DEVELOPMENT OF WATERSHED ACTION PLANS
FOR THE MILL CREEK AND YELLOW CREEK WATERSHEDS

By

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ABSTRACT

Development of Watershed Action Plans for the Mill Creek and Yellow Creek Watersheds

The Mill Creek and Yellow Creek watersheds, located in northeast Ohio, cover an area of approximately 85,000 acres. Available monitoring data indicate that the lakes and streams within these watersheds have significant water quality and aquatic habitat problems. With the assistance of a Section 319 mini-grant from the Ohio EPA, *A Guide to Developing Local Watershed Action Plans in Ohio* (Ohio EPA, 1997) was pilot-tested on the two watersheds with two main objectives. First, comprehensive watershed action plans were written to identify and remediate the water quality problems. Second, the effectiveness of the OEPA guide was evaluated and useful changes identified.

The process of evaluating the watershed using the EPA model consisted of researching existing land use, geology, topology, and lithology data as well as gathering existing water quality data on the watershed. Once the data were collected, they were analyzed and summarized in order to identify the major problems and their likely sources. This was done with the help of the AWARE (Alliance for Watershed Action and Riparian Easements) committee, a group of concerned citizens, environmental professionals and government representatives. Finally, with the help of the AWARE Goals and Objectives Committee, the initial goals and objectives for water quality were set. The results of this procedure were incorporated in Watershed Action Plans for the Mill Creek and Yellow Creek watersheds.

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Chapter 1

Introduction

The Mill Creek and Yellow Creek watersheds, located in northeast Ohio, cover a combined area of approximately 85,000 acres. Monitoring data indicate that the lakes and streams of the watersheds have common water quality and aquatic habitat problems. These include high sediment and nutrient loading rates, low dissolved oxygen and aquatic habitat modification. These issues prompted the Mahoning Soil and Water Conservation District (MSWCD) and Mill Creek Metroparks to apply for and obtain a Section 319 mini-grant from Ohio EPA. The grant supported significant research and planning activities. The research and planning were completed using *A Guide to Developing Local Watershed Action Plans in Ohio* (Ohio EPA, 1997) as a model. The primary objectives of this project were to compose watershed action plans for both watersheds and to critically evaluate the effectiveness of the OEPA *Guide*.

The process of writing the action plans and evaluating the existing model consists of a series of steps. Initially, research and compilation of existing data on land use, population, geology and hydrology were completed with the goal of establishing a thorough and accurate base of facts. Data on water quality in the waterways of each watershed were also tabulated to form an accurate depiction of the major water quality problems and sources of the problems. Once the data were obtained and summarized, the initial goals and objectives for the watersheds were discussed. These goals and subsequent objectives are the basis on which the effectiveness of the action plans will be judged. Throughout the composition of the action plans, the thoroughness and effectiveness of the *Guide* were evaluated. Reports submitted to the OEPA described the progress made in using the *Guide* and initial observations on the *Guide's* effectiveness.

Chapter 2

Methods and Procedures

In the mid-1990's, the sediment accumulation in Lake Newport warranted the formation of a group of concerned citizens, environmental professionals and government representatives to discuss options to prolong the life of the lake. The Lake Newport Advisory Committee, as it was named, began developing strategies that would save Lake Newport and the other lakes in the Mill Creek watershed. The committee soon realized that the problems of Lake Newport were also the problems of the entire Mill Creek watershed and the adjacent Yellow Creek watershed. This realization led to the acquisition of two grants for projects aimed at improving water quality in the watersheds. First, an ODNR NatureWorks StreamBanking Project Grant was awarded to the Mahoning Soil and Water Conservation District (MSWCD) for the purchase of riparian easements along Mill Creek, Yellow Creek and their tributaries. Next, a Section 319 mini-grant was obtained from Ohio EPA to support development of Watershed Action Plans for both watersheds. The Lake Newport Advisory Committee was renamed AWARE (Alliance for Watershed Action and Riparian Easements) in the fall of 1998 because of its new, broader focus. The Section 319 mini-grant allowed the committee to pilot test *A Guide to Developing Local Watershed Action Plans in Ohio* (Ohio EPA, 1997) on the two watersheds.

A Guide to Developing Local Watershed Action Plans in Ohio (Ohio EPA, 1998) is a guidance document that outlines the exact steps that need to be taken to compose an effective watershed action plan. Each step is described in detail because all steps are equally important to the ultimate success of the action plan. Step one in the guide is to build and maintain public support. This step is very important because it gives residents of the watershed power to make changes to the environment that affect the quality of their lives. There are several important steps to building public support. Initially, a core group of individuals should develop a common understanding of problems or concerns and make a list of stakeholders. Stakeholders are individuals in the community who will be directly affected by activities in the watershed. Next, a permanent committee should be formed to coordinate the development and implementation of an action plan. In this case AWARE was already a functioning group that was ready to tackle the problems of the watersheds. The composition of AWARE is shown in Table 1.

Table 1: Affiliation of AWARE Members

Beaver Township Trustee	YSU, Civil and Environmental Engineering
The Youngstown Foundation	Mahoning County Engineers Office
County Health Dept.	OEPA Division of Surface Water
OEPA Northeast Division	Sierra Club
League of Women Voters	Mahoning County Soil and Water Management District
MRB Environmental Services Inc.	Vindicator
YSU-Center for Urban Studies	ODNR
Animal Charities	Natural Resources Conservation District
Youngstown/Warren Chamber of Commerce	Consumer's Ohio Water Company.
Audubon Society	Mahoning County Planning Dept.
Eastgate Development and Transportation Agency	Canfield Township
Columbiana City Manager	Mahoning County Soil and Water Conservation District
Crossroads Resource Conservation and Development	Mahoning County Sanitary Engineers Office

Chapter two of the guide assists in the identification of water resources and water resource quality. This process consists of defining the watershed boundaries and deciding which indicators of water quality are most representative. The indicators are based on the beneficial use designations that are set by the OEPA. In this case, AWARE is striving to achieve attainment of Warm Water Habitat Criteria, which is a stream quality indicator for the Mill Creek and Yellow Creek watersheds. Biological indicators are used to evaluate the aquatic health of the watershed. Examples of these indicators include the IBI (Index of Biological Integrity) and the ICI (Invertebrate Community Index). Other important indices that require attention include watershed hydrology, flooding patterns, water supply sources, wetlands, riparian areas and geology. Furthermore, wastewater discharge patterns, sources of nonpoint source pollution and current land use trends should also be inventoried. Once all of these parameters are researched, an appropriate database of the water quality problems can be created.

Developing the inventory of water quality data was a time-consuming task. Various companies and individuals in the community were contacted and asked for their help in compiling water quality data for the Action Plans. Instrumental in this phase of the project was Consumer's Ohio Water Company, YSU, Eastgate Development and Transportation Agency (EDATA), Mahoning County Engineer's Office and Mahoning County Soil and Water Conservation District. Each of these organizations was extremely helpful and prompt in providing AWARE with accurate water quality data.

Diagnosing and prioritizing the problems is the next step in the process. The two key aspects of defining the watershed problems are linking the cause of the water quality problems to the pollutant source and quantifying the pollutant load. In this project, it was necessary to link several sources or causes of problems to estimate multiple pollutant loads. This was done with the help of AWARE at the monthly meetings.

Once the sources and magnitudes of the problems were identified, goals and objectives for each watershed were set. Goals and objectives for the watershed were formulated with the help of the AWARE Committee on Goals and Objectives and a Goal Setting workshop provided by ODNR on February 24, 1999. Goals are defined as statements of the desired outcomes while objectives represent specific changes that must occur to reach an outcome. Objectives require indicators that can be used to monitor progress toward the goal. Many objectives involve the implementation of Best Management Practices (BMPs). BMPs are described as "activities or management procedures and structures that prevent or reduce water pollution" (OEPA, 1997). Oftentimes the committee had difficulty in quantifying the objectives. The formulated goals and objectives will determine the effectiveness of the action plan. Finally, implementation of the Action Plans will require the use of available resources and BMPs to mitigate the water quality problems. The motivation and education of stakeholders will also be key components of the implementation phase.

As a requirement of the Section 319 mini-grant, semi-annual reports on AWAREs progress through the Action Plan development process are submitted to Ohio EPA. The reports describe activities related to each chapter of the *Guide*. In these reports, AWARE critically evaluates the *Guide* and recommends any necessary additions. Thus, not only does the Ohio EPA assist AWARE in development of the Action Plans, but AWARE also helps Ohio EPA publish the most useful guide possible.

Chapter 3

Results

The following pages contain the Action Plans written for the Mill Creek and Yellow Creek Watersheds, followed by an evaluation of the *A Guide to Developing Local Watershed Action Plans* (Ohio EPA, 1997).

<u>Watershed Action Plan for Mill Creek</u>

Introduction

The Mill Creek watershed, located in northeast Ohio, covers an area of 50,820 acres and contains several main tributaries and lakes. The watershed has had a history of water quality problems over the past several decades. These include high sediment loading rates, aquatic habitat modification and high concentrations of nutrients that stimulate algal growth. These problems can be attributed to a number of factors, including agricultural activities, the rapid rate of development within the watershed, and two wastewater treatment plant discharges. These problems have contributed to the decline in the water quality and severe sedimentation in Lake Newport that spawned the formation of the Lake Newport Advisory Committee in 1995. The committee was later renamed AWARE (Alliance for Watershed Action and Riparian Easements). However, the committee soon realized that the problems in Lake Newport are the result of activities throughout the entire watershed. This realization led to the application for, and acquisition of, two grants - an ODNR NatureWorks StreamBanking grant and a Section 319 mini-grant for watershed planning from Ohio EPA. The Stream Banking grant provides funding for the acquisition of riparian easements, which will provide immediate benefits toward water quality protection. The Section 319 watershed planning grant supports research and planning on the watershed as a whole leading to the development of a watershed action plan. The process of developing a watershed action plan consists of the following steps:

1. Compile water quality data
2. Define the problems
3. Set goals and objectives for mitigation of the problems; and
4. Write and implement the watershed action plan.

