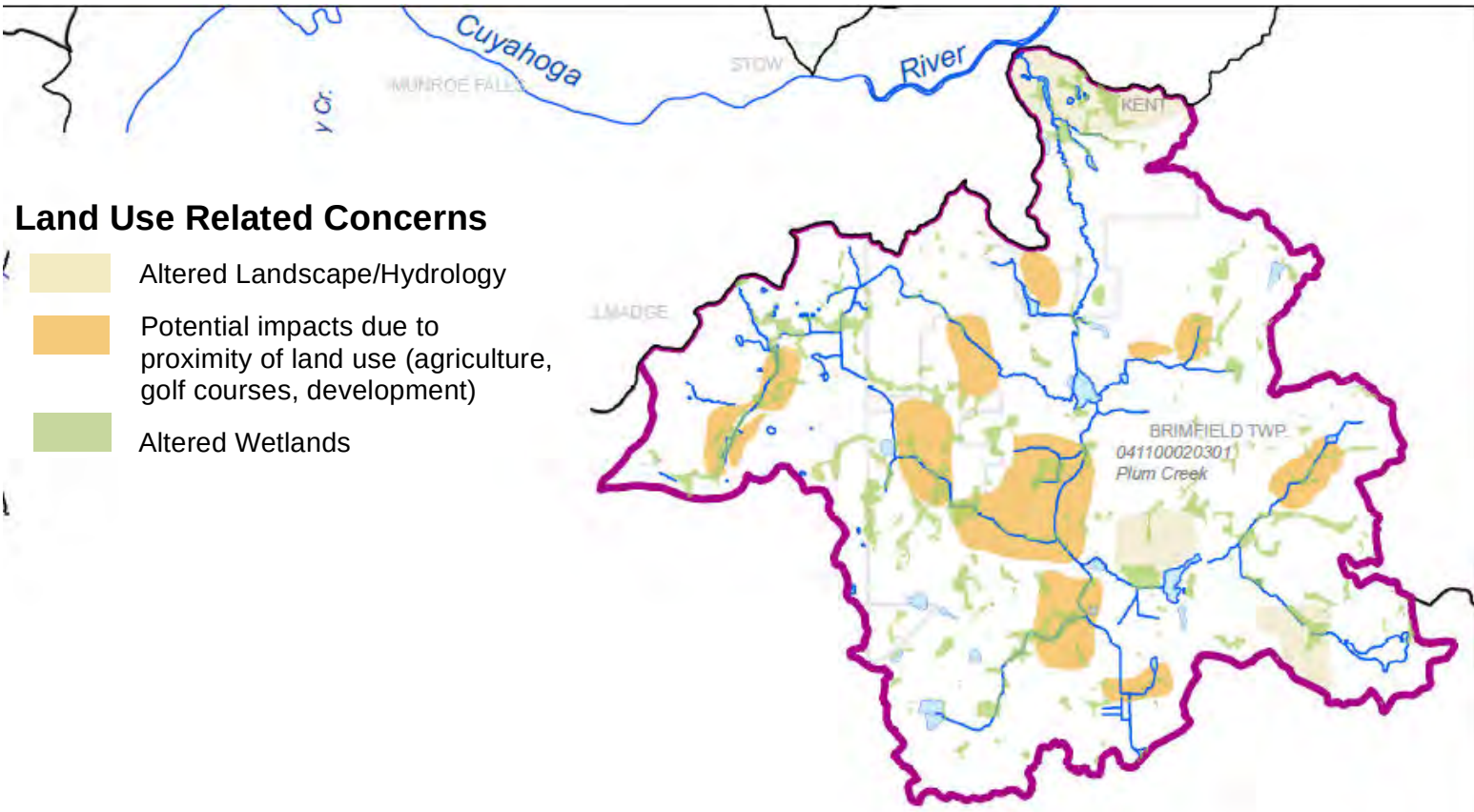
With recent development in the area, it is important to continue monitoring water quality of the creek.



***Sources:** NEFCO, 2010; Portage County GIS 2010; Summit County GIS 2009; Stark County Planning Commission 2010; Ohio DNR GIS 2010*

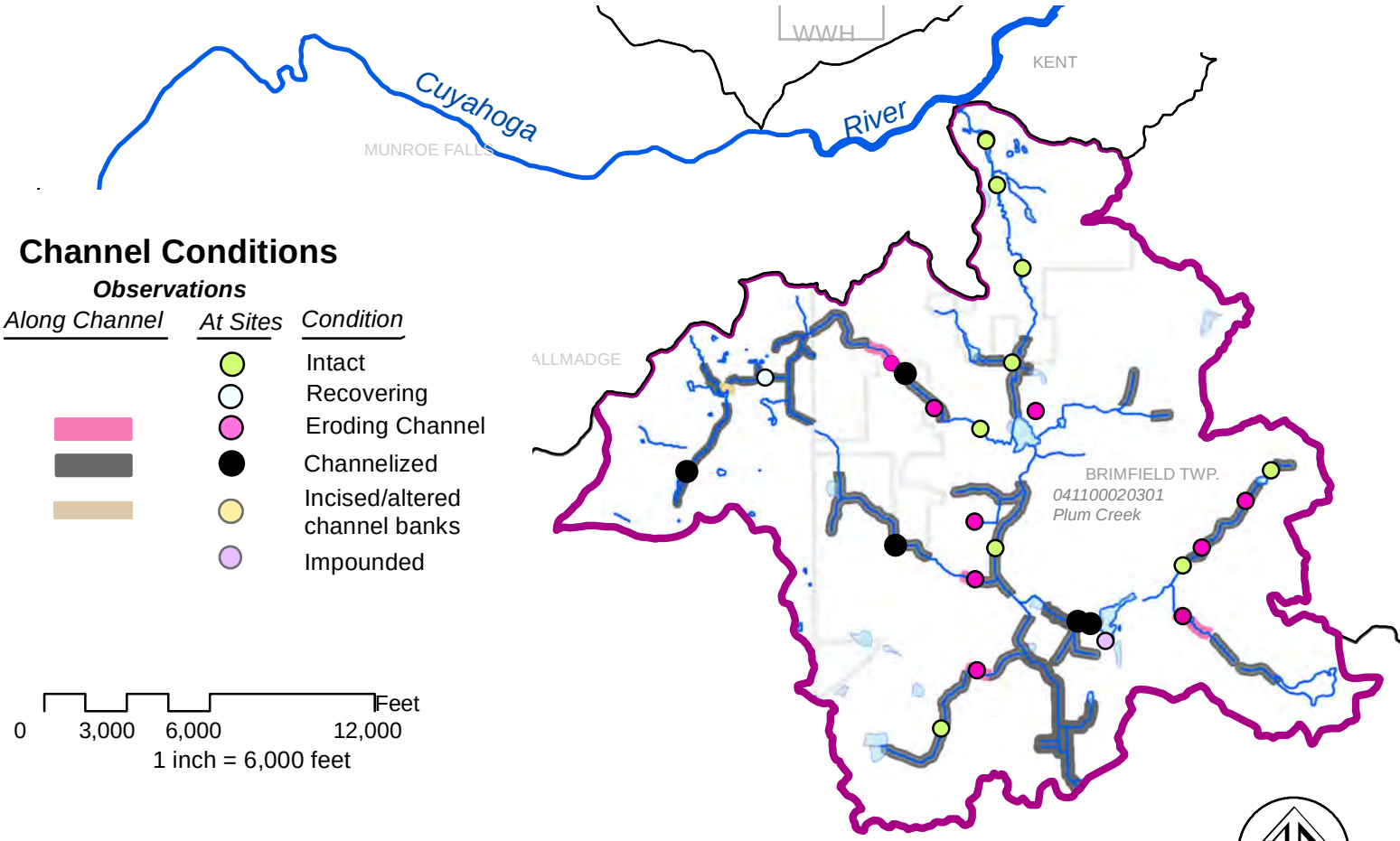
Figure PI-2 Problem Areas Plum Creek Subwatershed

Plum Creek Subwatershed
041100020305 Fish Creek — Other Subwatershed, 12-Digit HUC
Streams and Rivers
Lakes
WWH — Aquatic Life Use Designation



Land Use Related Concerns

- Altered Landscape/Hydrology
- Potential impacts due to proximity of land use (agriculture, golf courses, development)
- Altered Wetlands



Channel Conditions

Observations

Along Channel	*At Sites*	*Condition*
		Intact
		Recovering
		Eroding Channel
		Channelized
		Incised/altered channel banks
		Impounded

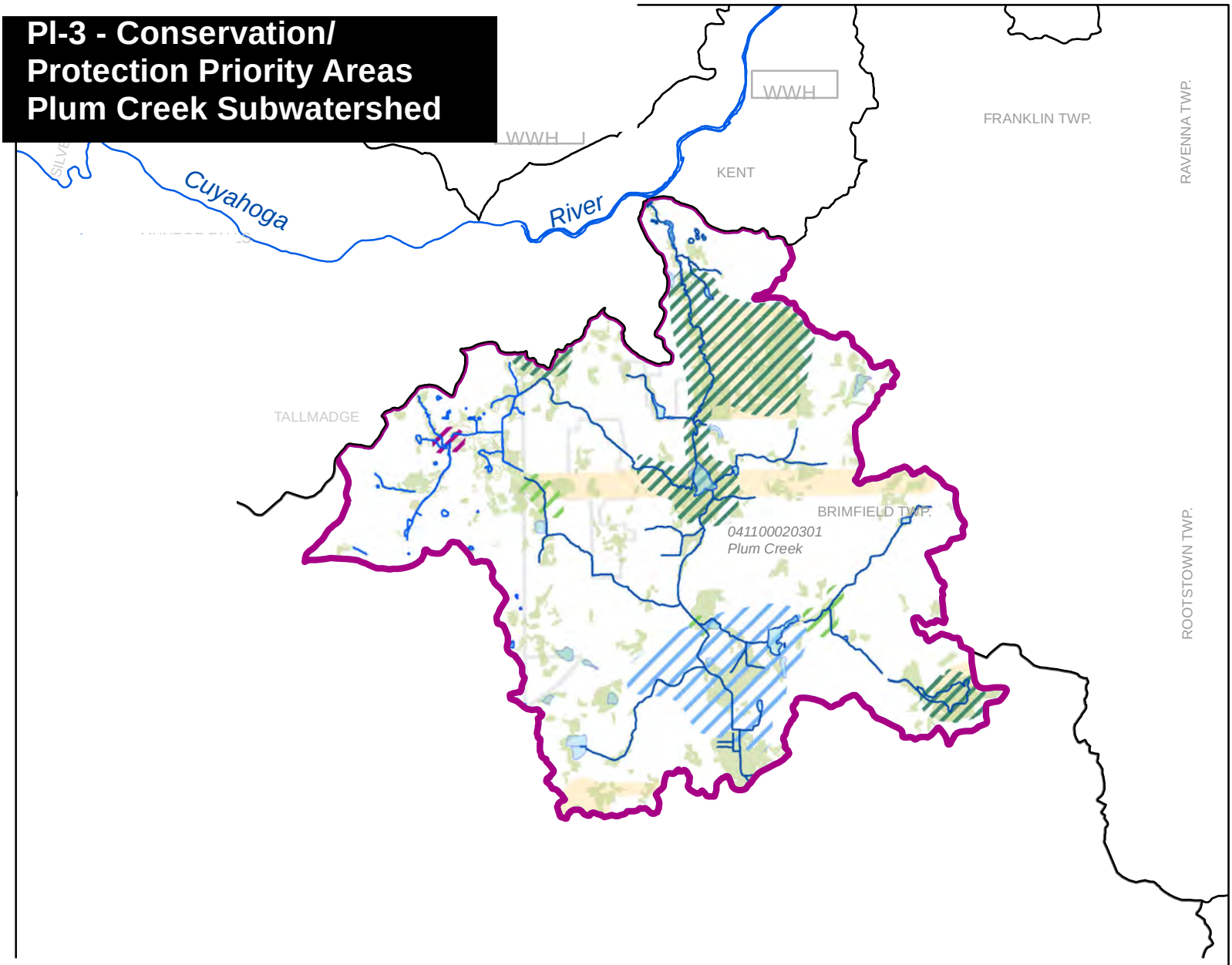
0 3,000 6,000 12,000 Feet

1 inch = 6,000 feet

N

**Problem areas are approximate, identified by limited interpretation of 2006 aerial photography, visits to stream crossings, and flooding, impoundment, or eutrophication concerns identified by partners or in Ohio EPA documents. Sources: NEFCO 2010, Summit, Portage, and Stark Co. GIS 2009-2010; Ohio DNR GIS base map, 2006 OSIP aerial photography.*

PI-3 - Conservation/ Protection Priority Areas Plum Creek Subwatershed



Conservation/Protection Priority Areas

- Riparian Corridor/Wetland
- Wetlands of Additional Importance (e.g., buffering) - enhance/protect
- Water Supply Protection - Conservation/BMPs/Outreach
- Restoration/Conservation of Riparian Area/Wetlands
- Mapped Wetlands
- Habitats or Species of Concern - Identified on DNR biodiversity database spanning 30 years; Western Reserve Land Conservancy workshop, 2010.)

- Streams and Rivers
- Lakes
- WWH — Aquatic Life Use Designation
- 041100020305 Fish Creek — Subwatershed, 12-Digit HUC
- Local Jurisdictions

N

0 3,000 6,000 12,000 Feet

1 inch = 6,000 feet

*Sources: NEFCO 2010, Summit, Portage, and Stark Co. GIS 2009-2010; Ohio DNR GIS base map, biodiversity data; 2011. Western Reserve Land Conservancy GIS mapping of conservation areas, 2010; Summit and Portage Counties wetland mapping conducted by Davey Resource Group, 2000-2004. Stark County -2003 land cover mapping; CCAP - NOAA coastal Change Analysis Program 2006 mapping.

Table Pl-1
Summary of Plum Creek Subwatershed Characterisitcs

Concern	Amount/Item	Comments
Water Quality Attainment, latest assessed	Plum Creek has been monitored at two locations in 2000 and 2007 and was in attainment of WWH water quality standards in 2000.	The sampling site is in a wetland/ woods complex, likely to continue to attain WWH standards.
Public water supplies	Portage County wellfield	
Land Cover acres, %	Developed 2,884 34.2% • *High Density* *121* *1.3%* • *Moderate Density* *479* *5.4%* • *Low Density* *1,186* *15.9%* • *Dev. Open Space* *1,089* *11.6%* Agricultural 1,563 24.4% Grassland/scrub-shrub 330 3.5% Woods/wetlands 2,842 24.5%	
Imperv./runoff	11.3% **Additional runoff 3/4" storm**: 13 million gal.	
75 foot buffer	Developed 18% *Dev. Open Space 9%* Agricultural 33% Woods/wetlands 49%	Much of lower Plum Creek and portions of Johnson Ditch are intact.
Wetlands (ac)	**Mapped** 1,388 **Converted** 698 ac. (hydric) 946 ac.(hydric incl.)	
Future development	Brimfield and Rootstown near I-76 were developing rapidly prior to economic downturn that began in 2007-2008.	
Channel quality (miles)	**Intact** **Altered/channelized** **Eroding** **Recovering** 4.7 12.2 .5 (incl. livestock) 1	2 mi of Plum Creek, portions of Johnson Ditch intact, tribs - altered.
Non-pt source load/yr	**Tot. N** (lb) 30,725 **Tot. P (lb)** 5,799 **Sed**. (tons) 888	
Septic systems	Portions of Brimfield not served by sewers, 2 or more severe limitations	
Problem areas	Sediment erosion from construction and agricultural sites; eroding stream banks; channelization; high development potential	
Resource areas	Portage County wellfield 5 year zone; habitats of concern, wetlands; Plum Creek riparian corridor	
Park/conserv./inst.	Plum Cr. Park, Kent Bog, Brimfield Twp. Park, JayCee Park (Tallmadge)	
Riparian setback	Kent, Tallmadge, and Brimfield	
Recreational opportunities	Plum Creek Park in Kent and restored creek; Howe Ave/Jaycee park, Tallmadge; Kent Bog Nature Preserve; Brimfield Twp Park	

Table Pl-2 Summary of Impairments
Plum Creek
HUC 041100020301

	Attainment issue/other concern	**Cause**	**Source**	**Other likely sources**
	HUC: 041100020301 Plum Creek	Direct habitat alteration Flow alteration Nutrients Organic enrichment/DO Siltation Total toxicity Unknown toxicity	Channelization – development Dam construction* Major municipal point source Natural Septic systems Sewer construction Urban runoff	Ag runoff Livestock access Development Impervious surface Construction runoff
			*Plum creek dam has since been removed.	
	Streambank erosion			Excess water, livestock access, lack of riparian veg., lack of floodplain access construction
	Flooding problems?			
	LOCAL CONCERNS			
	Wetland and habitat loss – existing and potential			
	Wellhead protection		Contaminants urban runoff, fracking	

7/15/2012

Non-point Source Pollution – sediment, nitrogen, phosphorous *(See Problem Statements Pl-1, Pl-2, and Pl-3)*

Siltation and nutrients are listed as causes of impairments, with noted sources including septic systems and urban runoff. Erosion from agricultural fields, banks, ditches, and uncontrolled livestock access has been observed. Much of the Plum Creek subwatershed is served by sewers or planned for sewer service. In the remaining areas, minimal areas present two or more severe limitations. The Plum Creek subwatershed is 11 percent impervious, which is near the threshold of degradation. This STEP-L model indicates this subwatershed generates, 30,725 lb/year of nitrogen, 5,739 lb per year of phosphorous and 888 tons per year of sediment through surface runoff, failing septic systems, and bank erosion. Channelization contributes to siltation by allowing sediment to accumulate in the channels. Over 600 acres of wetland have been converted, predominantly along the headwater tributaries, and approximately half of the 75-foot buffer has been altered, reducing pollutant uptake and flood storage, and degrading habitat. Future development will increase the imperviousness, runoff, and alterations.

Public Water Supplies *(See Problem Statement Pl-4)*
Brimfield contains a wellfield and wellhead protection area for the Portage County public water supply. The five-year time-of-travel zone around the Portage County wellfield is largely unprotected and resides within an active golf course, raising the potential for groundwater contamination. Concerns have been raised about the potential for groundwater contamination from "fracking."

Habitat *(See Problem Statement Pl-5)*
Siltation is degrading habitat in Plum Creek streams. Approximately half of the 75-foot buffer is developed or agricultural, and half is woods/wetlands. As noted above over 600 acres of wetlands have been converted. Development fragments intact habitat. Only about 4.7 miles of the channels in this watershed are intact, predominantly in the lower reaches of Plum Creek. The rest is channelized and/or eroding, primarily along Johnson Ditch and other tributaries.

The City of Kent recently restored a dammed portion of the lower creek in Plum Creek Park to a free-flowing state and reconstructed floodplains and other riparian features. The lower portion of Plum Creek flows through an intact riparian corridor, with fringing wetlands, floodplains, riparian zones, and floodplains. Protecting this remaining corridor is important, as it is maintaining the quality of the creek and helping to mitigate the effects of channelization and alteration upstream. The corridor is connected to a large wetland complex, a small portion of which is protected as the Kent Bog.

There are several parcels currently conserving portions of Plum Creek, its tributaries, and wetlands, including:

- The Cooperrider-Kent Bog Nature Preserve, protecting one of the largest stands of tamarack in Ohio.
- Parcels associated with the Portage County public water supply and Mogadore Reservoir.
- The JayCee/Howe Ave. Park in Tallmadge protects a large, diverse wetland complex on Johnson Ditch (portions of which are culverted upstream of the park)
- The City of Kent owns the Plum Creek Park at the lower end of the creek immediately downstream of the most intact portion of the riparian corridor.
- Brimfield Township Park, much of which is undeveloped, encompasses headwater wetlands.

- The Tallmadge school district owns a substantial parcel downhill from two schools and the City recreation center. The school district recently reconstructed a ditched wetland into a large dry retention basin along this valley to handle stormwater from the new high school and recreation center. The Tallmadge-owned parcels provide an opportunity for additional enhancement or demonstration projects.

The Western Reserve Land Conservancy workshop (described in Section 4a-ii1) identified important areas to protect, including a large area including the protected Kent Bog, the intact Plum Creek corridor, and the lake within the Pleasant Lakes development. The workshop also identified a large wetland complex in the southeastern portion of the watershed as important to protect. These resources are currently intact but could be degraded by development. The ownership of much of the undeveloped land by a few owners presents opportunities to work with landowners to protect and/or restore large portions of the stream network, riparian corridor, wetlands, contiguous habitat, and habitat corridors.

Recreation *(Refer to Problem Statement Pl-6).*

There are limited opportunities for access to Plum Creek or its tributaries.

Direct access to Plum Creek or tributaries is found at JayCee Park in Tallmadge and Plum Creek Park in Kent. The Kent Bog Nature Preserve provides an opportunity for passive recreation in a tamarack bog. Parks located along Plum Creek, its tributaries, and wetlands could become the focus of a virtual watershed tour or other activities that bring the public to watershed features in parks. Additional access for passive recreation could promote stewardship/understanding of the riparian system.

2 Problem Statements, Goals, Objectives, and Actions

Table Pl-1.3 summarizes the actions proposed in the subwatershed and their associated pollutant load reductions, listing which problem statements/goals employ these tools. Tables Pl 4.1 through 4.5 present the problem statements, goals, objectives, and actions for each problem area. The tables are numbered to reflect each problem statement number, e.g., Table Pl 4.1 corresponds to Plum Creek (Pl) Problem Statement 1. It should be noted that because many of the objectives address more than one goal, the actions associated with each objective are listed only once, in the first table in which they appear (most frequently, Table Pl 4.1). All other listings of the same objective refer back to the actions at their first occurrence.

Refer to Sections 6 and 7a for a discussion of the format of the problem statements, goals, objectives, actions, and considerations for implementation.

Table Pl-3 Action Item Summary by Subwatershed: Plum Creek

12-digit HUC/ Water Body	Sed	Nutrients	GW contam	Habitat	Recreation	Category/Practices	Target amount by 2023	Units	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
041100020301												
						Riparian Restoration						
Plum Cr./tribs	√	√		√		Restore/stabilize eroding Streambank (Bio-Engineering/ re-contouring/ re-grading)	1000	Linear Feet	$25-200/lf	6	12.5	5
Plum Cr./tribs	√	√		√		streambank stabilization - pasture	3000	lf		14	38	10
Plum Cr. Tribs	√	√		√		Plant Native plants, trees, or shrubs in Riparian Areas	8	Acres	$4,000 + labor shrubs	4	67	7
						Stream Restoration						
Plum Cr. Tribs	√	√		√		Restore Flood Plain	10	Acre-foot		4	60	8
						Restore Channel	1000	Linear Feet	$100-200/	20		
						Feasibility study remove small low head	1	study				
						Wetland Restoration						
Plum Cr. Tribs	√	√		√		Reconstruct, Restore, Reconnect Wetlands	25	Acres	$5k-100k/ac.	25	700	158
						Home Sewage Treatment Systems						
Plum Cr.		√				Repair/Replace HSTS	10	HSTS			311	122
						Urban runoff and green infrastructure						
Plum Cr.	√	√				Rain gardens	6000	sq feet			0.5	0.1
Plum Cr.						Parking lot retrofit - bioinfiltration/ permeable pavement	5000	sq ft		0.02	1.1	0.14
Plum Cr. watershed	√	√				Storm water inventory	1	inventory				
Plum Cr.	√	√				Storm water retrofits	60	acres treated	$400-17k/ ac	2.7	30	12
Plum Cr. watershed	√	√				Retrofit drainage No-mow ditch/ veg swale/ daylighting	500	linear feet		0.05	0.4	0.2

Table Pl-3 Action Item Summary by Subwatershed: Plum Creek

12-digit HUC/ Water Body	Sed	Nutrients	GW contam	Habitat	Recreation	Category/Practices	Target amount by 2023	Units	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
Middle Cuyahoga River watershed						Neighborhood-scale green infrastructure	1		$25-50k design $20k bumpout	5	200	25
	√	√				**Agricultural BMPs**				150	110	6
Plum Creek watershed	√	√				Survey of practices	1	survey				
Plum Cr. and tribs	√	√				Construct 2-Stage Channel/overwide	500	Linear Feet			147	46
Plum Cr. and tribs						Install Grassed Waterways/ vegetated buffer strips	50	Acres treated		72	211	113
Plum Cr. watershed						Cover crops	100	acres		110	256	128
Plum Cr. watershed						Residue applied to fields	50	acres		55	128	64
Plum Cr. and tribs						Livestock Crossings	1	Crossings				
Plum Cr. and tribs	√	√		√		Install Livestock Exclusion Fencing & accompanying watering measures	3,000	Linear Feet	$11,300 + watering	7	56	12
						Conservation Easements						
Plum Creek main and trib	√	√		√	√	Acquire Wetlands/ conservation land/ easements	100	Acres	$5-25k/ac	prevent 100	prevent 2800	prevent 632
	√	√	√	√	√	**Education and Outreach**						
Plum Creek & tribs						Develop Brochures/Fact Sheets	10	Brochures/Fact Sheets				
Plum Creek						Watershed Festivals	2	Festivals				
Plum Creek						Websites	1	Website				
Plum Creek watershed						Install Signs	10	Signs	$200-500/ sign			
Plum Creek						Stream Clean-Ups	5	Clean-Ups				
Plum Creek						New lake/stream stewardship groups	1	new group active				
Plum Creek watershed						Conduct Workshops	5	Workshops				

Table Pl-3 Action Item Summary by Subwatershed: Plum Creek

12-digit HUC/ Water Body	Sed	Nutrients	GW contam	Habitat	Recreation	Category/Practices	Target amount by 2023	Units	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
Plum Creek watershed						Conduct Training		Training Sessions				
Plum Creek watershed						Develop Manual(s)	1	Manuals				
Plum Creek watershed						Rain barrel workshops	50	rain barrels				
Plum Creek watershed						Outreach for golf courses	2	golf courses contacted				
Plum Creek watershed						Develop Newsletters		Newsletters				
						Local Policy						
Plum creek watershed	√	√		√		Green code audit/update Develop or Customize	2	audits/ updates				
						Monitoring						
Plum Creek		√		√		Chemical Sampling	1	Sites				
Plum Creek	√			√		Macroinv./Fish/QHEI Sampling		Sites				
						Recreation						
						Construct trail	1	mile				
Plum Creek					√	Construct access sites	1	site				
Plum Creek watershed					√	Economic benefit study	1	study				
Plum Creek watershed					√	Develop quest(s)/ virtual watershed tour	2 quests/ 1 tour					
Total										474.77	2328.5	716.44

Table Pl 4.1 Plum Creek - Sediment

HUC 041100020301

Plum Creek (Pl) Problem Statement 1: Sediment

Siltation has been identified as a cause of non-attainment. Excess sediment is of concern in the Middle Cuyahoga River, downstream in the shipping channel and in Lake Erie, because of the nutrients that enter the water with the sediment. The STEP-L model indicates that the watershed contributes 888 tons of sediment from runoff and eroding streambanks due to excess storm water, inadequate flood storage, and unrestricted livestock access. Mapping indicates alteration of at least 698 acres of wetland, loss of riparian features (floodplain access, riparian zone) of nearly 12.2 miles of streams, and alteration of approximately 50% of riparian corridor within 75 feet. The loss of beneficial watershed features reduces the flood-storage capacity and vertical stability of watershed tributaries. Potential loss of riparian vegetation with further development could result in increased loading and reduced storage in the future.