Physical Characteristics of the Mill Creek Watershed

Size and Location:

Mill Creek, as seen in the map of the watershed (Figure 1), has its origin in northern Columbiana County. It flows north through the Village of Columbiana and then into Mahoning County, passing through Beaver Township into Boardman Township and on into Mill Creek Park. Mill Creek then flows through Lakes Newport, Cohasset and Glacier before emptying into the Mahoning River. Mill Creek has several major tributaries including Indian Run, Anderson's Run, Cranberry Run and Ax Factory Run. The total length of the creek is about 21 miles.

Land Use:

Land use in the watershed varies from natural forest to industrial. Land use data from 1985 are shown in Figure 1. The land use data originate from ODNR OCAP (Ohio Capability Analysis Program) Land Use Files. A summary of the land use in the Mill Creek watershed is presented in Table 2. There is not much industrial land use but there is a significant amount of commercial property. However, the northern section of the watershed is primarily residential while the southern portion is almost exclusively agricultural. Residential development is expanding into the southern part of the watershed at a rapid rate. Since 1985, at least several hundred acres of agricultural and forestland has been converted to residential and commercial development. Mill Creek Park occupies a significant amount of land within the watershed. The Parks forests and waterways are used primarily for recreational activities.

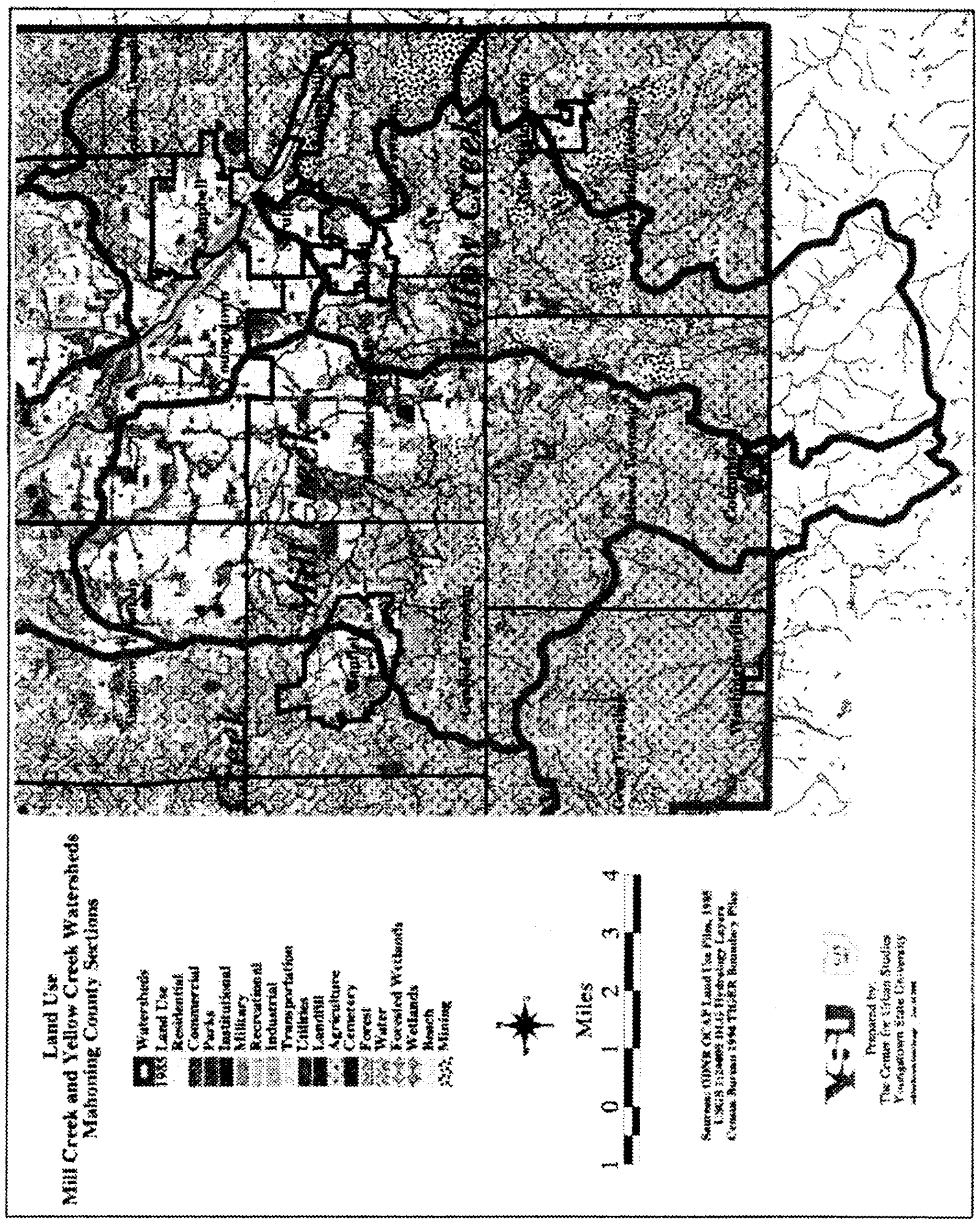

Figure 1: Land Use and Zoning Map for the Mill Creek and Yellow Creek Watersheds (YSU-CUS, 1998)

Table 2: Mill Creek Watershed Land Use by Acreage (ODNR, 1985)

Land Use	Land Area (Acres)	Percentage (%)
Agriculture	19,750	38.9
Residential	16,010	31.5
Forest	6,670	13.1
Commercial	2,460	4.84
Transportation	1,620	3.19
Built Up Urban Land	1,620	3.19
Transitional Area	815	1.60
Industrial	680	1.39
Wetlands	530	1.04
Strip Mines, Quarries	350	0.69
Water	300	0.59

Geology/Topography:

The soils of the Mill Creek watershed are primarily from parent material deposited during the late Wisconsin glaciation. The entire watershed is covered by a fairly thick glacial till deposited by melt water from retreating glaciers. The soils from the glacial till were formed approximately 15,000 years ago. Therefore, they have a well-developed profile. The topography of the Mill Creek watershed consists of gently sloping plains, leading to a moderate velocity of flow in Mill Creek. The bedrock consists of sedimentary rocks including rocks from the Erie Ontario Lake Plain (EOLP). The advancing glaciers of the last ice age pushed the rocks of Canadian origin to this part of North America (ODNR, 1971).

Soils:

In general, the soils in the Mill Creek watershed are moderately erodible with moderate clay content and fair drainage (ODNR, 1971). The major soil types present are sandy and silty loam and dense clay formations. The parent material for the soil was from glacial outwashes of gravel, sand, clay and silt. The level soils and rocks are fairly high in water content because of the fluctuating water table levels resulting from moderate precipitation in this part of the country (ODNR 1971). The Mahoning County Soil Survey (ODNR, 1971) lists the most prevalent types of soil in the Mill Creek watershed (see Table 3). It is expected that soils in the Mill Creek watershed are similar to Mahoning County as a whole.

Table 3: Mill Creek Watershed Soil Classifications (ODNR, 1971)

Abbreviation	Description of Soil Type	Land Area (Acres)
WbB	Wadsworth-Urban Land Complex	5000
RuB	Rittman-Urban Land Complex	6600
WaB	Wadsworth silt loam, 2 to 6 percent slopes	10000
RsB	Rittman silt loam, 2 to 6 percent slopes	7300
RsC	Rittman silt loam, 6 to 12 percent slopes	386
RsC2	Rittman silt loam, 6 to 12 percent slopes, moderately eroded	2100
BgB	Bogart loam, 2 to 6 percent slopes	8500
BgC	Bogart loam, 6 to 12 percent slopes	1400
JtB	Jimtown loam, 2 to 6 percent slopes	4600
CdC	Canfield silt loam, 6 to 12 percent slopes	690
Da	Damascus loam	2000
Dc	Damascus loam, till substratum	557
FhB	Fitchville silt loam, 2 to 6 percent slopes	2500

Demographics:

The Mill Creek watershed has seen a dramatic increase in population over the last 40 years. This is contributing to the water quality problems in the watershed. As seen in Table 4, Beaver, Boardman and Canfield Townships have seen rapid urbanization trends.

Based on the 1996 Census Bureau estimate, Boardman Township is continuing to experience urban sprawl. The increase in population and intense commercial development in Boardman has caused an increase in the amount of impervious surface and runoff. The continuous construction has increased the rate of soil erosion and sediment runoff and flux into Mill Creek (YSU-CUS, 1998). There has also been a recent increase in home construction in the southern part of the watershed.

Table 4: Census Bureau Population Estimates for Boardman, Beaver and Canfield Townships (YSU-CUS, 1998)

Township	1960	1970	1980	1990	1996
Beaver	5101	5575	5401	5433	5637
Boardman	26617	30852	41806	41797	43375
Canfield*	6679	9397	10350	10831	11203
Total	38397	45824	57557	58061	60215

* Figures are for the City of Canfield and Canfield Township

Summary of Water Quality Problems in the Mill Creek Watershed

Several studies have been performed on the water quality of streams and reservoirs in the Mill Creek watershed. Many of these were used in compiling data for this plan. Monthly reports from the Boardman Wastewater Treatment Facility (WWTF) were used to determine the quantities of nutrients, total suspended solids (TSS) and heavy metals that the plant releases in its effluent. Studies of sediment (MRB-HER, 1993 and 1994) and nutrient (Kaza, 1996) loading to Mill Creek and Lake Newport were also a major source of information. In addition, extensive biological and water quality data were collected by the Ohio EPA in the summer of 1994 (Ohio EPA, 1996). This report uses biological indicators to determine the attainment of warm water habitat criteria and provides water quality data versus river mile for nine sampling stations on Mill Creek. These reports proved to be an invaluable source of information in determining the water quality problems of Mill Creek.

The Mill Creek watershed has a variety of water quality problems. AWARE held several meetings in the fall of 1998 to review the data and identify and prioritize water quality problems in the watershed. The three main problems identified by AWARE are sediments, nutrients and aquatic habitat modification. The problems of sediments and aquatic habitat modification are linked very closely. Aquatic habitat modification, which includes channelization, sediment deposition and resuspension, stream bank erosion and flow alterations, is typically caused by construction and agricultural activities. Construction in the Mill Creek Watershed has increased markedly over the last 40 years.

Construction causes more impervious surface, which increases the amount and velocity of runoff. This causes erosion of both the land surface and stream channels to increase. The development has also changed the natural drainage and recharge patterns in the watershed. After large precipitation events, the flow of water entering Mill Creek and its tributaries is rapid and laden with sediments. Much of this sediment makes its way into Lake Newport where it settles out and rapidly fills up the lake. It is estimated that over 400,000 cubic yards of sediment deposits have accumulated in Lake Newport since it was formed in 1928 (MRB-HER, 1993). Another source of sediment in Mill Creek is the Boardman WWTF that discharges directly into Mill Creek. However, this contribution is minor compared to nonpoint sources to Mill Creek. Table 5 summarizes the sediment loading from various parts of the watershed.

Table 5: Suspended Solids Flux in Mill Creek and its Tributaries (MRB-HER, 1993)

Sampling Site	Avg. SS Conc. (mg/l)	Avg. SS Flux (kg/d)	Mean SS Loading Rate (kg/d/sq. mi.)
Western Reserve Rd.	37	12220	420
Indian Run @ Rt. 224	25	10280	580
Mill Creek @ Rt. 224	24	16370	
Cranberry Run @ Shields Rd.	5.9	126.0	25
Mill Creek @ Lake Newport	33	12000	
Anderson Run @ Lockwood Blvd.	18	4000	570

Nutrients are also a major concern in the watershed. Excess nutrients can cause a waterway to become too productive. This means that the water will be prone to excess algal growth. When the algae dies, it decomposes aerobically which leads to depleted oxygen conditions in the water column. The nutrients in the Mill Creek watershed originate from several sources. The Boardman WWTF is the largest point source of nutrients (phosphorous and nitrate). The Columbiana wastewater treatment plant also discharges to Mill Creek. The Ohio EPA is in the process of limiting the amount of total phosphorous (TP) that the Boardman WWTF is able to release into Mill Creek. Another source of nutrients is the combined sewer overflows (CSO) that enter Mill Creek in the City of Youngstown. These CSOs enter Mill Creek below Lake Newport. After large precipitation events, pipes carrying sewage and rainwater tend to overflow allowing amounts of organic matter from human waste to enter the watershed. Nutrients in the watershed also originate from nonpoint sources such as runoff from fertilized fields and urban areas. Kaza (1996) made estimates of the total point and nonpoint phosphorous loadings to Lake Newport. The total point source loading was estimated at 11,950 kg/yr, while the total nonpoint source phosphorous loading was estimated to be between 6,950 kg/yr and 9,600 kg/yr (Kaza, 1996). The total annual phosphorous loading was estimated to be between 18,900 kg/yr and 21,550 kg/yr (Kaza, 1996). Therefore, it is estimated that point sources contribute 55-63% of the total phosphorous loading while nonpoint sources contribute 37-45% (Kaza, 1996).

Biological indicators are the primary basis on which the water quality of Mill Creek is judged by Ohio EPA. Four main parameters were measured in 1994 by Ohio EPA. The Qualitative Habitat Evaluation Index (QHEI) is a measure of the aquatic habitat quality. Mill Creek and its tributaries were graded fairly low for this parameter because of low flow rates, sludge and sediment deposits. The Invertebrate Community Index (ICI) is another parameter that Ohio EPA uses to judge water quality. ICI values on Mill Creek ranged from poor to good with the lowest values recorded in the section of the creek affected by Boardman WWTF effluent. The Index of Biological Integrity (IBI) and the Modified Index of Well Being (MIwb) are both based on the structure and function of the fish community in a stream. Both of these parameters were on the poor end of the spectrum as many of the fish caught in the study were highly tolerant species such as carp. Table 6 summarizes the findings of Ohio EPA (Ohio EPA, 1996).

Table 6: Summary of Biological Criteria (Ohio EPA, 1994)

Mill Creek	Creek Mile	QHEI	ICI	IBI	MIwb
Station 1	11.2	37.0	28	17	3.4
Station 2	9.70	44.0	30	16	2.9
Station 3	9.50	59.0	14	15	1.5
Station 4	7.70	38.5	12	16	1.5
Station 5	6.20	60.5	24	18	4.0
Station 6	2.60	71.5	40	18	4.5
Station 7	1.90	53.0	38	20	4.0
Station 8	1.60	73.0		24	4.7
Station 9	0.80	67.0		27	4.8
Station 10	0.30	46.5		31	4.1
Bears Den Run	0.30	67.0		20	
Ax Factory Run	0.10	69.5		30	
Anderson Run	0.30	63.5		20	
Indian Run	0.20	65.0		24	
WWHC*		60-80	34	40	8.7

*WWHC is the minimum acceptable value of the parameters for boating Warm Water Habitat.

Table 7 summarizes water quality data from the 1994 OEPA Mahoning River Basin Study and was used to produce graphs on the sources of the nutrient loading to Mill Creek.

Table 7: 1994 Water Quality Statistics for Mill Creek (Ohio EPA, 1996)

All numbers are average values.
All units are mg/l except river mile (RM)

Station	D.O.	NH3-N	Total P	TDS	RM
1	6.54	0.150	0.128	477.0	11.3
2	5.12	0.448	0.288	479.6	10.1
3	5.40	1.270	0.495	520.8	9.50
4	2.70	2.020	0.862	492.8	7.80
5	4.02	1.636	0.858	464.8	5.40
6	6.50	0.438	0.440	384.8	2.60
7	7.00	0.328	0.420	365.2	1.10
8	9.55	0.198	0.252	296.4	0.80
9	7.03	0.205	0.254	333.0	0.10

Figures 2 and 3 show phosphorous and ammonia nitrogen concentrations, respectively, at the nine sampling stations along Mill Creek. The nutrient levels are the highest at stations four and five. These two stations are at Route 224 and Shields Road, respectively, and are directly downstream of the Boardman WWTF. As a result of high nutrient loadings, Lakes Newport, Cohasset and Glacier are highly eutrophic. The Boardman WWTF discharge also causes a significant drop in dissolved oxygen (DO) in Mill Creek. DO levels are later restored when water passes over a series of four dams before entering the Mahoning River.

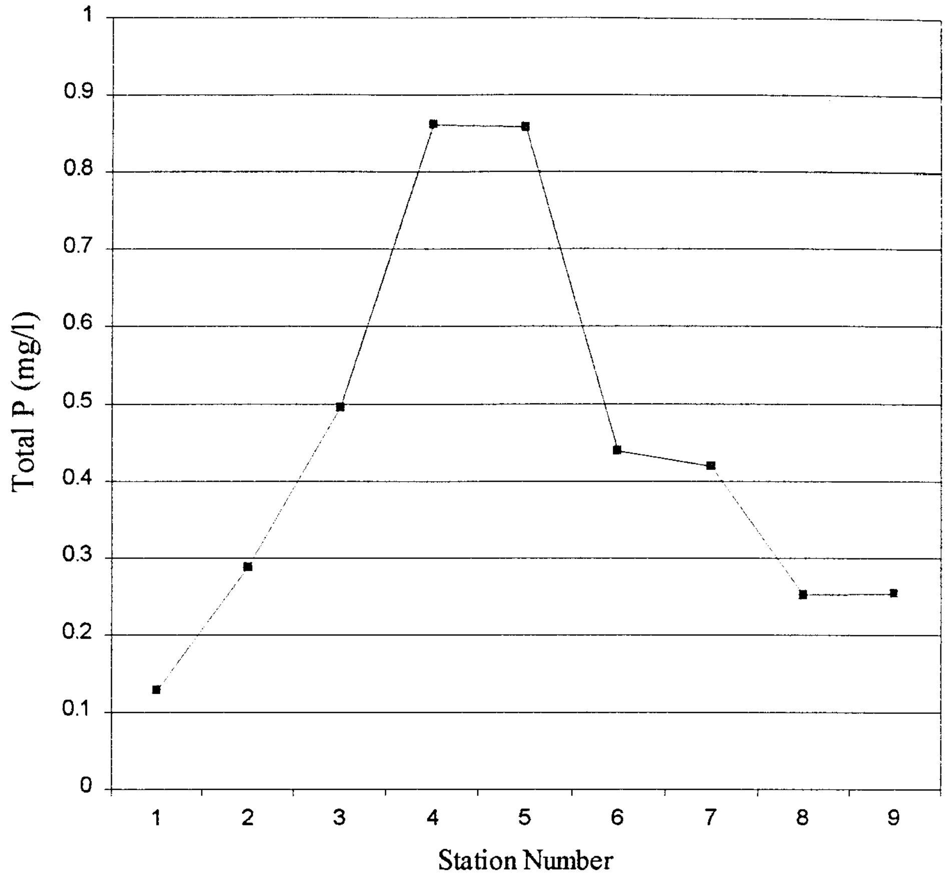

Figure 2: Total Phosphorous Levels at Sampling Stations on Mill Creek (OEPA, 1996)