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Goal Pl 1a Reduce streambank erosion, thereby reducing sedimentation by 43 tons per year.				
Pl 1a-1 Stabilize 1,000 lf of eroding tributary banks, improve morphology, and restore vertical stability, in order to reduce sediment loading by 5 tons/year.				
Target areas: eroding streams				
	1 Identify target areas using mapping			
	2 Work with partners to determine priorities			
	3 submit grant proposal(s)			
	4 Develop restoration strategies			
	5 Submit grant proposal, design/build, coordination, signage,			
	6 Outreach with neighborhoods			
	7 Restoration work - vertical stability, banks, floodplain		$100-250/linear foot plus plantings	
	8 Encourage volunteer assistance with riparian plantings etc.		plants, planting plan	
	9 Install signage - riparian buffer, etc.	Partners, WC, communities	$200-300/sign	
	10 Comment on wetland alteration permit applications concerning impacts to watershed functions/riparian setbacks	WC and partners		on-going
Pl 1a-2 Stabilize 3,000 l.f. of stream bank with livestock access, in order to reduce sediment loading by 38 tons/yr				
Focus areas, e.g., Tributaries with livestock access				
	1 Map target areas to investigate for wetland, floodplain, riparian, habitat, or stream corridor restoration/protection/ enhancement	WC, partners	available mapping - compile and build on previous efforts	1 map by 2014, revisit and update if necessary every 3 years
	2 Meet with landowners to determine interest	WC, partners		
	4 Submit grant applications	WC, partners		
	5 Restore floodplain access/flood storage		design-build consultant	
	6 Public outreach			

Table Pl 4.1 Plum Creek - Sediment

HUC 041100020301

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Goal Pl 1b Reduce sediment from urban runoff by 3.7 tons/yr.				
Pl 1b-1 Install 5,000 sq ft green infrastructure retrofit (e.g., bioinfiltration/permeable pavement) in developed area, to reduce sediment loading by 0.02 tons/yr				
Focus areas, e.g., parking lots public facilities				
	1 Submit grant proposal	WC		
	2 Inventory of green infrastructure opportunities	WC, partners, with guidance from outside consultant?	mapping, intern?	1 inventory of top sites
	3 Design/construct green infrastructure	Communities	engineering capability - outside consultant?	Retrofit 1 by 2022 to treat 10 ac institutional.
	4 Green infrastructure codes workshop	WC, partners, CSU, developers	location, materials, fee	1 workshop series by 2015
	5 Evaluate and update local ordinances for opportunties to reduce pavement, improve use of green infrastructure, conservation development, etc. in new/existing development	WC/communities	Volunteers/ interns can assist - outside funding could be used for consultant and/or work-shop - could be done with Portage zoning official meetings	2 code audits by 2017; update 1 code by 2018 (Kent/Portage??)*
	6 Outreach with developers, local officials			
Pl 1b-2 Retrofit stormwater volume devices to improve water quality from 60 acres of residential land, in order to reduce sediment loading by 2.7 tons/yr				
	1 Stormwater retrofit inventory		WC/NEFCO with communities	
	2 Submit grant application			
	3 Design/construct retrofit to improve water quality	Communities	Varies, depending on treatment provided (e.g., $400/acre treated to $17,000 per acre treated)	Retrofit 2 by 2022, 1 every 8 years afterward
Pl 1b-3 Retrofit 500 lf of roadside ditch in no-mow grass/veg swale/daylighiting to reduce sediment loading by 0.5 tons /year.				
	1 Workshop on maintaining ditches/improving drainage for water quality improvements	SWCD	Location, materials	
	2 Install 500 lf of drainage with retrofit			
Pl 1b-4 Install 500 lf of vegetated swale at Plum Creek Park to reduce sediment loading by 0.5 tons/yr.				
Pl 1b-5 Establish two monitoring efforts for QHEI/chemistry along Plum Creek with volunteer, school, or university groups.				
Pl 1b-6 Conduct survey of yard management practices				
Pl 1b-7 Develop stormwater management design manual for Portage County				
	1 Stormwater management design manual for Portage County	Portage SWCD	In-house task	1 manual by 2014
Pl 1b-8 Maintain Stream database				1 database
Pl 1b-9 Facilitate review and update of local codes to include measures for green infrastructure				
	1 Green code audit workshop			

Table Pl 4.1 Plum Creek - Sediment

HUC 041100020301

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
	2 Review codes in two communities for green infrastructure language	partners	volunteers/consultant	
	3 update code language		possibly outside consultant/funding	1 community by 2022
Pl 1b-10 Conduct workshops on use BMPs at urban sites				
	1 Stormwater management design manual for Portage County	Portage SWCD	In-house task	1 manual by 2015
	2 Workshops for community officials on developing/enforcing riparian setbacks	partners, PIPE		2 workshops by 2015; additional workshops - included in general workshop series
	3 Workshops for community officials on enforcing bmp requirements			
Pl 1b-11 Conduct Education outreach to encourage golf course operators to adopt Audubon Habitat practices				2 contacts
	1 funding			
	2 outreach			
	3 workshops			
	4 assistance			
Pl 1b-12 Conduct public outreach by providing information and studies electronically or in print.				
	1 Continue to compile, centralize, and make available studies, data, information sources on the watershed, including recreational opportunities, volunteer needs, permitting or regulatory issues; green infrastructure information sources, etc.	WC	Website, technical information and outreach materials	Update and develop pages for website by Dec. 2013, then on-going
	2 e-newsletter or article issued 3 times per year	wc	website, share with partners	
	3 Develop/reproduce informational brochure or website article concerning topics of interest, including reducing runoff, recreational opportunities, private wells, septic systems etc.	WC, health depts, SWCDs	technical/outreach materials, possibly printing costs	10 by 2022; 1 each year
Pl 1b-13 Conduct 18 outreach/stewardship activities related to non-point source pollution and watershed issues.				
	1 Establish clean-up/monitoring/planting efforts at additional tributaries and lakes	WC, communities, parks, residents, home-owners' associations, lake associations	Funding or donation of trash disposal, refreshments, monitoring supplies, crew leaders, volunteers; training for monitoring/planting	1 new tributary or lake monitoring, clean-up, or other stewardship program by 2018
	2 Distribute 50 rain barrels through workshops	SWCDs/ Communities	Space for workshop; rain barrel kits	50 rain barrels distributed
	3 Survey of yard management practices	WC/partners		

Table Pl 4.1 Plum Creek - Sediment

HUC 041100020301

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
	4 Develop/reproduce informational brochure or website article concerning topics of interest, including reducing runoff, recreational opportunties, private wells, septic systems etc.	WC, health depts, SWCDs	technical/outreach materials, possibly printing costs	10 by 2022; 1 each year
	5 Educational outreach workshops on topics of importance, including LID/green infrastructure, restoration, field trips for examples	Partners, WC, communities	Location, speaker, supplies	5 workshops by 2022; 1 every 2 years (listed under other topics)
	6 Work with schools or city day camps to develop/encourage use of watershed care activities/curricular items	WC, SWCDs, partners, schools		1 educational outreach program/curriculum item by 2018
	7 River Day festivities	Portage Parks, partners		3
	8 Watershed "brand," logo, art project	WC, Kent State/ Standing Rock Gallery/River Day communities	Host for project, graphic design capabilities	1 logo or art project by 2015, then 1 every 3 years;
	9 Create social network or google presence	WC		1 by 2014
MCR-1 Establish 1 neighborhood-scale green infrastructure projects as demonstration within the developed areas of one of the Middle Cuyahoga River subwatersheds, where suitable neighborhoods are identified, reducing loading of nitrogen by 200 lb/year, phosphorous by 25 lb/yr, and sediment by 5 tons/yr				
	1 Work with communities to identify suitable target neighborhoods	WC, partners		
	2 Meetings to gauge neighborhood support			
	3 Determine/establish maintenance framework (e.g., easements, homeowner participation)	partner community		
	4 Get grant(s)			
	5 Design/build	outside consultant	Site, outside funding. Design ~$25-50,000; Rain gardens $15-20/sq. foot; Green street bump-outs $20,000 each; per-meable concrete $12-15/ sq. ft	1 project by 2022
	6 Outreach, neighborhood participation			
Goal Pl 1c Reduce sediment loading from agricultural runoff by 244 tons/yr				
Pl 1c-1 Install 3,000 lf of livestock exclusion and accompanying measures to reduce sediment loading by 7 tons per year				
	1 Contact landowners to determine willingness			
	2 Submit proposal for grant funds			
	3 Work with landowners to install measures			
	4 Outreach			
Pl 1c-2 Conduct survey of existing agricultural practices				
	1 Develop survey of existing practices			
	2 Administer survey to willing landowners			
	3 Windshield survey of visible practices			

Table Pl 4.1 Plum Creek - Sediment

HUC 041100020301

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
	4 Tally and summarize survey results			
	5 Outreach with property owners based on results, use results to target practices			
Pl 1c-3 Install grassed waterway/buffer strips to treat 50 ac and reduce sediment by 72 tons /yr.				
Pl 1c-4 Install cover crops to treat 100 ac and reduce sediment by 110 tons/yr				
Pl 1c-5 Increase use of residue on ag fields by an additional 50 acres, reducing sediment loading by 55 tons/yr				
Goal Pl 1d Restore riparian features to reduce sediment loading by 33 tons/yr.				
Pl 1d-1 Plant 8 ac of deep-rooted riparian vegetation, reducing loading of sediment by 4 tons/yr Focus areas: large parcels single ownership, headwaters.				
	1 Submit grant applications e.g., OEEF	WC/SWCDs/partners		
	2 Targeted outreach to public, institutional, and other owners of large properties	WC**/SWCDs/ Communities	Lists of golf courses, lake associations, homeowners' associations; maps of large parcels; printed outreach materials.	Target 1 group every 3 years (3 by 2022); improvements to best management practices or riparian management at one site every 4 years(2 sites by 2020); 2 outreach contacts per year
	3 Outreach to golf course owners encouraging Audubon-certification		labor, printing	
	4 Assist with plantings	SWCDs, master gardeners	native plants/trees and shrubs $250 ($500-1,000 per acre);	
	5 Construct and install signage	communities, partners,	$300-500/sign	
	6 Follow-up outreach (individualized guide to riparian zone) and publicize		funding for handouts/brochures	
Pl 1d-2 Restore 25 ac of wetland, in order to reduce sediment loading by 25 tons/year.				
	1 Map target areas to investigate for wetland, floodplain, riparian, habitat, or stream corridor restoration/protection/ enhancement	WC, partners	available mapping - compile and build on previous efforts	1 map by 2013, revisit and update if necessary every 3 years
	2 Meet with landowners to determine interest	WC, partners		
	3 Identify wetland restoration site for clearinghouse	WC, Communities, other partners	meetings with landowners; readily available mapping, outside assistance from consultant, possible assistance from Kent State University wetland ecology class	5 concept plans by 2020; 1 every 2 years afterward.
	4 Submit grant application			
	5 Restore/protect/enhance wetlands	Partners	$5,000-$100,000 per acre, design/build consultant, sites -protection by ease- ments would be at the low end of the range	25 acres by 2024

Table Pl 4.1 Plum Creek - Sediment

HUC 041100020301

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Pl 1d-3 Restore 10 acre-ft of floodplain access, in order to store 4 tons of sediment per year.				
	1 Map target areas to investigate for wetland, floodplain, riparian, habitat, or stream corridor restoration/protection/ enhancement	WC, partners	available mapping - compile and build on previous efforts	1 map by 2014, revisit and update if necessary every 3 years
	2 Hold meetings with landowners to determine interest	WC, partners		
	3 Submit grant proposals			
	4 Design & Restore floodplain access/flood storage			
	5 Public outreach			
Goal Pl 1e Reduce causes of streambank erosion by reducing channel loading/increasing flood storage by 98,000 cu ft. in a 3/4 in storm.				
Pl 1e-1 Conduct 6 meetings/workshops among neighboring communities regarding watershed approaches to reducing stormwater effects				
	1 Coordinate with nearby communities/schools to identify areas of concern or opportunity			4 meetings
	3 Coordinated stormwater study on target areas??		outside funding or assistance	
	2 Workshops with public officials to address shared stormwater concerns			2 workshops
Pl 1e-2 Install 5,000 sq ft of permeable pavement/biofiltration in a developed site to reduce runoff by 937 cubic feet in a 3/4-inch storm.				
	Actions: See Pl 1b-1			
Pl 1e-3 Plant 8 ac of deep-rooted riparian vegetation, reducing channel loading by 5,800 cu ft in a 3/4 in storm.				
	Actions: See Pl 1d-1			
Pl 1e-4 Conduct outreach education with 2 golf courses to encourage use of Audubon International techniques.				
	Actions: See Pl 1b-11			
Pl 1e-5 Restore 25 ac of wetland, reducing channel loading by 16,500 cu ft in a 3/4 in event.				
	Actions: See Pl 1d-2			
Pl 1e-6 Restore 10 acre-ft of floodplain access, increasing storage volume by 435,600 cu ft.				
	Actions: See Pl 1d-3			
Pl 1e-7 Install 6,000 square feet of rain gardens, to reducing channel loading by 262 cu ft in a 3/4 in storm				
	1 Identify partners	WC, partners		
	2 Submit grant application	WC/partners		
	3 Workshop/installation	WC/partners		

Table Pl 4.1 Plum Creek - Sediment

HUC 041100020301

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Pl 1e-8 Facilitate review and update of 2 local codes to include measures for green infrastructure				
	Actions: See Pl 1b-9			
Pl 1e-9 Update, increase, and disseminate available information concerning sediment from urban runoff				
	Actions: See Pl 1b-12			
Pl 1e-10 Increase/sponsor 18 stewardship activities related to non-point source pollution and watershed issues.				
	Actions: See Pl 1b-13			
Goal Pl 1-f Protect wetlands and beneficial watershed features to reduce future loading of sediment by 100 tons/yr				
Pl 1f-1 Protect 100 acres of wetlands, through acquisition of land or easements, preventing increased loading of sediment by 100 tons/yr ***Target areas: Plum Cr. Riparian corridor, other remaining wetlands***				
	1 Mapping			
	2 Contact landowners/partner land trusts			
	3 Submit grant proposal			
	4 Acquire wetlands/easements			
Pl 1f-2 Conduct 2 workshops on effectively implementing riparian setbacks				

Table Pl 4.2 Plum Creek Nitrogen

HUC 041100020301

Plum Creek (Pl) Problem Statement 2: Nitrogen

Nutrients are listed as a cause of non-attainment in Plum Creek. While Nitrate+nitrite levels are below state EOLP median for WWH (0.4 mg/l) and state guidelines (1.0 mg/l), measurements generally increased from approximately 0.1 mg/l to 0.2 mg/l from 2000 to 2007, a period of rapid growth in the subwatershed. Middle Cuyahoga nitrate+nitrogen levels measured in 2007 frequently exceed the EOLP median (1.0 mg/l) and the state guidelines (1.5 mg/l), ranging from 0.9 mgl/l to 6 mg/l.

The STEP-L model indicates that the watershed contributes 30,725 lb of nitrogen from runoff, failing septic systems, unrestricted livestock access and eroding streambanks, related to excess stormwater and loss of flood storage. Mapping indicates alteration of at least 698 acres of wetland, loss of riparian features (floodplain access, riparian zone) along nearly 12.2 miles of streams, and alteration of approximately 50% of riparian corridor within 75 feet. Altered riparian features increases streambank erosion and associated nutrient loading, and reduced pollutant uptake. Continued development, increased imperviousness, and altered/degraded watershed features could result in increased loading and reduced storage in the future.

Goal ***Objective*** **Actions**	**Lead/ cooperating organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal Pl 2a Reduce streambank erosion, thereby reducing nitrogen loading by 50.5 lb per year.			
Pl 2a-1 Stabilize 1,000 lf of eroding tributary banks, improve morphology, and restore vertical stability, in order to reduce nitrogen loading by 12.5 lb/year.			
Actions: See Pl 1a-1			
Pl 2a-2 Stabilize 3,000 l.f. of stream bank with livestock access, in order to reduce nitrogen loading by 38 lb/yr			
Focus areas, e.g., Tributaries with livestock access			
Actions: See Pl 1a-2			
Goal Pl 2b Reduce nitrogen loading from urban runoff by 15 lb/yr.			
Pl 2b-1 Install 5,000 sq ft green infrastructure retrofit (permeable pavement/bioinfiltration) in developed area, to reduce nitrogen loading by 0.14 lb/yr			
Focus areas, e.g., parking lots public facilities			
Actions: See Pl 1b-1			
Pl 2b-2 Install 6,000 square feet of rain gardens, reducing nitrogen loading by 0.5 lb/yr			
Actions: See Pl 1e-7			
Pl 2b-3 Retrofit stormwater volume devices to improve water quality from 60 acres of residential land, in order to reduce nitrogen loading by 12 lb/yr			
Actions: See Pl 1b-3			
Pl 2b-4 Plant 500 lf of roadside ditch with no-mow grass to reduce nitrogen loading by 0.2 lb/yr.			
Actions: See Pl 1b-4			
Pl 2b-5 Install 500 lf of vegetated swale at Plum Creek Park to reduce nitrogen loading by 2 lb/yr.			
Pl 2b-6 Establish two chemical/QHEI monitoring efforts along Plum Creek with volunteer, school, or university groups.			
Pl 2b-7 Conduct survey of yard management practices			
Pl 2b-8 Develop stormwater management design manual for Portage County			
Pl 2b-9 Maintain Stream database			1 database
Pl 2b-10 Conduct outreach education with 4 golf courses to encourage use of Audubon International practices			
Pl 2b-11 Conduct workshops on use BMPs at urban sites			
Actions: See Pl 1b-7			
Pl 2b-12 Conduct public outreach by providing information and studies electronically or in print.			
Actions: See Pl 1b-9			

Table Pl 4.2 Plum Creek Nitrogen

HUC 041100020301

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Pl 2b-13 Conduct 18 outreach activities related to non-point source pollution and watershed issues.				
	Actions: See Pl 1b-10			
MCR-1 Establish 1 neighborhood-scale green infrastructure projects as demonstration within the developed areas of one of the Middle Cuyahoga River subwatersheds, where suitable neighborhoods are identified, reducing loading of nitrogen by 200 lb/year, phosphorous by 25 lb/yr, and sediment by 5 tons/yr				
Goal Pl 2c Reduce nitrogen loading from agricultural runoff by 754 lb/yr				
Pl 2c-1 Install 3000 lf of livestock exclusion and accompanying measures to reduce nitrogen loading by 12 lb per year				
	Actions: See Pl 1c-1			
Pl 2c-2 Conduct survey of existing agricultural practices				
	Actions: See Pl 1c-2			
Pl 2c-3 Install grassed waterway/buffer strips to treat 50 ac and reduce nitrogen by 211 lb/yr.				
Pl 2c-4 Install cover crops to treat 100 ac and reduce nitrogen by 256 lb/yr				
Pl 2c-5 Increase use of residue on ag fields by an additional 50 acres, reducing nitrogen loading by 128 lb/yr				
Pl 2c-6 Construct 500 lf of 2-stage/overwide ditch along existing ditched channel, to reduce nitrogen loading by 147 lb/yr.				
Goal Pl 2d Reduce nitrogen loading from failing septic systems by 300 lb/yr				
Pl 2d-1 Correct 1 failing HSTS per year, reducing nitrogen loading by 300 lb/yr Focus areas: vicinity of water courses				
	1 Inspect systems	PCHD		
	2 Correct failing/discharging home sewage treatment systems	Portage County Health District, landowners	Continued inspection and enforcement of illicit discharge regulations. Remedies depend on cause of failure and proximity of sewer service.	10 by 2022; 1 per year afterward
	3 Continue to investigate funding sources	PCRPC, PCHD, wc		
	4 Outreach:			
Goal Pl 2e Restore riparian features to reduce nitrogen loading by 827 lb/yr.				
Pl 2e-1 Plant 8 ac of deep-rooted riparian vegetation, reducing loading of nitrogen by 67 lb/yr Focus areas: large parcels single ownership, headwaters.				
	Actions: See Pl 1d-1			
Pl 2e-2 Restore 25 ac of wetland, in order to reduce nitrogen loading by 700 lb/year.				
	Actions: See Pl 1d-2			
Pl 2e-3 Restore 10 acre-ft of floodplain access, in order to store 60 lb of nitrogen per year.				
	Actions: See Pl 1d-3			
Goal Pl 2f Reduce causes of streambank erosion by reducing channel loading/increasing flood storage by 458,962 cu ft. in a 3/4 in storm.				
Pl 2f-1 Increase coordination between communities to reduce stormwater effects				
	Actions: See Pl 1e-1			
Pl 2f-2 Install 5,000 sq ft of permeable pavement/biofiltration in a developed site to reduce runoff by 800 cubic feet in a 3/4-inch storm.				
	Actions: See Pl 1e-2			
Pl 2f-3 Construct 6,000 sq ft of rain gardens, to reduce runoff by 262 cu ft in a 3/4 in event				

Table Pl 4.2 Plum Creek Nitrogen

HUC 041100020301

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
	Actions: See Pl 1e-7			
Pl 2f-4 Plant 8 ac of deep-rooted riparian vegetation, reducing channel loading by 5,800 cu ft in a 3/4 in storm.				
	Actions: See Pl 1d-1			
Pl 2f-5 Restore 25 ac of wetland, reducing channel loading by 16,500 cu ft in a 3/4 in event.				
	Actions: See Pl 1e-6			
Pl 2f-6 Restore 10 acre-ft of floodplain access, increasing storage volume by 435,600 cu ft.				
	Actions: See Pl 2b-3			
Pl 2f-7 Conduct outreach education with 2 golf courses to encourage use of Audubon International techniques.				
	Actions: See Pl 1b-11			
Pl 2f-8 Facilitate review and update of 2 local codes to include measures for green infrastructure				
	Actions: See Pl 1b-9			
Pl 2f-9 Update, increase, and disseminate available information concerning nitrogen from urban runoff				
	Actions: See Pl 1b-12			
Pl 2f-10 Increase/sponsor 18 stewardship activities related to non-point source pollution and watershed issues.				
	Actions: See Pl 1b-13			
Goal Pl 2g Protect wetlands and beneficial watershed features to reduce future loading of nitrogen by 2,800 lb/yr				
Pl 2g-1 Protect 100 acres of wetlands, preventing increased loading of nitrogen by 2,800 lb/yr Target areas: large wetland complexes along Plum Cr. other remaining wetlands, areas containing habitats of concern				
	Actions: See Pl 1f-1			
Pl 2g-2 Conduct 2 workshops on effectively implementing riparian setbacks				
	Actions: See Pl 1f-2			

Table Pl 4.3 Plum Creek Phosphorous

HUC 041100020301

Plum Creek (Pl) Problem Statement 3: Phosphorous

Nutrients are listed as a cause of non-attainment in Plum Creek. Phosphorous (P) levels measured in 2000 and 2007 ranged from 0.027-0.8 mg/l, occasionally exceeding the state median for EOLP headwaters of 0.5 mg/l. The Middle Cuyahoga exhibits signs of slight nutrient enrichment, with large diurnal oxygen swings suggesting increased algal activity. Cuyahoga River Total P levels measured in 2007 ranged from 0.044 to 0.37, occasionally exceeding EOLP targets for medium rivers (0.12 mg/l), especially in wet weather and downstream of Breakneck Cr. The STEP-L model indicates that the Plum Cr. watershed contributes 5,799 lb of phosphorous from runoff, failing septic systems, unrestricted livestock access and eroding streambanks, related to excess stormwater and loss of flood storage. Mapping indicates alteration of at least 698 acres of wetland, loss of riparian features (floodplain access, riparian zone) of 12 miles of streams, and alteration of approximately 50% of riparian corridor within 75 feet. The alteration of watershed features reduces the flood-storage capacity and vertical stability of watershed tributaries. Further development and loss of riparian vegetation could result in increased loading and reduced storage in the future.

Goal ***Objective***	**Actions**	**Lead/ cooperating organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal Pl 3a Reduce streambank erosion, thereby reducing phosphorous associated with sedimentation by 15 lb per year.				
Pl 3a-1 Stabilize 1,000 lf of eroding tributary banks, improve morphology, and restore vertical stability, in order to reduce phosphorous loading by 5 lb/year.				
Target areas: eroding streams				
	Actions: See Pl 1a-1			
Pl 3a-2 Stabilize 3,000 l.f. of stream bank with livestock access, in order to reduce phosphorous loading by 10 lb/yr				
Focus areas, e.g., Tributaries with livestock access				
	Actions: See Pl 1a-2			
Goal Pl 3b Reduce phosphorous loading from urban runoff by 13.2 lb/yr.				
Pl 3b-1 Install 5,000 sq ft green infrastructure retrofit (permeable pavement) demo project to reduce phosphorous loading by 0.14 lb/yr				
Focus areas, e.g., parking lots public facilities				
	Actions: See Pl 1b-1			
Pl 3b-2 Install 6,000 sq ft of rain garden to reduce phosphorous loading by 0.1 lb/yr				
	Actions: See Pl 2b-2			
Pl 3b-3 Retrofit stormwater volume devices to improve water quality from 60 acres of residential land, in order to reduce phosphorous loading by 12 lb/yr				
	Actions: See Pl 1b-2			
Pl 3b-4 Plant 500 lf of roadside ditch with no-mow grass to reduce phosphorous loading by 0.2 lb/yr.				
	Actions: See Pl 1b-4			
Pl 3b-5 Install 500 lf of vegetated swale at Plum Creek Park to reduce nitrogen loading by 0.8 lb/yr.				
Pl 3b-6 Establish two chemistry/QHEI monitoring efforts along Plum Creek with volunteer, school, or university groups.				
Pl 3b-7 Conduct survey of yard management practices				
Pl 3b-8 Develop stormwater management design manual for Portage County				
Pl 3b-9 Maintain Stream database				1 database
Pl 3b-10 Conduct Education outreach to encourage golf course operators to adopt Audubon Habitat practices				2 contacts

Table Pl 4.3 Plum Creek Phosphorous

HUC 041100020301

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Pl 3b-11 Conduct 2 workshops on use of BMPs at urban sites				
	Actions: See Pl 1b-7			
Pl 3b-12 Conduct public outreach by providing information and studies electronically or in print.				
	Actions: See Pl 1b-9			
Pl 3b-13 Conduct 18 outreach activities related to non-point source pollution and watershed issues.				
	Actions: See Pl 1b-10			
MCR-1 Establish 1 neighborhood-scale green infrastructure projects as demonstration within the developed areas of one of the Middle Cuyahoga River subwatersheds, where suitable neighborhoods are identified, reducing loading of nitrogen by 200 lb/year, phosphorous by 25 lb/yr, and sediment by 5 tons/yr				
	Actions: See MCR-1 Problem Statement 1			
Goal Pl 3c Reduce phosphorous loading from agricultural runoff by 353 lb/yr				
Pl 3c-1 Install 3000 lf of livestock exclusion and accompanying measures to reduce phosphorous loading by 12 lb per year				
	Actions: See Pl 1c-1			
Pl 3c-2 Conduct survey of existing agricultural practices				
	Actions: See Pl 1c-2			
Pl 3c-3 Install grassed waterway/buffer strips to treat 50 ac and reduce phosphorous by 113 lb/yr.				
Pl 3c-4 Install cover crops to treat 100 ac and reduce phosphorous by 128 lb/yr				
Pl 2c-5 Increase use of residue on ag fields by an additional 50 acres, reducing nitrogen loading by 64 lb/yr				
Pl 2c-6 Construct 500 lf of 2-stage/overwide ditch along existing ditched channel, to reduce phosphorous loading by 46 lb/yr.				
Goal Pl 3d Reduce septic system failure to reduce annual loading of phosphorous by 122 lb				
Pl 3d-1 Correct 1 failing HSDS per year, reducing nitrogen loading by 122 lb/yr Focus areas: vicinity of water courses				
	Actions: See Pl 2d-1			
Goal Pl 3e Restore riparian features to reduce phosphorous loading by 43 lb/yr.				
Pl 3e-1 Plant 8 ac of deep-rooted riparian vegetation, reducing loading of phosphorous by 12 lb/yr Focus areas: large parcels single ownership, headwaters.				
	Actions: See Pl 1d-1			
Pl 3e-2 Restore 25 ac of wetland, in order to reduce phosphorous loading by 316 lb/year.				
	Actions: See Pl 1d-2			
Pl 3e-3 Restore 10 acre-ft of floodplain access, in order to store 8 lb of phosphorous per year.				
	Actions: See Pl 1d-3			
Goal Pl 3f Reduce causes of streambank erosion by reducing channel loading/increasing flood storage by 458,700 cu ft. in a 3/4 in storm.				
Pl 3f-1 Increase coordination between communities to reduce stormwater effects				
	Actions: See Pl 1e-1			
Pl 3f-2 Install 5,000 sq ft of permeable pavement/biofiltration in a developed site to reduce runoff by 800 cubic feet in a 3/4-inch storm.				
	Actions: See Pl 1e-2			
Pl 3f-3 Construct 6,000 sq ft of rain gardens, to reduce runoff by 262 cu ft in a 3/4 in event				

Table Pl 4.3 Plum Creek Phosphorous

HUC 041100020301

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
	Actions: See Pl 1e-7			
Pl 3f-4 Plant 8 ac of deep-rooted riparian vegetation, reducing channel loading by 5,800 cu ft in a 3/4 in storm.				
	Actions: See Pl 1d-1			
Pl 3f-5 Restore 25 ac of wetland, reducing channel loading by 16,500 cu ft in a 3/4 in event.				
	Actions: See Pl 1d-2			
Pl 3f-6 Restore 10 acre-ft of floodplain access, increasing storage volume by 435,600 cu ft.				
	Actions: See Pl 1d-3			
Pl 3f-7 Conduct outreach education with 2 golf courses to encourage use of Audubon International techniques.				
	Actions: See Pl 1b-11			
Pl 3f-8 Facilitate review and update of 2 local codes to include measures for green infrastructure				
	Actions: See Pl 1b-9			
Pl 3f-9 Update, increase, and disseminate available information concerning phosphorous from urban runoff				
	Actions: See Pl 1b-12			
Pl 3f-10 Increase/sponsor 18 stewardship activities related to non-point source pollution and watershed issues.				
	Actions: See Pl 1b-13			
Goal Pl 3-g Protect wetlands to reduce future loading of phosphorous by 632 lb/yr				
Pl 3g-1 Protect 100 acres of wetlands, preventing increased loading of phosphorous by 632 lb/yr Target areas: Plum Creek riparian area, vicinity of Kent Bog				
	Actions: See Pl 1f-1			
Pl 3g-2 Conduct 2 workshops on effectively implementing riparian setbacks				

Table Pl 4.4 Plum Creek - Groundwater Supplies/Contamination

HUC 041100020301

Plum Creek Problem Statement 4, Groundwater/public water supply contamination

The subwatershed contains the Portage County wellfield, both of which is susceptible to contamination from surface spills and leaks to groundwater. The public water supply has a source water protection plan, but the contributing groundwater zone is largely privately owned and susceptible to contamination from uses or spills.

Plum Cr. HUC 041100020301

Goals			**Amount to complete, time frame**
Objectives	**Lead/ cooperating**		(contingent on funding, resources,
Actions	**Organizations**	**Resources needed/cost**	landowner willingness)
Goal Pl 4a Conduct coordination and public outreach to provide information concerning potential risks to groundwater quality and protective measures.			
Pl 4a-1 Develop fact sheet(s) or web page describing how to obtain information concerning oil/gas wells, and the related permitting process, safeguards, and inspections.			
1 Coordinate with state agencies and communities concerning fracking and controls			
2 Coordinate with state agencies to receive notification of drilling permit requests			
3 Outreach to communities and property owners - website, brochures, etc., concerning permitting process, protective measures that can be taken, etc.			
Pl 4a-2 Conduct outreach with community officials and property owners within the 5-year time of travel to provide education concerning reducing groundwater contamination from land use			
1 Coordinate with water suppliers concerning outreach needs			
2 Apply for funding if needed			
3 Develop and disseminate outreach materials - written, website			
Pl 4a-3 Conduct baseline monitoring for groundwater contamination from or near wells			
1 Baseline monitoring for groundwater contamination from or near wells	Portage Water Supply	funding for certain analyses, others in-house?	
Pl 4a-4 Conduct outreach education with 2 golf courses to encourage use of Audubon International techniques.			
Actions: See Pl 1b-11			
Pl 4a-5 Update, increase, and disseminate available information concerning watershed protection			
Actions: See Pl 1a-12			
Pl 4a-6 Increase/sponsor 18 stewardship activities related to non-point source pollution and watershed issues.			
Actions: See Pl 1a-13			

Table Pl 4.5 Plum Creek - Habitat

HUC 41100020301

Plum Creek (Pl) Problem Statement 5: Habitat Loss

Alteration of approximately 700 acres of wetland, 50% of vegetated riparian corridor, and loss of riparian features (e.g., riparian zone, channel form, floodplain access) along approx. 12 miles of watercourses has degraded riparian and wetland habitat in the subwatershed. Stream channel erosion degrades channel form and causes embedded substrate. The undisturbed riparian corridor and wetlands fringing much of lower Plum Creek have helped maintain the high quality of the creek in spite of agricultural and urban influences. A portion of the Kent bog wetland complex is protected as a nature preserve, but other Brimfield and Kent have wetland and riparian setback ordinances. However, to avoid the risk of encroachment or fragmentation, and conflicts related to private ownership, high value wetland complexes should be protected through easements or purchase.

Goals ***Objectives*** Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal Pl 5a Restore/improve 93 acres of altered habitat/stream channel morphology.			
Pl 5a-1 Plant 8 ac. of deep-rooted riparian vegetation. Focus areas: large parcels single ownership, headwaters.			
Actions: See Pl 1a-1			
Pl 5a-2 Restore/improve 25 acres of wetland habitat. Focus: *altered wetlands.*			
Actions: SeePl 1b-3			
Pl 5a-3 Restore 10 acre-ft of floodplain access/storage. Focus areas - areas with modified floodplain access.			
Actions: See Pl 1b-2			
Pl 5a-4 Remove/treat 50 acres of invasive species.			
Pl 5a-5 Conduct outreach education with 2 golf courses to encourage use of Audubon International techniques.			
Actions: See Pl 1b-11			
Pl 5a-6 Conduct feasibility study for removing small low-head dams			
Goal Pl 5b Reduce bank erosion from overloaded channels.			
Pl 5b-1 Stabilize 4,000 lf of eroding tributary banks, improve morphology, restore vertical stability, and reduce sedimentation. Target areas: eroding streams			
Actions: See Pl 1a-1			
Pl 5b-2 Increase coordination between communities to reduce stormwater effects			
Actions: See Pl 1e-1			
Pl 5b-3 Install 5,000 sq ft of permeable pavement/biofiltration in a developed site to reduce runoff by 800 cubic feet in a 3/4-inch storm.			
Actions: See Pl 1e-2			
Pl 5b-4 Construct 6,000 sq ft of rain gardens, to reduce runoff by 262 cu ft in a 3/4 in event			
Actions: See Pl 1e-7			
Pl 5b-5 Facilitate review and update of 2 local codes to include measures for green infrastructure			
Actions: See Pl 1b-9			
Goal Pl 5c Protect 50 acres of landscape features to prevent future habitat degradation.			
Pl 5c-1 Protect 50 acres of wetlands through acquisition or easement. *Focus areas: vicinity of Kent Bog, other high-value habitat areas noted in WAP, resources providing multiple ecological functions and habitat connectivity.*			
Actions: See Pl 1f-1			
Pl 5c-2 Update, increase, and disseminate available information concerning watershed habitats			
Actions: See Pl 1b-12			
Pl 5c-3 Increase/sponsor 18 stewardship activities related to stream channel health, non-point source, runoff, erosion, habitats, etc.			
Actions: See Pl 1b-13			

Table Pl 4.6 Plum Creek - Recreation

HUC 041100020305 (part)

Problem Statement Fi-6: Recreational Opportunities

Along Plum Creek and its tributaries are several public and private recreation, institutional, and open space parcels, including JayCee Park, Plum Creek Park, Tallmadge City/Schools parcels two golf courses, and the Portage bike-hike trail. In addition the Tom S. Cooperrider Kent Bog preserve offers passive recreation hiking through a tamarack bog. These provide the opportunity for a watershed-wide system of access or education.

Goal *Objective*	Actions	Lead/ cooperating organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Goal Fi-6a: Increase recreational opportunities along Plum Creek and in the subwatershed by 1 mile/2 access points.				
Fi-6a.1 Expand hiking opportunities along Plum Creek and its tributaries by 1 mile.				
	1 Submit grant proposal	City of Kent	funding, plans, design - Kent State University students could help with assessments, etc.	
	2 Wetland delineations		Assistance from KSU classes	
	3 Design/build			
	4 signs			
	5 Brochure/outreach			
Pl 6a-2. Develop 1 River Quest or virtual watershed tour				
	1 Determine appropriate River Quest structure (cuyahoga canalway or new one)	WC, partners, volunteers, parks	Permission to develop quests, printing costs	2 quests by 2017 or 1 watershed tour by 2017
	2 Public workshop concerning River quests			
	3 Seek quests from volunteer groups			
	4 Review, print, distribute		funding for printing, place on website	
Pl 6a-3 Improve access points at 2 locations				
Goal Pl 6b: Increase awareness of recreational opportunities, stewardship, and watershed issues.				
Pl 6b-1. Economic impact study recreational uses		WC with KSU	outside funding	1 study by 2018
	1 Coordinate with KSU and others on study			
	2 Submit grant proposal			
	3 Conduct study			
	4 Publicize			
Pl 6b-2. Increase signage related to Plum Creek or watershed at local parks/conservation/recreation sites.				
	1 apply for funding			
	2 Design, install signs			8 signs by 2022
	3 Continued outreach with local communities			
Pl 6b-3 Update, increase, and disseminate available information concerning recreational opportunities and care of Plum Creek, its tributaries, and watershed.				
	1 Web page of recreational opportunities/access	wc		
	2 Other Actions - see Pl 1b-12			
Pl 6b-4. Increase stewardship activities related to watershed issues				
	Actions - Pl 1b-13			
Pl 6b-5. Acquire conservation land, targeting important resource protection areas (e.g., wetland complexes in vicinity of Plum Creek/Kent Bog)				
	Actions - See Pl 1f-1			

7 Br Breakneck Creek

HUC 041100020202

1 Summary of Existing Conditions

Table Br 1 summarizes some of the key characteristics of this subwatershed. Table Br 2 presents a summary of identified impairments, causes, and sources. Figure Br 1 shows the subwatershed and jurisdictions. Figures Br 2 and 3 have been compiled from mapping in Volume I and show potential areas of concern and resource areas for protection. (Greater detail is shown in the various maps in Vol. I.) Also see photos in Section 4P, Breakneck Creek.

Key concerns in this subwatershed include:

- addressing the impacts of the urbanized, altered landscape in the north, including heavily altered Wahoo Ditch;
- determining the cause of and addressing nutrient enrichment/algal blooms in Lake Hodgson and nutrient enrichment in Breakneck Creek;
- reducing agricultural sources of non-point source pollution;
- addressing failing septic systems;
- minimizing impacts from development;
- improving hydrology and stream morphology/habitat as possible along channelized streams;
- protecting the Kent wellfield;
- addressing improperly closed dumps/landfills;
- protecting the intact riparian corridor and wetland complexes along Breakneck Creek; and
- improving recreational opportunities.

The problem statements in Tables Br 4.1 through Br 4.8 address individual problems related to these concerns and may overlap. For instance, urban runoff, septic system failure, and agricultural runoff all contribute to the problems of nitrogen and phosphorous enrichment in Breakneck Creek and the Cuyahoga River.

Water Quality Assessment and Attainment *For problem statements/goals/objectives related to contaminants, refer to Problem Statements Br-4 and 8, (Groundwater and Contaminants, Wahoo Ditch and contaminants), Table Br 4.4 and 4.8; for problem statements related to channel morphology refer to tables 4.1-4.3, 4.5 and 4.6.*

Breakneck Creek, a low-gradient, sinuous swamp creek flows through a nearly intact corridor of wetlands, woods, and floodplains. Breakneck Creek was last monitored in 2000 and has been in attainment of water quality standards downstream to Wahoo Ditch. The most recent bioassessment indicated that Breakneck Creek was in partial attainment of WWH below the Ravenna and Franklin Hills wastewater treatment plants and then recovered at the junction with the Cuyahoga River. Noted causes and sources of impairment included organic enrichment/major point sources. However, since the 2000 bioassessment, the wastewater treatment plants have been upgraded. The Ohio EPA has not assessed the effect on biological communities.

Wahoo Ditch does not meet its MWH criteria due to the heavily urbanized nature of the ditch, legacy contamination, and extreme ditchlike morphology. It is a maintained ditch, but there may be potential for restoring some floodplain access.

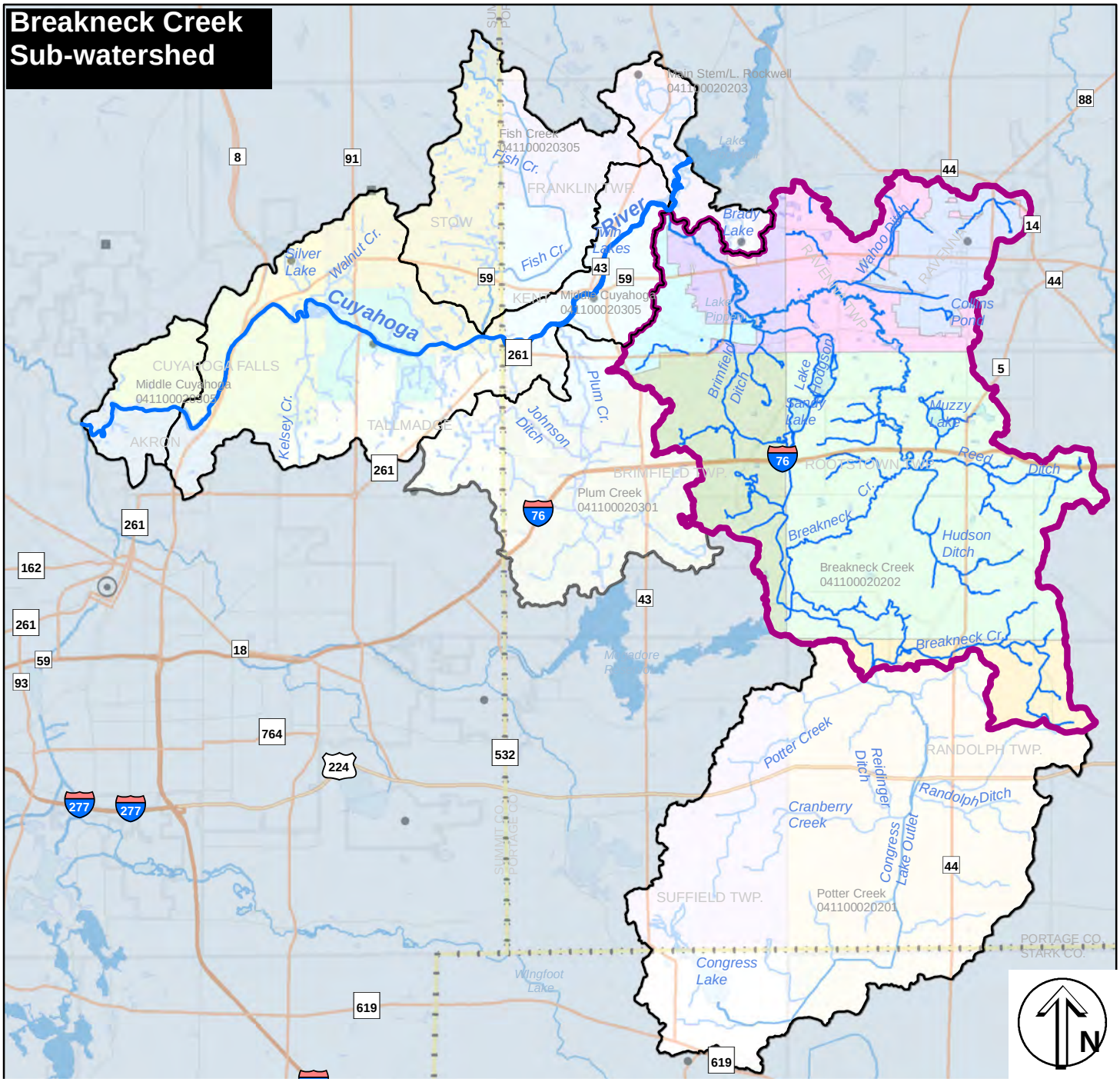


Figure Br-1
Subwatershed Jurisdictions

0 0.5 1 2 3 4 Miles

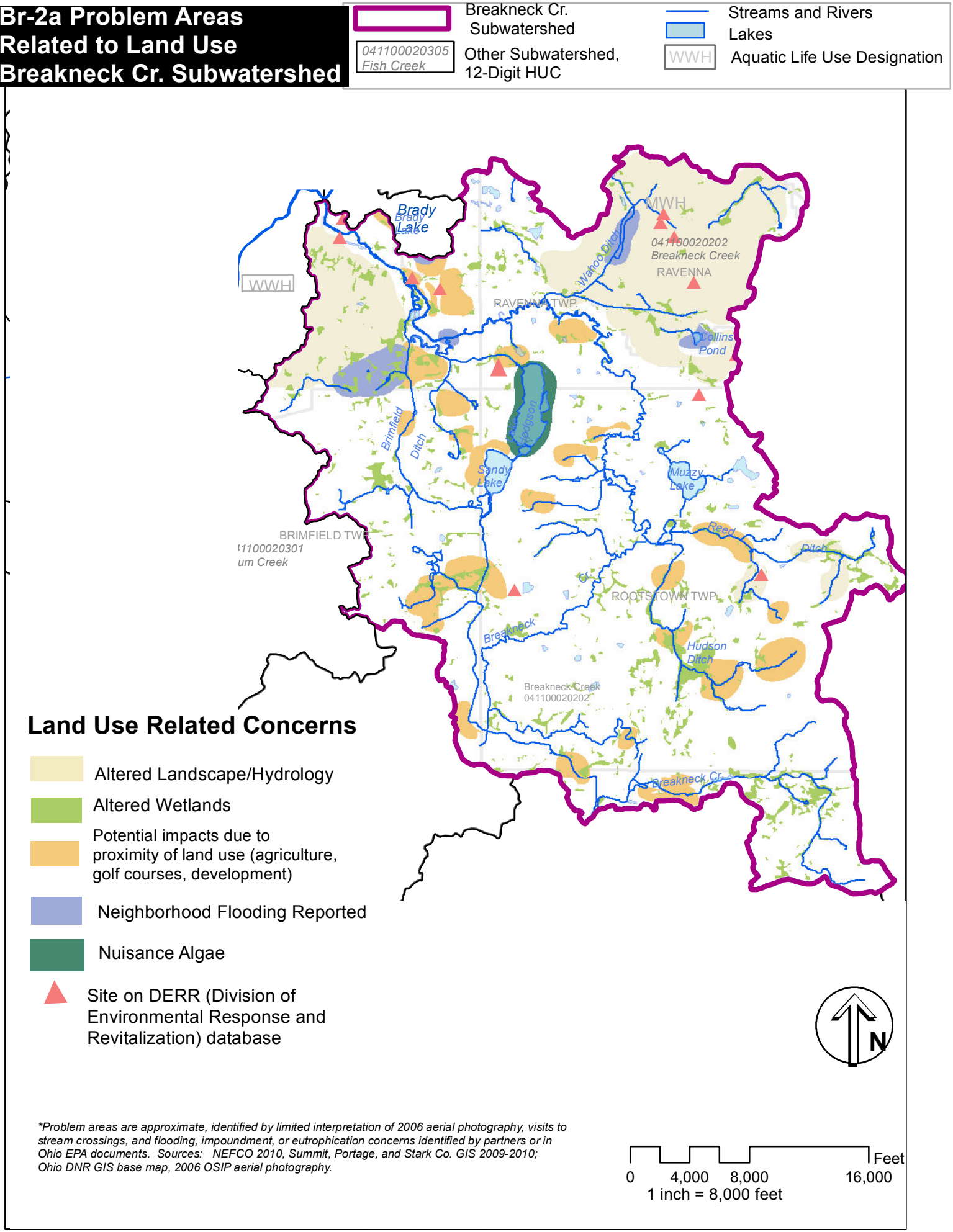
- Streams and Rivers
- Lakes
- Breakneck Cr. Subwatershed
  12-Digit HUC: 041100020202
- Fish Creek 041100020305 — Other Sub-watersheds
- Counties
- Jurisdictions outside watershed
- Interstate Highways
- State Divided Highways
- State Numbered Rtes
- Local Roads

Subwatershed Local Jurisdictions

- BRADY LAKE
- KENT
- FRANKLIN TWP.
- RAVENNA TWP.
- RAVENNA
- BRIMFIELD TWP.
- ROOTSTOWN TWP.
- RANDOLPH TWP.