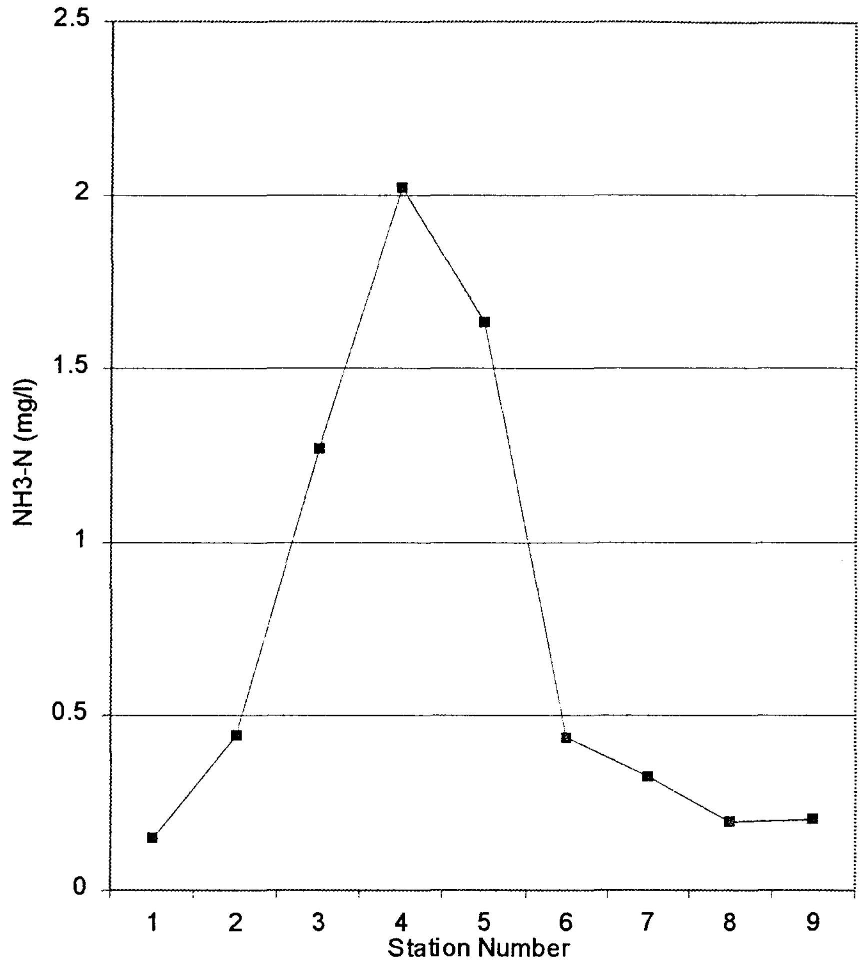

Figure 3: Ammonia Nitrogen Levels at Sampling Stations on Mill Creek (OEPA, 1996)

Development of Goals and Objectives

AWARE utilized an *adhoc* Committee on Goals and Objectives to develop the initial goals and objectives for the Mill Creek Watershed Action Plan. The committee was aided by the full AWARE committee and a workshop presented by Dorothy Farris of ODNR. The workshop clarified many of the problems that the *adhoc* committee had with developing and wording the goals and objectives. In order to formulate the initial goals and objectives, the following definitions were utilized at the ODNR workshop.

1. Goal: statement of long-term outcomes; results the group wants to achieve.
2. Objective: defines the level of change expected
3. Indicators: measurable events accepted as evidence of change.
4. Strategy: action steps to accomplish goals and objectives.

The Ohio EPA *Guide to Developing Local Watershed Action Plans in Ohio* (Ohio EPA, 1997) uses slightly different definitions to formulate goals and objectives. According to the *Guide*, a goal "defines what the group wants to achieve" while objectives "describe how the group will achieve the goals" (Ohio EPA, 1997). Using a combination of both sets of definitions AWARE was able to establish three goals and several associated objectives for the Mill Creek Watershed. Table 8 summarizes these goals and objectives. Since the problems facing Mill Creek and Yellow Creek are very similar, the committee decided to adopt the same set of goals and objectives for both watersheds.

Table 8: Goals and Objectives for the Mill Creek and Yellow Creek Watersheds

Goal	Objective(s)
Develop a thorough understanding of water quality, aquatic habitat, and biological communities throughout the Mill Creek and Yellow Creek watersheds.	• Conduct a baseline survey of water quality, aquatic habitat, and biological communities • Prepare a natural resources inventory - e.g. habitat, flora and fauna • Identify, evaluate and rank the risk of sources of pollution • Generate appropriate media for dissemination of survey/inventory information-e.g. reports, maps, databases • Redefine pollutant loading estimates and re-evaluate the importance of pollutant sources based on periodic monitoring data.
Achieve a heightened awareness of environmental impacts of human activities in the watersheds.	• Obtain baseline information on public awareness of, and attitudes toward, environmental issues related to the watersheds. • Develop outreach activities for various audiences within the watershed communities and set target numbers of citizens to be reached by the program. • Create volunteer activities to promote appreciation and cleanup of the watershed environment • Provide recreational opportunities that promote appreciation for the watershed environment
Attain aquatic use designations and applicable in-stream standards in both watersheds.	• Develop and implement a riparian protection program • Develop a model ordinance for riparian protection and circulate this to all townships and villages in the watershed. • Implement Best Management Practices (BMPs) for control of nonpoint source pollution. • Conduct periodic monitoring of water quality, aquatic habitat, and biological communities in both watersheds.

Introduction

Watershed Action Plan for Yellow Creek

The Yellow Creek Watershed, located in Northeast Ohio covers an area of 32,330 acres and has several main tributaries and three main reservoirs. The watershed has had a variety of water quality problems over the past several decades. These include high nutrient concentrations, sediments, dissolved oxygen depletion and degraded aquatic habitat. Many of these problems can be attributed to the rapid rate of residential and commercial development within the watershed. These problems caused the Lake Newport Advisory Committee, which was renamed AWARE (Alliance for Watershed Action and Riparian Easements), to include the Yellow Creek watershed into its area of concern. With the acquisition of a Section 319 Watershed Planning Grant from Ohio EPA and a NatureWorks StreamBanking grant from ODNR, the Yellow Creek Watershed has been included in the planning process. The watershed action plan has several goals. They are:

1. Compile the available background information and water quality data
2. Identify the water quality problems
3. Set goals and objectives for mitigation of the problems; and
4. Write and implement the watershed action plan

Chapter 2: Physical Characteristics of the Yellow Creek Watershed

Size and Location:

Yellow Creek originates in Northern Columbiana County and drains approximately 32,360 acres of land (YSU-CUS, 1998). It flows north through Beaver, Springfield and Poland Townships in Mahoning County and empties into the Mahoning River at Struthers, Ohio. Impoundments along the main stem of Yellow Creek form four lakes - Pine, Evans, Beaver and Hamilton. The total length of the creek is about 11 miles.

Land Use:

The land uses in the watershed are primarily agricultural, residential, forest and commercial. A summary of 1985 ODNR OCAP statistics on land use in the Yellow Creek watershed is presented in Table 9. At least several hundred acres of forest and farmland have been converted to residential and commercial development since 1985. In general, the northern section of the watershed is residential and commercial while the southern part is residential and agricultural. Residential development is expanding into the majority of the watershed at a rapid rate. Within the watershed, other significant features include the Poland Forest (242 acres) and Pine and Evans Lakes (totaling over 1000 acres). Figure 4 is a map which illustrates the land use and zoned areas in the watershed (YSU-CUS, 1998).

Table 9: Yellow Creek Watershed Land Use by Acreage (ODNR, 1971)

Land Use	Land Area (Acres)	Percentage (%)
Agricultural	17,860	55.2
Residential	5620	17.4
Forest	4590	14.2
Water	1100	3.40
Transitional Area	940	2.91
Transportation	500	1.55
Built Up Urban Land	490	1.52
Commercial	400	1.23
Wetlands	360	1.11
Strip Mines, Quarries	320	0.99
Industrial	150	0.46

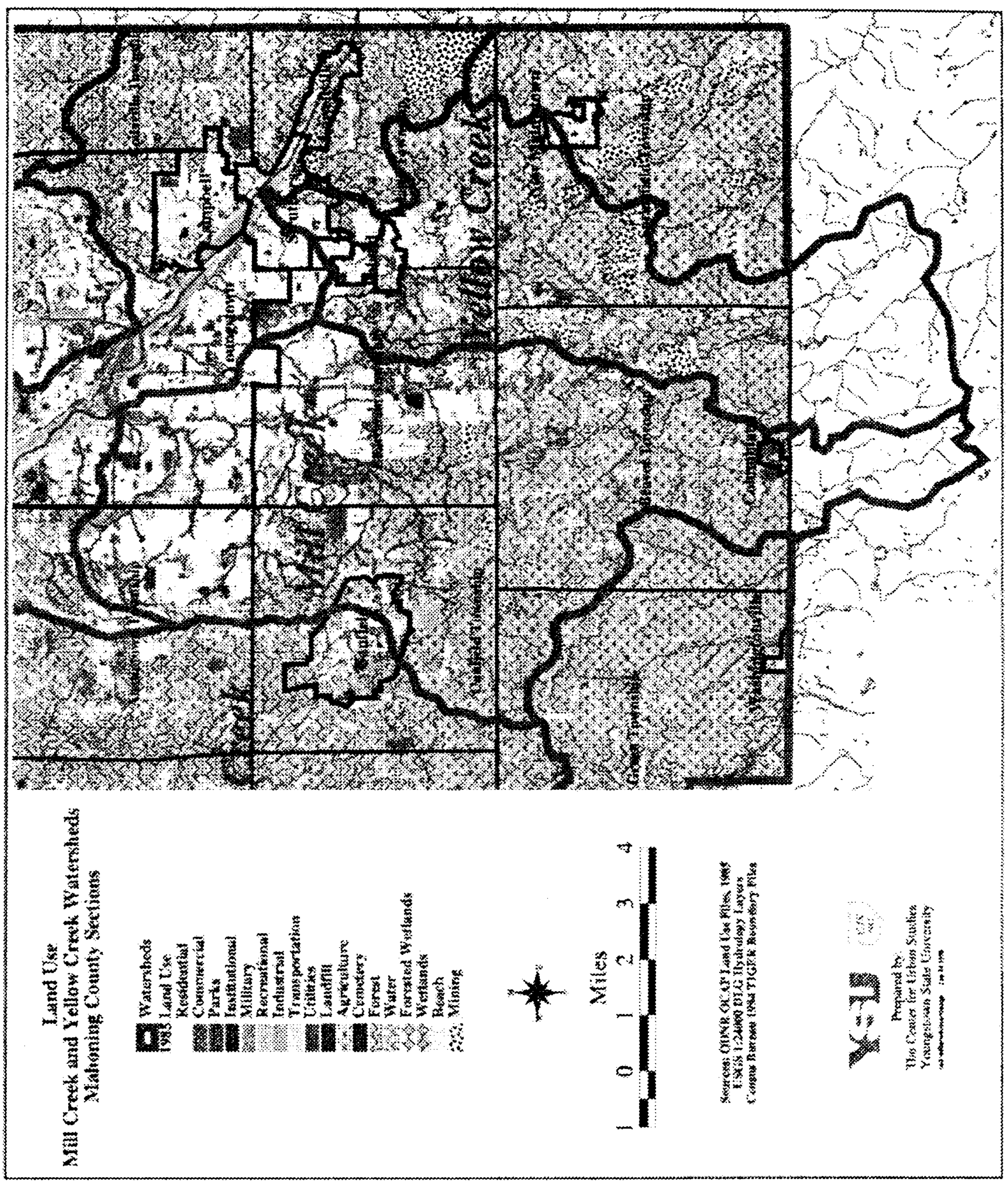

Figure 4: Land Use and Zoning Map for the Yellow Creek and Mill Creek Watersheds (YSU-CUS, 1998)

Geology and Topology:

The soils of the Yellow Creek watershed are primarily from parent material deposited during the Late Wisconsin glaciation. The lithology of watershed is almost identical to the soils in the Mill Creek watershed as the entire watershed is covered by a fairly thick glacial till that was deposited by meltwater from the retreating glaciers. These soils originating from the glacial till were formed approximately 15,000 years ago. Therefore, they have a well-developed profile that makes analyzing their strength and transmissive properties much easier. The bedrock consists of sedimentary rocks and rocks of Canadian origin that were pushed here by the advancing glaciers (ODNR, 1971).

Soils:

In general, the soils in the watershed are moderately erodible with moderate to substantial clay content and fair drainage. The parent material for the soil was from glacial outwashes of gravel, sand, clay and silt. The level soils and rocks are fairly wet because of precipitation and fluctuating water levels in this part of the country. Table 10 lists the most prevalent types of soil in the Yellow Creek watershed, along with the total acreage of each soil type in Mahoning County (ODNR, 1971).

Drinking Water Supplies:

Consumer's Ohio Water Company is a major supplier of drinking water to residents in the watershed. Lake Evans supplies the residents of Struthers and Poland with water, while Lake Hamilton water is sold to the City of Campbell. Consumer's Ohio Water Company not only owns the lakes but also some property around the lakes.

Table 10: Yellow Creek Watershed Soil Classifications (ODNR, 1971)

Abbreviation	Description of Soil Type	Land Area (Acres)
CdB	Canfield silt loam, 2 to 6 percent slopes	24000
BgB	Bogart loam, 2 to 6 percent slopes	8500
CmB	Chili loam, 2 to 6 percent slopes	3000
RaB	Ravenna silt loam, 2 to 6 percent slopes	12000
BeB	Bennington silt loam, 2 to 6 percent slopes	2200
CmC	Chili loam, 6 to 12 percent slopes	3900
CgB	Cardington silt loam, 2 to 6 percent slopes	1100
Wsb	Wooster silt loam, 2 to 6 percent slopes	2100
JwB	Jimtown-Urban land complex	2500
JtB	Jimtown loam, 2 to 6 percent slopes	4600

They own buffer areas of 25, 35, and 10 acres around Lakes Pine, Evans and Hamilton, respectively (Consumers Ohio Water Company, 1999).

Hydrology:

Water flow into and out of Lakes Hamilton and Evans is very substantial. Lake Hamilton drains 14.1 square miles of the watershed and covers an area of 104 acres (Consumers Ohio Water co., 1998). The flow annually into Lake Hamilton is approximately $2.4x10^7 m^3/yr$ (Schroeder and Farran, 1986). Lake Evans drains 10.3 square miles and covers an area of 566 acres (Consumers Ohio Water Co., 1998). Also there is a substantial amount of wetland area within the watershed. Figure 5 shows the locations and types of wetlands in the watershed. The total area or wetlands in the Yellow Creek watershed is approximately 360 acres. The table values for wetland acreage are drastically lower than the map values because the table values are wetlands year round and do not include lake areas. Some of the map areas are only wetlands during a few months in any given year.

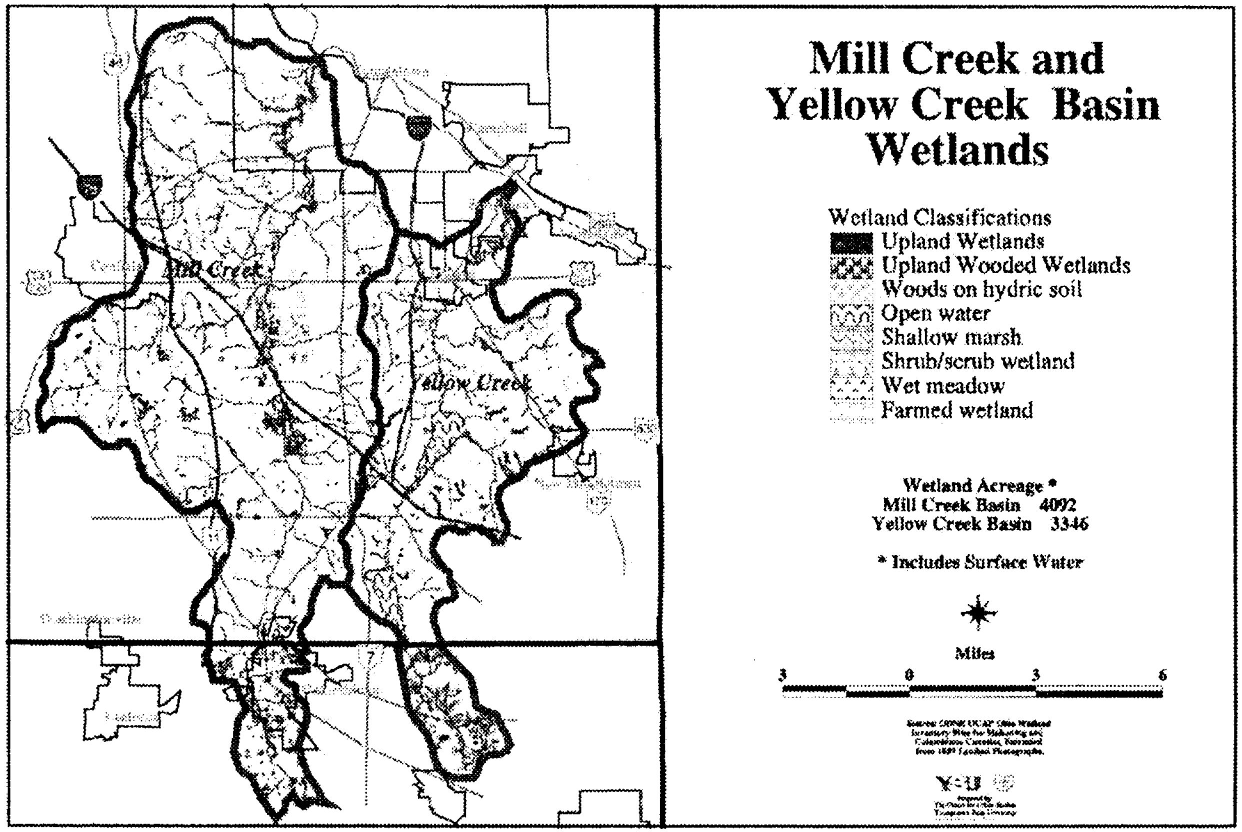

Figure 5: Wetland Acreage in the Yellow Creek Watershed

Demographics

The Yellow Creek watershed has seen a significant increase in population over the past 40 years. As seen in Table 11, the 1996 Census Bureau estimate indicates that Poland Township is experiencing significant growth. Also, between 1970 and the present, the northwestern corner of the watershed (Boardman Township) experienced intense commercial development. Since much of the development within the watershed is commercial in nature, population statistics alone do not give an accurate picture of the rate of development. Within the past two years, there has also been an increase in residential development throughout the watershed. The increase in construction and population has caused an increase in the amount of impervious surface and runoff. Also, the continuous construction has increased the rate of soil erosion and sediment runoff into Yellow Creek. Springfield Township, on the other hand, has experienced a recent decrease in population (YSU-CUS, 1998).