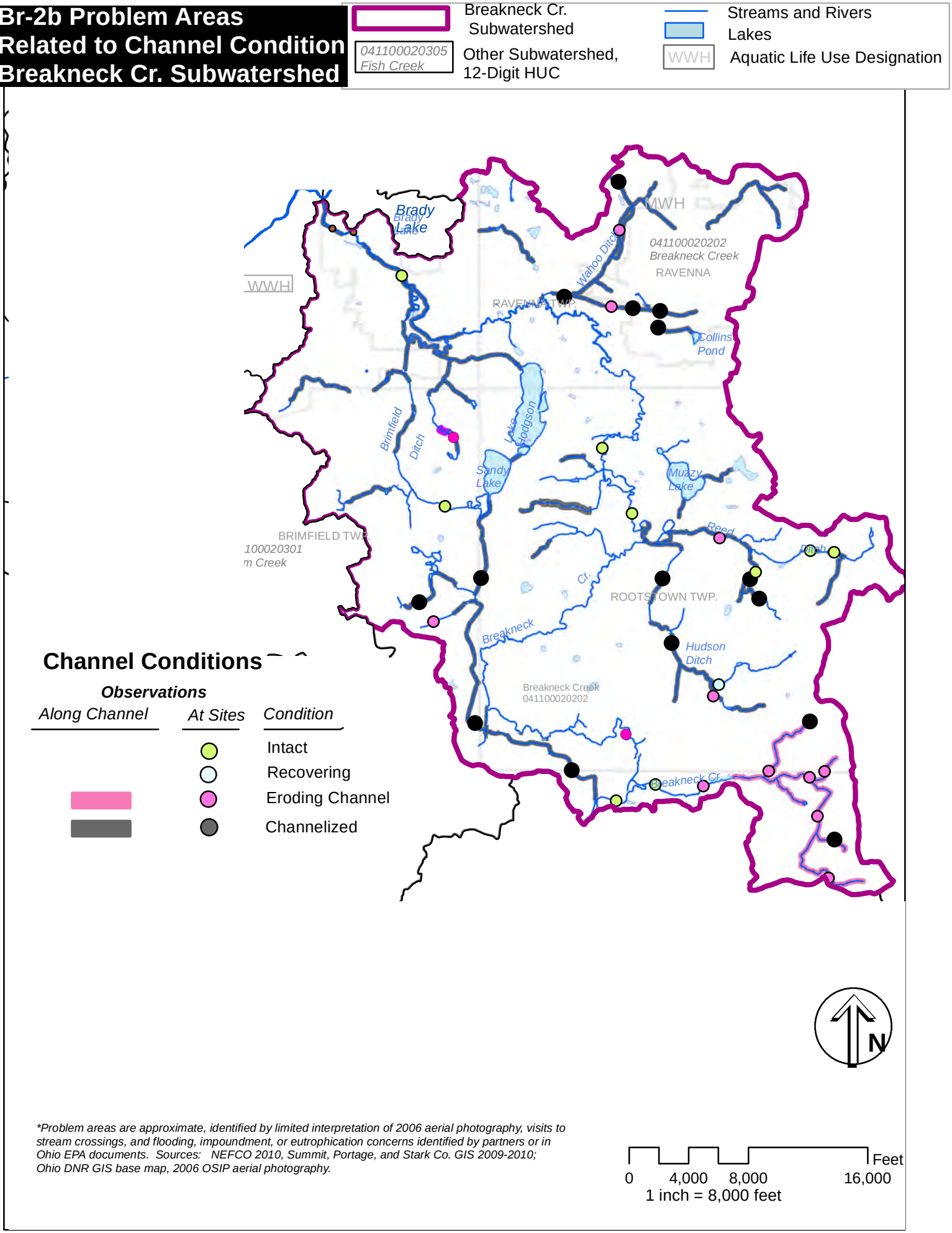
Sources: NEFCO, 2010; Portage County GIS 2010; Summit County GIS 2009; Stark County Planning Commission 2010; Ohio DNR GIS 2010

Br-2a Problem Areas Related to Land Use Breakneck Cr. Subwatershed



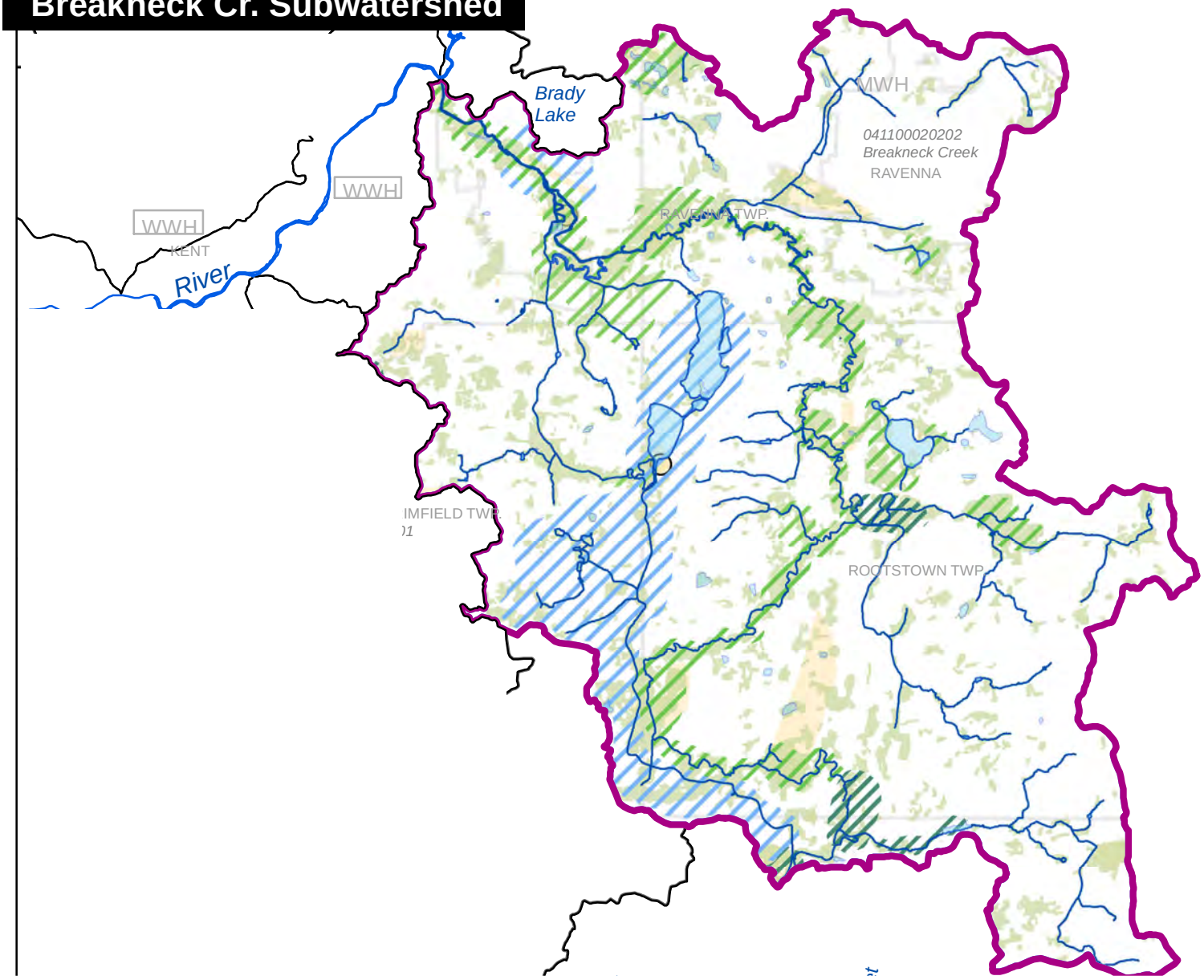
Problem areas are approximate, identified by limited interpretation of 2006 aerial photography, visits to stream crossings, and flooding, impoundment, or eutrophication concerns identified by partners or in Ohio EPA documents. Sources: NEFCO 2010, Summit, Portage, and Stark Co. GIS 2009-2010; Ohio DNR GIS base map, 2006 OSIP aerial photography.

Br-2b Problem Areas Related to Channel Condition Breakneck Cr. Subwatershed



*Problem areas are approximate, identified by limited interpretation of 2006 aerial photography, visits to stream crossings, and flooding, impoundment, or eutrophication concerns identified by partners or in Ohio EPA documents. Sources: NEFCO 2010, Summit, Portage, and Stark Co. GIS 2009-2010; Ohio DNR GIS base map, 2006 OSIP aerial photography.

Br-3 - Conservation/Protection Priority Areas Breakneck Cr. Subwatershed



Conservation/Protection Priority Areas

- Riparian Corridor/Wetland
- Wetlands of Additional Importance (e.g., buffering) - enhance/protect
- Water Supply Protection - Conservation/BMPs/Outreach
- Mapped Wetlands
- Habitats or Species of Concern Identified on DNR biodiversity database spanning 30 years; Western Reserve Land Conservancy workshop, 2010.)

- Streams and Rivers
- Lakes
- WWH — Aquatic Life Use Designation
- 041100020305 Breakneck Creek — Subwatershed, 12-Digit HUC
- Local Jurisdictions

N

*Sources: NEFCO 2010, Summit, Portage, and Stark Co. GIS 2009-2010; Ohio DNR GIS base map, biodiversity data; 2011. Western Reserve Land Conservancy GIS mapping of conservation areas, 2010; Summit and Portage Counties wetland mapping conducted by Davey Resource Group, 2000-2004. Stark County -2003 land cover mapping; CCAP NOAA coastal Change Analysis Program 2006 mapping.

0 4,000 8,000 16,000 Feet

1 inch = 8,000 feet

Table Br 1
Summary of Breakneck Creek Subwatershed Characterisitcs

Concern	Amount/Item	Comments
Water Quality Attainment, latest assessed	Breakneck Cr., monitored until 2000, has generally been in attainment in the upper portions but has been in non-attainment from Wahoo Ditch downstream. The WWTP have been upgraded but there have not been additional bioassessments. Wahoo Ditch consistently is in non-attainment. The Feeder Canal attains MWH standards.	Cause/source: Breakneck Cr. – WWTP (upgraded since latest assessment); Wahoo Ditch – ditchlike conditions, legacy contaminants, channelization; urban influences
Public water supplies	Kent wellfield, recharged by Breakneck Cr.; Lake Hodgson	Taste/odor/algae at L. Hodgson
Land Cover acres, %	Developed 7,975 26.0% • *High Density* *406* *1.3%* • *Moderate Density* *1,760* *5.7%* • *Low Density* *4,042* *13.5%* • *Dev. Open Space* *1,767* *5.5%* Agricultural 8,316 32.2% Grassland/scrub-shrub 689 2.3% Woods/wetlands 11,183 37.5%	
Impervious/runoff	10.1% **Additional runoff 3/4" storm**: 40 million gal.	
75 foot buffer	Developed 16% *Dev. Open Space 1.7%* Agricultural 33% Woods/wetlands 48%	
Wetlands (ac)	**Mapped Converted** 1,739 ac. (hydric) 6,039 ac.(hydric incl.)	Urban areas may mask earlier wetlands
Development potential	Brimfield, Rootstown near I-76 developed rapidly from 2000-2007 and may do so again.	
Channel quality (miles)	**Intact** **Altered/channelized** **Eroding** **Recovering** 25.3 47.4 6.6 4.7	Much of the intact channel is along Breakneck Creek, but tribs are altered.
Non-pt source load/yr	**Tot. N (lb)** 78,429 **Tot. P (lb)** 16,470 **Sed**. **(tons)** 2,592	
Septic systems	Approximately half presents 2 or more severe limitations to septic systems and is not served by sewers. In 2010, there were over 600 suspected illicit discharges in subwatershed communities.	
Problem areas	Wahoo Ditch; Lake Hodgson algae; eroding stream banks; unrestricted livestock access;	Upstream influences; streams most intact in woods
Resource areas	Kent wellfield 5 year zone and surface recharge; surface water public water supply and watershed; habitat/species of concern, wetlands	
Park/ conserv./inst.	Acreages to be filled in	
Riparian setback	Cities of Kent and Ravenna	
Recreational oppor.	Breakneck Creek preserve; Ravenna parks;	

Table Br 2 Breakneck Creek Summary of Impairments
HUC 041100020202

Attainment issue/other concern	**Cause**	**Source**	**Other likely sources**
Breakneck Creek – ranges from non-attainment to full attainment	Unknown toxicity (high) Flow alteration (high) Organic enrichment/DO (mod)	Major/minor municipal point source (high) Natural (high)	
Wahoo Ditch – non-attainment MWH-C, poor IBI, ICI	Habitat alterations (high) Organic enrichment (mod) Unknown contaminants	Urban runoff Channelization Sediment PPAH Legacy contaminants Severe ditchlike condition Channelization Major municipal point sources	
Lake Hodgson – high algae counts	Nutrients	Agriculture/ resid. development	
Elevated nutrient levels	Nutrients	Agriculture/ resid. development	
Bank erosion/ sedimentation	Excess water/limited flood storage/loss of vertical stability		Loss of floodplain storage, bank vegetation
LOCAL/Other CONCERNS			
Hommon Ave. Ditch – erosion			Urban runoff, lack of flood storage
Potential loss of wetlands, habitat			
Wellhead protection			Fracking, runoff urban runoff
Flooding: Wahoo Ditch, Collins Pond			Excess storm water, limited flood storage
Protect water supplies			Contamination from fracking, land use
Old Landfills			Ground/surface water contam.

Nonpoint source pollution – Sediment, Nutrients (nitrogen, phosphorous) *(Refer to Problem Statements Br 1, 2 and 3, Tables Br 4.1-4.3)*

Sediment has not specifically been identified as a cause of non-attainment in Breakneck Creek, but it is of concern in the main stem of the Cuyahoga River, and during storm events, suspended solids at the mouth of Breakneck Creek are comparatively high. Portions of headwater streams also show embeddedness. Nutrients, which are a cause of non-attainment, are exported to the river along with sediment.

The lower portion of Breakneck Creek and the Cuyahoga River downstream of Breakneck Creek are somewhat enriched in nutrients. Limited water chemistry data indicate several instances when state median or criteria values were exceeded for phosphorous or nitrogen. Because higher values often coincide with increased flows (apparently post-storm), runoff is likely a contributing factor. The lower, more urbanized, portion of Breakneck Creek exhibits the highest levels of nutrients. Lake Hodgson, which generally receives water from a small area of the Breakneck Creek subwatershed, exhibits elevated chlorophyll and phosphorous levels. The City of Ravenna uses in-lake techniques to reduce the effects of algae in Lake Hodgson, but managing algae will require reduction of nutrients from the watershed as well.

The STEPL model indicates that the Breakneck Creek watershed contributes 78,429 pounds per year of nitrogen, 16,470 pounds per year of phosphorous, and 2,592 tons per year of sediment from a combination of urban, rural residential, and agricultural sources, eroding stream banks, and septic systems. The model assumes that 75 percent of farms use reduced tillage practices.

Factors contributing to non-point source pollution include

- *High percent of imperviousness* in the northern portion of the subwatershed,
- A large portion of agricultural land, especially in the southern portion. Agricultural producers are using various practices (e.g., cover crops, buffers, conservation tillage) to varying and unknown degrees.
- *Runoff from development* in Brimfield and Rootstown,
- *Unrestricted livestock access* at two observed locations
- *Septic systems* - Approximately half of the subwatershed presents two or more severe limitations for septic systems and is not served by sewers, indicating the potential for failure of older systems. Over 600 potential illicit discharges have been identified in subwatershed communities.
- *Channelization and alteration of channels, floodplain access, and wetlands*. Approximately 58 miles of stream corridor, 7,633 acres of riparian corridors within 75 feet, and 1,739 acres of wetland on hydric soils have been channelized or altered in the agricultural and urbanized areas, reducing their ability to absorb, filter, and store storm water, sediment, and the non-point source pollutants entering the streams from the landscape. Breakneck Creek remains largely intact, but much of the tributaries appear channelized.
- *Eroding streambank.* These contribute nitrogen, phosphorous, and sediment, and are often associated with high volumes, lack of floodplain access, and unstable banks from livestock access. Eroding streambanks have been observed at the southeastern Breakneck headwater tributaries (agricultural area), Feeder Canal (rural residential/developing area, affected by volume), Hudson and Reed Ditches (developed area), Breakneck Creek below Hudson and Reed Ditches, and Wahoo Ditch (channelized stream in heavily developed area). Some eroding banks appear to be associated with

livestock access (e.g., Brimfield Ditch at Meloy, Breakneck Creek at Cline), while others (Breakneck headwaters, lower end of Reed Ditch, Wahoo Ditch, Feeder Canal) appear to be related to stormwater volume and lack of floodplain access. There may be potential for improving flood storage through floodplain or wetland restoration along portions of Wahoo Ditch, Hudson/Reed Ditches.

Potential for degradation of riparian/wetland features - The wetlands and floodplains flanking Breakneck Creek appear to be reducing the effects of channel alteration and runoff upstream and maintaining the high quality of Breakneck Creek. Protecting these areas from further encroachment will be one of the most effective ways to reduce future problems related to nutrients and volume/erosion.

Public Water Supplies *(Refer to Problem Statement Br 4 Table Br 4.4)*

The Breakneck Creek subwatershed contains two major public water supplies.:

- The City of Kent's wellfields, recharged in part by Breakneck Creek. Concerns have been raised about potential contamination from hydraulic fracturing ("fracking"), and several inventoried sites (e.g., dumps).
- Lake Hodgson, the City of Ravenna's water supply. Lake Hodgson is generally fed by groundwater and runoff from a small watershed, but occasionally receives water from Congress Lake/ Congress Lake Outlet. The Ravenna public water supply has had taste and odor problems from excessive algal growth due to nutrient enrichment (nitrogen/phosphorous). In managing eutrophic lakes, it is important to reduce both the influx of new nutrients from the watershed and also those resident in the sediments.

Flooding *(Refer to Problem Statement Br 5 Table Br 4.5)*

Reed Ditch, the Feeder Canal, Wahoo Ditch, Collins Pond, and Brimfield Ditch are influenced by runoff from impervious surfaces in developed areas. The watershed as a whole is 10 percent impervious, but the northern, developed portion is between 15 and 20 percent impervious, with Individual areas having a higher percentage of imperviousness. The altered channel form, floodplain access, and wetlands noted above reduce the ability of the landscape to handle storm events, increasing damaging floods:

- Homes near Collins Pond experience flooding. This area is mapped as poorly drained "D" soils and wetlands. The flow from Collins Pond apparently has been culverted and channelized. The City of Ravenna has recently enacted a riparian setback ordinance, which will help prevent further development in this unsuitable area.
- Brimfield Ditch appears to be largely channelized. Repeated flooding problems have occurred near the confluence of Breakneck Creek and Brimfield Ditch.
- Flooding problems have been noted along Wahoo Ditch near Route 59 west of Ravenna, a maintained ditch with no floodplain access in a largely impervious area.
- Flooding has been noted at the Breakneck Creek crossing of Lakewood Road, an area where the channel has been altered.

Habitat and Conservation Areas *(Refer to Problem Statement Br 6 Table Br 4.6, also problem statements related to non-point source pollution and flooding)*

Approximately 54 miles of streams in the subwatershed are either eroding or channelized, degrading habitat by altering the riparian zone, floodplain access, stream channel sinuosity and cross-section, rate of flow, and substrate. Wahoo Ditch is in non-attainment of MWH status due

in part to its extreme ditchlike character. Approximately 1,739 acres of wetland on hydric soil and 50% of the 75-foot riparian corridor have been altered, degrading important habitats.

Approximately 28 miles of Breakneck Creek flows through a broad riparian corridor of woods, wetlands, and floodplains, much of which has been identified in the Portage County Watershed Plan and in the Western Reserve Land Conservancy workshop as high value. The wetlands that line the margins of Breakneck Creek likely reduce much of the impacts of the agricultural and channelized lands upstream. Riparian corridors and other high value features outside the incorporated areas are vulnerable to development. Several areas of species of concern are found in the subwatershed, and most remain unprotected.

Alteration of wetlands is regulated under state and federal permitting requirements. Kent, Ravenna, and Brimfield have riparian setback regulations. While these laws offer some protection, this important corridor and other high value resources (e.g., Kent wellfield) could still be vulnerable to impacts from development.

Portage County and local cities, and the Nature Conservancy own several key parcels in this subwatershed, including land around Lake Hodgson and Muzzy Lake. The Sandy Lake Association also holds several parcels adjacent to Sandy Lake for hunting by members. However, large tracts of wetlands and floodplains along Breakneck Creek remain unprotected.

Key areas to focus preservation efforts include:

- Wetland-floodplain systems fringing the length of Breakneck Creek, which extensive, intact habitat corridors and handle and provide treatment for large volumes of water.
- At the confluence of Reed and Hudson ditches – a wetland complex likely mitigates the damaging effects of the combined ditches on the creek.
- A wetland immediately upstream of the confluence of the Breakneck Creek headwaters with Congress Lake Outlet appears to be reducing the effects from the degraded channels upstream, as the channel downstream of the wetland appears intact.
- Wetlands at the upstream end of Sandy Lake may be improving water quality of the Feeder Canal entering the water supply.

Recreational Opportunities *(Refer to Problem Statement Br 7 Table Br 4.7)*

There are limited opportunities for access to and recreation along Breakneck Creek. Portage Park District owns a parcel along the banks of the creek at Lakewood Rd., but this parcel is currently not developed for recreation and offers limited access. The City of Ravenna has developed parks in the watershed. Boating is allowed on Lake Hodgson. Conservation parcels in the subwatershed allow passive recreation (e.g., hiking). The Portage Bike-hike trail crosses Breakneck Creek near its confluence with the Cuyahoga River.

2 Problem Statements, Goals, Objectives, and Actions

Table Br 3 summarizes the actions proposed in the subwatershed and their associated pollutant load reductions, listing which problem statements/goals employ these tools. Tables Br 4.1 through 7 present the problem statements, goals, objectives, and actions for each problem area. The tables are numbered to reflect each problem statement number, e.g., Table Br 4.1 corresponds to Problem Statement Br-1. It should be noted that because many of the objectives address more than one goal, the actions associated with each objective are listed

only once, in the first table in which they appear (most frequently, Table Br 4.3). All other listings of the same objective refer back to the actions at their first occurrence.

Refer to Sections 6 and 7 Introduction for a discussion of the format of the problem statements, goals, objectives, actions, and considerations for implementation.

Table Br-3 Action Item Summary by Subwatershed: Breakneck Creek

12-digit HUC/ Water Body	Sed	Nutrients	GW contam	Flooding	Habitat	Recreation	Contamin. Sites	Category/Practices	Target amount by 2023	Units	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
041100020202														
Breakneck Creek								**Brownfields**						
Breakneck Cr./ Wahoo Ditch, tribs			√				√	Conduct brownfields inventory	1	inventory				
Breakneck Cr./ Wahoo Ditch, tribs			√				√	Determine status of listed sites	11	sites				
Breakneck Cr./ Wahoo Ditch, tribs			√				√	Brownfields plan	1	plan				
								Riparian Restoration						
Breakneck Cr. - Wahoo Ditch/ Brimfield Ditch	√	√						Restore Streambank (Bio-Engineering/ re-contouring/ re-grading)	3,000	Linear Fee	$25-200/lf	207	300	112
Breakneck Cr./tribs	√	√		√	√			Plant Native plants, trees, or shrubs in Riparian Areas	12	Acres	$6,000 + labor shrubs	6	93	17
Breakneck Cr. watershed								Remove/treat Invasive Species	50	Acres				
								Stream Restoration						
Breakneck Cr./ Wahoo Ditch/tribs	√	√		√	√			Restore Flood Plain	50	Acre-foot		22	300	41
Breakneck Cr./ Wahoo Ditch/tribs								Restore Channel	5000	Linear Feet	$100-200/lf			
B Creek/ Collins Pd/ Brimfield D./ Wahoo Ditch				√				Hydrological study in flood-prone area	1	study				
								Feasibility study to remove small low-head dams	1					
								Wetland Restoration						
Breakneck Cr. - Reed/ Hudson Ditch/ Feeder Canal	√	√		√	√			Reconstruct, reconect, & Restore Wetlands	80	Acres	$5k-100k/ac.	80	2240	506
								Home Sewage Treatment Systems						

Table Br-3 Action Item Summary by Subwatershed: Breakneck Creek

12-digit HUC/ Water Body	Sed	Nutrients	GW contam	Flooding	Habitat	Recreation	Contamin. Sites	Category/Practices	Target amount by 2023	Units	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
Breakneck Cr. Wshed		√						Obtain correction of failing HSTS	30	HSTS			933	366
								Urban runoff and green infrastructure						
Breakneck Cr. Wshed	√	√		√				Rain gardens	20,000	sq feet	$500,000		2.00	0.50
Breakneck Cr. Wshed		√		√				Parking lot retrofit - permeable pavement/ biofilt.	10,000	sq feet	$200,000		2	0.4
Breakneck Cr. Wshed	√	√		√				Storm water inventory	1	inventory				
Breakneck Cr. Wshed	√	√						Storm water retrofits	100	acres treated	$400-17k/ ac	4.5	70.1	10
Breakneck Cr. Wshed	√	√						Retrofit drainage - No-mow ditch/ grassed swale/ daylighting	2,000	linear feet		0.2	1.6	0.8
Any middle cuyahoga watershed								Neighborhood-scale green infrastructure			$25-50k design $20k bumpouts			
Breakneck Cr. Wshed	√	√						**Agricultural BMPs**						
Breakneck Cr. Wshed	√	√						Survey of practices	1	survey				
uncontrolled livestock access along Breakneck Cr and tribs	√	√			√			Install Livestock Exclusion Fencing & accompanying watering measures	3,000	Linear Feet	$11,300 + watering	140	280	140
uncontrolled livestock access along Breakneck Cr and tribs	√	√			√			Install Alternative Water Supplies	1	Supplies				
Breakneck Cr. Ag tribs or ditch	√	√			√			Construct 2-Stage Channel/overwide	1,000	Linear Feet			295	91
Breakneck Cr./ Wahoo Ditch/tribs	√	√						Install Grassed Waterways/ vegetated buffer strips	100	Acres treated		177	466	26
Breakneck Cr. Wshed	√	√						Cover crops	100	acres		101	240	120

Table Br-3 Action Item Summary by Subwatershed: Breakneck Creek

12-digit HUC/ Water Body	Sed	Nutrients	GW contam	Flooding	Habitat	Recreation	Contamin. Sites	Category/Practices	Target amount by 2023	Units	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
Breakneck Cr. Wshed	√	√						Residue applied to fields	200	acres		202	480	120
uncontrolled livestock access along Breakneck Cr and tribs	√	√			√			Livestock Crossings	1	Crossings				
								Conservation Easements						
Breakneck Cr. Wshed	√	√		√	√	√		Acquire Wetlands/ easements	100	Acres	$5-25k/ac	prevent 100	prevent 2800	prevent 632
Breakneck Cr. Wshed	√	√	√	√	√	√	√	**Education and Outreach**						
								Brochures/Fact Sheets	10	Brochure				
								Watershed/tributary Festivals	10	Festivals				
								Websites	1	Website				
								Install Signs	24	Signs	200-500			
								Develop Displays		Displays				
								Tours/canoe floats		Tours				
								Stream Clean-Ups	3	Clean-				
								New lake/stream stewardship groups	1	new group				
								Workshops/Training	5	Workshop				
								Develop Manual(s)	1	Manuals				
Breakneck Cr wshed				√				Rain barrel workshops	250	barrels				
								Develop Newsletters	10	Newslette				
								Local Policy						
Breakneck Cr wshed	√	√		√	√			Riparian setback	1	code		prevent 22	prevent 320	prevent 57
Breakneck Cr wshed	√	√		√	√			Green code audit/update	2	audits/ updates				
								Monitoring						
BC wshed - Lake Hodgson/feeder Canal		√						Chemical Sampling	4	Sites				

Table Br-3 Action Item Summary by Subwatershed: Breakneck Creek

12-digit HUC/ Water Body	Sed	Nutrients	GW contam	Flooding	Habitat	Recreation	Contamin. Sites	Category/Practices	Target amount by 2023	Units	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
Breakneck Cr., tribs								Macroinv./ Fish/ Habitat Sampling		Sites				
Breakneck Cr., tribs								Fish (IBI) Sampling	3	Sites				
Breakneck Cr., tribs								Habitat (QHEI/HHEI) Sampling	3	Sites				
								Recreation						
Breakneck Cr. Wshed								Construct trail	2	miles				
Breakneck Cr.						√		Construct water trail/access sites	1	site				
Breakneck Cr. Wshed						√		Economic benefit study	1	study				
Breakneck Cr. Wshed						√		Develop quest(s)/ virtual watershed tour	3 quests/ 1 tour					
												939.7	5702.7	1550.7

Table Br 4.1 Breakneck Creek - Sediment

HUC 041100020202

Problem Statement Br-2: sediment

While siltation has not been listed as a cause of non-attainment in Breakneck Creek, some tributaries exhibit embeddedness, eroding banks contribute nitrogen and phosphorous, and TSS levels were comparatively high at the mouth of Breakneck Creek during high flow (35 and 47 mg/l July 2007), which affects sediment levels in the Cuyahoga River. Siltation has been identified in the Cuyahoga River as a cause of non-attainment and is of concern in the shipping channel in Cleveland.

The STEP-L model indicates that the watershed generates 78,429 lb/yr of sediment from urban runoff, eroding banks, agricultural runoff, and failing septic systems. systems. Alteration of at least 1,739 acres of wetland, 50% of vegetated riparian corridor, and loss of riparian features (e.g., riparian zone, floodplain access) along an estimated 54 miles of watercourses has reduced the sediment uptake of the system. Further development and alteration of riparian vegetation could result in increased loading in the future.

Goals				**Amount to complete, time frame**
	Objectives	**Lead/ cooperating**		(contingent on funding, resources,
	Actions	**Organizations**	**Resources needed/cost**	landowner willingness)
Goal Br 1a Reduce non-point source pollution from urban runoff to reduce annual loading of sediment by 11.5 tons.				
	Br 1a-1 Plant 12 ac.of deep-rooted riparian vegetation, reducing loading of sediment by 7 tons /yr Focus areas: large parcels single ownership, headwaters.			
	1 Submit grant applications e.g., OEEF	WC/SWCDs/partners		
	2 Targeted outreach to public, institutional, and other owners of large properties	WC**/SWCDs/ Communities	Lists of golf courses, lake associations, homeowners' associations; maps of large parcels; printed outreach materials.	Target 1 group every 3 years (3 by 2022); improvements to best management practices or riparian management at one site every 4 years(2 sites by 2020); 2 outreach contacts per year
	3 Outreach to golf course owners encouraging Audubon-certification		labor, printing	
	4 Assist with plantings	SWCDs, master gardeners	native plants/trees and shrubs $500-1,000/ac	
	5 Construct and install signage	communities, partners,	$300-500/sign	
	6 Follow-up outreach (individualized guide to riparian zone) and publicize		funding for handouts/brochures	
	Br 1a-2 Retrofit stormwater volume devices to treat 100 acres of commercial/institutional land and improve water quality, reducing loading of sediment by 4.5 tons/yr			
	1 Stormwater retrofit inventory		WC/NEFCO with communities	
	2 Submit grant application			
	3 Design/construct retrofit for existing stormwater (volume) infra-structure to improve water quality	Communities	Varies, depending on treatment provided (e.g., $400/acre treated to $17,000 per acre treated)	Retrofit 5 by 2022, 1 every 8 years afterward
	Br 1a-3 Retrofit 2,000 lf of drainage with no-mow grass, daylighting, or grass swale as a demonstration project, reducing sediment loading by 0.2 tons per year			
	1 Workshop on drainage improvements/ditch maintenance for water quality improvements	SWCD	Location, materials	
	2 Identify site			
	3 Seek funding			
	4 Prepare site/install no-mow grass/retrofit			
	5 outreach			

Table Br 4.1 Breakneck Creek - Sediment

HUC 041100020202

Goals				**Amount to complete, time frame**
Objectives		**Lead/ cooperating**		(contingent on funding, resources,
	Actions	**Organizations**	**Resources needed/cost**	landowner willingness)
Br 1a-4 Review two development codes and update one to encourage use of green infrastructure in new developments.				
	1 Submit grant application	WC		
	2 Green infrastructure codes workshop	WC, partners, CSU, developers	Funding for outside assistance, location, materials	1 workshop series by 2015
	3 Evaluate and update local ordinances for opportunties to reduce pavement, improve use of green infrastructure, conservation development, etc. in new/existing development	WC/communities	Volunteers/ interns can assist - outside funding could be used for consultant and/or work-shop - could be done with Portage zoning official meetings	2 code audits by 2017; update 1 code by 2018 (Kent/Portage??)*
	4 Revisions to community development codes to better incorporate green infrastructure		partner communities, possibly funding for outside consultant	update 1 code by 2018
Br 1a-5 Update, increase, and disseminate available information concerning sediment from urban runoff				
	1 Continue to compile, centralize, and make available studies, data, information sources on the watershed, including recreational opportunities, volunteer needs, permitting or regulatory issues; green infrastructure information sources, etc.	WC	Website, technical information and outreach materials	Update and develop pages for website by Dec. 2013, then on-going
	2 Chemical or biological sampling/assessment along streams - volunteer, intern, or class	Community/partner sponsors, Ohio EPA, KSU interns/classes	possibly funding for stipends, analysis, equipment	Sampling at 1 location every 3 years. 3 sample sets by 2022.
	3 Survey of yard management practices	WC/partners		
	4 Continue to develop stream database			
	5 e-newsletter or article issued 3 times per year	wc	website, share with partners	
	6 Develop/reproduce informational brochure or website article concerning topics of interest, including reducing runoff, recreational opportunties, private wells, septic systems etc.	WC, health depts, SWCDs	technical/outreach materials, possibly printing costs	10 by 2022; 1 each year
Br 1a-6 Increase/sponsor 25 stewardship activities related to non-point source pollution and watershed issues.				
	1 Establish clean-up/monitoring/planting efforts at additional tributaries and lakes	WC, communities, parks, residents, home-owners' associations, lake associations	Funding or donation of trash disposal, refresh-ments, monitoring supplies, crew leaders, volunteers; training for monitoring/planting	1 new tributary or lake monitoring, clean-up, or other stewardship program by 2018
	2 Distribute 250 rain barrels through workshops	SWCDs/ Communities	Space for workshop; rain barrel kits	5 workshops/50 rain barrels distributed
	3 Survey of yard management practices	WC/partners		

Table Br 4.1 Breakneck Creek - Sediment

HUC 041100020202

Goals ***Objectives*** Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
4 Develop/reproduce informational brochure or website article concerning topics of interest, including reducing runoff, recreational opportunties, private wells, septic systems etc.	WC, health depts, SWCDs	technical/outreach materials, possibly printing costs	10 by 2022; 1 each year
5 Educational outreach workshops on topics of importance, including LID/green infrastructure, restoration, field trips for examples	Partners, WC, communities	Location, speaker, supplies	5 workshops by 2022; 1 every 2 years
6 Work with schools or city day camps to develop/encourage use of watershed care activities/curricular items	WC, SWCDs, partners, schools		1 educational outreach program/curriculum item by 2018
7 Breakneck Creek Day (others?)	Portage Parks, partners		1 per year
8 Watershed "brand," logo, art project	WC, Kent State/ Standing Rock Gallery/River Day	Host for project, graphic design capabilities	1 logo or art project by 2015, then 1 every 3 years;
9 Create social network or google presence	WC		1 by 2014
Br 1a-7 Develop storm water management design manual for Portage County			
Storm water management design manual	Portage SWCD	In-house task	1 manual by 2014
MCR 1 Establish 1 neighborhood-scale green infrastructure project as demonstration within the developed areas of one of the Middle Cuyahoga River subwatersheds, where suitable neighborhoods are identified, reducing loading of sediment by 200 lb/year			
1 Work with communities to identify suitable target neighborhoods	WC, partners		
2 Workshops/meetings to gauge neighborhood support			
3 Determine/establish maintenance framework (e.g., easements, homeowner participation)	partner community		
4 Submit grant application			
5 Design/build	outside consultant	Site, outside funding. Design ~$25-50,000; Rain gardens $15-20/sq. foot; Green street bump-outs $20,000 each; per-meable concrete $12-15/ sq. ft	1 project by 2022
6 Outreach, neighborhood participation			

Table Br 4.1 Breakneck Creek - Sediment

HUC 041100020202

Goals ***Objectives*** Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal Br 1b Reduce bank erosion to reduce sediment loading by 79.5 tons/year.			
Br 1b-1 Stabilize 3,000 l.f. of eroding/incised/channelized bank, reducing sediment loading by 79.5 tons/yr *Focus areas, e.g., eroding stream banks with livestock access, headwaters, Brimfield Ditch, other ditches*			
1 Map target areas to investigate for wetland, floodplain, riparian, habitat, or stream corridor restoration/protection/ enhancement	WC, partners	available mapping - compile and build on previous efforts	1 map by 2013, revisit and update if necessary every 3 years
2 Hold focus meetings to discuss areas of interest, including Wahoo Ditch, Brimfield Ditch, Breakneck headwaters, Feeder Canal	WC, partners		8 meetings to determine focus of restoration efforts along specified (and other) streams
3 Hold meetings with landowners to determine interest	WC, partners		
4 Submit grant applications	WC, partners		
5 Restore floodplain access/flood storage		design-build consultant	
6 Public outreach			
Br 1b-2 Restore 50 acre-feet of floodplain access/storage, reducing channel loading by 2,178,000 cu. Ft.. *Focus areas - areas with modified floodplain access. and at/upstream of flooding problem areas, e.g., Wahoo Ditch, Brimfield Ditch, Feeder Canal, Breakneck headwaters*			
1 Map target areas to investigate for wetland, floodplain, riparian, habitat, or stream corridor restoration/protection/ enhancement	WC, partners	available mapping - compile and build on previous efforts	1 map by 2014, revisit and update if necessary every 3 years
2 Hold meetings to determine landowner interest	WC, partners		
4 Submit grant application			
5 Restore floodplain access/flood storage	design-build consultant	funding for design-build consultant	
6 Public outreach			
Br 1b-3 Restore 80 acres of wetland thereby increasing storage by 76,000 cubic feet of water in a 3/4 inch storm.			
1 Map target areas to investigate for wetland, floodplain, riparian, habitat, or stream corridor restoration/protection/ enhancement	WC, partners	available mapping - compile and build on previous efforts	1 map by 2014, revisit and update if necessary every 3 years
2 Hold meetings to determine landowner interest	WC, partners		
3 Identify wetland restoration site for clearinghouse	WC, Communities, other partners	meetings with landowners; readily available mapping, outside assistance from consultant, possible assistance from Kent State University wetland ecology class	5 concept plans by 2020; 1 every 2 years afterward.
4 Submit grant application			
5 Restore/protect/enhance wetlands	Partners	$5,000-$100,000 per acre, design/build consultant, sites -protection by easements would be at the low end of the range	20 ac by 2022; 10 ac every 5 years afterward

Table Br 4.1 Breakneck Creek - Sediment

HUC 041100020202

Goals *Objectives* Actions	Lead/ cooperating Organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Br 1b-4 Install 20,000 sq ft of rain garden, reducing channel loading by 3,750 cu ft in a 3/4 inch storm			
1 Identify partners and sites	WC, partners		
2 Submit grant application	WC/partners		
3 Workshop/installation	WC/partners	Small rain gardens: Approx. $500 for materials for 100 rain garden of approx. 100 square feet, with amended soil. Cost depends on whether labor and materials are donated. Larger rain garden projects can be in the thousands or tens of thousands of dollars, depending on the level of engineering.	1 project or 300 square feet by 2022, an additional project in the following 5 years
Br 1b-5 Install 10,000 sq. ft. of biofiltration/permeable pavement in a developed site, reducing channel loading by 1,875 cu ft in a 3/4 in storm			
1 Identify parcel(s) and landowner(s) for project	partners, WC		
2 Grants	WC/partners		
3 Design/construct BMPs	outside consultant		
4, 5, 6 Green infrastructure workshops, code revision	(see Br 1a-4)		
Br 1b-6 Facilitate installation of 250 rain barrels, thereby reducing stream channel loading by 1,376 cu ft in a 3/4-inch storm.			
1 Obtain funding			
2 Obtain rain barrel materials			
4 Workshop		space, rain barrel materials, outreach, staff time	
5 Outreach			
Br 1b-7 Plant 12 ac of deep-rooted riparian vegetation, thereby reducing channel loading by 1,782 cu ft in a 3/4 inch storm .			
Actions: See Br 1a-1			
Goal Br 1c Reduce agricultural runoff to reduce annual loading of sediment by 620 tons			
Br 1c-1 Conduct survey of existing practices			
1 Develop survey of existing practices	WC, KSU?, NRCS		
2 Administer survey to willing landowners			
3 Windshield survey of visible practices			
4 Tally and summarize survey results			
5 Outreach with property owners based on survey			
Br 1c-2 Work with landowners to treat 100 acres of agricultural land with grassed waterways/vegetated filter strips, to reduce annual sediment loading by 177 tons			
1 Identify need and willing landowners			
2 Obtain funding			
3 Design/install			
4 Outreach			

Table Br 4.1 Breakneck Creek - Sediment

HUC 041100020202

Goals *Objectives* Actions	Lead/ cooperating Organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Br 1c-3 Work with landowners to install 100 ac of cover crops, reducing annual sediment loading by 101 tons.			
1 Identify need and willing landowners			
2 Obtain funding			
3 Install			
4 Outreach			
Br 1c-4 Work with landowners to use residue on 200 acres, to reduce annual sediment loading by 202 tons.			
1 Identify need and willing landowners			
2 Obtain funding			
3 Design/install			
4 Outreach			
Br 1c-5 Install 3,000 lf of livestock exclusion and accompanying measures to reduce sediment loading by 140 tons per year			
1 Contact landowners to determine willingness			
2 Submit proposal for grant funds			
3 Work with landowners to install measures			
4 Outreach			
Goal Br 1e Restore riparian features to reduce sedimentation by 108 tons/yr .			
Br 1e-1. Restore 80 ac of wetland, reducing loading of sediment by 80 tons/yr. Focus areas -altered wetlands in central watershed or headwaters.			
1 Map target areas to investigate for wetland, floodplain, riparian, habitat, or stream corridor restoration/protection/ enhancement	WC, partners	available mapping - compile and build on previous efforts	1 map by 2013, revisit and update if necessary every 3 years
2 Hold meetings to determine landowner interest	WC, partners		
3 Identify wetland restoration site for clearinghouse	WC, Communities, other partners	meetings with landowners; readily available mapping, outside assistance from consultant, possible assistance from Kent State University wetland ecology class	5 concept plans by 2020; 1 every 2 years afterward.
4 Submit grant application			
5 Restore/protect/enhance wetlands	Partners	$5,000-$100,000 per acre, design/build consultant, sites -protection by easements would be at the low end of the range	20 ac by 2022; 10 ac every 5 years afterward
Br 1e-2 Restore 50 acre-feet of floodplain access/storage, reducing annual sediment loading by 22 tons/yr. *Focus areas - areas with modified floodplain access. and at/upstream of flooding problem areas, e.g., Brimfield Ditch, Collins Pond, Wahoo Ditch*			
Actions: See Br 1b-2.			
Br 1e-3 Plant 12 ac.of deep-rooted riparian vegetation, reducing loading of sediment by 7 tons /yr Focus areas: large parcels single ownership, headwaters.			
Actions: See Br 1a-1			
Br 1e-4 Restore 3,000 lf of incised/channelized stream			
Actions: See Br 1b-1			

Table Br 4.1 Breakneck Creek - Sediment

HUC 041100020202

Goals *Objectives* Actions	Lead/ cooperating Organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Goal Br 1f Protect landscape features to prevent future sediment loading by 116 tons/yr.			
Br 1f-1 Protect 40,000 linear feet of riparian buffer by increasing the number of communities using riparian setbacks by 1, reducing loading of sediment by 16 tons/ yr			
1 Workshops for community officials on developing/enforcing riparian setbacks	Portage County Regional Planning Commission	Workshops would occur during regularly scheduled zoning inspector meetings, etc.	2 workshops by 2015; additional workshops - included in general workshop series
2 Provide written comment on wetland alteration permit applications concerning impacts to watershed functions/riparian setbacks	WC and partners		on-going
3 Increase the number of communities using riparian setbacks	WC, communities, Counties	Outreach	1 additional community with riparian setbacks by 2022
4 Install signage for riparian areas in publicly visible places	Partners	$200-$500 per sign. Outside funding or community sign facility	Signs at 2 locations by 2022; signs at 1 additional location every 5 years afterward
5 Continued outreach	Partners	funding for outreach	brochure, workshops on enforcement, outreach to homeowners etc.
Br 1f-2 Protect 100 acres of wetlands, preventing increased loading of sediment by 100 tons/yr			
1 Identify key areas for protection	Partners - Portage Park District		
2 Contact landowners/partner land trusts			
3 Submit grant proposal			
4 Acquire wetlands/easements			

Table Br 4.2 Breakneck Creek - Nitrogen

HUC 041100020202

Problem Statement Br-2: Nitrogen

Lake Hodgson, in the Breakneck Creek subwatershed, experiences algal blooms from excessive nutrients, with chl-A as high as 23 mg/l during the summer. Nitrogen levels in Breakneck Creek exceed state EOLP median (0.43 mg/l) and guidelines (1 mg/l) for WWH streams of this size, with levels ranging from 0.68 mg/l to 7.43 mg/l in 2007 at Summit Road. Upstream measurements from 2000 occasionally exceeded state median/guidelines, ranging from 0.29-0.64 mg/l. Communities in the northern portion of the subwatershed grew rapidly from 2000-2010, potentially increasing nitrogen loading from measured levels. The Middle Cuyahoga River downstream of Breakneck Cr. shows signs of slight nutrient enrichment, with large diurnal oxygen swings suggesting increased algal activity. Middle Cuyahoga River nitrate+nitrogen levels measured in 2007 frequently exceed the EOLP median (1.0 mg/l) and the state guidelines (1.5 mg/l), ranging from 0.9 mgl/l to 6 mg/l.

The STEP-L model indicates that the watershed generates 78,429 lb/yr of nitrogen from urban runoff, eroding banks, agricultural runoff, and failing septic systems. systems. Alteration of at least 1,739 acres of wetland, 50% of vegetated riparian corridor, and loss of riparian features (e.g., riparian zone, floodplain access) along an estimated 54 miles of watercourses has reduced the nitrogen uptake of the system. Further development and alteration of riparian vegetation could result in increased loading in the future.

Goals ***Objectives*** Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal Br 2a Reduce non-point source pollution from urban runoff to reduce annual loading of nitrogen by 168.6 lb			
Br 2a-1 Plant 12 a c.of deep-rooted riparian vegetation, reducing loading of nitrogen by 93 lb/ yr Focus areas: large parcels single ownership, headwaters.			
Actions: See Br 1a-1			
Br 2a-2 Retrofit stormwater volume devices to treat 100 acres of developed land and improve water quality, reducing loading of nitrogen by 70 lb/yr			
Actions: See Br 1a-2			
Br 2a-3 Retrofit 2,000 lf of drainage with no-mow grass/vegetated swale/daylighting to reduce nitrogen loading by 1.6 lb/yr.			
Actions: See Br 1a-3			
Br 2a-4 Review two development codes and update one to encourage use of green infrastructure in new developments.			
Actions: See Br 1a-4			
Br 2a-5 Install 20,000 sq ft of rain gardens to reduce nitrogen loading by 2 lb/yr			
1 Identify partners	WC, partners		
2 Submit grant application	WC/partners		
3 Workshop/installation	WC/partners	Approx. $500 for materials for 100 rain garden of approx. 100 square feet, with amended soil. Cost depends on whether labor and materials are donated. Larger rain garden projects can be in the thousands or tens of thousands of dollars, depending on the level of engineering.	1 project or 300 square feet by 2022, an additional project in the following 5 years
Br 2a-6 Install 10,000 sq ft of biofiltration in a commercial/institutional site(s), to reduce nitrogen loading by 2 lb per year			
1 Identify parcel(s) and landowner(s) for project	partners, WC		
2 Grants	WC/partners		
3 Design/construct BMPs	outside consultant		
4, 5, 6 Green infrastructure workshops, code revision - see Br 1a-4			

Table Br 4.2 Breakneck Creek - Nitrogen

HUC 041100020202

Goals *Objectives* Actions	Lead/ cooperating Organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Br 2a-7 Develop storm water management design manual for Portage County			
Actions: See Br 1a-7			
Br 2a-8 Update, increase, and disseminate available information concerning nitrogen from urban runoff			
Actions: See Br 1a-5			
Br 2a-9 Increase/sponsor 25 stewardship activities related to non-point source pollution and watershed issues.			
Actions: See Br 1a-6			
MCR 1 Establish 1 neighborhood-scale green infrastructure project as demonstration within the developed areas of one of the Middle Cuyahoga River subwatersheds, where suitable neighborhoods are identified, reducing loading of nitrogen by 200 lb/year			
Actions: See previous listing, MCR 1			
Goal Br 2b Reduce bank erosion to reduce nitrogen loading by 300 lb/year.			
Br 2b-1 Stabilize 3,000 l.f. to reduce nitrogen loading by 300 lb/yr *Focus areas, e.g., eroding streams with livestock access, headwaters, Brimfield Ditch, other ditches*			
Actions: See Br 1b-1			
Br 2b-2 Restore 50 acre-ft of floodplain access/storage, reducing channel loading by 217,800 cu. Ft. . Focus areas - areas with modified floodplain access. *and at/upstream of flooding problem areas, e.g., Wahoo Ditch, Brimfield Ditch, Feeder Canal, Breakneck headwaters*			
Actions: See Br 1b-2			
Br 2b-3 Restore 80 acres of wetland thereby increasing storage by 76,000 cubic feet of water in a 3/4 inch storm.			
Actions: See Br 1b-3			
Br 2b-4 Construct 20,000 square feet of rain gardens to reduce channel loading by 3,750 cu ft in a 3/4 inch event.			
Actions: See Br 1b-4			
Br 2b-5 Construct 10, 000 sq ft of bioinfiltration/permeable pavement in an institutional/commercial use, thereby reducing channel loading by 1,875 cu ft in a 3/4 inch storm .			
Actions: See Br 1b-5			
Br 2b-6 Facilitate installation of 250 rain barrels, thereby reducing stream channel loading by 1,376 cu ft in a 3/4-inch storm.			
Actions: See Br 1b-6			
Br 2b-7 Plant 12 ac of deep-rooted riparian vegetation, thereby reducing channel loading by 1,782 cu ft in a 3/4 inch storm .			
Actions: See Br 1b-7			
Goal Br 2c Reduce septic system failure to reduce annual loading of nitrogen by 933 lb			
Br 2c-1 Correct 3 failing HSDS per year, reducing nitrogen loading by 933 lb/yr Focus areas: vicinity of water courses			
1 Inspect systems	PCHD		
2 Correct failing/discharging home sewage treatment systems	Portage County Health District, landowners	Continued inspection and enforcement of illicit discharge regulations. Remedies depend on cause of failure and proximity of sewer service.	10 by 2022; 1 per year afterward

Table Br 4.2 Breakneck Creek - Nitrogen

HUC 041100020202

Goals *Objectives* Actions	Lead/ cooperating Organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
3 Continue to investigate funding sources	PCRPC, PCHD, wc		
4 Outreach:			
Goal Br 2d Reduce agricultural runoff to reduce annual loading of nitrogen by 1,466 lb			
Br 2d-1 Conduct 1 approximately year-long nutrient survey along Breakneck Creek, Feeder Canal, Lake Hodgson, Congress Lake Outlet, and Potter Creek.			
Actions: See Br 1c-1			
Br 2d-2 Work with landowners to treat 100 acres of agricultural land with grassed waterways/vegetated filter strips, to reduce annual nitrogen loading by 466 lb			
Actions: See Br 1c-2			
Br 2d-3 Work with landowners to install 100 ac of cover crops, reducing annual nitrogen loading by 240 lb.			
Actions: See Br 1c-3			
Br 2d-4 Work with landowners to use residue on 200 acres, to reduce annual nitrogen loading by 480 lb.			
Actions: See Br 1c-4			
Br 2d-5 Install 3,000 lf of livestock exclusion and accompanying measures to reduce nitrogen loading by 280 lb per year			
Actions: See Br 1c-5			
Goal Br 2e Restore riparian features to reduce nitrogen loading by 2,835 lb/yr.			
Br 2e-1. Restore 80 ac of wetland, reducing loading of nitrogen by 2,240 lb/yr. Focus areas -altered wetlands in central watershed or headwaters.			
Actions: See Br 1b-3			
Br 2e-2 Restore 50 acre-ft of floodplain access/storage, reducing annual nitrogen loading by 300 lb. Focus areas - areas with modified floodplain access. *and at/upstream of flooding problem areas, e.g., Brimfield Ditch, Collins Pond, Wahoo Ditch*			
Actions: See Br 1b-2.			
Br 2e-3 Improve channel morphology, e.g., 2-stage ditch, by 1,000 lf to increase nitrogen uptake by 295 lb/yr. Focus areas: altered headwater channels.			
1 Map target areas to investigate for wetland, floodplain, riparian, habitat, or stream corridor restoration/protection/ enhancement	WC, partners	available mapping - compile and build on previous efforts	1 map by 2013, revisit and update if necessary every 3 years
2 Hold meetings to determine landowner interest	WC, partners		
4 Submit grant application			
5 Construct ditch improvements	design-build consultant	funding for design-build consultant	
6 Public outreach			
Br 2e-4 Restore 3,000 lf of incised/channelized stream, e.g., Wahoo, Brimfield, Hudson ditches; Breakneck headwaters/channel			
Actions: See Br 1b-1			

Table Br 4.2 Breakneck Creek - Nitrogen

HUC 041100020202

Goals *Objectives* Actions	Lead/ cooperating Organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Goal Br 2f Protect landscape features to prevent future nitrogen loading by 3,020 lb/yr.			
Br 2f-1 Protect 40,000 linear feet of riparian buffer by increasing the number of communities using riparian setbacks by 1, reducing loading of nitrogen by 220 lb/yr			
1 Workshops for community officials on developing/enforcing riparian setbacks	Portage County Regional Planning Commission	Workshops would occur during regularly scheduled zoning inspector meetings, etc.	2 workshops by 2015; additional workshops - included in general workshop series
2 Provide written comment on wetland alteration permit applications concerning impacts to watershed functions/riparian setbacks	WC and partners		on-going
3 Increase the number of communities using riparian setbacks	WC, communities, Counties	Outreach	1 additional community with riparian setbacks by 2022
4 Install signage for riparian areas in publicly visible places	Partners	$200-$500 per sign. Outside funding or community sign facility	Signs at 2 locations by 2022; signs at 1 additional location every 5 years afterward
5 Continued outreach	Partners	funding for outreach	brochure, workshops on enforcement, outreach to homeowners etc.
Br 2f-2 Protect 100 acres of wetlands, preventing increased loading of nitrogen by 2,800 lb/yr			
1 Identify key areas for protection	Partners - Portage Park District		
2 Contact landowners/partner land trusts			
3 Submit grant proposal			
4 Acquire wetlands/easements			

Table Br-4.3 Breakneck Creek Phosphorous

HUC 041100020202

Problem Statement Br-3: Phosphorous

Breakneck Creek and the Cuyahoga River downstream of Breakneck are enriched in phosphorous. Lake Hodgson, in the Breakneck Creek subwatershed, experiences algal blooms from excessive nutrients. The STEP-L model indicates that the watershed generates 16,470 lb/yr of phosphorous from urban runoff, eroding banks, agricultural runoff, and failing septic systems. Alteration of at least 1,739 acres of wetland, 50% of vegetated riparian corridor, and loss of riparian features (e.g., riparian zone, floodplain access) along an estimated 54 miles of watercourses has reduced the phosphorous uptake of the system. Potential loss of additional riparian vegetation through development could increase loading in the future.