Table 11: Census Bureau Population Estimates for Poland and Springfield Townships (YSU-CUS, 1998)

Township	1960	1970	1980	1990	1996
Poland	10276	12652	12827	13993	14252
Springfield	5370	6684	8115	7943	6262
Total	15646	19336	20942	21936	20514

Summary of Water Quality Problems in Yellow Creek

Several studies have been performed on water quality in Yellow Creek and its reservoirs. Many of these were used in compiling data for this report. Consumer's Ohio Water Company was helpful in providing maps of water distribution lines and water quality data from Lakes Hamilton and Evans. From this data, it was possible to determine the levels of nutrients and suspended solids in the water. Dr. Lauren Schroeder and others in the YSU Biology Department were able to supply two reports on the water quality of Lake Hamilton. These reports contained information on dissolved oxygen, temperature, nutrients and sediments from a sampling program that extended over several years and a range of climate conditions. In addition, two graduate students wrote thesis reports on the lakes in the Yellow Creek Watershed. In particular, nutrient studies by Abbas (1992) provide an excellent source of data. Finally, biological and water quality data were collected by the Ohio EPA in the summer of 1994 (Ohio EPA, 1996) at one sampling site near the mouth of Yellow Creek. This study used biological indicators to determine the attainment of warm water habitat criteria.

Biological parameters are the basis on which the water quality of the watershed is judged by Ohio EPA. The Qualitative Habitat Evaluation Index (QHEI) value for Yellow Creek was 64.5, which was in the acceptable range of 60-80 for warm water habitat. The Invertebrate Community Index (ICI) value (32) fell just below the acceptable value of 34 which means Yellow Creek is marginally healthy. The Index of Biological Integrity and the MIwb values for Yellow Creek were 22 and 5.3 respectively which placed them below the acceptable limits of 40 and 8.7.

A summary of water quality data was presented to AWARE to serve as a basis for identification of water quality problems in the Yellow Creek watershed. The problems were identified and prioritized at AWARE meetings during the fall of 1998. Since the problems were believed to vary with location, the watershed was divided into a northern section (Walker Mill Rd. to the Mahoning River) and a southern section (Walker Mill Rd. to the headwaters). For the most part, the prioritized problems (Table 12) were the same.

Table 12: Prioritized Problems in the Yellow Creek Watershed

North	South
Degraded Habitat	Degraded Habitat/Nutrients (tie)
Sediments	Sediments
Other NPS	Other NPS
Nutrients	Mine Drainage
Low Dissolved Oxygen	Low Dissolved Oxygen
Pathogenic Organisms	Invasive Species
Invasive Species	Pathogenic Organisms
Flooding	Flooding
Mine Drainage	

In the northern section, AWARE listed degraded habitat, sediments, other nonpoint sources (i.e. pesticides, oil and trash associated with runoff), nutrients and low dissolved oxygen (D.O.) as the main problems. Similarly, in the southern section, degraded habitat, nutrients, sediments, other NPS, mine drainage and low dissolved oxygen were listed as the top five problems.

Two of the main problems in the Yellow Creek watershed are nutrients and sediments. The problems of nutrients and sediments are closely linked within the watershed. The two major nutrients of concern are nitrogen and phosphorous. Much of the phosphorous that enters the watershed is attached to suspended sediments. Nutrients enter Yellow Creek from several sources, including non-point sources such as leaky septic systems and agricultural runoff, as well as combined sewer overflows (CSO's). Phosphorous levels are very high. Fifty micrograms per liter (μg/l) is considered high for lakes and typically results in eutrophic conditions. Lake Hamilton commonly has total soluble phosphorous levels of 50 to 200 μg/l. When heavy rain events occur causing increased flow in Yellow Creek, the sediments which are rich in nutrients spread into the lakes of the watershed (Schroeder and Farran, 1986). The nutrients in the sediments become dissolved during turnover causing algal blooms (Schroeder and Farran, 1986). Dr. Scott Martin of YSU studied the phosphorous input into Lake Hamilton in 1987. The results of his findings are listed in Table 13. Also, annual phosphorous output from spillway flow and water withdrawal for the City of Campbell was estimated as 1363 kg (Schroeder and Farran, 1987). This figure accounts for only about one half of the estimated total phosphorous input, suggesting that approximately half of the phosphorous may be trapped in the lakes bottom sediments. Figure 6 shows typical phosphorous levels as a function of depth in Lake Hamilton (Abbas, 1992).

Table 13: Sources of Phosphorous into Lake Hamilton (unpublished data from Martin, cited by Schroeder and Farran, 1987)

Phosphorous Source	Loading (kg/yr)
Yellow Creek	2172
Pastures	16
Urban	393

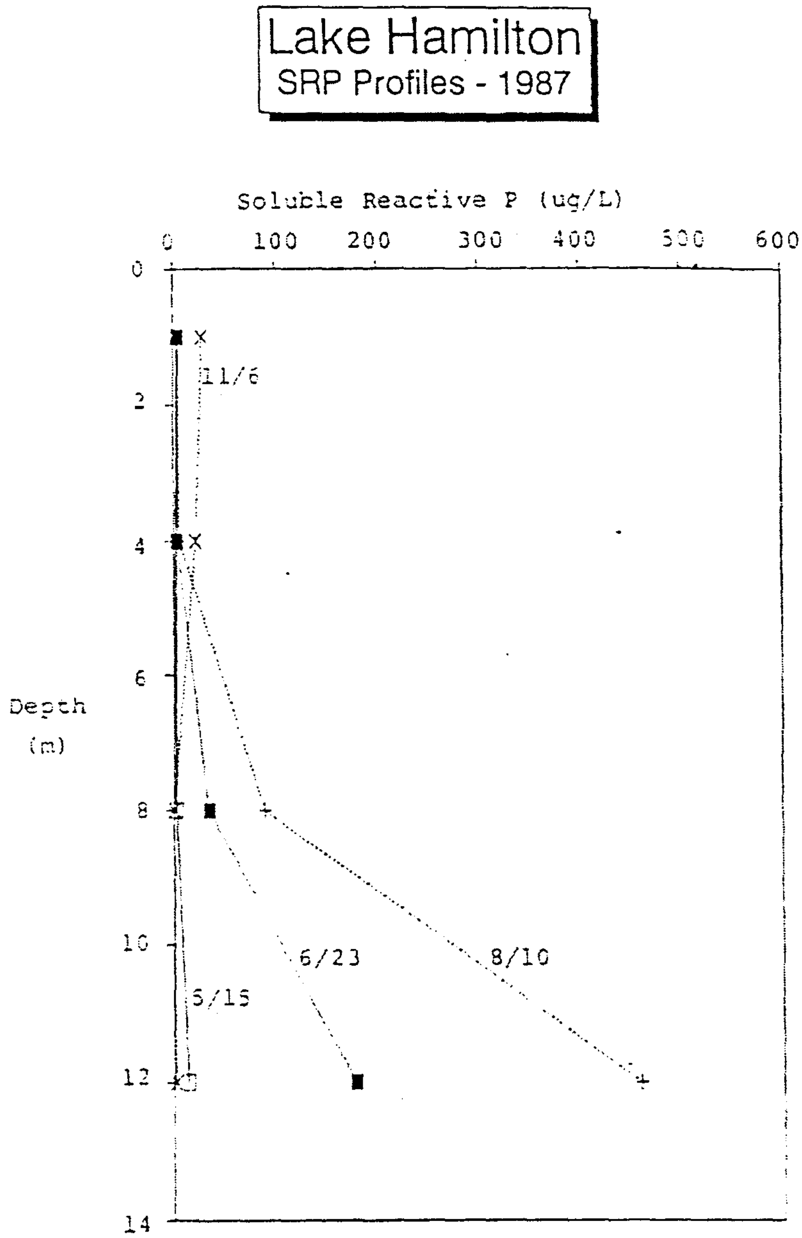

Figure 6: Phosphorous in Lake Hamilton by Lake Level (Abbas, 1992)

Nitrate is also a significant concern in the Yellow Creek watershed. The maximum ammonia nitrogen (NH_3-N) concentration in a surface water should be no greater than 1.0 to 1.5 mg/l if compliance with the Ohio EPA warm water criteria are the ultimate goal (Ohio EPA, 1996). However, the hypolimnion of Lake Hamilton commonly exceeds 200 mg/l (Schroeder and Farran, 1986). The nitrate and generally comes from direct runoff, precipitation and nitrogen fixation by blue-green algae (Schroeder and Farran, 1986). NH_3-N comes from decomposition of organic matter in the lake. Figures 7 and 8 show typical nitrate and NH_3-N levels, respectively, in Lake Hamilton as a function of lake layer. The values shown in the figures are averages of three observations.

As a result of these high nutrient loads, the waterways of the Yellow Creek watershed have low dissolved oxygen (D.O.) levels. Low dissolved oxygen is caused by aerobic decomposition of organic matter in water. The oxygen can be depleted faster than it is returned to the water column from the atmosphere. In this way, oxygen in the water can fall below the threshold level necessary to maintain desirable forms of aquatic life. Figure 9 shows typical spring and summer dissolved oxygen profiles in Lake Hamilton (Abbas, 1992). The figure shows a severe dissolved oxygen depletion in deeper layers of the lake. This low D.O. results in the formation of hydrogen sulfide, which causes a strong "rotten eggs" odor, and makes the deeper water unacceptable as a drinking water supply.

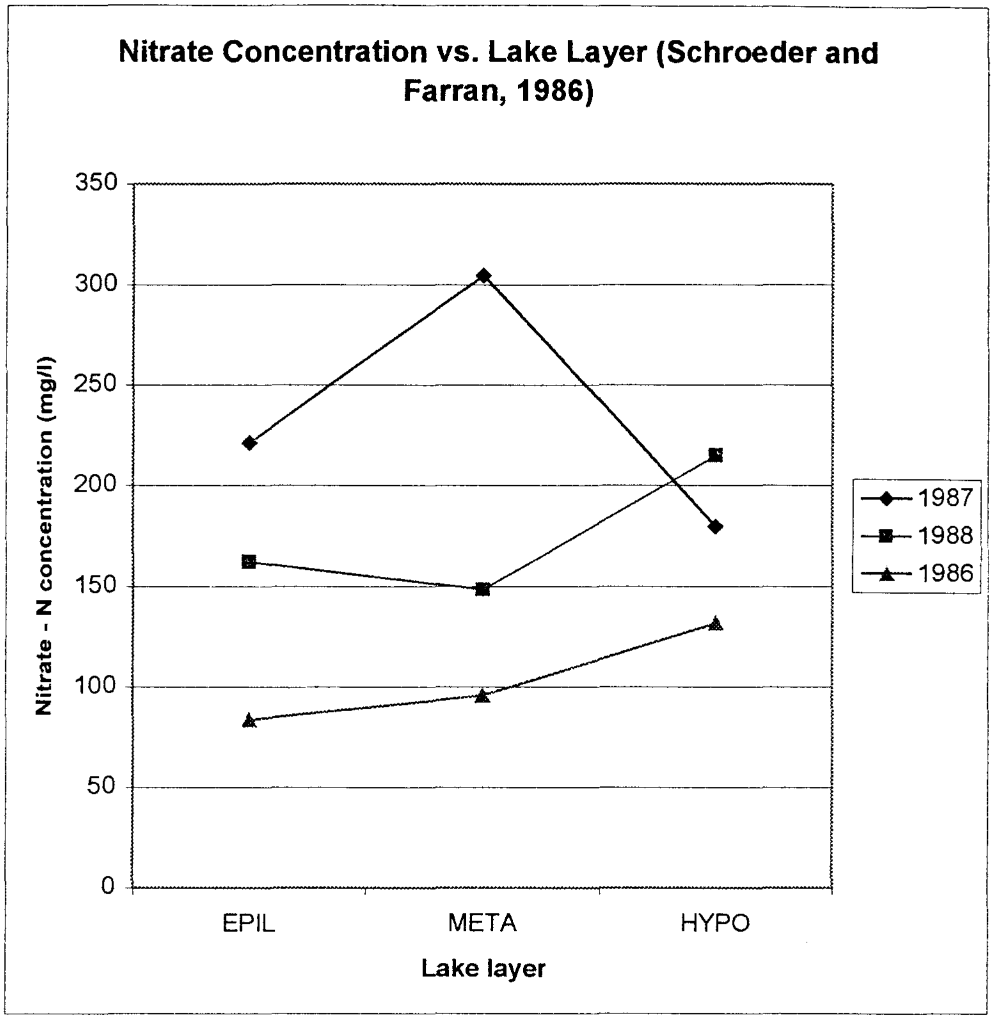

Figure 7: Nitrogen Concentration as a Function of Lake Layer in Lake Hamilton

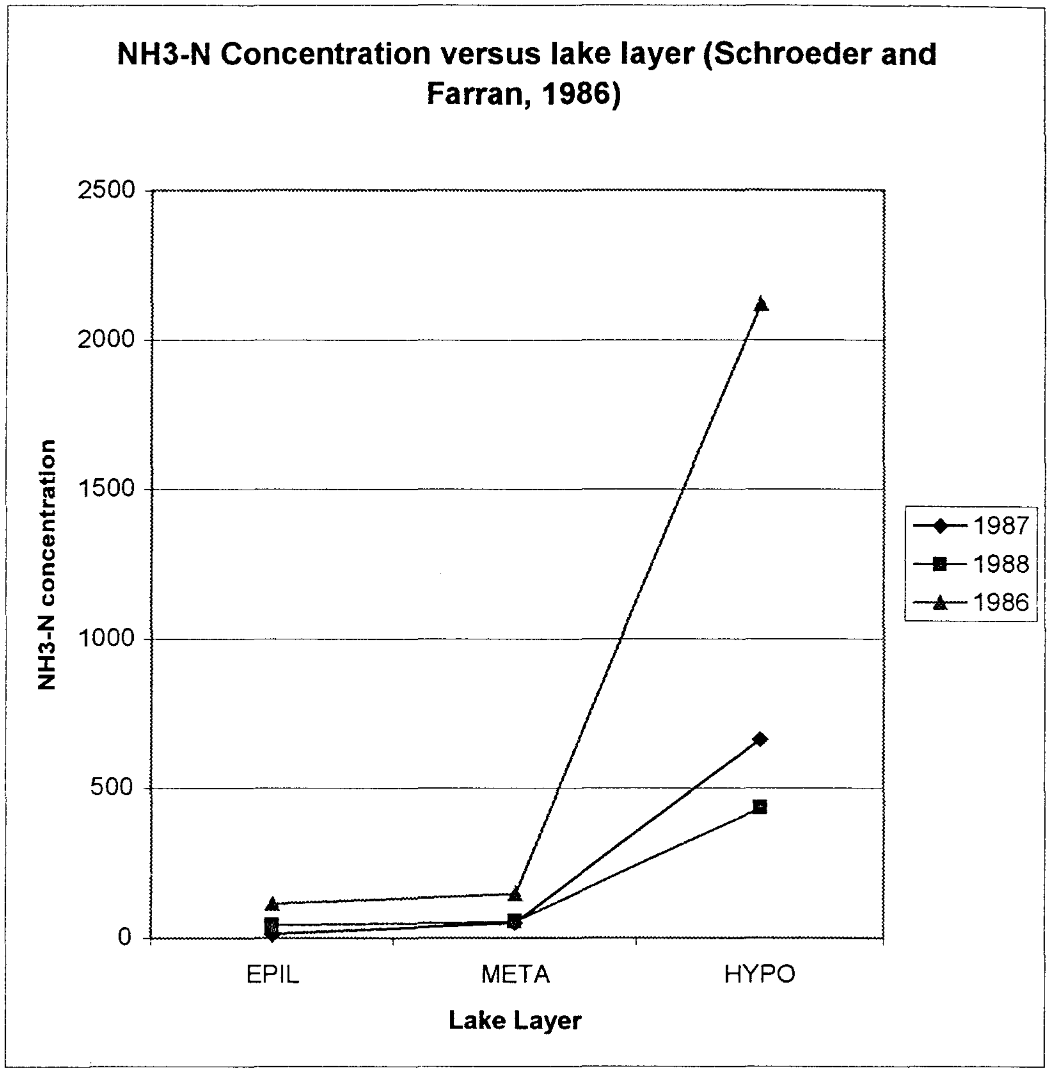

Figure 8: NH_3-N as a Function Lake Layer in Lake Hamilton

In summary, the problems of nutrients and dissolved oxygen are important to the residents who live in the Yellow Creek watershed since the water is a primary source of drinking water. High nutrient content causes the water to become very productive, which leads to massive algal blooms. When the algae decomposes it uses the water's oxygen, which can impair aquatic life and cause odors. Hardness is also a problem due ot acid mine drainage. These problems make the water expensive to treat and unpleasant to drink or use for bathing.

Lake Evans is of considerable concern in the Yellow Creek watershed because it is used as a primary drinking water source for the City of Struthers and Poland (Village and Township). The statistics in Table 14 summarize the raw water quality data that is taken daily at Lake Evans. It should be noted that phosphorous is measured daily but was below detection limits each day that measurements were taken. Hardness is very high due to several sources of mine drainage that enter the lake, carrying high concentrations of calcium and magnesium. Consumers Ohio Water Company recently diverted a large mine drainage stream, resulting in a dramatic decrease (almost 50%) in raw water hardness in Lake Evans.