Goals ***Objectives*** Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal Br 3a Reduce non-point source pollution from urban runoff to reduce annual loading of phosphorous by 28.7 lb			
Br 3a-1 Plant 12 ac of deep-rooted riparian vegetation, reducing loading of phosphorous by 17 lb/yr Focus areas: large parcels single ownership, headwaters.			
Actions - See Br 1a-1			
Br 3a-2 Retrofit stormwater volume devices to treat 100 acres of commercial/institutional land and improve water quality, reducing loading of phosphorous by 10 lb/yr			
Actions - See Br 1a-2			
Br 3a-3 Retrofit 1,000 lf of roadside ditch with no-mow grass, vegetated swale, or daylighting to reduce phosphorous loading by 0.8 lb/yr			
Actions - See Br 1a-3			
Br 3a-4 Review two development codes and update one to encourage use of green infrastructure in new developments.			
Actions - See Br 1a-4			
Br 3a-5 Install 20,000 sq ft of rain gardens to reduce phosphorous loading by 0.5 lb/yr			
Actions - See Br 2a-5			
Br 3a-6 Install 10,000 sq ft of biofiltration/permeable pavement, to reduce phosphorous loading from a developed site by 0.4 lb per year			
Actions: see Br 2a-6			
Br 3a-7 Develop storm water management design manual for Portage County			
Actions: See Br 1a-7			
Br 3a-8 Update, increase, and disseminate available information concerning phosphorous from urban runoff			
Actions: see Br 2a-8			
Br 3a-9 Increase/sponsor 25 stewardship activities related to non-point source pollution and watershed issues.			
Actions: see Br 2a-9			
MCR 1 Establish 1 neighborhood-scale green infrastructure project as demonstration within the developed areas of one of the Middle Cuyahoga River subwatersheds, where suitable neighborhoods are identified, reducing loading of phosphorous by 25 lb/year			
Actions - See TableBr 4.1			
Goal Br 3b Reduce bank erosion from overloaded channels/livestock access to reduce phosphorous loading by 38 lb/year.			
Br 3b-1 Stabilize 3,000 l.f. of eroding streambank to reduce phosphorous loading by 112 lb/yr Focus areas, e.g., headwaters, Brimfield Ditch, other ditches			
Actions: see Br 2b-1			
Br 3b-2 Restore 50 acre-ft of floodplain access/storage, reducing channel loading by 217,800 cu. Ft.. Focus areas - areas with modified floodplain access. *and at/upstream of flooding problem areas, e.g., Wahoo Ditch, Brimfield Ditch, Feeder Canal, Breakneck headwaters*			

Table Br-4.3 Breakneck Creek Phosphorous

HUC 041100020202

Goals ***Objectives*** Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Actions: See Br 1b-2			
Br 3b-3 Restore 80 acres of wetland thereby increasing storage by 76,000 cubic feet of water in a 3/4 inch storm.			
Actions: See Br 1b-3			
Br 3b-4 Construct 20,000 square feet of rain gardens to reduce channel loading by 3,750 cu ft in a 3/4 inch event.			
Actions: See Br 1b-4			
Br 3b-5 Construct 20,000 sq ft of bioinfiltration/permeable pavement in an institutional/commercial use, thereby reducing channel loading by 1,875 cu ft in a 3/4 inch storm .			
Actions: See Br 1b-5			
Br 3b-6 Facilitate installation of 250 rain barrels, thereby reducing stream channel loading by 1,376 cu ft in a 3/4-inch storm.			
Actions: See Br 1b-6			
Br 3b-7 Plant 12 ac of deep-rooted riparian vegetation, thereby reducing channel loading by 1,782 cu ft in a 3/4 inch storm .			
Actions: See Br 1b-7			
Br 3a-8 Review two development codes and update one to encourage use of green infrastructure in new developments.			
Actions: See Br 1a-4			
Br 3a-9 Restore 3,000 lf of incised/channelized stream, e.g., Wahoo, Brimfield, Hudson ditches; Breakneck headwaters/channel			
Actions: See Br 1b-1			
Goal Br 3c Reduce septic system failure to reduce annual loading of phosphorous by 366 lb			
Br 3c-1 Correct 3 failing HSDS per year, reducing phosphorous loading by 366 lb/yr Focus areas: vicinity of water courses			
Actions: See Br 2c-1			
Goal Br 3d Reduce agricultural runoff to reduce annual loading of phosphorous by 526 lb			
Br 3d-1 Conduct 1 approximately year-long nutrient survey along Breakneck Creek, Feeder Canal, Lake Hodgson, Congress Lake Outlet, and Potter Creek.			
Actions: See Br 1c-1			
Br 3d-2 Work with landowners to treat 100 acres of agricultural land with grassed waterways/vegetated filter strips, to reduce annual phosphorous loading by 26 lb			
Actions: See Br 1c-2			
Br 3d-3 Work with landowners to install 100 ac of cover crops , reducing annual phosphorous loading by 120 lb.			
Actions: See Br 1c-3			
Br 3d-4 Work with landowners to use residue on 200 acres , to reduce annual phosphorous loading by 240 lb.			
Actions: See Br 1c-4			
Br 3d-5 Install 3,000 lf of livestock exclusion and accompanying measures to reduce phosphorous loading by 140 lb per year			
Actions: See Br 1c-5			
Goal Br 3e Increase uptake of phosphorous by riparian/in-stream features by 637 lb/yr.			
Br 3e-2 Restore 50 acre-ft of floodplain access/storage, reducing annual phosphorous loading by 41 lb. Focus areas - areas with modified floodplain access. *and at/upstream of flooding problem areas, e.g., Brimfield Ditch, Collins Pond, Wahoo Ditch*			
Actions: see Br 1b-2			

Table Br-4.3 Breakneck Creek Phosphorous

HUC 041100020202

Goals			**Amount to complete, time frame**
Objectives Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	(contingent on funding, resources, landowner willingness)
Br 3e-2. Restore 80 ac of wetland, reducing loading of phosphorous by 505 lb/yr. Focus areas -altered wetlands in central watershed or headwaters.			
Actions: see Br 1b-3			
Br 3e-3 Improve channel morphology, e.g., 2-stage ditch, by 1,000 lf to treat increase phosphorous uptake by 91 lb/yr			
Actions: see Br 3e-3			
Goal Br 3f Protect landscape features to prevent future phosphorous loading by 711 lb/yr.			
Br 3f-1 Protect 40,000 linear feet of riparian buffer by increasing the number of communities using riparian setbacks by 1, reducing loading of phosphorous by 79 lb/yr			
Actions: see Br 2f-1			
Br 3f-2 Protect 100 acres of wetlands, preventing increased loading of phosphorous by 632 lb/yr			
Actions: see Br 2f-2			

Table Br 4.4 Breakneck Creek - Groundwater

HUC 041100020202

Problem Statement Br-4: Groundwater, Public Water Supplies

The subwatershed contains two public water supplies, both of which are susceptible to contamination from surface spills and leaks to groundwater. Both public water supplies have source water protection plans, but their contributing surface and groundwater zones are largely privately owned and susceptible to contamination from uses or spills.

Goals			
Objectives Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal Br 4a Increase community awareness of procedures, protective measures, and groundwater chemistry related to fracking			
Br 4a-1 Monitor groundwater chemistry at 4 sites up-gradient of public water supplies for chemicals associated with fracking			
1 Work with partners to identify sites and chemicals of concern			
2 Develop baseline profile			
3 Monitor 5 times by 2022			
Br 4a-2 Increase awareness of potential hazards and protective measures associated with fracking			
1 Coordinate with state agencies and communities concerning fracking and controls			
2 Coordinate with state agencies to receive notification of drilling permit requests			
3 Outreach to communities and property owners - website, brochures, etc.			
Goal Br 4a Reduce risks of groundwater contamination from land use, spills, or hazardous waste sites.			
Br 1a-1 Inventory brownfield sites in the Breakneck Creek subwatershed, focusing on Ravenna			
1 Submit grant proposal	wc/Portage County		
2 Compile available mapping		mapping, coordinate with city officials	
3 Conduct inventory			1 inventory by 2017
4 Identify likely site(s) for clean-up	County, cities, Ohio EPA, landowners	outside consultant	
Br 1b-1 Initiate clean-up of 1 existing brownfield site, focusing on areas near water supplies or water courses.			
1 Coordinate with state regulators concerning status of DERR-listed sites	WC		
2 Submit grant application	WC/Portage County agencies		
3 Consultant inventory of brownfield sites		outside consultant and funding	1 inventory

Table Br 4.4 Breakneck Creek - Groundwater

HUC 041100020202

Goals			**Amount to complete, time frame**
Objectives	**Lead/ cooperating**		(contingent on funding, resources,
Actions	**Organizations**	**Resources needed/cost**	landowner willingness)
3 Work with property owners and state regulators to identify site and conditions/plans for clean-up			
4 Submit grant application for clean-up funds	WC/Portage County		
5 Clean-up		outside consultant and funding, disposal	clean-up/cap one site
6 Redevelopment		development/use plan	
Br 4b-1 Provide public and agency outreach efforts to assist with implementation of 2 source water protection plans			
1 Coordinate with water suppliers concerning			
2 Apply for funding if needed			
3 Develop and disseminate outreach materials - written, website			
Br 4b-2 Update, increase, and disseminate available information concerning watershed protection			
Actions: See Br 1a-5, Table Br 4.1			
Br 4b-3 Increase/sponsor 25 stewardship activities related to non-point source pollution and watershed issues.			
Actions: See Br 1a-6, Table Br 4.1			

Table Br 4.5 Breakneck Creek - Flooding Problems

HUC 041100020202

Problem Statement Br-5: Flooding Problems

Areas within the subwatershed experience damaging flooding, including Brimfield Ditch near Route 261/Summit Rd., Wahoo Ditch, Breakneck Creek at Lakewood Rd., and Collins Pond. The watershed as a whole is 10% impervious, but the development is concentrated in the northern portion, which is approximately 17% impervious. Throughout the watershed, runoff from a 3/4 inch storm is increased by approx. 500,000 cu ft over an undeveloped watershed. The flood-management capacity along approximately 58 miles of stream channel has been reduced through alteration of watershed features, such as wetlands, riparian corridor, floodplain access, and stream morphology. Additional development or alteration will likely increase the total volume in streams.

Goals			**Amount to complete, time frame**
Objectives	**Lead/ cooperating**		(contingent on funding, resources,
Actions	**Organizations**	**Resources needed/cost**	landowner willingness)
Goal Br 5a Address flooding problems in one area by restoring altered watershed hydrology/watershed characteristics			
Br 5a-1 Conduct 1 stormwater management study focusing on flooding problem area to identify potential landscape restoration opportunities that will reduce problem flooding.			
1 Develop detailed maps for areas of interest identifying topography, existing and altered wetlands, drainage, and imperviousness.			
2 Conduct engineering study	Ravenna/Portage County	Outside funding for consultant	
3 Outreach with neighborhoods to discuss feasible approaches			
4 Submit grant proposal	wc/city or county staff		
5 Construct improvements		outside consultant	
Goal Br 5b Reduce runoff throughout the subwatershed by 29,600 cu ft in a 3/4 in storm to reduce flooding potential.			
Br 5b-1 Review two development codes and update one to encourage use of green infrastructure in new developments.			
Actions - SeeBr 2a-4			
Br 5b-2 Construct 20,000 square feet of rain gardens to reduce channel loading by 3,750 cu ft in a 3/4 inch event.			
Actions: See Br 1b-4			
Br 5b-2 Construct 20,000 sq ft of bioinfiltration/permeable pavement in an institutional/commercial use, thereby reducing channel loading by 1,875 cu ft in a 3/4 inch storm .			
Actions: See Br 1b-5			
Br 5b-4 Facilitate installation of 250 rain barrels, thereby reducing stream channel loading by 1,376 cu ft in a 3/4-inch storm.			
Actions: See Br 1b-6			
Br 5b-5 Plant 12 ac of deep-rooted riparian vegetation, thereby reducing channel loading by 1,782 cu ft in a 3/4 inch storm .			
Actions: See Br 1b-7			
Br 5b-6 Update, increase, and disseminate available information concerning reducing runoff			
Actions - See Br 1a-5			
Br 5b-7 Increase stewardship activities related to runoff and watershed issues by 25 events/activities			
Actions - See Br 1a-6			

Table Br 4.5 Breakneck Creek - Flooding Problems

HUC 041100020202

Goals *Objectives* Actions	Lead/ cooperating Organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
MCR 1 Establish 1 neighborhood-scale green infrastructure project as demonstration within the developed areas of one of the Middle Cuyahoga River subwatersheds, where suitable neighborhoods are identified, reducing channel loading by 14,963 cu ft in a 3/4 in storm			
Actions - See Table Br 4.2			
Goal Br 5c Restore/improve altered watershed landscape features throughout watershed to increase flood storage by 295,582 cu ft in a 3/4 in storm.			
Br 5c-1 Restore 50 acre-ft of floodplain access/storage, reducing channel loading by 217,800 cu. Ft. . Focus areas - areas with modified floodplain access. *and at/upstream of flooding problem areas, e.g., Wahoo Ditch, Brimfield Ditch, Feeder Canal, Breakneck headwaters*			
Actions: See Br 1b-2			
Br 5c-3 Restore 80 acres of wetland thereby increasing storage by 76,000 cubic feet of water in a 3/4 inch storm.			
Actions: See Br 1b-3			
Br 5c-3 Improve channel morphology, e.g., 2-stage ditch by 1,000 lf. Storage at higher intensity storms than 3/4 inch would increase.			
Actions - See Br 1b-7			
Br 5c-4 Plant 12 ac of deep-rooted riparian vegetation, thereby reducing channel loading by 1,782 cu ft in a 3/4 inch storm.			
Actions - See Br 1a-1			
Br 5c-5 Restore 3,000 lf of incised/channelized stream, e.g., Wahoo, Brimfield, Hudson ditches; Breakneck headwaters/channel			
Actions: See Br 1b-1			
Goal Br 5d Protect landscape features to prevent future channel loading by 67,760 cu ft in a 3/4 in storm.			
Br 5d-1 Protect 40,000 linear ft of riparian buffer by increasing use of riparian setbacks by 1 community, to reduce channel loading 3,960 cu ft in a 3/4 in storm			
Actions - See Br 2e-1			
Br 5d-2 Protect 100 acres of wetlands through purchase of land/easement, preventing increased channel loading of by 63,800 cu ft in a 3/4 in storm			
Actions - See Br 2e-1			

Table Br 4.6 Habitat

HUC 041100020202

Problem Statement Br-6: Habitat

Alteration of at least 1,739 acres of wetland, 50% of vegetated riparian corridor, and loss of riparian features (e.g., riparian zone, channel form, floodplain access) along an estimated 54 miles of watercourses has degraded riparian and wetland habitat in the subwatershed. Wahoo Ditch is in non-attainment of MWH status due to its extreme ditchlike nature, with recent QHEI scores of 44.5-55, rating as "poor." Causes/sources of non-attainment include poor habitat due to channelization. The lower portion of Breakneck Creek received QHEI scores of 56.5 and 59, due in part to channelization. Several tributaries have been highly channelized. The undisturbed riparian corridor and wetlands fringing Breakneck Creek have helped maintain high the high quality of the creek in spite of agricultural and urban influences. Remaining wetlands are at risk of degradation/encroachment from development. Three communities do not have riparian setbacks, placing remaining riparian vegetation at risk. The Breakneck riparian corridor and other areas are listed in the Portage County Watershed Plan as priorities for protection, and species of concern are found throughout this watershed..

Goals ***Objectives*** Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal Br 6a Restore/improve 21.7 acres of altered habitat/stream channel morphology.			
Br 6a-1 Plant 12 ac. of deep-rooted riparian vegetation. Focus areas: large parcels single ownership, headwaters.			
Actions: See Br 1a-1			
Br 6a-2 Restore/improve 80 acres of wetland habitat. Focus: altered wetlands.			
Actions: See Br 1b-3			
Br 6a-3 Restore 50 acre-ft of floodplain access/storage. Focus - areas with modified floodplain access. e.g., Wahoo Ditch, Brimfield Ditch, Collins Pond, Wahoo Ditch			
Actions: See Br 1b-2			
Br 6a-4 Improve channel morphology, e.g., 2-stage ditch, by 1,000 lf to increase floodplain access by 10,000 sq. feet.			
Actions: See Br 2e-3			
Br 6a-5 Restore 3,000 lf of incised/channelized stream, e.g., Wahoo, Brimfield, Hudson ditches; Breakneck headwaters/channel			
Actions: See Br 1b-1			
Br 6a-6 Conduct feasibility study for removing small low-head dams.			
Goal Br 6b Reduce bank erosion from overloaded channels.			
Br 6b-1 Restore 50 acre-ft of floodplain access/storage, reducing channel loading by 217,800 cu. Ft.. Focus areas - areas with modified floodplain access. *e.g., Wahoo Ditch, Brimfield Ditch, Feeder Canal, Breakneck headwaters*			
Actions: See Br 1b-2			
Br 6b-2 Restore 80 acres of wetland thereby increasing storage by 76,000 cubic feet of water in a 3/4 inch storm.			
Actions: See Br 1b-3			
Br 6b-3 Improve channel morphology, e.g., 2-stage ditch by 1,000 lf. Storage at higher intensity storms than 3/4 inch would increase.			
Actions - See Br 1b-7			
Br 6b-4 Plant 12 ac of deep-rooted riparian vegetation, thereby reducing channel loading by 1,782 cu ft in a 3/4 inch storm.			
Actions - See Br 1a-1			
Goal Br 6c Protect 128 acres of landscape features to prevent future habitat degradation.			
Br 6c-1 Protect 40,000 linear feet of riparian buffer by increasing the number of communities using riparian setbacks by 1			
Actions: See Br 1f-1			
Br 6c-2 Protect 100 acres of wetlands through acquisition or easement. Focus areas: high value habitat identified in WAP or Portage County Watershed Plan.			
Actions: See Br 1f-2			
Br 6c-3 Update, increase, and disseminate available information concerning watershed habitats			
Actions: See Br 1a-5			
Br 6c-4 Increase/sponsor 25 stewardship activities related to stream channel health, non-point source, runoff, erosion, habitats, etc.			
Actions: See Br 1a-6			

Table Br 4.7 Breakneck Creek - Recreation

HUC 041100020202

Problem Statement Br-7: Recreation

Limited public recreational opportunities exist along Breakneck Creek. Parks districts and communities are actively seeking to increase recreational trails in the vicinity of the creek and Cuyahoga River. The Portage Park District property along Breakneck Creek is not yet open to the public. The Portage Bike/Hike Trail is planned and partially complete.

Goals			**Amount to complete, time frame**
Objectives	**Lead/ cooperating**		(contingent on funding, resources,
Actions	**Organizations**	**Resources needed/cost**	landowner willingness)
Goal Br 7a Increase/improve recreational opportunities related to Breakneck Creek and tributaries.			
Br 7a-1 Construct 1 mile of bike/hike trail (e.g., Portage bike-hike greenway).			
1 Submit grant proposal			
2 Develop design			
3 Construct link			
4 Develop and install informational signs			
5 Outreach, pubicity			
Br 7a-2 Increase/improve access points along Breakneck Creek by 1 publicly accessible location			
1 Submit grant proposal			
2 Work with Portage Parks to design access			
3 Construct access points and related facilities (e.g., parking, signs, etc.) as appropriate			
Br 7a-3 Develop 2 quests or 1 virtual watershed tour			
1 Determine appropriate River Quest structure (cuyahoga canalway or new one)	WC, partners, volunteers, parks	Permission to develop quests, printing costs	2 quests by 2017 or 1 watershed tour by 2017
2 Public workshop concerning River quests			
3 Seek quests from volunteer groups			
4 Review, print, distribute		funding for printing, place on website	
Goal Br 7b: Increase awareness of recreational opportunities, stewardship, and watershed issues.			
Br 7b-1. Economic impact study recreational uses	WC with KSU	outside funding	1 study by 2018
1 Coordinate with KSU and others on study			
2 Submit grant proposal			
3 Conduct study			
4 Publicize			
Br 7b-2. Increase signage related to watershed at local parks by 18.			
1 apply for funding			
2 Design, install signs			
3 Continued outreach with local communities			
Br 7b-3 Update, increase, and disseminate available information concerning recreational opportunities and care of Breakneck Creek, its tributaries, and watershed.			
1 Web page of recreational opportunities/access	wc		
2 Other Actions - see Br 2a-5, Table Br 4.1			
Br 7b-4. Increase stewardship activities related to watershed issues			
1 Annual park clean-ups?			
Actions - See Br 2a-6, Table Br 4.1			

Table Br 4.8 Breakneck Creek - Contamination from Brownfields
HUC 041100020202

Problem Statement Br-8: Contaminants from brownfield sites and spills

The Breakneck Creek subwatershed has 11 sites of potential chemical releases, listed on the DERR database or otherwise known. Wahoo Ditch is in non-attainment due in part to legacy contaminants

Goals ***Objectives*** Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal Br-8a Address contamination at one site along Wahoo Ditch.			
Br 8a-1 Inventory brownfield sites in the Breakneck Creek subwatershed, focusing on Ravenna			
1 Submit grant proposal	wc/Portage County		
2 Compile available mapping		mapping, coordinate with city officials	
3 Conduct inventory			1 inventory by 2017
4 Identify likely site(s) for clean-up	County, cities, Ohio EPA, landowners	outside consultant	
Goal Br 8b Reduce risks of surface or groundwater contamination from toxic releases from 1 existing sites.			
Br 8b-1 Initiate clean-up of 1 existing brownfield site, focusing on areas near water supplies or water courses.			
1 Coordinate with state regulators concerning status of DERR-listed sites	WC		
2 Submit grant application	WC/Portage County agencies		
3 Consultant inventory of brownfield sites		outside consultant and funding	1 inventory
4 Work with property owners and state regulators to identify site and conditions/plans for clean-up			
5 Develop brownfields plan to identify priorities for clean-up	WC/Portage County agencies, cities	outside consultant and funding	1 plan (combine with inventory?)
6 Submit grant application for clean-up funds	WC/Portage County		
7 Clean-up		outside consultant and funding, disposal	clean-up/cap one site
8 Redevelopment		development/use plan	

7 Po Potter Creek
HUC 041100020201

1 Summary of Existing Conditions

Table Po 1 summarizes some of the key characteristics of this subwatershed. Table Po 2 presents a summary of identified impairments, causes, and sources. Figure Po 1 shows the sub-watershed and jurisdictions. Figures Po 2 and 3 have been compiled from mapping in Volume I and show potential areas of concern and resource areas for protection. (Greater detail is shown in the various maps in Vol. I.) Also see photos in Section 4P, Potter Creek.

This subwatershed is 62 percent agricultural, 25 percent woods and wetlands, and the remainder is developed. The riparian landscape is highly altered.

The primary drainage is from Congress Lake through the Congress Lake Outlet, a stream that was channelized during the 1800s canal era and which is maintained as a ditch as part of the Ravenna water supply. Congress Lake Outlet joins with Potter Creek in the lower reaches of the subwatershed. During most of the year, the combined Congress Lake Outlet/Potter Creek flows directly into Breakneck Creek. A control structure at the upper end of the Breakneck Creek watershed (immediately downstream of the Potter Creek subwatershed) allows the City of Ravenna to draw from Congress Lake Outlet via the Feeder Canal to supplement Lake Hodgson water, which is done only occasionally during dry summers. The City has experienced problems with taste, odor, and algae in Lake Hodgson.

Priorities for this subwatershed include reducing non-point source pollution from agricultural land, addressing failing septic systems, protecting remaining large wetland complexes, and as possible improving hydrology and riparian conditions along channelized streams.

The problem statements in Tables Po 4.1 through Po 4.4 address individual problems related to these concerns and may overlap. For instance, agricultural runoff and channelization contribute to the problems of nutrient enrichment and sedimentation.