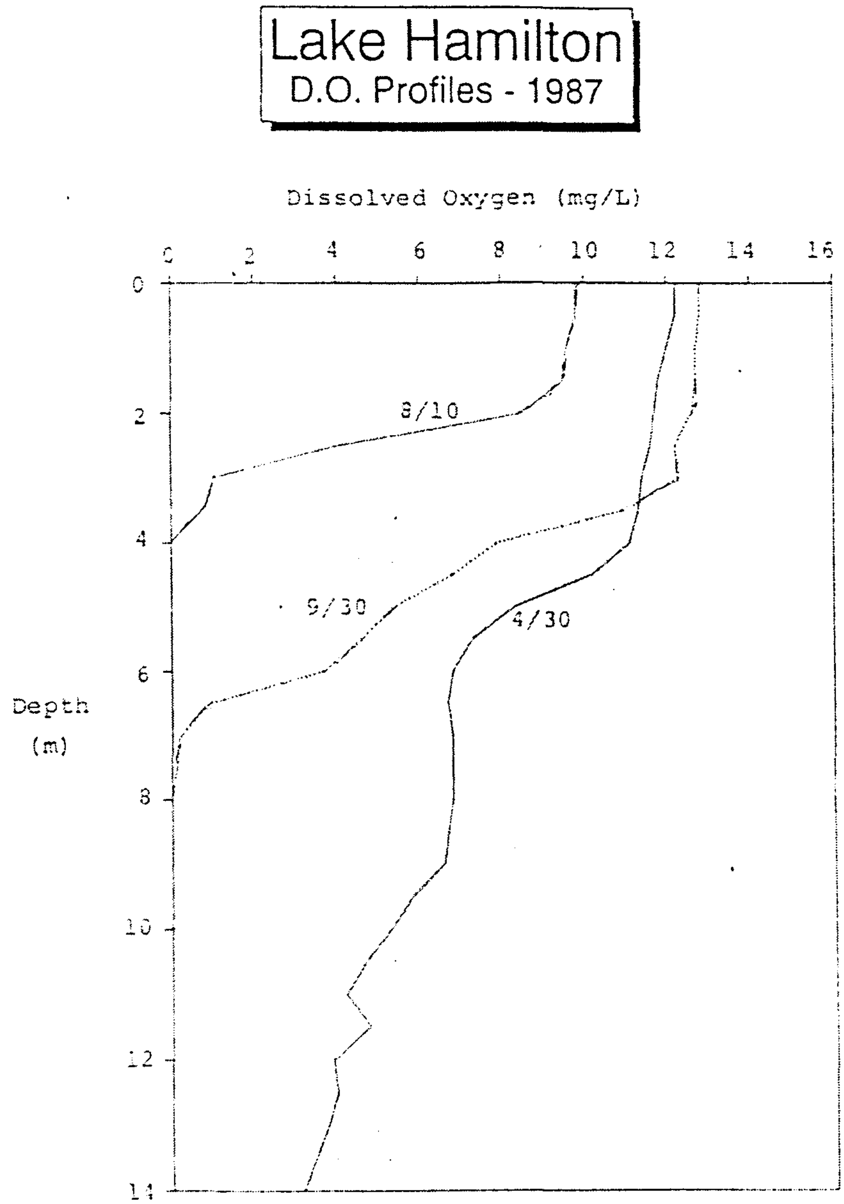

Figure 9: Dissolved Oxygen Profile for Lake Hamilton (Abbas, 1992)

Table 14: Raw Water Quality Data for Lake Evans (Consumers Ohio Water Company, 1998)

	Alka-linity	Total Hard-ness	pH	Ca Hard-ness	Mg Hard-ness	Turb-idity
Mean	107.7	359.41	8.190	242.4	116.51	10.7
St. Dev	2.880	19.10	0.127	18.93	5.660	2.58

*Alkalinity, Total Hardness, Calcium and Magnesium all expressed as mg/l as $CaCO_3$

Aquatic habitat modification, which includes channelization, sediment deposition and resuspension, stream bank erosion and flow alterations, is also a major concern in the watershed. Construction in the Yellow Creek watershed has increased markedly over the last 40 years. Construction causes more impervious surface, which increases the amount and velocity of runoff. This causes erosion of both the land surface and stream channels to increase. The development has also changed the natural drainage and recharge patterns in the watershed. After large precipitation events, the flow of water entering Yellow Creek and its tributaries is rapid and laden with sediments. Much of this sediment makes its way into Lakes Hamilton and Evans where it settles out and fills the lakes. Since the drainage area of Lake Evans is relatively small compared to that of Lake Newport in the neighboring Mill Creek watershed, sedimentation problems are much less severe. The sediments carried by runoff are rich in nutrients, which cause the lakes to become highly productive. This, in turn, leads to other problems mentioned previously.

Chapter 4

Development of Goals and Objectives

AWARE utilized an *adhoc* Committee on Goals and Objectives to develop the initial goals and objectives for the Yellow Creek Watershed Action Plan. The full AWARE committee aided the committee and a workshop presented by Dorothy Farris of ODNR. The workshop clarified any of the problems that the *adhoc* committee had with developing and wording the goals and objectives. In order to formulate the initial goals and objectives, the following definitions were utilized at the ODNR workshop.

1. Goal: statement of long-term outcomes; results the group wants to achieve.
2. Objective: defines the level of change expected
3. Indicators: measurable events accepted as evidence of change.
4. Strategy: action steps to accomplish goals and objectives.

The Ohio EPA *Guide to Developing Local Watershed Action Plans in Ohio* (Ohio EPA, 1997) uses slightly different definitions to formulate goals and objectives. According to the Guide, a goal "defines what the group wants to achieve" while objectives "describe how the group will achieve the goals" (Ohio EPA, 1997). Using a combination of both sets of definitions, AWARE was able to establish three goals and several related objectives. Table 15 summarizes the goals and objectives developed by AWARE for the Yellow Creek watershed. A Watershed Action Plan was developed for Mill Creek watershed simultaneously. Since the water quality problems are similar, AWARE decided to adopt the same set of goals and objectives for both watersheds.

Table 15: Goals and Objectives for the Yellow Creek and Mill Creek Watersheds

Goal	Objective(s)
Develop a thorough understanding of water quality, aquatic habitat, and biological communities throughout the Mill Creek and Yellow Creek watersheds.	• Conduct a baseline survey of water quality, aquatic habitat, and biological communities • Prepare a natural resources inventory-e.g. habitat, flora and fauna • Identify, evaluate and rank the risk of sources of pollution • Generate appropriate media for dissemination of survey/inventory information-e.g. reports, maps, databases • Redefine pollutant loading estimates and re-evaluate the importance of pollutant sources based on periodic monitoring data.
Achieve a heightened awareness of environmental impacts of human activities in the watersheds.	• Obtain baseline information on public awareness of, and attitudes toward, environmental issues related to the watersheds • Develop outreach activities for various audiences within the watershed communities and set target numbers of citizens to be reached by the program. • Create volunteer activities to promote appreciation and cleanup of the watershed environment • Provide recreational opportunities that promote appreciation for the watershed environment
Attain aquatic use designations and applicable in-stream standards in both watersheds.	• Develop and implement a riparian protection program • Develop a model ordinance for riparian protection and circulate this to all townships and villages in the watershed. • Implement Best Management Practices (BMPs) for control of nonpoint source pollution. • Conduct periodic monitoring of water quality, aquatic habitat, and biological communities in both watersheds.

Evaluation of the *Guide*

Overall, *A Guide to Developing Watershed Action Plans in Ohio* (Ohio EPA, 1997) is a very effective publication. The *Guide* is well organized and describes each item in such a way that a person with a non-technical background could understand. Each chapter gives several specific tasks that need to be completed before moving to the next phase of the project. However, the *Guide* is flexible enough that it allows several tasks to be attempted at one time. The *Guide* also contains several appendices that cite specific sources within the state government where information and assistance can be found. The appendices list contact persons and organizations that can help even inexperienced groups to compose an effective action plan.

There are a few items that could be added to make the *Guide* even more effective. A section on wetlands, wetland mitigation and the applicable laws associated with wetlands would be extremely useful. The Mill Creek and Yellow Creek watersheds have a considerable amount of wetland area. These areas are vital to the aquatic health of the region. In addition, guidelines for evaluating the adequacy of existing water quality data would be helpful. AWARE frequently questioned how thoroughly the extent and sources of water quality problems were understood. A section could be added to describe approaches for estimating loading rates of nonpoint source pollutants.

Furthermore, the goals and objectives chapter of the *Guide* should include more on the role of education. The public and all stakeholders should be included in the education process. They need to be made aware of how their actions affect the water quality in the watershed. A section listing examples of educational activities and ways to evaluate their effectiveness would be helpful. Also, there should be some consideration of terrestrial issues mentioned in the goals and objectives chapter. The issues of wildlife habitat protection and greenways are important but often-overlooked aspects of Watershed Action Plans. . Another helpful section would be a sample watershed action plan. This addition could possibly be another appendix or distributed as a separate document. Many times, having a model to work from is very helpful to a group trying to compose a watershed action plan for the first time.

Chapter 4

Conclusions and Recommendations

<u>Conclusions:</u>

1. *A Guide to Developing Local Watershed Action Plans in Ohio* (Ohio EPA, 1998) was applied to develop Watershed Action Plans for Mill Creek and Yellow Creek watersheds.
2. The *Guide* was found to be an effective tool, however, improvements could be made.
3. The main water quality problems identified in both watersheds were; 1. Aquatic habitat modification, 2. Sediment erosion and deposition, 3. Nutrient loading, 4. Nonpoint source pollution
4. Watershed Action Plans were developed to describe and address the water quality problems.
5. Existing databases of water quality information were inadequate, particularly for Yellow Creek, which made setting and quantifying goals and objectives difficult.

<u>Recommendations:</u>

1. Ohio EPA should gather the comments made by AWARE and similar organizations and revise the *Guide.*
2. AWARE should conduct baseline studies on water quality and public awareness of environmental issues in the watersheds.
3. AWARE should implement the Action Plans in order to remediate the water quality problems in Mill Creek and Yellow Creek watersheds.

4. Based on the monitoring data and experience with implementation, progress should be evaluated and the Action Plans revised periodically.

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