Water Quality Assessment and Attainment Non-Point Source Pollution *(Refer to Problem Statements Po-1 through Po-3.)*

When Potter Creek was assessed at Trares Road in 2000, the creek was in partial attainment of water quality standards due to siltation and channelization. The 2000 Middle Cuyahoga River TMDL noted that Potter Creek was recovering in locations. Observations suggest that these conditions have not changed and occur throughout the subwatershed.

Nutrients are a concern in this watershed, because Lake Hodgson occasionally draws from Congress Lake Outlet/Potter Creek. Congress Lake, which feeds Congress Lake Outlet, is a hyper-eutrophic kettle lake. However, due to the sporadic influx of water from Congress Lake to Lake Hodgson, the effects of Congress Lake/Congress Lake Outlet/Potter Creek on Lake Hodgson water quality have not been determined.

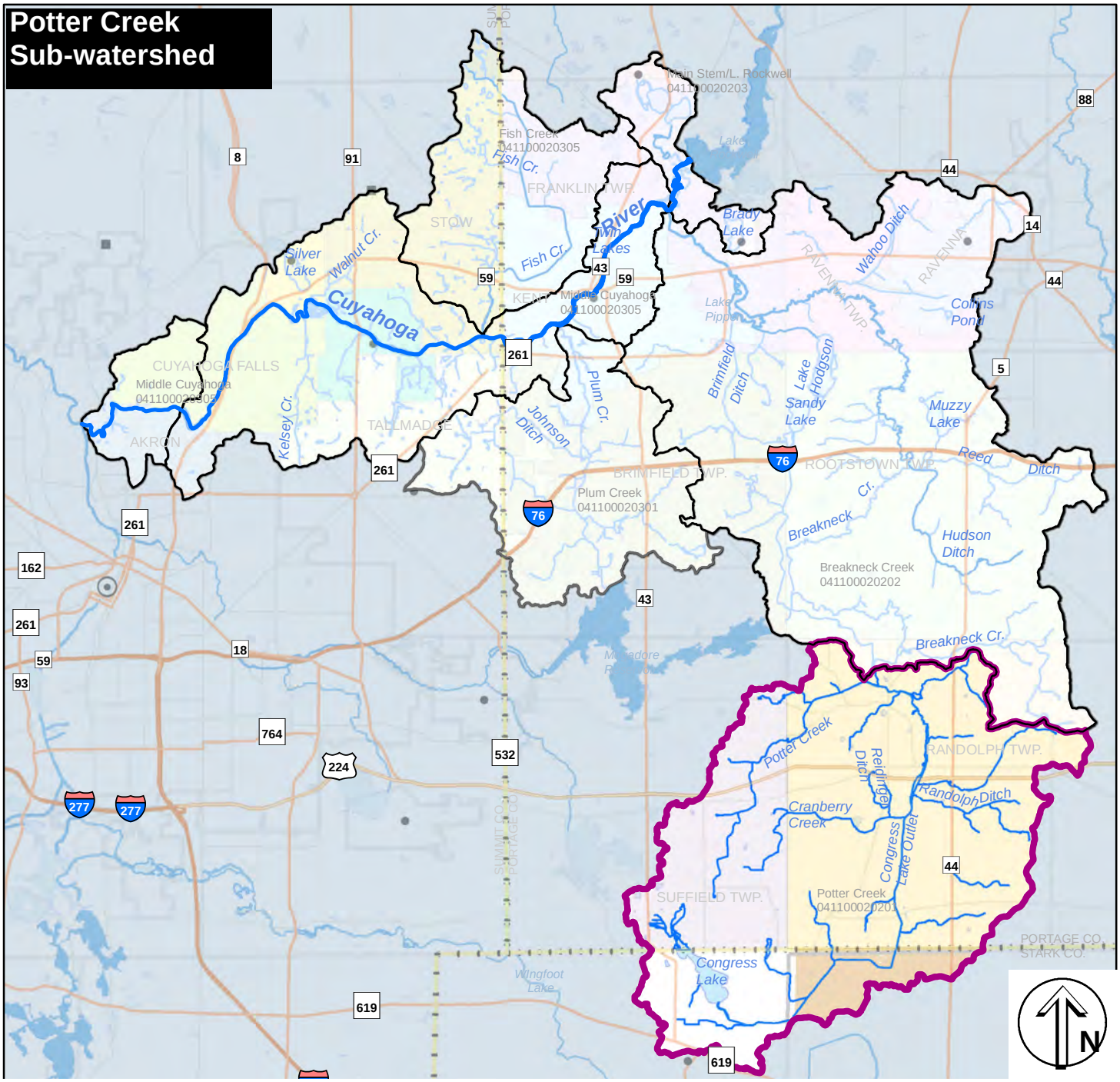


Figure Po-1
Subwatershed Jurisdictions

- Streams and Rivers
- Lakes
- Potter Cr. Subwatershed
  12-Digit HUC: 041100020201
- Fish Creek 041100020305 — Other Sub-watersheds
- Counties
- Jurisdictions outside watershed
- Interstate Highways
- State Divided Highways
- State Numbered Rtes
- Local Roads

Subwatershed Local Jurisdictions

- SUFFIELD TWP.
- RANDOLPH TWP.
- MARLBORO TWP
- LAKE TWP

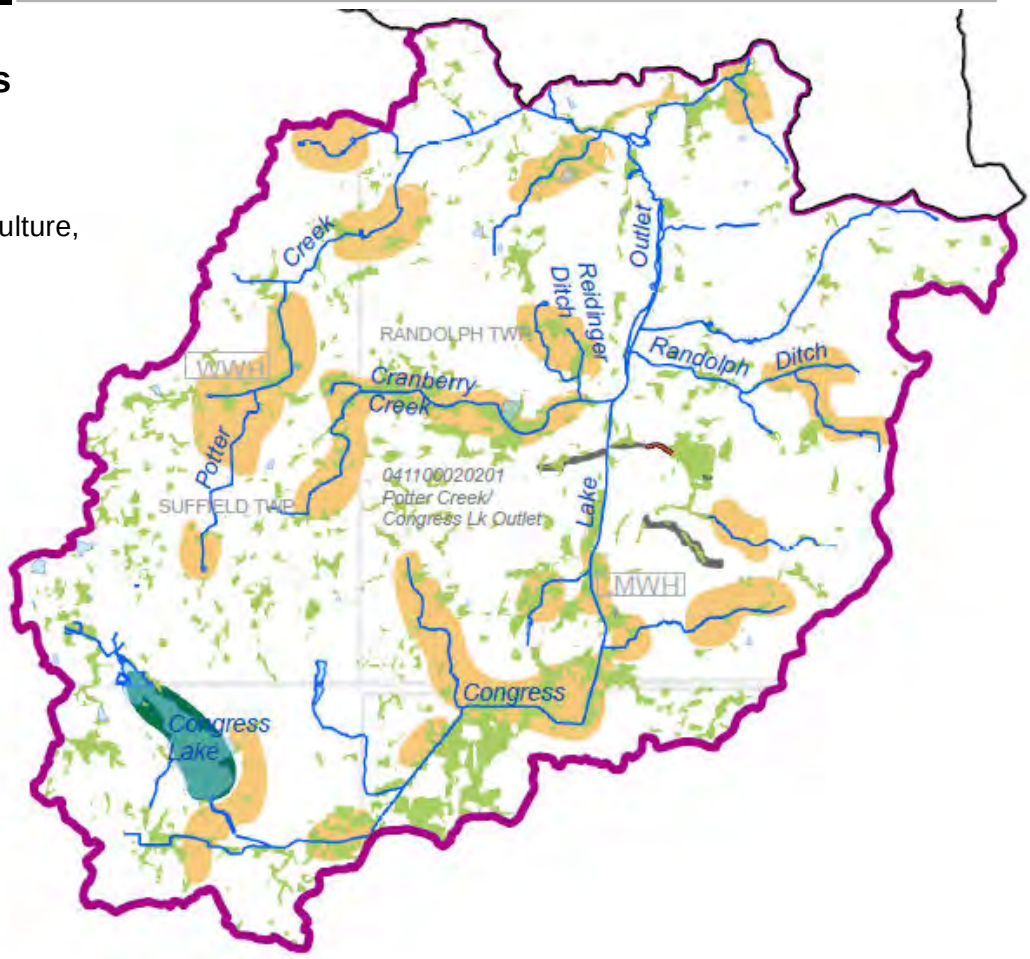
Sources: NEFCO, 2010; Portage County GIS 2010; Summit County GIS 2009; Stark County Planning Commission 2010; Ohio DNR GIS 2010

Po-2 Problem Areas
Potter Creek Subwatershed

Potter Creek Subwatershed
041100020305 Fish Creek — Other Subwatershed, 12-Digit HUC
Streams and Rivers
Lakes
WWH — Aquatic Life Use Designation

Land Use Related Concerns

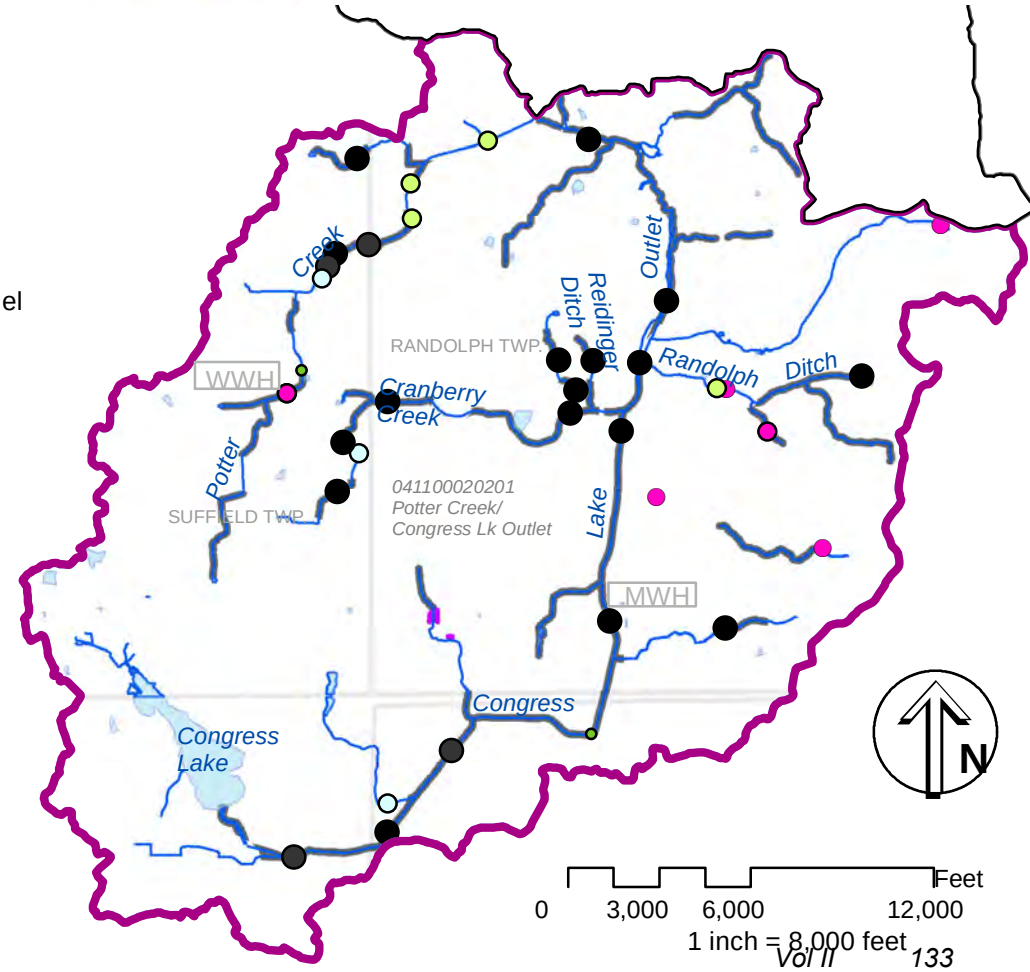
- Potential impacts due to proximity of land use (agriculture, golf courses, development)
- Altered Wetlands
- Nuisance Algae



Channel Conditions

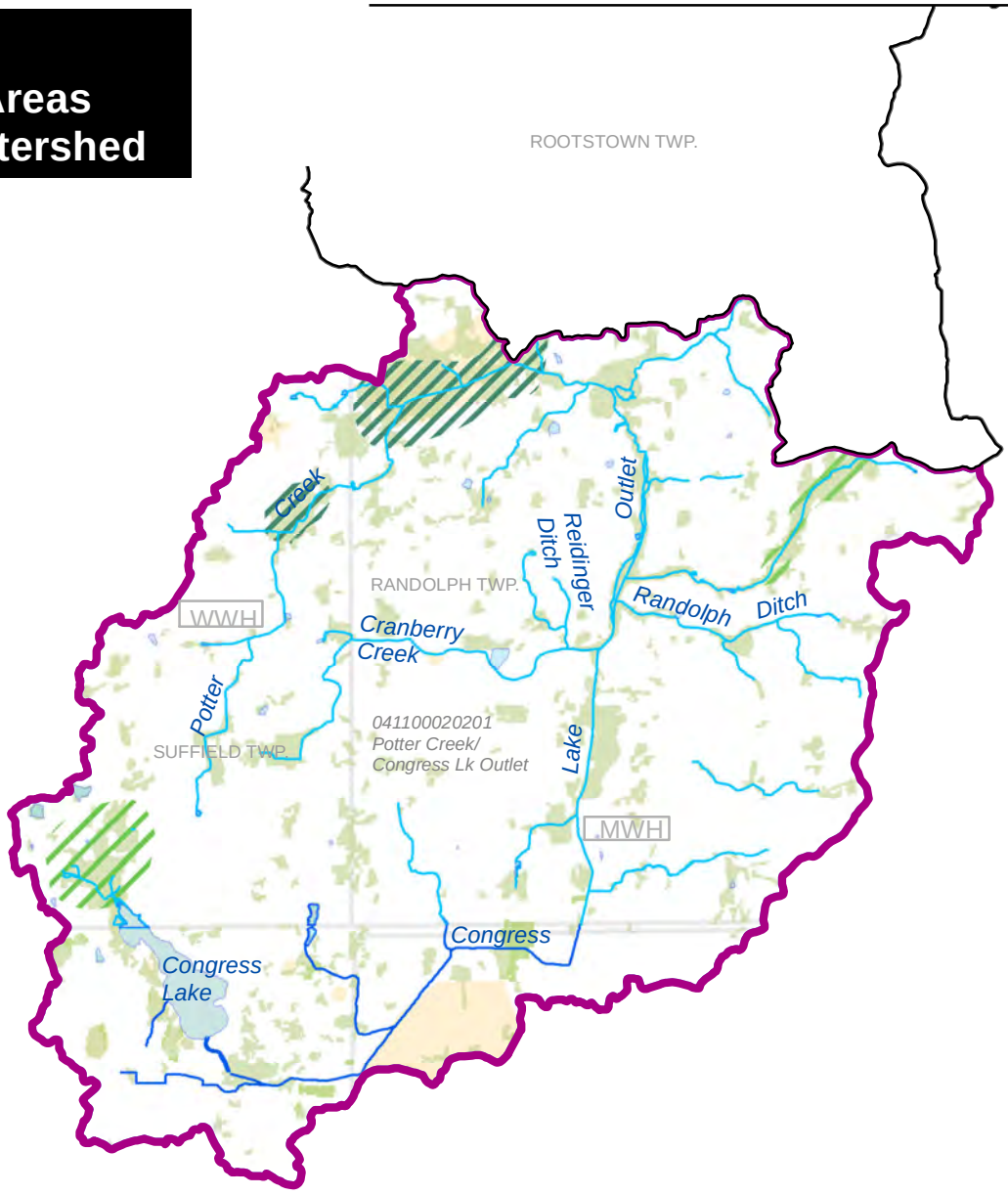
Observations

Along Channel	*At Sites*	*Condition*
	●	Intact
	○	Recovering
▬	●	Eroding Channel
▬	●	Channelized
▬	○	Incised/altered channel banks



**Problem areas are approximate, identified by limited interpretation of 2006 aerial photography, visits to stream crossings, and flooding, impoundment, or eutrophication concerns identified by partners or in Ohio EPA documents. Sources: NEFCO 2010, Summit, Portage, and Stark Co. GIS 2009-2010; Ohio DNR GIS base map, 2006 OSIP aerial photography.*

Po-3 Conservation/ Protection Priority Areas Potter Creek Subwatershed



Conservation/Protection Priority Areas

- Riparian Corridor/Wetland
- Wetlands of Additional Importance (e.g., buffering) - enhance/protect
- Mapped Wetlands
- Habitats or Species of Concern - Identified on DNR biodiversity database spanning 30 years; Western Reserve Land Conservancy workshop, 2010.)

- Streams and Rivers
- Lakes
- WWH — Aquatic Life Use Designation
- 041100020201 Potter Creek — Subwatershed, 12-Digit HUC
- Local Jurisdictions

N

*Sources: NEFCO 2010, Summit, Portage, and Stark Co. GIS 2009-2010; Ohio DNR GIS base map, biodiversity data; 2011. Western Reserve Land Conservancy GIS mapping of conservation areas, 2010; Summit and Portage Counties wetland mapping conducted by Davey Resource Group, 2000-2004. Stark County -2003 land cover mapping; CCAP NOAA coastal Change Analysis Program 2006 mapping.

0 4,000 8,000 16,000 Feet

1 inch = 8,000 feet

Table Po 1
Summary of Potter Creek Subwatershed Characterisitcs

Concern	Amount/Item	Comments
Water Quality Attain., latest assessed	Potter Creek was in partial attainment of WWH standards in 2000 due to siltation and channelization. Congress Lake experiences harmful algal blooms.	
Public water supplies	Lake Hodgson occasionally draws from Congress Lake Outlet during dry months.	
Land Cover acres, %	Developed 1,810 8.1% • *High Density* *82* *0.4%* • *Moderate Density* *204* *0.9%* • *Low Density* *986* *4.4%* • *Dev. Open Space* *538* *2.4%* Agricultural 13,439 62.2% Grassland/scrub-shrub 563 2.4% Woods/wetlands 5,665 25.7%	
Impervious/runoff	2.7% **Additional runoff 3/4" storm**: 7.7 million gal.	
75 foot buffer	Developed 3% *Dev. Open space 1.4%* Agricultural 75.5% Woods/wetlands 22.5%	.
Wetlands (ac)	**Mapped** 2,728 **Converted** 2,585 (hydric) (4,819 hydric incl.)	
Likelihood of future development	Access to infrastructure is limited in this sub-watershed, although the Randolph wastewater treatment plant was recently constructed. There are numerous large parcels, and Stark County has experienced recent development in the watershed.	
Channel quality	**Intact** **Altered/channelized** **Eroding** **Recovering** 2.8 29.5 2.2 7.5	
Non-pt source pollution/year	**Tot. N** 63,795 lb **Tot. P** 12,250 lb **Sed**. 2,753 tons/yr	
Septic Systems	Approx. one-third of the subwatershed presents 2 or more severe limitations for septic systems and is not served by sewer. Approx. 300 potential illicit discharges have been identified in subwatershed communities.	
Problem areas	Randolph Ditch, Outlet Cr. are eroding vertically; unrestricted access Randolph Ditch; Cranberry Cr. Incised/channelized, little buffer	
Resource areas	Wetlands, especially large complexes along tribs; bog habitats/species are found in wetlands near Congress Lake	
Park/ conserve./inst.		
Riparian setback	None	
Recreational oppor.	Quail Hollow State Park	

Table Po 2
Summary of Impairments Potter Creek Subwatershed
HUC 041100020201

	Attainment issue/other concern	**Cause**	**Source**	**Other likely sources**
	Partial attainment WWH habitat	sediment	Ag runoff	Streambank erosion
		Habitat, flow alteration	channelization	
	Algal blooms	Nutrients – congress lake	Non-irrigated crop production	Septic system failures
	High algal counts	Nutrients – Lake Hodgson	Non-irrigated crop production	Septic system failures, lake sediments, groundwater, other NPS
	Elevated nutrient levels in river		Non-irrigated crop production	Livestock, septic systems
	Wetland/habitat alteration			

The STEPL model indicates that the watershed contributes 2,753 tons per year of sediment, 63,795 lb/year of nitrogen, and 12,250 lb/year of phosphorous, primarily from agricultural runoff, eroding streambanks, and septic systems. USDA staff indicate that farmers in the watershed are using reduced till and no-till to a large extent (40 percent and 50 percent, respectively, and are using agricultural best management practices (e.g., buffers, filter strips) to varying degrees. It is estimated that 75 percent of the livestock operations allow unrestricted access to the streams.

In much of the watershed, soils present two or more severe limitations for septic systems and are not served by sewer, raising the risks of failure of older septic systems. Portage County inspections have identified approximately 300 potential illicit discharges in subwatershed communities. Septic system failures have been noted in Stark County.

Alteration of wetlands, floodplains, and riparian corridors has reduced the ability of the system to absorb and process nutrients and sediment.

Habitat, Conservation, and Recreation Areas
Approximately 75 percent of the buffer has been altered – converted to agriculture, and is likely associated with alteration or destruction of riparian environments, headwater channels, wetlands, and floodplain access. Over 2,500 acres of wetland have been altered to other uses, and approximately 30 miles of the streams in this subwatershed are channelized, reducing the ability of the channels to store floodwater, deposit

sediment, treat nutrients, and provide habitat. At several locations, including Potter Creek at Saxe Road, stream substrates were embedded with silt and would be unlikely to provide sufficient habitat to meet water quality standards.

With the exception of Quail Hollow State Park and the Breakneck Creek preserve, most conservation areas in this subwatershed are intended for agricultural use. There are several areas of species and habitats of concern that are not protected or held as conservation land, including bog areas near Congress Lake, a large wetland complex at the north end of Potter Creek, and wetlands adjacent to the tributaries. In addition, remaining riparian corridor could be fragmented by use. These areas provide important benefits to the watershed and are susceptible to alteration.

It would be valuable to protect the large wetland complexes and habitat corridors from encroachment or development. Wetlands along the tributaries probably mitigate the effects of the altered landscape upstream and should be protected.

Quail Hollow State Park provides a natural area for passive recreation.

2 Problem Statements, Goals, Objectives, and Actions

Table Po 3 summarizes the actions proposed in the subwatershed and their associated pollutant load reductions, listing which problem statements/goals employ these tools. Tables Po 4.1 through 4 present the problem statements, goals, objectives, and actions for each problem area. The tables are numbered to reflect each problem statement number, e.g., Table Po 4.1 corresponds to Problem Statement Po-1. It should be noted that because many of the objectives address more than one goal, the actions associated with each objective are listed only once, in the first table in which they appear (most frequently, Table Po 4.1). All other listings of the same objective refer back to the actions at their first occurrence.

Refer to Sections 6 and 7 Introduction for a discussion of the format of the problem statements, goals, objectives, actions, and considerations for implementation.

Table Po 3 Action Item Summary by Subwatershed: Potter Creek

12-digit HUC/ Water Body	Sed	Nutrients	Habitat	Category/Practices	Target amount by 2023	Units	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
041100020201										
				Riparian Restoration						
Potter Cr./Congress Lake Outlet & tribs	√	√	√	Restore Streambank (Bio-Engineering/ re-contouring/ re-grading)	1,600	Linear Feet	$25-200/lf	110	160	60
Potter Cr./Congress Lake Outlet & tribs	√	√	√	Plant Native plants, trees, or shrubs in Riparian Areas	5	Acres	$2,500 + labor shrubs	2.8	40	7
Potter Cr. Watershed			√	Remove/treat Invasive Species	50	Acres				
				Stream Restoration						
Potter Creek, CLO, tribs	√	√	√	Restore Flood Plain	10	Acre-foot		4.4	60	8
Potter Creek watershed			√	Dam removal feasibility	1	study				
				Wetland Restoration						
Potter Creek CLO, tribs	√	√	√	Reconstruct/reconnect & Restore Wetlands	50	Acres	$5k-100k/ac.	50	1400	316
				Home Sewage Treatment Systems						
		√		Repair/Replace HSTS	15	HSTS			466	183
				Urban runoff and green infrastructure						
Potter Creek watershed	√	√		Rain gardens	1000	sq feet			0.2	0.04
Potter Creek watershed	√	√		Storm water retrofits	20	acres treated	$400-17k/ ac	0.9	10	4
Potter Creek watershed	√	√		No-mow ditch/grassed swale demo	500	linear feet		0.05	0.4	0.2
Middle Cuyahoga River Watershed				Neighborhood-scale green infrastructure	1		$25-50k design	5 tons	200 lb	25 lb
	√	√		**Agricultural BMPs**						
Congress Lake Outlet/ Potter watershed	√	√		Survey of practices	1	survey				
Potter Cr. And tribs	√	√	√	Install Livestock Exclusion Fencing & accompanying watering measures	3,000	Linear Feet	$11,300 + watering	140	280	140

Table Po 3 Action Item Summary by Subwatershed: Potter Creek

12-digit HUC/ Water Body	Sed	Nutrients	Habitat	Category/Practices	Target amount by 2023	Units	Cost	Sed. (tons/ yr)	N (lb/ yr)	P (lb/ yr)
Potter Cr. And tribs	√	√		Install Alternative Water Supplies	1	Supplies				
Potter Cr. And tribs	√	√		Construct 2-Stage Channel/overwide	1,000	Linear Feet			295	91
Potter Cr. And tribs	√	√	√	Install Grassed Waterways/ vegetated buffer strips	100	Acres treated		177	466	26
Potter Cr.watershed	√	√		Cover crops	100	acres		101	240	120
Potter Cr.watershed	√	√		Residue applied to fields	200	acres		202	480	120
Potter Cr.watershed	√	√		Conservation cover	100	acres		101	240	120
Potter Cr.watershed	√	√		Livestock Crossings	1	Crossings				
				Conservation Easements						
Potter Cr.watershed	√	√	√	Acquire riparian buffer/ Wetlands/ easements	50	Acres	$5-25k/ac	prevent 50	prevent 1400	prevent 316
Potter Cr.watershed	√	√	√	**Education and Outreach**						
				Develop Brochures/Fact Sheets	4	Brochures/Fact Sheets				
				Websites	1	Website				
				New lake/stream stewardship groups	1	new group active				
				Conduct Field Days/workshops	3	workshops				
				Develop Manual(s)	1	Manuals				
				Local Policy						
Potter Cr.watershed	√	√	√	Riparian setback	1	jurisdiction		prevent 25	prevent 400	prevent 71
Potter Cr.watershed	√	√	√	Green code audit/ update	1	audits/ updates				
				Monitoring						
Potter Cr. And tribs		√	√	Chemical Sampling	3	Sites				
Potter Cr. And tribs	√		√	Habitat (QHEI/HHEI) Sampling	1	Sites				
								889	4,138	1,195

Table Po 4.1 Potter Creek - Sediment

HUC 041100020201

Potter Creek (Po) Problem Statement 1: Sediment

Potter Creek is listed as partial attainment, due in part to sediment from agricultural runoff. The QHEI indicates the lack of silt-free substrate. The STEP-L model indicates that the watershed generates 2,753 tons of sediment per year, mostly from agricultural runoff but also from eroding banks and urban runoff. Alteration of at least 2,585 acres of wetland, 78% of vegetated riparian corridor, and loss of riparian features (e.g., riparian zone, floodplain access) along an estimated 31.7 miles of watercourses has reduced the sediment storage of the system. Further alteration of riparian vegetation could result in increased loading in the future.

Goals			**Amount to complete, time frame**
Objectives	**Lead/ cooperating**		(contingent on funding, resources,
Actions	**Organizations**	**Resources needed/cost**	landowner willingness)
Goal Po 1a Reduce non-point source pollution from urban runoff to reduce annual loading of sediment by 4.3 tons			
Po 1a-1 Plant 5 ac of deep-rooted riparian vegetation, reducing loading of sediment by 2.8 tons/yr Focus areas: large parcels single ownership, headwaters.			
1 Submit grant applications	WC/SWCDs/partners		
2 Targeted outreach to owners of large properties	WC**/SWCDs/ Communities	Lists of golf courses, lake associations, homeowners' associations; maps of large parcels; printed outreach materials.	Target 1 group every 3 years (3 by 2022); improvements to best management practices or riparian management at one site every 4 years(2 sites by 2020); 2 outreach contacts per year
3 Assist with plantings	SWCDs, master gardeners	native plants/trees and shrubs $250 ($500-1,000 per acre);	
4 Construct and install signage	communities, partners,	$300-500/sign	
5 Follow-up outreach (individualized guide to riparian zone) and publicize		funding for handouts/brochures	
Po 1a-2 Plant 500 lf of roadside ditch with no-mow grass to reduce annual load of sediment by 0.05 tons/yr			
1 Workshop on maintaining ditches for water quality improvements	SWCD	Location, materials	
2 Plant 500 lf of roadside ditch with no-mow grass			
Po 1a-3 Retrofit developed site to treat 20 acres for water quality (e.g., bioinfiltration, green infrastructure, permeable pavement), reducing sediment load by 1.5 tons /year.			
1 Stormwater retrofit inventory		WC/NEFCO with communities	
2 Submit grant application.			
3 Design/construct retrofit for existing stormwater (volume) infra-structure to improve water quality	Communities	Varies, depending on treatment provided (e.g., $400/acre treated to $17,000 per acre treated)	Retrofit 3 by 2023 to treat 60 ac res., 1 every 3 years afterward
Po 1a-4 Install 2,000 square feet of rain gardens, to reducing channel loading by 87 cu ft in a 3/4 in storm			
1 Identify partners	WC, partners		
2 Submit grant application	WC/partners		
3 Workshop/installation	WC/partners		
Po 1a-5 Maintain Stream database			1 database

Table Po 4.1 Potter Creek - Sediment

HUC 041100020201

Goals *Objectives* Actions	Lead/ cooperating Organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Po 1a-6 Conduct public outreach by providing information and studies electronically or in print.			
1 Continue to compile, centralize, and make available studies, data, information sources on the watershed, including recreational opportunities, volunteer needs, permitting or regulatory issues; green infrastructure information sources, etc.	WC	Website, technical information and outreach materials	Update and develop pages for website by Dec. 2013, then on-going
2 e-newsletter or article issued 3 times per year	wc	website, share with partners	
3 Develop/reproduce informational brochure or website article concerning topics of interest, including reducing runoff, recreational opportunties, private wells, septic systems etc.	WC, health depts, SWCDs	technical/outreach materials, possibly printing costs	4 by 2022
Po 1a-7 Increase/sponsor 11 outreach/stewardship activities related to non-point source pollution and watershed issues.			
1 Establish clean-up/monitoring/planting efforts at additional tributaries and lakes	WC, communities, parks, residents, home-owners' associations, lake assoc.	Funding or donation of trash disposal, refreshments, monitoring supplies, crew leaders, volunteers; training for monitoring/planting	1 new tributary or lake monitoring, clean-up, or other stewardship program by 2018
2 Distribute 50 rain barrels through workshops	SWCDs/ Communities	Space for workshop; rain barrel kits	2 workshops/50 rain barrels distributed
4 Develop/reproduce informational brochure or website article concerning topics of interest, including reducing runoff, recreational opportunties, private wells, septic systems etc.	WC, health depts, SWCDs	technical/outreach materials, possibly printing costs	4 by 2022
5 Educational outreach workshops on topics of importance, including LID/green infrastructure, restoration, field trips for examples	Partners, WC, communities	Location, speaker, supplies	3 workshops by 2022
8 Watershed "brand," logo, art project	WC, Kent State/ Standing Rock Gallery/River Day	Host for project, graphic design capabilities	1 logo or art project by 2015, then 1 every 3 years;
9 Create social network or google presence	WC		1 by 2014
Goal Po 1b Reduce bank erosion to reduce sediment loading by 110 tons/year.			
Po 1b-1 Stabilize 1600 l.f. of eroding stream bank, reducing sediment loading by 110 tons/yr *Focus areas - eroding channels, some with livestock access e.g., Randolph Ditch, eroding Congress Lake Outlet headwaters*			
1 Map target areas to investigate for wetland, floodplain, riparian, habitat, or stream corridor restoration/protection/ enhancement	WC, partners	available mapping - compile and build on previous efforts	1 map by 2014, revisit and update if necessary every 3 years
2 Hold meetings with landowners to determine interest	WC, partners		
4 Submit grant applications	WC, partners		
5 Restore floodplain access/flood storage		design-build consultant	

Table Po 4.1 Potter Creek - Sediment

HUC 041100020201

Goals *Objectives* Actions	Lead/ cooperating Organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
6 Public outreach			
Po 1b-2 Restore 10 acre-ft of floodplain access/storage, reducing channel loading by 435,600 cu ft. Focus areas - areas with modified floodplain access.			
1 Map target areas to investigate for wetland, floodplain, riparian, habitat, or stream corridor restoration/protection/ enhancement	WC, partners	available mapping - compile and build on previous efforts	1 map by 2014, revisit and update if necessary every 3 years
2 Hold meetings to determine landowner interest	WC, partners		
4 Submit grant application			
5 Restore floodplain access/flood storage	design-build consultant	funding for design-build consultant	
6 Public outreach			
Po1b-3 Restore 50 acres of wetland thereby increasing storage by 48,500 cubic feet of water in a 3/4 inch storm. Target areas headwaters with altered wetlands.			
1 Map target areas to investigate for wetland, floodplain, riparian, habitat, or stream corridor restoration/protection/ enhancement	WC, partners	available mapping - compile and build on previous efforts	1 map by 2014, revisit and update if necessary every 3 years
2 Hold meetings to determine landowner interest	WC, partners		
3 Identify wetland restoration site for clearinghouse	WC, Communities, other partners	meetings with landowners; readily available mapping, outside assistance from consultant, possible assistance from Kent State University wetland ecology class	5 concept plans by 2020; 1 every 2 years afterward.
4 Submit grant application			
5 Restore/protect/enhance wetlands	Partners	$5,000-$100,000 per acre, design/build consultant, sites -protection by easements would be at the low end of the range	20 ac by 2022; 10 ac every 5 years afterward
Goal Po 1c Reduce agricultural runoff to reduce annual loading of sediment by 729 tons			
Po 1c-1 Conduct survey of practices to target application of BMPs			
1 Develop survey of existing practices			
2 Administer survey of existing practices			
3 Outreach with property owners based on survey			
4 Apply for external funding for BMP incentives			
5 Work with landowners and operators to increase use of BMPs based on survey results			
Po 1c-2 Install 3,000 lf of livestock exclusion and accompanying measures (e.g., watering, stream crossing) to reduce sediment loading by 140 tons per year			
1 Contact landowners to determine willingness			
2 Submit proposal for grant funds			
3 Work with landowners to install measures			
4 Outreach			

Table Po 4.1 Potter Creek - Sediment

HUC 041100020201

Goals *Objectives* Actions	Lead/ cooperating Organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Po 1c-3 Install grassed waterway/buffer strips to treat 150 ac and reduce sediment by 236 tons /yr.			
Po 1c-4 Install cover crops on 150 ac and reduce sediment by 151 tons/yr			
Po 1c-5 Increase use of residue on ag fields by an additional 200 acres, reducing sediment loading by 202 tons/yr			
Goal Po 1d Increase sediment uptake in wetlands and floodplains by 54.4 tons/yr.			
Po 1d-1. Restore 50 ac of wetland, increasing storage of sediment by 50 tons/yr. Focus areas -altered riparian wetlands *Target areas: altered riparian wetlands, Cranberry Creek, Potter Creek, headwater tribs, Congress Lake Outlet*			
Actions: See Po 1b-3			
Po 1d-2 Restore 10 acre-ft of floodplain access/storage, reducing sediment loading by 4.4 tons/yr. Focus areas - areas with modified floodplain access.			
Actions: See Po 1b-2			
Goal Po 1e Protect 75 ac wetlands and riparian corridors to prevent future sediment loading by 64 tons/yr.			
Po 1e-1 Protect 25 ac of riparian buffer by increasing the number of communities using riparian setbacks by 1, reducing annual sediment load by 14 tons/yr			
1 Workshops for community officials on developing/enforcing riparian setbacks	Portage County Regional Planning Commission	Workshops would occur during regularly scheduled zoning inspector meetings, etc.	2 workshops by 2015; additional workshops - included in general workshop series
2 Provide written comment on wetland alteration permit applications concerning impacts to watershed functions/riparian setbacks	WC and partners		on-going
3 Increase the number of communities using riparian setbacks	WC, communities, Counties	Outreach	1 additional community with riparian setbacks by 2022
4 Install signage for riparian areas in publicly visible places	Partners	$200-$500 per sign. Outside funding or community sign facility	Signs at 2 locations by 2022; signs at 1 additional location every 5 years afterward
5 Continued outreach	Partners	funding for outreach	brochure, workshops on enforcement, outreach to homeowners etc.
Po 1e-2 Protect 50 ac. of riparian buffer/wetland through acquisition of land/easements, preventing increased loading of sediment by 50 tons/yr.			
1 Identify key areas for protection	Partners		
2 Contact landowners/partner land trusts			
3 Submit grant proposal			
4 Acquire wetlands/easements			

Table Po 4.2 Potter Creek - Nitrogen

HUC 041100020201

Potter Creek (Po) Problem Statement 2: Nitrogen

Limited data suggest that Potter Creek is enriched in nutrients relative to state criteria, with nitrate+nitrogen values ranging from 0.473 to 7.32 mg/l in 2000. Downstream, Breakneck Creek and the Cuyahoga River are enriched in nitrogen. Lake Hodgson, downstream in the Breakneck Creek subwatershed, occasionally draws water from the Congr due to excessive nutrients. Congress Lake has experienced nuisance algal blooms. The STEP-L model indicates that the watershed generates 63,796 lb/yr of nitrogen from eroding banks, agricultural runoff, and failing septic systems. Alteration of at least 2,585 acres of wetland, 78% of vegetated riparian corridor, and loss of riparian features (e.g., riparian zone, floodplain access) along an estimated 31.7 miles of watercourses has reduced the nitrogen uptake of the system. Further alteration of riparian vegetation could result in increased loading in the future.

Goals ***Objectives*** Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal Po 2a Reduce non-point source pollution from urban runoff to reduce annual loading of nitrogen by 44.5 lb			
Po 2a-1 Plant 5 ac of deep-rooted riparian vegetation, reducing loading of nitrogen by 40 lb/yr Focus areas: large parcels single ownership, headwaters.			
Actions: See Po 1a-1	WC/SWCDs/partners		
Po 2a-2 Plant 500 lf of roadside ditch with no-mow grass to reduce nitrogen loading by 0.4 lb/yr.			
Actions: See Po 1a-2	WC/SWCDs/partners		
Po 2a-3 Retrofit developed site to treat water quality from 20 acres (e.g., stormwater retrofit/green infrastructure), reducing nitrogen loading by 4 lb/yr.			
Actions: See Po 1a-3			
Po 2a-4 Install 2,000 square feet of rain garden, reducing annual nitrogen loading by 0.08 lb/yr.			
Actions: See Po 1a-4	WC/SWCDs/partners		
Po 2a-5 Maintain Stream database			1 database
Po 2a-6 Conduct public outreach by providing information and studies electronically or in print.			
Actions: See Po 1a-6	WC/SWCDs/partners		
Po 2a-7 Increase/sponsor 11 outreach/stewardship activities related to non-point source pollution and watershed issues.			
Actions: See Po 1a-7			
Goal Po 2b Reduce bank erosion to reduce nitrogen loading by 160 lb/year.			
Po 2b-1 Stabilize 1600 l.f. of eroding bank, to reduce nitrogen loading by 160 lb/yr *Focus areas, e.g., eroding streams with livestock access, headwaters, Brimfield Ditch, other ditches*			
Actions: See Po 1b-1			
Po 2b-2 Restore 10 acre-ft of floodplain access/storage, reducing channel loading by 435,600 cu ft. Focus areas - areas with modified floodplain access.			
Actions: See Po 1b-2			
Po 2b-3 Restore 50 acres of wetland thereby increasing storage by 48,500 cubic feet of water in a 3/4 inch storm. Target areas headwaters with altered wetlands.			
Actions: See Po 1b-3			

Table Po 4.2 Potter Creek - Nitrogen

HUC 041100020201

Goals *Objectives* Actions	Lead/ cooperating Organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Goal Po 2c Reduce septic system failure to reduce annual loading of nitrogen by 470 lb			
Po 2c-1 Correct 3 failing HSDS every 2 years, reducing nitrogen loading by 470 lb/yr Focus areas: vicinity of water courses			
1 Inspect systems	PCHD		
2 Correct failing/discharging home sewage treatment systems	Portage County Health District, Stark Co. Health Dist. landowners	Continued inspection and enforcement of illicit discharge regulations. Remedies depend on cause of failure and proximity of sewer service.	10 by 2022; 1 per year afterward
3 Continue to investigate funding sources	PCRPC, PCHD, wc		
4 Outreach:			
Goal Po 2d Reduce agricultural runoff to reduce annual loading of nitrogen by 1,819 lb			
Po 2d-1 Conduct 1 approximately year-long nutrient survey along Breakneck Creek, Feeder Canal, Lake Hodgson, Congress Lake Outlet, and Potter Creek.			
1 Arrange internship with KSU			
2 Determine sampling sites, frequencies			
3 Coordinate lab analysis with Ravenna utilities			
4 Monitor throughout the year			
Po 2d-2 Conduct survey of practices to target application of BMPs			
Actions: See Po 1c-1			
Po 2d-3 Install 3,000 lf of livestock exclusion and accompanying measures (e.g., watering, stream crossing) to reduce nitrogen loading by 280 lb per year			
Actions: See Po 1c-2			
Po 2d-4 Install grassed waterway/buffer strips to treat 150 ac and reduce nitrogen by 699 lb /yr.			
Po 2d-5 Install cover crops on 150 ac and reduce nitrogen by 360 lb/yr			
Po 2d-6 Increase use of residue on ag fields by an additional 200 acres, reducing nitrogenloading by 480 lb/yr			
Goal Po 2e Increase uptake of nitrogen by wetlands and floodplains by 1,755 lb/yr.			
Po 2e-1. Restore 50 ac of wetland, to reduce loading of nitrogen by 1,400 lb/yr. Focus areas -altered riparian wetlands *Target areas: Cranberry Creek, Potter Creek, headwater tribs Congress Lake Outlet*			
Actions: See Po 1b-3.			
Po 2e-2 Restore 10 acre-ft of floodplain access/storage, reducing annual nitrogen loading by 60 lb. Focus areas - areas with modified floodplain access.			
Actions: See Po 1b-2.			
Po 2e-3 Improve channel morphology, e.g., 2-stage ditch, by 1,000 lf to increase nitrogen uptake by 295 lb/yr. Focus areas: altered headwater channels. Cranberry Cr.			
1 Map target areas to investigate for wetland, floodplain, riparian, habitat, or stream corridor restoration/protection/ enhancement	WC, partners	available mapping - compile and build on previous efforts	1 map by 2013, revisit and update if necessary every 3 years
2 Hold meetings to determine landowner interest	WC, partners		
4 Submit grant application			

Table Po 4.2 Potter Creek - Nitrogen

HUC 041100020201

Goals ***Objectives*** Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
5 Construct ditch improvements	design-build consultant	funding for design-build consultant	
6 Public outreach			
Goal Po 2f Protect wetlands and riparian corridors to prevent future nitrogen loading by 1,600 lb/yr.			
Po 2f-1 Protect 36,000 linear feet of riparian buffer by increasing the number of communities using riparian setbacks by 1, reducing loading of nitrogen by 200 lb/yr			
Actions: See Po 1e-1.			
Po 2f-2 Protect 50 acres of wetlands/riparian corridor through purchase of land/easements, preventing increased loading of nitrogen by 1,400 lb/yr. Target areas high value wetlands, Potter Cr., Cong. Lk Outlet headwaters			
Actions: See Po 1e-3			

Table Po 4.3 Potter Creek Phosphorous

HUC 041100020201

Potter Creek (Po) Problem Statement 3: Phosphorous

Limited data suggest that Potter Creek is enriched in phosphorous relative to state criteria for WWH headwater streams, ranging from 0.05 to 0.16. The 1997 TSD notes that phosphorous in Potter Creek is high compared to the rest of the Breakneck Creek drainage, likely a result of agriculture. Downstream, Breakneck Creek and the Cuyahoga River are enriched in phosphorous. Lake Hodgson, downstream in the Breakneck Creek subwatershed, occasionally draws water from the Congress Lake Outlet, and experiences nuisance algal blooms due to excessive nutrients. Congress Lake has experienced nuisance algal blooms. The STEP-L model indicates that the watershed generates 12,250 lb/yr of phosphorous from eroding banks, agricultural runoff, and failing septic systems. Alteration of at least 2,585 acres of wetland, 78% of vegetated riparian corridor, and loss of riparian features (e.g., riparian zone, floodplain access) along an estimated 31.7 miles of watercourses has reduced the nitrogen uptake of the system. Further alteration of riparian vegetation could result in increased loading in the future.

Goals ***Objectives*** Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal Po 3a Reduce non-point source pollution from urban runoff to reduce annual loading of phosphorous by 11.3 lb			
Po 3a-1 Plant 5 ac of deep-rooted riparian vegetation, reducing loading of phosphorous by 7 lb/yr Focus areas: large parcels single ownership, headwaters.			
Actions: See Po 1a-1	WC/SWCDs/partners		
Po 3a-2 Plant 500 lf of roadside ditch in no-mow grass to reduce phosphorous by 0.2 lb/yr			
Actions: See Po 1a-2	WC/SWCDs/partners		
Po 3a-3 Retrofit developed site to treat water quality from 20 acres (e.g., stormwater retrofit/green infrastructure), reducing phosphorous loading by 4 lb/yr.			
Actions: See Po 1a-3			
Po 3a-4 Install 2,000 square feet of rain garden, reducing annual phosphorous loading by 0.08 lb/yr .			
Actions: See Po 1a-4	WC/SWCDs/partners		
Po 3a-5 Maintain Stream database			1 database
Po 3a-6 Conduct public outreach by providing information and studies electronically or in print.			
Actions: See Po 1a-4	WC/SWCDs/partners		
Po 3a-7 Increase/sponsor 11 outreach/stewardship activities related to non-point source pollution and watershed issues.			
Actions: See Po 1a-5			
Goal Po 3b Reduce bank erosion to reduce phosphorous loading by 60 lb/year.			
Po 3b-1 Stabilize 1600 l.f. of eroding bank, reducing phosphorous loading by 60 lb/yr *Focus areas, e.g., eroding streambanks with livestock access, Congress Lake Outlet headwater tribs, Randolph/other ditches*			
Actions: See Po 1b-1			
Po 3b-2 Restore 10 acre-ft of floodplain access/storage, reducing channel loading by 435,600 cu. Ft.. Focus areas - areas with modified floodplain access.			
Actions: See Po 1b-2			
Po 3b-3 Restore 50 acres of wetland thereby increasing storage by 19,000 cubic feet of water in a 3/4 inch storm. Target areas headwaters with altered wetlands.			
Actions: See Po 1b-3			
Goal Po 3c Reduce septic system failure to reduce annual loading of phosphorous by 183 lb			
Po 3c-1 Correct 3 failing HSTS every 2 years, reducing phosphorous loading by 183 lb/yr Focus areas: vicinity of water courses			

Table Po 4.3 Potter Creek Phosphorous

HUC 041100020201

Goals / Objectives / Actions	Lead/ cooperating Organizations	Resources needed/cost	Amount to complete, time frame (contingent on funding, resources, landowner willingness)
Actions: See Po 2c-1			
Po 3c-2 Outreach			
Goal Po 3d Reduce agricultural runoff to reduce annual loading of phosphorous by 599 lb			
Po 3d-1 Conduct 1 approximately year-long nutrient survey along Breakneck Creek, Feeder Canal, Lake Hodgson, Congress Lake Outlet, and Potter Creek.			
Actions: See Po 2d-1			
Po 3d-2 Conduct survey of practices to target application of BMPs			
Actions: See Po 1c-1			
Po 3d-3 Install 3,000 lf of livestock exclusion and accompanying measures (e.g., watering, stream crossing) to reduce phosphorous loading by 140 lb per year			
Actions: See Po 1c-2			
Po 3d-4 Install grassed waterway/buffer strips to treat 150 ac and reduce phosphorous loading by 39 lb /yr.			
Po 3d-5 Install cover crops on 150 ac and reduce sediment by 180 lb/yr			
Po 3d-6 Increase use of residue on ag fields by an additional 200 acres, reducing sediment loading by 240 lb/yr			
Goal Po 3e Increase uptake of phosphorous by wetlands and floodplains by 415 lb/yr.			
Po 3e-1. Restore 50 ac of wetland, reducing loading of phosphorous by 316 lb/yr. Focus areas -altered riparian wetlands *Target areas: Cranberry Creek, Potter Creek, headwater tribs Congress Lake Outlet*			
Actions: See Po 1b-3.			
Po 3e-2 Restore 10 acre-foot of floodplain access/storage, reducing annual phosphorous loading by 8 lb. Focus areas - areas with modified floodplain access.			
Actions: See Po 1b-2.			
Po 3e-3 Improve channel morphology, e.g., 2-stage ditch, by 1,000 lf to increase phosphorous uptake by 91 lb/yr. Focus areas: altered headwater channels. Cranberry Cr.			
Actions: See Po 2e-3.			
Goal Po 3f Protect wetlands and riparian corridors to prevent future phosphorous loading by 352 lb/yr.			
Po 3f-1 Protect 36,000 linear feet of riparian buffer by increasing the number of communities using riparian setbacks by 1, reducing loading of phosphorous by 36 lb/yr			
Actions: See Po 1e-1.			
Po 3f-2 Protect 50 acres of wetlands/riparian corridor through acquisition of land/easements, preventing increased loading of phosphorous by 316 lb/yr. Target areas high value wetlands, Potter Cr., Cong. Lk Outlet headwaters			
Actions: See Po 1e-3			

Table Po 4.4 Potter Creek - Habitat

041100020201

Potter Creek (Po) Problem Statement 4: Habitat

The 1997 TSD notes that because Potter Creek was channelized, habitat was characterized by modified attributes and lacked WWH characteristics, scoring 41 on the QHEI. Much of the Potter Creek subwatershed drainage has been altered by channelization (29 miles). Alteration of at least 2,585 acres of wetland, 78% of vegetated riparian corridor, and loss of riparian features (e.g., riparian zone, floodplain access) along an estimated 31.7 miles of watercourses has degraded habitat. The remaining large wetland complexes and areas containing species of concern are largely unprotected.

Goals ***Objectives*** Actions	**Lead/ cooperating Organizations**	**Resources needed/cost**	**Amount to complete, time frame** (contingent on funding, resources, landowner willingness)
Goal Po 4a Restore 65 ac of riparian habitat and wetlands			
Po 4a-1 Plant 5 ac of deep-rooted riparian vegetation. Focus areas: large parcels single ownership, headwaters.			
Actions: See Po 1a-1	WC/SWCDs/partners		
Po 4a-2. Restore/reconnect 50 ac of wetland. Focus areas -altered riparian wetlands *Target areas: Cranberry Creek, Potter Creek, headwater tribs Congress Lake Outlet*			
Actions: See Po 1b-3.			
Po 4a-3 Restore 10 acre-ft of floodplain access/storage. Focus areas - areas with modified floodplain access.			
Actions: See Po 1b-2.			
Goal Po 4b Improve/restore 1,000 lf of channel habitat			
Po 4b-1 Improve channel morphology, e.g., 2-stage ditch, by 1,000 lf. Focus areas: altered headwater channels, Cranberry Creek			
Actions: See Po 2e-3.			
Po 4b-2 Conduct feasibility study to remove small low-head dams			
Goal Po 4c Protect 75 ac of wetlands/riparian corridors to prevent future degradation. *Target - intact wetlands, riparian corridor, areas with species of concern, large/connected areas of woods/other important habitat*			
Po 4c-1 Protect 36,000 linear feet of riparian buffer by increasing the number of communities using riparian setbacks by 1			
Actions: See Po 1e-1.			
Po 4c-2 Protect 50 acres of wetlands/riparian corridor through property acquisition/easement. Target areas high value wetlands, Potter Cr., Cong. Lk Outlet headwaters			
Actions: See Po 1e-2			

End of Volume